Flood Exposure and Child Malnutrition in Low- and Middle-Income Countries: A Systematic Literature Review of Stunting, Wasting, and Underweight Among Children Under Five

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ABSTRACT

Flood disasters are recurrent hydrometeorological events that disproportionately affect vulnerable populations, particularly children under five years of age. Post-flood conditions disrupt food systems, sanitation, livelihoods, and healthcare access, increasing the risk of child malnutrition.

This study aims to synthesize evidence on the association between flood exposure and the nutritional status of children under five. A systematic literature review was conducted following the PRISMA guidelines using the Scopus database. The search identified 1,495 articles, which were screened through a multi-stage selection process based on predefined criteria, resulting in 22 studies included in the final synthesis.

The findings indicate consistent associations between flood exposure and increased risks of stunting, wasting, and underweight among children under five. Stunting emerged as the most persistent long-term outcome, particularly among children under two years of age, while wasting and underweight were more commonly associated with short-term post-disaster conditions. Several studies also highlight the importance of age-appropriate food assistance, including breastfeeding support for infants (0–6 months), complementary feeding for children aged 6–23 months, and diversified diets for children aged 24–59 months.

The reviewed studies further identify key mediating pathways, including household food insecurity, infectious diseases, poor water and sanitation conditions, and socioeconomic vulnerability, highlighting the importance of integrating nutrition-sensitive and age-specific strategies into disaster risk reduction policies.

Keyword: child malnutrition; flood disaster; food security; stunting; underweight; wasting

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INTRODUCTION

Flooding is among the most frequent hydrometeorological disasters worldwide and poses significant risks to public health, particularly in low- and middle-income countries where populations are highly vulnerable to environmental shocks (IPCC, 2023). In flood-prone regions, extreme rainfall disrupts food systems, sanitation infrastructure, and healthcare access, increasing the risk of child malnutrition.

Children under five years of age represent one of the most vulnerable groups affected by these conditions. Adequate nutrition during early childhood is essential for optimal physical growth and cognitive development, and nutritional deficiencies during this critical period may lead to long-term health and developmental consequences (WHO, 2023). Nutritional status among young children is commonly assessed using anthropometric indicators, including stunting (height-for-age), wasting (weight-for-height), and underweight (weight-for-age) (WHO, UNICEF, & World Bank, 2023).

A growing body of empirical research suggests that flood exposure is associated with increased risks of child malnutrition. Studies conducted in flood-prone regions such as Bangladesh and South Asia have reported higher prevalence of stunting and underweight among children living in affected areas (Rodriguez-Llanes et al., 2016). Flood-related disruptions in food production, household income, and access to clean water may also contribute to increased infectious diseases such as diarrhea, which further aggravate nutritional deficiencies (FAO et al., 2023).

The relationship between flooding and child malnutrition can be conceptually understood through the UNICEF conceptual framework of malnutrition, which identifies three levels of determinants: immediate causes (inadequate dietary intake and infectious diseases), underlying causes (household food insecurity, inadequate caregiving practices, and limited access to health services and sanitation), and basic causes related to broader socioeconomic and environmental conditions. Flood disasters may influence child nutritional outcomes through multiple pathways within this framework, including disruptions to food systems, reductions in household income, and deterioration of water and sanitation conditions. The conceptual pathways linking flood exposure and child malnutrition are illustrated in Figure 1.

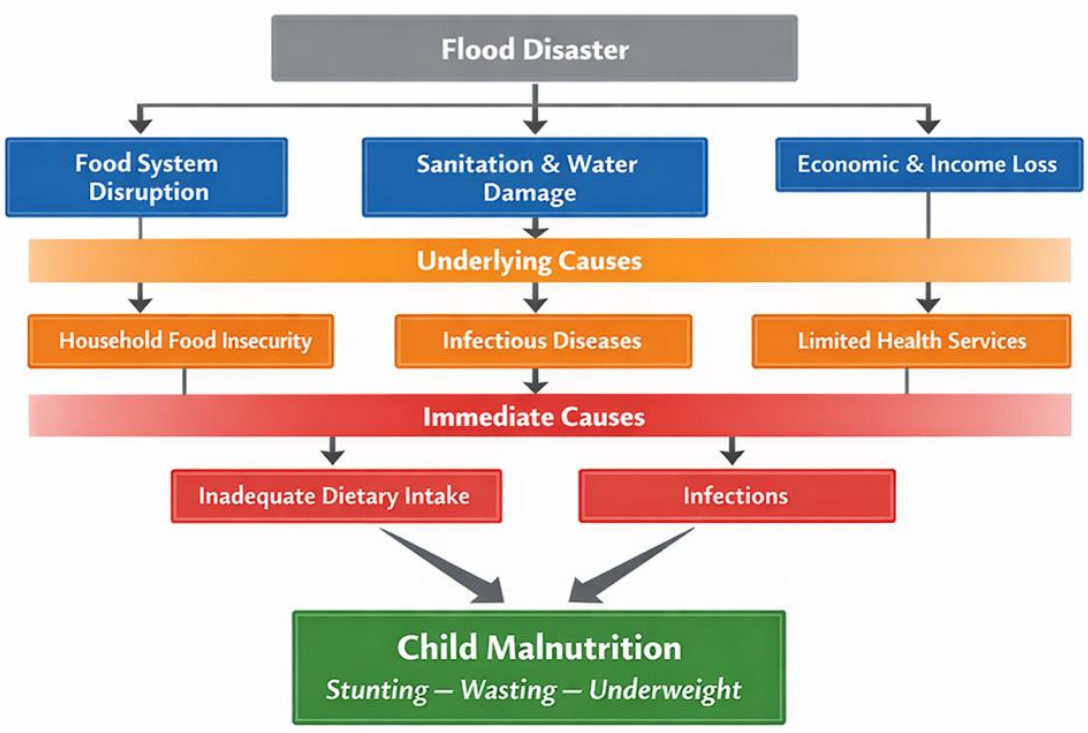

Figure 1. Conceptual pathways linking flood exposure and child malnutrition based on the UNICEF conceptual framework

Despite increasing research examining the health consequences of climate-related disasters, existing studies on flooding and child nutrition remain fragmented and largely context-specific. Most studies focus on individual case studies or single-country analyses, and relatively few attempts have been made to systematically synthesize the available evidence on the relationship between flood exposure and child malnutrition outcomes. Furthermore, the mechanisms linking flooding to different forms of child malnutrition have not been comprehensively examined across diverse contexts.

Therefore, a systematic synthesis of existing evidence is needed to clarify the patterns and mechanisms through which flood exposure is associated with child nutritional outcomes. Accordingly, this study aims to systematically review and synthesize empirical research examining the relationship between flood exposure and malnutrition among children under five years of age. By consolidating available evidence, this review seeks to provide a clearer understanding of the pathways linking flooding to child malnutrition and to inform nutrition-sensitive disaster risk reduction strategies in vulnerable regions.

METHODS

This study employed a Systematic Literature Review (SLR) to comprehensively examine the relationship between flood exposure and the nutritional status of children under five years of age. This review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guideline, which provides a standardized framework for identifying, screening, and selecting relevant studies in systematic reviews.

Research Question

The research question guiding this review was formulated using the PECO framework (Population, Exposure, Comparison, Outcome): population (children under five), exposure (flood disasters), comparison (non-flood conditions), and outcomes (stunting, wasting, and underweight). Based on this framework, the research question addressed in this review was:
"How do flood disasters influence the nutritional status of children under five years of age?"

Search Strategy

The literature search strategy was developed to identify studies examining the relationship between flood disasters and child nutritional outcomes. Relevant keywords were determined based on the research question and previous literature.

The keywords used in this review included: flood, flood disaster, post-flood, nutritional status, malnutrition, stunting, wasting, underweight, under-five children, children under five, and toddlers**.** These keywords were combined using Boolean operators (AND and OR) to broaden or narrow the search results in accordance with the research objectives.

The literature search was conducted using the Scopus database, which was selected due to its extensive coverage of peer-reviewed international journals and multidisciplinary scientific publications. Scopus is widely recognized as one of the largest academic databases and provides comprehensive indexing of high-quality research articles relevant to health, environmental, and social sciences. The search string applied in the Scopus database is presented in Table 1**.**

Table 1. Search String Used in the Scopus Database

Database	Keyword with string	Result
Scopus	TITLE-ABS-KEY (("flood" OR "flood disaster" OR "post-flood") AND ("nutritional status" OR "malnutrition" OR "stunting" OR "wasting" OR "underweight") AND ("under-five children" OR "children under five" OR "toddlers")) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (PUBSTAGE , "final"))	1,495

Study Selection Process

The study selection process followed several systematic stages. Initially, the database search identified 1,495 articles related to flooding and child nutrition. Several filters were applied to ensure study relevance. These filters included:

1. Publication years between 2021 and 2026, to ensure the inclusion of relatively recent scientific evidence;
2. Document type restricted to original research articles;
3. Articles in the final publication stage; and
4. Articles with accessible full texts.

After applying these criteria, a total of 207 articles remained for further screening. The screening process was conducted in several stages. First, duplicate records were removed. Second, titles and abstracts were screened to evaluate their relevance to the research question. Third, potentially relevant articles were assessed for eligibility based on predefined inclusion and exclusion criteria. This process resulted in 75 potentially eligible articles.

Finally, a full-text review was conducted to ensure that the selected studies clearly examined the relationship between flood exposure and child nutritional outcomes. Following this comprehensive evaluation, 22 articles met all eligibility criteria and were included in the final synthesis**.**

Inclusion and Exclusion Criteria

The eligibility assessment was conducted based on predefined inclusion and exclusion criteria to ensure the relevance and quality of the selected studies. Inclusion criteria: original research articles published in peer-reviewed journals; studies examining the relationship between flood exposure and child nutritional outcomes; studies focusing on children under five years of age (0–59 months); articles published between 2021 and 2026; and articles with accessible full texts.

Exclusion criteria: review articles, conference papers, editorials, or non-research publications; studies not specifically examining flood disasters; studies that did not report child nutritional status indicators; and articles with insufficient methodological information.

Screening Procedure

The screening and eligibility assessment were conducted by the author through a systematic evaluation of article titles, abstracts, and full-text documents. Each article was carefully reviewed based on the predefined inclusion and exclusion criteria to ensure its relevance to the research objectives and the consistency of the final dataset. The study selection process followed the PRISMA 2020 guideline and is illustrated in Figure 2.

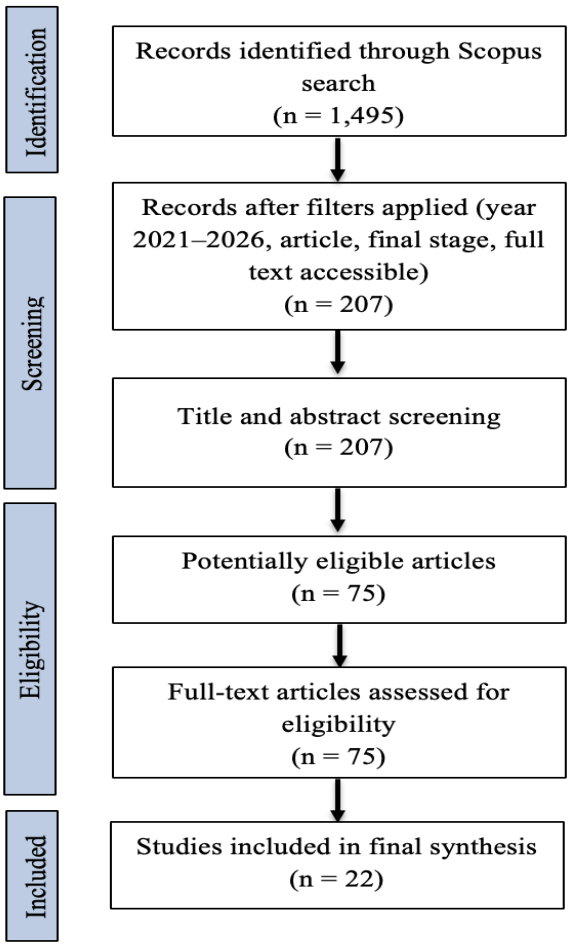

Figure 2. Prisma flow diagram of study selection

RESULTS AND DISCUSSION

A total of 22 studies were included in this systematic review after the screening and eligibility assessment process. Table 2 summarizes the characteristics of the included studies. Overall, the studies were conducted across multiple low- and middle-income countries, particularly in South Asia, Sub-Saharan Africa, and other flood-prone regions where child malnutrition remains a major public health concern.

Across the included literature, twelve studies reported an association between flood exposure and increased risk of stunting, making it the most frequently documented outcome. Seven studies identified wasting as a consequence of post-flood conditions, particularly during the immediate post-disaster period. In addition, nine studies highlighted household food insecurity as a key pathway linking flooding to child malnutrition, while eight studies reported increased infectious disease incidence, including diarrhea and respiratory infections. These outcomes collectively demonstrate the multidimensional pathways through which flooding contributes to child malnutrition. The characteristics of the included studies are summarized in Table 2.

Table 2. Characteristics of Included Studies

Author	Year	Country/Region	Study Design	Sample	Key Findings
Murshed et al.	2023	Bangladesh	Cross-sectional	Children under five	Flood exposure significantly associated with increased stunting prevalence
Babu et al.	2026	India	Community survey	Displaced children	Flood-affected children in relief camps had higher risk of underweight
Tiwari et al.	2022	South Asia	Secondary data analysis	Under-five children	Flood exposure linked to higher undernutrition prevalence
Broyles et al.	2026	Multi-country LMICs	National survey + satellite data	Children ≤5 years	Flood-affected areas show lower height-for-age scores
Agabiirwe et al.	2022	Global	Systematic review	Children under five	Stunting identified as the most consistent long-term outcome
Das et al.	2025	South Asia	Observational	Rural households	Flooding disrupts food production and food access

Islam et al.	2022	Bangladesh	Longitudinal survey	Rural households	Climate shocks reduce long-term food consumption stability
Veral et al.	2026	South Asia	Environmental health study	Children under five	Flood-related rainfall increases diarrhea incidence
Freudenreich et al.	2022	Multi-country	Econometric analysis	Children under five	Weather shocks associated with growth vulnerability
Rahut et al.	2024	South Asia	Cross-country analysis	Households with children	Socioeconomic factors strongly influence malnutrition
Li et al.	2025	100 LMICs	Case-control study	Children under five	Flood exposure contributes to increased child mortality
Backer & Billing	2024	Sub-Saharan Africa	Machine learning analysis	Children 6–59 months	Environmental factors predict acute malnutrition
Gupta et al.	2021	Nepal–India region	Environmental governance study	Flood-prone communities	Recurrent floods disrupt agriculture and food systems
Bosire et al.	2025	Sub-Saharan Africa	Observational study	Children under five	Recurrent flooding increases stunting risk
Fagbemi et al.	2025	West Africa	Panel data analysis	Population-level	Climate change impacts child health and mortality
Bukari & Aluko	2023	Africa	Socioeconomic analysis	Households	Climate hazards increase deprivation and vulnerability
Edwards et al.	2021	Global	Cross-country survey	Households	Disaster exposure increases food insecurity
Ogutu et al.	2026	Kenya	Environmental health study	Flood-affected communities	Flooding damages sanitation infrastructure
Hastutui et al.	2024	Indonesia	Cross-sectional	Children under five	ARI associated with stunting
Lawes et al.	2025	Europe	Policy review	Refugee children	Nutrition policy for migrant populations
Ahmadzai & Morrissey	2025	Afghanistan	Household survey	Rural households	Flood exposure reduces income and dietary diversity
Patlán-Hernández et al.	2025	Madagascar	Hydro-climate study	Children under five	Rainfall variability associated with SAM and infections

As presented in Table 2, the included studies were conducted across a diverse range of geographical contexts, with the majority located in flood-prone regions of South Asia and Sub-

Saharan Africa. Most studies employed cross-sectional or observational designs and focused on children under five years of age as the primary population of interest. The findings consistently highlight the association between flood exposure and adverse child nutritional outcomes, particularly through pathways related to food insecurity, infectious diseases, and socioeconomic vulnerability.

Table 3. Main Outcomes Reported in Included Studies

Outcome	Number of Studies	Key Interpretation
Stunting	12	Most consistent long-term nutritional outcome
Wasting	7	Acute malnutrition sensitive to post-flood shocks
Underweight	6	Associated with displacement and food shortage
Household food insecurity	9	Major pathway linking floods to malnutrition
Infectious diseases	8	Diarrhea and ARI increase post-flood
Socioeconomic vulnerability	10	Poverty, maternal education, and sanitation strongly influence outcomes

As presented in Table 3, Stunting emerged as the most frequently reported nutritional outcome, followed by wasting and underweight. Several studies also highlighted the role of household food insecurity and infectious diseases as key mechanisms linking flood exposure to child malnutrition. These findings indicate that the impact of flooding on child nutrition operates through multidimensional pathways involving environmental, health, and socioeconomic factors.

Impact of Flooding on the Nutritional Status of Children Under Five

Among the 22 studies included in this review, 12 studies (54.5%) reported a significant association between flood exposure and increased risk of stunting, while seven studies (31.8%) identified wasting as a short-term nutritional consequence, and six studies (27.3%) reported higher prevalence of underweight in flood-affected populations.

The majority of the empirical evidence derives from cross-sectional household surveys and secondary analyses of national datasets, particularly in South Asia and Bangladesh. For example, cross-sectional analyses conducted by Murshed et al. (2023), Babu et al. (2026), and Tiwari et al. (2022) consistently reported a significant association between flood exposure and increased prevalence of stunting and underweight among children under five. Similarly, a national survey–based ecological analysis integrating satellite imagery conducted by Broyles et al.

(2026)demonstrated that children residing in flood-affected areas had significantly lower height-for-age z-scores, with stronger effects observed in coastal regions and among children aged ≤2 years.

Comparable findings are also reported at the community level. A community-based observational study by Babu et al. (2026) found that children displaced to flood relief camps exhibited substantially higher risks of underweight and anthropometric failure compared with non-displaced children. These findings align with the systematic review conducted by Agabiirwe et al. (2022), which synthesized multiple observational studies and concluded that stunting represents the most consistent and long-term nutritional outcome following flood exposure, particularly more than one year after disaster events.

However, several studies report heterogeneous or contradictory findings. For instance, an econometric analysis of weather shocks across multiple countries conducted by Freudenreich et al. (2022) found that excessive rainfall—used as a proxy for flooding—was theoretically associated with increased stunting risk but did not reach statistical significance in their empirical models. Similarly, Rahut et al. (2024), using a cross-country econometric analysis, showed that socioeconomic factors such as maternal education, household poverty, and access to safe drinking water had stronger associations with child malnutrition than climatic variables such as rainfall variability and temperature changes. These findings suggest that the nutritional impact of flooding is highly context-specific and mediated by underlying socioeconomic determinants.

The reviewed studies consistently identify three key pathways linking flooding and child malnutrition: household food insecurity, infectious diseases, and socioeconomic vulnerability. Observational and household survey studies by Das et al. (2025) and Murshed et al. (2023) reported that flooding damages agricultural production, disrupts food supply chains, reduces household income, and limits access to healthcare services. These findings are supported by longitudinal analyses such as Islam et al. (2022), which demonstrated that climate shocks and extreme weather events reduce the long-term stability of household food consumption.

Environmental health studies also highlight the role of infectious diseases. For example, Veral et al. (2026), using spatial environmental health analysis, found that rainfall intensity and proximity to flood-prone areas were significantly associated with increased incidence of diarrhea among children under five. From a biological perspective, recurrent diarrheal episodes

may impair nutrient absorption and contribute to long-term growth impairment, particularly stunting.

Beyond nutritional outcomes, several studies also highlight broader health implications. A large-scale sibling-matched case–control study across 100 low- and middle-income countries conducted by Li et al. (2025) estimated that flood exposure contributes to tens of thousands of premature child deaths annually, with long-term impacts substantially exceeding direct flood-related mortality. This finding reinforces the argument that flooding functions as a structural determinant of child health rather than merely a temporary environmental disaster.

Overall, the synthesis of the included studies indicates that stunting is the most consistently reported outcome, whereas wasting and underweight appear more sensitive to short-term post-disaster conditions. The evidence also suggests that children under two years of age, households experiencing poverty, families with low maternal education, and communities living in coastal or repeatedly flood-prone regions represent the most vulnerable groups. However, because the majority of the included studies employ cross-sectional designs, the causal relationship between flood exposure and child malnutrition remains difficult to establish. Consequently, future research employing longitudinal cohort designs is needed to strengthen causal inference and support the development of climate risk–informed nutrition interventions.

Wasting and Underweight in the Post-Flood Context

The literature indicates that wasting and underweight, which represent indicators of acute malnutrition, are highly sensitive to environmental and socioeconomic shocks triggered by flooding. Among the 22 studies included in this review, seven studies reported wasting or other forms of acute malnutrition as a short-term nutritional consequence of flood exposure**,** while six studies documented increased prevalence of underweight among children living in flood-affected areas. These findings suggest that acute malnutrition tends to emerge particularly during the immediate post-disaster period when household food access, sanitation systems, and healthcare services are disrupted.

Several studies highlight the predictive role of environmental conditions in shaping acute malnutrition dynamics. For instance, Backer and Billing (2024) employed a machine learning–based predictive model across 36 Sub-Saharan African countries and found that variations in rainfall, temperature, vegetation cover, and conflict intensity were significantly associated with

changes in the prevalence of acute malnutrition among children aged 6–59 months by approximately 1–2 percentage points ($R^2 \approx 0.60$). Their findings indicate that environmental indicators, including extreme rainfall events associated with flooding, may serve as early predictors of wasting trends up to 12 months in advance.

In contrast, other studies emphasize the structural socioeconomic pathways through which flooding contributes to acute malnutrition. For example**,** Gupta et al. (2021) examined recurrent flooding in the transboundary Koshi and Gandak river basins between Nepal and India and demonstrated that repeated flood events disrupt agricultural production, exacerbate poverty, and increase migration pressures. Although the study does not directly measure anthropometric indicators, its findings on food system disruption, income loss, and increased incidence of waterborne diseases such as diarrhea provide important contextual evidence explaining the heightened vulnerability to wasting and underweight in flood-prone regions.

Other observational and cross-sectional studies included in this review also report similar patterns, indicating that children living in flood-affected communities frequently experience short-term deterioration in nutritional status due to reduced dietary intake, temporary food shortages, and increased disease exposure. However, compared with stunting, the evidence on wasting and underweight remains more heterogeneous across studies, suggesting that acute malnutrition outcomes are strongly influenced by disaster severity, duration of displacement, and the availability of humanitarian assistance.

Overall, the synthesis of the included studies suggests that wasting and underweight represent acute manifestations of nutritional vulnerability following flood events, often emerging in the months immediately after disasters. These outcomes reflect the interaction between environmental exposure, disrupted food systems, and weakened household adaptive capacity. Consequently, integrating environmental early warning systems with nutrition surveillance programs may play an important role in preventing spikes in acute malnutrition among children under five in flood-prone regions.

Post-Flood Stunting

The literature indicates that post-flood stunting represents a long-term consequence arising from the interaction between food insecurity, increased infectious disease burden, and weakened access to healthcare services. Among the 22 studies included in this review, 12 reported stunting

as a key nutritional outcome. However, the majority of these studies employed cross-sectional or ecological research designs, while only a limited number used longitudinal or panel data approaches. This methodological pattern is important because stunting reflects chronic growth impairment that develops over extended periods of nutritional deprivation and repeated exposure to environmental stressors.

For instance, Freudenreich, Aladysheva, and Brück (2022) employed a cross-country econometric analysis using climate and household survey data to examine the relationship between weather shocks and child growth outcomes. Their findings suggest that exposure to extreme weather events during early childhood increases vulnerability to chronic growth impairment, particularly during critical developmental periods. Although excessive rainfall—used as a proxy for flooding—did not always reach statistical significance in their empirical models, the study emphasizes that children residing in environmentally vulnerable areas face higher risks of long-term growth disruption.

Complementary evidence is reported by Bosire et al. (2025) through an observational study examining the relationship between recurrent flooding and child nutritional status. The study found that children living in flood-affected regions were significantly more likely to experience linear growth impairment compared with children in non-affected areas. Similar to several other studies included in this review, the analysis was based on cross-sectional household survey data, which identifies statistical associations but provides limited capacity to capture the cumulative and long-term effects of repeated flood exposure on child growth trajectories.

Despite these methodological differences, several studies consistently identify similar mechanistic pathways linking flooding to stunting. These pathways include disruption of household food security due to agricultural land damage and income loss, increased incidence of diarrhea and recurrent infections resulting from deteriorating sanitation conditions, and reduced access to maternal and child healthcare services. From a biological perspective, recurrent infections and prolonged dietary inadequacy may impair nutrient absorption and utilization, ultimately contributing to chronic linear growth failure.

Overall, the synthesis of the included studies suggests that post-flood stunting is not merely a consequence of temporary food shortages but rather a manifestation of prolonged structural disruption, particularly among households with high socioeconomic vulnerability. However, because most available evidence is derived from cross-sectional analyses, establishing a clear

causal relationship between flood exposure and long-term stunting remains challenging. Future research employing longitudinal cohort designs or repeated panel surveys would therefore be essential to better understand how cumulative flood exposure influences child growth trajectories over time.

The Role of Household Food Security

The literature consistently identifies household food security as a critical pathway linking flood exposure to child malnutrition. Flood events frequently disrupt agricultural production, damage food supply chains, and reduce household income, thereby limiting the availability and accessibility of food at the household level. These disruptions ultimately affect dietary intake among children, increasing the risk of inadequate nutrient consumption and subsequent nutritional outcomes such as stunting, wasting, and underweight.

Several studies included in this review emphasize the role of environmental shocks in weakening household food systems. For example, Edwards, Gray, and Borja (2021) found that cumulative exposure to natural disasters—including floods—significantly increases the likelihood of severe household food insecurity (OR = 1.27), both through direct disaster impacts and community-level disruptions. In flood-affected settings, damaged infrastructure, agricultural losses, and market disruptions often limit food access, which may result in reduced dietary diversity and insufficient nutrient intake among children.

Other studies highlight the broader socioeconomic pathways through which climate-related shocks influence food security. Bukari and Aluko (2023) demonstrate that exposure to climate hazards increases household deprivation and reduces adaptive capacity, thereby weakening the ability of households to maintain stable food access during environmental crises. Although the study primarily examines socioeconomic vulnerability rather than nutritional indicators directly, its findings provide important contextual evidence explaining how environmental shocks—including floods—may indirectly contribute to child malnutrition by reducing household food availability and purchasing power.

At a broader macroeconomic level, Fagbemi et al. (2025) report that climate-related environmental stressors are associated with declining population health outcomes across several West African countries. Although the study does not directly measure household food security or nutritional status, it highlights how environmental pressures on agricultural systems can undermine food production and nutrition systems. In flood-prone regions, these pressures may translate into

reduced household food supply, lower dietary quality, and increased vulnerability to malnutrition among children.

Overall, the synthesis of the included studies indicates that household food security functions as a key mediating mechanism linking flood exposure to child nutritional outcomes. Flood-induced disruptions to agricultural production, household income, and food markets can reduce both the quantity and quality of food available to households. These conditions ultimately affect children's dietary intake and nutrient adequacy, increasing the risk of both acute and chronic forms of malnutrition. Strengthening household food security—through livelihood diversification, disaster-resilient agricultural systems, and social protection programs—therefore represents an essential strategy for mitigating the nutritional impacts of flooding in vulnerable communities.

Infectious Diseases and Post-Flood Sanitation

The literature indicates that flooding increases the risk of infectious diseases primarily through damage to water and sanitation systems and the contamination of drinking water sources. Flood events frequently disrupt sanitation infrastructure, increase reliance on unsafe water sources, and limit access to hygiene facilities, thereby creating favorable conditions for the transmission of waterborne and environmentally related infectious diseases.

Evidence from Ogutu et al. (2026) demonstrates that flooding significantly increases the prevalence of open defecation, dependence on unprotected water sources, and damage to sanitation facilities. These conditions are associated with higher incidence of waterborne diseases, including diarrhea, cholera, and bilharzia. In addition, deteriorating water quality following flood events has been linked to other health risks, including urinary tract infections in several regions. Infrastructure damage caused by flooding may also restrict access to healthcare services, further increasing the health burden among vulnerable populations. These findings highlight that weakened water and sanitation systems constitute a key environmental pathway through which flood exposure increases infectious disease risks.

The relationship between infectious diseases and child nutritional outcomes in flood-affected areas is also reflected in the study by Hastutui et al. (2024) conducted in Sayung, Demak. The study reports a significant association between a history of acute respiratory infections (ARI) and child nutritional status based on the height-for-age index (HAZ) ($P = 0.023$), suggesting that children experiencing recurrent infections are more likely to face impaired linear growth. Although

diarrhea was not found to have a statistically significant association with nutritional status (P > 0.05), the findings nevertheless indicate that infectious diseases remain an important health concern in flood-prone environments.

Overall, the synthesis of the available studies suggests that post-flood deterioration of water and sanitation conditions increases the risk of infectious diseases, which may subsequently contribute to adverse child nutritional outcomes. Flood-induced contamination of water sources, inadequate sanitation, and limited healthcare access create conditions that facilitate disease transmission and compromise child health. These pathways may ultimately impair nutrient absorption and utilization, thereby increasing the risk of growth faltering among children living in flood-affected communities.

Socioeconomic Factors and Toddler Vulnerability

A cross-study synthesis indicates that climate shocks—particularly flooding and increased rainfall variability—exacerbate toddler vulnerability through interrelated socioeconomic pathways. The study by Ahmadzai & Morrissey (2025) in Afghanistan demonstrates that flood exposure reduces household income by approximately 40%, suppresses agricultural earnings, and decreases dietary diversity, followed by increased hunger and the adoption of negative coping strategies. Although the study does not directly measure toddler nutritional status, the deterioration in purchasing power, high dependency ratios, and reliance on the agricultural sector reflect weakened food security as a fundamental determinant of child malnutrition risk.

Similarly, Patlán-Hernández et al. (2025), through the HydroNut project in Amboasary and Betioky-Atsimo, Southern Madagascar, found that increases in rainfall and the Leaf Area Index (LAI) were significantly associated with higher prevalence of Severe Acute Malnutrition (SAM), diarrhea, and acute respiratory infections (ARI) among toddlers. Although socioeconomic variables were not quantitatively incorporated into the model, both study areas are characterized by high poverty levels, low food security, and limited adaptive capacity—structural contexts that intensify the hydroclimatic impacts on child nutritional and health outcomes.

Socioeconomic vulnerability is also reflected in populations experiencing displacement and migration. Lawes et al. (2025) emphasize that refugee and asylum-seeking children often face multiple structural barriers affecting their nutritional well-being, including limited access to health services, food assistance, and stable living conditions. Although the study focuses primarily on

migrant nutrition policies in Europe rather than flood-specific impacts, it highlights how socially and economically marginalized populations are particularly susceptible to nutritional deterioration. In disaster contexts, including flooding, displacement and social instability may further exacerbate these vulnerabilities by disrupting access to food, healthcare, and social protection systems.

Synthesizing these findings, the studies collectively underscore that environmental shocks do not operate in a simple linear relationship with child malnutrition but are mediated by broader socioeconomic determinants such as poverty, food access, education, and health system capacity. Conceptually, these findings align with the UNICEF malnutrition framework, in which basic causes (socioeconomic conditions and political–economic structures) influence underlying determinants (household food security, caregiving practices, health services, and sanitation), which ultimately shape the immediate causes of malnutrition (inadequate dietary intake and infectious diseases).

Taken together, the evidence demonstrates that toddler vulnerability in climate-affected regions results from the interaction between environmental exposure and pre-existing poverty structures. Strengthening social protection systems, diversifying livelihoods, and enhancing food security therefore emerge as critical interventions to disrupt the pathway leading to child malnutrition risk.

Conclusion and Recommendations

Conclusion

This systematic literature review of 22 studies demonstrates that flooding functions as a structural determinant of child malnutrition through interconnected mechanisms, including disruptions to household food security, increased infectious diseases due to sanitation damage, and worsening socioeconomic conditions. These impacts are mediated by household adaptive capacity and existing vulnerabilities. Stunting emerges as the most persistent long-term outcome, particularly among children under two years of age during critical growth periods, while wasting and underweight more often reflect acute post-disaster conditions when access to food, clean water, and healthcare services is disrupted. The findings also highlight the importance of age-specific nutritional support in disaster response, where food assistance for children aged 0–59 months should be adapted to developmental stages, including breastfeeding support for infants (0–6 months), complementary feeding for children aged 6–23 months, and diversified diets for

children aged 24–59 months to ensure that nutritional needs are adequately met in flood-affected communities.

Recommendations

These findings reveal a policy gap in integrating child nutrition issues into disaster risk reduction and climate change adaptation frameworks. Current disaster responses remain largely reactive and focus on short-term emergency assistance. Without long-term structural interventions, flooding has the potential to perpetuate intergenerational cycles of poverty and malnutrition. Therefore, climate risk-informed social protection policies, early warning systems integrated with nutritional vulnerability data, and investment in disaster-resilient infrastructure should be prioritized within public health development agendas. From an academic perspective, longitudinal and cross-country research employing integrated causal modeling approaches is needed to further clarify the interaction mechanisms between flood exposure, food security, infectious diseases, and socioeconomic determinants within the context of the global climate crisis.

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