Literature Review on Linkages between Child Nutrition and Economic Growth

IFPRI – MCC Series: Prioritizing Agricultural Investments for Income, Poverty Reduction, and Nutrition

Technical Paper 6

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ACRONYMS AND ABBREVIATIONS

ASF	Animal Source Foods
BMI	Body Mass Index
DHS	Demographic and Health Surveys
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
GNP	Gross National Product
HAZ	Height-for-Age Z-score
IYCF	Infant and Young Child Feeding
IUGR	Intrauterine Growth Retardation
LBW	Low Birth Weight
LiST	Lives Saved Tool
MCC	Millennium Challenge Corporation
NCD	Non-Communicable Diseases
SDG	Sustainable Development Goals
SD	Standard Deviation
SES	Socio Economic Status
SGA	Small for Gestational Age
SSA	Africa South of the Sahara
UN	United Nations
UNICEF	United Nations International Children's Emergency Fund
WASH	Water, Sanitation, and Hygiene
WAZ	Weight-for-Age Z-score
WFP	World Food Program
WHO	World Health Organization
WHZ	Weight-for-Height Z-score

EXECUTIVE SUMMARY

This document summarizes published and grey literature on conceptual framework on the link between child nutrition and economic growth, determinants of child undernutrition, types of investments to enhance maternal and child nutrition, and linkages between urbanization and child nutrition. Several insights emerge from the review.

First, and despite progresses over the last several decades, maternal and child malnutrition is still prevalent in developing countries and the progress has been uneven. While the percentage of chronically malnourished (stunted) children declined across the developing world, the number of stunted children in Africa increased due to slower reduction in stunting prevalence and population growth. Many developing countries are experiencing the coexistence of different forms of malnutrition including undernutrition, micronutrient deficiency, and overnutrition.

Second, child undernutrition, especially stunting during the first 1,000 days of life, has several short- and long-term effects on individuals and economies that include impaired cognitive and non-cognitive development, poor educational performance, low productivity and earnings, and higher healthcare costs. Third, the determinants of child undernutrition are broadly classified as the immediate determinants including dietary intake and diseases; the underlying determinants that include household food security, quality of care and household living environment, and access to healthcare; and the basic determinants that include access to productive resources, stock of capital, as well as socioeconomic, political and cultural factors. Investments to enhance child nutrition can target either the immediate determinants (known as nutrition-specific investments) or the underlying determinants (known as nutrition-sensitive investments).

Fourth, the effect of urbanization on child nutrition is mostly determined by the extent to which urban settlements offer their residents with better economic opportunities (e.g., better paying jobs and markets for nutritious food) and services (e.g., healthier living environments). Fifth, given the multilayer causes of child undernutrition, a multi-sectoral approach is needed to address the various determinants of undernutrition to improve maternal nutrition, promote optimal infant and young child feeding practices, enhance household food security, as well as improve healthy living environment and access to quality health care.

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1 INTRODUCTION

It has long been acknowledged that adequate nutrition is critical for the formation and accumulation of human capital, with individuals who are adequately nourished at different stages of the life cycle, and especially during the first 1,000 days, better able to learn faster, develop more sophisticated and remunerative skills, and are ultimately more productive (Lucas 1988; Strauss and Thomas 1998; Arcand 2001; Becker 1962). Despite this acknowledgement and progresses made, undernutrition of children under the age of five years old (hereinafter "under-5" children) is still widespread and progresses made have been uneven. While developing countries have historically been affected by undernutrition, they are increasingly been affected by overnutrition due to rapid urbanziation and nutrition transition with diets traditionally dominated by unprocessed staple cereals are replaced by highly processed energy-dense foods and animal sourced foods.

Child malnutrition results from deficiencies or excesses in nutrient intake, imbalances in essential nutrients or diminished utilization of nutrients. Its effects manifest themselves at different stages of the life cycle and in different forms including impaired cognitive development, growth retardation, high morbidity and mortality, and poor educational and labor market outcomes. It is estimated that countries of Africa and South Asia facing high malnutrition lose 4% to 11% of their Gross Domestic Product (GDP) annually due to lower productivity and higher cost of health care (Horton and Steckel 2013). These individual and societal costs are behind ambitious nutritional goals such as UN's Sustainable Development Goal 2 that aims to eradicate hunger and all forms of malnutrition by 2030. Several interventions have been proposed to tackle the immediate determinants of child nutrition (nutrition-specific investments) or the underlying determinants of child nutrition (nutrition-sensitive investments). Nutritional investments are shown to have significant economic returns and are ranked among the development investments with the highest benefit-cost ratios.

This study is conducted to guide program design at the MCC to maximize nutritional benefits of its investments. The rest of the document is organized as follows. Section 2 discusses the current state of child malnutrition. Section 3 presents a framework to conceptualize the link between childhood nutrition and economic growth. Section 4 summarizes the evidence on the correlates of child undernutrition with a focus on stunting. Section 5 presents evidence on the economic returns to nutritional investments. Section 6 lays out pathways through which urbanization may influence child nutrition. Section 7 examines the state of undernutrition in countries MCC has worked in and assesses MCC's investment profile through the lens of the evidence discussed here. Section 8 concludes the document by highlighting nutrition-specific (health) and nutrition-sensitive investment options for tackling child malnutrition.

2 THE STATE OF CHILD MALNUTRITION

About 21% and 6.9% of the 144 million children under the age of five years old globally were, respectively, stunted and wasted in 2019 (UNICEF, WHO and World Bank 2020). Asia and Africa accounted for, respectively, 54% and 40% of the stunted and 69% and 27% of the wasted children with Africa South of the Sahara (SSA) having the least progress in tackling undernutrition. While the number of stunted under-5 children globally declined by 28% between 2000 and 2016, the rate of decline for Africa was just 7% (from 38% to 31%), a decline that is about half of Asia's (from 38% to 24%). In some cases, progress is being reversed with undernourishment and food insecurity increasing in Africa and parts of South America (FAO et al. 2018).

The diets of millions of children and adults lack micro- and macro-nutrients. Macronutrients include fats, carbohydrates, and proteins and provide the body with calories. Micronutrients are vitamins and minerals that work in tandem with macronutrients. They are needed in relatively small amount enable the body to produce various substances (e.g., enzymes and hormones) that are essential for normal growth and development, regulate metabolism, maintain tissue functions, and prevent diseases. Micronutrient deficiency (also known as "hidden hunger" given that symptoms are not visible) is an integral aspect of the malnutrition challenge, with a third of the global population suffering from at least one form of micronutrient deficiency.

WHO estimates show widespread iron-deficiency anemia among women in the reproductive age (15-49 years old) and children 6 – 59 months in Africa and Southern Asia where 20% to 60% of women and over 40% of children are affected. Iron-deficiency anemia among pregnant women is associated with several adverse health and developmental effects including maternal and perinatal mortality, preterm delivery, intrauterine growth restriction, low-birth-weight, and low iron stores among babies, while iron deficiency among children is linked to cognitive and physical impairments (Pasricha et al. 2021; Shekar et al. 2017). Derived from foods such as animal flesh foods, liver, and dark green leafy vegetables, vitamin A is essential for a healthy immune system, healthy vision, proper organ function, and overall growth and development. Vitamin A deficiency among children is a leading risk factor for morbidity (e.g., from pediatric blindness, diarrheal diseases, and malaria infection) and mortality affecting up to a third of the children globally, with the highest prevalence observed in Africa (48%) and South Asia (44%) (UNICEF 2019).

Another public health challenge is deficiency in iodine especially among populations with inadequate intake of marine foods. Iodine-deficiency disorders can result in hypothyroidism and hyperthyroidism that impair childhood cognitive development and, subsequently, educational and labor market outcomes (WHO 2010). Zinc is another mineral that plays a critical role in several biological processes including cell development, gene expression, and immune function. While there are no global estimates of zinc deficiency, mild-to-moderate zinc deficiency is prevalent among children in developing regions who face high incidence, severity, and duration of diseases (e.g., diarrhea) and impaired growth (Imdad and Bhutta 2011). While exclusive breastfeeding for the first six months of life is associated to many proven benefits, it is not practiced by millions of mothers in developing regions due to limited awareness, culture, and other factors.

At the same time overnutrition is on the rise (Swinburn et al. 2011; Lobstein et al. 2015; IFPRI 2016) accompanied by nutrition transition whereby diets traditionally dominated by unprocessed staple cereals are being replaced by ASF and energy-dense nutrient-poor plant based foods (Popkin 2011). For example, the number of overweight under-5 children in Africa increased from 6.6 million to 9.3 million between 2000 and 2019 (43% increase) while Asia (excluding Japan) experienced a 19% increase in under-5 overweight during the same period (from 14.4 to 17.2 million) (UNICEF et al. 2020). Childhood overweight and obesity increase the risk of noncommunicable diseases (NCDs), such as type 2 diabetes, cardiovascular diseases, and cancer later in life (WHO 2010). Additionally, stunting – a marker of childhood malnutrition – has been linked with higher risk of obesity (BMI >=30 kg/meter^2) in adults due to metabolic programming in early diets. Malnourishment during childhood may result in the development of "thrifty genes" that alter the body's physiology and metabolism to adapt to food shortages, and that may become maladaptive later in life when calories are abundant (Hales and Barker 2013; Barker 1992; Fung 2009).

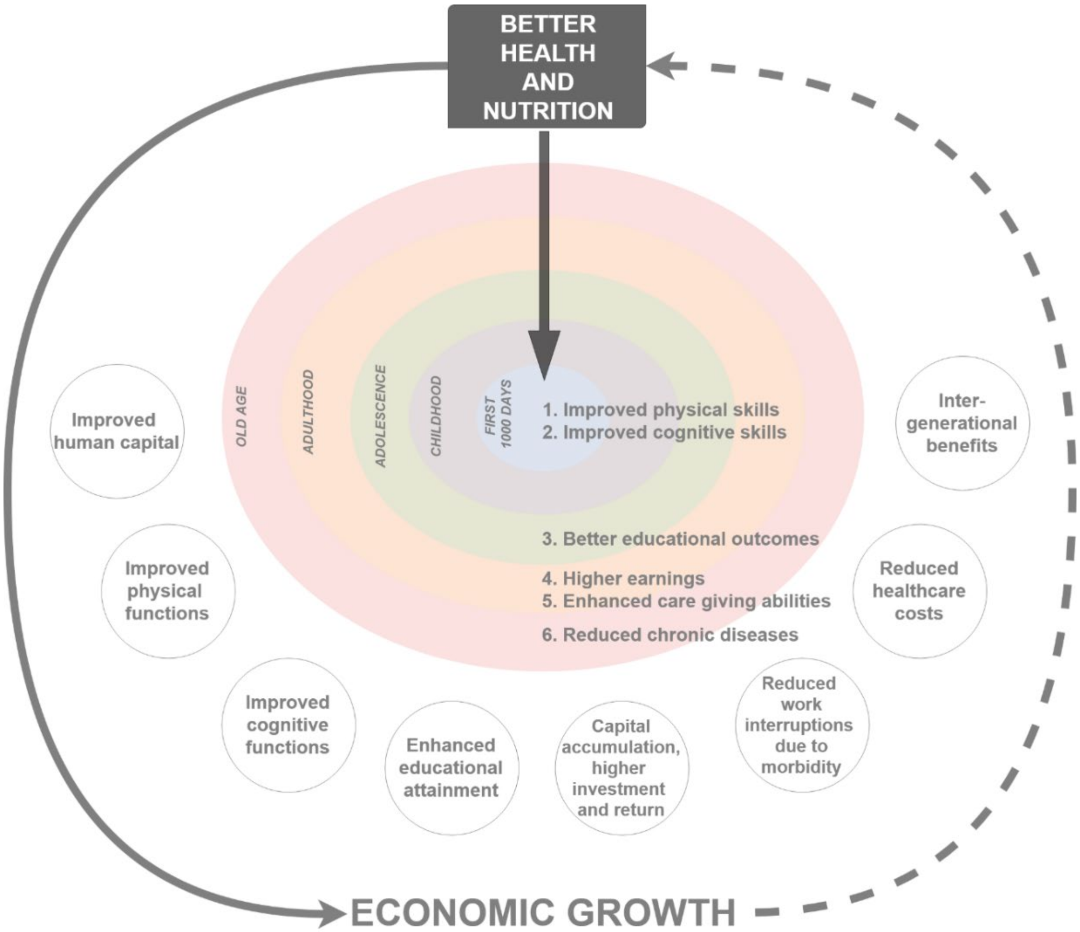
3 CONCEPTUAL FRAMEWORK

The linkage between nutrition and economic growth is bi-directional, with improved nutrition contributing to economic growth -- and growth and poverty reduction contributing to improved nutrition and health. Failure to address undernutrition, especially stunting, during this first window of opportunity has irreversible negative effects (Heckman, Stixrud and Urzua 2006; Shekar et al. 2017). Child malnutrition is a "syndrome of developmental impairment" that hinders individual development and is manifested through several symptoms including growth retardation; cognitive, physical, and behavioral deterioration; immunocompetence vulnerability; and increased morbidity and mortality (Beaton et al. 1990; Martorell 1999; Stein et al. 2009; UNICEF 2010; Alderman, Hoddinott and Kinsey 2006).

These result in a considerable amount of economic loss through human capital losses and a higher health expenditure burden (Shekar et al. 2017). For example, poor nutrition has led to an 11% loss in Gross National Product (GNP) in Africa and Asia (Bocquenet et al. 2016). Malnutrition also perpetuates inequality and poverty as children born to malnourished pregnant women are more likely to face Intrauterine Growth Retardation (IUGR) that undermines their life prospects before they are ever born[1] (Alderman, Behrman and Hoddinott 2004). The nutrition-growth linkage is conceptualized in Figure 1 with a focus on the link from improved nutrition (indicated by the solid downward arrow). The different concentric circles illustrate the private returns that may accrue to a well-nourished child at different stages of his/her life. Social benefits stemming from the individual benefits are listed underneath the concentric circles.

[1] Other risk factors that lead to IUGR include diarrheal disease, intestinal parasites and respiratory infections, and malaria.

Figure 1: Framework for understanding linkages between nutrition and economic growth



Source: Adapted from Hoddinott et al. (2013).

Broadly speaking, the benefits of improved childhood nutrition materialize at five main stages of the life cycle. The two inner most concentric circles in Figure 1 represent improved nutrition during the first 1,000 days and childhood. Better nutrition during this stage reduces the risk of morbidity and mortality and is likely to foster improved physical and cognitive development. As a result, teenagers with adequate nutrition during their early formative years will likely perform better in school and as caregivers if they become a parent (concentric circle 3). When a well-nourished cohort reaches adulthood, it continues to display higher physical and intellectual productivity that is passed on to the next generation through improved earning and other socioeconomic outcomes (concentric circle 4). When the cohort reaches old age, it is likely that they will live longer and healthier (concentric circle 5) due to the cumulated benefits over the lifespan to date. Private benefits transmit to societal gains through improved human capital formation, enhanced productivity, and reduced health expenditure, and higher intergenerational benefits. In this way, the private good has an important positive externality.

3.1 First 1,000 Days and Childhood

Early childhood nutrition shapes the cognitive and noncognitive development of children and affect several subsequent outcomes including schooling, employment, and productivity (Heckman et al. 2006;

Heckman 2006). Nutritional investment during this stage is shown to produce one of the best 'value-for-money' development investments (Kakietek et al. 2017; Hoddinott et al. 2013; Alderman et al. 2006). Childhood diets deficient in crucial micronutrients hamper normal growth and cognitive development. Damages inflicted during this window are particularly detrimental due to the irreversibility of health, cognitive, and productivity implications (World Bank 2006). While intervention at later stages of the life-cycle can help improve deficiencies in skills and human capabilities later in life (e.g., preschool program, educational investments, and job trainings), such investments often cost much more than the cost of early remediation to achieve a certain level of desired outcomes later in life (Heckman 2008).

Given the importance of this first "window of opportunity", benefits, costs, and economic returns of several nutrition-specific investments have been studied including as part of *The Lancet* Series on Maternal and Child Undernutrition (2008, 2013) and Copenhagen Consensus Project (2004, 2008, and 2012). One *Lancet* study shows that investments to promote optimal breastfeeding, enhance intake of nutrient-rich complementary foods, supplementation of crucial micronutrient for pregnant women and children (vitamin A, zinc, iron, and iodine) as well as those that reduce the burden of diseases by promoting handwashing and other strategies for tackling malaria during pregnancy in 36 countries that account for 90% of the global burden of stunting could reduce stunting by 36% and mortality by 25% (Bhutta et al. 2008). Subsequently, another study estimated the budgetary cost of scaling up these interventions in high burden countries with unit costs derived from actual cost of implementing the interventions in poor countries. Total costs per child was estimated at about $96 with the cost of providing complementary foods accounting for about 60% of the total per child cost (Horton et al. 2010).

In another 2012 study conducted as part of the Copenhagen Consensus (Hoddinott, Rosegrant and Torero 2012) that estimated the economic return to scaling up a package of nutritional investments in four countries–Bangladesh, Ethiopia, Kenya, and India, it was shown that benefit-cost ratios range between 15:1 and 138:1 depending on the country, assumed discount factor (3% versus 5%), and the returns to earnings from averted stunting (15% versus 24%). Building on the analysis done as part of the 2008 *Lancet* series, a 2013 *Lancet* study showed that the scaling up of a package of nutrition-specific investments in 34 countries with high burden of stunting can reduce stunting by 20.3%, severe wasting by 61%, and child morality by 15% (Bhutta et al. 2013).

3.2 Adolescence and Adulthood

Undernourished children with impaired cognitive development are likely to face learning disabilities and subsequently low scholastic achievement during adolescence (between the ages of ten and nineteen years (Campisi et al. 2018)) and early adulthood. Cross-country analysis of data from five long-standing cohort studies in Brazil, Guatemala, India, the Philippine, and South Africa show that childhood undernutrition was strongly associated with lower educational attainment (Victora et al. 2008). The evidence from the Philippine specifically shows that children who were stunted at the age of two were more likely to have delayed school entry, repeat grade, dropout as well as less likely to finish primary and secondary school (Daniels and Adair 2004).

Another study from Zimbabwe showed that had the median pre-school child in the sample had the stature of a median child in a developed country, the child would have completed an additional 0.85 grades of schooling and finish school six months earlier (Alderman et al. 2006). Cross-country evidence from Egypt, Ethiopia, Swaziland and Uganda also found that students who were stunted during childhood were more likely to repeat grades and drop out of school due to reduced cognitive capacity and poor school performance (African Union Commission et al. 2014). Hungry children attending schools will have reduced ability to learn and realize their full potential. In addition to individuals and societal costs of nutrition-related poor educational performance in the form of lost income and reduced human capital, school repetitions are costly to families and education systems as they demand extra resources. Given that 15–20% total stature and 45% of adult bone mass are achieved during adolescence, studies have examined the potential for a “catch-up” growth during adolescence–the second “window of opportunity”–, although the timing, sensitivity and mechanisms for catch up growth during this stage remain uncertain (Campisi et al. 2018).

Productivity gains of childhood nutrition manifest themselves during adulthood both for manual and non-manual activities. Workers who have been stunted during childhood have shorter adult stature and reduced lean body mass, and therefore are less productive in activities requiring manual labor, such as carrying weights (African Union Commission et al. 2014; Victora et al. 2008). For non-manual activities, workers who have been stunted during childhood earn less due lower educational attainment or shorter height (Victora et al. 2008; World Bank 2006; Shekar et al. 2017). Adult height is largely determined by nutritional status in the first 1,000 days and shortness tends to persist throughout life. Evidence shows the existence of adult height-wage premium, even after controlling for health condition, education, and cognitive skills, with taller adults earning more on average (Leroy and Frongillo 2019). Children who received adequate nutrition and care before their second birthday are able to perform better in schools and earned more in adulthood (Gertler et al. 2013).

3.3 Old age

One aspect that trickles down all the way from childhood malnutrition to old age is the burden of diseases. Infectious diseases like diarrhea are prominent determinants of malnutrition, but other NCDs like cardiovascular disease and type-2 diabetes are often linked to childhood malnutrition. Experts now believe that childhood stunting increases the risk of adult obesity, as the body is adapting to catch up growth (Reinhardt and Fanzo 2014; Eckhardt 2006). Additionally, the danger of disease complications due to micronutrient deficiencies is now coming to light.

Depending on the level of private and public investments made at different stages of the life cycle, the effects of childhood undernutrition can be magnified or mitigated. For example, private and public nutritional and educational investments targeted at historically undernourished students can give them the extra boost they need to perform well in school thereby mitigating the subsequent negative effects of childhood undernutrition. Similarly, absent the necessary private and public health investments targeted at historically undernourished students at a higher risk of morbidity, the negative effects of childhood undernutrition will propagate.

The foregoing discussions highlight the fact that investments that improve child nutrition have multiple benefits that materialize in the short- medium-, and long-term. Estimating economic returns requires assessment of returns at different stages of the life cycle that can be estimated based either on the economic cost of not tackling malnutrition or the economic benefits of improving child nutrition. Costs include mortality; health care expenditures, and lost productivity and earning due to poor physical and cognitive development. Benefits from improved nutrition materialize in the form of averted infant and child mortality; reduced neonatal, infant, and child health care costs; higher educational attainment, productivity and earning; lower cost of chronic diseases; and higher intergenerational benefits due to better nutritional outcomes of children born to well-off parents.

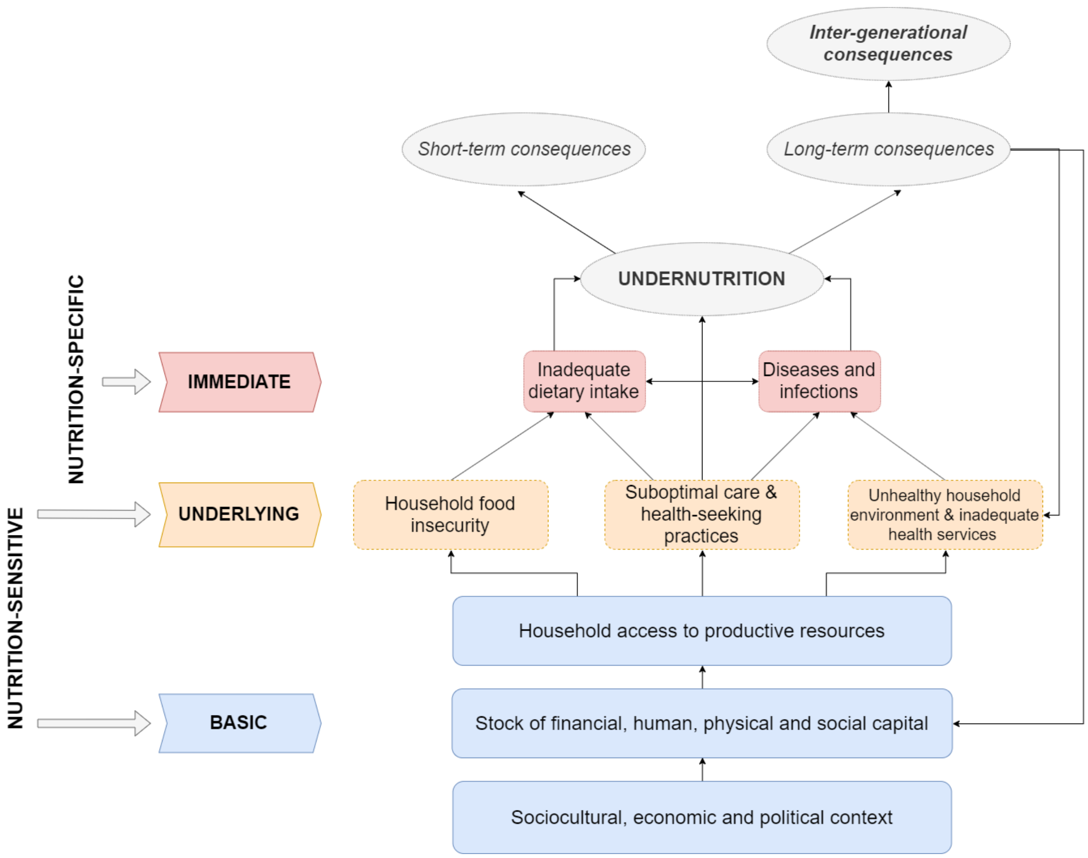
4 DETERMINANTS OF CHILD UNDERNUTRITION AND THE ROLE OF NUTRITIONAL INVESTMENTS

The WHO Child Growth Standards (WHO 2006) are used to measure undernutrition among under-5 children based on three indicators: height-for-age Z-score (HAZ), weight-for-height Z-score (WHZ), and weight-for-age Z-score (WAZ). A moderately (severely) stunted child has HAZ below -2 (-3) standard deviation (SD) from the median of the WHO Child Growth Standards for the same sex and age. WHZ below -2 (-3) SD captures a state of moderate (severe) wasting. A moderately (severely) underweight child's WAZ is below -2 (-3) SD from the median of the reference group. Underweight is a composite index of stunting and wasting; an underweight child can be wasted, stunted or both (Goudet et al. 2015; WHO 2010). For adolescents and adults, a BMI below 18.5 shows underweight (Gross et al. 2000).

Stunting describes a chronic state of deficiency due to undernutrition and illnesses that deprive a fetus and child of required nutrients. It captures "past and future predictions", unveiling the growth environment of individuals as well as children's potential to fulfill their physical and economic potential (Leroy and Frongillo 2019). The first 1,000 days following conception present a critical integral "window of opportunity" for tackling child stunting (Ruel 2013; UNICEF 2015). Stunting is more prevalent than wasting and underweight -- and continues to persist even when underweight falls globally (Smith and Haddad 2015). Wasting describes an acute state of deficiency where a child has been deprived of food and/or has suffered recurring illness that impacts her body's absorption capacity of crucial nutrients. Underweight is a manifestation of both chronic and acute factors (Dop 2016; WHO 2010).

The dynamics of undernutrition are determined by several linked factors operating at different levels as depicted in the conceptual framework in Figure 2 below. This framework includes both causal factors leading to undernutrition and outcomes expected from it.

Figure 2: Framework for understanding the determinants of undernutrition



Source: Adapted from UNICEF conceptual framework of undernutrition (UNICEF 2015)

Inadequate dietary intake, diseases, and infections are the immediate determinants of undernutrition which in turn are affected by underlying factors, including household food insecurity, suboptimal care (for children), the availability and cost of nutrient-dense food, and health-seeking practices, unsanitary living environment, and limited access to health services. At a larger scale, underlying factors including household's access to productive resources; available stock of human, social, and physical capital; and socioeconomic and cultural factors affect nutrition through their effects on the underlying and immediate determinants of nutrition.

An important distinction shown in Figure 1 is the role of nutrition-specific versus nutrition-sensitive investments for tackling constraints at different scales. As defined in *The Lancet* Maternal and Child Nutrition Series, nutrition-specific investment refers to "interventions or programs that address the immediate determinants of fetal and child nutrition and development—adequate food and nutrient intake, feeding, caregiving and parenting practices, and low burden of infectious diseases" (*The Lancet* 2013, pp. 3). On the other hand, nutrition-sensitive investments include "interventions or programs that address the underlying determinants of fetal and child nutrition and development—food security; adequate caregiving resources at the maternal, household and community levels; and access to health services and safe and hygienic environments—and incorporate specific nutrition goals and actions" (ibid).

A wide range of interventions in agriculture, social safety nets, early child development, women's empowerment, education, and water, sanitation, and hygiene are nutrition-sensitive (Ruel, Alderman and The Maternal and Child Nutrition Study Group 2013). Within agriculture, investments in nutrient-dense value chains including ASF, fruits and vegetables are more nutrition-sensitive than investments that historically focus on increasing yield of staple cereals. Biofortification is considered both nutrition-sensitive and nutrition-specific, the latter since it involves modification of the agricultural economy to address specific micronutrient deficiency among the target population. Table 1 provides examples of different nutritional investments.

Table 1: Nutritional investments

Panel A. Examples of proven nutrition-specific investments

High-impact interventions for pregnant women, mothers of infant and young children, and children

- Maternal multiple micronutrient supplement to improve birth outcomes and reduce‡
- Counseling for mothers and caregivers about infant and young child feeding and hygiene practices (e.g., immediate initiation of breastfeeding, exclusive breastfeeding for six months and continued breastfeeding until two years, and age-appropriate complementary feeding for 6-24 months old children)
- Balanced energy-protein supplementation for pregnant women, i.e., food supplements that contain less than 25% protein as their total energy content
- Intermittent presumptive treatment of malaria during pregnancy in moderate to high malaria transmission areas†
- Micronutrient supplementation (vitamin A and preventative zinc) for children
- Complementary foods for children

Interventions to tackle iron deficiency anemia

- Maternal multiple micronutrient supplementation and presumptive treatment of malaria during pregnancy
- Iron and folic acid supplementation for nonpregnant women of reproductive age (15 – 49 years old)
- Iron fortification of staple foods such as wheat, maize, and rice

Interventions to promote exclusive breastfeeding

- Maternity leave benefits
- Promotion of pro-breastfeeding policies and legislations for the general population
- National breastfeeding promotion campaigns and mass advertising

Treatment of severe acute malnutrition (wasting)

- Outpatient treatment of severe acute malnutrition without complication using ready-to-use therapeutic food

Panel B. Examples of nutrition-sensitive investments

- Agriculture (e.g., biofortification of foods; development of nutrient-dense value chains such as livestock, fish, fruits, and vegetables; on-farm production diversification including through home-gardening; research and extension around nutrient-rich varietal development and dissemination)
- Social safety nets (cash transfers linked to participation in health and nutrition programs especially for vulnerable households with infant and young children)
- School feeding programs for adolescents and young adults
- Programs to empower women by enhancing their access to productive resources, social services (e.g., education and health care), and better employment opportunities
- Economic (e.g., roads and electrification) and social (education and health) infrastructural development
- Water, hygiene, and sanitation
- Early childhood development to promote psychosocial stimulation and responsive parenting

Source: Shekar et al. (2017) (panel A) and authors' based on literature review (panel B)

4.1 Immediate Determinants

Several studies highlight the criticality and vulnerability during the first 1,000 days of life, when the consequences of a child's impaired physical and mental growth are the most significant (Alderman and Headey 2018; Beiersmann et al. 2013; Victora et al. 2010). Nutrition outcomes are also affected by other non-modifiable characteristics, such as age and gender. Researchers have identified positive association between being a male child and reduced underweight prevalence (Abuya, Ciera and Kimani-Murage 2012; Akombi, Agho, Merom, Renzaho, et al. 2017; Gewa and Yandell 2011). Children who are born small, weighing less than 2,500 grams, are more likely to be undernourished (Abuya et al., 2012; Akombi et al., 2017; Bomela, 2009; Danaei et al., 2016). Exposure to physical illnesses like diarrhea (Gewa and Yandell 2011; Danaei et al. 2016; Checkley et al. 2008), anemia and parasitic infection (Erismann et al. 2017) and fever (Akombi et al., 2017) can also deprive the child of necessary nutrients, ultimately resulting in underweight. Emerging research suggests that exposure to toxins, such as aflatoxin and pesticides, may also negatively affect child growth and development (Reinhardt and Fanzo 2014).

Parental traits, especially of mothers, affect child nutritional outcomes; the cycle of undernutrition can continue as the mother's nutritional status plays a role in the neonatal, postnatal, infant, and early childhood stages of her offspring. An association between maternal BMI or short stature and fetal growth restriction has been widely discussed as low maternal BMI increases the risk of small for gestational age (SGA) newborns (Black et al. 2013). Recently, researchers identified positive association between SGA and nutritional deficiencies during infancy and childhood, along with other factors such as feeding practices or home environments (Britto et al. 2017). Maternal education especially has been identified as a strong predictor of child nutrition using at least one of the indicators of undernutrition – stunting, wasting, and underweight (Gewa and Yandell 2011; Headey 2014; Hoffman et al. 2017). Maternal education can affect child nutrition in several ways including through better knowledge about the importance of prenatal care and optimal IYCF and better intra-household bargaining power.

Nutrition-related growth restrictions as a fetus, stunting, and severe wasting constitute the largest percentage of risk factors for under-5 children (Black et al. 2008) thereby attracting the attention of most of the empirical research. However, adolescent and adult nutritional status is also important, since these demographic groups are preparing for or are already in the workforce. This demographic also serves a caregiver role – both for children – and for elders. The focus on adolescent health and nutrition is vital, as this life stage is often described as the "second window of opportunity" with triple returns from nutritional improvement in the form of better adolescent health now, adult health later, and the health of future generations (Choudhury, Headey and Masters 2019; Patton et al. 2016). Adolescence, covering 10 to 19 years of age, is a period when rapid physiological changes occur, both at physical and cognitive levels, preparing individuals for the roles and responsibilities of adulthood (Das et al. 2017; Christian and Smith 2018). Although the causes of adolescent nutritional deficiencies are dependent on multiple factors and circumstances, the special need for certain micronutrients (e.g. iron, calcium, vitamin D) and dietary energy intake is apparent especially as puberty triggers rapid growth (Patton et al. 2016; Das et al. 2017; WHO 2018). This transitional period can aggravate the double burden of malnutrition and micronutrient deficiencies. Stunting in adolescents is a critical indication of poor nutrition that has built up and is correlated with numerous factors from early life (e.g. insufficient feeding and care practices as infants and children) to the current state, such as poverty and/or illnesses (WHO 2018; Christian and Smith 2018).

Finally, the health and nutrition of future generations can be significantly compromised through child marriages. There were around 650 million child brides in world in 2018, with the highest prevalence in South Asia and SSA (UNICEF 2018). Child brides are among the most nutritionally vulnerable groups -- not only for the girl herself but also for her future children. As adolescent girls are still growing, competition for nutrients is unavoidable between the mother and her fetus, where the mother is at risk of becoming stunted and the fetus in danger of having a low birth weight and facing other postpartum risks including stunting and death (Christian and Smith 2018; Das et al. 2017; Forouzanfar et al. 2016). At a social level, child brides are often deprived of their education and decision-making ability (WHO 2007; Wodon, Onagoruwa and Savadogo 2017), both of which can affect the nutrition of their children.

4.2 Underlying Determinants

Several studies document a strong association between household socio-economic status (SES) and nutrition. Empowering caregivers and creating an enabling environment for the family positively contributes to optimal child growth and development (Black et al. 2017). Economic growth and poverty reduction have generally been identified as key factors in reducing the burden of hunger and malnutrition (Gödecke, Stein and Qaim 2018). Household assets (Bomela 2009; Headey 2014; Hoffman et al. 2017), crop production (Belesova et al. 2017), and ownership of saving accounts (Gudina, Yemane and Alemayehu 2013) are highly correlated with nutritional outcomes. Both adults and children living in poorer households have higher likelihoods of suffering from undernutrition, *ceteris paribus* (Adebowale, Palamuleni and Odimegwu 2015; Kismul et al. 2017; Letamo and Navaneetham 2014). Access to social services, including maternal health and antenatal care, also play a vital role in nutritional outcomes (Gudina et al. 2013; Headey 2014). Access to information and infrastructure like roads and electricity tackle undernutrition through their effects on diets and exposure risk of diseases and infections. For example, the likelihood of being stunted is higher among children who live in dwellings that lack electricity (Hoffman et al. 2017).

4.3 Basic Determinants

Nutrition is determined by complex interactions of factors that operate at different scales. As mentioned above, the immediate level factors, such as age, gender, and physical illnesses are important while intergenerational factors like mother's nutritional status, parental education, and child marriage are notably important. At the underlying level, household SES and access to social and economic infrastructure are crucial. Now at the basic level, we turn our attention to political systems and environmental factors that can affect nutrition through multiple pathways.

The environment and various climate-related risks are major determinants of nutrition, especially in economies that rely heavily on rainfed agriculture. These risks can impact nutrition both through their effects on agricultural production (Schlenker and Lobell 2010) and the spread of water- and vector-borne diseases (Lloyd, Kovats and Armstrong 2007; Levy, Hubbard and Eisenberg 2008). Warming can induce famine that weakens people and suppresses immune systems and resistance to infection. It can also reduce yields (Khasnis and Nettleman 2005) and crop nutrient density while facilitating the spread of pests such as the TseTse flies that attack livestock (Alsan 2015). Children who face drought are more likely to be undernourished (Mulmi et al. 2016; Kumar, Molitor and Vollmer 2016; Hoddinott and Kinsey 2001).

5 ECONOMIC RETURNS TO NUTRITIONAL INVESTMENTS

Nutritional investments do not just improve social welfare and equity, but they are also productivity enhancing (Alderman 2010; Berg and Muscat 1972; Shekar et al. 2017; Alderman, Behrman and Puett 2017). There were various efforts to assess the returns and cost-effectiveness of alternative nutritional investments, including *The Lancet* Series of papers on maternal and child nutrition. Regardless of the assumptions made or models used, nutrition-specific investments have been shown to have significant economic returns.

The first *Lancet* Series (2008) focused on a crucial period encompassing the time from conception to a child's second birthday and identified several nutrition-specific interventions to tackle undernutrition. These investments can be categorized into behavior change communication interventions to improve breastfeeding and complementary feeding; micronutrient supplementations to pregnant women and children; and provision of complementary foods and therapeutic feeding to treat acute malnutrition. Subsequent *Lancet* Series (published in 2013 and 2021) re-evaluated maternal and child undernutrition and their effects using new data, examined the prevalence and consequences of overweight and obesity among women and children, and identified alternative delivery platforms to scale up nutrition-specific interventions.

One of the 2008 *Lancet* papers shows that existing interventions for nutrition and disease preventions can reduce stunting at 36 months by 36%; mortality between birth and 36 months by 25%; and disability-adjusted life years (DALYs) due to undernutrition by 25% (Bhutta et al. 2008). In a follow-up 2013 *Lancet* paper that uses the Lives Saved Tool (LiST), scaling up ten evidence-based nutrition-specific interventions has been shown to results in a 20% and 61% reduction in stunting and severe, respectively, among other health benefits (Bhutta et al. 2013). Another longitudinal study from Guatemala showed a 20% reduction in severe childhood stunting and 46% increase in earnings during adulthood among children who received nutritious food supplement (Hoddinott et al. 2008).

While nutrition-specific investments are shown to have high economic return, they are not enough to eradicate all forms of malnutrition including stunting. Multi-sectoral nutrition-sensitive approaches are therefore needed to tackle the complex sociocultural, economic, political, and environmental factors that shape nutritional outcomes (Ruel et al. 2013; Lancet 2013). Specific to agriculture, investments have historically focused on increasing the productivity of a few staple crops, without much consideration for health and nutrition implications (Bouis and Welch 2010; World Bank 2007; Ruel 2001). In recent years, however, increased emphasis is placed on the need for including nutritional goals into agricultural investment decisions including through on-farm production diversity into nutrient-dense value chains (e.g., animal-sourced foods, fruits, and vegetables) and integration of micronutrients into staples and complementary foods through biological and industrial fortification (Bouis and Saltzman 2017; Bouis and Welch 2010; Ruel 2001).

Promising results have emerged from various biofortification efforts including iron-biofortification of beans, cowpea, and pearl millet that thrives in arid and semi-arid areas; zinc-biofortification of maize, rice, and wheat; and provitamin A carotenoid biofortification of cassava, maize, rice, and sweet potato (De Moura, Miloff and Boy 2015; Bouis et al. 2011). Evidence from randomized controlled trials shows that the consumption of provitamin A-biofortified maize in Zambia increases vitamin A store among children suffering from vitamin A deficiency and improves visual function (Palmer et al. 2016; Gannon et al.

2014). The increase in vitamin A store is found to be comparable with that from vitamin A supplementation. The consumption of zinc-biofortified maize and wheat products has also been linked with higher zinc absorption and lower morbidity (Sazawal et al. 2018; Chomba et al. 2015).

Nutrient deficiency can also be tacked through industrial fortification of foods that are consumed by the general population known as mass fortification (e.g., salt iodization), fortification of foods consumed by specific segments of the population known as targeted fortification (e.g., fortification of complementary foods for children), or market-driven fortification. Fortification of staple cereals can be an effective strategy when there is significant demand for flour milled by industrial roller mills versus homemade flour and regulations are in place to guide and monitor the selection of food vehicles, fortificants, and fortification concentrations.

Interest has also grown on how to leverage social protection programs for improved nutrition, programs that are often perceived as a means for distributing income from productive to unproductive individuals (Mathers and Slater 2014). Social safety nets consisting of transfers (conditional, unconditional, cash or in-kind) and school feeding programs have been linked to better outcomes including among child nutrition. Evidence from Latin America and Africa suggests that the impact of transfers is mediated by several factors including the size and predictability of the transfer, the characteristics of beneficiaries, and the type of messaging where programs that target households with infants and young children are more likely to be more effective during the critical 1,000 days (Oxford Policy Managment 2014; FAO 2017).

A recent meta-analysis the impact of school feeding programs across lower income countries shows that, in addition to their impact on schooling outcomes such as enrollment and attendance, school feeding programs have helped improve children’s dietary energy and micronutrient intake and weight (Wang and Fawzi 2020). Their nutritional and local economy impacts can be maximized by enhancing the quality of program design including through provision of nutritionally superior food, ensuring stronger linkages with local farmers, and making school feeding program part of a broader curriculum of nutrition and health education programs. Ensuring adequate nutrition among adolescents during the “second window” of opportunity can contribute to the continuum of children’s development by building on nutritional investments during the first 1,000 days.

Given that women are the primary care takers in many developing countries, empowering them by enhancing their access to productive resources and essential services, and creation of better economic opportunities is crucial. Better access to resources and employment opportunities enhances their intra-household decision-making which contributes to better child nutrition both directly through better infant and young child care and feeding and indirectly via improved maternal nutrition (Jones et al. 2019; Allendorf 2007a). Children in households where women have better access to and control over land and other productive resources are found to be less likely to be undernourished (Rahman, Saima and Goni 2015; Allendorf 2007b; SPRING 2014).

6 LINKAGES BETWEEN URBANIZATION AND NUTRITION

The urban population is expected to surpass that of rural residents for the first time by 2050 (Saghir and Santoro 2018) with regions like Africa scoring the fast rate of urbanization. Many rapidly urbanizing developing countries are facing a “triple-burden” of malnutrition: the co-existence of undernutrition, overnutrition, and micronutrient deficiency. The literature on nutrition transition often cites rapid urbanization as one of the contributing factors to malnutrition (Haddad, Cameron and Barnett 2015; WHO, NHM and

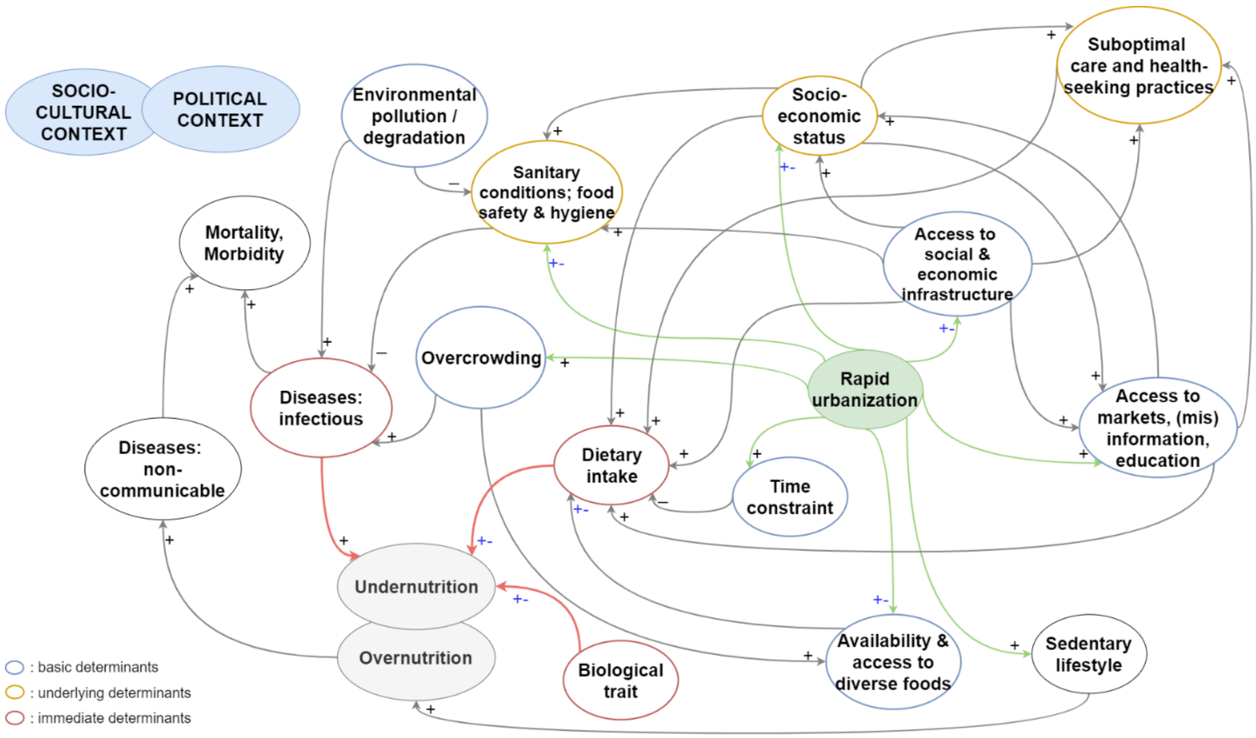
NDM 2017; Hawkes, Harris and Gillespie 2017). Although availability of nutrient-dense foods (e.g., animal source foods - ASF) may increase with rapid urbanization, accessibility can be a challenge for the urban poor who may have to resort to nutrient-poor and calorie-rich processed foods due to cost and convenience (Parnell and Pieterse 2014). Supermarkets, local shops and street vendors are significant food delivery platforms in an urban setting, with both benefits and costs for urban dwellers (Hawkes et al. 2017; Ruel, Garrett and Yosef 2017). One challenge with rapid urbanization is the proliferation of media advertisements for soft drinks and other unhealthy foods that can significantly increase the demand among urban dwellers (Lobstein et al. 2015).

The link between urbanization and nutrition is context specific and depends on the type of urbanization. There is also is growing about the role of rural diversification and development of smaller cities (versus mega cities) to bring about a more inclusive economic growth (Christiaensen and Kanbur 2016; Christiaensen, De Weerdt and Todo 2013). An urban area may offer better opportunities for improved nutrition, including through better education (of women), WASH, and overall household socioeconomic status (Smith, Ruel and Ndiaye 2004). At a basic level, access to public infrastructure, markets and information may be easier in urban areas (Amare et al. 2018). On the other hand, a rapidly urbanizing area that faces high unemployment and poverty, inadequate social services, and poor WASH will most likely have poor nutrition (Frayne, Crush and Mclachlan 2014). The urban poor who lack cooking and storage facilities inside their residence and who face infrastructural and time constraints may have hard time acquiring nutritious food (Crush, Frayne and Mclachlan 2011). The flourishing of supermarkets in an urbanizing area may provide greater availability and accessibility to diverse foods. At the same time, they may instigate greater access to nutrient-poor, highly processed foods. Lifestyle and environmental changes urban setting may also result s increased environmental pollution or poor WASH due to overcrowding (Crush et al. 2011; Eckert and Kohler 2014). These developments may inevitably increase the risk of infectious and non-communicable diseases (NCDs) (Eckert and Kohler 2014; Hawkes et al. 2017).

While the aforementioned pathways may not be exhaustive, they provide a good starting point to conceptualize the urbanization-nutrition linkage using a ‘causal map’ (Enserink et al. 2010). A causal map is a mental model or tool develop based on existing literature and interviews with relevant stakeholders about possible causal mechanisms within a system. Since it visually represents the various components and connections within a system, it promotes shared understanding between various stakeholders (Zhang et al. 2018). The causal map in Figure 3 illustrates the various pathways through which rapid urbanization may affect nutrition. The tool may not be exhaustive but should be used to conceptualize multifaceted interactions between urbanization and children. Different color combinations are used to depict core elements of the tool as they relate to the determinants of child undernutrition discussed in Section 4. Red, orange, and blue circles denote the immediate, underlying, and basic determinants, respectively. Red lines from the immediate determinants to nutrition (captured by the two grey circles) indicate a direct association. Indirect pathways from urbanization to nutrition are illustrated using green lines.

Positive (+) and negative (-) signs indicate positive and negative associations, respectively, while (+-) indicates indeterminate association *a priori.* The complexity of the topic leads to potentially numerous feedback loops where the arrows are essentially bidirectional, especially as the urban context is disaggregated by wealth and other socioeconomic variables. For example, urban slums present a unique setting where diverse foods may be avaiable but are not affordable (Ruel et al. 2017). Since our focus here is on pathways from rapid urbanization to malnutrition, not all the bi-directional relationships are captured. It is also worth noting that displayed signs may not hold always and in all settings. Bold font is used in the subsequent discussion for ease of mapping discussion points with specific elements of the causal map.

Figure 3: `Causal map' for conceptualizing linkages between urbanization and nutrition



Source: Author's construction based on literature review and stakeholder interviews.

In alignment with the conceptual framework in Section 2, dietary intake and diseases are crucial determinants of nutrition at an immediate level, which in turn are connected to various determinants at underlying and basic levels. Infectious diseases like diarrhea are prominent causes of wasting in particular (WHO 2010; UNICEF; WHO; World Bank 2018), but also stunting if the child suffers from repeated diarrhea (Checkley et al. 2008; Danaei et al. 2016). In addition to increasing morbidity (+), infectious diseases may lead to increased risk of mortality (+) (Liu et al. 2015). Dietary intake, which entails both quality and quantity, can have either positive or negative association (+-) with malnutrition.

Greater dietary intake may decrease the level of undernutrition (-) but may also increase overweight and obesity (+) if there is an excessive intake of macronutrients (Haddad et al. 2015). Being overweight or obese increases the danger of NCDs like diabetes or cardiovascular disease (+), which may also increase mortality (Development Initiatives Poverty Research 2018). Biological trait has been identified as an associative factor, with indeterminate association with underweight depending on the sex (Abuya et al. 2012; Akombi, Agho, Merom, Hall, et al. 2017; Akombi, Agho, Merom, Renzaho, et al. 2017; Gewa and Yandell 2011).

Three underlying determinants are encapsulated into the causal map: household's sanitary condition; SES; and care and health-seeking practices. A household's sanitary condition, which also entails food safety and hygiene, may improve as infrastructural changes result from urbanization (e.g., improved water management). With this improvement, the incidence of infectious diseases will likely decrease (-), as the evidence from WASH initiatives suggests (UNICEF 2015). Especially in poor urban neighborhoods with insufficient housing and overcrowding, sanitary condition may get worse (+-) (Godfrey and Julien 2005; WHO et al. 2017) resulting in proliferation of parasites, viruses and bacteria that directly contribute to undernutrition through, for example, by impacting nutrient absorption (Endo, Yamana and Eltahir 2017). Household's SES may either improve or deteriorate with urbanization (+-), which is a key determinant for an individual's dietary intake either directly, through improved purchasing power, or indirectly, through improved knowledge and practice of individuals and caregivers (+) (Amare et al. 2018; Hirvonen 2016). Household's SES is a crucial determinant of nutrition in an urban setting since most foods need to be purchased (Ruel et al. 2017).

Overcrowding in urban settings may increase vulnerability to health repercussions (Crush et al. 2011), possibly through the proliferation of infectious diseases (+) (Ruel et al. 2017; Eckert and Kohler 2014). Close proximity to urban centers may improve availability and access to diverse foods, leading to new ways in which people acquire taste and habits (Seto and Ramankutty 2016). While supermarkets allow greater availability to fresh fruits and vegetables that are integral to a healthy diet (+), supermarkets are also laden with cheap, highly processed, nutrient poor foods, that may be targeted disproportionally by the poor (-) (Crush et al. 2011; Parnell and Pieterse 2014). Time constraint placed on urban residents and caretakers may prevent them from properly meeting the needs of their children or themselves (-) (Crush et al. 2011).

Depending on the extent of urban planning that goes into the development of social and economic infrastructure[2] (WHO et al. 2017), access to such services can either be inclusive of different segments of urban residents (+) or may exclude those living in slums (-). Those who migrate to urban areas in search of better opportunities may be forced to live in slums or informal settlements with no or limited access to quality infrastructure (World Bank 2015). Through greater and smarter investments on economic infrastructure such as roads, electricity and water supply, access to markets, information, and education may be enhanced (+) (Amare et al. 2018) as will sanitary conditions (+).

Similarly, investments on social infrastructure such as schools and hospitals will increase access to information and education (+), generating greater opportunities for attaining higher education, better SES, and enhanced knowledge and caring practices (+). As mentioned earlier, education and SES play crucial roles in shaping the nutritional status of individuals, children, adolescents and adults alike (Abuya et al. 2012). Environmental degradation may result in the deterioration of foods safety and hygienic situation (-) thereby exasperating the spread of diseases (+) (Mukabutera et al. 2016).

Finally, external factors that include political and sociocultural context (depicted by blue circles in Figure 3) are also integral to our causal map. Volatile and corrupt political systems will affect the elements of the causal map in multiple ways including the availability and accessibility of food. For example, while the cause of sudden famines is quite complex, democratic and stable societies with more accountability and transparency may be in a better position to deal with famines. Similarly, cultural norms that shape food and lifestyle choices may have detrimental effects on nutritional outcomes (Mabry et al. 2016).

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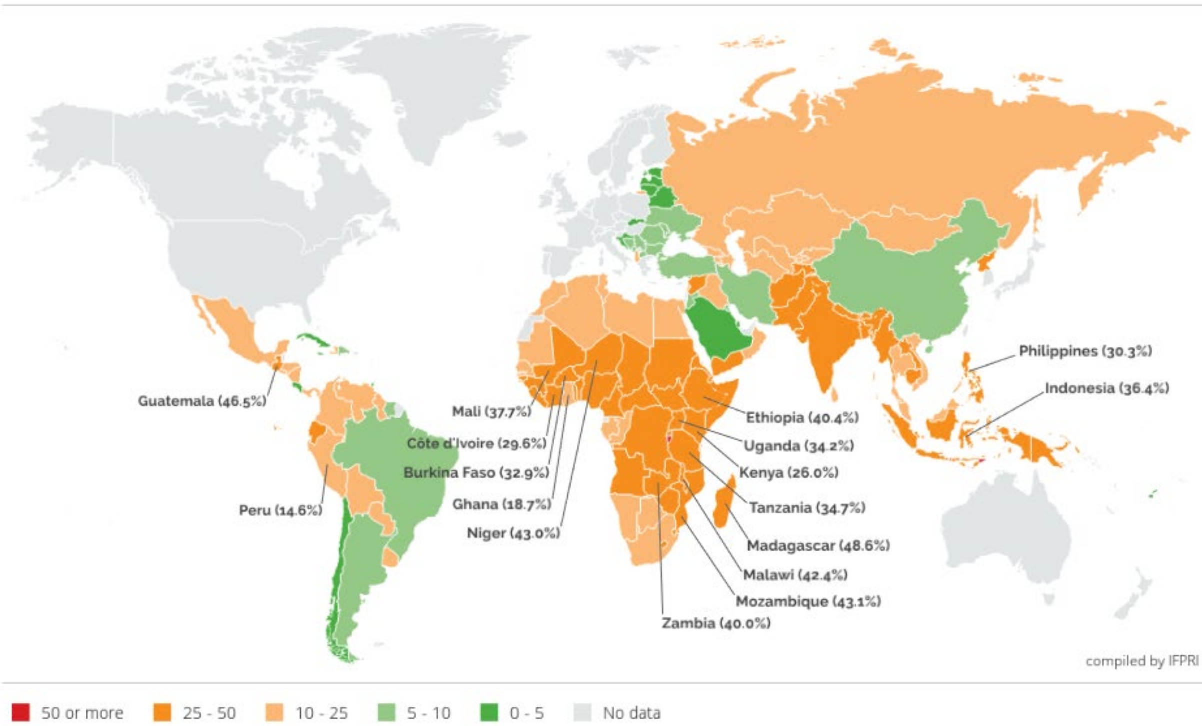
[2] Economic infrastructure represents, but is not limited to, transportation, roads, irrigation, and electricity. Social infrastructure represents, but is not limited to, education, health services, and administrative institutions.

7 ASSESSING MCC'S INVESTMENTS THROUGH NUTRITION LENS

This section assesses the state of undernutrition in countries MCC has worked in (hereinafter referred to as MCC countries). As shown in Figure 4, several of the MCC countries are among the 36 countries where 90% of the stunted under-5 children live (Black et al. 2008). MCC countries with a stunting rate above 40% ─ high prevalence countries (WHO 2010) ─ include Madagascar (48.6%), Guatemala (46.5%), Mozambique (43.1%), Niger (43% percent), Malawi (42.4%), Ethiopia (40.4%), and Zambia (40%).

Figure 4: Prevalence of under-5 stunting in MCC target countries



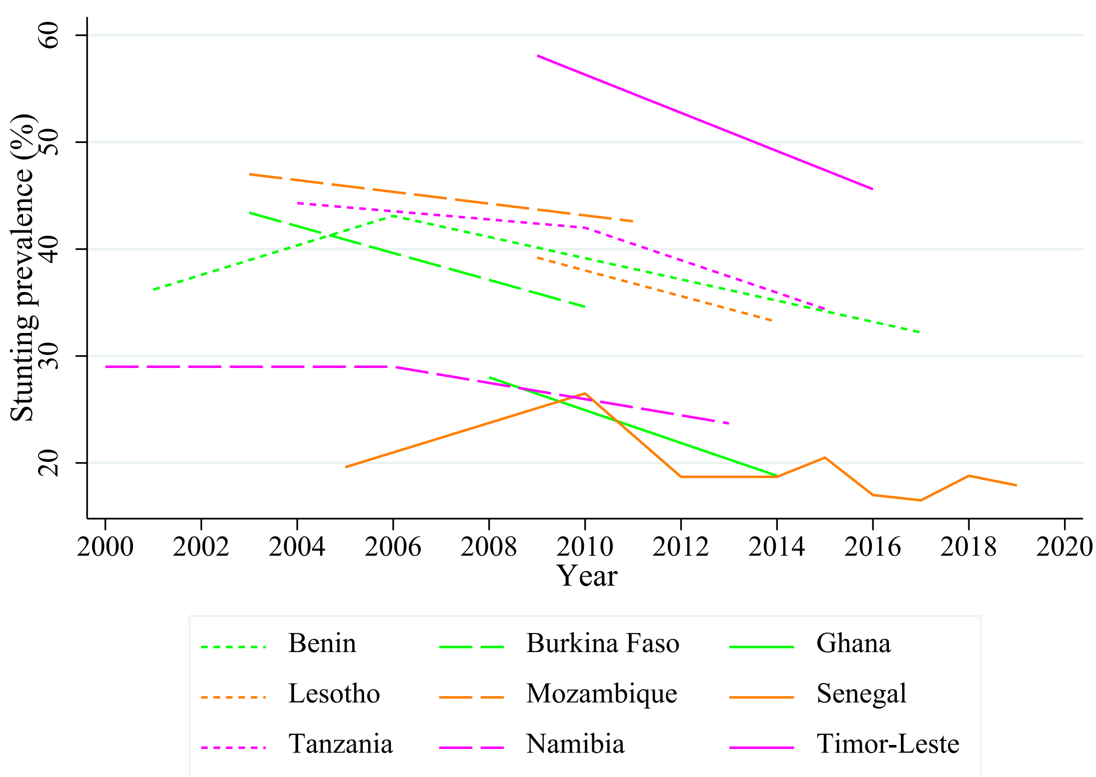
Source: IFPRI Policy e-Atlas from the Global Hunger Index (von Grebmer et al. 2015), retrieved from https://tellmaps.com/ifpri/#!/tellmap/-1995728506/2. Note: Country names and stunting rates are added to the map by the authors.

To further examine under-5 stunting trends, we selected nine MCC countries with Compact investment worth more than $300 million.[3] Figure 5 shows stunting trends for selected MCC target countries. Stunting has been very high (>40%) or high (30% - 39%) in all but three of the MCC countries (Senegal, Ghana, and Namibia) with Timor-Leste and Senegal having, respectively, the highest and lowest stunting rate. The decline in stunting over the last two decades has generally been modest despite some of

[3] Data on Compact values are obtained here https://www.mcc.gov/where-we-work. Morocco was excluded since available nutrition data were outdated.

the countries like Mozambique scoring real GPD growth rate above 6% on average.[4] These trends suggest that while economic growth and poverty reduction are generally associated with lower child undernutrition, economic growth is not a sufficient condition to tackle undernutrition (Lawrence Haddad et al. 2002; Subramanyam et al. 2011).

Figure 5: Stunting trends in selected MCC target countries

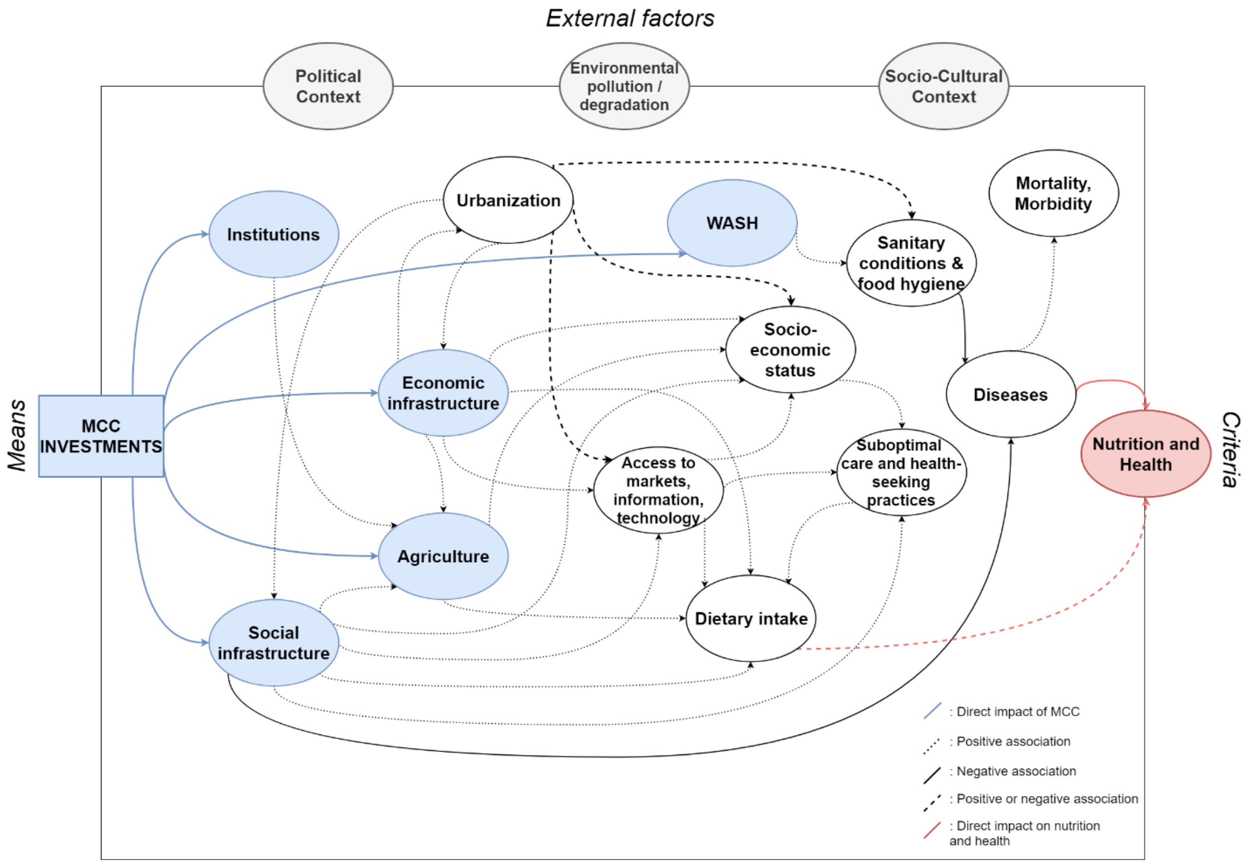


Source: Authors based on data from the DHS (Accessed April 19, 2021).

To better assess MCC's investments through the lens of nutrition, we have developed a 'system diagram'. A system diagram is a visual tool often used to demarcate the boundaries around an issue (malnutrition in our case) and identify possible means and pathways to achieve a goal (better nutrition and health in our case). Tailored from a previous study (Enserink et al. 2010), the means (i.e. MCC investments) in our diagram signify actions for influencing the criteria (i.e. better maternal and child nutrition and health) through a chain of internal factors that are inside the system as pathways of influence. There could also be external factors that are outside the direct control of decision makers but can impact the criteria by affecting elements of the system. Figure 6 shows the system diagram with blue circles denoting MCC's sectors based on information obtained from MCC's website (https://www.mcc.gov/sectors). The circles/components of the system are as defined before in the causal map in Figure 3.

[4] GDP growth rates computed based on data from the International Monitory Fund obtained here: https://www.imf.org/external/datamapper/NGDP_RPCH@WEO.

Figure 6: 'System diagram' for assessing MCC investments through the lens of nutrition



Per the taxonomy discussed in Section 4, MCC's investments fall under nutrition-sensitive (versus nutrition-specific) category. Investments that improve the economic (e.g., roads, transportation, energy) and social (e.g., education, health) infrastructure have significant potential to improve child nutrition. Investments on economic infrastructure have numerous nutritional benefits including through improved access to (food) markets and information creating opportunities for improved household SES and dietary intake. Similarly, investments on social infrastructure will promote nutrition through improvements in household SES and quality of caregiving as well as the prevention and treatment of diseases.

MCC's WASH investments specifically will reduce the risk of infectious diseases, morbidity, and mortality thereby promoting nutrient bioavailability and labor productivity, among others. MCC's investments on institutions, focused mostly on land and property rights, will help improve nutrition and health through sustainable agricultural production and resource management on which the poor and undernourished rely on. Insecurities with land and property rights result in sub-optimal agricultural investments due to fear of expropriation, lack of collateral, and credit constraints. The political, socio-cultural context and environmental factors that are external to the system will mediate interactions within the system.

Relative to nutrition-specific investments, quantifying nutritional benefits to nutrition-sensitive investments is more challenging (Leroy, Olney and Ruel 2016). This is because the latter investments not only tackle the immediate determinants of undernutrition but also the broader underlying and basic determinants. Naturally, the need for considering longer pathways and time frames and spillovers is necessary. For example, one may arrive at an erroneous conclusion about nutritional impacts of investments with spatial spillovers (e.g., road investments) unless the analysis adequately captures positive externalities received. That is why there are calls for developing a multi-stakeholder framework to inform the cost-effectiveness of nutrition-sensitive investments (Britto et al. 2017; Richter et al. 2017; Black et al. 2017).

8 CONCLUSION

Malnourishment in utero and during childhood can have profound effects on individuals at different stages of their lifecycle– childhood, adolescence, adulthood, and old age– and on economies. Preventing chronic malnutrition or stunting during the first 1,000 days of life is especially important to prevent its detrimental long-term effects on cognitive and physical development. At individual level, the costs of malnutrition include high risk of mortality and morbidity; impaired cognitive and physical development; and lower educational attainment and earnings. At societal level, malnutrition compromises the quantity and quality of human capital and imposes a significant burden on the health budget of economies. Malnutrition also perpetuates poverty as children born to malnourished pregnant women are more likely to face various health risks including low birth weight–a markert of fetal growth. Countries in Africa and South Asia lose up to 11% of their GDP annually due low productivity and high health cost associated with malnutrition.

Despite improvements over the last several decades, child malnutrition is still widespread. An estimated 21% and 6.9% of the 144 million children globally are stunted and wasted in 2019, respectively, with Southern Asia and SSA bearing the highest burden. Food insecurity was already on the rise before the COVID-19 outbreak and the pandemic poses a significant threat to food systems by impacting small-scale food producers and consumers. Investments to improve child nutrition are broadly classified into two–nutrition-specific and nutrition-sensitive. The former addresses the immediate determinants of child nutrition including dietary intake and diseases and infections. The latter addresses the underlying determinants consisting of household food insecurity, suboptimal infant and young childcare and feeding practices, unhealthy living environments, and limited access to health services.

Benefit-cost estimates show that nutritional investments are among development investments with the highest value-for-money, making a strong business case for nutrition improving investments including on behavior change communication (e.g., on infant and young child feeding and hygienic practices), micronutrient supplementation (e.g., zinc and vitamin A supplementation for children, iron and folic acid supplementation), and food-based strategies (e.g., food fortification and complementary foods). At the same time, nutrition-specific investments are not adequate to eradicate all forms of malnutrition by 2030 as stated in Sustainable Development Goal 2–and there is a need for nutrition-sensitive investments to tackle the underlying determinants of fetal and child undernutrition including household food insecurity, inadequate caregiving resources, limited access to health services, and unsanitary living environments.

Nutrition-specific and nutrition-sensitive investments address different determinants of nutrition and therefore are complementary. Their relative importance depends on local conditions and the needs of the target population. Nutrition-specific investments such as delivery of micronutrient supplements provide the fastest improvements in the micronutrient status of children and pregnant women. Nutrition-sensitive investments can bring about a wider and more sustained nutritional impact if adequate nutritional considerations are made during their design.

Better integration of nutritional considerations into sectoral investments can be achieved by understanding context-specific severity and causes of child and maternal malnutrition, making the enhancement of nutritional outcomes part of program goals, spelling out the impact pathways for improving nutrition, and identification of nutritional indicators to monitor progress. In settings where children are affected by multiple micronutrient deficiencies, agricultural investments that target nutrient-rich value chains (e.g., livestock, fish, fruits, and vegetables) will help enhance the quality and range of available foods and nutrient intake. In settings with there is a widespread deficiency of specific micronutrient (e.g., vitamin A) and where production diversification into value chains that are rich in the specific micronutrient due to environmental suitability or other factors, food fortification and micronutrient supplementation should be considered.

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Appendix A: Examples of initiatives that aim to improve child and maternal nutrition

Initiative	*Additional details*
1000 Days	http://www.thousanddays.org/
Scaling Up Nutrition (SUN)	http://www.scalingupnutrition.org/
Saving Brains	https://developingchild.harvard.edu/about/what-we-do/global-work/saving-brains/
Grand Challenges Canada	https://www.grandchallenges.ca/grantee-stars/0249-01/
Power of Nutrition	https://www.powerofnutrition.org/
Alive and Thrive	https://www.aliveandthrive.org/
Nutrition for Growth	https://nutritionforgrowth.org/

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