Drivers of stunting reduction in Ethiopia: an exemplar study

Dr. Nadia Akseer[1], Dr. Seifu Hagos[2], Kaitlin Conway[1], Hana Tasic, Dr. Emily Keats[1], Dr. Bilal Shikur[2], Afrah Mohammedsanni[2], Muhammad Islam[1], Dr. Anushka Ataullahjan[1], Argie Gingoyon[1,3], Zahra Hussain[1,3], Rachel Jardine[1], Erica Confreda[1], Kimberly Charbonneau[1], Dr. Zulfiqar Bhutta[1,3]

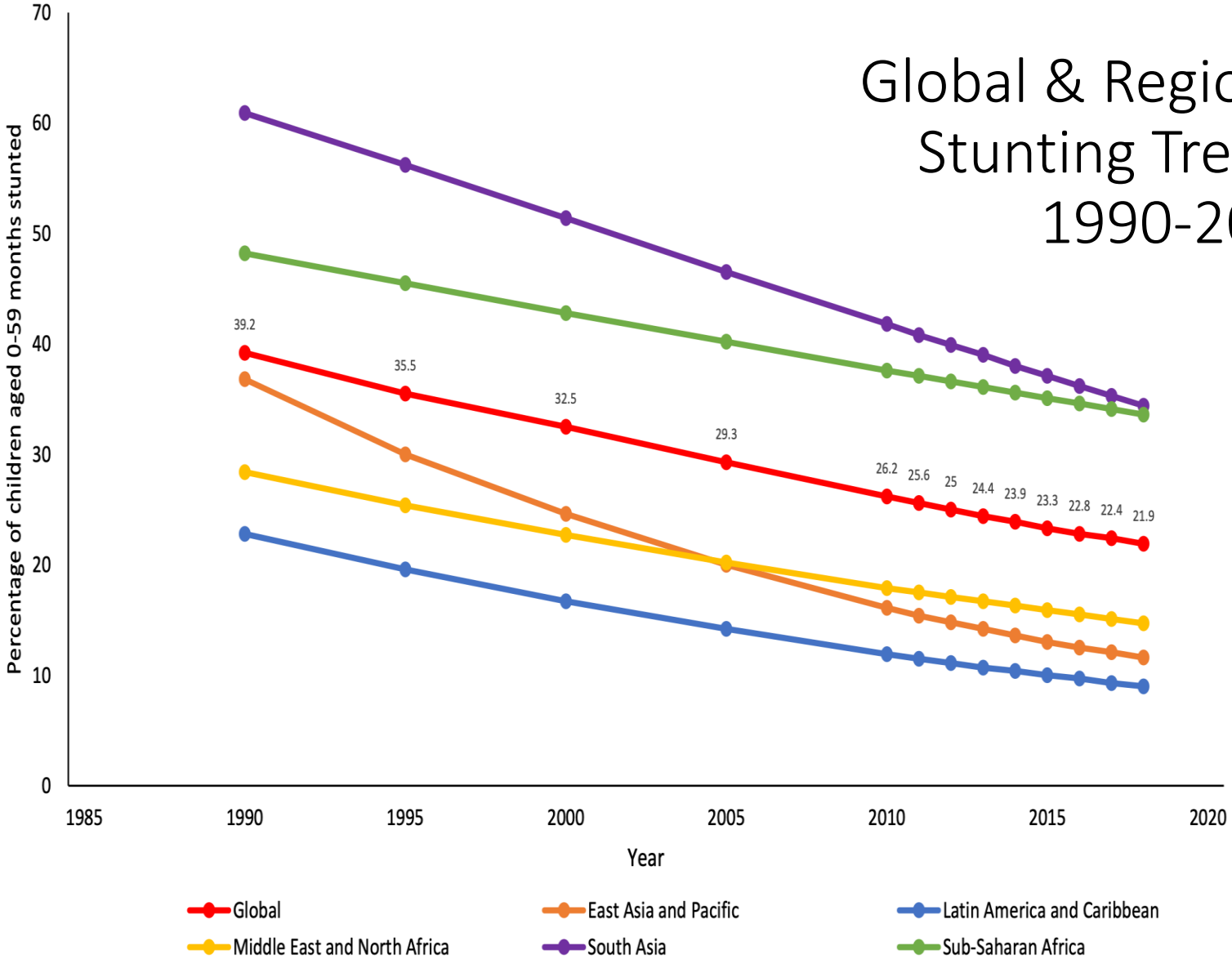
[2] *Department of Nutrition, School of Public Health, Addis Ababa University, Addis Ababa, Ethiopia*

Outline

- Global stunting epidemiology, burden, and trends

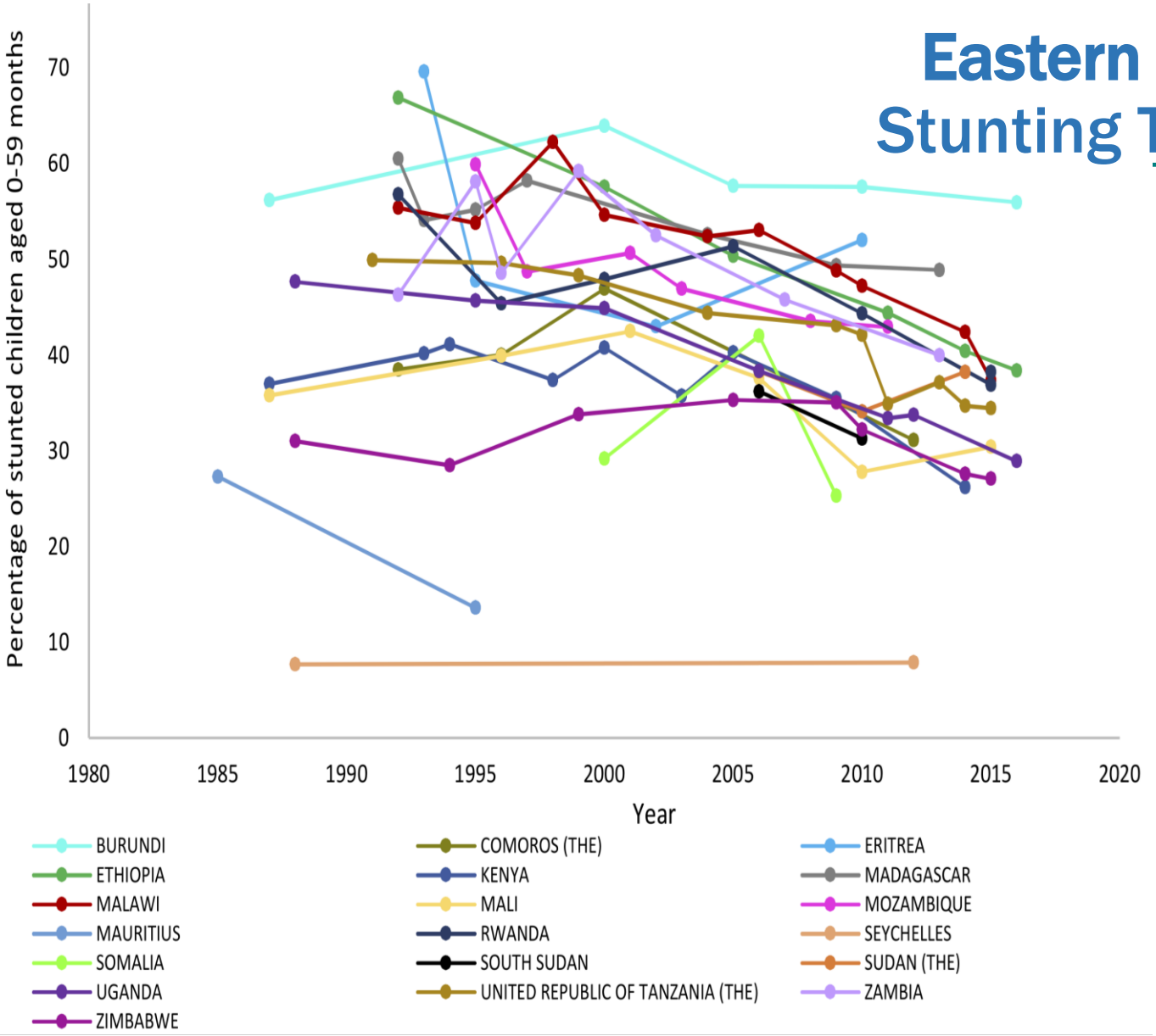
- Exemplars in Stunting Reduction Project:
  - Methodology
  - Conceptual framework
  - Quantitative findings for Ethiopia

Global & Regional Stunting Trends 1990-2018

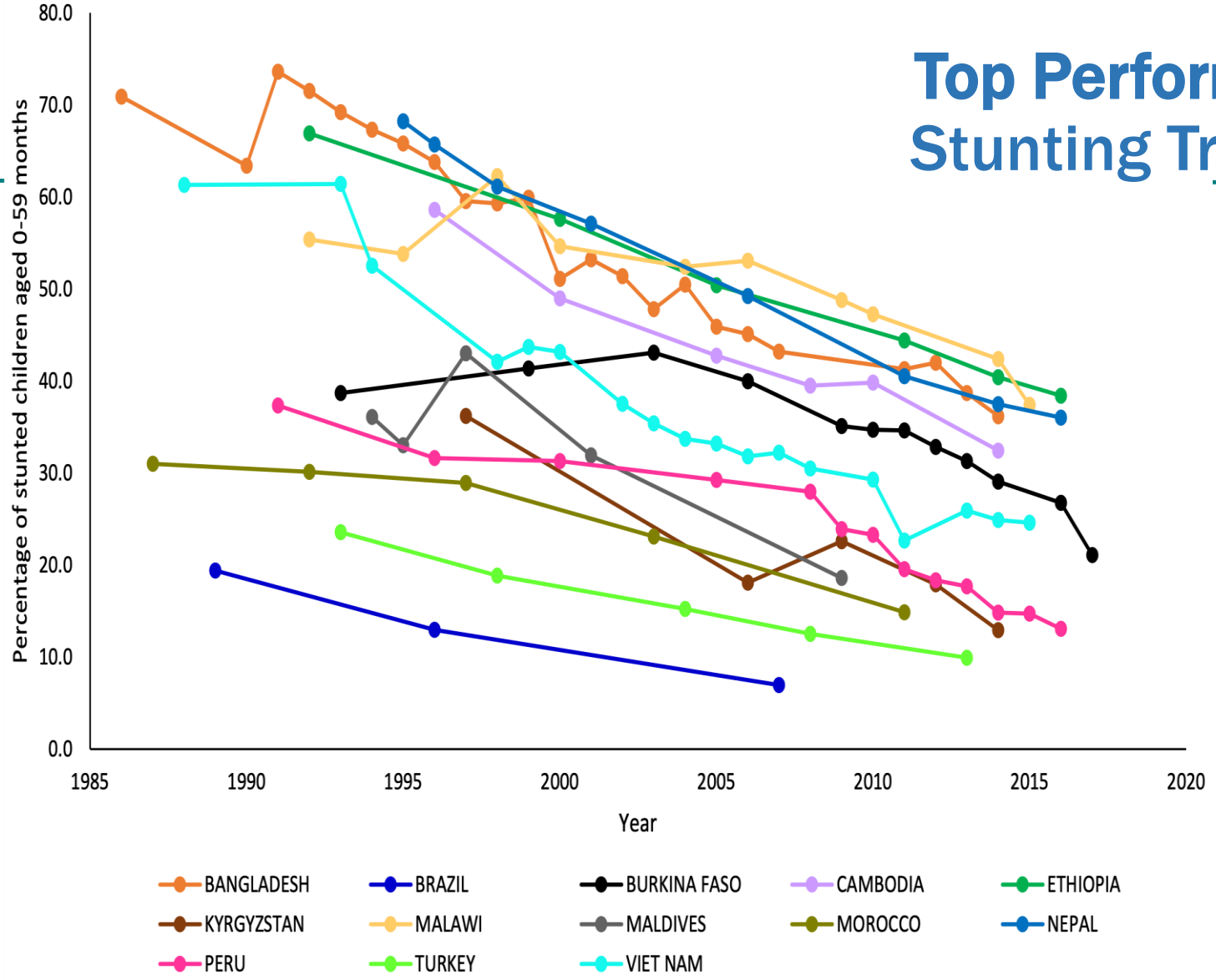


Source Data: Joint Malnutrition Estimates 2019

Eastern Africa Stunting Trends



Top Performers
Stunting Trends



Source Data: Joint Malnutrition Estimates 2019

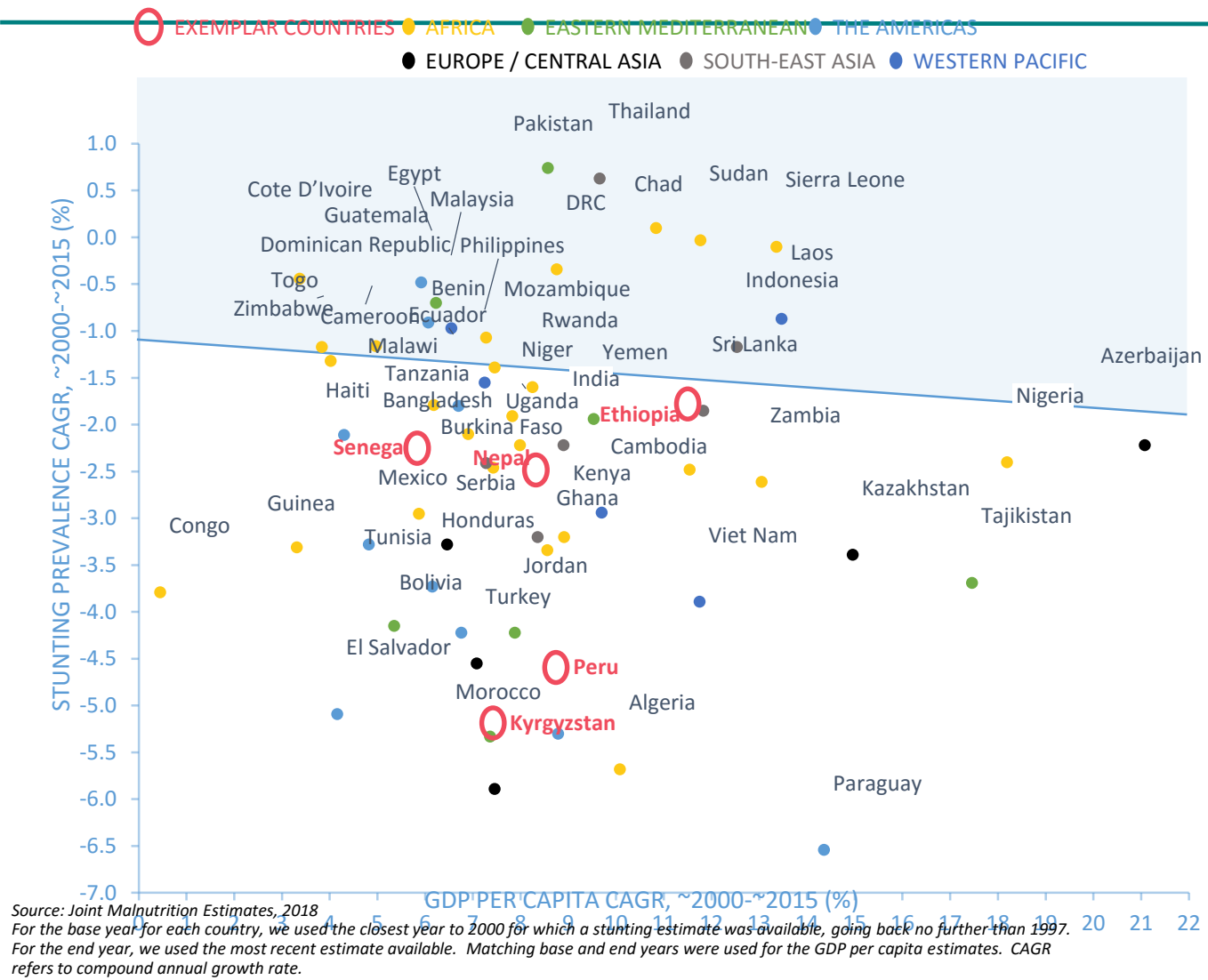
Exemplars in Stunting Reduction: The Case of Ethiopia

Addis Ababa, Dec 8-10, 2021

Broad Stunting Exemplars Study Objective

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

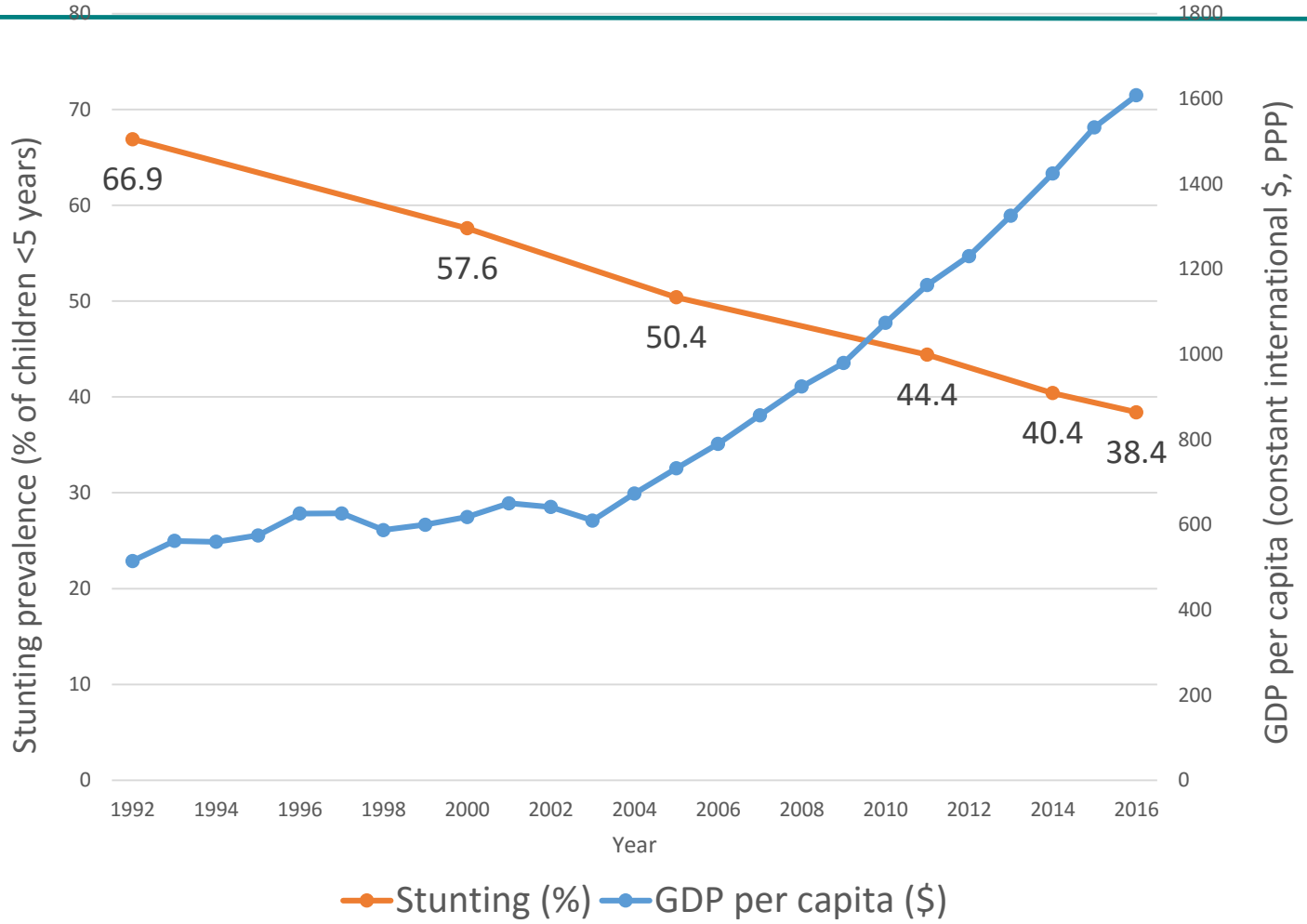


Source: Joint Malnutrition Estimates, 2018
For the base year for each country, we used the closest year to 2000 for which a stunting estimate was available, going back no further than 1997. For the end year, we used the most recent estimate available. Matching base and end years were used for the GDP per capita estimates. CAGR refers to compound annual growth rate.

- ✓ **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
- ✓ **Technical Advisory Panel** comprised of academic experts voted on final exemplar countries to research

Addis Ababa, Dec 8-10, 2021

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: 1992 – National Rural Nutrition Survey; 2000, 2005, 2011, 2016-DHS; 2014 – Mini demographic and health survey*

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
- Research design, data collection, analysis informed by the conceptual framework of Black, et al (2008)

- 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

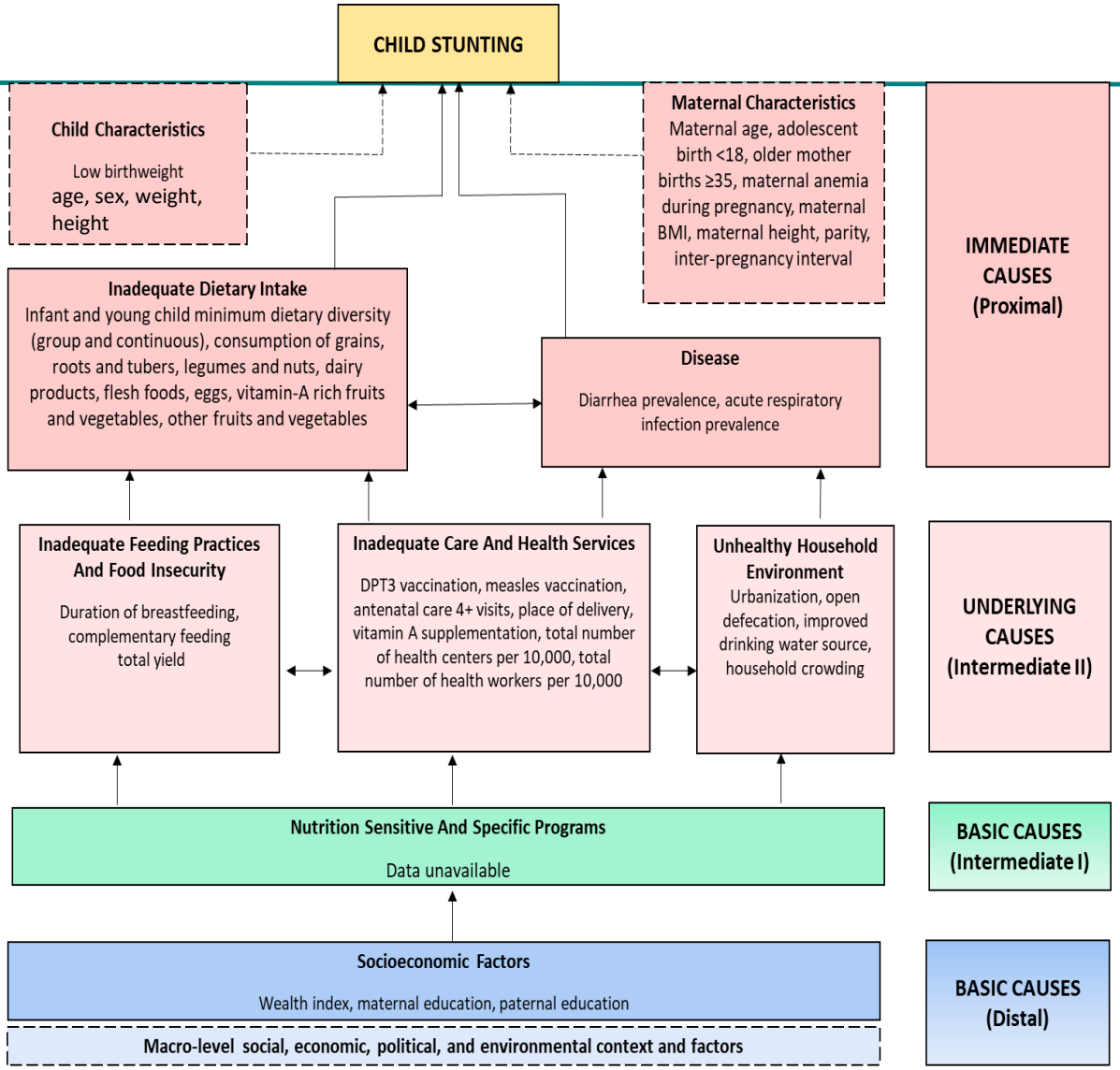
Victora Curves/ Kernel Density Plots

- 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

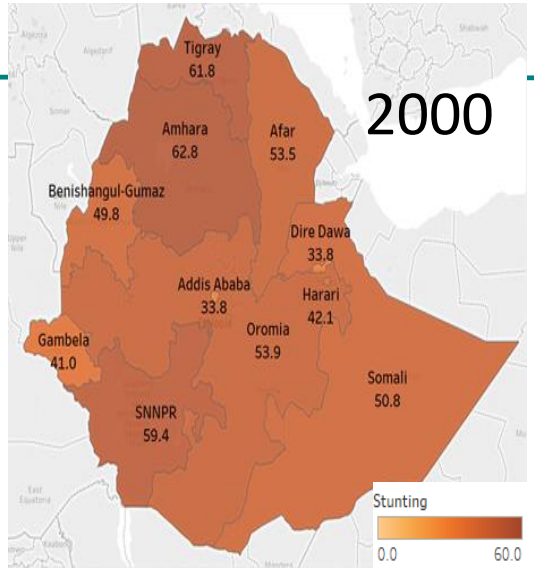
- Linear least squares regression models used to assess associations between outcome and determinants, to derive β coefficients
- The difference between weighted means of explanatory variables at two time points is multiplied by β coefficients to obtain predicted change in HAZ as a result of the determinant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

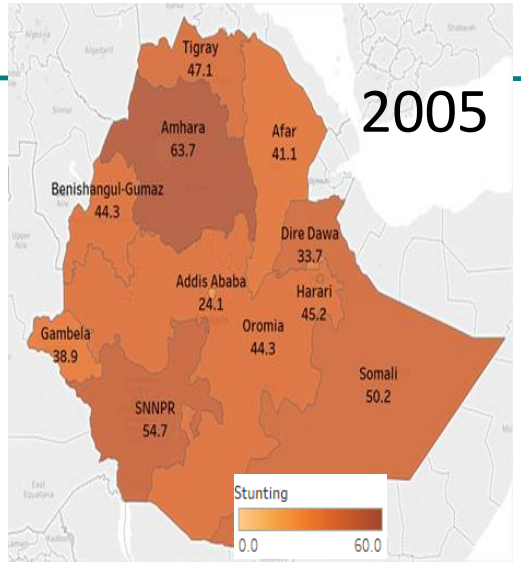
Conceptual framework modified for Ethiopia quantitative analysis

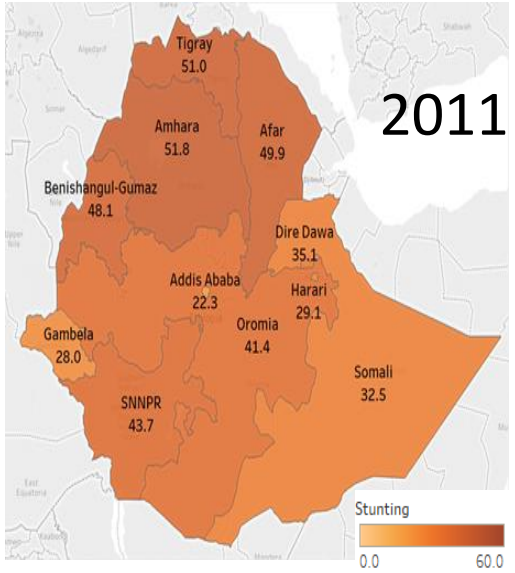


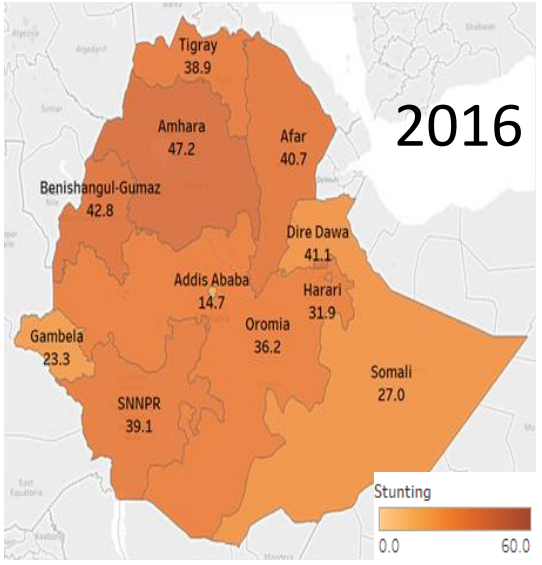
Note: Skilled birth attendance was omitted, as estimates were not available for the first year of study. Data on early initiation of breastfeeding was also unavailable.

Geospatial stunting decline in Ethiopia from 2000 to 2016

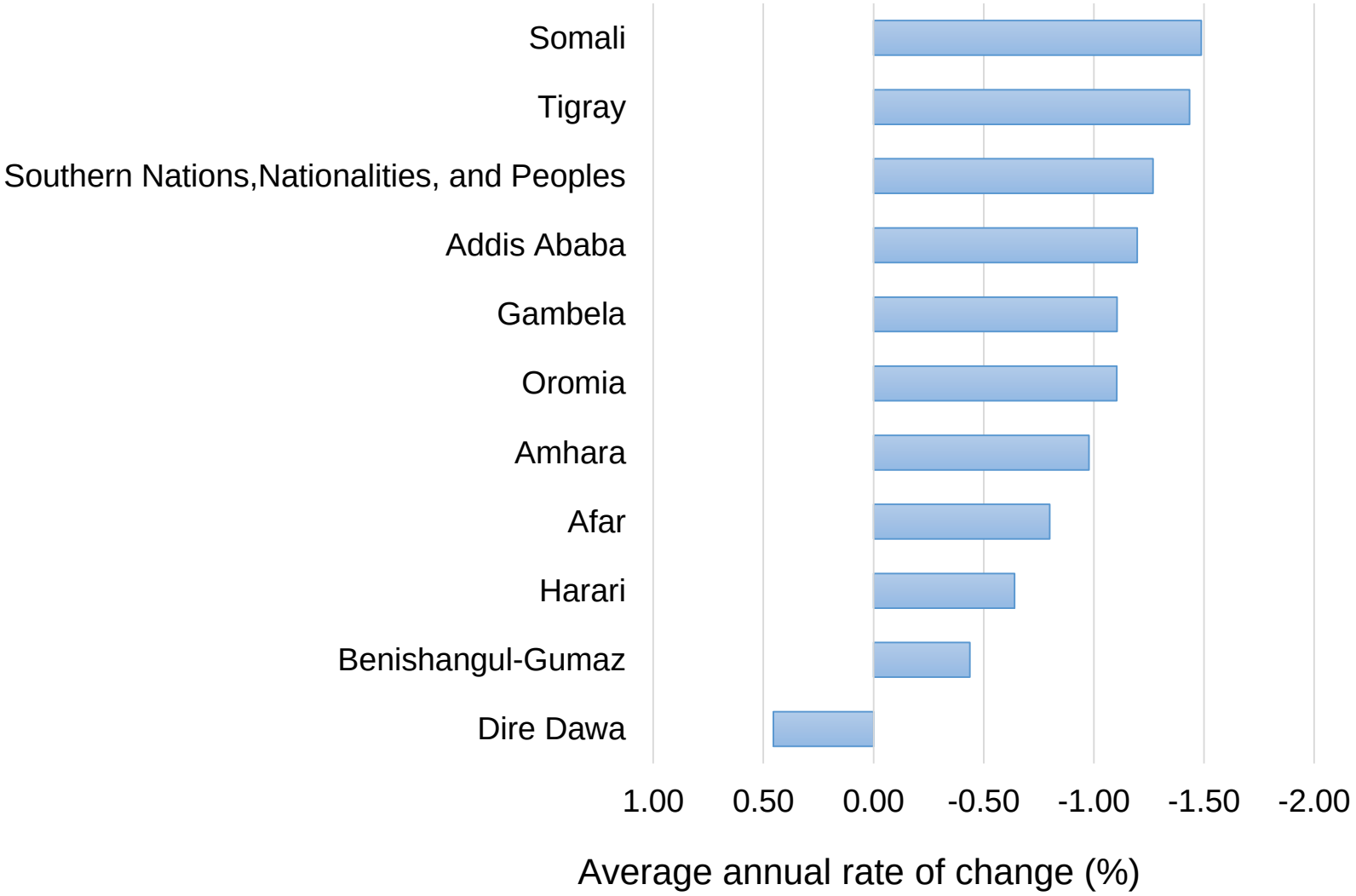




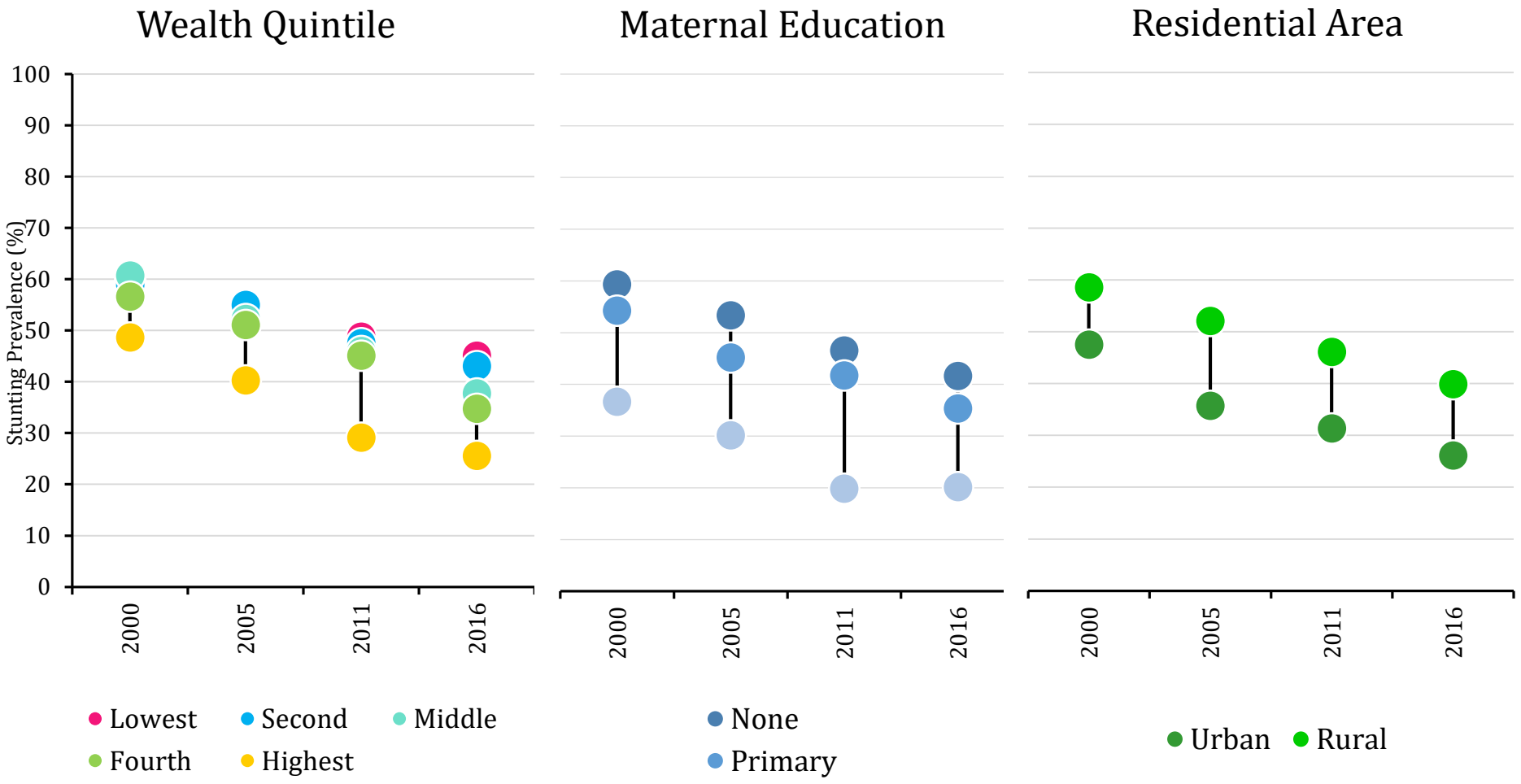




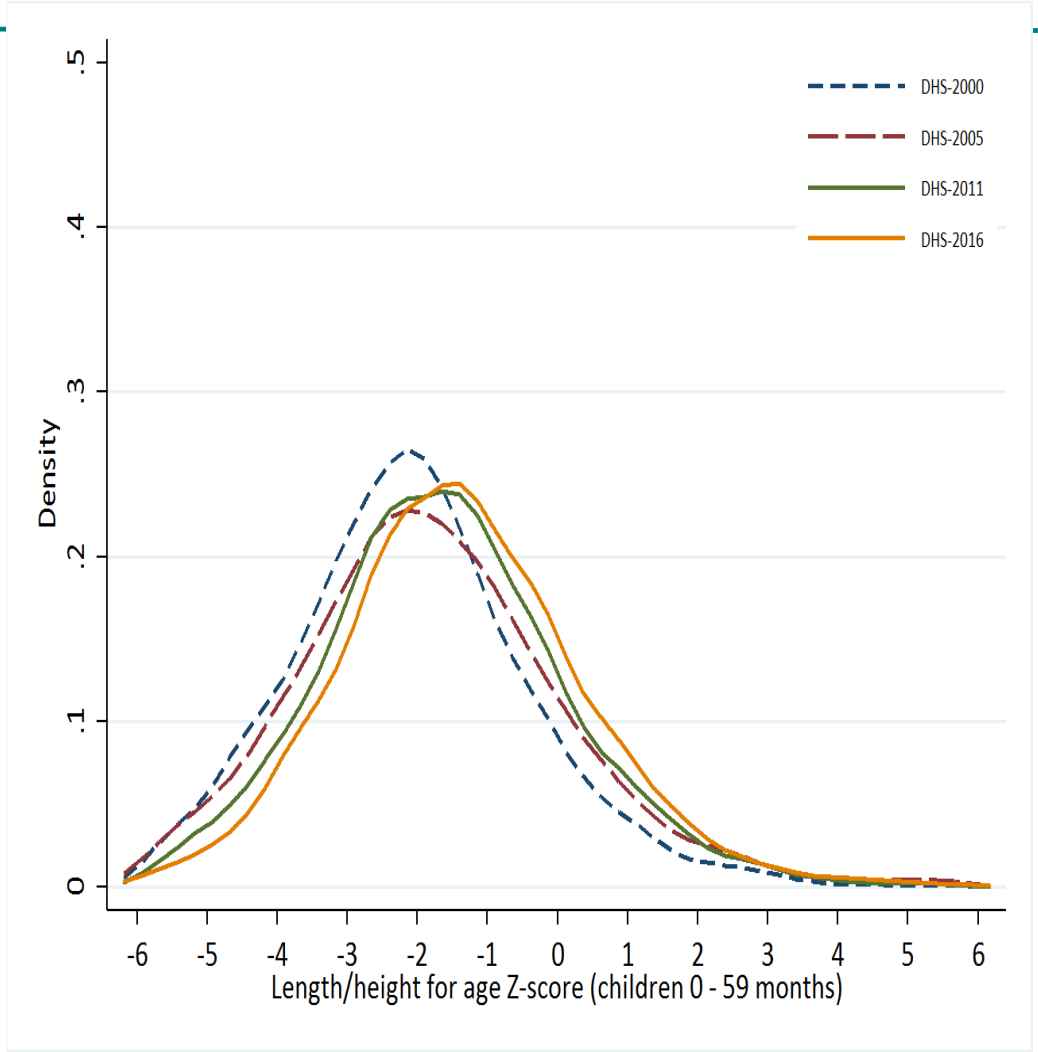
Sub-national reduction rates showed variation



Inequalities in stunting increased over time



Kernel density plots show overall improvements in mean HAZ over time



Rightward shift of distribution:

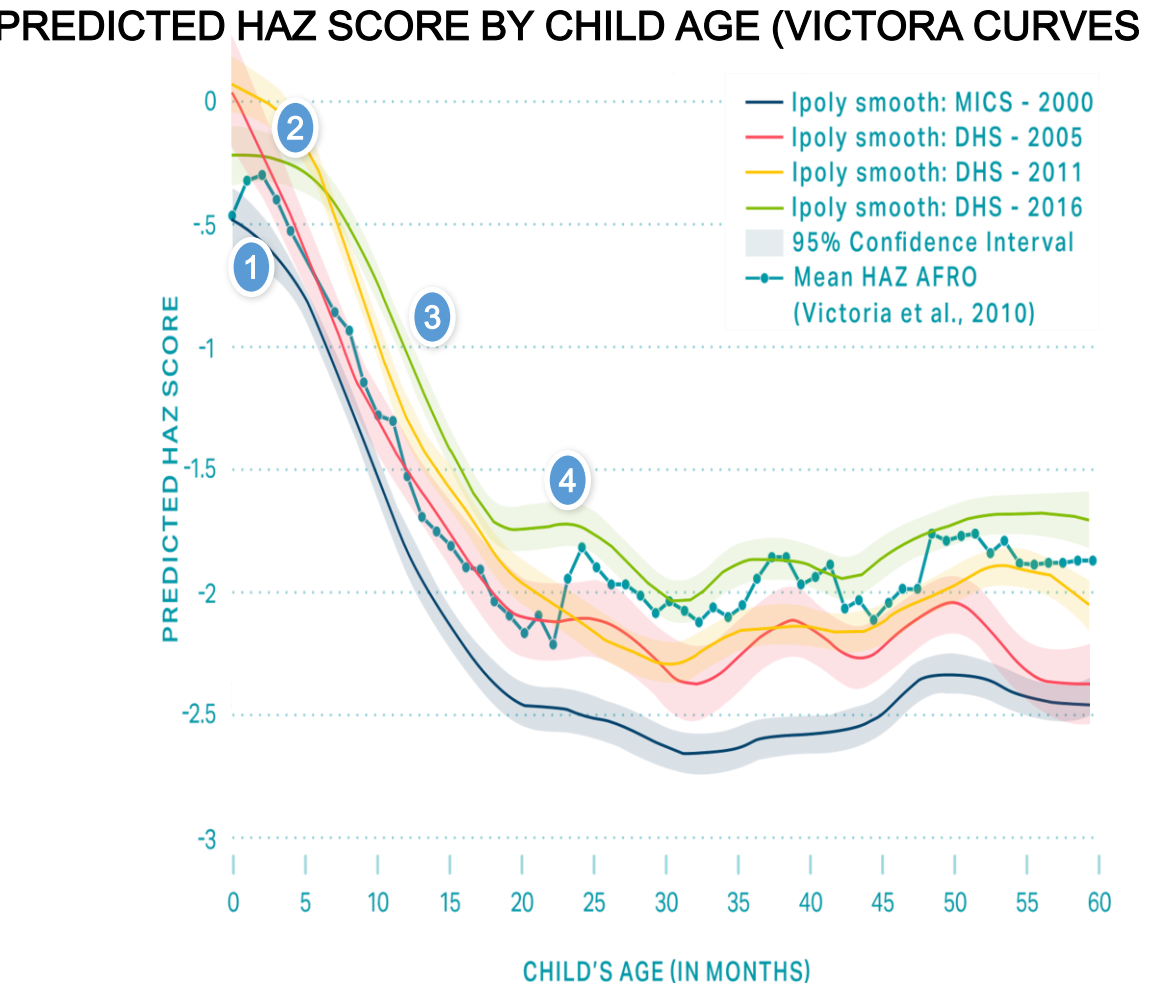
- Gradual rightward shift of the curve from 2000 to 2016
- Indicates improvement in population HAZ scores
- Mean HAZ score changed from -2.14 in 2000 to -1.35 in 2016

Peakness of curve (kurtosis):

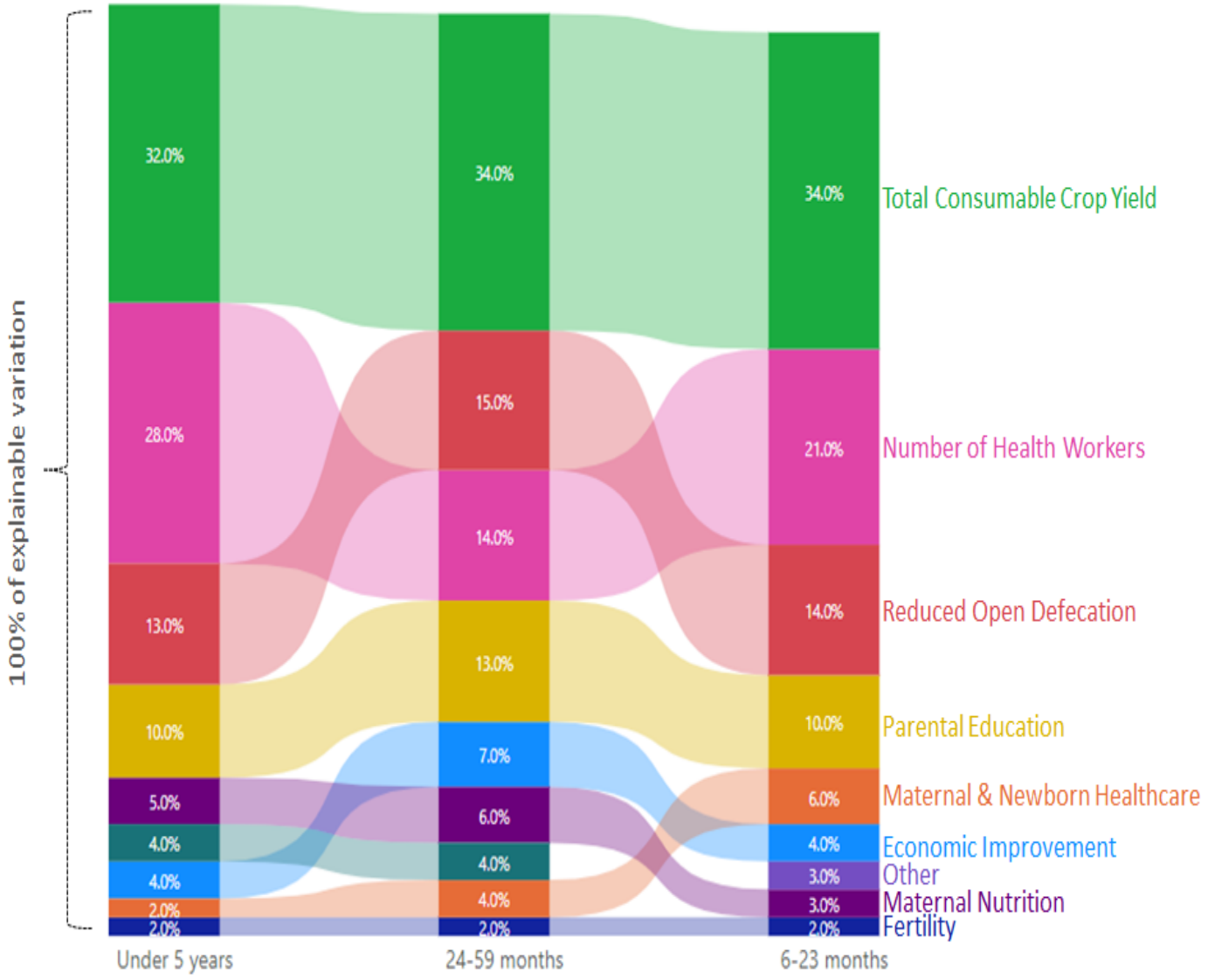
- Curve widens over time, underscoring an increase in inequalities over the study period (less HAZ scores clustering around the mean)

Material improvements in HAZ, with rapid gains in recent years

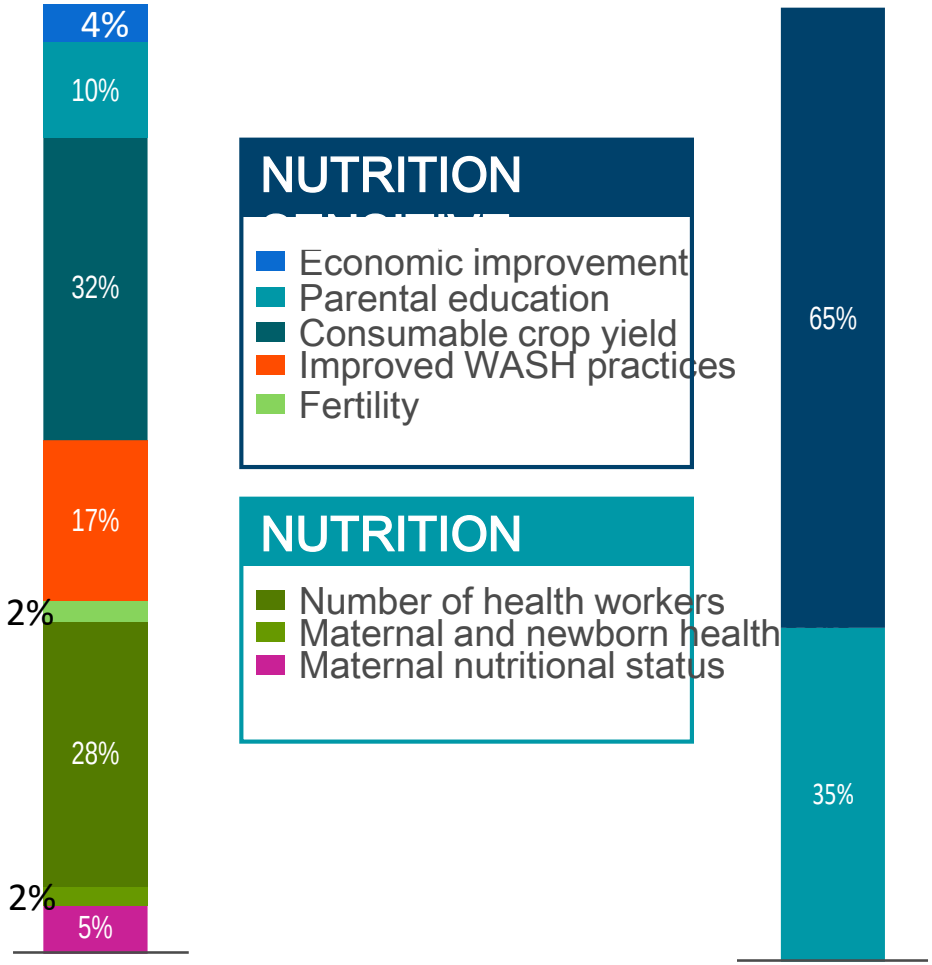
1. The increase in y-intercept from 2000 to 2016 demonstrates **improvements in maternal health and nutrition** – addressing the issue of intergenerational transfer
2. A flattening of HAZ curve for 0-6 month children from 2000 to 2016 suggests **positive impact of breastfeeding**, providing an extended 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