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Impacts of rising food prices on nutritional outcomes and mortality of children in low and middle-income countries: a systematic review

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ABSTRACT

Background Estimates indicate that 45% of mortality among children under 5-year old is linked to nutrition. Increased food prices can reduce access to nutritious foods, increasing nutritional and health risks for children, particularly in low and middle-income countries (LMICs). We synthesised evidence on the relationship of rising food costs with nutritional outcomes and mortality in children in LMICs.

Methods EMBASE, MEDLINE, Global Health, EconLit, Web of Science and six grey literature sources were searched in September 2023. Searches included key phrases such as 'food price shocks' and 'child malnutrition'. We included any longitudinal study design, with any measure of food price increase and any measure of child malnutrition or mortality as outcomes. Results were analysed narratively with risk of bias assessed using the Newcastle Ottawa Scale.

Results A total of 18 studies were included, covering 104 LMICs. There were 16 repeated cross-sectional or panel studies, one longitudinal cohort study and one quasi-experimental study. Five of these studies were multicountry. 16/18 studies reported a range of adverse nutritional outcomes associated with higher food costs, including mortality (five studies), stunting and low height for age (six studies), and wasting and low weight for height (five studies). Low birth weight, admissions to feeding centres, reduced consumption of rice, fruit, vegetables and animal protein, and reduced haemoglobin concentrations were also associated with higher food prices in one study each. Subgroup analyses were limited although two studies identified larger impacts on children in urban areas, and two studies identified larger impacts where children were exposed to higher food prices at younger ages.

Discussion Rising food prices present a risk to child health and nutrition in LMICs. Policies should prioritise increasing household income alongside structural reforms to mitigate the nutritional impacts of elevated food prices on young children and pregnant women.

PROSPERO registration number CRD42023469198.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Increasing food costs can reduce affordability and accessibility to nutritious foods, increasing nutritional risk and mortality in children, particularly in low and middle-income countries (LMICs) who are more at risk.

WHAT THIS STUDY ADDS

⇒ Evidence from 18 studies across 104 LMICs shows that rising food prices are associated with increased risks of stunting, wasting, low birth weight, anaemia, reduced food consumption and mortality. Younger children and pregnant women from urban lower socioeconomic backgrounds are more vulnerable to undernutrition.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Policies should focus on supporting household income alongside structural reforms in food and agricultural systems to mitigate the adverse nutritional impacts of rising food prices, particularly for children in urban and lower socioeconomic households in LMICs. Future research should prioritise the effects of food price increases on low birth weight, dietary consumption patterns and anaemia, where evidence remains limited, as well as how rising food prices shape dietary patterns linked to ill-health.

INTRODUCTION

Malnutrition, including undernutrition and overnutrition, is defined as a deficiency, excess or imbalance of nutrients that adversely affects body function.[1] The Sustainable Development Goals (2015–2030) aim to reduce malnutrition in all its forms, while the UN Decade of Action on Nutrition (2016–2030) recognises a need to scale up efforts to achieve this.[1 2] In 2022, approximately 150 million children under 5 years were stunted, 45 million wasted and 37 million overweight or obese.[3] Malnutrition is highly prevalent in LMICs, with 32% of children under 5 stunted, 9.5% wasted and 5% affected by both.[4]

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Childhood can be divided into key developmental periods: prenatal (in utero, during pregnancy), perinatal (late pregnancy through the first week after birth), neonatal (first 28 days after birth), infancy (0–12 months), under-5 (1–59 months) and school-age childhood (5–9 years). Most leading risk factors of disability-adjusted life-years among children under 9 years old are related to malnutrition.[5] Major undernutrition outcomes, including low birth weight, stunting (low height for age), wasting (low weight for height), underweight (low weight for age) and micronutrient deficiencies in children are linked to increased child mortality.[6] At the same time, undernutrition during the early stages of life increases susceptibility to non-communicable diseases such as type 2 diabetes, obesity and coronary heart disease in later life.[7–9] Maternal, perinatal and child diets are key determinants of malnutrition in all its forms and are heavily influenced by food prices and affordability, which shape both overall caloric intake and nutrient intakes.[6 10]

Food prices are influenced by emerging global crises, such as climate change, the COVID-19 pandemic and the Russia-Ukraine war.[11 12] For example, prices of staple foods that provide two-thirds of dietary energy and supply 50% of 11 essential nutrients across many LMICs[13] have significantly increased over the last few years.[12] Inaccessible foods may lead households to consume fewer calories or substitute with cheaper, less nutritious meals, particularly affecting maternal and child nutrition during the first 1000 days of life.[7] Such dietary compromises can result in impaired growth, declines in cognitive development and lower survival.[7–9] Previous research has highlighted issues around the affordability of nutritious diets, and the importance that diets meet both calorie and micronutrient needs.[14] In LMICs, rising food costs can exacerbate household economic stress, which is associated with broader child health risks, including child labour, unhealthy behaviours such as smoking and poor mental health.[14]

While rising food prices are linked to worsened undernutrition outcomes,[15] variations exist across regions, age groups and localities. Wasting and stunting are more prevalent in South and East Asia compared with Africa.[16] While wasting rates decline from 12 to 60 months in both Asia and Africa, the Sahel region in Africa experiences a sharp increase at 12 months.[16] Rural areas tend to have lower rates of stunting and wasting compared with their urban counterparts.[16] Economic downturns are associated with higher child mortality, with this being particularly prevalent in Africa.[14] Previous systematic reviews have examined the dietary and health effects of economic crises primarily in HIC,[17 18] focusing largely on adult populations.[18] These reviews predate recent findings and include studies with limited quantitative evidence, and a high risk of bias.[17] Compared with HICs, LMICs experience a higher burden of malnutrition and mortality and are disproportionately affected as households spend a greater share of their income on food on average.[11 12] In this review, we assessed the impact of rising food prices on nutritional outcomes and mortality in children in LMICs and examined potential differential associations across socioeconomic groups and localities.

METHODS

This systematic review was registered with PROSPERO (CRD42023469198).

Search strategy

EMBASE, MEDLINE, Global Health, EconLit, Web of Science and grey literature sources, including the International Food Policy Research, WHO, World Bank, International Monetary Fund, OpenGrey and Google Scholar were searched in September 2023. The search strategy included key terms related to rising food prices, such as ‘food price shocks’, and all indicators of child undernutrition, overnutrition and mortality. Terms specific to LMICs were also included, along with keywords focused on younger children, such as ‘infant’ (see online supplemental appendix 1). No date or language restrictions were applied. The reference lists of eligible studies were also screened for additional studies.

Inclusion and exclusion criteria

Population: studies were eligible for inclusion if the population group consisted of children aged 0–12 years or prenatal development in LMICs (online supplemental appendix 2). Countries were classified as LMI if they met the World Bank criteria at the time the study was conducted. There were no other exclusion criteria by population group.

Exposure: we included studies if rising food prices, defined as an increase in the price of food through either inflation (the gradual rate at which food prices increase over time) or shocks (a large increase in the average price of food commodities in a short period of time), were measured. We excluded studies that examined general economic downturns without assessing the impact of rising food costs on child nutrition. These studies focused on broad macroeconomic factors such as unemployment, neglecting the direct effects of food price increases.

Comparator: we included a range of study designs where outcomes were measured among the same population before and after the exposure or among different populations before and after the same exposure.

Outcomes: we included several nutritional outcomes: micronutrient deficiency indicators, such as anaemia and haemoglobin blood levels, dietary intake indicators, such as energy intake, dietary intake of nutrients or food groups, dietary patterns, and diet quality and diversity scores, and anthropometric indicators, such as stunting, wasting, underweight, overweight and obesity, length and weight at birth, Body Mass Index (BMI) and Z-scores of child growth. Admissions to healthcare services for malnutrition were also considered. Finally, we included all-cause and cause-specific mortality. Studies assessing multiple outcomes were included, as were studies that assessed these as their primary or secondary outcome.

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Study designs

Studies involving different populations before and after different exposures were excluded. Studies were eligible for inclusion if they provided more than one quantitative data point before and after the exposure or throughout the exposure. This includes longitudinal, cohort, panel and repeated cross-sectional studies and excludes cross-sectional, qualitative, simulation, descriptive studies, review articles and conference abstracts.

Data extraction and quality assessment

Titles and abstracts were screened by three reviewers (TD, AAL and TH) using Covidence software. The full texts of the eligible articles were then screened by two reviewers (TD and AAL). Conflicts were resolved by a third reviewer (TH). Data extraction was conducted by one researcher (TD) and checked by two (AAL and TH). The extracted data included data on study characteristics (title, authors, year, country, duration of the study, study objectives, study design, sample size, exposure, effect estimates and their significance level and CIs, statistical methods, covariates adjusted, method of data collection, risk of bias assessment and limitations). Population characteristics included age range and locality (urban or rural). In studies with multiple regression models, data were extracted from the fully adjusted model. Where necessary, corresponding authors were contacted for clarifications or missing data through email.

The Newcastle-Ottawa Scale (NOS) was used to assess the risk of bias and was adapted for each study type (see online supplemental appendix 3). For cohort studies, the original NOS scale was used. For repeated cross-sectional studies and quasi-experimental studies, adapted versions for cross-sectional studies were sourced from other studies.[19 20] For panel studies, a category examining adequacy of follow-up was added. Studies were classified as having high risk of bias (a score of less than 5), moderate risk of bias (a score of 5 or 6) or low risk of bias (a score of 7 or 8). Due to heterogeneity between study designs, population characteristics and outcome measures, we conducted a narrative synthesis of the findings, structured by outcomes. Differences in effects across age groups (prenatal, neonates, infants and under-5s) and localities (urban and rural) were also synthesised narratively.

Role of the funding source

None.

Patient and public involvement

Patients and the public were not involved in the preparation of this paper.

RESULTS

Study characteristics

The search identified 5038 records. Following the exclusion of 268 duplicates, 4770 titles and abstracts were screened (figure 1). 4668 were rejected for not meeting the inclusion criteria. 50% of these exclusions were for not assessing food price inflation or shocks; 36% were excluded as these were the wrong type of study; 8% included only ineligible outcomes; 6% were from high-income countries; and the final 4% did not include any comparator. The full texts of 102 articles were then assessed for eligibility, resulting in the final inclusion of 18 studies. The main reasons for study exclusion of 84 studies at full-text stage were no measure of food price changes (n=48), no measure of nutritional status or health outcome (n=5) and incorrect study design (n=31) (online supplemental appendix 4 for details).

The 18 included studies presented data from 104 LMICs (table 1). Five multicountry and 13 single country studies were conducted between 1995 and 2021. Study follow-up times ranged from less than a year to 21 years. Ten studies were repeated cross-sectional,[16 21–29] six were panel studies,[30–35] one was a longitudinal cohort[36] and one was a quasi-experimental study.[37] Five studies examined percentage increases in food prices,[16 21 23 26 34] while six studies focused on percentage increases in inflation.[22 24 29 30 33 35] One study used the Consumer Price Index for food, which reflects percentage change in food prices compared with the beginning of price rises in Mozambique.[37] Four studies investigated periods of high food prices,[25 27 36] including the peak inflation period.[28] Finally, two studies utilised a high food price index (when the cost of a standard basket of food was elevated relative to baseline).[31 32]

Ten studies had a low risk of bias, four moderate risk and four high risk of bias.[27 29 33 35] Risk of bias details are in online supplemental appendix 5. All high-risk studies were conducted across multiple countries and assessed mortality rates[29 33 35] and admissions to feeding centres.[27] Reasons for high risk of bias scores included a lack of randomisation and poor reporting of study characteristics such as sample size, population characteristics and study attrition. Additionally, in all high-risk studies, it was unclear if outcome measures were independently collected or self-reported with no disclosure regarding the completeness of the data, estimation methods for incomplete data or whether the data were aggregated from various sources.

Included outcomes

Outcomes and associations are summarised in figure 2. Five outcome categories were assessed: child mortality,[24 26 29 30 33 35] anthropometric measures including stunting,[22] Height-for-Age Z-scores (HAZ),[16 21 22 31 32 34 37] Weight-for-Age Z-scores (WAZ),[16 32 37] Weight-for-Height Z-scores (WHZ),[34 37] Low Birth Weight (LBW)[25 36] and infant weight and length[36]; changes in dietary consumption[23]; admission to feeding centres[27] and haemoglobin concentrations.[28] Most measures were self-reported and sourced from household surveys, while five used data from national statistics offices, the ministry of health or World Bank databases (World Bank's cross-country Database of Inflation, The World Bank's Database of Global

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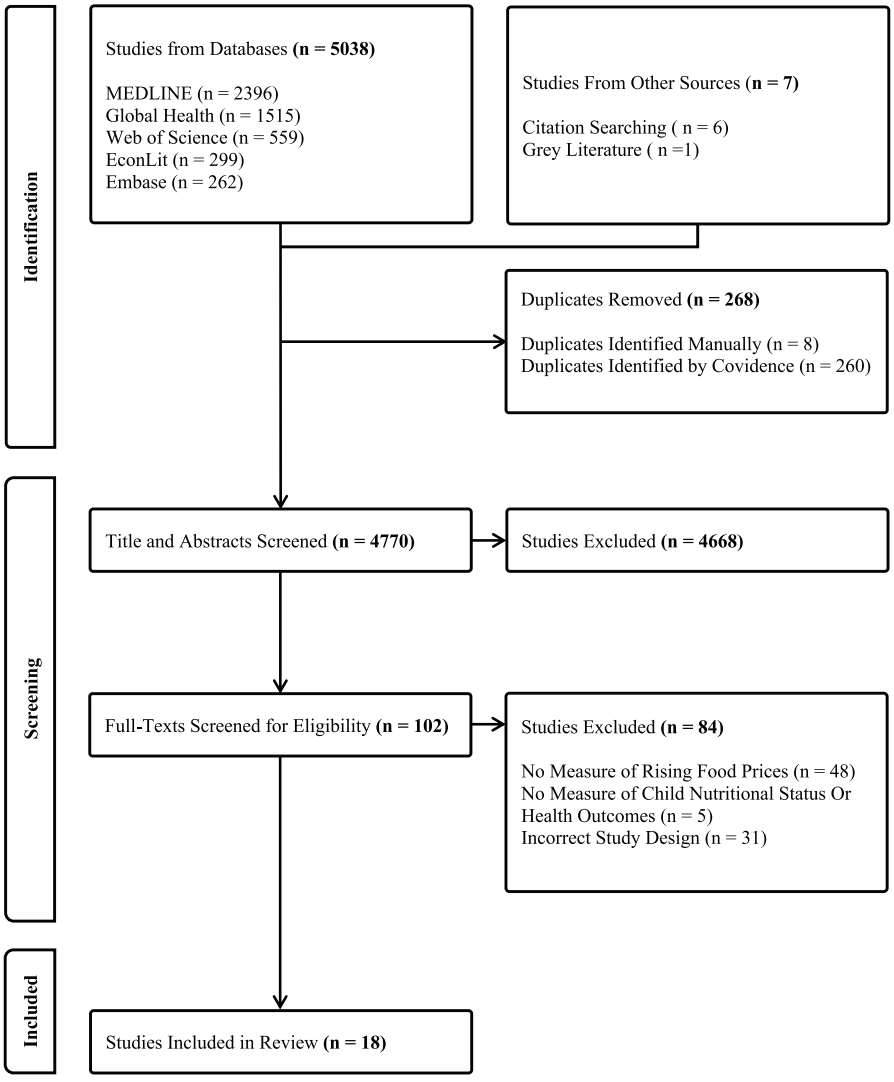


Figure 1 PRISMA diagram. PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

Development Indicators). One study collected primary outcome measures as part of a longitudinal cohort.[36] Sixteen studies collected data in two waves, one in three waves[23] and another in 14 waves at 3-month intervals.[28]

Mortality

Out of the six studies on infant and under-5 mortality, five, comprising data from 99 countries, demonstrated a positive association between food prices and mortality.[24 26 29 33 35] These covered Ethiopia, the Philippines, India, two multicountry studies focused on six and 31 African nations, and one across 95 different LMICSs. Associations between food price rises and mortality included a −5.4% reduction in child survival from a 10% rise in staple food prices in Ethiopia and a −0.49% reduction in neonatal survival with a 1% increase in food prices in India.[24 26] The one study which did not identify an association of food prices and mortality was of food price inflation between 2009 and 2013 in the Philippines.[30] Among the other five studies, comprising 99 countries, countries in Africa had the highest prevalence of child mortality. In one high-quality study in India, only neonatal mortality was found to be statistically significantly associated with increasing food prices compared with infant and under-5 mortality,[26] while another high-quality study in Ethiopia indicated a significant reduction in survival probabilities in children under 5 following increased food prices.[24] One moderate quality study with an undisclosed sample size from the Philippines identified no significant associations between an increase in food price inflation and under-5 mortality rates.[30] Additionally, one low-quality study across 95 LMICs found a strong positive association between food price inflation and infant mortality rates in low-income countries after accounting for time trends.[33] Two multicountry studies with high risks of bias also identified significant associations between rising food prices and mortality.[29 35]

Anthropometry

Eight studies investigated associations between food prices and stunting, HAZ or infant length. Six reported negative impacts of increased food prices on stunting, HAZ and infant length, including three moderate-quality studies[16 21 31] and three high-quality studies[22 32 36] across

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Table 1 Key characteristics of included studies

Study	Location	Study design	Study years	Sample size and child ages	Exposure measure	Outcome	Statistical methods	Risk of bias
Chibuye[21]	Zambia	Repeated cross-sectional	2006, 2010	11 338 children 0-59 months	10% increase in the price of maize flour	HAZ	Fixed effects regression	Moderate
Woldemichael *et al*[22]	Ethiopia	Repeated cross-sectional	2005, 2010	12 296 children 6–59 months	1% increase in food inflation	HAZ and probability of stunting	Fixed effects regression	Low
Vellakkal *et al*[23]	India	Repeated cross-sectional	2002, 2006, 2009	1918 children 0–8 years	10.0 rupee ($0.170) increase in the price (per kilogram) of food	Daily food consumption	Regression	Low
Kidane and Woldemichael[24]	Ethiopia	Repeated cross-sectional	2005, 2010	32 353 children 0–59 months	10% increase in month-to-month food inflation	Infant and child mortality	Cox proportional hazard model	Low
Headey and Ruel[16]	44 Lmics	Repeated cross-sectional	2000, 2021	1 271 000 children 0–59 months	A 5% increase in food prices	HAZ and WAZ	Linear regression	Moderate
Grace *et al*[25]	Kenya	Repeated cross-sectional	2003, 2009	1900 children 0–28 days	Period of high maize prices	Low birth weight	Fixed effects multilevel model	Low
Fledderjohann *et al*[26]	India	Repeated cross-sectional	2002–2004, 2007–2008	284 087 children 0–59 months	1% increase in total food prices	Neonatal, infant and under-5 mortality	Multivariate linear regression model	Low
Cornia *et al*[27]	Niger, Malawi	Repeated cross-sectional	2003, 2006, 2009, 2010	Not stated	Period of high food prices	Admissions for malnutrition to feeding centres	Linear regression	High
Block *et al*[28]	Indonesia	Repeated cross-sectional	1995, 2001	107 753 children 0–59 months	1998 peak inflation period	Haemoglobin concentrations	T-tests	Low
Ibikunle *et al*[29]	Nigeria, South Africa, Egypt, Angola, Mauritius, Mali	Repeated cross-sectional	2000, 2020	Six countries 0–59 months	1% increase in food price inflation	Neonatal, infant and under-5 mortality	Multiple linear regression	High
Ang *et al*[30]	Philippines	Panel study	2009, 2013	16 regions 0–59 months	1% increase in food price inflation	Under-five mortality	Fixed effects regression	Moderate
De Brauw[31]	El Salvador	Panel study	2008, 2008	3062 children 0–12 years	High food price index	HAZ	Fixed effects regression	Moderate
Yamauchi and Larson[32]	Indonesia	Panel study	2007, 2010	98 villages in 7 provinces 0–12 years	The Laspeyres price index (based on local food prices)	HAZ and WAZ	Fixed effects regression	Low
Lee *et al*[33]	95 Lmics	Panel study	2001, 2011	909 households 0–59 months	10% increase in food inflation	Infant and child mortality	Regression	High
Brenton and Nyawo[34]	Ethiopia	Panel study	2013–2014, 2015–2016	2880 children 6–59 months	10% increase in staple food prices	WHZ, HAZ	Fixed effects panel regression	Low

Continued

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Table 1 Continued

Study	Location	Study design	Study years	Sample size and child ages	Exposure measure	Outcome	Statistical methods	Risk of bias
Akinlo and Odusanya[35]	31 LMICs	Panel study	2001, 2012	31 countries 0–59 months	1% increase in food price inflation	Infant and under five mortality	Fixed effects regression	High
Gitau *et al*[36]	Zambia	Longitudinal cohort study	2001–2004	429 children infants (≤16 weeks)	Period of high maize prices	Infant length and weight	ANOVA	Low
Arndt *et al*[37]	Mozambique	Quasi-experimental study	2008, 2009	7000 children 0–59 months	Period where food CPI was over 100	WHZ, WAZ, HAZ	Propensity score matching	Low

ANOVA, Analysis of Variance; CPI, Consumer Price Index; HAZ, Height-for-Age Z-scores; LMICs, low and middle-income countries; WAZ, Weight-for-Age Z-scores; WHZ, Weight-for-Height Z-scores.

Africa, Asia and South America. One high-quality study in Zambia found that infants exposed to higher food prices in utero were 18 mm shorter at 6 weeks and 5 mm shorter at 16 weeks after birth compared with infants not exposed to higher food prices.[36] Another high-quality study in Indonesia examined the impact of rising food prices on HAZ, showing significant reductions.[32] Conversely, one high-quality study in Ethiopia found that increases in teff (a grain commonly used in Ethiopia) prices were associated with improved HAZ scores in a rural sample.[34] One high-quality study in Mozambique reported no statistically significant associations between increasing food prices and HAZ scores.[37]

Six studies across Asia, Africa and South America reported negative impacts of increased food prices, with increased probability of wasting, low WAZ and WHZ scores and lower infant weights. Five of these studies were high quality.[25 32 34 36 37] One moderate-quality study across 44 countries showed a 9% increased probability of moderate wasting and 14% of severe wasting linked to a 5% increase in food prices.[16] Two high-quality studies measured the impact of maize price increases on LBW in Africa.[25 36] One found that prepregnancy exposure to higher prices decreased the likelihood of LBW[25] while the other found no difference in LBW.[36] However, infants exposed prenatally to higher maize prices had marginally lower weights at 16 weeks of age than those not exposed.

Dietary consumption

Two studies investigated shifts in dietary consumption associated with changes in food prices[23 27] in India, Niger and Malawi. Associations between food prices and consumption were identified in two out of three of these countries. One high-quality study reported a significant decrease in the consumption of rice, fruit, vegetables and animal protein in children under 12-year old following a 10 rupee increase in prices in Andhra Pradesh in India (p=0·001).[23] For example, a 10-rupee increase in the price of rice per kilo was linked to a decrease of 73 g/day of rice consumption in children.

Admission to feeding centres

One low-quality study examined the spike in international food prices between 2007 and 2011 and found that higher maize prices were positively associated with child admissions to feeding centres in Malawi, which may imply a reduction in food availability. However, these associations were not statistically significant in Niger.[27]

Haemoglobin concentration

A high-quality study found that high food inflation during the 1997 Indonesian crisis led to malnutrition-induced anaemia in children, with the greatest haemoglobin reductions in those aged 6–18 months compared with children under 6 months and those aged 18–59 months.[28]

Inequalities

Of the 18 studies, 9 presented data on inequalities by locality and age.

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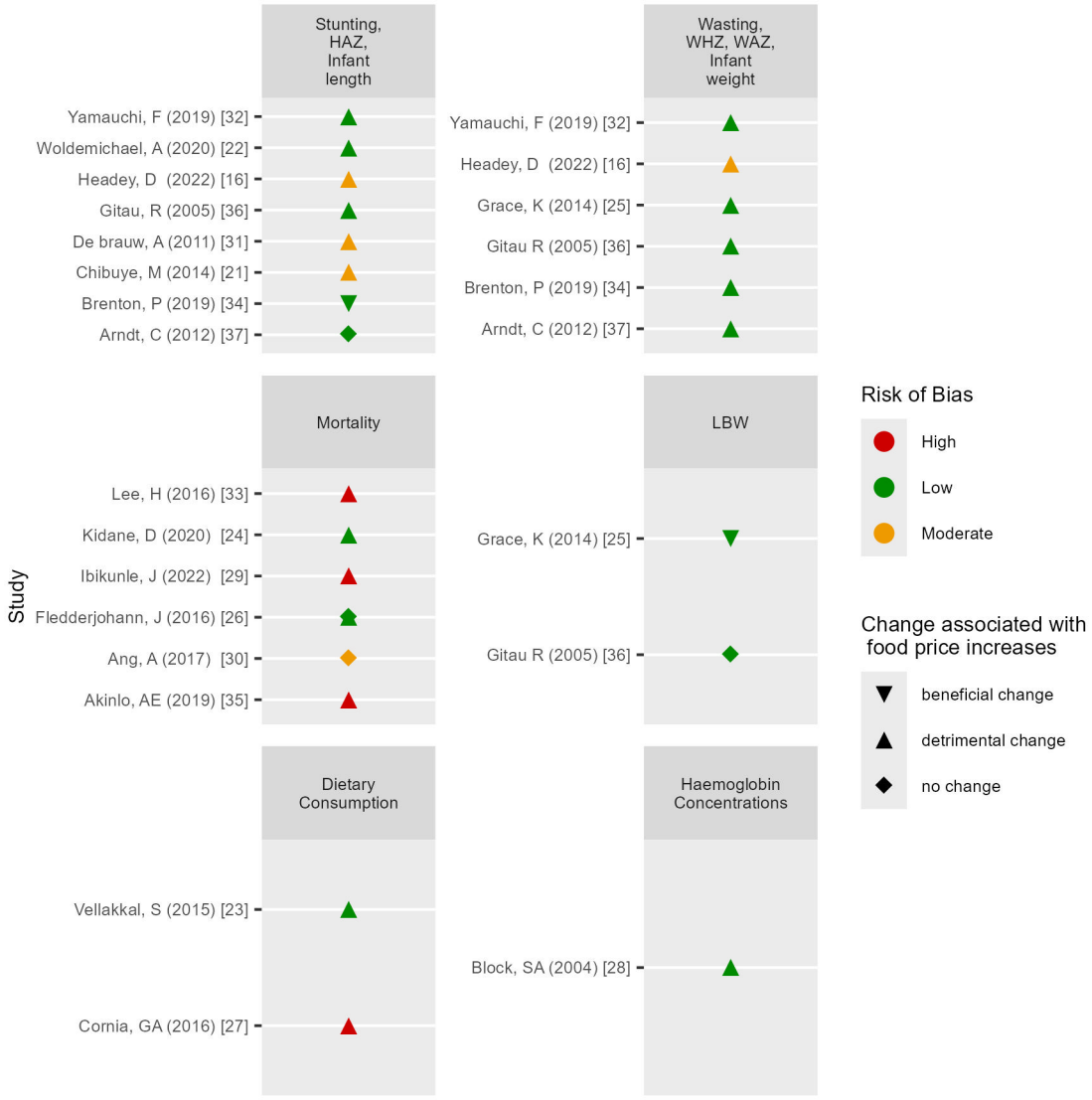


Figure 2 Summary of results. HAZ, Height-for-Age Z-scores; WAZ, Weight-for-Age Z-scores; WHZ, Weight-for-Height Z-scores.

Across four studies spanning Africa, East Asia and South America, the findings were consistent and found that children living in urban areas face poorer growth outcomes and survival probabilities from increased food prices compared with their rural counterparts.[16 21 24 32] In two studies, farmland ownership, used as a proxy for higher socioeconomic status, showed protective effects against stunting and wasting following food price increases.[16 32] One multicountry study found that farmland ownership among rural populations reduced the risk of wasting by nearly 50% when compared with rural households without farmland ownership.[16]

Eight studies focused on children under 5-year old and stratified results by age, although the results were conflicting (table 2). Four of these studies examined mortality; two examined stunting; one examined both stunting and wasting; while one examined haemoglobin concentrations.

Age differences in mortality were mixed. Three of the four studies across India and multiple countries in Africa found similar impacts of rising prices on mortality among neonates, infants and children under 5 years.[26 29 35] One study in Ethiopia, however, found an 8.6% reduction in under 5 survival rates among children exposed to high food price inflation in infancy, compared with a 5.4% reduction among children exposed to high food price inflation in utero.[24]

The three studies examining stunting found mixed associations across age groups. In Ethiopia, one study found increased risks of stunting among children exposed to higher food prices prenatally, compared with children exposed at infancy, with effects varying by month of prenatal exposure.[22] One study in Zambia created composite groups based on urban/rural area combined with age group and found stunting to vary by these as well as the specific foodstuffs impacted by raised prices.[21] One study across 44 LMICs found that exposure to high food price inflation in the prenatal period or first year of life was significantly linked to later stunting, although results for exposure in the second year of life were not

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Table 2 Results from studies examining inequality impacts by locality and age groups

Study	Outcome studied	Effects
Differences across locality		
Chibuye[21]	Stunting	Impacts varied across age group, urban/rural locations and specific foodstuffs with high prices
Headey and Ruel[16]	Stunting	Farmland ownership protective against price rises impacting stunting
Yamauchi and Larson[32]	Stunting	Farmland ownership protective against price rises impacting stunting
Kidane and Woldemichael[24]	Mortality	Lower survival probabilities in urban areas than rural areas
Differences across age groups		
Fledderjohann *et al*[26]	Mortality	Similar across ages
Ibikunle *et al*[29]	Mortality	Similar across ages
Akinlo and Odusanya[35]	Mortality	Similar across ages
Kidane and Woldemichael[24]	Mortality	Larger impacts on survival among children exposed to food price inflation in utero than in infancy
Chibuye[21]	Stunting	Impacts varied across age group, urban/rural locations and specific foodstuffs with high prices.
Woldemichael *et al*[22]	Stunting	Impacts varied across month of food price inflation
Headey and Ruel[16]	Stunting	Larger impacts if affected in prenatal period or first year of life than if affected in second year of life
Headey and Ruel[16]	Wasting	Larger impacts for younger children than older children
Block *et al*[28] (2004)	Haemoglobin concentrations	Greater reductions for children born during this period compared with older children who were already past these critical stages when the crisis occurred

significant.[16] This study also found that associations between price increases and wasting were significantly different between children aged 0–11 months, 12–23 months and 24–59 months in 44 LMICs, with larger effect sizes for the youngest children.[16] This study also explored associations with severe wasting and found similar results across age groups. Finally, one study examining haemoglobin concentrations in Indonesia found that children who were in utero or in the weaning period during the 1998 financial crisis experienced greater reductions, compared with older children who were already past these critical stages when the crisis occurred.[28]

DISCUSSION

This systematic review included 18 studies from 104 LMICs. 16/18 studies reported that rising food prices were associated with adverse nutritional outcomes in children, leading to increased infant mortality and undernutrition. Studies reported adverse outcomes in prenatal, neonates, infants and children aged 5–12 years old. Child mortality was commonly associated with higher food costs. Children exposed to higher food costs prenatally led to increased risk of stunting in childhood. The negative effects of wasting were greater in children aged 0–11 months. Both findings were consistent among 44 regions in Africa, Asia and South America. Two studies representing 44 countries found that children living in urban households or without access to farmland (an indicator for high socioeconomic status) faced higher stunting and lower survival probabilities compared with their rural counterparts in response to higher food prices.

The key finding that rising food prices negatively impacts child nutrition and mortality aligns with the literature.[17 18 38] Included studies in our review found evidence of increased mortality associated with price rises. The magnitude of the associations varied across countries and studies, with findings indicating that a 1% rise in food prices led to increases in neonatal mortality ranging from 0.01% to 0.49%; infant mortality from 0.03% to 0.57%; and under-5 mortality from 0.01% to 0.18%. A larger increase in mortality associated with rising prices was reported for children in the lowest income countries,[33] consistent with other studies.[38 39] Our findings on stunting and wasting are largely consistent with previous studies, which report similar associations between rising food prices and child undernutrition in LMICs.[39 40] Our findings and previous literature indicate that, on average, children in rural households are less affected by rising food prices than urban children in terms of stunting and mortality.[41 42] While the size of these associations does differ, their existence across multiple contexts suggests that these links are more overarching than specific.

Included studies found associations between rising food prices and poorer dietary intakes, which is likely to be a key pathway through which rising prices affect child health and nutrition.[23] For example, in one high-quality study in India, a 10-rupee increase in individual food items was strongly associated with a daily decrease

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in egg, milk, fruit and vegetable intake, consistent with findings from previous systematic reviews in high-income countries.[17 18] It also identified that increased food costs were also associated with a significant decrease in rice consumption, which is usually considered resistant to price increases as a dietary staple.[23] The explanation for this finding likely lies in socioeconomic factors, as low-income children tend to experience more pronounced declines in consumption overall, including commodities assumed to be inelastic.[43] Again, these findings were reasonably consistent across a number of contexts and were identified in many high-quality studies.

Rising food prices have a disproportionate impact on vulnerable populations, as indicated by studies examining markers of socioeconomic status.[43] Two high-quality studies representing 44 countries indicated that urban areas exhibit worse child nutritional outcomes in response to rising food costs, consistent with prior research.[14 41] Studies included in this review found evidence of greater adverse outcomes in younger children than older children, consistent with the existing literature.[39 44] Some of the findings from this review were mixed, however, which may be caused in part by the differing locations of studies and price shocks covered. For example, the association between rising food prices, improved HAZ scores and lower rates of LBW in Ethiopia and Kenya is surprising. These studies, however, tended to include greater proportions of rural populations, who may own farmland, shielding them from impacts of price rises as well as potentially benefiting from increased food prices compared with their urban counterparts. Also, the observed reduction in LBW rates after exposure to prepregnancy higher prices may be in part due to inadequate nutritional impacts for mothers, meaning that births are not carried to term. Nonetheless, the fact that these studies were high quality indicates that more research work in this area would be useful to unpack these patterns and drivers behind them.

There are multiple strengths to this review. In contrast to prior reviews that provided limited evidence from LMICs, our review synthesised data from 104 LMICs. Moreover, we explored associations between food prices and nutritional outcomes among high-risk subgroups, which can help inform policy to focus on populations most vulnerable to food price shocks. There are also some important limitations. First, significant heterogeneity existed across studies, particularly concerning exposures, study populations and outcomes, prohibiting meta-analysis or statistical summary of the results. Second, we did not use controlled vocabulary such as MeSH (Medical Subject Headings) terms in our search, although our search strategy was comprehensive. There were only limited numbers of studies for each outcome, and expanding outcomes studied, including longer term effects, is a priority for future studies. Third, many of the studies had methodological weaknesses. Included studies were restricted to longitudinal studies to capture changes before and after the exposure and reduce the risk of bias. However, eight studies had flaws related to undisclosed methods of data collection, missing data (along with unclear methods for estimation) and attrition rates. Most of the studies heavily relied on self-reported outcomes, introducing the possibility of recall bias and reporting errors.

More research in LMICs on the effects of food prices on outcomes such as LBW and dietary consumption patterns is needed due to insufficient data despite their established significance in nutritional pathways. While this review aimed to address malnutrition in all forms, there was a lack of studies investigating the impact of rising food costs on overnutrition in LMICs. This should not be overlooked given the rising prevalence of the double burden of malnutrition (coexistence of under and overnutrition) in LMICs.[45] Furthermore, research suggests that stunting and wasting respond differently to fluctuations in food prices. Immediate effects of rising food prices are more likely to trigger wasting, whereas stunting develops over time as a result of prolonged inadequate nutrition.[46] Recognising these differences is important for mitigating the nutritional effects of rising food prices. Policies promoting nutrition-sensitive agriculture can improve maternal and child nutrition and act as 'double-duty actions' addressing multiple forms of malnutrition.[44] Reforming agricultural policies through biofortification, homestead food production and agricultural extension services can reduce production costs and stabilise supply,[44] making nutritious foods more affordable and accessible even during price spikes. Other initiatives, such as school gardens and urban agriculture, can further support children in urban environments.[44] Analyses from 159 countries indicate that the minimum cost of a nutritious diet in LMICs is $2.42 per day, which often exceeds 90% of household income, particularly in parts of South Asia and Africa.[46 47] Evidence from social safety net programmes, including conditional cash transfers and food transfers in Mexico and Egypt, demonstrates their potential to reduce food insecurity, improve dietary quality, provide education on healthy eating and decrease rates of undernutrition among children.[44] These findings underscore the need for multipronged strategies that combine income support with structural reforms in food systems to reduce both acute and chronic undernutrition.

CONCLUSION

The evidence from this systematic review shows that increasing food prices can reduce food affordability and influence adverse nutritional outcomes in children in LMICs, particularly among those from lower socioeconomic groups or living in urban areas. Policies should prioritise protecting household income alongside structural reforms in agriculture. Future research should focus on how fluctuations in food prices influence dietary consumption and child nutrition across different settings, while considering interventions that can simultaneously address acute and chronic malnutrition.

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