



Food Security as a Foundation for National Health

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Abstract

Food security, defined by stable access to sufficient, safe and nutritious food, serves as a fundamental determinant of human health. When any dimension of food security availability, accessibility, utilization, or stability is compromised, the health consequences are severe and multifaceted. Malnutrition manifests in paradoxical forms: undernutrition leads to stunted growth, micronutrient deficiencies and compromised immune systems, while overnutrition results from limited access to quality foods, driving obesity and diet-related non-communicable diseases. These dual burdens disproportionately affect vulnerable populations in developing nations like India, where children, pregnant women and low-income communities face heightened risks. The roots of food insecurity extend beyond agricultural production to encompass socio-economic disparities, inadequate infrastructure and policy gaps that hinder equitable food distribution. Climate change and economic instability further threaten food system resilience, exacerbating health inequities. Addressing these challenges requires integrated approaches that combine agricultural innovation, social protection programs, nutrition education and healthcare system strengthening. By tackling food insecurity holistically, nations can break the intergenerational cycle of poor health, enhance human capital development and progress toward Sustainable Development Goals. The relationship between food security and health underscores the urgent need for policies that prioritize both nutritional quality and food system sustainability to achieve better population health outcomes.

Keywords: Nutrition, Health, Undernutrition, Malnutrition and Obesity

Introduction

Food security, as defined by the Food and Agriculture Organization (FAO), exists when "all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs for an active and healthy life" (FAO 2008). However, the reality for millions of people across the globe, including in India, paints a starkly different picture.

Despite significant strides in agricultural productivity, India continues to grapple with widespread food insecurity. According to the Global Hunger Index 2023, India ranked 111th out of 125 countries, with high levels of child undernutrition. These figures highlight the continuing disconnect between food availability and its equitable access and proper utilization.

Food insecurity does not only result in hunger but manifests in multiple forms—chronic undernutrition, micronutrient deficiencies and obesity. These conditions significantly compromise human health, productivity and life expectancy. Understanding and addressing food security is, therefore, crucial not just for economic development but for safeguarding public health.

Dimensions of Food Security and Their Impact on Human Health

Food Availability

Food availability constitutes the most fundamental dimension of food security, referring to the consistent physical presence of sufficient food supplies within a region. This supply may come from domestic agricultural production, commercial food imports, or

humanitarian food aid programs (FAO 2008). Without adequate food availability, populations face immediate risks of hunger and malnutrition. The health implications of insufficient food availability are severe, particularly in regions prone to environmental shocks, economic instability, or conflict.

When food production or distribution systems fail, communities experience acute food shortages that can escalate into full-scale famine. Famines are characterized by widespread starvation, social breakdown and mass displacement (Devereux 2009). Children bear the heaviest burden of food shortages, with protein-energy malnutrition manifesting in two devastating forms: kwashiorkor, marked by edema, skin lesions and liver damage; and marasmus, characterized by severe wasting and muscle atrophy (Black *et al.* 2013). Chronic food shortages also lead to stunted growth, impaired cognitive development and weakened immune systems, leaving children more vulnerable to infectious diseases (Victora *et al.* 2021).

Multiple global and local factors influence food availability. Climate change has emerged as a major disruptor of crop yields, particularly in vulnerable regions like sub-Saharan Africa and South Asia where agriculture remains largely rain-fed (IPCC 2022). Political instability and armed conflict, as seen in Yemen and South Sudan, often destroy farmland, block food imports and displace farming communities (FSIN 2023). Additionally, economic policies such as export bans or price controls can artificially restrict food supplies in markets, exacerbating shortages (World Bank 2020). These complex challenges require comprehensive solutions that address both immediate needs and long-term food system resilience.

Food Access

Even when food is physically available within a region, many individuals and families cannot obtain adequate nutrition due to economic constraints or logistical challenges. Food access depends on multiple factors including household purchasing power, market infrastructure and transportation networks (Sen 1981). The inability to access nutritious food has profound consequences for population health, manifesting in various forms of malnutrition and diet-related diseases.

One of the most pervasive health consequences of limited food access is micronutrient deficiency, often referred to as "hidden hunger." When households can only afford cheap, calorie-dense but nutrient-poor staple foods like rice,

maize, or cassava, they miss essential vitamins and minerals critical for health. Vitamin A deficiency can cause blindness and increase child mortality rates, while iron deficiency leads to anemia, resulting in fatigue, maternal mortality and impaired cognitive development. Iodine deficiency, another common problem, causes goiter and intellectual disabilities (WHO 2021). Paradoxically, food insecurity often coexists with obesity and diet-related diseases, as processed foods high in sugar, salt and unhealthy fats are frequently more affordable and accessible than fresh, nutritious alternatives (Popkin *et al.* 2020).

The determinants of food access are complex and interrelated. Poverty and unemployment remain the primary barriers, preventing families from purchasing diverse, nutritious diets. Gender inequality further exacerbates the problem, as women's limited control over household food budgets often correlates with worse child nutrition outcomes (UNICEF 2019). In urban areas, the phenomenon of "food deserts" neighbourhoods lacking grocery stores with fresh produce creates additional challenges for low-income populations seeking healthy food options (USDA 2021). Addressing these systemic barriers requires multifaceted approaches that combine economic empowerment, infrastructure development and targeted nutrition interventions.

Food Utilization

Food utilization represents a critical but often overlooked dimension of food security, referring to the body's ability to digest and absorb nutrients effectively. This process depends on several factors including individual health status, sanitation conditions and dietary knowledge (FAO 2013). Poor food utilization means that even when people consume sufficient calories, they may still suffer from malnutrition due to biological or environmental factors that prevent proper nutrient absorption.

The health risks associated with poor food utilization are particularly severe in developing countries. Diarrheal diseases, frequently caused by contaminated water sources, lead to significant nutrient loss and dehydration, exacerbating child malnutrition (UNICEF 2020). Intestinal parasites such as hookworm further compound the problem by reducing iron absorption, contributing to widespread chronic anemia (Hotez *et al.* 2016). Maternal malnutrition presents another serious concern, as it often results in low-birth-weight babies who face higher risks of infant mortality and lifelong health complications (Black *et al.* 2013).

These interconnected health challenges create cycles of malnutrition that persist across generations.

Several key factors influence effective food utilization. Access to clean water and proper sanitation is fundamental for preventing infections that impair nutrient absorption (WHO 2019). Nutrition education programs can empower caregivers with knowledge about balanced meal preparation and proper food hygiene practices (FAO 2017). Additionally, accessible healthcare services are essential for treating infections and providing micronutrient supplementation, such as vitamin A capsules and iron tablets, to vulnerable populations. Addressing food utilization challenges requires integrated approaches that combine public health interventions with nutrition education and infrastructure development.

Stability

The stability dimension of food security ensures that populations maintain consistent access to nutritious food despite economic, environmental, or political disruptions (FAO 2020). Without stability, short-term crises can escalate into long-term health disasters, particularly for vulnerable groups. The health impacts of food instability are far-reaching and often intergenerational, making this dimension crucial for sustainable development.

Seasonal hunger represents one of the most common manifestations of food instability, particularly in agricultural communities that experience predictable "lean seasons" before harvests (IPC 2022). During these periods, families often reduce meal frequency and nutritional quality, leading to cyclical malnutrition. Economic shocks such as inflation or unemployment similarly force households to make difficult choices between food quantity and quality, worsening malnutrition rates. The COVID-19 pandemic demonstrated how global crises can disrupt food supply chains, interrupt school feeding programs and reduce household incomes, leading to increased child wasting and stunting (Headey *et al.* 2020). These examples underscore the vulnerability of food systems to external shocks.

Strengthening food security stability requires proactive measures at multiple levels. Social safety nets, including food vouchers and school meal programs, provide critical protection for vulnerable populations during crises (World Bank 2022). Agricultural diversification, through the promotion of drought-resistant crops and alternative farming methods, reduces reliance on single food sources (IFAD 2021). Early

warning systems for famine and price spikes enable more effective humanitarian responses before food shortages become catastrophic (FSIN 2023). Building resilient food systems demands coordinated action across sectors, combining short-term relief with long-term structural improvements.

Health Impacts of Food Insecurity

Undernutrition

Food insecurity manifests most visibly through undernutrition, which encompasses stunting (low height for age), wasting (low weight for height) and underweight conditions. These forms of malnutrition have severe and long-lasting health consequences, particularly in children. Stunting, for instance, is not merely a physical condition but an indicator of chronic nutritional deprivation that impairs both physical and cognitive development. In India, the National Family Health Survey-5 (NFHS-5 2021) reports that over 35% of children under five suffer from stunting, a statistic that underscores the persistent challenge of malnutrition in the country. The implications of stunting extend far beyond childhood, as affected individuals face higher risks of cognitive impairment, delayed motor development and reduced educational attainment. Furthermore, undernutrition weakens the immune system, making children more susceptible to infectious diseases such as pneumonia, diarrhea and measles. The cycle of malnutrition and infection creates a vicious loop, where illness further depletes nutrient stores, exacerbating poor health outcomes. In adulthood, those who experienced undernutrition in early life are more prone to chronic conditions such as cardiovascular disease and diabetes, highlighting the intergenerational impact of food insecurity (Black *et al.* 2013; Victora *et al.* 2021).

Micronutrient Deficiencies

Beyond the visible forms of undernutrition, food insecurity also drives micronutrient deficiencies, often termed "hidden hunger" due to their less apparent but equally damaging effects. Globally, over two billion people suffer from deficiencies in essential vitamins and minerals, with iron, vitamin A and iodine being among the most critical. Iron deficiency anemia is particularly widespread, affecting nearly 50% of women and adolescent girls in developing countries. This condition not only causes fatigue and reduced work capacity but also has severe implications for maternal and neonatal health, contributing to complications such as preterm birth, low birth weight and increased maternal mortality (WHO 2021). Vitamin A deficiency, another

common consequence of inadequate diets, impairs vision and compromises immune function, leaving children vulnerable to infections and increasing childhood mortality rates. Iodine deficiency, though preventable through fortified salt programs, remains a significant public health challenge in regions where dietary diversity is limited. Its most devastating consequence is impaired brain development, leading to irreversible cognitive deficits in children (Hotez *et al.* 2016). Addressing these deficiencies requires not only increased food availability but also targeted interventions such as supplementation, food fortification and dietary diversification programs.

Overnutrition and Obesity

While food insecurity is commonly associated with undernutrition, it also paradoxically contributes to overnutrition and obesity, particularly in low- and middle-income countries undergoing rapid dietary transitions. In urban India, for example, rising food prices and limited access to fresh, nutritious foods have driven low-income populations to rely on cheap, calorie-dense, but nutrient-poor processed foods. These dietary patterns, characterized by high consumption of refined carbohydrates, sugars and unhealthy fats, are linked to the growing prevalence of obesity, type 2 diabetes and cardiovascular diseases (Popkin *et al.* 2020). The dual burden of malnutrition where undernutrition and obesity coexist within the same communities or even households present a complex public health challenge. Economic constraints often force families to prioritize quantity over quality in their diets, leading to excessive calorie intake without adequate micronutrients. This phenomenon is particularly evident in urban slums and peri-urban areas, where the proliferation of fast food and packaged snacks has outpaced access to affordable fruits, vegetables and whole grains (Swinburn *et al.* 2019). Tackling this issue requires policies that not only address food affordability but also promote nutrition education and regulate the marketing of unhealthy food products.

Mental Health

The psychological toll of food insecurity is an often-overlooked dimension of its health impacts. Chronic hunger and nutritional inadequacy are strongly associated with mental health disorders, including depression, anxiety and increased suicidal tendencies. Studies have shown that adolescents and mothers in food-insecure households are particularly vulnerable

to these effects, as the stress of uncertain food access compounds existing socioeconomic pressures (Seligman *et al.* 2010). For children, food insecurity has been linked to behavioral problems, poor academic performance and emotional dysregulation, with long-term implications for their mental well-being. Among adults, the inability to provide adequate food for one's family contributes to feelings of shame, helplessness and chronic stress, which can exacerbate existing mental health conditions (Gundersen and Ziliak 2015). In India, where social safety nets are still evolving, the mental health burden of food insecurity remains understudied but is likely significant, especially among marginalized communities. Integrating mental health support with nutrition programs could help mitigate these effects, recognizing that food security is not just a physiological need but also a determinant of psychological resilience.

Food Security in the Indian Context

India's food security landscape presents a paradoxical scenario where the country has achieved food self-sufficiency yet continues to grapple with a triple burden of malnutrition encompassing undernutrition, micronutrient deficiencies and rising obesity. This complex situation stems from multifaceted socioeconomic, cultural and systemic factors that require comprehensive analysis. The Indian context demonstrates how food security extends beyond mere production statistics to encompass issues of equitable distribution, cultural practices and policy implementation.

Economic Inequality and Its Impact on Food Access

One of the most significant barriers to food security in India lies in the persistent economic disparities that affect both rural and urban populations. The rural poor, particularly landless agricultural laborers and marginal farmers, face chronic food insecurity despite living in food-producing regions. Land ownership patterns show that nearly 85% of farmers are small or marginal landholders with less than 2 hectares of land, severely limiting their production capacity and economic stability (NSSO 2019). In urban areas, the informal sector workforce constituting nearly 90% of employment faces income volatility that directly impacts food purchasing power (ILO 2021). The National Family Health Survey-5 (2021) reveals that households in the lowest wealth quintile experience child stunting rates nearly double those in the highest quintile, demonstrating how economic inequality translates directly into

nutritional outcomes. This economic stratification creates food access barriers that persist even when national food availability remains stable.

Post-Harvest Losses

India's food system suffers from substantial inefficiencies, with approximately 30% of produced food being lost before reaching consumers (FAO 2019). These losses occur across the entire supply chain, from inadequate harvesting techniques to poor storage infrastructure and inefficient transportation networks. Grains rot in government warehouses while vegetables spoil in transit due to lack of cold chain facilities. The Indian Council of Agricultural Research (ICAR 2020) estimates that post-harvest losses in fruits and vegetables reach 40-50%, representing both economic waste and nutritional deprivation. These systemic failures disproportionately affect small farmers who lack access to modern storage solutions and market linkages, creating a vicious cycle where production increases don't translate to improved food security. Addressing these losses requires massive investment in rural infrastructure, including cold storage facilities, modern warehousing and efficient transportation networks that connect production centers to consumption areas.

Gender Inequity

Cultural norms and patriarchal structures in India have created significant gender disparities in food access and nutritional outcomes. The deeply entrenched practice of women eating last and least in households has led to alarming health consequences. NFHS-5 data shows that 57% of women aged 15-49 suffer from anemia, compared to 31% of adolescent boys (NFHS-5 2021). This disparity begins in childhood, with girls often receiving less nutritious food than male siblings and continues through pregnancy, where 35% of women report reduced food intake during pregnancy (UNICEF 2022). The intergenerational impact is profound - malnourished mothers give birth to underweight babies, perpetuating the cycle of malnutrition. Social programs often fail to address these cultural barriers, focusing on food provision without challenging the gender norms that dictate intra-household food allocation. Transformative change requires not just nutritional interventions but fundamental shifts in social attitudes and women's empowerment.

Policy Implementation Gaps

The Indian government has established numerous programs to address food insecurity,

including the Public Distribution System (PDS), Mid-Day Meal Scheme and Integrated Child Development Services (ICDS). However, implementation challenges significantly limit their effectiveness. Leakage in the PDS remains a persistent issue, with studies suggesting that 40-50% of subsidized grains don't reach intended beneficiaries (Drèze and Khera 2015). The Mid-Day Meal Scheme, while successful in improving school attendance, often provides meals lacking in protein and micronutrient diversity (Singh *et al.* 2020). ICDS centers frequently face shortages of supplies and trained staff, limiting their ability to address child malnutrition comprehensively. These implementation gaps stem from bureaucratic inefficiencies, corruption and lack of community participation in program design and monitoring. Additionally, the focus on calorie provision often overshadows the need for dietary diversity, resulting in programs that prevent starvation but don't ensure optimal nutrition. Recent innovations like direct benefit transfers and Aadhaar-linked distribution show promise but require rigorous evaluation to assess their impact on food security outcomes.

Strategies for Improving Food Security and Health Outcomes

Nutrition-Sensitive Agriculture

The transformation of conventional agricultural practices into nutrition-sensitive systems represents a paradigm shift in addressing India's malnutrition challenges. This approach moves beyond mere calorie production to focus on enhancing the nutritional quality of food supplies through strategic crop diversification. Traditional monoculture farming systems that prioritize rice and wheat production have contributed to dietary monotony, particularly among rural populations. Introducing nutrient-dense crops such as millets, pulses and horticultural produce can significantly improve micronutrient availability at the household level (Ruel *et al.* 2018). The promotion of kitchen gardens has demonstrated remarkable success in states like Odisha and Andhra Pradesh, where women's self-help groups have been trained to cultivate seasonal vegetables and fruits in homestead plots, increasing household consumption of vitamin-rich produce (NITI Aayog 2020). Biofortification initiatives have gained particular traction, with iron-rich pearl millet (bajra) and zinc-enriched wheat varieties showing promise in addressing anemia and stunting in pilot districts (ICRISAT 2021). These agricultural interventions must be complemented by developing value chains that ensure fair prices for nutritious crops, creating

economic incentives for farmers to shift production patterns. The integration of nutrition education with agricultural extension services can further amplify impact by helping communities understand the health benefits of diverse diets.

Strengthening Social Safety Nets

India's extensive network of food security programs requires systematic strengthening to fulfil their potential as buffers against nutritional vulnerability. The Public Distribution System (PDS), while covering nearly 800 million beneficiaries, continues to face challenges in quality control and exclusion errors (Drèze and Khera 2020). Recent innovations like the 'One Nation One Ration Card' system aim to improve access for migrant workers, but implementation hurdles persist. The Integrated Child Development Services (ICDS) scheme needs substantial augmentation in service delivery quality, with studies showing that only 60% of anganwadacenters provide the full complement of supplementary nutrition and preschool education services (NITI Aayog 2021). The Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) has demonstrated potential as an anti-hunger program by putting cash in the hands of food-insecure households during agricultural lean seasons, but delayed wage payments and reduced workdays limit its effectiveness (Shah *et al.* 2021). A convergence approach that links these programs with health and sanitation initiatives could create synergistic impacts, such as conditioning MGNREGA wages on nutrition counseling attendance or integrating growth monitoring into PDS distribution points. The expansion of cash transfer programs, carefully designed to avoid inflationary effects on local food markets, presents another avenue for enhancing household food purchasing power during crises.

Nutrition Education

Behavior change communication represents one of the most cost-effective yet underutilized strategies for improving food security outcomes. Despite India's cereal-surplus status, inappropriate infant feeding practices contribute significantly to the country's high rates of child malnutrition. The NFHS-5 data reveals that only 42% of infants receive timely complementary feeding, while 36% of children under five consume inadequately diverse diets (NFHS-5 2021). Community-based nutrition education programs that employ culturally appropriate messaging have shown remarkable success in states like Maharashtra and Tamil Nadu. The "Suposhan" project in Bihar

demonstrated that intensive interpersonal counseling through frontline workers could increase exclusive breastfeeding rates by 18 percentage points within two years (UNICEF, 2022). Digital platforms are emerging as powerful tools for scaling nutrition education, with mobile-based counseling services reaching remote areas through voice messages in local dialects. School-based nutrition literacy programs that engage children as change agents within their families have demonstrated particular promise, with studies showing improved dietary diversity in households where children received nutrition education (Gaiha *et al.* 2020). However, these interventions require sustained investment in training community health workers and developing contextually relevant educational materials that account for regional dietary patterns and food taboos.

Monitoring and Data Systems

The development of robust nutrition surveillance systems has become increasingly critical for targeting interventions to high-burden populations. India's POSHAN Abhiyaan (National Nutrition Mission) represents a significant step forward, establishing real-time monitoring through the ICDS-CAS (Common Application Software) platform that tracks over 80 million beneficiaries monthly (NITI Aayog 2022). This system enables frontline workers to identify and prioritize severely malnourished children while providing policymakers with granular data on intervention coverage gaps. Advanced analytics incorporating satellite imagery and machine learning are being piloted to predict malnutrition hotspots by correlating agricultural production patterns, water availability and health infrastructure with nutritional outcomes (UNICEF 2023). The integration of Aadhaar-based beneficiary identification has reduced duplicate entries in some states, though concerns about exclusion errors persist. District-level nutrition dashboards that display real-time indicators of stunting, wasting and anemia prevalence are empowering local administrators to make data-driven decisions. However, the full potential of these systems remains untapped due to uneven digital infrastructure across states and capacity constraints among frontline workers in data utilization. Investment in both technological infrastructure and human capital is essential to transform nutrition monitoring from a reporting exercise into a management tool for improving program effectiveness.

Multi-sectoral Approach

The complex etiology of malnutrition demands coordinated action across traditionally siloed sectors. The agriculture-nutrition disconnect remains particularly stark, with agricultural policies rarely considering nutritional outcomes despite their profound interlinkages (Gillespie *et al.*, 2019). Kerala's multi-sectoral nutrition strategy demonstrates the potential of integrated approaches, combining agricultural extension with nutrition counseling, school meal programs with parent education and sanitation drives with growth monitoring. The "Kuposhan Mukh Bihar" initiative has shown how convergence between the rural development, health and education departments can amplify impact, reducing stunting prevalence by 8 percentage points in focus districts between 2016-2021 (World Bank 2022). Water, sanitation and hygiene (WASH) interventions are particularly crucial for improving food utilization, as repeated enteric infections from poor sanitation contribute significantly to child undernutrition (Humphrey 2019). Urban nutrition security requires collaboration between municipal corporations, food regulators and public health departments to improve food safety, regulate food marketing and create enabling environments for healthy eating. Institutional mechanisms like inter-departmental nutrition councils and joint monitoring frameworks can help sustain these collaborations beyond political cycles. International experience from countries like Brazil and Thailand underscores that sustained reductions in malnutrition require high-level political commitment to maintain multi-sectoral coordination over decades (Headey *et al.* 2020).

Conclusion

The complex interplay between food security and human health presents one of the most pressing challenges of our time, particularly in developing nations like India. As this analysis has demonstrated, food insecurity manifests in multiple dimensions - from physical availability and economic access to proper utilization and stable supply - each with profound implications for population health. The Indian paradox of being a food surplus nation while ranking poorly on global hunger indices underscores the need to move beyond production-focused solutions to address systemic inequities in distribution, social norms and policy implementation.

The health consequences of food insecurity create vicious cycles that span generations. Undernutrition in early childhood leads to irreversible cognitive and physical impairments, while micronutrient deficiencies silently erode human capital. The emerging dual burden of

malnutrition, where undernutrition coexists with obesity, reflects the complex nutritional transitions underway in rapidly urbanizing societies. These challenges are compounded by mental health impacts that are only beginning to receive due attention in food security discourse.

India's experience highlights several critical lessons for achieving sustainable food security and improved health outcomes. First, agricultural policies must evolve from being production-centric to nutrition-sensitive, promoting dietary diversity through crop diversification, biofortification and localized food systems. Second, social protection programs need strengthening through reduced leakages, better targeting and integration with health and nutrition services. Third, persistent gender inequities in food access demand transformative approaches that challenge patriarchal norms while empowering women economically and socially.

The multi-sectoral nature of food security calls for breaking down policy silos between agriculture, health, education and social welfare sectors. Successful models from various Indian states and other developing countries demonstrate that coordinated action across these domains can yield synergistic benefits. Technological innovations in monitoring and service delivery offer promising tools, but must be implemented with attention to equity and local contexts.

As India strives to meet its Sustainable Development Goal commitments, prioritizing food security must go hand-in-hand with improving health systems and social determinants of health. This requires sustained political commitment, increased public financing and robust accountability mechanisms. Community participation in program design and monitoring will be crucial for ensuring interventions are culturally appropriate and effectively address local needs.

Ultimately, ensuring food security is not just an agricultural or economic imperative, but a fundamental requirement for achieving health equity and human development. The time has come to view access to adequate, nutritious food not as a privilege but as a basic human right that forms the foundation for individual well-being and national progress. Only through such a comprehensive, rights-based approach can we hope to break the intergenerational cycles of malnutrition and build a healthier, more food-secure future for all.

Conflict of Interest

The author declares no conflict of interest.

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