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DRIVERS OF STUNTING REDUCTION IN ETHIOPIA: A COUNTRY CASE STUDY

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Abbreviations

AARC	Average Annual Rate of Change
ADLI	Agricultural Development Led Industrialization
AGP	Agricultural Growth Program
AIDS	Acquired Immune Deficiency Syndrome
ANC	Antenatal Care
BCC	Behavior Change Communication
BCG	Bacillus Calmette–Guérin Vaccine
BMI	Body Mass Index
CAGR	Compound Annual Growth Rate
CBN	Community Based Nutrition
CHD	Child Health Days
CI	Confidence Interval
CIX	Concentration Index
CMNCH	Community Maternal, Neonatal and Child Health Program
CRGE	Climate Resilient Green Economy Strategy
DHS	Demographic and Health Survey
DID	Difference in Difference
DPT3	Diphtheria, Tetanus, Pertussis Vaccine, 3 doses
EHNRI	Ethiopia Health and Nutrition Research Institute
ENA	Essential Nutrition Action
EOS	Enhanced Outreach Strategy
EPI	Expanded Program on Immunization
EPRDF	Ethiopian People's Revolutionary Democratic Front
ERRP	Emergency Recover and Reconstruction Program
ESDP	Education Sector Development Program
ESSP	Ethiopian Strategy Support Program
EU	European Union
FAO	Food and Agriculture Organization
FGD	Focus Group Discussion
FMOH	Federal Ministry of Health
FSP	Food Security Program
GDP	Gross Domestic Product
GNI	Gross National Income
GTP	Growth Transformation Plan
HAZ	Height-for-Age Z Score
HDA	Health Development Army
HEP	Health Extension Program
HEW	Health Extension Worker
HIV	Human Immunodeficiency Virus
HSDP	Health Sector Development Plan
HSTP	Health Sector Transformation Plan
IDS	Industrial Development Strategy
IEC	Information, Education and Communication
IHME	Institute for Health Metrics and Evaluation
IRS	Indoor Residual Spraying
ITN	Insecticide Treated Net
IYCF	Infant and Young Child Feeding
JME	Joint Malnutrition Estimates

JMP	Joint Monitoring Programme
LMIC	Lower Middle-Income Country
MNCH	Maternal, Newborn and Child Health
NHPCS	National Health Promotion and Communication Strategy
NNS	National Nutritional Policy and Strategy
ODA	Official Development Assistance
ORS	Oral Rehydration Salts
ORT	Oral Rehydration Therapy
OWNP	One Wash National Program
PASDEP	Plan of Action for Sustainable Development and Eradication of Poverty
PCA	Principal Components Analysis
PHCU	Primary Health Care Unit
PPP	Purchasing Power Parity
PSNP APL	Productive Safety Net Program Adaptable Program Loan
RED	Reaching Every District
REKSS	Rural Economy Knowledge Support Program
SD	Standard Deviation
SDPRP	Sustainable Development and Poverty Reduction Program
SFP	School Feeding Program
SII	Slope Index of Inequality
SNNP	Southern Nation, Nationalities and Peoples
SOS	Sustainable Outreach Services
SUN	Scaling Up Nutrition Movement
SURE	Sustainable Undernutrition Reduction in Ethiopia
TAG	Technical Advisory Group
TSF	Targeted Supplementary Feeding Program
UN	United Nations
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Fund
USD	United States Dollar
VIF	Variance in Inflation
WASH	Water, Sanitation and Hygiene
WHO	World Health Organization
WSP	Water and Sanitation Program

Chapter 1: Background & Introduction

1.1: Global Burden of Stunting and Implications

Chronic malnutrition in infants and young children remains a global public health problem associated with poverty. Linear growth faltering often begins *in utero* with maternal malnutrition, which contributes to intrauterine growth restriction and subsequent low birthweight. During infancy, suboptimal feeding practices and a high burden of infectious diseases further contribute to poor growth. Linear growth stunting, defined as a height-for-age z-score (HAZ) that is ≤2 standard deviations below the mean, is a visible and easily measurable physical manifestation of chronic malnutrition. Children who are stunted have higher rates of mortality and morbidity, and experience suboptimal cognitive and motor development (1).

Globally, stunting prevalence declined from 39.2% to 32.5% to 21.9% across 1990, 2000 and 2018, respectively (2). The 17% reduction noted over 28 years was most rapidly achieved in the post-2000 period. Despite impressive progress, in 2018, about 149 million children under the age of 5 years worldwide were still stunted (2). Both regional and within-country disparities exist, with prevalence ranging from 35.2% in eastern Africa to 4.9% in eastern Asia as of 2018 (2). An estimated 17% of mortality in children under-5 years is attributable to stunting (1). Meta-analyses of five prospective cohort studies have shown that a unit increase in HAZ for children ≤2 years was associated with a 0.22 SD improvement in cognitive function later in childhood at 5 to 11 years (3), illustrating the lingering effects of early life chronic malnutrition. This has serious implications for population health and the fulfillment of the intellectual and economic potential of low and middle-income countries (LMIC).

Countries that prioritize the implementation and scale-up of nutrition-sensitive and nutrition-specific policies and programs stand to make great economic gains, as these initiatives generally have very high benefit-cost ratios (4).

1.2: Exploring Exemplars

While several developing countries worldwide have experienced meaningful decreases in stunting prevalence over the past several decades, a handful of countries, or 'positive exemplars', have achieved a more rapid rate of stunting reduction. These high-achieving positive exemplars may provide instructive case studies in the effects of economic and political change on child growth.

Recent analyses have expanded their scope and explored the drivers behind stunting reduction in a handful of high-performing countries worldwide, such as Cambodia (5), Kenya, Zambia (6), Peru (7), Indonesia (8), and Ethiopia (9,10). More comprehensive analyses have examined trends and determinants in multiple countries including Bangladesh, Nepal, India (Odisha), Ethiopia, and Zambia (11), while others have explored the drivers of stunting reduction regionally, such as in high-burden South Asian countries (12). Some of the strongest drivers of stunting reduction identified in these analyses include higher maternal education, improved household asset index, access to improved sanitation, and the scale-up of certain health and nutrition interventions.

Setting out to augment existing literature with more diverse methodologies, our investigation takes a more holistic approach than prior quantitative analyses. In order to tease apart the effects of economic growth and national-level nutrition policy, we took a systematic approach in the selection of country case studies. From the outset, we applied a common conceptual framework and a standardized, rigorous methodological process to evaluate progress on stunting across all country case studies. In our quantitative analyses, we examined multiple levels of determinants (e.g. basic, intermediate, and immediate) of stunting reduction in a hierarchical model. This was coupled with

qualitative data gathered from in-depth interviews and focus groups involving key stakeholders. Additionally, a comprehensive review of prior research and national-level policies enriched our analysis and allowed us to construct a clearer picture of the story of success in stunting reduction.

1.3: Exemplar Selection Process: Ethiopia

In light of accelerated reductions in stunting globally and in several LMICs post-2000, this study focused on highlighting exemplars in the 2000 to 2018 period. The systematic country selection process aimed to identify *true exemplars* i.e. those having reduced stunting prevalence beyond the projected nutritional gains associated with general poverty reduction/economic growth. To this end, the process of selecting case study countries involved plotting the average annual rate of change (AARC) in absolute stunting prevalence as a function of the AARC in gross domestic product (GDP) per capita. We additionally stratified by the World Bank income groups (low, lower middle, and upper middle) so as to examine countries within comparable income bands. Using the plots, we identified those countries with: i) steep declines in stunting rates over time, and/or ii) high AARC in stunting prevalence relative to AARC in GDP per capita. In other words, those countries that demonstrated greater reductions in stunting prevalence while experiencing relatively smaller increases in GDP per capita were ideal candidates for case study selection.

See Figure 1 for the associated scatterplot for low-income countries. Countries ranked in the bottom left quadrant are the closest to exemplar status – Ethiopia, Nepal, Senegal, and Tanzania were considered important contenders in this income band. Across income groups, a total of ten countries were initially shortlisted in this manner (Table 1). The proposed exemplary nations were thereafter deliberated among expert stakeholders [the technical advisory group (TAG)] who considered additional factors such as the countries' total population (minimum threshold of 5 million), variability across income bands and geographic region, physical accessibility/country security, feasibility of case study activities (e.g. qualitative data collection), and the existence of local contacts and potential partners. After the study TAG convening in March 2018, an additional 2 countries were added based on the above criteria. At the time of this report, a total of 5 countries were selected as exemplars (Peru, Kyrgyzstan, Nepal, Senegal & Ethiopia), and others were under consideration. Within the low-income category, Ethiopia was chosen as an East Africa example due to a high AARC in stunting relative to GDP growth.

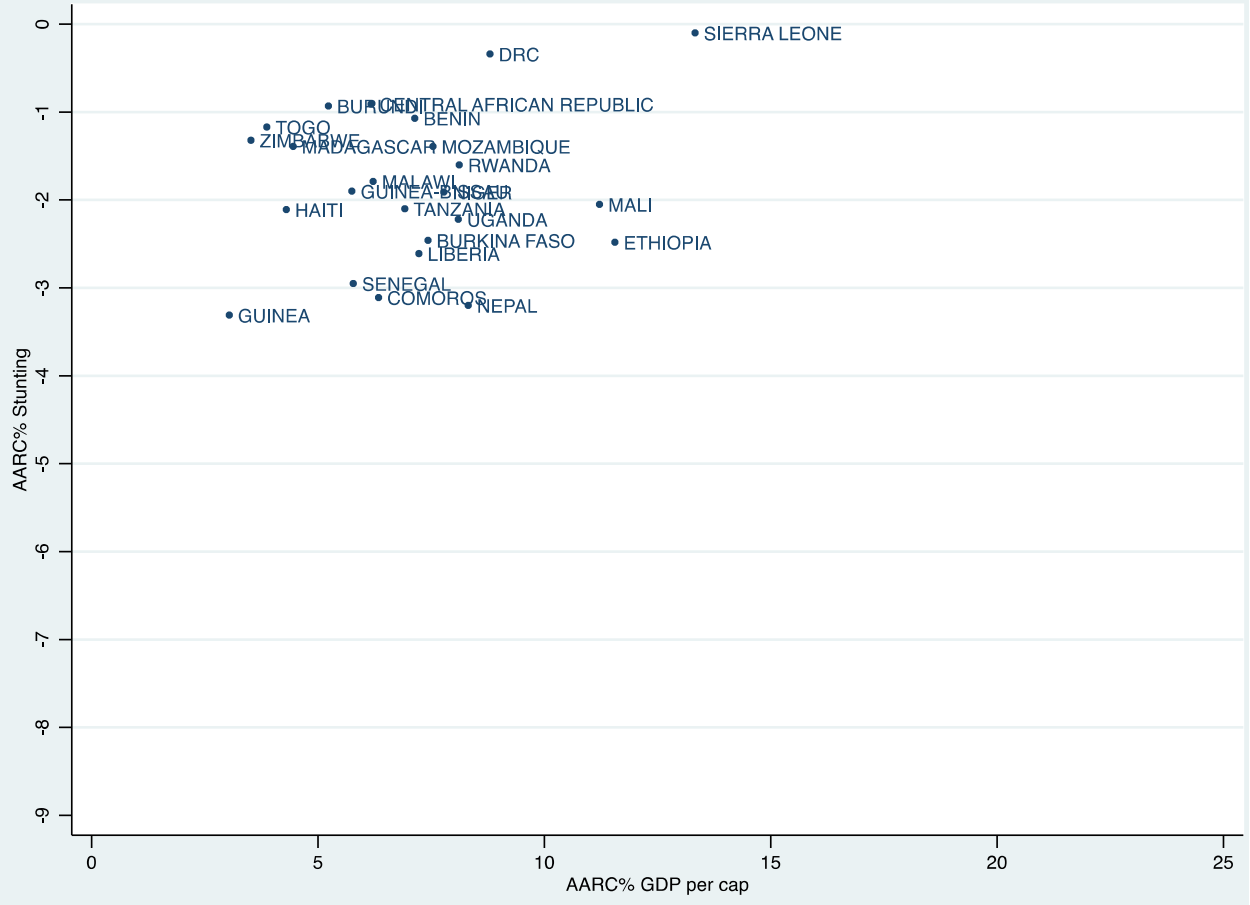


Figure 1: Scatterplot of the average AARC in national-level under-5 stunting prevalence as a function of AARC in GDP per capita for low-income countries.

Table 1: Final shortlist of top ten countries considered for case study selection, stratified by region and income level

	Latin America	**North Africa**	**Sub-Saharan Africa**	**South & Central Asia**	**Southeast Asia**
Low income			• Senegal • Tanzania • Ethiopia • Uganda**	• Nepal	
Lower middle income	• El Salvador	• Morocco • Mauritania		• Kyrgyzstan	• Vietnam* • Cambodia**
Upper middle income	• Peru			• Turkey	
* Vietnam was selected as a potential exemplar to represent Southeast Asia, but did not appear in the original shortlist of ten countries. **Cambodia and Uganda were added based on further technical expert deliberations					

1.4: Ethiopia's Stunting Reduction

In recent decades, Ethiopia has achieved substantial reductions in the prevalence of stunting (Figure 2). In 1992, 66.9% of children under-5 years experienced linear growth stunting. By 2005,

stunting prevalence had decreased to 50.4%. By 2016, stunting had reached a national low with a prevalence of 38.4%.

Since 1992 GDP has been increasing, with steeper growth occurring after 2003. Per capita GDP grew from $515 to $1608 (constant international, PPP) from 1992 to 2016 (Figure 2). GNI per capita follows similar patterns as GDP per capita, though GNI data is only available from 2011-2018 (Appendix 1). The annual growth rate GNI per capita has fluctuated during this period, reaching a high of +7.5% in 2013 and a low of +3.9% in 2018 (13).

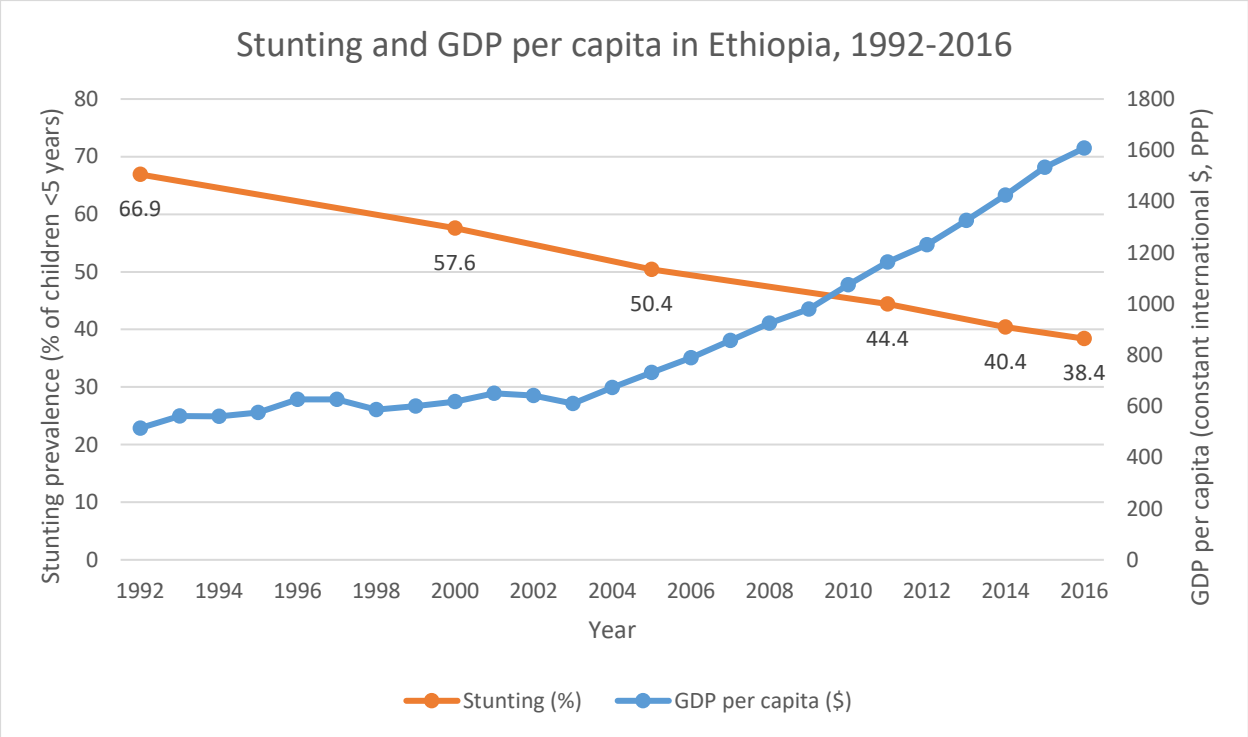


Figure 2: Trends in under-5 stunting prevalence and GDP per capita from 1992 to 2016 in Ethiopia (14,15)[1]

1.5: Ethiopia Country Context

Ethiopia is a country in East Africa, landlocked by neighbouring countries including Eritrea, Somalia, Kenya, South Sudan, and Sudan (16). As of 2016, Ethiopia has a population of approximately 102 million and is considered the second most populous country in Africa, after Nigeria (16–18). With around 80% of the population living in the rural highlands, Ethiopia is also predominantly agriculture-based, generating most of its economic growth via major crops such as coffee, grain sorghum, and castor bean (19,20).

Based on Ethiopia's last national census in 2007, the country is comprised of 14 major ethnic groups: Oromo 34.4%, Amhara (Amara) 27%, Somali (Somalie) 6.2%, Tigray (Tigrinya) 6.1%, Sidama 4%, Gurage 2.5%, Welaita 2.3%, Hadiya 1.7%, Afar (Affar) 1.7%, Gamo 1.5%, Gedeo 1.3%, Silte 1.3%, Kefficho 1.2%, and other 8.8% (16). Ethiopia is also comprised of more than 68 zones, grouped under 9 ethnically-based regional states and 2 self-governing administrations (Addis Ababa and Dire Dawa)

[1] Stunting estimates are based on Joint Malnutrition Estimates (JME). Data sources are as follows: 1992—NNS/SMART; 2000, 2005, 2011,2016—DHS; 2014—DHS- Ethiopia Mini Demographic and Health Survey

(Figure 3) (16). The capital city, Addis Ababa, is located in the administrative region of Addis Ababa, which accounts for only 4% of the total population based on 2007 census estimates. The region of Oromia is the most populous of all administrative regions with 36.7% of the population, followed by Amhara (23.3%) and the Southern Nations and Nationalities and Peoples (20.4%) (21,22).

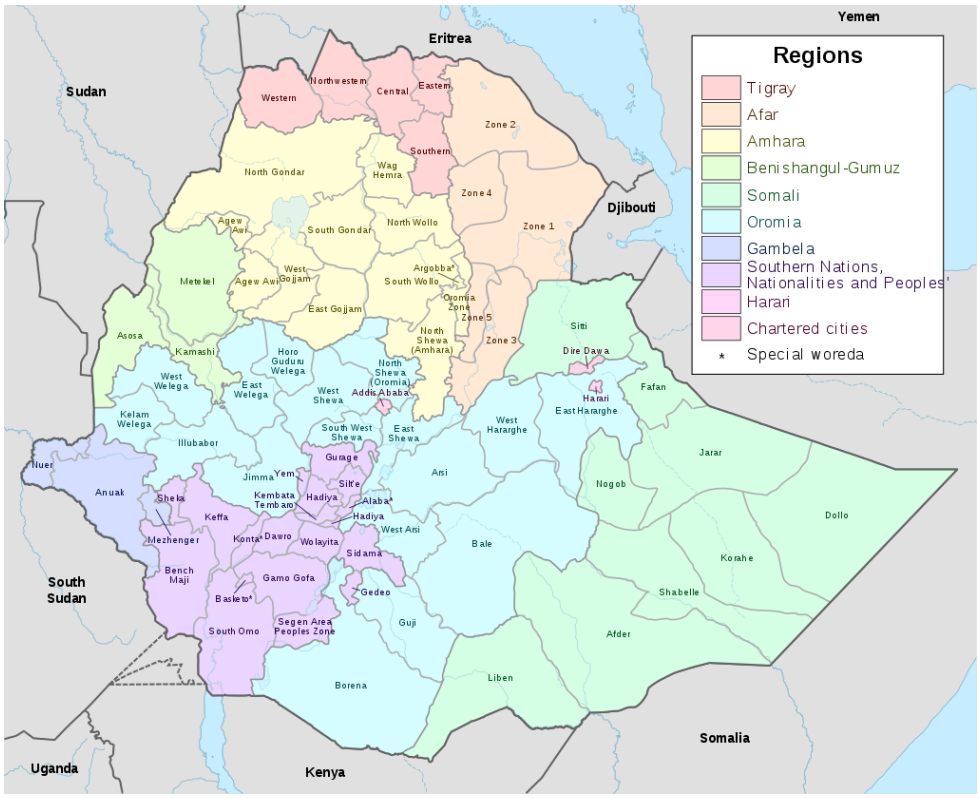


Figure 3: Regions and Zones of Ethiopia
Source: (23)

Ethiopia's diverse terrain spans across plateaus, mountain ranges, and plains. Geographically, the country is divided between the Ethiopian highlands and lowlands, split by the Great East African Rift Valley (16). The highlands of Ethiopia are the best suited for settlement due to the density of moist forests, wetlands, and unique habitat that exists there. In contrast, Ethiopia's lowlands remain relatively warm and dry, resulting in a lack of biodiversity compared to other regions of the country (19).

The highest point in Ethiopia is at Ras Dejen – the tallest mountain in the country at 4,550 metres above sea level (16). The salt flats of the Danakil Depression are the lowest point of the country at 120 metres below sea level (Figure 4). Temperatures in Ethiopia can range from below 15°C to above 25°C across the lowlands. However, between 1960 and 2003, high temperatures from July through September have become more frequent, with the average number of 'hot days' per year increasing by 20% over this period (24). Often referred as the hottest place on earth, Ethiopia's Dallol region has the world's highest average annual temperature of 34°C (24,25).

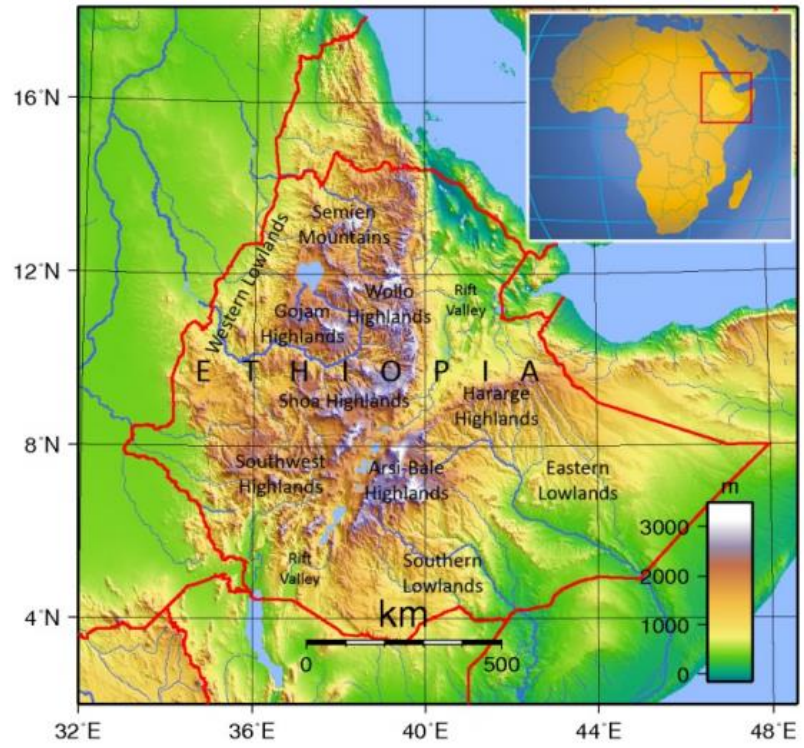


Figure 4: Topographic Map of Ethiopia
Source: (26)

Ethiopia has a history of being a country at high risk for natural disasters (Figure 5). For example, in 2011-2012, a severe drought impacted over 4.5 million people across the Horn of Africa peninsula where the Ethiopian regions of Afar, Somali, and Oromia are situated (27). Overall, the frequency and magnitude of natural hazards around the geologically active Great Rift Valley has been increasing since the 1970s. This makes Ethiopia extremely susceptible to recurring earthquakes, volcanic eruptions, frequent flooding and droughts (16,27). The resulting food and water shortages play a significant role in perpetuating the effects of poverty and food insecurity on the Ethiopian people, particularly among pastoral and agro-pastoral communities that live in drought-prone areas (27,28).

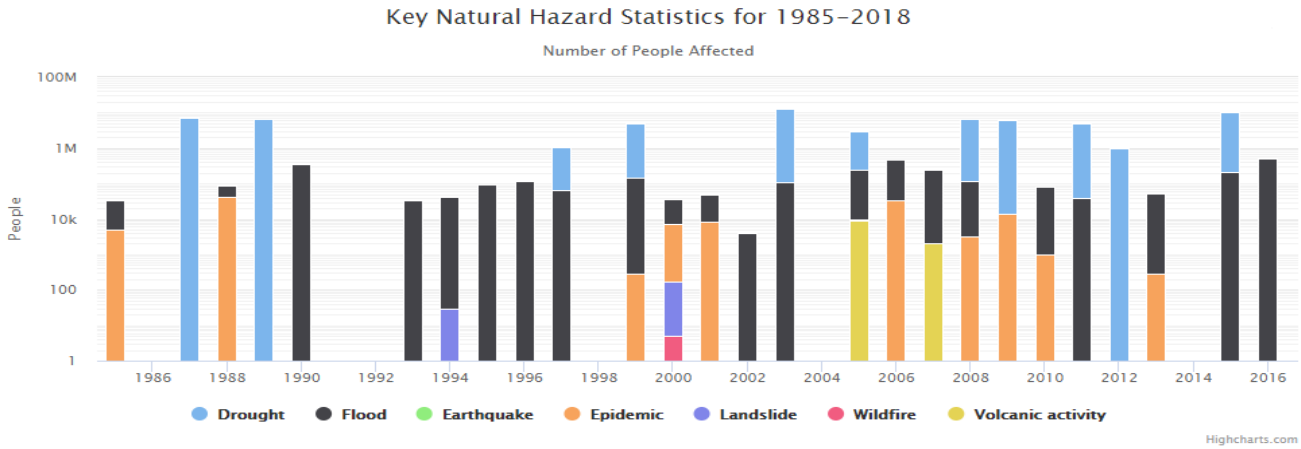


Figure 5: Key Natural Hazard Statistics of Ethiopia
Source: (27)

Ethiopia's urbanization is characterized by the formation of many new cities, where numerous small cities outnumber medium and large-sized cities of more than ~50,000 inhabitants (29). Ethiopia

experienced a threefold increase in urbanization from 1984 (~4.5 million urban dwellers) to 2012 (~14.5 million urban dwellers). According to the most recent statistics from 2015, Ethiopia's capital, Addis Ababa, accounts for ~20% of the country's total urban population (29).

1.6: Ethiopia's Governance and Health Care System

Ethiopia's unique history has served as a symbol of African independence from colonial rule amidst numerous struggles and political instability. The country faced recurrent conflicts with Italian invasions in 1895 and 1935. Led by Emperor Haile Selassie I – an important figure in the creation of the "Rastafari movement" – Ethiopia succeeded in regaining its independence in 1941 alongside British and Commonwealth troops (30).

Nevertheless, drought and natural hazards continue to plague the country, resulting in an estimated 200,000 deaths in the Wallo province due to famine from 1973-1974. Food shortages and border wars led to civil unrest and the eventual overthrow of Emperor Selassie in September 1974. Under the direction of Ethiopia's new Marxist dictator Mengistu Haile Mariam, communism ruled the country, and hundreds of thousands of Mengistu's adversaries were killed during the "Red Terror" purges between 1977-1979 (30).

These events prompted a humanitarian crisis which saw major shifts in Ethiopia's governance structure. In 1991, the Ethiopian People's Revolutionary Democratic Front (EPRDF) coalition – comprised of four political parties from the Tigray, Amhara, Oromo, and Southern Ethiopia regions – deposed Mengistu. Ethiopia's economy eventually prospered under Prime Minister Meles Zenawi throughout his authoritarian rule which spanned from 1991-2012. Despite this, regional and territorial wars between Ethiopia, Eriteria, and Somalia continue. Since 2000, recurring ceasefire agreements and peace treaties between partisan sides have been in place (31–33).

As a result of this turbulent history, major political and national reforms such as Ethiopia's constitution of 1994 divided the country into its ethnically-based regions, leading to Ethiopia's first democratic multiparty election (30). Today, Ethiopia continues to exemplify its leadership both in Africa and on the global stage as a founding member of the United Nations, as well as a collaborator with the World Health Organization (34). The last decade saw Ethiopia achieve major strides in economic and human development, with decentralization and political liberalization guiding the country's governance structures (35–37).

Detailed organograms of Ethiopia's government and ministerial structures are presented in Appendix 2. The Federal Democratic Republic of Ethiopia consists of the federal government alongside nine region-based member states known as "Killil" (Appendix Figure 3) (38). Ethiopia's Federal Ministry of Health is one of 58 ministries and agencies headed by the executive Prime Minister and the Minister of Health. Ethiopia's Health Sector is comprised of the Federal Ministry of Health (FMOH), the Federal Health Directorates and Agencies, Regional Health Bureaus, Woreda Zone offices, Woredas (administrative district units of ~100,000 people), as well as regional and federal health facilities such as hospitals and health centers (Appendix Figure 4) (39). Alongside the Cabinet, the Minister of Health also oversees 15 Directorates which promote and engage with communities in the implementation and evaluation of health programs. These Directorates include, but are not limited to, the Directorate of Ethics and Anticorruption, Maternal Child Health and Nutrition, Health Service Quality, and Resource Mobilization (40). Financing, procurement, utilization of resources, and expenditures are accountable to the State Minister for Operations. The State Minister of Programs implements programs, interventions, and activities to regions and health facilities on issues such as family planning, maternal health, and nutrition (41).

Ethiopia's health system has progressively become decentralized since 1997 through the implementation of the Health Sector Development Plan (HSDP) (42). Responsibilities and

management of the public health system have gradually shifted to the local and regional levels, with the aim of improving efficiency, efficacy, sustainability, and health equity. Part of the program includes a Community Health Extension Program (HEP) implemented since 2003. The HEP has enabled significant improvements in access to preventive and curative health interventions through community-level Health Extension Workers (HEWs) (43,44). Following the fourth adaptation of the HSDP, Ethiopia introduced the Health Sector Transformation Plan (HSTP) – a twenty-year strategy targeting initiatives geared towards healthcare quality, equity, universal health coverage, and interventions to tackle prevalent issues such as maternal and child mortality (45,46). Efforts to address the underutilization of Ethiopia's referral system among health facilities, including improvements to community-based health care delivery, continue amidst the persistent health disparities observed across the country (47,48).

Ethiopia's health sector consists of a three-tiered healthcare delivery system (Appendix Figure 5). The first level is a Woreda/District health system, covering primary hospitals (~60,000-100,000 people), health centers (1 per ~15,000-25,000 population), as well as satellite health posts (1 per ~3,000-5,000 population) to accommodate referrals outside major health centers. The second level contains coverage for the majority of the population receiving care at General Hospitals (covers ~1-1.5 million people). The third and final tier provides coverage (~3.5-5 million people) for Specialized Hospitals (42,45).

1.7: Ethiopia Background and Demographics

Over our study period (2000-2016), the population of Ethiopia has increased by approximately 50.0% and growth has remained relatively consistent (Table 2). There has also been continuous urbanization; 14.7% of the population lived in urban areas in 2000, rising to 19.9% in 2016. This has occurred alongside a decline in the rural population, which represented 85.3% of the country in 2000 and 80.1% in 2016.

Both the infant and under-5 mortality rates (per 1000 live births) reduced significantly in Ethiopia between 2000 and 2016. In 2000, the infant mortality rate was 120.2 out of 1000 live births, decreasing to 42.5 deaths per 1000 live births in 2016, a 64.6% decline. Under-5 mortality has reduced from 142.6 deaths per 1000 live births in 2000 to 61.2 deaths in 2016, a 57.1% decline. Maternal mortality (per 100,000 live births) has also greatly decreased in the last two decades, from 897 deaths in 2000 to 353 deaths in 2015, a 60.7% decline.

Related to population growth and survival trends, Table 2 also presents several indicators on economy, healthcare, environment and other contextual factors in Ethiopia from 2000-2016. For example, in terms of overarching improvements to socioeconomic indicators, the country's Human Development Index rose from 0.28 in 2000 to 0.46 in 2016. In contrast, the GINI Index increased slightly from 30 in 1999 to 39.1 in 2015, indicating a widening gap in income inequalities between the rich and the poor within the country.

Gross Domestic Product (GDP) per capita PPP (constant 2011 international $) has increased by 160.1%, and adjusted net national income per capita (current US$) increased by 347.7% over our study period. National level poverty appears to have reduced significantly from 1999 to 2015 with the proportion of the population living below the national poverty line declining by 46.8% and the proportion of the population living in extreme poverty, i.e. less than $1.90 per day, declining by 55.4%. However, the Multidimensional Poverty Index only moderately decreased by 12.5% from 2005 to 2016. Similarly, total unemployment decreased only slightly from 3.7% to 2.2% of the total labor force from 1999 to 2013.

Government spending on health as a percent of current health expenditure in the country has fluctuated over the study period with an overall decrease of 33.0% from 2000 to 2016. Out-of-pocket health expenditure has slightly increased, from 36.0% to 37.4% between 2000-2016. According to the most recent data from 2012, official development assistance (ODA) to child health was $20.0 USD per child, while ODA to maternal and neonatal health was $32.0 USD per live birth in the same year.

The median age at first marriage for women in Ethiopia has slightly increased over the study period from 16.4 years to 17.5 years. Although the prevalence of child marriage has decreased since 2000 when it had a prevalence of 49.1%, it remains a significant issue in Ethiopia, with 41.0% of women 20-24 years old married by age 18 in 2011. The total fertility rate (average births per woman 15-49 years) has dropped by 22.0% between 2000 and 2016, with an average of 5.9 births per woman in 2000 lowering to 4.6 in 2016. The adolescent fertility rate has seen a more marked decline, lowering from 110.14 births per 1000 girls aged 15-19 years in 2000 to 64.86 births in 2016, a 41.1% decrease.

Literacy of all adults, female adults (15 years and older), and young females (age 15-24 years) increased from 2004-2007. In 2007, 39.0% of all adults, 28.9% of female adults and 47.0% of young females, respectively, were literate. Composite global indices related to gender equality and gender development have also shown positive improvements in Ethiopia over the last two decades.

There was negligible increase in the deployment of general physicians (0.001 per 1,000 population change) and nurses and midwives (0.021 per 1,000 population change) from 2000-2010. Births attended by skilled health staff have increased significantly, from approximately 5.6% of births in 2000 to 15.5% of births in 2014. More notably, the percentage of women attending 4+ antenatal care (ANC) visits increased from 10% in 2000 to 32.0% in 2016.

Access to improved drinking water sources increased appreciably from 57.8% to 75.3% from 2000-2015. At the rural level access increased slightly more from 51.7% to 70.02% over the same period. Those using piped water as their drinking source also increased across the country from 17.2% in 2000 to 32.7% in 2015. Access to improved sanitation facilities increased from 7.1% to 13.9% between 2000 and 2015, and at the rural level this increase was slightly less notable, rising from 1.3% in 2000 to 5.6% in 2015. Over the same time period, the percentage of people engaging in open defecation has decreased by 52.7%.

Though both food exports and imports have increased dramatically for Ethiopia over the last 16 years, the country remains a net importer of food (i.e. food imports exceed exports). In 2000, food exports totaled 320.9 million USD of revenue and this rose to 1155.9 million USD by 2016. Food imports, on the other hand, cost 88.1 million USD in 2000 and grew to cost 1608.1 million USD in 2016. In terms of agricultural production and livestock, Ethiopia has managed impressive gains in livestock production (such as meat, dairy products and eggs), food production (crops that are considered edible and that contain nutrients), overall crop production (all crops except fodder crops), and cereal production between 2000 and 2016, though forested areas in the country have decreased by 8.5% over this period.

Table 2: Ethiopia national demographic, economic, and other contextual statistics and trends

Indicator	2000	2016	Change (current metric)
Total population (millions)[1]	66.5	102.4	+35.87 (2016-2000)
Population growth (annual %)[1]	2.9	2.5	-0.39 (2016-2000)
Rural population (% of total)[1]	85.3	80.1	-5.13 (2016-2000)
Urban population (% of total)[1]	14.7	19.9	+5.13 (2016-2000)
Mortality Rate, Infant (per 1,000 live births)[1]	120.2	42.5	-77.7 (2016-2000)

Indicator	2000	2016	Change (current metric)
Mortality Rate, Under-5 (per 1,000 live births)[1]	142.6	61.2	-81.4 (2016-2000)
Maternal Mortality Ratio (modelled estimate, per 100,000 live births)[2]	897	353 (2015)	-544 (2015-2000)
Human Development Index[3]	0.283	0.457	+0.174 (2016-2000)
Forest Area (thousands of km^2)[1]	137.1	125.4	-11.65 (2016-2000)
Improved drinking water source (% with access)[4]	24.5	66.4	+41.9 (2016-2000)
Improved drinking water source, rural (% of rural population with access)[4]	13.5	58.9	+45.4 (2016-2000)
Piped water drinking source (% using)[4]	16.6	34.9	+18.3 (2016-2000)
Improved sanitation facilities (% with access)[4]	7.2	14.2	+7.0 (2016-2000)
Improved sanitation facilities, rural (% of rural population with access)[4]	1.5	5.5	+4.0 (2016-2000)
Open defecation (% engaging in)[4]	79.1	25.6	-53.5 (2016-2000)
Adjusted net national income per capita (current US$)[1]	97.0	434.4	+434.35 (2016-2000)
Multidimensional Poverty Index (MPI)[5]	0.56 (2005)	0.49	-0.07 (2016-2005)
GDP per capita, PPP (constant 2011 international $)[1]	618.2	1608.3	+990.05 (2016-2000)
GNI per capita, PPP (constant 2011 international $)[1]	1160.3 (2011)	1602.8	+442.55 (2016-2011)
Personal remittances received (% GDP)[1]	0.6	1.1	(2016-2000)
Poverty headcount ratio at national poverty lines (% of population)[1]	44.2 (1999)	23.5 (2015)	-20.7 (1999-2015)
Poverty headcount ratio at $1.90 a day (2011 PPP) (% of population)[1]	61.2 (1999)	27.3 (2015)	-33.9 (1999-2015)
Total unemployment (% of total labor force, national estimate)[1]	3.7 (1999)	2.3 (2013)	-1.46 (1999-2013)
Current health expenditure (% of GDP)[1]	4.4	4.0	-0.39 (2016-2000)
Domestic General Government Health Expenditure (% Current Health Expenditure)[1]	41.2	27.6	-13.61 (2016-2000)
Out-of-pocket expenditure (% of current health expenditure)[1]	36.0	37.4	+1.46 (2016-2000)
Net ODA received per capita (current US$)[1]	10.3	39.8	+29.44 (2016-2000)
ODA to Child Health per child (US$)[6, 7]	17.0 (2011)	20.0 (2012)	+3 (2012-2011)
ODA to Maternal and Neonatal Health per live birth (US$)[6, 7]	33.0 (2011)	32.0 (2012)	-1 (2012-2011)
Total ODA to Reproductive Health (million US$)	*No data*	*No data*	*N/A*
ODA to Additional Reproductive Services per capita women 15-49 (US$)	*No data*	*No data*	*N/A*
Age at first marriage (median, women 20-49)[8]	16.4	17.5	+1.1 (2016-2000)
Child marriage (% women 20-24 married by age 18)[8]	49.1	41 (2011)	-8.1(2011 - 2000)
Total fertility rate (births per woman 15-49)[8]	5.9	4.6	-1.3 (2016-2000)
Antenatal Care, 4+ visits (% of women)[8]	10.0	32.0	+22 (2016-2000)
Births attended by skilled health staff (% of total)[1]	5.6	15.5 (2014)	+9.9 (2014-2000)
Adolescent fertility rate (births per 1000 girls aged 15-19 years)[9]	110.1	64.9	-45.28 (2016-2000)

Indicator	2000	2016	Change (current metric)
Adult total literacy rate (% of people ages 15 years and above)[1,10]	35.9 (2004)	39.0 (2007)	+3.10 (2007-2004)
Female adult literacy rate (% of females ages 15 years and above)[1,10]	22.8 (2004)	28.9 (2007)	+6.12 (2007-2004)
Female youth literacy rate (% of females ages 15-24 years)[1,10]	38.5 (2004)	47.0 (2007)	+8.54 (2007-2004)
Gender Inequality Index (0-1; closer to 1 is higher inequality)[3]	0.6 (2005)	0.5	-0.11 (2016-2005)
Gender Development Index (0-1; closer to 1 is improvement?)[3]	0.7	0.9	+0.11 (2016-2000)
GINI Index (0-100; closer to 100 is higher inequality, World Bank estimate)[1]	30.0 (1999)	39.1 (2015)	+9.1 (1999-2015)
Density of Physicians (per 1,000)[1]	0.021	0.022 (2010)	+0.001 (2010-2000)
Density of Nurses and Midwives (per 1,000)[1]	0.215 (2003)	0.236 (2010)	+0.021 (2010-2003)
Food exports (USD) (millions)[11]	320.9	1155.9	+834.95 (2016-2000)
Food imports (USD) (millions)[11]	88.1	1608.1	+1520.04 (2016-2000)
Livestock production index* (shows livestock production for each year relative to the base period 2004-2006)[12]	65.4	120.1	+54.69 (2016-2000)
Food production index** (shows food production for each year relative to the base period 2004-2006)[12]	69.9	161.9	+92.02 (2016-2000)
Crop production index*** (shows crop production for each year relative to the base period 2004-2006)[12]	74.3	187.6	+113.28 (2016-2000)
Cereal production**** (million metric tons)[12]	8.0	25.4	+17.36 (2016-2000)

Sources: World Bank[1], WHO/UNICEF/UN Population Fund/World Bank[2], UNDP[3], WHO/UNICEF JMP 2019[4], OPHI[5], Countdown to 2015[6], Countdown to 2030[7], DHS[8], UN Population Division/World Population Prospects[9], UNESCO Institute for Statistics[10],WITS(World Integrated Trade Solution)[11], FAO[12]

* includes meat and milk from all sources, dairy products such as cheese, and eggs, honey, raw silk, wool, and hides and skins
** Food production index covers food crops that are considered edible and that contain nutrients. Coffee and tea are excluded because, although edible, they have no nutritive value.
*** Crop production index shows agricultural production for each year relative to the base period 2004-2006. It includes all crops except fodder crops. Regional and income group aggregates for the FAO's production indices are calculated from the underlying values in international dollars, normalized to the base period 2004-2006.
**** Production data on cereals relate to crops harvested for dry grain only. Cereal crops harvested for hay or harvested green for food, feed, or silage and those used for grazing are excluded.

1.8: Research Aim and Objectives

Ethiopia has experienced significant improvement in several key areas since the early 2000s, including economic growth, poverty reduction, decreased maternal, newborn and child mortality, increased access to maternal care, increased adult/youth literacy and gender equality, a reduction in open defecation, and changes in agricultural production patterns and consumption – all of which allude to a multifactorial stunting reduction success story. Understanding and disentangling these causes was the broader aim of this study.

Research Aim: To conduct a systematic in-depth assessment of the determinants, specifically national (macro), community and household, and individual level factors, and relevant nutrition-specific and nutrition-sensitive interventions/innovations/policies/strategies, that have driven stunting reduction in Ethiopia from 2000 to 2016.

Specific Objectives:

1. To quantitatively examine determinants of stunting reduction in Ethiopia and to decompose long-term stunting change into relative contribution from key drivers;
2. To explore national and community level perspectives on Ethiopia's nutrition evolution (focused on progress in stunting) and the major contributing factors behind it;
3. To generate a systematic landscape of the major stunting-relevant policies and programs in Ethiopia, with focus on both nutrition-specific and –sensitive initiatives; and
4. To track and document nutrition-related investments in Ethiopia by government and partners (e.g. financial allocations, expenditures).

Chapter 2: Methodology

2.1: Study Design

This mixed methods study applied several complementary approaches to inform study objectives. Methodological details of the literature review, and quantitative and qualitative inquiry approaches are discussed below. Table 3 briefly summarizes each method type and its purpose in our work.

Table 3: Methods utilized and purpose

Method	**Purpose**
Systematic literature review	To synthesize information on contextual factors, national and subnational interventions, policies, strategies, programs, and initiatives that may have theoretically contributed to reductions in child stunting in Ethiopia over time. Retrieved literature would inform the research process from study planning, answering study objectives, to results interpretation.
Geospatial, equity and growth curve analysis	To examine the distribution of stunting across the country and between important population subgroups to examine inequalities. To assess child growth faltering trajectories by age to gain an understand of stunting risk at birth vs postnatal and how that changes over time.
Linear mixed effect regression	A panel datasets time-series analyses using individual/household level data from 1992 to 2017 to understand the major predictors of stunting decline in Ethiopia.
Oaxaca-Blinder decomposition	A complementary regression-based analysis based on individual- and household-level data to understand the major predictors of stunting decline in Ethiopia from 2000 to 2016.
Focus group discussion/in-depth interviews	To understand national and community stakeholder perspectives on Ethiopia's nutrition evolution (focused on

	progress in stunting) and the major contributing factors behind it. To access key sources of data related to financials/budget/expenditure on nutrition-specific and -sensitive initiatives.
Policy and program document review	To gain a comprehensive understanding of the major nutrition-specific and –sensitive policies/programs/strategies; this would be supplemented with information from key informants.

2.2: Systematic Scoping Literature Review

A systematic search of published peer-reviewed and grey literature related in Ethiopia was undertaken in order to synthesize information on contextual factors, national and subnational interventions, policies, strategies, programs, and initiatives that may have theoretically contributed to reductions in child stunting in Ethiopia over time. Three broad categories of search terms were used: stunting, child, and Ethiopia. Keywords representing these terms were combined with Boolean operators, adapted with appropriate syntax, and executed in multiple databases. An example of a search syntax is provided below:

1. *Stunting*: "stunting" or "linear growth" or "linear growth stunting" or "HAZ" or "height" or "height-for-age" or "LAZ" or "length" or "length-for-age" or "undernutrition" or "malnutrition" or "nutr*"
2. *Child*: "child*" or "infan*"
3. "Ethiopia*"
4. 1 AND 2 AND 3

The search for indexed literature was conducted in 15 online databases: MEDLINE, Embase, AMED, CAB Abstracts, CINAHL, Cochrane CENTRAL, Campbell Collaboration, EPPI Centre Trials Register (TRoPHI), 3ie, JOLIS, African Journals Online, WHOLIS, LILACS, Scopus, and Web of Science. Additional searches for grey literature were conducted using Google, a hand search of reference lists of relevant reviews, and direct searching organizational websites, including: National, regional and headquarter websites for UNICEF, WHO, UNDP, WFP, FAO, World Bank Group Open Knowledge Repository, African Development Bank, Nutritional International, Global Alliance for Improved Nutrition, International Food Policy Research Institute, Growth Through Nutrition, Concern Worldwide, Alive and Thrive, Ethiopian Public Health Institute and the Government of Ethiopia including the Ministry of Health and the Ministry of Agriculture.

The exported set of records were de-duplicated and screened for relevance. Records were included if they met all of the following inclusion criteria:

i) included an under-5 population in Ethiopia;
ii) published between January 1, 1990- June 12, 2019;
iii) examined one or more of the determinants of chronic undernutrition (e.g. determinants, risk factors, policies, programs, interventions, or initiatives); and
iv) examined effects on child growth or a reduction in stunting

Initial database searches returned 10,789 records, which was reduced to 4,485 after de-deduplication. Applying the screening criteria to titles and abstracts left 147 records, which was then reduced to 102 upon full-text review. All included studies were categorized for the purposes of thematic exploration and mapping. Three broad categories of studies were identified: i) quantitative

analysis of child health or nutrition outcomes; ii) qualitative studies with quantitative analysis; and iii) grey literature reports from non-governmental and multilateral organizations. See Figure 6 for a flow diagram outlining the components and progression of the review. Relevant literature was iteratively synthesized and summarized to inform our research questions and to contrast our findings with existing evidence.

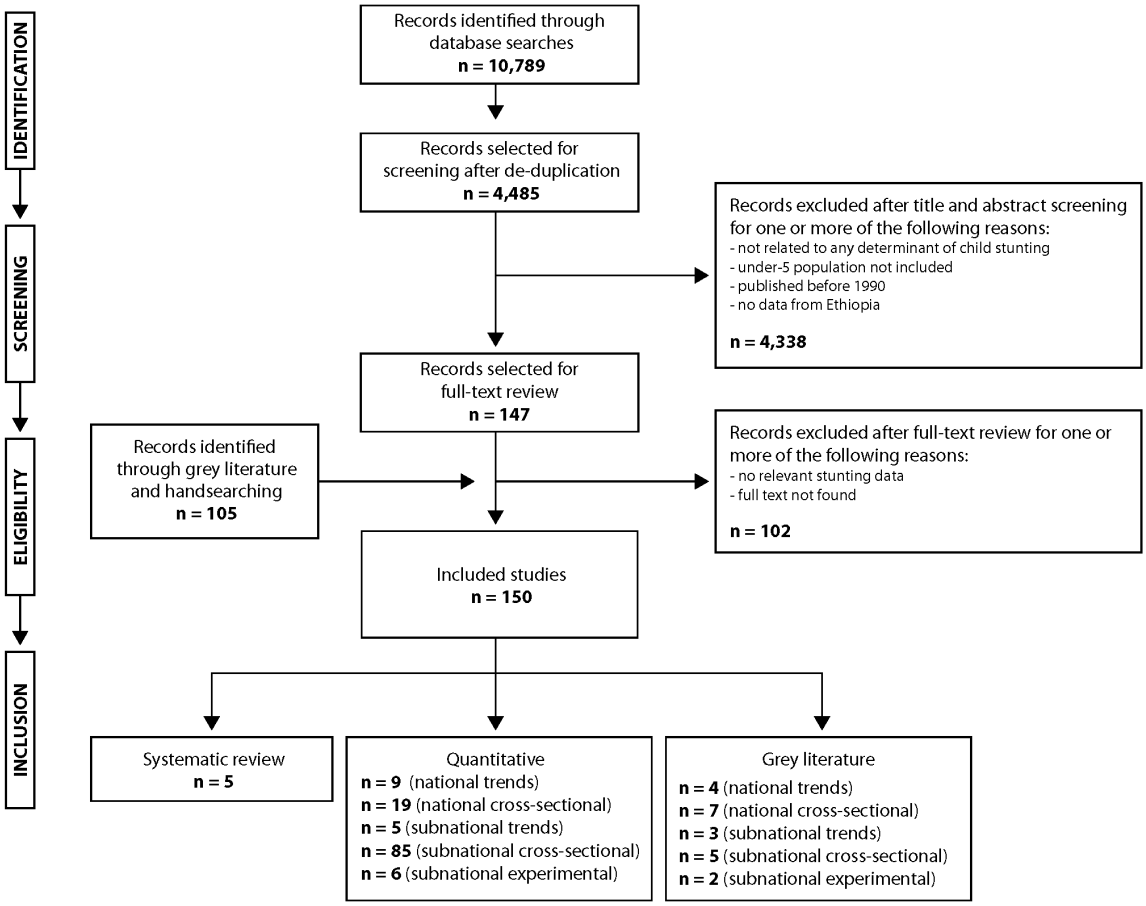


Figure 6: Literature review flow diagram

Targeted additional searches were completed for key topics to supplement and expand on important factors in the Ethiopia stunting narrative; a total of 402 additional documents spanning grey literature and published peer-reviewed reports were collated and summarized.

2.3: Quantitative Analyses

2.3.1: Data Sources

Ethiopia's series of Demographic and Health Surveys (DHS) (2000, 2005, 2011, 2016) were the primary quantitative datasets used in this study. These nationally-representative household surveys have comparable, standardized methods with data for a wide range of indicators in the areas of population, health, and nutrition (49–52). Detail on DHS methodology and content areas are available elsewhere (49–52). Ethiopia had standard DHS completed in each of the years studied, and we felt confident that the data collected did not suffer from anthropometry quality concerns as has been the case for other surveys. Thus, we used all available Ethiopia DHS for our study. Available under-5

anthropometry data by survey round are presented in Table 4 (index child - to be subsequently described) and Table 5 (all under-5 children). The detailed description of sample size changes while selecting the index child can be found in Appendix 4.

Table 4: Sample size by survey year based on the index child with valid anthropometric data

Age group	**Year of DHS survey**			
	2000	**2005**	**2011**	**2016**
Under five	5975	2600	6561	6184
Under 36 months	4623	1980	4998	4800
6 – 23 months	2470	1113	2615	2620
24 & above	2697	1164	2978	2640
Under six months	808	323	968	924

Table 5: Based on non-index child with valid anthropometric data

Age group	**Year of DHS survey**			
	2000	**2005**	**2011**	**2016**
Under five	8565	3846	9593	8853
Under 36 months	5108	2215	5614	5403
6 – 23 months	2588	1147	2740	2749
24 & above	5154	2370	5855	5158
Under six months	823	329	998	946

2.3.2: Analyses Time Periods

Ethiopia experienced gradual, but steady stunting decline from the early 1990s through to 2016. Given this general trend, there appear to be continuous commitments to stunting decline over this time period and initiatives implemented from the early 90s onward appear to have had steady impact on stunting decline. Our analyses and inference are thus presented in line with the entirety of this period.

2.3.3: Outcome Definition

Two related indicators of chronic undernutrition in children (height-for-age z-score, % stunted) were the primary study outcomes. Outcomes were calculated using WHO child growth standards (53). The HAZ reflects the number of standard deviations below or above the population average a child's anthropometry value falls. Children were classified as stunted if their HAZ was more than 2 standard deviations below the median of the WHO reference population.

2.3.4: Conceptual Framework and Determinants

Factors that may have contributed to stunting reduction in Ethiopia are organized in line with the established UNICEF undernutrition conceptual framework (54). A modified version of it was published in the 2008 Lancet nutrition series (55) (Figure 7).

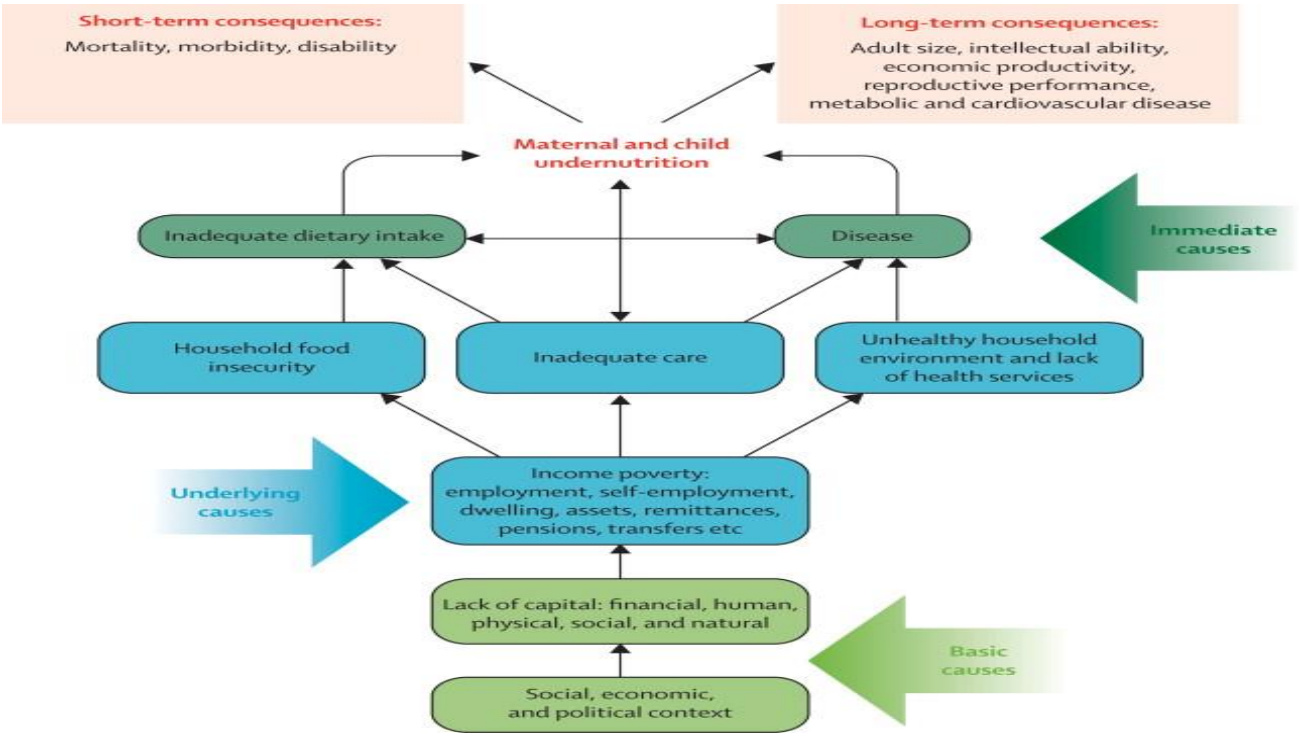


Figure 7: Evidence-based framework for the basic, underlying and immediate causes of undernutrition in mothers and children

We prepared an adapted version of this framework for the Ethiopian context and present it in Figure 8. The new conceptual framework resulted from an iterative team discussion and consensus that led to modifications deemed relevant to the scope of our study and based on data availability.

In brief, determinants of maternal and child undernutrition can be grouped in different hierarchical levels, in terms of their causal proximity to the impact of interest, specifically in "basic causes", "underlying causes" and "immediate causes". Each of these lay on a causal path towards nutritional outcomes, with more proximal causes functioning as mediators of the distal determinants.

Variables that were available for analysis are categorized for hierarchical analysis as follows:
Distal level (basic causes): Socioeconomic factors
Intermediate level (underlying causes): Unhealthy household environment, inadequate care and health services, and inadequate feeding practices and food insecurity
Proximal level (immediate causes): Disease and inadequate dietary intake. The proximal level also includes child and maternal characteristics, which are especially important to track factors that directly impact the child's nutritional status. For example, intergenerational transmission of malnutrition and epigenetic effects, which could be measured by proxies such as low birthweight, maternal height and body mass index (BMI) amongst others.

It should be noted that some important factors, including many direct nutritional interventions (e.g. complementary feeding practices, food intake including frequency and diet diversity, etc.), were only available for the 6-23-month subset of under-5 children. DHS typically administers a separate food recall questionnaire to collect this information from the infant and young child cohort. We analyzed these dietary variables only for our 6-23-month subgroup analyses. We did use an alternative measure of food security, total yield, and this was analyzed for the entire under-5 age group, as well as subgroup analyses.

The total yield variable includes the yield of a variety of crops measured in quintals in the numerator, including cereals (teff, barley, wheat, maize, sorghum, finger millet, oats, and rice), pulses (faba beans, field peas, haricot beans, chick-peas, lentils, vetch, soya beans, fenugreek, and gibto), oilseeds (neug, linseed, groundnuts, sunflower, sesame, and rapeseed), vegetables (lettuce, head cabbage, Ethiopian cabbage, tomatoes, green peppers, red peppers, and Swiss chard), root crops (beetroot, carrot, onion, potatoes, garlic, taro, and sweet potatoes), fruit crops (avocados, bananas, guavas, lemons, mangoes, oranges, papayas, and pineapples), chat, coffee, hops, sugar cane, and enset. The denominator for this indicator is hectares.

In addition to the total yield variable, additional ecological variables we found that were meaningful to our analyses included: total number of health workers, and total number of health facilities. These two variables have the total number of health workers and total number of health facilities in the numerator, with the total population in each district as the denominator. These variables were analyzed as total number of health workers/health facilities per 10,000 population. These ecological variables were included in addition to the DHS variables to provide a more complete picture of child nutrition in Ethiopia. A complete list of analysis variables, their definitions and sources are shown in Appendix 5.

Figure 8 presents the *universe* of variables considered in the analysis of children <5 years of age.

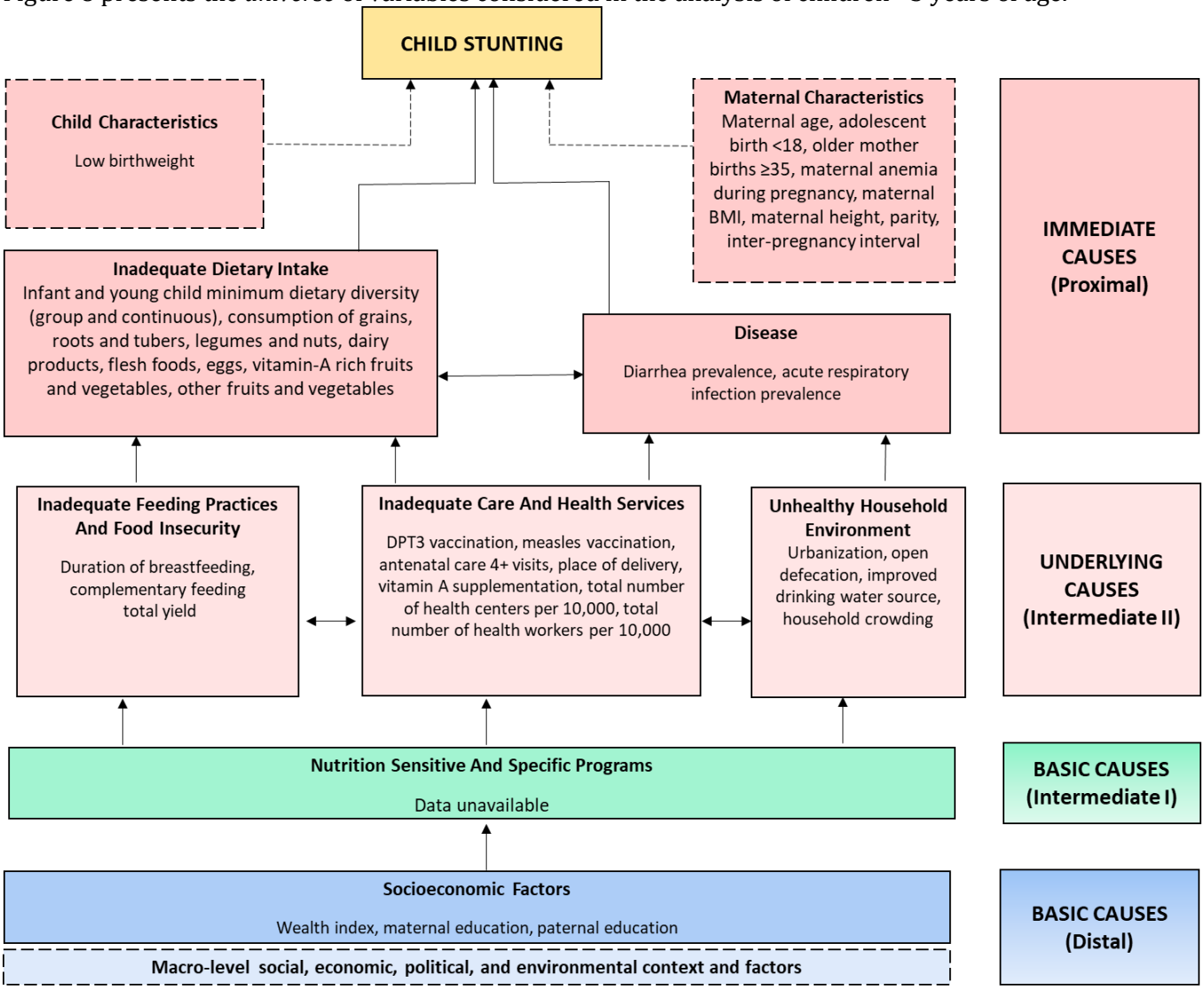


Figure 8: Conceptual framework showing distal, intermediate and proximal determinants of stunting

Note: Skilled birth attendance was omitted as estimates were not available for the first year of study, and were only available for the last two years studied (2011 and 2016), thus this indicator was omitted from analysis. Data on early initiation of breastfeeding was unavailable, and this indicator was also not included in analyses. Other variables included in analyses were child age in months, child sex, child weight, and child height.

2.3.5: Descriptive Analyses

Subnational analyses

Stunting estimates for subnational dimensions were calculated using standardized and well-established methods (56–58). Dimensions examined include wealth quintile, maternal education, area of residence and child gender. Wealth quintiles were derived from asset indices based on principal components analyses in a survey level. The scores were then broken into five quintiles, with the lowest quintile (Q1) representing the poorest 20%, and the highest quintile (Q5) richest 20%. Maternal education was classified as none, primary, or secondary education and higher. Area of residence was defined as rural or urban, and child gender estimates were obtained for boys and girls. Estimates accounted for survey design and weighting.

We also calculated the Slope Index of Inequality (SII) and Concentration Index (CIX) to measure absolute and relative socioeconomic inequalities, respectively. Indicators of relative inequality measure the degree of unfairness between extreme wealth groups (relative to one another) and absolute measures quantify the actual gap between the richest and poorest and thus the required effort to close it (59,60). Estimated from logistic regression models of the cumulative distribution of the asset index (x-axis) plotted against the stunting prevalence (y-axis), the SII and CIX are weighted for population size and consider any changes in the ordinal categories of the socioeconomic marker (e.g. differentials between wealth quintiles 2, 3 and 4). The difference in predicted values of the highest and lowest quintile (Q5 - Q1) generate each of the SII and CIX (61). Positive values indicate higher stunting prevalence among the wealthy, negative values suggest stunting is greater among the poor, and values of 0 suggest no difference between the richest and poorest populations. The SII and CIX presented in this study range from -100 to +100. All equity analyses accounted for survey design and weighting.

To explore within-department stunting variation, we obtained 5x5 km area stunting estimates as produced by the Institutes of Health Metrics and Evaluation (IHME) (62). The IHME used all available Ethiopia DHS and other survey datasets incorporated into Bayesian spatial models to generated posterior predicted prevalence of stunting. The model draw strength from covariables, years, and locations where data is available. General details on these methods have been previously published (63–65).

Annual rates of change

We calculated district (or woreda)-level stunting prevalence across all survey years to examine geospatial stunting patterns. Estimates accounted for survey design and weighting. Subsequently, district-level average annual % point change in stunting (AARC) were estimated through ordinary least square regression models, whereby stunting prevalence was regressed on survey year for the period 2000-2016. District performance was determined by ranking the model β estimate or AARCs and assessing statistical significance of p-values. These are interpreted as the *actual* average annual change in stunting prevalence. We also calculated compound annual growth rate (CAGR) formula to assess *relative* change (decline) in stunting prevalence over time for each region.

Multivariable Analyses

We undertook two sets of hierarchical multivariable analyses as discussed below. Using complementary approaches, each of these analyses attempts to answer the same research question i.e. what are the main predictors of change in child linear growth in Ethiopia during 2000-2016? The linear regression based on panel datasets uses a difference-in-difference analysis framework where time*covariable interactions are used to assess factors impacting HAZ decline. This allows the analysis of multiple years of survey data and adjusts for baseline levels of covariables and varying hypothesized growth trajectories through the interaction term. The Oaxaca-Blinder decomposition is based on the same set of individual/household level data (with ecological variables). However, by design, the decomposition only uses two survey time points in a given analysis and thus "ignores" in-between survey rounds and any intermittent fluctuations in the predictors. As has been suggested in previous decomposition analyses, we operationalize child HAZ as the linear growth outcome due to its greater statistical efficiency relative to the dichotomous child stunting variable. Each of the two multivariable regression-based analysis methods pose their own strengths and limitations – however, as sensitivity analyses, study inferences should be anchored in both and congruent findings between the methods strengthen the key messages.

2.3.6: Linear Multivariable Regression (Difference-in-Difference Analysis)

We undertook linear multivariable regression analyses, and included all covariables and adjustment factors as fixed effects. We added interaction terms between each potential determinant and time (i.e. time*covariable interaction terms), which signify whether a change in a proposed predictor of HAZ leads to a change in HAZ over the studied time period. The four cross-sectional surveys used in this analysis were assembled into panel datasets, and difference-in-difference (DID) analyses were used. Univariate statistics were estimated using means/standard deviations and frequencies/proportions as appropriate. We used the interaction estimators in unadjusted and adjusted regression methods to estimate the DID effect. The general model specification included an interaction term between time and the various indicators. The multivariable regression models were adjusted for child age, sex and region. Effect estimates were reported with 95% confidence intervals. All statistical analyses were performed using Stata version 14.0. The complex sampling design of DHS surveys was taken into account by using the STATA's svyset function. Standard errors were estimated using the Taylor series linearization method, which incorporates sampling weight, primary sampling unit, and stratum appropriate to the DHS sample design.

To examine the association between HAZ and various indicators, we conducted a series of step-wise linear regression models. A hierarchical modelling approach using distal, intermediate and proximal level variables was executed as suggested by Victora 1997 (54) to generate the final multivariable models. Variables within each level were selected from our general conceptual framework as defined in Figure 8. Step 1 was a series of bivariate regressions to determine crude associations between indicators in our conceptual framework and HAZ outcome. Step 2 was to use all candidate variables for multivariable model building (i.e. with p-value ≤0.20) irrespective of their direction to move forward for multivariable modeling. Selected variables are entered into backward stepwise elimination modeling within their respective levels and those with p-values <0.15 are retained. At each step, the crude and adjusted associations between the indicator and HAZ was analyzed for statistical significance. Multicollinearity among adjustment variables was evaluated using variance inflation factors (VIF) where VIF>3 were considered suspect for collinearity.

2.3.7: Kernel Density Plots and Victora Curves

HAZ Kernel Density Plots

The distributions of HAZ scores for Ethiopian children under the age of 5 were plotted using Kernel density plots. These plots produce smooth curves which estimate the probability density function of the continuous variable HAZ. Each plot displays four curves using data from the 2000, 2005,

2011, and 2016 DHS. This allows us to observe the change in mean and kurtosis of child HAZ distributions.

Victora Curves
Child growth curves, or *Victora* curves, display predicted child HAZ from smoothed local polynomial regressions that have been plotted against child age. We plotted four curves using data from the four surveys with a 95% confidence interval band around each. These curves allow for the examination of the growth faltering process from birth to 5 years of age among Ethiopian children.

Victora Curve Splines
To assess the functional form of HAZ over the first 60 months of life, raw values of HAZ were regressed on child age using kernel-weighted local polynomial smoothing. Expected values of HAZ were generated for each of the five countries at two time points and plotted against child age. For ease of interpretation, piecewise linear splines were fitted to the polynomial curves with knots corresponding to major changes in gradient occurred. Optimal knot placement was determined based on visual inspection of the plotted curves. Predicted values of HAZ at each month from 0 to 60 were obtained using linear combinations of the beta coefficients for each spline and the predicted value of HAZ at the previous knot (or the model intercept in the case of the first spline) as follows:

$\mathbf{0 \leq\ m \leq k_1}$:

1) $$\propto\ + (m *\ \beta_{s1})$$

$\boldsymbol{k_1 + 1 \leq\ m \leq k_2}$:

2) $$\propto\ + (k_1 *\ \beta_{s1}) + ((m - k_1) * \beta_{s2})$$

$\boldsymbol{k_2 + 1 \leq\ m \leq k_3}$:

3) $$\propto\ + (k_1 *\ \beta_{s1}) + \big((k_2 - k_1) * \beta_{s2}\ \big) +\ ((m - k_2) * \beta_{s3})$$

...

$\boldsymbol{k_n \leq\ m \leq 60}$:

4) $$\propto\ + (k_1 *\ \beta_{s1}) + \big((k_2 - k_1) * \beta_{s2}\ \big) +\ \big((k_3 - k_2) * \beta_{s3}\big) + \cdots + ((m -\ k_n) *\ \beta_{sn})$$

where:
$\propto$ = model intercept
β = slope for linear spline
s = splines 1 to n
k = values of knots 1 to n
m = month of age

For months (m) 0 to k1 (the value of the first knot), the predicted value of HAZ was computed as the mean value of HAZ at 0 months of age (α) plus the horizontal distance from the intercept to m (m - 0) multiplied by the beta coefficient for the first slope (βs1) (Equation 1). For months k1+1 to k2 (the value of the second knot, if present), the predicted value of HAZ at month m was computed in the same manner, except this time using the beta coefficient for the second slope (βs2), the distance between m and the previous knot (m – k1) and a derived intercept for the second slope (i.e. the predicted value of HAZ at k1 given by Equation 1 when m = k1) (Equation 2). This process was repeated for values along the third slope (if present) and so forth until the final slope beginning at the last knot value (kn) (Equation 4). Lines connecting the predicted values of HAZ at 0-60 months were overlaid onto the original polynomial curves for visual comparison.

2.3.8: Oaxaca-Blinder Decomposition

We also undertook the commonly used Oaxaca-Blinder decomposition methods (11,66) to assess determinants of nutritional change over time in Ethiopia. These methods based on individual-level data have high statistical power and have been widely used to assess nutrition determinants in low and middle income settings (10–12,67).

We analyzed individual-level data from four rounds of Ethiopia's DHSs: 2000, 2005, 2011, 2016. Our analysis focused on the index mother-child pair from each survey round. Defined as the youngest child of the youngest mother in each household, selection of an index pair simplifies the model and interpretation, and is common practice in advanced analysis of DHS datasets. The total number of index pairs available from each survey were n=5975, n=2600, n=6561, and n= 6184 for DHS 2000, 2005, 2011, and 2016, respectively. A flow chart outlining sample size breakdown during the index pair selection process is presented in Appendix 4. Given that the dietary needs/practices and growth trajectories of children in the first 1000 days of life vary notably from children beyond 2 years of age, it has been suggested that these two cohorts be analyzed separately to unmask true effects of environmental conditions and other factors on undernutrition. We conducted analyses for the entire under-5 year child population, the 24-59 month child population, and the 6-23-month population (68). The <6-month population had too small a change in HAZ, thus rendering the results of analysis not meaningful. Thus, only the decomposition results for the under-5, 6-23-month and 24-59-month populations are presented.

We used the continuous formulation of HAZ (as opposed to categorical stunting) as the dependent outcome to strengthen statistical power of the analyses. Linear least square regression models - accounting for survey design and weights - were used to assess associations between $\boldsymbol{y_{i,t}}$, our outcome variable measured for a child *i* at time *t*, a vector of time-varying determinants (**X**), time-invariant child age and sex control variables (**C**), and a survey round time variable (**T**) to capture any trend effects. Collectively, with the standard error term, the model is expressed in Equation 1.

$$\boldsymbol{Y_{i,t}} = \boldsymbol{\beta}\, \boldsymbol{X}_{i,k} + \boldsymbol{C}_i + \boldsymbol{T} + \varepsilon_{i,t} \qquad \text{[Equation 1]}$$

The conceptual framework and corresponding list of covariables, their data sources, and definitions used in decomposition assessment are included in Appendix 5. Applying the conceptual framework, we used a similar hierarchical modelling approach (as described for DID analysis) whereby we examined the distal, intermediate, and proximal level determinants of HAZ.

Equation 1 was applied to derive β coefficients for determinants (DHS 2000 – DHS 2016). To explain the relative contribution of each covariable over time to HAZ change, we used the Oaxaca- Blinder decomposition under the assumption that the β coefficients are the same across the two populations and the error term has the mean zero. Using the estimated parameters from Equation 1 and the (weighted) means of explanatory variables in the two time points, we applied Equation 2 (e.g. for years 1992/93 to 2017) to obtain the predicted change in HAZ due to the change in each determinant (57).

$$\Delta \bar{Y}_{i,t} = \beta \;\; (\bar{X}_{2016} - \bar{X}_{2000})$$

The product coefficients for individual determinants were subsequently ranked to identify the relative contribution of each factor to HAZ change. Like determinants were also grouped into broader domains for interpretation. We examined variance inflation factors (VIF) to assess multicollinearity between variables whereby a VIF > 3 was considered suspect of high inter-variable correlation. For model building, a p-value <0.20 was considered statistically important and variables with p< 0.15 were retained in the final hierarchical multivariable models. All analyses were carried out in Stata version 14.0.

2.4: Qualitative Inquiry Processes

The qualitative component of the case study aimed to understand the drivers of stunting reduction among children in Ethiopia through exploring the perspectives of key national stakeholders in the development and implementation of relevant policies and programs, the experiences of community health workers and mothers in the community. Specific qualitative research objectives included:

1. To explore nutrition-specific and –sensitive key events (policies/strategies/programs/guidelines) in Ethiopia that may have contributed to a reduction in child stunting;
2. To identify important contextual factors that have functioned as enablers/drivers and barriers to reduction of stunting in Ethiopia; and
3. To document community-level insight and experiences on the stunting transition in Ethiopia from community/volunteer health workers and mothers of young children.

The conceptual framework (Figure 7) by Black et al., informed the development of an adapted framework (Figure 8), the design of the in-depth interview and focus group discussion guides, as well as analysis and interpretation of the qualitative data. Our qualitative data collection tools were also informed by existing literature and nutrition questionnaires; for example, the International Food Policy Research Institute's nutrition-focused qualitative data collection toolkit was consulted and relevant tools were adapted to our research objectives as appropriate. Data was analyzed using key themes including: basic causes, underlying causes, and immediate causes of reduction in stunting and malnutrition.

2.4.1: Qualitative Research Design

We undertook three independent research activities to inform study objectives. At the first stage, national stakeholders were interviewed to provide insight and expertise on objectives 1 and 2. This top-down approach aimed to solicit macro-level perspectives and experiences in health and nutrition in Ethiopia. All the experts were interviewed in Addis Ababa, where main administrative structures and institutions are located. To understand how individuals in the community received and implemented major nutrition-specific and –sensitive policy/program events and their experiences in the nutritional transition as a whole, we consulted childcare workers in the community (e.g. at schools, health facilities, etc.) and the mothers of these children. These latter two research activities largely informed objectives 2 and 3, but also shed light on objective 1.

Sampling and Recruitment Strategy

Participants were identified and selected using purposive sampling strategies (69), including snowballing sampling (70). National stakeholders were purposively selected due to their involvement in the design, implementation, monitoring or evaluation of nutrition-specific or –sensitive policies and programs (Table 6). Key informants were asked to identify and refer the research team to other individuals with knowledge and expertise in the area of nutrition, policy, and stunting reduction. Participants were recruited by phone and a follow-up email was sent to request their participation in the study.

At the district level, key informants were purposively selected based on their experiences working in communities for 10-15 years, and for working in the areas of health, education and agriculture. To obtain focus group discussion (FGD) participants, a set of core inclusion characteristics were identified. These included:

1. Women who had children born between 1987-1991, 1995-1999 and 2011-2015;
2. Those able to express their opinion freely;
3. Those who were willing to participate in the interview; and
4. Those who were from different geographical locations within the district.

In the focal areas, both the mothers of children over the different periods and the key informants were identified through support from the District Administration Health Office and via Health Extension Workers (HEWs). These sampling strategies helped to ensure that a range of diverse perspectives at national and community-levels were captured.

Table 6: Inclusion Criteria

Type of Stakeholder	Inclusion Criteria
National Stakeholders	• Key informants with extensive experience in and knowledge of design, implementation and evaluation of nutrition-specific and –sensitive policies and programs in Ethiopia. Examples include: national policymakers (e.g., Ministry of Health, Ministry of Education, etc.), bilateral/multilateral organization (e.g., UNICEF), international/local NGOs (e.g., Save the Children, Nutrition International, Alive and Thrive, World Vision, etc.) and academics.
Regional Stakeholders	• Paid/voluntary community stakeholders in the Southern Nation, Nationalities, and Peoples (SNNP) and Somali regions. Examples include: Health Extension Workers (HEWs), health surveillance personnel, Expanded Program on Immunization (EPI) implementers, maternal, newborn and child health workers, and teachers.
Mothers in Communities	• Mothers of children born in 1987-1991; • Mothers of children born in 1995-1999; • Mothers of children born in 2011-2015; and • Currently living in SNNP and Somali regions.

Semi-structured with regional respondents and focus group interviews with mothers were conducted in two regions: SNNP and Somali (Figure 9). These two regions were selected based on their geographic location, ability to capture urban and rural perspectives, as well as the substantial progress made in these regions to reduce stunting among children. Within these two regions, Yeki and Bonga districts in SNNP and Aware and Harshin districts in Somali were selected as particular areas of focus based on the substantial progress in the reduction of stunting made in these districts compared to other districts. Focus communities were purposively selected, using convenience sampling. One rural and urban district was randomly selected within each focal area, and three FGDs were conducted in each. These sampling strategies helped to ensure that a range of diverse perspectives at national and community levels were captured.

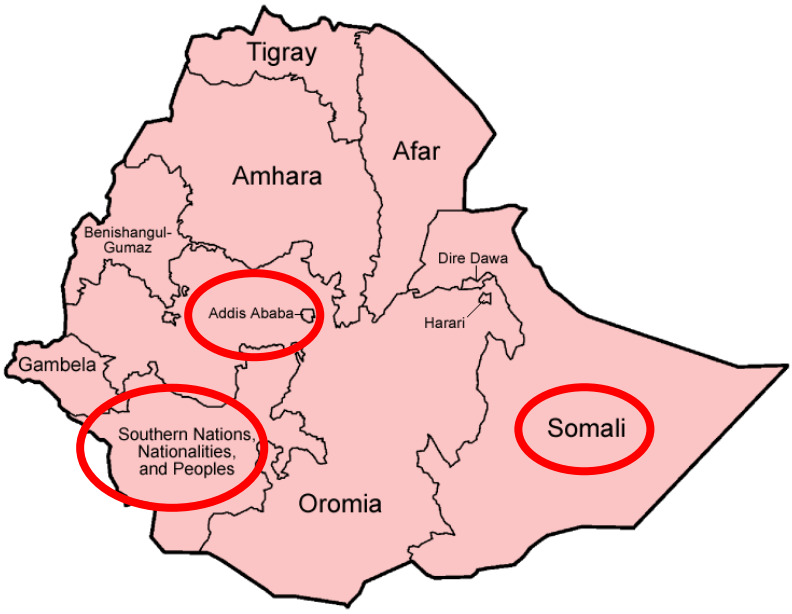


Figure 9: Regional map of Ethiopia displaying study sites for subnational key informant interviews and focus group discussions.

2.4.2: Research Methods

In-Depth Interviews

Firstly, 11 interviews were conducted with experts in Addis Ababa. These experts were officials from ministries directly or indirectly concerned by the issues of reducing malnutrition, including the Ministry of Health, Ministry of Education, Ministry of Agriculture, Ministry of Finance and Economic Development, experts from the specialized agencies of the United Nations, international NGOs and professors from Addis Ababa University. These individuals were purposively selected based on their expertise in nutrition, health and other sectors.

Secondly, 12 interviews were conducted in two districts of SNNP region (Bonga and Yeki) and two districts of Somali region (Harshin and Aware). These interviews targeted resource persons with several functions: teachers and health staff (health extension workers, maternal, newborn and child health care workers, district health surveillance focal persons, and senior health centre staff). Interviews were conducted in both urban and rural areas.

Focus Group Discussions

Thirdly, 12 focus groups discussions were organized, with three groups per district, across the two regions. In each region, three focus groups were held with mothers who gave birth between 1987-1991, three focus groups with mothers who gave birth between 2003-2007, and three focus groups with younger women who gave birth between 2011-2015.

Data Analysis

Data generated during focus group discussions, and semi-structured interviews were analyzed using the UNICEF Nutrition Framework (54), Lancet Nutrition framework (1), and the adapted framework for the country case studies (Figures 7 & 8). These conceptual frameworks guided the qualitative analysis and interpretation of key determinants and contextual factors, as well as facilitators and barriers to nutrition-specific and –sensitive events. The qualitative analysis explored distal/basic causes (e.g., GDP, education, political context), nutrition-sensitive and -

specific programs, underlying causes (e.g., inadequate feeding practices, and food insecurity, inadequate care and health services and unhealthy environment), and proximal/immediate causes (e.g., maternal characteristics, inadequate dietary intake, disease, and child characteristics). Responses from national stakeholders, regional stakeholders and mothers at community-level were analyzed separately. Thematic analysis was conducted to explore key themes that emerged based on stunting determinants including socioeconomic status (e.g., living conditions), migration, hygiene and sanitation, and nutrition and eating behaviours.

All interviews were audio recorded and conducted in the local language via a total of seven trained interviews (three in SNNP and four in Somali). The interviews were then translated into English. National key informant and regional stakeholder interviews took between 1-3 hours and focus group discussion took between 2.5 and 3.5 hours.

2.5: Nutrition Policy/Program Timeline and Financing Analysis

We assembled a timeline of key nutrition-specific and –sensitive policies and programs in Ethiopia through an iterative approach drawing on several of the above methods. Starting with a desk review of literature identified through our systematic approach, a suggested timeline was proposed by the Ethiopia study Principal Investigator and research team members. This timeline was shared with expert stakeholders to obtain their corroboration and insight on any missing initiatives. After reviewing additional literature and specific policy/program documents as suggested by experts, a second iteration of the timeline was proposed. This process ensued until consensus was reached between country experts and the Ethiopia research team.

A similar multi-pronged data collection and corroboration exercise was undertaken to track financial data linked to the nutrition policy and program timeline. The aim was to tag a dollar amount to financial allocations/actual disbursements and budgets/expenditures of the various programs, policies, interventions and other initiatives. The scan for financial commitments and spending spanned many sectors, including government, development partners, NGOs, others as applicable.

Chapter 3: Results – Quantitative Analysis

3.1: Subnational Variation Over Time

Stunting prevalence in Ethiopia declined between 2000 and 2016; however, declines were not uniform (Figure 10). Stunting for the under-5 population in Ethiopia was 50.9% in 2000, falling to 44.9% by 2005, 36.4% by 2011, and down to 32.4% by 2016. Although national stunting prevalence has reduced significantly, geographic disparities do exist, with some areas of the country making more gains than others, and one region actually experiencing a rise in stunting prevalence over the study period. Additionally, 5x5 km geospatial maps reveal important disparities within provinces and districts in Ethiopia (Appendix 9).

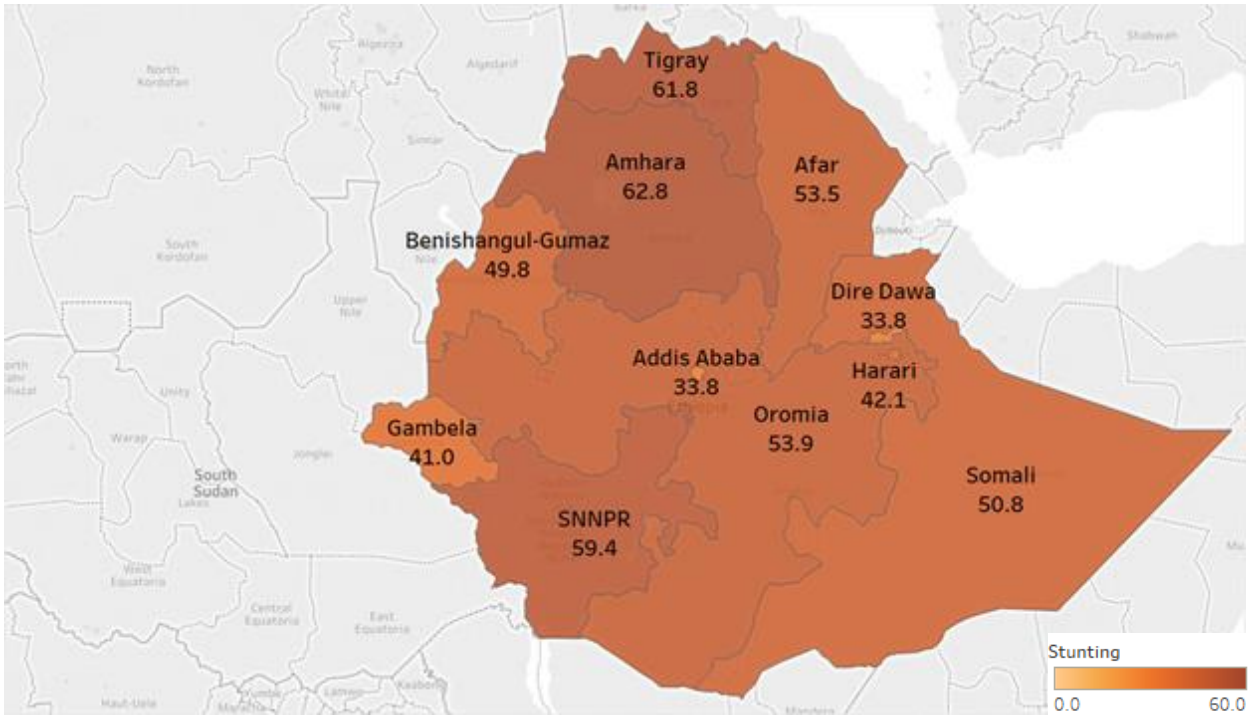
Ethiopia is divided into 11 regions, each with a varying level of stunting. In 2000, the two northernmost regions had the highest stunting prevalence, at 62.8% in Amhara and 61.8% in Tigray. The southern regions, SNNPR and Oromia, had the next-highest stunting prevalence at 59.4% and 53.9%, respectively. Afar and Somali also had stunting prevalence of over 50%, at 53.5% and 50.8%, respectively. Three regions had stunting prevalence of over 40%: Benishangul-Gumaz (49.8%), Harari (42.1%), and Gambela (41.0%). Only two regions had stunting prevalence below 40%, and these are both cities; both Addis Ababa and Dire Dawa have stunting prevalence of 33.8% The gap between the region with the highest and lowest stunting prevalence was 29.0% points.

By 2005, stunting had declined in nine regions, and risen in the remaining two regions (Amhara and Harari). The regions that had a stunting prevalence of above 50% were Amhara (63.7%), SNNPR (54.7%), and Somali (50.2%). Five regions had stunting prevalence above 40%, including Tigray (47.1%), Harari (45.2%), Oromia (44.3%), Benishangul-Gumaz (44.3%), and Afar (41.1%). Gambela, Dire Dawa and Addis Ababa had the lowest stunting prevalence at 38.9%, 33.7%, and 24.1%, respectively. The gap between highest and lowest prevalence grew to 39.6% points.

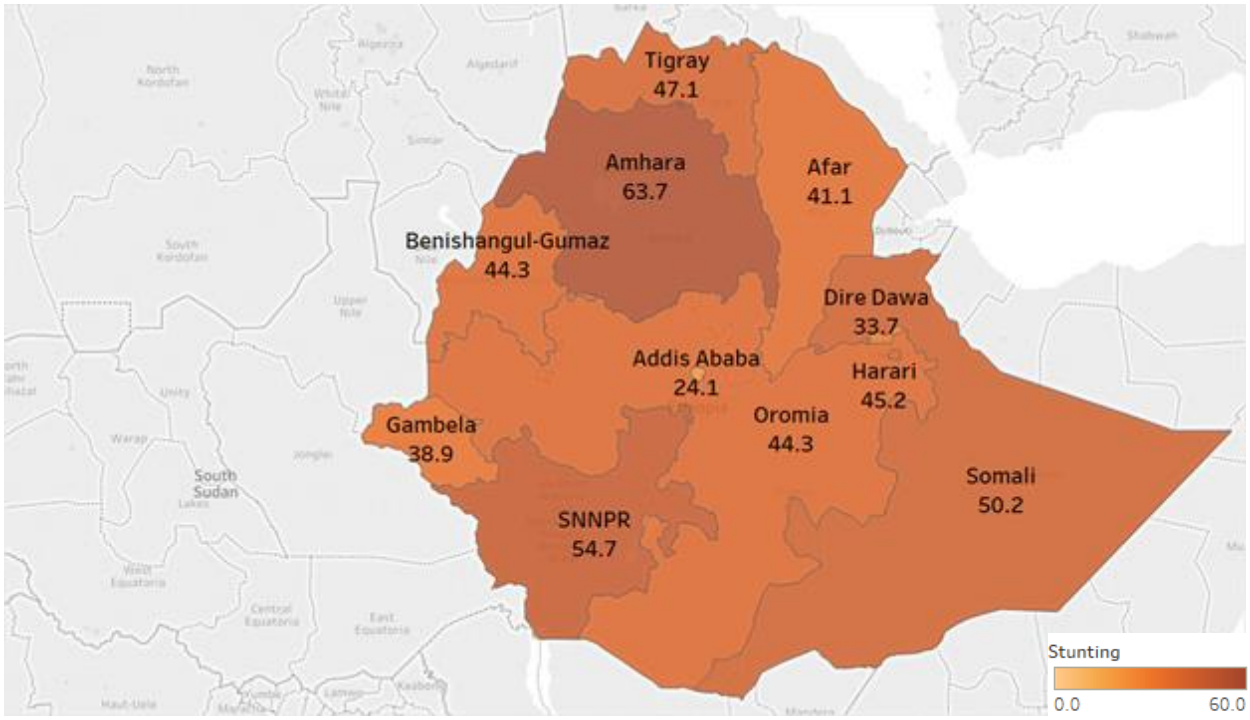
Six years later, in 2011, 7 regions experienced declines in stunting prevalence, but 4 regions' stunting prevalence rose. These four regions were: Tigray (51.0%), Afar (49.9%), Benishangul-Gumaz (48.1%), and Dire Dawa (35.1%). Amhara remained the region with the highest prevalence, though it had declined quite substantially from 63.7% in 2005 to 51.8% in 2011. Addis Ababa remained the region with the lowest stunting prevalence, at 22.3%. Gambela (30.0%) and Harari (29.1%) also reduced stunting prevalence to below 30%. The gap between the region with the highest prevalence and the lowest prevalence dropped to 29.5% points.

By 2016, no region had a stunting prevalence of over 50%, and only four regions had a stunting prevalence of over 40%. These four regions included Amhara (47.2%), Benishangul-Gumaz (42.8%), Dire Dawa (41.1%), and Afar (40.7%). In Dire Dawa, stunting increased from 35.1% in 2011 to 41.1% in 2016 and in Harari, stunting increased from 29.1% to 31.9% over the same 5-year period. Addis Ababa continued to be the region with the lowest prevalence, at 14.7%. The gap between the highest and lowest prevalence regions increased slightly to 32.5%.

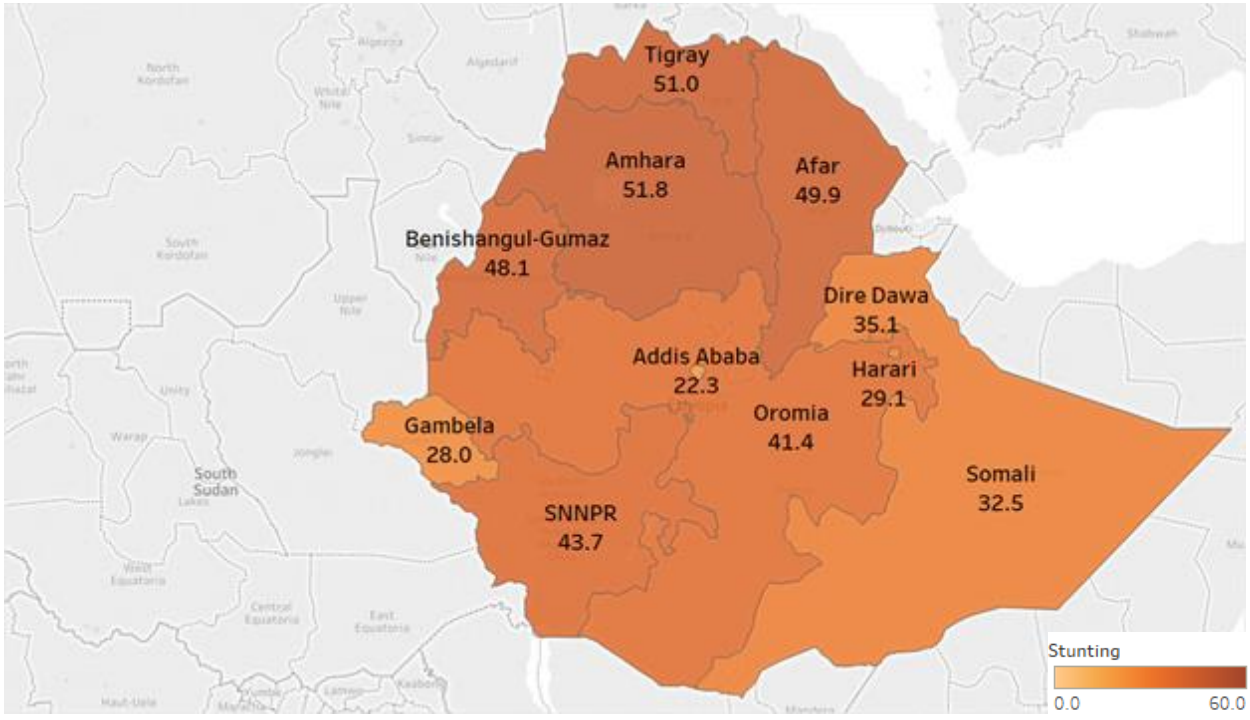
2000



2005


Tigray
47.1
Amhara
63.7
Afar
41.1
Benishangul-Gumaz
44.3
Dire Dawa
33.7
Addis Ababa
24.1
Harari
45.2
Oromia
44.3
Gambela
38.9
Somali
50.2
SNNPR
54.7
South Sudan
Stunting
0.0
60.0

2011


Tigray
51.0
Amhara
51.8
Afar
49.9
Benishangul-Gumaz
48.1
Dire Dawa
35.1
Addis Ababa
22.3
Harari
29.1
Oromia
41.4
Gambela
28.0
Somali
32.5
SNNPR
43.7
South Sudan
Stunting
0.0
60.0

2016

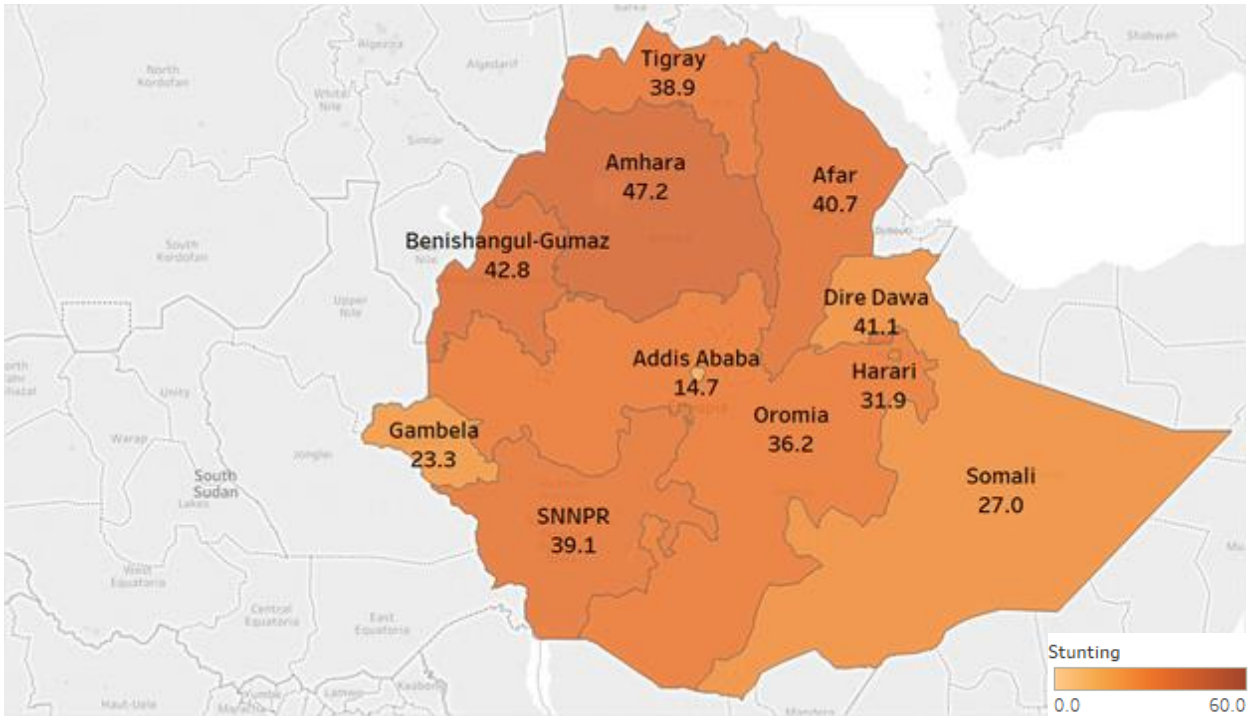


Figure 10: Stunting estimates for children under-5 years old

Table 7 and Figure 11 depict the average annual rate of change (AARC) in stunting prevalence by region through the years 2000 to 2016. The region that performed the best was Somali, which had an AARC of -0.015, followed closely by Tigray with an AARC of -0.014, and SNNPR with an AARC of -0.013. Addis Ababa had an AARC of -0.012, while Gambela and Oromia each had an AARC of -0.011, followed by Ambara (-0.010), Afar (-0.008), and Harari (-0.006). The lowest performing regions were Benishangul-Gumaz and Dire Dawa, which demonstrated an AARC of -0.004 and 0.005, respectively. Notably, stunting prevalence in Dire Dawa increased over the period, thus it had a positive AARC. Figure 11 depicts the AARCs in visual form; Somali experienced the greatest average annual reduction in stunting, while Dire Dawa is the clear outlier, with the only positive AARC.

Table 7: Prevalence and average annual rate of change of stunting among under-5 children, 2000 – 2016

Province	2000*	2016*	Stunting		
			AARC**	S.E.	p-value
Dire Dawa	33.8	41.1	0.005	0.003	0.087
Benishangul-Gumaz	49.8	42.8	-0.004	0.003	0.089
Harari	42.1	31.9	-0.006	0.002	0.002
Afar	53.5	40.7	-0.008	0.002	0.000
Amhara	62.8	47.2	-0.010	0.002	0.000
Oromia	53.9	36.2	-0.011	0.001	0.000
Gambela	41.0	23.3	-0.011	0.003	0.000
Addis Ababa	33.8	14.7	-0.012	0.002	0.000
Southern Nations, Nationalities, and Peoples	59.4	39.1	-0.013	0.002	0.000
Tigray	61.8	38.9	-0.014	0.001	0.000
Somali	50.8	27.0	-0.015	0.002	0.000

* All children data

**Average annual rate of change

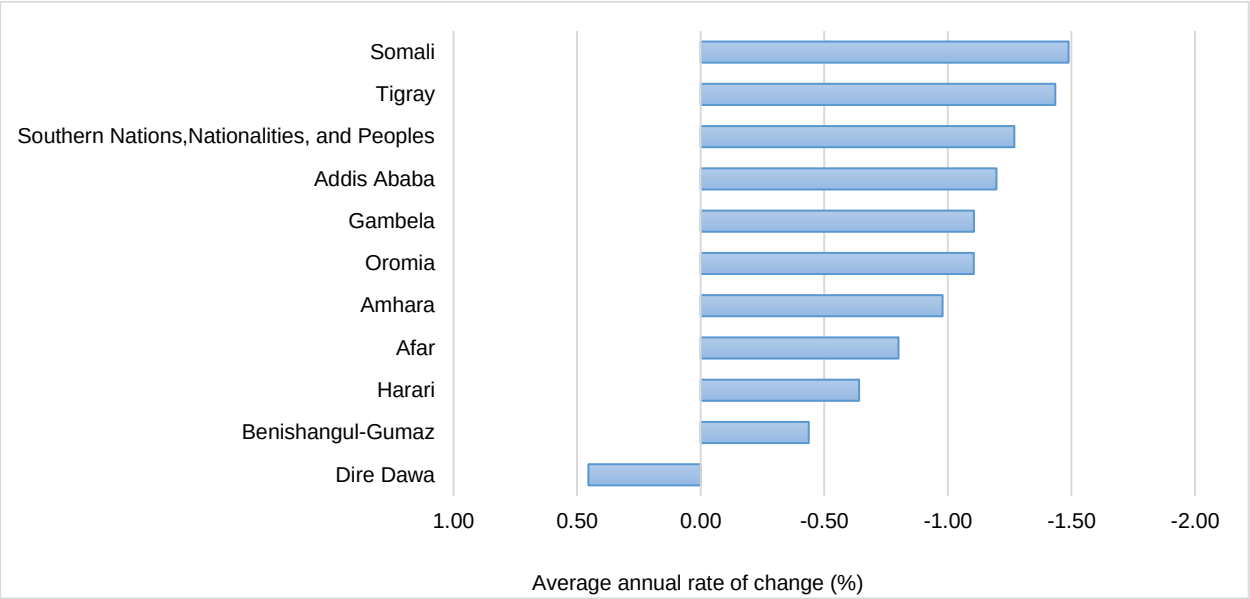


Figure 11: Average annual rate of change of stunting among under-5 children, region ranking 2000-2016

Table 8 and Figure 12 show the compound annual growth rate (CAGR), which is a measure of relative change in the proportion of stunted children by region. Addis Ababa had the largest relative decline in stunting, with a CAGR of -5.4. The next best performers were Somali (CAGR -4.1), Gambela (CAGR -3.7), Tigray (CAGR -3.0), followed by SNNPR (CAGR -2.7), Oromia (CAGR – 2.6), Amhara (CAGR -1.9), Harari (CAGR -1.8), and Afar (CAGR -1.8). The two regions with the smallest relative reduction in stunting were Benishangul-Gumaz (CAGR -1.0), and Dire Dawa (CAGR 1.3). As with the AARC, the CAGR for Dire Dawa is positive, indicating that stunting prevalence in this region increased over time. Figure 12 shows the CAGR visually, by region. Dire Dawa demonstrated the largest relative change in stunting, which increased over the study period, while Addis Ababa experienced the greatest relative reduction in stunting.

Table 8: Prevalence and compound annual growth rate (decline) of stunting among under-5 children, 2000-2016

Province	2000*	2016*	CAGR**
Dire Dawa	33.8	41.1	1.3
Benishangul-Gumaz	49.8	42.8	-1.0
Afar	53.5	40.7	-1.8
Harari	42.1	31.9	-1.8
Amhara	62.8	47.2	-1.9
Oromia	53.9	36.2	-2.6
Southern Nations, Nationalities, and Peoples	59.4	39.1	-2.7
Tigray	61.8	38.9	-3.0
Gambela	41.0	23.3	-3.7
Somali	50.8	27.0	-4.1
Addis Ababa	33.8	14.7	-5.4

* All children data
** Compound annual growth rate

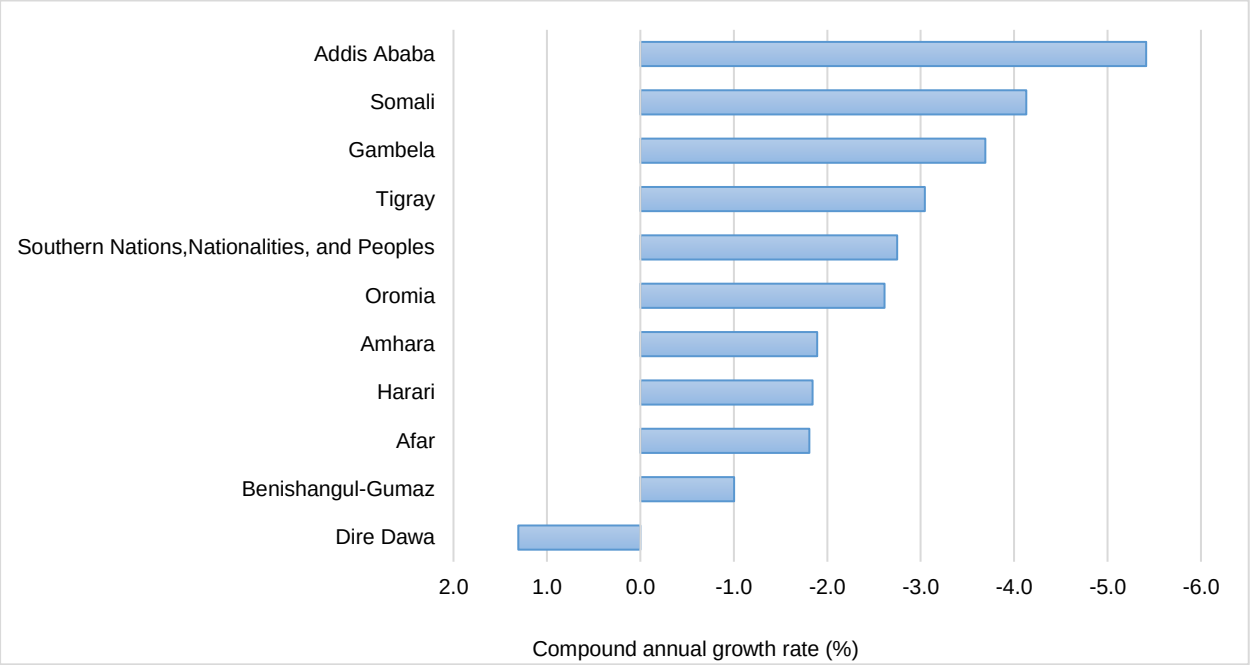


Figure 12: Compound annual growth rate (decline) of stunting among under-5 children, region ranking 1992/93 - 2017

3.2: Stunting Equity Analyses by Dimension and Over Time

We disaggregated national stunting prevalence into important subnational populations and examined reductions in inequalities over time. We discuss inequalities by wealth quintile, maternal education, urban vs rural residence, and child gender (Figures 13-16). The absolute numbers of stunted children in each group are included in Appendix 11.

Wealth Quintile: Stunting prevalence was quite high in 2000 and decreased by 2016, however, inequalities between the richest and poorest have increased over this time. In 2000, the difference in stunting prevalence between the richest and poorest wealth quintiles was 12% points, and by 2016, this difference rose to 20% points. The largest gains in stunting declines occurred among those in the highest wealth quintile (difference of 23% points from 2000 to 2016), while the smallest gains occurred among those in the lowest wealth quintile (15% point difference from 2000 to 2016). This indicates that, not only do the wealthy have the lowest rates of stunting, they have also experienced the largest declines in stunting over time. The absolute number of stunted children varied greatly by wealth quintile, with an estimated 1592 stunted children in the poorest quintile, and 917 stunted children in the wealthiest quintile in 2000. By 2016, there were an estimated 1427 stunted children in the poorest wealth quintile, and 651 in the wealthiest quintile (Appendix 10). ***Key takeaways:*** Stunting decline has occurred across all wealth quintiles from 2000 to 2016, however, gaps between rich and poor have nearly doubled over this time period, as the wealthy experience lower stunting prevalence and larger declines over time.

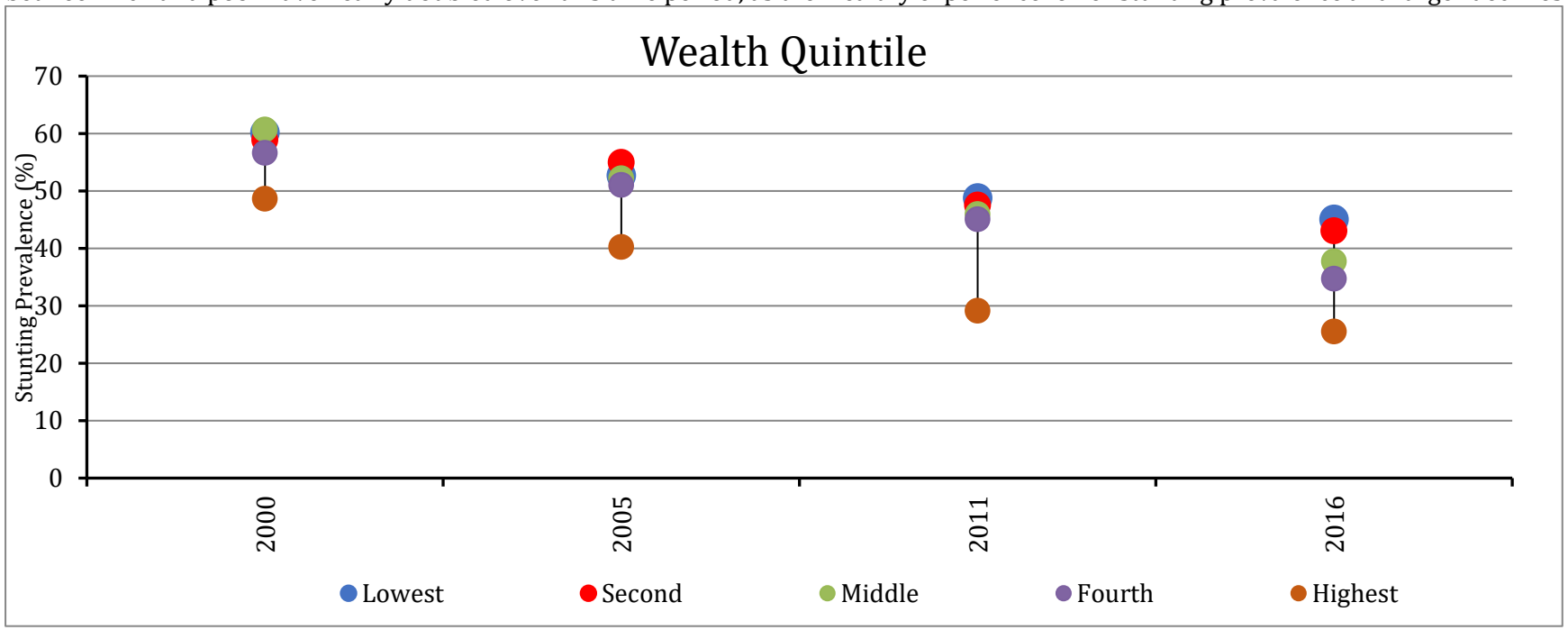


Figure 13: Stunting prevalence by wealth quintile 2000 – 2016

Maternal education: Stunting prevalence was consistently highest among mothers with no education and lowest among mothers with secondary education or higher. The largest gap in stunting prevalence occurred in 2011 (27% point difference), while the smallest gap occurred in 2016 (22% points). Between 2000 to 2016, absolute stunting decline was relatively equal for each education level (18% point, 19% point, and 17% point decline for children of mothers with no education, primary education, and secondary+ education, respectively). For all survey years, the absolute number of stunted children was highest among children of women with no education, and lowest for children of women with secondary or higher levels of education (Appendix 11). In 2016, there were an estimated 4134 stunted children of mothers with no education, 1459 stunted children of mothers with primary level of education, and 215 stunted children of mothers with secondary or higher education. ***Key takeaways:*** Stunting declined evenly for children of mothers at all education levels. Children of mothers with secondary or higher education are much less likely to be stunted compared to children of mothers with lower education levels.

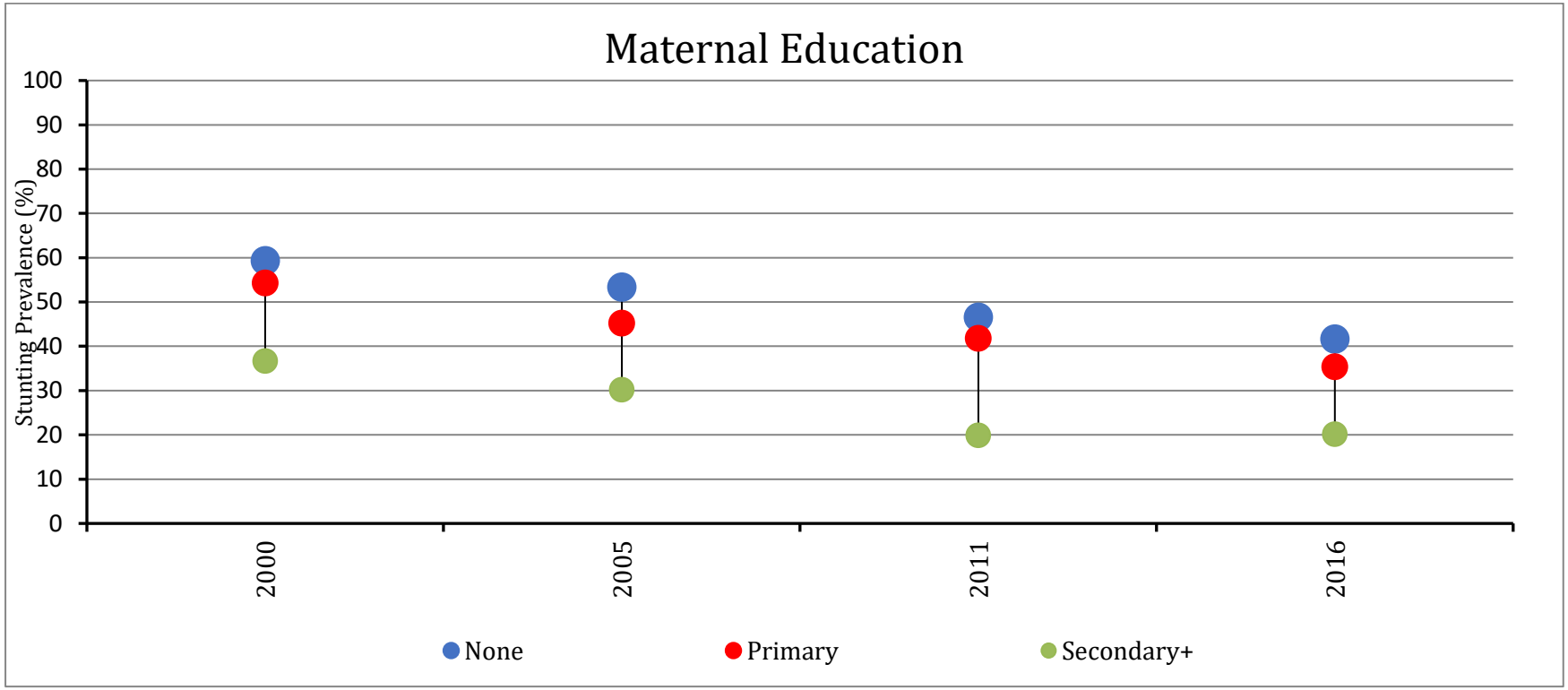


Figure 14: Stunting prevalence by maternal education 2000 – 2016
Note: Due to the small sample size for mothers with higher levels of education, a combined category (secondary+) was used.

Residential area: Disparities in stunting between children living in urban and rural areas have existed for the entire study period, and have remained relatively consistent. Children residing in rural areas had a stunting prevalence that was 11% points higher than those residing in urban areas in 2000, and this rose to 14% points by 2016. Over the course of the study period, stunting prevalence was reduced by 21% points in urban areas, and 19% points in rural ones. The disparities in stunting prevalence between urban and rural populations are also evident when comparing the absolute number of stunted children in each residential area. Throughout the studied years, the absolute number of stunted children remained noticeably higher in rural areas compared to urban ones, and in 2016, an estimated 5339 stunted children lived in rural areas, while 469 lived in urban areas (Appendix 10). ***Key takeaways:*** Stunting prevalence was reduced for children living in both urban and rural areas over the study period. Slightly greater reductions occurred for children in urban areas. Urban areas also consistently demonstrate lower stunting prevalence rates when compared to rural areas.

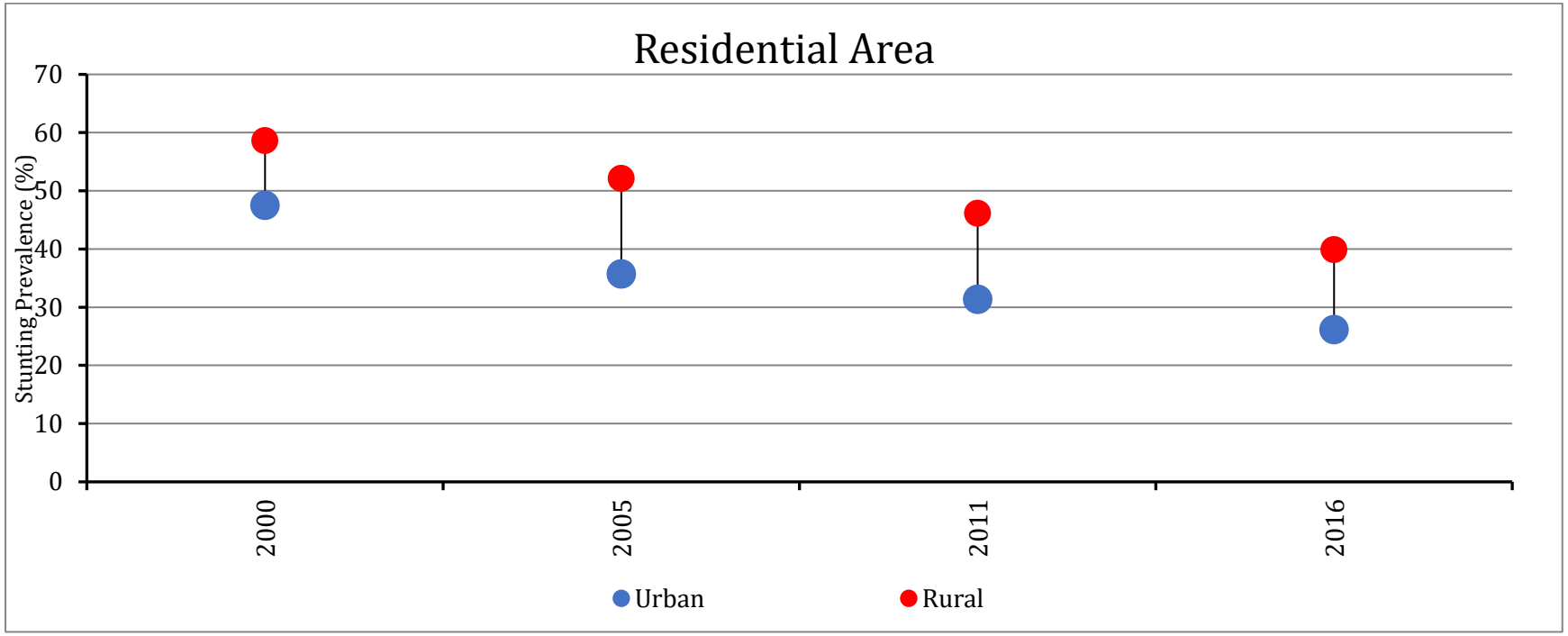


Figure 15: Stunting prevalence by residential area 2000 – 2016

Gender: The prevalence of stunting has consistently been higher among male versus female children under-5 in Ethiopia over the 16-year study period. Overall, stunting prevalence has decreased steadily for all children, though girls experienced a slightly larger overall decline between 2000 and 2016 (20.4% reduction versus 17.9% reduction). However, the gap between stunting prevalence in boys and girls has increased from 3.3% points in 2000 to 5.8% points in 2016. In 2016, an estimated 2698 stunted children were female, while 3111 stunted children were male (Appendix 10). ***Key takeaways:*** Gender disparities in stunting are persistent among Ethiopian children, with males experiencing higher rates of stunting than female children. This gap has increased over the study period.

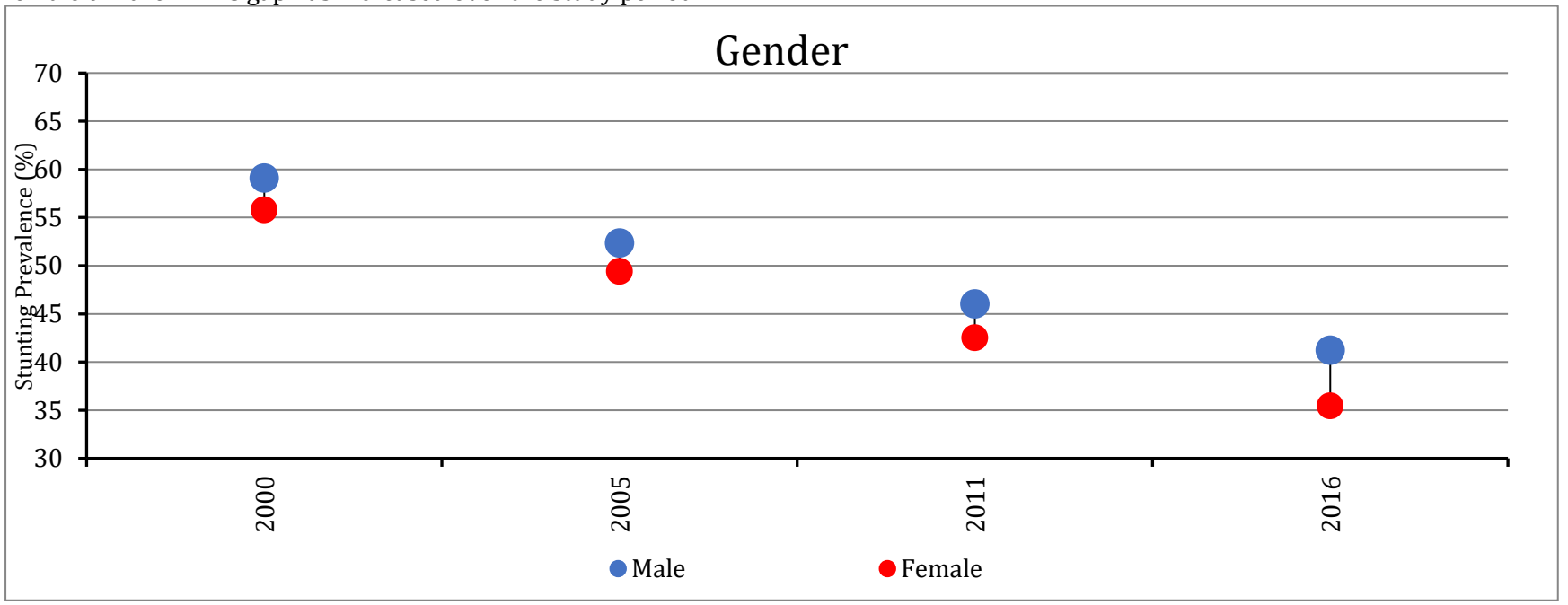


Figure 16: Stunting prevalence by gender 2000 – 2016

3.3: Stunting Equity: SII and CIX

Figures 18 and 19 present the slope index of inequality (SII) and the concentration index (CIX), respectively, over time to measure the extent of socioeconomic inequality in stunting burden in Ethiopia. As detailed in the methods, the SII measures absolute inequalities and the CIX measures relative inequalities – both are important for revealing the full picture of socioeconomic inequality. Relative inequalities measure the degree of unfairness between extreme wealth groups (relative to one another) and absolute inequalities quantify the actual gap between the richest and poorest, and thus, the required effort to close it (59,60). Conveying similar messages as those observed in the trends by wealth quintile (Figure 13), the SII and CIX use the complete wealth distribution and thus estimates are a more robust depiction of wealth inequality. Positive values indicate higher stunting prevalence among the wealthy, negative values suggest stunting is greater among the poor, and values of 0 suggest no difference between the richest and poorest populations. The SII and CIX presented in this study range from -100 to +100. Data were calculated for all survey years, and are presented below.

In terms of absolute inequalities (Figure 17), we observe a shift of SII from less negative to more negative values from 2000 to 2016. The gap between the rich and the poor is becoming larger over time. This follows a generally linear trend over the four years presented. In 2000, the SII gap was about -13, indicating that the poorest populations had about 13% point greater prevalence of stunting. Consequently, this is the gap that would need to be closed to achieve equality between the poorest and richest. From 2000 to 2016 the rich-poor gap increased to about 24% points by 2016. These findings suggest that larger reductions in stunting in Ethiopia were among the wealthiest segments of the population, and this may have been a strong contributor to the stunting decline in that period. There is room for improvement in terms of stunting reduction as a large rich-poor gap exists in Ethiopia.

Relative inequalities measure the comparative extent to which stunting prevalence is higher in the poorest vs richest populations. For example, in Figure 13, the relative ratio of stunting was 60.2%/48.7% = 1.2 times higher in the poorest populations in 2000; and this was increased to 45.1%/25.5% = 1.8 times in 2016. This change in relative inequalities is also reflected in the CIX values in Figure 18. Values over time fluctuated between -3.56 in 2000 to -10.19 in 2016, suggesting the relative rate at which the poorest are more undernourished than the richest is increasing over time (Figure 18).

In terms of the magnitude of inequalities, all SII values are large and are generally increasing. CIX values are also on the rise year over year, which is suggestive that the relative differences between wealth groups is increasing with time.

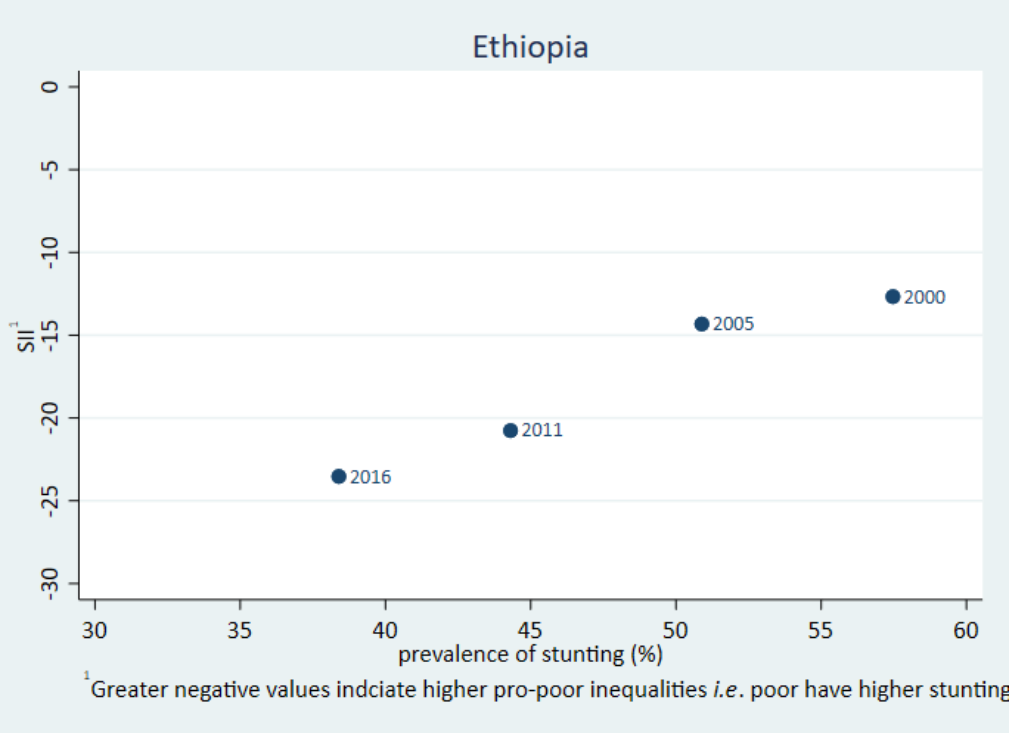


Figure 17: Change in absolute SII by year in Ethiopia

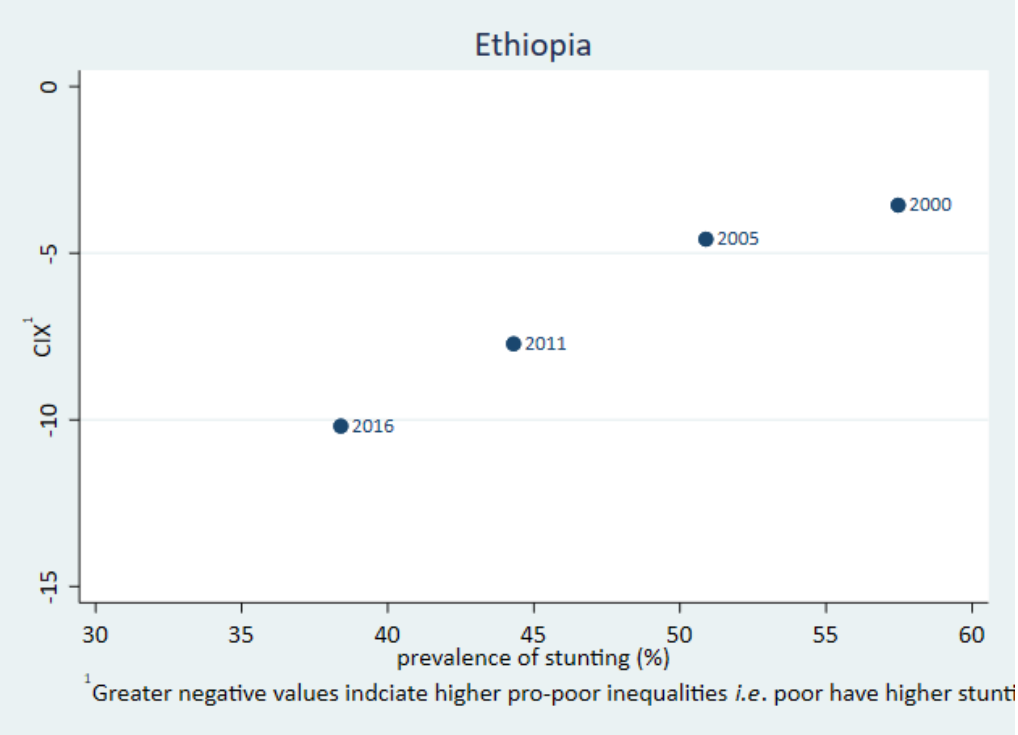


Figure 18: Change in relative CIX by year in Ethiopia

3.4: Intervention Equity Analyses by Dimension and Over Time

We disaggregated national prevalence of various essential interventions and child morbidities into important subnational populations and examined reductions in inequalities over time. We discuss inequalities by wealth quintile, maternal education, rurality, child gender, and geographic region. Plots can be found in Appendix 11. Data were suppressed for categories of indicators that had fewer than 50 children in the sample size.

3.4.1: Breastfeeding

Breastfeeding interventions were analyzed through looking at early initiation of breastfeeding, exclusive breastfeeding, and duration of breastfeeding (Appendix Figures 7-21).

Early initiation of breastfeeding rose steadily from 2000 to 2016. Disparities in wealth quintile, maternal education, residential area, and gender were minimal, especially compared to geographic region gaps. In terms of geographic region gaps, in 2016, the regions with the largest prevalence of early initiation of breastfeeding were Oromia and Dire Dawa – at 85% and 95% prevalence, respectively. The region with the lowest prevalence was Afar where only 55% of mothers initiated breastfeeding within one hour – about 40% points lower than Dire Dawa.

Exclusive breastfeeding remained relatively stable over the study period, with only minimal increases from 2000 to 2016. Discrepancies among maternal education levels, and geographic regions were largest in 2000, and were reduced by 2016, though for wealth quintiles, inequalities remained largely unchanged. The regions of Amhara and Tigray consistently had the highest levels of exclusive breastfeeding from 2000 to 2016. The largest shift in exclusive breastfeeding levels occurred in Addis Ababa, from 18% prevalence in 2000 to around 56% prevalence by 2016.

Duration of breastfeeding was the indicator with the least variation among the three that examined breastfeeding. Duration of breastfeeding declined from approximately 18 months in 2000 to around 15 months in 2016. From 2000 to 2016, gaps in the duration of breastfeeding based on maternal education fluctuated, though those with no education consistently breastfed the longest. Virtually no differences were observed across residential area and gender. In 2016, mothers in Amhara breastfed the longest (~20 months), while those in Somali breastfed for the shortest duration (~10 months).

3.4.2: Child Morbidities

Diarrhea and acute respiratory infection incidence in the past two weeks were analyzed based upon the same subnational populations as the previous section (Appendix Figures 22-31). Data were not available for the 2016 survey.

Diarrhea incidence declined over the study period, though not uniformly. Diarrhea incidence was lowest among those in the highest wealth quintile, though was highest among the middle quintile in 2000 and 2005, and the fourth quintile in 2011. Mothers with higher levels of education had children with lower incidence of diarrhea from 2000-2016. Those living in urban areas also had a lower incidence of diarrhea, while virtually no difference was found across gender. Diarrhea incidence varied greatly by geographic region. In 2011, Dire Dawa had an incidence below 10%, while Benishangul-Gumaz was nearly 25%.

ARI incidence declined most between 2000 and 2005, and remained steady in 2011. Inequality by wealth quintile can be observed only in 2000, after which the five quintiles have nearly the same incidence. Inequalities patterned by maternal education widened between 2000 and 2005, before lowering from 2005-2011. For 2000 and 2005, the lowest incidence occurred among the children of mothers with higher levels of education, though by 2011, the gap narrowed. Virtually no difference was found based on residential area and gender. By 2011, ARI incidence was lowest in in Addis Ababa, Dire Dawa, and Harari at around 10%, and highest in Tigray, reaching around 30%.

3.4.3 Integrated Management of Childhood Illnesses

Based on information available using Ethiopia DHS data, measures of integrated management of childhood illnesses (IMCI) were analyzed through four indicators: diarrhea treatment seeking, oral rehydration salts, oral rehydration therapy, and ARI treatment seeking (Appendix Figures 32-51).

Diarrhea treatment seeking measures the proportion of children for whom advice or treatment was sought, of the total number of children who had an episode of diarrhea. Large disparities by wealth quintile are evident between 2000 and 2016. Those in the highest wealth quintiles sought treatment for diarrhea at higher rates than those in the lowest wealth quintiles, and gaps were quite wide in all years. Mothers with higher levels of education had higher prevalence of diarrhea treatment seeking, with the largest disparities between those with no education and those with higher education occurring in 2011. People living in urban areas were consistently more likely to seek treatment compared to those in rural areas, while virtually no differences were observed across gender. Diarrhea treatment seeking by geographic region remained highly varied across all years, with the highest rates of treatment seeking from residents in Dire Dawa and Benishangul-Gumaz, and the lowest in Oromia and Amhara in 2016.

The following set of plots details the proportion of children who received oral rehydration salts (ORS) of the total number of children under-5 who had diarrhea in the past two weeks. People living in the highest wealth quintiles sought ORS treatment at a much higher rate than those in the lowest quintiles, with disparities between rich and poor slowly diminishing since 2000 to 2016, as those in the lower four wealth quintiles catch up to those in the highest. Mothers with higher levels of education were more likely to seek ORS treatment from 2000 to 2011, with inequalities diminishing over the study period. People living in urban areas consistently had higher proportions of ORS treatment seeking compared to those in rural areas, and the gap between the two narrowed over time. Gender differences were negligible. Variation exists by geographic region across all years. In 2016, Dire Dawa had the highest proportion of children receiving ORS following an episode of diarrhea (~60%), while Oromia had the lowest proportion (~30%).

Oral rehydration therapy (ORT) also had inequalities across most of the equity dimensions. Nearly half of those in the highest wealth quintiles sought ORT in 2011, compared to only 20% of those in the lowest wealth quintile. Mothers with higher education had the highest rate of ORT observed across all years. Similar to ORS, more of those living in urban areas sought ORT, while virtually no difference was observed by gender. Dire Dawa and Addis Ababa had the highest ORT seeking rate, with the gap narrowing across regions by 2011.

ARI treatment seeking varied greatly by all equity dimensions, save gender. A higher percentage of people living in the highest wealth quintiles sought ARI treatment compared to those in the lowest quintiles. Greater ARI treatment seeking could be seen among mothers with higher levels of education across all years. Prevalence was notably higher among urban residents compared to rural residents, and this gap persisted over time. Finally, disparities among geographic regions

were clearly present in all years, though due to small sample size, numerous regions' estimates required omission from the plot.

3.4.3: Vaccination for children under-5

We analyzed BCG, DPT3, and measles vaccines by equity dimension (Appendix Figures 52 -66).

BCG vaccination coverage was under 50% in 2000, and rose to above 60% by 2016, though inequalities persisted over this time. Inequalities in vaccination coverage by wealth quintile were apparent, with those in the poorest wealth quintile having the lowest coverage of the BCG vaccine, while those in the richest wealth quintile had the highest coverage. Consistently, children of mothers with secondary or higher levels of education had higher BCG vaccination coverage than those of mothers with no or primary levels of education. Rurality also showed inequalities with children in urban areas having a more than 20%-point higher vaccine coverage than those living in rural areas. Also notable was that the region of Afar was an outlier with a prevalence of BCG vaccine that had about 20% points lower than all the other regions.

DPT3 vaccination shows a similar pattern with inequalities by all dimensions apart from gender. Vaccination coverage was highest among those in the higher wealth quintiles, those born to mothers with higher levels of education, and those residing in urban areas. Once again, Afar had markedly lower prevalence of DPT3 vaccination rates as compared to the other regions, while children in Addis Ababa and Dire Dawa had the highest vaccine coverage.

Similar to the other two vaccines, measles vaccination had much variation across nearly all dimensions in the under-5 children's population. Those in the richest quintile had consistently higher rates of measles vaccination (~20% points higher) compared to the lowest four quintiles. In addition, measles vaccination was highest among children whose mothers had higher levels of education, and lowest for children born to mothers with no education. Measles vaccination was higher for those living in urban areas compared to rural ones. As with the other two studied vaccines, Addis Ababa maintained the highest coverage of measles vaccination, while Afar remained as the region with the lowest coverage.

3.4.4: Vaccination for children 12-23 months

Similar to the under-5 age group, three vaccines were studied across the subnational dimensions for the 12-23-month age group (Appendix Figures 67-81).

BCG vaccination for this population was also below 50% in 2000 and rose to around 70% by 2016. Those in the highest wealth quintile had the highest BCG vaccination coverage, with the gap between the richest and the poorest narrowing slightly over time. There were large discrepancies in vaccination coverage was by maternal education, where mothers with the highest education attained nearly 90% coverage compared to only 60% among mothers with no education in 2016. Variations also existed by residential area, and children in urban areas had 20%-point higher coverage than those in rural areas. Similar to the under-5 age group, the lowest BCG vaccination coverage was in Afar.

DPT3 vaccination rates followed a similar pattern, with variation occurring between wealth quintiles, maternal education groups, residential areas, and geographic regions. Again, people in the richest wealth quintile had the highest vaccination coverage, while the poorest had the lowest.

Children of mothers with higher levels of education had higher DPT3 vaccination coverage, with significant narrowing between the education categories observed over time. Consistent with other vaccines, children in urban areas had higher coverage than those in rural ones. Afar remained an outlier with markedly lower DPT3 vaccination coverage, as compared to the other regions.

Measles vaccination also had large discrepancies across all dimensions but gender. Higher wealth quintiles, higher levels of education, and urban residence all had higher measles vaccination coverage. Similar to other vaccines, measles vaccination was substantially lower in Afar (30% in 2016), while people living in Addis Ababa had the highest vaccination coverage (95% in 2016).

3.4.5: Water, Sanitation, and Hygiene

WASH improvements were measured through two interventions: piped water access and open defecation reduction (Appendix Figures 82-91). These were all disaggregated across the subnational dimensions to determine gaps.

Piped water access did not increase greatly over the study period, and large variations by equity dimension existed for all but gender. Those in the highest wealth quintiles had much higher levels of piped water access compared to those living in the lower four wealth quintiles, with a nearly 50%-point discrepancy between the highest and fourth wealth quintiles in 2016. Households with mothers who had higher levels of education had increased access to piped water compared to those with primary or no education. Households in urban areas had approximately 60%-point higher piped water access compared to households in rural areas. There were virtually no discrepancies in piped water access between genders. The greatest discrepancies in access to piped water were between geographic regions. Among people living in Addis Ababa, nearly all had access to piped water, while only around 10% of people living in Benishangul-Gumaz had access.

Open defecation rates decreased from 2000 to 2016 across Ethiopia. Large gaps existed across all dimensions save gender, though they decreased over the studied years. Households in the lowest wealth quintiles had higher levels of open defecation, as did households with mothers who had no education, and this was consistent through the studied years. Urban areas had consistently lower levels of open defecation, and by 2016 urban areas had below 10% levels of open defecation while rural areas had a prevalence of 40%. Large discrepancies existed among geographic regions, with people living in Addis Ababa having no open defecation by 2016, while those living in Afar continued to experience high open defecation rates of around 75%.

3.5: Linear Multivariable Regression (Difference-in-Differences Analysis)

The following two sets of analyses (bivariate and multivariable regressions which include time*covariable interaction terms) examine the relationship between proposed predictors and the stunting outcome, as well as the DID effect between predictors and time. The interaction/DID terms indicate whether the change in the covariable leads to a change in the outcome (HAZ) over time. Bivariate correlations estimate the absolute crude associations between the covariable and the outcome, and they highlight the total (unadjusted) effect of the factor on HAZ. In multivariable analysis, the final multivariable regression coefficient is adjusted for child age, sex and region (control variables) and all confounders in preceding levels.

3.5.1: Children under-5 years old from 2000-2016

The results of multivariable mixed effect regression for children under-5 years old can be found in Table 9. This analysis considers two time points: 2000 to 2016. Highlighted in red are the statistically significant interactions between maternal education level and time, delivery in a medical facility and time, and total number of health workers per 10,000 and time indicating that these relationships with HAZ changed over time.

Table 9: Difference-in-differences multivariable regression for children under-5 years from 2000 – 2016

Domain/Indicator	Outcome = HAZ (Height for age z-score for under-5 children)	
	Period 2000 to 2016	
	Bivariate regression coefficient	Final multivariable regression coefficient*
	b estimate (95% CI) *p*-value	b estimate (95% CI) *p*-value
Distal level		
Basic causes & Income poverty		
Wealth Index (nine components using PCA) (0 - 10)	0.062 (0.051; 0.072) <0.001	0.041 (0.029; 0.052) <0.001
Wealth Index # Year (0 - 10)	0 (-0.002; 0.001) 0.53	--
Mother years of schooling	0.074 (0.063; 0.084) <0.001	3.146 (-0.263; 6.556) 0.071
Maternal education # year	-0.002 (-0.003; 0) 0.042	-0.0016 (-0.0032; 0.0001) 0.073
Father years of schooling	0.062 (0.053; 0.07) <0.001	0.028 (0.017; 0.039) <0.001

Domain/Indicator	Outcome = HAZ (Height for age z-score for under-5 children)	
	Period 2000 to 2016	
	Bivariate regression coefficient	Final multivariable regression coefficient*
	b estimate (95% CI) *p*-value	b estimate (95% CI) *p*-value
Father education # Year	-0.0004 (-0.0017; 0.0009) 0.578	--
% of residual variance explained by covariates		**16.5%**
Intermediate level		
Inadequate care and health services		
Antenatal care (% women with at least 4 visits)	0.329 (0.242; 0.417) <0.001	0.13 (0.038; 0.223) 0.006
Antenatal care # Year	-0.013 (-0.026; 0.001) 0.061	--
Place of delivery (% of delivery at medical facility)	0.509 (0.412; 0.606) <0.001	47.342 (12.863; 81.822) 0.007
Place of delivery # year	-0.0329 (-0.0484; -0.0175) <0.001	-0.023 (-0.041; -0.006) 0.007
total number of health care centers per 10,000 population	-0.052 (-0.124; 0.02) 0.159	--
total number of health care centers per 10,000 population # Year	-0.0067 (-0.0181; 0.0047) 0.247	--

Domain/Indicator	Outcome = HAZ (Height for age z-score for under-5 children)	
	Period 2000 to 2016	
	Bivariate regression coefficient	Final multivariable regression coefficient*
	b estimate (95% CI) *p*-value	b estimate (95% CI) *p*-value
total number of health workers per 10,000 population	0.032 (0.02; 0.044) <0.001	5.03 (-0.326; 10.386) 0.066
total number of health workers per 10,000 population # Year	-0.0043 (-0.0071; -0.0016) 0.002	-0.0025 (-0.0051; 0.0002) 0.067
Inadequate feeding practices and food security		
Total crop yield	0.012 (0.001; 0.023) 0.026	0.022 (0.012; 0.033) <0.001
Total crop yield # Year	-0.0028 (-0.0051; -0.0005) 0.018	--
Unhealthy household environment		
Urbanization (% of urban population)	0.4653 (0.3433; 0.5872) <0.001	--
Urbanization # Year	-0.00162 (-0.02093; 0.01769) 0.87	--
Open defecation (% population)	-0.2967 (-0.3764; -0.2169) <0.001	-
Open defecation # Year	0.00771 (-0.00535; 0.02076)	

Domain/Indicator	Outcome = HAZ (Height for age z-score for under-5 children)	
	Period 2000 to 2016	
	Bivariate regression coefficient	Final multivariable regression coefficient*
	b estimate (95% CI) *p*-value	b estimate (95% CI) *p*-value
	0.247	--
Water source - piped (% of population)	0.286 (0.192; 0.38) <0.001	--
Water source - piped # Year	-0.0091 (-0.025; 0.0068) 0.261	--
Household crowding	0.02 (0.003; 0.036) 0.018	--
Household crowding # Year	0.0003 (-0.0022; 0.0027) 0.833	--
% of residual variance explained by covariates		**17.4%**
Proximal level		
Disease		
Acute Respiratory incidence/ reports (% under-5 population within last 2 weeks)	-0.012 (-0.088; 0.065) 0.765	--
Acute Respiratory incidence # Year	0.002 (-0.01; 0.014)	

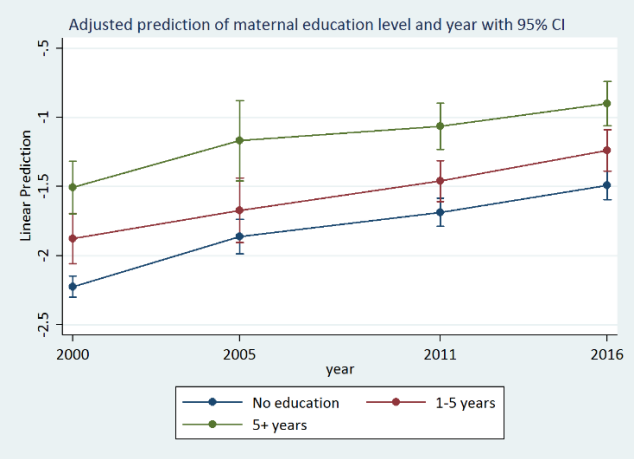
Domain/Indicator	Outcome = HAZ (Height for age z-score for under-5 children)	
	Period 2000 to 2016	
	Bivariate regression coefficient	Final multivariable regression coefficient*
	b estimate (95% CI) *p*-value	b estimate (95% CI) *p*-value
	0.742	--
Diarrhea incidence/reports (% under-5 population within last 2 weeks)	-0.1722 (-0.2532; -0.0911) <0.001	-0.256 (-0.332; -0.179) <0.001
Diarrhea incidence # Year	0.007 (-0.006; 0.02) 0.28	--
Maternal characteristics		
Age (Mean, mothers 15-49)	-0.016 (-0.021; -0.012) <0.001	0.012 (0.007; 0.016) <0.001
Age# Year	0.00022 (-0.00045; 0.0009) 0.517	--
Index births within last 5 years (% mothers <18 years)	-0.182 (-0.317; -0.047) 0.008	--
Index birth within last 5 years # Year	-0.012 (-0.033; 0.008) 0.238	--
Index births within last 5 years (% mothers >= 35 years)	-0.052 (-0.137; 0.034) 0.235	--

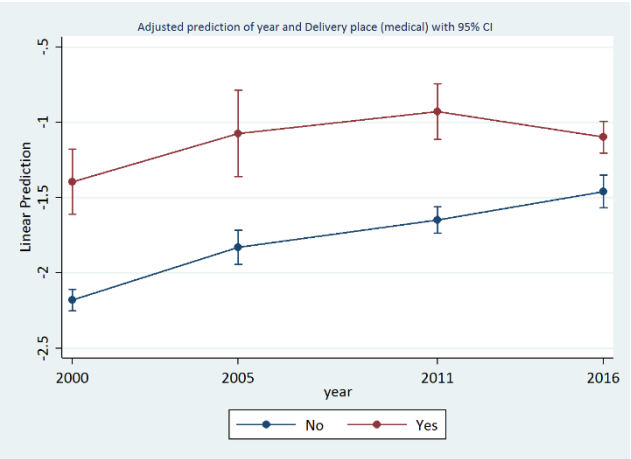
Domain/Indicator	Outcome = HAZ (Height for age z-score for under-5 children)	
	Period 2000 to 2016	
	Bivariate regression coefficient	Final multivariable regression coefficient*
	b estimate (95% CI) *p*-value	b estimate (95% CI) *p*-value
Index birth within last 5 years # Year	0.003 (-0.009; 0.016) 0.605	--
BMI level (Mean mothers 15-49 years)	0.054 (0.039; 0.068) <0.001	0.047 (0.034; 0.061) <0.001
BMI level # Year	0.0001 (-0.0021; 0.0023) 0.935	--
Height (Mean mothers 15-49 years)	0.046 (0.041; 0.051) <0.001	0.046 (0.041; 0.051) <0.001
Height # Year	0.0005 (-0.0003; 0.0013) 0.24	--
Parity (Total fertility rate)	-0.021 (-0.035; -0.008) 0.002	--
Parity # Year	0.001 (-0.001; 0.003) 0.281	--
Interpregnancy interval (in months)	0.005 (0.004; 0.007) <0.001	0.003 (0.002; 0.005) <0.001
Inter pregnancy intervals # Year	-0.0002 (-0.0004; 0.0001) 0.129	--

Domain/Indicator	Outcome = HAZ (Height for age z-score for under-5 children)	
	Period 2000 to 2016	
	Bivariate regression coefficient	Final multivariable regression coefficient*
	b estimate (95% CI) *p*-value	b estimate (95% CI) *p*-value
% of residual variance explained by covariates		**20.7%**
Time		
Time		
Year	0.049 (0.042; 0.055) <0.001	0.027 (0.013; 0.04) <0.001

* Adjusted for child age, sex, and province

Figure 19 shows the margins plots for maternal education level, delivery in a medical facility, and number of health workers. As expected, mothers with more education had children with notably higher HAZ compared to those with less education, and this trend persisted over time. Child HAZ improvement over time is slightly steeper in the group with no education, though all groups had positive gains. Delivering in a medical facility is associated with greater HAZ compared to not delivering in a facility, however the trends converge over time and annual change appears faster in the latter group . Trends for having >10 health workers per 10,000 population (vs <10) followed similar patterns of convergence and improvement in the latter group.





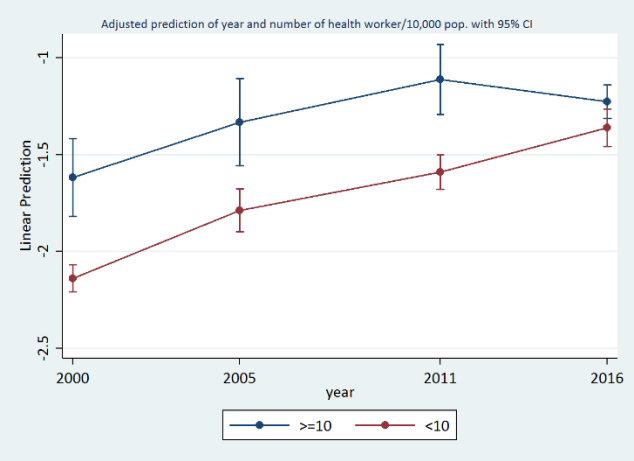


Figure 19: Margins plots for maternal education level and time; delivery in a medical facility and time; and number of health workers and time for children under-5

In adjusted analyses, several indicators such as wealth index, paternal education, antenatal care, total crop yield, diarrhea incidence, maternal age, maternal BMI, maternal height, and interpregnancy interval also show a statistically significant association with HAZ, though their interaction terms are not statistically significant. The percentage of variance explained by covariates in this model is: 16.5% at the distal level, 17.4% at the intermediate level, and 20.7% at the proximal level.

3.5.2: Children 24 to 59 months old from 2000 to 2016

The results of the multivariable linear DID regression analysis of children between 24 and 59 months from the two DHS surveys (2000 and 2016) can be found in Appendix 12. This analysis was conducted to understand potential determinants of change in the group of older children (2-5 years). Among distal level indicators, wealth index, maternal education, and paternal education show a statistically significant association with HAZ after adjustment for other covariables. Additionally, some intermediate level variables: antenatal care (4+ visits), delivery at a medical facility, and piped water source were significantly associated with HAZ. The statistically significant interaction term indicates that facility deliveries is a significant effect modifier of HAZ over time. At the proximal level, diarrhea incidence, maternal age, BMI, height, and interpregnancy interval are all significantly associated with HAZ, but none showed time-dependent effects.

Figure 20 depicts the margins plot for the time-dependent relationship with delivery at a medical facility. The margins plot shows that delivering in a medical facility leads to a greater HAZ change in all years studied. Patterns of convergence and the steady inclining slope in the non-facility delivery group are similar to the model for all under-5 children. The percentage of variance explained by covariables is: 7.5% at the distal level, 8.6% at the intermediate level, and 12.6% at the proximal level.

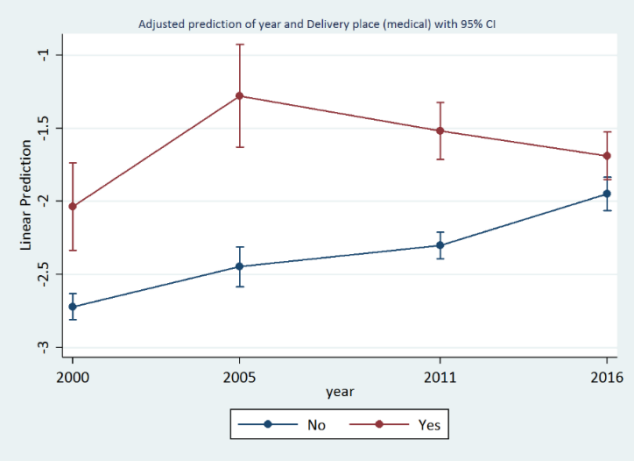
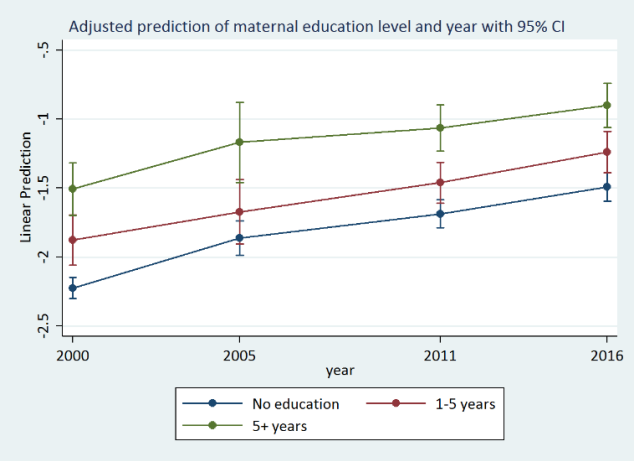


Figure 20: Margins plot for delivery at a medical facility and time for children 24-59 months

3.5.3: Children 6-23 months old from 2000 to 2016

The results from the multivariable linear DID regression analysis of children between the ages of 6 and 23 months can be found in Appendix 12. The following indicators are significantly associated with HAZ in our multivariable model with a p-value < 0.1: wealth index, maternal education, paternal education, duration of breastfeeding, complementary feeding, antenatal care, place of delivery, total number of health workers, total crop yield, open defecation, consumption of dairy products, flesh foods, eggs and other fruits and vegetables, births to mothers under-18, maternal BMI, height, and interpregnancy interval. Of these, only maternal education and delivery at a medical facility showed an interaction term that was significantly associated with HAZ.

Figure 21 presents the margins plots for maternal education and delivery at a health facility and time for children aged 6 to 23 months. Trends over time and patterns between groups are similar to the entire under-5 model results. The percent of variance explained by distal level covariables in this model is 15.3%, intermediate level covariables explain 18.9% of variance, and proximal-level covariables explain 23.2% of variance.



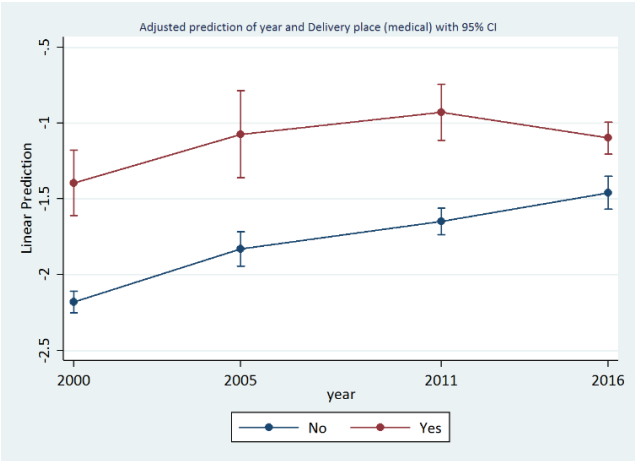


Figure 21: Margins plot for maternal education and time and delivery at a medical facility and time for children 6-23 months

3.6: Oaxaca-Blinder Decomposition

3.6.1: Descriptive HAZ Trends

Figure 22 shows the HAZ distribution for Ethiopian children under-5 years of age. The HAZ distribution from 2000 flattened out and underwent a parallel rightward shift to 2005. In comparing the 2000 and 2005 curves, the 2005 curve has a heavier right tail, indicating that more Ethiopian children were reaching higher HAZ. By 2011, the curve shifted slightly rightward again, highlighting overall nutritional gains. This trend persisted into 2016, where the curve shifted even further right, underscoring improved mean HAZ, and one that is closer to that of the international reference population. However, between 2000 and 2016, the curve widened, as opposed to getting more peaked, which highlights increasing inequalities as more children are shifting away from the population mean.

The mean HAZ score changed by 0.79 standard deviations (SDs) between the years 2000 and 2016. There have been incremental changes from -2.14 SDs in 2000 to –1.79 SDs in 2005, to -1.57 SDs in 2011, and finally to -1.35 SDs in 2016. Stunting prevalence follows a similar pattern, with steady declines over the studied time period. The percentage of Ethiopian children experiencing stunting decreased from 55% in 2000 to 49% in 2005, to 42% in 2011, and finally to 37% in 2016. Overall, stunting prevalence declined by 18% over the course of these 16 years.

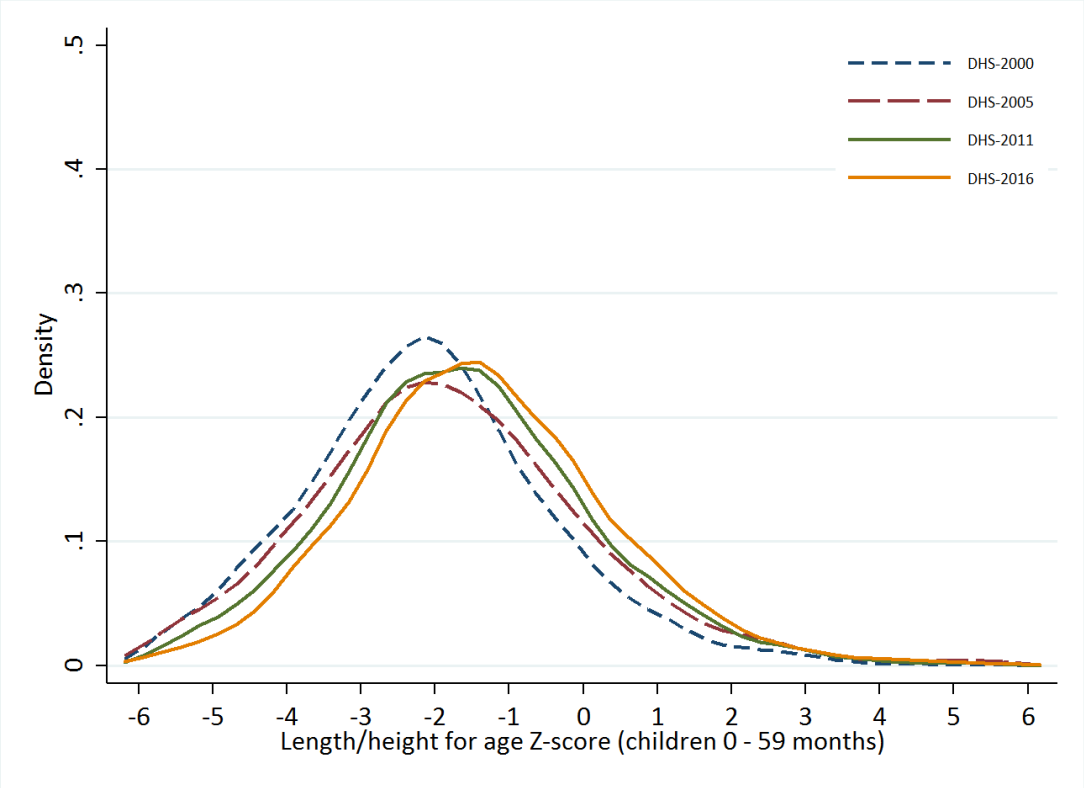


Figure 17: Kernel density plot for HAZ distribution in children <5 years DHS 2000, 2005, 2011, 2016

3.6.2: Child Growth Curves

As estimated by Victora et al (2010), Figure 23 shows growth faltering trends calculated from 54 countries globally. The graph on the right shows the mean WAZ, WHZ, and HAZ for all of the 54 countries studied. HAZ starts below the WHO standard and falters until 24 months, after which it levels out, and rises slightly. The graph on the left shows mean HAZ scores for all countries combined, organized by region. It shows that growth faltering can be observed in all 5 regions, though magnitude varies. Ethiopia falls under the AFRO region; a region that experiences high growth faltering and low HAZ scores.

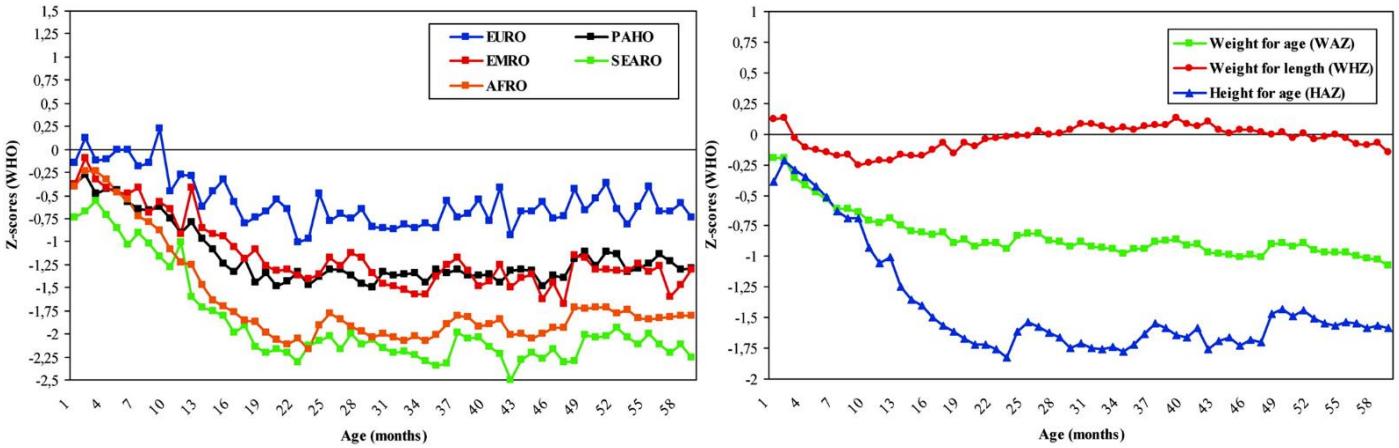


Figure 18: Mean HAZ z-scores by age, relative to the WHO standard, according to region (1-59 months) (left); Mean anthropometric z scores according to age for all 54 studies, relative to WHO standard (1-59 months) (right)
Source: Victora et al (2010)

We estimated these child growth curves, or Victora curves, for Ethiopia. Figure 24 shows predicted child HAZ from smoothed local polynomial regressions plotted against child age. We overlaid the mean HAZ score for children under-5 from the WHO African region countries included in Victora's global analysis. Graphs with only two-year data plotted sequentially can be found in Appendix 13.

These curves allow for the examination of the growth faltering process from birth to 5 years of age among Ethiopian children. There are two crucial features of child undernutrition that are revealed in the Victora curves: 1) The curve's intercept which shows the inter-generational susceptibility of child undernutrition, or the extent to which a mother's nutrition leads to small babies at birth; and 2) the post-natal growth faltering process, which is usually steepest between 6 and 24 months, after which it tapers off. This encompasses a child's first 1000 days of life, during which they are most vulnerable to poor diet and disease (68).

Improvements in Ethiopian children's HAZ trajectory can be observed over the 16-year study period. The 2000 curve intercepts at the lowest point of all the years studied, at a point that is well below that of the international reference population. This suggests that maternal nutrition throughout pregnancy and genetics may have been important markers of the child's size at birth. The size of a baby at birth is reflective of maternal nutrition (proxies used: maternal height and BMI), and genetics (proxy used: maternal height). There is a decline in predicted HAZ score in the first 6 months of age, which may suggest that breastfeeding practices were inadequate, as this is the time in a child's development that exclusive breastfeeding is recommended to occur. A sharp

decline can be observed during the growth faltering period between 6 and 24 months of age. After 6 months, food is being introduced to the child, and thus diet quality becomes a factor in their growth. The 2000 curve drops the lowest of all the curves during the growth faltering period, suggesting that children were being fed a poor diet, and experienced unmet nutritional needs.

The 2005 curve intercepts well above the 2000 curve, and above that of the international reference population. Maternal nutrition appears to have improved over this time period, resulting in babies being born larger. Breastfeeding practices, however, do not appear to have been improved, as the 2005 curve falls sharply from the intercept onward, with no plateau in the first 6 months. This steep decline is even more pronounced than it was in 2000, suggesting a worsening of breastfeeding practices. The steep decline persists into the growth faltering period and levels off at around the 24-month mark. Although the 2005 curve does not reach as low as the 2000 curve did, it still does reach below a HAZ of -2, which indicates stunting.

The 2011 curve also intercepts above the international reference population, suggesting that gains in maternal nutrition have been sustained. The 2011 curve has a pronounced plateau between 0 and 6 months, indicating that breastfeeding practices have improved since 2005. The growth faltering period in 2011 remains steep, and shows that child nutrition and disease remained evident in Ethiopia at this time.

In 2016, the Victora curve appears to intercept at a lower point than the two previous curves, though the confidence interval crosses 0 and overlaps with the 2005 and 2011 curves, indicating no statistically significant difference between them. The rest of the curve suggests that positive changes have occurred. The 2016 curve is markedly flatter in the first 6-month period, indicating that babies are being breastfed, and are maintaining their growth during the first 6 months of life. There remains a steep growth faltering period during which predicted HAZ declines sharply, though this decline does not reach 2011 levels. During the 16-year study period, it appears that improvements have occurred in maternal health and nutrition, breastfeeding practices, and childhood nutrition.

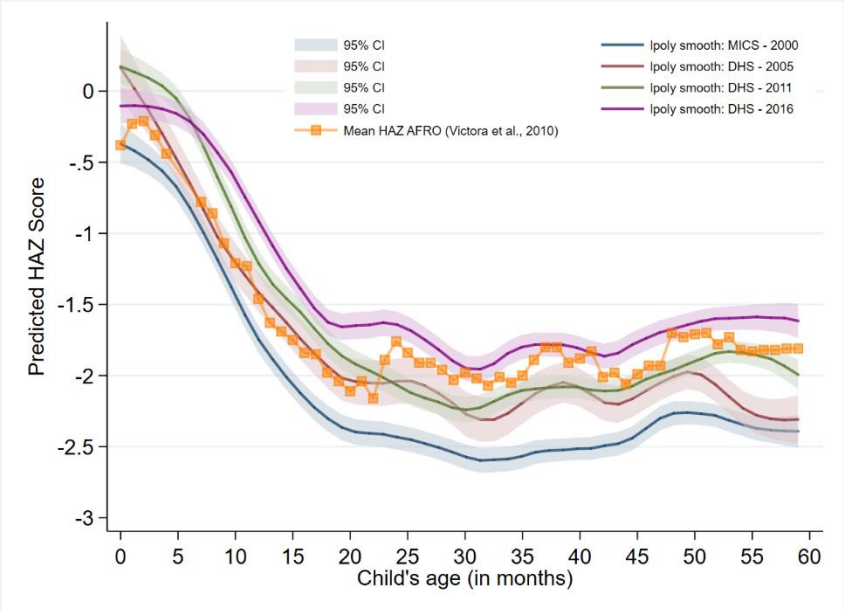


Figure 24: Victora curve using data from the 2000, 2005, 2011, 2016 surveys among children <5 years, including AFRO mean HAZ curve (Source: Victora et al., 2010)

In Figures 25-31, we have included statistical splines (as described in the methods) to quantify and objectively measure changes/trajectories in the Victora curves. In 2000 (Figure 25), HAZ dropped by 0.068 SD per month (95% CI: -0.090; -0.047), from -0.3 at birth to -0.7 at 5 months. After 5 months, HAZ began to fall sharply by 0.144 SD per month to -2.3 at 16 months (95% CI: -0.151; -0.136). From 16 months onwards, the rate of decline slowed drastically, down to only -0.020 SD per month (95% CI: -0.024; -0.016). After reaching a low of -2.6 at 32 months, HAZ began to increase by 0.012 SD per month (95% CI: 0.009; 0.014), back up to above -2.3 by 60 months.

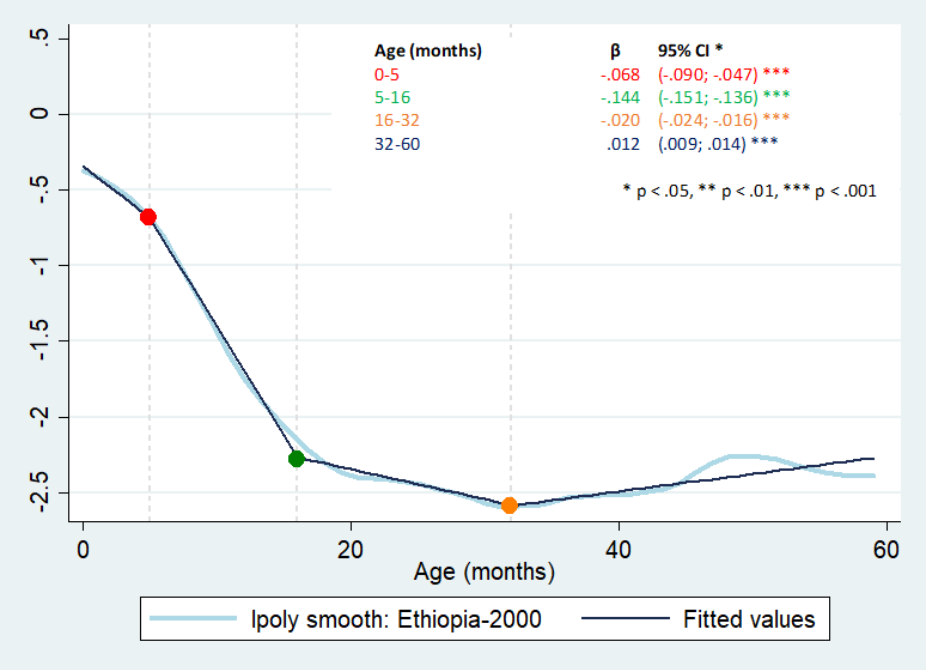


Figure 19: Victora curve using data from the 2000 survey, with splines

In 2005 (Figure 26), the relationship between child age and HAZ was characterized by a steady decrease in mean HAZ of 0.140 SD per month during the first 10 months of age (95% CI: -0.156; -0.125), from 0.2 to -1.2. At 10 months, the rate of decline decreased by nearly a half to -0.096 SD per month (95% CI: -0.107; -0.084). After reaching a low of -2.1 at 19 months, mean HAZ continued to decrease, but at a much slower rate of -0.003 SD per month (95% CI: -0.006; -0.001) down to -2.2 by 60 months.

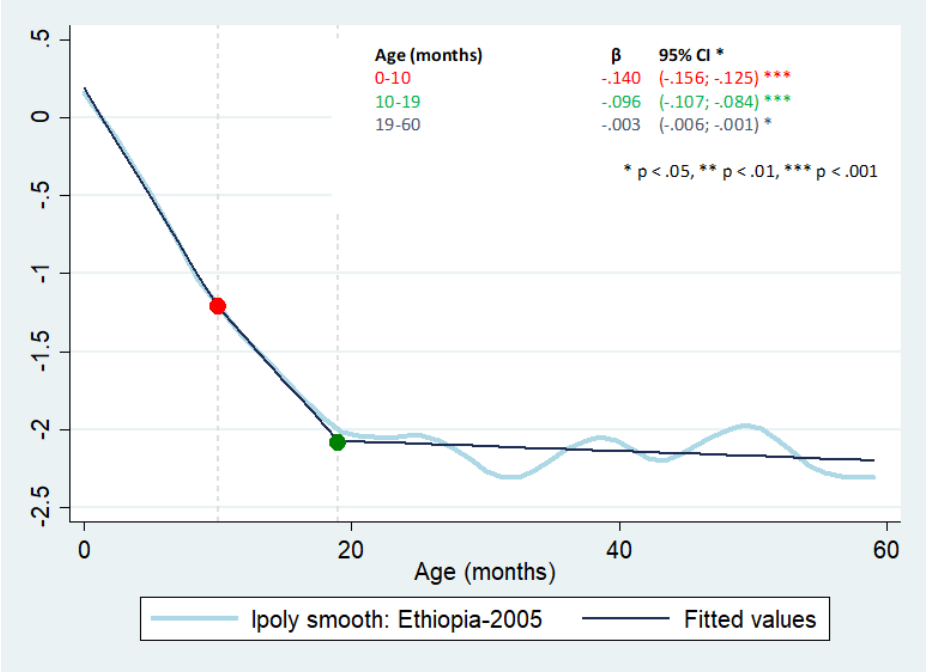


Figure 26: Victora curve using data from the 2005 survey, with splines

At birth, mean predicted HAZ was higher in 2005 compared to 2000 (0.2 vs -0.3) (Figure 27). By 6 months of age, this pattern continued as mean HAZ was -0.8 in 2000, and -0.7 in 2005. The first point of change in slope in 2000 was at 5 months, while in 2005, the first point of change occurs much later at 10 months. The final period of change in 2000 happens from 32 months onward and the slope rises, while for 2005, this final change period occurred from 19 months onward, and is slightly negative. By 60 months, HAZ was almost the same for both years, though was slightly higher in 2005.

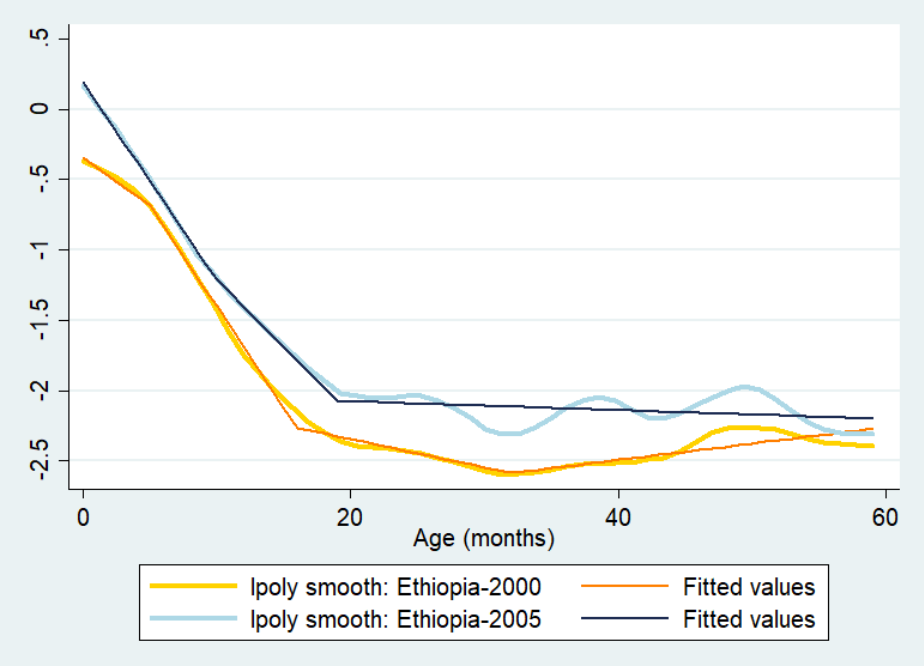


Figure 27: Victora curve using data from the 2000 and 2005 surveys

In 2011 (Figure 28), mean HAZ at birth was 0.2, and declined at a rate of 0.044 SD per month (95% CI: -063; -0.026) to -0.04 at 5 months. At 5 months, the rate of decline increased to 0.1641 SD per month (95% CI: -0.175; -0.154), with mean HAZ falling to -1.4 at 13 months. From 13 months onward, the decrease in HAZ slowed to 0.087 SD per month (95% CI: -0.102; -0.073), reaching a HAZ of -1.8 at 18 months. Between 18 and 28 months, HAZ was decreasing at a rate of 0.044 SD per month (95% CI: -0.050; -0.038) and reached its lowest point at -2.2 at 28 months. HAZ began increasing after this point at a rate of 0.013 SD per month, and reached -1.8 by 60 months.

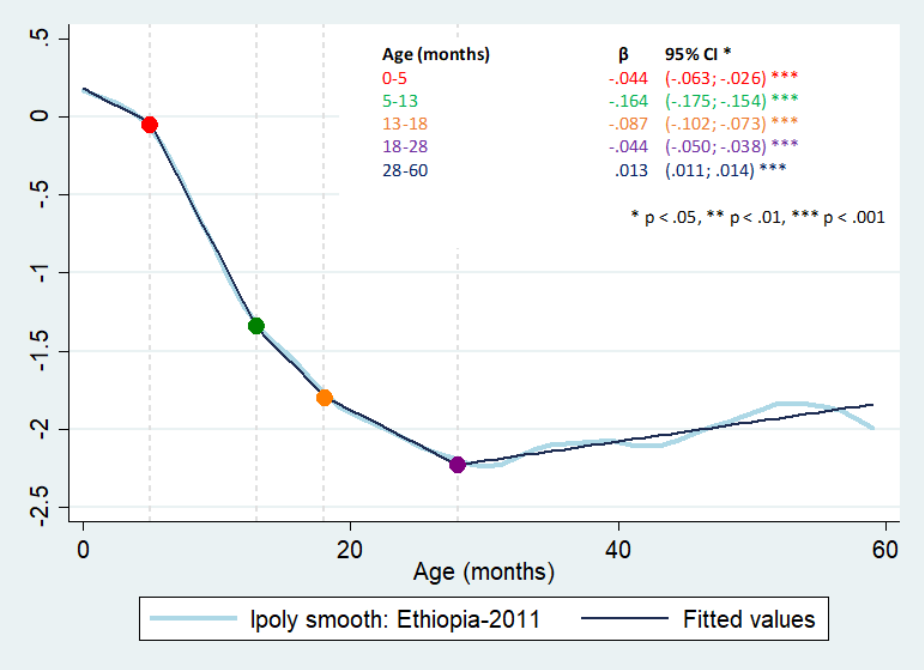


Figure 20: Victora curve using data from the 2011 survey, with splines

Trajectories for HAZ were quite different between 2005 and 2011 (Figure 29). In 2005, there was a sharp decline in HAZ from birth onward to 19 months, while in 2011, the largest growth faltering occurred between 5 and 13 months. This indicates that in 2011, there was improved child nutrition, breastfeeding, in the first 5 months of age. Although the lowest point for both curves is around the same, the 2011 curve has a rise in HAZ from 28 months onward reaching a higher point by 60 months as compared to 2005.

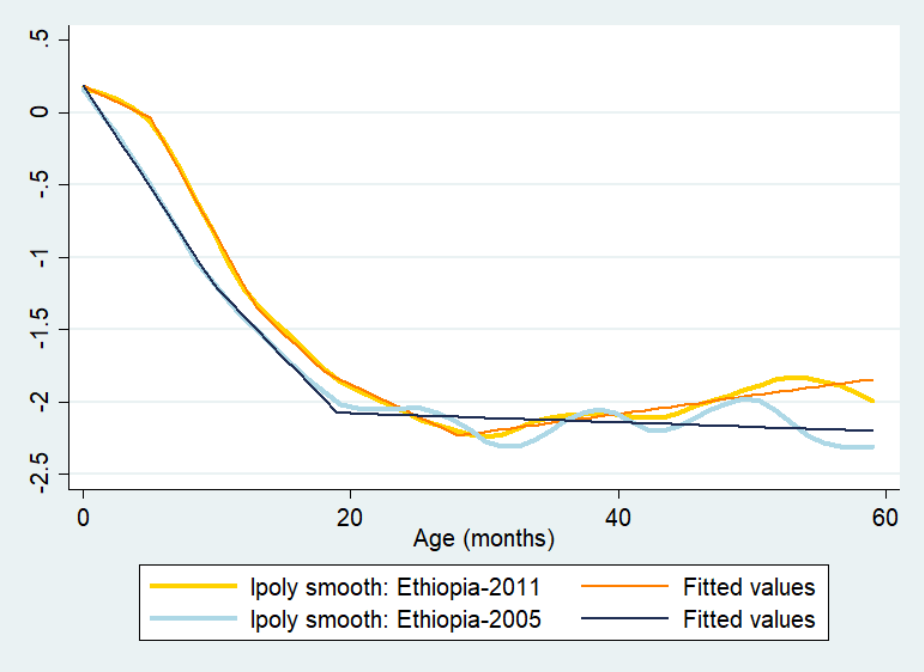


Figure 29: Victora curve using data from the 2005 and 2011 surveys

In 2016 (Figure 30), HAZ decreased slowly at a rate of 0.011 SD per month (95% CI: -0.023; -0.001), from -0.09 at birth to -0.16 at 6 months. After 6 months, the rate of decline increased to 0.125 SD per month (95% CI: -0.130; -0.120) and the predicted mean HAZ fell to -1.7 at 18 months. The decline leveled off for 6 months between 18 and 24 months and HAZ rose by 0.005 SD per month, reaching -1.6 at 24 months. In the following 6-month period from 24 to 30 months, HAZ decreased by 0.050 SD (95% CI: -0.059; -0.041) and reached a low of -1.9. From 30 months onwards, HAZ increased by 0.013 SD per month, rising to -1.6 by 60 months.

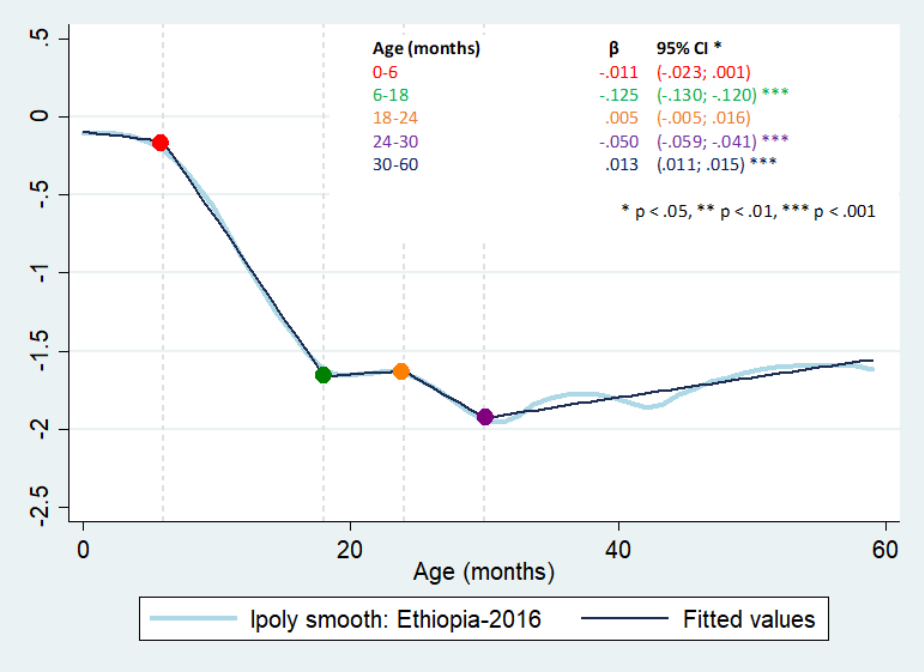


Figure 30: Victora curve using data from the 2016 survey, with splines

HAZ at birth was lower, on average, in 2016 (-0.09) compared to 2011 (0.2) (Figure 31). The first 6-month period was flatter in 2016 than in 2011, and the rate of decline was sharper in 2011. The 2011 curve was below the 2016 curve from 6 months onward, and while the 2011 curve reached a low point of below -2, the 2016 curve did not drop below -2. After 28 and 30 months for 2011 and 2016, respectively, both curves rise at the same rate. By 60 months, HAZ in 2011 was -1.8 while in 2016 it was at -1.6.

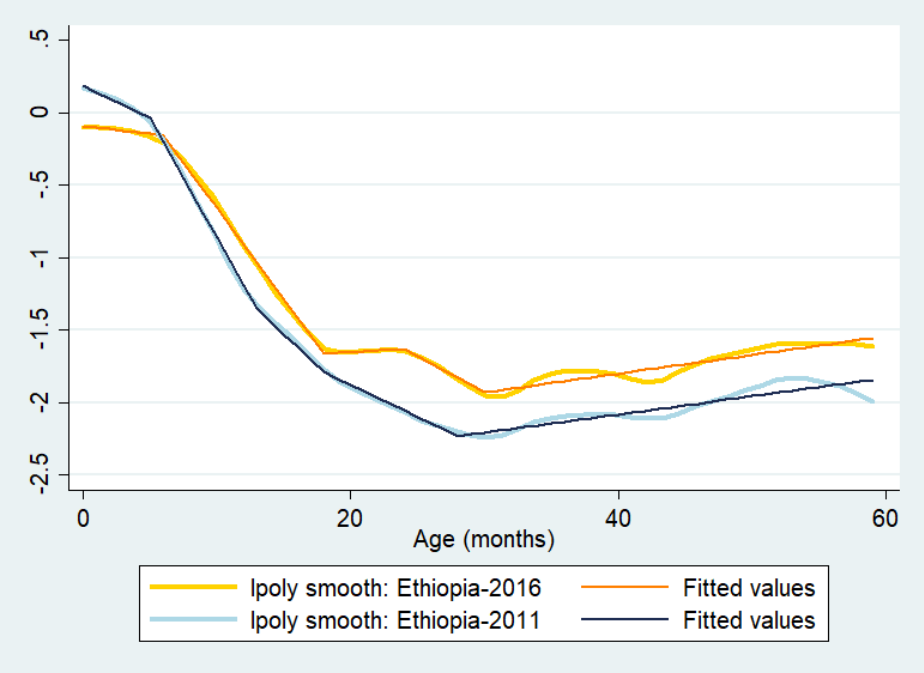


Figure 31: Victora curve using data from the 2011 and 2016 surveys

3.6.3: Explanatory Factors

Appendix Table 5 includes a list of quantitative indicators available for consideration as potential determinants of under-5 child stunting. Table 10 displays trends in the hierarchical determinants of child HAZ as estimated for children under 59 months of age from our sample datasets for 2000, and 2016. Data for the age stratified model of children 6-23 month and 24-59 months can be found in Appendix 13.

Socioeconomic factors

At the distal level, household wealth index (ranked from 0-10, as provided in the DHS surveys) significantly increased from 2000 to 2016 from an average of 1.64 to 2.50 ($p<0.001$). Maternal and paternal education also improved significantly over the 16-year period, with maternal years of education rising by 1.22 years ($p<0.001$), and paternal education years rising by 1.46 years ($p<0.001$).

Inadequate feeding practices and food insecurity

The average duration of breastfeeding decreased from 18.58 months to 15.41 months from 2000-2016, and this change was statistically significant ($p<0.001$). The total crop yield was 11.15 quintals per hectare in 2000, and increased to 18.09 quintals per hectare in 2016, which represents a rise of 6.94 between the years 2000 and 2016 ($p<0.001$).

Inadequate care and health services

Reproductive and maternal health interventions: The percentage of women whose live births were attended by skilled birth attendants increased drastically from 12 in 2011 to 30% in 2016, representing an increase of 18% points ($p<0.001$). Data was unavailable for earlier years. The proportion of women who attended at least 4 antenatal care visits increased from 11% to 32% between 2000 and 2016, and this 21% increase is statistically significant ($p<0.001$). The proportion of women who delivered babies at a medical facility increased from 5% to 32% in the 16-year study period, and this improvement was statistically significant, as well ($p<0.001$). The total number of health centers per 10,000 was 0.17 in 2000, and rose to 2.20 by 2016. This increase of 2.03 was statistically significant at a p-value of <0.001. Similarly, the total number of health workers per 10,000 increased from 1.26 to 7.37 between 2000 and 2016, and this drastic increase of 6.08 was statistically significant ($p<0.001$).

Supplementation: Vitamin A supplementation decreased from 61% in 2000 to 50% in 2016 ($p<0.001$).

Unhealthy household environment

Households living in urban settings remained relatively constant, and increased very slightly from 11% in 2000 to 12% by 2016 ($p=0.492$). The percentage of the population engaging in open defecation dropped significantly from 86% to 35% ($p<0.001$), while the proportion of the population receiving their water from a piped source rose by 15% ($p<0.001$). The number of household members has not changed significantly, as it declined by 0.07% in the 16-year time period ($p=0.319$).

Disease

Infections: Incidence of ARI in children (in the past 2 weeks) was reduced by more than half as it dropped from 31% in 2000 to 14% in 2016 ($p<0.001$). Diarrheal infection incidence was also halved as it dropped from 29% in 2000 to 15% in 2016 ($p<0.001$).

Child and maternal characteristics

The proportion of low birthweight children born rose from 7.5% to 12.9% between 2000 and 2016. This figure could be inaccurate due to poor reporting of this indicator in DHS surveys and change in reporting/recall over time. Average maternal age decreased very slightly from 29.61 to 29.46 years from 2000 to 2016 ($p<0.463$). The proportion of mothers giving birth to the index child before 18 years of age decreased minimally over the years from 6.47% to 5.41% from 2000 to 2016 ($p=0.100$). The proportion of older mother births (>35 years) also decreased slightly from 17.92% in 2000 to 15.12% in 2016 ($p= 0.005$). Anemia during pregnancy was not measured in every year, though it remained relatively consistent at 27% in 2005, and 28% in 2016, but dropped in the intervening year at 18% in 2011. Average BMI (20.05 – 20.67 kg/m^2) and height (156.47 – 156.98 cm) of mothers remained quite steady between 2000 and 2016. Average number of children per mother declined from 4.29 to 4.05 between 2000 and 2016 ($p=0.005$). The interpregnancy interval increased from 45.15 months to 49.11 months in this time ($p<0.001$).

Table 10: Hierarchical determinants of child HAZ as estimated for children under 59 months of age, 2000-2016

Domain/Indicator	2000 (n = 5975)	2005 (n = 2600)	2011 (n = 6561)	2016 (n = 6184)	(2016 - 2000) Change	(2016 - 2000) p-value
Outcome						
Height for age z-score	-2.14	-1.79	-1.57	-1.35	0.79	<0.001
Stunting % of children below -2sd	55.16	49.07	42.31	36.71	-18.45	<0.001
Child Demographic						
Child sex (male) % of males	50.43	50.84	50.92	51.03	0.60	0.601
Child age (in months)	22.48	22.79	23.25	22.64	0.16	0.746
Distal level						
Basic causes & Income poverty						
Wealth Index (nine components using PCA) (0 - 10)	1.64	2.26	2.77	2.50	0.85	<0.001
Mother yea of education	0.88	1.03	1.57	2.10	1.22	<0.001
Father year of education	1.92	2.21	2.92	3.37	1.46	<0.001
Intermediate level						
Inadequate feeding practices and food insecurity						
Duration of breastfeeding (in months)	18.58	18.35	16.10	15.41	-3.17	<0.001
Total yield	11.15	11.83	-	18.09	6.94	<0.001

Domain/Indicator	2000 (n = 5975)	2005 (n = 2600)	2011 (n = 6561)	2016 (n = 6184)	(2016 - 2000) Change	(2016 - 2000) p-value
Inadequate care and health services						
Live births attended by Skilled birth attendants (% women)	-	-	12.03	30.26	-	-
Antenatal care (% women with at least 4 visits)	10.73	13.22	19.47	32.07	21.34	<0.001
Place of delivery at medical facility (% women delivered at medical facility)	5.36	5.92	11.01	31.60	26.24	<0.001
Vitamin A supplementation	61.12	51.39	57.75	49.60	-11.52	<0.001
Total number of health center (per 10,000 population)	0.17	0.69	2.22	2.20	2.03	<0.001
Total number of health workers (per 10,000 population)	1.29	1.92	4.29	7.37	6.08	<0.001
Unhealthy household environment						
Urbanization (% of urban population)	11.00	8.92	14.34	12.50	1.50	0.492
Open defecation (% population)	85.52	65.80	42.34	35.18	-50.34	<0.001
Water source - piped (% of population)	13.40	17.65	27.48	28.26	14.87	<0.001

Domain/Indicator	2000 (n = 5975)	2005 (n = 2600)	2011 (n = 6561)	2016 (n = 6184)	(2016 - 2000) Change	(2016 - 2000) p-value
Number of household members	5.90	6.01	5.85	5.83	-0.07	0.319
Proximal level						
Disease						
ARI infection (% under-5 population within last 2 weeks)	37.48	21.08	22.48	22.31	-15.17	<0.001
Diarrhea infection (% under-5 population within last 2 weeks)	29.00	22.92	16.42	14.59	-14.42	<0.001
Child characteristics						
Low birthweight* (%, index child)	7.51	14.65	8.36	12.87	5.36	0.042
Maternal characteristics						
Age (Mean, mothers 15-49)	29.61	29.69	29.17	29.46	-0.15	0.463
Index births within last 5 years (% mothers <18 years)	6.47	6.91	5.91	5.41	-1.06	0.100
Index births within last 5 years (% mothers >= 35 years)	17.92	17.75	14.12	15.12	-2.80	0.005
Anemia during pregnancy (% women 15-49 years)	0.00	26.97	17.54	28.08	0.00	<0.001

Domain/Indicator	2000 (n = 5975)	2005 (n = 2600)	2011 (n = 6561)	2016 (n = 6184)	(2016 - 2000) Change	(2016 - 2000) p-value
BMI level (Mean mothers 15-49 years)	20.05	20.33	20.38	20.67	0.62	<0.001
Height (Mean mothers 15-49 years)	156.47	157.05	156.55	156.98	0.51	0.009
Parity (Total fertility rate)	4.29	4.49	4.12	4.05	-0.24	0.005
Interpregnancy interval (in months)	45.15	44.59	46.79	49.11	3.95	<0.001

3.6.4: Relative Contribution

Using mean differences of explanatory variables and hierarchical coefficients from Equation 1, the Oaxaca-Blinder decomposition results are discussed below. We aggregated individual factors into broader policy-relevant domains as listed in Table 11 The coefficient products or predicted change in HAZ estimated from Equation 2 for each indicator were summed within domains.
We conduct the decomposition analyses for HAZ change for 2000-2016 (Table 12).

Table 11: Determinant policy-relevant domains grouped by distal, intermediate and proximal factors

Individual Factors	**Domain**
Distal Level	
Wealth index	Wealth accumulation
Mother education	Mother education
Father education	Father education
Intermediate Level	
Duration of breastfeeding	Breastfeeding practices
Complementary feeding	

Individual Factors	Domain
Reduced open defecation	Reduced open defecation
Household crowding	Household crowding
DPT3 vaccination	DPT vaccination
Antenatal care visits 4+	Maternal and newborn healthcare
Delivery at medical facility	Place of delivery at medical facility
Total crop yield	Total yield
Number of health workers/10,000 pop	Number of health workers/10,000 pop
Proximal Level	
Diarrhea within the last 2 weeks	Diarrhea
Maternal age	Maternal age
Adolescent births <18 years of age	Early age pregnancy
Older mother births ≥35 years of age	Late age pregnancy
Low birthweight	Low birthweight
Inter-pregnancy interval (in months)	Fertility
Others	Child age, gender and region

Figure 32 depicts the decomposition results for the entire under-5 age group for the 2000-2016 period. The vertical axis (the y-axis) shows the predicted HAZ change as a result of the explanatory variables that are ranked in descending order on the horizontal (x) axis. The main explanatory factor of predicted HAZ change was an increase in total crop yield, which predicts a HAZ change of 0.306 standard deviations. Increases in the number of health workers contributed a predicted increase in HAZ of 0.271 SDs, followed by reductions in open defecation predicting a change of 0.125 SDs. Improvements in maternal nutrition (measured via maternal height and BMI) conferred a 0.052 standard deviation increase in HAZ. Improvements in maternal education contributed a predicted change of 0.050 SDs, while improvements in paternal education contributed 0.048 SDs. Increased wealth, and reductions in diarrhea each contributed a predicted 0.042 and 0.037 standard deviation change in HAZ. Maternal and newborn healthcare improvements (measured via 4+ antenatal care visits) and decreased fertility (measured via interpregnancy interval) contributed to a predicted 0.017, and 0.015 standard deviation increase in HAZ.

Of the total explained HAZ change, increase in total crop yield accounts for 32% of change (Figure 33). Increased number of health workers accounted for 28% of change, followed by a reduced open defecation (13%), improved maternal nutrition (5%), improved maternal education (5%), improved paternal education (5%), improved wealth index (4%), diarrhea reduction (4%), improved maternal and newborn healthcare (2%), and finally reductions in fertility (2%). This model explains 120% of the actual HAZ change between 2000 and 2016. This suggests that this

model presents the necessary factors to consider in understanding why HAZ improved in Ethiopia over this time period.

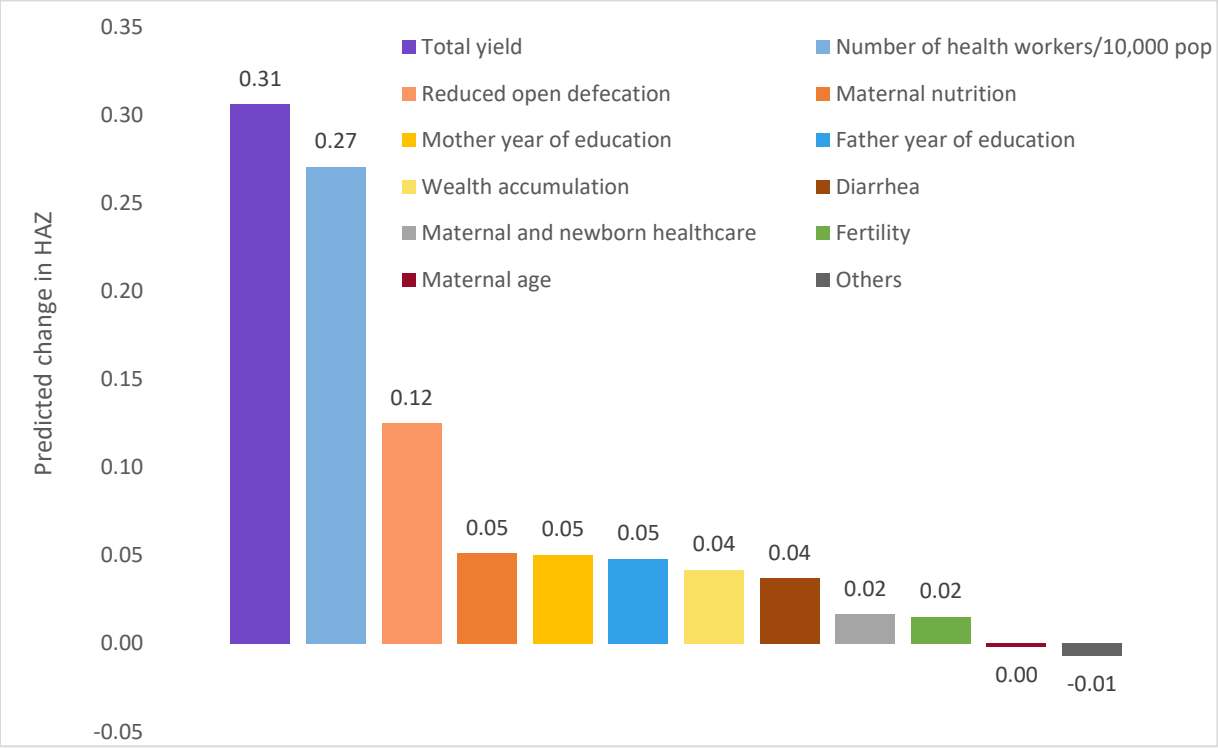


Figure 32: Decomposing predicted changes in HAZ (i.e. relative ranking of product coefficients for determinant domains), for children under-5 years, period 2000 – 2016

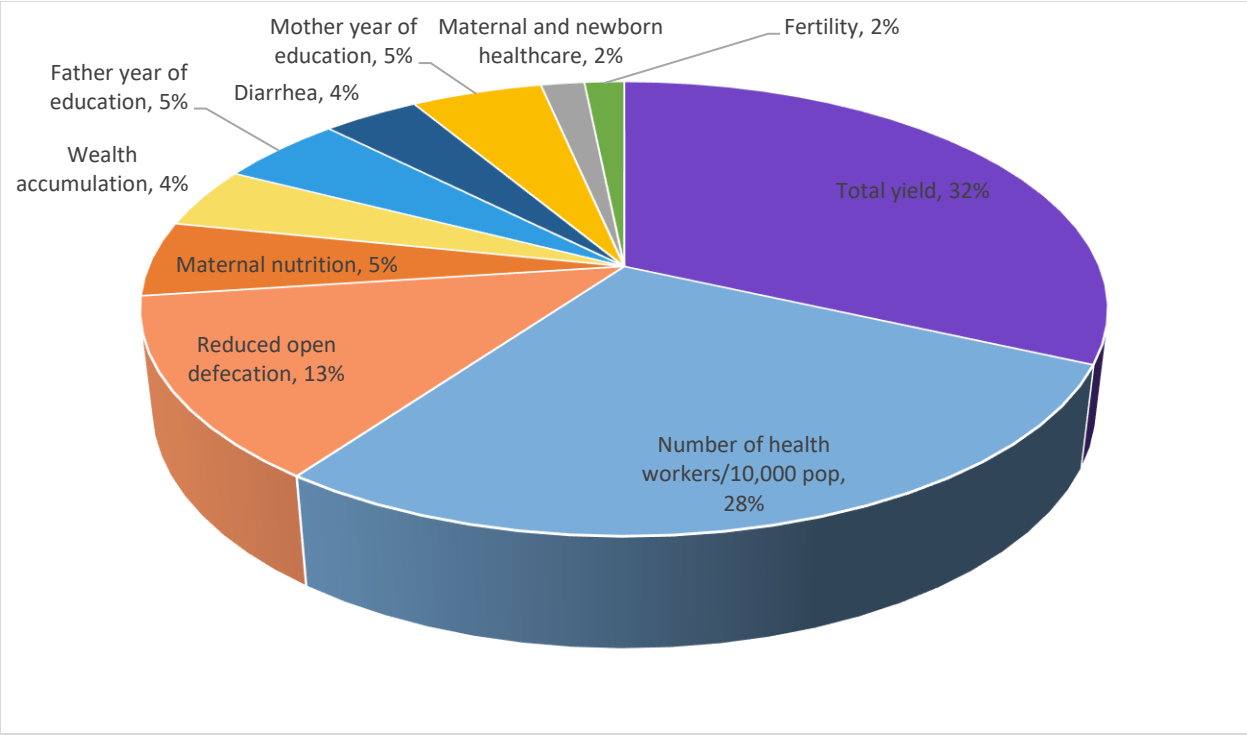


Figure 33: Decomposing predicted changes in HAZ outcome (i.e. % contribution of determinant domains), 2000 – 2016

Table 12: Hierarchal approach decomposition analysis for children under-5 years for the period 2000 – 2016

Factors	Estimated coefficient	Mean difference (2016 - 2000)	Predicted change in HAZ	Share of predicted change in (%)
HAZ Score	-	0.79	0.953	120.3%
Wealth index	0.049	0.85	0.042	4.4%
Mother education	0.041	1.22	0.050	5.3%
Father education	0.033	1.46	0.048	5.0%
Antenatal care visits 4+	0.078	0.21	0.017	1.8%
Number of health workers	0.045	6.08	0.271	28.4%
Total crop yield	0.044	6.94	0.306	32.1%
Reduced open defecation	-0.248	-0.50	0.125	13.1%
Diarrhea	-0.257	-0.14	0.037	3.9%
Maternal age	0.014	-0.15	-0.002	-0.2%
Maternal BMI	0.048	0.62	0.030	3.1%
Maternal height	0.043	0.51	0.022	2.3%
Inter-pregnancy interval (in months)	0.004	3.95	0.015	1.6%
Others	-	-	-0.007	-0.7%

The adapted conceptual frameworks including all available indicators for the 6-23-month age group, and over-24-month age group can be found in Appendix 13.

Decomposition of predicted HAZ changes for the 6-23-month age group can be found in Figure 34. Similar to the under-5 age group, the top explanatory factor is improved total crop yield, which contributes a 0.342 standard deviation increase in HAZ. This is followed by increased number of health workers conferring an increase of 0.207 standard deviations. Reduction in open defecation, maternal and newborn healthcare (where improvements consist of delivering at a medical facility, and 4+ ANC visits), and improved paternal education, represent 0.141, 0.062, and 0.057 SDs, respectively. Maternal education, wealth accumulation, and the Other category contribute predicted HAZ increases of 0.044, 0.040, and 0.033 standard deviations. Maternal nutrition, duration of breastfeeding, fertility, and decrease in early age of pregnancy confer 0.032, 0.029, 0.015, and 0.004 standard deviation improvements in HAZ. Variables that contribute to a decrease in predicted HAZ are decreases in complementary feeding, reductions in DPT vaccination, and reductions in use of dairy products, fruits and vegetables.

Of the total HAZ change, total crop yield increases represent 34% of the change (Figure 35). Increases in number of health workers account for 21% of total change, followed by reduced open defection (14%), maternal and newborn healthcare (6%), paternal education (6%), maternal education, (4%)wealth accumulation (4%), Others (3%), maternal nutrition (3%), duration of breastfeeding (3%), fertility (2%), and reductions in early age at pregnancy (0.4%). Our model

predicts 110% of the total change in HAZ, suggesting that relevant predictors are included, and accounted for.

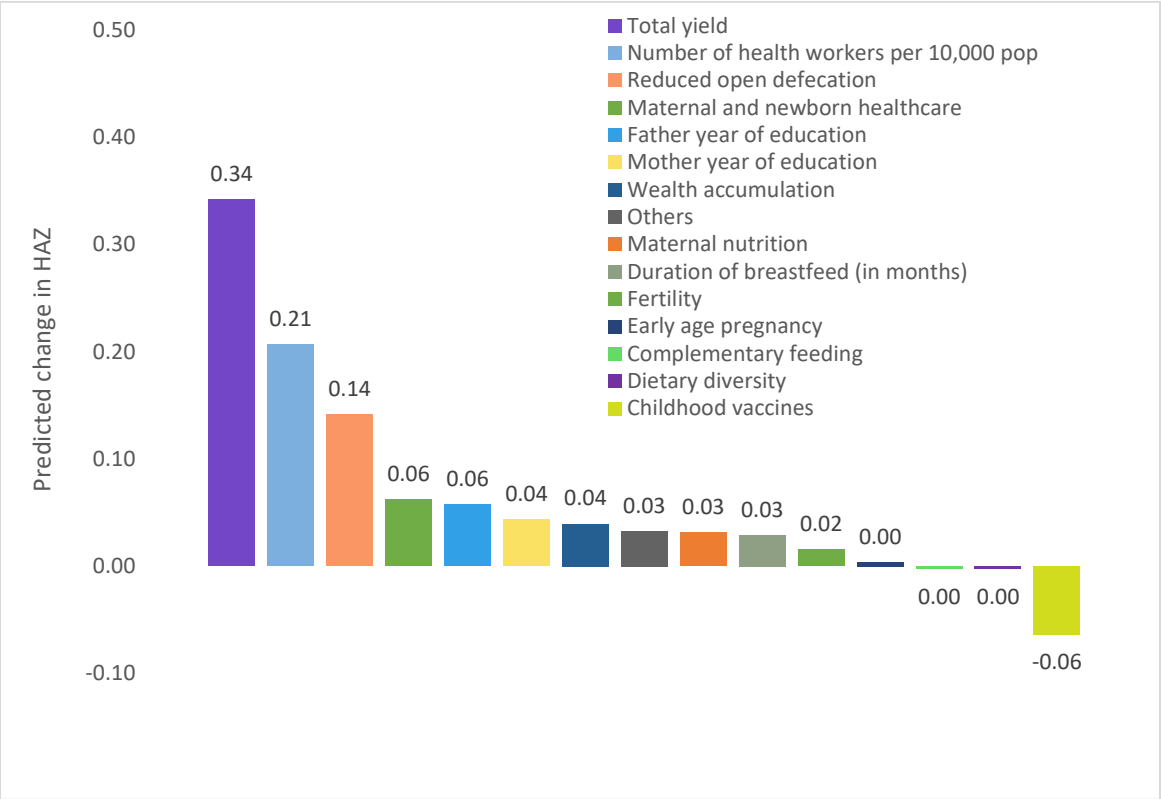


Figure 34: Decomposing predicted changes in HAZ (i.e. relative ranking of product coefficients for determinant domains), for children between 6-23 months, period 2000 – 2016

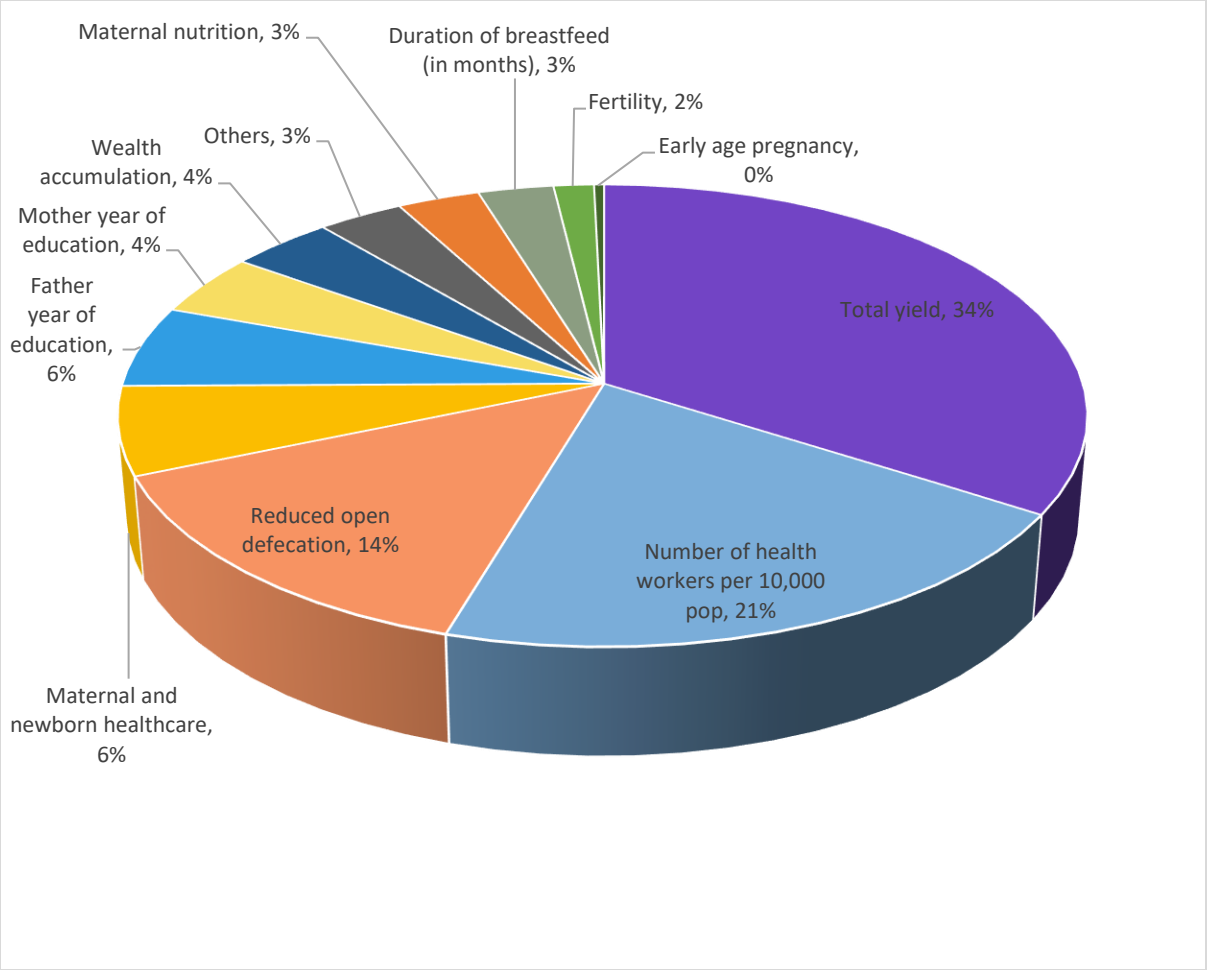


Figure 35: Decomposing predicted changes in HAZ outcome (i.e. % contribution of determinant domains), 2000 – 2016

Table 13: Hierarchal approach Decomposition analysis for children between 6-23 months for the period 2000 – 2016

Factors	Estimated coefficient	Mean difference (2016 - 2000)	Predicted change in HAZ	Share of predicted change in (%)
HAZ Score	-	0.85	0.937	109.9%
Wealth index	0.046	0.85	0.040	4.2%
Mother education	0.033	1.31	0.044	4.7%
Father education	0.038	1.52	0.057	6.1%
Duration of breastfeed (in months)	-0.073	-0.40	0.029	3.1%
Complementary feeding	0.210	-0.01	-0.002	-0.2%
DPT vaccination	-0.195	0.33	-0.063	-6.8%
Antenatal care visits 4+	0.053	0.25	0.013	1.4%
Place of delivery	0.155	0.32	0.049	5.2%
Health person per 10,000 pop	0.034	6.11	0.207	22.1%
Total crop yields	0.049	7.00	0.342	36.5%
Reduced open defecation	-0.281	-0.50	0.141	15.1%

Factors	Estimated coefficient	Mean difference (2016 - 2000)	Predicted change in HAZ	Share of predicted change in (%)
Use of dairy products	0.190	-0.01	-0.001	-0.1%
Use of fruits and vegetables	0.358	0.00	-0.001	-0.1%
Early age pregnancy	-0.358	-0.01	0.004	0.4%
Maternal BMI	0.037	0.51	0.019	2.0%
Maternal height	0.045	0.28	0.013	1.4%
Inter-pregnancy interval (in months)	0.003	4.41	0.015	1.6%
Others	-	-	0.033	3.5%

The decomposition analysis for the 2-5-year age group is depicted in Figure 36. As with the other age groups analyzed, increased total crop yield was the top explanatory factor for HAZ change, and predicts a 0.237 standard deviation increase. Reduction in open defection conveys a 0.101 SD increase in HAZ, while increases in the number of health workers provides a 0.100 SD increase. Maternal education confers a 0.058 standard deviation change in HAZ, followed by wealth index (0.048 SD), maternal nutrition (0.041 SD), paternal education (0.036 SD) maternal and newborn healthcare (0.030 SD), diarrhea reductions (0.027 SD), and fertility reductions (0.011 SD).

Of the explained change in HAZ, increased total crop yield is responsible for 34% of the predicted change, followed by reduced open defecation (15%), increased number of health workers (14%), maternal education (8%), wealth accumulation (7%), maternal nutrition (6%), paternal education (5%), maternal and newborn healthcare (4%), diarrhea reduction (4%), and fertility (2%) (Figure 37). Of the total change in HAZ for this age group, this model explains 84% of the change, suggesting that some variables remain unrepresented.

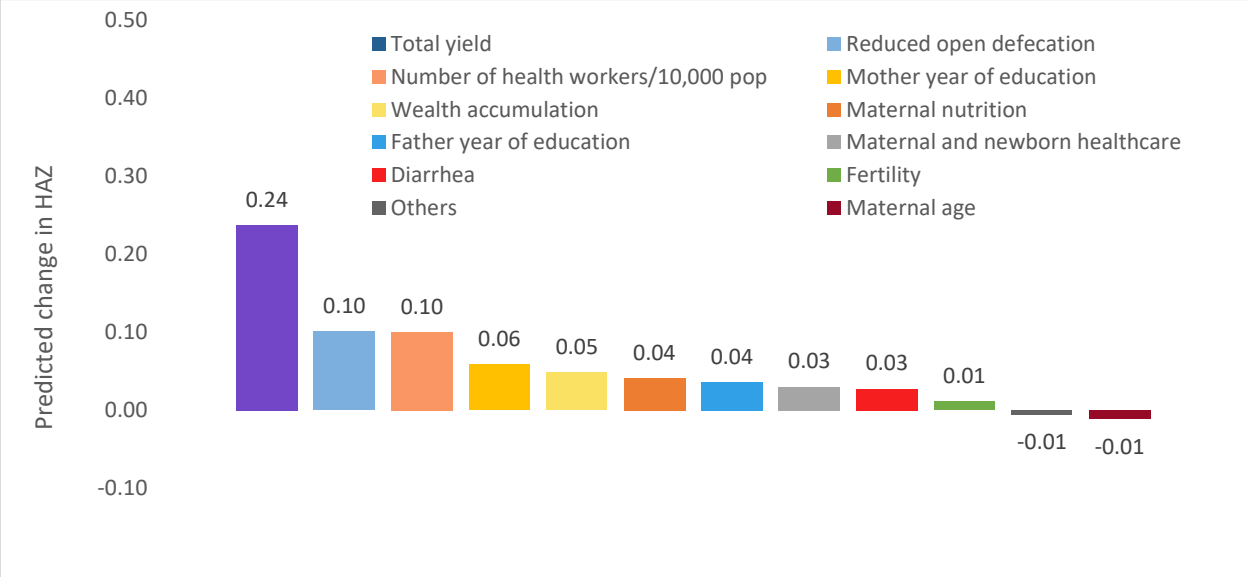


Figure 36: Decomposing predicted changes in HAZ (i.e. relative ranking of product coefficients for determinant domains), for children 24 months and above, period 2000 – 2016

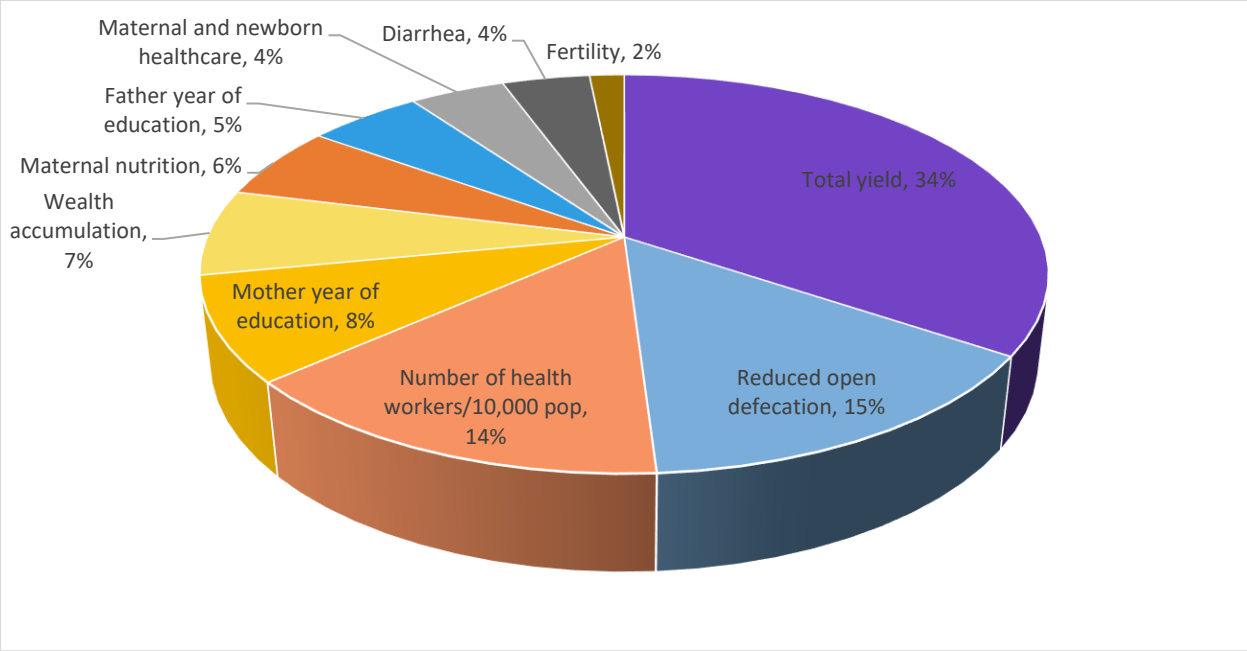


Figure 37: Decomposing predicted changes in HAZ outcome (i.e. % contribution of determinant domains), 2000 – 2016

Table 14: Hierarchal Approach Decomposition analysis for children 24-59 months for the period 2000 – 2016

Factors	Estimated coefficient	Mean difference (2016 - 2000)	Predicted change in HAZ	Share of predicted change in (%)
HAZ Score	-	0.80	0.67	84.3%
Wealth index	0.05	0.93	0.05	7.1%
Mother education	0.06	1.03	0.06	8.7%
Father education	0.02	1.45	0.04	5.3%
Antenatal care visits 4+	0.17	0.18	0.03	4.4%
Total number of health workers	0.05	2.02	0.10	14.8%
Total crop yield	0.04	6.10	0.24	35.2%
Reduced open defecation	-0.20	-0.51	0.10	14.9%
Diarrhea	-0.27	-0.10	0.03	4.1%
Maternal age	0.02	-0.57	-0.01	-1.6%
Maternal BMI	0.03	0.67	0.02	3.3%
Maternal height	0.04	0.46	0.02	2.8%
Inter-pregnancy interval (in months)	0.00	2.47	0.01	1.6%
Others	-	-	-0.01	-0.8%

We conducted analyses for the under 6-month age group, however, the model's results were unstable. The total mean HAZ change our model needed to explain was not a large enough change to render our model's results meaningful.

Chapter 4: Results – Qualitative Inquiry

Results from the in-depth interviews and focus group discussions are organized according to type of stakeholder, by national and community-level perspectives. Results are summarized according to key themes including basic (contextual) factors, nutrition-specific and –sensitive policies and programs, intermediate and immediate causes. Supporting evidence and quotes were selected to demonstrate a range of participants' diverse perspectives on the determinants, and policies and programs.

4.1: National Stakeholder Perspectives

A total of 11 national key informants were interviewed in Addis Ababa (Table 15). These State and non-State actors were identified and recruited based on their substantial expertise and experience working in nutrition-specific and –sensitive sectors, institutions, and programs in Ethiopia and include multilateral, bilateral, government (national and subnational), academic/research, as well as local/international non-governmental organizations.

Table 15: Description of National Key Informants

Participant #	Organization
Participant 1	Nutrition team Leader, Federal Ministry of Health, Ethiopia
Participant 2	Deputy Director, Nutrition International, Ethiopia
Participant 3	WASH System strengthening specialist, World vision, Ethiopia
Participant 4	Director , Alive and Thrive
Participant 5	Head of Food and Nutrition, Ministry of Agriculture, Ethiopia.
Participant 6	Professor of Nutrition, Addis Ababa University
Participant 7	Basic Education Section ,Ministry of Education, Ethiopia.
Participant 8	Advisor to the State Minster ,Ministry of Education, Ethiopia.
Participant 9	Plan, Implementation, Monitoring and Evaluation Directorate Director, Ministry of Finance and Economic Development
Participant 10	Nutrition Specialist, UNICEF Ethiopia.
Participant 11	Child Health Specialist, Independent Consultant

4.1.1 Nutrition and Stunting Trends in Ethiopia

National key informants acknowledged that the country has documented a significant reduction in the prevalence of stunting. However, they also stated that the stunting burden is still high considering the absolute number of stunted children in Ethiopia.

> *"As we know it and as researches also show the trend is decreasing. Twenty years ago, it [stunting] was 58% but now its 38%. This mean in the past 20 years the rate is decreasing but the reduction is a very slow rate. Stunting is declining but the rate is low. I personally think it's on a slow rate. Both Ethiopia and the SDG took commitment in making the rate of stunting zero by 2030. However, in the past 20 years we reduced stunting by 1% every year and now it's at 38% and we are left with only 11 years for 2030."* [Ministry of Education Representative]

Key informants elicited multiple reasons for the observed reduction of stunting in Ethiopia. These included the overall improvement in the economy, access to health services, access to education, agricultural productivity, WASH and emergency preparedness, and development programs such as the Productive Safety Net Program (PSNP).

"*The first is development activities the government set on agriculture. There are works done on agriculture and health sector. The second is governments plan for emergency prevention and preparedness in case of food insecurity. In case of food insecurity, the government contributes in quick and daily provision of food. The third is productive safety net program: This is helping those in need of help which can be by money or providing of food. This has its own contribution. The others are economic expansion, employment rate etc. This has contributed directly or indirectly for reduction of children stunting*." [Ministry of Finance Representative]

Key informants acknowledged that reduction of stunting is not uniform across regions. There are regions demonstrating higher prevalence of stunting and there is a difference in the burden of stunting within localities in the same region. They mentioned that poor infrastructure, recurrent drought, food insecurity, religious fasting, poor health services, and illiteracy are reasons for the observed regional variation in stunting. Respondents stated that they observed regional variations in states such as Amhara and Afar regions which have high stunting burden.

"The drop is not uniform across regions. There are regions with high prevalence and still suffering from that like Afar and Amhara. Their prevalence is 46% or 48% which is near to 50%. This means one in two kids is stunted. It is essential to see exact number but Amhara and Afar have high prevalence. When we see the two regions they are completely different in socio demographic, socio economic and agro ecological status. Amhara region is among highly productive regions except few food insecure woredas. Afar region have chronic food insecurity and highly dependent on support. Infrastructure of Afar region is weak. So the cause of stunting is completely different for these regions. In Afar it may be related to complementary food. In Amhara it is related with behavioral and religious issues." [iNGO representative]

4.1.2 Basic Drivers of Stunting Decline in Ethiopia

The key informants at the national level identified multiple key factors that have potentially facilitated the observed stunting reduction in Ethiopia over the past two decades. These include urbanization, poverty reduction, women's education and empowerment, labor migration and remittances, as well as sociopolitical contexts including peace and security, decentralization, political commitment, and change of political ideology.

Urbanization

Key informants indicated that the increase in urbanization is a noticeable phenomenon that continues to grow fast in Ethiopia. The urbanization seen in Ethiopia is often characterized by an increase in migration from rural areas to urban cities as well as massive constructions in the cities. The national key informants perceived that the increased urbanization was an important factor to the country's stunting reduction and multiple pathways were elicited. The pathways included improved access to services and supplies, stimulating the economy, job creation, and improved income and human capital.

Here is an example on how urbanization has influenced stunting:

"The importance of urbanization is that it helps people to get services nearby. It helps to manage services that are dispersed in to one area; both the health services and educational centers and in turn stimulate the economy. It will also improve the supply. If we don't increase the supply, then it will cause problem in sharing. But the positive side outweighs the negative. In

*urbanization, people live together when their economy increases. This is everywhere in the world. Urbanization is one of the reflections of development." [*Ministry of Finance Representative]

However, urbanization was also seen as a potential challenge to the stunting reduction by affecting the breastfeeding practices as mothers who work, food safety practices, and causing a reduction in crop production as farmer's landownership is threatened by expanded urbanization.

The following examples illustrate how urbanization has influenced stunting in the country over the past two decades:

"When there is urbanization there is increased access to health and improved literacy rate. But there is also a down side to urbanization, because it has led to increased slum areas. Breastfeeding practice has improved in our country but it is still low, it is around 50%. But breastfeeding practice is a challenge in urban areas because there are mothers who are employed. There is definitely a challenge in breastfeeding in urban area, so there is a plus and minus side to urbanization." [Child Health Specialist and Consultant]

*I think urbanization has effect on farmers. I don't know the political view but it is my opinion. This is because farmers' life bases on their land. They eat what they produce. If they lose their land because of urbanization, it will be difficult for them to survive. The family will end up in streets and labor works. Even though there is some compensation, farmers don't know how to use their money because we didn't work on behavioral change till now. Farmers' life is different from buying food and eating. Urbanization will be good if we give another land for farmers as replacement. [*Ministry of Agriculture Representative]

"… There is a direct relation between urbanization and globalization and nutrition and it is growing faster. You can see this everywhere; there is construction and large number of populations around. What I am concerned about is who will give services in rural areas…" [FMOH Representative]

:.. I hear that people are migrating to urban areas. I also agree that the number of people living in urban area is increasing. I believe that if the number of people living in urban area is not proportional with the available resource it will cause a problem. Though I can't say that this will cause stunting but in my opinion when there is urbanization knowledge will grow. People have knowledge in these areas and they will start implementing this knowledge…" [UNICEF Representative]

Poverty Reduction

Across all the national key informant interviews, respondents cited that the rate of poverty in the country had declined dramatically over the past 20 years. Moreover, the key informants indicated that not only was the general decrease important but also the absolute amount of poverty reduction.

The comment below from a respondent from the Ministry of Finance and Economic Development illustrates these points:

"I need to refer the percent not to cause of factual errors. Please wait me… There is a poverty trend … Lets' go and see the poverty trend …. Because it's a factual thing … When the 1st

poverty survey was done …. In 1995/96 the national figure was at 49.5% and in 2003 it reduced to 29.6%. Now, according to the 2008 survey it's reduced to around 23%. This data was around here…. Let me follow the fact … you have to follow the fact … Yes, its 23.5% on the survey done in 2008. Therefore, it has decreased this way from time to time. This means the poverty line has decreased almost in half from 1995/96 to 2016. It has reduced with a good amount…" [Ministry of Finance and Economic Development Representative]

According to the respondents, the rate of employment has improved in the country and resulted in improvements of food security in the respective households, which in turn contributed to improved nutritional status of children. Moreover, the respondents provided programs or actions that have potentially played significant roles in reducing child undernutrition in Ethiopia. The relevant programs elicited in the discussions included the Agricultural Transformation Program, the Disaster Prevention and Preparedness Program, the Productive Safety Net Program, and the government's public investment in construction of roads and buildings.

Below are some quotes that capture this well:

"Poverty is decreasing. National income is good. Productive safety net program like asset building is a key program for the changes we have seen including stunting reduction. This program helps households to cop up during shock/lean periods." [INGO Representative]

*"…The major thing that made a change is the focus given to the agriculture sector by the government. These are, the allocation of manpower in the agriculture, supply of fertilizers and use of different alternative methods for production like irrigation has increased the production of food/crops. On the other hand, the disaster prevention and preparedness commission has strengthened itself and provide food donations for areas where there is food insecurity. The 3rd one is the Productive Safety Ney program. These have made their contributions. Especially they have contributed for the reduction in people affected by sever poverty and also they contributed for it not to expand." [*Ministry of Finance Representative]

Improvements in Education & Women's Empowerment

For many of the respondents, there has been considerable improvement in women empowerment and girls' education across the nation in the past 20 years. The respondents indicated that the government has taken the issue of increasing enrollment of female students as one of the main agendas in the education sector. The government's actions to improve women's education included arrangements to retain females in schools and affirmative actions on enrollment marks to encourage female students to join higher education. Although the overall change was considerable, respondents did not agree that the proportion of girls/females in the school population was satisfactory especially at higher education institutions such as colleges and universities.

The following extracts from the interview transcripts illustrate some of these points:

"…The number is big but it has not yet become balanced. Currently the gender parity index is not equal. The number of dropouts is also high when we see the second cycle of primary education (5 to 8 grade level). You will see that there is huge dropout of girls. When they are enrolled in the primary education the number is relatively close but as you go higher the percent

of women will reduce. For example, in the university in the 1st degree level, only 32% of them are women. But at a lower level … if you see "Amhara' region and Dire Dawa city administration it's around the women to men proportion is 50:50. When you go higher let's say at a master's level the enrollment is around 20%. Therefore, the proportion is still growing up." [Ministry of Education representative]

"The gender proportionality is increasing from previous years. This is also due to government's support and this support contributed to their increased involvement. Women are now achieving better results and competing in class as 1st, 2nd, and 3rd places and this is increasing now. The proportion has increased from previous time in great number. One of the reasons for this is government support and supports from schools which have contributed their own parts. And also women competence has increased contributing to the high increasing situation from previous times." [Basic Education advisor, Ministry for Education]

At the community level, respondents indicated that there has been a change in perception regarding the importance of education, particularly girls' education. This is perceived to be the result of strong programs that promote women education in the country.

"…And when a student is absent the teacher asks the reason and if it is repeated and if he hears that she is about to get married then the teacher will link it to the legal bodies and an action will also be taken. There are such improvements and also an increase in the community awareness about women, the fact that most of the health extension workers are females, most teachers being female and attention given to girls' education by the government. It's improving in general." [Ministry of Education representative]

Another ministry of education representative further emphasized the importance of shifting community beliefs:

"These are the things. The other thing is role model, which I told you earlier, which is one factor. When women students are equal with the male students and achieve results that are better than males, parents and families will send girls to school. Parents and families now understand the use of education. So now they are sending both girls and boys to school." [Ministry for Education representative]

The national experts affirm that there was a direct relationship between women empowerment and girl's education and improvement in child nutrition. Respondents indicated that educated mothers could challenge traditional practices that are not good for child nutrition, better space births, and provide better foods and care to children.

"Education has a direct relation. Because even if we have the resources and if there is lack of awareness on how to use them, it can cause stunting. Therefore, it's not only about having the resources but also we need the knowledge on what pregnant women should eat, how to feed a child and what foods to eat at the adolescences age…" [iNGO representative]

Another iNGO representative also mentioned the relationship between women empowerment and improvement in child nutrition:

"…Yes, like I said educated women are becoming mothers. You observe this during surveys. This creates a fertile ground. Recently I visit one educated mother. Her children attend school. The

family is challenging common traditional practices. They question why. The number of educated mothers increased over the past 20 years and it will increase." [iNGO representative]

Remittances & Labour Migration

Key informants discussed the common types of migrations as well as the mechanisms and strategies through which migration could positively or negatively impact stunting in the Ethiopian context. The types of migrations identified by respondents included economic/labor migration, disaster related migration, as well as in country and international migration to foreign countries.

*" If you're asking me about migration, migrations can be due to different reason. One reason is natural disaster. People migrate to escape from such disaster. They will migrate to areas that don't have such problems and sometimes migrate to far areas. The other one is manmade disaster. The repeated conflicts we see these days in different areas will cause people to migrate. The other one is Economic migration. When we see it as a country now the number of people migrating to the Middle East country is increasing. They are migrating to look for a better life. Therefore, whatever reason is migration has an impact on children and it might also cause stunting." [*iNGO representative]

The labor migration to urban cities for construction work and other similar jobs does not necessarily result, as discussed by the key informants, in improved income and in turn improved household economy and nutrition. The national experts highlighted that there is a high chance of unemployment in the urban cities since the number of jobs may not be in line with the volume of migration and hence labor migration could negatively impact child nutrition.

*"In our country we might not call this migration… but due to the urbanization and increased activities like construction works in urban areas, people will migrate from rural areas to such urban areas to find a job. There will be sharing of resources and this might cause increased rate of un-employment in the urban area …. If there is high un-employment rate in urban area and if those who migrate start a family and have kids in the urban area, then this might create a problem in the children food intake." [*Ministry of Finance Representative]

" I can't say much about this but those who travel outside Ethiopia, such as those who travel to Arab countries might help advance the financial status of their family by sending money, so that might have contributions because it can help improve the capacity of the family to raise a child. But I don't think internal migration where people move from rural area to urban area has contributed for stunting reduction." [Child Health Specialist and Consultant]

However, the international migration to countries in the Middle East for in house work is perceived to be directly and indirectly influencing child undernutrition depending on whether the remittances sent back home are properly managed and used. In addition, the currency transfers from citizens living abroad is increasing the national foreign currency and its deposits. This would improve the country's capital to buy consumption goods, drugs and others, expansion of infrastructure, and supplies that could directly or indirectly impact reduction in child undernutrition.

"An increase in "HAWALA" increases the foreign currency and its deposit. An increase in the foreign currency deposit will have importance in the country's capital to buy goods, drugs, or anything in general. Therefore, it is important to pay for things the country imports from outside or materials the country doesn't produce since they are bought in foreign currency. It will also

be used for expansion of infrastructures for example: road construction will make schools accessible and to sell what has been produced. Therefore, the foreign currency will have importance to increase these supplies. These are foreign currency we get from selling things from outside the country and foreign currency we get from 'HWALA" is also important." [Ministry of Finance Representative]

Sociopolitical Context

For many of our respondents, the sociopolitical context has impacted stunting reduction over the past two decades. National informants mentioned that the government's ideology and commitment as well as the decentralization and democratization process are core components within the sociopolitical context that are potentially driving the observed improvements in nutrition. However, national informants also highlighted that the recent absence of peace and security is challenging the stunting reduction.

Respondents mentioned that the government's actions on decentralization helped regional states to improve agriculture productivity, infrastructure, and health services at the grassroots level. Key informants stressed the importance of political commitments over other factors as the main driver for regional states to perform better, as seen in the difference in undernutrition rates between regions.

*"This is from the time where the country developed decentralization into regional system. This has a positive impact because it will help in an increment of production. It will also help in development of basic infrastructures. This will indirectly help the regional economy to stimulate. It will also help to report problems as soon as possible. Therefore, it has a positive impact in such aspects." [*Ministry of Finance Representative]

Few of our respondents mentioned a change in political ideology from the monarchial system to the socialist Derge and later regimes during the interviews. In the monarchial system, the ownership of the agricultural land was owned by few individuals and the landlords. This change in ideology, also called "Land to the tiller," presented agricultural land reforms including ownership of land and governance system whereby the majority of the rural poor farmers owned agricultural land for their use.

The following extract from one of the interviews illustrates the relation between production and consumption within the "political ideology" dimension:

"It was in the derge regimen where land was given for society lastly. Young peoples if they don't get a land from their family then they will not have at all. Even if they get per capital size is small when it is given for all children. Land is a basic asset. The fundamental thing is access to basic resource which is land. If land is not available there will not be production if there is no production, there is no consumption." [iNGO representative]

Respondents highlighted that crop production reflected the level of peace and stability.

"In case of political factors: I don't know in the past 20 years since I have been working in ministry of health for the past 10 years only. It was peaceful until the past 3-5 years then conflict has been rising everywhere, which has a high impact. And due to the instability peoples are not

focusing on farming even in the winter time then displacement follows. The production that people got will also be destroyed during the conflict." [Ministry of Health representative]

Despite the longstanding peace and security, key informants highlighted that in the past five years there has been an absence of peace and security coupled with internal displacement, which has been challenging the exemplar reduction of child undernutrition in the country. The current instability has shifted the governments' and donors' focus from the development of nutrition programs to emergency responses.

"…When you have too much conflict and displaced peoples millions of birr/dollar will spent to support. So the nutrition development projects will be deprioritized. If you remember in 2016, there was high number of internally displaced people and humanitarian crisis. During this time, funding opportunity was significantly decreased for projects working on improving developmental nutrition. Because government prioritized emergency or short term interventions than long term project. Like I told you if you go to Afar with a 10 million long term project and a 3 million short term project; they prefer the short term program. It doesn't make sense for ministry of health if you bring long term development project when there are millions people who needs emergency interventions. So these issues have effect..." [iNGO representative]

4.1.3 Nutrition-Specific and –Sensitive Policies and Programs

National key informants identified nutrition-specific and –sensitive programs that have influenced stunting reduction in the country from 1990-2016 and further discussed programs/projects that have both nutrition -specific and -sensitive components. These include the National Nutrition Program (NNP), Sustainable Undernutrition Reduction in Ethiopia (SURE) and the Health Extension Program (HEP). Some of these projects/programs were implemented through a multi-sectoral collaboration approach.

Barriers and facilitators of program/policy implementations were also discussed during the interviews. Key informants stated that the National Health Policy of 1993 was the primary guide for the initiation of these programs/projects. Poor budgeting, inadequate human resources and capacity of professionals as well as problems related to accountability were the barriers identified for effective implementation of these programs. Key informants indicated that although the scale of implementation and effectiveness of programs differs from one program to another, all nutrition programs contribute to improvements in nutritional status in Ethiopia. Many key informants identified the HEP as the main driver to the observed stunting reduction in Ethiopia.

The nutrition-specific and –sensitive programs mentioned by the national key informants are described in detail below:

Health Extension Program (HEP)

The HEP is a community-based health program adopted by the government of Ethiopia in 2003 with the aim of achieving universal health coverage. The program had 16 packages and two additional packages were added later on. Key informants felt that integrating nutrition into the extension activities has led to significant improvements in nutritional status of families. In addition, key informants stated how the HEP addresses nutrition-sensitive components by preventing disease, expanding immunization services and generally making the family healthy. Key informants also mentioned the substantial contribution of the program towards hygiene and sanitation by creating

awareness about latrine construction in the community. According to the key informants, the fact that health extension workers are recruited from the same community helps them work hard and makes them acceptable by the community. Key informants also identified poor work motivation as a key challenge regarding the HEP.

> *"… Health extension program is working on prevention at community level. Health extension workers provide ANC service for pregnant women, provide health education on dietary intake and give iron foliate supplements. She follows if they are taking the iron foliate or not since she lives nearby. Therefore, this has a high impact. One thing I have seen in the socio-political area is the decentralization of the health extension program to reach the community and it has made a huge impact…"* [*iNGO representative*]

> *"Main achievements of the program include, improvement in immunization services, which is, almost all children are immunized against polio, measles and TB and children who are immunized can easily be traced in the community, mothers use of family planning service has increased, there is improved hygiene and sanitation from the previous time and improved latrine utilization etc."* [*iNGO representative*]

National Nutrition Program (NNP)

The NNP is a major nutrition program designed by the government of Ethiopia in 2008. Before the start of the NNP, the health sector was the primary sector supporting nutrition. Later on, the multi-sectoral nutrition approach was introduced involving thirteen sectors. The key informants highlighted the significant contribution of this program towards improving nutrition in Ethiopia. However, key informants also indicated that it is too early to identify the impact of the program, as it has not been fully evaluated yet.

> *"…. NNP is a basic document for all nutrition specific and sensitive programs. So I think it was one great program in the country …"* [iNGO representative]

> *"… This strategic document puts high-level impact indicators that can be assessed by conducting a survey. For example, currently the coverage of GMP is 46%. Timely follow up of GMP allows us to know the stunting rate and the aim is to reduce it from 38% to 26%. We don't exactly know the rate of stunting now because we didn't conduct a survey yet ... What I can now talk about is works done on capacity building. Integrated training modules are prepared on the strategic objectives and training has been provided by the national team for all the regions and city administrations. They also cascaded the program and trained respective health care providers. One round training was also given to health extension workers by IRT (integrated refreshment training) module, which is taken from NNP contents*." [Ministry of Education representative]

Key informants indicated that government commitment, support from donor organizations, engagement of the private sectors, and implementation of programs such as the Health Sector Development Program (HSDP), Sustainable Undernutrition Reduction in Ethiopia (SURE), and Growth Through Nutrition (GTN) were the prominent facilitators for the program. The multi-sectoral nature of the program was identified as both a facilitator and as a challenge for its implementation. Although the platform helps to improve the need for coordination of various sectors to solve the country's nutrition problem, key informants indicated that only the health and agriculture sectors

are actively working in the implementation of the program and that the poor coordination of the multi-sectoral platform is negatively influencing the effective implementation of the program.

> *"… Multi-sectoral task needs collaboration, planning, and evaluating. However, we are not doing it. There might be repetition of tasks by more than one sector because of communication gap. Nutrition interventions need collaboration; for example, if agriculture is working on home gardening, water sector has to facilitate availability of water, education has to work on awareness creation and health sector has to do cooking demonstration. This is how we will bring change…"* [Ministry of Agriculture representative]

Sustainable Undernutrition Reduction in Ethiopia (SURE)

SURE is a government-affiliated project with both nutrition-sensitive and -specific interventions at the community level. The main components of the program are primarily food and dietary diversification of complementary feeding promotion, teaching and awareness creation, and conducting campaigns. Multi-sectoral coordination is also one of the core program component. Key informants explained the multi-sectoral coordination component of the program by discussing how the health and agriculture extension workers make joint household visits to create awareness in the community by identifying households with pregnant mothers and children less than 2 years of age. The key informants also mentioned the contribution of the program in arranging cooking demonstrations and community dialogue.

> *"… It's a 5 year program and it has not been evaluated yet ... from the process indictor perspective there is no objective that is not being implemented. The major one was preparing training manual on (IYCN/NSA), facilitating guide, package and job aids on mothers and children's dietary intake. The training was provided for more than 7000 health extension workers and agricultural extension workers. This is how they (the health extension workers and DAs) did the Joint household visit"* [Ministry of Health representative]

Productive Safety Net Program (PSNP)

The Productive Safety Net Program (PSNP) is a social safety net program that supports chronically food insecure households, responds to shocks, and promotes sustainable development. The program started in 2005 and provides conditional food or cash transfer to households that joined the program. Under the PSNP, pregnant and lactating mothers are exempted from participation in public work and are allowed a direct benefit with soft conditionality/criteria. These include antenatal care, growth monitoring and promotion (GMP), family planning, behavioral change, communication programs, nutrition services, and other maternal and child health services. According to national key informants, the PSNP helped the poorest of the community by helping households build assets and become independent to feed their family better. Key informants indicated that the number of households receiving support from the program is gradually decreasing, implying resilience of families (households) for shock.

> *"… This program helps the community to save and build household asset. Asset leads to income and wealth so the family can have resilience during shock periods. They don't have to sell their cattle and other things. When the family buys cow then they will have milk and butter. That is an asset. They either can eat it or sell it. That is how I understand the program."* [iNGO representative]

"… Making PSNP-4 nutrition sensitive is one achievement for me. It is contributing for stunting reduction." [Ministry of Agriculture representative]

Health Sector Development Program (HSDP)

The Health Sector Development Program (HSDP) started in 1997. The main objective of the HSDP is to provide comprehensive, integrated, and cost effective primary health care service, with a focus on communicable diseases prevention and control, nutrition, environmental health and hygiene, reproductive health, and immunization. The HEP started in the second phase of the HSDP. Key informants highlighted that various initiatives were implemented by the HSDP to achieve the Millennium Development Goals (MDGs), that attention was given to maternal and child health services, and affirmed that the HSDP has contributed towards improving health and nutrition in Ethiopia.

"*…HSDP is one of the program, which I believe have great contribution for stunting reduction…in HSDP, we have achieved immunization, there is improvement in access to health in almost all regions and there is improvement in IYCF practice at community level such as breastfeeding and so on. There was a continuous evaluation on child health sensitive programs …"* [Child Health Specialist and Consultant]

4.1.4 Underlying Causes

Improved Household Environment: Water, Sanitation & Hygiene (WASH)

National key informants discussed contextualized improvements in the household environment in relation to separation of human and animal houses, presence of a separate kitchen, overcrowding, and availability of a toilet. However, there were mixed opinions and views regarding improvements in the household environment over time. For instance, some informants stated that there has been increased separation of human and animal houses while others stated that animal and human cohabitation continued to be common.

"*I had the chance to see some areas, there are improvements being made on separating human and animal's house, having another place for cooking, and making shelves for material/utensils storage and on household & personal sanitation. The health extension program is doing a good job on that*." [Ministry of Health representative]

"If we are talking about the households in rural area there is still a problem of crowding. I visited a lot of places in rural areas and animals and humans are still living together and the cooking places is still inside the house, it's very difficult to say there is improvement because the farmers give you reasons like others might steal their animals if they prepared another place for the animals only. Even though it's just my thought and it's not research based there is still no improvement in household crowding. Even in urban areas, people don't have toilets, they use water bottles and plastics for toilet, that is why we see urine in water bottles in the streets because the house is so small, and it's a place for every activity as they don't have kitchen and bed rooms." [iNGO representative]

According to the respondents, there is a modest improvement in the accessibility of clean water. The respondents discussed that the improvement is partly due to improved access to road and increased donation. However, the respondents highlighted that the improvement is not enough as there are many communities that continue to walk long distances to obtain clean water. The water access

problem is especially concentrated in rural areas across the country compared to the urban areas. Respondents highlighted that the lack of maintenance of water sources contributes to the decreased access of safe water.

The following extracts illustrate these points:

> "*I can say that there is improvement in the accessibility of clean water. But our big problem is we start the work but we don't do it in a way that it could be sustainable. Let's say you built water for some school and you don't arrange maintenance. If you go back after a year, because of simple problem you find it not functioning and very dirty. So it will be back to zero. Beside the number of water facilities, we build we should work in collaboration on making it sustainable.*" [Ministry of Health representative]

> "*There is improvement but it is not enough. Still there are peoples who walk one hour to get water. If they brought one jar they won't use it for washing. They will use it only for drinking and cooking. There is problem in availing WASH facilities; this is where the donors should involve*." [Ministry of Agriculture representative]

> "*There is also an improvement in water supply as well. But there is still a problem especially in rural area, these people have to travel lots of Kilometers to fetch water, they also use contaminated river water*." [Ministry of Health representative]

Key informants discussed sanitation and hygiene in terms of access to latrines, utilization of latrines, open defecation in free kebeles/districts, and hand washing practices. Respondents highlighted that although there is increased construction of latrines, a large gap remains regarding proper utilization. However, they mentioned that the HEP has significantly contributed to the construction of pit latrines as well as the promotion of hand washing and sanitation through community engagement.

> *"Back then, those who didn't use toilet was 70% to 80% but now it has reduced to 40%. This is achieved by collaboration of health offices environmental and sanitation department, NGO's and they are still working on it. In addition, now, there is a WASH national program and better hand washing practice before eating and preparing food in the community creating a high impact in improvement of hygiene and sanitation. Also safe water provision is reaching around 65% in collaboration of government and partners."* [iNGO representative]

> *"Pit latrines were also built but they don't give the service we want. They don't have hygiene and sanitation facilities. Without available WASH facilities, it doesn't give sense if we teach about behavioral change."* [iNGO representative]

> *"again thanks to the HEP a lot has been done regarding toilet utilization, especially on South and Tigray region there are open defection free woredas. A lot has been done regarding water sanitation through the HEP. The health extension workers provide education by going house to house to prevent water contamination by teaching them to use narrow mouth jar, to use boiled water and so on."* [Ministry of Health representative]

Food Security & Feeding Practices

Key informants described food security in terms of production, crop diversification, agricultural technology, land size, population growth, rainfall/irrigation, market driven production etc. Many of the key informants indicated that there has been increased agricultural production over time.

However, respondents indicated that a problem remains regarding the diversification of agricultural products.

The following extracts describe these points:

> *"as per my understanding in the past 20 years, more work has been done on improving production. The main focus is to provide food for the population. Even though I can't tell you the figure in number but the production is increasing. As we hear it from the media and from the news, the production is increasing. But after the introduction of nutrition sensitive agriculture in the past 3-4 years, the work being done is not only on production. We can't say there will be nutrition security by producing only maize. Therefore, the agriculture sector is working with nutrition sensitive agriculture strategy, which is focused on food diversification and micronutrients. Previously production of fruits and vegetables were not given attention. But now the agriculture sector is working on this with more focus. More focus is given for production of fruit and vegetables, fish farming, animal breeding and mixed farming (production of different types of crops."* [iNGO representative]

The key informants also indicated that there is decreased per capita yield due to actors such as the increased population size, lack of rainfall, lack of irrigation, and modern farming system.

> *"Agriculture is the same as when we were children. They are still using oxen and pick axe. Back then they were working only on productivity. But productivity only can't make difference we have to make it nutrition sensitive agriculture. Now National nutrition agriculture strategy is launched and it is one positive forward movement."* [iNGO representative]

Improved Access to Health Services

Key informants discussed improvements in health services in terms of the number of health facilities built, the improved access to the health service, human resources, supplies and equipment, and quality of health services.

Across all the respondents, there are substantial improvements and a huge expansion of health facilities in the country over time. The expansion of health services was related to the massive construction of health posts and health centers across all regions in the country. Informants indicated that the observed expansion of health services and the health posts in each village has resulted in improved coverage of basic health services, counselling services, and improved practices among mothers in the community.

The following extracts elucidate the views:

> *"I worked for 16 years in health system after graduation that is how far I know. There was no infrastructure when I was working at woreda level. Now it has improved and number of staff has also increased. Primary health care acceleration is very good. It was started by 300 health centers now it is more than 3000 health centers and more than 30,000 health posts. If we see the woreda I used to work, it used to have only 7 health facilities for 57 kebeles but now all kebeles have their own health post. The change is visible we can see health extension workers and midwives. Attention is given for mother, child health and child care nutrition. This shows that, nutrition services are engaging at lower level. Activities which were done through campaign like Vitamin A, CBN and CHD is now becoming routine activities. There are many*

midwifes so I think Iron folic acid distribution will be good. Changes in the health system brought a favorable ground for nutrition." [iNGO representative]

"The health system improvement is the reflection of the country progress. There is significant improvement in coverage. In previous years' peoples have to walk a long way to reach health facility, but now there are health centers, health posts and hospitals near to the community… There are still some regions which walk longer away to health facilities carrying patients." [iNGO representative]

Key informants also indicated that the massive training and deployment of health extension workers to heath posts in each village is a significant contributor to improved health service access. The deployment of health extension workers at the village level has helped to bring services such as immunization, health education, nutrition education, vaccination, antenatal care and referral services closer to the community level.

" The decentralization of the health extension program to reach the community has a high impact. Primarily the program made services available at the "kebele" level. Whenever something happened, they will go and visit the health extension worker since she lives nearby. The major and the main one is that the health extension worker provides ANC for all pregnant mothers and when there is problem, she will find solution at the pregnancy level. She also provides health education on dietary intake. She provides iron foliate. She follows if they are taking the iron foliate or not since she is nearby. Therefore, this has a high impact. One thing I have seen in the socio-political area is the decentralization of the health extension program to reach to the community and it has made a huge impact." [iNGO representative]

"...Relatively it's good. We can see at a "district" level that there is a health center and satellite health posts. There are health extension workers there providing services like immunization, health education, nutrition education, vaccination etc. Health extension workers will refer the patients to health center when there are cases that are complicated, then health center to zonal hospital then to referral hospitals. There is a health system structure from the community to a higher level of care." [iNGO representative]

Although the health system expansion has contributed to the observed stunting reduction, key informants indicated that there is a need for multi-sectoral collaboration to bring about the desired level of change in stunting reduction. They have also mentioned the lack of nutrition experts at heath facilities that can deliver the required quality nutrition services.

The following extracts elucidate these points:

"We need to assign one responsible person at each level. That responsible person should be an expert to understand the magnitude of the problem of nutrition on the population and children but we have very few experts on this area as a country. We also come from this population and it used to not bother us until we understand the situation. We had that understanding by working in this area then we started talking about the issue. The universities need to produce many experts on this area to address the issue up to "woredas" and health centers. In the health centers, you find Health officers, nurses and pharmacists but what about nutrition experts (clinical nutrition and community nutrition). In hospitals, doctors decide everything including the findings, the drugs and tell patients to eat or avoid certain foods. But if we have nutrition experts to give counseling on patients' dietary intake, the drugs will also be effective. In some

cases the person might be cured without taking medication just by improving his/her dietary intake and building his/her immunity." [Ministry of Health representative]

"The focus given for nutrition is still low. They are not addressing prevention of under nutrition and stunting. They are still doing acute malnutrition/SAM management. Because they are being evaluated based on that. This means they prefer to manage the aftermath than prevention. Even after management they don't counsel properly to prevent other family members or the next episode." [iNGO representative]

In addition, key informants pointed out a growing problem regarding the low motivation of health care providers working in the health system. Moreover, the quality of health services delivered in these facilities is rated as poor.

"Health care providers have no passion and they are demotivated. Let's say you give training this month and if you go after a month the routine work will not be there. Even if you give them a job aid to support the counseling they don't use it. When you ask them why they say there is high case load but it is more of motivation issue. This is a push factor for the mothers. If they don't get a quality care they will not come for follow-up. There is also high staff turnover." [iNGO representative]

"The health service is also poor; we need to work to improve the service provider's knowledge on nutrition. So if we work on this I think we can improve a lot in the future, but I think there is still a lot remaining at this stage." [Child Health Specialist and Consultant]

4.1.5 Immediate Causes

Dietary Intake

In response to our question about improvements or changes in diets and infant and young child (IYC) feeding over the past two decades, respondents highlighted a general improvement in the "concern or care" mothers give to IYC diet and the type/quantity of diet given. For example, mothers used to give whatever was available in the house but now they understand the benefits of a "good" IYC diet and tend to be concerned and try to explore options to access the IYC diet. The observed change is attributed to improved awareness on the benefits of a "good" IYC diet, agricultural production, and the knowledge on the components of IYC. However, for many of our respondents, diet diversity, quality, and accessibility remain major concerns in the country.

"Gruel [made of similar flour to that of porridge but thinner] used to be a universal meal for children Now it is changed. As of 2004 we started the IYCN and ENA promotion. Thin porridge, any mother can tell you about it now because it is promoted through health extension workers. There are mothers who still give gruel for their children but I am sure the number of mothers who uses thin porridge outweighs them. We don't know how much the thin porridge enriched with essential nutrients but there is improvement…" [iNGO representative]

"There is some improvement. Back then it was believed eating variety foods as luxury. Now the community is started understanding the benefit of eating diversified food though there is availability problem. Mothers understand the benefit of good diet on the fetus. The community

also understands the benefits of feeding children with diversified food on growth, mental development and school performance." [Ministry of Agriculture representative]

Getting a variety of food to feed children was a major concern for households as there is a challenge in the availability of foods throughout the seasons and the challenges families face in buying foods due to physical accessibility in markets. Moreover, the amount and quality of diets for children is perceived to be poor and is linked to the dominant cereal and grain based IYC diets and not being able to provide "nutrient rich or good" foods including animal source foods such as eggs, milk, and meats.

"Dietary diversity score figure is always burdensome. It shows us we are not successful on it so we have to think and work more. The diet is nutrient deficient and lack animal source food, it is mainly cereal and grain. Our food has no problem on energy content. We may eat much for compensation even if there is much fiber in it. But still it is deficient in zinc, which is important for stunting prevention. Iron, we can get from contamination. Calcium has relation with growth and stunting but milk is not available now…." …" [iNGO representative]

"Under quantity sustainability still matters. You think a child is fed throughout a year? The availability is also an issue because there are types of foods that are not available in areas. You can't feed it the same thing always like "Teff" or corn. But it needs to be diversified. So there need to be accessibility of diversified food. But not only diversity but also safe nutrition, accessibility and utilization of diversified food. And we need to see its availability throughout the year. So if this is not achieved it does not matter if we tell or teach a mother to prepare and feed a balanced diet. So to do all this food needs to be available. These foods need to be at least available at the market even if it's not produced at home." [Ministry of Health representative]

Maternal Characteristics

For most of our respondents, there had been a substantial improvement in maternal health related to the family planning programs in the country. The family planning program, coupled with the exclusive breastfeeding culture in the country has contributed to the significant reduction in the country's fertility rate. The key informants also noted a shift in the community's perception of having many children for future earning source.

"Based on what I heard it's decreasing. I don't know the exact data but previously it was around 8.5. Now the fertility rate is around 5 point something. This has a high impact to reduce malnutrition. I also hear that family planning utilization and birth interval is increasing. This has an impact on reducing malnutrition." [iNGO representative]

"Back then it was believed that having many children as a good thing. Many thought once the kid grow up he will bring income. It is changing now, parents no more wants to send their children for work in early age so they are having few children. Spacing between pregnancies also improved because parents are facing the effect of having repeated pregnancies with in short period of time. … Now birth control is available in the nearby health facility and the community can get advice from health professionals" [Ministry of Agriculture representative]

" I think the change is in the urban population because now they are having 1 or 2 children. This might be because of economic status of people (now with the inflation and so). There is a relation between this factor and nutrition especially with spacing. If people can feed their children, they can give birth as many as they want but, if you can't feed and give birth to 3 or 4 and let them be raised as their luck, it will have a negative impact. There are some areas where they don't care about nutrition and they will have babies thinking they will grow up by luck. And in this area rate of family planning is average…"[Ministry of Health representative]

Reduction in childhood illness

According to the national key informants, the magnitude of childhood diseases such as malaria, vaccine preventable diseases, and diarrhea have decreased impressively over time. They also mentioned that a reduction in childhood morbidities has contributed a lot for the observed stunting reduction in the country.

"… water sector policy, malaria prevention, and the one that I have mentioned earlier regarding communicable disease management have great contribution for stunting reduction. Malaria prevalence have decreased a lot in our country and that has contribution for stunting reduction." [Child Health Specialist and Consultant]

Moreover, our respondents indicated there were various programs implemented in the country that had played major roles in reducing childhood morbidities and in turn undernutrition. The programs mentioned included the Malaria Prevention Program, the Integrated Management of Childhood Illnesses, the WASH Program and the Community Based Nutrition Program.

The following extracts describe a few of the programs that have shown to improve child health:

"Integrated management of new born child illness (IMNCI) has relation with stunting. Diarrhea is the most important cause of stunting. Repeated infection will increase the risk. Beside a good dietary intake, the kid should get medical assistance during illness to be healthy and to have a normal growth. IMNCI, integrated child care management (ICCM) and community based nutrition are essential for survival and stunting reduction. Nutrition education during these times is also essential." [iNGO representative]

"The other is WASH program. The wash program aids the reduction in stunting by working to provide safe water and this will reduce the risks of acquiring parasitic infections that consumes micronutrients. "[WASH expert]

Child Characteristics

Child characteristics including birth weight and intergenerational factors were not highlighted by national key informants as contributing to stunting declines among children in Ethiopia.

4.2: Regional Stakeholder Perspectives

In-depth interviews were conducted with 12 sub-national key informants across the two regions and four districts. Those interviewed included teachers and health staff (health extension workers, maternal, newborn and child health care workers, district health surveillance focal persons, and senior health centre staff) (Table 16).

Table 16: Summary of Regional Stakeholders

Participant #	Organization
Aware participant 1	Medical director, Health center
Aware participant 2	Laboratory technician, Health center
Aware participant 3	Medical director, Health center
Harshini participant 1	District surveillance focal
Harshini participant 2	District EPI focal
Harshini participant 3	Nurse, Health center
Bonga participant 1	Health extension worker
Bonga participant 2	District Health extension program focal
Bonga participant 3	District Program officer
Yeki participant 1	Crops protection professional
Yeki participant 2	Medical director, Health center
Yeki participant 3	School teacher

4.2.1 Basic Drivers of Stunting Decline in Ethiopia

Social Political Context

Regional key informants mentioned that the absence of peace and security was a major challenge and a barrier for people to move from one place to the other. This was a larger concern in the Somali region compared to the SNNP region. The improved security status in the last five years now allowed residents to access markets without fear and helped to reach malnourished children earlier.

> "*Five years ago, things were quite different due to insecurities. People had no access to free trade and there were fear and it was difficult to reach the needy due to inaccessibility to some places. For us to reach Jigjiga it used to be a three-day trek but now it a half day trek. You can imagine the difference. Now there are many roads that connect Aware to different parts of the region and any one can move from one place to another without fear or military escort. This has resulted to reach more malnourished children who would otherwise die of it*." [Health worker, Somali region]

Improvements in Education & Women's Empowerment

Key informants discussed education in terms of increased access to school, increased number of educated people, better economic status of educated people, and a change in curriculum. The key informants indicated that there are considerable improvements in access to both elementary and high schools leading to increased number of educated people in the community. The informants also indicated that those with more education have a better economic status compared to uneducated ones.

> *"Lots of things have changed! First people are now educated. Every mother or every household has at least one educated child or person. It's very rare to find a household without one educated person today."* [Medical Director, Somali Region]

Across respondents, there has been a remarkable growth in the proportion of female students in schools. Regional key informants indicated that the community did not encourage female education and many were not willing to send their daughters to school. This has changed dramatically and now the number of female students was comparable and even sometimes higher than male students. However, concerns were raised in terms of the number of dropouts of female students at higher-grade levels. Respondents indicated that a lack of familial support, early marriage, and long distances to schools are the main reasons for the drop out of female students at higher grades, especially from high schools. However, many of the respondents discussed the positive role of female education including better childcare, prevention of malnutrition, and promoting health.

The following extracts illustrate how rates of female education had changed:

> *"Regarding female education, previously communities did not believe that girls could learn something as boys. People used to criticize girls' education. For instance, one class there may be two female students in those days. My class in my school time from grade four to eight there were only five female students. However, now girls' education improved. I can say that nowadays girls are better in schools than boys. The number of girls in schools is higher than boys. I believe educating girls would help the prevention of malnutrition. School children pass messages regarding health to their mothers in the home. Educated mothers would properly care their children because they know practices that lead their children's health problems. I can say health of children is in the hands of the mothers. If mothers' practice good behaviors, such keeping the hygiene and sanitation of their children and giving their children balanced diets children would enjoy good health."* [Health worker, Somali region]

Although female education has increased, the following quote demonstrates concern regarding the high dropout rate of females:

> *"Even though most of females are learning now there is also high rate of drop out from school. This is because women are forced to drop school when they lack someone to support economically. Numbers of women are found to attend school at elementary level but when it goes higher their number becomes reduced because of different reasons. The first one is lack of economic support. The other is distance of schools. It is difficult to go long distance and attend school especially for women."* [Health worker, Southern region]

Poverty Reduction

Key informants discussed that there is a considerable improvement in the economic condition of their respective communities in terms of having better housing, trade, and employment opportunities. The change in the standard of housing from a small hut to a house made of iron and bricks was seen as a sign of economic gain for farmers in the community. The improved agriculture and business opportunity in the locality were perceived to be the key factor for the economic improvement. In addition, more employment opportunities were believed to have improved food security and nutrition in the locality.

The following extracts illustrate how living conditions have changed:

> *"I think there are many changes after 15 years. For example, the farmer who used to live in a small hut is now living in a house made of tin and bricks. There were illiterate families, but now they are sending their children to school so that they will create educated children. Some*

farmers also send their children to private schools. Farmers are now opening "wefcho bet". They are now having improvements. Majority of people 90-95% of people live in a tin house. there is an improvement of the farmers in this district and it can be said it is the result of the agriculture. Nevertheless, when you look around, there might be poor farmers. These are farmers who came from another area recently and living in a small hut." [Agriculture expert, Southern region]

"If we also see the civil servants, the number of people now working for the government have increased and if you compare last year and this year the number have increased tremendously and we have almost 100 new persons employed. All these employed people will in one way or the other improve the food security in their respective household which will in turn improves the nutritional status of children." [Health professional, Somali region]

Nutrition-Specific and –Sensitive Policies and Programs

Key informants cited various nutrition -specific and -sensitive programs that were implemented in the community. These include the HEP, MERCY CORPS, one WASH, ENGINE, PSNP, and the Pastoralist Community Development Program (PCDP). Key informants emphasized substantial improvements in the health and nutrition of their respective communities after the start of the HEP. They mentioned that among the 18 health extension packages, 85% of the activities are on communicable diseases. Nutrition, hygiene and sanitation, and maternal and child health services were the major focuses of the HEP. They have indicated that the HEP was successful in implementing programs such as vaccination, family planning, nutrition, promotion of hygiene and sanitation, latrine construction and other maternal and child health services. Health education was mentioned as the most important strategy to achieve these goals. Key informants mentioned resistance to change by the community as a key challenge to the HEP. This resistance was rooted in the poor awareness regarding the importance of services and the misconception that health extension workers were paid directly by the community, which generated suspicions about the services provided by health extension workers.

The following extracts elaborate about the role of the HEP in improving maternal and child health services at the grass root level:

"*Before the start of the health extension program, there was huge challenge on maternal and child health in this community. Mothers bleed because of delays and also many other problems which negatively affected the women health. The health of the child too was jeopardized before the commencement of the health extension program."* [Health worker, SNNPR]

"Regarding nutrition, now the mothers are appropriately feeding themselves and their children. If possible, they prepare food from what is available at home. At times they sell what they produce and buy from the market what they don't have. Previously once they drink coffee in the morning, they won't take any other thing after that till night. Now the after a serious of health educations there are changes. At least mother eats now every 6 hours and 3 times a day. In addition, they might also diversify it from different sources" [Health worker, SNNPR]

The Pastoralist Community Development Program (PCDP) was elicited as one of the programs that contributed to stunting reduction by building schools, animal and human health posts, and water dams for the community. Key informants also indicated the role of the ONE WASH program in terms of improving hygiene and sanitation in their communities. The reflection on the one WASH program

indicates the successes in improving coverage and the challenges in terms of not reaching the entire community.

> *" …They (WASH) have a good name and a great plan but it is not up to our expectation. They dug few toilets for the governmental institutions but they have not dug toilets for the community…* They were implementing most of the WASH programs. They used to *provide hand washing facilities to the community with the demonstration of how to do. They used to teach and post pictures of how many times a mother needs to wash her hands while caring for a child. You can see their posters in this health center yourself..* [Community KI, Somali region]

4.2.2 Underlying Causes

Access to Health Services

Key informants indicated that there were substantial improvements in access to health services due to the massive construction of health centres and health posts. In addition, the key informants indicated there was an increase in the health workforce. A key informant mentioned that this remarkable change in access to health services is due to the country's high-level policies and programs. However, respondents indicated that there was still an inadequate health workforce especially for nutrition services. In addition, they reported that there was a lack of ownership, training, and emphasis regarding nutrition services in the health facility.

The following extracts from health workers illustrate the increased availability of health facilities and services at the community level:

> " *The availability and accessibility of health services were limited before twenty years. It was difficult for the community to access basic health services. This was due to the absence of health infrastructure and the insecurity that disrupted the availability of basic health services. Before twenty years, the woreda had one clinic and currently the district has three health centers and fifteen health posts. The number of health workers increased compared with previous years.*" [Health worker, Somali region)

> "*We only had once health center in this Woreda back in the days, but now we have 3 or 4 health centers. There is also health post that has changed to health center and health center that has changed to hospital. There was no hospital in Tepi but we have one hospital there now. There are also different health posts in each kebele, which has improved access to contraceptives. Overall there is great improvement in relation to health facility*."[Health worker, SNNPR]

Water, Sanitation & Hygiene

Key informants indicated an improvement in latrine coverage over time. They also mentioned that there has been a substantial reduction of open defecation. However, they indicated that there is still a gap in the number, quality, and utilization of latrines. They also highlighted the significant contribution of the HEP in improving coverage and utilization of latrines.

The following extracts illustrate these ideas:

"People didn't use toilet facilities back then. They used to defecate on open fields or in the bush. However, this has changed and people have their own toilets in their houses now. There is no one without toilet facility. They even dispose their children's call of nature using the toilet. They are also aware of how to wash their hands after using of toilets. The toilet coverage is more than 90 % now. Except those areas with the conflict that has a gap on implementation there is good coverage of toilets." [Health worker, SNNPR]

"*Everyone has toilet facility in their house but the quality is poor. It took us 5 years to make them dig hole for toilet because they don't think that toilet is important for them. And it will take a lot to make them build toilet with good quality. There are only few people who understood the benefit so they constructed the toilet very well. However, a lot is expected so that the community understands the benefit of toilet."* [Health worker, SNNPR]

"*All of the toilets that we have managed to construct through the community is not even 15% and the toilets constructed of poor quality and there are no slabs and most of them smell bad and these resulted people not to use the toilets regularly."[*Health worker, Somali Region]

Key informants indicated that there have been some improvements in access to safe water over time. However, they mentioned that there is still a significant gap in the provision of safe drinking water for the community as many people are still using river water without any treatment.

The following extracts illustrate these points:

"Years back, water shortages were common. Communities used to fetch water from long distances. The people used to go a place called Bulale to fetch water. Now there is improvement in accessing water. Now there are dams, Birkas and wells that were constructed by the government and private individuals. The changes in governance system and the restoration of peace in the district have resulted in improvement of the availability of water." [Health worker, Somali Region]

"In terms of access to clean water, there is no much improvement. There is no clean water. I cannot say there is no water at all. On areas where there is Action Aid project there is water investment and they are building pipe water. But if we count the water sources in a village there are only 3 or 4 improved water sources." [Health worker, SNNPR]

" Most people use spring water, and some use river water. Sometimes people are affected by Giardia and other water borne diseases. There is challenge with water supply in this kebele, they are working to improve the supply but now we face challenge in having access to safe water supply." [School teacher, SNNPR]

Food Security

Key informants indicated that there have been substantial improvements in food security in their communities. The observed improvement in food security was related to the increased agricultural productions as farmers started to use better farming practices and agricultural inputs. In addition, improved access to markets, availability of roads, and access to media were identified by key informants as factors in improving food security in their locality.

"There is no problem regarding having food in this district. People are independent in terms of that. They are now competing about what they can provide for the market. There might be a few farmers who are not able to feed themselves but majority of them are independent." [Agriculture Expert, SNNPR]

"They are now using new methods of farming and start to use fertilizers and improved seeds. This helped them to be more productive and live a better life. There was no road access so that becomes obstacle to sell what they have produced. And people in the nearby didn't buy them. However, the access is changed and they are able to sell what they produce with good amount of money now." [Health worker, SNNPR]

"It has improved a lot. Back then, they didn't get such information because they only get the information from agricultural professionals. Now, the farmer uses media like television and get different information. Now they are getting information from different directions. There are farmers who live in doubt and don't even want to know, but when we see it generally, I say it is improved from 15 years back. The hope is that this kind of farmers will change when they see other farmers improve in economy and will want to be like them and change." [Agriculture expert, SNNPR]

Although there is improvement in food security, key informants indicated that the market price of food items had increased overtime and this might decrease financial access to food. Key informants also stated that due to the increase in population size, the per capita farmland size was decreasing resulting in a small land size for one person to farm. Moreover, farmers were now shifting to farming cash crops and this could result in a decreased production and availability of food.

"The price of food is higher now compared to previous years. Previously people used to sell one goat and it was sufficient for the food of two households. However now money of one goat covers only two items of food, which is not adequate even for one household. Despite the high price of food, the accessibility of food is better now because of the modern transportation. Previously people used to transport foods from the town with their animals as a vehicle." [Community KI, SNNPR]

"Back then, the farmers had wide land. Now that the generation increased, the land is getting smaller and smaller so I will tell you openly that there is a land shortage in our district now. Majority of people are farmers so the land is divided and there is only a small land for one person to farm." [Agriculture Expert, SNNPR]

4.2.3 Immediate Causes

Dietary Intake

Key informants perceived that the quality of food given to children was better years back (no period specified) compared to the present. Informants highlighted that production itself had not decreased but access to animal source foods had decreased due to costs of purchasing these items. Increased market access had also resulted in farmers selling products that would have normally been primarily for their own consumption. Despite the perceived limited access to animal source foods, key informants indicated that the diversity of children's diets has improved over time. This

was mainly attributed to the improved availability of agricultural products in their community. Moreover, key informants indicated that the expansion and improved access of health services and the education given by the health extension workers have improved the knowledge of mothers to diversify diets of children.

The following extracts illustrate the issues regarding animal source foods, market access, and diet diversity:

> *"People used to consume the products of their animals such as meat, milk and butter however now people do not use animal products. People used to eat locally available foods such as maize and sorghum but now they use pasta, rice and flour. Now people sell milk and butter and in exchange, they take pasta, rice, oil and sugar. People used to cultivate farms before twenty years but the last fifteen years people abandoned cultivation of land due recurrent droughts and persistent conflict, which affected the availability of food."* [Community key informant, Somali region]

> *".... Back then as I mentioned people used to drink milk only but now the milk they used to depend on is not even available. So naturally when something gets out from somewhere something else gets in. So, food has replaced the milk which people used to depend on back then. Previously, it was very rare to see trucks with exception of government vehicles. Now many vehicles arrive in Aware each day and mostly these tracks carry food and vegetable that are meant for business. They are bringing food, vegetables and other needs for the district. For that reasons availability of food has increased so far*." [Community key informant, Somali region]

> *"Previously the dietary intake of people was poor. People used to eat foods that did not contain enough nutrients. People used to eat the same type of foods such as meat, butter maize and sorghum. Mothers and others adults could survive this type of foods however; children did not receive nutritious diets in previous years. Children need different kinds of foods such as vegetables, fruits, rice pasta fish and milk. Nowadays people consume various diets that is rich in many nutrients. Dietary intake is better now than previous years because of the availability of many different foods. Previously people did not know vitamins. The availability of vitamins was limited to towns. Majority of the people lived in rural areas. Before twenty years health facilities did not exist in the rural areas. However, people now get vitamins and others nutrients due to easy access of all types of health services everywhere."* [Community informant, Somali region]

Infant and Young Child Feeding

Key informants perceived that there had been significant improvements in breastfeeding pattern such as initiation of breastfeeding, colostrum feeding, prelacteal feeding as well as frequency and duration of breast-feeding. However, key informants also mentioned that there are problems regarding mixed feeding and delay in the initiation of complementary feeding.

> *"Yes there is change. In the past when a child was born the colostrum was discarded and the baby was not allowed to breastfeed that. They were unaware about the health benefit of it. Now immediately they gave birth they will start breastfeeding. There is no colostrum discarding. On the frequency of the breastfeeding, also there is a change. Previously once they left the house they will be back after long time. But now they feed at least 10 or 12 times. They frequently breastfeed. So they have understood the health education we gave them on immediately breastfeeding and they are applying it."*[Health worker, SNNPR]

"The main problems related to nutrition and dietary intake of children includes mixed feeding because mothers feed their children food or milk before the age of complementary feeding in addition to breast milk. Mixed feeding causes health problem to the child." [Community informant, Somali region]

Dietary Recommendations

Key informants indicated that increased access to health care and increased availability of health workers considerably changed dietary recommendations including optimal breastfeeding, complementary feeding, WASH etc. Before the expansion of health services, the elderly from the community were the ones providing counseling regarding infant and young child feeding as well as nutrition during pregnancy.

"Back then, there was no good functioning health system because the number of health facilities and health workers were limited. Mothers do not come to health facilities searching for information regarding nutrition of their children. They obtain information from the society especially the older people and health workers when children got sick." [Community informant, SNNPR]

Key informants indicated that an increase in health education combined with the advice health workers now provide to mothers positively influence the dietary intake of children.

"We advise mothers to give care to their children. We also advise mothers to feed their children with balanced diets containing every nutrient that children require for better growth. We recommend mothers to feed their children with various foods. We also tell mothers to feed their children every type of food the child can eat. We advise mother to feed their children healthy and hygienic foods. Health workers also recommend mothers to keep the hygiene and sanitation of their environment. Health workers recommend mothers to continue giving their children the breast milk until two years in addition to the supplementary foods."[Community informant, SNNPR]

"After the health professionals start educating the community widely, the education also included the negative effect of introducing other food before the appropriate age. The inappropriate feeding might lead to malnutrition. Even their gastric is not mature enough to handle the food at that age. There might be also other concomitant diseases. After we came here, we started screening for the malnourished kids using MUAC. After screening, we also started referring them, so that they will get further treatment. At health center or hospital, they will get treatments like formula milk then they will get better. And those who have vegetables garden at their backyard will appropriately feed their children. Those who take our counseling seriously are improving, their family and their children too."[Health worker, SNNPR]

"There is better counseling ever since we started implementing focused antenatal care. We used to just check her weight and tell her that she needs to maintain her weight and that she shouldn't get hungry. But now we counsel her about the type of food she needs to eat and how many times a day she needs to eat." [Health worker, SNNPR]

However, they also mentioned that poor families could not afford to give a balanced diet to their children even after they understood its benefits.

"back in the days there used to be parents who did not properly utilize food because of lack of knowledge despite having access and thus their children were affected by malnutrition. And there are also parents with nothing to provide their children and who can't do nothing about it. You can counsel and change those parents with poor knowledge because they have access the challenge is for the parents who did not have anything. There is nothing we can do for them. So these days you only see malnutrition among that family who don't have anything. There is no one coming with malnutrition because of poor knowledge as long as they have access to food. This has changed because for example they have milk at home but instead of using it they used to sell it, same is true for egg. But now if you go to the market mothers from rural village will be in line to buy egg just like the rest of us. This indicates change, but there is nothing we can do for those parents who don't have anything." [Health worker, SNNPR]

Despite the improvements in dietary recommendations, they highlight that there was still a need for health workers who provide proper nutrition counseling.

"There is no nutrition professional. I didn't see health extension workers teaching about this. There are health extension workers down to the community but they don't give lessons about nutrition and what to eat. They might give lessons about other health issues but they don't tell the farmer to eat this and that so that he can be healthy and you can have a full diet if you wat with what you have doing this and this. So I say there is a gap regarding this." [Agriculture expert, SNNPR]

Maternal Factors

Key informants discussed contraceptive use and its impact on malnutrition. Key informants from the SNNP region perceived that access and choice for family planning services have improved over time. They also indicated substantial improvement in the utilization of contraceptives and hence resulting in better child spacing. However, key informants from the Somali region indicated that there has been no improvements in contraceptive utilization due to religious beliefs.

The following extracts illustrate these points:

"There is a lot of improvements in this regard. In the past, they used to give birth every other year. At that time they counseling was too low. They were not aware about the different types of family planning methods. Now there is one which is given every 3 month, 3 year. If she decides not to give birth, she can take the one for 3 years and if she changed her mind and wanted to give birth she can have a bay after the 3 years. If she wants to have more space, she can take the one for 5 year. They have all the choice. They use which ever method they want according to their choice. There is much improvement on this."[Health worker, SNNPR]

"A mother will not give birth to a child soon after having another child. if there is spacing a child will not be affected by malnutrition. Back in the days they keep giving birth to the extent where they can't even remember their name. but now that is no longer the case so family will not stress because of malnutrition. And that is a big advantage." [Health worker, SNNPR]

"They see it as a very bad thing to use contraceptive and the few ones who use, use it in secret and they do not tell anyone else. They say we are Muslims and Allah is going to feed the children and it's disobeying to space children for the fear of "what they would eat" and "who will feed them". When we told them it's not about who will feed them or what they will eat

then they say Allah gave it to us it's something that is out of our control. They also belief if they use contraceptives, they will lose fertility forever. Women who use family planning or other contraceptives to space pregnancy are very rare." [Community informant, Somali region]

Disease

Key informants indicated there had been a significant decline in childhood communicable diseases such as diarrhea, parasitic infestation, typhus, and skin and eye infection. They indicated that the achievement is made because of improved community awareness, and improved hygiene and sanitation.

"There were lots of cases of diarrhea as an outbreak. But now there is no diarrhea at all. It was like an epidemic before." [Health worker, SNNPR]

"Typhus used to be an outbreak before but now the numbers of cases are reduced. Cases of diarrhea, typhus, eye infection, scabies and skin infection are reduced in the health centers. This is a change that is brought because of community members become aware and start to keep themselves clean." [Health worker, SNNPR]

"As I was saying before there were some gaps on hygiene and sanitation of children. This is related to abdominal parasites that influence on the child's appetite and feeding practice. So there was a gap on preventing this parasitic infection through keeping children's hygiene" [Health worker, SNNPR]

"When we summarize people in this are protected from different diseases because of the drinking water and toilet facility. Back then, children were affected by diarrheal disease and different other diseases, but now due to the availability drinking water and toilet facility the burden of these diseases are decreased." [Health worker, Somali region]

4.3: Mothers in Communities Perspectives

We conducted FGDs with mothers of children under-5 born during the three time periods (1987-1991, 1995-1999, 2011-2015) when the country documented substantial stunting reduction. We analyzed the contextual, underlying and immediate factors elicited by community members and compared them across the three time periods to identify the factors that were salient in the time periods. Table 17 depicts a summary comparison of the regions (Somali and SNNP), and mothers with children born in 1987-1991, 1995-1999, and 2011-2015, highlighting key contextual, underlying and immediate factors and trends over time

Table 17: Summary and comparison of contextual, underlying and immediate factors elicited across mothers of children born in three time periods, Ethiopia

Location	Drivers	Mothers of children born in 1987-1991	Mothers of children born in 1995-1999	Mothers of children born in 2011-2015
Somali Region	**Distal Causes** *(For example: political context/stability/conflict, poverty reduction, education, women's empowerment, urbanization, labour migration/remittances)*	• Poverty represented a concern • Conflict, instability and insecurity was a concern • Education was not prioritized	• Poverty represented a concern • Conflict, instability and insecurity was a concern • Education was not prioritized • Improved infrastructures such as roads and housing • Women's income improved	• Poverty and poor living condition remained a concern • Boys and girl's education improved • Improved infrastructures such as roads and housing • Women's income improved
	Basic Factors *(Nutrition-Specific & -Sensitive Policies & Programs)*	• NA	• NA	NA
	Underlying Causes *(e.g., improved feeding practices and food security, improved care and health services, improved household environment/WASH)*	• Drought and water shortage was less of a concern • Food price was not a concern • Animal source foods were accessible • Health service was a concern • Access to safe water supply was a concern • Poor hygiene and sanitation	• Drought and water shortage was a concern • Price of food was a concern • Animal source food was less accessible • Health service was a concern • Access to safe water supply was a concern • Improved hygiene and sanitation	• Drought and water shortage was a concern • Price of food was a concern • Animal source food was less accessible • Health service access improved • Access to safe water supply was a concern • Improved hygiene and sanitation

	Immediate Causes *(e.g., improved dietary intake (infant and young child, dietary diversity, etc.), disease, maternal characteristics (parity, interpregnancy intervals, maternal age, maternal height) and child characteristics (low birthweight)*	• Vaccination and FP service was absent or inaccessible • Childhood illnesses were a concern • Sociocultural practice and taboos on diet	• Improved child health services such as vaccination • Childhood illness of lesser a concern since health service were available nearby • Suboptimal feeding was a concern	• Improved child health services such as vaccination • Childhood illness of lesser a concern since health service were available nearby • Suboptimal feeding was a concern
SNNPR	**Distal Causes**	• Women and girls education was not a priority in families • Poor infrastructure • No role of women in decision making	• Boys and girl's education improved • Improved infrastructures such as roads and electricity • Poor role of women in decision making	• Boys and girl's education improved • Improved infrastructures such as roads and electricity • Improved role of women in decision making
	Basic Factors (Policies & Programs)	• NA	• NA	• NA
	Underlying Causes	• Child care was less of a concern/priority • Less use of agricultural supplies • Poor health service access • Access to safe water supply was a concern • Poor hygiene and sanitation	• Child care was less of a concern/priority • Improved crop production, supplies and methods • Health service access improved • Access to safe water supply was a concern • Improved hygiene and sanitation	• Improved child care • Improved crop production, supplies and methods • Health service access improved • Access to safe water supply remains a concern • Improved hygiene and sanitation

	Immediate Causes	• Vaccination and FP service were absent or inaccessible • Childhood illnesses were a concern • Diet rich in animal source	• Improved child health services such as vaccination • Childhood illness of lesser a concern since health service were available nearby • Fruits and vegetables access improved • Child care improved • Suboptimal feeding was concern	• Improved child health services such as vaccination • Childhood illness of lesser a concern since health service were available nearby • Fruits and vegetables access improved • Child care improved • Suboptimal feeding was concern

N/A = Topic/issue was not discussed by mothers in FG

4.3.1 Basic Drivers of Stunting Decline in Ethiopia

Poverty

FGD participants identified poverty, peace and security, and women empowerment and education as the most prominent contextual/distal factors. Mothers in the Somali region, across the different year groups, indicated that poverty remains the most salient factor. The discussants acknowledged the big role government support programs such as the PSNP had on vulnerable segments of the population. In addition, mothers in the SNNP region with children born in 1995-1999 and 2011-2015 noted some improvements in living conditions.

> *"Needs of the communities are more. People are poor now and they do not have animals. I came this town when my animals died and I was dependent on the aid of the government."* [Mother FGD Aware, Somali, 1987-1991].

Conflict and Security

Next to poverty, conflict and insecurity were the most commonly raised factors in both regions and across the year groups. The prevailing conflict between rebels and the government, particularly in Somali regions, directly and indirectly affects the food security situation of the communities. FGD participants indicated that the instability and conflict has influenced nutrition among children in a number of ways. For example, the conflict had obstructed availability of foods in the market, caused decreased crop production, hampered transport, and affected trade between communities.

The following four extracts from the FGD transcripts illustrate these points:

> *"…Regarding food access, things have changed over the past 20 years. People were farming but as due to the insecurity and absence of peace the farming was halted…. Farmers were forced to abandoned their farms and migrated to the villages and towns where they ended up jobless …Currently families started to cultivate lands due to the peace agreement that have been reached between the government and the rebels, Thanks to Allah."* [Mother FGD Aware, Somali, 1995-1999].

> *"Now that there is no insecurity, people are free to go anywhere unlike previous times when we were handicapped. All these different types of vegetables that the lady has mentioned is a result of the peace that has resulted free movement of vehicles. Before there were a lot of fear and there were no vehicles to bring food and the vegetables that were just mentioned. Those days' people never dreamt of getting vegetable."* [Mother FGD Aware, Somali, 2011-2015].

> *"Even though we cultivate and produce crops, we were not able to sell it since it was not safe. We were not able to buy foods for our children. We were living with fear. But now it has changed and we are living in peace. We are producing foods and selling them on market in order to buy what is not available at home. We are also feeding our children with foods from both what we produce and the market."* [Mother FGD Yeki, SNNP, 1987-1991].

Moreover, more and more farmers were joining the military away from home and this has left a huge burden on the women to feed their kids.

> *"my husband was forced to join the military which I was all alone by the time. I was in stress that I have nothing to feed my children. I was forced to move to my mother's house so that I could feed them. I was worried and spend terrible time."* [Mother FGD Yeki, SNNP, 1987-1991].

Women Empowerment and Education

The next distal factors elicited during the discussion were related to the improvements in women empowerment and education. FGD participants highlighted that the value towards education in general and girls' education in particular had improved over time. This attitude change was due to observing the benefits of education, the change in values given to children, and the improved access to schools, infrastructures and transportation availability in the communities. Moreover, the observed empowerment of mothers benefited children in terms of providing appropriate care and nutrition to their children.

> *"Previously we were just pastoralists and housewives, we use not work but currently women are working and they have their own source of income and in a position to feed their children. If you work you will be in a position to care for children but if don't the child may not get the proper care, he/she is supposed to get".* [Mother FGD Harshin, Somali, 1995-1999].

> *"A mother who is educated feed her child with foods of better quality. This is because she is aware and wants her child status to be improved. But those mothers who are not educated feed their children whatever they got and is available at home."* [Mother FGD Yeki, SNNP, 1987-1991].

In addition, FGD participants indicated that the role of women in the household and their earnings, and productivity has improved over the three periods (1987-1991, 1995-1999, and 2011-2015).

> *"Our view of girl education is not the same now and then. We used to think that a girl that goes out early to learn was a bad girl. Our cattle's and our farms were of more value to us than education. We did not even know what education was. Now that we have seen the results of education, and I think is too late to realize it. We have seen how others surpassed us while we wronged our female children. We sent them to do household chores such as grinding maize while boys went to learn. No we copy the good we saw others do. Now we educate both genders equally. Salaam alaykum"* [Mother FGD Aware, Somali, 1995-1999].

> *"He used to do whatever he wanted with the money, but now I am working too; so we both have to discuss and decide when buying things and it is better now."* [Mother FGD Yeki, SNNP, 1987-1991].

4.3.2 Underlying Causes

FGD participants identified environmental shocks (drought), access to health services, food insecurity, and access to safe water as the most prominent underlying factors. Drought is a major concern particularly in the Somali region while the high market price of foods remain important challenges in both the Somali and the SNNP region.

Food Security & Feeding Practices

The women highlighted a complex pattern of food insecurity in their communities over the time period. In particular, for communities in the Somali region, the earlier period (1987-1991) was ideal for women in terms of availability of "*good food*." The availability of good foods such as meat, milk and butter was better before than the present. Most attributed this change in availability due to the recurrent drought the Somali region had faced in the recent years leading to the death of livestock in the communities. However, in the same communities, the availability of fruits, vegetables, and other crops had improved in the recent years because of the improved peace and stability, transportation system, and accessible markets.

"Children had better growth in previous years because we used to feed them with grounded maize (cooked maize flour), camel's milk, and butter. Now it is different from previous years. Because communities do not have enough animals and income for better growth of children." " [Mother FGD Aware, Somali, 1987-1991].

"…There is change in climate because it is much hotter than before, the number of animals has also decreased, and decreased access to nutritious food. So, the cause is climate change…" [Mother FGD Harshin, Somali, 1995-1999].

"The main reasons for the changes in children's nutrition are drought, environmental changes that resulted in death of animals." [Mother FGD Harshin, Somali, 1987-1991].

For communities in the SNNP region and across the groups, FGD participants highlighted an overall improvement in agricultural production due to better farming practices such as increased fertilizer use. Moreover, women affirmed an improvement in the availability and physical accessibility of diverse agricultural produces. The major bottleneck for these communities was linked to the imbalance between the selling prices of their produces and buying prices of commodities that they do not produce including crops, fruits, and vegetables.

"There is an improvement related to the farming method. I am a woman and work on back yard vegetables. Back then we were just plant the crops by scattering but now we plant them in more organized way. We plant using by the methods that the agriculture sector persons show us. So I could say there is a change." [Mother FGD Bonga, SNNP, 1995-1999].

"… although you sell it like that, one kilogram "teff" is now 25 birr. Even if we sell the corn at 800 birr per quintal, we can't even buy 50 kilograms of teff with the money. Calculate the price with 25 birr per kilogram. If I sell my corn with 600 birr, it can't even buy me 25 kg of teff. There is price inflation; what we buy is expensive…" [Mother FGD Yeki, SNNP, 1995-1999].

Improved Access to Health Services

Across all regions and groups, women reported considerable improvements in health service availability and accessibility in their communities over time. We documented distinct service utilization differences among the mothers with children born in 1987-1991, 1995-1999, and 2011-2015. The participants indicated that due to the unavailability of maternal health services, mothers with children born in 1987-1991 were delivering at home with the help of mother in laws and/or traditional birth attendants, and had poor antenatal care follow-up, immunization, and contraceptive services compared to the mothers with children born in 1995-1999 and 2011-2015.

"Despite the financial problems, ability to access care at health facilities now is much better than back then. Back then, all rural mothers were in the bush and did not have access to health care services. Even those in the towns were not that much urbanized; their life style was almost similar to that of the rural" [Mother FGD Harshin, Somali, 1987-1991].

"When I was in labour [my son Mohammed], help is from Allah, I lived in a rural place and the Traditional Birth Attendant assisted me. I raised him with the culture of the rural people. I raised him up with animal products. I have never visited a healthy facility during my pregnancies. I had learnt the skills from the traditional birth attendant and she never used gloves. She (the TBA women) sits under the women and delivers the women with the help of Allah. In addition, the baby gets out, we were all familiar with the traditional birth attendant and we used to call her for every delivery." [Mother FGD Aware, Somali, 1995-1999].

"My children are eight in number and all were delivered in my home except the last child, who is delivered at the health center. I was given injection that stops bleeding and given good care." [Mother FGD Harshin, Somali, 2011-2015].

The participants indicated that the improved health service expansion has brought more services and benefits to the communities. Women indicated that the health extension workers provided key messages regarding the importance of a diversified diet, exclusive breastfeeding, personal and environmental hygiene, backyard gardening of fruits and vegetables, as well as notable services including bed net provision, and malaria prevention education and outbreaks control.

"Back then we used to suffer. Mothers used to die on child birth, we used to bleed. But now we get vaccination, our children are getting vaccination. We get regular checkups and vaccination during pregnancy. We used to suffer a lot. But now we are getting benefits. children that are born currently are way better than those born before."
[Mother FGD Bonga, SNNP, 1995-1999].

Improved Household Environment: Water, Sanitation & Hygiene

Mothers in both regions and across the focus groups indicated that access to safe water supply remained the most derailing experience for the communities over two decades. Although women reported some improvements in parts of the respective regions where the government was drilling ground water, there still remained a huge gap in terms of safe water reaching the majority of the population. Safe water scarcity was exacerbated especially during the dry season and left a heavy burden on the women who were responsible for this chore.

"Water availability is very poor in Aware, although a borehole was drilled; now drinking from that borehole. The borehole water is clean compared to the birka water (water collected from rain) which is not suitable for drinking and actually we don't drink birka water instead we use it for washing clothes and other house chores." . [Mother FGD Aware, Somali, 1995-1999].

"there is no difference in water supply, we have always used river water. We used to also use spring water. Now we use rain water and people who have young children will send them to fetch water from another place…" [Mother FGD Bonga, SNNP, 1987-1991].

With respect to hygiene and sanitation, FGD participants indicated that there had been considerable improvements in the ownership and use of toilets and a reduction of open defecation. However, some women argued that not all community members owned and utilized toilets and there was a difference in capacity to construct one's own toilet. Therefore, these households tended to either share a toilet or continued to use open field. Women also indicated that a poor waste disposal system remained a concern in the communities.

"People started using latrines for the last fifteen years. Now you do not observe feces in open environments which is something different from previous years. Years back open defecation was common and the feces were scattered everywhere like animal feces." [Mother FGD Aware, Somali, 1987-1991].

"Very few people have toilets, people use open air, when I say open air, I mean there are at least some bushes where you can hide and that is where people help themselves. I prefer open air because the toilets smell bad. People cannot afford to dig toilets and some are forced to use open fields or share with those have toilets. A person with toilet is someone who has money and has ability to construct it and for those who cannot afford they use open air to help themselves." [Mother FGD Aware, Somali, 2011-2015].

4.3.3 Immediate Causes

Dietary Intake and Feeding Behavior

Breastfeeding was a common cultural practice in both regions and across the groups. In addition, women indicated that milk was an important core IYC diet in both regions. However, there was suboptimal breastfeeding and complementary feeding practises that were still a concern in both regions and across the groups.

Women perceived that the quality of food given to children was better years back compared to the present. This was attributed to the unavailability of animal source foods such as milk, meat, butter, and other animal products in the market. Moreover, women indicated that household farming was reduced due to the recurrent drought and as a result, the production of milk and animal products had decreased over time. For these reasons, the market price of milk and animal products was a current challenge.

Women also indicated that there is a difference in nurturing children in the past compared to the present. Mothers with children born in 1987-1991 indicated that the children used to be "*strong*" and that time was characterized by plenty of meat, milk, and butter compared to the present time where the focus is on childcare, hygiene and children follow-ups.

> *"I bought up my child in a good manner. I had camel and goats. We used to eat meat and drink milk and consume butter. Now children are weaker they do not drink milk…*" [Mother FGD Aware, Somali, 1987-1991]

> *"First I want to thank God for getting us to this day. There is a big difference between now and then. Back then we wouldn't wash the children when they were born; but now we wash them. We are also immunizing them. There is a change."* [Mother FGD Bonga, Somali, 1995-1999]

Sociocultural issues such as giving "holy water" to the child before initiating breastfeeding continued to be practiced. Boiled water, milk, sugar, honey and butter were also culturally important foods given before initiating breastfeeding.

> *"I gave my child holy water and sugar immediately after birth. I gave him cow's milk after holy water. The next morning, I breast-fed my child."* [Mother FGD Aware, Somali, 1987-1991].

> *"I gave holy water to Safiya first and then breast milk. My breasts had plenty of milk. Tahlil (holy water) or Ashar is the Quran will help to have good understanding and tender to his parents. We did Adhan (prayer call) as well. We still do Adhan. We expect good from Allah. That's why we give them tahlil."* [Mother FGD Harshin, Somali, 1987-1991].

> *"When my son Mohamed was born, we gave him holy water since the breasts were empty. Religiously, prayer calls should be done in the newborns' ears but giving the holly water immediately after birth is part of our culture. I gave him boiled water with sugar and camel milk for the 1st three days because he could not get enough of the breast milk after birth."* [Mother FGD Aware, Somali, 1995-1999].

FGD participants also elicited a number of foods that are culturally not given, children used to be forbidden to eat uncooked foods or raw fruits. some individuals continue to restrict the consumption of these foods by children.

The following are some extracts that illustrate the above points:

> *"there was a fear cold and raw food to cause abdominal cramp. Because of these we didn't feed our children these foods. But after we got the knowledge we start to feed mangos that are healthy."* [Mother FGD Yeki, SNNP, 1987-1991].

> *"mango was one of the fruits that were restricted. It was believed a child might get sick if he/she eats mango so it was restricted."* [Mother FGD Yeki, SNNP, 1987-1991].

> *"injera is not allowed for children less one years of age. Unless a child is able to pee by him or herself, it is not allowed to feed injera. It is better to give pitta, gruel and porridge."* [Mother FGD Bonga, SNNP, 1987-1991].

The expansion of health services combined with health education provided by the extension program had contributed to the reduced misconception related to culturally "*inappropriate diets*". Women also indicated the health education they received from the HEP has helped them start the production of fruits and vegetables in the communities.

> *"Back then, we used to commonly feed kale to our children but now we are feeding them "metin" (a gruel made of different cereals). Now we breastfeed them until they are 6 months old and give them "mitin" after that."* [Mother FGD Bonga, SNNP, 2011-2015].

Child Characteristics and Disease

The FGD participants indicated that the burden of childhood diseases has declined in their communities over time and this was attributed to the increased availability of health services. Mothers with children born in 1995-1999 and 2011-2015 reported that their children received vaccination services, and had improved access to care and treatment at a nearby health facility. Although children born in 1987-1991 faced similar childhood diseases, the mothers were not able to take their kids to a health facility as the health facilities were either very far or not available in their respective communities. Therefore, these mothers heavily depended on traditional healers.

Across the focus groups and regions, mothers elicited common diseases and health conditions such as diarrhoea, vomiting, skin problems, and malnutrition that affected their children. Mothers attributed this problem to the unavailability of vaccination services in their communities and poor feeding practices.

> *"The children I had before the change used to get sick a lot because of malnutrition and other diseases. But the children I have after change are very fine. Even if they get sick we take them to health centers, we give them medicine on time. Even the disease does not occur now."*[Mother FGD Bonga, SNNP, 1995-1999].

> *"there is a lot of improvement, our children are healthier. Children in the past used to get sick a lot but now our children are healthy thanks to God. Most people are educated now, there is health center nearby so we get different counseling. Everyone is getting education and counselling so children are getting different fruits and different types of foods…"* [Mother FGD Yeki, SNNP, 2011-2015].

Maternal Characteristics

Maternal characteristics including maternal age, height, fertility and inter pregnancy spacing were not discussed by community level respondents as factors that have contributed to improved nutrition.

Conclusion

This qualitative analysis highlighted key contextual/distal, policy/program efforts, underlying and immediate causes of stunting decline according to national and community level respondents.

At the national level, the overall improvement in economy, expansion of health services, improved access to education, improved women and girl's education and empowerment, and improved agricultural production were the most prominent factors that have contributed to the stunting reduction in the country. In addition, the introduction of the Productive Safety Net Program as well as the Health Extension Program contributed a lot to the observed stunting reduction in the country.

At the regional level, respondents identified improvements in access to health services, education, market access to foods, and peace and stability as important causes for improved nutrition.

Mothers in communities identified reduction of poverty, peace and security, and women's empowerment and education as the most prominent contextual/distal factors. Women also identified environmental shocks (drought), improved access to health services, and food security the most prominent underlying factors while the decline in the burden of childhood diseases and improved child care practices as the key immediate causes in stunting decline. However, mothers indicated that drought, high market prices of foods, and access to safe water remain the most important challenges in both regions.

Chapter 5: Nutrition Policy and Program Timeline and Financing

In this chapter, we aim to address study objectives 3 and 4. That is:

- To generate a systematic landscape of the major stunting-relevant policies and programs in Ethiopia, with focus on both nutrition-specific and –sensitive initiatives; and
- To track and document nutrition-related investments in Ethiopia by government and partners (e.g. financial allocations, expenditures).

As detailed in the methodology, results tabulated here were informed by the literature review, qualitative and quantitative data, and expert consensus.

First, we present a timeline graphic of key nutrition-relevant policies and programs that were recognized as central to stunting reduction in Ethiopia (Figure 38). Next, basic summary information is provided on each initiative and arranged in chronological order. An in-depth review of each initiative including as much of the below information as we could track through literature and consultations with key stakeholders is provided in Appendix 14. These broad and specific areas are also formally defined in Appendix 14.

- Description
    - An overview of the major objectives of the program/policy
    - Area of the country where the program/policy was delivered
    - Population reached (number of people reached, setting)
    - Details of scale-up

- Delivery Platform: is the channel by which a nutrition-specific intervention reaches the population in need.
    - Fortification-based platforms
    - Financial incentive-based platforms
    - Community-based platforms
    - School-based platforms
    - Technology-based platforms
- Key stakeholders
- Initiation process
- Key components
- Monitoring and Evaluation of Implementation
- Funding
- Success factors/barriers

We subsequently provide an overview the type of delivery platform used for key policies/programs (Section 5.4). Finally, we summarize the obtainable data on financial allocations/ actual disbursements and budgets/expenditures of the various initiatives identified in the policy and program timeline. It should be noted that several data gaps may exist due to limitations in trackable/available information.

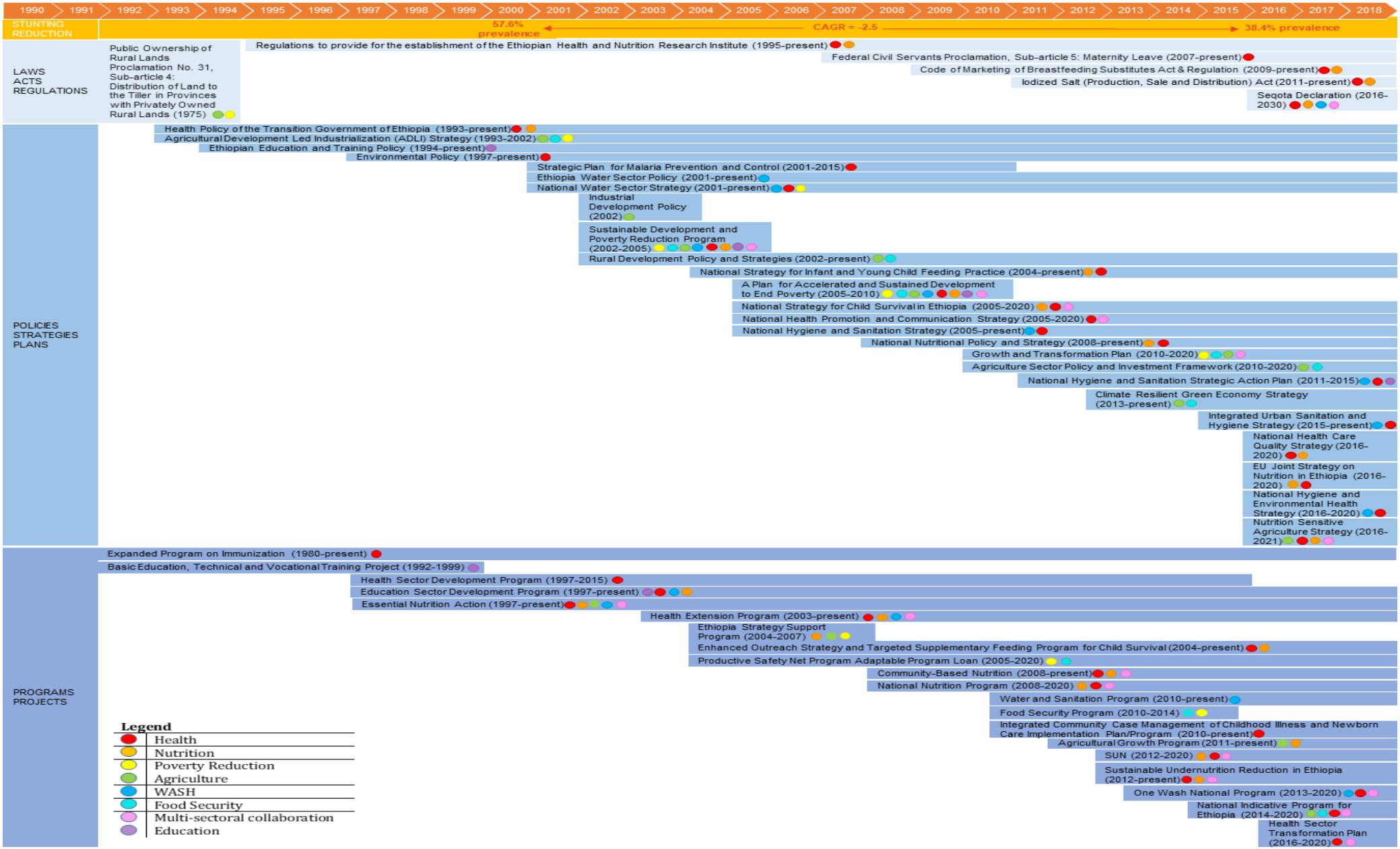


Figure 38: Overview of laws, policies, programs, and enablers between 1990-present in Ethiopia

5.1: Laws, Acts and Regulations

Further details on these laws, acts and regulations such as information on the initiation process, funders, and reforms can be found in Appendix 14.

ACTS/LAWS/REGULATIONS		
1. Regulations to Provide for the Establishment of the Ethiopian Health and Nutrition Research Institute (EHNRI) (1962- present)	Description	The Ethiopian Health and Nutrition Research Institute conducts research at the national level on the causes and spread of disease, as well as focusing on nutrition, traditional medicines, medical practices and modern drugs. It seeks to contribute to the advancement of health science and technology through data collection, research and study. Research duties of the Institute include research on the production of diagnostic, prophylactic and therapeutic substances; traditional drugs and practices; nutrition and food science and the prevention of diseases due to malnutrition. The Institute is given the power to study the cause, health impact and distribution of diseases as well as the production of traditional drugs. It was established with the duty to prepare a pharmacopeia of traditional drugs and enable traditional medicine practitioners to develop their profession through training in order to improve the quality of their services. Since its beginning, this institute has contributed to nutrition and public health interventions but has not significantly contributed to research activities (71,72).
	Importance	Likely important as a long-standing platform for gathering and sharing evidence for action focused on nutrition.
	Theme(s)	Health Nutrition
2. Public Ownership of Rural Lands Proclamation No. 31, Sub-article 4: Distribution of land to the Tiller in Provinces with Privately Owned Rural Lands (1975)	Description	The Public Ownership of Rural Lands Proclamation No.31 was initiated in the wake of the ouster of Emperor Haile Selassie from power in 1974, following the failure of his government to adequately address pervasive socio-economic issues and the famine of 1973/1974. Proclamation No. 31 was announced in 1975 by the Provisional Military Administrative Council (PMAC), commonly referred to as the Derg. It posits that any individual willing to cultivate land is to be given this land so long as it does not exceed 10 hectares. The Proclamation was designed to promote equality and economic development by removing the feudal system and land tenure system from Ethiopia. However, the evaluation of its implementation found that it did not lead to significant, positive productivity or improvements in the standard of living (73,74).
	Importance	Very Important
	Theme(s)	Agriculture Food Security
3. Federal Civil Servants Proclamation, Sub-Article 5: Maternity Leave (2007-present)	Description	The Federal Civil Servants Proclamation was created in 2007 and reformed in 2017. Based on the broader leave parameters of the 2017 reform, pregnant civil servants are entitled to paid leave for pre-natal medical examinations and paid maternity leave, in accordance with a physician's recommendation. 30 days leave before birth and 90 days after delivery for a cumulative total of 120 days of paid leave are allowed. Paternity leave is also allowed for 10 days from the time of delivery (75,76).
	Importance	Likely not important for stunting decline
	Theme(s)	Health
4. Code of Marketing of Breast-milk Substitutes Act & Regulation (2009 – present)	Description	The Code of Marketing of Breast-milk Substitutes aims to protect and promote breastfeeding and ensure the proper use of breastmilk substitutes when necessary. It sets out national responsibilities of the infant food industry, health workers, national governments and concerned organizations. This code applies to all products marketed to replace breastmilk and encourages breastfeeding by restricting aggressive marketing used to sell breastmilk substitutes. The code bans advertising breastmilk substitutes to the public and to health care workers. Under this code, samples and gifts of breastmilk substitutes are not to be given to mothers or healthcare workers and information on artificial feeding products must be science-based and not idealized. The superiority of breastfeeding must also be highlighted in information about artificial feeding options. Unsuitable products such as sweetened condensed milk are not to be marketed for babies. A 2018 evaluation of the code found that it had few legal provisions, and that information gaps existed in several of the enforceable areas of the code, as well as the criteria of the monitoring mechanism (77,78).
	Importance	Not important to stunting decline

	Theme(s)	Health
		Nutrition
5. Iodized salt (Production, Sale and Distribution) Act (2011-present)	Description	The Iodized Salt Act was established in 2011 and related to the importation, storage, transportation, distribution or sale of iodized salt for human consumption, in order to prevent and eradicate the public health effects of iodine deficiency in Ethiopia. Though iodization of salt began in the 1980s, progress was slow due to war and a lack of a clear enforcement strategy. This Act has helped to progressively increase the iodization of salt and included elements such as household visits, social promotion, committee creation and resource mobilization. Household iodized salt coverage increased from 15.4% in 2011 to 89% in 2016 (79–83).
	Importance	Likely not important
	Theme(s)	Health
		Nutrition
6. Seqota Declaration (2016-2030)	Description	The Seqota Declaration aims to ensure universal access to nutritious food in the first 1000 days of a child's life through the use of multi-sectoral nutrition-sensitive interventions around education, water, sanitation and social protection. Nutrition-specific interventions and the empowerment of women/girls is also supported through the Seqota Declaration. From 2016 to 2020, implementation is at a regional level around Tekeze River basin. National implementation is planned from 2020-2030. Key goals of the Declaration include: Zero stunting in children under-2 years old; 100% access to adequate food all year round; transformed smallholder productivity and income; zero post-harvest food loss; innovation in climate smart sustainable food systems; water, sanitation and hygiene; education and social protection. Multi-channel social and behavior change communication and community development will be utilized to achieve these goals (84).
	Importance	Promising recent initiative
	Theme(s)	Health
		Nutrition
		WASH
		Multi-sectoral Collaboration

5.2: Policies, Strategies and Plans

Further details on these policies, strategies and plans such as information on the initiation process, funders, and reforms can be found in Appendix 14.

POLICIES/STRATEGIES/PLANS		
1. Health Policy of the Transition Government of Ethiopia (1993-present)	Description	The Health Policy of the Transition Government of Ethiopia was created following the end of the Derg government, who had struggled to enact their envisioned health policy. The transitional government's health policy resulted from an assessment of the current state, extent and causes of existing and emerging health problems in the country. It focuses especially on women and children, the rural population, the poor, minorities, those affected by disaster, and those working at the forefront of economic productivity. Major components of this health policy include the decentralization and democratization of the health system; preventative and promotive components of health care; equitable standards of healthcare; promoting and strengthening inter-sectoral activities and maximally utilizing internal and external resources; strengthening international collaboration in relation to all activities contributing to health development; capacity development; capacity building; and promotion of participation of the private sector and NGOs. Priorities of this policy include information, education, support and communication related to a number of public health initiatives including: communicable diseases; malnutrition; mental health; occupational health; environmental health; and health management and infrastructure. This policy also aimed to conduct applied research and provide essential medicines, staff and equipment while concurrently acknowledging and giving attention to traditional medicine (85).
	Importance	Very important
	Theme(s)	Health
		Nutrition

2. Agricultural Development Led Industrialization (ADLI) Strategy (1993-2002)	Description	The Agricultural Development Led Industrialization Strategy (ALDI) is seen as the overarching strategic framework guiding Ethiopia's development. Its main objective focuses on strengthening ties between agriculture and industry by improving productivity among small-scale farmers and investing in industry in rural areas. The major motivation of this strategy is the presumption that strengthening of these sectors will motivate the economy in rural areas. Key components of this strategy focus on achieving rapid growth in agricultural production, raising incomes for rural families, achieving nation food self-sufficiency, and producing surpluses for sale within urban areas. This strategy utilizes a two-pronged approach which focuses on agricultural production and domestic manufacturing based on agro-processing. Agriculture and industry are expected to be expanded through this strategy for consumption domestically and via exports, while also reducing food insecurity. From this strategy came the Industrial Development Policy/Strategy (IDS), which was announced in 2002 (86,87).
	Importance	Very important
	Theme(s)	Agriculture
		Food Security
		Poverty Reduction
3. The Ethiopian Education and Training Policy (1994-present)	Description	The Ethiopian Education and Training Policy was launched to expand equitable access to relevant, high quality education across the country. The key objectives of this policy include providing equitable access to primary education and vocational training; restructuring the education system; changing the curriculum to increase the relevance to the community context; and overall quality improvement throughout the education system. The policy aims to improve the physical and mental potential of individuals and develop citizens who can utilize resources, respect human rights and equality and realize the full potential of all Ethiopians. This policy includes implementation strategies for formal and non-formal education, and led to the Education Sector Development Program, which began in 1997 (88).
	Importance	Very important
	Theme(s)	Education
4. Environmental Policy (1997-present)	Description	Ethiopia's Environmental Policy has the overall goal of improving and enhancing the health and quality of life of all Ethiopians, and promoting sustainable development through sound management and use of natural, human-made and cultural resources, as well as the overall environment. Focus is on sustaining biological diversity and renewable natural resources in order to improve the lives of the current generation while preserving the environment for future generations. The policy aims to develop, adapt and disseminate new technologies to develop under-utilized natural resources and manage the exploitation of non-renewable resources. Its guiding principles allow each community the right to a healthy environment and gives these communities the ability to make decisions to sustainably manage their resources. This also policy promotes social equity and the empowerment of women to be fully involved in decision-making and project design. It aims to integrate natural resource and environmental management across sectors with consideration and adjustment to full environmental cost pricing in the form of taxes, fees and incentives. While this policy is theoretically comprehensive, implementation has not resulted in significant environmental outcomes. This is likely due to a lack of resources, expertise and conflicting policies (89,90).
	Importance	Likely important (as the country's major policy focused on improving environment) but insufficient evidence
	Theme(s)	Health
5. Strategic Plan for Malaria Prevention and Control (2001- 2015)	Description	The Strategic Plan for Malaria Prevention and Control has the overall goal of reducing morbidity and mortality from malaria through expansion of the diagnosis, treatment, prevention, surveillance and control of the disease. The Plan focuses on scaling up malaria prevention and control activities alongside the Accelerated Expansion of Primary Health Care Coverage, with special attention paid to the capacity of Health Extension Workers (HEWs) in malaria prevention and control. Goals of this Strategic Plan include the widespread coverage of ACTs (artemisinin combination therapies), insecticide treated bed nets, indoor residual spraying and increased training across the health system. Activities focus on case management; selective vector control; epidemic prevention and control; information, education and communication (IEC) and behavioral impacts; and

		capacity building. This Plan is reformed and scaled up in 5 year intervals with increases in coverage goals at each reformation. The success of this plan has been supported by strong political commitment and robust malaria policies as well as strong financing from the government and outside donors. Challenges in the implementation of this plan have been associated with the absence of tracking and monitoring systems, high turnover of health staff, logistics, limited equipment and delays at the district level (91–96).
	Importance	Likely important (since very effective program and contributed to reduced disease burden) but insufficient evidence to link program to stunting decline
	Theme(s)	Health
6. Ethiopian Water Sector Policy (2001- present)	Description	The Ethiopian Water Sector Policy aims to develop water resources in an equitable and sustainable way for the economic and social benefit of the country's people. Among its goals is to mitigate disasters such as drought and flooding through efficient management of water resources. Objectives include the equitable, efficient and sustainable allocation of water and the conservation and protection of water resources. This policy identifies water as an economic and social good, commonly owned by the people of Ethiopia, each of who shall have adequate water of acceptable quality. This policy indicates that the development of water should be decentralized via multi-stakeholder participation, and especially the participation of women in water management. The policy is translated into action through the National Water Sector Strategy (97).
	Importance	Likely not important to observed stunting decline given limited improvement in water sector and no major national programs linked to this policy
	Theme(s)	WASH
7. National Water Sector Strategy (2001-present)	Description	The National Water Sector Strategy provides an action plan for meeting the goals of the Ethiopian Water Sector Policy. This strategy implements guidelines for water supply and sanitation services, including livestock watering, and more broadly supports poverty reduction and sustainable human resources development. This strategy aims to improve living standards and socioeconomic wellbeing while improving water resources. Key objectives of this strategy include: improving people's living standard and socio-economic well-being; allowing Ethiopians to realize food self-sufficiency and food security; extending water and sanitation coverage and improving environmental health; generating additional hydropower; utilizing water resources to achieve national development priorities; and promoting integrated water resource management (98).
	Importance	Likely not important to observed stunting decline given limited improvement in water sector and no major national programs linked to this policy
	Theme(s)	WASH Health Food security
8. Industrial Development Policy/Strategy (IDS) (2002)	Description	The Industrial Development Policy/Strategy (IDS) endeavors to work towards a broader goal of agriculture-led industrialization, export-led development and labor-intensive industries. It aims to ensure the competiveness of Ethiopian goods in international markets and as a result, export-oriented sectors are given preferential treatment. The government therefore plays a leading managerial role in this policy and in the implementation of domestic-foreign partnerships. IDS is linked to subsequent development plans within the country such as the Sustainable Development and Poverty Reduction Program (SDPRP) and the Plan of Action for Sustainable Development and Eradication of Poverty (PASDEP) (87,99,100).
	Importance	Very important
	Theme(s)	Agriculture
9. Sustainable Development and Poverty Reduction Program (SDPRP) (2002-2005)	Description	The Sustainable Development and Poverty Reduction Program strives to reduce poverty and maintain macroeconomic stability for Ethiopia. This Program aimed to reduce poverty by 10% and increase the GDP by 7% by 2005. These economic improvements were expected to be achieved through: a focus on agriculture; strengthening private sector growth and development; increased exports, especially for high value agriculture products and skins, leather and textiles; investment in education to build capacity; decentralization of decision making to improve responsiveness; research on agriculture including water harvesting and small scale irrigation; and increased water resource utilization (101).
	Importance	Very Important
	Theme(s)	Poverty Reduction

		Food Security
		Agriculture
		WASH
		Health
		Nutrition
		Education
		Multi-sectoral Collaboration
10. Rural Development Policy and Strategies (2002-present)	Description	The Rural Development Policy and Strategies works to minimization the need for foreign aid through the development of a market economy where rapid growth is assured and all Ethiopian people may benefit. To achieve this, a number of strategies are utilized including: providing basic direction to agricultural development; strengthening the agricultural labor force; proper use of land; preparing area compatible development packages; working towards market-led agriculture development; improving rural finance; promoting private sector participation in agricultural development; strengthening non-agricultural rural development activities; and managing rural development. This approach has experienced a number of challenges in its implementation including inadequate infrastructure, difficulty among farmers in acquiring new knowledge and technological backlog (87,99,100).
	Importance	Very important
	Theme(s)	Agriculture
		Food Security
11. National Strategy for Infant and Young Child Feeding Practice (2004-present)	Description	The National Strategy for Infant and Young Child Feeding Practice is focused on standardizing infant and young child feeding in order to improve child health and clarify the roles of those responsible for promoting these feeding practices. This Strategy outlines targets based on child age. For children 0-6 months it promotes immediate initiation of breastfeeding; colostrum feeding; exclusive breastfeeding for the first six months; and adequate nutrition, support and care for lactating mothers. For children 6 to 24 months targets include: maintaining breastfeeding for up to two years; practicing responsive feeding; proper preparation and storage of complementary foods; adequate feeding based on a child's age; appropriate food consistency, frequency and density; adequate nutrition provided by complementary foods; use of vitamin and mineral fortified products as needed; and continued feeding during illness. Targets are also specifically outlined for the feeding of infants and young children living with HIV/AIDs. Despite these recommendations, recent monitoring has shown that this strategy has not been fully executed, with front-line medical staff lacking updated guidelines (102,103).
	Importance	Likely important but insufficient evidence regarding effectiveness and impact on child stunting
	Theme(s)	Nutrition
		Health
12. A Plan for Accelerated and Sustained Development to End Poverty (PASDEP) (2005-2010)	Description	A Plan for Accelerated and Sustained Development to End Poverty (PASDEP) aims to pave the way to achieve the Millennium Development Goals by 2015. It aims to build a foundation upon which Ethiopia is able to become a middle income country in the next 20-30 years through rapid and enduring economic development. This plan utilizes a number of strategies to provide direction in meeting its goals. Strategies include: managing the balance between economic and population growth; empowering women; accelerating growth and implementation capacity; managing risk; creating employment; and strengthen infrastructure and human resources. The scope of PASDEP is large—policies, strategies and programs drafted as part of PASDEP are associated with every industry including agriculture, healthcare, water and child nutrition. At implementation, base case and high growth scenarios were determined for GDP as well as agriculture, industry and services. Ethiopia was able to exceed the high growth scenario for GDP, agriculture and services but fell short of even the base case scenario for industry. Success was achieved through the use of small scale agriculture diversification, capacity building, investment in infrastructure and growth of non-agricultural production. Challenges throughout the process of achieving the Plan's stated goals included climate challenges, low domestic saving, difficulty in collecting domestic revenue and high inflation (104,105).
	Importance	Very Important
	Theme(s)	Poverty Reduction
		Food Security

		Agriculture WASH Health Nutrition Education Multi-sectoral Collaboration
13. National Strategy for Child Survival in Ethiopia (2005-2020)	Description	The National Strategy for Child Survival in Ethiopia aims to achieve universal high quality health coverage for mothers and newborns in communities and health facilities. It also aims to utilize community empowerment for interventions and reduce neonatal and child mortality rates nationally. Within the community, this strategy utilizes Health Extension Workers (HEWs) to identify and refer sick children to appropriate care; encourage breastfeeding; support healthy newborn care; and promote contraception for birth spacing. Facilities manage cases referred by HEWs and provide treatment, disease testing and advice for feeding. Mass media communication via radio is utilized to support these activities. Interventions under this strategy specifically target maternal and neonatal care, nutrition and disease control in an effort to reduce the under-five mortality rate to less than half of the 2013 rate by 2020. Guiding principles of this strategy include: equity and accessibility; community engagement; integration across the health system; evidence-based innovation; provision of quality service; responsiveness; evidence-based decision-making; efficient resource use; and strong monitoring and communication of best practices. The success of this strategy is a result of strong commitment, collaboration and funding across sectors, decentralization of health services, increased opportunity for women and girls and the implementation of related programs and policies. Barriers to this program include limited coverage, human resources, and lack of a robust health information system. Staff were also limited by lack of advanced training, lack of motivation and staff shortages (106,107).
	Importance	Very important
	Theme(s)	Nutrition Health Multi-sectoral Collaboration
14. National Health Promotion and Communication Strategy (NHPCS) (2005-2020)	Description	The National Health Promotion and Communication Strategy aims to coordinate health communication and promotion within the country. This strategy guides health education and communication in order to improve knowledge and attitudes using evidence-based best practices. It aims to reduce barriers to behavior change and improve social determinants of health through strong multi-sectorial communication. It utilizes a range of communication strategies and technologies to improve health communication, including the use of mass and social media as well as dissemination of information through community groups. This strategy seeks to empower communities by improving capacity at the community level through the use of standardized guidelines as well as monitoring and evaluation (46).
	Importance	Likely important
	Theme(s)	Health Multi-sectoral Collaboration
15. National Hygiene and Sanitation Strategy (2005-present)	Description	The National Hygiene and Sanitation Strategy aims to reduce fecal contamination and the spread of waterborne diseases. Its main goal is to prevent feces from entering the living environment and disrupting the fecal-oral route of disease. To achieve this, the strategy puts responsibility of hygiene improvement at the household-level with additional resources provided by community-level health workers. Three pillars represent the foundation of this strategy—Pillar 1 involves the creation of enabling environments through capacity creation, evaluation and supporting finance and policy; Pillar 2 includes the promotion of hygiene and sanitation through communication, community participation and social marketing; and Pillar 3 centers on the improvement of access to technology to facilitate waste management and water supply capabilities. The National Hygiene and Sanitation Strategy falls under the Health Sector Development Program, which focuses on public health interventions that are expected to have significant impact and reach (108).
	Importance	Very important
	Theme(s)	WASH Health

16. National Nutritional Policy and Strategy (NNS) (2008-present)	Description	The National Nutritional Strategy has an overarching goal of ensuring the best nutrition possible for all Ethiopians. This strategy provides particular focus to the nutrition of vulnerable populations and aims to protect all citizens from malnutrition-related health problems, including unhealthy dietary patterns and lifestyles. Nutrition coordination across sectors working towards improvements in nutrition is an additional goal. The use of health facilities at the community level to provide education, growth monitoring, and care improvement, as well as fortification based interventions (i.e. Vitamin A supplementation and salt iodization) are key components of this strategy (83,109).
	Importance	Likely important but late introduction so may not have impact on national stunting change
	Theme(s)	Nutrition Health Multi-sectoral Collaboration
17. Growth and Transformation Plan (GTP) (2010-2020)	Description	The Growth and Transformation Plan (GTP) has the overarching goals of improving economic growth and ending poverty. Its objectives include maintenance of 11% GDP growth, improvements in the quality of education and health, and engaging in sustainable state building and macroeconomic frameworks. Pillars of this plan include quicker and more equitable economic growth with a focus on agriculture; developing an environment that is friendly to the growth of industry; expanding infrastructure and social development quality; empowering women and youth; and ensuring good governance. Monitoring of this program is done through the use of a census, administrative and survey data currently utilized by the Welfare Monitoring System Program (110,111).
	Importance	Very Important
	Theme(s)	Poverty Reduction Food Security Agriculture Multi-sectoral Collaboration
18. Agriculture Sector Policy and Investment Framework (2010-2020)	Description	The Agriculture Sector Policy and Investment Framework utilizes policy instruments in an aim to increase agricultural production and food security, resulting in the achievement of middle-income status for Ethiopia by 2020. Its objectives include improved productivity in agriculture and natural resources, improved commercialization and industrialization of agriculture, and universal food security. This initiative utilizes a number of key components to reach its objectives. For example, to improve production, it aims to increase the capacity of the least productive farmers in the country and move farmers to semi-commercial farming in order to improve food security. The management of natural resources will also be done in a sustainable way to reduce degradation (112).
	Importance	Promising recent initiative
	Theme(s)	Agriculture Food Security
19. National Hygiene and Sanitation Strategic Action Plan (2011-2015)	Description	The National Hygiene and Sanitation Strategic Action Plan aims to achieve universal basic sanitation in Ethiopia by 2015. It includes multiple objectives to improve sanitation, hand washing, and reduce open defecation. It is intended to empower communities and increase access to facilities and services while improving emergency preparedness, regulation and human capacity for the implementation of good sanitation practices. This plan implements school and community-based interventions to educate and provide appropriate resources and hardware (e.g. improved latrines) to empowered communities (113).
	Importance	Promising recent initiative
	Theme(s)	WASH Health Education

20. Climate Resilient Green Economy (CRGE) Strategy (2013-present)	Description	The Climate Resilient Green Economy Strategy aims to increase the per capita GDP to $1000 USD and achieve middle-income status by the year 2025, and prevent an increase in greenhouse gas emissions above the levels seen in 2013. This strategy consists of both a plan for a green economy and a plan for climate resilience. It also has specific goals around improving food security, production and income while reducing emissions, leapfrogging to energy efficient technology and the use of renewable sources of energy. Additionally, it aims to protect and re-establish forests. Specific initiatives have been selected to fast track these goals, including: exploiting Ethiopia's vast hydro-power potential; large scale promotion of advanced rural cooking technology; efficient improvements in the livestock value chain and REDD+ (87,114).
	Importance	Promising recent initiative
	Theme(s)	Agriculture Food Security
21. Integrated Urban Sanitation and Hygiene Strategy (2015-present)	Description	The Integrated Urban Sanitation and Hygiene Strategy was created to reduce the impact of poor sanitation on health by implementing sanitation systems, encouraging behavioral change, and strengthening regulatory and institutional capacities. Key elements include the construction of latrines at the community level as well as providing adequate sanitation in schools. These interventions are supported by communication encouraging behavior change through mobile SMS messaging and print media. Goals of this strategy include the elimination of open defecation by 2020, universal access to latrines and toilets, significant goals for waste management and healthcare waste and strengthening the capacity of the sector as a whole through the creation of a coordination body and the creation of a monitoring system and sanitation database (115).
	Importance	Promising Recent initiative
	Theme(s)	WASH Health
22. National Health Care Quality Strategy (2016-2020)	Description	The National Health Care Quality Strategy aims to increase access to health care for all Ethiopians, as well as improve clinical care and patient safety. It utilizes interventions within facilities and within communities to improve quality of care and create awareness among patients and health care workers of best practice strategies. It aims to improve health care quality across a number of domains including effectiveness, patient safety, patient centeredness, access and equity. This strategy focused on five key areas which were expected to result in the greatest improvement to the health system: maternal and child health; nutrition; communicable diseases; chronic diseases; and clinical and surgical services (116).
	Importance	Promising recent initiative
	Theme(s)	Health Nutrition
23. EU Joint Strategy on Nutrition in Ethiopia (2016-2020)	Description	The EU Joint Strategy on Nutrition in Ethiopia aims to contribute to the National Nutrition Program and the Seqota Declaration. This Joint Strategy has objectives focused on achieving a common understanding of development challenges, filling gaps, determining guiding principles with EU partners, improving quality of policy discussions, making current financing more effective and enhancing the leverage of EU support. Because of the European Commission's commitment to reduce stunting in 7 million children globally by 2025, nutrition has been chosen as the theme through which to collaborate with member states. Notable components of this strategy include increasing capacity; designing common monitoring and evaluation systems; empowering women; addressing foodborne and waterborne diseases; internal cooperation; and community focused approaches (117).
	Importance	Promising recent initiative
	Theme(s)	Nutrition Health
24. National Hygiene and Environmental Health Strategy (2016-2020)	Description	The National Hygiene and Environmental Health Strategy was designed to support the Health Sector Transformation Plan and is implemented with a vision to prevent disease and promote health, safety and wellbeing. The objectives of this strategy include improving access to adequate, safe and equitable sanitation and water; improving food safety; control of communicable and vector borne diseases; community empowerment; and reduction in pollution exposure. Major components include sanitation, personal hygiene, water quality, food hygiene, housing and institutional health, vector control, pollution and occupational health and safety (118).

	Importance	Promising recent initiative
	Theme(s)	WASH
		Health
25. Nutrition Sensitive Agriculture Strategy (2016-2021)	Description	The Nutrition Sensitive Agriculture Strategy was created to add value to the National Nutrition Program and Seqota Declaration, and to ensure that Ethiopia's food system has positive impacts on nutrition outcomes, with a particular focus on women and children. This strategy has a number of major objectives including leveraging nutrition into agriculture policies; strengthening organizational structures and capacity; improving year-round availability, access and consumption of nutritious foods; community resilience; empowerment of women and gender equality; and the establishment and strengthening of multi-sectoral coordination. It works towards strengthening multi-sectorial coordination between sectors and development partners (119).
	Importance	Recent promising initiative
	Theme(s)	Agriculture
		Health
		Nutrition
		Multi-Sectoral Collaboration

5.3: Programs and Projects

Further details on these programs and projects such as information on the initiation process, funders, and reforms can be found in Appendix 14.

PROGRAMS/PROJECTS		
1. Expanded Program on Immunization (EPI) (1980-present)	Description	The Expanded Program on Immunization (EPI) aims to accomplish 90% coverage nationally with all vaccines by 2020. This program utilizes community interventions to reach individuals through health facilities and through mobile units to provide access to immunization for those living at increased distance from health facilities. This program has existed since the early 1980s and initially had limited success due to high turnover of staff, poor infrastructure, limited trained personnel and lack of donor funding. Implementation of Reaching Every District (RED) and Sustainable Outreach Services (SOS) since the early 2000s has focused on providing coverage in hard to reach and below-target areas. Women of reproductive age and children under one year of age are current targets of the program. Priorities include improvement of the cold chain for vaccine transportation and storage, and introduction of a broader range of vaccines. Objectives for 2016 – 2020 include: increasing and maintaining vaccine coverage; maintaining polio free status and achieving recommended Acute Flaccid Paralysis (AFP) surveillance; eliminating measles and promoting the elimination of rubella and congenital rubella syndrome; attaining and maintaining elimination/control of vaccine preventable diseases; expanding cold chain capacity; improving healthcare worker knowledge; strengthening monitoring and evaluation; and increase government financing for traditional and new vaccines (83,120,121).
	Importance	Very important
	Theme(s)	Health
2. Basic Education, Technical and Vocational Training Project (1992-1999)	Description	The Basic Education, Technical and Vocational Training Project was created in 1992 as part of the Emergency Recover and Reconstruction Program (ERRP). It focuses on improving the quality of education and cultivating specialized training. The program aims to close the gaps that exist in the quality of education and institutional availability between regions, while creating a significant number of new spaces across all levels of the education system. The initial project was due to be completed in 1996, but was extended to 1999 in order to provide more time to meet targets. Upon completion, it was relatively successful with 96% of school construction complete. Radio receivers were distributed to primary schools to provide access to educational programming and training was provided to educational media personnel (122).
	Importance	Very important
	Theme(s)	Education
3. Health Sector Development Program (HSDP) (1997-2015)	Description	The Health Sector Development Program has the overall goal of providing comprehensive, integrated, and cost-effective primary care, with a special focus on communicable disease prevention and control, nutrition, environmental health and hygiene, reproductive health and immunization.

		Major objectives of this program include: the reduction of maternal and under-five mortality; reduction of the total fertility rate; reduction of the incidence of and mortality from communicable and vector-borne diseases; and increased coverage of the Health Extension Program (HEP). Notable achievements of this program include: an increased number of health centers, posts and hospitals; increased number of health care workers and Health Extension Workers (HEWs) and frontline worker training; improved contraceptive coverage and maternal care; improvements to infectious and communicable diseases, including improvements to bed net distribution; and improvements in the number of children receiving Vitamin A supplementation and community nutrition coverage (123,124).
	Importance	Very important
	Theme(s)	Health
4. Education Sector Development Program (ESDP) (1997-present)	Description	The Education Sector Development Program (ESDP) derives its goals from the Ethiopian Education and Training Policy. Specific objectives of the Education Sector Development Program include increased access to and participation in education and training, ensuring equity; ensuring quality and relevance of education and training; lower education inefficiencies; prevention of HIV/AIDS and increased stakeholder participation. The major goals of ESDP include the production of good citizens, achieving universal primary education, meeting the needs of the workforce and building capacity within the education system. While early iterations of this program focused mainly on primary education, more recent amendments have expanded its reach to adult and non-formal education. Evaluations indicate that this program has been quite successful since its inception in 1997. While some regional variations continue to exist, the number of primary schools has nearly tripled and primary-level enrollment has grown from 3 to 18 million. These improvements have been focused at the primary level with work yet to be done at higher levels of education. Some of the challenges associated with this program include management challenges, regional and gender disparities and challenges related to community participation (125–127).
	Importance	Very important
	Theme(s)	Education Health WASH Nutrition
5. Essential Nutrition Action (ENA) (1997-present)	Description	Essential Nutrition Action (ENA) is part of a wider program implemented by USAID across Asia and Africa. It aims to consolidate seven areas of nutrition behaviors that will provide the greatest reduction in maternal and child morbidity and mortality. This program is delivered both in communities and health facilities. Education and counselling are provided on best practice feeding for the prevention of malnutrition in children, and care associated with the prevention of malnutrition and improved maternal health are provided within health facilities. ENA seeks to improve health services and encourage behavior change in the first 1000 days of life through the use of interventions at 6 key contact points with the health system: during pregnancy; during delivery; postnatal and during family planning; during immunization; during well child and growth monitoring appointments, and during the care of a sick child. It recognizes the importance of sector integration to provide additional coverage, and leverages the role of agriculture, schools, sanitation and community nutrition in improving maternal and child health (102,128,129).
	Importance	Likely important as a preventive nutrition framework adopted by country
	Theme(s)	Health Nutrition Agriculture WASH Multi-sectoral Collaboration
6. Health Extension Program (HEP) (2003-present)	Description	The Health Extension Program (HEP) is a collaboration between the Ministry of Health and Ministry of Education which aims to improve equitable access to health care in rural areas, despite limited resources. In order to do this, it is focused on shifting health care resources from urban areas to rural areas where are larger proportion of the population resides. HEP utilizes high impact health services and focuses on four major components: family health; disease prevention and control; hygiene and environmental sanitation; and health education and communication. Decentralization and the provision of

		health coverage at the community and household-level, along with improving community knowledge are additional objectives. This program also aims to empower women and reduce maternal and child mortality while promoting an overall healthy lifestyle, with multiple new components being added addressing these elements at the community-level. Interventions are delivered within the community, health facilities and in schools. Healthy WASH practices, bed net usage and feeding are communicated by Health Extension Workers (HEWs) during home visits. Schools engage in deworming and health education. Within facilities, maternal and child care as well as nutritional and family planning advice is provided. Outreach and training for health workers and improvement in the quality of health services at the local level has also been implemented as part of this program. Evaluation of HEP has shown it has led to improvements in the health of participating communities. Use of latrines, family planning methods, maternal care, infectious diseases and immunization have also all been positively impacted by the HEP. Despite this, challenges remain including high turnover and poor salary of HEWs, poor referral system and gaps in equipment and pharmaceuticals (44,130–133).
	Importance	Very important
	Theme(s)	Health
		Nutrition
		WASH
		Multi-sectoral Collaboration
7. Ethiopia Strategy Support Program (ESSP) (2004-present)	Description	The Ethiopia Strategy Support Program (ESSP) aims to reduce poverty through sustainable development and improving the policymaking process and capacity in Ethiopia. Objectives of the program aim to fill knowledge gaps and create a more integrated knowledge support system to solve complex issues associated with developing a pro-poor rural development strategy. Through this program, food policy analysis and rural policy development is supported using the Rural Economy Knowledge Support System (REKSS). Major activities of this program include engaging in collaborative research, knowledge management, knowledge dissemination and capacity building, and improving communication and institutional collaboration (134,135).
	Importance	Not sufficient evidence to conclude any impact on stunting reduction
	Theme(s)	Nutrition
		Agriculture
		Poverty Reduction
8. Enhanced Outreach Strategy and Targeted Supplementary Feeding Program (TSF) for Child Survival (2004-present)	Description	The Enhanced Outreach Strategy and Targeted Supplementary Feeding (TSF) Program for Child Survival is a biannual campaign to target immediate and underlying causes of malnutrition by providing mothers and children with preventative health care. This program utilizes a range of delivery platforms to improve immunization; prevent and control communicable and vector-borne diseases; identify malnutrition and provide deworming and vitamin A supplementation. Technology is utilized to provide education at the community-level directly to the targeted population. After 2012, the Community Health Days Program, part of the Health Extension Program (HEP), was implemented to replace the Enhanced Outreach Strategy. Community Health Days (CHDs) are implemented in four regions to provide proven health interventions to women and children. These include immunization, Vitamin A supplementation, deworming, and care for malnutrition. CHDs are held quarterly to reach women and children in communities and improve the coverage of the aforementioned health interventions (136,137).
	Importance	Very important
	Theme(s)	Health
		Nutrition
9. Productive Safety Net Program Adaptable Program Loan (PSNP APL) (2005-2020)	Description	The Productive Safety Net Program Adaptable Program Loan (PSNP ADL) was created to improve resiliency and reduce the vulnerability of rural households in Ethiopia who experience chronic food insecurity. The most recent revision of this program targets 10 million people, and is delivered utilizing financial incentives and community-based programs. Households with able bodied adults are given cash transfers for 6 months of the year in exchange for participation in public works projects such as the development of infrastructure and water improvement which contribute to the creation of sustainable community assets. Those households who do not have a member who is able to work are provided with 12 months of transfers unconditionally. Both types of transfers reduce household reliance on credit unions, which

		contribute to a cycle of indebtedness. Within the communities, training is provided to allow households to diversify their skill set and earning potential while stimulating local markets. Monitoring and evaluation have indicated that this program has performed well in reducing food insecurity in chronically food insecure areas of Ethiopia with a number of target indicators being surpassed. A number of households reported benefits from the public works projects which included the construction of roads, classrooms, health facilities and improved water management (138–140).
	Importance	Very important
	Theme(s)	Poverty Reduction
		Food Security
10. Community-based Nutrition (CBN) Program (2008-present)	Description	The Community Based Nutrition (CBN) Program aims to utilize cost effective and sustainable community-based interventions to improve the lives of mothers and their children. This program engages the community in malnutrition prevention and is an element of the umbrella Community Maternal, Neonatal and Child Health (CMNCH) Program. Activities under the CBN include growth monitoring and screening, expanded referral services, monthly community discussions, micronutrient supplementation and deworming, and creating multi-sectoral links to improve nutrition through agriculture, WASH and social programs. Evaluation activities conducted by this program indicate significant improvements in stunting in areas in which this program was well implemented (141–143).
	Importance	Likely important but late introduction, so may not have impact on national stunting change
	Theme(s)	Health
		Nutrition
		Multi-sectoral Collaboration
11. National Nutrition Program (2008-2020)	Description	The National Nutrition Program (NNP) aims to develop nutrition-sensitive interventions and address immediate causes of malnutrition by creating an enabling environment for evidence-based decision-making. It aims to improve maternal and child nutrition in addition to providing services for communicable and non-communicable disease-related nutrition services across the lifespan. It is implemented to strengthen initiatives that were not sufficiently addressed by the initial NNP launched in 2008 and to target emerging issues with a view to the multi-sectorial and multidimensional complexity of malnutrition. At the community level this program provides malnutrition prevention through nutrient supplementation, feeding advice and nutritional assessments. It uses a program called Engage the Media to advocate for nutrition policy both with the public and policy makers while building capacity of the media. School feeding and deworming interventions and fortification of oil and flour are additional points of contact for this program. Key programs under the NNP include: the Health Extension Program (HEP); Essential Nutrition Action (ENA); Community Based Nutrition (CBN); Therapeutic Feeding Programme (TFP); Enhanced Outreach Strategy/Extended Enhanced Outreach Strategy and Targeted Supplementary Feeding (TSF); School Feeding Program; Food Fortification; and WASH. Monitoring for this program is done using a number of objectives associated with stunting, fruit and vegetable consumption, maternal and newborn feeding and care, micronutrient supplementation, policy creation objectives and HIV care. Major drivers of success in this program are the interest and collaboration of development partners and government as well as human capacity for nutrition. Challenges in implementing this program include inadequate resources and financial mobilization and inadequate facilities and governance structure (83,103,144,145).
	Importance	Likely important but late introduction, so may not have impact on national stunting change
	Theme(s)	Nutrition
		Health
		Multi-sectoral Collaboration
12. The Water and Sanitation Program (WSP) (2010-present)	Description	The Water and Sanitation Program (WSP) is a multi-donor partnership created by the World Bank to assist governments in providing affordable, safe and sustainable water access to their citizens. This program assisted the Ethiopian Government in creating a 5-year plan from 2011 to 2015 to support providing sanitation for Amhara, Oromia, Tigray and SNNPR regions, which account for

		80% of Ethiopia's population. Activities under WSP include hand washing and sanitation promotion, capacity building and monitoring. By 2014 improvements included 29% of individuals with access to sanitation as a result of WSP and 71% of individuals with access to sanitation as a result of other factors (146–148).
	Importance	Promising recent initiative
	Theme(s)	WASH
13. Food Security Program (FSP) (2010-2014)	Description	The Food Security Program (FSP) aims to substantially contribute to the reduction of food insecurity among rural households in Ethiopia and work towards achieving the Millennium Development Goals through the elimination of poverty. This program has 4 major components: the Productive Safety Net Program (PSNP) to simulate local economies and prevent asset depletion; the Household Asset Building Program to increase food security though the diversification of income producing employment; the Complementary Community Investment Program to develop community infrastructure in food insecure areas; and the Resettlement Program to provide resources for households in PSNP woredas (149).
	Importance	Promising program adopted through the Productive Safety Net Program (PSNP)
	Theme(s)	Food Security Poverty Reduction
14. Integrated Community Case Management of Childhood Illness and New Born Care Implementation Plan/Program 2010 (2010-present)	Description	The Integrated Community Case Management of Childhood Illness and Newborn Care Implementation Plan/Program aims to strengthen the quality of maternal and child health at Primary Health Care Units (PHCUs). Objectives of this program include improving use of services and competency of health care workers; improving monitoring and accountability in primary care; ensuring ownership and evaluation of integrated community case management of childhood illness and newborn care; and improving supply chain management of resources for child health. This program is delivered through health care workers and distribution of related resources in the community, and utilizes pre-deployment training to fill gaps in health care worker knowledge and avoid interruptions in health services. Major factors for success in this program include the implementation of supportive supervision and on-the-job mentoring for staff and rapid scale-up and the focus on the health unit as a whole rather than individual health care workers. This program was not without challenges. Some challenges to implementation have included poor coverage and utilization of services, inadequate accountability, non-standardized referral mechanisms, mismanagement of medical supplies and inadequate budget implementation (150,151).
	Importance	Promising recent initiative
	Theme(s)	Health
15. Agricultural Growth Program (AGP) (2011-present)	Description	The Agricultural Growth Program (AGP) aims to diversity diets and improve nationwide growth through the increase and commercialization of agriculture in high potential areas. At the household-level, it aims to cultivate nutrient dense produce and animal products while supporting the participation of women and youth. It includes components of agricultural public support; agricultural research; small scale irrigation; agricultural marketing and value chain; and program management, capacity building and monitoring and evaluation. The evaluation of this program utilized a number of indicators including food yield and sale increases as well as dietary diversity (152).
	Importance	Promising recent initiative
	Theme(s)	Agriculture Nutrition
16. Scale Up Nutrition (SUN) Movement Strategy (2012-2020)	Description	The Scale Up Nutrition (SUN) Movement, which Ethiopia joined in 2012, is an international, multi-sectoral collaboration which has agreed upon a number of malnutrition related goals to be achieved by 2025. This collaboration is motivated to end all forms of malnutrition by 2030. It has a number of global targets including a reduction in stunting, wasting and low birth weight, a reduction in anemia among reproductive age women, an increase in breastfeeding for the first 6 months and no increases in overweight, obesity and diabetes. It aims to reach these targets through implementation of proven nutrition interventions and the introduction of sustainable nutrition policy. Globally, SUN has goals to improve the overall nutrition of women and children through improved access to food healthcare, water and sanitation as well as improving feeding practices that contribute to positive nutritional outcomes.

		SUN has identified four strategic objectives, including: creating enabling political environments and improving the environment to increase collaboration; establishing best practice to scale up interventions; aligning actions around high quality plans with multi-stakeholder accountability; and improved resources for coordinated approaches. The evaluation of SUN has proven difficult as many elements are country-specific and have not been quantified. The way in which SUN has led to changes in stakeholder practices through increased collaboration and attention brought to the problem of malnutrition remains unclear (153–157).
	Importance	Promising recent initiative
	Theme(s)	Nutrition
		Health
		Multi-sectoral Collaboration
17. Sustainable Undernutrition Reduction in Ethiopia (SURE) (2012-present)	Description	The Sustainable Undernutrition Reduction in Ethiopia (SURE) Program focuses strongly on agriculture and was the inaugural government-led multi-sectoral nutrition program in Ethiopia. This program utilized mobile health and mass media to share its messaging while also providing education at the community-level on infant feeding and community nutrition. By 2020 this program has a goal of reducing stunting by 26% in four regions, namely Tigray, Amhara, Oromia, and SNNPR. The SURE program aspires to improve dietary diversity and complementary feeding, strengthen the system of health and agriculture overall and foster coordination across sectors to improve nutrition (158).
	Importance	Promising recent initiative
	Theme(s)	Health
		Nutrition
		Multi-sectoral Collaboration
18. One Wash National Program (OWNP) (2013-2020)	Description	The One Wash National Program (OWNP) pursues the improvement of sanitation and water supply, as well as good hygiene practices. Improved multi-sectoral collaboration and integration are major guiding principles of the program. It is built upon the pillars of good governance, efficient use of resources and capacity development to deliver WASH across all levels of the country. The program is broken down into the specific categories of rural, urban and institutional WASH along with overall capacity building and program management. Within these areas it seeks to improve hardware and infrastructure access, wastewater management, and support to hygiene practices (159).
	Importance	Promising recent initiative
	Theme(s)	WASH
		Health
		Multi-sectoral Collaboration
19. National Indicative Program for Ethiopia (2014-2020)	Description	The National Indicative Program for Ethiopia works within the broad objectives of the Growth and Transformation Plan (GTP) and the Climate Resilient and Green Economy Strategy (CRGE). It focuses on three main sectors for cooperation towards sustainable socio-economic development: sustainable agriculture and food security; improved quality of health care and overall health outcomes while addressing social determinants of health; and improvement and support for energy efficiency and the energy sector while phasing out support to the road sector (160).
	Importance	Promising recent initiative
	Theme(s)	Agriculture
		Food Security
		Health
		Multi-sectoral Collaboration
20. Health Sector Transformation Plan (HSTP) (2016-2020)	Description	The Health Sector Transformation Plan (HSTP) was implemented to realize a long-term plan in which all Ethiopians are able to access health services when needed without significant hardship. This program is part of the Growth and Transformation Plan (GTP) and is built upon the pillars of excellence in health service delivery, quality improvement, leadership and governance, and health system capacity. This plan includes a number of targets for 2020 associated with a reduction in infectious diseases, child malnutrition and under-5 mortality. It has strategic initiatives to improve community engagement, financial management, emergency management, quality and equity, leadership capacity and regulation (45).
	Importance	Very important

	Theme(s)	Health
		Multi-sectoral Collaboration

5.4: Delivery Platforms

5.4.1: Delivery Platforms for Nutrition Specific and Sensitive Interventions

Delivery platforms for nutrition-specific and -sensitive interventions are often of 5 types that have proven to be most impactful, including: fortification-based, financial incentive-based, community-based, school-based and technology-based platforms (Table 18).

Fortification-based platforms focus on improving the nutritional value of staple foods, which can be done at four levels: mass/universal fortification, targeted fortification, household fortification and bio-fortification. Mass/universal fortification is done in conjunction with food production industries (e.g. flour fortification); targeted fortification is done for particularly nutritionally vulnerable populations or in emergency situations (e.g. micronutrient powders); household fortification involves the fortification of particular foods consumed especially by women and children (e.g. fortified lipid spreads); and bio-fortification involves increasing key nutrients within food crops (161,162).

Financial incentive-based platforms include the delivery of cash transfers (either conditional or unconditional), vouchers or food stamp interventions, as well as the removal of user fees in order to eliminate financial barriers and enable individuals to better their health (162,163).

Community-based platforms include the delivery of interventions by health care workers through outreach channels at the community-level, as well as the implementation of interventions which are driven by community groups themselves (162,163).

School-based platforms focus on the delivery of targeted school feeding programs, and the promotion of health and nutrition information to children while they are attending school (163).

Technology-based platforms include the delivery of nutrition information and communication-based interventions using mass or social media as well as mobile health (also known as mHealth), via mobile phones (e.g. SMS messaging) (163).

Platform	Intervention	General Examples	Papers
Fortification-based	Mass/universal fortification	Salt iodisation, flour fortification with iron and folate	Gillespie et al., 2013 Keats et al., 2018
	Targeted fortification	Nutrient-fortified complementary food for children 6-24 months, micronutrient powders, fortified foods/food-based supplements	
	Household fortification	Micronutrient powders, small quantities of food-based fortified lipid spreads for women and children	
	Biofortification of food crops	Increasing iron, provitamin A, zinc, and folate contents in staple foods	
Financial incentive-based	Conditional cash transfer, vouchers, unconditional cash transfers, food stamps	For participation in health education and attendance to health visits	Gillespie et al., 2013
	Removal of user fees	For access to health services	Bassani et al., 2013
Community-based	Community Health Workers	Providing skilled birth attendance, immunization and micronutrient supplementation, promotion of breastfeeding and complementary feeding, child growth monitoring, treatment of common childhood illnesses	Haines et al., 2007 Bhutta et al., 2013 Lassi et al., 2010 Lewin et al., 124 GHWA, 2010 Shakir, 2010
	Women's/Mother's Groups	Infant and Young Child Feeding	Kushwaha et al., 2014
	Community Campaigns	Child Health Days, providing an integrated package of essential health and nutrition interventions, including: • Micronutrient supplementation (e.g. Vitamin A), Immunization, Deworming, Insecticide-treated bednets	Doherty et al., 2010 UNICEF, 2011 UNICEF, 2017 Oliphant et al., 2010
	Integrated Management of Childhood Illness (IMCI) Program	"Whole child" health approach, focusing on: • Improved case management by health workers and strengthening the overall health system capacity • Providing basic care to communities with poor access to health facilities • Improve home-based and community nutrition practices	Gove, 1997 Ahmed et al., 2010 Schellenberg et al., 2004 Arifeen et al., 2009 Costello & Dalgish, 2016
School-based	School feeding programs	Promotion of school enrollment (Note: evidence of nutrition benefits scarce)	Kristjansson et al., 2009 Gillespie et al., 2013
	Promotion of health and nutrition	For older children and adolescents , linked to school health programs	N/A
Technology-based	Mobile Health (mHealth)	Greater connectivity between health care workers and remote communities More accurate and timely child growth monitoring	Källander et al., 2013 Barnett et al., 2016 Marcolino et al., 2018
	Mass/social media outlets	Broad dissemination of health information Discussion of health-related topics Social marketing	N/A

Table 18: Delivery Platforms for Nutrition Interventions

5.4.2: Successful Delivery Platforms Used in Ethiopia

The policies and programs indicated to have played a role in reducing stunting in Ethiopia between 2001 and 2016 can be tied to many of the aforementioned delivery platforms (Tables 19 and 20). By far the most commonly used approach seen in Ethiopia is the community-based delivery platform. Several programs considered by experts and stakeholders to be critical to Ethiopia's stunting reduction success, including the National Strategy for Child Survival, National Hygiene and Sanitation Strategy, The Expanded Program on Immunization (EPI), Health Extension Program (HEP), Enhanced Outreach Strategy and Targeted Supplementary Feeding Program (EOS/TSF) for Child Survival, and the Productive Safety Net Program Adaptable Program Loan all utilize a community-based approach. These initiatives rely on local-level health workers, Health Extension Workers (HEWs) and/or health facilities to deliver their corresponding interventions. The main focus of these programs is to improve the quality of health care and reduce neonatal, infant, and child mortality rates. Utilization of outreach and mobile health services was most commonly used in order to provide primary care to women and children, provide immunizations, and screen and treat malnutrition. Education was another common theme amongst these programs, with an emphasis on promotion of preventative actions, breastfeeding and complementary feeding, and sanitation and hygiene.

Another commonly used approach seen in Ethiopia is the technology-based delivery platform. This platform has also been seen as a useful way to deliver health and nutrition messaging to much of Ethiopia's rural and remote population. For example, implementation of the National Strategy for Child Survival in Ethiopia relies on technology such as radio to promote maternal, newborn, and child health services and related initiatives (106,107). The National Hygiene and Sanitation Strategy and Enhanced Outreach Strategy and Targeted Supplementary Feeding Program (EOS/TSF) for Child Survival also rely on technology-based delivery platforms for providing information related to maternal, newborn, and child health, general population health, and clean water, sanitation and hygiene awareness campaigns, respectively. The regulations to provide for the establishment of the Ethiopian Health and Nutrition Research Institute (EHNRI) also utilized a technology-based approach to conduct and share research regarding health and nutrition (71,72). More recent programs such as the Integrated Urban Sanitation and Hygiene Strategy have also begun to use mobile phone/SMS technology, as well as mass and social media, for the delivery of messages on urban sanitation and hygiene issues (115).

Though somewhat less common compared to community-based or technology-based interventions, the school-based delivery platform has also been seen as a useful way to deliver health and nutrition messaging to Ethiopia's school-age population. Programs that utilized a school-based approach targeted promotion of safe hygiene practices and construction of improved sanitation facilities, including the National Hygiene and Sanitation Strategy, National Hygiene and Sanitation Strategic Action Plan, and Integrated Urban Sanitation and Hygiene Strategy. The Health Extension Program (HEP), Enhanced Outreach Strategy and Targeted Supplementary Feeding Program (EOS/TSF) for Child Survival, and Integrated Community Case Management of Childhood Illness and Newborn Care Implementation Plan/Program were additional efforts that applied a school-based platform, focusing on provision of supplies within schools to treat childhood illnesses, including supplements and deworming. Though most of these school-based interventions do not target the right population or time period for the reduction in under-5 stunting that was the focus of this study, these programs still prove important in stunting reduction due to the impact they have on adolescent girls who will go on to have children of their own.

Less commonly used in Ethiopia is the fortification-based delivery platform. A small number of health and nutrition initiatives have used this for provision of health and nutrition interventions, including the Iodized Salt Act, 2011, which established the production, import, sale and distribution of salt fortified with iodine for the purpose of combatting the country's high prevalence of iodine deficiency disorders (79–83) . The fortification of salt with iodine was additionally included under

the National Nutritional Strategy (83,109). In 2008, the National Nutrition Program was introduced that incorporated the fortification of oil and flour to address micronutrient deficiencies (83,103,144,145).
Financial-incentive based delivery platforms have also been used by only a small number of key programs in Ethiopia. Most notably, financial incentives were used in the Productive Safety Net Program Adaptable Program Loan (PSNP-APL), which began in 2005. In this program, financial incentives were provided through cash and/or food transfers to chronically food insecure households and pregnant and lactating women (138,139,164). Financial-incentives in the form of the removal of user fees were also utilized within the Enhanced Outreach Strategy and Targeted Supplementary Feeding Program (EOS/TSF) for Child Survival where insecticide treated nets (ITNs) were distributed to pregnant women and children under-5 years of age in malaria endemic EOS kebele (136,137).

A number of Ethiopian policies and programs vital for reductions in stunting are being implemented across multiple delivery platforms, with most combining community-based and technology-based platforms. These include the National Strategy for Child Survival in Ethiopia, Seqota Declaration, and Health Extension Program (HEP), among others. Many initiatives additionally incorporated school-based platforms with community-based and technology-based platforms, such as the National Hygiene and Sanitation Strategy, Enhanced Outreach Strategy and Targeted Supplementary Feeding Program (EOS/TSF) for Child Survival, and the Integrated Community Case Management of Childhood Illness and Newborn Care Implementation Plan/Program. Programs utilizing multiple delivery platforms aimed to improve feeding practices, nutrition status, prevalence of childhood illnesses, and overall health care quality for mothers, newborns, and children.

5.4.3: Future Areas of Focus

From our analysis of the most impactful policies and programs implemented in Ethiopia to reduce stunting between 2000 and 2016, the major focus seems to be on those that utilized a community-based delivery platform. Through the use of local-level health workers such as Health Extension Workers (HEWs), community-based programs including the National Strategy for Child Survival, The Expanded Program on Immunization (EPI), Health Extension Program (HEP), and Enhanced Outreach Strategy and Targeted Supplementary Feeding Program (EOS/TSF) for Child Survival have worked over the last few decades to tackle issues of accessibility within, and quality of, the health care system. Bringing interventions straight to the local level, and in some cases via outreach and mobile services, has been especially important for reaching Ethiopia's largely rural and at times highly remote population.

With the higher utilization of community-based and technology-based delivery platforms among Ethiopian policies and programs, future areas of focus could lie in addressing some of the gaps in utilization of school-based, fortification-based, and financial incentive-based delivery platforms. For example, increasing the use of school curriculums to promote health and nutrition initiatives could further reach the adolescent and future parent population while bolstering existing community-based interventions. Similarly, with agriculture development and food security becoming a major priority area for the Government of Ethiopia, incorporating larger scale fortification-based interventions into initiatives could be a way to further improve nutritional outcomes.

Lastly, while the use of a financial incentive-based delivery platform was only prominent in a small number of the policies and programs we looked at in Ethiopia, this was shown to be quite impactful for stunting outcomes in other exemplar countries, such as Peru. With particular influence on removing barriers to care and helping to alleviate some of the constraints poverty can have on nutritional outcomes, an increase in the utilization of financial incentive-based initiatives may prove to be an untapped area for policies and programs in Ethiopia.

Table 19: Ethiopia-Specific Delivery Platforms for Nutrition-Specific and -Sensitive Interventions

Delivery Platform	Intervention	Ethiopia-Specific Examples	Implementation Examples
Fortification-based	Mass/universal fortification	**Iodized Salt (Production, Sale, and Distribution) Act (2011-present):** Established to import, store, transport, distribute, or sell iodized salt for human consumption to prevent and eradicate extensive and serious effects to public health caused by iodine deficiency.	• Common salt is fortified with iodine nationwide, legislated and enforced by the government (79–83).
	Targeted fortification	N/A	N/A
	Household fortification	N/A	N/A
	Biofortification of food crops	N/A	N/A
Financial incentive-based	Conditional cash transfer	N/A	N/A
	Removal of user fees	N/A	N/A
Community-based	Community Health Workers	**The Expanded Program on Immunization (EPI) (1980-present):** Primarily aims to achieve at least 90% national coverage, and 80% in every district, with all vaccines by 2020.	• Along with immunizations provided at health facilities, Health Extension Workers (HEWs) and mobile teams provide an outreach service to immunize those living farther than 5 km from the nearest health facility (83,121,165).
	Community Initiatives	**National Health Care Quality Strategy (2016-2020):** Aims to consistently improve the outcomes of clinical care, patient safety, and patient-centeredness, while increasing access and equity for all segments of the Ethiopian population, by 2020.	• Focused on the provision and quality improvement of health services via engagement with communities and community health workers (166).
		Community-Based Nutrition Program (CBN) (2008-present): Aims to improve the nutritional status of mothers and children through cost-effective and sustainable interventions within communities.	• Nutrition interventions are provided at the community-level, with families and community members involved in assessing health and nutrition issues, analyzing potential causes, working towards solutions, and monitoring overall progress towards improvement (141–143).
		The Water and Sanitation Program (WSP) (2010-present): Is a multi-donor partnership administered by the World Bank to support the poor in obtaining affordable, safe, and sustainable access to water and sanitation services.	• Community-led promotion and improvement of handwashing and sanitation, building capacity for sanitation, and performance monitoring for sanitation (146–148).
		Health Sector Development Program (HSDP) (1997-2015): Aimed to provide comprehensive, integrated, and cost-effective primary health care service, with focus on communicable disease prevention and control, nutrition, environmental health and hygiene, reproductive health, and immunization.	• Participation of the community in the planning, implementation, monitoring, and evaluation of health care. This includes health facility construction and expansion for increased health service access, improvement in the number, skills, distribution, and management of health workers, and provision of education, for control of communicable diseases and promotion of healthful living.
	Women's/Mother's Groups	N/A	N/A
	Integrated Management of Childhood Illness (IMCI) Program	N/A	N/A
School-based	School feeding programs	N/A	N/A
	Promotion of health and nutrition	**Education Sector Development Program (ESDP) (1997-present):** Calls for a fundamental restructuring of the organization and delivery of education to provide greater access to primary education with enhanced equity, quality, and relevance.	• Improvement in the quality of education through increases in programs implemented via the school curriculum surrounding sanitation and hygiene, HIV/AIDS prevention, environmental protection, nutrition, and drug and substance abuse prevention (125–127).

Technology-based	mHealth	N/A	N/A
	Mass/social media outlets	**Regulations to provide for the establishment of the Ethiopian Health and Nutrition Research Institute (EHNRI) (1962-Present):** Conducting research on the causes and spread of diseases, nutrition, traditional medicines, medical practices, and modern drugs, with the aim of contributing to the development of health science and technology.	• Utilization of mass/social media outlets to conduct health, nutritional science, and technology research (71,72).
		Code of Marketing of Breast-milk Substitutes (2009-present): Aims to contribute to providing safe and adequate nutrition for infants by protecting and promoting breastfeeding and ensuring the proper use of breast-milk substitutes, when necessary, based on adequate information and through appropriate marketing and distribution.	• Utilization of Information Communication Technology to disseminate food safety-related messages (77,78).

Table 20: Ethiopia-Specific Delivery Platforms for Multi-Component Nutrition-Specific and -Sensitive Interventions

Multi-Component Platform	Delivery Platforms	Delivery Interventions	Implementation Examples
Seqota Declaration (2016-2030): Aimed at providing nutritious food in the first 1000 days through nutrition-sensitive and nutrition-specific interventions surrounding health, agriculture, water, education, and social protection.	*Community-based*	Community Initiatives	• Integrated a community development approach, with families and community members involved in community labs focused on promotion of nutrition security in more food insecure areas of the country.
	Technology-based	Mass/social media outlets	• A multichannel social and behaviour change communication approach (167).
Strategic Plan for Malaria Prevention and Control (2001-2015): Aimed to reduce malaria-associated morbidity and mortality and rapidly scale-up access to early diagnosis and treatment service.	*Community-based*	Community Health Workers	• Utilized Health Extension Workers (HEWs) to provide Insecticide Treated Nets (ITNs) to pregnant women and Indoor Residual Spraying (IRS).
	Technology-based	Mass/social media outlets	• Disseminated information on malaria prevention through a multi-channel approach, such as leaflets, radio, TV, and regular community awareness campaigns (91–96).
National Strategy for Infant and Young Child Feeding Practice (2004-present): Aims to improve infant and young child feeding practices in Ethiopia.	*Community-based*	Community Health Workers, Mother's Groups, Health Facilities	• Alongside community health facilities increasing provision of antenatal care, follow-up care, and therapeutic care for sick children, community health workers provide education and counselling on optimal infant and young child feeding practices, while monitoring growth and development of infants and young children.
	Technology-based	Mass/social media outlets	• Utilization of mass media to provide accurate and complete information surrounding infant and young child feeding practices (102,103).
National Strategy for Child Survival in Ethiopia (2005-2020): Aims to provide universal coverage of high impact neonatal and child survival interventions, as well as high quality essential health care for mothers, newborns, and children to reduce neonatal, infant, and child mortality rates.	*Community-based*	Community Health Workers, Community Initiatives, Health Facilities	• In addition to mobile health services and health facilities providing basic health promotion, disease prevention, and curative services, Health Extension Workers (HEWs) support this initiative through education on breastfeeding, complementary feeding, and contraception.
	Technology-based	Mass/social media outlets	• Information Education Communication/Behaviour Change Communication (IEC/BCC) presented through mass media to promote use of high-impact maternal, newborn, and child health (MNCH) services (106,107).
National Health Promotion and Communication Strategy (NHPCS) (2005-2020): Aims to address gaps in the health status of the population through behavior	*Community-based*	Community Health Workers	• Utilization and linkage of Health Extension Workers (HEWs) and Health Development Armies (HDA) to support enhancement of health promotion activities through community discussions and radio listening groups.

change, creation of demand, nurturing enabling environments for sustained change, and increasing access and universal coverage of health.	*Technology-based*	Mass/social media outlets	• Deployment of mass media for behaviour change communication (BCC) and advocacy for health (46).
National Hygiene and Sanitation Strategy (2005-present): Aims to reduce incidence of diseases deriving from fecal contamination and reduce incidence of waterborne, washed, water-related, and water-based disease.	*Community-based*	Community Initiatives	• Participation of the community in education provision on proper hygiene and sanitation, and construction of toilet facilities.
	School-based	Promotion of health and nutrition	• Under this initiative, schools are to improve sanitation facilities, while utilizing parent-teacher associations and children to promote safe hygiene practices and behavior change.
	Technology-based	Mass/social media outlets	• Using mass media to educate and raise awareness of hygiene issues (108).
National Nutritional Strategy (2008-present): Aims to ensure that all Ethiopians secure adequate nutritional status required for a healthy and productive life in a sustainable manner.	*Community-based*	Community Health Workers, Health Facilities	• Utilization of Health Extension Workers (HEWs) and health facilities to support Vitamin A and Iron supplementation program.
	Fortification-based	Mass/universal fortification	• Mass fortification of common salt with iodine (83,109).
National Hygiene and Sanitation Strategic Action Plan (2011-2015): Aimed to ensure that all Ethiopians had access to basic sanitation by 2015, that 77% of the population was practicing hand washing at critical times, safe water handling, and water treatment in the home, and that 80% of communities in the country had achieved 'open defecation free' status.	*Community-based*	Community Initiatives	• Engagement of the community in hygiene and sanitation activities through provision of education on proper hygiene and sanitation, construction of improved toilets, and adoption of hygiene behaviours.
	School-based	Promotion of health and nutrition	• Under this initiative schools are to improve sanitation facilities, while utilizing the curriculum, student clubs, and outreach initiatives to promote safe hygiene practices (113).
Integrated Urban Sanitation and Hygiene Strategy (2015-present): Aims to mitigate the negative impacts of poor urban sanitation on health, environment, society, education, and the economy.	*Community-based*	Community Initiatives	• Construction of latrines.
	School-based	Promotion of health and nutrition	• Schools support this initiative through provision of safe and adequate water, sanitation, and hygiene facilities, while implementing sanitation and hygiene promotion activities.
	Technology-based	mHealth, Mass/social media outlets	• Utilization of mobile SMS to send key messages on urban sanitation and hygiene issues • Promotion of campaigns and generation of awareness through social media and print communication (115).
Nutrition Sensitive Agriculture Strategy (2016-2021): Aims to maximize the positive impact of the food system on nutrition outcomes while minimizing any unintended negative consequences of agricultural policies and interventions for the population.	*Community-based*	Community Initiatives	• Community-led promotion and support of increased farming production through establishment of fruit and vegetable nurseries and demonstration sites, as well as education on intercropping, mixed farming technologies, and rearing of dairy animals.
	School-based	Promotion of health and nutrition	• Schools to promote school milk feeding.
	Technology-based	Mass/social media outlets	• Promotion for the production of improved fruits and vegetables and bio-fortified crops through social and behavioural change communication (SBCC) materials and mass media (119).
Health Extension Program (HEP) (2003-present): Aims to create a healthy society and reduce rates of maternal and child morbidity and mortality. This program promotes four areas of care including disease prevention and control, family health, hygiene and environmental sanitation, and health education and communication.	*Community-based*	Community Health Workers, Health Facilities	• Alongside community health facilities provision of immunizations, and essential maternal, newborn and child health services under this initiative, Health Extension Workers (HEWs) conduct home visits and outreach services for promotion of preventative actions and communication of health messages.
	School-based	Promotion of health and nutrition	• Provision of health education and deworming through schools (44,130–133).
Enhanced Outreach Strategy and Targeted Supplementary Feeding Program (EOS/TSF) for Child Survival (2004-present): Aims to address the immediate and	*Community-based*	Community Health Workers, Community Initiatives, Health Facilities	• Utilization of Health Extension Workers (HEWs) and health facilities for support of the Child Health Days (CHD) Program and distribution of vitamin A and deworming tablets, malnutrition screening, and immunizations. HEWs further

underlying causes of malnutrition; enhancing child survival by reducing mortality and morbidity in children less than 5 years of age.			support information, education, and communication (IEC) on infant and young child feeding, Essential Nutrition Actions (ENA), personal hygiene, and HIV/AIDS prevention.
	Financial incentive-based	Removal of user fees	• The program distributes Insecticide Treated Nets (ITNs) to children under five years of age and pregnant women in malaria prone EOS kebele.
	School-based	Promotion of health and nutrition	• Provision of vitamin A and deworming tablets in schools.
	Technology-based	Mass/social media outlets	• Transmission of information regarding health service coverage using social mobilization, posters, banners, and brochures (136,137).
Productive Safety Net Program Adaptable Program Loan (PSNP APL) (2005-2020): Aims to reduce household vulnerability, improve resilience to shocks, and promote sustainable community development in food insecure areas of rural Ethiopia.	*Financial incentive-based*	Conditional cash and/or food transfer, Removal of user fees	• Provision of cash and/or food transfers to chronically food insecure households, and provision of livelihood transfers to poor households. The program additionally facilitates linkages with health and nutrition services for pregnant and lactating women.
	Community-based	Community Health Workers, Community Initiatives	• Provision of technical assistance and training in livelihood activities to enable households to increase and diversify their incomes, as well as build their assets. • With the help of community volunteers such as the Health Development Army, Health Extension Workers (HEWs) plan, organize, and provide community behaviour change communication (BCC) sessions (138,139,164).
National Nutrition Program (2008-2020): Aims to address the immediate causes of suboptimum growth and development, and the potential effects of nutrition-sensitive interventions that address the underlying determinants of malnutrition.	*Community-based*	Community Health Workers, Health Facilities	• Utilization of community health workers and health facilities to support nutritional assessments and treatments, provision of supplements and deworming tablets during pregnancy, as well as counselling on breastfeeding, complementary feeding, and diversification of diets.
	Technology-based	Mass/social media outlets	• Utilization of media to promote nutrition policy and practice among the public and policymakers, and promote optimal nutrition practices.
	Fortification-based	Mass/universal fortification	• Fortification of oil and flour to address micronutrient deficiencies.
	School-based	School feeding programs, Promotion of health and nutrition	• Provision of meals in school through the School Feeding Program (SFP) to improve school children's health and nutrition status • School-based biannual deworming tablets (83,103,144,145).
Sustainable Undernutrition Reduction in Ethiopia (SURE) (2012-present): Aims to reduce stunting by up to 26% by 2020.	*Community-based*	Community Health Workers, Community Initiatives	• Community-level health workers support the enhancement of Community-based Nutrition (CBN) programming, infant and young child feeding counselling, nutrition-sensitive agriculture, and behaviour change communication (BCC) to address inadequate feeding and household dietary diversity.
	Technology-based	Mass/social media outlets, mHealth	• Delivery of health messages through mobile health and mass media (158).
Integrated Community Case Management of Childhood Illness and New Born Care Implementation Plan/Program (2010-present): Aims to strengthen the delivery of quality maternal, newborn and child health (MNCH) services through implementation of integrated community-based case management of newborn and childhood illnesses at primary health care units (PHCU) level.	*Community-based*	Community Health Workers, Community Initiatives, Health Facilities	• Along with health facilities, Health Extension Workers, (HEWs), Health Workers (HWs), and the Health Development Army (HDA) are responsible for the implementation of this program to provide and improve sick newborn and children service utilization at the primary health care unit (PHCU) level.
	School-based	Promotion of health and nutrition	• Distribution of supplies within schools to treat childhood illnesses.
	Technology-based	Mass/social media outlets	• Child and newborn health-related messages shared via mass and local media (150,151).
Essential Nutrition Action (ENA) (1997-present): An action-orientated, life-cycle focused approach that promotes seven clusters of nutrition behaviors that have been empirically proven to	*Community-based*	Community Health Workers, Community Initiatives	• Alongside community health facilities provision of immunizations, and essential maternal, newborn and child health services under this initiative, community health workers provide education and counselling on optimal nutrition for women, early initiation of breast feeding and

reduce morbidity and mortality, including addressing women's nutrition during pregnancy and lactation, optimal breastfeeding and complementary feeding, nutritional care of sick and malnourished children (including zinc, vitamin A, and ready to use therapeutic foods), and the control of anemia, vitamin A, and iodine deficiencies.			exclusive breastfeeding, appropriate complementary feeding, iodized salt use, Vitamin A supplementation in infants and children 6–59 months of age. Community negotiating is also used to work towards better Essential Nutrition Actions practices.
	Technology-based	Mass/social media outlets	• Behaviour Change Communication (BCC) presented using mass media (102,129,168).

5.5: Summary of Budget Expenditure Data for Nutrition Specific and Sensitive Initiatives

Budget data for nutrition-specific and nutrition-sensitive programs can be found in Table 21. This includes information on the name of the program and policy, duration of funding, and funding source. When funds were not originally listed in USD, they were converted from their local currency (e.g. Ethiopian birr, Euros) using an online tool described below.

A large number of the Government of Ethiopia's social and economic policies and programs in the past two decades have been long-term, multi-phase initiatives focused on poverty reduction and WASH. Among initiatives specifically focused on poverty reduction is the Productive Safety Net Program (PSNP), which ran its first three phases from 2005-2014 with a budget of USD $3.7 billion, and its fourth phase from 2014-2020 with a budget of USD $1.1 billion. There have also been significant and growing investment in macro-level economic development programs, such as the Climate Resilient Green Economy (CRGE) Strategy, which began in 2013 and has a budget of USD $75 million per year. Along with this, the National Indicative Program for Ethiopia is set to run from 2014-2020 with an overall budget of USD $989 million. Lastly, notable achievements in WASH outlined elsewhere in this report may be tied to an increase in funding to large-scale WASH programs such as the National Hygiene and Sanitation Strategic Action Plan (2011-2015), with a four-year budget of USD $414 million, and the One WASH Program (2013-2020), with a seven-year budget of approximately USD $3 billion.

Similar to increased investment in social and economic programs, investments have also grown in recent years in programs focused on child health and the delivery of essential health services. Among these is the National Strategy for Newborn and Child Survival in Ethiopia, which runs from 2015-2020 and has an overall budget of USD $1.16 billion, and the Expanded Program on Immunization, which saw a 27% increase in funding between its 2011-2015 phase and its 2016-2020 phase (USD $893 million to USD $1.137 billion, respectively).

Funding allocated to nutrition-specific programs in Ethiopia has also been increasing. Most notably, the National Nutrition Program, which launched in 2013, saw a near doubling in its budget between the first phase (2013-2015), and the second phase (2015-2020), increasing from USD $547 million to USD $ 1.1 billion, respectively. Similarly, the long-term Agricultural Growth Program, which ran in two phases from 2010-2019 and was focused, among other things, on improving dietary diversity, had a significant budget, USD $ 361 million in its first phase (2010-2017), and an additional USD $ 264 million in its second phase (2015-2019).

Table 21: Available data on cost for nutrition-sensitive and -specific programs

Program or policy	Funding Source	Time period	Amount Spent (USD)[1]	Source
Social and Economic Programs				
Productive Safety Net Program (PSNP 1-3)	Adaptable Program Loan world bank, Government of Ethiopia	2005-2014	USD $3,742.9 million	(138)
Productive Safety Net Program (PSNP 4)	Adaptable Program Loan world bank, Government of Ethiopia	2014-2020	USD $1,100 million	(139)
National Indicative Program for Ethiopia	European Development Fund (EDF), Promotion of Basic Services (PBS) Program, MDG Performance Fund	2014 - 2020	USD $989,754,850	(169)
National Hygiene and Sanitation Strategic Action Plan	Government of Ethiopia (Ministry of Health (MoH), Ministry of Education (MoE)	2011-2015	USD $414 million	(113)
One Wash National Program (OWNP)	European Development Fund (EDF), Promotion of Basic Services (PBS) Program, MDG Performance Fund	2013- 2020	USD $3,052,000,000	(170)
Climate Resilient Green Economy (CRGE) Strategy	Government of UK, Norwegian Government	2013-present	USD $75 million /year	(114)
Broader Health Sector Programs				
The First National Five Year Malaria Prevention and Control Strategic Plan	Government (Ministry of Health), United Nations Children's Fund (UNICEF), Global Fund to Fight AIDS, Tuberculosis and Malaria (GFATM), World Health Organization (WHO), Dénominations communes internationales (DCI), Ethiopian Social Rehabilitation & Development Fund (ESRDF), United States Agency for International Development (USAID), United Nations Development	2001-2005	USD $57,771,276	(91)

Program or policy	Funding Source	Time period	Amount Spent (USD)[1]	Source
	Program, International Development Association (IDA)			
The Expanded Program on Immunization (EPI) Comprehensive Multi-Year Plan (cMYP) 2011-2015	Government of Ethiopia, Clinton Health Access Initiatives (CHAI), WHO and UNICEF	2011-2015	USD $893 million	(9)
Expanded Program on Immunization (EPI) Comprehensive Multi-Year plan (cMYP) 2016-2020	Government of Ethiopia, Clinton Health Access Initiatives (CHAI), WHO and UNICEF	2016-2020	USD $1.137 billion	(121)
Community Health Days (CHD) Program	Government of Ethiopia, UNICEF (finance the program implementation, responsible for procurement and distribution of logistics), WFP, Micronutrient Initiative (finance the program implementation, procurement of vitamin A capsules, provide technical support for the program implementation), Pharmaceuticals Fund and Supply Agency (PFSA)	2012, for one year	USD $6,137,875	(136)
National Strategy for Newborn and Child Survival in Ethiopia	UNICEF, African Development Fund, USAID, WHO, Ethiopia Essential Services for Health (ESHE)/ John Snow, Inc. (JSI), World Bank and CIDA	2015 – 2020	USD $1.16 billion	(107)
Nutrition-specific Programs				
National Nutrition Program (NNP I)	Government of Ethiopia (MOH), Ministry of Finance, UNICEF, Micronutrient Initiative (MI), World Food Program (WFP), ENGINE (Empowering the	2013-2015	USD $547,000,000	(145)

Program or policy	Funding Source	Time period	Amount Spent (USD)[1]	Source
	New Generation to Improve Nutrition and Economic opportunities), World Bank, Department for International Development (DFID) and World Vision			
National Nutrition Program (NNP II)	Government of Ethiopia (MOH), Ministry of Finance, UNICEF, Micronutrient Initiative (MI), World Food Program (WFP), ENGINE (Empowering the New Generation to Improve Nutrition and Economic opportunities), World Bank, Department for International Development (DFID) and World Vision	2015-2020	USD $1,100,000,000	(144)
Agricultural Growth Program I (AGP-I) **Remark:** ***AGP I and II were implemented side by side until 2017, having their own separate budget***	International Development Association (IDA), Global Agriculture and Food Security Program (GAFSP), Multi-donor Trust Fund with contributions from the Netherlands, Canada and Spain, and parallel financing from USAID and Italy	2010 -2017	USD $361,723,404	(152)
Agricultural Growth Program II (AGP-II)	International Development Association (IDA), Global Agriculture and Food Security Program (GAFSP), Multi-Donor Trust Fund with contributions from the Netherlands, Canada and Spain, and parallel	2015 - 2019	USD $264,392,734	(171)

Program or policy	Funding Source	Time period	Amount Spent (USD)[1]	Source
	financing from USAID and Italy			
Seqota Declaration	Government, community, implementing partners, donors' contribution	2016 - 2018	USD $538,718,444	(167)

[1]Notes: Data that were originally in Ethiopian birr or Euros were converted to USD using average annual exchange rates for the applicable opening year of the program/policy, https://www.oanda.com/currency/average.

Figure 39 outlines general government spending on health from 1990-2016, including funding provided to large-scale national initiatives such as the Health Sector Development Program (1997-2015). Overall, the trend in government spending on health from 1990-2016 mirrors that of the country's GDP growth over the same period, wherein little change occurred prior to 2003, after which a steady increase in spending can be seen. Unlike GDP growth, however, a slight decrease in spending on health can be seen after 2015, which coincides with the end of several MGD-era programs.

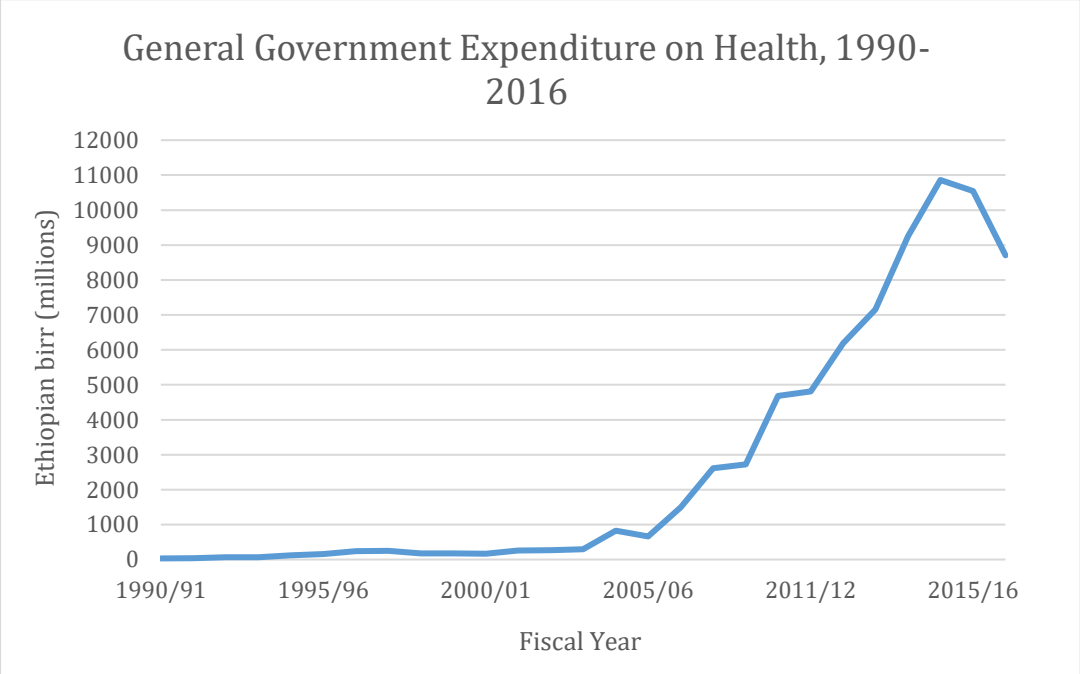


Figure 39: General government health expenditure, 1990-2016
Note: Expenditure data is presented in local currency (Ethiopian birr) as exchange rates are unavailable for Ethiopia prior to 2000.
Source: Ministry of Finance and Economic Development

Looking more specifically at our study period (Figure 40), despite notable GDP growth after 2003, current health expenditure as a percent of the country's GDP remained relatively stagnant from 2000-2016, fluctuating between 3.9% and 5.5%. Current expenditure on health over this period (expressed in current US $) followed the same general pattern as GDP growth, remaining around US $5 until 2003, after which time it increased rapidly, reaching US $27.5 by 2016. Out-of-pocket expenditure on health has also increased notably between 2000 and 2016, though to a lesser degree than current health expenditure, rising from US $1.93 in 2000 to US $10.3 in 2016.

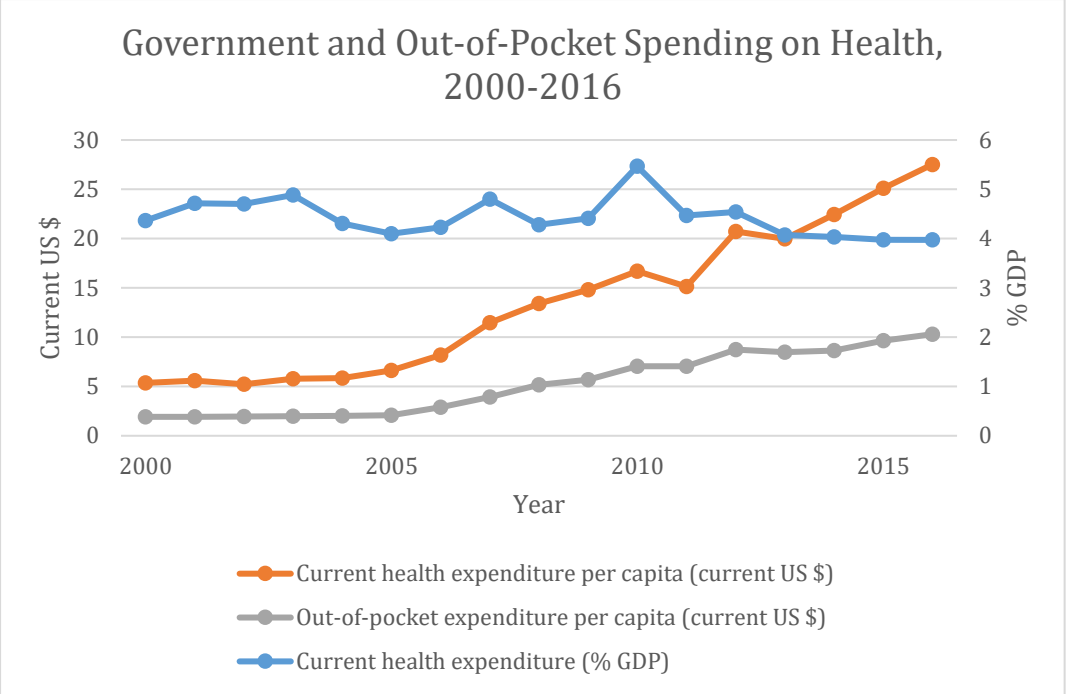


Figure 40: Overall and out-of-pocket spending on health, 2000-2016
Source: World Health Organization Global Health Expenditure database

Chapter 6: Discussion

6.1: Summary of Main Findings

Our synthesis of results from diverse quantitative and qualitative approaches highlight a combination of drivers have contributed in the accelerated under-5 stunting reduction in Ethiopia from 2000 onwards. Below, we narrate a story of multifactorial determinants that influenced child nutrition, which have been put into practice at a country level in Ethiopia. We contrast and contextualize our findings with existing literature. A detailed synthesis and review of literature on key drivers of stunting reduction in Ethiopia is available in Appendix 15.

To preface the subsequent detailed synthesis of the pathways to achievements in health, nutrition and stunting reduction in Ethiopia, we have summarized major findings below:

Summary of Key Takeaways

- Overall, national stunting prevalence decreased by 18.5% points and mean HAZ improved notably from 2000 to 2016. However, gains were not consistent across Ethiopia's regions, with Dire Dawa experiencing an increase in stunting from 33.8% in 2000 to 41.1% in 2016.
- A number of agriculture-focused policies, beginning with the Public Ownership of Rural Lands Proclamation (1975) that provided willing individuals land to cultivate, improved agricultural growth, economic opportunities, and food security, especially in rural areas.
- Early investments in expanded access to good quality, basic education, especially for girls, improved school attendance over the last several decades. This had downstream, positive effects on women's empowerment, fertility rates, and the intergenerational transfer of malnutrition.
- Through implementation of the Health Sector Development Plan in 1997, followed by the Health Extension Program in 2003, an increasingly decentralized health system has allowed

for strides in economic and human development and improved efficiency and sustainability in health service delivery.

- Several multi-sectoral poverty reduction plans including the Sustainable Development and Poverty Reduction Program, the Rural Development Policy and Strategies, and the Plan for Accelerated and Sustained Development to End Poverty (PASDEP), contributed to substantial economic improvement and reduction in poverty across Ethiopia. While the first two focused largely on agricultural improvements, PASDEP encompassed agriculture, healthcare, water and sanitation, women's empowerment, and child nutrition.
- Continued strengthening and integration of Ethiopia's health system through outreach by Health Extension Workers (HEWs), community-level behaviour change communication strategies, and an increased number of facilities improved access to quality services and increased coverage of nutrition-sensitive and -specific interventions.
- Health extension workers, in particular, played an instrumental role in improving reach of both preventive and curative evidence-based interventions.
- Widespread, community-based efforts to improve sanitation, and reduce open defecation in particular, have contributed substantially to the reduction in stunting since 2000.
- Resilience to climate shocks, including major droughts in 2002-03 and 2011, was observed by reactive implementation of strategies to alleviate poverty and hardship among those affected, including through the use of social protection and resettlement programs.
- Improvements in health, nutrition, and stunting were achieved despite ongoing ethnic clashes, conflicts in neighbouring countries, and the Ethiopian-Eritrean war.
- Sustained political support for improving maternal and child nutrition is noted through Ethiopia's Seqota Declaration and other recent promising initiatives including the Nutrition-Sensitive Agriculture Strategy, The Sustainable Undernutrition Reduction in Ethiopia Program, and membership of the Scale Up Nutrition Movement.

Key Enablers

Contextual factors in Ethiopia have acted as critical enablers for the achievements in improved child chronic malnutrition and reduced stunting rates over time. These improvements have occurred amidst major political and national reforms that saw the country divided into ethnically-based regions and led to the first democratic multiparty election in 1995, and despite decades of regional and territorial wars between Ethiopia and its neighbouring countries, Eritrea and Somalia. In addition, Ethiopia has experienced major and recurring climate shocks, including droughts, floods, and severe famines, that have had significant and acute consequences on food security but subsequently led to resettlement strategies and the implementation of effective social protection programs for vulnerable populations, including the Productive Safety Net Program in 2005. Ethiopia has successfully met several ambitious targets outlined in the MDGs, including MDG 1C (to reduce the prevalence of hunger) and MDG 4 (to reduce child deaths by two-thirds). Since the change of government in the early 1990s, Ethiopia has established several long-term strategic plans for national development with a major focus on agricultural improvement and poverty reduction, along with targeted policies and programs to address health challenges and inequities for rural populations. Several key health sector strategies and programs, including the Health Policy of the Transition Government, the Health Sector Development Program and the Health Extension Program, focused on strengthening primary care and integrating the health system through expansion of infrastructure, HEW cadres and community-based initiatives. These programs have improved coverage of services (e.g. child immunization, vitamin A supplementation, bed net distribution) and knowledge of healthy infant feeding and good water and sanitation practices. Progress towards achieving SDG targets are ongoing, and include several commitments that are specific to child

nutrition. These efforts are summarized in the ***Timeline of Key Events*** in Ethiopia, which our work posits as central to child stunting reduction from 2000 to 2016 (Figure 41).

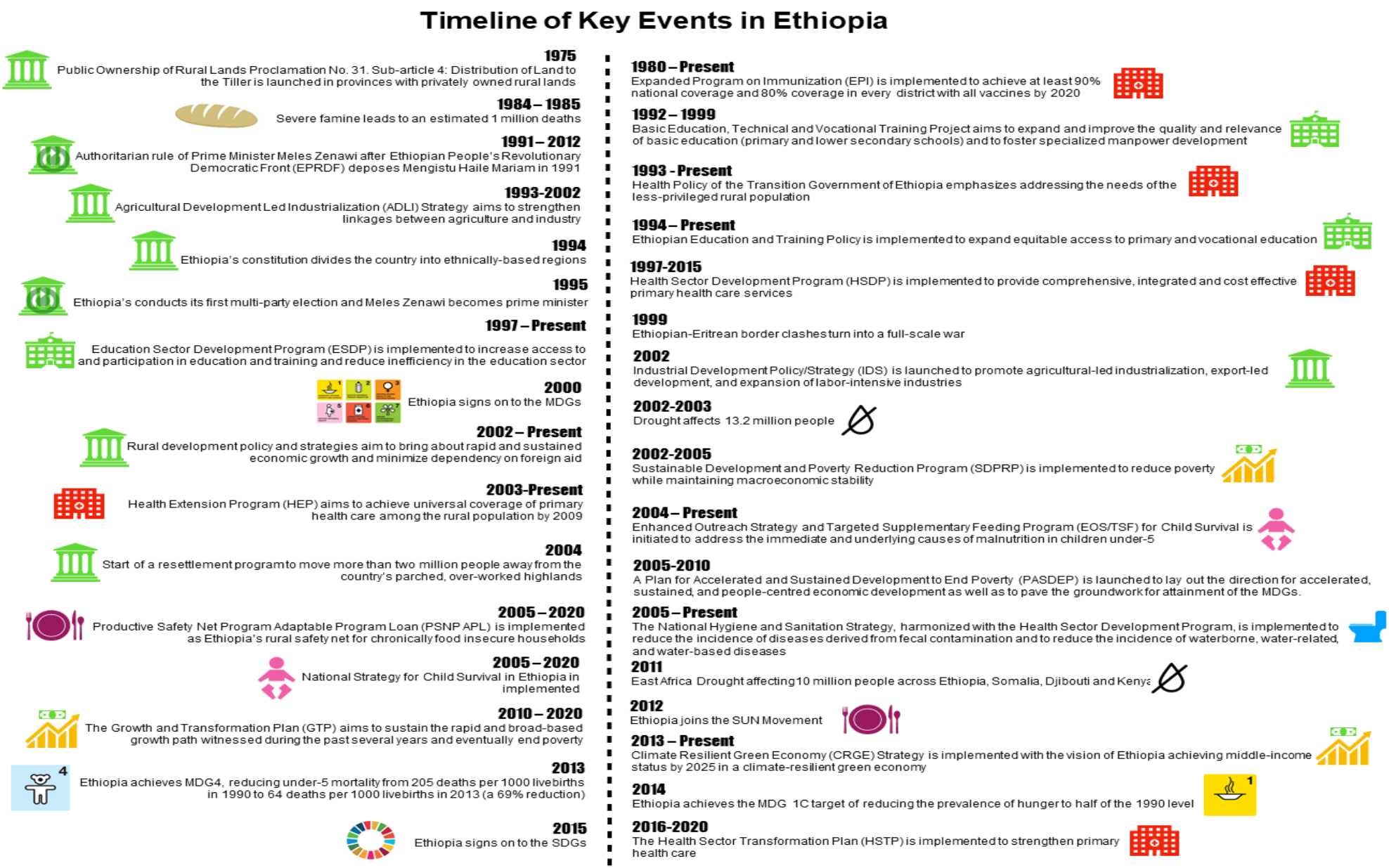


Figure 41: Timeline of key events in Ethiopia

Political Context & Conflict

Over the past four decades, Ethiopia has undergone a process of ***democratization marked by periods of political instability***. In the early 1970s, civil unrest ensued due to ongoing border conflicts and food shortages that resulted in famine and the death of 200,000 in Wallo province (30). As a result, then leader, Emperor Haile Selassie I, was overthrown by a military committee known as the Derg. The Derg was led by Marxist dictator, Mengistu Haile Mariam, from 1974 to 1991 during a period of time that is known as the "Red Terror". During the Red Terror, it is estimated that thousands of government opponents were killed under this military rule, and thousands more were imprisoned, disappeared, or fled as a result of the oppressive state of the country (172). It was during this period when tensions between Ethiopia and Somalia rose due to Somalia's invasion of the southern highland regions of Ogaden (now known as Ethiopia's Somali region)(173,174). These cataclysmic events led to the formation of a coalition government, the Ethiopian People's Revolutionary Democratic Front (EPRDF), comprised of four political parties from Tigray, Amhara, Oromo, and Southern Ethiopia. Together this coalition overthrew Mengistu, marking the end of the ethno-regional war and diffusing tensions among neglected minorities and language groups. Ethiopia gained significant economic and social grounds under Prime Minister Meles Zenawi, who led the country from 1991 to 2012. In 1994, Ethiopia was divided into its ethnically-based regions, which led to Ethiopia's first democratic multiparty election and saw Meles Zenawi officially elected Prime Minister (30). Through ongoing democratization and decentralization that began in 1997, Ethiopia now encompasses five levels of government (Federal, Regional, Zonal, Wereda, and Kebele); a process that has had major impacts on Ethiopia's health system through improved accountability, better use of resources, and more equitable health service delivery.

Despite Ethiopia's progress, as evidenced by major national and political reforms, ***ongoing internal conflicts as well as those with neighbouring countries have persisted throughout the past 3 decades***. A 1993 referendum marked Eritrea's independence from Ethiopia but incited territorial disputes at the countries' borders. The Ethiopia-Eritrea war escalated in the late 1990's, until a comprehensive peace agreement was reached in 2000 (31). Despite this, regional and territorial wars remained. Between January to February 2004, nearly 200 people were killed in ethnic clashes in the region of Gambela. In total, both sides suffered casualties of more than 70,000 people (175) and mass displacement that mostly affected northern regions of Tigray, Amhara, and Afar. These events prompted a humanitarian crisis, which saw the start of Ethiopia's resettlement program in 2004 that aimed to move more than 2 million people away from war-torn and drought-prone highlands (172). The end of the war between Ethiopia and Eritrea was not declared until 2018 (30). In parallel was the violent conflict between Ethiopia and Somalia, arising due to the intent of the Somali Council of Islamic Courts (SCIC) to convert Somalia into an Islamic state. With Ethiopia fighting for the Transitional Federal Government in Somalia, thousands of armed Ethiopian troops entered Somalia in 2006 to engage in heavy fighting that saw the Islamists eventually disperse (30,176). Accusations and infighting from both Ethiopia and Somalia continued until 2009, at which point Ethiopia formally withdrew troops from Somalia (30). Following the civil war or "Red Terror" period, Ethiopia's timeline has been peppered with intra-state conflict due mostly to ethnic disputes, rebel groups, and anti-government activists. For example, several towns were captured by the Ogaden National Liberation Front in 2009, a rebel group which operates in Ethiopia's Somali region in the hopes of seeking regional autonomy (172). In addition, violent anti-government protests erupted in October 2016 and continued intermittently until the resignation of Prime Minister Hailemariam Desalegn in 2018 (172). Post-1991, Dire Dawa has been one of the most politically contested areas of the country due to high turnover of administrative structure and changes in political ownership of the city, along with longstanding ethnic clashes and territorial disputes between Oromia Regional State and Somali Regional State (177). In September 2017, hundreds of people were killed from both sides, and 50,000 were internally displaced because of this regional conflict (177). Now, Dire Dawa has special administration (extra-constitutional federal governance)(178), but it is likely that this ongoing conflict has contributed to the increase in stunting prevalence that this region has witnessed due to

food shortages, depression of services, and disruption of transportation that typically occurs during conflict.

While there is an obvious role that conflict plays on malnutrition, including instigating widespread food insecurity, inadequate dietary intake, displacement, lower access to health services, and higher levels of disease (179), there were no studies that specifically examined this association in Ethiopia. However, a national-level study that examined governance indicators and stunting outcomes found that government effectiveness, regulatory quality, and control of corruption were all positively associated with a reduction in stunting among children (180), highlighting the progress that Ethiopia has made through good governance combined with a democratic society. Key informants spoke to improved peace and security and its association with better access to markets. They also noted that improved security allowed for better reach of health workers in finding and treating malnourished children.

Economic Conditions & Poverty Reduction

Over the last two decades, ***Ethiopia's economy has experienced significant gains*** and this has contributed to a decline in stunting prevalence through several direct and indirect pathways. National GDP per capita increased from $618 in 2000 to $1608 in 2016 (PPP constant 2011, international $) and GNI per capita increased from $1160 in 2000 to $1603 in 2016 (PPP constant 2011, international $) (Table 2). Ethiopia is currently aiming to reach lower-middle income status by 2025 (181).

When examining GDP growth over time in terms of sector contribution (Figure 42), it is clear that, historically, the agricultural sector was the most prominent (182). The importance of investments in agriculture, as they relate to economic improvements at both the household and the national level, has emerged as a major contributor to the decline in stunting over the study period. This is described in further detail below, under Environmental Context & Agriculture. By the mid-2000's, an economic transition was underway whereby the industry sector (largely consisting of construction), followed by the services sector, began to contribute to a higher percentage of GDP growth in the country (182). This represents a shift in terms of employment trends that may also suggest an increase in urbanization. Throughout the study period, ***fluctuations in GDP have occurred due to climate shocks and political disruptions, and stunting reduction has occurred despite this***. In 2002-03, a severe drought caused a recession due to the negative contribution to GDP by the agricultural sector, while in 2017-18 economic growth slowed because of political insecurities and restrictive policies (182).

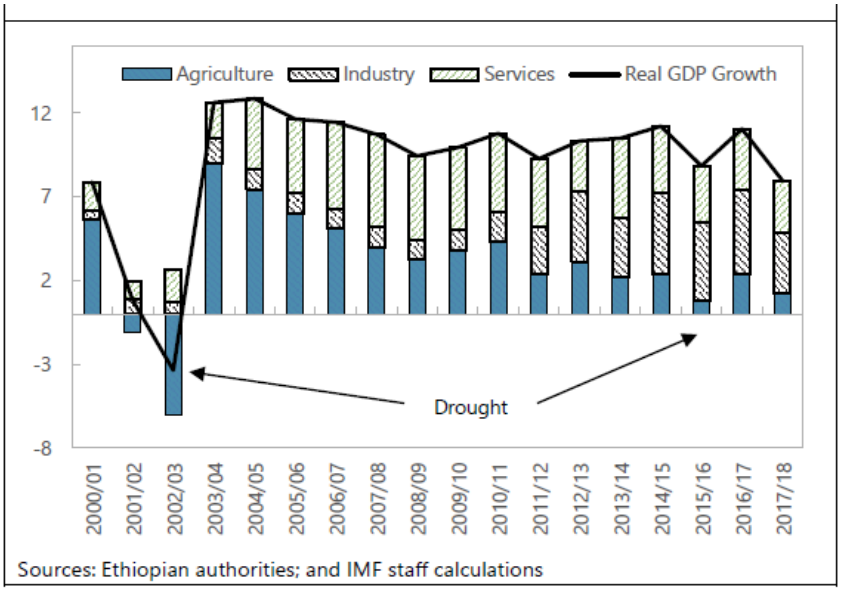


Figure 42: GDP Growth in Ethiopia and Sector-Specific Contributions (182)

With strong economic growth and more investments in construction and infrastructure, ***national poverty levels declined*** by 47% and levels of extreme poverty (<$1.90 per day) declined by 55% from 1999 to 2015 (Table 2). The Multidimensional Poverty Index showed some improvement, decreasing from 0.56 in 2000 to 0.49 in 2016. Supported by a vast array of research that implicates the role of improved wealth and/or assets on increased HAZ (180,183–202), our work suggests that ***poverty reduction and economic growth were important drivers of stunting reduction in Ethiopia***. Specifically, we found that improved asset index, or wealth accumulation, explained 4% of total change in HAZ for children under-5 years, 7% in children aged 2-5 years, and 4% in children aged 6 to 23 months of age from 2000 to 2016. Additionally, national experts felt that poverty had declined dramatically in the past 20 years, which was the largely the result of successful government-led programs that helped to drive agriculture as an economic means and protect citizens during periods of climate shock and during lean periods. Community-level stakeholders also perceived improved agriculture, along with employment opportunities, to be the main driver of economic gains. Overall, mothers acknowledged the positive role that government support programs have played on reducing poverty and improving living conditions, though for some mothers, poverty remains a concern. Results from our equity analyses highlight this inequality, whereby stunting has improved within each wealth quintile from 2000 to 2016, but gaps between the richest and poorest populations have widened over time and stunting decline has been faster among the wealthy. This is likely the result of wealthier populations' ability to withstand or ride out the negative effects of shocks, such as droughts and famines, in a way that poorer households cannot.

Poverty reduction has been a major national priority in Ethiopia, and the government has demonstrated ongoing commitment to strengthening national and local development through the implementation of the ***Sustainable Development and Poverty Reduction Program*** (2002-2005), the ***Plan for Accelerated and Sustained Development to End Poverty (PASDEP)*** (2005-2010) and the ***Growth and Transformation Plan (GTP)*** (2010-2020). As a means of further encouraging economic growth and poverty reduction, the Government has also invested in several agriculture-specific policies, including the ***Agricultural Development Led Industrialization Strategy (ADLI)*** (1993-2002), ***the Industrial Development Policy/Strategy (IDS)*** (2002), and the ***Rural Development Policy and Strategies*** (2002-present). These policies were successful in enhancing agricultural productivity, strengthening ties between agriculture and industry, increasing exports,

and ultimately improving both the national-level economy and household income, especially for rural farmers. In addition to these important initiatives, the ***Productive Safety Net Program Adaptable Program Loan (PSNP APL)*** (2005-2020) worked to improve resiliency among populations at risk of food insecurity through food (oil and flour) and cash transfers in exchange for public works. The PSNP APL provided food and cash unconditionally to households that did not have an able-bodied member. While the program linked recipients to health and nutrition services, these were not mandatory conditions of the program. Monitoring and evaluation suggested that this PSNP APL strengthened household and community resilience to shocks and led to improved infrastructure through the public works component. Overall, each of these policies and programs discussed here was deemed important or very important to stunting decline over the study period.

In addition to achieving poverty reduction through agricultural growth, improved household finances were linked to an ***increase in remittances*** received from labour migration over the study period. In Ethiopia, migration mostly occurs internally, though the number of individuals emigrating to high-income countries has steadily increased from 2000 to 2017 (203). Personal remittances received went from USD $121.6 billion in 2000 to $551.1 billion in 2016, and in 2015, Ethiopia was one of the top 10 remittance-receiving countries. In 2017, remittances accounted for over 5% of Ethiopia's GDP (204), underscoring the pivotal nature of this form of income in improving household wealth and the standard of living in Ethiopia more generally. A survey in 2004 reported that 93% of urban households, compared to only 14% of rural households, rely on remittances as a primary source of income (205). For rural households, remittances or cash reserves are used ahead of selling agricultural assets in the face of climate shocks or natural disasters (205,206); findings that underscore differences in remittance use patterns, whereby urban households purchase daily necessities, including food, and rural households use this income to improve resilience and food security in the face of crises (205,207). Though regional and community participants did not associate remittances with HAZ, key informants at the national level pointed to international labour migration and remittances as an important driver of stunting reduction through increased purchasing power, improved food security, and poverty reduction.

Infrastructure Development & Urbanization

Ethiopia's urban population has grown slightly from 15% in 2000 to 20% in 2016, underscoring the ***vast rural populations*** in Ethiopia. Though stunting prevalence was reduced for children under-5 living in both urban and rural areas, our study and previous literature support the notion that children living in urban areas in Ethiopia have a lower stunting prevalence than children living in rural areas (188,190,191,193,197,200,201,208–216).

In Ethiopia, ***urbanization has been mainly characterized by the formation of new cities*** as opposed to increased population growth in established urban centers, a concept which contributes to some subjectivity when defining an urban area (29). This type of urbanization has resulted from political changes including decentralization and, with it, the provision of new infrastructure and improved access to services, including health facilities, schools, and markets. Road infrastructure in Ethiopia has improved, but not uniformly across the country. Inequalities remain in the quality, quantity, and types (e.g. asphalt versus gravel) of roads across regions. When comparing roads by area (1000 square km), SNNPR and Dire Dawa have the highest number of roads while Somali has the lowest (217). Despite these differences, all stakeholders, along with mothers from communities in both SNNPR and Somali, noted improvements to roads that allowed greater physical access to markets over the study period. Though urbanization in Ethiopia has been relatively slow throughout the past two decades, it is projected to triple by the year 2034 (218).

In general, rural-urban migration tends to be associated with reduced poverty, improved access to services, and better job opportunities, though there are constraints to this type of migration in Ethiopia. Firstly, unemployment in Ethiopia is largely an urban phenomenon, due to the substantial focus and investments in agriculture. Less than 5% of rural households have an unemployed adult compared to 15% in urban areas (219). Additionally, unemployment increases with the size of the labour market; in the capital city of Addis Ababa, unemployment is higher (24%) when compared to other urban centers (11%) (219). Loss or restriction of land rights is common, and the fact that migrants cannot register their new address until they have resided there for at least 6 months underscores restricted access to basic services (218). Additionally, while there has been progress in improving infrastructure, including roads and sanitation services, at a national level, cities do not always bear an advantage in this regard. For example, Addis Ababa is the only city to house a municipal sewage system and even then, it reaches only 10% of the population (218). Still, we found a consistently lower stunting prevalence in urban areas, which may be a proxy of more proximal and immediate factors including healthcare access and quality. In fact, national level stakeholders perceived that urbanization was an important driver of stunting decline based on related improvements in education, health service access, and the economy, though our quantitative analyses ***did not suggest any meaningful contribution of urbanization to the stunting decline*** in Ethiopia from 2000 to 2016.

Improvements in Education

Maternal education has been shown to be a consistent driver of improved child health and nutrition. From 2000 to 2016, the percentage of literate women increased from 24% to 42% and the percentage of women with secondary or higher education increased from 9% to 17% over the same period, indicating year over year advances in maternal education but underscoring room for further improvement. Pathways between education and health outcomes are well understood, and are detailed in Appendix 18. Our equity analyses also provide putative pathways by which child HAZ is improved among educated mothers in Ethiopia. Compared to mothers with no education, those with some education demonstrate increased care seeking for and treatment of childhood illness (diarrhea and ARI), improved child vaccination rates, greater access to piped water, and reduced open defecation.

Our study ***supports the link between improved education (particularly of girls and women) and child health and nutrition*** in Ethiopia. Our decomposition analysis for the entire population of under-5 children demonstrated that maternal and paternal education each accounted for 5% of the total change in HAZ across the period examined. Similar findings were noted when looking at select age groups of children; maternal and paternal education contributed to 8% and 5% of HAZ change for children aged 2 to 5 years and to 6% and 4% of HAZ change for infants aged 6 to 23 months, respectively. A number of national-level trend and cross-sectional studies have corroborated this, reporting that both maternal and paternal education were positively associated with HAZ and negatively associated with stunting (180,183,184,187,188,190,194,196,200,202,214,220–222). Similarly, both national and regional stakeholders, and mothers within SNNPR and Somali regions, confirmed that considerable improvements in education, particularly of girls and women, has advanced child care and nutritional knowledge, ultimately contributing to gains in child HAZ. These improvements are due, in part, to national-level investments, including the ***Ethiopian Education and Training Policy*** (1994-present) and related ***Education Sector Development Program*** (1997-present), that aim to achieve greater access to quality education across the country, ensure universal primary education and, in more recent years, reach adult and non-formal education sectors.

Women's Empowerment

Though the direct measurement of empowerment is a challenge, there are several related proxies, including maternal education, fertility, age at first marriage, and age at first birth, that can be used to better understand women's empowerment in the Ethiopian context. These indicators have demonstrated marginal improvements since 2000 (Table 2). Age at first marriage increased from 16.4 years in 2000 to 17.5 years in 2016; total fertility rate declined from 5.9 births in 2000 to 4.6 births in 2016; child marriage, or the proportion of women 20-24 years married by age 18, decreased from 49% in 2000 to 41% in 2011; and the adolescent fertility rate has declined from 110 births per 1000 girls in 2000 to 65 births per 1000 (Table 2). Women's empowerment at the collective level has demonstrated greater improvement, as noted by the proportion of seats held by women in Ethiopian parliament. This indicator has increased dramatically from 7.7% in 2000 to 38.8% in 2018 (223), gaining substantial progress towards achieving gender parity in national decision making structures. Gender equity indicators for Ethiopia have shown mixed progress. The Gender Development Index increased from 0.7 to 0.9 in 2016, though there was a slight decline in the Gender Inequality Index from 0.6 in 2005 to 0.5 in 2016. This is despite the ***stated investments in women's education and empowerment in several policies and programs***, including the 1997 Environmental Policy, the Growth and Transformation Plan (2010-2020), and more recent initiatives such as the Sequota Declaration (2016-2030) and the Nutrition Sensitive Agriculture Strategy (2016-2021). Our systematic review identified several studies that looked at the effect of empowerment on HAZ or stunting. Most reported no direct association (189,216,221,224), though two reported an increase in child malnutrition with empowerment, as measured by female employment (191,215). However, there were several limitations to these studies that limit our certainty of the evidence provided, including the use of imperfect proxies that require further context for appropriate interpretation. Results from our qualitative inquiry did not specifically highlight substantial gains in relation to women's empowerment, though national and regional stakeholders, along with mothers spoke to the substantial improvements in women's education. In the case of national stakeholders and mothers, ***improved education was associated with empowering mothers*** to better care for their children through more informed feeding practices, family planning, and improved nutrition in general; facets that we found to have a notable impact on stunting reduction. Overall, ***we found no strong evidence of the impact of empowerment, separate from education, on the observed child stunting decline in Ethiopia***.

Environmental Context & Agriculture

Agriculture has been a driving force behind the increased economic and social stability that Ethiopia has experienced over the past 30 years, and has been a ***major contributing factor to improved child HAZ*** and nutrition more generally. Beginning with the 1975 Public Ownership of Rural Lands Proclamation, the government initiated a policy whereby anyone who wanted to be an agricultural producer could own a plot of government-distributed land. Since, the government has invested heavily in this sector, putting forth several large-scale policies and programs, including the ***Agricultural Development Led Industrialization Strategy (ADLI)*** (1993-2002), the ***Industrial Development Policy/Strategy (IDS)*** (2002), and the ***Rural Development Policy and Strategies*** (2002-present), that succeeded in improving agricultural practices and proper use of land, motivated the economy in rural areas, and strengthened agriculture-led industrialization. In 2000, the agricultural sector employed close to 85% of the Ethiopian workforce and proportions are still high today with 60% of all employed females and 72% of employed males working in agriculture in 2018 (225). Through this focus on agriculture, the production of staple crops, including wheat, rice, barley, maize, millet, and sorghum, increased steadily since 1990 across all regions (226,227). For example, maize production increased from 1,456,000 tonnes in 1993 to 6,674,000 tonnes in 2013 (226), while the cereal yield (including teff) in kg per hectare increased from 1313 to 2538 over the same period (225). Production of fruits, vegetables, and animal-source products, though more reactive to climate shocks, has also increased over time (226). The widespread distribution of seeds and fertilizer was shown to be an important driver of crop production over the study period. The

food production index, which covers edible food crops that contain nutrients, increased by 92 points from 2000 to 2016 and the crop production index increased by 114 points over the same period, underscoring the overall increase in food production. Comparatively, food exports have traditionally focused on a few key agricultural commodities, such as coffee, though in more recent years the export earnings for fruits, vegetables, and meat products have increased substantially, as have earnings from domestic cash crops (228). However, today, Ethiopia still imports more food than it exports. Interestingly, arable land in hectares per person has remained consistent, and arable land as a percentage of land area increased only slightly from 10% in 2002 to 15% in 2016, indicating that improvements in farming practices and technologies, as opposed to direct increases in farmable land, has contributed to enhanced agricultural production.

The reasons behind such significant investments in agriculture in Ethiopia are two-fold. Firstly, there are the economic outputs that have been garnered through improvements in this sector. Secondly, agriculture in Ethiopia is largely subsistence (227), with small farms (less than 25 hectares) comprising up to 95% of agricultural farmland (229). However, over the study period, ***Ethiopia has experienced several major climate-related shocks***, including floods and severe droughts, that have increased vulnerability to food insecurity. Floods, determined to be related to deforestation and land degradation coupled with climate change, have occurred almost yearly, destroying crops and reducing road access to markets, services, and aid (230,231). However, droughts have had an even greater negative impact in terms of population affected (Appendix Figure 99). In 2002-03, a severe drought affected 18% of Ethiopia's population, ending in widespread famine due to the devastation of crops and household food shortages (231). The situation in Dire Dawa, which saw an increase in stunting over the study period, is one that may be partially related to the environment and agriculture The majority of urban Dire Dawa's settlements are slums, which are vulnerable to the frequent floods that typically break through flood barriers and have resulted in deaths and homelessness (232,233). In contrast, poor soil for crop production and a lack of political will have undermined the agricultural sector in rural Dire Dawa. In addition, nearly 70% of farmers practice rain-fed agriculture, meaning that when droughts occur (which are common), these farmers have no available assets and experience high food insecurity (177,234).

Social protection programs, such as the Ministry of Agriculture's ***Productive Safety Net Program Adaptable Program Loan (PSNP ALP)*** (2005-2020), were put into place to help mitigate the negative effects of climate shocks and bolster income and food security through cash transfers in exchange for public works. As a further safeguard, some populations were resettled away from drought-prone areas. The aim of the resettlement program was to relocate approximately 2.2 million people between 2003 to 2005 from areas in the highlands with high land degradation that were drought-prone and chronically food insecure to potentially more productive, fertile, and less populated areas in the lowlands of Ethiopia. This resettlement program specifically targeted individuals residing in the four regional states most affected by recurrent droughts: Amhara, Oromia, SNNPR, and Tigray (235,236). However, the program was implemented as an emergency response by government officials (236) and thus, most resettlement sites lacked access to clean water, health care, shelter, education, and food (235,236). Of those who resettled, 36% returned to their communities of origin, but most were unable to afford the return travel (236). As such, these resettlement programs, along with domestic migration and population expansion, triggered an ***increase in deforestation of land*** for agricultural use and fuelwood (237,238). Between 1990 and 2005, an average of 140,000 hectares per year of deforestation has taken place, an act that has further accelerates soil degradation, floods, and droughts in Ethiopia (229). In addition to the current environmental concerns, future climate change scenarios will force adaptations to agricultural production in Ethiopia, implicating availability of water and the type and location of available crops. However, the government of Ethiopia has taken some measures to combat these effects, including implementation of the ***Climate Resilient Green Economy Strategy*** (2013-present), which aims to strengthen climate resilience and a green economy simultaneously.

Despite these persistent and severe climate shocks, Ethiopia has demonstrated resilience. We found that ***improvements in agriculture across Ethiopia are considered a significant driver of stunting decline over the study period***. Results from our decomposition analysis for under-five children demonstrated that ***total consumable crop yield accounted for the largest proportion (32%) of the total change in HAZ across the period examined***. Similar findings were noted when looking at children aged 2 to 5 years (34%) and infants aged 6 to 23 months (34%), highlighting the importance of food security in stunting reduction. The crop yield variable is an indicator of food production and may also be an indicator of consumption, given the subsistence nature of farming in Ethiopia, and is discussed further below under Food Security. These quantitative findings are further supported by our discussions with national, regional, and community-level informants, who identified improved agricultural productivity as a major driver of stunting decline, but noted the detrimental impact of climate shocks (especially by mothers) and farmers' shifting focus from subsistence to cash crops. In addition, national and regional stakeholders spoke to ongoing challenges with Ethiopia's increasing population, which is associated with decreased available land size per person. Some studies have examined the association between environmental factors, such as rainfall, temperature, and food availability, and HAZ/stunting in Ethiopia. While we could not draw any definitive overall conclusions, some studies suggested that variation in HAZ can be partially explained by climate and food shocks (209,239,240), whereby more environmental disruptions are associated with lower HAZ.

Increased Food Security

Ethiopia is a ***highly food insecure*** country, with an estimated 7.88 million people requiring food assistance, even in the face of economic growth and poverty reduction (241). ***Recurrent climate shocks,*** including major droughts in 2002 and 2011, have affected Ethiopians' food security. This, along with large numbers of ***population displacement*** and some periods of ***political instability*** and armed clashes, has resulted in 8.5 million food insecure people in need of urgent action (242). Despite the number of food insecure people decreasing over the years in Ethiopia, a finding that is likely linked to improved agricultural production, the food insecurity being experienced is becoming more severe (242).

Our literature review found that climate and food shocks partially explain the variation in child stunting in Ethiopia, while household food insecurity was found to be negatively associated with HAZ and positively associated with child stunting risk (Appendix 15). As discussed above, our quantitative analysis showed that ***crop yield was an important factor in improvements to child stunting***. Total crop yield in Ethiopia increased from 11.15 quintals per square hectare in 2000 to 18.09 quintals per hectare in 2016. Total crop yield was positively associated with HAZ in our difference-in-differences analysis, and our decomposition analysis showed that total crop yield was the variable with the most explanatory power in decomposing the total change in HAZ over time for all studied age groups. ***It explained between 32% and 34% of HAZ change between 2000 and 2016***. Key informants reinforced this finding, indicating that increased agricultural production has occurred over time, though problems relating to diversity of crops, droughts, and increasing population size remain. Interviews with mothers in Ethiopian communities uncovered the complex nature of food insecurity. Although respondents spoke of the recent Somali region drought and its negative impact on the availability of animal food products, they also spoke to ***improvements in the availability of fruits, vegetables and other crops*** in recent years. This was attributed to improved transportation, better farming practices, peace and stability, and access to markets. However, there was a general consensus among stakeholders that economic barriers to accessing diverse and nutritious foods in the market place remain an ongoing challenge.

Various policies and programs have helped improve food security in Ethiopia. ***The Agriculture Development Led Industrialization Strategy*** (1993-2002) was the overarching strategic framework guiding Ethiopia's development, and included a clear focus on improving links between

agriculture and industry, and investing in rural areas. The goal was to achieve national food self-sufficiency while raising incomes of rural farmers (86)(87). The ***Industrial Development Policy,*** which emanated from this strategy, endeavors to strengthen agricultural-led industrialization, export-led development, and labor-intensive industries (87,100,243). From 2002 onward, the ***Rural Development Policy and Strategies*** has worked to minimize foreign aid requirements by developing Ethiopia's market economy. This policy provides direction to agricultural development, strengthens the agricultural labor force, improves rural finance, and manages rural development (87,99,100). The ***Productive Safety Net Program Adaptable Program Loan (PSNP ALP)*** (2005-2020) has played a critical role in improving food security, particularly after climate shocks, reaching close to 8 million at-risk individuals since its inception. More recently, the ***Growth and Transformation Plan*** (2010-2020) has plans to promote quicker and more equitable economic growth focused on agriculture (244,245).

Ethiopia has several promising recent initiatives related to agriculture and food security, including the ***Nutrition Sensitive Agriculture Strategy***, the ***Climate Resilient Green Economy Strategy***, the ***Agriculture Sector Policy and Investment Framework***, the ***Agricultural Growth Program***, and the ***National Indicative Program for Ethiopia.***

Health System Strengthening & Reforms

The health system in Ethiopia has gone through several reforms that have led to marked improvements in population health and reductions in child stunting. The ***decentralization of health services*** to local governments and ***increased emphasis on primary care provision***, especially among rural and vulnerable populations, led to the increased availability of facilities and services. In addition, Ethiopia gradually transitioned from the implementation of vertical programs (i.e. the Expanded Program on Immunization) towards a more integrated approach to healthcare.

The total health expenditure as a proportion of GDP in Ethiopia has decreased marginally from 4.4% in 2000 to 4.0% in 2016. Further, the domestic general government health expenditure as a proportion of GDP has shown a marked decline from 41.2% in 2000 to 27.6% in 2016 (Table 2). In addition, over this same time period, individuals' out-of-pocket expenditure as a proportion of total health expenditure increased by 1.5% (Table 2). Despite this, improved access to evidence-based interventions and increases in child growth have been evident over the study period.

Ethiopia's ***Expanded Plan on Immunization*** began in 1980 and is ongoing, with an aim to achieve 90% coverage of all vaccines by 2020. Vaccines are delivered in health facilities and through mobile units, which has allowed for targeted outreach and community engagement. The current beneficiaries of this program are women of reproductive age and children less than 1 year, with priorities including maintaining the cold chain for vaccine transportation, and the introduction of more vaccines (120,121,246). Interviews with mothers in the community confirmed improved vaccination rates over time, and national key informants linked decreases in vaccine-preventable diseases with the reduction in stunting observed. Our quantitative analyses showed that vaccination rates went up; however, inequalities persisted over the study period, with the poorest and least educated mother/child pairs experiencing markedly lower vaccination rates than their richer, more educated counterparts. The literature indicates that there is evidence to support the protective effect of immunization on stunting, though the pathways through which this happens are unclear (Appendix 15).

The Health Policy of the Transition Government of Ethiopia (1993-present) was catalytic in instigating major and effective changes to health care in Ethiopia. It focuses on vulnerable populations, including women and children, rural communities, the poor, minorities, and those impacted by disaster. Decentralization and democratization of the health system, preventative health care, equity, inter-sectoral collaboration, and capacity development comprise some of the major components of this policy. Additionally, the policy aims to provide Ethiopians with essential

medicines, staff and equipment for health services (85). Decentralization was noted by national stakeholders to be a main driver for the observed improvements in nutrition.

The Health Sector Development Program (HSDP) was introduced in 1997 and continued into 2015. This significant program had the overall goal of comprehensive, integrated, and cost-effective primary care provision, with a focus on communicable diseases, immunization, nutrition, and reproductive health. The HSDP led to an increase in the number of new health centers, posts, and hospitals, and an increase in the number of trained healthcare workers (44,124). Healthcare worker training, though government initiated and led, may have been supported by NGOs that helped with curriculum development and review, supply of books, and training of instructors. One of HSDP's major objectives was to increase coverage of the ***Health Extension Program (HEP)*** (123,124), which was initiated within the second phase of HSDP (2002-2005). HEP sought to improve access to healthcare in rural and resource-limited areas through community-level provision of services. ***Health Extension Workers (HEWs) are the mainstay of this program, and have been critical to improving child health and nutrition.*** HEWs initiate home visits and provide outreach services that encompass a range of activities including antenatal and postnatal care, referrals, family planning, HIV testing and counseling, malaria prevention, and education on healthy WASH practices, feeding practices, and nutrition (44,131–133,247). HEWs are also in direct contact with the community through a "1 to 5" arrangement, whereby 1 woman out of every 5 households becomes a 'women's development leader'. Leaders encourage health promoting behaviours (e.g. through community discussions) and are in direct contact with HEWs, which works to strengthen the health system through linking the health facility directly with members of the community. Key informants spoke about HEP and its impact on preventing disease, expanding immunization, and improving hygiene and sanitation. Key informants also noted the HSPD as instrumental in Ethiopia's achievement of the Millennium Development Goals, with particular attention given to maternal and child health services, and identified its contribution to the reduction of child stunting in Ethiopia.

Our quantitative analysis showed that the total number of health centers increased, as did the total number of health workers. Additionally, deliveries at a medical facility rose by 26% over the study time period (Table 2). Our decomposition analysis demonstrated that ***increased maternal and newborn healthcare, as well as the increased number of health workers, positively contributed to HAZ change over the studied time period***. For the under-5 population, the increased number of health workers accounted for 28% of change and improved maternal and newborn healthcare, measured through antenatal care, accounted for 2% of total explained HAZ change. Our qualitative research corroborates the importance of health system strengthening. Respondents consistently described the link between expansion of health facilities, especially in villages, and increased coverage of basic health services. Key informants did add that there is a need for nutrition experts at health facilities to bring about further improvements in stunting. Our literature review further supports these findings, as national-level studies found that skilled birth attendance and antenatal care are both negatively associated with stunting among under-5 children in Ethiopia. Studies did not, however, establish a strong relationship between healthcare access and stunting outcomes, though these studies lacked detail on health service provision and quality of services (Appendix 15).

As the availability of human resources for health continues to improve in Ethiopia, ensuring equitable access to interventions is a major target of the current government. ***The Health Sector Transformation Plan*** (2016-2020) is the first phase of a 20-year plan that aims to facilitate universal access to health services (promotion, prevention, curative, rehabilitative, and palliative services) for all Ethiopians. The strategic areas of focus are health service delivery, quality improvement and assurance, leadership and governance, and health system capacity (45). Key nutritional targets of the plan include the reduction of stunting, wasting, and underweight in under-5 children to 26%, 5% and 13%, respectively.

Health & Nutrition Programs

The implementation of several nutrition-specific and –sensitive programs in Ethiopia between 1990-2016 are related to important achievements in health and nutrition outcomes.
As described above, the ***Health Sector Development Program (HSDP)*** (1997-2015) was implemented as a national plan and framework to improve maternal health, reduce child mortality, and prevent and control communicable diseases through comprehensive primary health care services (123). The program was executed in four phases between 1997 and 2015 by all levels of government and health institutions (123). The first two phases of the program were characterized by challenges such as resource constraints; specifically, there was poor availability of trained professionals and lack of physical access to health services in rural areas (131). However, monitoring and evaluation of the program overall has revealed notable improvements in nutritional screening of infants and young children, prevalence of exclusive breastfeeding and vitamin A supplementation (124).

In order to address the gap in health care services for all segments of the population, the ***Health Extension Program (HEP)*** (2003-present) was initiated in 2003 and is currently being implemented by the Government of Ethiopia to achieve universal coverage of primary health care in rural areas. The community-based health program contains 16 intervention packages focusing on hygiene and environmental sanitation, disease prevention and control, family health services, and health education and communication (131), plus additional services recently added for newborn, child, and maternal health (133). Positive outcomes of the program include improved family planning and maternal care, greater use of latrines, reduction in infectious diseases, and increased immunization coverage. Overall, the program has been vital to improving population access to health services and, subsequently, better health outcomes (133). In our qualitative analysis, ***several key informants have identified the HEP as the main driver to the observed stunting reduction in Ethiopia*** because it has led to improvements in family health, hygiene and sanitation at the community level. Key challenges facing the HEP including resource gaps in medication and medical equipment, lack of established referral system, high turnover of human resources due to unattractive salaries, and poor career advancement (132).

The Enhanced Outreach Strategy/ Targeted Supplementary Feeding Program (EOS/TSF) for Child Survival (2004-present) was the first national program to address the immediate and underlying causes of malnutrition through community-based health services that include supplementary feeding. It was introduced in 2004 as a response to acute famine in 2003 and as a stop gap measure to prevent child deaths while the HEP was in the process of roll out. As Ethiopia's health system has become more decentralized in the past two decades, community-level interventions have increasingly become more important to meet the needs of the population. The interventions include Vitamin A supplementation, de-worming, screening for acute malnutrition, immunization, education on infant and young child feeding, hygiene, prevention of communicable diseases and malaria. The EOS/TSF program has achieved high coverage across the country, reaching 11 million children every six months by 2006/2007 (136). In 2012, EOS/TSF fully transitioned to the ***Community Health Days/Health Extension Program (CHD/HEP)*** (2012-present); a strategy that encompasses quarterly events organized by health extensions workers at kebele level to provide nutrition-related services for children under-5, pregnant women and lactating women.

Two recent initiatives, the ***National Nutrition Program (NNP)*** (2008-2020) and the ***Sustainable Undernutrition Reduction in Ethiopia (SURE)*** (2012-present) highlight the government's multi-sectoral approach to reducing malnutrition in Ethiopia. The objectives of the NNP are to improve the nutritional status of women, infants and children through community-based nutrition interventions and the delivery of nutrition services related to communicable and non-communicable diseases. The Accelerated Stunting Reduction Strategy is a component of the NNP with specific focus on stunting outcomes, nutrition-sensitive interventions, and involvement of multiple sectors (103). Current implementation challenges include insufficient resources, facilities

and financial support (144)(145). However, with nutrition rising on the global agenda, the program has recently gained attention and has led to successful collaboration between government and development partners (144,145). Similarly, the SURE program is the foundational government-led, multi-sectoral nutrition program for improving nutrition outcomes, with a particular focus on health and agriculture. The goal of the program is to reduce stunting by 26% in 2020 among four rural regions in Ethiopia through community-based nutrition, strengthening health and agriculture systems, developing coordination mechanisms for delivery of nutrition services (158). The program is currently ongoing and has not been evaluated.

Results from our study support the positive impacts of these initiatives, and although we could not quantitatively examine the HSDP, HEP, EOS/TSF, NNP or SURE, these were highlighted by several experts in our policy and program review as very important. Therefore, we posit that these represented ***critical contributions towards stunting decline*** from 2000 to 2016 in Ethiopia.

Water, Sanitation and Hygiene (WASH) Initiatives

Clean water, adequate sanitation facilities, and good hygiene practices are important determinants of child health and survival. In Ethiopia, only 35% of the population have access to piped water, though this is an improvement from 17% in 2000. Similarly, access to improved sanitation facilities has improved moderately, from 7% in 2000 to 14% in 2016. However, open defecation rates have reduced dramatically, from 79% to 26% over the same period. A vast array of studies has linked access to improved water sources with lower rates of stunting in Ethiopia, though the relationship between HAZ and distance to a water source was less clear (Appendix 15). Similar to accessing improved water sources, several studies in Ethiopia found that access to improved sanitation was associated with improvements in HAZ and declines in child stunting (Appendix 15). Lastly, though our systematic review revealed only 3 studies that examined open defecation in relation to child growth, the findings of these studies suggest that there is an increased in risk of child stunting among households that practice open defecation (183,185,194). Though we could not include improved sanitation within our analysis due to data availability, our decomposition analysis found that ***reduced open defecation was the third most important factor in explaining HAZ change in children under-5*** (explaining 13% of HAZ change among under-5 children, 15% among children 2-5 years, and 14% among infants 6-23 months). In addition, ***reductions in diarrhea were important for stunting decline,*** accounting for 4% of the total explained HAZ change among children under-5. These reductions in diarrhea may, in part, be attributable to improvements in WASH.

Findings from the qualitative analysis support these results, as stakeholders at all levels identified the substantial reduction in open defecation as an important contributing factor to improved child growth. It was also noted that, although latrine coverage had improved over time, gaps remain in terms of utilization and individual ownership of improved sanitation facilities. The dichotomy between the DHS data and our findings of improved sanitation can be reconciled once the classification of 'improved sanitation' is understood. First, sanitation facilities are not considered improved if they are shared by two or more households. Second, improved sanitation facilities must ensure hygienic separation of human excreta from human contact, indicating that pit latrines without a slab or platform, hanging latrines, and bucket latrines would be classified as unimproved (248). DHS data from 2005 to 2016 showed a particular increase in the use of pit latrines without a slab/open pits, with 18.5% of households using these types of pit latrines in 2005 and 52% of households using them in 2016 (83,249). Resource constraints caused a majority of the latrines constructed to be open pits.

The observed reduction in open defecation and increase in latrine use are likely attributable to community-led sanitation programs. National and regional stakeholders accredited the Health Extension Program (2003-present) with increased construction of pit latrines and community engagement around healthy WASH practices led by health extension workers. ***The National***

Hygiene and Sanitation Strategy (2005-present) ***and Action Plan*** (2011-2015) also contributed to the achievement of reduced open defecation through increased access to facilities, education, and community empowerment strategies. Lastly, the ***Community-led Total Sanitation (CLTS) Program*** was implemented in Ethiopia in 2007 to advocate for "open defecation free" communities, pushing for communities to assess their defecation situation and resolve it through construction and utilization of latrines. Construction of latrines were to be completed by the communities themselves, with no external materials or hardware subsidies. As a result of CLTS, there was an increase in the construction and utilization of latrines and a subsequent decrease in open defecation (250,251). While these programs resulted in increased construction and use of latrines, resource constraints caused a majority of the latrines constructed to be open pits (i.e., no slab or superstructure) (250–252).

The qualitative report also supports the finding that diarrheal infection decreased over the study period. National and regional stakeholders stated that childhood diseases, including diarrhea, have dramatically decreased over the years. Women with children born in 1995-1999 and 2011-2015 mentioned that the burden of childhood diseases decreased due to improved access to care and treatment at nearby health facilities.

Aligned with our decomposition results, which did not indicate a substantial contribute of water access to improved HAZ, the qualitative report reveals that improvements are needed in terms of safely accessing clean water in Ethiopia. Mothers, in particular, felt that accessing water was burdensome and water scarcity was a significant barrier to good health, particularly in the dry season. This intervention is particularly challenging to implement uniformly because of the requirement of ground water (which is not found everywhere in Ethiopia) and because of the costs associated with building and maintaining piped water supplies. Indeed, our equity analyses revealed substantial disparities in terms of access to piped water, including by region (highest coverage in Addis Ababa and lowest in Benishangul-Gumaz, Somali and Amhara), residence (with urban populations having much greater access), and maternal education (with educated mothers having greater access). However, the government of Ethiopia has recognized these persistent WASH issues, and has invested in a number of recent promising initiatives that aim to improve access to clean water and sanitation facilities. These include the Integrated Urban Sanitation and Hygiene Strategy (2015-present), the National Hygiene and Environmental Health Strategy (2016-2010), The Water and Sanitation Program (2010-present), and the One Wash National Program (2013-2020). Though more progress could be made in terms of water access, our ***work thus posits that improvements in WASH, particularly reduced open defecation, are strongly linked to the observed child stunting declines in Ethiopia***.

Delivery Platforms

In terms of delivery platforms for the above successful nutrition-specific and –sensitive initiatives (i.e., fortification-based, financial incentive-based, community-based, school-based and technology-based platforms), Ethiopia's stunting reduction is largely attributable to success in programs delivered through ***community-based platforms*** (detailed in Section 5.4). Nutrition-specific strategies key to nutrition gains in Ethiopia, such as the National Strategy for Child Survival, the National Nutrition Program, the Sustainable Undernutrition Reduction in Ethiopia (SURE) program, and the Enhanced Outreach Strategy and Targeted Supplementary Feeding Program (EOS/TSF) for Child Survival, have utilized a community-based approach. Key poverty reduction strategies and programs like the Productive Safety Net Program Adaptable Program Loan (PSNP APL), and other nutrition-sensitive efforts such as the National Hygiene and Sanitation Strategy, the Expanded Program on Immunization (EPI), the Health Extension Program (HEP), and the Health Sector Development Program (HSDP), have targeted vulnerable and marginalized populations through development of infrastructure, services, and education at the community-level. Through improved access to maternal and child health services, expansion of immunization services, improved WASH,

and increased resilience to shocks, these initiatives were significant drivers in the reduction of stunting in Ethiopia.

Reduced Fertility & Early Pregnancies

Total fertility decreased between 2000 and 2016 from 5.9 to 4.6 births per woman 15-49 years, and adolescent fertility experienced a more dramatic decline from 110 to 65 births per 1,000 girls aged 15-19 years (Table 2). The median age at first marriage increased from 16.4 years to 17.5 years over the same period and, while there was a small decline in the prevalence of child marriage (from 49% in 2000 to 41% in 2011), it remains a significant problem in Ethiopia. In our decomposition analysis, ***decreases in fertility, measured by interpregnancy interval, represented a driving factor for change in HAZ*** for all age groups, explaining 2% each for children under-5 children 2-5 years, and infants 6-23 months. In addition, ***reductions in early age at pregnancy were important for infants aged 6-23 months*****,** explaining 0.4% of the change in HAZ in this age group. Though mothers and regional stakeholders did not discuss maternal age or fertility as a factor in stunting reduction, national-level respondents identified the importance of decreased fertility, which they attributed to both the success of family planning programs and the shift in community perceptions related to having children as a source for future earnings. A detailed review of the linkages between reduced fertility, inter-pregnancy intervals, and adolescent births and the impact on child nutrition in Ethiopia is provided in Appendix 18. ***Our research posits that reduced overall fertility and early pregnancy may have been drivers of child stunting decline in Ethiopia*** and could be linked to improved education, family planning efforts and several of the MNCH strategies previously described.

Maternal Nutrition

Women's nutritional status in Ethiopia has improved substantially over time. Pathways to improved maternal nutrition may exist through several links previously discussed (e.g., improvements in education, empowerment, greater use of RMNCH services, and decreased fertility). In short, higher education is associated with delayed marriage and pregnancy, decreased adolescent pregnancy, and increased capacity for decision-making related to health and nutrition (Appendix 18). Increased utilization of primary health services among women, including RMNCH services, has been linked to improved maternal healthcare and nutrition. For example, antenatal care attendance may encourage community-based counseling which, in turn, can improve maternal diet and fetal growth, encourage supplementation of iron and folic acid to address maternal anemia, and provide education on fetal growth monitoring, infant feeding practices, and awareness of family planning methods to increase spacing between pregnancies; the latter contributes to increased maternal nutrient stores and supports fetal growth (Appendix 18).

Our quantitative analyses highlight the importance of maternal nutrition in stunting reduction. Over the past several decades in Ethiopia, maternal height has improved slightly and more pronounced increases in weight and BMI have been noted (Appendix 19). Our decomposition analysis has revealed that ***increased maternal height and BMI were significant drivers of stunting reduction***, contributing to a combined 5.4% of the predicted HAZ change in children under-5. When disaggregated by age, maternal height and BMI accounted for 6.1% of the predicted change in HAZ among children aged 2-5 years and 3.4% among infants aged 6-23 months. Our Victora curve analysis also supports these findings, suggesting that ***better maternal nutrition over the study period may have led to an improved intergenerational transfer of nutrients*** and, subsequently, greater birth size. The 2000 curve intercepts at the lowest point of all the years studied, and is well below the international reference population. Improvements are seen in the intercepts for the 2005 and 2011 curves, suggesting that maternal nutrition has improved over this period. While the 2016 curve intercepts at a lower point that the two previous survey years, the upper confidence interval crosses 0, indicating a relative uncertainty that intrauterine growth faltering is occurring among these infants. Aligning with our quantitative work, several studies have

illustrated an association between shorter maternal stature and increased stunting risk in their children (189,191,193,253), particularly in mothers shorter than 145 cm (193). Similarly, a majority of studies support the inverse relationship between maternal BMI and risk of stunting (185,186,190,191,194,201,202), as underweight mothers (BMI<18.5 kg/m^2) were more likely to have stunted children. There was little evidence that emerged from the qualitative findings to link maternal nutrition and child HAZ.

It should be noted that the two most common religions in Ethiopia are the Ethiopian Orthodox Tewahedo Church (EOTC) (44%) and Islam (39%), both of which encompass prescribed fasting and certain dietary restrictions (254,255) . When practiced, adult EOTC members will fast for given periods of the day on approximately 180 days per year. This is contrast to fasting in the Islam culture, where food and drink are not taken between sunrise and sunset during the month of Ramadan. Though there is an overall lack of information on the effects of ***religious fasting*** on the nutritional status of women, qualitative work has reported that it is the norm for both pregnant and breastfeeding Orthodox and Muslim women to fast (254). Our own qualitative work has underscored the regional variation in religious fasting which aligns with high stunting prevalence in some cases (e.g. Amhara), but requires further research in order to elucidate the true effect of this religious practice on child HAZ.

Dietary Intake

Dietary intake is undoubtedly a significant determinant of child growth, though establishing adequate indicators for measuring intake remains an ongoing challenge. In Ethiopia in 2016, only 7% of infants aged 6-23 months achieved the minimum acceptable diet and 14% of children had an adequately diverse diet (83). However, the coverage of minimum meal frequency for this age group was much higher, reaching 45% in 2016, and underscoring improved quantity but not necessarily diversity in food consumed. Several recent studies have corroborated the association between diet and growth, reporting that the proportion of adequate diet diversity in Ethiopia is very low, with dairy products, grains, roots, and tubers accounting for over 50% of foods consumed among infants aged 6-23 months (256,257). Several factors, including wealth, education, urbanicity, access to news and media, and antenatal care were found to be significant predictors of diversified diets (256,257). Studies have shown that greater dietary diversity is associated with improved HAZ and lower stunting prevalence in Ethiopian children (186,253,258–261). Our decomposition analysis for infants aged 6-23 months of age found a slightly negative effect of complementary feeding (-0.2%) and dietary diversity (-0.1%) on the total change in HAZ. This is due to the ***marginal decreases in complementary feeding and intake of dairy products, fruits, and vegetables over the study period*** for this age group. Our Victora curve analysis also demonstrates a sharp decline in HAZ between ages 6 and 24 months, when diet quality becomes a factor in child growth (Figure 25). However, the 2016 curve does not reach the same decline in HAZ that was noted for the previous years (it does not dip below -2 HAZ) and the slope is slightly flatter, indicating ***some improvements in child nutrition over the study period*** that may be attributed to factors other than complementary feeding. One such factor could be improved diet quality and nutrition of mothers, which increases the intergenerational transfer of nutrients to her fetus and may provide sustained benefits. The Victora curves from 2000 to 2016 clearly underscore improved maternal nutrition based on the increasing intercept values over the study period. Both national and regional stakeholders have noted that, while education around healthy diets and good feeding practices has improved, achieving diet diversity of remains a challenge and inappropriate foods are often mixed in during the period of complementary feeding. National respondents attribute this to inaccessibility from both a physical and economic standpoint. Mothers from both regions also felt that this related to the unavailability of good quality foods (especially animal products) due to recurrent droughts and low household farm production coupled with high and inhibiting market prices. Some mothers also commented on foods that are considered culturally inappropriate (e.g. raw fruits) but contain high nutrient contents,

though note that the expansion of health services and education has helped to assuage some of these misconceptions. Lastly, timely initiation of complementary feeding appears to be problematic for nearly 40% of the Ethiopian population; timely initiation is more common in urban, versus rural, areas (262), which may link to the gaps in stunting prevalence by residence. Taken together, complementary feeding remains deficient. Despite the increased production of diverse crops in Ethiopia, barriers to access and uptake, such as cost, can be prohibitive to household consumption of these products. The ***Sustainable Undernutrition Reduction in Ethiopia program*** (2012-present), though relatively new, shows promise for further improving stunting rates through multi-sectoral action that will enhance dietary diversity and complementary feeding through community engagement, systems strengthening, improved delivery of nutrition services, and expansion of nutrition-sensitive agriculture.

Breastfeeding Promotion

While the vast benefits of breastfeeding on child health and nutrition are well understood, the literature on breastfeeding practices and stunting in Ethiopia has been mixed, a finding that is likely due to the challenges associated with data collection and measurement methods for this variable. In Ethiopia, the prevalence of exclusive breastfeeding has remained relatively consistent over time; in 2000, 54% of infants under 6 months were exclusively breastfed compared to 58% of infants in 2016. The percentage of exclusive breastfeeding tends to decline with age of the infant. In 2016, 74% of infants 0-1 months were exclusively breastfed compared to only 36% of infants 4-5 months. In contrast, early initiation of breastfeeding increased considerably from 52% of infants in 2000 to 73% in 2016. The average duration of breastfeeding in Ethiopia declined slightly, from 18 months in 2000 to around 15 months in 2016. A recent systematic review and meta-analysis demonstrated improved exclusive breastfeeding practices among Ethiopian mothers who attended ANC visits (compared to those who didn't) and those who had facility births (compared to mothers who gave birth at home) (263). Cross-sectional studies have pointed to additional associated factors that include maternal education, marital status, place of residence, employment, economic status, and postnatal care (264–267).

Improvements in breastfeeding practices can be observed in our Victora curve analyses, and our equity intervention analyses. In examining the Victora curves across the study period, a clear flattening pattern can be observed among children between 0 and 6 months. The 2000 and 2005 curves show a steep decline in predicted HAZ score from birth onwards, while the 2011 curve shows a plateauing in the first 6 months of life, indicating that breastfeeding practices may have improved. The 2016 curve is flatter still in the initial 6-month window, suggesting breastfeeding has been further improved. Our equity analyses revealed relatively few gaps in early initiation and duration of breastfeeding based on sociodemographic characteristics, though we did note some regional differences that disadvantaged mothers in Afar. In contrast, we found that gaps in exclusive breastfeeding by maternal education, urban/rural residence, gender, and region improved over the study period. Aligned with these findings, our decomposition analysis revealed that ***among infants aged 6-23 months, improved breastfeeding duration accounted for 3% of the change in HAZ*** from 2000 to 2016. National, regional, and community level respondents all noted Ethiopia's improved culture around and knowledge of good breastfeeding practices, which was largely attributed to the expansion of health services and education, particularly through health extensions workers. In 2009, a code was put in place to promote breastfeeding and ensure proper substitutes of breastmilk (Code of Breast-milk Substitutes Act & Regulation; 2009-present), though an evaluation found that it had few legal provisions and monitoring was poor. Similarly, the National Strategy for Infant and Young Child Feeding Practice (2004-present), though focused on breastfeeding and complementary feeding targets, was found to be only partially executed. It is likely that other policies and programs that encompassed breastfeeding initiatives (e.g. The National Strategy for Child Survival in Ethiopia, the

Health Sector Development Program, the Health Extension Program) and included elements of education were impactful in reaching the community. Overall, ***our work suggests that improvements in breastfeeding practices may have played a significant role in child stunting gains in Ethiopia.***

Political Will & Multisectoral Action

Government efforts to improve nutrition in Ethiopia began nearly six decades ago with the establishment of the Ethiopian Health and Nutrition Research Institute in 1962; an institute that has contributed to data collection, research, and evidence for action on population health and nutrition. In addition, the ***Ethiopian Public Health Institute (EPHI)***, formed through a merger of the National Research Institute of Health (NRIH), the Ethiopian Nutrition Institute (ENI) and the Department of Traditional Medicine (DTM) of the Ministry of Health in 1995, works to promote the health and nutrition of Ethiopian people through research, surveillance, and wide dissemination of knowledge (268). However, the major turning point occurred alongside the ***Transition Government's creation of a comprehensive Health Policy*** (1993-present) that centered on the decentralization and democratization of the health system in order to better the health and nutrition of Ethiopia's population. Since, there has been high-level commitment and prioritization through multi-sectoral strategies that have coordinated efforts across nutrition-specific and -sensitive sectors including health, agriculture, WASH, and education. The ***National Nutritional Policy and Strategy*** (NNS; 2008-present), and its related ***National Nutrition Program (NNP)***, were instrumental in synchronizing nutrition actions across sectors as an effort to improve the nutritional status of mothers and children, enhance the delivery of nutrition services for communicable and non-communicable diseases, and strengthen the implementation of nutrition-sensitive interventions. An evaluation of NNP I (2013-2015) revealed significant progress towards achieving its nutritional targets. In addition, the ***Community-Based Nutrition (CBN) Program*** (2008-present), the ***Scale Up Nutrition (SUN) Movement Strategy*** (2012-2020) and the ***Sustainable Undernutrition Reduction in Ethiopia (SURE) Program*** (2012-present) each represent recent multi-sectoral strategies that aim to reduce malnutrition through sustainable nutrition policy and the implementation of cost-effective and evidence-based interventions. Activities include micronutrient supplementation, deworming, growth monitoring and screening, referrals, community discussions, and the creation of multi-sectoral links to improve nutrition through education, agriculture, WASH, and social programs. High-level government commitment was renewed with the ***Seqota Declaration*** (2016-2030) that aims to ensure the provision of nutritious foods throughout the first 1000 days, and the ***Health Sector Transformation Pla***n (HSTP; 2016-2020) that targets reductions in child malnutrition, under-five mortality, and infectious diseases. Recently, many multi-sector and sector-specific efforts have been initiated, recognizing the continued prioritization and collaboration of diverse stakeholders to improve nutrition nationally (Box 1).

Box 1: Recent nutrition-related policy and program efforts in Ethiopia

Recent Multi-Sectoral Efforts to Improve Nutrition

- 2012-2020: Scaling up Nutrition (SUN) Movement
- 2012-present: Sustainable Undernutrition Reduction in Ethiopia (SURE)
- 2014-2020: National Indicative Program for Ethiopia
- 2016-2020: Health Sector Transformation Plan (HSTP)
- 2016-2030: Seqota Declaration

Recent Sector-Specific Efforts to Improve Nutrition

Health System Strengthening & MNCH

- 2010-present: Integrated Community Case Management of Childhood Illness and Newborn Care Implementation Plan/Program 2010
- 2016-2020: National Health Care Quality Strategy
- 2016-2020: EU Joint Strategy on Nutrition in Ethiopia

Food Security & Agriculture

- 2010-2014: Food Security Program (FSP)
- 2010-2020: Agriculture Sector Policy and Investment Framework
- 2011-present: Agricultural Growth Program (AGP)
- 2013-present: Climate Resilient Green Economy (CRGE) Strategy
- 2016-2021: Nutrition Sensitive Agriculture Strategy

Water, Sanitation, & Hygiene

- 2010-present: The Water and Sanitation Program (WSP)
- 2011-2015: National Hygiene and Sanitation Strategic Action Plan
- 2013-2020: One Wash National Program (OWNP)
- 2015-present: Integrated Urban Sanitation and Hygiene Strategy
- 2016-2020: National Hygiene and Environmental Health Strategy

6.2: Remaining Nutritional Challenges

Though stunting prevalence at the national level has declined, sub-national variation persists, with some provinces, such has Amhara, continuing to have a prevalence over 45%. Similarly, while stunting reduction occurred in all wealth quintiles and among the lowest maternal education groups (i.e. no education, primary education), notable differences in stunting outcomes by wealth index and maternal education continue to exist. Across wealth quintiles – a pro-rich inequality pattern is visible (i.e. the richest are better off than all other wealth groups), and thus there is a continued need for nutrition strategies to target these remaining four wealth quintiles (Appendix 20). Stunting by maternal education in 2016 shows that mothers with no or primary levels of education are notably worse off than those with at least a secondary-level education. This suggests that nutrition strategies should also target those who remain uneducated or under-educated. Urban-rural disparities in stunting prevalence have decreased progressively over time, but the prevalence is still around 1.5 times higher in rural areas compared to urban. Given these differences, children in rural areas must also be targeted with appropriate nutrition interventions.

Similar to stunting trajectories, the prevalence of underweight children in Ethiopia also experienced a steady decline between 1992 and 2016. Overweight and wasting prevalence also decreased, but both were already below or around 10% since the start of this period, so only slight declines were seen. As of 2016, 38% of under-5 children in Ethiopia are stunted, 24% are underweight, 10% are wasted, and about 3% of children are overweight (Appendix 20). Significant variation exists in these indicators across the country. Child underweight varies most notably with the highest rates in 2016 reported in Afar and Benishangul-Gumaz (35%) and the lowest in Addis Ababa (5%). Furthermore, the degree of disparity between the highest and lowest estimates has persisted over time. Wasting also varies across provinces, and the provinces that are faring the worst seem to shift over our study period. In 2000, Gambela, in the western part of the country was the most wasted at 20%. However, by 2005, Gambela had reduced wasting to a prevalence of 10%, and the highest prevalence of wasting were seen in Benishangul-Gumaz in the country's northwest (20%), and the Somali region in the east (23%). In 2011, the highest wasting prevalence continued to be found in Somali (21%), as well as in the Afar region (20%). As of 2016, Somali remains the region with the highest wasting prevalence (23%), in contrast to the least wasted region, Addis

Ababa (4%). Overweight prevalence in 2016 is generally quite low across the country and variation across regions is minimal. Compared to other nutritional indicators, the overweight prevalence of Addis Ababa (7%) remains the highest as of 2016, with most regions sitting at or below 2%. Between 2000-2016, maternal short stature (<145 cm) also remained low (<5%) across all regions in Ethiopia, and was less than 3% in 2016. In contrast, maternal anemia remained persistently high from 2000-2016. Over this time period, maternal anemia rates in Somali spiked from 29% to a staggering 60%, while Addis Ababa has the lowest prevalence at 16% as of 2016 (up 4% since 2005). Overall, a large proportion of anemic mothers are located around the eastern and northeastern regions of Ethiopia (Appendix 20). Maternal underweight (BMI <18.5 kg/m^2), however, had wide variations, reaching 40% to 45% in Afar and Somali regions, respectively, in 2000. By 2016, maternal underweight prevalence remained high for Afar (38%) and lowest for Addis Ababa (13%) (Appendix 20).

6.3: Study Strengths

Several strengths of this work should be noted. First, this is the first mixed-method systematic and comprehensive overview of the major determinants of stunting reduction in Ethiopia. We undertook a range of exercises, including a systematic literature review, qualitative inquiry with diverse national and community stakeholders, robust quantitative analyses, policy/program mapping and an exploration of financial allocations, to paint a holistic picture of the stunting situation in Ethiopia. This contrast between qualitative and quantitative approaches expanded the horizon for unraveling key drivers of under-5 stunting reduction. Second, we explored a range of determinants, on the basis of a comprehensive set of variables according to an evidence-based and context-specific conceptual framework on stunting chain of causality, providing further detail and granularity to our analyses. We harmonized all standardized individual-level DHS surveys conducted at different time points (2000, 2005, 2011, 2016); though we chose to examine the entire period, as opposed to exploring different time periods, because of the steady decline in stunting prevalence throughout. Third, the hierarchical modeling approaches undertaken in all quantitative analyses permitted more appropriate modeling of pathways (adjusting for confounders and examining mediators) between potential stunting determinants. Fourth, the qualitative component aimed to capture diverse, multi-level perspectives. In particular, the addition of twelve focus group discussions with mothers of children born in 1987-1991, 1995-1999, and 2011-2015 across two regions and four districts helped to elicit diverse tangible changes in socioeconomic status, local infrastructure, as well as changes in behaviour, health and nutrition over time. Finally, this was the first systematic effort to compile all nutrition-relevant published and un-published literature and accompanying in-depth policy/program analysis on Ethiopia – to date, no other such effort has been conducted for the country.

6.4: Study Limitations

Several limitations of our work should be noted. Qualitative data collection, transcription and analysis was conducted primarily in the local language. This approach may have limited the selection and diversity of quotes for inclusion in the report, as only select quotes were translated and presented. However, efforts to capture and integrate diverse perspectives that were representative of findings were made.

Our decomposition analyses were statistically powerful and included a wide range of potential explanatory factors. Nonetheless, limitations of the Oaxaca-Blinder decomposition apply, as cited in previous literature (11,12,68). Another limitation pertains to confounding. Although we adjusted for confounding variables in the quantitative analyses, some residual confounding may remain from unmeasured confounders or poorly estimated variables. Interactions between different factors

within and between the different hierarchical levels may also affect the results, although they were not assessed due to measurement challenges.

Our mapping of financial data pertaining to nutrition-specific and -sensitive initiatives in Ethiopia may be incomplete considering we reported only data we could obtain from stakeholders and published literature. Significant gaps in national health expenditure data, and the financial allocations for specific programs highlights a gap in our understanding of the investment, implementation and scale of these efforts.

Several data limitations should also be noted. As discussed above, data pertaining to direct measures of food insecurity and dietary intake of all under-5 children (e.g. exclusive breastfeeding, appropriate introduction of complementary feeding, actual food consumption frequency and diversity) were generally lacking. As a result, we relied on proxies and available survey indicators (e.g. 24-hour recall) – though these imprecise indicators are not without their shortcomings. Information on migration patterns within the country was also limited. The DHS lacked data to measure intrauterine growth, such as low birthweight (which was only collected in select surveys and is poorly reported), small for gestational age babies, preterm birth, etc. We were not able to quantitatively examine several programs due to the challenges posed in measuring such phenomena (e.g., political will, political instability and changes in governance structures, conflict etc.) and limitations of data availability on several programs, including for evaluation purposes. We were not able to conduct age-stratified analyses for <6 month children due to HAZ change over time that was not significant; and thus, could have missed important age-specific HAZ determinants (e.g. breastfeeding, maternal characteristics).

Further work is needed to examine and test our narrative on subnational drivers of stunting decline in Ethiopia. Additionally, future work should consider examining determinants of other child and maternal nutritional outcomes in tandem with stunting. For example, stunting and wasting combined – a population of children that has been reported to be the most nutritionally disadvantaged and at risk for premature mortality. Cost-effectiveness analysis of various programs to understand the return on investment would assist in prioritizing future investments and for cross-country learnings. In general, further strengthening of information systems is needed at central and local levels, to collect quality of care indicators systematically. This will provide further insight on interventions beyond the information provided by quantitative coverage data.

6.5: Conclusions

In closing, this systematic and comprehensive overview of stunting decline in Ethiopia describes a multifactorial story of stunting change, highlighting the importance of political will, leadership and prioritization of commitments to improved nutrition. The implementation of nutrition-specific and –sensitive interventions, often using community-based approaches, has led to significant gains in child growth. Ethiopia has largely focused on the agricultural sector as a means of stimulating economic growth and household food security, and this has had major positive effects on HAZ. Implementation of cadres of health extension workers, as well as strengthening of the health system more generally, has increased utilization and accessibility of health services at the community and household level. Lastly, multi-sectoral efforts to improve access to sanitation, namely through reduction of open defecation and construction of pit latrines, has also contributed to important declines in childhood stunting. Taken together, child stunting reduction success in Ethiopia can be attributed to long-standing prioritization of nutrition in national development plans, implementation of national nutrition-specific and –sensitive interventions, and targeting the most disadvantaged, rural populations. The adoption of a multisectoral approach has been critical to facilitate the prioritization, coordination and implementation of nutrition efforts and activities across diverse sectors and stakeholders.

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