Modelling the relation between climate change and undernutrition at the global level

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Objectives

Developing a new global-level model:

… for estimating future child undernutrition

… under various SSP/RCP combinations

... explicitly accounting for:

- rural and urban poverty
- food prices

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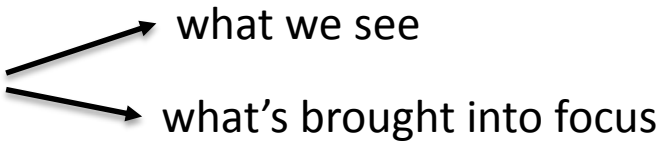
Outline

- Hunger and undernutrition
  - some key considerations
- Previous climate change-undernutrition modelling
  - basis on which we're building
- New model
  - where we're heading…

Hunger and undernutrition

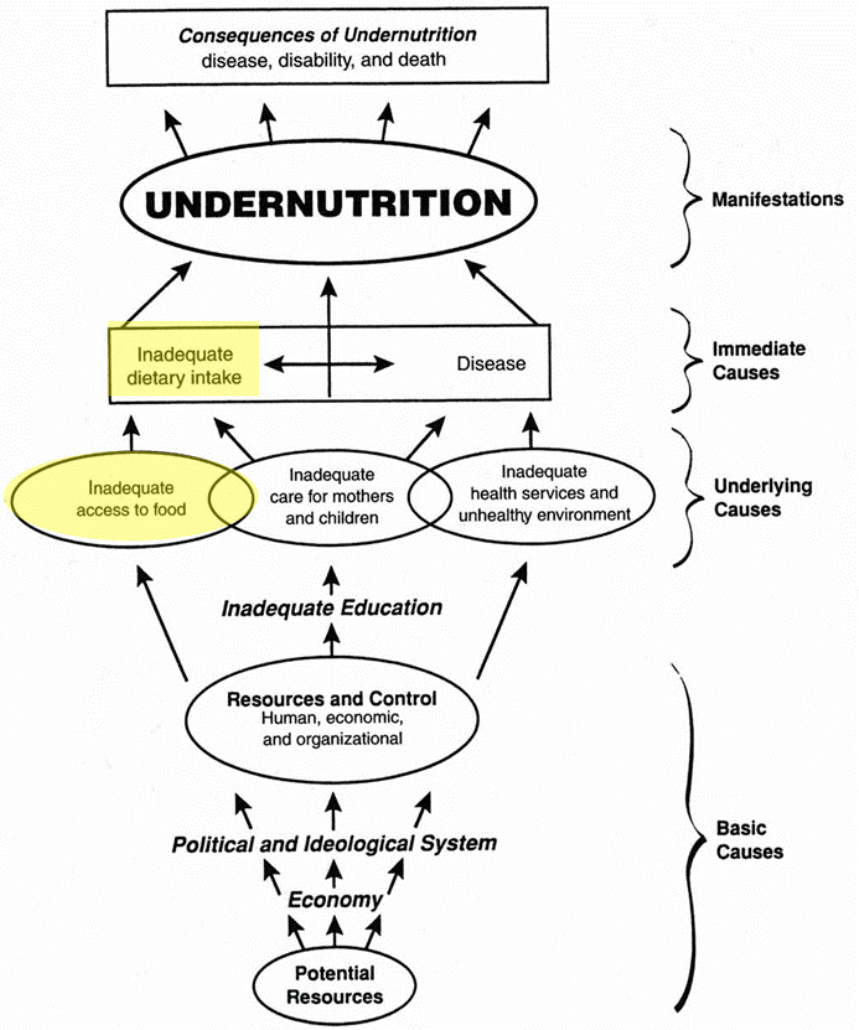
- ‘Hunger amidst scarcity’ to ‘hunger amidst abundance’ (Araghi 2000)
- Decades of high level attention but uneven progress
- Measured in various ways
  - ‘undernourishment’ or ‘hunger’
  - ‘undernutrition’, e.g. stunting, underweight



- Causation
  - undernourishment: national-level calorie availability (Svedberg 2000, FAO 2003 & 2014)
  - undernutrition: food just one cause

    a reflection of nutrition – environment interaction (Rayner & Lang 2012)

Undernutrition: causal pathway



UNICEF Conceptual Model of the Causation of Undernutrition, Modified To Include Its Consequences

(UNICEF, 1990)

Factors associated with popn patterns:

1970 to 1995, reduction in child underweight attributable to:

- **43%, improved female education**
- **26%, increase food availability**
- **19%, improved water access**

(Smith and Haddad, 2000)

Irreversible stunting at 24 months:

- **25% (8-38%) due to having >=5 episodes of diarrhoea**

(Checkley et al, 2008)

Undernutrition: climate change

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Climate change impacts may be via:

Changed labour productivity

Changed crop productivity

Changed water quantity &/or quality

Changed infectious disease patterns

And via changed patterns of poverty

Factors associated with popn patterns:

1970 to 1995, reduction in child underweight attributable to:

- 43%, improved female education
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- 19%, improved water access

(Smith and Haddad, 2000)

Irreversible stunting at 24 months:

- 25% (8-38%) due to having >=5 episodes of diarrhoea

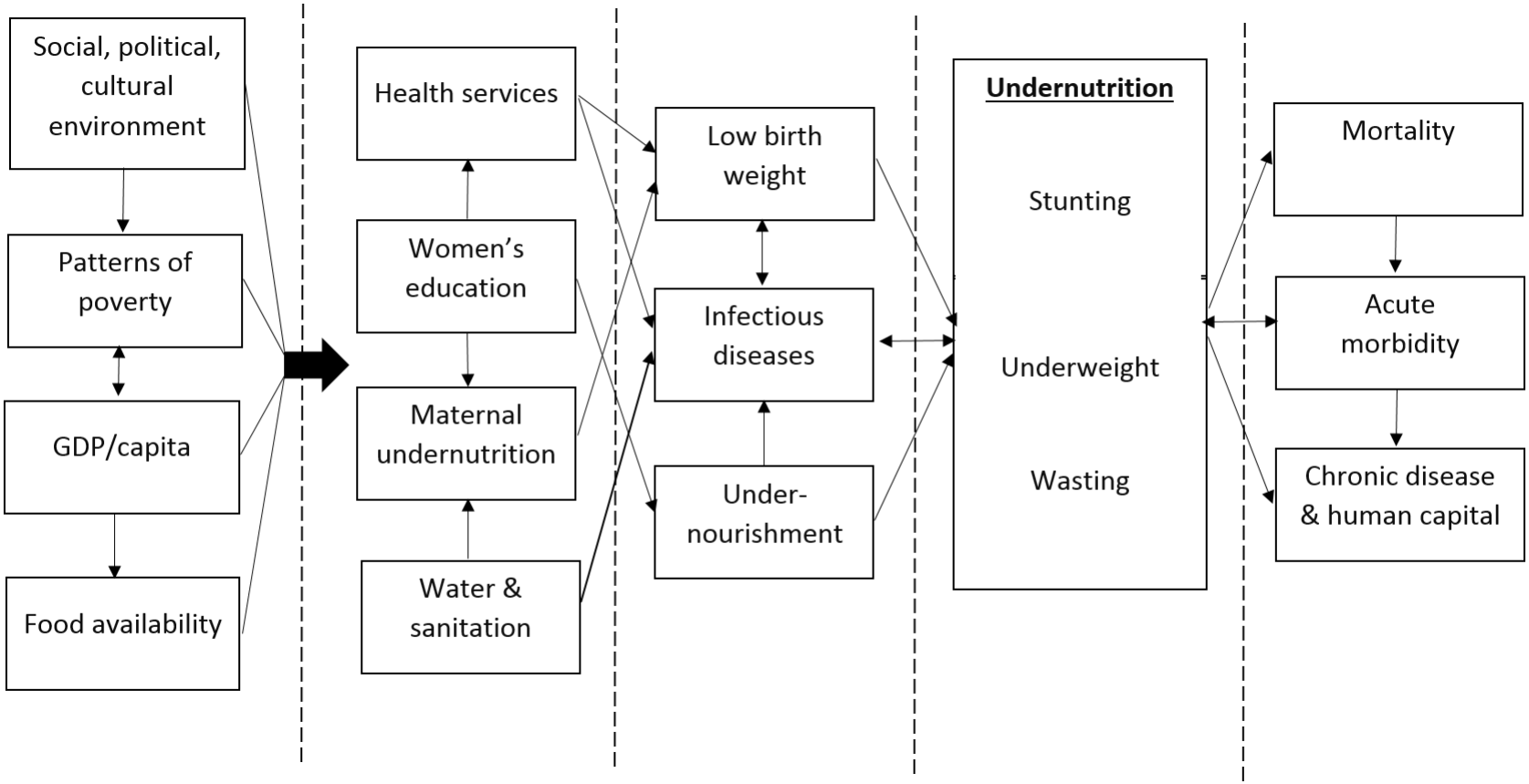
(Checkley et al, 2008)

Previous health impact modelling

- Major simplifications
- Upstream models:
  - focus on changed crop productivity under climate change
  - post-trade national calorie availability

What was included in the model?

Causal pathway* of undernutrition in children under 5



*Shows selected major pathways only. Structure open to debate.

What was included in the model?

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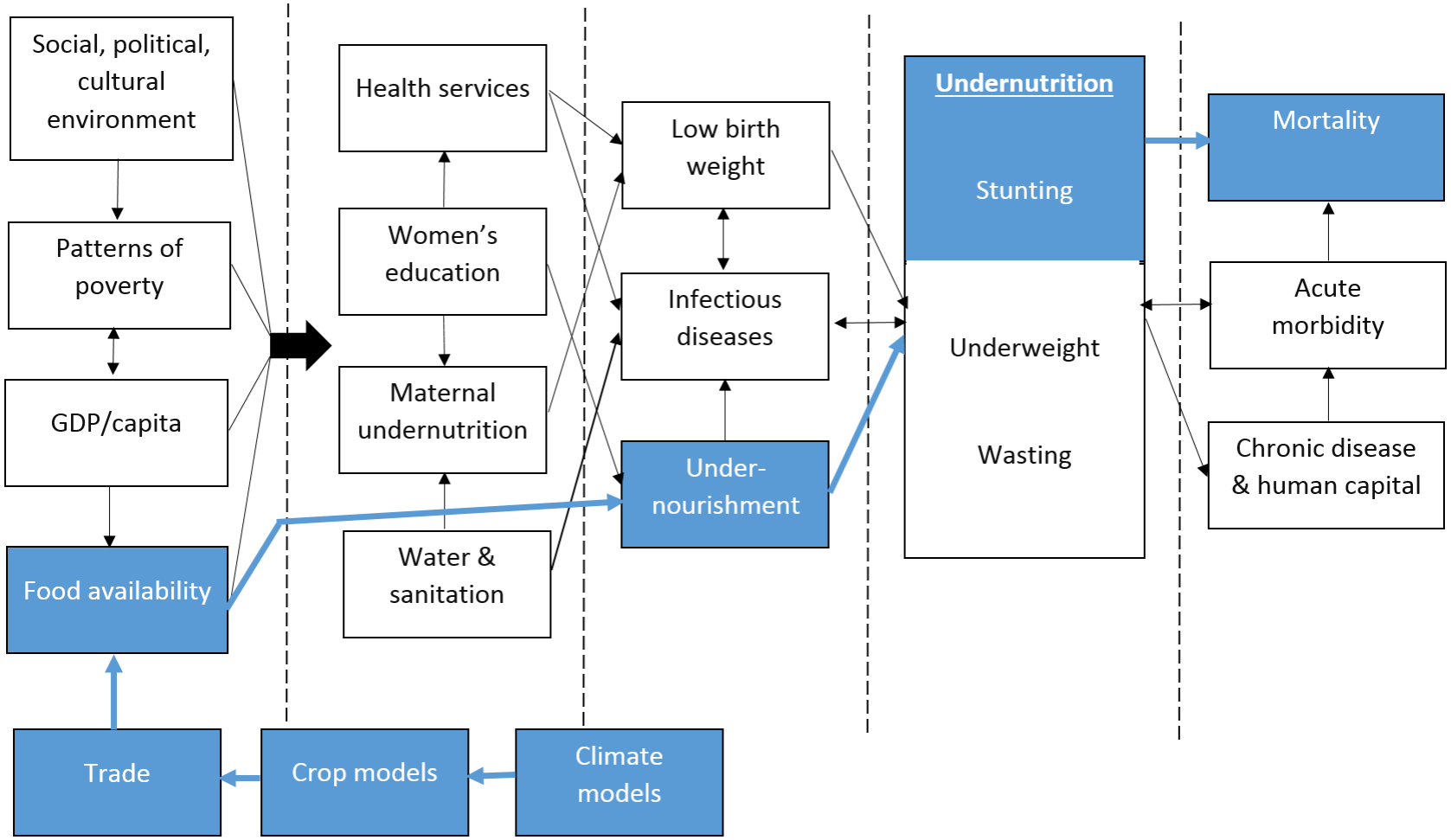
Modelled pathway: climate via crops to stunting



What was included in the model?

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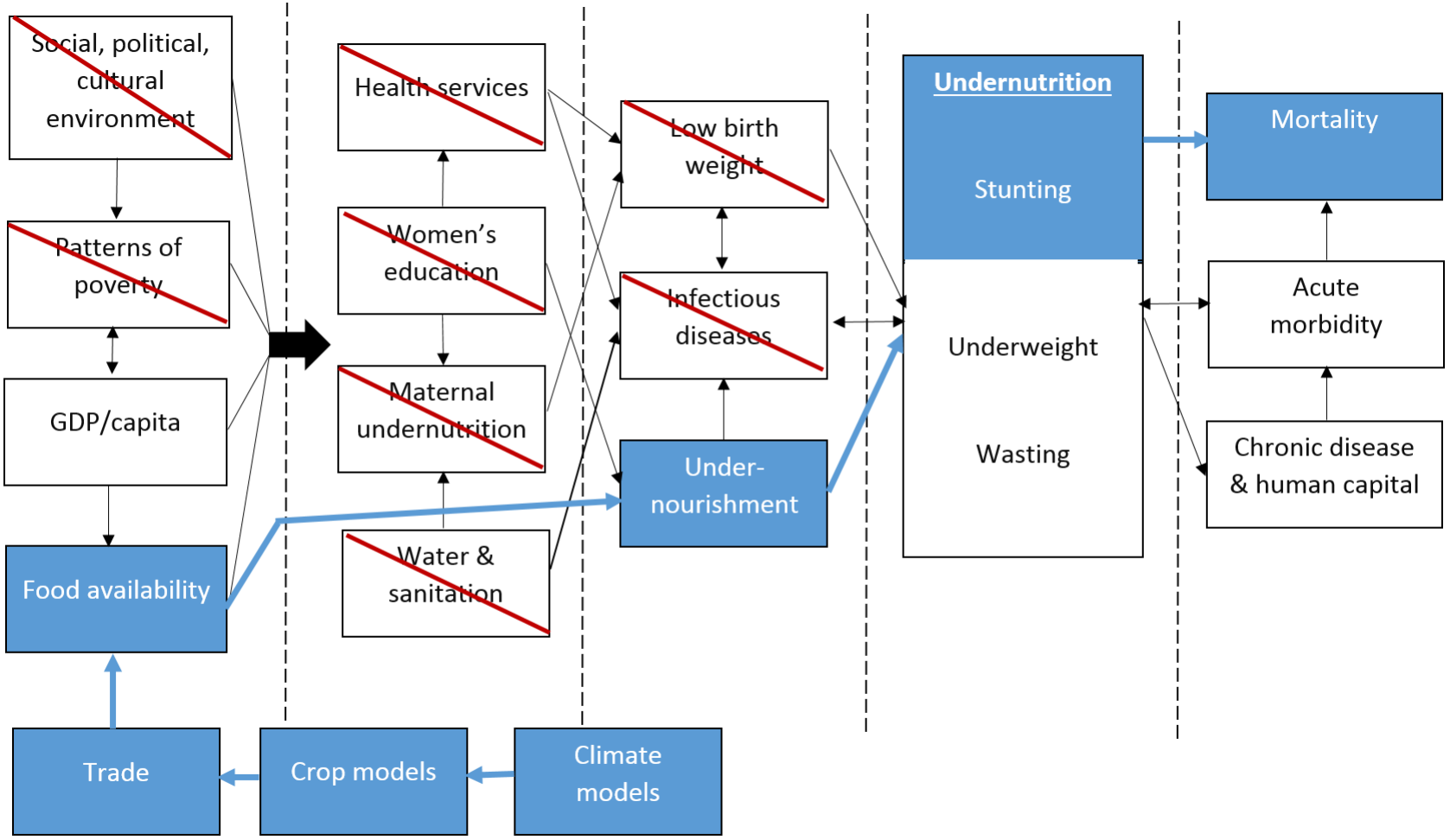
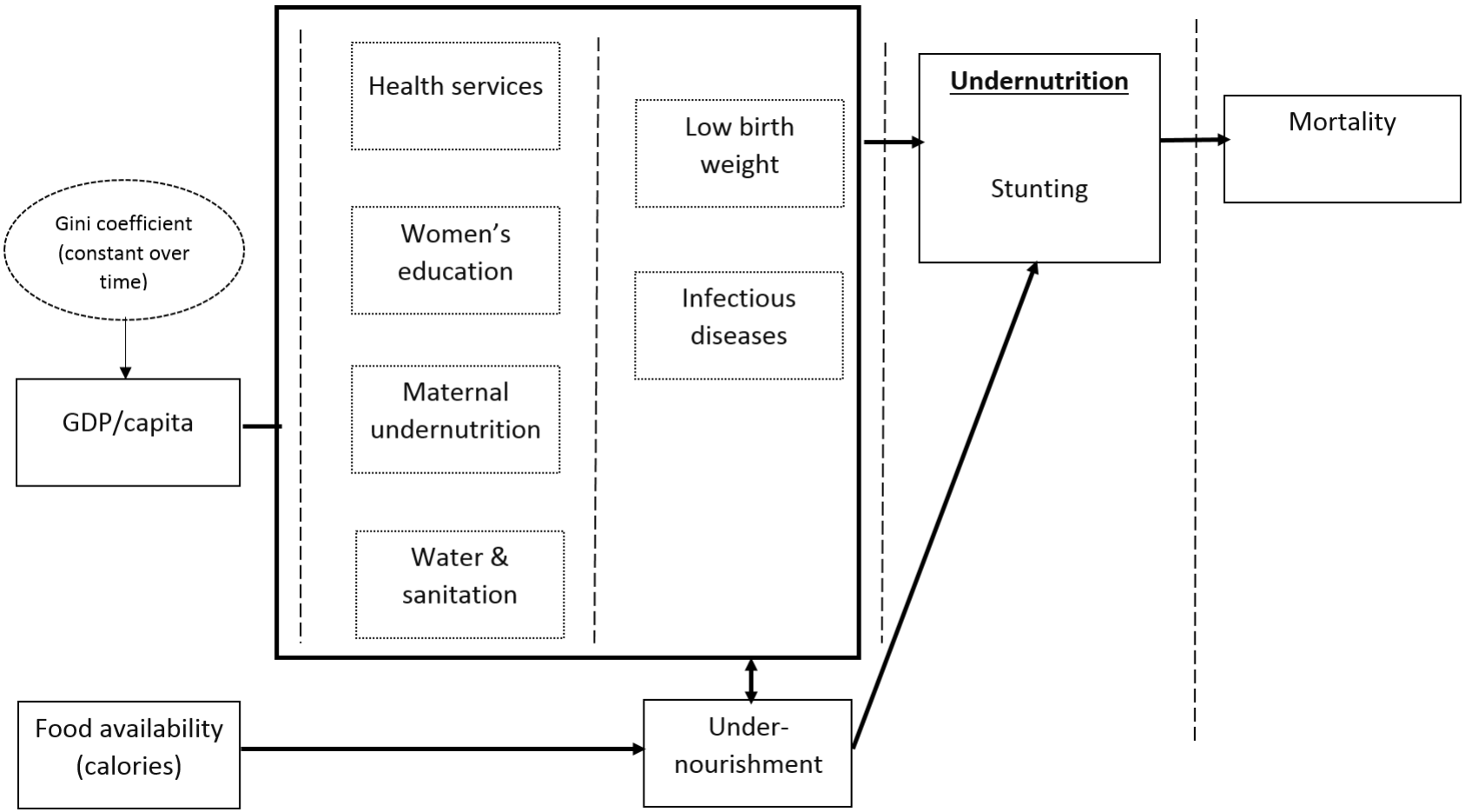
Available scenario data?



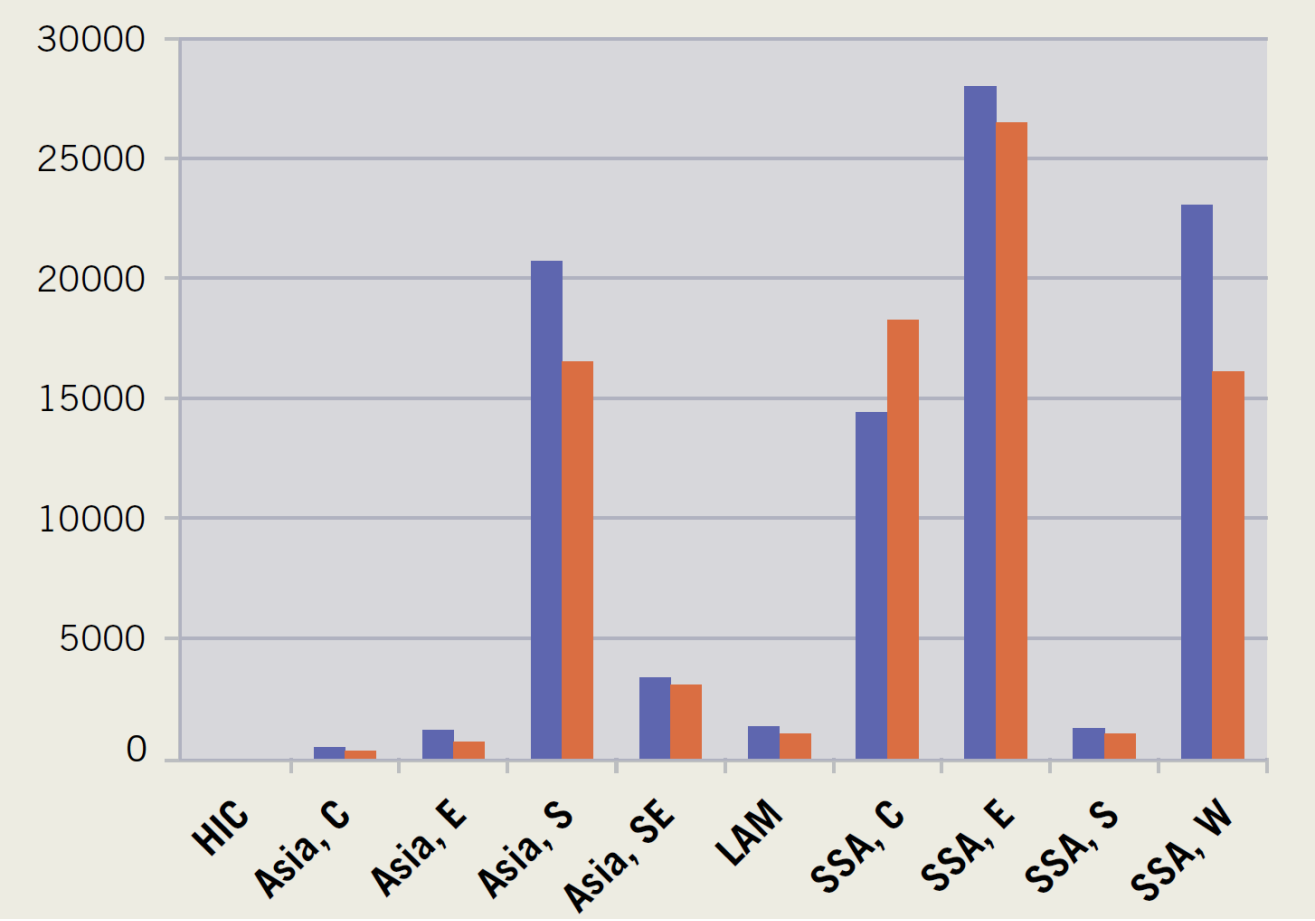
Simplified approach

‘Food’ and ‘non-food’ causes



Future estimates: mortality by region

Estimated under 5 mortality* due to climate change-attributable stunting in 2030 (blue) and 2050 (orange) by region, under A1b emissions and for 'base case' socioeconomic scenario



Globally:
~95 000/year by 2030
~85 000/year by 2050

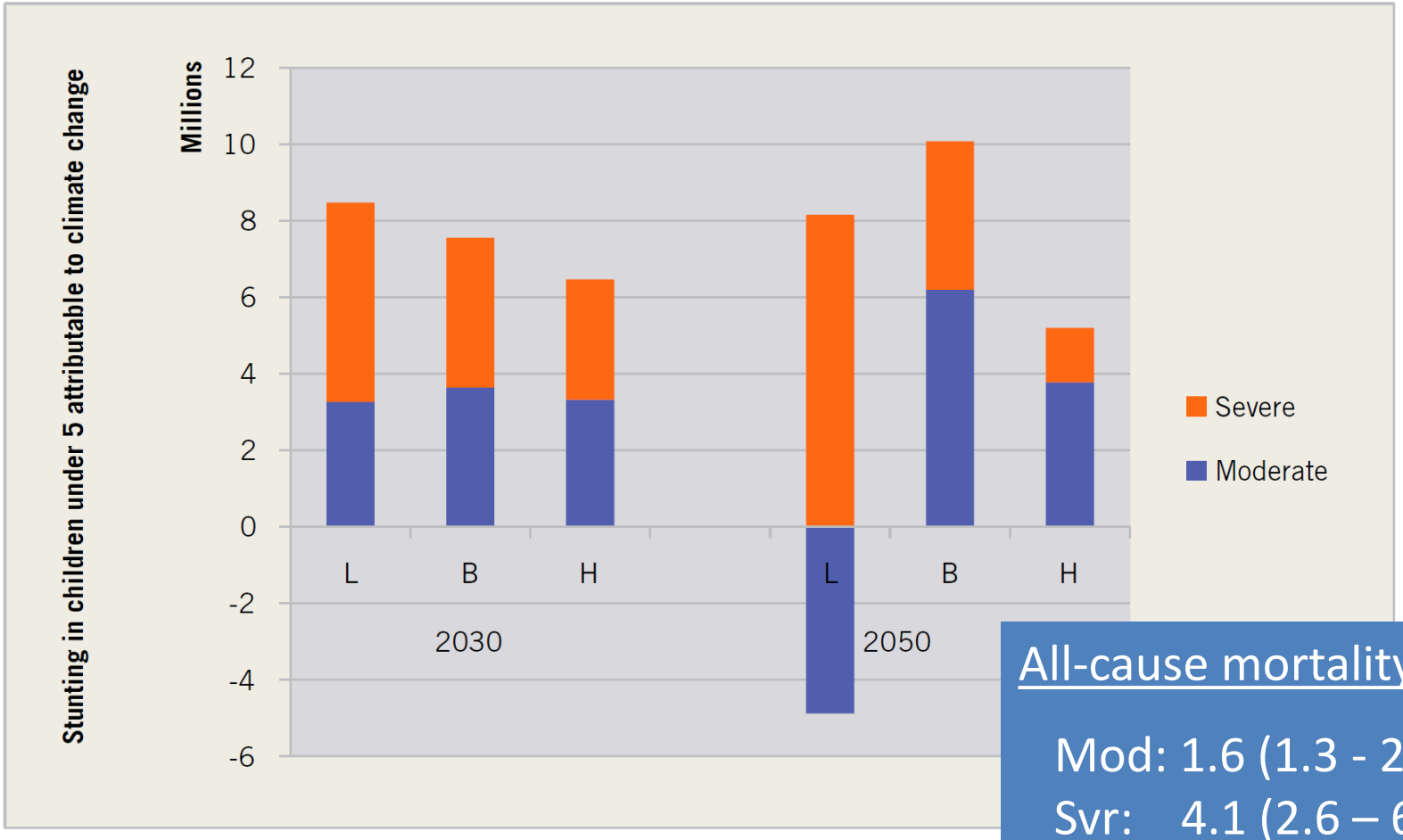
Asia, C – Asia, central; Asia, E – Asia, east; Asia, S – Asia, south; Asia, SE – Asia, south-east; HIC, high-income countries (includes Asia Pacific, high income; Australasia; Europe, central; Europe, eastern; Europe, western; North America, high income; and Oceania); LAM – Latin America (includes Latin America, Andean; Latin America, central; Latin America, southern; Latin America, tropical; and Caribbean); SSA, C – sub-Saharan Africa, central; SSA, E – sub-Saharan Africa, eastern; SSA, S – sub-Saharan Africa, southern; SSA, W – sub-Saharan Africa, western. Estimates for North Africa/Middle East are not included.

* x-axis is number of deaths

Source: WHO, 2014

Future estimates: CC-attr stunting

Estimated climate change-attributable stunting in children under 5, under A1b emissions and three socioeconomic scenarios*



* L – low economic growth, B – base case, H – high economic gr

All-cause mortality risk

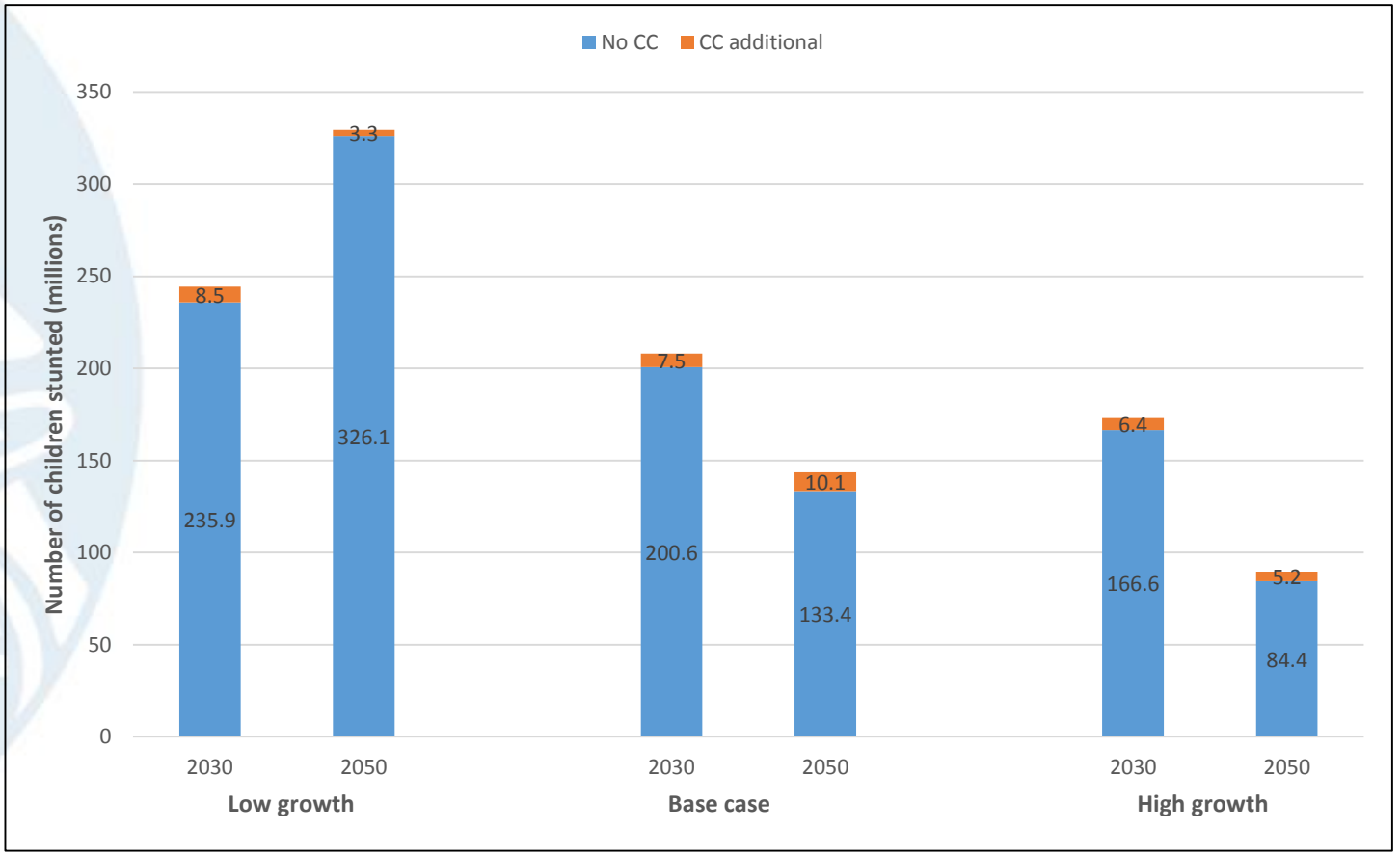
Mod: 1.6 (1.3 - 2.2)

Svr: 4.1 (2.6 – 6.4)

(Black et al, 2008)

Future estimates: no CC cf. CC

Estimates of number of children stunted in futures with and without climate change in 2030 and 2050, under A1b emissions and three socioeconomic scenarios



Source: WHO, 2014

New child stunting model

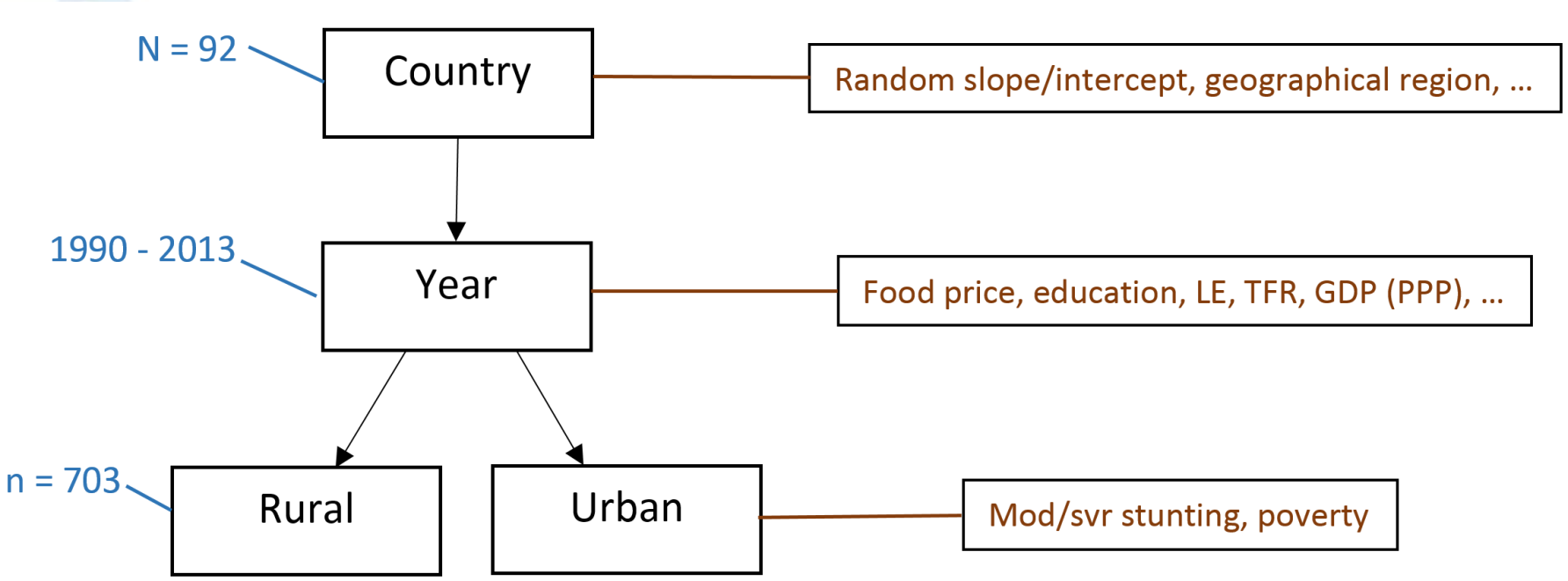
Implications of findings from previous modelling:

- level (mod/svr) of stunting is critical
- socioeconomics matter a lot, but
  - crudely represented, and
  - expect climate to impact via non-crop routes

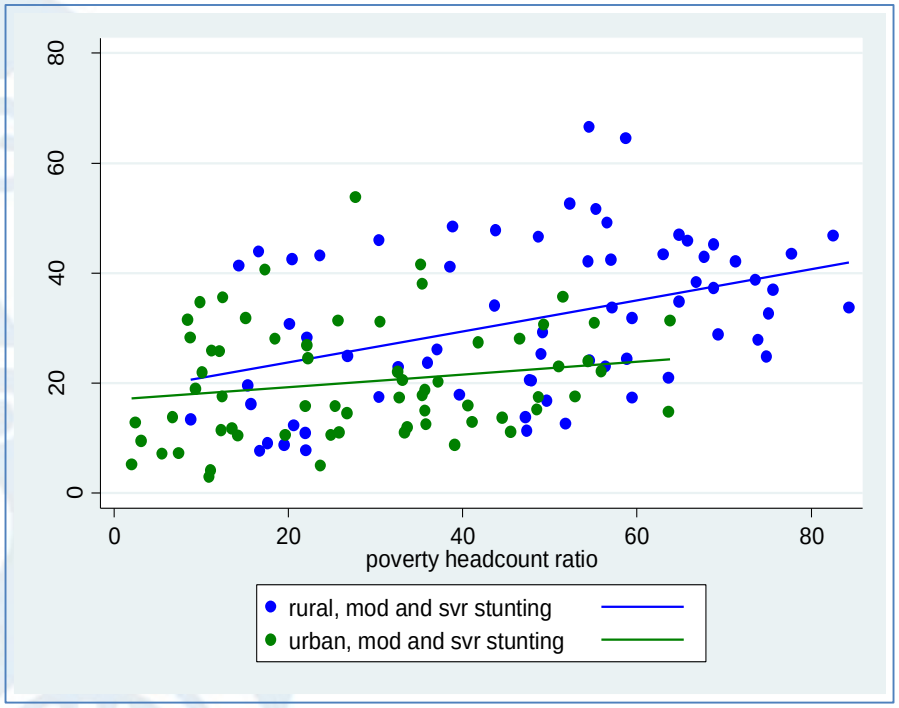
New child stunting model

- Global-level, statistical model
- Inputs to drive the model:
  - socioeconomic factors:
    - modelled: rural and urban poverty, Gini
    - scenario: education, LE, TFR, …
  - food as 'food price' (PPI and CPI)
- Climate signal via poverty and food price
- Longitudinal data/country-level random effects
- Outputs:
  - national/regional-level, rural & urban, mod & svr stunting
  - what's important?

Data for model fitting

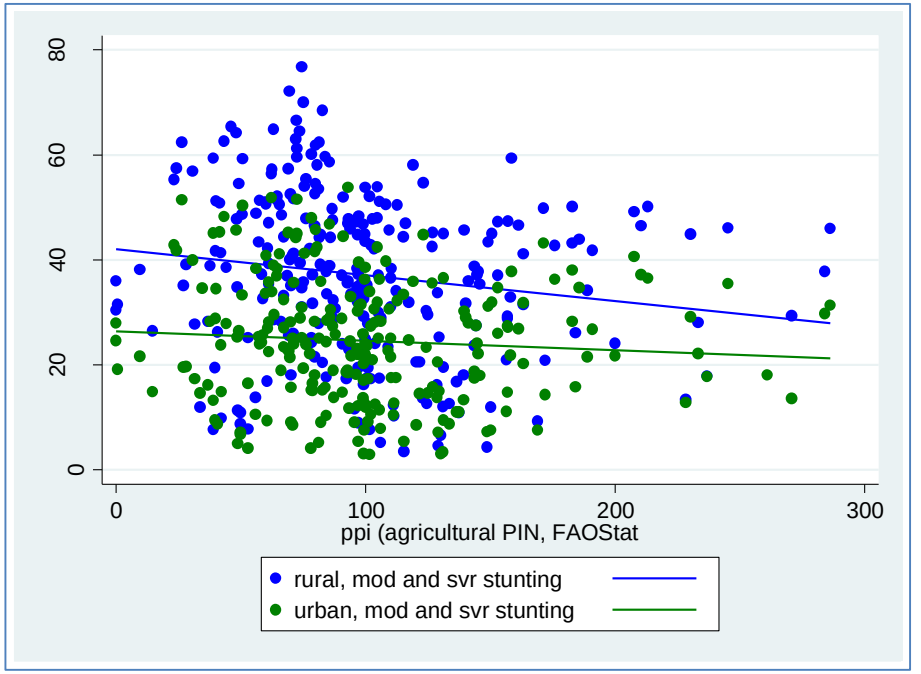


Crude correlations* by area



Poverty headcount ratio

Producer price index



* Each point is for a given area (rural/urban), in a given country, for a given year. Complete data for poverty and price are not yet available.

Conclusions

- New model will make advances on previous work
- Still many aspects – inevitably - not modelled
- Multiple health models looking at the problem from various angles required…

….modelling as an ongoing process

(Levins, 1966)

The End

Thanks…

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