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Occupational and Environmental Risk Factors of Pregnant Workers: Systematic Review

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ABSTRACT

Despite numerous national and global programs focused on maternal and child nutrition, industrial workers are often overlooked in policy and practice. These workers frequently expose by several occupational hazards yet lack access to antenatal care and workplace accommodations that would support maternal health. This paper seeks to synthesize current evidence on occupational hazards in pregnant workers and its effect on pregnancy complication and birth outcomes that risk to stunting. This review searched PubMed, and Scopus artificial intelligent for 2010–2025 literature on pregnant workers and low birth weight/preterm birth related articles. This review highlights a wide range of workplace hazards during pregnancy that affect birth outcomes such as preterm birth and low birth weight (stunting-risk baby). This study combines 40 eligible English language articles, then it classified an occupation exposure that affect birth outcome into nine main categories: biological, physical, chemical, radiation, infectious, psychological, socio-economic, biomechanics, and organizational governance. Even though there are a lot of evidence that pregnancy risks might appear because of occupational hazard exposure, occupational health and maternity protection legislation have not done enough effort to address them, especially in informal and low-resource workplaces. To lower health disparities and stunting between generations, we need better employment rights, better integration of maternity care, and more support for labor governance.

KEYWORDS: Industrial workers, Low Birth Weight, Pregnancy, Preterm Birth, Public health, Stunting.

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INTRODUCTION

Stunting impacts millions of children worldwide. Stunting occurs when a child's growth and development are hindered, resulting in a height-for-age significantly below World Health Organization (WHO) growth criteria. Inadequate nutrition, infections, healthcare access, and socioeconomic situations contribute to it (Black et al., 2008; Kana et al., 2020; Unicef/WHO/World Bank, 2021).

Beyond childhood, stunting has an impact on educational attainment, productivity, and the socioeconomic development of the nation as a whole (Saaka, 2020; Santoso et al., 2019; Sofiatin et al., 2019). Prevention of stunting during pregnancy is of the utmost significance because it lays the foundation for the child's future health and development. Pregnancy is a crucial opportunity to promote optimal growth and development, thereby assuring the child's lifelong health (Saaka, 2020; Santoso et al., 2019; Sofiatin et al., 2019).

Despite numerous national and global programs focused on maternal and child nutrition, industrial workers are often overlooked in policy and practice. These workers frequently expose by several occupational hazards yet lack access to antenatal care and workplace accommodations that would support maternal health (Henrotin et al., 2017; Lavin et al., 2017).

OBJECTIVE

This paper seeks to synthesize current evidence on occupational hazards in pregnant workers and its effect on pregnancy complication and birth outcomes that risk to stunting, such as low birth weight and preterm birth. The study explored through systematic review and outline a policy framework to mitigate its impact on childbirth outcomes.

MATERIAL AND METHODS

A. Search Strategy

This review searched PubMed, and Scopus artificial intelligent (AI) for 2010–2025 literature on pregnant workers and low birth weight/preterm birth related articles. Search terms included “occupational hazard during pregnancy,” “pregnant workers and low birth weight,” and “pregnant worker and preterm birth.”

Table 1 shows the Population, Intervention, Comparison, Outcome (PICO) structure that implemented to limit the literature search

Population	Pregnant workers in the formal sectors
Intervention	Occupational Expossure during pregnancy
Comparison	No comparison
Outcome	Pregnancy complication, Low birth weight, preterm birth

B. Eligibility Criteria

This study excludes articles discussing trials of intervention models for stunting management, such as cash transfer programs, mobile health, etc. The review process is circumscribed to articles written in English with pregnant workers in the formal sectors as subjects and newborns as outcomes, but the countries involved are unrestricted. The inclusion criteria were studies that: (1) analyzed occupational health risks related to pregnancy, (2) occupational hazard exposure, and (3) focused on industrial or labor-intensive work environments. Exclusion criteria included non-English language publications, studies unrelated to maternal or child outcomes, and opinion articles lacking empirical data.

C. Study Selection, data extraction and analysis

Articles obtained from multiple digital libraries ate included in the endnote; then, the duplicated articles are omitted. The article was then screened based on the title and abstract, which were subsequently screened based on the full text to ensure that it met the eligibility requirements. The data from the selected documents are entered into the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) diagram depicted in Figure 1.

D. Risk of Bias Assessment

Risk of bias assessment is a critical step in evaluating the quality and reliability of research studies included in systematic reviews or other evidence synthesis. It involves assessing the methodological rigor and potential biases in individual studies that can affect the validity of their findings. The assessment of risk of bias involves evaluating specific domains or aspects of a study design that may introduce biases. The risk of bias assessment in this study employed different instruments based on the research methodology used in each article. For systematic literature reviews and meta-analyses, the AMSTAR 2 tool developed by Shea et al. (2017) was applied. Cohort, case-control, and descriptive studies were evaluated using the JBI Critical Appraisal Checklist by Moola et al. (2017), while cross-sectional studies were assessed using the checklist provided by Aromataris et al. 2020. All risk of bias assessments is provided in the supplementary materials.

FINDINGS

Study selection contains in 2 different steps, first through PubMed advance search. 298 articles were identified, 12 were duplicated; title and abstract screening resulted in the exclusion of 108 articles. The 165 articles were then subjected to deeper content screening, which resulted in the exclusion of 127 articles due to non-compliance with the PICO.

Second step, through Scopus AI, articles were searched using 3 prompts “occupational hazard during pregnancy related article from 2010-2025”, “pregnant workers and low birth weight related article from 2010-2025” and “Pregnant workers and preterm birth related article from 2010-2025.” This search resulted 16 eligible articles to review. In the concluding phase, 40 articles from PubMed and Scopus AI search meeting the review criteria were identified (Figure 1).

These 40 articles used several types of methodology, such as 7 narrative literature review, 2 meta-analysis, 10 prospective cohort study, 8 retrospective cohort study, 11 cross-sectional articles, 1 case-control study, and 1 descriptive article (Table 1).

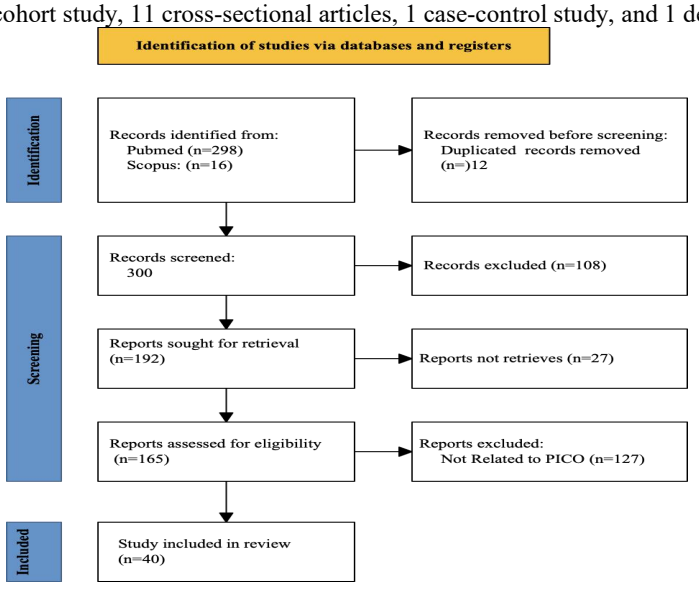

Figure 1. PRISMA Flow Diagram (Page et al., 2021)

Table 1. Study Characteristics

No	Author	Study Design	Subject	Country	Exposure	Key Findings
1.	(Birks et al., 2016)	Retrospective Cohort	133,957 mother–child pairs	European countries	Endocrine-Disrupting Chemicals Exposure	Employment during pregnancy in occupations classified as possibly or probably exposed to Endocrine-Disrupting Chemicals was associated with an increased risk of low birth weight
2.	(Szczesna et al., 2019)	Narrative Literature Review	Surgeon	Poland	Physical, biological, chemical, radiation and infection hazards	Multiple occupational hazards can harm pregnant surgeons and their foetuses. Standing, heavy lifting, long hours, and night shifts can raise the risk of preterm birth and foetal growth limitation. Infectious diseases like CMV, Rubella, and HIV, surgical smoke, disinfectants, and anaesthetic gases can also affect the foetus.
3.	(Weis et al., 2020)	Prospective cohort study	246 pregnant military women	United States	Prenatal maternal anxiety and depression	An increase in pregnancy-related anxiety was significantly associated with low birth weight and preterm birth.
4.	(Hanprasertpong & Hanprasertpong, 2015)	Retrospective chart review study	240 pregnant migrant workers	Thailand	Socioeconomic and healthcare access barriers	The study found high rates of maternal complications among southeast Asian migrant workers, including pre-eclampsia (15%), gestational diabetes (7.9%), and preterm birth (13.7%). Neonatal issues included low APGAR scores, IUGR (3.7%), and NICU admissions (11.3%). Key risk factors for adverse maternal outcomes were anaemia, underlying disease, and antenatal care location. Preterm birth was the only significant predictor of poor neonatal outcomes.
5.	(Francis et al., 2021)	Narrative literature review	Not specified	USA, Europe, Asia	Chemical, physical, biological, ergonomic, and psychosocial hazards	Occupational exposures such as standing for long periods, shift work, heavy lifting, exposure to hazardous substances (like solvents or aesthetic gases), and high job stress are linked to increased risks of miscarriage, preterm birth, low birth weight, and other complications.
6.	(Flores et al., 2025)	Narrative literature review	23 studies	Not Specified	Shift work during pregnancy	Shift work during pregnancy influences the prevalence for heart disease is of paramount clinical importance for minimizing the risk for cardiovascular disease for both the mother and offspring
7.	(Tyagi et al., 2023)	Systematic scoping review	95 studies related to Bidi workers	India	Chemical exposure of the Bidi workers	Multiple organ disease is common in bidi labourers. Research on female bidi workers shows lower fertility, miscarriage, and cervical cancer risk. Non-bidi workers have lower risks of anaemia, pregnancy-induced hypertension, neonatal death, stillbirth, and preterm delivery than pregnant bidi workers.
8.	(Lee et al., 2024)	Prospective cohort study	1,512,350 pregnant women who gave birth between 2011 and 2015	South Korea	Night shift	Miscarriage, stillbirth, and preterm birth were significantly elevated by longer maternal working hours during pregnancy. Even after controlling for age, income, employment, and comorbidities, women who worked more than 52 hours per week had the highest risks.
9.	(Selander et al., 2019)	Retrospective Cohort	19 studies	Low- and middle-income countries (LMIC's) across Asia, Africa, and Latin America.	Occupational Noise	Occupational noise exposure during pregnancy was categorised into three levels: <75 dba, 75-85 dba, and >85 dba. After controlling for BMI, smoking, parity, education, physically hard employment, and low job control, full-time exposure to high noise levels (>85 decibels) was substantially related with adverse birth outcomes. Compared to those exposed to <75 dba, the probabilities of delivering a small-for-gestational-age newborn and low birth weight were 1.44 and 1.36 times greater, respectively. No significant connection was seen for premature birth.
10.	(Shirangi et al., 2020)	Nationwide prospective cohort study	1,422,333 singleton children	Sweden	Occupational exposure to endocrine disrupting chemicals (EDC)	Maternal occupational exposure to pesticides and phthalates during pregnancy was significantly associated with increased risks of adverse birth outcomes.
11.	(Sejbaek et al., 2025)	The register-based cohort	Approximately 1 million unique women	Denmark	Physical workload	This study confirms past findings that excessive physical exertion during pregnancy increases the likelihood of unfavourable pregnancy outcomes in an unselected group of employed women tracked over 40 years.
12.	(Corchero-Falcón et al., 2023)	Cross-sectional study	1,743 pregnant women	Iran	Work-related factors such as physical strain, long working hours, and job satisfaction	Several work-related illnesses were linked to poor pregnancy outcomes. Women who stood longer than 6 hours a day or worked 40 hours a week had an increased risk of preterm birth and low birth weight. Workplace unhappiness and insufficient rest also elevated hazards.
13.	(Norlén et al., 2019)	Prospective cohort study	66,693 singleton pregnancies	Denmark	Occupational exposure to organic particles and Combustion products	Occupational exposure to organic particles or combustion products during pregnancy has been associated with an increased risk of foetal growth restriction and preterm birth.

No	Author	Study Design	Subject	Country	Exposure	Key Findings
14.	(Cai et al., 2019)	Systematic review and meta-analysis	Five electronic databases and 3 Gray literature sources were searched up to March 15, 2019.	Canada	Occupational shift work and working hours	Pregnant women who work rotating shifts, fixed night shifts, or longer hours have an increased risk of adverse pregnancy outcomes.
15.	(Suzumori et al., 2020)	Prospective cohort study	99,744 singleton pregnancies	Japan	Long working hours and shift work	Employment during pregnancy slightly increased the chance of threatening miscarriage and premature labour. Long work hours also increased the incidence of hypertensive pregnancy problems, vacuum/forceps delivery, and SGA infants.
16.	(Bergstra et al., 2021)	A cross-sectional study	4488 singleton live births	the Netherlands	Air pollution	Exposure to PM_{10}, NOX, SO_2, and VOCs significantly reduced birth weight, length, and head circumference, with each interquartile range increase resulting in a 21-30 g birth weight drop. Exposure to PM_{10} at the 90th percentile level resulted in a 74 g drop in birth weight, highlighting the negative effects of industrial air pollution on foetal growth.
17.	(Davari et al., 2018)	Historical cohort study	429 pregnant women (215 morning workers and 214 shift workers)	Iran	Rapid cycling shift schedules	The risk of premature delivery increased considerably with shift work. It also increased spontaneous abortion, intrauterine foetal death, and pre-eclampsia, but these relationships were insignificant after correction.
18.	(Bengtsson et al., 2017)	Prospective follow-up cohort study	1,202 pregnant women	Denmark	Maternal occupational exposure to endocrine disrupting chemicals (EDC's)	The study showed no link between occupational EDC exposure and preterm or low birth weight. mothers possibly exposed to EDCs had somewhat greater birth weights than the general population, although this was not statistically significant compared to other referred mothers..
19.	(Admas et al., 2025)	Literature review	26 studies	Global	Psychosocial work stress	Workplace psychosocial stress increases the risk of pre-eclampsia, premature birth, pregnancy loss, and low foetal weight. Occupational therapists, employers, policymakers, and other stakeholders must work together to reduce these hazards and protect mother and infant.
20.	(Tartaglia et al., 2025)	Prospective cohort study	12,851 pregnant women	France	Occupational exposures to 47 agents (chemical, physical, biological, biomechanical, organizational and psychosocial)	An occupational profile with postural restrictions (e.g., extended standing, uncomfortable positions) and psychological stressors (e.g., high job strain, inadequate support) may raise the risk of foetal growth restriction during pregnancy.
21.	(Abderhalden-Zellweger et al., 2024)	Descriptive and correlational statistical analyses	328 work situations	Switzerland	Occupational hazards and insufficient protective measures for pregnant workers	Workplace hazards were present in 98% of cases. Only 14% of organisations analysed risk and 39% adapted jobs. Safe return to work was predicted by early occupational medicine consultation and pre-existing preventive measures.
22.	(Martiana et al., 2024)	Analytical, observational case-control study	144 female workers	Indonesia	Occupational hazards affecting pregnancy disorders	Identified significant occupational hazards including workload, hot working environment, strong odours, shift work, and night shift work, all contributing to pregnancy disorders.
23.	(Wada et al., 2021)	Cross-sectional study	450 working women	Not specified	Factors affecting presenteeism and absenteeism among pregnant workers	Occupational stress, physical conditions, and workplace adjustments were related to presenteeism. Pregnancy complications were the only factor associated with absenteeism.
24.	(Patil et al., 2020)	Retrospective Cohort	2,871 pregnant workers	USA	Employment precarity	Women with high employment precarity had higher risk of a LBW delivery compared with women with low employment precarity
25.	(Ali et al., 2020)	Analytical review and data analysis	237 pregnant women and their Neonates	Sudan	Working workloads	Employed women gave birth more to LBW babies compared to non-employed group
26.	(Mangla, 2022)	Literature Review	N/A	N/A	All work-related exposure risks for pregnant obstetrics and gynaecology professionals	Pregnant healthcare workers often face discrimination, lack of adjusted duties for their condition, limited job-protected leave, and insufficient wage support during maternity leave.
27.	(van Beukering et al., 2022)	Prospective cohort study	269 participants	The Netherlands	Adherence to legislation and guidelines for safe working conditions during pregnancy	Poor adherence to national guidelines, with 50% of pregnant women working under hazardous conditions. Lower educational attainment and employment in certain sectors increased risk of non-compliance.
28.	(Xavier et al., 2019)	Cross-sectional study	469 respondents	Not specified	Adverse pregnancy outcomes among healthcare workers	Higher risk of adverse pregnancy outcomes among healthcare workers, with complete miscarriage being the most common, especially among those working shifts.

No	Author	Study Design	Subject	Country	Exposure	Key Findings
29.	(Rahman & Martiana, 2020)	Cross-sectional study	307 female workers	Indonesia	Risk factors associated with pregnancy disorders	Identified vibrations, irritants, and repetitive work as significant risk factors for pregnancy disorders.
30.	(Zachek et al., 2019)	Cross-sectional survey	69 participants	USA	Occupational and environmental exposures during pregnancy	Consistent incorporation of exposure assessment into prenatal care can improve clinical communications and early interventions for at-risk pregnant women.
31.	(d'Errico et al., 2025)	Prospective cohort study	3938 nulliparous women	Italy	Maternal occupational exposures and birth outcomes	Passive smoking, heat, and dust exposure linked to adverse birth outcomes
32.	(Gustavsson et al., 2025)	Prospective cohort study	307,985 births	Sweden	Chemical exposure during pregnancy and gestational diabetes/preeclampsia	Diesel and gasoline exhaust linked to preeclampsia; lead exposure linked to gestational diabetes
33.	(Olirk et al., 2025)	Cross-sectional study	400 post-delivery women	Tanzania	Maternal occupation and adverse foetal outcomes	Agriculture workers had higher odds of congenital malformations, preterm birth, low birth weight, and low Apgar scores 4
34.	(Henrotin et al., 2017)	Cross-sectional study	1,495 workers	France	Occupational hazards and sick leave during pregnancy	Higher occupational hazards linked to increased sick leave
35.	(Pilarz & Pac, 2024)	Literature Review	Not Specified	Not Specified	Working during pregnancy	Policies related to pregnancy employment can affect maternal and infant health
36.	(Izadi et al., 2024)	Cross-sectional study	733 healthcare workers	Iran	Occupational exposures and reproductive health	Chemical exposures linked to stillbirth; prolonged working hours linked to spontaneous abortion and reduced breastfeeding period
37.	(M. V. et al., 2017)	Cross-sectional study	100 pregnant working women	Not specified	Work place stress	work conditions for working women working more than 40 hours/week, social stress index were found to be a significant risk factor for adverse pregnancy outcome
38.	(Casas et al., 2015)	Population-based birth cohort design	>200,000 mother-child pairs	13 European countries	Association between maternal employment and birth outcomes	Employment during pregnancy associated with reduced risk of preterm birth. Food industry workers had increased risk of preterm delivery
39.	(HM et al., 2015)	Cross-sectional study	500 pregnant women	Egypt	Work Related Risk Factors	Working more than 40 hours/ week and social stress index were found to be a significant risk factors for adverse pregnancy outcomes
40.	(Seung- et al., 2023)	Retrospective Cohort	1,825,845 employed and non-employed women	South Korea	Job activity	Health, social work, and manufacturing women lost more pregnancies than finance or insurance women. Manufacturing, retail, education, and public service jobs continuously had higher no-live-birth rates. These results imply that some jobs during pregnancy may cause unfavourable outcomes, stressing the need for more job-related studies.

A total of 40 relevant studies were included in the table 1 then classified into the thematic analysis, study found nine occupational hazards linking to stunting-risk childbirth such as: biological, physical, chemical, radiation, infection, psychological, socio-economic, and biomechanical hazards, along with organizational governance. Findings from each theme were then synthesized to develop a conceptual framework to formulate a policy recommendation.

Table 2. Occupational Hazards linking to Stunting-Risk Childbirth Found in Several Studies

No	Hazards	Author	Frequency (Article)
1.	Biological	(Tartaglia et al., 2025), (Francis et al., 2021), (Flores et al., 2025), (Lee et al., 2024), (Abderhalden-Zellweger et al., 2024), (Zachek et al., 2019), (Henrotin et al., 2017), (Seung- et al., 2023)	8
2.	Physical	(Szczesna et al., 2019), (Tartaglia et al., 2025), (Francis et al., 2021), (Flores et al., 2025), (Selander et al., 2019), (Sejbaek et al., 2025), (Corchero-Falcón et al., 2023), (Suzumori et al., 2020), (Davari et al., 2018), (Abderhalden-Zellweger et al., 2024), (Martiana et al., 2024), (Wada et al., 2021), (Ali et al., 2020), (Mangla, 2022), (Xavier et al., 2019), (Rahman & Martiana, 2020), (Zachek et al., 2019), (d'Errico et al., 2025), (Henrotin et al., 2017), (M. V. et al., 2017), (Casas et al., 2015), (HM et al., 2015), (Seung- et al., 2023)	23

3.	Chemical	(Birks et al., 2016), (Szczesna et al., 2019), (Tartaglia et al., 2025), (Francis et al., 2021), (Tyagi et al., 2023), (Shirangi et al., 2020), (Norlén et al., 2019), (Bergstra et al., 2021), (Bengtsson et al., 2017), (Abderhalden-Zellweger et al., 2024), (Mangla, 2022), (Zachek et al., 2019), (d'Errico et al., 2025), (Gustavsson et al., 2025), (Olirk et al., 2025), (Henrotin et al., 2017), (Izadi et al., 2024), (Seung- et al., 2023)	18
4.	Radiation	(Szczesna et al., 2019), (Abderhalden-Zellweger et al., 2024)	2
5.	Infection	(Szczesna et al., 2019), (Abderhalden-Zellweger et al., 2024), (Mangla, 2022), (Xavier et al., 2019), (Seung- et al., 2023)	5
6.	Psychological	(Weis et al., 2020), (Tartaglia et al., 2025), (Francis et al., 2021), (Sejbaek et al., 2025), (Corchero-Falcón et al., 2023), (Cai et al., 2019), (Suzumori et al., 2020), (Davari et al., 2018), (Admas et al., 2025), (Abderhalden-Zellweger et al., 2024), (Martiana et al., 2024), (Wada et al., 2021), (Patil et al., 2020), (Ali et al., 2020), (Mangla, 2022), (Xavier et al., 2019), (Rahman & Martiana, 2020), (Henrotin et al., 2017), (M. V. et al., 2017), (Casas et al., 2015), (HM et al., 2015), (Seung- et al., 2023), (Flores et al., 2025), (Lee et al., 2024)	24
7.	Socio-economic	(Hanprasertpong & Hanprasertpong, 2015), (Mangla, 2022)	2
8.	Biomechanical	(Tartaglia et al., 2025), (Francis et al., 2021)	2
9.	Organizational governance	(van Beukering et al., 2022), (Xavier et al., 2019), (Pilarz & Pac, 2024), (Casas et al., 2015), (Hanprasertpong & Hanprasertpong, 2015), (Abderhalden-Zellweger et al., 2024), (Mangla, 2022)	7
No	**Hazards**	**Author**	**Frequency (Article)**
10.	Biological	(Tartaglia et al., 2025), (Francis et al., 2021), (Flores et al., 2025), (Lee et al., 2024), (Abderhalden-Zellweger et al., 2024), (Zachek et al., 2019), (Henrotin et al., 2017), (Seung- et al., 2023)	8
11.	Physical	(Szczesna et al., 2019), (Tartaglia et al., 2025), (Francis et al., 2021), (Flores et al., 2025), (Selander et al., 2019), (Sejbaek et al., 2025), (Corchero-Falcón et al., 2023), (Suzumori et al., 2020), (Davari et al., 2018), (Abderhalden-Zellweger et al., 2024), (Martiana et al., 2024), (Wada et al., 2021), (Ali et al., 2020), (Mangla, 2022), (Xavier et al., 2019), (Rahman & Martiana, 2020), (Zachek et al., 2019), (d'Errico et al., 2025), (Henrotin et al., 2017), (M. V. et al., 2017), (Casas et al., 2015), (HM et al., 2015), (Seung- et al., 2023)	23
12.	Chemical	(Birks et al., 2016), (Szczesna et al., 2019), (Tartaglia et al., 2025), (Francis et al., 2021), (Tyagi et al., 2023), (Shirangi et al., 2020), (Norlén et al., 2019), (Bergstra et al., 2021), (Bengtsson et al., 2017), (Abderhalden-Zellweger et al., 2024), (Mangla, 2022), (Zachek et al., 2019), (d'Errico et al., 2025), (Gustavsson et al., 2025), (Olirk et al., 2025), (Henrotin et al., 2017), (Izadi et al., 2024), (Seung- et al., 2023)	18
13.	Radiation	(Szczesna et al., 2019), (Abderhalden-Zellweger et al., 2024)	2
14.	Infection	(Szczesna et al., 2019), (Abderhalden-Zellweger et al., 2024), (Mangla, 2022), (Xavier et al., 2019), (Seung- et al., 2023)	5
15.	Psychological	(Weis et al., 2020), (Tartaglia et al., 2025), (Francis et al., 2021), (Sejbaek et al., 2025), (Corchero-Falcón et al., 2023), (Cai et al., 2019), (Suzumori et al., 2020), (Davari et al., 2018), (Admas et al., 2025), (Abderhalden-Zellweger et al., 2024), (Martiana et al., 2024), (Wada et al., 2021), (Patil et al., 2020), (Ali et al., 2020), (Mangla, 2022), (Xavier et al., 2019), (Rahman & Martiana, 2020), (Henrotin et al., 2017), (M. V. et al., 2017), (Casas et al., 2015), (HM et al., 2015), (Seung- et al., 2023), (Flores et al., 2025), (Lee et al., 2024)	24
16.	Socio-economic	(Hanprasertpong & Hanprasertpong, 2015), (Mangla, 2022)	2
17.	Biomechanical	(Tartaglia et al., 2025), (Francis et al., 2021)	2
18.	Organizational governance	(van Beukering et al., 2022), (Xavier et al., 2019), (Pilarz & Pac, 2024), (Casas et al., 2015), (Hanprasertpong & Hanprasertpong, 2015), (Abderhalden-Zellweger et al., 2024), (Mangla, 2022)	7

Table 2 shows that psychological exposure at work is the most reported issue among pregnant workers, followed by physical, chemical, and biological exposures. However, socio-economic and biomechanical exposures are the least explored topics in the literature, indicating significant opportunities for further research in these areas.

DISCUSSION

A summary of the evidence that is currently available regarding the connection between maternal occupational exposures and the risk of poor birth outcomes that may lead to stunting was the objective of this investigation. According to the findings, pregnant workers in a variety of industries are constantly exposed to several risks in the workplace. These risks are typically neglected by policies that concern to maternal health. The findings were referred to in the previous sentence. Occupational hazards that emerged from the literature are organized into nine thematic areas with the purpose of facilitating a more complete understanding. This is done to promote a more thorough understanding. The following are the categories that fall under this category: biological, physical, chemical, radiation, infectious, psychological, socio-economic, biomechanical, and organizational governance risks.

Biological Hazards

Cytomegalovirus (CMV), Rubella, Toxoplasma gondii, Hepatitis B and C, and HIV are all examples of infectious microorganisms that can be found in the workplace (Szczesna et al., 2019). Biological hazards in the workplace include exposure to these bacteria. It is very common for personnel in the healthcare industry, childcare, laboratories, and animal handling industries to suffer from these conditions. As a result of the possibility of vertical transmission, these infections present a considerable risk to pregnant workers. This risk can manifest itself in the form of fetal illness, miscarriage, stillbirth, or congenital abnormalities (Izadi et al., 2024; Szczesna et al., 2019). It has been demonstrated in several studies that early intrauterine infections can have a negative impact on the growth trajectory of the fetus, which in turn raises the probability of low birth weight and long-term stunting(Izadi et al., 2024; Szczesna et al., 2019).

The implementation of preventive measures, which include routine screening, immunization, and stringent hygiene regulations, is still lacking in many work contexts, even though these measures are needed (Izadi et al., 2024; Szczesna et al., 2019).

Physical Hazards

Standing for extended periods of time, lifting large objects, being exposed to high temperatures (Martiana et al., 2024), vibrations, high levels of occupational noise, high working workloads are all examples of physical risks (Francis et al., 2021; Rahman & Martiana, 2020; Sejbaek et al., 2025; Selander et al., 2019; Suzumori et al., 2020; Tartaglia et al., 2025). These pressures are frequently experienced by pregnant women who are employed in settings such as industries, retail, or healthcare facilities (Casas et al., 2015; Francis et al., 2021; Sejbaek et al., 2025; Suzumori et al., 2020; Tartaglia et al., 2025). Standing for extended periods of time and lifting heavy loads are linked to intrauterine growth restriction (IUGR) as well as preterm labour and miscarriage (Martiana et al., 2024; Sejbaek et al., 2025) In addition, there is a correlation between prolonged exposure to occupational noise that is higher than 85 decibels and the development of low birth weight and small-for-gestational-age (SGA) newborns (Selander et al., 2019). With these outcomes, there is a greater chance that a kid would experience stunting later in life. Particularly in low- to middle-income areas, where protective labor legislation is frequently inadequate, the absence of ergonomic adjustments and rest times further exacerbates these hazards. Rest periods and ergonomic modifications are both essential (Francis et al., 2021).

Chemical Hazards

There are a variety of unfavorable birth outcomes that have been linked to chemical exposure during pregnancy, particularly in places of employment such as agriculture, industry (Olirk et al., 2025), laboratories, and beauty salons (Norlén et al., 2019; Tyagi et al., 2023). Pesticides, solvents (such as toluene and benzene), heavy metals (such as lead and mercury), phthalates, and anesthetic gases are examples of substances that have the potential to interact with the endocrine system or cause teratogenic effects (Bengtsson et al., 2017; Birks et al., 2016; Gustavsson et al., 2025; Shirangi et al., 2020; Szczesna et al., 2019). They have the potential to hinder the function of the placenta or the growth of the cells in the fetus, which can result in a lower birth weight, premature birth, or problems in neurodevelopment (Birks et al., 2016; Izadi et al., 2024; Szczesna et al., 2019). Because of the process of bioaccumulation, chronic low-dose exposure can be especially hazardous (Norlén et al., 2019; Shirangi et al., 2020).

A pregnant worker who exposed by the air pollution is another example of chemical exposure (Bergstra et al., 2021; d'Errico et al., 2025). it has been reported that air pollution exposure during pregnancy to have negative effects on pregnancy outcomes. Like particulate matter ($PM_{2.5}$ and PM_{10}), nitrogen oxides (NO_x), Sulphur dioxide (SO_2), ozone (O_3), and volatile organic compounds (VOCs), their babies are more likely to affect low birth weight (LBW), preterm birth (PTB), and intrauterine growth restriction (IUGR) (Bergstra et al., 2021). Nevertheless, a significant number of employers do not provide enough safety training, protective equipment, or chemical exposure tracking for female employees, particularly during pregnancy (Birks et al., 2016). For example, pregnant women employed in the bidi sector are often risked to the hazards of chemical exposure during pregnancy. They frequently do it in poorly ventilated environments and without utilizing personal protective equipment. Nicotine, nitrosamines, and polycyclic aromatic hydrocarbons (PAHs) are hazardous molecules absorbed through the skin and lungs during continuous exposure (d'Errico et al., 2025; Norlén et al., 2019; Tyagi et al., 2023).

Radiation Hazards

Workers in the disciplines of radiology, nuclear medicine, industrial imaging, and telecommunications are exposed to both ionizing radiation (such as X-rays and radioactive isotopes) and non-ionizing radiation (such as microwaves and electromagnetic fields) in their line of work. Especially during organogenesis (weeks 2–8 of gestation), prenatal exposure to ionizing radiation has been related to congenital abnormalities, developmental delays, and fetal growth restriction. This is especially true during the beginning stages of pregnancy (Seung- et al., 2023; Xavier et al., 2019). Even though radiation exposure is subject to regulation, there is frequently a lack of compliance with rules regarding shielding and dose monitoring.

Reassignment to low-exposure tasks is recommended for pregnant workers; however, this policy is rarely followed in a consistent manner across all institutions (Seung- et al., 2023; Xavier et al., 2019).

Infection Hazards

Pregnant workers face considerable dangers when they are exposed to infectious environments, such as those found in hospitals, childcare facilities, or veterinary clinics (Seung- et al., 2023; Xavier et al., 2019) is not uncommon to come across pathogens such as parvovirus B19, influenza, varicella, and group B streptococcus. These pathogens have the potential to cause difficulties such as miscarriage, neonatal infection, or premature birth. The natural growth trajectory of the fetus can be disrupted because of these consequences, which can also damage the nutritional health of the postnatal period. In environments where there is insufficient infection control, a lack of personal protective equipment, and no routine health surveillance for pregnant employees, the risk is significantly increased (Seung- et al., 2023; Xavier et al., 2019).

Psychological Hazards

It has been shown without a doubt that psychological stress at work might give the bad effect for maternal's health (Weis et al., 2020). These pressures might also include emotional labor, bullying at work, long working hour (Ali et al., 2020), precarity (Patil et al., 2020) and not having enough freedom (Corchero-Falcón et al., 2023; Weis et al., 2020) (Admas et al., 2025).

Additionally shift work, especially night shifts and rotating schedules, has been shown to be a major source of stress at work that could be bad for the health of both the mother and the fetus (Cai et al., 2019; Davari et al., 2018; Flores et al., 2025; Lee et al., 2024; Suzumori et al., 2020). Pregnant women who work shifts are more likely to have circadian rhythm problems, sleep problems, and longer recovery times, all of which can cause physiological stress (Ali et al., 2020). Studies have shown that these kinds of interruptions might affect the hormones that are essential for a healthy pregnancy, namely melatonin and cortisol (Cai et al., 2019; Flores et al., 2025; Lee et al., 2024). Several large cohort studies have found links between working shifts and a higher risk of preterm birth, low birth weight, and pregnancy-related high blood pressure (Cai et al., 2019; Davari et al., 2018; Flores et al., 2025; Lee et al., 2024; Suzumori et al., 2020). Night shifts have been associated to miscarriage and intrauterine growth restriction (IUGR) (M. V. et al., 2017). This is because the unsynchronized between biological clock and the placenta (Flores et al., 2025). Also, working odd hours can make it harder to eat properly, make it less likely to access prenatal care, and make a burnout at work, all of which could have an indirect effect on fetal development (M. V. et al., 2017). Being in these kinds of situations for a long time might raise the mother's cortisol levels, which could change how blood flows through the placenta and how nutrients get to the growing fetus (Flores et al., 2025; Wada et al., 2021)It is crucial to remember that anxiety disorders are very common in pregnant women who are in the military (Weis et al., 2020). This is because the stress of deployment, the responsibilities of duty, and the pressure of being in a hierarchy all add to the mental stress (Henrotin et al., 2017; HM et al., 2015; Weis et al., 2020) Mental health protections and stress-reduction programs for pregnant workers are still not widely used, even though there is evidence to support them. They are also rarely included in occupational health policies. This is especially true for people who work in jobs that are expossed by stress (Abderhalden-Zellweger et al., 2024; Admas et al., 2025).

Socio-economic Hazards

There is a substantial relationship between the socio-economic conditions of the workplace and the health of both mothers and children (Mangla, 2022). These conditions include low earnings, the absence of maternity benefits, insecure contracts, and informal employment status. Women who are pregnant and work in low-paying or informal sectors frequently put off or don't receive antenatal care, suffer from poor nutrition, and do not have access to postpartum support. Because of these limitations, the growth of the fetus may not be ideal, and the risk of stunting after delivery may be increased. The absence of paid maternity leave also forces women to return to work earlier than they would otherwise, which restricts breastfeeding patterns and the quality of childcare, both of which are key variables in preventing stunting in the first one thousand days of a child's life (Hanprasertpong & Hanprasertpong, 2015; Mangla, 2022).

Biomechanic Hazards

The terms "repetitive tasks," "awkward body postures," and "manual handling of loads" are all examples of biomechanical stress, which is widespread in contexts such as agriculture, construction, garment manufacturing, and factories (Francis et al., 2021; Tartaglia et al., 2025). Increasing the likelihood of uterine contractions, placental abruption, and mechanical strain on the abdomen, which could potentially result in premature birth or intrauterine growth restriction (IUGR), is the result of these physical demands (Francis et al., 2021; Tartaglia et al., 2025). Despite the existence of proof, pregnant women frequently do not have access to ergonomic adjustments in the job. A damaged fetal development, an inadequate birth weight, and restricted growth during infancy and early childhood are some of the long-term effects of this condition (Francis et al., 2021; Tartaglia et al., 2025).

Organizational Governance

It is important to note that workplace policies, maternity rights, and management's response to the requirements of pregnant employees are all included in organizational governance. Risk evaluations, duty changes, flexible scheduling, and maternity leave are all examples of supportive governance (Abderhalden-Zellweger et al., 2024; Zachek et al., 2019). On the other hand, a significant number of workplaces either do not have explicit policies or fail to effectively apply them (Pilarz & Pac, 2024). Women who are pregnant are forced to continue working in dangerous conditions without being provided with accommodations because of poor administration (Mangla, 2022; van Beukering et al., 2022). The necessity of structural adjustments to enhance maternal-child health in the workforce is highlighted by the fact that this systemic neglect contributes to hazards to foetal development that could have been avoided (Hanprasertpong & Hanprasertpong, 2015; Pilarz & Pac, 2024; van Beukering et al., 2022).

Policy Recommendation

Given these findings, it is imperative to translate evidence into actionable strategies that protect maternal and fetal health in the workplace. The following policy recommendations aim to address the identified gaps and promote safer working conditions for pregnant women across various occupational settings.

1. **Improve Workplace Risk Assessments**
   Employers should be forced to undertake thorough antenatal risk assessments that cover psychological, chemical, socio-economic, and biomechanical exposures in addition to physical dangers. These assessments should go beyond the physical hazards that are present in the workplace.
2. **Occupational Health standards Should be Expanded**
   It is important that national and sector-specific occupational health standards be updated so that they reflect the wider range of dangers that pregnant women encounter, particularly in employment sectors that are informal or pay low wages.
3. **Occupational Hazards Screening**
   Screening for occupational exposures should be incorporated into maternal and child health services, and pregnant workers should be provided with specialized counselling and support. Occupational risk should be incorporated into maternal health programs.
4. **Improve Research Funding and Innovation**
   The government and research institutions should priorities funding for studies on the impact of socio-economic stresses and biomechanical demands during pregnancy, particularly in low- and middle-income settings. This will help to promote research on hazards that have not yet been well investigated.
   In the workplace, protective policies should be implemented. These policies should mandate duty modification, maternity leave protections, and flexible scheduling for pregnant workers who are exposed to high-risk situations, such as shift work, heavy lifting, or chemical exposure.

CONCLUSION

This review highlights a wide range of workplace hazards during pregnancy that affect birth outcomes such as preterm birth and low birth weight (stunting-risk baby). This study combines 40 eligible English language articles, then it classified an occupation exposure that affect birth outcome into nine main categories: biological, physical, chemical, radiation, infectious, psychological, socio-economic, biomechanics, and organizational governance. Even though there are a lot of evidence that pregnancy risks might appear because of occupational hazard exposure, occupational health and maternity protection legislation have not done enough effort to address them, especially in informal and low-resource workplaces. To lower health disparities and stunting between generations, we need better employment rights, better integration of maternity care, and more support for labor governance.

DECLARATION

Ethics approval: This study was approved by the Health Research Ethics Committee of Institute of Health Science Ganesha Husada Kediri. After undergoing various stages of ethical review, the study was deemed ethically feasible, as evidenced by the issuance of the Ethical Approval Letter No. 29/SGH.KEPK/IX/2024.

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Supplementary Materials

Table 1. Risk of Bias Assessment for Literature Review Articles

No	Author (Year)	Clear Research Question	Comprehensive Literature Search	Duplicate Study Selection & Data Extraction	Quality Assessment of Included Studies	Consideration of Risk of Bias in Analysis	Appropriate Methods for Combining Studies	Overall Risk of Bias
1.	(Szczesna et al., 2019)	Yes	Yes	No	No	No	No	High
2.	(Francis et al., 2021)	Yes	Yes	Yes	No	No	Yes	Moderate
3.	(Admas et al., 2025)	Yes	Yes	Yes	Yes	Yes	Yes	Low
4.	(Corchero-Falcón et al., 2023)	Yes	Yes	Yes	Yes	Yes	Yes	Low
5.	(Flores et al., 2025)	Yes	No	No	Yes	No	Yes	Moderate
6.	(Mangla, 2022)	Yes	No	No	No	No	No	High
7.	(Pilarz & Pac, 2024)	Yes	No	No	No	No	No	High

Table 2. Risk of Bias Assessment for Meta Analysis Study

No	Author (Year)	Clear Research Question	Comprehensive Literature Search	Duplicate Study Selection & Data Extraction	Quality Assessment of Included Studies	Consideration of Risk of Bias in Analysis	Appropriate Methods for Combining Studies	Overall Risk of Bias
1.	(Tyagi et al., 2023)	Yes	Yes	Yes	Yes	Yes	Yes	Low
2.	(Cai et	Yes	Yes	Yes	Yes	Yes	Yes	Low

	al., 2019)							

Table 3. Risk of Bias Assessment for Retrospective Cohort Study

No	Author (Year)	Similar Groups at Baseline	Exposure Measured Reliably	Outcome Measured Reliably	Confounding Factors Identified & Controlled	Follow-up Complete	Statistical Analysis Appropriate	Overall Risk of Bias
1.	(Hanprasertpong & Hanprasertpong, 2015)	Yes	Yes	Yes	Yes	Yes	Yes	Low
2.	(Sejbaek et al., 2025)	Yes	Yes	Yes	Yes	Yes	Yes	Low
3.	(Davari et al., 2018)	Yes	Yes	Yes	Yes	Yes	Yes	Low
4.	(Casas et al., 2015)	Yes	Yes	Yes	Yes	Yes	Yes	Low
5.	(Birks et al., 2016)	Yes	Yes	Yes	Yes	Yes	Yes	Low
6.	(Selander et al., 2019)	Yes	Yes	Yes	Yes	Yes	Yes	Low
7.	(Patil et al., 2020)	Yes	Yes	Yes	Yes	Yes	Yes	Low
8.	(Seung- et al., 2023)	Yes	Yes	Yes	Yes	Yes	Yes	Low

Table 4. Risk of Bias Assessment for Prospective Cohort Study

No	Author (Year)	Similar Groups at Baseline	Exposure Measured Validly & Reliably	Outcome Measured Objectively	Confounders Identified & Adjusted	Follow-up Adequate & Complete	Timeframe Sufficient for Outcome	Statistical Analysis Appropriate	Overall Risk of Bias
1.	(Weis et al., 2020)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Low
2.	(Shirangi et al., 2020)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Low
3.	(Norlén et al., 2019)	No	No	Yes	Yes	Yes	Yes	Yes	Low
4.	(Suzumori et al., 2020)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Low
5.	(Bengtsson et al., 2017)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Low
6.	(Tartaglia et al., 2025)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Low
7.	(van Beukering et al., 2022)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Low
8.	(d'Errico et al., 2025)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Low
9.	(Gustavsson et al., 2025)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Low
10	(Lee et al., 2024)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Low

Table 5. Risk of Bias Assessment for Case Control Study

No	Author (Year)	Clear Definition of Cases	Selection of Controls Appropriate	Exposure Measurement Valid & Reliable	Same Method for Cases and Controls	Confounders Identified & Controlled	Non-Response Bias Addressed	Statistical Analysis Appropriate	Overall Risk of Bias
1.	(Martiana et al., 2024)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Low

Table 6. Risk of Bias Assessment for Cross Sectional Study

NO	Author (Year)	Clear Inclusion Criteria	Study Subjects & Setting Described	Exposure Measured Validly & Reliably	Outcome Measured Validly & Reliably	Confounders Identified	Strategies to Deal with Confounders	Statistical Analysis Appropriate	Overall Risk of Bias
1.	(Bergstra et al., 2021)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Low
2.	(Wada et al., 2021)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Low
3.	(Ali et al., 2020)	Yes	Yes	Yes	Yes	No	No	Yes	Moderate
4.	(Xavier et al., 2019)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Low
5.	(Rahman & Martiana, 2020)	Yes	Yes	Yes	Yes	Yes	No	Yes	Low
6.	(Zachek et al., 2019)	Yes	Yes	Yes	Yes	No	No	Yes	Low
7.	(Olirk et al., 2025)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Low
8.	(Henrotin et al., 2017)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Low
9.	(Izadi et al., 2024)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Low
10.	(M. V. et al., 2017)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Low
11.	(HM et al., 2015)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Low

Table 7. Risk of Bias Assessment for Descriptive Study

No	Author (Year)	Clear Inclusion Criteria	Sampling Method Appropriate	Sample Size Adequate	Study Subjects & Setting Described	Data Collection Reliable	Measurement Validated	Response Rate Adequate	Overall Risk of Bias

1.	(Abderhalden-Zellweger et al., 2024)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Low