


# *Is it risky for epidemiologists to be advocates??*

## *Aka*

## *Who and what are we arguing for??*


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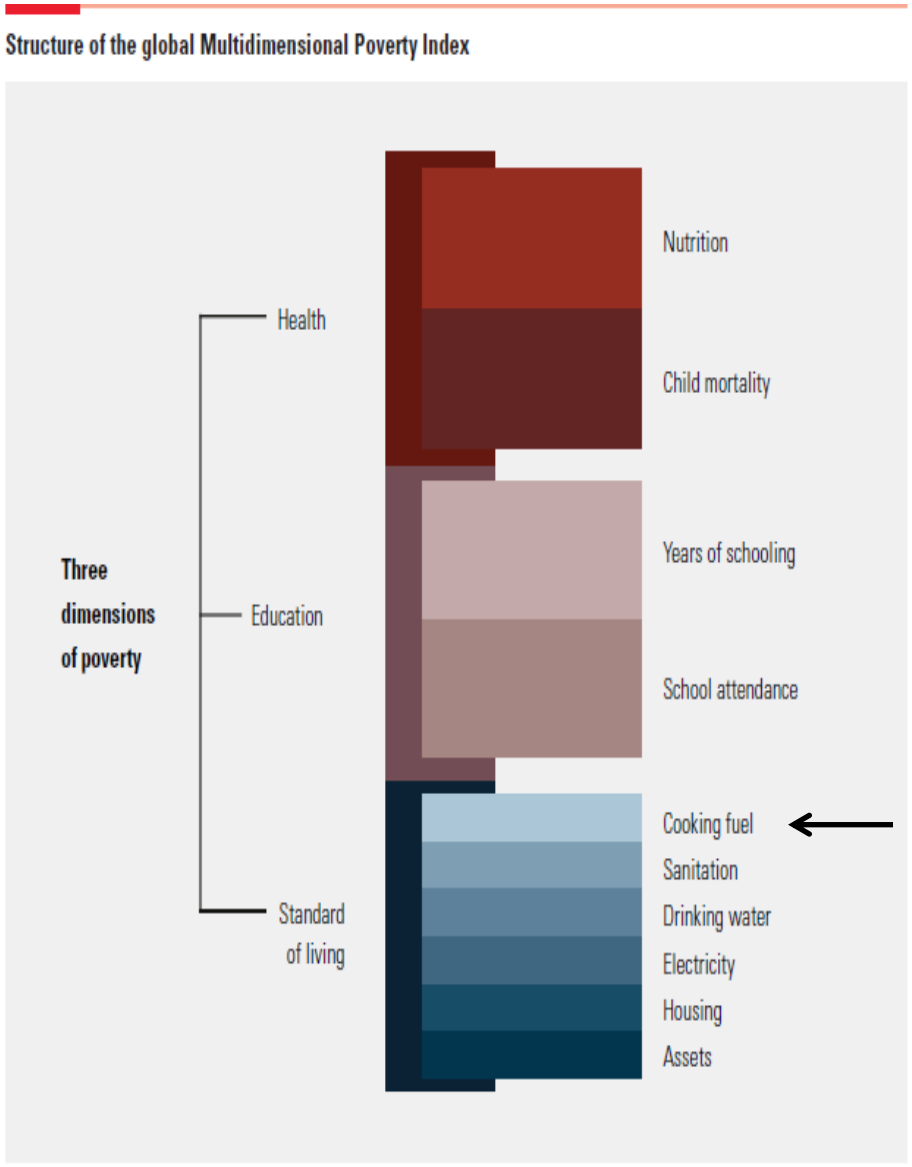
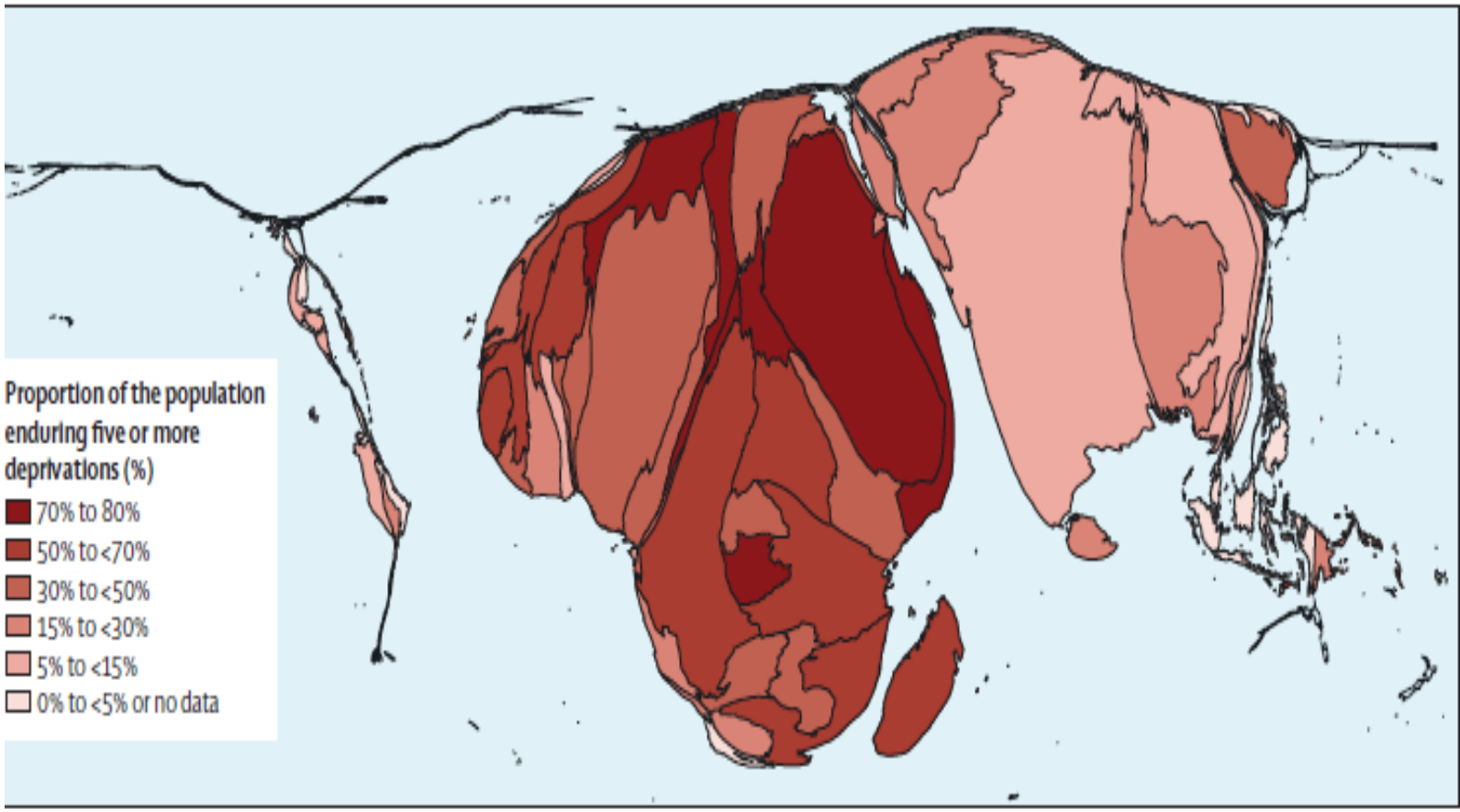
Chennai, India


**World Congress of Epidemiology**
**2024**




# Who bears the highest global burden of multi-dimensional poverty?

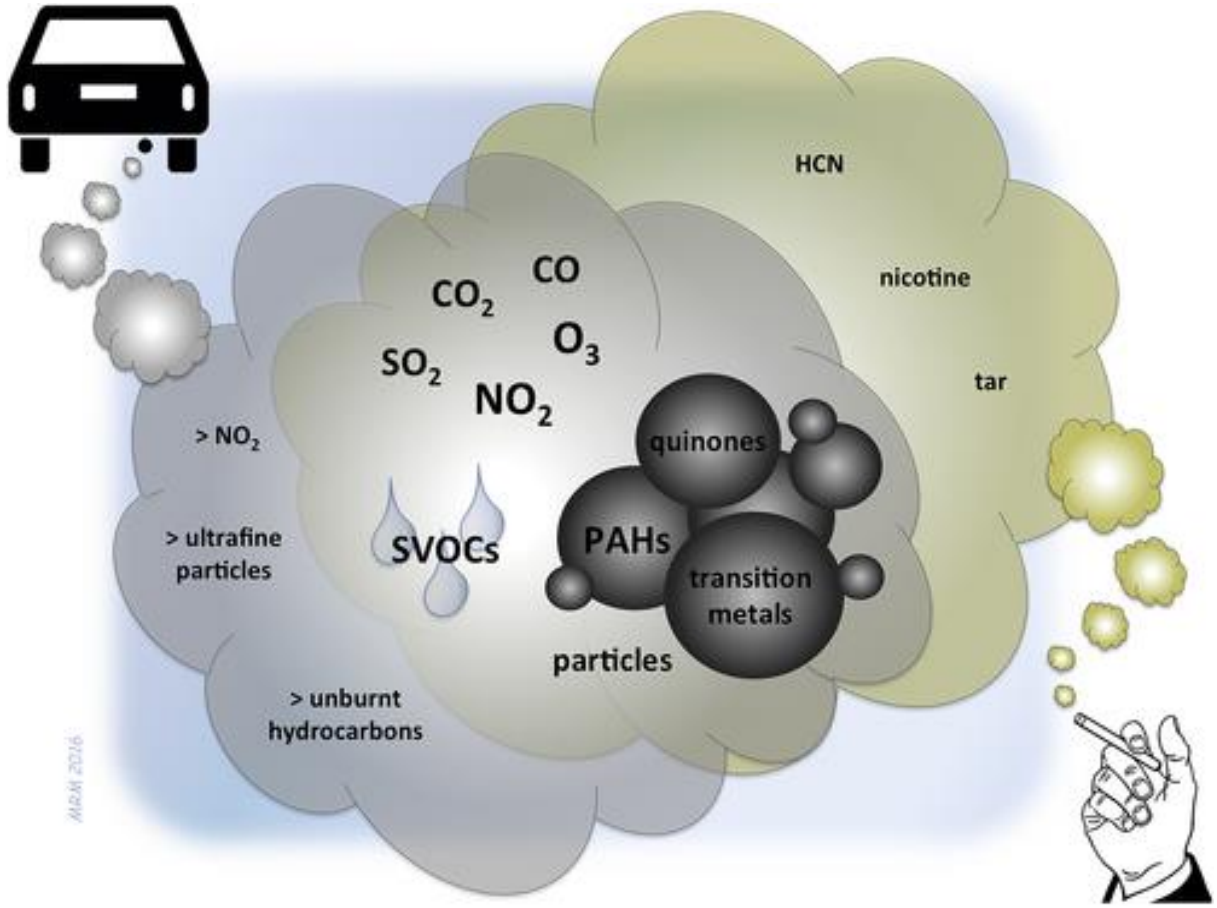


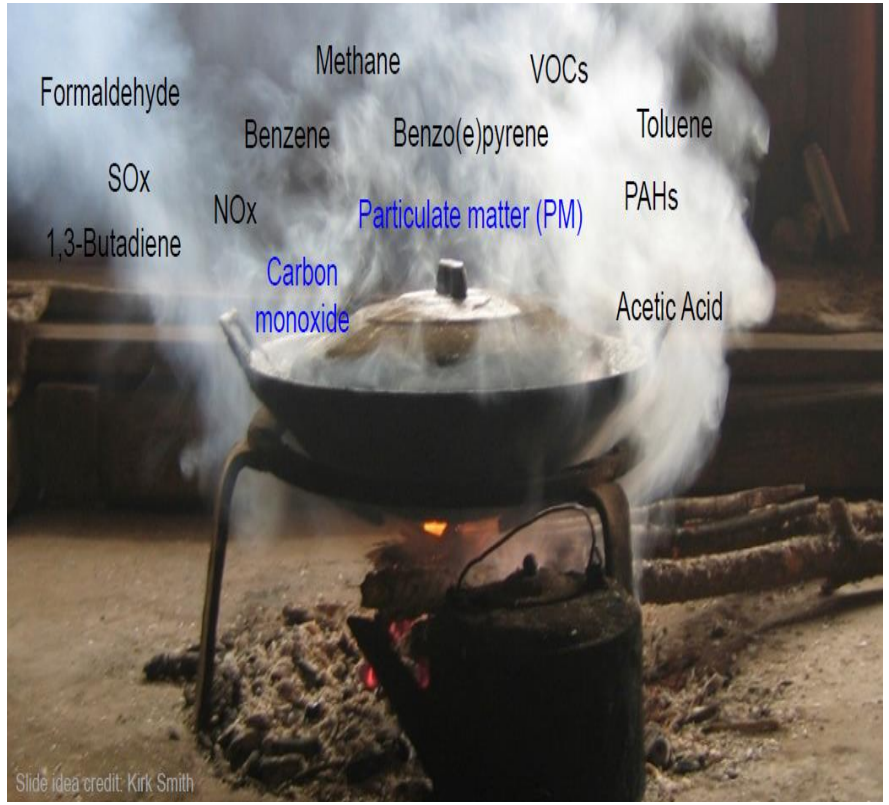




Geographical distribution of the poorest billion with country sizes drawn proportional to the number of people with >5 deprivations

***Lancet*** *Poverty NCDI Commission, 2020*

# Air Pollution- the new tobacco




Bernd Niemann et al. *JACC* 2017; 70:230-251.

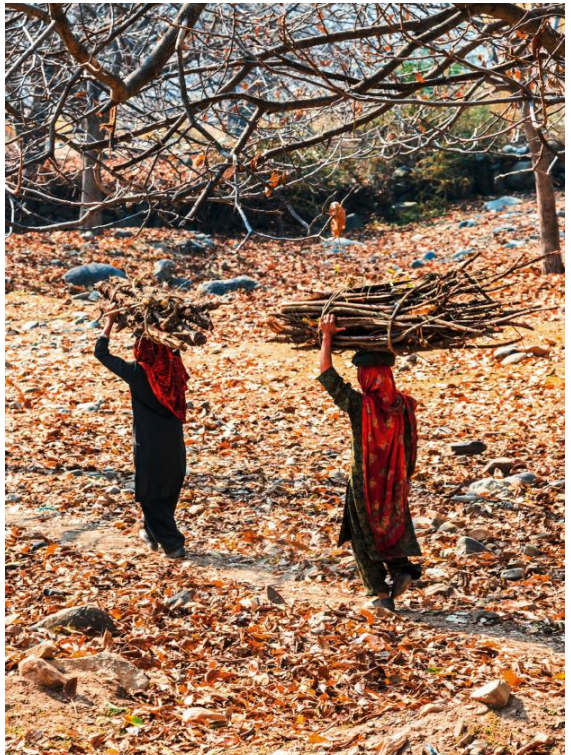
The common enemy –Products of Incomplete Combustion

# The Household Air Pollution (HAP) exposure setting in LMICs is “inequitably and universally unhealthy” exceeding WHO Air Quality Guidelines by several fold

***Photo Courtesy:*** *SRIHER Research Group*

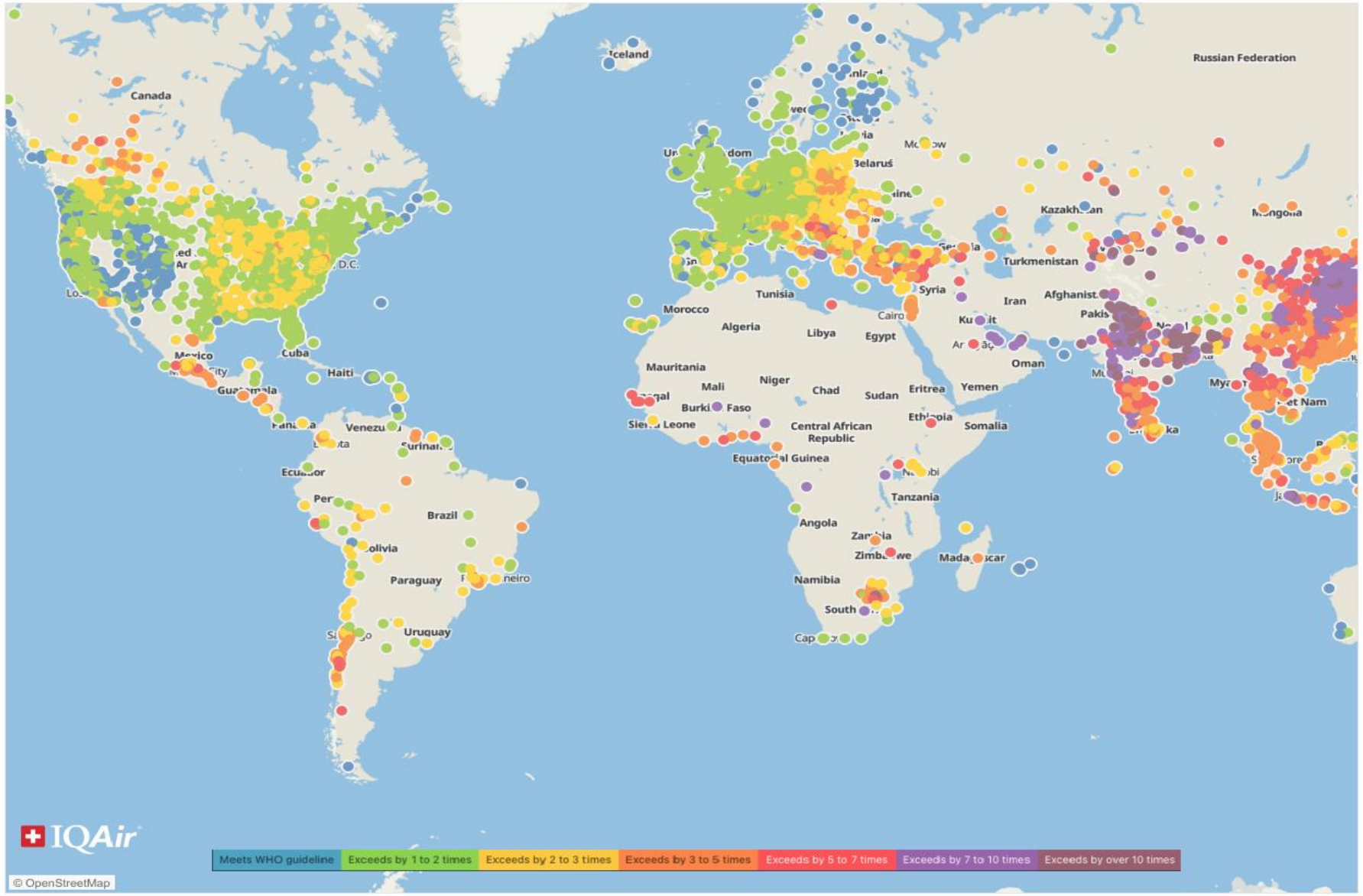
# HAP exacerbates health  inequities that are mostly invisible

- 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.

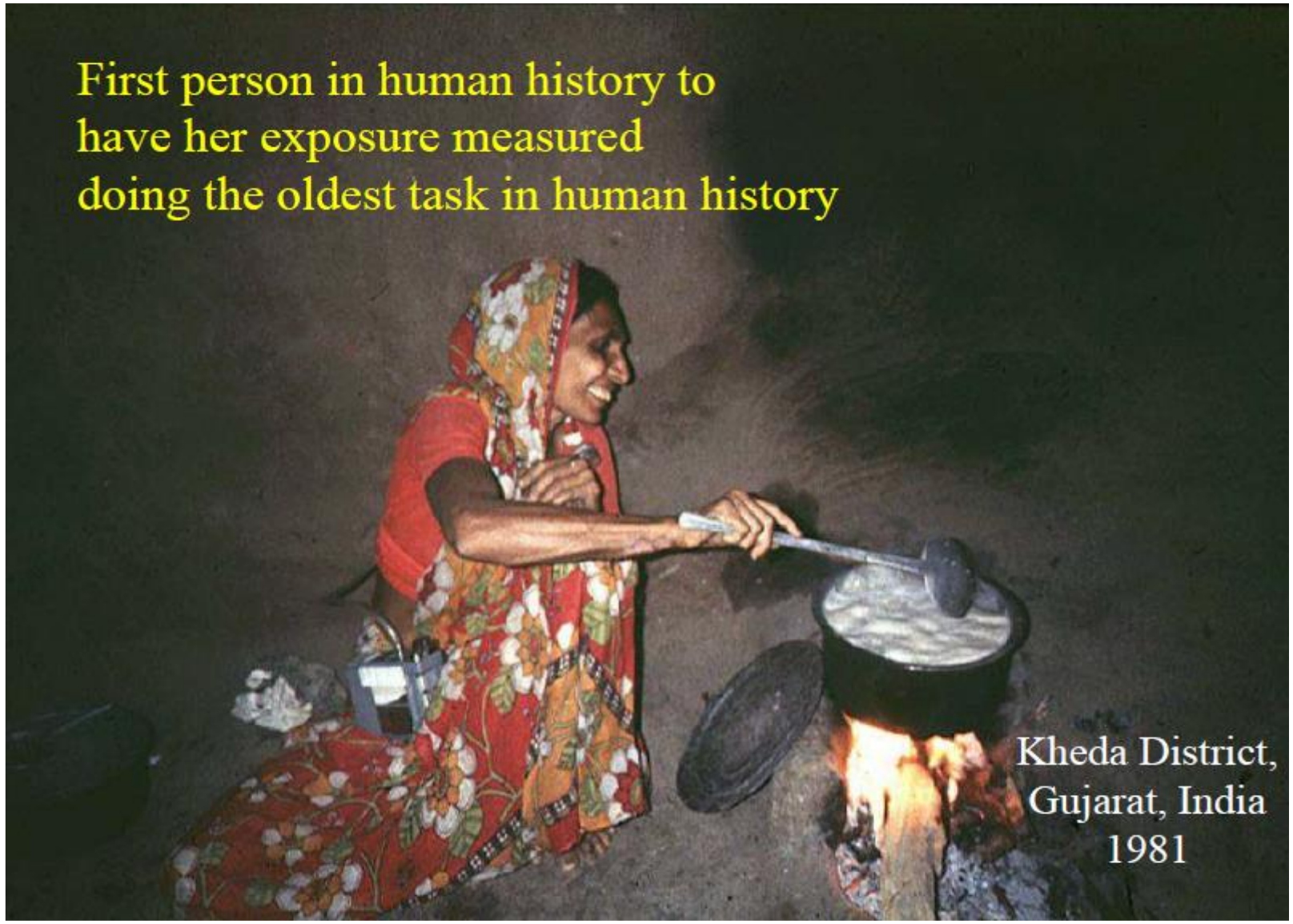


**What did it take for epidemiologists to move the needle on household air pollution actions for >3 billion people at risk?**

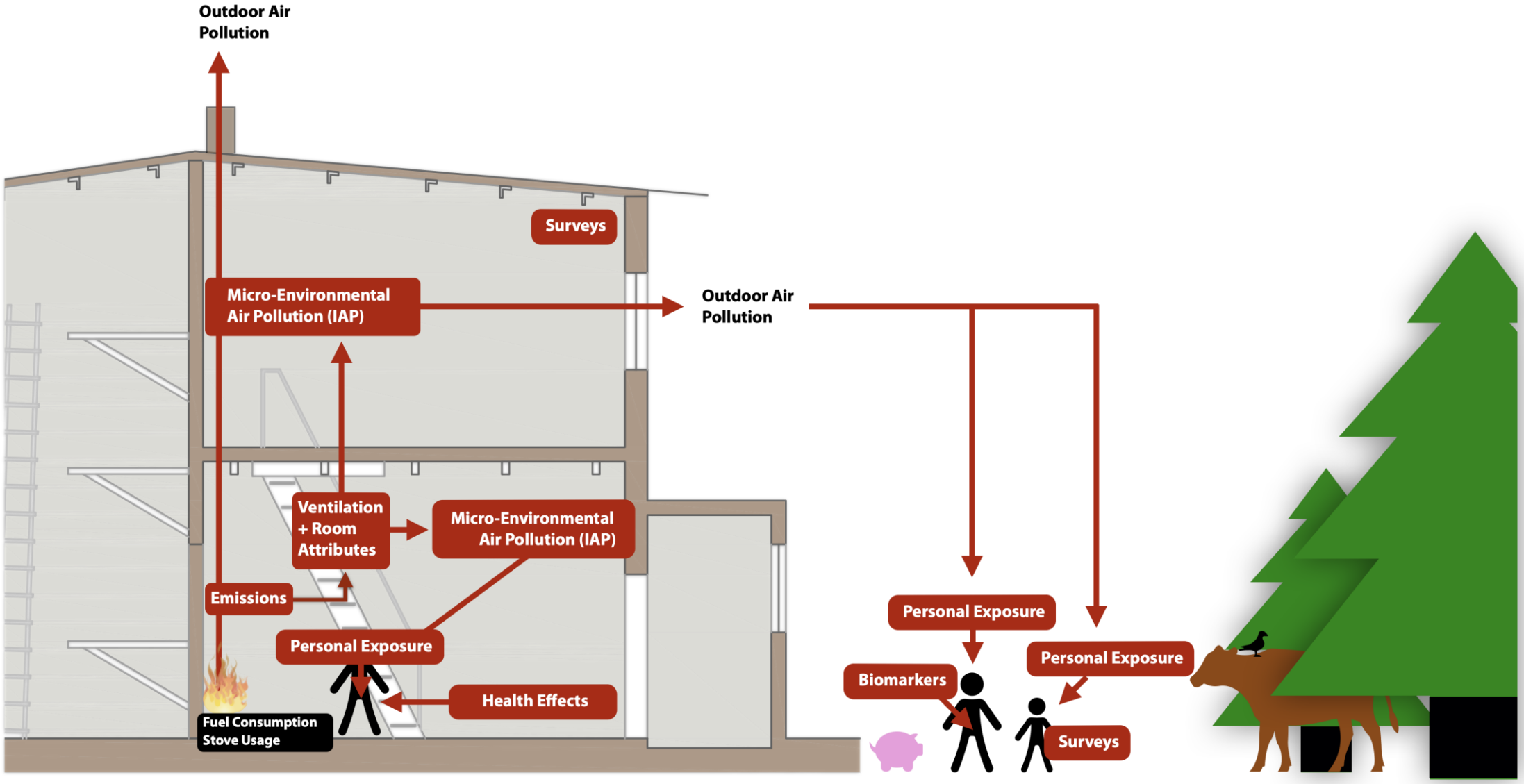
# The Global Ambient Air Pollution(AAP) network




# How could we possibly begin to make a case for HAP in poor rural households without measurements?



# What are we now able to measure in rural households?




*Art Credit: Ajay Pillarisetti, UC Berkeley*

# From carrying to wearing Personal Exposure Monitors…

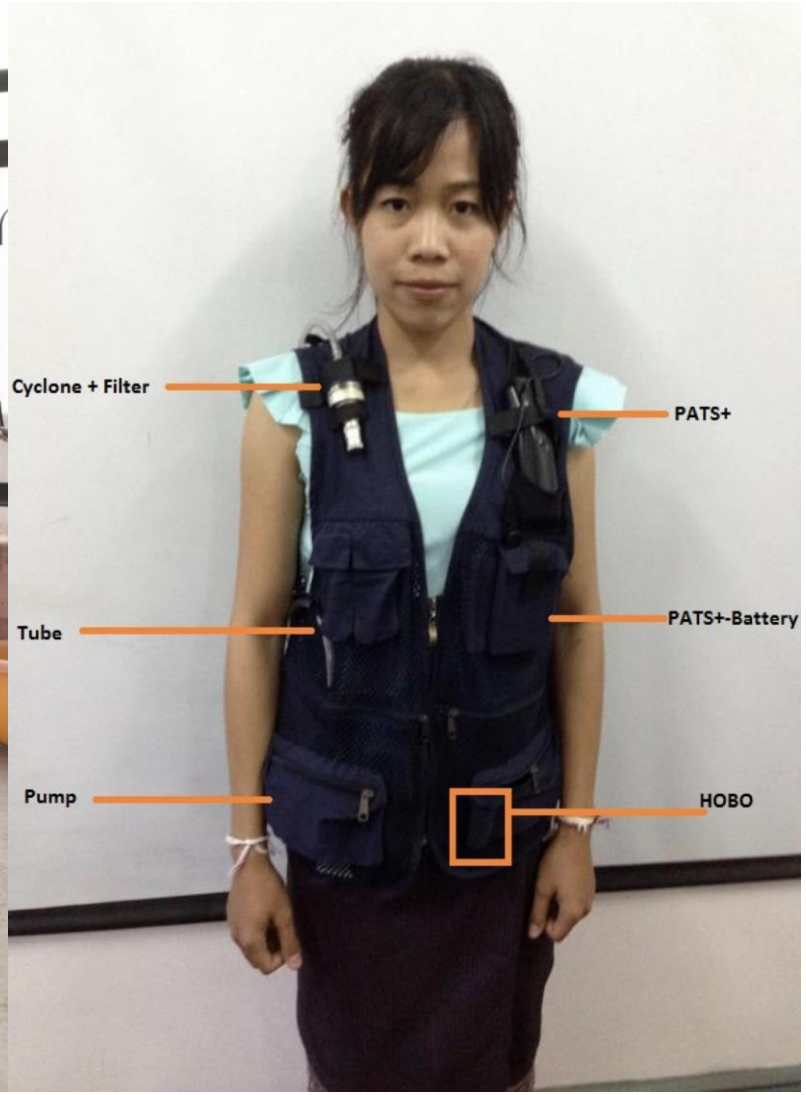
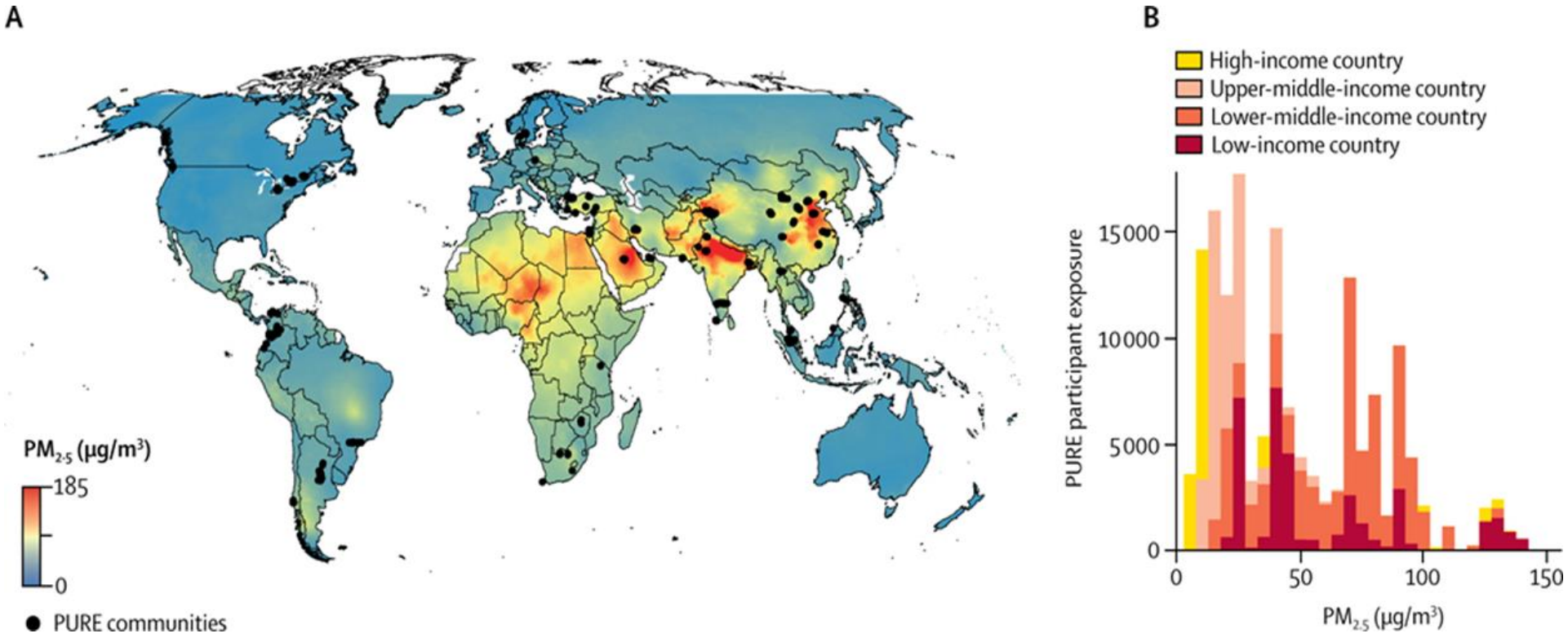




*Photo Credit: Ajay Pillarisetti, UC Berkeley*

# Ambient and HAP Exposure Ranges Overlap in LMICS

- Range of $PM_{2.5}$ exposures in HAP settings (n >70 studies ) **25- 186 µg/m³**

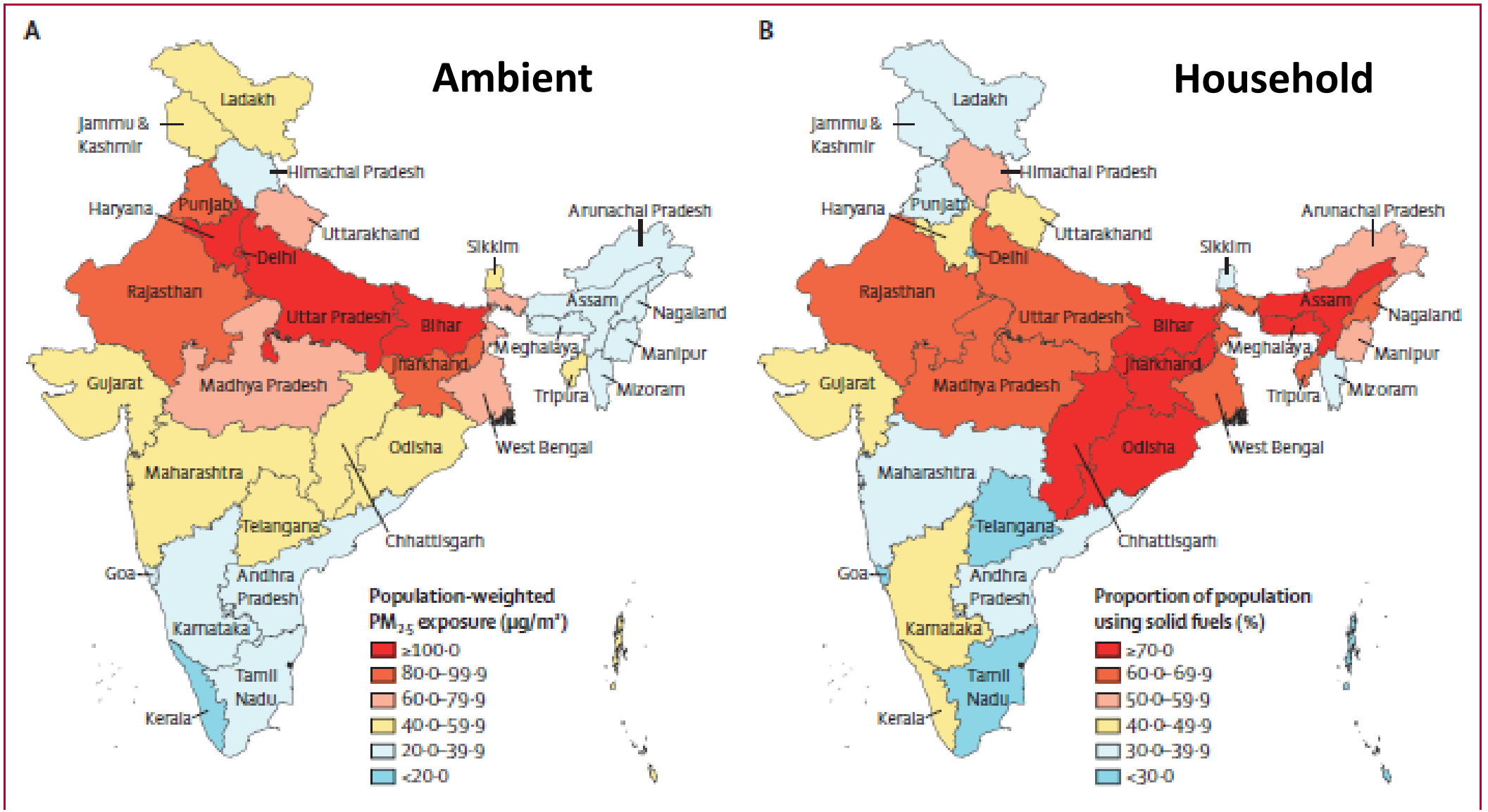
- Range of annual average ambient $PM_{2.5}$ in 500 most polluted cities globally **27- 173 µg/m³**




*Balakrishnan et al 2014*
*Shupler et al 2020,*
*Chilrud et al 2021,*
*Johnson et al 2022,*
*WHO Global Observatory*

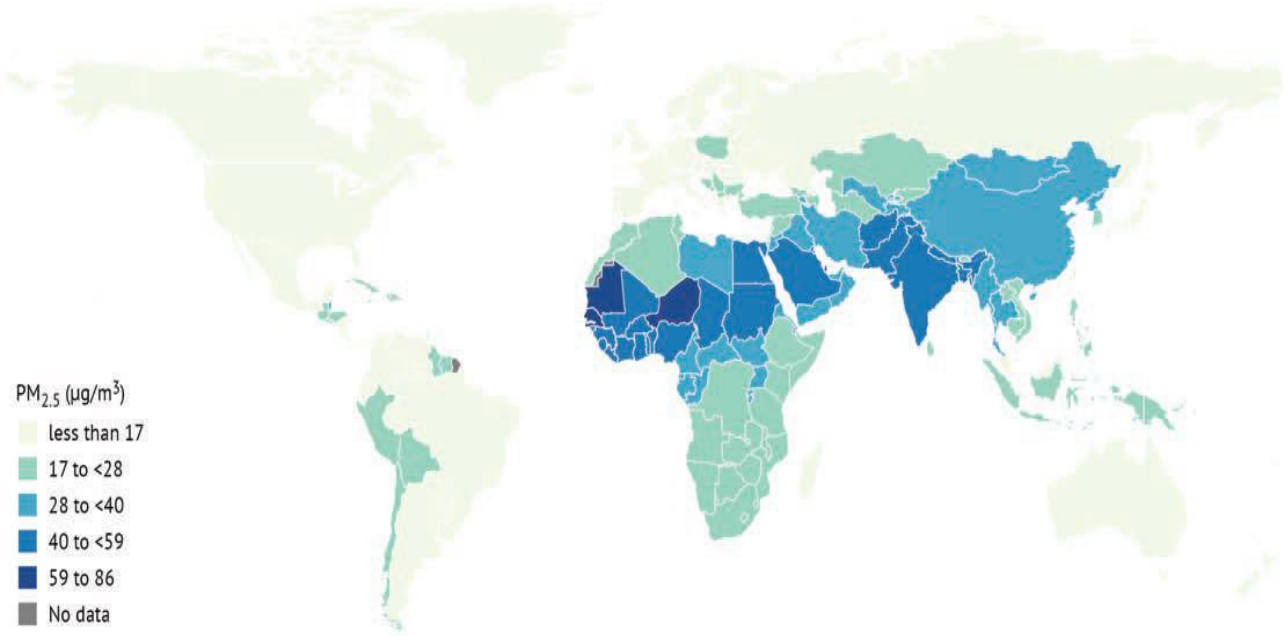
*Hystad et al :* ***Lancet Planet. Health****, 2020*

# Exposures to ambient and household air pollution are seamless and exceed WHO-AQGs in all states in India

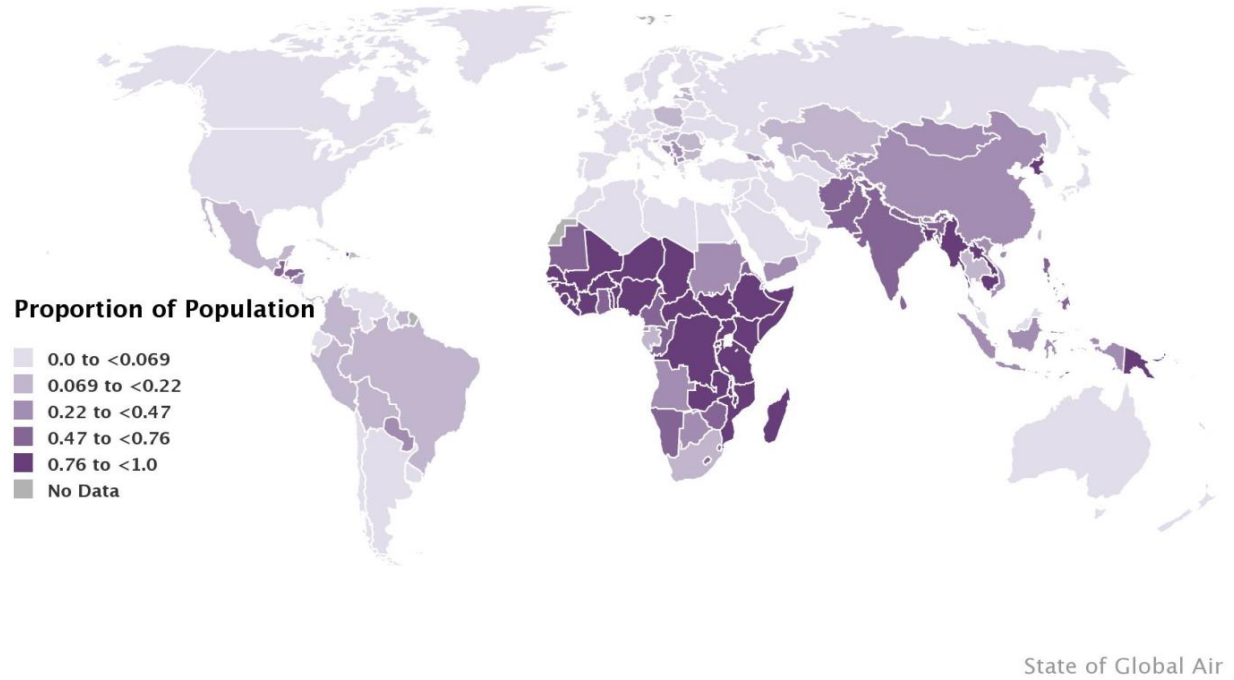



India SLDBI Collaborators ***Lancet 2021***, Balakrishnan et al. ***Lancet Planetary Health*** 2019

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



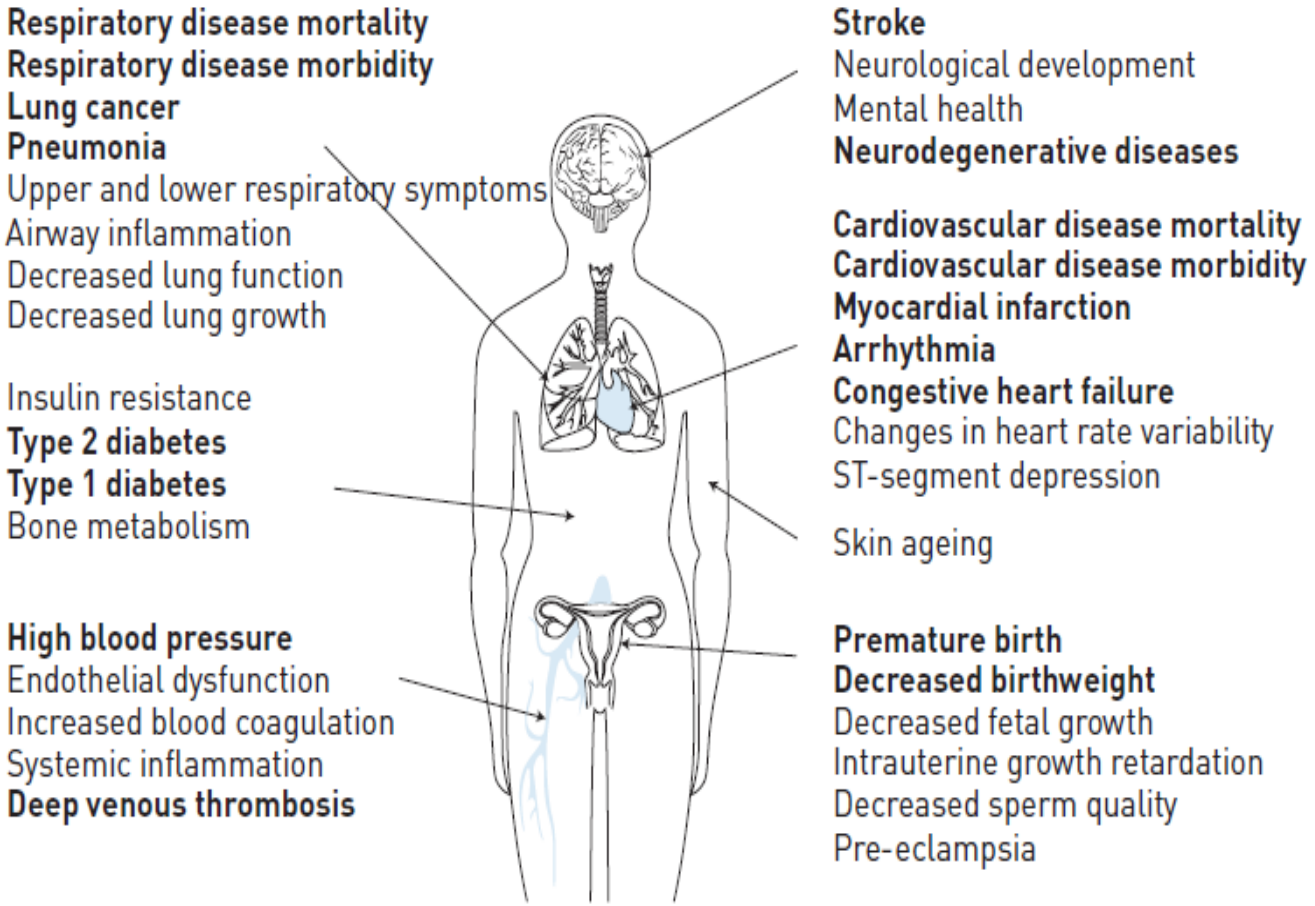

Global map of national population-weighted annual average $PM_{2.5}$ concentrations in 2020




Global map of proportion of population using solid cook-fuels 2020

***Source HEI SOGA Report 2024***

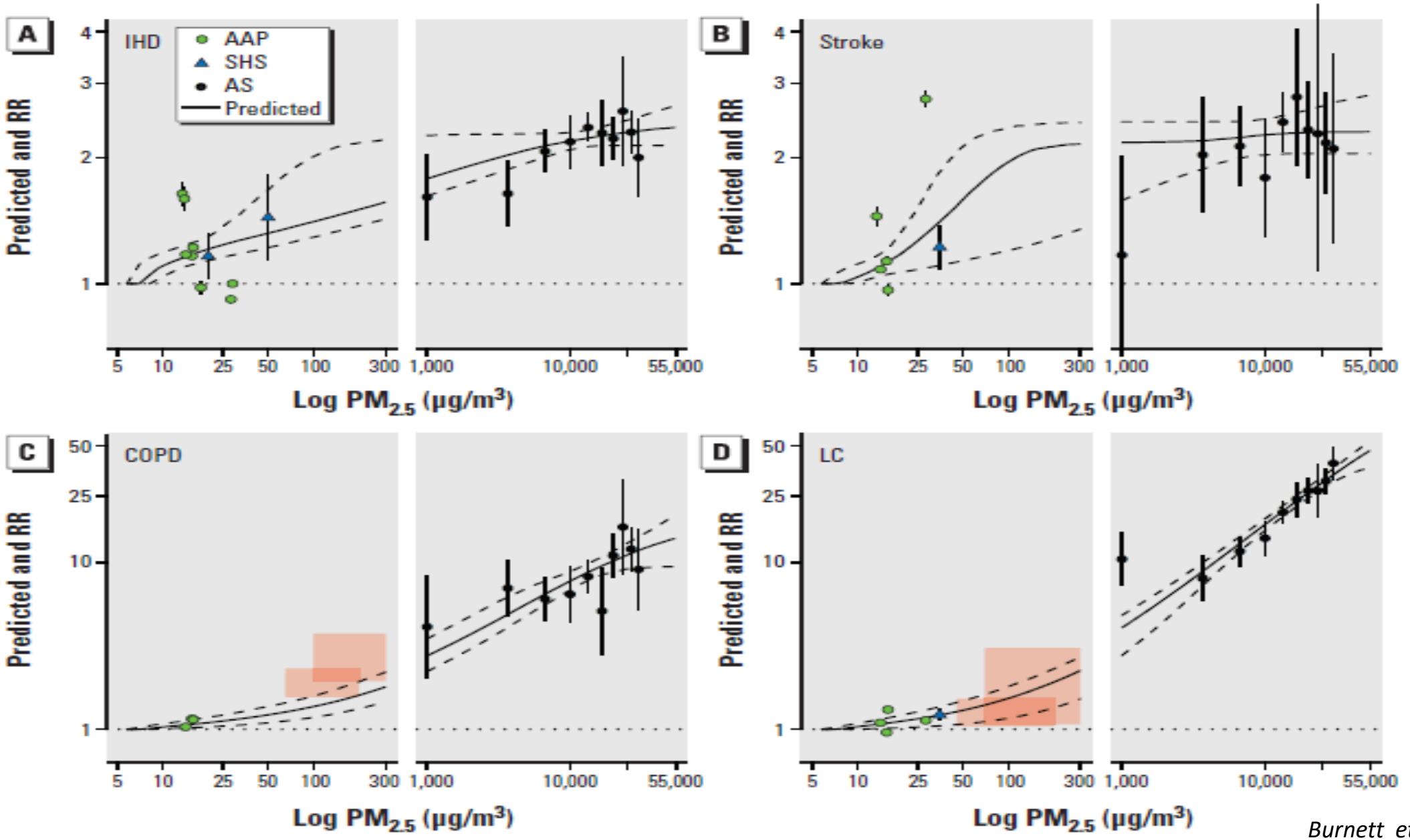
# What constitutes an adverse health effect of air pollution: ERS/ATS statement




**Thurston et al . , Eur Respir J 2017**

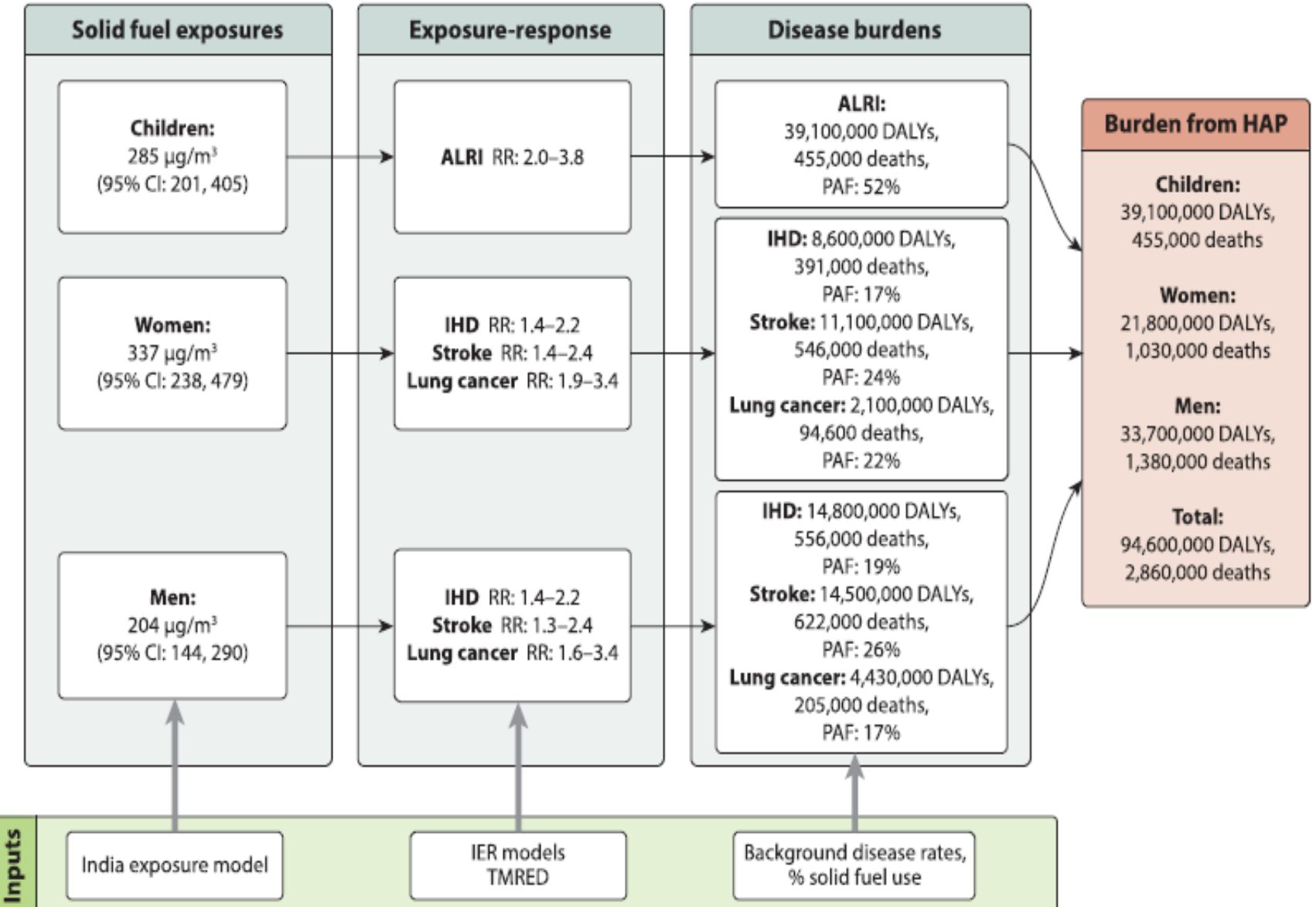

Update of the WHO global air quality guidelines: Systematic reviews – An introduction
Román Pérez Velasco* and Dorota Jarosińska
**(Env. Intl. 2022)**

# Integrated Exposure-Response Curves : Strategic epidemiology to fill evidence gaps in LMICs




*Burnett et al EHP 2014*

# Integrated Exposure-Response Curves : Strategic epidemiology to fill evidence gaps in LMICs




## Millions Dead: How Do We Know and What Does It Mean? Methods Used in the Comparative Risk Assessment of Household Air Pollution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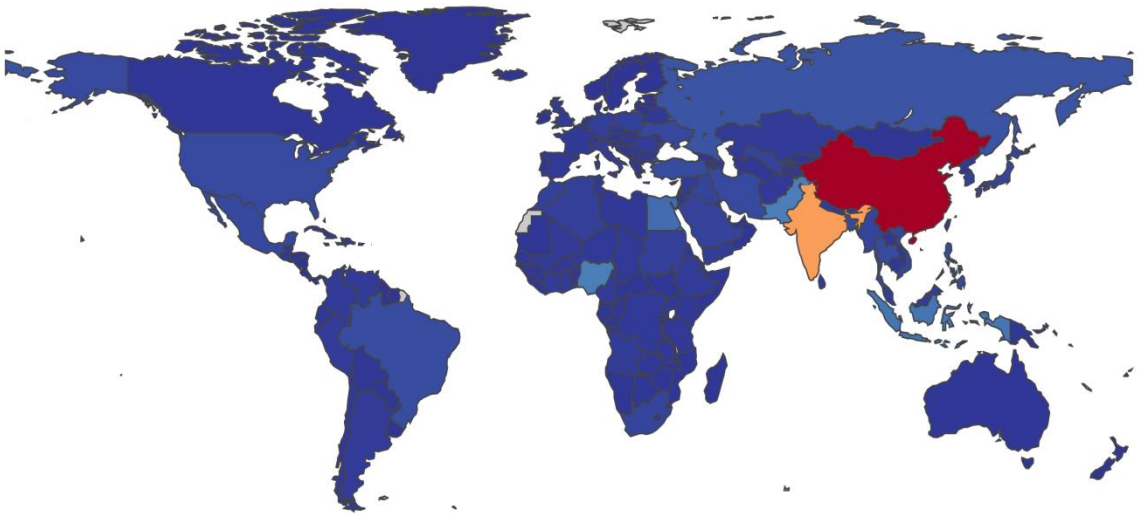
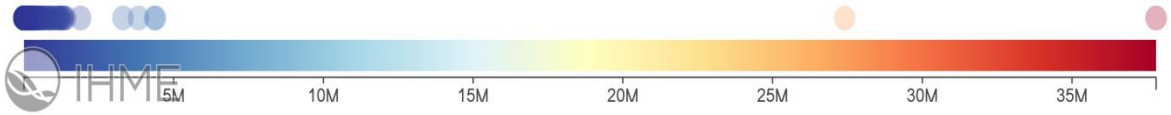
# Air Pollution Attributable Disease Burden (GBD 2021)

Ambient particulate matter pollution
Both sexes, All ages, 2021, DALYs

**4 million deaths**
**120 million DALYs**

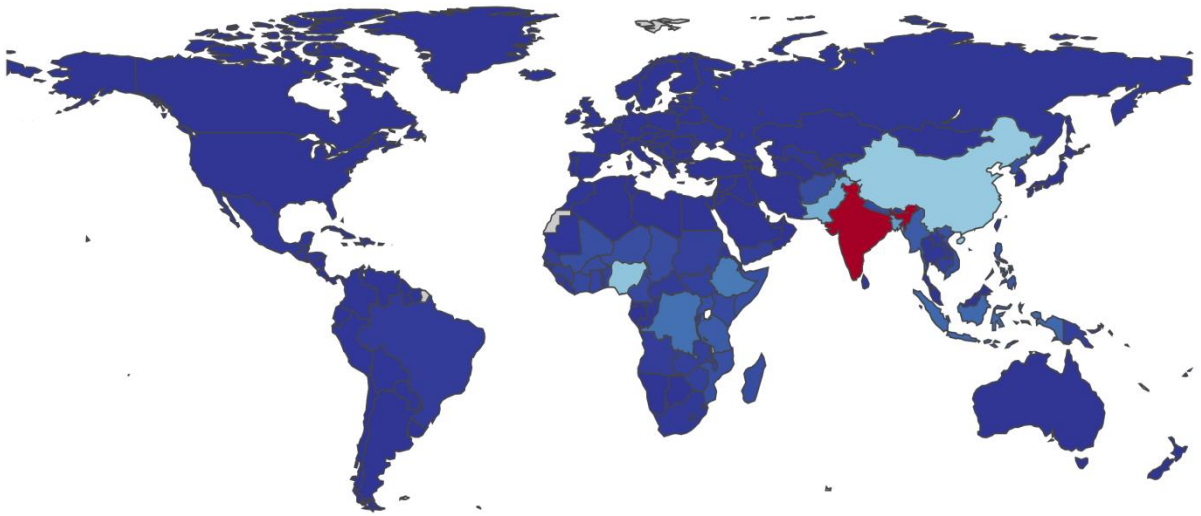


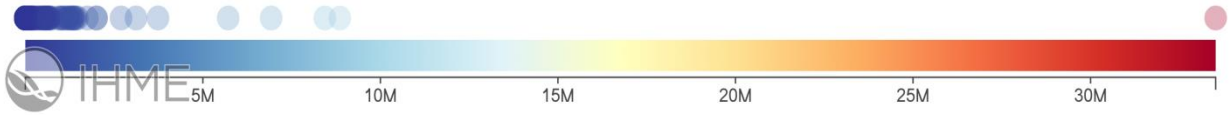



**8. 3 million deaths**
**235 million DALYs**

Household air pollution from solid fuels
Both sexes, All ages, 2021, DALYs

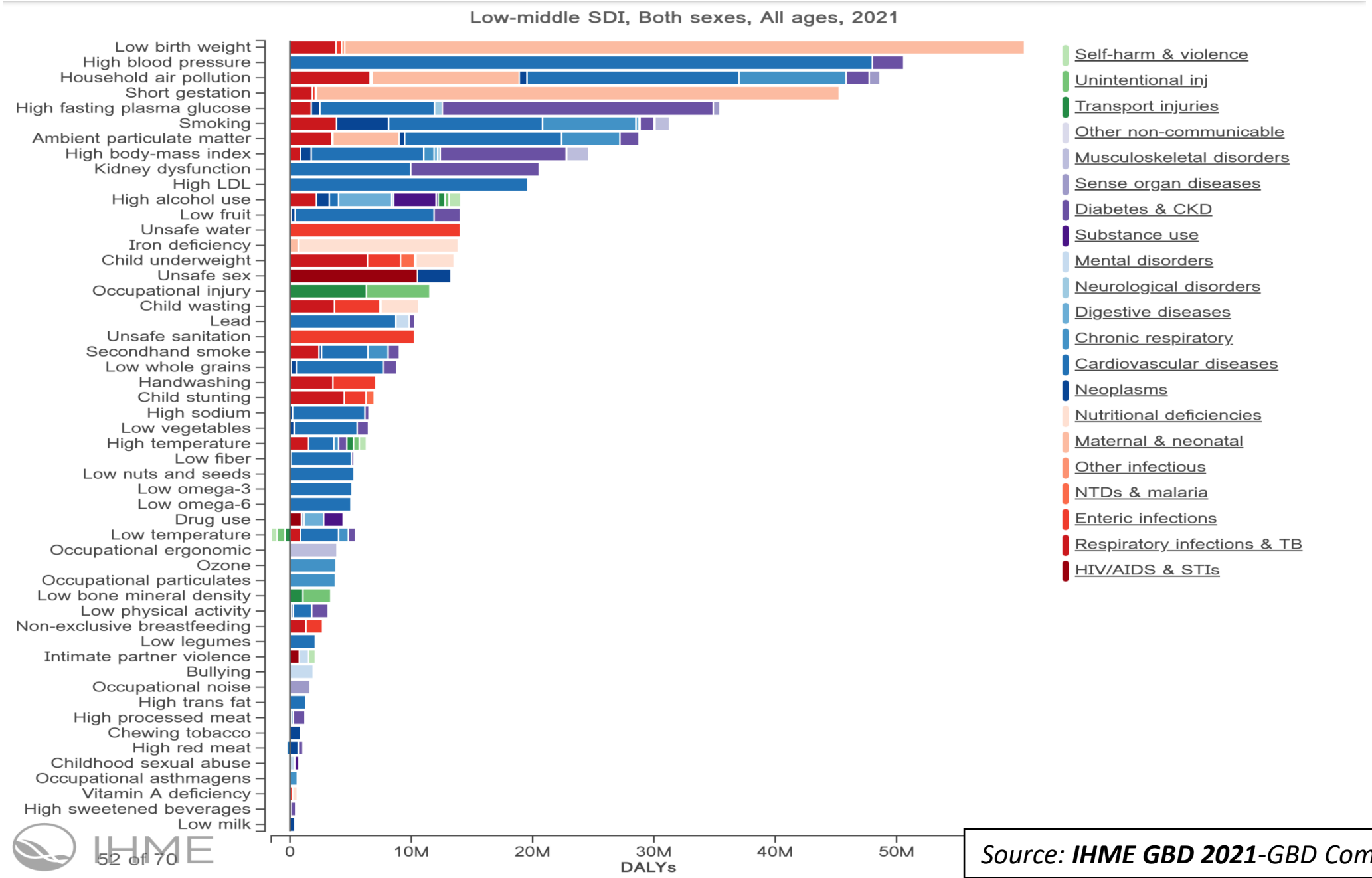
**3.1 million deaths**
**111 million DALYs**






*Source: **IHME GBD 2021**- GBD Compare (2024)*

# Comparative Risk Assessment (GBD 2021)






*Source: **IHME GBD 2021**-GBD Compare (2024)*

# Has the advocacy helped?

# Spurring national and regional actions: National Clean Air Program in India- Clean Air Africa


CLEAN Air Africa

Global Health Research Unit

*Information Sheet on the NIHR CLEAN-Air(Africa) Global Health Research Unit*

**2.1 billion people rely on polluting solid fuels and kerosene for household energy**

**Health**

- Household air pollution kills 3.2 million people each year (237,000 children under 5 years): 32% ischaemic heart disease, 23% stroke, 21% lower respiratory infection, 19% chronic obstructive pulmonary disease, and 6% lung cancer.
- 86 million healthy life years lost each year.
- Evidence that disease burden is greater (low birth weight, tuberculosis, cataracts, nasopharyngeal and laryngeal cancers).

**Deforestation/ climate**

- Firewood and charcoal for cooking and heating responsible for 40% of global wood harvest.
- Cooking with solid fuels and biomass responsible for almost one third of total black carbon emissions and up to 8% of total anthropogenic climate impacts.

**Gender impacts**

- Women and children, typically responsible for household chores including cooking and collecting firewood, bear the greatest health burden from use of polluting fuels.
- Women spend more than 40 hours per month collecting fuel (time poverty). Reliance on solid fuels has detrimental impacts on women's mental health and wellbeing.

## Clean modern energy for all

**Benefiting health, society, environment and climate in sub-Saharan Africa to achieve the 2030 Sustainable Development Goals**

### CLEAN-Air(Africa)

The NIHR CLEAN-Air(Africa) Global Health Research Unit will accelerate the understanding of air pollution related disease burden through a unique set of studies that will:

1. strengthen national health systems for community health prevention of HAP related disease and,
2. provide evidence-based recommendations for population transition to clean household and institutional energy.

### CLEAN-Air(Africa)'s Aims

**Aim 1:** To facilitate transition for vulnerable communities and public institutions to clean cooking

**Aim 2:** To evaluate and quantify chronic and hidden health burdens from polluting fuel use that can be addressed through clean cooking

**Aim 3:** To advocate for disease prevention from reductions in air pollution through health systems strengthening

**Aim 4:** To develop a sub-Saharan African Air Pollution Centre of Excellence (training and air quality monitoring)

**Aim 5:** Maximising impact through community and stakeholder engagement

### Why focus on sub-Saharan Africa?

**More than 920 million people** (79% of the region) rely on polluting fuels in Sub-Saharan Africa (SSA)- the highest dependence worldwide. This number continues to climb.

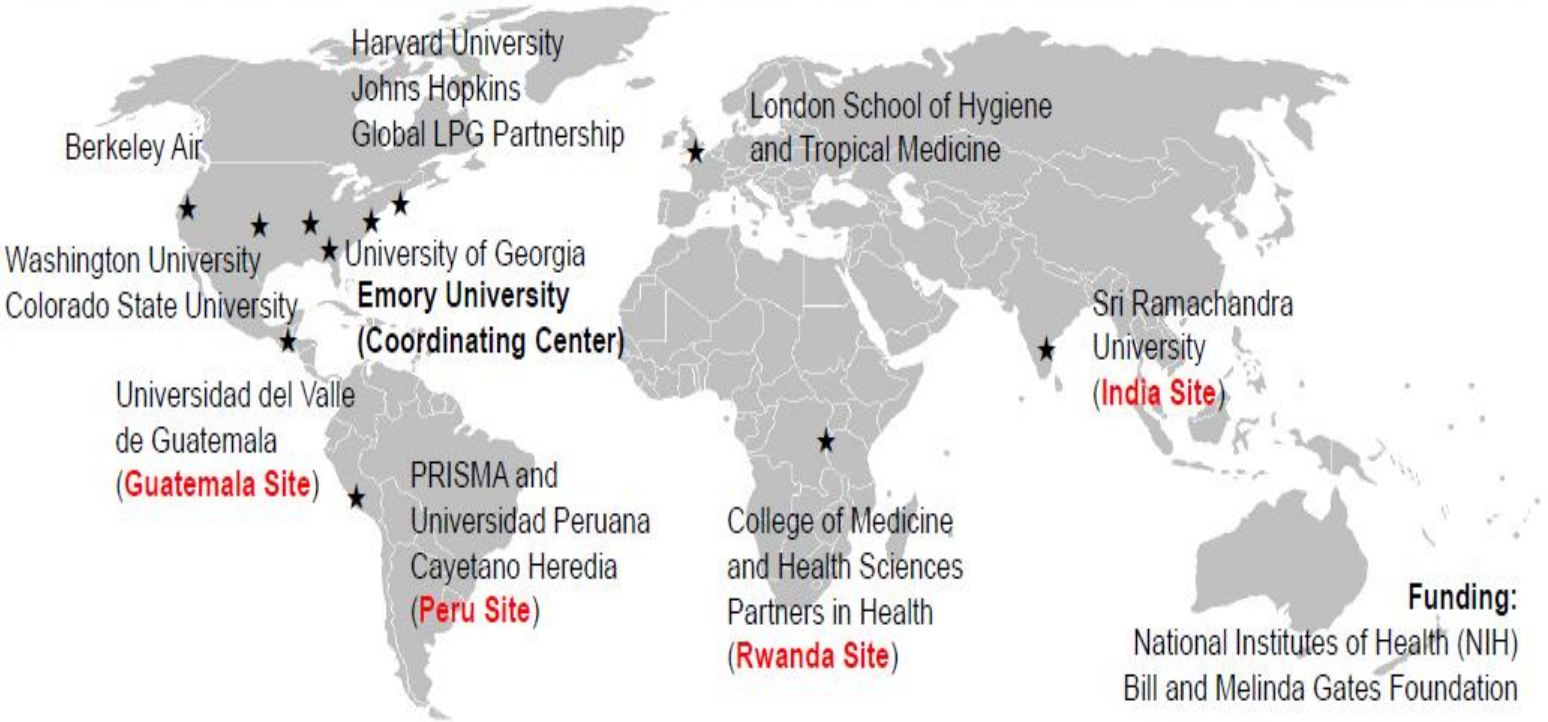
**683,984 deaths each year** (8.9% of total mortality) in SSA, more than deaths from malaria and HIV/AIDS.

**38 million healthy life years lost** each year (7.5% of total burden of disease).

**50% of forest degradation** in SSA from gathering wood for cooking and charcoal production.

# Spurring Global Heath Research

## The Household Air Pollution Intervention Network (HAPIN)

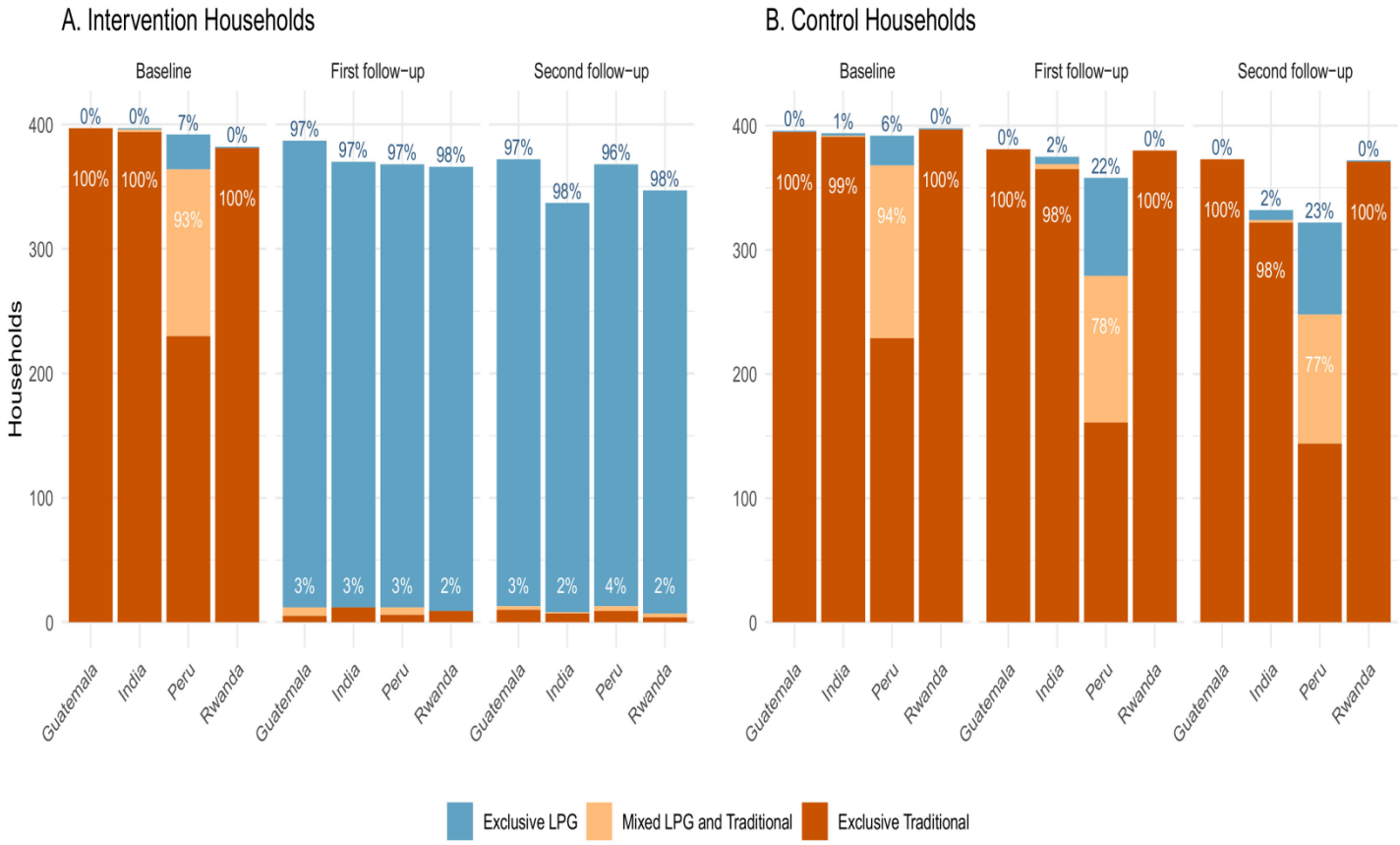


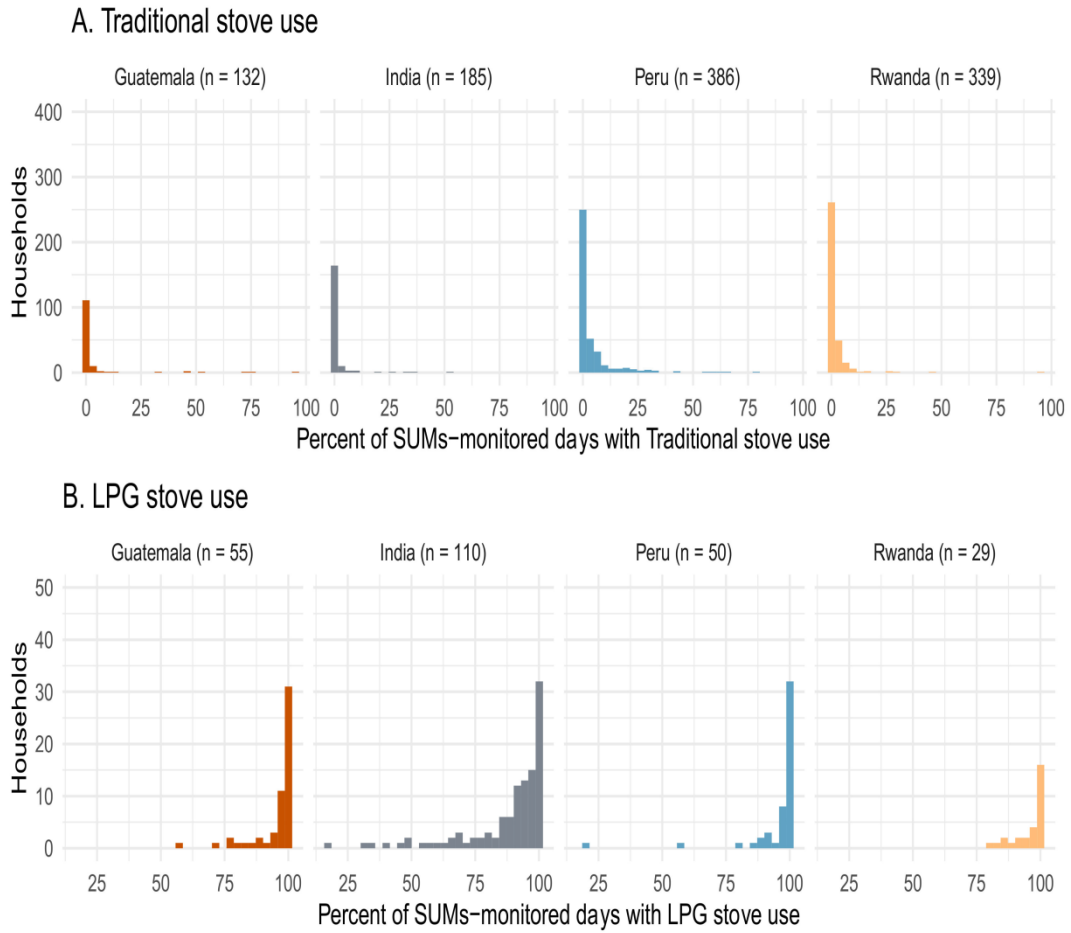

**Funding:**
National Institutes of Health (NIH)
Bill and Melinda Gates Foundation

**LPG intervention** → Birth weight
Child severe pneumonia
Child linear growth/stunting
Adult blood pressure

Ambient PM:
E-Sampler
and Purple
Air monitors

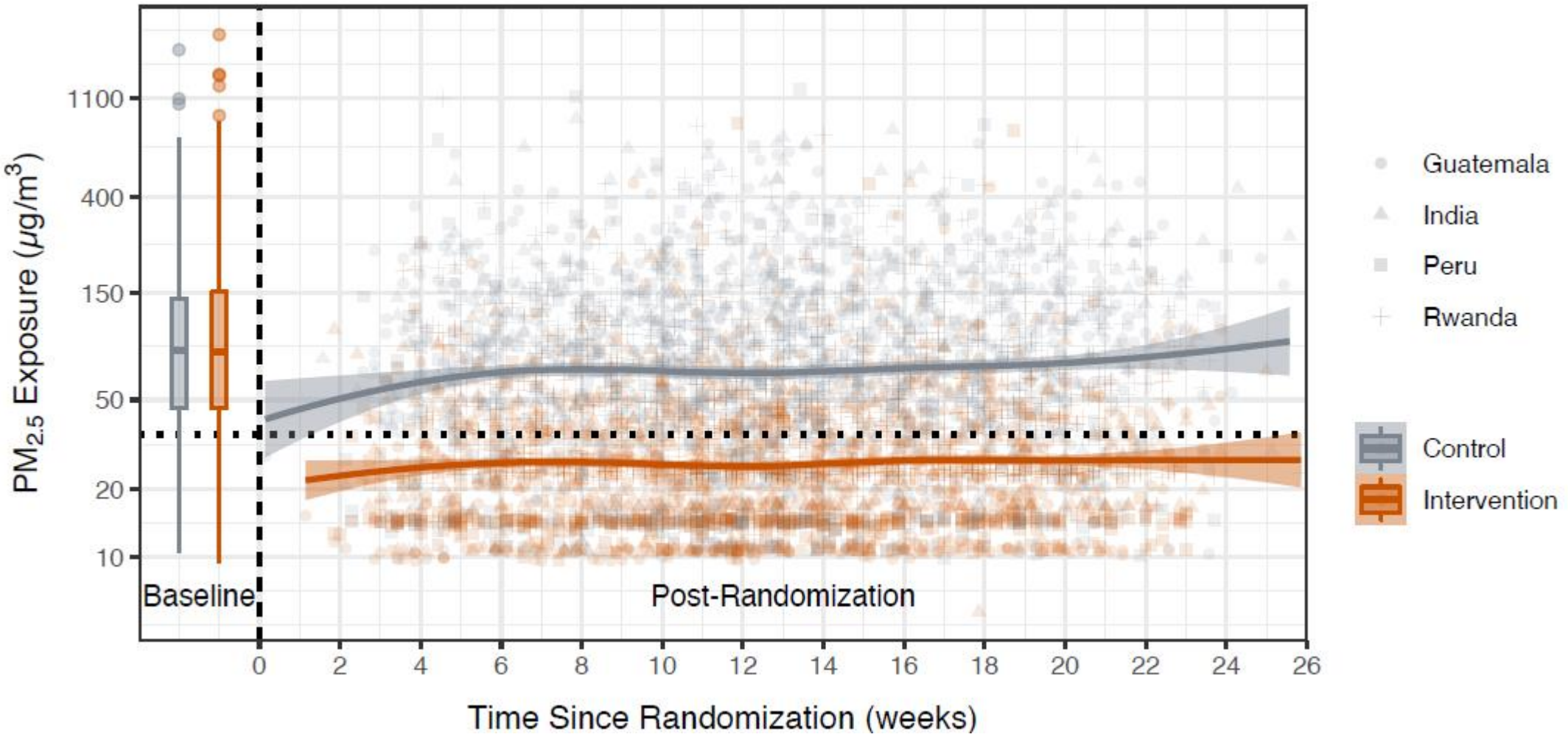
# Intervention assessment in the HAPIN Trial: Fidelity and Adherence




*Quinn et al IJERPH 2022*

# Intervention assessment in the HAPIN Trial: WHO-ITG attainment via exclusive LPG Use

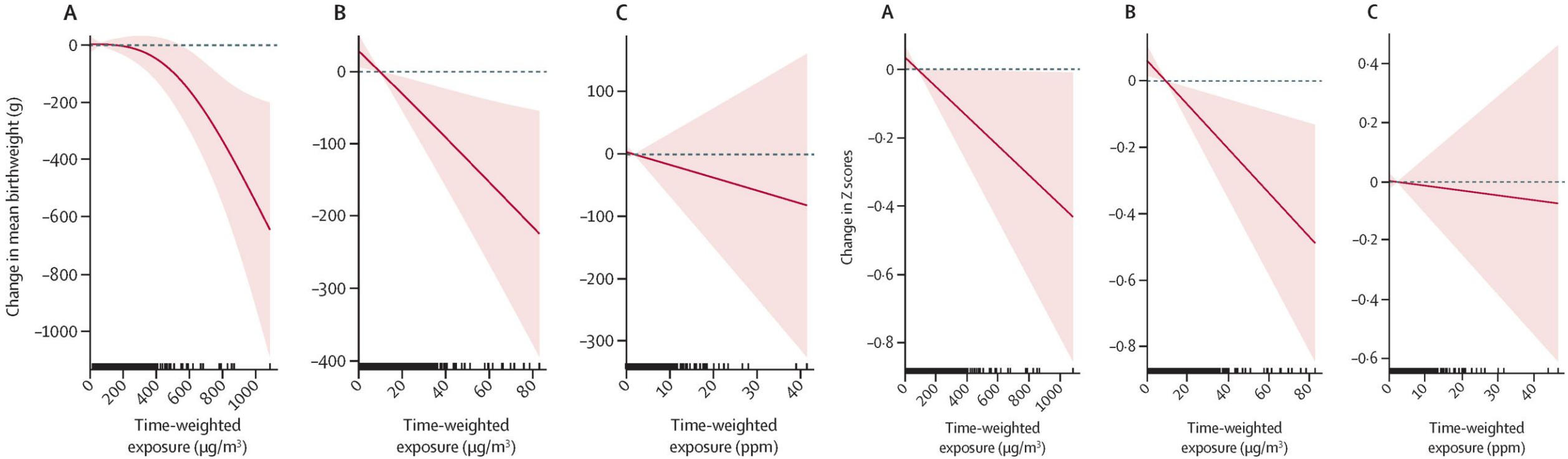



*Johnson et al EHP 2022*

# Summary of Exposure-Response Assessments in HAP Clinical Trials

| Country-Intervention | Pollutants | Outcomes |
|---|---|---|
| Guatemala (RESPIRE)-ICS | CO (P) | Child Pneumonia |
| Nigeria-Ethanol | CO(P); PM (P) | Birth weight, IUGR |
| Nepal-ICS, LPG | PM (K) | Adverse pregnancy outcomes, ALRI |
| Ghana (GRAPHS)-ICS, LPG | CO(P) | Birthweight, Child Pneumonia |
| Honduras | PM(K),PM(P) | BP, Biomarkers |
| Malawi (CAPS) | CO(P) | Child Pneumonia |
| Rwanda-ICS | PM (P), CO(P) | ARI |
| Peru (CHAP) | PM (P),CO(P),BC(P) | BP, PEF, Respiratory Symptoms |
| Guatemala, India, Peru, Rwanda (HAPIN) | PM (P),CO(P),BC(P) | Birthweight, Child Linear Growth, Child Pneumonia, Adult BP |
| Bangladesh (CHanGE) | PM (P) | Perinatal mortality |

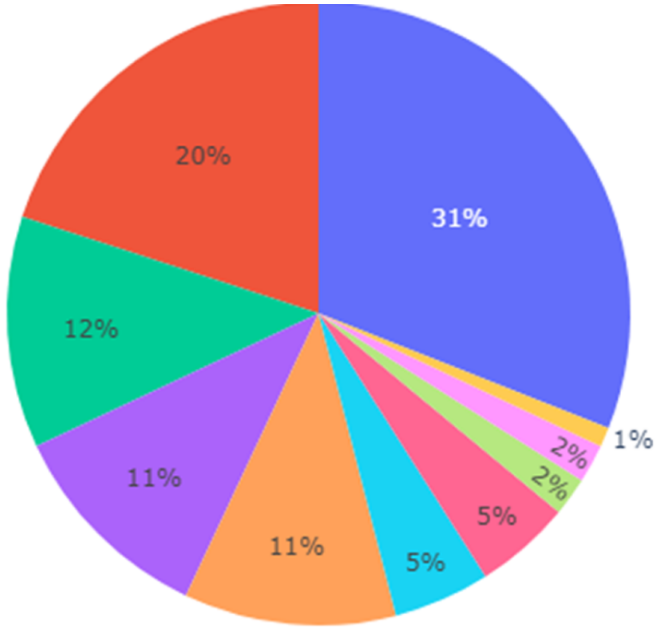
# Household air pollution and birthweight- Results from the HAPIN Trial



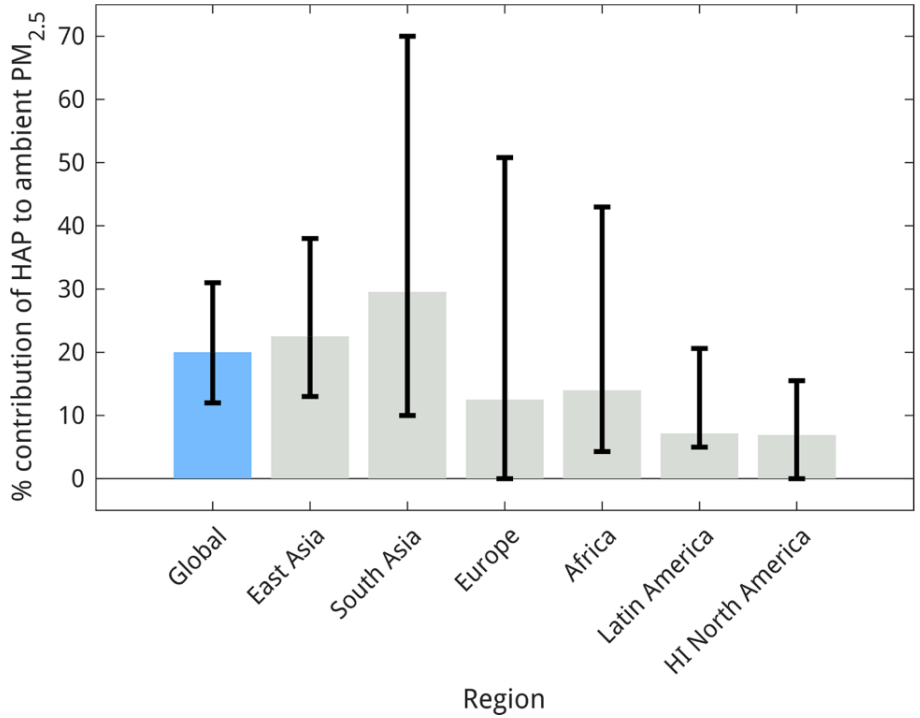

Balakrishnan et al. , ***Lancet Planetary Health*** 2023

# Integrating the AAP-HAP Continuum: HAP is the single largest contributor to AAP globally

- HAP is a dominant source of ambient fine particulate matter (PM2.5) globally — regardless of variations in model types, configurations, and emission inventories used — that contributes approximately 20 % of total global PM2.5 exposure.
- There are large regional variations: in South Asia, HAP contributes ~ 30 % of ambient PM2.5, while in high-income North America the fraction is ~ 7 %.

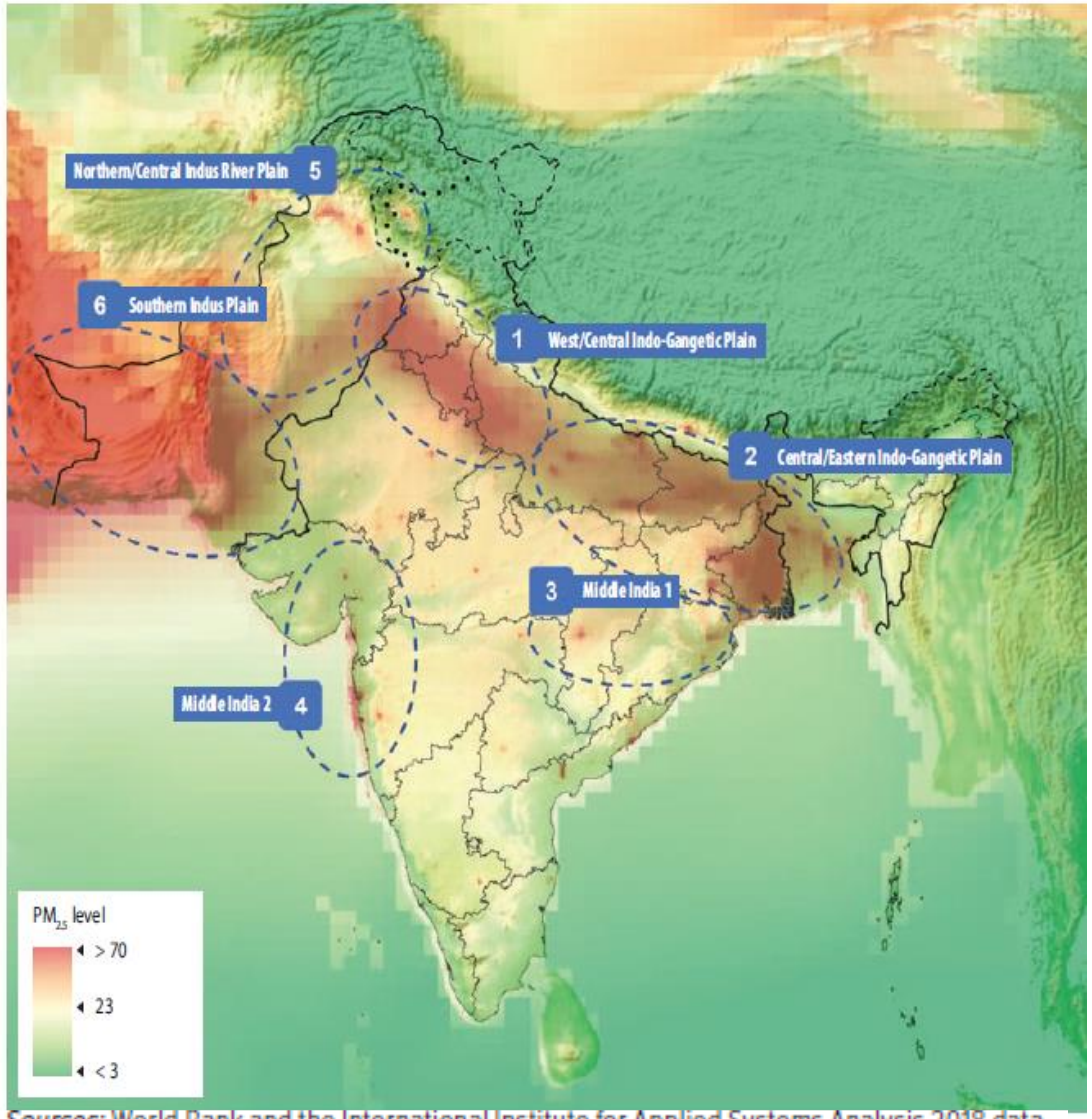







Chowdhury et al ***Environment International 2023***

# Striving for clean air in South Asia- World Bank Assessment



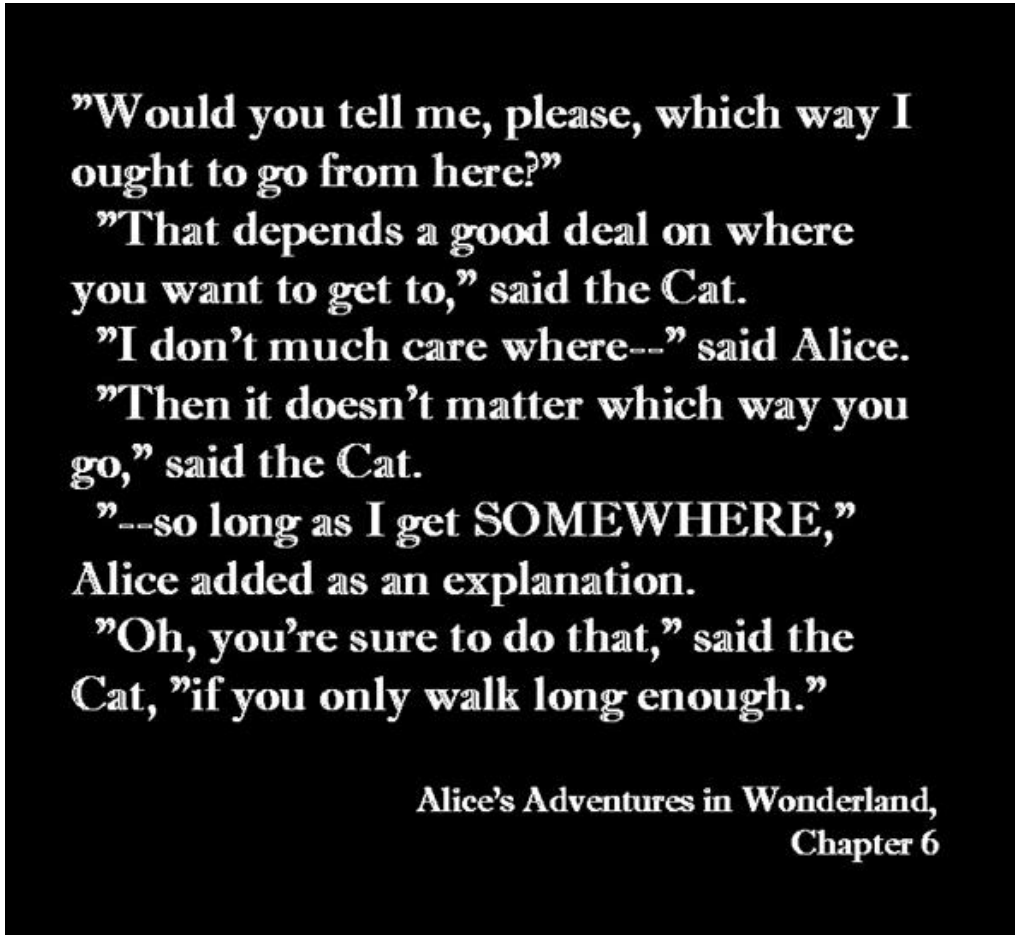

*Sources:* World Bank and the International Institute for Applied Systems Analysis 2018 data.
*Note:* Fine particulate concentrations ($PM_{2.5}$) are in micrograms per cubic meter ($\mu g/m^3$).

Air pollution travels long distances in South Asia and gets trapped in large "airsheds" that are shaped by climatology and geography.

Current policy measures will only be partially successful in reducing $PM_{2.5}$ concentrations across South Asia even if fully implemented. The focus of policy makers should expand into other sectors, particularly small manufacturing, agriculture, **residential cooking**, and waste management.

At any given location, $PM_{2.5}$ in ambient air originates from a wide range of upwind sources extending over several hundred kilometers. The most cost-effective scenario, which calls for full coordination between airsheds, would cut the average exposure of $PM_{2.5}$ in South Asia to **30 $\mu g/m^3$ at a cost of $278 million per $\mu g/m^3$** of reduced exposure, and save more than 750,000 lives annually.

# Can epidemiologists enable the vulnerable to get out of the rabbit hole??




**Grateful Acknowledgements**

**(Late) Professor. Kirk R Smith, UC Berkeley**

Sankar Sambandam, Gurusamy Thangavel, Krishnendu Mukhopadhyay, Naveen Puttaswamy (SRIHER)
Sreekanth Vakacherla (EDF), Sagnik Dey (IIT-Delhi), Santu Ghosh (SJRI), Chandra Venkatraman (IIT-Mumbai)
Ajay Pillarisetti, (UC Berkeley), Michael Johnson (Berkeley Air), Suresh Dhaniyala (Clarkson University)

# Part II: Is there a need for continued advocacy?

# What is in favor of LPG for HAP in LMICs?

1. There is a surplus of LPG globally
2. The main barrier is affordability and not accessibility or acceptability
3. Subsidies for LPG (based on level of poverty) have been successfully piloted at scale but need to be augmented
4. Halving the price via targeted subsidies will already enable half the HAP exposed population (1 plus billion) to transition to clean household energy and yet will cause no significant changes in health expenditures/developmental assistance
5. Switching from biomass to LPG is not against climate actions and will not impact current sustainable development trajectories
6. Electricity is powered mostly by coal in the most populous countries in South Asia
7. You can’t wish HAP away . Concerted efforts are needed by many stake holders including epidemiologists.

# Healthy breathing spaces for the vulnerable: Impractical dream or feasible reality?