



Image by Michael Foley. (CC BY-NC-ND 4.0)

Household Air Pollution and Health in LMIC

Presented by:

Sara Adar, Sc.D.
Department of Epidemiology
University of Michigan

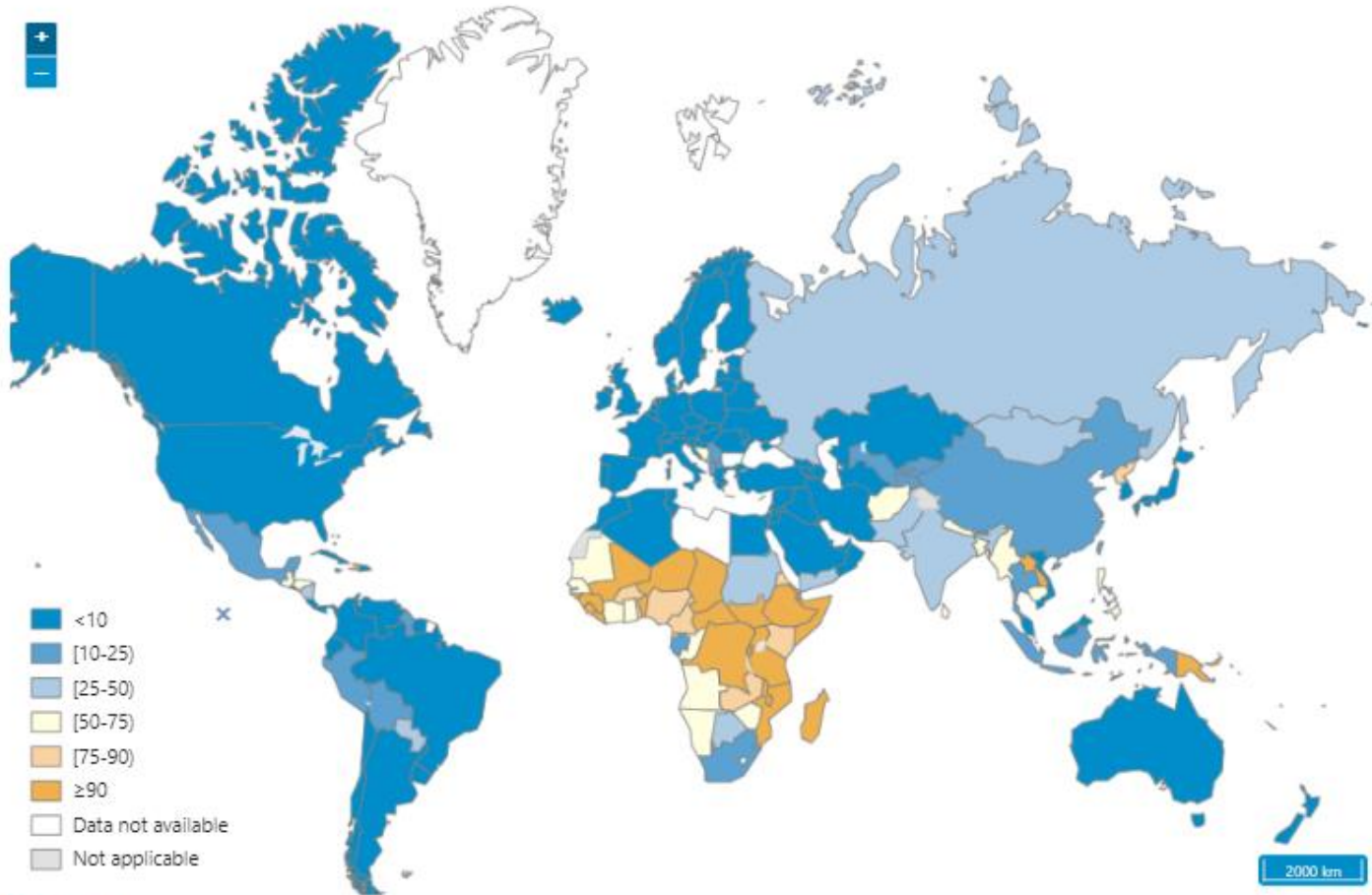
September 8, 2023

Overview

- ◆ Use of biomass fuel in LMIC
- ◆ Household air pollution and its health burdens
- ◆ Interventions to reduce household air pollution
- ◆ Global implications of findings
- ◆ Potential next steps

Biomass Fuel Around the World

Proportion of population with primary reliance on polluting fuels and technologies for cooking (%)



Disclaimer

The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of WHO concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.



World Health Organization

© WHO 2023. All rights reserved.

- ◆ Approximately 3 billion people use biomass fuels as energy source for cooking and heating
- ◆ Use is almost exclusively in LMIC



Household air pollution (HAP) is a complex mixture including: Carbon monoxide, fine particulate matter (PM_{2.5}), polycyclic aromatic hydrocarbons (PAHs), formaldehyde, benzene, volatile organic carbons, nitrogen dioxide, sulfur dioxide



Put into Context

- ◆ A wood-fired three-stone stove produces roughly the same amount of smoke as
 - ◆ 400 cigarettes in an hour
 - ◆ 20 diesel trucks, each driving 30,000 miles in one year

(Smith and Pillarisetti 2017)

Pollution Impacts Health

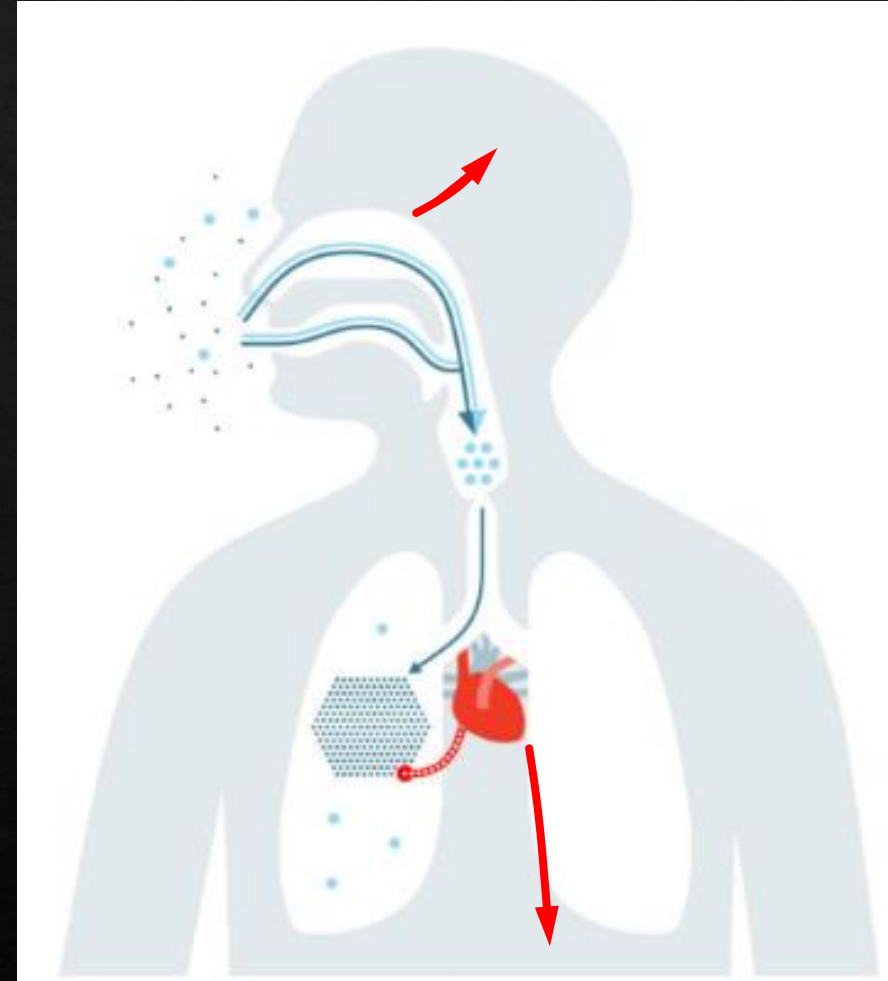


Photo by Neil de Souza on Unsplash

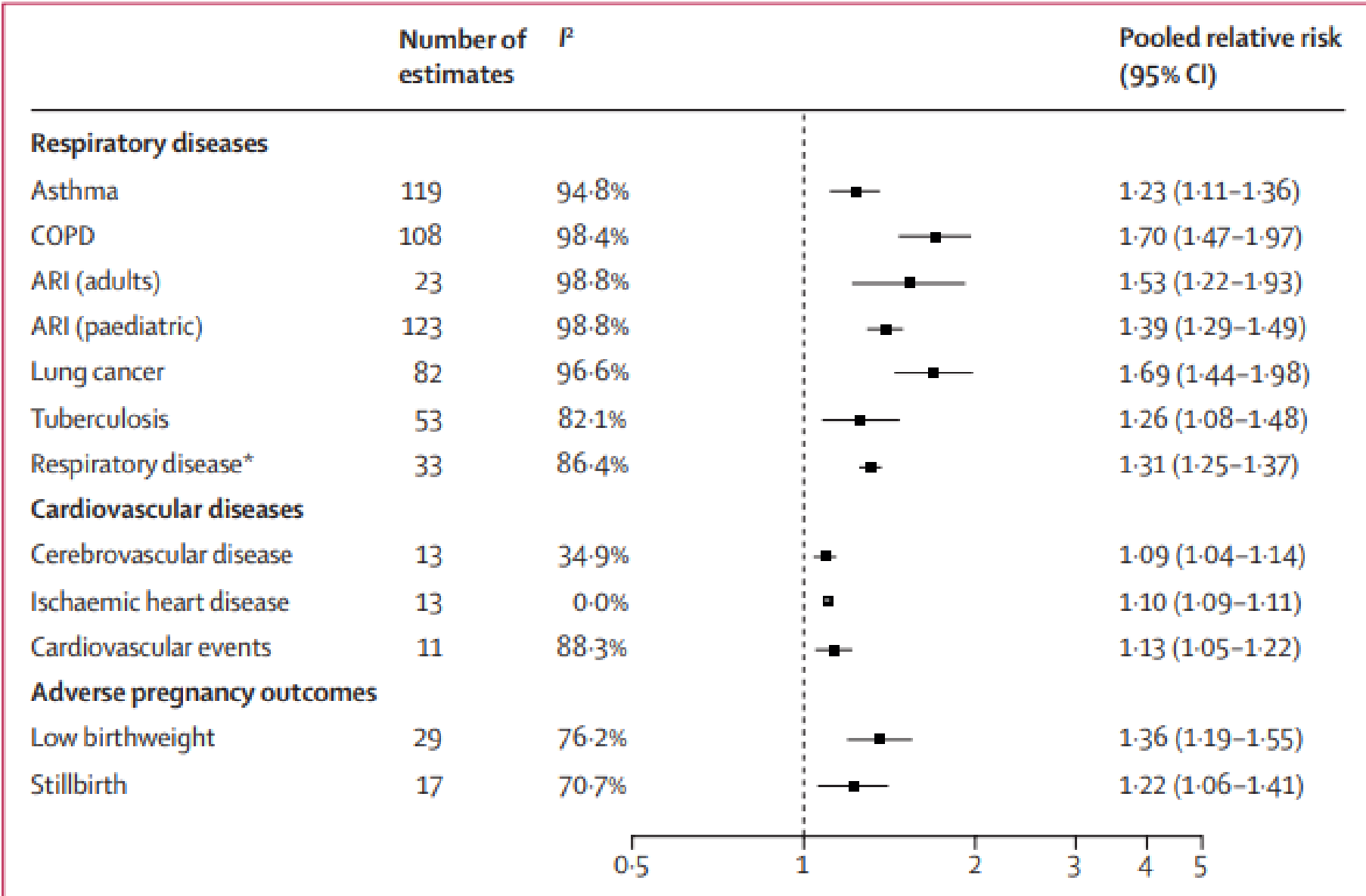


Figure 1: Pooled relative risks for cardiovascular, respiratory, and adverse pregnancy outcomes associated with use of polluting fuels and technologies

ARI=acute respiratory infection. COPD=chronic obstructive pulmonary disease. *Composite estimate from studies that did not break down their findings by constituent respiratory disease.

Lee et al 2020
Lancet Global
Health 8: e1427-34

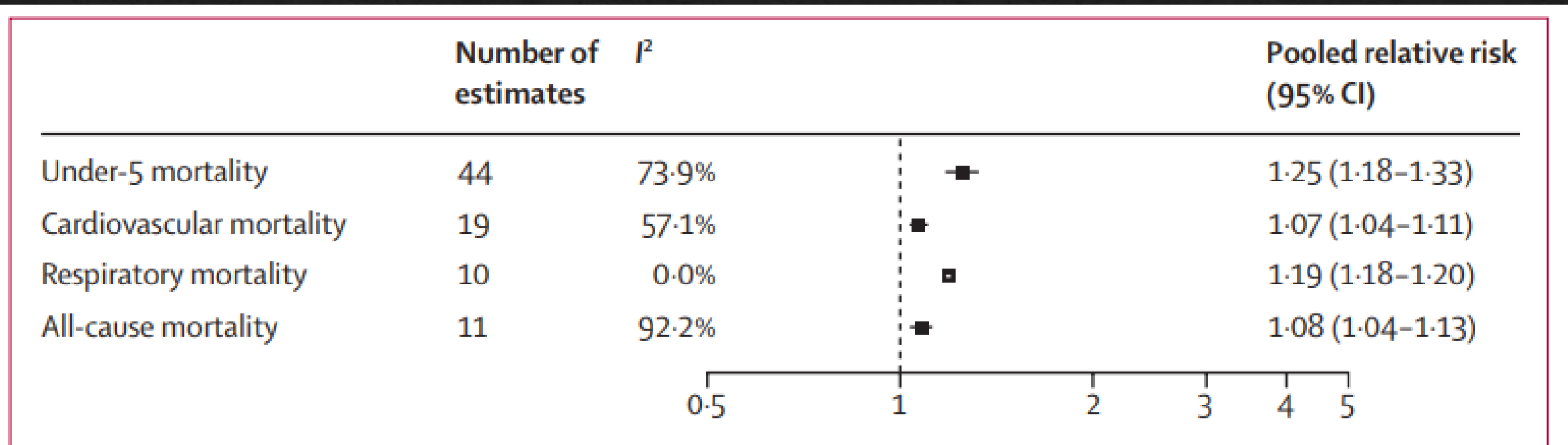


Figure 2: Pooled relative risks for under-5, cardiovascular, respiratory, and all-cause mortality associated with use of polluting fuels and technologies

Estimated Burden of Disease

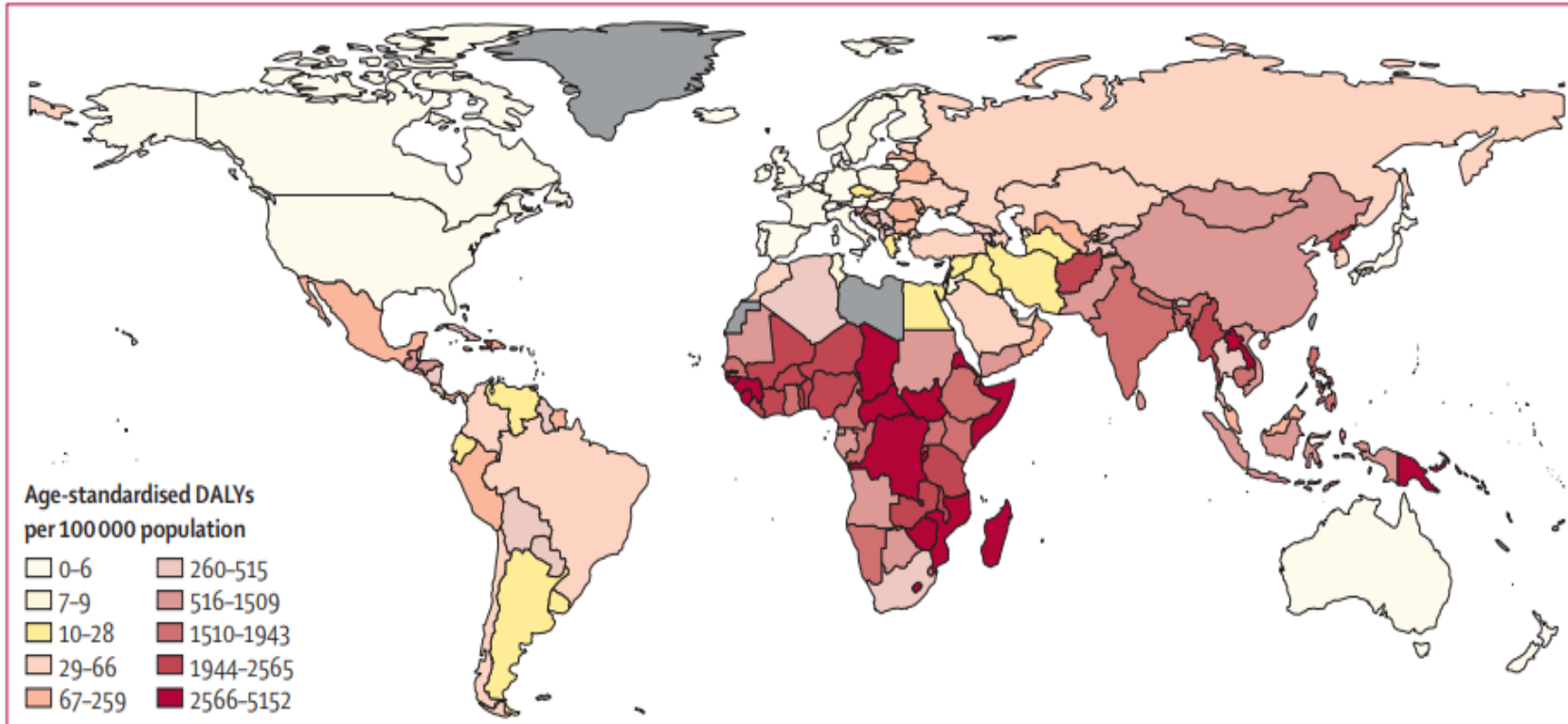


Figure 5: Age-standardised DALY rates attributable to household air pollution by country, 2017
Countries for which data were not available are shown in grey. DALY=disability-adjusted life-year.

- ◇ Globally (2017): 1.8 million premature deaths & 60.9 million DALYs
- ◇ Almost entirely carried by LMIC

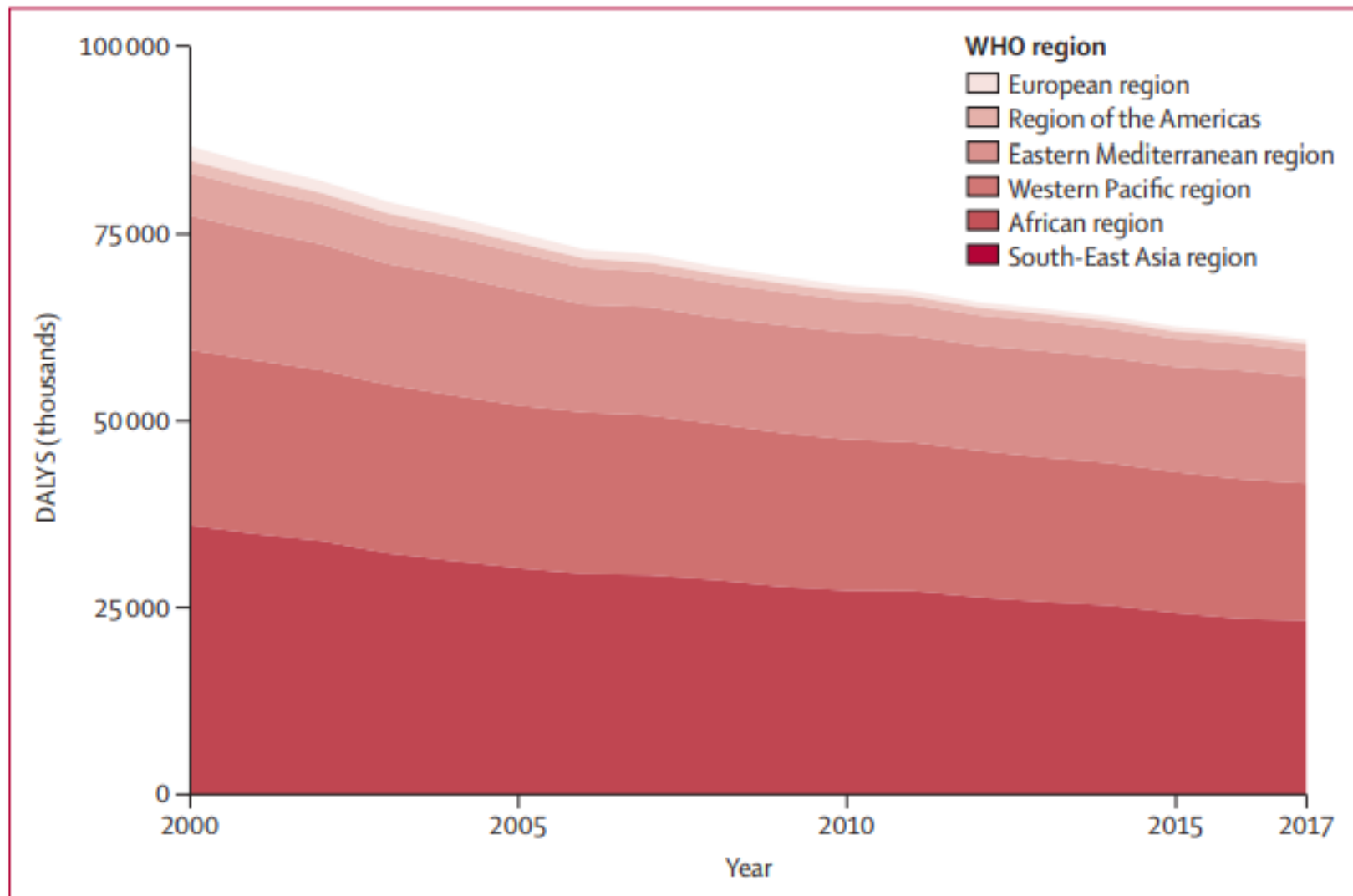


Figure 4: Trends in burden of disease attributable to household air pollution stratified by WHO region, 2000–17

DALYs=disability-adjusted life-years.

◇ Largest burdens in South-East Asia, Africa, and Western Pacific

Other Outcomes of Aging Important Too

GATEWAY TO GLOBAL AGING DATA

A platform for population survey data on aging around the world



ELSEVIER

Environment International

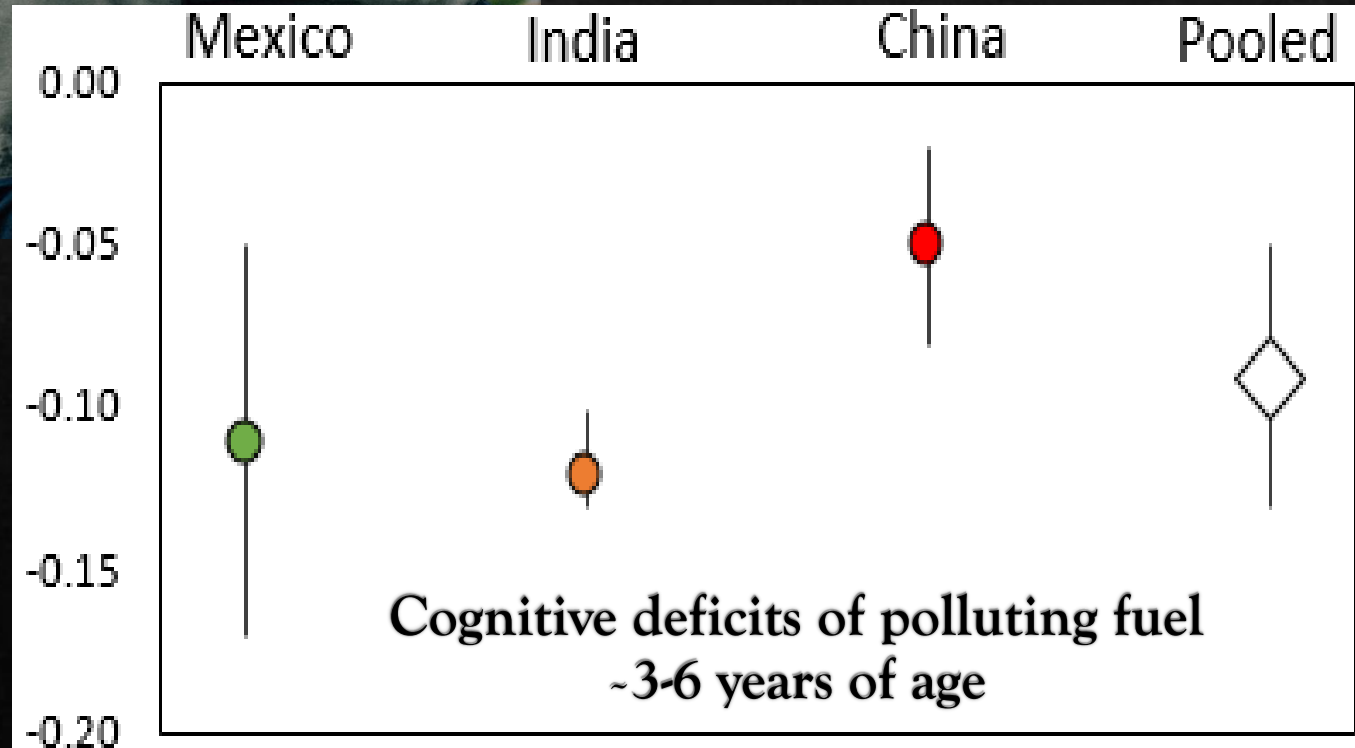
Volume 156, November 2021, 106722



Household use of polluting cooking fuels and late-life cognitive function: A harmonized analysis of India, Mexico, and China

Joseph L. Saenz ^a, Sara D. Adar ^b, Yuan S. Zhang ^c, Jenny Wilkens ^d, Aparajita Chattopadhyay ^a, Jinkook Lee ^{d, f}, Rebeca Wong ^e

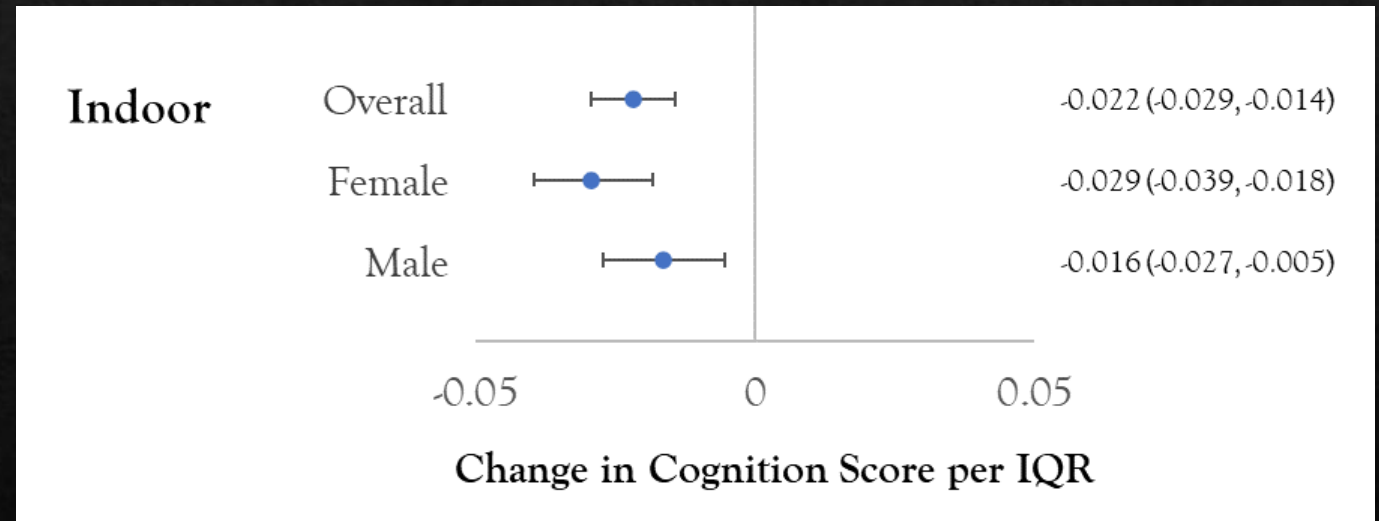
Cognitive Score



Efforts to Disentangle HAP from Poverty



UNPUBLISHED PLEASE DO NOT CITE OR QUOTE



IQR Differences $35 \mu\text{g}/\text{m}^3$
equivalent 2 years of aging

What Are Some Possible Solutions?



Photo by IvanBE pratama on Unsplash



Photo by Brett Jordan on Unsplash



Photo from Clean Cookstove Alliance

Effectiveness of Interventions

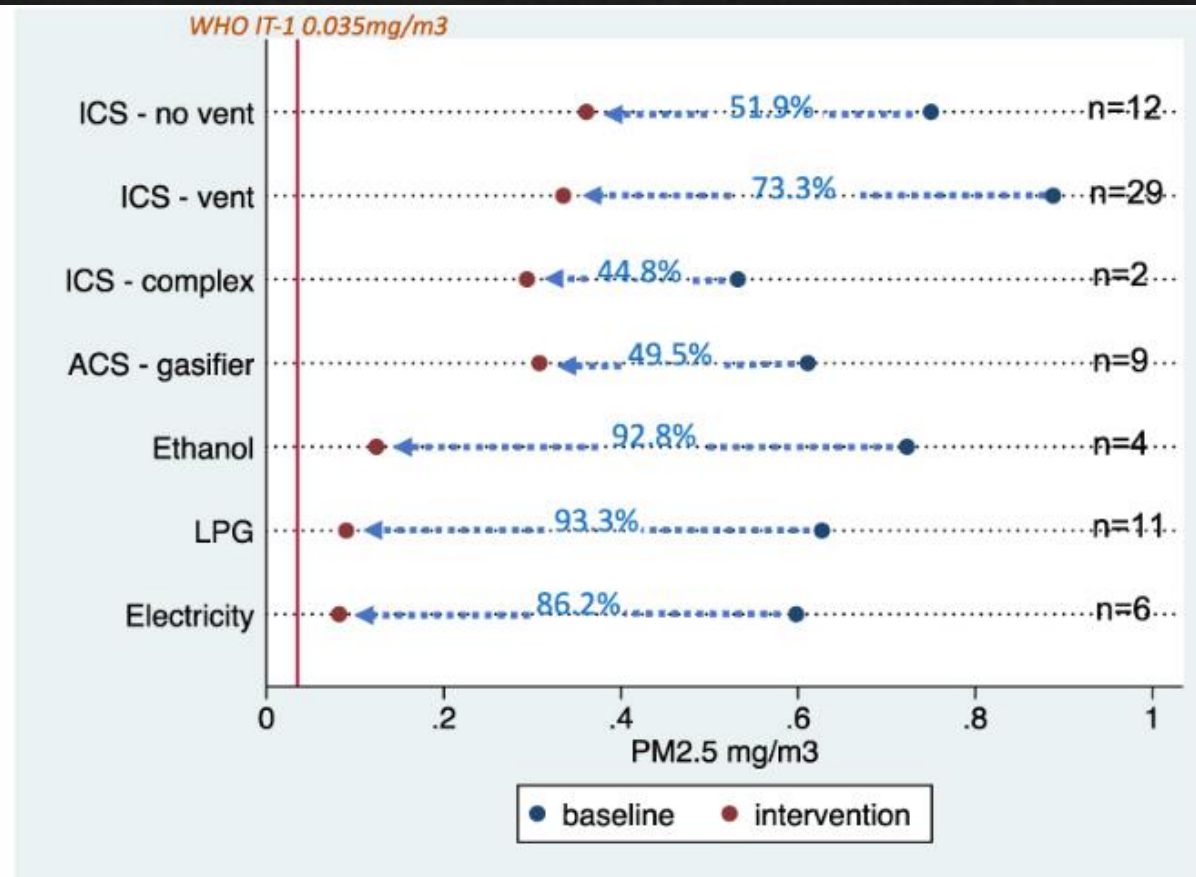


Figure 6.1: Kitchen concentrations (PM_{2.5})

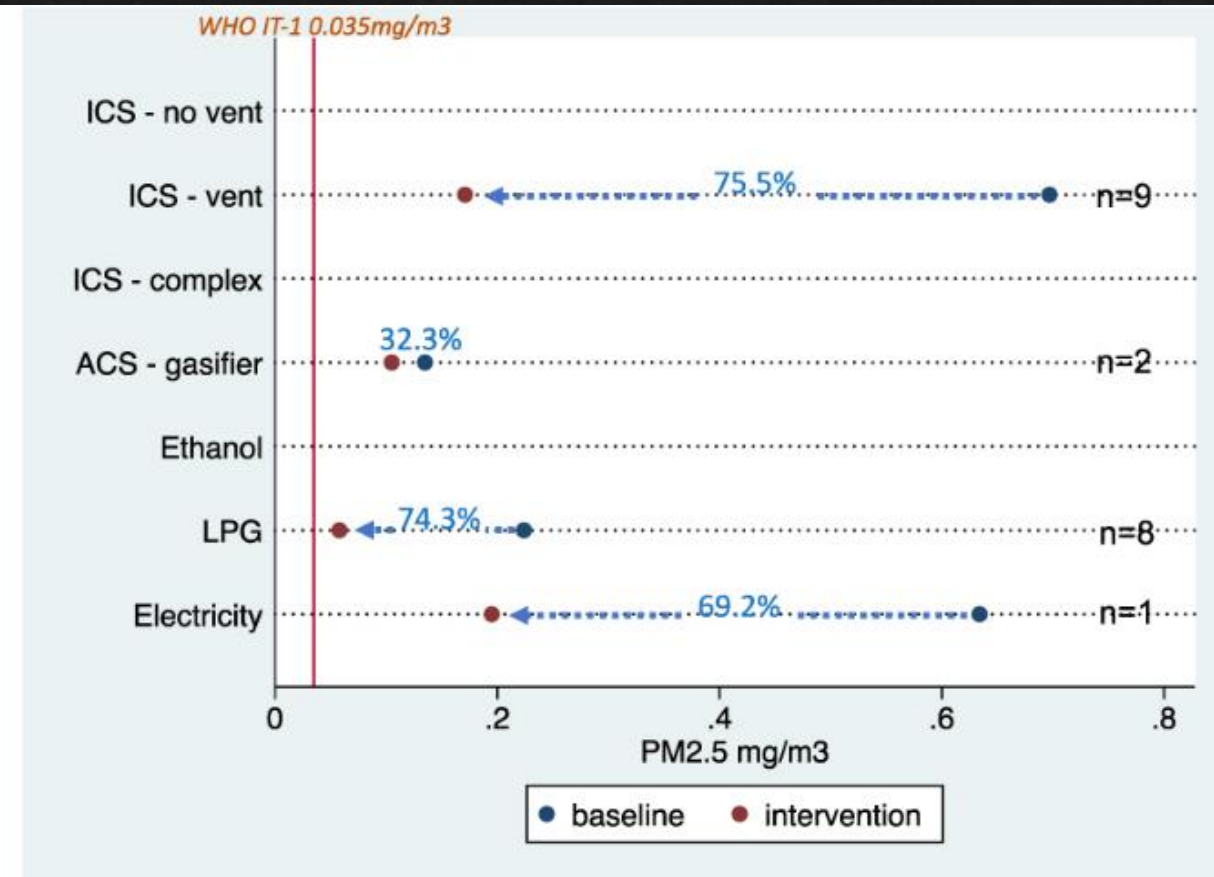


Figure 6.2: Personal exposure (PM_{2.5})

Perhaps More
Effective if
Whole
Communities
Targeted



Photo by Antoine Pluss

Effects Can be Far Reaching



Photo by NASA on Unsplash



Photo by NASA on Unsplash

- ◆ Deforestation and pollutants contribute to climate change

Wildfires and the Aging Brain

The Health and Retirement Study

The University of Michigan Health and Retirement Study (HRS) is a longitudinal panel study that surveys a representative sample of approximately 20,000 people in America, supported by the National Institute on Aging (NIA U01AG009740) and the Social Security Administration.

Through its unique and in-depth interviews, the HRS provides an invaluable and growing body of multidisciplinary data that researchers can use to address important questions about the challenges and opportunities of aging.



JAMA Internal Medicine | Original Investigation

Comparison of Particulate Air Pollution From Different Emission Sources and Incident Dementia in the US

Boya Zhang, PhD; Jennifer Weuve, ScD; Kenneth M. Langa, MD, PhD; Jennifer D'Souza, PhD; Adam Szpiro, PhD; Jessica Faul, PhD; Carlos Mendes de Leon, PhD; Jiaqi Gao, MPH; Joel D. Kaufman, MD; Lianne Sheppard, PhD; Jinkook Lee, PhD; Lindsay C. Kobayashi, PhD; Richard Hirth, PhD; Sara D. Adar, ScD

- ❖ Long-term exposure to wildfire smoke associated with a 5% higher risk of dementia (HR, 1.05; 95% CI, 1.02-1.08) after adjustment for other sources of PM_{2.5}
- ❖ Stronger than other sources including PM_{2.5} from energy generation, industry, and traffic

Summary

- ◆ Household air pollution contributes importantly to health of LMIC populations
- ◆ Interventions are promising but there remain hurdles to overcome
- ◆ Intervening on household air pollution may improve health in LMIC and more broadly due to reduced climate burdens

Thoughts on Future Opportunities

- ◆ Further examine impacts of household air pollution
 - ◆ Understand “how low is low enough?”
 - ◆ Better exposure assessment is needed
 - ◆ Better consider outcomes of aging and aging populations
 - ◆ Implementation research
- ◆ Impacts of and resilience to climate change
- ◆ Understand heterogeneity of experiences
- ◆ Capacity building and models that promote LMIC investigators

Thank you!

◆ **National Institute of Aging**

(U01 AG009740, R01AG030153, R01AG042778,
R01AG055273, U01AG064948)

◆ **National Institute of Environmental
Health Sciences** (R01ES028694)

sadar@umich.edu

◆ **Ministry of Health and Family Welfare,
Government of India** (T22011/02/2015) and the
United Nations Population Fund
(IND8U105/IIPSMU1D07)