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Review

Pesticide exposure increases the incidence of low birth weight in agricultural areas

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Abstract:
The widespread use of pesticides in agriculture and households poses serious health risks, especially in low-income countries with weak regulatory enforcement. Pregnant women are particularly vulnerable, as prenatal pesticide exposure is linked to low birth weight (LBW) through hormonal and neurotoxic effects. Socioeconomic challenges and proximity to agricultural areas further increase these risks, making it essential to address this issue to improve maternal and neonatal health in farming communities. This study analyzes the incidence of LBW according to levels of prenatal pesticide exposure among pregnant women in agricultural communities by examining environmental exposure patterns and birth outcome data. A literature review was conducted for 2019–2025 using PubMed, ScienceDirect, SSRN, Wiley Online Library, and ProQuest, and from an initial pool of 142,730 records, filters for research articles, full-text availability, and topic relevance yielded 14 studies for final analysis. Across the 14 studies, prenatal pesticide exposure was consistently associated with an increased risk of LBW and fetal growth restriction. Key factors influencing this risk included low socioeconomic status, pesticide type (organophosphates, fumigants), and timing of exposure—particularly during the second trimester. Living near agricultural areas also correlated with higher exposure levels, which may impair placental function, disrupt hormonal balance, and interfere with fetal tissue development. Some studies additionally reported long-term developmental problems. Prenatal pesticide exposure significantly increases the risk of LBW. Reducing maternal pesticide exposure and strengthening protective health interventions are crucial to improving agricultural communities' birth outcomes.

Keywords:
pesticide, low birth weight, and agriculture

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INTRODUCTION

Maternal and child health issues remain important globally, especially in developing countries (Thapa et al., 2022). One of the most common pregnancy complications is low birth weight (LBW). According to the World Health Organization (WHO), LBW is defined as a birth weight of less than 2500 grams, regardless of gestational age. LBW is one of the leading indicators for assessing the

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quality of neonatal health and a predictor of the risk of chronic diseases in the future, such as diabetes mellitus and coronary heart disease (Yang et al., 2021).

According to the WHO, approximately 60–80% of neonatal deaths were attributed to low birth weight (LBW). More than half of LBW cases originated from the Asian continent, with South Asia being the most significant contributor globally, followed by Southeast Asia, which accounted for 12.3% of global LBW births. Between 2000 and 2015, the reduction in LBW incidence among ASEAN countries was slow, with a decrease of only 1.4% (95% confidence interval, 0.9 to 1.9). In contrast, South Asian countries experienced a greater decline of 5.9% (95% CI, 3.8-8.8) during the same period (Arsyi et al., 2022).

Pesticides are chemical compounds that kill or control pests, including insects, weeds, and fungi (Ahmad et al., 2024). Pesticides are used in various fields, ranging from the agricultural sector to protect crops from pest attacks to public health efforts aimed at controlling the spread of diseases through vectors such as mosquitoes (Shekhar et al., 2024). However, uncontrolled use can cause environmental contamination and exposure to humans, including pregnant women. Pesticide exposure has long been associated with endocrine disruption, neurotoxicity, and teratogenic effects, all of which can affect fetal development during pregnancy (Lin et al., 2022).

Some pesticides commonly used in agricultural areas include organophosphates, pyrethroids, organochlorines, and herbicides such as glufosinate-ammonium and linuron (Pathak et al., 2022). Organophosphates inhibit the enzyme acetylcholinesterase, which plays a crucial role in nerve function (López-Benítez et al., 2024). Each type of pesticide has a different toxic mechanism, but most can potentially disrupt the hormonal system and fetal metabolism. For example, exposure to organophosphates during pregnancy has been linked to reduced birth weight and shorter gestational duration (Simões et al., 2023).

Low Birth Weight (LBW) can be caused by various factors, ranging from maternal medical conditions such as hypertension and diabetes to environmental factors such as exposure to harmful chemicals. In agricultural areas, pregnant women who work or live near farmland are at high risk of pesticide exposure through air, water, or soil (Herawati & Tridiyawati, 2023). However, environmental factors such as pesticide exposure should not be overlooked, especially in agrarian regions. Exposure can occur directly through skin contact during pesticide application or indirectly through the consumption of contaminated groundwater or unwashed food, thereby increasing the risk of exposure among residents (Cecchi et al., 2021).

Maternal exposure to pesticides, particularly through residential proximity to agricultural areas, has been increasingly recognized as a potential risk factor for adverse birth outcomes such as low birth weight, shortened gestational age, and increased perinatal mortality, as these chemical agents may disrupt hormonal balances, impair placental function, and interfere with critical stages of fetal development even at low environmental exposure levels (Simões et al., 2023).

Research by Wylie et al. (2025) indicates that pesticide exposure during the second trimester of pregnancy (weeks 16 to 27) is a critical period with a high risk of resulting in decreased birth weight. In this phase, the fetus is experiencing rapid organ and tissue growth, making it vulnerable to disorders due to exposure to toxic substances. Lin et al. (2022) found that pregnant women with low economic status living in agricultural areas have a two-fold higher risk of experiencing LBW if exposed to pesticides. This is due to limited access to health services, poor nutrition, and a lack of

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protection when using pesticides. Maternal body mass index (BMI) <18.5kg/m2 and maternal height <1.5m were also associated factors of LBW (Herwanto et al., 2024).

With the increasing use of pesticides in the agricultural sector and their impact on reproductive health, strict regulations and education are needed for agricultural communities. Prevention efforts must begin at the individual level and extend to national policies, including training on the use of PPE (Personal Protective Equipment), the establishment of agricultural safe zones, and prenatal screening programs that incorporate biomarkers of pesticide exposure (Hu et al., 2024). This study aimed to analyze the incidence of LBW according to levels of prenatal pesticide exposure among pregnant women in agricultural communities by examining environmental exposure patterns and birth outcome data.

METHOD

This research uses the literature review method. Literature sources were collected from research journal databases and the internet, focusing on PubMed, Science Direct, SSRN, Wiley Online Library, and ProQuest between 2020 and 2025. English search keywords were used to find relevant literature. The literature search was conducted in English, using the keywords "Pesticide," "low birth weight," and "Agriculture."

The journal search process began by identifying specific keywords. At the search stage, 142.730 journal articles were found relevant to the keywords used. The next step is to filter the articles based on their year of publication, from 2020 to 2025, and select those that are free full-text, open-access, and open-archive articles to ensure that they meet the study's criteria. At the filtering stage, 12.500 articles were found to meet the criteria. The publications were then filtered based on the research criteria for inclusion and exclusion. 2.220 articles met the inclusion and exclusion criteria obtained in the search.

At the next stage, 50 articles met the initial criteria. The articles were then filtered again based on abstract match and result match with other predetermined criteria. After the screening process, 12 final articles were selected. The results of this screening process are shown in the following PRISMA chart.

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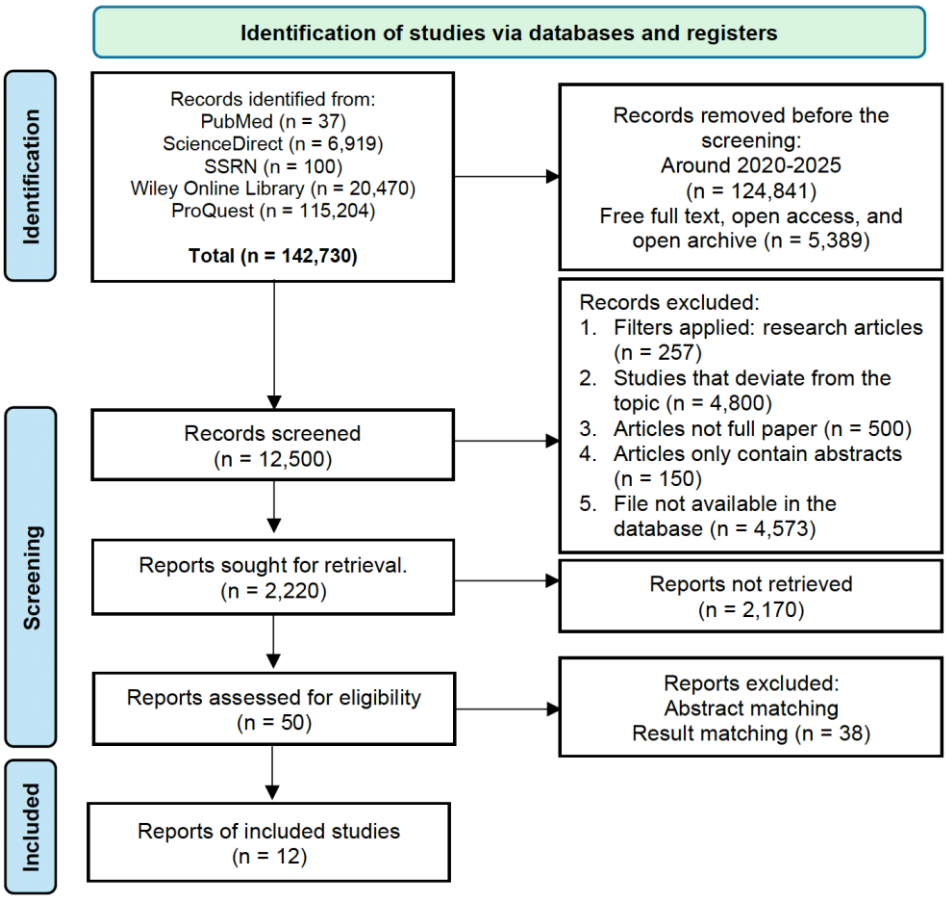

Figure 1. PRISMA Flow Diagram

RESULT

After assessing the studies and articles, 12 showed an association between Pesticide Exposure and the Risk of Low Birth Weight in Agricultural Areas. For more detailed information, see Table 1 for the results of the following literature analysis.

Table 1. Literature Identification and Review

No.	Author and Journal Identity	Journal Title	Objective	Population and Sample	Method	Summary of Results
A1	**Author:** Lin et al. (2022) **Journal Identity:** *BMC Public Health*, *22*(1), 1–11. https://doi.org/10	Interactive effects of maternal exposure to chemical fertilizer and socioeconomic status on the risk	To explore the interactive effects of maternal exposure to chemical fertilizers during pregnancy and disadvantaged socioeconomic status (SES) on the risk of term low birth weight (tLBW)	In this population-based case-control study, 179 tLBW cases (birthweight < 2500 g and gestational age 37 weeks) and 204 controls	The study used a population-based case-control design in Pingding County, Shanxi Province, China, involving 179 cases of term low birth weight (tLBW) and 204 controls. Data on socio-demographic, dietary,	The study's results revealed that low maternal socioeconomic status (SES) and high exposure to chemical fertilizers were associated with an increased risk of term-low birth weight (tLBW). Specifically, the combination of low SES

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No.	Author and Journal Identity	Journal Title	Objective	Population and Sample	Method	Summary of Results
	.1186/s12889-022-13604-z	of low birth weight		(birthweight≥2500 g and gestational age≥37 weeks) were chosen from the Perinatal Health Care Surveillance System of Pingding County, Shanxi Province, China between 2007 and 2012	and lifestyle factors and exposure to chemical fertilizers were collected through structured interviews with trained health workers. Household exposure was assessed directly, while village-level exposure was obtained from official statistics. Logistic regression models analyzed the relationships between maternal exposure to chemical fertilizers, socioeconomic status, and the risk of tLBW.	and high village-level fertilizer exposure showed an adjusted odds ratio (aOR) of 2.62. Low SES combined with household fertilizer use had an aOR of 2.18. Furthermore, significant additive interactions were detected, with a relative excess risk due to interaction (RERI) of 1.79 for village-level exposure and 0.77 for household exposure, indicating that the joint effect of low SES and high chemical fertilizer exposure was greater than the individual effects. These findings underscore the heightened vulnerability of women with low SES to the adverse effects of chemical fertilizers during pregnancy.
A2	**Author:** Matsuki et al. (2020) **Journal Identity:** *International Journal of Occupational and Environmental Medicine*, *11*(1), 15–23. https://doi.org/10.15171/ijoem.2020.1809	Association Prenatal Exposure to Household Pesticides and Neonatal Weight and Length Growth in the Japan Environment and Children's Study	To investigate the effects of prenatal exposure to various household pesticides on neonatal growth, explicitly focusing on body weight and length during the first month of life, utilizing data from the Japan Environment and Children's Study (JECS).	Consisted of pregnant women recruited for the Japan Environment and Children's Study (JECS) between 2011 and 2014, including 93,718 pairs of pregnant women and their children	The study employed a cohort design, utilizing data from the Japan Environment and Children's Study (JECS). Pregnant women completed self-report questionnaires during their second or third trimesters, detailing demographic characteristics and the frequency of household pesticide usage.	The study indicated that most household pesticides assessed did not significantly affect neonatal birth weight and length. However, two notable associations were identified: the use of fumigation insecticides was linked to a decrease in birth weight, while exposure to pyrethroid-based pesticides, particularly mosquito coils and mats, was associated with reduced length growth in neonates during the first month of life. The effect sizes for these associations were small but statistically significant, suggesting that prenatal exposure to certain household pesticides may have adverse effects on fetal and postnatal growth trajectories.
A3	**Author:** Wylie et al. (2025) **Journal Identity:** *Environment International*, *196*(June 2024),	Evaluation of gestational nonpersistent pesticide exposure with newborn	To examine associations between gestational exposure to nonpersistent pesticides and newborn outcomes and identify critical windows of susceptibility.	Pregnant women in rural Ghana participated in the Ghana Randomized Air Pollution and Health Study (GRAPHS), and	This study uses observational cohort study conducted in rural Ghana as part of the Ghana Randomized Air Pollution and Health Study (GRAPHS). A novel time-varying extension of multiple	One thousand two hundred eleven pregnant women contributed 3,786 gestational urinary samples. In models assuming constant associations with exposures across pregnancy, in a given week,

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No.	Author and Journal Identity	Journal Title	Objective	Population and Sample	Method	Summary of Results
	109292. https://doi.org/10.1016/j.envint.2025.109292	size and gestational length in rural Ghana using a novel time-varying extension of multiple informant models		1,211 pregnant women contributed 3,786 gestational urinary samples.	informant models was developed to assess critical exposure windows and their impact on birth outcomes.	a doubling of 3-phenoxybenzoic acid (pyrethroid biomarker) was associated with a 15.8 g difference in birth weight (95 % CI:-28.1,-3.6), and a doubling of the 2,4-dichlorophenoxyacetic acid (2,4-D, herbicide biomarker) was associated with an 11.1 g increase in birth weight (95 % CI:1.0,21.1). In time-varying models, significant associations were identified for pyrethroid exposure measured between weeks 16–27 and 2,4-D exposure measured during weeks 25–33. Organic phosphates were not associated with birth weight. No associations were found for birth length or head circumference for any pesticide. In constant association models, a doubling of weekly 2,4-D was associated with a 0.05-week increase in gestational length (95 %CI:0.01,0.09); no associations were found with other biomarkers.
A4	**Author:** Rahmawati et al. (2023) **Journal Identity:** *Proceedings of the 3rd Borobudur International Symposium on Humanities and Social Science 2021 (BIS-HSS 2021)*, 40–46. https://doi.org/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	To determine the relationship between pesticide exposure in pregnant women and low birth weight (LBW) incidence.	The study population was all mothers with live births in the last 1 year at the Sawangan 1 Health Centre. The sampling technique used was purposive sampling with a sample of 50 respondents.	This quantitative research has an analytical observational character and a case-control approach. The instruments used are medical records, baby birth weight data at the Sawangan 1 Health Centre, and a pesticide exposure questionnaire that experts have tested.	The study found that 66.7% of mothers in the case group (LBW babies) were exposed to pesticides, whereas only 33.3% of mothers in the control group (normal birth weight babies) experienced pesticide exposure. Conversely, 17.6% of mothers who were not exposed to pesticides still had LBW babies, while 82.4% of unexposed mothers gave birth to babies with normal birth weight. Statistical analysis using the Chi-Square test yielded a p-value of 0.001, indicating a statistically significant relationship between pesticide exposure and LBW incidence. Furthermore, the Odds Ratio (OR) of 2.471 suggests that pregnant women exposed to

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						pesticides are twice as likely to give birth to LBW babies compared to those who are not exposed.
A5	**Author:** Simões et al. (2023) **Journal Identity:** *Environment International*, *178*(April). https://doi.org/10.1016/j.envint.2023.108085	Exploring associations between residential exposure to pesticides and birth outcomes using the Dutch birth registry	To explore associations between residential exposure to specific pesticides and birth outcomes using individual-level exposure and pregnancy/birth data.	The study population included all singleton births recorded in the Dutch birth registry from 2009 to 2013. The sample consisted of 339,947 mothers who met specific criteria: they were over 16 years old, resided in non-urban areas, and had a stable address history, meaning they had changed their residence at most once during pregnancy.	From all 2009–2013 singleton births in the Dutch birth registry, we selected mothers > 16 years old living in non-urban areas who had complete address history and changed addresses at most once during pregnancy (N = 339,947).	Regression analyses showed that maternal residential exposure to fluroxypyr-meptyl was associated with longer GA, glufosinate-ammonium with higher risk of LBW, linuron with higher BW and higher odds of LGA, thiacloprid with lower odds of perinatal mortality and vinclozolin with longer GA. Variable selection analysis revealed that picoxystrobin was associated with higher odds of LGA. We found no evidence of associations with other AIs. Sensitivity and additional analysis supported these results except for thiacloprid.
A6	**Author:** Yang et al. (2021) **Journal Identity:** *Environment International*, *148*, 106374. https://doi.org/10.1016/j.envint.2020.106374	Prenatal exposure to organochlorine pesticides and infant growth: A longitudinal study	The study aimed to examine the associations between prenatal exposure to OCPs and infant growth at birth, 6, 12, and 24 months of age, and further explore the potential sex-specific effects.	The study was conducted based on a longitudinal cohort study at Wuhan Women and Children Medical and Health Center in Wuhan, China. All participants signed written informed consent at enrollment. In the present study, we restricted using mother-infant pairs with birth data and available cord serum samples from 2014 to 2015 (n =1046). After excluding mother-infant pairs with congenital disabilities (n = 7), a total of	The study population included 1039 mother-infant pairs who participated in a birth cohort study in Wuhan, China. The infants' weight, length, and body mass index (BMI) z-score were measured and calculated at birth, 6, 12, and 24 months. The overweight status was defined as a BMI z-score ≥85th percentile according to the standard of the World Health Organization.	Higher cord serum β-HCH concentrations were associated with higher BMI z-score at 12 [β =0.07, 95% CI: 0.01, 0.13] and 24 months of age [β =0.08, 95% CI: 0.02, 0.14]. Similar patterns were observed for relationships of γ-HCH [β =0.04, 95%CI: 0.01, 0.07] and p,p′-DDT [β =0.03, 95% CI: 0.00, 0.06] with BMI z-score at 6 and 12 months of age, respectively. However, higher cord serum p,p′-DDE concentrations were associated with a reduced BMI z-score at 6 months of age [β = 0.07, 95% CI: 0.12, 0.01]. Cord serum β-HCH was also positively associated with the risk of being overweight at 12 months of age [RR =1.16, 95% CI (1.02, 1.33), for the medium vs the lowest tertile]. Among girls, the effects of β-HCH on BMI z-score and overweight status were stronger than boys at 12 and 24 months

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				1039 mother-infant pairs were left for analysis.		of age. No statistically significant relationships between other OCPs and infant growth were observed.
A7	**Author:** van den Dries et al. (2021) **Journal Identity:** *Environmental Health Perspectives*, *129*(11), 1–13. https://doi.org/10.1289/EHP9178	Prenatal Exposure to Nonpersistent Chemical Mixtures and Fetal Growth: A Population-Based Study	To assess the association between prenatal exposure to phthalates, bisphenols, and organophosphate (OP) pesticides and fetal head circumference, femur length, and weight measures.	The study population consisted of pregnant women participating in the Generation R Study, a population-based birth cohort in the Netherlands. The sample included 776 mother-child pairs with complete urine data collected during pregnancy and birth weight measurements recorded at delivery.	The Generation R Study is a prospective population-based birth cohort designed to identify early environmental and genetic determinants of development.	The average EFW at 18–25 wk and >25 wk was 369 and 1,626 g, respectively, and the average birth weight was 3,451 g. Higher exposure was associated with smaller fetal and newborn growth parameters in a nonlinear fashion. At 18–25 wk, fetuses in the second, third, and fourth quartiles of exposure (Q2–Q4) had 26 g [95%confidence intervalsðCIÞ:−38, −13], 35 g (95%CI: −55, −15), and 27 g (95%CI: −54, 1) lower EFW compared with those in the first quartile (Q1). A similar dose-response pattern was observed at >25 wk, but all effect sizes were smaller, and no association was observed comparing Q4 to Q1. At birth, we observed no differences in weight between Q1–Q2 and Q1–Q3. However, fetuses in Q4 had 91 g (95%CI: −258, 76) lower birth weight than those in Q1. Results observed at 18–25 and >25 wk were similar for femur length; however, no differences were observed at birth. No associations were observed for head circumference.
A8	**Author:** Cecchi et al. (2021) **Journal Identity:** *Environmental Science and Pollution Research*	Residential proximity to pesticide applications in Argentine Patagonia impacts pregnancy and newborn parameters.	The study investigates whether maternal residential proximity to fruit croplands with intense pesticide applications is associated with pregnancy complications and alterations in newborn parameters.	The study included 776 pregnant women who met the inclusion criteria. They were divided into two groups. Rural Group (RG), Women living near intensive pesticide application areas (<5000m). Urban Group (UG), Women	A multicenter study was conducted with a prospective approach. Data were collected via hospital records, interviews, and anthropometric measurements of newborns. Statistical analyses included chi-square tests and t-tests, with significance at $p < 0.05$.	The threatened miscarriage rate was significantly higher in the rural group. Birth length and head circumference were lower in the rural group, while birth weight was similar between groups. The rural group had a higher ponderal index, indicating potential fetal growth alterations.

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				from Neuquen City with no prior pesticide exposure.		
A9	**Author:** Suwannakul et al. (2021) **Journal Identity:** *Environmental Science and Pollution Research*	Prenatal organophosphate exposure can cause adverse birth outcomes in humans	The study examines the association between prenatal organophosphate (OP) pesticide exposure among pregnant agricultural workers and adverse birth outcomes. It also investigates the factors influencing OP metabolite levels in urine.	Pregnant agricultural workers in Chiang Mai Province, Thailand. Seventy-one pregnant women aged 18–35 years, with gestational age <28 weeks, were healthy and working in the agricultural sector.	This birth cohort study was conducted from September 2019 to June 2020 in Chiang Mai Province, Thailand. Seventy-one pregnant agricultural workers aged 18–35, with gestational age less than 28 weeks, participated in the study. Urine samples were collected to measure six organophosphate (OP) metabolites, and birth outcome data, including gestational age at birth, birth weight, birth length, head circumference, and Apgar scores, were obtained from medical records. Multiple regression analysis was performed to examine the association between prenatal OP exposure and birth outcomes, as well as the factors influencing OP metabolite levels, with a significance level of $p < 0.05$	The study found that pregnant women who frequently worked in agriculture had higher OP metabolite levels. A significant negative association was observed between gestational age at childbirth and diethylphosphate (DEP) levels, indicating that higher OP exposure could lead to shorter gestation periods. Additionally, Apgar scores 1 and 5 minutes after birth were negatively associated with diethyl-dithiophosphate (DEDTP) levels, suggesting potential adverse effects on newborn health.
A10	**Author:** Hu et al. (2024) **Journal Identity:** *Environmental Health (2024) 23:60*	Gestational exposure to organochlorine compounds and metals and infant birth weight: effect modification by maternal hardships.	The study investigates whether maternal hardships modify the relationship between gestational exposure to organochlorine compounds (OCs) and metals with infant birth weight.	Pregnant women in Canada. One thousand nine hundred eighty-two pregnant women from the *Maternal-Infant Research on Environmental Chemicals (MIREC) Study* were recruited between 2008 and 2011. The study included only those who provided complete socio-demographic data, biological samples in the	This cohort study analyzed blood samples from the first trimester to measure six organochlorine compounds and five metals levels. Maternal hardships, such as financial strain, low education, and chronic illness, were assessed using questionnaires. Birth weight was adjusted for gestational age and analyzed using *elastic net regression* to identify significant interactions between chemical exposures and maternal hardships. Multiple linear regression	The study found that higher levels of trans-nonachlor and lead (Pb) were associated with lower infant birth weight. Additionally, maternal hardships such as low education, racial minority status, and inadequate folic acid intake independently contributed to reduced birth weight. The adverse effects of chemical exposure on birth weight were more pronounced among mothers experiencing financial strain, low education, or single parenthood. Interestingly, some interactions showed unexpected positive associations, such as an

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				first trimester, and singleton live births.	models were then used to estimate associations .	increase in birth weight among infants of mothers with high mercury (Hg) exposure and low education, which dietary factors like selenium intake may influence.
A11	**Author:** Kumar et al. (2021) **Journal Identity:** Journal of Biochemical and Molecular Toxicology (2021)	Occupational exposure to pesticides in female tea garden workers and adverse birth outcomes.	The study aims to evaluate the effects of pesticide exposure on pregnancy outcomes in female tea garden workers (TGWs) by analyzing acetylcholinesterase (AChE) activity, placental structure, and expression of hypoxia-inducible factor (HIF)-1α.	Pregnant women working in tea gardens in Assam, India. One hundred seventy-five pregnant women were divided into two groups. Tea Garden Workers (TGW) (n = 102) who were exposed to pesticides and Housewives (HW) (n = 73) who were not exposed	This cross-sectional study was conducted in Assam, India. Maternal, umbilical cord, and placental tissues were collected to measure AChE activity. Placental histology was analyzed to assess structural changes, and scanning electron microscopy (SEM) was used to examine microvilli alterations. Immunohistochemical analysis was conducted to detect HIF-1α expression, indicating placental hypoxia. Statistical analyses included correlation and regression models, with significance set at $p < 0.05$.	The study found significantly lower AChE activity in maternal blood and cord blood of TGWs compared to HWs, particularly in cases of low birth weight (LBW). Placental analysis revealed increased syncytial knots, fibrinoid necrosis, cholangitis, and vascular abnormalities in TGWs. SEM findings showed morphological changes in microvilli, suggesting impaired placental function. Moreover, HIF-1α expression was significantly higher in the placenta of TGWs, indicating hypoxic conditions.
A12	**Author :** Calzada et al. (2023) **Journal Identity :** *UB Economics Working Paper No. 405 (Preprint, not peer-reviewed)*	The Hidden Cost of Bananas: Pesticide Effects on Newborns' Health.	The study investigates the effects of aerial fumigation of banana plantations on newborns' birth weight in Ecuador from 2015 to 2017. It aims to assess how pesticide exposure impacts birth weight and newborn health.	Newborns in Ecuador. Nearly 270,000 newborns from Ecuador's National Register of Live Births (2015-2017). Around 51,000 mothers lived within 2.5 km of banana plantations, forming the primary exposure group.	The study employed three identification strategies to analyze the impact of pesticide exposure on newborns' health. First, a difference-in-differences (DID) model was used to compare birth outcomes of newborns exposed to pesticides during intensive and non-intensive fumigation periods. Second, a geographical comparison model examined birth weight differences between newborns near banana plantations and those near other fumigated crops. Third, a maternal fixed-effects model analyzed siblings exposed to different levels of pesticide fumigation based on maternal relocation	The findings indicate that newborns exposed to pesticide fumigation during the first trimester of pregnancy had an average weight reduction of 38 to 89 grams, with an increased risk of low birth weight (0.35 probability) and low Apgar scores (0.33 probability). Compared to exposure to other fumigated crops, banana plantation pesticides led to an additional birth weight deficit of 29 to 76 grams. The maternal fixed-effects model further revealed that female newborns exposed to pesticides had a birth weight deficit of 346 grams compared to their unexposed siblings.

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					during pregnancy. The key outcome variables were birth weight, gestational length, and Apgar scores.	

DISCUSSION

Agro-nursing, an interdisciplinary approach that combines agriculture and healthcare, addresses health risks in agricultural communities, including exposure to pesticides. Prolonged exposure to pesticides—common in farming areas—has been linked to adverse reproductive outcomes, including low birth weight (LBW). Pregnant women exposed to these chemicals, either through direct application or environmental contamination, face heightened risks of placental dysfunction, restricted fetal growth, or preterm birth. Studies indicate that pesticides like organophosphates and pyrethroids can disrupt endocrine systems or induce oxidative stress, impairing nutrient transfer to fetuses and increasing LBW incidence (Kurniyawan et al., 2024; Damiri et al., 2025).

Agro-nursing mitigates these risks by promoting safe pesticide use, advocating for protective measures (e.g., gloves, masks), and educating farmers on how to reduce exposure during pregnancy. Healthcare providers in agricultural regions also monitor maternal health and implement early interventions for at-risk pregnancies. By integrating occupational safety with prenatal care, agro-nursing aims to lower LBW rates, ensuring healthier outcomes for infants in farming communities while balancing agricultural productivity and worker well-being (Putri et al., 2024; Kurniyawan et al., 2023).

Pesticide exposure during pregnancy has been consistently associated with adverse birth outcomes, particularly low birth weight (LBW), as evidenced by the majority of the 12 studies reviewed. Despite their varied geographical and methodological contexts, these studies converge on a shared conclusion: prenatal contact with pesticides negatively affects fetal growth. The mechanisms behind this include endocrine disruption, neurotoxicity, and placental dysfunction. LBW is a crucial neonatal health indicator that increases risks of infant mortality, delayed development, and chronic health conditions later in life. The prevalence of this issue in agricultural areas underscores the vulnerability of rural and farming populations to environmental hazards.

Socioeconomic factors significantly exacerbate the impact of pesticide exposure. Lin et al. (2022) demonstrated that low socioeconomic status (SES) and exposure to chemical fertilizers significantly increased the risk of term LBW. This suggests a synergistic effect where poverty limits access to healthcare and protective measures, thereby amplifying health risks. Hu et al. (2024) further supported this, showing that maternal hardships such as financial strain or inadequate education intensified the adverse effects of toxic exposures on birth weight. These findings highlight that addressing environmental health risks in isolation is insufficient without parallel efforts to improve socioeconomic conditions.

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The route and type of pesticide exposure also play an important role. Similarly, Matsuki et al. (2020) in Japan found that fumigation insecticides and pyrethroids were associated with reduced birth weight and length in neonates, although the effects were subtle. This highlights the need for comprehensive risk assessments not only in agricultural but also in domestic environments where pregnant women may unknowingly be exposed to hazardous chemicals.

Several studies have identified specific critical windows during pregnancy where the fetus is most vulnerable. Wylie et al. (2025) identified weeks 16 to 27 of gestation as a particularly sensitive period during which exposure to certain pesticides significantly reduced birth weight. Likewise, Rahmawati et al. (2023) confirmed that pesticide exposure doubled the risk of LBW. These temporal insights are crucial in designing targeted interventions such as health education or restricting pesticide application during key developmental stages of pregnancy.

Biological evidence further substantiates the epidemiological findings. Kumar et al. (2021) provided histological proof, showing that pesticide-exposed pregnant tea workers had placental abnormalities and elevated HIF-1α expression, indicative of hypoxic conditions. These molecular and cellular disruptions impair nutrient and oxygen transfer to the fetus, explaining the observed birth outcomes in a mechanistic manner.

Environmental proximity and occupational exposure also significantly influence outcomes. Calzada et al. (2023) found that living within 2.5 km of banana plantations undergoing aerial pesticide spraying resulted in a substantial decrease in newborn birth weight. Similarly, Suwannakul et al. (2021) found that agricultural workers with high organophosphate metabolite levels in urine had babies with shorter gestation periods and lower Apgar scores. This highlights the significance of spatial risk factors in evaluating prenatal exposure and implementing community-level regulations.

CONCLUSION

Analysis of 12 reviewed studies demonstrates that prenatal exposure to pesticides in agricultural settings is consistently associated with an increased risk of low birth weight. Across diverse study populations and geographic regions, multiple investigations have identified that factors such as socioeconomic disadvantage, proximity to treated fields, and specific chemical classes (notably organophosphates and pyrethroids) heighten fetal vulnerability. Critical windows, particularly during mid-gestation (weeks 16–27), emerge as periods of excellent sensitivity, during which pesticide exposure can significantly impede fetal growth and impair placental function. Furthermore, mechanistic evidence supports the epidemiological findings, including histological placental changes and altered hormone levels. These collective insights underscore the urgency of implementing targeted public health interventions such as stricter regulation of pesticide use, community education on safe handling practices, and enhanced prenatal screening to protect maternal and neonatal health in farming communities. By addressing environmental and socioeconomic risk factors, stakeholders can work toward reducing the incidence of low birth weight and improving long-term outcomes for children born in agricultural regions.

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