Considering climate and conflict conditions together to improve interventions that prevent child acute malnutrition

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Despite early warning signs about threats to food security, humanitarian interventions often lag behind these warning signs. Climate and conflict conditions are among the most important factors preceding food system failures and malnutrition crises around the world. Research shows how conflict and climate conditions can upend functional food and economic systems, but this research does not address the severe health impacts of these conditions on infants and young children. Translating quantitative research findings into humanitarian interventions requires geographical detail, resulting in location-specific alerts of risks of food insecurity. We describe how the use of readily available, spatially referenced quantitative data can support targeted interventions for nutrition resiliency. Effective humanitarian programmes for targeted nutrition interventions require real-time datasets on food security drivers and models that can provide actionable guidance to mitigate negative impacts of conflict and climate conditions on the people most susceptible to food insecurity. Although treatment of acute malnutrition is important, treating existing malnutrition is not enough. Instead, action to prevent acute malnutrition should be taken to minimise suffering and to maximise wellbeing, particularly in contexts prone to worsening climate and conflict conditions.

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Introduction

Links between food insecurity and poor climate conditions, such as droughts, floods, and wind events, have been explored since the famines that spread across Sahel, Ethiopia, and south Asia in the 1980s.[1–4] Drought and high temperatures lead to reductions in agricultural productivity,[5] which affect the availability of food in regions that are not well connected to the international economy.[6] The advent of near real-time satellite sensing of vegetation productivity,[7] and subsequently of rainfall,[8] has allowed for the remote monitoring of all agricultural regions, enabling near real-time assessment and reporting of potentially substantial declines in food availability.[9] Food security analysts who contribute to early warning systems have integrated near real-time assessment of growing conditions, and their wider impacts on food availability, into projections of food security outcomes,[10–12] particularly under the Integrated Food Security Phase Classification.[13]

This sophisticated engagement with environmental drivers of food security is not reflected in how the broader nutrition and humanitarian community understands the role of conflict in food security. A 2020 review found that only a small number of empirical studies have examined the relationship between conflict events and nutrition outcomes in children.[14] Although the foundations exist for an understanding of the effect of conflict events on food security outcomes,[15,16] operationalisation of data on conflict events when programming food security interventions does not often occur.[17,18] The task of programming food security interventions is complex and requires appropriate elaboration of processes and connections between cause and effect through empirical analysis. Factors that influence conflict and climate conditions occur spatially and temporally, which propagates inequalities between countries and over time. Although causal pathways have not been decisively established, climate shocks and conflict disruptions might influence each other.[19–21] Research shows that there are relationships between the stability of societies and the climate;[19] however, this research reveals little about the mechanisms that translate extreme climate conditions into conflict incidence[1] and, ultimately, to poor nutritional outcomes among children.

Another shortcoming of current knowledge is that research about risk factors for malnutrition typically focuses on chronic outcomes, such as stunting, rather than acute outcomes, such as wasting, which are more often fatal if left untreated and more amenable to mitigation, or avoidance, with timely, tailored interventions.[22] This imbalance in attention arises despite the implications of acute malnutrition in food security crises, the expectation that these crises might be anticipated as a result of climate and conflict shocks, and the potential to implement programmatic interventions to support maternal and child health. Several studies have assessed the effect of ready-to-use therapeutic foods, with attention to various settings and populations.[23–25] The findings from these studies provide a foundation for protocols that lead to the successful alleviation of acute malnutrition. Such protocols focus on individual-level interventions that require specialised clinical care tailored to reduce the risk of mortality caused by malnutrition.[26,27]

Analyses of individual-level interventions for acute malnutrition rely on detailed, individual-level data to capture growth trajectories of children in relation to feeding schedules and nutrient intakes.[28] The optimal data for these analyses are from repeated anthropometric measures of children before and after an emergency and from their response to treatment for malnutrition, which enables measurement of treatment responsiveness with sufficient fidelity.[26] These individual-level longitudinal data are scarce, especially in emergency contexts. Even when the data exist, the samples are frequently small and have little geographical scope.[29] An additional constraint of current analyses is that most have been confined to

Level of measurement	Dynamic variables	Static variables
Country	Gross domestic product per capita	Education quality, life expectancy, and dietary energy supply per capita
Region and community	Rainfall, temperature, vegetation quality, conflict in region, and conflict exposure	Health centre access, altitude of region, environment (rural or urban), and distance to markets
Household	Pregnancy care availability, food diversity, number of children in household, and body-mass index of mother	Education of parents, indigenous status, water quality, and availability of sanitation facilities
Child	Fever, vaccinations, and diarrhoea	Sex, age, multiple birth, birth order, and interval between births

Figure 1: **Drivers of child malnutrition**
Static variables are not expected to change substantially over time, whereas values of dynamic variables change over short time scales (eg, daily, weekly, monthly, or seasonally). Information on variables from Brown and colleagues.[14]

planning humanitarian responses during crises, rather than in anticipation of crises.

The persistent threat of conflict in regions already susceptible to food insecurity warrants a proactive use of existing datasets, multi-scalar analytical approaches, and programmatic frameworks to trigger and guide interventions when conflict and climate events co-occur. Several existing datasets provide event-level conflict information that is spatially and temporally disaggregated and includes details on conflicts between government security forces and rebel groups, violence against civilians, terrorist attacks, riots, and demonstrations.[30] These data, like what can be obtained from satellite-based remote sensing of the environment,[31] are still evolving; however, they should be put to better use when designing and deploying effective livelihood support for children and families affected by various forms of civil unrest.

Building an integrated climate–conflict–health framework

Around the world, armed conflict tends to increase malnutrition[1,19] and hunger-related mortality among women, children, and infants.[32–34] For example, an ongoing war in Yemen has resulted in the deaths of nearly 250 000 people, either directly or because of insufficient access to food.[35] Additionally, the number of people internally displaced by an upsurge of violent conflict in Burkina Faso had more than doubled from 560 000 to around 1·3 million from February, 2020, to July, 2021.[36,37] In both settings, children comprise a substantial share of the affected population. When children experience food insecurity, they have an increased chance of death or long-term consequences for their health, education, and incomes.[38] Yemen and Burkina Faso are countries that have been distressed by simultaneous conflict and climate extremes that reduce the vitality of the agriculture sector, causing routine and seasonal food insecurity due to dependence on small-holder and rainfed agriculture.[39] Increasing temperatures, resulting in higher evapotranspiration demand,[40] more extreme and variable precipitation,[41] and greater likelihood of extended heatwaves,[42] have been recorded in Yemen and Burkina Faso, impacting them both biophysically and socioeconomically.[43]

To increase scientific understanding of the effect of these changes in climate on the stability of society and to develop strategic humanitarian, public health, and public policy interventions, it is necessary to consider the combined and inter-related effects of climate and conflict on the food system.[14] The research community urgently needs to develop forecasts of malnutrition prevalence that can be used to accelerate the creation of nutrition interventions (eg, child feeding, school lunches, and hospital clinics) to alleviate the negative repercussions of conflict and climate events on nutritional outcomes. We contend that, with improved models and a broad understanding of the effect of conflict and climate events on malnutrition, early interventions can be designed to support the health and wellbeing, and to reduce the mortality, of children who are at risk of malnutrition.

Data have now emerged that can facilitate targeted, timely interventions before food insecurity and health situations reach a crisis state. Spatially detailed, high-frequency, and publicly available data that can capture within-community variation in individual-level susceptibility to malnutrition are ideal for programmes supporting child nutrition.[44] With existing quantitative modelling frameworks, such as UNICEF's conceptual framework,[45] a range of important relationships can be captured with a mixture of static and dynamic variables measured at different spatial and temporal units of observation. A quantitative model developed with a mix of static and dynamic variables could be used with dynamic climate and conflict measures to estimate how current events might affect the future nutrition status of the most susceptible to malnutrition (figure 1). Practical applications for such a framework include providing early warning of when increased prevalence of malnutrition might occur and improving the information on where these regions of high risk are located. Our framework supports the estimation of how conflicts are expected to affect child malnutrition, particularly when the events co-occur with natural disasters. The model yields forecasts of malnutrition disaggregated to the level of individual children, which can also be aggregated to project prevalence rates of malnutrition within the populations of communities or regions of a country. By making this early warning analysis accessible to practitioners, the timeliness and tailoring of humanitarian programming can be improved. Among the outputs of the model, results include evidence-based indications of where and when crises can occur, the types of individuals and households that are most likely to be affected, and the key reasons for susceptibility to malnutrition.

Communicating the complexity of conflict and climate drivers

Early warning of the effects of extreme climate events on food security, months before it happens, has become routine in humanitarian networks,[46] including through a scenario-based framework.[10] We propose to improve the ability of humanitarian actors to incorporate the expected effects of both conflict and climate shocks via the development and socialisation of models that reveal relationships of conflict and climate events to nutritional outcomes. This proposal requires presenting evidence about food security outcomes with different kinds of conflict events (eg, conflict between government and rebel soldiers, atrocities against civilians, violent clashes over natural resources, riots in urban settings, and attacks on aid distribution and humanitarian personnel) and how they interact with climate events. Incorporating the theory and empirical substantiation of how climate events affect nutritional outcomes into scenario development has taken humanitarian networks a long time to achieve. Likewise, adding the conflict dimension to this scenario development will entail careful and sustained engagement by the nutrition community with the available research on conflict and food security and the analysts responsible for developing food security scenarios. Presenting findings of forecasted malnutrition in a way that fosters the formulation of scenarios relevant to creating nutrition interventions is important for ease of uptake by decision makers.

An illustrative use case for the predictive model is the work of the Food Security and Nutrition Working Group (FSNWG), a regional platform headquartered in Nairobi, Kenya, which is chaired by the Intergovernmental Authority on Development in the Eastern Africa Climate Prediction and Application Center and the regional office of the UN Food and Agriculture Organization. Current membership of the FSNWG includes approximately 80 regional, national, and local organisations, including donors, UN and government agencies, non-governmental organisations, and research institutions. Members of the FSNWG contribute to subgroups (eg, nutrition, markets, food security, and livelihoods) and to strategising of interventions. The FSNWG also do scenario planning, bringing together the participants of the Greater Horn of Africa Climate Outlook Forum, who provide seasonal climate forecasts ahead of each rainfall season.[47] Our engagement with the FSNWG has shown that the members are eager to consider data on conflict in their scenario analysis, but they need a clear understanding of the nature and role of conflict and how it interacts with natural disasters to affect agricultural productivity. Figure 2 shows an example of a decision-support system that is easy to use and could allow participants in the FSNWG, and similar stakeholders, to engage with models that explore the conflict and climate drivers of food security outcomes in their periodic scenario-development exercises.

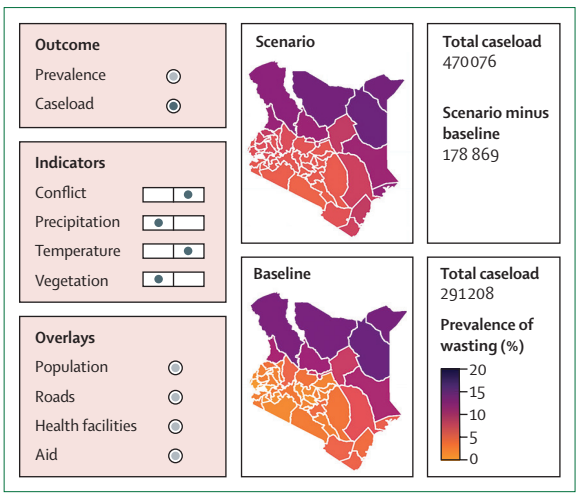

Figure 2: **Illustration of an interactive dashboard to assist nutrition experts and humanitarian actors in appreciating the role of conflict and climate conditions in malnutrition outcomes**

The results on the dashboard would be based on a quantitative model's estimation using historical datasets. The baseline map displays model-based predictions for indicators set at average levels and the scenario map displays predictions for indicators set to below-average or above-average levels.

In Yemen, the ongoing conflicts between Houthi rebels, the Yemeni Government, and various rival groups and their international sponsors have caused extremely poor macroeconomic conditions, reducing the opportunity for jobs, increasing the cost of food and agricultural inputs, and restricting energy imports needed for delivery of public services. Weather shocks can exacerbate the conflict, economic instability, and food insecurity. The Famine Early Warning Systems Network works together with the UN Office for the Coordination of Humanitarian Affairs and other actors to assess current food security conditions and forecast future conditions, enabling the delivery of monetary and food assistance to large areas of Yemen.[35] However, even in the presence of large-scale humanitarian assistance, the western part of Yemen continues to see crisis conditions, particularly as transportation and trade disruptions continue. The consequences of these disruptions for the burden of acute malnutrition could be anticipated with the modelling framework suggested in this Personal View, which uses temporally lagged data on conflict, climate, and other factors that are leading indicators of malnutrition risk.

Conclusion

As the research community develops new datasets and models related to malnutrition, it is important to communicate these insights to decision makers and practitioners on the ground, who are positioned to intervene through programming activities. An immediate target should be programming that can assist children who are affected by malnutrition. Children who have had severe acute malnutrition are nine times more likely to die

than their well nourished counterparts, and recurrent or sustained malnutrition early in life—especially during the first 1000 days of life—can compromise a child's ability to learn, thrive, and prosper as an adult.[48,49] Although treatment of acute malnutrition is important, it is not enough. Actions should instead be taken to minimise suffering and maximise wellbeing by preventing acute malnutrition before it begins, particularly in places prone to both climate shocks and conflict.

An emphasis on the prevention of malnutrition would be a shift in the way national and international actors approach nutrition resiliency. Despite the progress in strengthening early warning systems for food insecurity, current approaches to detect declines in nutritional status still tend to be late warning systems that rely on metrics such as the prevalence of moderate and severe acute malnutrition, which can only be used to detect a nutrition crisis after it has already begun.[50] Therefore, effective prevention requires a change in how nutrition security is conceptualised, how nutrition-related vulnerabilities at a local level are forecasted, how the causal factors driving nutritional deterioration are identified, and how nutrition-sensitive services that mitigate the effect of climate and conflict events on households and communities are designed. Improvements in near real-time data on conflict and satellite-derived environmental data, and their use in models to provide actionable guidance to the humanitarian community for interventions and livelihood support, are essential to mitigate malnutrition faced by future generations around the world.

Contributors

MEB conceptualised the Personal View; DB acquired funding and created the figures; MEB, KG, and DB wrote the initial draft and edited the final version; and TB edited the final version and helped create the figures.

Declaration of interests

We declare no competing interests.

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