Drivers of stunting reduction in Ethiopia: an exemplar study

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Outline

- Global stunting epidemiology, burden, and trends
- Exemplars in Stunting Reduction Project:
  - Methodology
  - Conceptual framework
  - Quantitative findings for Ethiopia
Global & Regional Stunting Trends 1990-2018

Source Data: Joint Malnutrition Estimates 2019
Eastern Africa Stunting Trends

Addis Ababa, Dec 8-10, 2021
Source Data: Joint Malnutrition Estimates 2019
Exemplars in Stunting Reduction: The Case of Ethiopia
To understand the major determinants of stunting prevalence decline in Exemplar nations, focusing on key transitionary periods between 1990 and 2018.
We selected Exemplar countries that reduced stunting faster than would be expected given GDP per capita growth.

- **Data used:** UNICEF-WHO-World Bank Joint child malnutrition estimates, 2016-17
- **Filters:** countries that reflected the following criteria were excluded
  - Conflict
  - <5 million population in 2016
  - High-income
  - No recent survey data (after 2010)
- Countries were then selected to be representative of income, geography, generalizability

![Graph showing stunting prevalence CAGR vs. GDP per capita CAGR](image)

*Source: Joint Malnutrition Estimates, 2018*

For the base year for each country, we used the closest year to 2000 for which a stunting estimate was available, going back no further than 1997. For the end year, we used the most recent estimate available. Matching base and end years were used for the GDP per capita estimates. CAGR refers to compound annual growth rate.
Trends in under-5 stunting prevalence and GDP per capita from 1990 to 2016 in Ethiopia

Data Source: Stunting estimates are based on Joint Malnutrition Estimates (JME). Data sources as follows:
Given the complex, multi-causal nature of stunting, we used several analytical methods to triangulate our findings.

- **Systematic search of peer-reviewed and grey literature**
- **DHS datasets**
- **Descriptive analyses**
  - Subnational variation over time
  - Equity analyses (stunting prevalence by wealth quintile, maternal education, residence, gender)
  - Slope Index of Inequality & Concentration Index
- **Linear Mixed Effect Regression**
- **Oaxaca-Blinder Decomposition**
- **Expert and community interviews to understand stakeholder / community perspectives on drivers of stunting decline**
- **Timeline assembly of key nutrition-specific and –sensitive policies / programs using iterative approach**
- **Outline of financial allocations, actual disbursements and budget / expenditure of programs, policies and interventions**
- **Data from each exercise used to derive and contextualize key results**
- **Findings triangulated with country experts, literature and subject matter experts**
## Quantitative Methods

### Equity Analyses
- National stunting prevalence was disaggregated to examine changes in inequalities over time
- Analysis by wealth quintile, maternal education, urban vs rural residence, and child gender

### SII/CIX
- Slope Index of Inequality (SII) and Concentration Index (CI) measure absolute and relative socioeconomic inequalities, respectively
- Estimated from logistic regression models of the cumulative distribution of the asset index, plotted against stunting prevalence
- All analyses accounted for survey design and weighting

### Difference-in-Difference Analysis
- Linear multivariable regression analyses, including all covariables and adjustment factors as fixed effects
- Interaction terms between potential determinant and time indicate if change in proposed predictor leads to HAZ change over time
- Multivariable models adjusted for child age, sex and region, Variance inflation factors were used to assess multi-collinearity

### CAGR vs AARC
- Compound annual growth rate (CAGR) assessed relative change (decline) in stunting prevalence over time for each region
- Average annual % point change (AARC) estimated through ordinary least square regression models; stunting prevalence regressed on survey year
- Estimates accounted for survey design and weighting

### Victora Curves/ Kernel Density Plots
- Victora curves: smoothed local polynomial regressions are used to depict HAZ predictions with 95% confidence intervals, estimated by surveys
- Predicted HAZ score is plotted against child’s age in months
- Kernel density plots: depict the distribution of HAZ scores for studied time periods
- Kernel smoothing is used which allows for a smooth distribution
- Peaks show where the HAZ scores are concentrated

### Oaxaca-Blinder Decomposition
- Linear least squares regression models used to assess associations between outcome and determinants, to derive β coefficients
- The difference between weighted means of explanatory variables at two time points is multiplied by β coefficients to obtain predicted change in HAZ as a result of the determinant in question
- Variance inflation factors were used to assess multicollinearity
- Factors included vary by country as different data are available
Conceptual framework modified for Ethiopia quantitative analysis

**CHILD STUNTING**

- **Child Characteristics**
  - Low birthweight
  - age, sex, weight, height

- **Inadequate Dietary Intake**
  - Infant and young child minimum dietary diversity (group and continuous), consumption of grains, roots and tubers, legumes and nuts, dairy products, flesh foods, eggs, vitamin-A rich fruits and vegetables, other fruits and vegetables

- **Inadequate Feeding Practices And Food Insecurity**
  - Duration of breastfeeding, complementary feeding total yield

- **Inadequate Care And Health Services**
  - DPT3 vaccination, measles vaccination, antenatal care 4+ visits, place of delivery, vitamin A supplementation, total number of health centers per 10,000, total number of health workers per 10,000

- **Disease**
  - Diarrhea prevalence, acute respiratory infection prevalence

- **Maternal Characteristics**
  - Maternal age, adolescent birth <18, older mother births ≥35, maternal anemia during pregnancy, maternal BMI, maternal height, parity, inter-pregnancy interval

**IMMEDIATE CAUSES (Proximal)**

**UNDERLYING CAUSES (Intermediate II)**

**BASIC CAUSES (Intermediate I)**

**BASIC CAUSES (Distal)**

**Nutrition Sensitive And Specific Programs**

Data unavailable

**Socioeconomic Factors**

- Wealth index, maternal education, paternal education

Macro-level social, economic, political, and environmental context and factors

Note: Skilled birth attendance was omitted, as estimates were not available for the first year of study. Data on early initiation of breastfeeding was also unavailable.
Geospatial stunting decline in Ethiopia from 2000 to 2016
Sub-national reduction rates showed variation

Average annual rate of change (%)
Inequalities in stunting increased over time

Wealth Quintile
- Lowest
- Second
- Middle
- Fourth
- Highest

Maternal Education
- None
- Primary

Residential Area
- Urban
- Rural

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Kernel density plots show overall improvements in mean HAZ over time

Rightward shift of distribution:
- Gradual rightward shift of the curve from 2000 to 2016
- Indicates improvement in population HAZ scores
- Mean HAZ score changed from -2.14 in 2000 to -1.35 in 2016

Peakness of curve (kurtosis):
- Curve widens over time, underscoring an increase in inequalities over the study period (less HAZ scores clustering around the mean)
Material improvements in HAZ, with rapid gains in recent years

1. The increase in y-intercept from 2000 to 2016 demonstrates improvements in maternal health and nutrition – addressing the issue of intergenerational transfer.

2. A flattening of HAZ curve for 0-6 month children from 2000 to 2016 suggests positive impact of breastfeeding, providing an extended period of protection.

3. Slight flattening of HAZ slope for 6-23 month children over time suggests marginal improvement in complementary feeding and disease management.

4. Children at 24 months are significantly taller and healthier in 2016 than those in 2000; growth faltering plateaus thereafter.
Decomposition analysis: % of explainable variation in HAZ by age
Pathways to stunting reduction require both nutrition-sensitive and nutrition-specific strategies

- For the total under-5 population, supportive strategies (nutrition-sensitive) contributed to 65% of the predicted change in HAZ over the study period
- Nutrition-specific strategies accounted for 35% of change

Note: Parental education breakdown: 5.2% maternal, 5.0% paternal
Summary of Quantitative Findings (1)

• Sub-national stunting decline was not uniform
  • Somali experienced the greatest decline over time (AARC -1.5%) while in Dire Dawa, stunting prevalence increased over the study period (AARC +0.5%)

• Inequalities in stunting by wealth quintile, maternal education, and urban/rural residence increased slightly over time
  • Wealthy, better educated, and urban residents have an advantage

• Mean HAZ improved incrementally over time

• Victora curve analysis underscores improvement in birth disadvantage (+0.5 SD) and across all age groups, particularly at 0-6 months
  • Better maternal nutrition, reductions in intrauterine growth restriction, and improved breastfeeding practices have contributed to these gains
Summary of Quantitative Findings (2)

• Decomposition analysis reveals a combination of predictors of improved HAZ
  • Increased production of consumable crops, increased number of health workers, reduced open defecation, improved maternal nutrition, parental education, wealth accumulation, reductions in diarrhea, maternal and newborn healthcare, fertility, and maternal age

• Difference-in-difference analysis in line with decomp findings
  • Shows significant time*covariate interaction terms for: maternal education, place of delivery, and number of health workers

• A combination of nutrition-specific and sensitive strategies are required for improved linear growth and declines in childhood stunting
Thank you