Analysis of Pesticide Exposure Can Increase the Risk of Low Birth Weight Incidence in Agricultural Areas

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Abstract

Pesticide exposure can have various negative impacts on pregnant women, especially for fetal development, so it can cause low birth weight. This study aims to analyze the literature findings over the past five years related to the relevance of pesticide exposure to the incidence of low birth weight in agricultural areas. This research method uses a literature review of 10 selected articles. The databases used were ScienceDirect, Google Scholar, and PubMed, with the keywords pesticides, low birth weight, and agriculture. A total of 10 articles were obtained, and they will go through the screening process through inclusion and exclusion criteria. The results showed that pregnant women in agricultural areas have a greater risk of being exposed to pesticides, which can have an impact on the growth and development of the fetus they are carrying. In addition, it can also cause a decrease in IGF1 levels, which can impact the incidence of LBW. Pregnant women can do prevention by minimizing the use of chemicals containing pesticides and using personal protective equipment. This study found that pesticide exposure can increase the risk of low birth weight incidence in agricultural areas, where most people, especially pregnant women in agricultural areas, feel the negative impact of pesticide exposure on the incidence of low birth weight.

Keywords: pesticide, low birth weight, agriculture

Introduction

Low birth weight (LBW), defined as a birth weight of less than 2500 grams irrespective of gestational age, remains a critical global health challenge, contributing significantly to neonatal mortality, morbidity, and long-term developmental disabilities[1]. LBW infants face heightened risks of respiratory distress, infections, and chronic conditions such as diabetes and cardiovascular diseases later in life[2]. These outcomes substantially burden healthcare systems and families, underscoring the urgency of addressing preventable risk factors[3]. Despite advancements in maternal care, LBW prevalence persists, particularly in regions where environmental and occupational hazards intersect with socioeconomic vulnerabilities[4].

The etiology of LBW is multifactorial, encompassing maternal, fetal, and environmental determinants[5]. Maternal factors include preexisting health conditions (hypertension, diabetes), inadequate prenatal care, malnutrition, substance abuse, and chromosomal abnormalities[6]. Sociodemographic variables such as young maternal age, low education, and poverty further exacerbate risks[7]. Fetal contributors, such as chromosomal anomalies, multiple gestations, and placental insufficiency, also play significant roles[8]. Meanwhile, environmental exposures—ranging from high-altitude hypoxia to chemical toxins—emerge as modifiable risk factors with far-reaching implications for public health interventions[9].

Among environmental hazards, pesticide exposure has garnered increasing attention due to its pervasive use in agriculture and documented toxicity[10]. Pesticides, including herbicides, insecticides, and fungicides, are widely used to protect crops but often contaminate air, soil, and water, affecting occupational and residential populations[11]. Agricultural workers, particularly in low- and middle-income countries, frequently face unsafe handling practices, inadequate protective equipment, and limited regulatory oversight, heightening their exposure risks[12]. Chronic or acute pesticide poisoning is linked to neurological, reproductive, and immunological disorders, with pregnant individuals and their fetuses being uniquely vulnerable[13].

The agricultural sector, a cornerstone of global food production, relies heavily on manual labor, with women constituting a significant proportion of the workforce[14]. Tasks such as weeding, pest inspection, irrigation, and harvesting often place women in direct contact with pesticide-treated crops[15]. Even when not directly involved in

spraying, women may encounter residues through equipment preparation, contaminated clothing, or proximity to sprayed fields[16]. These exposures can disrupt maternal-fetal health, potentially impairing placental function, fetal growth, and developmental trajectories, thereby increasing LBW incidence[17].

Pesticide exposure pathways in agricultural communities are diverse and interconnected. Occupational exposure occurs through dermal contact, inhalation, or accidental ingestion during mixing, application, or post-application activities[18]. Residential proximity to farms amplifies risks via drift contamination of homes, water sources, and food supplies[19]. Pregnant individuals in these settings may experience cumulative exposures across multiple pathways, compounding the threat to fetal development[20]. Epidemiological studies have associated prenatal pesticide exposure with intrauterine growth restriction, preterm birth, and LBW, though gaps remain in understanding dose-response relationships and mechanistic pathways[21].

Women's roles in agriculture and susceptibility to pesticide-related health impacts warrant targeted investigation. Physiological factors, such as increased body fat composition and hormonal fluctuations during pregnancy, may enhance pesticide absorption and retention[22]. Sociocultural norms often relegate women to tasks involving prolonged pesticide contact while limiting their access to safety training or protective resources[23]. These inequities, coupled with systemic barriers to healthcare, create a high-risk scenario for adverse birth outcomes. Addressing these disparities requires gender-sensitive policies and interventions to mitigate occupational hazards[24].

This study seeks to elucidate the relationship between pesticide exposure in agricultural settings and LBW incidence among infants. By examining maternal occupational histories, pesticide exposure levels, and birth outcomes in vulnerable communities, the research aims to inform evidence-based strategies for reducing environmental risks. Findings may guide policymakers in strengthening regulatory frameworks, promoting safer agricultural practices, and enhancing prenatal care protocols to safeguard maternal and child health in agrarian regions.

Method

The researcher will raise the topic of the relationship or association between agricultural and household pesticide exposure to the incidence of low birth weight in

agricultural areas. This research uses the literature review method by retrieving databases from trusted sources, namely ScienceDirect, Google Scholar, and Pub Med. The database search used three English keywords based on the theme or topic the researcher will use: pesticides, low birth weight, and agriculture.

In the search method, researchers filtered the articles used as sources. The first screening was done to limit the article's publication year. Researchers took databases published in the last five years. From the first screening, researchers found 84,079 articles from the three sources published over the last five years, leaving 19,349 articles that met the inclusion criteria published within the last five years.

Then, the second article filtering is done by selecting databases that can be accessed in full to make it easier for researchers to analyze the article. From the second screening results, researchers found 7,091 articles that could not be accessed in full, so researchers could only access 12,258 databases in full.

Researchers only selected databases that included research articles. So, filtering was carried out and found as many as 3,334 included in research articles and 8,924 articles that were not included in research articles. Because the database is still vast and not yet specific, researchers filter again to make it easier for researchers to analyze.

We screened articles from nursing and medical research for the last screening. The filtering results obtained 2,657 articles were excluded due to inappropriate sources. Furthermore, the researcher selected articles that discussed pesticide exposure to pregnant women, which had an impact on low birth weight conditions, and pesticide exposure, which had an impact on infant growth and development. We found 495 articles that did not meet the inclusion criteria from these exclusions. To maximize the analysis, we selected articles that conducted their research in agricultural areas and found 172 articles that did not fit. So, from several filters that researchers have carried out, the final result of the articles researchers take to analyze is 10.
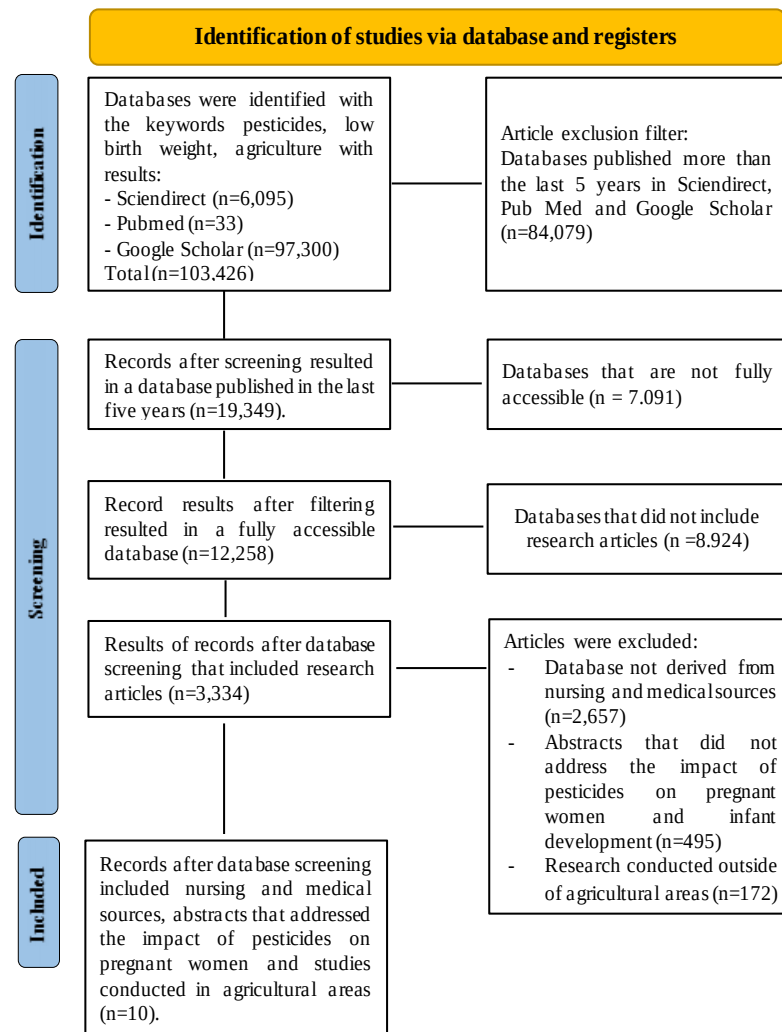
PRISMA 2020 Flow Diagram

Identification of studies via database and registers

Identification	Databases were identified with the keywords pesticides, low birth weight, agriculture with results: - Sciendirect (n=6,095) - Pubmed (n=33) - Google Scholar (n=97,300) Total (n=103.426)	Article exclusion filter: Databases published more than the last 5 years in Sciendirect, Pub Med and Google Scholar (n=84,079)

Screening	Records after screening resulted in a database published in the last five years (n=19,349).	Databases that are not fully accessible (n = 7.091)
	Record results after filtering resulted in a fully accessible database (n=12,258)	Databases that did not include research articles (n =8.924)
	Results of records after database screening that included research articles (n=3,334)	Articles were excluded: - Database not derived from nursing and medical sources (n=2,657) - Abstracts that did not address the impact of pesticides on pregnant women and infant development (n=495) - Research conducted outside of agricultural areas (n=172)

Included	Records after database screening included nursing and medical sources, abstracts that addressed the impact of pesticides on pregnant women and studies conducted in agricultural areas (n=10).	

Figure 1. PRISMA 2020 Flow Diagram

Results

From the 10 databases selected, the researchers found databases conducted on pregnant women who live in agricultural areas that have a high risk of exposure to pesticides and pregnant women who often use pesticide-like chemicals in household activities that have an impact on the development of the unborn child. The study found in the database addresses how exposure to pesticides may raise the prevalence of low birth weight. As for the literature analysis, four databases discuss the triggering factors for birth weight: Journals 1, 2, 3, and 4. Then, there are two databases, namely journals 5 and 6, which discuss the relationship between IGF-1 levels and the incidence of LBW.

There are four databases, namely journals 7, 8, and 9, which focus on discussing the impact of pesticides on LBW and its prevention.

Table 1. Literature Analysis Results

ID No.	Author and Journal Identity	Journal Title	Objective	Population and Sample	Method	Summary of Results
A1	Author: Triyani, N., et al. Journal Identity: International Journal of English Literature and Social Sciences, 4(6), 1639–1642. 2019. 10.22161/ijels.46.1	Factors Associated with Low Birth Weight in Horticulture Area, Semarang District, Indonesia[25]	This is to prove that exposure to pesticides during pregnancy is a risk factor that contributes to the birth of babies with low birth weights in Bandungan Village, Semarang Regency.	The case and control groups totaled 104 mother-respondent samples.	This study used a case-control design. The sampling technique used purposive sampling—data processing using the Chi-square test for continuity correction.	Agricultural activities such as pesticide spraying and pesticide use have been shown to pose a risk for LBW. Female farmers who sprayed pesticides had a 2 times greater risk of giving birth to LBW babies compared to female farmers who did not spray pesticides.
A2	Author: Rahmawati, I., et al. Journal Identity: Nursing and Health Sciences Journal (NHSJ), 1(3), 249–253. 2021. 10.53713/nhs.v1i3.85	The Effect of Hormonal Contraceptive on Low Birth Weight (LBW) Baby Delivery in Agronursing Area[26]	To find out how the relationship of hormonal contraceptive use can have an impact on the birth rate of babies with low birth weight.	This study involved 441 people.	Analysis of sample data in the study was carried out using sampling quotas. The characteristics of respondents are displayed in the form of univariate analysis. The analysis method is used to describe the characteristics that exist in respondents. Regression testing involves several other variables, such as parity, initial membrane rupture, and history of pre-eclampsia, to examine the validity of factors that can lead to low birth weight (LBW).	It was found that mothers who work in agricultural environments with limited economic and educational resources will be less concerned about the safety of using hormonal contraceptives. Low birth weight has a reasonably high incidence rate around agricultural areas. Another factor contributing to low birth weight is pesticide exposure by pregnant women in agricultural environments.
A3	Author: Lin, S., et al. Journal Identity: BMC Public Health, 22(1), 1–11. 2022. 10.1186/s12889-022-13604-z	Interactive Effect of Maternal Exposure to Chemical Fertilizer and Socioeconomic Status on The Risk of	To investigate how poor socioeconomic position and maternal exposure to chemical fertilizers during	In this investigation, cases from the Perinatal Health Care Surveillance System between 2007 and 2012 were selected,	Data were collected through face-to-face interviews using a structured questionnaire within 42 days after delivery.	The interactive analysis of this study suggests that high chemical fertilizer exposure and socioeconomic status disadvantage may amplify the risk of LBW. In Chinese research, farmers with low education levels

		Low Birth Weight[27]	pregnancy interact to increase the risk of low birth weight.	comprising 179 LBW cases (birth weight <2500 g and gestational age 37 weeks) and 204 cases (birth weight 2500 g and gestational age 37 weeks).		tend to overuse chemical fertilizers, making them more vulnerable to chemical fertilizers.
A4	Author: Rahmawati, A., et al. Journal Identity: Proceedings of the 3rd Borobudur International Symposium on Humanities and Social Science 2021 (BIS-HSS 2021), 40–46. 2023. 10.2991/978-2-494069-49-7_8	The Relationship between Pesticide Exposure in Pregnant Women and the Incidence of LBW at the Sawangan 1 Public Health Centre, Magelang Regency[28]	To ascertain whether pregnant women's exposure to pesticides and low birth weight (LBW) prevalence are related.	According to this study, the population of Puskesmas Sawangan 1 Brebes Jawa Tengah is made up of all the parents who have lost a child in the last year of life.	Purposive sampling was used to choose samples from a total of 50 respondents. Employing the Chi-Square statistical test for data analysis.	The case group's exposure category outcomes were better than the control group's. There were 22 responders in the exposed category in the case group. Eleven respondents fell into the exposed category in the control group.
A5	Author: Widyawati, S., et al. Journal Identity: International Journal of Occupational and Environmental Medicine, 11(1), 15–23. 2020. 10.15171/ijoem.2020.1809	The Relationship between Pesticide Exposure and Umbilical Serum IGF-1 Levels and Low-birth Weight: A Case-control Study in Brebes, Indonesia[29]	To examine the relationship between low birth weight (LBW) occurrence and pesticide exposure during pregnancy (IGF-1 hormone disruption).	Mothers who gave birth at Brebes Regional Hospital and Bhakti Asih Hospital in Brebes, Central Java, between January and May 2018.	Analyzing pesticide exposure by interviewing mothers with LBW babies. Two hospitals in Brebes provided LBW babies (less than 2,500 g) and normal-weight babies (more than 2,500 g) for the case-control research. Assaying serum IGF-1 with the ELISA technique.	Pregnancy-related exposure to harmful substances, like pesticides, lowers umbilical serum IGF-1 levels, which leads to LBW symptoms. Pregnancy-related pesticide exposure was significantly linked to lower levels of umbilical serum IGF-1 in LBW.
A6	Author: Kartini, A., et al. Journal Identity: International Journal of Occupational and Environmental Medicine, 10(1), 17–29. 2019. 10.15171/ijoem.2019.1428	Pesticide Exposure and Stunting among Children in Agriculture Areas[30]	To evaluate the relationship between pesticide exposure and stunting in children living in agricultural communities.	The study was conducted in four primary schools in the Bulumba sub-district, with 112 pupils in the control group and 48 in the case group, all aged 8 to 12 years.	The study measured pesticide exposure based on exposure history during pregnancy, infancy, and childhood. To assess stunting, the z-score of height for age was used along with levels of hormones TSH, IGF-1, hemoglobin, zinc, albumin, energy and protein, history of infection, low weight,	There was no significant change in features between the case and control groups, but one significant difference: the case group had lower IGF-1 levels. High pesticide exposure combined with low IGF-1 levels is linked to stunting in children, as are other independent risk factors.

						and maternal height.
A7	Author: Matsuki, T., et al. Journal Identity: International Journal of Environmental Research and Public Health, 17(12), 1–19. 2020. 10.3390/ijerph171 24608	Association between Prenatal Exposure to Household Pesticides and Neonatal Weight and Length Growth in the Japan Environment and Children's study[31]	The study aimed to examine the effects of prenatal pesticide exposure on body size and neonatal growth during the first month of life.	93.718 pairs of expectant mothers and their offspring from the Japan Environment and Children Study were included.	During the second and third trimesters, participants filled out questionnaires about their demographics and the frequency with which they used pesticides during pregnancy. ANCOVA was used to calculate birth weight and length based on pesticide levels.	The majority of pesticides have little effect on length or weight at birth. Although the effects are minor, a significant association was found between the use of fogging insecticides and low birth weight and between the frequency of exposure to certain pyrethroid-based pesticides and suppression of infant length growth. In addition, exposure to household insecticides before delivery, especially pyrethroid-containing mosquito coils, may impact fetal and newborn growth rates.
A8	Author: Soesanti, F., et al. Journal Identity: BMC Pregnancy and Childbirth, 20(1), 1–8. 2020. 10.1186/s12884-020-03162-w	The effect of non-organophosph ate household pesticides exposure during pregnancy on infants birth sizes and growth rate: a cohort study[32]	To evaluate the relationship between exposure to non-organophosph ate household pesticides to pregnancy and other health conditions around the agricultural environment.	The enrollment of participants was between June 2012 and January 2017. There were 284 participants in all for this study.	Mothers selected to be respondents will complete questionnaires about exposure to non-organophosphate household pesticides in the third trimester of pregnancy. The baby's weight and length will be measured consistently starting at birth, after which weight, height, and head circumference (HC) will be measured respectively at 7 days, 1, 2, 4, and 6 months of age.	In the third trimester of pregnancy, mothers answered a questionnaire on their exposure to non-organophosphate household insecticides. The newborn's weight, height, and head circumference (HC) were measured at birth, followed by seven days, one, two, four, and six months of age.
A9	Author: Jaacks, L. et al. Journal Identity: Environment International, 133, 1–9. 2019. 10.1016/j.envint.2 019.105243	Association of prenatal Pesticide Exposures with adverse pregnancy outcomes and stunting in rural Bangladesh[33]	To measure the levels of pesticide biomarkers in urine during <16 weeks of pregnancy and correlate them with stunting, low birth weight, small for gestational age, premature birth, and stunting in children aged	The population of this study was 1,613 diads of mothers (aged 18-40 years) in rural Bangladesh, and a sample of 289 diad mothers that met the study's criteria were found.	In this study, eight pesticide biomarkers were examined in urine samples. Children's index is measured anthropometrically at birth and about a year and a half. A set of appropriate minimum adjustments is identified using a directed acyclic graph. Relative risk (RR) is calculated using log-binomial regression	The study found that exposure to pesticides in pregnant women increases the risk of having a baby with a low birth weight, which is a risk factor for stunting. Pregnant women with the highest levels of 4-nitrophenol are more likely to give birth to children who are less weighty for their age.

			1-2 years.		with a 95% confidence interval.	
A10	Author: Lubis, F. H. Journal Identity: Jurnal Kesmas Dan Gizi (Jkg), 3(1), 39–47. 2020. 10.35451/jkg.v3i1 .477	Analisis Faktor Risiko Paparan Pestisida Pada Kehamilan Dengan Kejadian Berat Badan Lahir Rendah (BBLR) di Kota Padangsidimp uan Tahun 2019[34]	To determine risk factors for pesticide exposure and the incidence of low birth weight diseases.	The research sample was divided into 25 people from the case group and 25 from the control group.	This study used interviews and observation as its method. Moreover, it employs univariate and bivariate analysis in data analysis.	The findings from this study reveal that exposure to pesticides has been identified as a contributing factor to the low incidence of birth severity in the field, which can be supported by work related to the pesticide of pregnant women, the lack of complete personal protective equipment (PPE) during field activities, and the storage of the pest.

Discussion

Agronursing, an interdisciplinary field merging agricultural health and nursing science, focuses on addressing the unique health challenges farming communities face, particularly those linked to occupational and environmental hazards[35]. Agronursing integrates healthcare principles with agricultural safety; agronursing emphasizes preventing, managing, and mitigating health risks associated with farming activities, including pesticide exposure[36]. In agricultural regions, pesticides are extensively used to protect crops, yet their toxic residues often contaminate air, soil, and water, creating pervasive exposure risks[37]. Pregnant individuals engaged in farming activities—such as handling crops, preparing pesticides, or residing near treated fields—are particularly vulnerable to chronic or acute exposure. These chemicals can disrupt maternal physiological processes, impair placental function, and induce oxidative stress or inflammation, all linked to intrauterine growth restriction and low birth weight (LBW)[38]. Agronursing bridges agricultural practices with public health priorities by identifying these pathways and advocating for interventions to protect maternal-fetal health[39].

Agronursing professionals are pivotal in mitigating pesticide-related risks through education, advocacy, and preventive care. By assessing occupational and environmental hazards in farming communities, they design interventions to reduce exposure among

pregnant women. This includes promoting safe handling practices, advocating for protective equipment, and raising awareness about the dangers of pesticide drift and contaminated food/water sources[37]. Additionally, agronursing integrates prenatal care with agricultural health monitoring, enabling early detection of exposure-related complications[38]. Such efforts are critical in resource-limited settings where regulatory frameworks may be weak and healthcare access is limited. By fostering collaboration between healthcare providers, agricultural stakeholders, and policymakers, agronursing reduces LBW incidence and safeguards future generations' health in agrarian populations[39].

a. Factors of Low Birth Weight in Agriculture Areas

When producing food, pesticides are essential for the quality of agricultural output, but farmers often ignore safety advice to remain safe. Do not use personal protection equipment can have adverse effects such as blisters, rashes, blindness, nausea, dizziness, diarrhea, and even death. In addition, low birth weight and initial delivery are two effects of using unfavorable pesticides on female farmers. According to a study by Triyani et al. (2019), fetal condition (multiple pregnancies, chromosomal disorders, polyhydramnios), environmental factors (exposure to toxic substances), and history of maternal disease during pregnancy (hypertension, heart, lungs, and infectious diseases), all can contribute to low birth weight (LBW). Women's participation in agricultural arrangements, including tasks such as mixing and spraying pesticides. It has been determined that using and spraying pesticides is one of the agricultural practices that increases the risk of LBW. Compared to women who do not spray pesticides, female farmers are at risk of giving birth to children with low birth weight.

Another factor that leads to BBW is ignorance. According to a study by Rahmawati et al. (2021), mothers who work in the context of agriculture with inadequate economic and education resources tend to be less concerned about safety using hormonal birth control. Low socioeconomic status can also increase the prevalence of LBW. According to research by Lin et al. (2022), low-income developing countries have a higher BBW frequency and are more likely to use chemical fertilizers such as pesticides. This claim is supported by research by Rahmawati et al. (2023), who found a strong correlation between LBW events and exposure to pregnant women against pesticides in agricultural areas.

b. Relationship between IGF-1 Serum Level and Low Birth Weight

Production and secretion of growth hormone-1 (IGF-1), such as insulin, can be disrupted by exposure to hazardous chemicals, such as pesticides. The most important hormone for fetal development, especially in the last stage of pregnancy, is IGF-1. IGF-1 impacts fetal development during pregnancy by affecting the placenta and metabolism. Low levels of IGF-1 in the mother's blood can affect the baby's health, increasing the likelihood of low birth weight and even benefiting offspring. This is caused by the role of IGF-1 in metabolism, mitogenesis, and cell differentiation, which includes controlling and promoting trophoblast cell growth, which causes placenta. This situation is consistent with research by Widyawati et al. (2020), which shows that mothers previously exposed to pesticides have IGF-1 levels 3.6 times lower than mothers who have not experienced pesticides. Low birth weight newborns can result from the mother's low IGF-1 levels. Different studies have found that children who are exposed to pesticides and have low IGF-1 levels are more likely to experience stunting[30].

c. Pesticide Exposure's Effect on the Prevalence of Low Birth Weight

Using liquid insecticides, plantation herbicides, and insect repellent insecticides has a bad impact on pregnant women and the fetus. These chemicals are not only used in areas of agricultural activity but these materials are often used to clean the house from insects. Exposure of pregnant women to chemicals has been shown to result in shorter infant body length than pregnant women with minimal exposure to pesticides. In addition to body length, exposure to chemicals such as pesticides and insecticides and exposure to similar substances also impact the incidence of low birth weight[31]. This is consistent with studies by Soesanti et al. (2020) that show low birth weight is associated with non-organophosphate pesticides, with smaller birth head circumferences than babies born to moms who receive less exposure to pesticide chemicals. Extended exposure to pesticides during pregnancy can hurt fetus growth, which can disrupt the child's development[33].

Therefore, pregnant women must be aware of exposure to the use of pesticides

to protect and prevent their fetuses from being born with low birth weight conditions. Pregnant women can do prevention by minimizing the use of chemicals containing pesticides in house cleaning activities and staying away from areas of agricultural activities that use pesticides. If pregnant women are trapped in conditions of pesticide exposure, pregnant women must use personal protective equipment such as wearing long sleeves, long pants, cloth masks, cloth gloves, and head coverings[34].

Conclusion

The agricultural industry is one of the most labor-intensive for men and women. Millions of people who work in agriculture are noted to suffer from pesticide poisoning every year, and thousands of farmers and agricultural workers are poisoned by pesticides every day. Women are among the most vulnerable to the harmful effects of pesticide exposure in the body since they work in agriculture; this can disrupt fetal growth and development when the mother is carrying the fetus and result in low birth weight (LBW) newborns. We found a strong correlation between pesticide exposure and low birth weight events in agricultural areas, where most people, especially pregnant women, experience the harmful effects of pesticide exposure in the prevalence of low birth weight.

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Conflict of Interest

None

Author contribution

All authors contributed to completing this research

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