# ALIGNING CLIMATE CHANGE AND NUTRITION STRATEGIES TO MITIGATE MALNUTRITION IN CHILDREN UNDER FIVE: A SCOPING REVIEW

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**Abstract**

**Introduction:** Climate change is one of the major threats worldwide to children under five especially, in terms of malnutrition. This scoping review has worked towards finding evidence on nutritional interventions implemented by different countries to effectively mitigate malnutrition caused by climate disasters and climate changes.

**Methods:** A scoping literature analysis was done of literature published in the past ten years, that is, between 2015 and 2025. It included English articles which sufficed all three concepts of childhood malnutrition under five, climate change and nutrition strategies. The literature consisted of mixed method having qualitative as well as quantitative peer reviewed articles from three databases, PUBMED, Scopus and UNICEF publication. A total of 11 articles were shortlisted after scrutiny and screening by two reviewers following JBI and PRISM-ScR reviewing methodology.

**Results:** Climate change affects childhood malnutrition through direct pathways, like crop failure and food supply disruptions. Indirect pathways also affect nutrition status by reduction in nutrient quality and density of foods. Post natural disaster micronutrient supplementation and therapeutic feeding can significantly help in anemia and wasting. For long term resilience of nutritional policies, breastfeeding promotion, local food system upliftment and protective policy implementation against UPFs and formula foods is mandatory. However, a major policy gap occurs that more than 40% of policies fail to acknowledge child health and role of nutritional strategies in climate driven malnutrition therefore the policies lack accountability.

**Conclusion:** From nutrition-climate centered policy to climate-resilient proactive policies are needed. It requires strengthening frameworks, transformation in food systems and multi-sectoral collaborations. Adaptive strategies to safeguard children under five years by implementing immediate evidence-based food system and health system protecting interventions should be made.

**ACKNOWLEDGEMENT**

I express my heartfelt gratitude to my advisor, Dr. S.D. Gupta, for his invaluable supervision and unwavering support at every step. His constant encouragement and assurance gave me the confidence to complete my work with utmost sincerity. I am truly thankful to my friends for their steadfast help in completing my capstone project. Lastly, but certainly not the least, I thank my family for their immense patience.

Mitul Purohit

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**List of abbreviations**

WHO- World Health Organization

IPCC- Intergovernmental Panel on Climate Change

UNICEF- United Nations Children's Fund

ScR- Scoping Review

JBI- Joanna Briggs Institute

PRISMA-ScR- Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews

GHGs- Green House Gases

LMIC- Low- and Middle-Income Countries

SMART- Specific, Measurable, Achievable, Relevant, and Time-bound

SDGs- Sustainable Development Goals

UPF- Ultra- Processed Foods

## 1. Introduction

Malnutrition is considered among the top five health impacts due to climate change according to the Intergovernmental Panel on Climate Change (IPCC) and the World Health Organization (WHO).[1,2] According to WHO, malnutrition implies deficiency, imbalance and excess consumption of nutrients by a person. It includes undernutrition (stunting, known as, low height-for-age; wasting, known as low weight-for-height;; and, underweight, known as, low weight-for-age), overweight or obese and micronutrient deficiencies.[2] Globally, in 2024, 150.2 million (that is, 23.2 per cent) children under the age of five years suffered from stunted growth, wasting in 42.8 million (6.6 per cent) and 35.5 million (5.5 per cent) from being overweight. Whereas in Asia, in 2024, more than fifty percent children under five were found to be stunted, seventy percent suffered from wasting and nearly fifty percent children were found overweight.[3] Micronutrient deficiencies also cause malnutrition which are considered as the deficiencies of vitamin A, iodine, vitamin D, iron, vitamin $B_{12}$, and folate, that can have severe consequences like birth defects, high susceptibility to infections, cognitive impairment, blindness, decreased productivity in work, reduced growth, and even death. Globally, in 2022, 372 million (56 percent) children aged 6-59 months, had micronutrient deficiencies. Whereas, in 2022, in South-Asia, 99 million (57 percent) preschool-aged children were found deficient.[4] The picture in India is grim too. According to NFHS-5[5], 35.5 percent children aged 6-59 months suffered from stunting, 19.3 percent suffered from wasting, 3.4 percent were found to be obese, and a staggering 67.1 percent were found to be anemic.

If this trend continues, around 30 million children below five years may not live past 2030, in which 50 percent would be neonates. Around 60 per cent (18 million) of these deaths would occur in Africa (Sub-Saharan) and 24 per cent (7 million) in South-Asia.[6] Changes in the climate damages the global food system stability by reducing the quality of diet and security

of food thus leading to malnutrition in vulnerable populations.[7] Extreme climate changes lead to droughts, floods, storms, extreme heat, wildfires, rise in sea-level and storms, air pollution (like increase in particulate matter and pollen count and, ozone layer reduction), heat waves and food insecurity. These affect many pathways and most specifically the food systems and health systems which in turn affects individual health status thus having an impact on the wellbeing by causing malnutrition, nutritional deficiencies and even mortality.[8] World over, roughly all children are exposed to a minimum one extreme climate change event.[9] Around 51 percent of Indian children are affected by poverty and climate change crisis. About 352 million children in India face at least one climate event each year.[10]

Climate change misaligns the food systems' capacity in providing nutritious foods. Due to unavailability of fresh foods caused by climate change events, it has been predicted that more than half a million deaths worldwide would occur by 2050.[11] Climate change impacts crop yields and affects quality of crops which results in childhood malnutrition.[12] Changes in atmosphere like carbon dioxide, rainfall and temperature, deteriorates the nutrient content of the produce thus affecting nutrition in reduced food consumption setting. Even the greenhouse gas emissions (GHGs) brings changes in the micronutrient levels affecting their bioavailability from the soil affecting rice, wheat, vegetables and legumes.[13] A recent IPCC report, mentioned that due to climate changes, the global production of rice and wheat have reduced by 3.2% and 6%, respectively, for every degree Celsius rise in mean temperature globally.[14] An interesting point of discussion is, that the countries may have adequate food produce, but can still have a prevalence of malnutrition thus, hinting towards deficiency of better policies with respect to distribution, supply chains, and infrastructure for food storage caused due to extreme climate events.

**Rationale of the study:** There is strong evidence that, actions to mitigate or adapt to climate change can improve malnutrition status, benefiting both climate and nutrition agendas. Yet, these two crises are often treated in isolation, limiting the impact of policies and investments in both areas. Though climate change has an impact on food safety, nutrition, and health outcomes, there are not enough successful strategies as evidence to support their integration in food system policies and programs. Thus, with the help of this scoping review, the existing literature mapping, key concept identification and evidence for future integration was studied. This scoping review (ScR) is a mixed method study that included both peer-reviewed and grey literature to find out the gaps related to nutrition strategies. This ScR shall provide base for future actions and subsequent research to address the problem of malnutrition in children under five caused due to climate change so that an effective foundational evidence base for policymakers, NGOs and researchers could be contributed.

**Study Objective:** This literature review aims to explore nutritional strategies aligned with climate change that are implemented globally to lessen the burden of childhood malnutrition in children under five.

## 2. Methodology

### 2.1 Search strategy

The search was conducted using PUBMED, Scopus, and the publications section of WHO and UNICEF as databases. Same search strategy was used for PUBMED and Scopus whereas for WHO and UNICEF website search specific for each was followed. The keywords search was based on PCC framework suggested for scoping reviews. The basic key words selected were based on Population- “children under five”; Concept- nutrition-related strategies and policies like “nutrition policy” “nutrition intervention” and Context - climate change to mitigate

childhood malnutrition like “climate change” “childhood malnutrition” which were further refined to get the required search results. The search terms used for PUBMED and Scopus databases along with Boolean operators and filters are given below:

1. PUBMED- Mesh "Floods" ,Mesh "Natural Disasters", Mesh "Climate Change", Mesh "Extreme Environments", Mesh "Environment", Mesh "Extreme Weather", Mesh "Temperature", Title/abstract search for - climate risk, climate change*, climate effect, climate action, heat waves, temperature*, flood*, earthquake*,drought*, global warming, rising temperature* AND Mesh "Nutrition Policy", Mesh "Child, Preschool", Title/abstract- nutrition* polic*, nutrition* strategy, nutrition* program*, nutrition* framework, nutrition* intervention, nutrition* response, nutrition* effect, diet* framework, diet* polic*, health polic*, nutrition* approach AND Mesh "Infant", Title/abstract- Child* under five, Child*, pre-school, toddler, young child, early childhood AND Mesh "Overnutrition", Mesh "Wasting Syndrome", Mesh "Malnutrition", Mesh "Protein-Energy Malnutrition", Mesh "Severe Acute Malnutrition", Mesh "Global Health", Title/abstract- stunting, wasting, child* obesity, undernutrition, underweight, micronutrient deficiency, vitamin deficiency, mineral deficiency, iron deficiency, anemia, anaemia, folic acid deficiency, low weight-for-age, low height-for-age, low weight-for-height, Childhood malnutrition, Child* malnutrition
2. SCOPUS- TITLE-ABS-KEY ( Flood*, "Natural Disasters", "Climate Change*" , "Extreme Environment*" , Environment* , "Extreme Weather" , Temperature*or "climate risk" , "climate change*" , "climate effect" , "climate action" , "heat waves" , earthquake* , drought* , "global warming" , "rising temperature*" ) AND TITLE-ABS-KEY ( "Nutrition Policy" , "nutrition* polic*" , "nutrition* strategy" , "nutrition* program*" , "nutrition*

framework" , "nutrition* intervention" , "nutrition* response" , "nutrition* effect" , "diet* framework" , "diet* polic*" , "health polic*" , "nutrition* approach" ) AND TITLE-ABS-KEY ( stunting, wasting,"child*obesity", undernutrition , underweight ,"micronutrient deficiency" , "vitamin deficiency" , "mineral deficiency" , "iron deficiency" , anemia , anaemia , "folic acid deficiency" , "low weight-for-age" , "low height-for-age" , "low weight-for-height" , Overnutrition , "Wasting Syndrome" , "Childhood malnutrition" , "Child* malnutrition" , Malnutrition , "Protein-Energy Malnutrition" , "Severe Acute Malnutrition" , "Global Health" ) AND TITLE-ABS-KEY ( Infant , "Child* under five" , Child* , pre-school, toddler , "young child" , "early childhood" , "Child Preschool" ) )

- Filters- Title/ abstract/ keyword; 10 years; English; (for PUBMED- Infant: birth-23 months, Preschool Child: 2-5 years; Human)

3. UNICEF publication- Search categories: Climate change impacts, nutrition policy, malnutrition, under five children

- Filter: global, language- English, Topics- Child rights, climate change and impacts, early childhood development, Climate change, effects of hunger, environment, food crisis and famine, health, human made disasters, infant and young child nutrition, malnutrition, nutrition, policy advocacy, stunting

**2.2 Inclusion and exclusion criteria**

Inclusion criteria included past ten years studies, that is, January 2015 to October 2025 which were only in English language. Only human based studies were selected. Articles related to children under five with a focus on nutrition strategies (like nutrition policies or nutrition

interventions or nutrition programs) that aligned with malnutrition caused by climate change were selected. A mixed method approach of peer reviewed articles and grey literature was considered. Those articles which did not include the concept of childhood malnutrition in children under five along with nutrition strategies/policies and climate change, not sufficing all the three concepts together, were excluded.

**2.3 Selection criteria**

The articles were reviewed, and the results were reported according to Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR). About 393 articles were retrieved from three databases, namely, PUBMED, Scopus, and UNICEF publication. The screening of the articles was done in three steps-

**First step**: From PUBMED and Scopus, the CSV files of shortlisted articles from the databases were uploaded to Rayyan software and 8 duplicates were removed. Based on the title and abstract screening, 119 articles were screened, and 60 articles were selected by a review team of two unbiased reviewers. For UNICEF website, title and abstract screening was done from the website, and the selected literature was downloaded for main text screening by the review team. From UNICEF publication inventory 87 articles were selected and 179 removed as the document was either not in English or did not align with the study objective.

**Second phase**: With the help of Rayyan software full text screening was done by the review team and 6 articles were removed due to no permission for access. Around 52 articles did not align with the objective of the study. About 9 articles were finally selected. The downloaded articles from UNICEF website were then screened for full text. Conflict of interest between the reviewers was removed by discussion. Thus, 2 articles from UNICEF were shortlisted by the review team.

**Data extraction:** Total 11 articles were included, and the data was extracted in a tabular form for year of publication, author name, journal/publication name, study aim of the study, country/region of study, type of study, population, climate change event, nutrition strategy/policy/intervention and key findings. Zotero was used for managing references and citations.

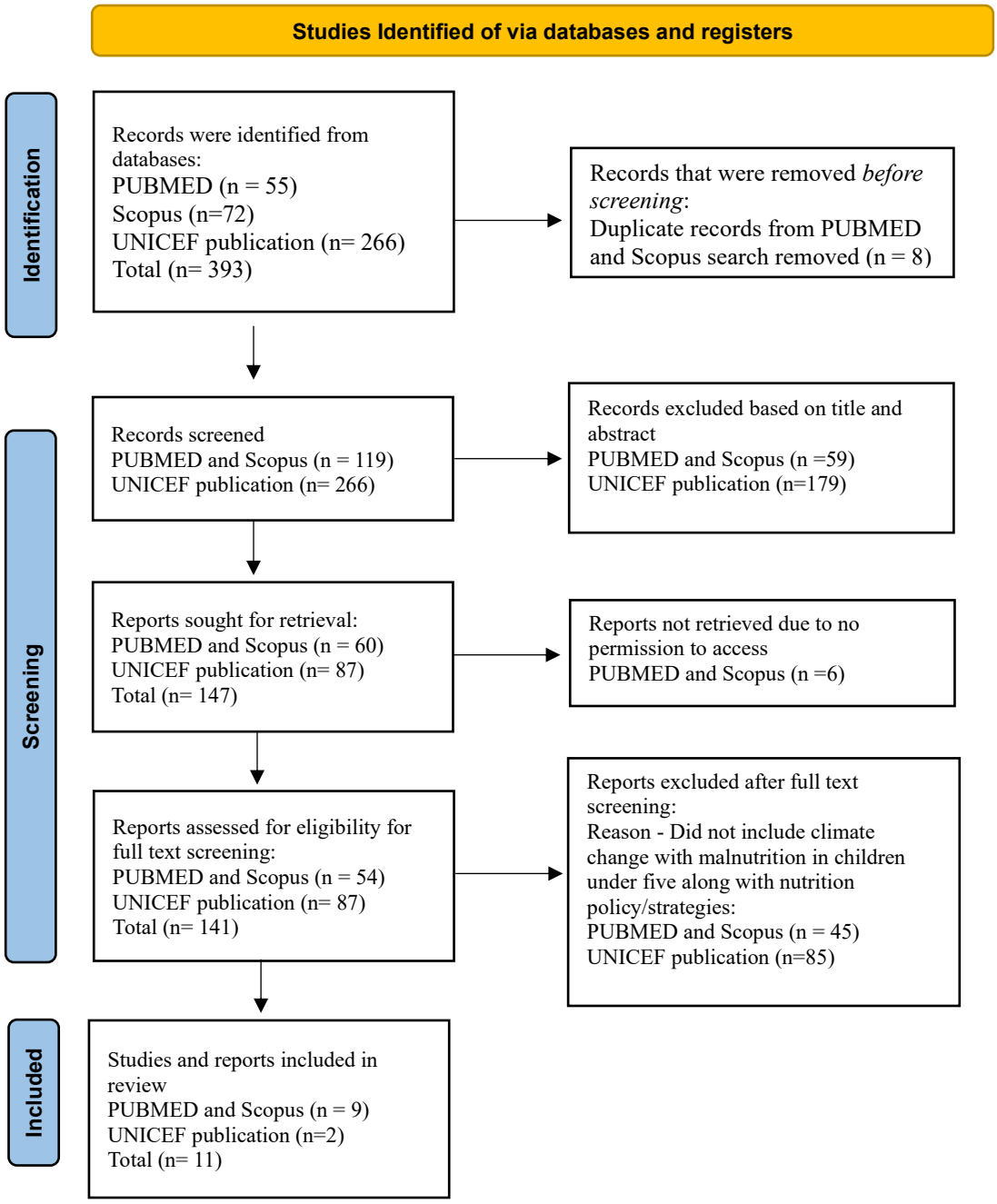


Figure 1. Prisma 2020 flow chart of article inclusion according to PRISMA-ScR

## 3. Results

The systematically analyzed literature can be categorized into different focus areas. It is essential to understand the characteristics of the studies to contextualize findings in an analytical manner.

### 3.1 Characteristics of the included studies

The literature review included 11 articles published between 2015 to 2025. From data extraction the following characteristics were revealed indicating towards potential trends.

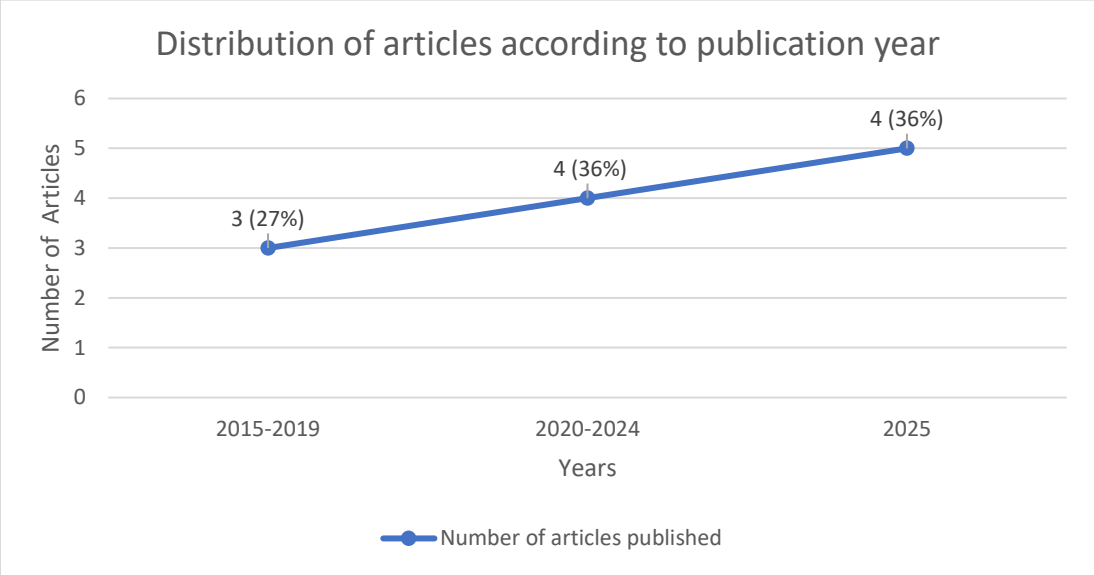


Figure 2. Distribution of articles according to the publication year

This graph suggests a recent increase in research and development of policies which reflects the importance of nutritional intervention in combating malnutrition caused by climate change as a global agenda.

Distribution is based on the type of study method incorporated in the literature review.

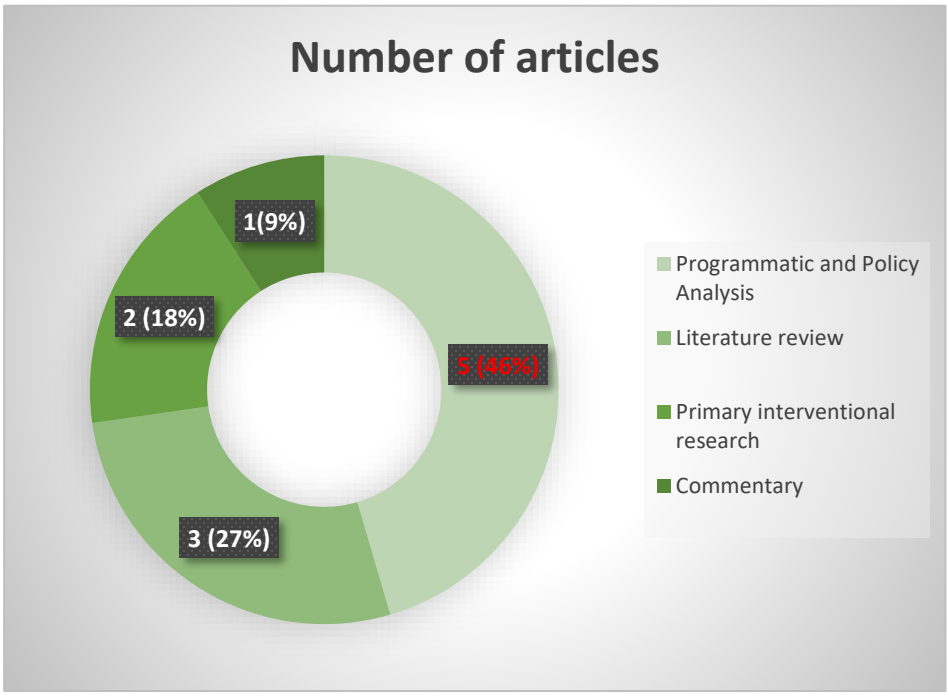


Figure 3. Distribution of articles based on the type of study

Highest number of studies were in programmatic and policy analysis making it the most common category (46%) in the type of study methods used.

In summary, main geographic focus was on most vulnerable populations present in Asia and Africa.

### 3.2 Nutritional interventions in different climate settings

The table summarizes different types of studies combining the effects of climate events and the nutritional mitigation strategies used by different countries. One of the notable interventions which can be commonly practiced is being promoted during climate events. Breastfeeding has been mentioned in studies done by Smith[15], Binns et al[16] and Pacheco-Miranda et al[17] as nutritional intervention which can benefit mother and child during extreme climate events like drought, floods, extreme weather, during water crisis, etc.

Table 1. Nutritional strategies aligning with climate change events

| Author, Year, place | Journal/ Publication | Type of study | Climate linkage | Nutrition strategy/policy/ intervention/ | Key Findings |
|---|---|---|---|---|---|
| **Smith JP, 2019, Asia** | International Breastfeeding Journal | Commentary | Climate change caused by greenhouse gas emissions due to production of formula milk and dairy industry, contributing significantly to methane and $CO_2$ emissions. | Breastfeeding should be made a climate resilient strategy to mitigate malnutrition. Leave with pay for mothers, Baby-Friendly initiatives carried out by hospitals by implementing WHO International Code of Marketing of Breast-milk Substitutes and strict policy regulations on marketing of formula milk. | 1 kg of milk formula makes 11 to 14 kg $CO_2$ eq. GHG emissions throughout its lifecycle. Toddler formulas unnecessary contribute to emissions. Breastfeeding is economically friendly and makes better health outcomes. Failure to comply with policy regulations affects health and environment. During drought, famine, other natural calamities, lack of drinkable water makes it difficult to feed formula fed infants. |

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| **Ubalde J, Bradshaw CJA, Le Souëf PN, Judge MA[18], 2025, Global** | Globalization and Health | Policy analysis | Effect of Climate change events, like, on high temperature, water and food insecurity, extreme weather, conflict and displacement, focusing on adaptation planning | Nutritional interventions were mostly mentioned in policies of LMIC: Interventions in food security improvement which included feeding programmes, diversification of home diets, fortified food intake promotion and expansion and improvement in harvesting technology and crop quality | 43 percent of total policies evaluated had no mention of child health. 27 percent mentioned action for children's health but had no specific target. Only 7 percent mentioned mechanisms to monitor without directly measuring the outcomes. About 12 percent of nations involved stakeholders but without defining roles. LMIC recognized vulnerabilities of child health better than high income countries. Policies lacked SMART goals, proper resource allocation and accountability of the stakeholders |

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| **Binns CW, Lee MK, Maycock B, Torheim LE, Nanishi K, Duong DTT, 2021, Global** | Annual Review of Public Health | Narrative Review | Increase in temperatures, extreme weather events (storms, floods, droughts), water scarcity, ocean acidification, increase in pest/pathogens, sea-level rise. These climate events result in reduction of nutrient density, affecting yield of crops and dysregulate supply of food. | Adhering to diet related guidelines by emphasizing plant-based diets, promotion of Breastfeeding to reduce carbon footprint, reduce wastage of foods, improvements in production and food distribution chain. | Following plant-based diet can help in reducing GHGs emissions. Political investment and commitment can help produce enough food, but equitable distribution must be carried out. Climate crisis reduces nutrient density of food and dietary diversity too. Vulnerable groups are affected the most, Food wastage contributes to GHGs emissions. |
| **Tabunga T, Medcalf S, Workman A[19], 2025, Pacific, Asia and Africa** | The Journal of Climate Change and Health | Scoping review | Temperature rise, natural disasters, rainfall, sea-level rise. | Targeted intervention related to nutrition and climate resilient policy which aims to increase security of food thus improving maternal and child health outcomes | Diarrhea and malnutrition due to climate events affecting nutrition of the mothers and children caused by rainfall and temperature. Kiribati's implemented policies do not address health |

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| | | | | | outcomes related to climate. |
| **Woldeyohannes M, Girma M, Petros A, et al.[20], 2023, Ethopia** | BMJ Open | Population-based cross-sectional survey | Climate change aftereffects like soil nutrient depletion that pose challenges in agriculture and nutrition quality of crop | Assessment of coverage of vitamin A supplementation, IYCF counselling, WASH and food-cash assistance interventions. Implementation of national food nutrition strategy and food system transformation plan | Assessment of wasting, stunting, micronutrient deficiencies, diet intake, and implementation of nutrition related plans |
| **UNICEF India Country Office[21], 2024, India** | UNICEF Programme Note | Programme Guidance | Floods, heatwaves, droughts, vector-borne problems, scarcity of water and cyclones | Multi-pronged approach on nutritional strategy-strengthen health system-make nutrition services climate resilient, poshan tracker to be used for early warning sign. Promote seasonal and local diets, discourage UPF, advocacy for fair policy on food pricing. | Climate change affects food system and undermines nutrition of children. It increases disease and disrupts services CCES helps to protect gains and makes sure of community service in emergencies |

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| | | | | Training the decision makers by capacity building. Gender equity. CSR, promote literacy on nutrition. | |
| **UNICEF[22], 2025, Africa** | UNICEF Publication | Programmatic Strategy | Climate shocks like floods and droughts reduce food quantity/quality. | A multi-step strategy: 1. Incentivize Local African Production companies so that they can produce safe, sustainable, affordable, nutritious complimentary food, snacks supplements like MNPs<br>2. Policy Strengthening: Enforce and develop standards for food industry, strict regulations, and policies (like taxing UPFs); integrate social protection with nutrition like cash/voucher transfers.<br>3. Social marketing and programs on social behavior change (SBC). | The initiative is positioned to sustainably reduce child food poverty and malnutrition by transforming food systems into child-sensitive, locally driven, and climate-resilient. It aims for a ~10% reduction in child food poverty by 2030 (15 million fewer children). |

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| **Huo J, Sun J, Fang Z, et al.[23], 2015, China** | Food and Nutrition Bulletin | Pre-post observational intervention study | Earthquake | Fortification of complementary food at home with Ying Yang Bao (YYB), a soy-based micronutrient powder, provided by the Chinese government for free with nutrition education. | On consuming YYB Hemoglobin rose to 11.3-11.7 g/dL (follow-ups) from 10.8 g/dL (baseline). Prevalence of anemia decreased to 24.8-27.9%. Moderate anemia prevalence decreased by 15%. Good compliance and high coverage (≥95%) were achieved. Hemoglobin levels correlated positively with YYB and the nutrition intervention was successful |
| **Pradhan PMS, Dhital R, Subhani H[24], 2016, Global** | BMJ Open | Systematic Review | Earthquakes, cyclones, Tsunamis, Drought | Supplementation of food by supplementary feeds and therapeutic diet, Micronutrient enriched powders, Feeding, education related to health and community movement | Reduction in wasting and underweight was shown by 4 studies and stunting by 3 studies. Only 1 study reported anemia reduction. Community based interventions |

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| | | | | along with complimentary supplement food. | gave positive results. |
| **Pacheco-Miranda J, Wagner N, Ponce J, 2025, Ecuador** | Economics and Human Biology | Quasi-experimental study | Earthquake | National nutrition programs were continued like vitamin, "Chizpas", micronutrientpromotion and increase in breastfeeding | Post earthquakes, no stunting, wasting, being underweight and anemia were found in children. Government continued nutrition related programs and increase in breastfeeding stabilized children's health outcomes. |
| **Conti MV, Vincenti A, Beretta A, et al[26], 2024, Global** | Nutrients | Narrative Review | Degradation in climate is causing environmental degradation which is related to food systems. | Follow plant-based diet to reduce methane production, GHGs. Adapting EAT-Lancet PHD for pediatric use; programmes in school meal; family education on food as interventions | Obesity prevention aligns with PHD and environmental goals but cannot meet nutrient needs of energy, proteins and minerals of children and adolescents without modification like fortifying foods. |

Nutritional interventions need to be tailored-made to combat malnutrition for a specific climate change event to protect children effectively. During naturally occurring disasters like

cyclones, and earthquakes, food supply and infrastructure is disrupted therefore ready to eat foods, micronutrient powders, Yin Yng Bao powder used in China post-earthquake proved to be beneficial.[17,23,24]

For climate events like floods, droughts and sea-level rise, food security degrades therefore climate resilient strategies were promoted that involved sustainable diets, boosting local produce and levying heavy taxes on UPFs. Strategies must be made that are systemically resilient.[16,18,22]

### 3.3 Gaps in nutritional interventions

In the table below, the challenges to implement, sustain or carry forwarding the nutritional interventions have been explained.

**Table 2 Gaps/ challenges of implemented nutritional interventions**

| Author, Year | Population | Location | Nutrition strategy/policy/ intervention/ | Gaps/Challenges |
|---|---|---|---|---|
| Smith JP, 2019 | Infants, young children and mothers | Asia | Breastfeeding should be made a climate resilient strategy to mitigate malnutrition. Leave with pay for mothers, Baby-Friendly initiatives carried out by hospitals by implementing WHO International Code of Marketing of Breast-milk Substitutes and strict policy regulations on marketing of formula milk. | Failure to acknowledge economic and environmental benefits of breastfeeding by people. Regulation lacunae in marketing of formula milk, especially export. Unpaid leaves to mothers and neglects her contributions lending inadequate support. Environmental |

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| | | | | harm caused by formula production is not being internalized. Policies restricting formula milks conflict with interests of dairy industries. |
| Ubalde J, Bradshaw CJA, Le Souëf PN, Judge MA, 2025 | Children (children under 5 were emphasized being the vulnerable group) | Global | Nutritional interventions were mostly mentioned in policies of LMIC: Food security improvement interventions which included feeding programmes, diversification of home diets, fortified food intake promotion and expansion and improvement in harvesting technology and crop quality | Lack of targeted approach of health policies by LMIC. More than 40 percent of policies lacked focus on children's health. No SMART goals and absence of age-appropriate achievable targets. Implementation lacunae as resource allocation were poor along with strategy mobilization. No defined stakeholder roles and engagement. Inconsistency in evaluation and monitoring of outcomes. |

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|---|---|---|---|---|
| Binns CW, Lee MK, Maycock B, Torheim LE, Nanishi K, Duong DTT, 2021 | Global population focuses on children, and other vulnerable groups. | Global | Adhering to diet related guidelines by emphasizing plant-based diets, promotion of Breastfeeding to reduce carbon footprint, reduce wastage of foods, improvements in production and food distribution chain. | Short-term political planning and requirement for foreign collaboration. Lack of Monitoring of nutrient density of food, unequitable food distribution, reversing marketing of UPFs and unhealthy foods. Lack of integration of dietary guidelines with climate change events. Widespread prevalence of micronutrient deficiencies and malnutrition. Unstable food system due to climate crisis and politics. Globally less adherence to nutrition strategies with climate change. |
| Tabunga T, Medcalf S, Workman A, 2025 | Children and maternal population of Pacific and developing countries | Pacific and developing countries (South Asia, Africa, Sub-Saharan Africa) | Targeted intervention related to nutrition and climate resilient policy which aims to increase security of food thus improving maternal and child health outcomes | Lack of research in Pacific Island and Kiribati. Outdated assessment tools for finding out climate/health vulnerability. Lack of interventions and locally collected data to integrate into policy decisions. Intersectoral |

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| | | | | collaborations are needed. |
| Woldeyohannes M, Girma M, Petros A, et al., 2023 | Children (0–59 months), school-aged children (6–12 years), adolescent girls (10–19 years) and Women of reproductive age (15–49 years) | Ethiopia | Assessment of coverage of vitamin A supplementation, IYCF counselling, WASH and food-cash assistance interventions. Implementation of national food nutrition strategy and food system transformation plan | Lack of data related to diet intake, and effects of climate change like soil nutrients. Limited data on school children; outdated baseline evidence to formulate new plans. A cross sectional study cannot establish causality or account for seasonal nutrient variation Recall bias in survey |
| UNICEF India Country Office, 2024 | Children, adolescents, women | India | Multi-pronged approach on nutritional strategy-strengthen health system-make nutrition services climate resilient, poshan tracker to be used for early warning sign. Promote seasonal and local diets, discourage UPF, advocacy for fair policy on food pricing. Training the decision makers by capacity building. Gender equity. CSR, promote literacy on nutrition. | A future work plan including multi-sectoral intervention. Challenge in finding resources, complex nature of inter ministry collaborations and the requirement to implement the strategies into concrete future action |

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| United Nations Children's Fund, 2025 | Children under 5 years, focus on the 6-23 months old children. | Sub-Saharan Africa | A multi-step strategy: 1. Incentivize Local African Production companies so that they can produce safe, sustainable, affordable, nutritious complimentary food, snacks supplements like MNPs/SQ-LNS 2. Policy Strengthening: Enforce and develop standards for food industry, strict regulations, and policies (like taxing UPFs); integrate social protection with nutrition like cash/voucher transfers. 3. Social marketing and programs on social behavior change (SBC). | High amount of funding is required, that is, $300 million (program-$250M; investment-$50M). 2. Need to ensure policy harmonization in entire regions. Competing with aggressive marketing of UPFs and easy affordability. Mak e effective delivery and procurement. Moving from countries to continent, possessing scalability. |
| Huo J, Sun J, Fang Z, et al., 2015 | Infants and children aged 6-23 months | China | Fortification of complementary food at home with Ying Yang Bao (YYB), a soy-based micronutrient powder, provided by the Chinese government for free with nutrition education. | No control group. Selection bias as sample was not randomly selected. No reduction in anemia was noticed after first 6 months of intervention. Sample demographics varied due to movement by population. |
| Pradhan PMS, Dhital R, Subhani H, 2016 | Children under 5 years old | Global | Supplementation of food by supplementary feeds and therapeutic diet, Micronutrient enriched powders, Feeding, education related to health and community movement along with complimentary supplement food. | Lack of strong evidence as no RCTS and quasi-experimental studies were selected. Too less number of studies. Most studies had no control group. |

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| | | | | Variations in outcome made study synthesis difficult, improvements cannot be solely due to interventions. |
| Pacheco-Miranda J, Wagner N, Ponce J, 2025 | Children under 5 years old | Ecuador | National nutrition programs were continued like vitamin, "Chizpas", micronutrients. Promotion and increase in breastfeeding | Limited socio-economic variables like maternal education. Observed and cross-sectional data was not included. Focused only on short term impact post disaster. Reported data may have inconsistencies. |
| Conti MV, Vincenti A, Beretta A, et al, 2024 | Children and Adolescents (2-18 years) | Global | Follow plant-based diet to reduce methane production, GHGs. Adapting EAT-Lancet PHD for pediatric use; programms in school meal; family education on food as interventions | No longitudinal studies prove its long-term effect on child growth. Adoption of PHD due to culture and economic barriers. Lack of standard metrices for evaluation and adherence. |

The literature reviews did not have RCTs or quasi-experimental studies as most evidence is observational and grey literature which makes suggesting improvements difficult.[24] Even local research and policy making without proper evidence does not give fruitful results.[19] Another crippling gap is in the implementation. Due to poor allocation of resources, corruption, no accountability and logistic problems, even good existing policies do not have effective results.[18,22]

**Discussions**

The compelling evidence supports that child nutrition in climate risk events requires food system transformations. UNICEF'S first foods carried out in Africa demonstrates that it is essential to provide food along with local, resilient and nutrition sensitive value chain. This initiative tackled economic aspect, environmental sustainability through reduced climate unsafe packaging. Supporting local companies helps to tackle that. Thus, it also catered to reduction in food wastage and plant-based diets that helps in promoting climate safe environment.[26]

But with depleting nutrients we cannot base plant-based diet for children under five without careful consideration of micronutrient deficiencies. This emphasizes that transformation in food systems must be sustainable and nutritionally viable requiring involvement of nutritionists and public health workers.[27]

Climate policies do not have children as stakeholders in most cases because of lack of political will and no interministerial collaboration on such policies. The policy vacuum gets filled by interests of political parties and people having commercial interests therefore effectively policies are not mandated. As we have seen in the case of formula milk and UPFs.[28] Effective interventions for local agriculture zones and climates must be formulated considering food cultures and climate effects with an equitable lens. Growing local, having easy access to fresh foods, discarding packaged foods and storing grains at home with proper care and consideration can help during climate disasters.

Thus, it can be said that the nutritional strategies implemented at grass root level are benefiting the vulnerable groups, but more innovative approaches and robust policies can be worked out with the help of stakeholders and governments. Nutrition is a major part of our lives; resilient

nutritional strategies can help in combating unstable and climate and protecting vulnerable groups.

**Recommendations**

A multi-level approach for recommendation is required:

1. For Governments and Policymakers: Nutrition should be made mandatory in all climate adaptation policies and disaster risk reducing strategies. Strict regulations on marketing formula foods, UPFs, especially those that target young children. Implementation of policies that tax sale of sweetened beverages, UPFs, formula foods for toddlers should be done. Nutrition sensitive programmes must be put at the fore front. Food vouchers and cash coupons must be provided to ensure access to food and nutritious meals as part of social protection programmes.

2. For Public Health workers and Researchers:

   Develop better monitoring tools in climate change context and for tracking benefits of the interventions. Planetary health diet provides clear guidance, hence, such easy-to-follow area specific diets must be advocated and promoted.

**Limitations**

There are many limitations for this literature review. Even though a systematic methodology was followed, it cannot be guaranteed that all relevant articles were captured. There is no formal mandatory guideline for critical appraisal for a scoping review. The review was limited in scope and wanted to find evidence on nutritional interventions specifically for under five children affected by malnutrition caused by climate change. It was difficult to find valid

articles as climate change and nutritional strategies are considered as separate topics and therefore with recent development in this direction paucity of literature was one of the limitations.

**Conclusion**

From the evidence generated it can be concluded that climate change poses threat to the vulnerable groups the most especially children under five. Nutritional strategies which are climate resilient are needed to help in mitigating malnutrition. Climate change results in malnutrition as evidenced by many researchers. The pathway to malnutrition is synergistic and has multiple routes both direct and indirect. Ranging from soil erosion due to heavy mindless cutting of trees and forests, crop failure due to drought, poor accessibility of food due to supply chain issues, poor storage and due to extreme weather events, high temperatures, heavy rainfalls, floods, earthquakes, etc. all these factors and many more affect the food system and health system causing malnutrition and deficiency diseases. Nutritional interventions that are being carried out need robust implementation and planning strategy. Breastfeeding during climate events like water crisis, mobilization, post climatic disaster like earthquakes, floods, etc. in a way can help fight malnutrition but cannot be called intervention. It is essential that governments come together to fight the battle of climate change and help in situations which can be easily avoided with proper planning and policy implementation, keeping in mind a paradigm shift from short to long term by building resilient food and health systems. It requires equitable, sustainable, nutrition sensitive and child centric policies and interventions and confronting the determinants that harm the healthy food system. We can work towards making a climate risk resilient environment and build a healthy future for children.

## Appendix

Table 3. Extracted data after review search

| Year | Author | Journal/ Publication | Sample size | Population | Type of study | Location | Study Aim | Climate linkage | Nutrition strategy/policy/ intervention/ | Key Findings | Gaps/Challenges |
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| 2019 | Smith JP | International Breastfeeding Journal | NA | Infants, young children and mothers | Commentary | Asia | Carbon footprint left by formula milk production and use causes environmental harm and advocate for policy interventions promoting breastfeeding as a sustainable alternative. Links infant feeding practices with climate change, public health issues and economic externalities | Climate change caused by greenhouse gas emissions due to production of formula milk and dairy industry, contributing significantly to methane and $CO_2$ emissions. | Breastfeeding should be made a climate resilient strategy to mitigate malnutrition. Leave with pay for mothers, Baby-Friendly initiatives carried out by hospitals by implementing WHO International Code of Marketing of Breast-milk Substitutes and strict policy regulations on marketing of formula milk. | 1 kg of milk formula makes 11 to 14 kg $CO_2$ eq. GHG emissions throughout its lifecycle. Toddler formulae unnecessary contributes to emissions. Breastfeeding is economic and environment friendly and makes better health outcomes. Failure to comply with policy regulations affects health and environment. During drought, famine, other natural calamities lack of drinkable water makes it difficult to feed formula fed infants. | Failure to acknowledge economic and environmental benefits of breastfeeding by people. Regulation lacunae in marketing of formula milk, especially export. Unpaid leaves to mothers and neglect towards her contributions lending inadequate support. Environmental harm caused by formula production is not being internalized. Policies restricting formula milks conflict with interests of dairy industries. |

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| 2025 | Ubalde J, Bradshaw CJA, Le Souëf PN, Judge MA | Globalization and Health | 160 climate change policies of different countries were analyzed | Children (children under 5 were emphasized being the vulnerable group) | Policy analysis | Global | To evaluate how effective the climate change related policies of nations are in protecting health of children by using a structured policy determining checklist. | Effect of Climate change events, like, on high temperature, water and food insecurity, extreme weather, conflict and displacement, on children focusing on adaptation planning | Nutritional interventions were mostly mentioned in policies of LMIC: Food security improvement interventions which included feeding programmes, diversification of home diets, fortified food intake promotion and expansion and improvement in harvesting technology and crop quality | 43 percent of total policies evaluated had no mention of child health. 27 percent mentioned action for children health but had no specific target. Only 7 percent mentioned mechanisms to monitor without directly measuring the outcomes. About 12 percent of nations involved stakeholders but without defining roles. LMIC recognized vulnerabilities of child health better than high income countries. Policies lacked SMART goals, proper resource allocation and accountability of the stakeholders | Lack of targetted approach of health policies by LMIC. More than 40 percent of policies lacked focus on children's health. No SMART goals and absence of age-appropriate achievable targets. Implementation lacunae as resource allocation were poor along with strategy mobilisation. No defined stakeholder roles and engagement. Inconsistency in evaluation and monitoring of outcomes. |

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| 2021 | Binns CW, Lee MK, Maycock B, Torheim LE, Nanishi K, Duong DTT | Annual Review of Public Health | Not Applicable | Global population focuses on children, and other vulnerable groups. | Narrative Review | Global | To review effect of climate change on global food supply and how dietary guidelines can help in promotion and sustainability of healthy diets. To align nutrition related strategies to SDGs. | Increase in temperatures, extreme weather events (storms, floods, droughts), water scarcity, ocean acidification, increase in pest/pathogens, sea-level rise. These climate events result in reduction of nutrient density, affecting yield of crops and dysregulate supply of food. | Adhering to diet related guidelines by emphasizing plant-based diets, promotion of breastfeeding to reduce carbon footprint, reduction in wastage of food, improvements in production and food distribution chain. | Following plant-based diet can help in reducing GHGs emissions. Political investment and commitment can help produce enough food, but equitable distribution must be carried out. Climate crisis reduces nutrient density of food and dietary diversity too. Vulnerable groups are affected the most, Food wastage contributes to GHGs emissions. | Short-term political planning and requirement for foreign collaboration. Lack of Monitoring of nutrient density of food, unequitable food distribution, reversing marketing of UPFs and unhealthy foods. Lack of integration of dietary guidelines with climate change events. Widespread prevalence of micronutrient deficiencies and malnutrition. Unstable food system due to climate crisis and politics. Globally, less adherence to nutrition strategies with climate change. |
| **2025** | Tabunga T, Medcalf S, Workman A | The Journal of Climate Change and Health | 34 studies included | Children and maternal population of Pacific and developing countries | Scoping review | Pacific and developing countries (South Asia, Africa, Sub-Saharan Africa) | To review literature on health outcomes related to food security, water security and vector borne illnesses with respect to maternal and children health while | Temperature rise, natural disasters, rainfall, sea-level rise. | Targeted intervention related to nutrition and climate resilient policy which aims to increase security of food thus improving maternal and child health outcomes | Diarrhea and malnutrition due to climate events affecting nutrition of mothers and children caused by rainfall and temperature. Kiribati's | Lack of research in Pacific Island and Kiribati. Outdated assessment tools for finding out climate/health vulnerability. Lack of interventions and |

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| | | | | | | | considering evidence for Kiribati's current health and climate policy. | | | implemented policies do not address health outcomes related to climate. | locally collected data to integrate into policy decisions. Intersectoral collaborations are needed. |
| 2023 | Woldeyohannes M, Girma M, Petros A, et al. | BMJ Open | 16,596 households | Children (0–59 months), school-aged children (6–12 years), adolescent girls (10–19 years) and Women of reproductive age (15–49 years) | Population-based cross-sectional survey | Ethiopia | To improve understanding of nutrition related problems from soil to environment. To also conduct a nutritional assessment survey of diet of children, adolescents and women. Assess nutrition intervention coverage and develop food system transformation plan. To implement food and nutrition national strategy | Climate change aftereffects like soil nutrient depletion that pose challenges in agriculture and nutritional quality of crop | Assessment of coverage of vitamin A supplementation, IYCF counselling, WASH and food-cash assistance interventions. Implementation of national food nutrition strategy and food system transformation plan | Assessment of wasting, stunting, micronutrient deficiencies, diet intake, and implementation of nutrition related plans | Lack of data related to diet intake, and effects of climate change like soil nutrients. Limited data on school children; outdated baseline evidence to formulate new plans. A cross sectional study cannot establish causality or account for seasonal nutrient variation Recall bias in survey |
| 2024 | UNICEF India Country Office | UNICEF Programme Note | Not applicable | Children, adolescents, women | Programme Guidance | India | To study the climate change impact on proposed nutrition strategies to integrate climate change and environmental sustainability (CCES) into nutrition related programmes | Floods, heatwaves, droughts, vector-borne problems, scarcity of water and cyclones | Multi-pronged approach on nutritional strategy-strengthens health system- make nutrition services climate resilient, POSHAN tracker to be used for early warning sign. Promote seasonal and local diets, discourage UPF, advocacy for fair policy on food pricing. Training the decision makers by capacity building. Gender equity. CSR, promote literacy on nutrition. | Climate change affects food system and undermines nutrition of children. It increases disease and disrupts services CCES helps to protect gains and makes sure of community service in emergencies | A future work plan including multi-sectoral intervention. Challenge in finding resources, complex nature of inter ministry collaborations and the requirement to implement the strategies into concrete future action |

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| 2025 | United Nations Children's Fund | UNICEF Publication | NA | Children under 5 years, focus on the 6-23 months old children. | Programmatic Strategy | Sub-Saharan Africa | To make sustainable and systemic transformation in food system of Africa to tackle food poverty and malnutrition in children. To reduce malnutrition and poverty by improving affordability, access and availability to healthy first foods. | Climate shocks like floods and droughts reduces food quantity/quality. | A multi-step strategy: 1. Incentivize Local African Production companies so that they can produce safe, sustainable, affordable, nutritious complimentary food, snacks supplements like MNPs/SQ-LNS 2. Policy Strengthening: Enforce and develop standards for food industry, strict regulations, and policies (like taxing UPFs); integrate social protection with nutrition like cash/voucher transfers. 3. Social marketing and programs on social behavior change (SBC). | The initiative is positioned to sustainably reduce child food poverty and malnutrition by transforming food systems to be child-sensitive, locally driven, and climate-resilient. It aims for a ~10% reduction in child food poverty in SSA by 2030 (15 million fewer children). | High amount of funding is required, that is, $300 million (program-$250M; investment-$50M). 2. Need to ensure policy harmonization in entire regions. Competing with aggressive marketing of UPFs and easy affordability. Make effective delivery and procurement. Moving from countries to continent, possessing scalability. |
| 2015 | Huo J, Sun J, Fang Z, et al. | Food and Nutrition Bulletin | Baseline: 1,290; Follow-ups: 1,142, 1,118, 1,040 | Infants and children aged 6-23 months | Pre-post observational intervention study | China | To evaluate how home-based complementary food fortification with ying yang bao affect hemoglobin levels and prevalence of anemia in infant and young children. | Earthquake | Fortification of complementary food at home with Ying Yang Bao (YYB), a soy-based micronutrient powder, provided by the Chinese government for free with nutrition education. | On consuming YYB Hemoglobin rose to 11.3-11.7 g/dL (follow-ups) from 10.8 g/dL (baseline). Prevalence of anemia decreased to 24.8-27.9%. Moderate anemia prevalence decreased by 15%. Good compliance and high coverage (≥95%) were achieved. Hemoglobin levels correlated positively with YYB and the | No control group. Selection bias as sample was not randomly selected. No reduction in anemia was noticed after first 6 months of intervention. Sample demographics varied due to movement by population. |

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| 2016 | Pradhan PMS, Dhital R, Subhani H | BMJ Open | 7,128 children (5 total studies) | Children under 5 years old | Systemat ic Review o | Global | To review interventions of nutrition for under five years old after natural disasters and find out the effects on nutrition related outcomes | Earthquakes, cyclones, Tsunamis, Drought | Supplementation of food by supplementary feeds and therapeutic diet, Micronutrient enriched powders, Feeding, education related to health and community movement along with complimentary supplement food. | Reduction in wasting and underweigh t was shown by 4 studies and stunting by 3 studies. Only 1 study reported anemia reduction. Community based interventio ns gave positive results. | Lack of strong evidence as no RCTS and quasi-experiment al studies were selected. Less number of studies. Most studies had no control group. Variations in outcome made study synthesis difficult, improveme nts cannot be solely due to interventio ns. |
| 2025 | Pacheco-Miranda J, Wagner N, Ponce J | Economi cs and Human Biology | 219,948 observa tions | Children under 5 years old | Quasi-experime ntal study | Ecuado r | To assess short duration impact after earthquake on health outcomes in children under 5 | Earthquake | National nutrition programs were continued like vitamin, "Chizpas", micronutrients. Promotion and increase in breastfeeding | Post earthquakes, no stunting, wasting, underweigh t and anemia was found in children. Governmen t continued nutrition related programs, and increase in breastfeedi ng stabilized children's health outcomes. | 1. Limited socio-economic variables like maternal education. Observed and cross-sectional data was not included. Focused only on short term impact post disaster. Reported data may have inconsisten cies. |
| 2024 | Conti MV, Vincenti A, Beretta A, et al | Nutrients | NA | Children and Adolescents (2-18 years) | Narrative Review | Global | To find out how Planetary Health Diet (PHD) suits when addressing childhood obesity by nutrition adequacy assessment | Degradation in climate is causing environmen tal degradation which is related to food systems. | Follow plant-based diet to reduce methane production, GHGs. Adapting EAT-Lancet PHD for pediatric use; programs in school meal; family education on food as interventions | Obesity prevention aligns with PHD and environmen tal goals but cannot meet nutrient needs of energy, proteins | No longitudina l studies to prove its long-term effect on child growth. Adoption of PHD due to culture and |

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| | | | | | | | and propose adaptations for children | | | and minerals of children and adolescents without modification like fortifying foods. | economic barriers. Lack of standard metrices for evaluation and adherence. |

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