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## Disaster mitigation for pregnant women in natural disaster situations: a scoping review

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### Abstract

**Background:** The incidence of disasters has increased every year. However, disaster mitigation policies generally focus on the needs of the general population, while the needs and care of vulnerable groups such as pregnant women are often overlooked. The aim of this literature review is to provide an overview of disaster mitigation for pregnant women in various disaster situations occurring worldwide.

**Method:** This study is a scoping review of journals by examining several types of literature reviews sourced from PubMed, Scopus, SpringerLink, and MDPI using the PRISMA-ScR approach. The literature search was conducted on articles published from 2015 to 2024 based on predetermined inclusion criteria to examine disaster mitigation efforts for pregnant women during natural disasters. A total of 10 articles were reviewed.

**Results:** The findings of this scoping review indicate the need for a policy shift from a generalized disaster management approach toward one that is responsive to the specific needs of pregnant women. Disaster management policies should explicitly integrate maternal health services across all phases of disaster management, including preparedness, emergency response, and recovery. Policies must also ensure the continuity of antenatal care, childbirth services, nutrition, and mental health support for pregnant women, accompanied by strengthened health system preparedness through maternal-specific protocols, routine training, and adequate resource allocation.

**Conclusion:** Pregnant women's vulnerability emerges when health service systems, social protection mechanisms, and institutional preparedness fail to function simultaneously during emergency situations.

**Keywords:** Mitigation; Disaster; Pregnant Women; Scoping Review.

### INTRODUCTION

Natural disasters refer to events or a series of events that cause major disruption, including loss of life, material damage, economic loss, environmental degradation, and psychological impacts that exceed local response capacity(1). These events often occur suddenly and with high intensity, disrupting daily activities and generating urgent need for food, shelter, health services, and basic support (2). Earthquakes, floods, tsunamis, volcanic eruptions, cyclones, landslides, droughts, forest fires, and extreme storms reflect the wide range of hazards that challenge community resilience and

preparedness. Disasters emerge from the interaction between natural hazards and underlying social, economic, and environmental vulnerabilities that limit the ability of affected populations to cope with adverse impacts (3).

Over the past five decades, the number and severity of natural disasters have increased substantially, largely driven by climate change. Data from the Centre for Research on the Epidemiology of Disasters Emergency Events Database (EM-DAT) between 1970 and 2019 indicate that weather-, climate-, and water-related disasters accounted for 50% of all recorded

disasters, 45% of reported fatalities, and 74% of economic losses, equivalent to 2.06 million deaths and USD 3.6 trillion in losses (4). Climate change has intensified extreme weather events and altered spatial and temporal exposure patterns (5). It has also increased the occurrence of compound and cascading events, such as concurrent heatwaves and droughts, fire-prone conditions, and combined flood events, further elevating disaster risk in vulnerable communities (4–6).

Disaster risk affects all population groups, making disaster management a shared societal responsibility. Effective mitigation therefore requires multisectoral, culturally appropriate, and community-based approaches. Engagement of families, community health volunteers, and local leaders strengthens preparedness and emergency response capacity (7). Community-based interventions, including emergency kits for pregnant women, evacuation planning, and preparedness training, can reduce maternal and fetal complications. However, implementation remains uneven, and many regional disaster management agencies lack clear technical and operational strategies to address the specific needs of pregnant women during emergencies (8).

Pregnant women represent a particularly vulnerable group in disaster settings due to physiological changes, psychological stress, limited mobility, and increased dependence on healthcare services. Empirical evidence consistently shows that disasters increase the risk of physical injury, psychological trauma, malnutrition, disrupted antenatal care, and obstetric complications among pregnant women (9). Interruptions to essential maternal health services elevate the risk of preterm birth, low birth weight, stillbirth, and maternal mortality, particularly in low-resource settings with fragile health systems (10–16). Severe stress, environmental exposure, and nutritional insecurity further exacerbate these risks, underscoring the need to integrate maternal health into disaster mitigation and preparedness planning.

Culturally grounded and community-responsive strategies further strengthen disaster mitigation efforts. Integrating local knowledge, traditions, and religion-based frameworks, such as disaster fiqh, enhances community participation and adaptive capacity (17). Despite this potential, disaster literacy among pregnant women and their families remains limited, highlighting the need for targeted education through community health centers, schools, and local media (18). Improved disaster literacy supports preparedness and enables informed decision-making during emergencies. International experience reveals similar gaps. Major disasters, including Hurricane Katrina and the 2022 Pakistan floods, demonstrated that reproductive and maternal health services are frequently overlooked during emergency response efforts (19,20). These events exposed structural weaknesses in disaster preparedness systems, particularly the limited integration of gender-responsive approaches and maternal health indicators. Recent studies emphasize the importance of coordinated action among healthcare providers, policymakers, and emergency responders to ensure continuity of maternal services during crises (21). Despite the growing volume of research on disasters and maternal health, existing evidence remains fragmented across disciplines, settings, and intervention types. There is limited systematic mapping and synthesis of disaster mitigation strategies that explicitly address the vulnerabilities, continuity of care, and contextual needs of pregnant women, particularly in disaster-prone and resource-limited settings.

Accordingly, this study aims to conduct a scoping review to systematically identify, map, and synthesize existing evidence on disaster mitigation approaches for pregnant women during natural disasters. In line with PRISMA-ScR guidance, this review seeks to clarify key concepts, types of interventions, implementation contexts, and knowledge gaps within the literature. The findings are expected to contribute to the development of a coherent, maternal-centered mitigation framework and to inform

policy by supporting the integration of maternal health indicators into disaster preparedness planning, strengthening community-based and culturally responsive interventions, and guiding national and local disaster management agencies in formulating targeted and sustainable policies to protect pregnant women before, during, and after disaster events.

## METHOD

This research uses a Scoping Review approach, which is a literature review method aimed at mapping scientific evidence, identifying key concepts, types of evidence, and research gaps related to disaster mitigation for pregnant women in natural disaster conditions. This approach was chosen because the research topic is broad, multidisciplinary, and still evolving, thus requiring comprehensive literature mapping.

Data for this review were obtained from four reputable international academic databases: PubMed, Scopus, SpringerLink, and MDPI. These databases were selected because they provide extensive coverage of peer-reviewed literature relevant to health sciences, disaster management, and maternal vulnerability. The search process utilized a combination of keywords and Boolean operators, including “pregnant women,” “maternal health,” “disaster mitigation,” “disaster preparedness,” “emergency response,” “natural disaster,” “earthquake,” “flood,” and “climate change.” The search strategy was adapted for each database to optimize article retrieval while ensuring alignment with the research objectives.

The review included articles published between January 2015 and May 2024 to capture contemporary advancements and recent developments in disaster mitigation for pregnant women. Studies were considered eligible if they were written in English, focused specifically on pregnant women in natural disaster contexts, and consisted of either primary research (quantitative or qualitative) or relevant systematic reviews. Only full-text articles published in peer-reviewed journals were included to maintain methodological

rigor and ensure the credibility of the synthesized evidence.

Studies were excluded if they did not focus on pregnant women, examined disaster contexts unrelated to natural hazards such as pandemics or political conflicts, or were non-research publications such as editorials, commentaries, opinion papers, or conference summaries. Duplicate records identified across the databases were also removed during the screening process.

The selection of studies followed the *Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews* (PRISMA-ScR) flow framework. All articles identified in the initial search were imported into a reference management system, where duplicates were removed. The remaining articles underwent a sequential screening process beginning with title and abstract review, followed by full-text assessment based on the established inclusion and exclusion criteria. The PRISMA-ScR flowchart provides a detailed summary of the study identification, screening, eligibility assessment, and final inclusion stages carried out in this review.

To assess the methodological quality of the included studies, the review employed appraisal tools adapted from the Joanna Briggs Institute (JBI) and the Critical Appraisal Skills Programme (CASP). The appraisal focused on evaluating the clarity of each study’s research design, the relevance of its disaster context, its specific attention to pregnant women, the transparency of its methodology, the robustness of the empirical data presented, and its overall contribution to policy or practical implementation. Only studies meeting acceptable quality standards were included in the final synthesis.

Methodological quality appraisal of quantitative studies included in this scoping review was conducted using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist, in line with JBI recommendations for scoping reviews.

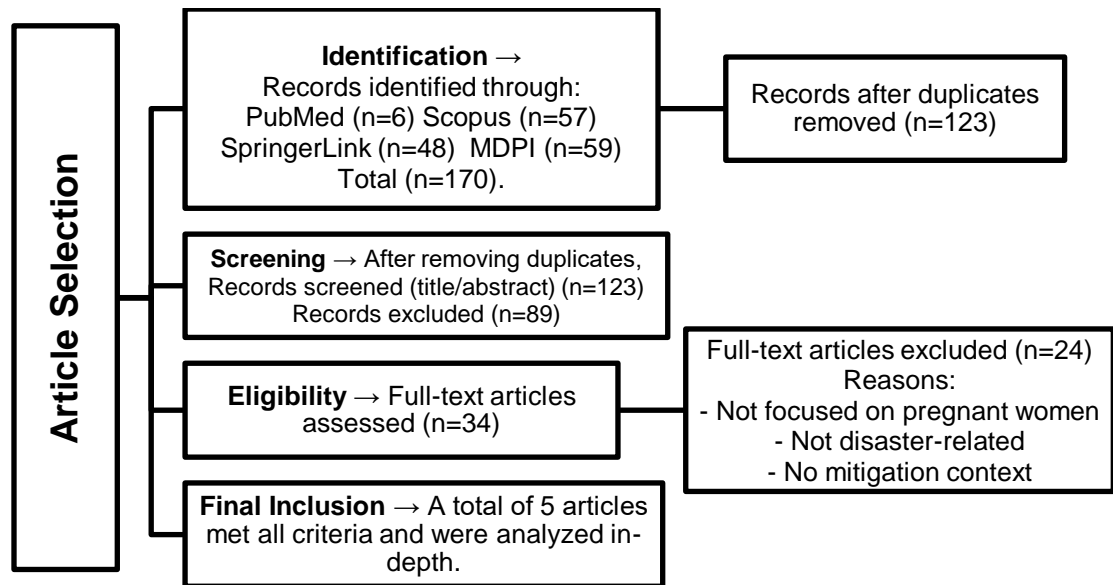


Figure 1. The PRISMA-ScR flowchart

**Table 1.** Methodological Quality Appraisal of Quantitative Studies Using the JBI Checklist

Author (Year)	Study Design	JBI Criteria Met	Score (%)	Quality Rating	Key Methodological Notes
Adebayo et al. (2020)	Randomized experiment	8/9	88.9	High	Clear intervention comparison
Kim-Herrera et al. (2025)	Cross-sectional	7/8	87.5	High	Adequate analysis; limited sample
Welton et al. (2019)	Cohort study	8/9	88.9	High	Well-defined exposure and follow-up
Austin et al. (2017)	Prospective cohort	8/9	88.9	High	Strong longitudinal design
Guo et al. (2020)	Survey	9/9	100	High	Large population-based sample

Notes: JBI = Joanna Briggs Institute. Quality ratings were assigned based on the proportion of checklist items rated as 'Yes':  $\geq 80\%$  = High quality; 60–79% = Moderate quality;  $< 60\%$  = Low quality. In accordance with JBI scoping review methodology, no studies were excluded based on quality appraisal

**Table 2.** Methodological Quality Appraisal of Qualitative Studies Using the CASP Tool

Author (Year)	Qualitative Design	CASP Criteria Met	Score (%)	Quality Rating	Key Methodological Notes
Sayeed et al. (2019)	FGD & IDI	9/10	90	High	Strong data triangulation
Zotti & Williams (2024)	Expert consensus	8/10	80	High	High policy relevance
Lafarga Previdi et al. (2022)	Qualitative analysis	9/10	90	High	Rich thematic findings
Giusti et al. (2022)	Narrative qualitative	8/10	80	High	In-depth contextual insights
Horn et al. (2024)	Exploratory qualitative	7/10	70	Moderate	Limited participant perspectives

Notes: CASP = Critical Appraisal Skills Programme. Quality ratings were determined based on the number of criteria met out of ten:  $\geq 80\%$  = High quality; 60–79% = Moderate quality;  $< 60\%$  = Low quality. Quality appraisal was undertaken to support interpretation of findings and did not constitute exclusion criteria.

Qualitative studies were appraised using the Critical Appraisal Skills Programme (CASP) qualitative checklist, which consists of ten core questions evaluating methodological rigor, credibility, and relevance

## RESULTS

Based on the literature search, several articles were identified as relevant to the objectives of this study. The results of the literature review are summarized below :

**Table 3.** Characteristics of included studies

First Author, year; Natural disaster; Country; Study Design	Objective	Study Sample	Key Finding
Sayed et al.,2019 (22);flood;Bangladesh ;Qualitative	To explore the community perception of maternal deaths influenced by natural disaster (flood), and the practice of maternal complications during natural disaster among the rural population in Bangladesh.	Three focus group discussions (FGD) and eight in-depth interviews (IDI) were conducted in two unions of the sub-district where three maternal deaths occurred during the previous flood	Flood is one of the major risk factors for influencing maternal death. Pregnant women seriously suffer from maternal complications, lack of antenatal checkup, and lack of doctors during flooding. During the time of delivery, it is difficult to find a skilled attendant, and referring the patient with delivery complications to the healthcare facility. Boats are the only mode of transport. The majority of maternal deaths occur on the boats during transfer from the community to the hospital
Adebayo et al.,2020 (23);Climate change;English;Randomized experiment	To compare the effectiveness of brief narrative-based information about the maternal and child health risks associated with climate change to comparable information presented in a didactic format	Pregnant women recruited through convenience sampling in the waiting rooms of a diverse set of private obstetrical practices (n = 2) and hospital clinics (n = 2) in Washington, DC, Largo, Maryland, and Maryville, Illinois. One of the hospital-based practices specifically serves women with high-risk pregnancies. Total of 151 pregnant women participated	Narratively based information was more effective than didactic information in increasing pregnant women's knowledge, risk perceptions, self-efficacy, and intentions to adopt risk-reducing behavior, and more effective at influencing their subsequent actual information seeking behavior — even though the factual content of the two forms of information were equivalent
Kim-herrera et al.,2025 (24);Hurricanes and earthquakes;Mexico;cross-sectional study	To compare data collected before and after Hurricane John related to maternal, infant and young child feeding (IYCF)	76 pregnant women	need to strengthen preparedness and response systems for maternal and child nutrition in emergencies. Maternal consumption of different food groups decreased after the emergency, reflecting deteriorating food security and access to nutritious foods.



First Author, year; Natural disaster; Country; Study Design	Objective	Study Sample	Key Finding
	practices and the nutritional status of pregnant women		
Zotti & Williams, 2024 (25);All disaster;United States;Qualitative	To guide post-disaster assessment and surveillance, we initiated a collaborative process with nationwide expert partners to identify post disaster epidemiologic indicators for these at-risk groups.	three population subgroups (pregnant women, postpartum women, and infants	In post-disaster surveillance, we envision that users will not use all indicators and measures but will select ones appropriate for their setting. These proposed indicators and measures promote uniformity of measurement of disaster effects among U.S. P/PP women and their infants and assist public health practitioners to identify their post-disaster needs
Lafarga Previdi et al., 2022(26);Hurricanes Irma and María;Puerto Rico;Qualitative	To assess the impact of natural disasters on maternal health during Hurricanes Irma and María	a total of 375 women who were recruited for the study and we conducted a qualitative analysis	The following themes were identified: pregnancy and birth challenges, lack of access to basic services, housing conditions, stressful working conditions, concerns about health, concerns about their children, and positive or protective aspects. The results indicate how the disruption in access to basic services has a unique impact on the physical and mental health of pregnant and post-partum women in an emergency situation. These findings point to the potential benefit of developing specific protocols designed for emergency preparedness aimed at this population, which can inform healthcare providers and community organizations in case of future events
Giusti et al., 2022 (27);Earthquake;Italy; Qualitative	To explore women's experiences of pregnancy, childbirth, and infant feeding during and after L'Aquila earthquake emergency	Six women who were pregnant at the time of the earthquake	the reconfiguration of relationships and the central role of partners and family support; the need of spaces for sharing experiences and practices with other mothers; the lack of breastfeeding support after the hospital discharge; the inappropriate donations and distribution of Breast Milk Substitutes. The response system appeared not always able to address the specific needs of pregnant and lactating women. It is urgent to develop management plans, policies and procedures and provide communication, sensitization, and training on infant and young child

First Author, year; Natural disaster; Country; Study Design	Objective	Study Sample	Key Finding
			feeding at all levels and sectors of the emergency response.
Horn et al., 2024 (28); floods and pandemic; South Africa; an exploratory, descriptive qualitative design within a contextual approach	to make recommendations to improve disaster preparedness in an obstetric ward based on the nurses' knowledge and attitudes	17 participants who participated in the open-ended, semi-structured interviews.	The results indicate that the participants demonstrate an awareness of disaster terminology but need more assertiveness in executing the institutional disaster policy. The results illustrate that more frequent training, disaster rehearsals, and simulations should be implemented to improve disaster readiness
Welton et al., 2019 (29); Hurricanes; Puerto Rico; Cohort Study	to investigate environmental risk factors for perinatal health outcomes among Puerto Rican mothers and infants	450 total participants	Major challenges post-hurricanes were access to care and nutrition, maternal stress, and environmental damage, need to integrate disaster preparedness into our programs' operating procedures and future applications, recognizing that these events will recur
Austin et al., 2017 (30); Floods; Australia; Prospective cohort study	To investigate the impact of stress during pregnancy resulting from the Queensland Floods in 2011 on toddlers' cognitive and language development, and examines how maternal emotional availability is associated with these outcomes	131 families	Maternal structuring and sensitivity play a significant role in enhancing the language development of children whose mothers experienced high levels of stress during pregnancy.
Guo et al., 2020 (31); Flood; China; Survey	To explore the risk of cognitive impairment in children following maternal exposure to the 1998 Yangtze River flood in China during pregnancy	the 108 175 children	Prenatal flood exposure had a long-term negative effect on cognitive development of children. Greater maternal support and public health interventions during pregnancy and early life after a natural disaster are warranted to facilitate healthy cognitive development in later life.

Thematic analysis of the reviewed articles focus and recurring patterns of the research identified four main themes that represent the findings :

1. Theme 1. Impact of Disasters on Maternal Health and Pregnancy.

The literature indicates that natural disasters increase the risk of pregnancy complications and maternal mortality. Barriers during childbirth, delays in referral, and unsafe evacuation conditions are key contributing factors. The impact of disasters is not limited to the acute phase but extends into the post-disaster period.

2. Theme 2. Disruption of Health Services and Basic Health Needs of Pregnant Women.

Most studies reported disruptions in access to and continuity of maternal health services. Antenatal care, delivery services, nutrition support, and breastfeeding assistance were often not optimally available. Food insecurity and limited resources further worsened the health conditions of pregnant women.

3. Theme 3. Psychosocial Impact and Child Development.

Natural disasters generate psychological stress and emotional distress among pregnant women. Stress during pregnancy is associated with long-term outcomes in children, including cognitive and language development. Maternal emotional support acts as a protective factor in this context.

4. Theme 4. Health System Preparedness and Response for Pregnant Women. The literature highlights limited preparedness of health systems in protecting pregnant women during disasters. Gaps are evident in policy implementation, health workforce readiness, and the availability of specific protocols. Studies emphasize the need for training, simulation exercises, and the integration of maternal health services into disaster management frameworks

## DISCUSSION

The findings of this scoping review indicate that natural disasters and climate change-related risks have a significant impact on maternal health through increased pregnancy complications, disruption of essential health services, psychosocial stress, and limited health system preparedness. These findings are consistent with international and national evidence demonstrating that pregnant women represent a vulnerable population that is often insufficiently addressed in disaster management policies. Accordingly, this discussion situates the review findings within the context of previous empirical evidence and examines their policy and health practice implications.

**Table 4.** Thematic matrix of included studies

Author (Year)	Country	Disaster Type	Study Design	T1	T2	T3	T4
Sayeed et al. (2019)	Bangladesh	Flood	Qualitative	✓	✓		✓
Adebayo et al. (2020)	United States	Climate change	Randomized experiment			✓	✓
Kim-Herrera et al. (2025)	Mexico	Hurricanes, earthquakes	Cross-sectional		✓		✓
Zotti & Williams (2024)	United States	All disasters	Qualitative				✓
Lafarga Previdi et al. (2022)	Puerto Rico	Hurricanes (Irma, Maria)	Qualitative	✓	✓	✓	✓
Giusti et al. (2022)	Italy	Earthquake	Qualitative	✓	✓	✓	✓
Horn et al. (2024)	South Africa	Flood, pandemic	Qualitative				✓
Welton et al. (2019)	Puerto Rico	Hurricanes	Cohort	✓	✓	✓	✓
Austin et al. (2017)	Australia	Flood	Prospective cohort			✓	
Guo et al. (2020)	China	Flood	Survey			✓	

Exposure to natural disasters during pregnancy has been shown to increase the risk of adverse obstetric outcomes. A systematic review and meta-analysis by



Lawler et al. reported a consistent association between disaster exposure and increased risks of preterm birth, low birth weight, and impaired fetal growth (32). These findings are further supported by longitudinal evidence from the Fukushima Health Management Survey, which documented changes in obstetric outcomes up to eight years after the Great East Japan Earthquake (33). National studies in Indonesia have also reported increased pregnancy complications and delays in referral in flood- and earthquake-affected areas, particularly in regions with limited access to health services (34–36). Collectively, these findings reinforce the results of this review, indicating that failures in referral systems and transportation barriers are key mechanisms contributing to increased maternal health risks during disasters.

Beyond clinical outcomes, this review highlights substantial disruptions to maternal health services and the fulfillment of basic needs among pregnant women. Studies conducted in Puerto Rico, Bangladesh, and Mexico demonstrate that disasters lead to interruptions in antenatal care and reduced access to nutritious food (22,24,26,29). Fan & Zlatnik, (2023) further emphasize that climate change intensifies pressure on food systems and health services, thereby exacerbating vulnerability among pregnant women (37). Similar patterns have been reported in national studies, which document decreased antenatal care attendance and increased risk of anemia among pregnant women in post-disaster settings (38). These findings suggest that maternal health policies and disaster management policies continue to operate in silos and have not ensured the continuity of essential services for pregnant women.

The psychosocial impact of disasters on pregnant women and children represents a critical finding of this review. A meta-analysis by Lafortune et al. demonstrated that disaster-related prenatal stress is associated with impaired cognitive development, emotional regulation, and adverse child health outcomes (39). Cohort studies from Australia and China have similarly reported associations between disaster-related prenatal stress and impairments in child

language development and cognitive function (30,31). At the national level, qualitative studies have documented increased anxiety and stress among pregnant women during disasters, which often remain unaddressed due to limited availability of mental health services (40,41). These findings underscore that disaster responses that neglect maternal mental health may generate intergenerational consequences.

Health system preparedness emerged as a cross-cutting issue influencing all review findings. Evidence from multiple countries indicates that although disaster policies are in place, their implementation within maternal health services remains weak. Galang et al. emphasize the importance of strengthening maternal and newborn health system resilience prior to climate- and weather-related disasters (42). A climate justice perspective advanced by Keenan et al. further demonstrates that pregnant women from lower socioeconomic groups face disproportionately higher risks due to limited health system capacity (43). National studies in Indonesia also report insufficient disaster preparedness training for maternal health providers and the absence of specific protocols for pregnant women in emergency situations (44,45). These findings indicate the need for more implementable and sustainable policy measures.

This review also indicates that disaster management policies must shift from a generalized approach toward strategies that explicitly protect maternal health. Integrating maternal health services across all phases of disaster management represents an urgent priority (37,45). Policies should designate antenatal care, childbirth services, and maternal nutrition as essential services that must be maintained during disasters (34). In addition, emergency obstetric referral systems and safe transportation for pregnant women should be incorporated into local contingency planning (46–48). Evidence from both international and national studies indicates that policies that fail to respond to the specific needs of pregnant women risk widening health inequities and worsening maternal and neonatal outcomes.

The findings of this review further highlight the strategic role of midwives and primary health care services in mitigating the impacts of disasters on pregnant women. Previous studies indicate that midwives are the health professionals most consistently accessed by pregnant women in disaster-prone areas (45). Strengthening midwives' capacity in disaster preparedness, early detection of pregnancy-related risks, and psychosocial support should therefore be prioritized. Midwifery services require operational guidelines for practice in disaster settings, including emergency birth planning and safe referral pathways. National evidence shows that preparedness education delivered by health workers, including midwives, can improve knowledge and preparedness among pregnant women facing disaster risks (49–54).

This scoping review has several limitations. First, heterogeneity in study designs and disaster contexts limited the ability to conduct quantitative synthesis and draw causal conclusions. Second, most studies originated from specific countries, which necessitates caution when generalizing findings to other national contexts. Third, the limited availability of national studies published in high-impact international journals may result in underrepresentation of local contexts. Nevertheless, the scoping review approach enabled comprehensive mapping of the existing evidence and provides a strong foundation for policy development and future research.

## CONCLUSIONS

This scoping review underscores that the impacts of natural disasters and climate change on pregnant women represent a systemic problem closely linked to limited integration between disaster management policies and maternal health policies. The increased risk to maternal health during disasters is driven not only by the natural hazards themselves but also by failures in health service delivery and social protection

systems to ensure the continuity of essential services. These findings indicate that reactive, event-focused disaster approaches have not been effective in adequately protecting pregnant women.

Based on these findings, policymakers need to position maternal health as a core priority across the entire disaster management cycle. Policies should ensure the continuity of antenatal care, childbirth services, nutrition, and mental health support for pregnant women, alongside strengthened health system preparedness through maternal-specific protocols, routine training, and adequate resource allocation. Without integrated and long-term policy approaches, the impacts of disasters on maternal and neonatal health will continue to recur and further widen health inequalities.

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