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

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Improving health worldwide

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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
  – undernutrition: food just one cause
    a reflection of nutrition – environment interaction (Rayner & Lang 2012)
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

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

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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?

Modelled pathway: climate via crops to stunting

- Social, political, cultural environment
  - Patterns of poverty
  - GDP/capita

- Food availability
  - Trade
  - Crop models
  - Climate models

- Health services
  - Women’s education
  - Maternal undernutrition

- Water & sanitation

- Low birth weight
  - Infectious diseases

- Under-nourishment

- Undernutrition
  - Stunting
  - Underweight
  - Wasting

- Mortality
  - Acute morbidity
  - Chronic disease & human capital
What was included in the model?

Available scenario data?

- Social, political, cultural environment
- Patterns of poverty
- GDP/capita
- Food availability
- Trade
- Crop models
- Climate models

- Health services
- Women’s education
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- Undernutrition
  - Stunting
  - Underweight
  - Wasting

- Mortality
- Acute morbidity
- Chronic disease & human capital
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

* 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 growth

Source: WHO, 2014

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

- **Country**
  - Random slope/intercept, geographical region, ...

- **Year**
  - Food price, education, LE, TFR, GDP (PPP), ...

- **Rural**
- **Urban**
  - Mod/svr stunting, poverty

- N = 92
- 1990 - 2013
- n = 703
Crude correlations* by area

* 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...