Reducing Child Pneumonia Risks *through actions on* Household Air Pollution (HAP)




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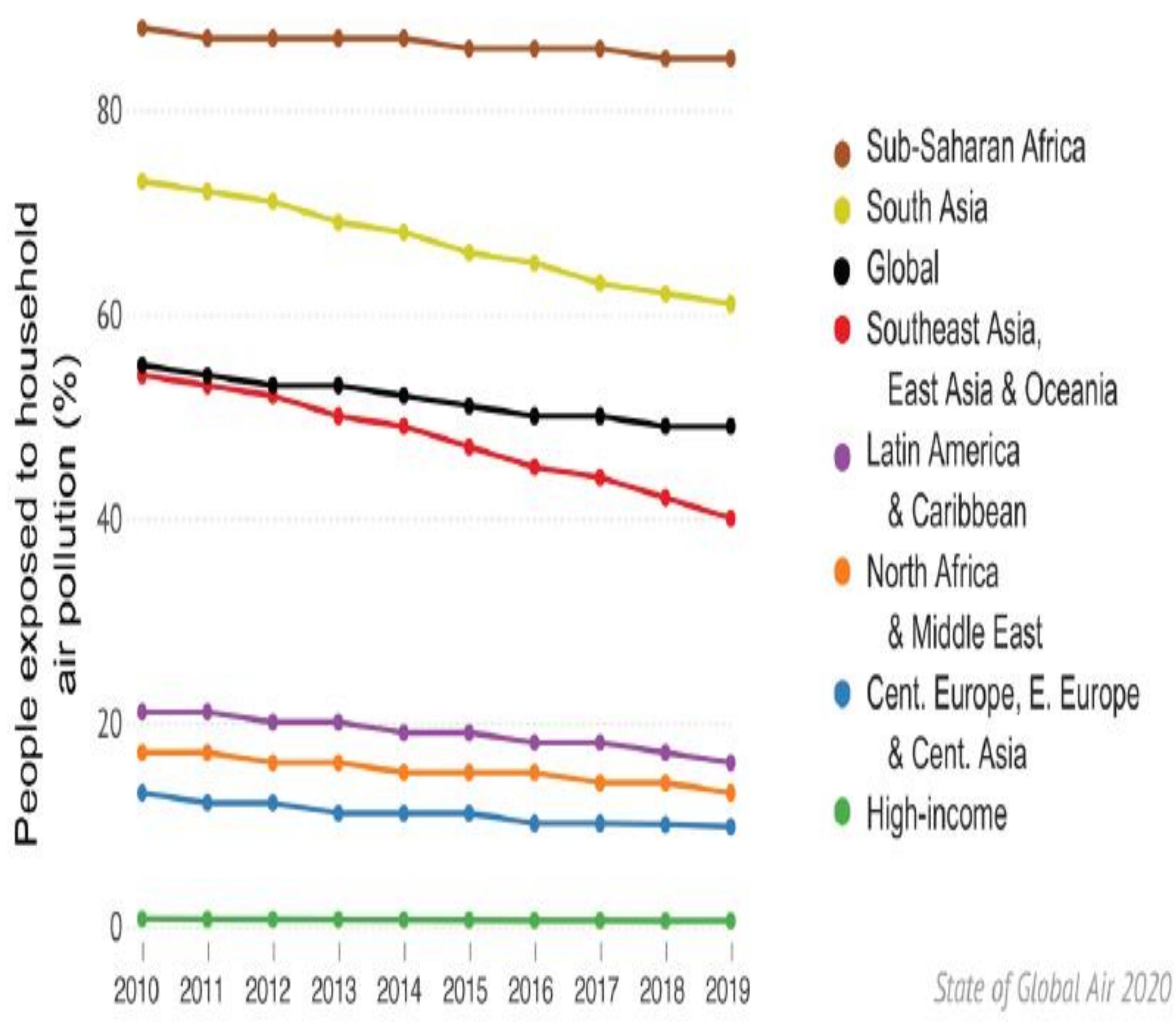
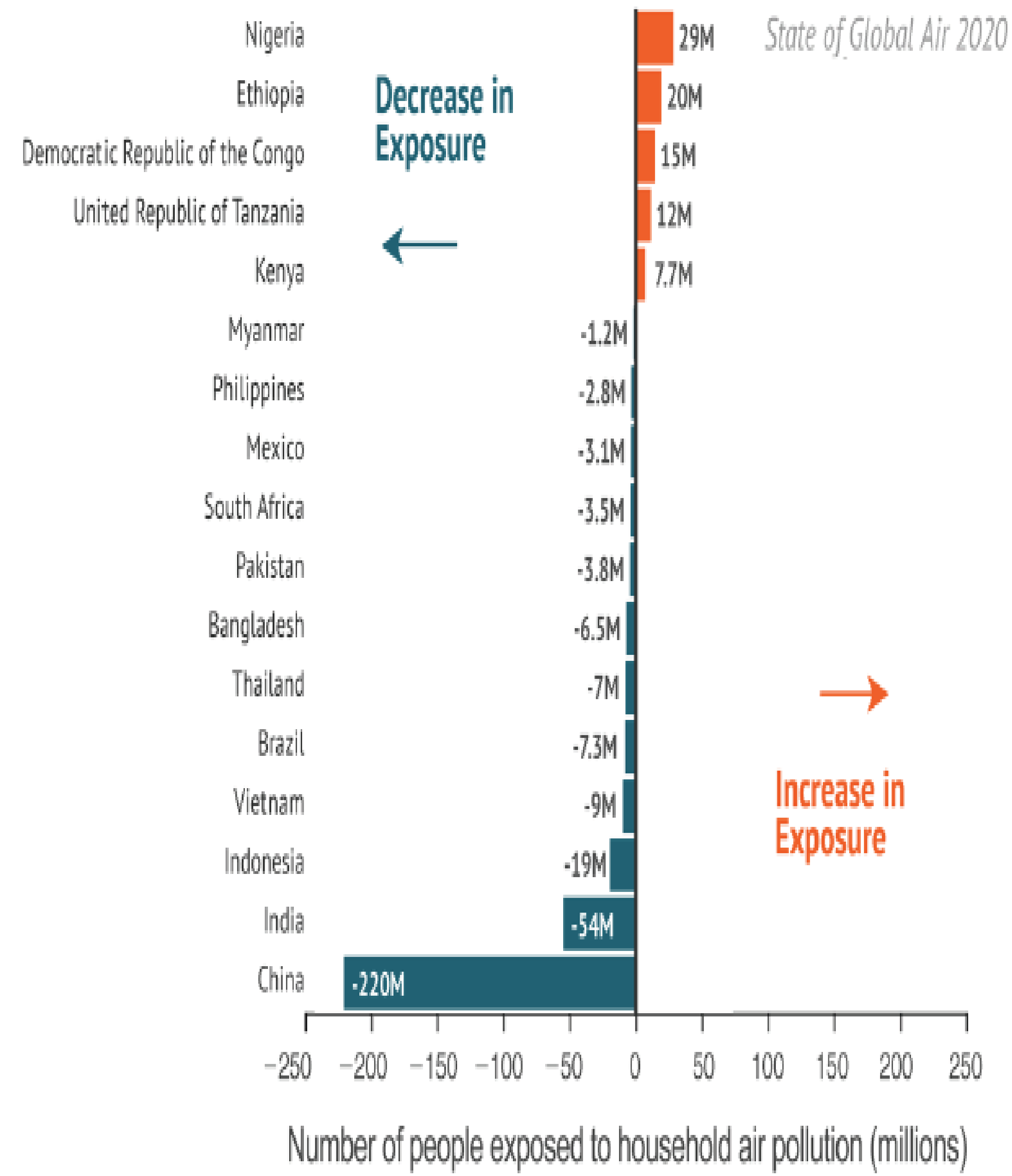
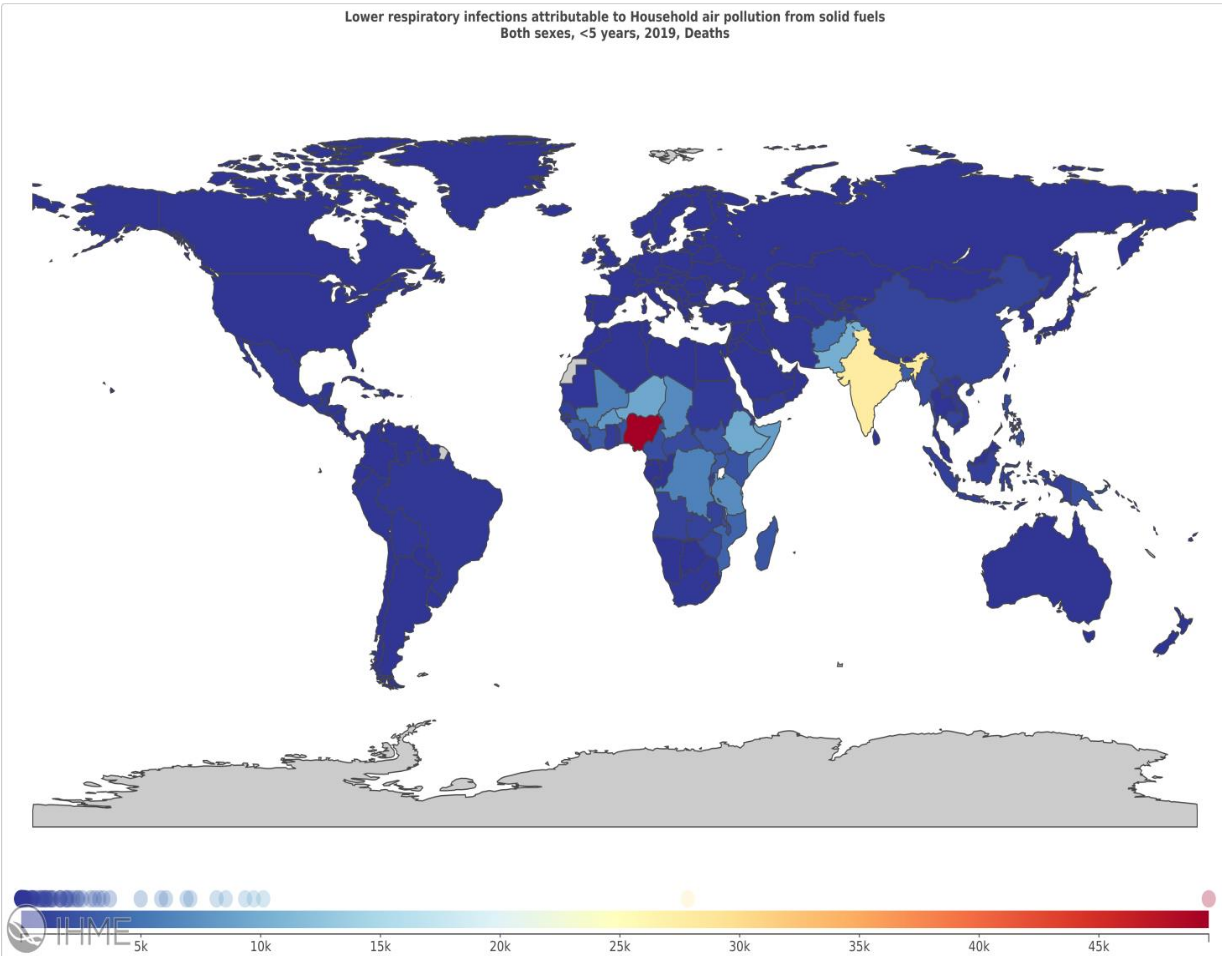
Global distribution of HAP Exposures

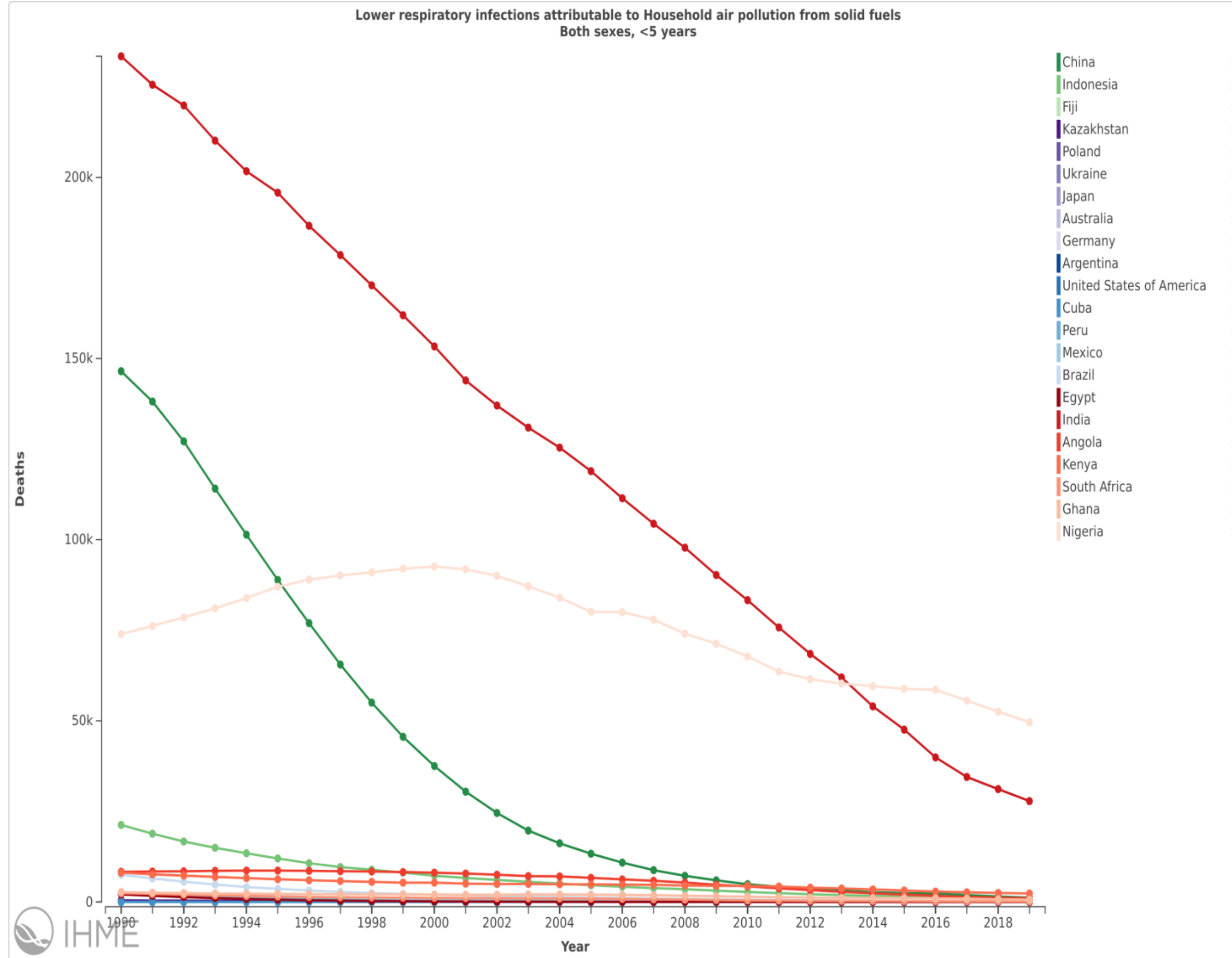




India and Nigeria are currently home to the largest numbers of people experiencing HAP exposures.

Global burden of child pneumonia deaths attributable to HAP





Just five countries were responsible for more than half of child pneumonia deaths in 2018: **Nigeria (162,000), India (127,000)**, Pakistan (58,000), the Democratic Republic of Congo (40,000) and Ethiopia (32,000). **Nigeria and India** have the highest number of child pneumonia **deaths attributable to HAP**

Source: GBD 2019, IHME

Stock-taking of Exposure-Response evidence for HAP actions

- What do we know about E-R for HAP from clinical trials and beyond?

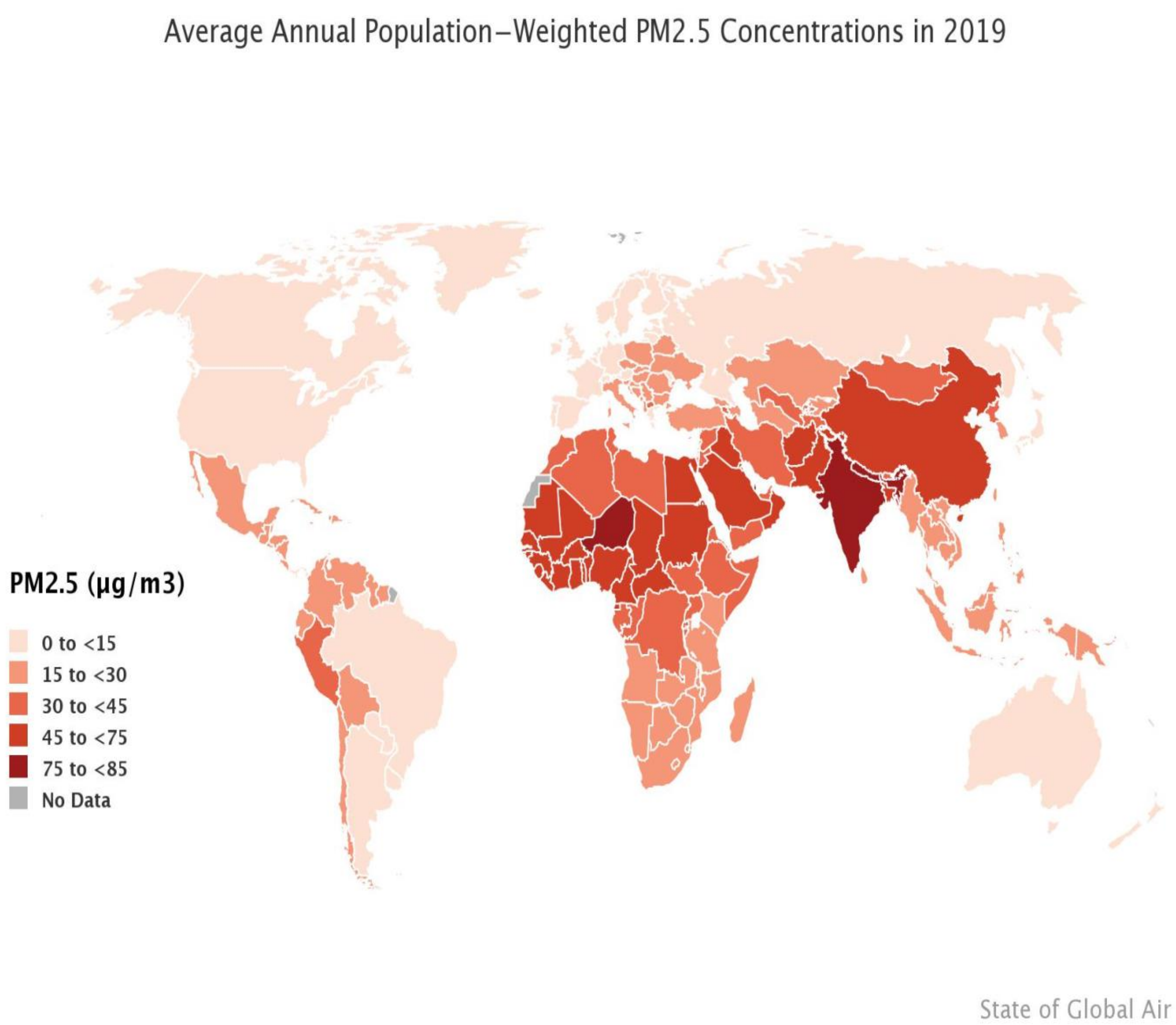
- Where are the critical gaps?

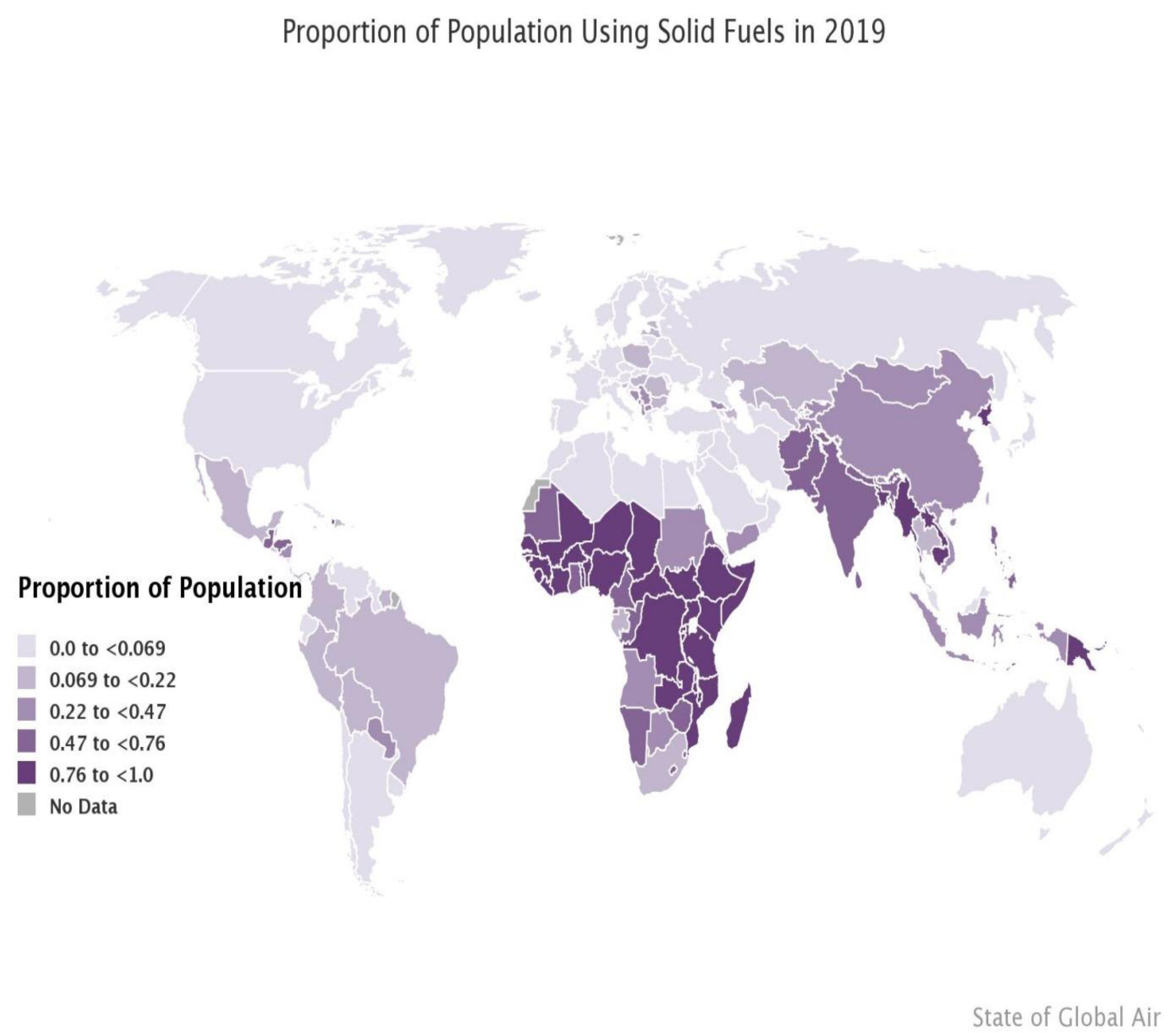
- Do we know enough to act and sustain actions?

Household solid fuel combustion generates a complex cocktail of pollutants with high intake fractions in LMICs

Art Credit: Ajay Pillarisetti, UC Berkeley

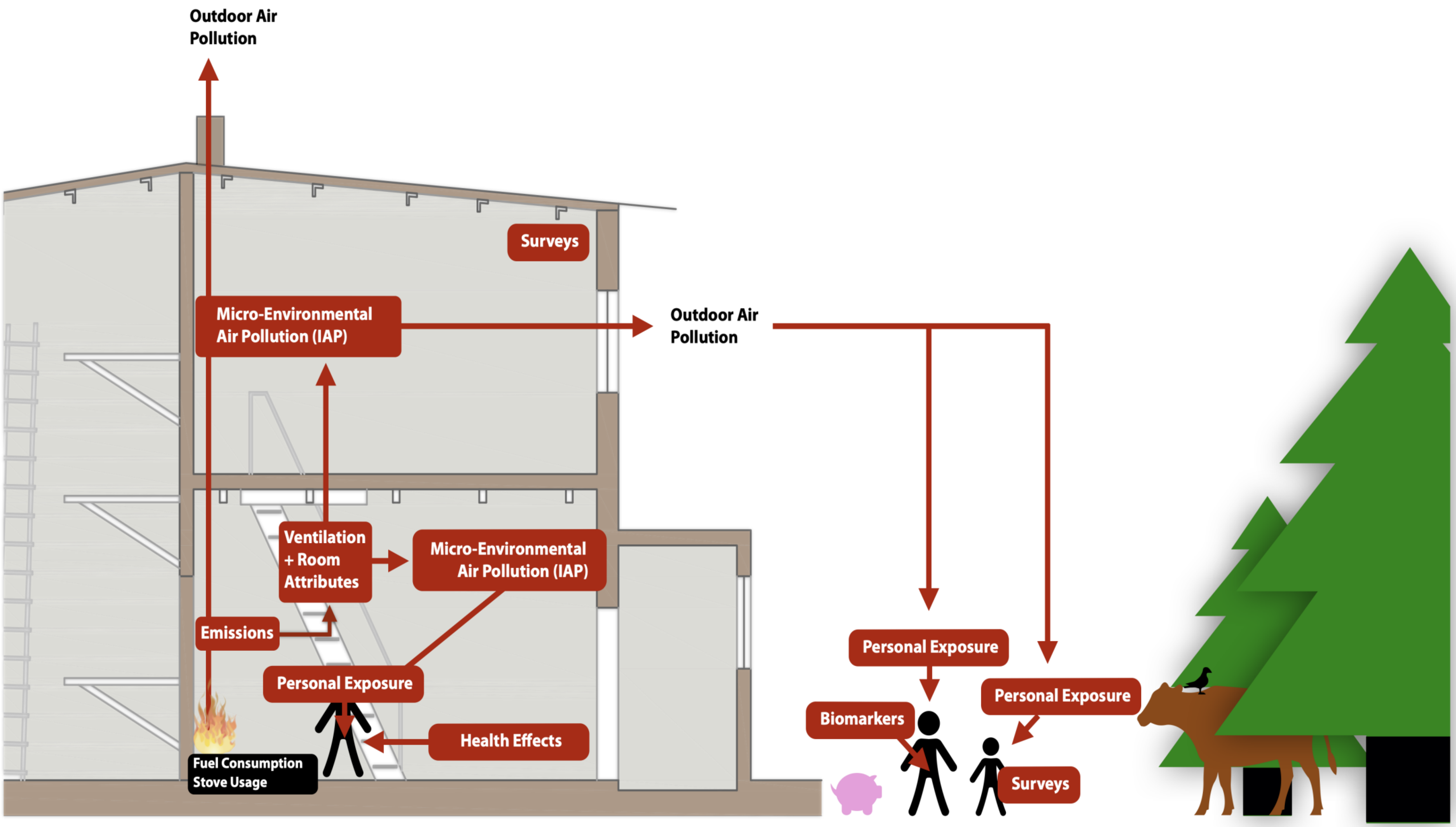
Exposures to ambient and household air pollution co-exist in LMICs





HEI SOGA 2020

What are we now able to measure in rural households?



Art Credit: *Ajay Pillarisetti, UC Berkeley*

Exposure-response associations for household air pollution

HAP RCTs/Observational Studies

- Acute Lower Respiratory Infections
- Lung function
- Birthweight
- Child growth and development
- Blood Pressure
- Biomarkers
- All cause/CVD mortality(?)

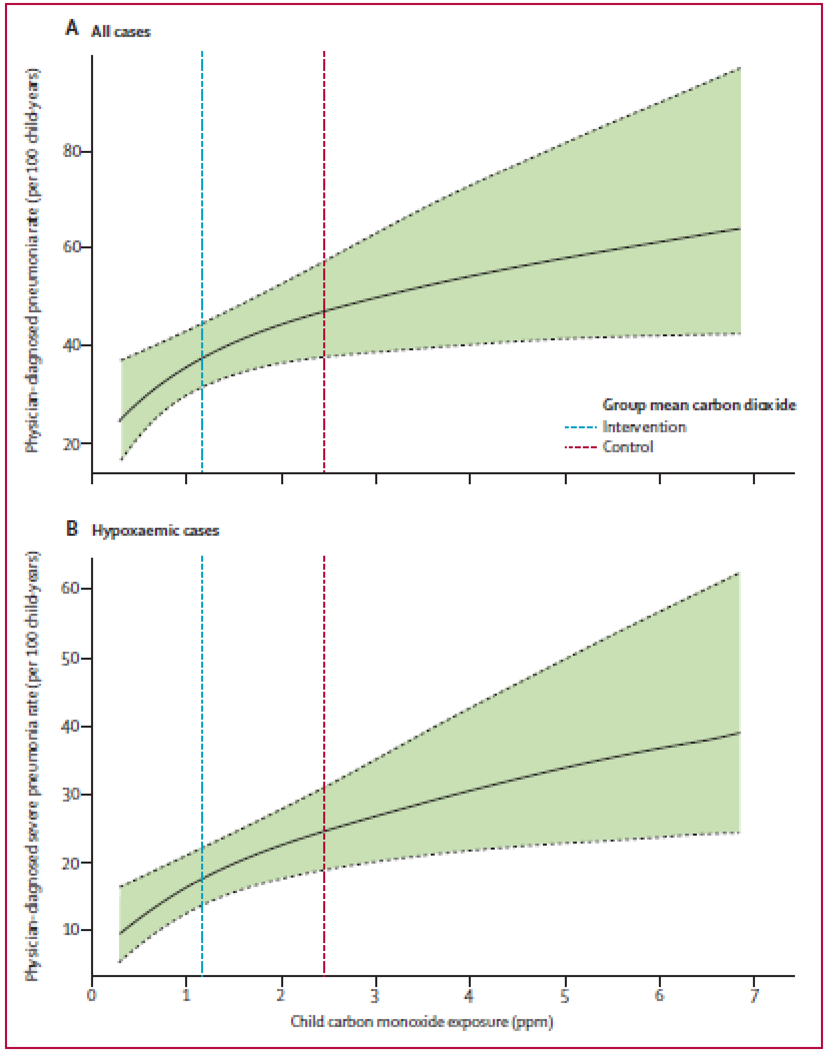
GBD IERs

- Acute Lower Respiratory Infections
- COPD
- Lung Cancer
- Stroke/IHD
- Diabetes
- Birth weight

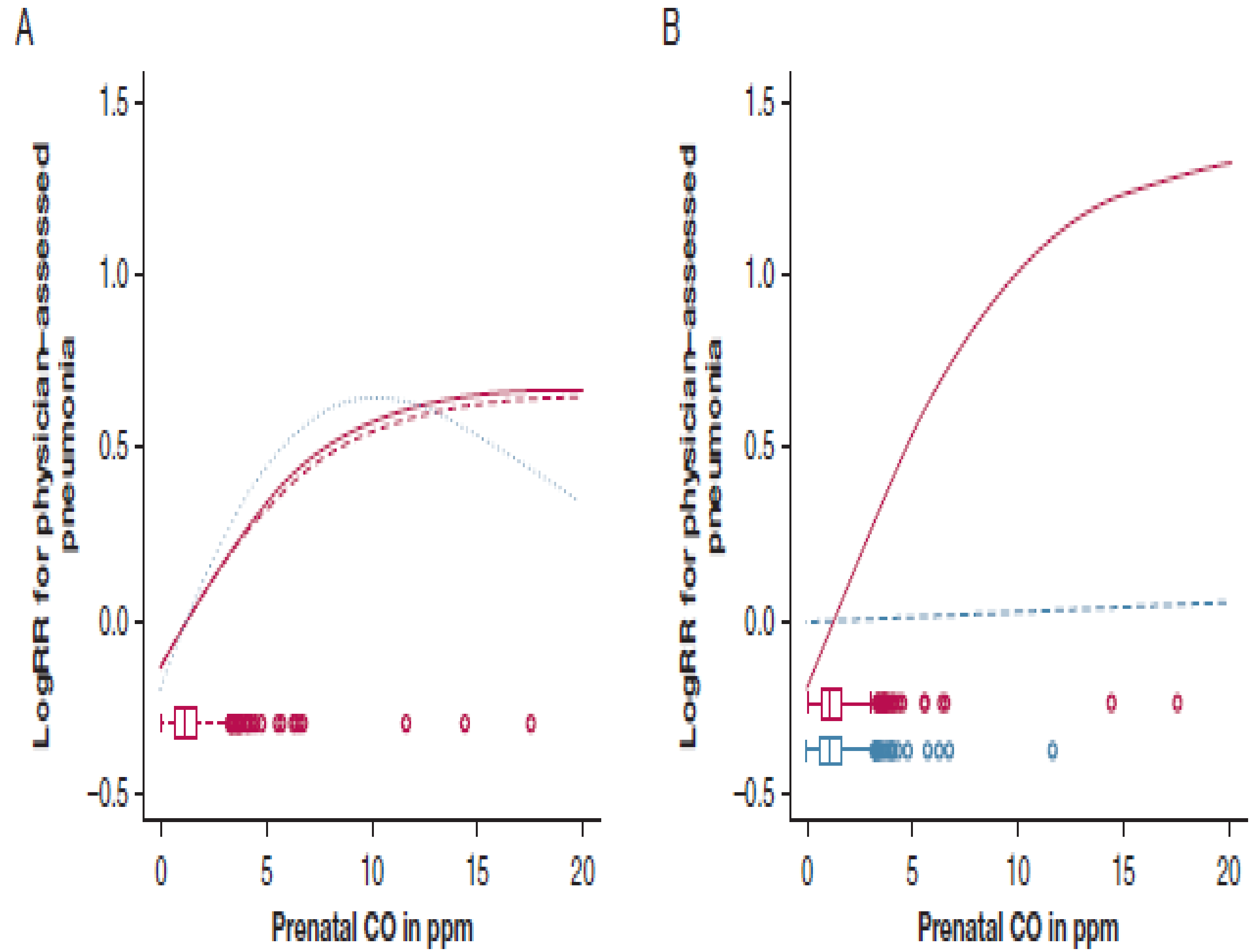
Exposure-response: HAP- Pneumonia

RESPIRE Trial in Guatemala, GRAPHS Trial in Ghana

Guatemala



Ghana



Smith et al 2011

Kinney et al, 2021

Exposure-response: HAP- Pneumonia

Combining multiple studies in Nepal

Nepal

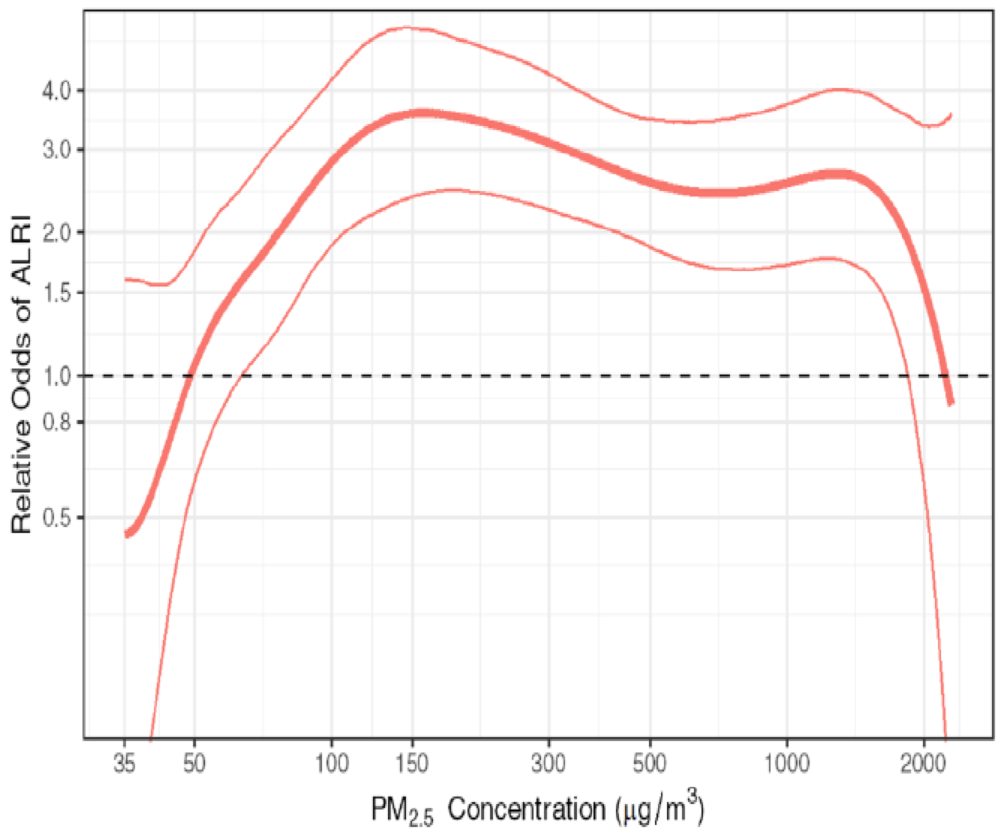


Figure 6. Estimated exposure-response curve (posterior mean with pointwise 95% credible intervals) for the relationship between exposure to $PM_{2.5}$ and ALRI in children, for all three studies combined.

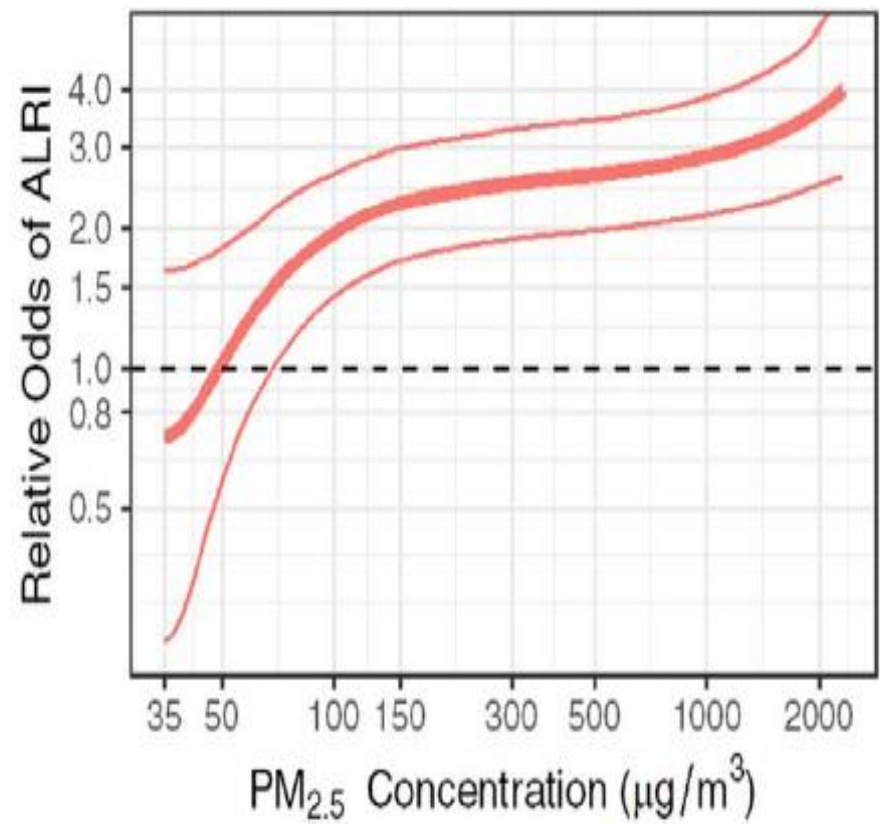


Figure 7. Estimated exposure-response curve (posterior mean with pointwise 95% credible intervals) for the relationship between exposure to $PM_{2.5}$ and ALRI in children, for all three studies combined in a model that restricts the curve to be nondecreasing.

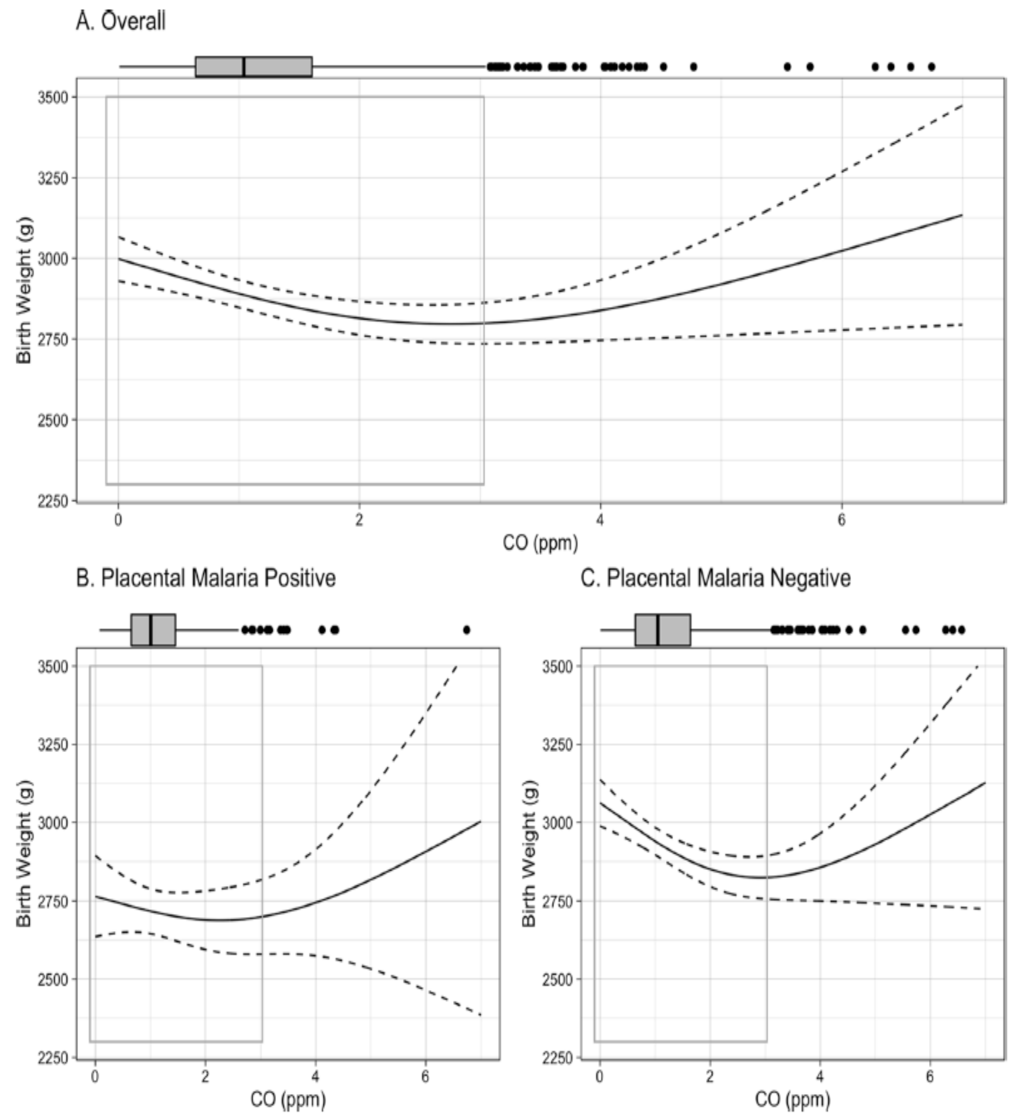
Keller et al, 2020

Exposure-response : HAP-Birthweight

GRAPHS Trial in Ghana

- N=1288 live births with valid exposures (time –series of daily CO exposures via linear interpolation of days in between four 48-hr measures during pregnancy, with one occurring prior to intervention)
- Mean Pre-natal Exposure CO 1.3(0.9) ppm; Median 1.1 ppm
- Mean Pre-natal Exposure $PM_{2.5}$ 85.8μg/m^3 (SD 58.8μg/m^3); Median 69μg/m^3
- **-38.7 gm(95%cI: -66g,-11g) / 1ppm CO**

Ghana

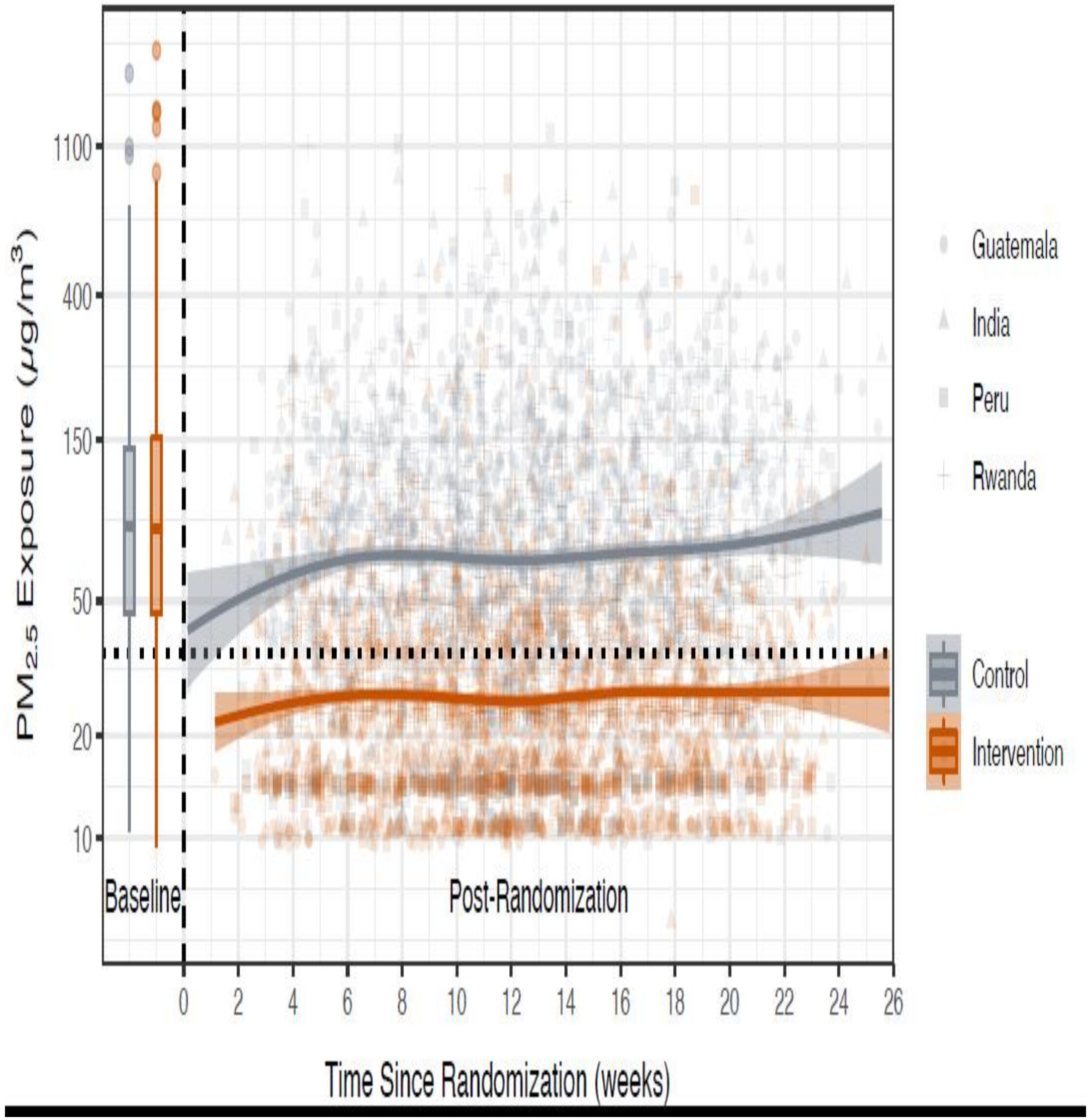


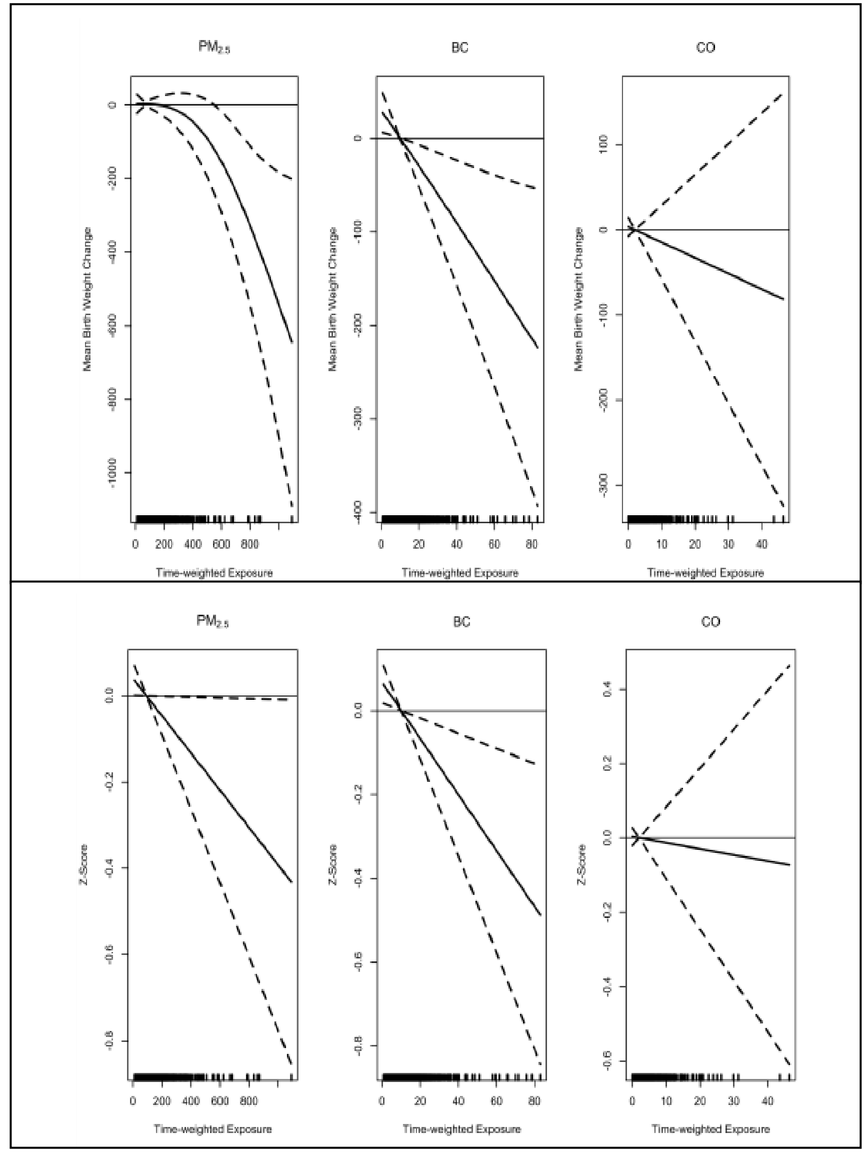
-38.7 gm(95%cI: -66g,-11g) per 1ppm change in pregnancy period CO exposures

Quinn et al 2021

Exposure-response : HAP-Birthweight

HAPIN Trial in Guatemala, India, Rwanda and Peru





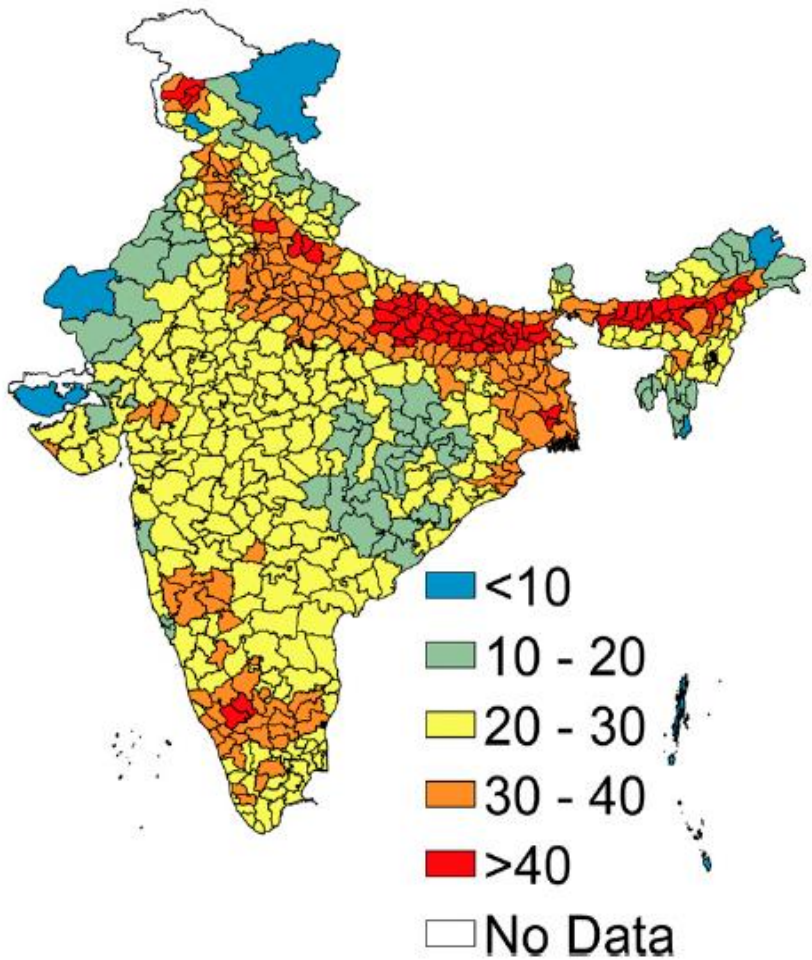
Johnson Pillarisetti et al EHP 2022

Balakrishnan et al Pre-print: Do not Quote or Cite
https://www.medrxiv.org/content/10.1101/2022.08.06.22278373v1

Do we know enough to act ?

More importantly, do we have arguments against exposure reduction from clean energy use for LMIC households?

Ambient concentrations could set the floor for exposure-response benefits in many HAP contexts



Percentage of ambient $PM_{2.5}$ exposure that can be attributed to household $PM_{2.5}$ sources at baseline

Chowdhury ,Dey et al, PNAS 2019

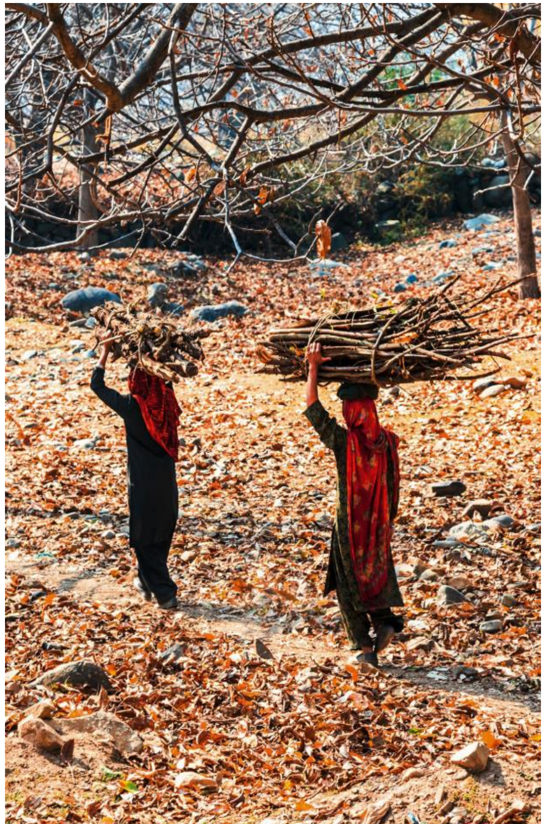
22 – 52% of Indian ambient PM2.5 is attributable to household sources

Complete mitigation of these sources would reduce population-weighted annual $PM_{2.5}$ exposure by ~17%

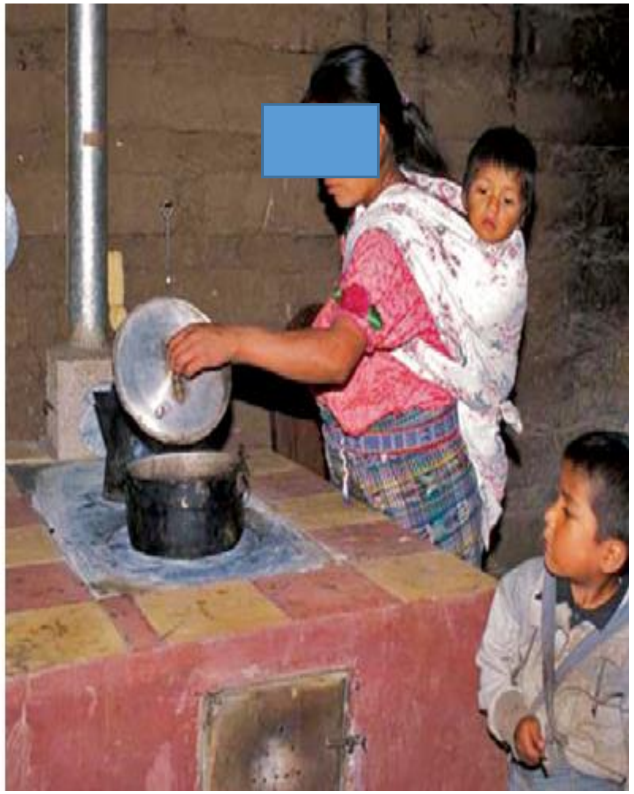
Capturing Health Inequities

- Fuel gathering and cooking with solid fuels imposes a tremendous burden on the physical and mental health of women.
- Solid cook-fuels are a triple whammy on women's time (work, housework and child care).
- Opportunity cost for women's time is not factored in most cost-benefit analyses at the household, community or national levels.






Clean Energy Transitions in LMICs: Trajectory for eliminating air pollution attributable burden for pneumonia and beyond



THANK YOU

Photo Credit: Ajay Pillarisetti, UC Berkeley