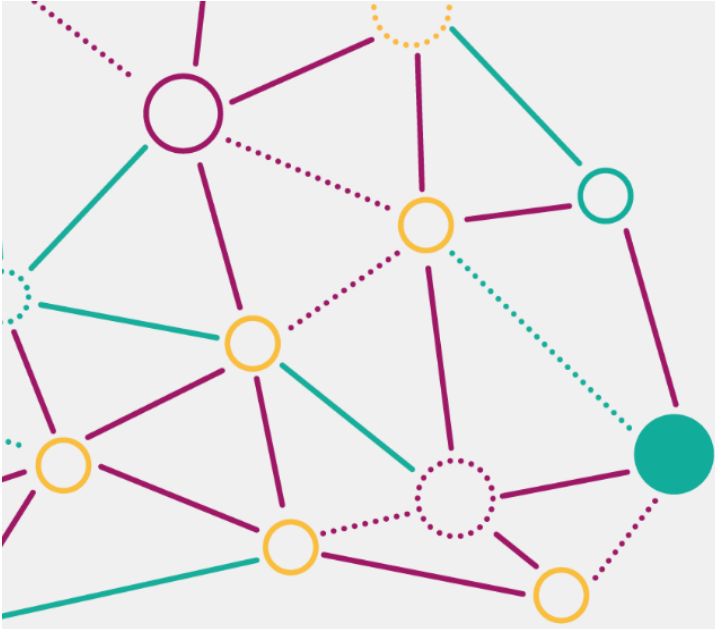




Research for health
in humanitarian crises

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FOOD INSECURITY, MATERNAL AND CHILD MALNUTRITION, MORBIDITY AND MORTALITY LINKAGES IN HUMANITARIAN CONTEXTS

A Scoping Review

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ABSTRACT

Globally, about 2.3 billion people are food insecure. This can be attributed to multiple factors including acute and protracted conflict, economic shocks (which encompasses the ongoing impacts of the COVID-19 pandemic and the conflict in Ukraine), and the increasing effects of climate change. The consequences and impact of food insecurity are dire and can result in malnutrition which often disproportionately affects women and children and increases their risk of morbidity and mortality from malnutrition and other diseases. Food insecurity exposes affected households to consuming cheaper, high-calorie foods with lower nutritional value, increasing their risk of non-communicable diseases (NCDs). Further, food insecurity is associated with high-risk behaviours which are often adopted as a coping mechanism, particularly amongst women, increasing the risk of sexually transmitted infections (STIs).

Countries undergoing humanitarian crises, such as those in the Greater Horn of Africa, and fragile states are the hardest hit by food insecurity due to the persistence of food insecurity drivers such as conflict, extreme weather patterns and poverty. Better understanding of the linkages between food insecurity, maternal and child malnutrition and health, and mortality, is necessary for developing appropriate strategies in these contexts. The goal of this scoping review was to evaluate the evidence around the relationship between food insecurity, malnutrition, health and disease, and mortality among women and children under five years (CU5) in humanitarian contexts.

Keywords searches were conducted in PubMed, ClinicalTrials.gov, Cochrane, World Health Organization (WHO) Global Library, ScienceDirect and Google Scholar, websites of organisations – UNICEF, United Nations Population Fund (UNFPA), World Bank Group (WBG) and the Food and Agriculture Organization (FAO) – and document references. Forty-eight full-text articles were reviewed, of which, 24 papers reported on the linkages between food insecurity and malnutrition, three on childhood diseases, five on linkages with NCDs, two on linkages with mortality, and eight on impact of food insecurity. A further nine reports did not directly assess food insecurity but reported indicators that implied food insecurity, and their linkages with disease outcomes.

The review found that food insecurity was as high as half to three-quarters of households in humanitarian contexts and driven by persistent drought or other extreme weather events due to climate change, poverty or low wealth index, rural living, and low socio-economic status. Hunger and famine, inadequate dietary diversity, decreased number of total meals, low intakes of essential nutrients, low consumption of animal source foods, and poor micronutrient intakes such as vitamin A, were all forms of food insecurity reported. Food insecurity was linked to childhood stunting, wasting and being underweight, micronutrient deficiencies and maternal

underweight and anaemia. Food insecurity was also linked with higher risk of malaria, anaemia, diarrhoea, dehydration and poor overall child health. HIV/AIDS transmission, stemming from increased risky sexual behaviour like transactional sex, multiple sexual partners and condomless sex, and tuberculosis (TB) were associated with inadequate food access. People living with HIV/AIDS had increased disease progression and poorer anti-retroviral therapy (ART) adherence if they were food insecure. Food insecurity increased risk for NCDs like diabetes, dyslipidaemia, hypertension, and mental health disorders including depression, while food insecure people with NCDs had increased disease severity. Longer term impacts on aspects of social, physical and economic life on food insecure households perpetuate the linkages between food insecurity, malnutrition and mortality, creating a vicious cycle, ultimately increasing maternal and child deaths.

In conclusion, the scoping review reveals the linkages between food insecurity and malnutrition, disease and mortality in women and children, with long term impact on socio-economic and quality of life. Further investigation of these relationships is required to better inform the humanitarian response and key areas for collaboration with relevant stakeholders. Interventions to address food insecurity drivers and to support food insecure households in these contexts are needed to prevent the long-term impact of food insecurity on health outcomes, and social and economic wellbeing.

BACKGROUND

The world is experiencing a global food insecurity crisis characterised by high and unstable food prices and increasing numbers of people affected by inadequate access to healthy food. This crisis has many drivers, including acute and protracted conflict, economic shocks (including ongoing impacts of the COVID-19 pandemic and the conflict in Ukraine), and the increasing effects of climate change.

About 2.3 billion people in the world (29.3%) are moderately or severely food insecure; of these, the estimated number who are severely food insecure is 924 million (11.7%) ([WHO, 2022](#)). This estimate is 350 million more than was reported in the period before the outbreak of the COVID-19 pandemic. Severe food insecurity has increased by 207 million in the past two years. The Integrated Food Insecurity Phase Classification (IPC) system in 2021 classified 45 million out of 188 million people as IPC Phase 3 or higher in Southern Africa alone. IPC Phase 3 means people are marginally able to meet minimum food needs, but only by depleting essential livelihood assets or through crises or adopting emergency coping strategies.

The Greater Horn of Africa, comprising Kenya, Ethiopia, Djibouti, South Sudan, Sudan, Somalia, Eritrea and Uganda, bears a disproportionate burden of food insecurity and its vicious repercussions. Climate and weather forecasting is part of the essential early warning systems and subsequent preparation of appropriate humanitarian responses and planning. Even where food assistance will be required, projections are needed to make such programmes and interventions more efficient and effective (Brown et al., 2007). Errors in forecasting climatic conditions results in climate and production shocks, which negatively impact the livelihoods of families (Headey & Barrett, 2015). In the Greater Horn of Africa, consecutive failed rainy seasons contribute about twice as much to food insecurity than conflicts (Krishnamurthy et al., 2020; Solomon et al., 2018). The COVID-19 pandemic exacerbated food insecurity in humanitarian contexts due to its direct impact on food supply systems and indirectly impact on purchasing power, the capacity to produce and distribute food, and the intensification of care tasks, all of which disproportionately and highly affected vulnerable populations like those in humanitarian contexts (FAO, 2020).

The Greater Horn of Africa faces a lot of security threats and is among the most fragile places in the world. Civil war and unrest, terrorism, drug and human trafficking, among other crimes, make countries within the territory highly politically unstable. These threats are sometimes fuelled by political unrest and socio-economic inequalities, and the threats themselves worsen the stability of political systems, constitutional rule, government programmes and strategies, as well as widening the inequality gap (Kabandula & Shaw, 2018). The resultant effects of these happenings in this context are unemployment, population displacement, and poverty – all of

which have a negative impact on population food security, health and quality of life. Population displacement is a major consequence of drought where people leave their homes in search of water, food and a better quality of life. Malnutrition rates amongst displaced populations are typically high and reaching this vulnerable group with health services remains a challenge.

Indeed, the above-mentioned factors fuel violence and insecurity, which are not uncommon in the region. Hungry and vulnerable youth are recruited into armed groups, most notably Al-Shabaab, which are widespread throughout the Horn of Africa, particularly in Ethiopia, Kenya and Somalia. The activities of such groups lead to the displacement of individuals, households and sometimes entire communities, most of whom already live in impoverished situations, extreme hunger and poverty. The factors described weaken state capacities and interventions geared towards achieving food security or even decreasing the prevalence of food insecurity and malnutrition. A combination of weak governance, chronic humanitarian crises, persistent social tensions, and violence limits economic and social performance, which incapacitates countries to achieve global targets towards ending hunger and other forms of food insecurity (Patrick, 2011). These exposures are estimated to account for up to a third of deaths through predisposing the population to malnutrition, deficiency diseases, infections and NCDs (Ghani & Lockhart, 2009).

Existing evidence shows that food insecurity is linked to undernutrition and disease in a vicious cycle where limited food availability and access increases risk of undernutrition (Alaimo et al., 2020). An impaired immune system is often an outcome of undernutrition, increasing risk of infectious morbidity. Diseases then cripple the capacity of individuals and communities to sustain access to food, further driving food insecurity and maintaining the vicious cycle. The high regional prevalence of undernutrition mirrors the rate of food insecurity that persists across Africa and particularly in fragile and conflict-affected countries – wasting affects 45.4 million (6.7%) and stunting affects 149.2 million (22.0%) children (UNICEF & WHO, 2020). Globally, an estimated nine million people, (about 24,000 per day) die from hunger every year (WFP, 2021). In low- and middle-income countries (LMICs), food insecurity, malnutrition and childhood diseases continue to increase morbidity and mortality, but this is more severe in fragile states. For example, according to a 2019 overview of acute malnutrition and food insecurity among children during the conflict in Yemen, the prevalence of reported measles was three times greater among severe acute malnutrition (SAM) cases than among other children (Dureab et al., 2019). The SAM group also had significantly more cases of diarrhoea, fever and cough.

Food insecurity is also linked to NCD risk; although the relationship in humanitarian contexts requires further examination, it is reported in non-humanitarian contexts that food insecure adults were more obese, had less healthy diets, and lower serum

nutrients (Seligman et al., 2010). Data from a USA National Health and Nutrition Examination Survey showed women who reported having low food security had higher odds of developing pre-diabetes and pre-hypertension than women who reported having adequate food security (Seligman et al., 2010). Food-insecure people are more likely to consume cheap foods with a high energy density but low nutritional value, which increases their risk of being obese, overweight, and having high blood pressure (Yaemsiri et al., 2012). Other factors, including spatial-temporal access to nutritious food; interpersonal food choice and distribution, and non-dietary behaviours are reasons why food insecurity increases obesity risk in LMICs (Farrell et al., 2018).

Food insecurity can impact society in various ways. It is linked with high-risk lifestyle behaviour (GharachOrlO et al., 2018) and the adoption of negative coping mechanisms. It is hypothesised to increase sexual vulnerability, especially among women living in poverty who are often dependent on others for food and other resources and whose human rights are inadequately protected due to conflict, social instability or both (Miller et al., 2011). Through risky coping mechanisms, food insecurity can raise the risk of contracting sexually transmitted infections, which includes the Human Immunodeficiency Virus (HIV) and hepatitis. These diseases can also make people more vulnerable to food insecurity by reducing food production and household income for food acquisition (Kadiyala & Rawat, 2013; Weiser et al., 2011). A vicious cycle exists between food insecurity, gender roles, and HIV/AIDS that increases vulnerability to and exacerbates the severity of each condition (Muderedzi et al., 2019). Food insecurity may also hinder health access in humanitarian crises (Berkowitz et al., 2014), as people may use their time and efforts to look for food rather than access health services. This can lead to low uptake of maternal and child health services, such as antenatal and postnatal care, family planning, facility delivery and immunization, and consequently increased morbidity and mortality.

Although the interrelationships between food insecurity and its drivers, maternal and childhood malnutrition, morbidity and mortality are generally known, a better understanding of these linkages from recent studies, and also in humanitarian contexts, is recommended to promote appropriate responses. Synthesizing such evidence will make the linkages more comprehensible for informing policy and delivery of appropriate interventions.

SCOPING REVIEW OBJECTIVES

The goal of the scoping review was to evaluate the scientific evidence around the relationship between food insecurity, malnutrition, health and disease, and mortality among women and CU5 in humanitarian contexts. The diseases of focus included both communicable (childhood diseases) and NCDs, and those linked to animal-human interactions (zoonotic). The impact of food insecurity on maternal health access included coverage of antenatal and postnatal services, deliveries, family planning, and infant immunisation were assessed. A conceptual framework was to be developed to illustrate the linkages observed from the review.

SCOPING REVIEW QUESTIONS

In humanitarian contexts:

1. What relationship does food insecurity have on maternal and child malnutrition?
2. What is the linkage between food insecurity and infant morbidity (particularly in relation to communicable diseases)?
3. What linkages does food insecurity have on NCD prevalence, including heart disease, diabetes, and cancers?
4. How is the occurrence of zoonotic diseases, especially anthrax, Ebola, etc. linked to food insecurity?
5. What is the linkage between food insecurity and maternal health outcomes, including access to maternal health services such as antenatal, postnatal, delivery, family planning services and infant immunisation?
6. What is the linkage between food insecurity and maternal and child mortality?

SCOPING REVIEW METHOD

ELIGIBILITY CRITERIA

Specific inclusion criteria for the studies were determined in consultation with the community of practice across diverse humanitarian contexts and staff of humanitarian organisations and international agencies who operate in these contexts. Specifically, consultations were held with key informants from WHO, Médecins Sans Frontières (MSF), Mercy Corps and Elrha to determine the scale of the review. Articles and reports from both the academic and grey literature were eligible for inclusion if they addressed the linkage between food insecurity and malnutrition and any of the prior agreed health and nutrition outcomes (ie, malnutrition, morbidity, mortality, and health service access/utilisation) in CU5 and women of reproductive age. Although humanitarian contexts were the focus, reports or studies identified in LMICs broadly that helped the understanding of these linkages were included. A humanitarian crisis is a singular or a series of events that are threatening in terms of health, safety or well-being of a community or large group of people, or an internal or external conflict usually occurring throughout a large land area (Olsen et al., 2003). Such crises usually require local, national and international responses.

SPECIFIC ELIGIBILITY CRITERIA WERE:

Geographic boundaries: The list of fragile and conflict-affected situations (FCS) were obtained from the World Bank Group website (available at [FCSList-FY23.pdf](#)). The list had, as of March 2023, 17 countries categorised as conflict zones and 20 institutionally and socially fragile countries and includes all countries within the Greater Horn of Africa (worldbank.org).

Time frame: Studies or reports conducted from 2000 till March 2023 qualified for inclusion in the review. This was to ensure the review findings were relevant to new trends and understandings. Review findings conducted on the topic before 2000 were consulted to compare with current review.

Disease boundaries: The review focused on the following three areas of disease:

1. Infectious diseases, particularly those that cause significant morbidity and mortality in children. These included, but are not limited to, vaccine preventable illnesses (such as measles, meningitis, pneumonia and diarrhoeal diseases,) HIV, TB, and vector-borne diseases (such as malaria, yellow fever, and dengue fever)

2. Zoonotic diseases, including Anthrax were taken into account as they are being reported among pastoralists, and general literature had linked zoonotic diseases like Rift Valley fever and Ebola to food insecurity.
3. NCDs such as diabetes, cancer and heart disease.

Impact indicators: The review focused on impact of food insecurity on maternal health access, including coverage of antenatal and postnatal services, deliveries, family planning, and infant immunisation, domestic and social violence, and risky sexual behaviour.

INFORMATION SOURCES

Electronic databases searched to identify relevant studies were PubMed, Google Scholar, Cochrane and WHO Global Library. In addition, websites of relevant organisations were searched for reports or published publications. References of studies that qualified for inclusion were also searched. We also asked colleagues to lead us to any articles that may have been missed in the database and reference list searches.

SEARCH STRATEGY

The search terms used to identify documents for the review are presented in the appendix (**Table 1**). The keyword combinations were defined from the inclusion and exclusion criteria described earlier. As this review was scoping rather than systematic, the keywords search did not aim to provide an exhaustive search but a comprehensive search of the literature. However, the titles obtained from the database and website searches were combined in a MS Excel template and screened, first titles, then abstracts and then full texts by two reviewers.

DATA EXTRACTION

Data was extracted into evidence tables to give detailed information for each study, using a PICO framework as a guide. Information was extracted using appropriate templates, tabulated methodological approaches and key findings of each study. Key data extracted included study title, authors, location and date of study, design and sample size, and key findings.

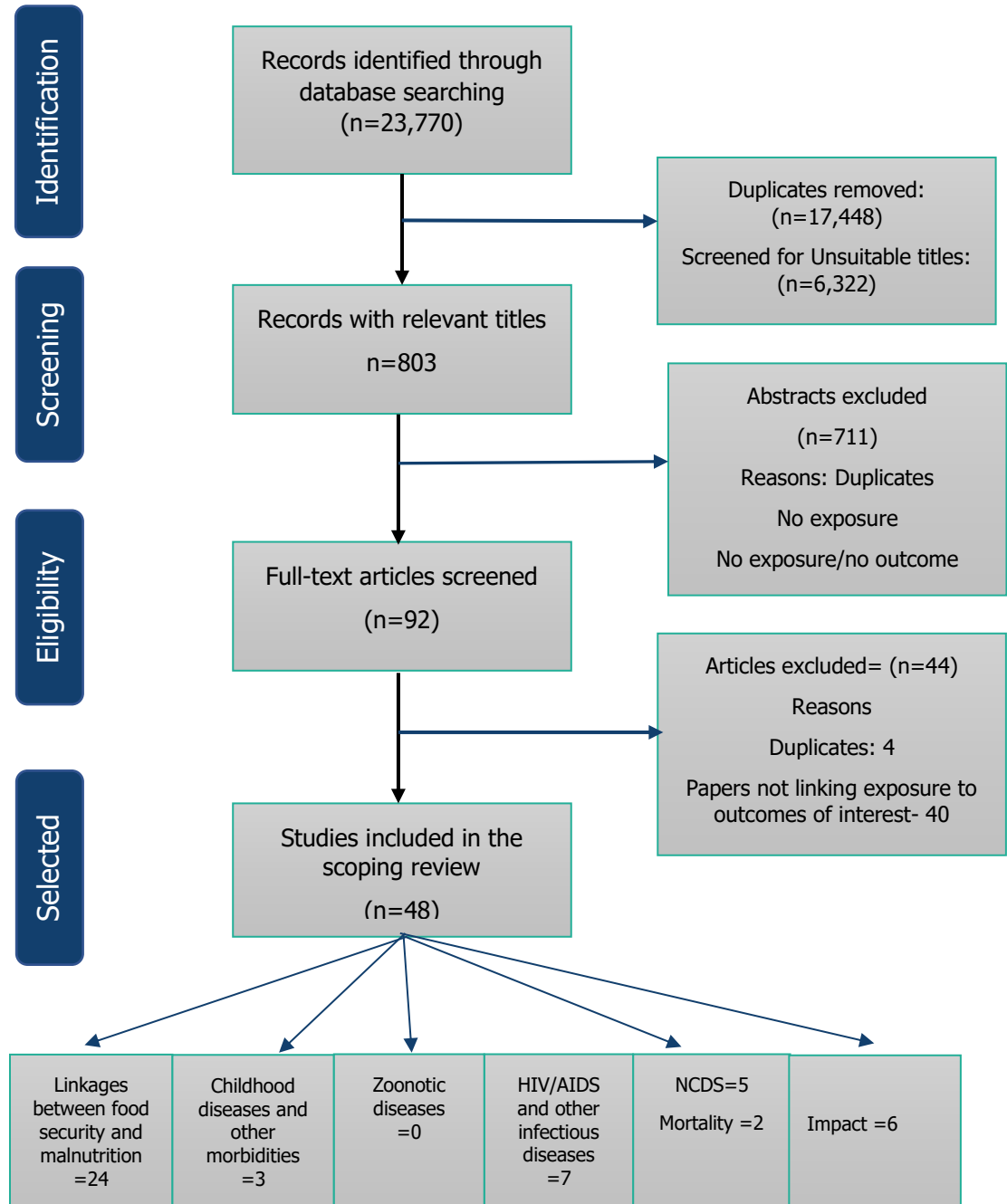
RESULTS

STUDY SELECTION

We identified a total of 23,770 studies using the keyword search terms in six databases (ie, PubMed, ClinicalTrials.gov, Cochrane, WHO Global Library, ScienceDirect and Google Scholar) and websites of organisations (UNICEF, UNFPA, WBG and FAO). Of these, 17,448 duplicates were removed, while 6,322 were screened for inappropriate titles, of which 5,519 were rejected for being inappropriately titled. Of the 803 appropriately titled papers for which abstracts were reviewed, 711 were rejected because they did not link food insecurity to the outcomes of interest, nor referenced the exposure or outcome. Ninety-two full text papers were screened for inclusion, of which 44 were rejected because they were either outside the age range of interest, did not report on food insecurity and/or its impact on any of the outcomes, or reported on the outcomes of interest without linking them to food insecurity and 4 duplicates. One paper was outside the date range for consideration. Finally, 48 full-text articles that met the inclusion criteria were included in the review.

Figure 1 shows the PRISMA flow diagram of the screening, eligibility evaluation, and study selection process. Out of the final number of papers included in this review, 24 papers reported on the linkages between food insecurity and malnutrition, three on childhood diseases and five on NCDs. Seven studies reported on the linkages between food insecurity and HIV and other infectious disease, while nine studies did not use the terminology 'food insecurity' or 'food intake' but reported on indirect or proxy indicators that implied food insecurity such as 'lack of income' or 'wealth index' and how these are linked to the outcomes of interest. Two studies/reports linked food insecurity with mortality.

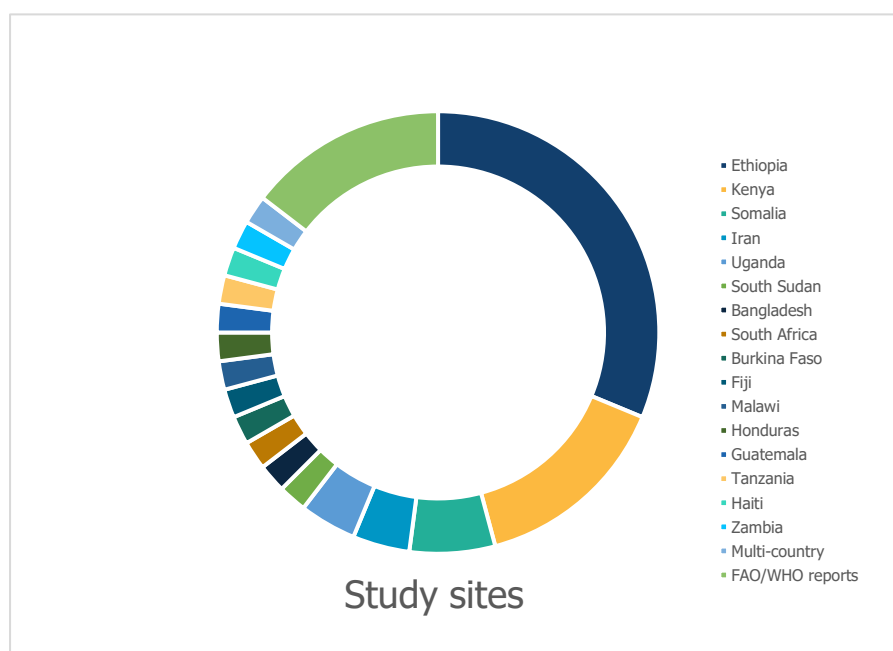
Figure 1: PRISMA of study screening process



STUDY CHARACTERISTICS

A total of 48 documents (38 peer-reviewed papers, 7 reports, and 3 theses) qualified to be included in this scoping review. Ethiopia was the country with the highest number of included documents (31.25%); then Kenya (14.58%). Three of the studies were reported from Somalia. Two studies each were conducted in Uganda and Iran. One study each was conducted in South Africa, Burkina Faso, Fiji, Malawi, Honduras, Guatemala, Tanzania, Haiti, Zambia, South Sudan and Bangladesh. One of the documents reported a multi-country study, and seven were reports from the FAO or WHO. The majority of the studies were cross-sectional (29%) and seven were secondary analyses of Demographic Health Surveys. Four of the studies were qualitative studies that collected data through focus group discussions, key informants and in-depth interviews. Seven of the studies were mixed methods studies, while three each were case-control and four, randomised control trials. One study each employed a time series analysis and structural equation modelling (SEM) and there were seven documents that were reports. The studies that were conducted among children mostly reported on children with ages 6–23 months, and a few reported on CU5. For the studies on women and or households, the studies often reported on women who were 18 years or above. Altogether, the primary studies reported on about 4,000 women and 13,500 children and the rest of the studies collected data at the household level. For the papers that reported on the linkages between food insecurity and nutritional status of children or women, nutritional status was often assessed using weight-for-height (wasting), height-for-age (stunting), micronutrient deficiencies, minimum acceptable diet, and dietary diversity.

Figure 2: Countries studies were conducted.



RESULT SYNTHESIS

Data extracted on study characteristics are summarised in **Appendix 1** and are detailed in the next sections.

FOOD INSECURITY SITUATION AND DRIVERS

Our results show that the prevalence of food insecurity and hunger is high among households affected by crises and is driven by multiple factors. Some of the studies included in this review corroborate what is already known about the drivers of food insecurity at the household level. Eight studies reported the prevalence of household food insecurity; in 2021, between 702 and 828 million people globally, were affected by hunger or did not have enough food, while 50 million people faced emergency levels of hunger. Four studies reported that more than half (69%, 44.2% and 50.7%, 75%) of households were food insecure; food insecurity was characterised by insufficient access to adequate food, with a mean food access score of 7.9 using the Household Food Insecurity Access Scale (FAO, 2021; Betebo et al., 2017; [WHO, 2022](#); Berra, 2020; Munthali, 2017; Koss et al., 2016).

Regarding climate change, drought and other extreme weather events as drivers of food insecurity, three studies reported that less-developed countries with elevated risk of droughts had higher prevalence of moderate-to-severe food insecurity. Also, measurements across different scales showed that drought hazard was reported as a significant risk for vulnerability to food insecurity; the majority of respondents (93%) stated that the threats that emanated from drought hazard are primarily on food and well-being. Two studies' results also indicated high levels of food insecurity during long periods of flooding and varying flood and drought periods. 60% of households reported often (32.5%) or sometimes (25.5%) skipping meals. Incidence of undernutrition was also found to be high during these extreme changes (Tora et. al, 2021; Cavuilati, 2018; Posner, 2019).

Poverty was reported as a driver of food insecurity, with one study reporting 43.4% of undernourished children coming from the poorest households and another showing 75% of the study population suffering poor iron diets and linking poverty as the leading cause of food insecurity resulting in the observation among the participants. Poverty and urban food insecurity are directly related, where an unstable socio-economic situation of street traders was shown to threaten their food access and affect the dietary diversity of their households.

Low socio-economic status was associated with food insecurity. Children living in particular clusters, including poor wealth status and rural communities, were likely to have sub-optimal diets, especially diets deficient in vitamin A-rich foods. In addition, the dominant pathway to undernutrition was limited access to income sources,

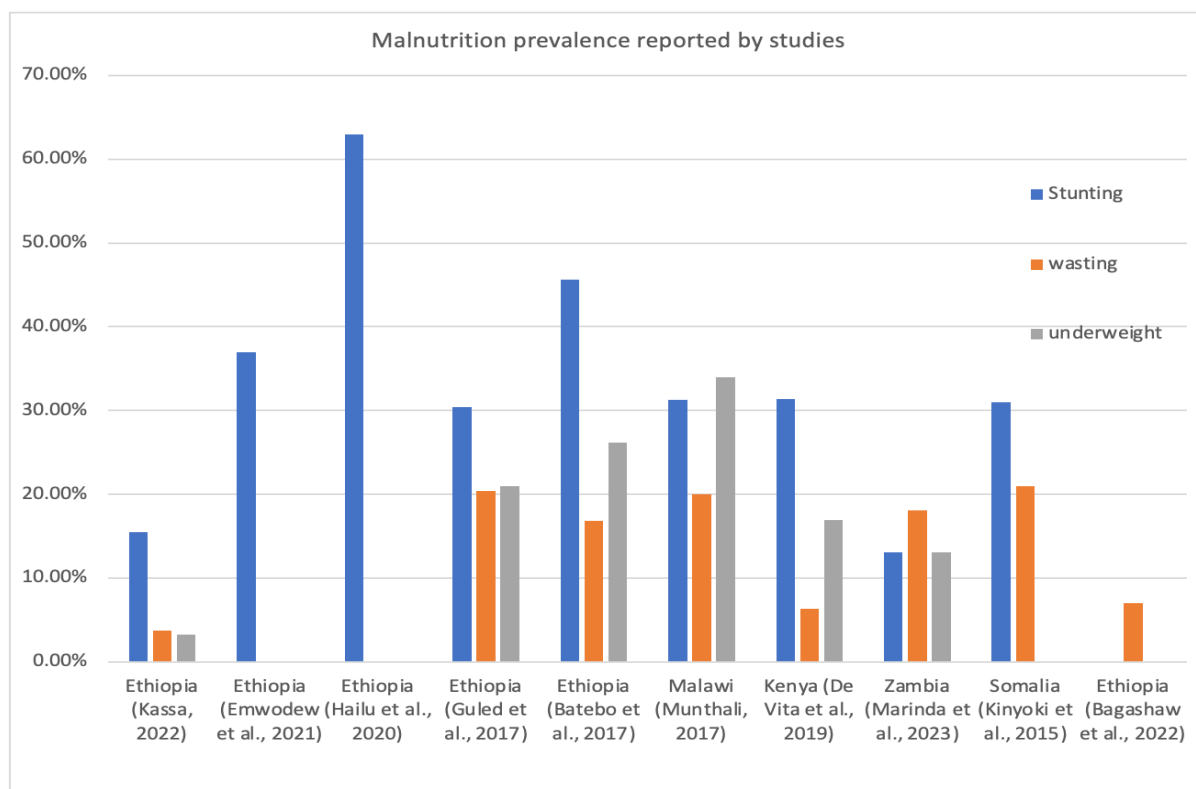
which triggers inadequate coping strategies, such as reducing meal frequency and eating inexpensive food, and affects dietary intake at the household level.

LINKAGES BETWEEN FOOD INSECURITY AND MALNUTRITION

Overall, findings of studies reporting on linkages between food insecurity and malnutrition indicate that food insecurity is directly linked with poor nutritional status of both women and children. Among populations who are food insecure, malnutrition is prevalent and has a negative impact on children and women. Food insecurity often manifests among children, women and at the household level as inadequate dietary diversity, decreased number of total meals, low intake of essential nutrients (eg, essential amino acids), low intake protein intake (eg, meat and eggs) and or micronutrient intakes such as vitamin A and iron which present as anaemia. At the household level, food access/consumption is influenced predominantly by household purchasing power and/or own food production. In periods of shocks or seasonality, food insecurity becomes severe and, consequently, its effect on nutritional status worsens.

Food insecurity was associated with wasting, stunting, underweight and micronutrient deficiencies (Yehualashet et al., 2021; Hailu et al., 2020; Cavuilati, 2018; Munthali, 2017; Tasic, et al., 2020; Posner, 2019; Gebremaryam et al, 2020; Guled et al, 2014; Kumar et al., 2021; Berra, 2020; De Vita et al., 2019; Betebo et al., 2017; Kinyoki et al., 2015; Much, 2014; FAO, 2009). The prevalence of undernutrition (wasting, stunting, underweight) reported among studies ranged between 6.3% and 34.0%. The majority of the studies reported a higher prevalence of stunting compared to wasting and underweight. In a study conducted among young children in Ethiopia, findings revealed that children from the lowest wealth quintiles were twice as likely to be stunted compared to their counterparts from higher quintiles (AOR = 2.00; 95% CI: 1.46–2.73); the stunted growth was explained by low consumption of micronutrients, animals source foods and low dietary diversity (Tiruneh et al., 2019; Emwodew et al., 2021). Children who consumed less than five food groups had higher odds of developing SAM (Gebremaryam et al., 2021). One cross-sectional study conducted in Ethiopia and a case-control study in Kenya reported that food insecurity was significantly associated with underweight and stunting but not wasting (De Vita et al., 2019; Berra, 2020). Four studies reported that food insecurity was associated with underweight, anaemia, and malnutrition among pregnant and lactating women (Cavuilati, 2018; Munthali, 2017; Posner, 2019; FAO, 2020). This was also emphasised in a qualitative study where participants pointed out that their weight has been negatively affected due to lack of quality food which is a result of limited economic resources (Brown et al., 2016).

Figure 3: Reported child undernutrition prevalence by studies



LINKAGES BETWEEN FOOD INSECURITY, CHILDHOOD DISEASES AND OTHER MORBIDITIES

Findings from three documents reported on childhood diseases and other morbidities and indicated that among children, food insecurity is linked with increased prevalence of malaria, diarrhoea, cholera, dehydration and overall poor child health (WHO, 2022; WHO, 2019; Posner, 2019). One technical report by the WHO on adapting to healthy climate health impacts on nutrition specifically mentioned that diarrhoeal diseases are avoidable and treatable but are widespread in sub-Saharan Africa, driven by food insecurity and food contamination (WHO, 2022, 2022). In a related report, increased food insecurity was associated with increased risk of heat stress, diarrhoeal diseases, and dehydration among children (WHO, 2019). In Kenya, Posner (2019) documented a significant association between the incidence rate of malaria and food insecurity – high malaria rates are a significant predictor of food insecurity even when controlling for household sociodemographic factors such as ethnicity and location. Specifically, households who were food secure had lower odds for reporting an incidence of malaria (OR = 0.54; 95% CI: 0.32-0.91; $p < 0.05$) when compared to food insecure households.

LINKAGES BETWEEN FOOD INSECURITY AND STIS, TB AND OTHER INFECTIOUS DISEASES

Seven papers reported associations between household food insecurity and HIV/AIDS infection, uptake of health services for managing HIV/AIDS, as well as adherence to HIV medication which has implications for viral suppression and prevention of ongoing transmission (Austin et al., 2020; Weiser et al., 2016; Koss et al., 2016; Miller et al., 2021; Onono et al., 2021; Nicastro, 2022; Richterman et al., 2018). Food insecurity directly increases HIV prevalence among women in Kenya and exacerbates the fragile mental and physical health status of adults living with HIV (Miller et al., 2021). Food insufficiency among HIV-infected pregnant and lactating women was associated with lower viral suppression (Koss et al., 2016) and those who received ART treatment had poorer outcomes. Potential causes for the observation included behavioural causes such as decreased adherence due to lack of food with which to take medicines, competing resource demands precluding access to medicines, psychological causes like depression and anxiety leading to decreased adherence, and pharmacokinetic alterations like altered ART absorption and reduced bioavailability in food insecure individuals. The study reported that increases in their food supply from farming and the corresponding reduction in hunger resulted in fewer ART side effects (Weiser et al., 2016). Studies that provided food and cash interventions for food-insecure people showed that improved food security attenuated some obstacles that HIV patients faced in adhering to ART and scheduled clinic appointments (Weiser et al., 2016). The provision of the dietary intervention also resulted in improved tolerance to ARTs.

Another study linked food insecurity and lack of dietary diversity to engagement in risky behaviours that predisposed participants to HIV infection (Weiser et al. 2016; Onono et al., 2021). Two studies showed that prior to the food and cash intervention, participants (primarily adolescent girls) engaged in high-risk sexual behaviour such as transactional sex, sex with multiple partners, and condomless sex. The girls had risky sex in exchange for money, clothes, food and basic necessities like sanitary towels, soap and body lotions and often resulted in infection with HIV (Onono et al., 2021).

Adolescents who received the intervention described no longer needing to engage in transactional sex or have multiple concurrent sexual partners as a way to meet their basic needs, including food. The key mechanisms for these effects included increased confidence and self-efficacy in overcoming existing reciprocity norms and sexual relationship power inequity.

HIV infection was reported to coexist with other opportunistic infections like cholera, which worsened with food insecurity. Analysis from a study showed that known HIV infection, female gender of the household member with known HIV, source of income in the household, food insecurity in the household, and time required to

fetch water were positively correlated with a reported history of cholera infection (Richterman et al., 2018).

The linkage between food insecurity and TB was driven by hunger and undernutrition. Food insecurity (undernutrition) was outlined by the WHO to be responsible for approximately 20% of new TB cases in 2020, and for old cases it was associated with poor prognosis of the disease. People with undernutrition were three times more likely to develop TB, had worsened TB treatment outcomes and had an increased risk of dying from TB ([WHO, 2022](#)).

LINKAGES BETWEEN FOOD INSECURITY AND NCDs

The documents reporting on the association between food insecurity and NCDs indicated that food insecurity increases the risk of NCDs such as diabetes, dyslipidaemia, hypertension, and mental health disorders including depression (Tezera et al., 2022; Hamed-Shahraki, 2021; Mahmoodi & Khodabakhshi, 2021; Kumar et al., 2021; Miller et al., 2021). NCD risk and or severity worsens with increasing food insecurity (Hamed-Shahraki, 2021; Mahmoodi & Khodabakhshi, 2021). In a study conducted among Iranian women that assessed household food insecurity, it was found that the risk of chronic diseases such as hypertension were significantly associated with food insecurity and the odds of cardiovascular diseases and metabolic risk factors such as hypertriglyceridemia, general obesity, abdominal obesity and hypertension (Hamed-Shahraki, 2021). Among diabetics, food insecurity was associated with non-adherence to dietary counselling/regimen (Tezera et al., 2022). However, food insecurity was not associated with glucose monitoring or glycaemic control (Tezera et al., 2022). Two studies showed that food insecurity is associated with low intake of fruits and vegetables, legumes, cereals and grains (Tezera et al., 2022; Hamed-Shahraki, 2021).

IMPACT OF FOOD INSECURITY

Six papers reported on the impact of food insecurity citing different impacts. Two global reports from WHO revealed that increased occurrence of drought affects access to water for irrigation and food processing thereby increasing food insecurity, which increases food contamination and occurrence of diarrhoeal diseases ([WHO, 2022](#)). One study conducted in Durban, South Africa showed that about 59.2% of members of households experienced various forms of chronic diseases including high blood pressure, diabetes, heart conditions and/or arthritis. These conditions threaten household food security by limiting household purchasing power due to their inability to work to improve their economic status due to the disease. Limited purchasing power in turn worsens the food security situation in the household resulting in a vicious cycle (Bikombo, 2014). In a focus group discussion (FGD) conducted among African women, they reported that hunger affects marital relationships, increases

conflict and reduces the likelihood of conception during seasonal periods of hunger (Grace et al., 2017).

Qualitative analyses of some studies showed that strengthening health systems and improved agriculture positively impacted food security, improved breastfeeding/knowledge of complementary feeding, disease prevention and management (Tasic et al., 2020). Additionally, food incentives and cash were shown to increase retention and adherence to treatment by alleviating economic barriers to attend clinics. In many instances, this manifested as a price effect reducing opportunity cost which means that individuals could attend clinics instead of spending time looking for food or money, a commonly reported reason for missing clinic visits (Czaicki et al., 2017; Gebremaryam et al., 2022).

FOOD INSECURITY PROXIES

The studies reporting on factors that implied food insecurity linked these factors directly to the outcomes of interest without mentioning food insecurity or linking food insecurity directly with the outcomes. Factors such as climate change, conflict, floods, droughts and other extreme weather conditions, resilience, coping strategies during periods of shocks and or famine were directly linked to undernutrition such as stunting, wasting and underweight, vitamin A deficiency and other micronutrient malnutrition. These factors can lead to undernutrition through their direct effects on quantity and quality of foods consumed (Begashaw, 2022; Ketsela, 2022; Emwodew et al., 2021; Demsash et al., 2022). Wealth index, poverty and poor socio-economic status were also linked with undernutrition directly by studies, even though their linkage with undernutrition would be indirect, through inadequate food consumption, care practices and access to healthcare services (Begashaw, 2022).

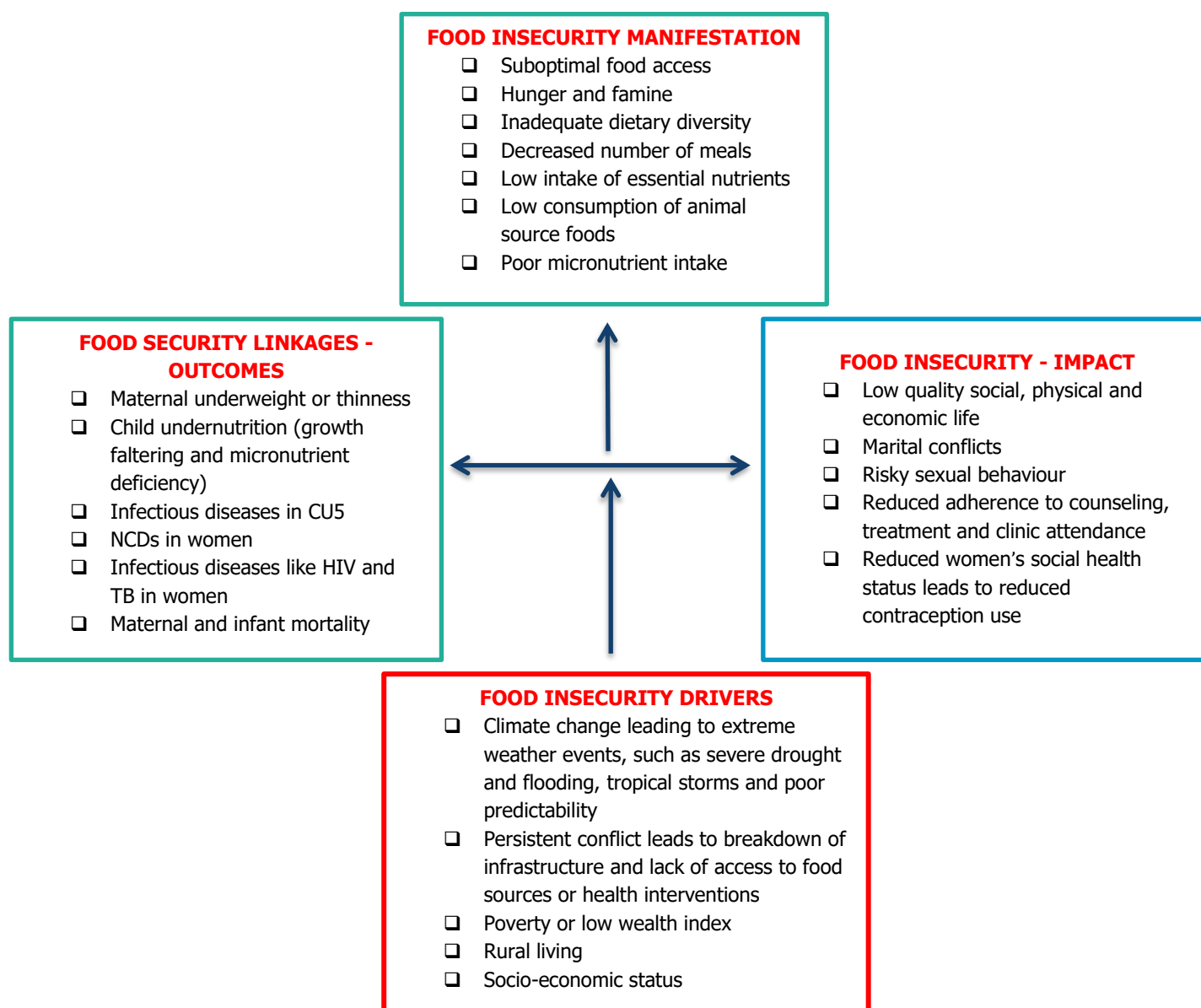
Specifically, two studies in Ethiopia reported several factors including low socio-economic status in the family were associated with vitamin A deficiency among children 6–23 months. Stunting was associated directly with rural living and vitamin deficiency was also associated directly with rural living, but these could have happened via their direct effect on food insecurity (Begashaw, 2022; Ketsela, 2022). Two studies linked wealth index directly to stunting. Poverty was linked directly to undernutrition and stunting. Another study in Ethiopia on the drivers of stunting showed food security, health systems strengthening, poverty, social safety nets and stunting seem interrelated. Here again, the relationship between poverty and social safety nets on stunting could be through food insecurity (Emwodew et al., 2021; Demsash et al., 2022).

LINKAGES OF FOOD INSECURITY AND MORTALITY

Findings from the two studies that linked food insecurity and mortality indicated that food insecurity was associated with increased childhood mortality (FAO, 2021). One technical report by the FAO stated that programs that enabled adequate provision of food (quality and quantity) reduced child mortality by 60% in Brazil (FAO, 2021). Another study that linked seasonal hunger and childbearing found that the health of a baby born during the hunger season was compromised, while there was reduced survival for women during childbirth (Grace, 2017).

Summary of findings on food insecurity and its linkages are illustrated in a conceptual framework in **Figure 4**.

Figure 4: Linkages between food insecurity, maternal and child malnutrition, morbidity and mortality.



DISCUSSION

The goal of this scoping review was to evaluate the linkages between food insecurity, malnutrition, health and disease, and mortality among women and CU5 in humanitarian contexts. Although humanitarian contexts were the focus, reports or studies identified in LMICs broadly that helped the understanding of these linkages were included. Our search and screening of studies and reports led to 48 documents, with six reporting the food security situation and its drivers, 24 reporting linkages with malnutrition, three on childhood diseases, five on NCDs, seven on HIV/AIDS and other infectious diseases, six reporting impacts of food insecurity, while nine studies reported on linkages between indirect or proxy indicators of food insecurity, such as lack of income or wealth index and the outcomes of interest. Two documents linked food insecurity with mortality.

The key findings of this review indicated that food insecurity is pervasive in fragile and resource-limited countries, with levels ranging from over half to three-quarters of households being food insecure or facing severe hunger in these contexts (FAO, 2021; Betebo et al., 2017; [WHO, 2022](#)).; Berra, 2020; Munthali, 2017; Koss et al., 2016). The drivers of food insecurity reported were persistent drought and other severe weather conditions such as extreme flooding – driven by climate change, poverty or low wealth index, rural living, low socio-economic status, and structural violence corroborating known food insecurity determinants reported globally (Tora et. al, 2021; Cavuilati, 2018; Posner, 2018).

CLIMATE CHANGE

Drought has been a known driver of food insecurity in the Greater Horn of Africa for many decades, but climate change has made the droughts more severe and the weather increasingly unpredictable. This seems to explain why food insecurity has also become more severe in the Greater Horn of Africa in recent decades. The poor weather conditions and lack of rain in the Region is expected to continue in 2023 (Button, 2023). Severe annual flooding in South Sudan worsened by climate change in recent years displaced 500,000 people in 2021 alone.

The most prolonged and severe drought on record is still occurring in the Horn of Africa, endangering millions of refugees and internally displaced people's lives and means of subsistence. The capacity of many people to farm crops, raise livestock, and purchase food has been hampered by persistent drought and high food prices. Thousands of people have been compelled to evacuate as the situation worsens in need of shelter and assistance.

The impact of climate change on food insecurity is indeed unprecedented in the Greater Horn of Africa generally, but countries in the region experiencing conflicts have deepened food insecurity. These conflicts cause displacement of people and

loss of their livelihoods, and the breakdown of both physical and social infrastructure which make interventions to address the impact of drought difficult to implement (Kabandula & Shaw, 2018).

Countries with extreme weather conditions should build resilience through climate smart agriculture, home gardening, and targeted food rations to cushion households and individuals against food insecurity and its attendant health risk (Clearinghouse, 2021). More resilient methods of crop production should be researched. Crop varieties that can withstand harsh environmental climatic conditions should be cultivated. Additionally, informal safety nets and social networks have implications for food security through the acts of sparing some free resources (food) for other households and or diseases. Implementing economic empowerment policies and programmes, especially among women, can promote economic status and improve household food insecurity and dietary diversity. As agriculture extension workers and aid providers may not be able to work in conflict zones such as the Greater Horn of Africa, where droughts also persist, the underlying drivers of conflicts and violence in such contexts must be addressed to ensure interventions to promote livelihood and food security are implementable.

MALNUTRITION

This review demonstrated an association between food insecurity and malnutrition, both directly and indirectly. Twenty-four articles and reports demonstrated the linkages between food security and malnutrition. These reports showed clearly that maternal and child undernutrition was associated with food insecurity. These studies were conducted across countries in the Horn of Africa, except a couple that were carried out in other parts of Sub-Saharan Africa and Bangladesh. The different manifestations of food insecurity were all linked to different forms of maternal and child undernutrition.

Malnutrition manifested as wasting, stunting and underweight in children, and underweight and anaemia in women (Yehualashet et al., 2021; Hailu et al., 2020; Cavuilati, 2018; Munthali, 2017; Tasic, et al., 2020; Posner, 2018; Gebremaryam et al, 2020; Guled et al, 2014; Kumar et al., 2021; Bera, 2020; De Vita et al.,2019; Betebo et al., 2017; Kinyoki et al., 2015; Much, 2014). Inadequate dietary diversity, decreased number of total meals, low consumption of animal source foods (meat and eggs), low intake of essential nutrients (essential amino acids) and or micronutrient intakes such as (vitamin A deficiency and anaemia) were all linked to different forms of malnutrition (Tiruneh et al., 2019; Emwodew et al., 2021). This implies that food insecurity affected the quantity and/or quality of food consumed, and the manifested malnutrition indicator reflected the nature of food insecurity.

The results of this review give a high certainty and confidence of enough relevant studies that demonstrate food insecurity increases maternal and child undernutrition risk in populations affected by crisis. Given the limited funding available in humanitarian settings, funds tend to be targeted to treatment of malnutrition, as opposed to the prevention of it, despite the known negative impacts on the health and wellbeing of women and children when they suffer episodes of undernutrition (eg, low birth weight infants, anaemia, susceptibility to infection, reduced physical growth and cognitive effects). At present, there is no standard operational package of preventative measures for food insecurity or malnutrition being implemented in humanitarian settings. The results of this review suggest that investing in a preventative package encompassing both food insecurity, nutrition and health services could have significant implications on malnutrition-related morbidity and mortality, specifically amongst vulnerable populations, in crisis contexts if adopted at a system-wide level.

INFECTIOUS DISEASES

Links were shown between food insecurity and increased rates of infectious diseases. In CU5, food insecurity was linked with increased prevalence of malaria, diarrhoea, dehydration and poor overall child health ([WHO, 2022](#); [WHO, 2019](#); Posner, 2019). An association was also observed between these diseases and climate change. Climate change can also affect access to water, sanitation and hygiene (WASH), leading to contaminated food and poor access to clean water. Climate change can therefore drive the synergy between inadequate dietary intake and childhood diseases, leading to malnutrition ([WHO, 2022](#)).

For childhood diseases, three studies reported on linkages between food insecurity and diarrhoeal diseases, hookworm parasitaemia and malaria. One study was conducted in Kenya while two were WHO reports. The reports did not reflect the entire Horn of Africa as it reported only one country in that region (Kenya). The findings do not reflect other humanitarian contexts such as countries with natural disasters like flooding or earthquakes. This means that the review findings give little certainty and low confidence on the linkage between food insecurity and childhood infectious diseases. No studies were found that linked food insecurity and childhood diseases like pneumonia, meningitis, measles, polio, diphtheria and pertussis in humanitarian contexts. However, our understanding of the synergy between malnutrition and disease suggests the two will further exacerbate each other in humanitarian contexts. No study showed how food insecurity is linked with the occurrence of zoonotic diseases, especially anthrax, Ebola, etc.

Further exploration of the relationship between food insecurity, malnutrition and other infectious diseases such as vaccine preventable illnesses like pneumonia, measles, meningitis, polio, diphtheria and pertussis is urgently needed in order to

understand their relationship and the impact these factors have on overall morbidity and mortality in vulnerable population groups, such as CU5 and pregnant and lactating women (PLW), and how to mitigate this effect.

HIV/AIDS AND TB

The results from this review also linked food insecurity to increased prevalence of HIV/AIDS, stemming from adoption of negative coping mechanisms and increased risky sexual behaviour resulting from lack of access to food (Weiser et al. 2016; Onono et al., 2021). Women from food insecure households were more likely to engage in transactional sex, have multiple sexual partners, and agree to condomless sex to receive money for food or receive food from men. Food insecure adolescent girls were reported to have sex for money, clothes, food and necessities like sanitary towels, soap and body lotions (Onono et al., 2021). If these women are pregnant or get pregnant, then the risk of transmission to the unborn child is high and this makes food insecurity also a risk factor for mother-to-child HIV transmission. Food insecurity increased the percentage of HIV cases among women and led to lower viral suppression due to weakened immune system and reduced adherence to ART. This means that food insecure people have increased HIV risk while food insecure people living with HIV/AIDS have increased disease progression due to lack of adherence to medication, more secondary infections, amongst other complications. The fact that food-based interventions for people living with HIV/AIDS improved adherence to ART, clinical appointments, and reduced risky sexual behaviour, suggests that addressing food insecurity can reduce the likelihood of disease progression to AIDS, increase levels of viral suppression, and subsequently reduce HIV incidence amongst populations living in crisis (Weiser et al., 2016).

Hunger and undernutrition were also linked with TB in this review. Evidence exists that the relationship between undernutrition and TB is bidirectional. Active TB leads to weight loss, which is also a risk factor for TB infection (Dargie et al., 2016). Several studies have reported a high undernutrition prevalence in TB patients (Dargie et al., 2016; Admassu et al., 2020); and as undernutrition is a known cause of a quarter of all new TB infections (Seid and Ayele, 2020), food insecurity leading to undernutrition and TB infection as observed in this review is very likely.

The linkage between food insecurity and HIV/AIDS, TB and other infectious diseases were assessed in eight studies. Of these seven were on HIV/AIDS and one on TB. The countries of these studies/reports reflected different humanitarian contexts such as the earthquake in Haiti, the Greater Horn of Africa, and many fragile less developed countries. The studies showed HIV prevalence increased with food insecurity due primarily to risky sexual behaviour among adolescent girls and women. Adherence to counselling and treatment were also reduced among food insecure people living with HIV/AIDS on treatment, and this made viral suppression

lower and HIV/AIDS disease progression faster. This means that the level of certainty that food insecurity increases HIV prevalence through risky sexual behaviour in humanitarian contexts is high. Although, one report showed food insecurity increased TB new cases by about 20%, increasing the risk of undernutrition, which in turn made treatment outcomes worse, the report was global. Therefore, the confidence and certainty on the linkage between food insecurity, undernutrition, TB incidence and treatment outcomes is moderately strong. Ensuring that high-risk individuals for HIV and TB are targeted in food-insecurity and malnutrition-related responses is essential to stagnating the spread of disease amongst these populations. Furthermore, ensuring that HIV-testing, treatment and counselling services are available to crises-affected populations would help to drive down transmission rates. Integrating HIV services into nutrition and antenatal clinics could be another way of increasing uptake of testing and treatment and preventing ongoing transmission of disease.

NON-COMMUNICABLE DISEASES (NCDs)

In terms of linkages with NCDs, food insecurity in LMICs showed an increased risk for diabetes, dyslipidaemia, hypertension, and mental health disorders including depression. Furthermore, food insecure people with NCDs had increased disease severity (Tezera et al., 2022; Hamedi-Shahraki, 2021; Mahmoodi and Khodabakhshi, 2021; Kumar et al., 2021; Miller et al., 2021). A comprehensive review based on published articles from 2010 to 2018 in Ethiopia echoed the findings of this review where food insecurity was shown to lead to malnutrition and obesity, which was highly associated with several NCDs such as diabetes, cancer, and cardiovascular disease, causing premature deaths (Mosadeghrad et al., 2019). The upsurge of NCDs globally has been associated with rapid unplanned urbanisation, globalisation of unhealthy lifestyles, and population ageing. Unhealthy diets and a lack of physical activity in LMICs increased metabolic risk factors like hypertension, hyperglycaemia, elevated blood lipids and obesity leading to NCDs and premature mortality (Candeias et al., 2010). Although many people in humanitarian contexts have hardly any food to eat, those who have some food have poor quality or empty calories. A coping strategy for lack of food includes compromising the quality for quantity (Das et al., 2020) as nutrient-rich healthier foods may be more expensive.

The linkage between food insecurity and NCD prevalence, including heart disease, diabetes, and cancers were reported by five studies, two conducted in Iran, and one each in Kenya, Ethiopia and Honduras. This implies just two studies show the linkages in humanitarian contexts. Clearly, the level of certainty and confidence to answer the linkage between food insecurity and NCDs in humanitarian contexts is low. Further research is therefore required to explore the relationship between food insecurity, malnutrition and different NCDs and determine how these can be most appropriately prevented/addressed in humanitarian crisis settings.

MORTALITY

Ultimately, food insecurity leads to mortality through malnutrition, maternal and child morbidity, infectious and non-infectious diseases. The two studies that reported on mortality showed both childhood and maternal mortality increased with food insecurity. The linkages between food insecurity, malnutrition, disease and mortality explain the third of all deaths among the two billion people in poor/crisis-affected countries where hunger and food insecurity are most prevalent. Reducing these preventable deaths may not happen without addressing the root causes of food insecurity and its linkages wholly. Just two studies reported the linkage between food insecurity and mortality and demonstrated that mortality increased in both children and women. It should be of note that both studies were conducted in LMICs and not in humanitarian contexts. This implies that the linkage between food insecurity and mortality in humanitarian contexts specifically cannot be answered with the current body of evidence in the literature; however, the link is expected to be similar. Further evidence is required to not only strengthen confidence in this association but also to enable the community to understand the scale of the problem. This will have implications for resource mobilisation, policy change and action.

SOCIAL AND GENERAL WELLBEING

Food insecurity does not only have a direct effect on nutrition, disease and mortality but has a long-term impact on other aspects of social, physical and economic life. It often exacerbates the effect of other risk factors on social and general wellbeing. The impact of food insecurity on marital relationships, increased conflict and risky sexual behaviour, among others, suggests that food insecurity can perpetuate a vicious cycle of household and community violence and ethnic conflicts (Ogun et al., 2018). Interventions that improved food insecurity alleviated economic barriers and promoted uptake of health services. Although not specifically mentioned, access to health services here will include antenatal, postnatal, delivery, family planning services and infant immunisation (Weiser et al., 2017).

RECOMMENDATIONS

Overall, further research to better understand the linkages between food insecurity, maternal and child nutrition and health, and survival is recommended. Specifically, well-designed research is needed to answer how food insecurity is linked with infectious disease prevalence, incidence, morbidity, and mortality. Studies are needed to show the linkages between food insecurity and childhood killer diseases like pneumonia, meningitis, measles, polio, diphtheria, and pertussis in humanitarian contexts. Further studies to better understand the linkage between food insecurity and NCDs in humanitarian contexts are required. Such studies should explore the mechanism by which food insecurity increases NCDs risk, especially whether food quality is compromised for quantity and how that is linked to obesity. Studies are also needed to show the linkages between food insecurity, maternal and child malnutrition, and other comorbidities, and mortality. Research to identify interventions that work for specific groups such as pregnant and lactating women, children, people living with HIV, mobile populations, conflict affected populations and insecure contexts should also be conducted. Investigation into the relationship between food insecurity, malnutrition and zoonotic diseases like Ebola and Marburg virus is also warranted.

Studies are also needed to investigate the impact of addressing the drivers of food insecurity. For example, research to evaluate the effectiveness of promoting resilient crop production methods and varieties that can withstand harsh environmental climatic conditions for cultivation are needed.

Multi-sectoral collaborative research to understand both short- and long-term impact of food insecurity interventions are needed. This will help optimize humanitarian response for social protection. Studies to investigate the impact of interventions that promote food security and nutritional status of women and children, maternal and child health, mortality, and social and economic life of households are recommended. These studies are needed to show the effect and mechanism by which food and livelihood interventions promote better nutrition, health, and survival of women, children and households in humanitarian contexts.

Cross-sector collaboration is needed to provide holistic preventative solutions to food insecurity drivers and impact. Sectors involved in food insecurity, nutrition, health, livelihoods, and WASH at global, national and sub-national levels should collaborate to provide long term preventive strategies to address the drivers of food insecurity, and food insecurity outcomes and impact. Humanitarian and research communities should work together to find lasting solutions to the drivers of food insecurity in this context.

KEY RECOMMENDATIONS

- **Collaboration between sectors involved in food insecurity, nutrition, health, livelihoods, water, sanitation and hygiene (WASH)** at global, national and local levels to provide long term preventive strategies to address and alleviate impact of the drivers of food insecurity, and food insecurity outcomes and impact.
- **A holistic approach to nutrition and health services in maternal care and early childhood development should be adopted.** Clear linkages have been shown between food insecurity and malnutrition, and poor health outcomes for pregnant and lactating women as well as children under five.
- **Integrated case management for malaria, pneumonia, diarrhoea and malnutrition, specifically for infants and children is recommended.** Community case management of these diseases could bridge the gaps between clinical care and hard-to-reach communities affected by humanitarian crises.
- **Provision of social protection services or safety nets to communities affected by food insecurity and crises** will reduce the chances of persons affected adopting negative coping mechanisms such as skipping meals, transactional sex, and reluctance to access healthcare in the event of illness - all of which contribute to increased risk of morbidity and mortality.
- **HIV and TB-sensitive nutrition programmes are a priority in regions affected by food insecurity.** Regular assessment, counselling and support services for improved nutrition behaviour and specialised nutritious foods should be provided to people living with HIV and TB in food insecure areas. These services could be implemented alongside social protection safety nets for food insecure families affected by HIV and TB. This will improve treatment outcomes and contribute to reducing ongoing transmission of both diseases.
- **Given the association between food insecurity and intimate partner violence, it is imperative that nutrition and health services have the sensitivity to pick up cases and refer them for appropriate support.** Future interventions should consider livelihood strategies alongside relationship and mental health approaches.
- **Integration of malnutrition and anaemia interventions with malaria programmes is essential to improving child survival rates in areas with high levels of food insecurity.** Although data in the literature on the direct links between recurrent and severe malaria and malnutrition is limited, evidence suggests that children who are malnourished have worse malaria outcomes. Further investigation into this relationship is required to better understand the immediate links between malaria and malnutrition and to better improve these targeted services.
- **Further collaborative research between the health and nutrition sectors is needed to better understand the linkages between food insecurity, malnutrition and health,** and to develop integrated prevention packages for both malnutrition and disease.

CONCLUSION

In conclusion, the scoping review demonstrates linkages between food insecurity and malnutrition, disease and mortality in women and children, as well as food insecurity's long-term impact on social, cultural and economic wellbeing in humanitarian contexts and LMICs. Food insecurity manifested as lack of food, inadequate dietary diversity, decreased number of total meals, low intakes of essential nutrients, low consumption of animal source foods and poor micronutrient intake. Food insecurity is extremely high in humanitarian contexts, ranging from half to three-quarters of households, and is attributable to climate change-driven severe drought and other extreme weather events, poverty, rural living, and low socio-economic status.

Food insecurity was linked to childhood stunting, wasting and underweight, micronutrient deficiencies and maternal thinness, underweight and anaemia. Children from food insecure households had a higher risk of malaria, anaemia, diarrhoea, dehydration and poor overall health.

Food insecurity increased risk of HIV/AIDS transmission through risky sexual behaviour such as transactional sex, multiple sexual partners and condomless sex. Food insecure people living with HIV/AIDS had increased disease progression and poorer ART adherence, while hunger and undernutrition increased the risk of TB infection and led to poor prognosis.

Food insecurity increased risk for NCDs like diabetes, dyslipidaemia, hypertension, and mental health disorders including depression. At the same time, food insecure people with NCDs had increased disease progression. The vicious cycle of the linkages between food insecurity, maternal and childhood malnutrition and disease, and the longer term social, physical and economic impact on food insecure people and households can increase maternal and childhood deaths

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APPENDIX 1

Table 1: Characteristics of reviewed studies

SN	Title	Author/publication year/study year	Study design	Study location	Age group, Final sample size	Food insecurity situation and causes	Linkages between food insecurity and outcomes
1	Drying Climates and Gendered Suffering: Links Between Drought, Food Insecurity, and Women's HIV in Less-Developed Countries	Kelly F. Austin, Mark D. Noble, and Virginia Kuulei Berndt (2020)	structural equation modeling (SEM) was used to assess the impact of drought on the portion of the adult population living with HIV that are women.	Multi-country analysis (less developed countries)	15 to 24 (Women) 91	Less-developed countries with elevated suffering from droughts have increased levels of moderate and severe food insecurity (0.28). Food insecurity also reduces women's socio-health status, which in turn, is associated with lower contraceptive use.	<p>MALNUTRITION</p> <p>Malnutrition was found to be prevalent in communities with a high rate of droughts and food insecurity.</p> <p>HIV</p> <p>food insecurity directly increases the percentage of HIV cases among women (0.53).</p>
2	Wasting and stunting risk factors in Somalian internally displaced person settlement	Blanárová and Pajak, 2022	Secondary quantitative data analyses using datasets provided by the Food Security and Nutrition Analysis Unit (FSNAU)	Key findings of a recent Link Nutrition Causal Analysis (NCA) study conducted in Settlements for the Internally	Women of reproductive age and children under five years of age.	The dominant pathway to undernutrition likely takes its roots in limited access to income sources which triggers inadequate coping strategies with an effect on the dietary intake of the household	<p>MALNUTRITION</p> <p>Inadequate dietary intake is linked with undernutrition.</p>

				Displaced Population in Dollow, Somalia			
3	Determinants of Stunting and Wasting Among Under-Five Children of Ethiopia: Analysis of Mini-demographic and Health Survey 2019 of Ethiopia	Bashaw Wogderes Begashaw (2022)/2022	Cross-sectional data from the 2019 mini demographic and health survey was used	Ethiopia	children aged 0-59 months, 5279 stunted under-five children 5408 wasted children	Results show wealth index as a determinant of stunted growth at p- value<0.05	IMPLIED FOOD INSECURITY Low wealth index implies a low standard of living where people don't have enough to purchase food stuffs
4	EXPLORATORY SPATIAL ANALYSIS OF UNDERNUTRITION AND ITS DETERMINANTS AMONG UNDERFIVE CHILDREN IN ETHIOPIA: A MULTI_LEVEL ANALYSIS	KASSA KETSELA (2022), DHS data from 2000 to 2016	Thesis using Four full-scale DHS surveys were conducted in 2000, 2005, 2011, and 2016.	Ethiopia	Children, 0-59 months	43.4 % and 24.3 % of the undernourished children in the sample came from the poorest and richest households	MALNUTRITION Dietary diversity is linked with nutritional status
5	Microcredit and Food Security: Evidence from Rural Households in Uganda	Faith M. Namayengo, Gerrit Antonidesa and Francesco Cecchic (2018)/ Between September 2013 and March 2014 with a follow-up study	A quasi-experimental cross-sectional design in which food security parameters of Old Borrowers and New Borrowers were compared based on the methodology sometimes referred to	Buikwe and Mukono districts in the central region of Uganda	Women who are serviced in 15-20 person Village Organisations (VO), 312 old borrowers 222 new borrowers (NB) 226 Comparison group (CG) Follow up Study	Microcredit does not improve food security of households. There is lower dietary diversity among long-time borrowers than new borrowers as well as larger reductions in dietary diversity scores among	

		between September 2014 and April 2015	as the USAID/AIMS comparative cross-sectional analysis design.		370 respondents (163 NB 207 CG)	new borrowers, after 1 year, compared to controls.	
6	Factors associated with maternal anaemia in Dadaab Refugee Camp, Kenya: a secondary data analysis.	James Smith, 2013	This was a secondary data analysis using data from a 2001-2002 study conducted in Hagadera and Ifo camps, Dadaab, Kenya	Dabaab Refugee Camp, Kenya	10-49, 319	75% of the study population suffered from anemia due to low levels of iron in their diets. several factors including poverty were leading causes of food insecurity among the refugees.	CHILDHOOD DISEASES food insecurity associated with low Hb. Diseases like Hookworm and malaria parasitemia were predictors of lower hemoglobin
7	Spatial distribution and determinants of childhood stunting among under-five children in Ethiopia: evidence from the 2019 Ethiopian demographic and health survey	Delelegn Emwodew et al., 2021/2019	The study used data from the 2019 Ethiopian Mini-Demographic and Health Survey (EMDHS).	Ethiopia	0-59 months old children, 4971	Climatic factors like dryness of land/ droughts may create food shortages (food insecurity) and occurrence of starvation, which may eventually lead to stunting. Stunting increased with poverty (highest in poorest quintile) and higher in rural than urban population. Children from the poorest wealth quintile were 2 times (AOR = 2.00; 95 % CI: 1.46–2.73) more likely to be stunted than children from the richest wealth quintile	MALNUTRITION Children from the poorest wealth quintile were 2 times (AOR = 2.00; 95 % CI: 1.46–2.73) more likely to be stunted than children from the richest wealth quintile.

8	<p>Spatial distribution and variation of risk factors for poor consumption of foods rich in vitamin A among children age 6-23 months in Ethiopia. Geographical weighted regression analysis</p>	<p>Sofonayas Abebaw Tiruneh et al., 2019</p>	<p>This study is a community-based cross-sectional study that was conducted using a nationally representative 2016, Ethiopian Demographic and Health Survey (EDHS) dataset.</p>	<p>Ethiopia</p>	<p>children between 6-23 months, 3055</p>	<p>Low socio-economic status has a higher potential of increasing food insecurity in Ethiopia.</p>	<p>MALNUTRITION</p> <p>Overall, two-thirds (62%: 95% CI: 60.56, 64.00) of children aged 6-23 months had poor consumption of foods rich in Vitamin A. Animal source foods rich in vitamin A were reported primarily poor in consumption preceding the last 24 hours in the survey period. Egg consumption was reported mostly taken foods in the last 24 hours period. Poor consumption of foods rich in vitamin A across regions of Ethiopia might be due to the regional variation in dietary preference, the low practice of complementary feeding, and socioeconomic status, among others.</p>
9	<p>Spatial distribution and Determinates of poor consumption of foods rich in vitamin A among children aged 6–23 months in Ethiopia using data from Ethiopia Demographic and Health Survey 2019:</p>	<p>Addis Bilal Muhye et al., 2022</p>	<p>A Secondary data analysis of Ethiopian Demographic and Health Survey (EDHS) 2019 was done to investigate the spatial distribution and determinants of poor consumption of foods rich in vitamin A</p>	<p>Ethiopia</p>	<p>children between 6-23 months, 1605</p>		<p>several factors including low socioeconomic status in the family were associated with poor consumption of foods rich in vitamin A, which eventually leads to vitamin A deficiency.</p>

	Spatial and Multilevel Analysis		among children aged 6–23 months.				
10	Spatial Distribution of Foods Rich in Vitamin A Intake Status and Associated Factors among Children aged 6–23 Months in Ethiopia: Spatial and Multilevel Analysis of 2019 Ethiopian Mini Demographic and Health Survey.	Addisalem Workie Demsash et al., 2022	A repeated cross-sectional study design was used to carryout the study.	Ethiopia	children between 6-23 months, 1407	Children living in particular clusters, poor wealth status, and rural living were associated with poor consumption of vitamin A-rich foods	MALNUTRITION Intake of vitamin A was proven to be an effective way of preventing malnutrition in Ethiopia.
11	TECHNICAL SERIES ON ADAPTING TO CLIMATE SENSITIVE HEALTH IMPACTS DIARRHOEAL DISEASE	WHO	WHO report				CHILDHOOD DISEASES Increased occurrence of drought affect access to water for irrigation and food processing increasing food insecurity. Also increases food contamination and diarrhoeal diseases. Diarrhoeal diseases are preventable and treatable, but they were responsible for approximately 1.5 million deaths globally in 2019, and most occurred in SSA and South Asia

							<p>IMPACT</p> <p>Extreme weather and increased frequency and duration of drought both decreased food security and led to increasing poor hygiene and environment, acute malnutrition, food contamination, cholera and other diarrhoeal diseases.</p>
12	Technical series on Adapting to Climate Sensitive Health Impacts Undernutrition	WHO, 2019	WHO report				<p>CHILDHOOD DISEASES</p> <p>increased risk of heat stress, diarrhoeal diseases, and dehydration among children, were some of the health factors associated with climate change and food insecurity</p>
13	Understanding household food insecurity and coping strategies of street traders in Durban	Bikombo (2014)	This thesis paper used a cross sectional and descriptive design	Isipingo, Durban, and Phoenix of eThekweni municipality in South Africa	Street traders above 18 years, 120	Poverty and urban food insecurity are directly related. Unstable socio-economic situation of street traders threatens their food access and affect the dietary diversity of their households.	<p>IMPACT</p> <p>59.2% of members of street traders' households suffer from various chronic diseases such as high blood pressure, diabetes, heart conditions and/or arthritis posed a threat to household food security as they limit their purchasing power.</p>

14	An analysis of food demand in a fragile and insecure country: Somalia as a case study	Mohamud Hussein et al., 2021	A novel World Bank household survey data collected in 2018, was used to estimate demand elasticities for Somalia taking into account, differences in household type, regional conflict, and income remittances from overseas.	Somalia	5145		<p>MALNUTRITION</p> <p>The findings indicate that food insecurity has resulted in an increase in the levels of micronutrient and macronutrient malnutrition in Somalia. Macronutrient implications have obvious consequences for increasing the level of malnutrition in Somalia</p>
15	A qualitative investigation of childbearing and seasonal hunger in peri-urban Ouagadougou, Burkina Faso	Kathryn Grace et al (2017), 2013	Qualitative data was collected in a series of five group interviews in a peri-urban community, located on the outskirts of Ouagadougou	Burkina Faso	19 – 32 years, 26 women participated in the focus groups, which ranged from 2–7 participants in each group		<p>IMPACT</p> <p>The participants reported that hunger can affect marital relationships, increasing conflict and impacting the likelihood of conception during the hunger season.</p> <p>MORTALITY</p> <p>They also discussed concerns over the health of a baby born during the hunger season as well as concerns over the birthing woman’s survival during childbirth</p>
16	Spatial heterogeneity and factors influencing stunting and severe stunting	Bayuh Asmamaw Hailu et al., 2020/2019	his study is a secondary data analysis of the 2019 Ethiopian Mini	Ethiopia	Children below 5 years		<p>MALNUTRITION</p> <p>Children whose household wealth index were middle,</p>

	among under-5 children in Ethiopia: spatial and multilevel analysis		Demographic and Health Survey (EMDHS).				poorer, and poorest had 3.25, 6.19- and 5.95-times higher risk of severe stunting, respectively, as compared to children from the richest households Supplementary
17	Changes in Health and Antiretroviral Adherence Among HIV-Infected Adults in Kenya: Qualitative Longitudinal Findings from a Livelihood Intervention	Weiser et al., 2017/2016-19	longitudinal qualitative study	Kenya	HIV adults 18 years and above, 117		HIV/AIDS Improved food security attenuated some obstacles that participants faced in adhering to ART or to scheduled clinic appointments. Many participants said that increases in their food supply from farming and the corresponding reduction in hunger resulted in fewer ART side effects
18	AGRICULTURAL DEVELOPMENT AND FOOD SECURITY IN POST-CONFLICT SOUTHERN SUDAN	Michael Roberto Kenyi (2011)/2009	This thesis paper adopted a quantitative-qualitative design. The quantitative measures were taken from the Sudan Institutional Food Security Information for Action (SIFSIA) database. The qualitative measures for the study were sourced from the household interviews, Focus Group	South Sudan	542 households	The small increase in cereal production after the conflict period in South Sudan was inadequate to support the cereal needs of households, leading to food insecurity. Major causes of food insecurity at the household level were drought, flood and erratic	IMPACT Poor infrastructure, weak policies, and lack of access to services to improve farm production were among the key constraints reported by households in Southern Sudan.

			Discussions (FGDs) and Key Informant Interviews (KIIs)				
19	Food security status of patients with type 2 diabetes and their adherence to dietary counselling from selected hospitals in Addis Ababa, Ethiopia: A cross-sectional study	Robel Tezera, 2022/2019	A facility-based cross-sectional study was conducted among adult patients with T2DM at selected public hospitals in Addis Ababa, Ethiopia, from July 10 to August 10, 2019.	Ethiopia	Patients with T2DM, 602 aged 18 and above	More than half of the respondents, 305 (50.7%), were food insecure. The proportion of mildly food insecure, moderately food insecure, and severely food insecure were 51 (8.5%), 176 (29.2%), and 78 (13%), respectively	NCDS Over half of the diabetics were food insecure. Moderate and severe food insecurity was associated with nonadherence to dietary counseling.
20	Food Insecurity and Cardiovascular Risk Factors among Iranian Women	Soudabeh Hamedi-Shahraki et al, 2021/2019	This cross-sectional study was carried out from February 14 to April 15, 2019, among a representative sample of women aged 18–60 years under cover of health centers affiliated to	Iran	women aged 18–50 years, 630	The mean (\pm standard deviation) age of participants was 33.2 ± 7.8 years. The prevalence of food security and mild, moderate, and severe food insecurity in participants was 44.2, 26.8, 20.0, and 9.0%, respectively. As expected, the food insecurity problem was more common among	NCDS The prevalence of hypertriglyceridemia was significantly higher in women suffering from food insecurity compared to food-secure women ($P = .025$). Furthermore, the prevalence of hypertension was significantly higher among those suffering from a more severe form of food

			Zabol University of Medical Sciences.+			educational level (P = .037).	insecurity compared with those experienced the milder form one (P = .015). Likewise, the prevalence of general and abdominal obesity among food-secure women were 9.0% and 14.0%, respectively, which were significantly lower than food-insecure women (P = .003 and P = .017, respectively)
21	Drought vulnerability perceptions and food security status of rural lowland communities: An insight from Southwest Ethiopia	Tora et al, 2021	The research design used in this study was a community-based cross-sectional survey. The mixed methods research approach was employed to associate both qualitative and quantitative data.	Ethiopia	20-90 years, 285	Across the varied arrays of scales, drought hazard is reported as a cause of vulnerability to food insecurity. The survey findings showed that the vast majority of respondents (93%) stated the threats emanated by drought hazard on food and well-being related concerns	MALNUTRITION In Ethiopia, drought is among the drivers of food insecurity and malnutrition. It induces sudden disease occurrences and progressive worsening of malnutrition.
22	Association between depression and food insecurity in patients with diabetes: a cross-sectional study	Mahmoodi and Khodabakhshi (2021)	This was a cross-sectional study	Iran	women aged 35-75 years, 200		NCDS There was a significant association between household food insecurity and depressive disorders. The more severe the

							depression, the greater the food insecurity
23	Food Insufficiency Is Associated With Lack of Sustained Viral Suppression Among HIV-Infected Pregnant and Breastfeeding Ugandan Women	Catherine A. Koss <i>et al.</i> , (2016)/2009-12	A secondary data analysis from the PROMOTE-Pregnant Women and Infants study (NCT00993031) was performed.	Tororo, Uganda	HIV-infected, ART-naive (Anti-Retroviral Therapy) pregnant women between 12 and 28 weeks gestation, 171	74.9% of participants reported food insufficiency. In multivariable analysis, food insufficiency [adjusted odds ratio (aOR) 0.38, 95% confidence interval (CI): 0.16 to 0.91], higher pretreatment HIV-1 RNA (aOR 0.55 per 10-fold increase, 95% CI: 0.37 to 0.82), and lopinavir/ritonavir versus efavirenz (aOR 0.49, 95% CI: 0.24 to 0.96) were associated with lower odds of sustained viral suppression.	HIV/AIDS Food insufficiency among HIV-infected pregnant and breastfeeding women is associated with lower viral suppression. Food insufficiency also makes viral suppression low among those receiving treatment.
24	Climate Change and Human Health: An Ecological study on climate variability and malnutrition in Fiji.	Vakaruru Cavuilati, 2018/2006-16	A times series analysis was used to examine the association between climate change and malnutrition in Fiji	Fiji		The availability of food was dependent on agricultural production while the variation in food availability was linked to climate change.	MALNUTRITION As the severity of food insecurity increased, maternal thinness and anemia also increased.

25	Food Accessibility and Nutrition Status of Tenant Women of Reproductive Age and Under-Five Children on Smallholder Tobacco Farms in the Northern Malawi	Justice Munthali, 2017/2017	A quantitative study approach was used. This approach was fit for the demographic, socio-economic, HFIAS, HHS, MAHFP, IDDS and nutrition status indicators from anthropometric measurements used in this study.	Malawi	women 15 to 49 years children 0-59 months, 110 women of reproductive age 139 under-five children	The experience of food insecurity access was severe for 75% of the households. Nearly one-fifth of households were severely hungry, and had adequate food for only about eight months of the year. The women and their children consumed a mean of two food groups in the previous 24 hours. For the women, 21% were malnourished.	<p>MALNUTRITION</p> <p>More than three-quarters of households were food insecure, and malnutrition was also high. Among the children, 20% were wasted, 31.3% were stunted and 34% were underweight. It can be concluded that food insecurity is associated with malnutrition in children and women.</p>
26	Drivers of stunting reduction in Ethiopia: a country case study	Hana Tasic, 2020/2000-16	This study employed both quantitative and qualitative methods. Specifically, a systematic literature review, retrospective quantitative data analysis using Demographic and Health Surveys from 2000–2016, qualitative data collection and analysis, and analyses of key nutrition-specific and sensitive policies and	Ethiopia			<p>MALNUTRITION</p> <p>Food security, social safety nets and poverty reduction programs, among others are associated with stunting.</p> <p>IMPACT</p> <p>Health systems strengthening, improved access to health agriculture improvements and food security, breastfeeding, promotion/improved knowledge of complementary</p>

			programs were undertaken				feeding, disease prevention and management, social safety nets and poverty reduction programs, better access to education, and reductions in open defecation were named key drivers of child stunting reduction in Ethiopia.
27	Climate Change, Food Security and Health of Rural Populations in Isiolo, Kenya	Sarah Posner, 2019	The study adopted a cross-sectional survey design method to assess respondents' preferences, decision-making, attitudes, and perceptions of factors that influence rural household food security in Isiolo, Kenya	Kenya	Women of reproductive age (18 to 50) years, 274	Results indicated that high levels of food insecurity were experienced during periods of climate change by households in Isiolo with 60% of households reporting often (32.5%) or sometimes (25.5%) skipping meals. Household wealth is an important contributor to food security and other related health outcomes and can be a long-term indicator of successful livelihood strategies.	<p>MALNUTRITION AND MALARIA</p> <p>Women and children under five were differentially vulnerable to both malaria transmission and malnutrition related to food insecurity, due to limited access to household resources.</p> <p>IMPLICATION</p> <p>Household socio-economic factors are proxy for food security</p>
28	Countdown to 2015: Ethiopia's Progress Towards Reduction in Under-five Mortality	Ethiopian public health institute (2014)/2000-11	Mixed methods approach was used to explore how policy development and	Ethiopia	Children under 5 years		<p>IMPLICATION</p> <p>Wealth index is proxy for food insecurity and stunting</p>

		<p>strategic planning, health system and health programming, and financing intersect with the scaling-up of key life-saving interventions to improve child survival. National level data sets used in the analyses included: the Ethiopian Demographic and Health Survey (EDHS: 2000, 2005, 2011 & Mini DHS: 2014), National Malaria Indicator Survey (2007 & 2012), National Nutrition Program baseline Survey (2009), the National Immunization Coverage Survey (2012), and Performance Monitoring and Accountability 2020 (PMA 2020)</p>		<p>20% richest households having a large advantage over the bottom four wealth quintiles. Recurrent droughts was a major factor of food insecurity.</p>	
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29	Determinants of severe acute malnutrition among children aged 6–23 months in bahir darcity public hospitals, Northwest Ethiopia, 2020:a case control study	Tigist Gebremaryam et al, 2020/2020	Institutional based unmatched case control study was conducted among cases (children 6–23 months of age with SAM) and controls (children 6–23 months of age without SAM) admitted in the pediatric ward of Bahir Dar city public hospitals of Northwest Ethiopia	Ethiopia	Children 6–23 months with SAM and without SAM, 67 cases and 134 controls		<p>MALNUTRITION</p> <p>Dietary diversity was found to be significantly associated with the risk of SAM. Children who had poor dietary diversity (< 5 food groups) were 9.20 times more likely to be acutely malnourished as compared to children with good dietary diversity (\geq 5 food groups).</p> <p>IMPLICATION</p> <p>Family size was found to be significantly associated with SAM. Children from households with large family size > 5 were 3.89 times more likely to be affected by SAM as compared to children from households with smaller family size.</p>
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30	UNDERNUTRITION PREVALENCE AND ITS DETERMINANTS AMONG CHILDREN BELOW FIVE YEARS OF AGE IN SHABELLE ZONE, SOMALI REGION, EASTERN ETHIOPIA	RASHID ABDI GULED et al, 2017/2014	A cross sectional study was carried out in August 2014 among 415 child-mothers/caregivers. Face-to-face interview using a standard questionnaire, scales and stadiometer measurements of children's weight and height were done. Bivariate analysis to identify candidate variable for multivariable analysis were done. Multivariable linear regression were used to determine predictors for undernutrition	ETHIOPIA	415		<p>MALNUTRITION</p> <p>As number of children in the family increases the tendency of being chronically malnourished increased (P= 0.01, CI= 0.04, 0.33). While wasting rate increases when number meals decrease (P= 0.04, CI= -0.262, -0.006).</p>
31	Household food insecurity and health in a high-migration area in rural Honduras	Sanjeev Kumar, Nicholas A. Christakis , and Rafael Pérez-Escamilla (2021)		Honduras	24695	Females (OR: 1.11, p-value: 0.0001)), indigenous people (OR: 2:00, P-value:.0001 0), and those planning to migrate (OR: 1.24, p-value: 0.0001) have higher odds of experiencing food insecurity. The risks of food insecurity and poor health were mitigated	<p>NCDS</p> <p>Living in a food insecure compared to a food secure household was associated with 77 percent higher odds of being depressed, 35 percent higher odds of low overall mental health, and 20 percent higher odds for low overall health.</p>

						where they were born and having multi-generations of relatives living in the same village—a measure of the opportunity and availability of social networks.	
32	Household Food Insecurity Predicts Childhood Undernutrition: a Cross-Sectional Study in West Oromia (Ethiopia)	Wondu Garoma Berra, 2020	Cross-sectional design	Ethiopia	(Children aged 6-23 months), 525	Two-thirds (69%) of households were classified as food insecure (had insufficient access to adequate food), with a mean (SD) household food access score of 7.9 (7.7). The respective prevalence of mild and moderate food-insecure households was 56.6% and 12.4%.	MALNUTRITION Higher proportions of children in food-insecure households were stunted (41.8% vs. 15.5%), underweight (22.0% vs. 6.1%), and wasted (14.9% vs. 6.1%). Food-secure households were 54% protective (OR: 0.46, 95% CI: 0.25–0.84) for child undernutrition. Compared to children in food-secure households, children who were reportedly living in moderately food-insecure households were over twice more likely stunted (OR: 2.09, 95% CI: 1.02–4.28) and over 4 times more likely underweight (OR: 4.73, 95% CI: 1.81–12.35). Food insecurity was not a correlate for acute malnutrition (wasting) in children.
33	Household Water and Food Insecurity Are	Miller, J. D., et al., (2021)/2017	Cluster randomized controlled trial	Kenya	720	Hc an	NCDS

	Positively Associated with Poor Mental and Physical Health among Adults Living with HIV in Western Kenya					Correlations between household FI, WI, and wealth were low, meaning they measure distinct constructs.	Poor mental and physical health among adults living with HIV. Food insecurity was associated with numerous physical and mental health outcomes
34	Malnutrition, morbidity and infection in the informal settlements of Nairobi, Kenya: an epidemiological study	De Vita, et al., (2019)/2003	case control	Kenya	children under five), 1119	Household food insecurity (Accessibility)	<p>MALNUTRITION</p> <p>The prevalence of malnutrition was high, with 26.3% of the children being stunted, 6.3% wasted and 13.16% underweight. Stunting was higher among children consuming less than four food groups. There was a significant association (p-value < 0.05) between moderate and severe food insecurity and both stunting and underweight, but not with wasting.</p>
35	Leave no one behind to end tuberculosis and end world hunger (who.int)	WHO, 2022		Global		<p>Food insecurity (inadequate/unavailability)</p> <p>The World Food Programme estimates that globally, up to 828 million people do not have enough food and 50 million face emergency levels of hunger.</p>	<p>TUBERCULOSIS</p> <p>Hunger (Undernutrition) is one of the most significant drivers of tuberculosis, accounting for an estimated 19% of incident TB in 2020, worldwide. People with undernutrition are three times more likely to develop TB disease and undernutrition is a common consequence of TB. Undernutrition also worsens</p>

							TB treatment outcomes and increases the risk of dying from TB.
36	The role of livestock in food security, poverty reduction and wealth creation in West Africa	FAO, 2020	Report	West Africa		Food insecurity (Inadequate intake of animal source food)	<p>MALNUTRITION</p> <p>Animal products provide energy, minerals, and vitamins. Their predominant role is the supply of some essential amino acids and vitamins, which the human body cannot synthesize and must be necessarily provided by food. Foods of animal origin are also important in the recuperation of nutritionally deficient kids and pregnant or lactating women, and many cases of malnutrition in West Africa may be related to the poor animal product intake</p>
37	Mixed-methods study identifies key strategies for improving infant and young child feeding practices in a highly stunted rural indigenous population in Guatemala	Kelley Brown et al., 2016	Data were collected using a mixed-methods approach. Qualitative methods: FGD with caregivers and KII with community leaders and NGO staff. Quantitative methods included structured surveys with primary caregivers and local store vendors	Guatemala	Caregivers of infants, 102 caregivers, FGD and KII numbers not specified	FGD participants reported that food production was not sufficient to satisfy domestic consumption needs, making it necessary to purchase additional food. Lack of dietary diversity was attributed to financial difficulties	<p>MALNUTRITION</p> <p>FGD participants attributed child malnutrition to lack of quality food, stemming from limited economic resources. Juan, a male participant from K'exel, stated, 'where does it [malnutrition] come from? It comes from extreme poverty. There is no food.' A female participant from K'exel, Ana, remarked,</p>

							their weights are affected because of a lack of food.
38	It helps me live, sends my children to school, and feeds me: a qualitative study of how food and cash incentives may improve adherence to treatment and care among adults living with HIV in Tanzania	Czaicki, et al, 2017/February to May, 2015	This study utilized a mixed method approach which included a randomized controlled trial which evaluated the effectiveness of conditional food and cash incentives to improve adherence to ART among food insecure HIV patients and a qualitative study to understand the social factors affecting the uptake of ART services	Tanzania	Adults from 18years of age, 29 adults used for in-depth interview	This study was conducted among food insecure HIV patients	IMPACT Food incentives and cash increased retention and adherence by alleviating economic barriers to attend clinic. In many instances, this manifested as a price effect reducing opportunity cost which means that individuals could attend clinic instead of spending time looking for food or money, which was a commonly reported reason for missing clinic visits.
39	Household Food Insecurity and Its Association with Nutritional Status of Children 6–59 Months of Age in East Badawacho District, South Ethiopia	Bealu Betebo et al., 2017	Community based cross-sectional study design was employed using quantitative approach in East Badawacho District, from February 20 to 30, 2014	East Badawacho District, South Ethiopia	children 6–59 months of age, 482	More than three-fourths of households (376) (75.8%) experienced some degree of food insecurity in the one month preceding the survey. Among these households 62 (12.6%) were mildly food insecure, 162 (32.2%) were	MALNUTRITION The mean HAZ, WHZ, and WAZ were lower for children from food insecure households than for children from food secure households ($P < 0.05$). However, the mean WHZ has no significant difference between the two

						(31.0%) were severely food insecure	groups. Similarly, the prevalence rates of stunting and underweight were slightly higher among children from food insecure households than among children from food secure households. However, the prevalence of wasting among children did not differ significantly between food insecure (14.8%) and food secure households (14.1%). During both bivariate and multivariable analysis, household food insecurity was associated with stunting and underweight but not with wasting
40	Measles Control and Elimination in Somalia: The Good, the Bad, and the U	Raoul Kamadje/January 2021 and April 2021	A cross-sectional study was conducted among from the selected settings between January 2021 and April 2021	Somalia	mothers/caregivers who had children <5 y old, 1190	The univariate regression analysis showed that children from families having a monthly income >15,000 BDT, who had mothers having a college education, fathers aged 26–30 y and having a college education or above, and those aged 12–35 months were more likely to get minimum DD. Household food security status was associated with DD of children.	

41	The role of food security in increasing adolescent girls' agency towards sexual risk taking; qualitative findings from an income generating agricultural intervention in southwestern Kenya	Onono, M. A., et al., (2021). /October 2018–December 2019.	Qualitative study Semi-structured indepth interviews of adolescent girls 13-19 years	Kenya	13-19 years	Agricultural and finance intervention to improve food security. Food insecurity (struggles in obtaining food	<p>HIV/AIDS</p> <p>Prior to the intervention and in the control arm, girls engaged in high-risk sexual behaviour such as transactional sex, multiple partnerships, and condomless sex. This high-risk sexual behaviour among the adolescent girls took place in different types of sexual relationships. The girls had sex in exchange of money, clothes, food and necessities like sanitary towels, soap and body lotions one contracted HIV through that. At times, it was not so much the lack of food that prompted the sex, but desire for more dietary diversity in form of snacks.</p>
42	Perceived impacts of a pilot agricultural livelihood and microfinance intervention on agricultural practices, food security, and nutrition for Kenyans living with HIV	Nicastro, T. M., et al., (2022)/July 2012-August 2013	pilot randomized controlled trial, Qualiitative study	Kenya	18–49 living with HIV, 54	Having to go without food, or limit intake of foods, limited diversity of food	<p>HIV/AIDS</p> <p>Provision of the intervention resulted in improved tolerance to Anti-Retroviral therapy.</p>

43	Dietary diversity and nutritional status of children aged 6–59 months from rural fishing and non-fishing communities in Zambia	Marinda et al., 2023	A descriptive, cross-sectional study design was used. A questionnaire comprising sub-sections with questions on respondent demographic and socioeconomic characteristics, fishing and fishing-related activities was used to collect the data.	Zambia	children of ages 6–59 months, 198		MALNUTRITION Low dietary diversity was observed across the fishing and non-fishing communities and less than half of the children consumed fish despite the proximity of the study sites to one of the largest water bodies in Zambia. Better nutrition outcomes were observed among children in capture fisheries dependent households.
44	Predictors of the risk of malnutrition among children under the age of 5 years in Somalia	Damaris K Kinyoki, James A Berkley, /2007-10 Grainne M Moloney, Ngianga-Bakwin Kandala and Abdisalan M Noor , 2015	Cross-sectional. Nutritional assessment surveys using structured interviews were conducted among communities	Somalia	children aged 6–59 month, 73 778 children	Household consumption of carbohydrate and proteins were high. Low household access (consumption) to fruits and vegetables	MALNUTRITION Children who had consumed any of the staple sources of carbohydrates within the 24 h prior to the survey had lower risk of wasting and stunting.
45	Preventing Moderate Acute Malnutrition (MAM) Through Nutrition-Sensitive Interventions	Noreen Much, 2014	Technical report			Peak periods of food insecurity	MALNUTRITION Wasting or sudden weight loss often occurs during specific seasons or 'seasonality' when a known 'shock' such as peaks in food insecurity.

46	Risk Factors for Self-Reported Cholera Within HIV-Affected Households in Rural Haiti	Richterman et al., 2018/2010-13	Randomised Control Trial	Haiti	18years and older, 352 HIV affected patients in households		HIV/AIDS The univariable analyses showed known HIV infection, female gender of the household member with known HIV, source of income in the household, food insecurity in the household, and time required to fetch water was correlated with a reported history of cholera infection, with P < .05.
47	The state of food and agriculture, Livestock in the balance	FAO, 2009	Report	Global	Women and children	Low livestock consumption	MALNUTRITION Low intake of livestock is associated with micronutrient deficiencies among women and children
48	The state of food insecurity in the world	FAO, 2021	Report	Global		Between 702 and 828 million people were affected by hunger in 2021	MORTALITY Food insecurity is associated with increased childhood morbidity and mortality. The adequate provision of food (quality and quantity) program reduced child mortality by 60 percent in Brazil

ABOUT ELRHA

We are Elrha. A global charity that finds solutions to complex humanitarian problems through research and innovation. We are an established actor in the humanitarian community, working in partnership with humanitarian organisations, researchers, innovators, and the private sector to tackle some of the most difficult challenges facing people all over the world. We equip humanitarian responders with knowledge of what works, so that people affected by crises get the right help when they need it most. We have supported more than 200 world-class research studies and innovation projects, championing new ideas and different approaches to evidence what works in humanitarian response. Elrha has two successful humanitarian programmes: Research for Health in Humanitarian Crises (R2HC) and the Humanitarian Innovation Fund (HIF).

RESEARCH FOR HEALTH IN HUMANITARIAN CRISES (R2HC)

R2HC aims to improve health outcomes for people affected by humanitarian crises by strengthening the evidence base for public health interventions. Our globally recognised research programme focuses on maximising the potential for public health research to bring about positive change in humanitarian response. Since 2013, we have funded more than 100 research studies across a range of public health fields.