

# **Global and Regional estimates of the Burden Due to Ambient Air Pollution: results from GBD 2013**

**1ST AFRICA/MIDDLE-EAST EXPERT MEETING AND  
WORKSHOP ON THE HEALTH IMPACT OF AIRBORNE  
DUST**

**November 3, 2013**

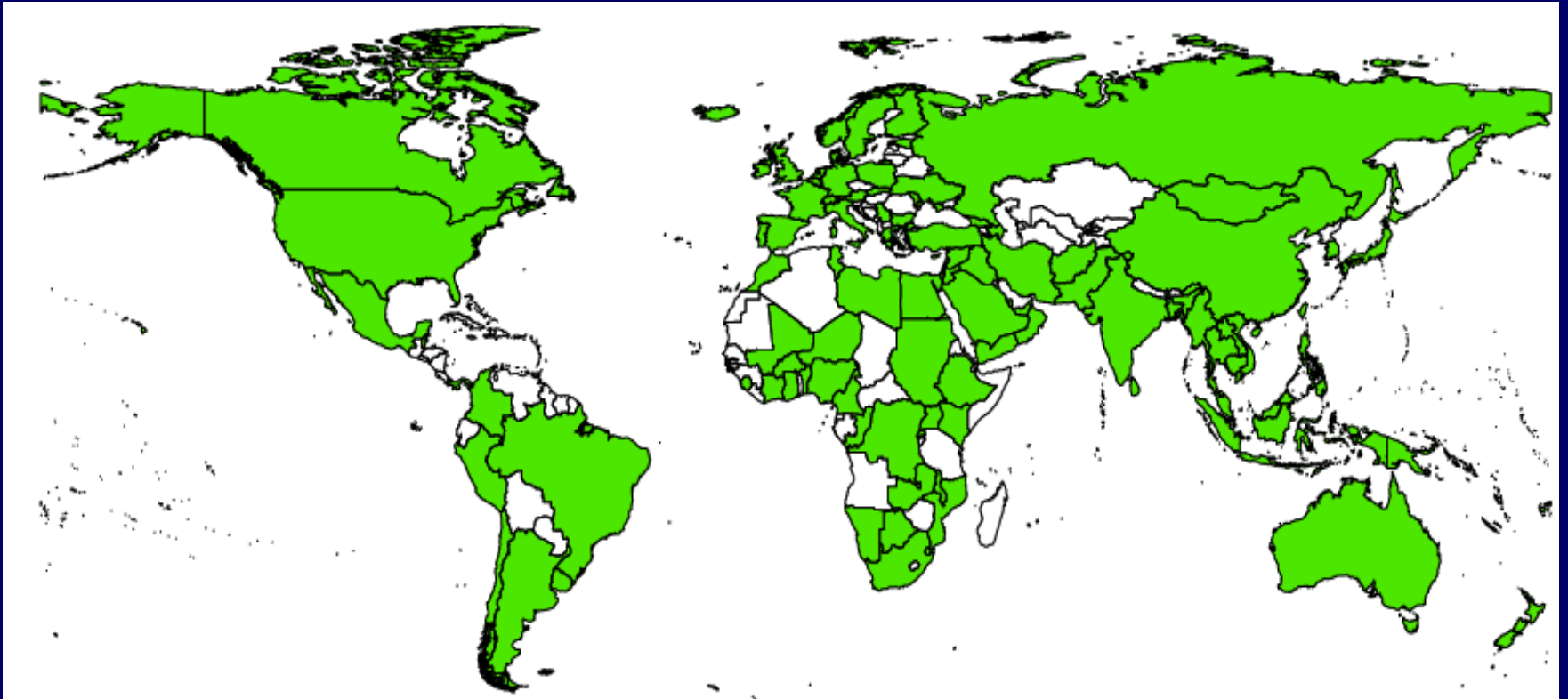
**Aaron J Cohen  
Health Effects Institute**

**on behalf of the Global Burden of Disease  
Collaboration**

# **The Global Burden of Disease (GBD) 2013**

- **Systematic effort to quantify the magnitude of health loss from over 200 disease and injuries in 188 countries around the world from 1990 to 2013 with subnational estimates for China (provincial-level), Mexico and UK**
- **Burden measured as “Disability Adjusted Life Years” (DALYs) – lost years of healthy life-and Deaths in a given year**
- **Estimates burden of disease due to 78 risk factors, e.g. smoking, diet, high blood pressure, overweight, ambient and household air pollution**
- **Major GBD 2013 results for Mortality, Healthy Life Expectancy and Years Lived with Disability , and Risk Factor burden published in *The Lancet* 2014-2015**
- **Data and results publically available at:**  
**<http://vizhub.healthdata.org/gbd-compare/>**

# GBD collaborative measurement model



**Over 1,000 collaborators from 108 countries**

# Global Life-Expectancy and Healthy-Years-of-Life-Lost 2013

Global, regional, and country estimates of life expectancy (LE) and healthy life expectancy (HALE) for 306 diseases and injuries, and the epidemiologic transition.

GBD 2013 DALYs and HALE Collaborators

## Summary

**Background** The Global Burden of Disease (GBD) Study uses a coherent measurement framework for comparisons of health loss over time and across countries. Summary measures such as disability-adjusted life expectancy (DALE) and healthy life expectancy (HALE) can be used to quantify the composite burden of disease and injury.

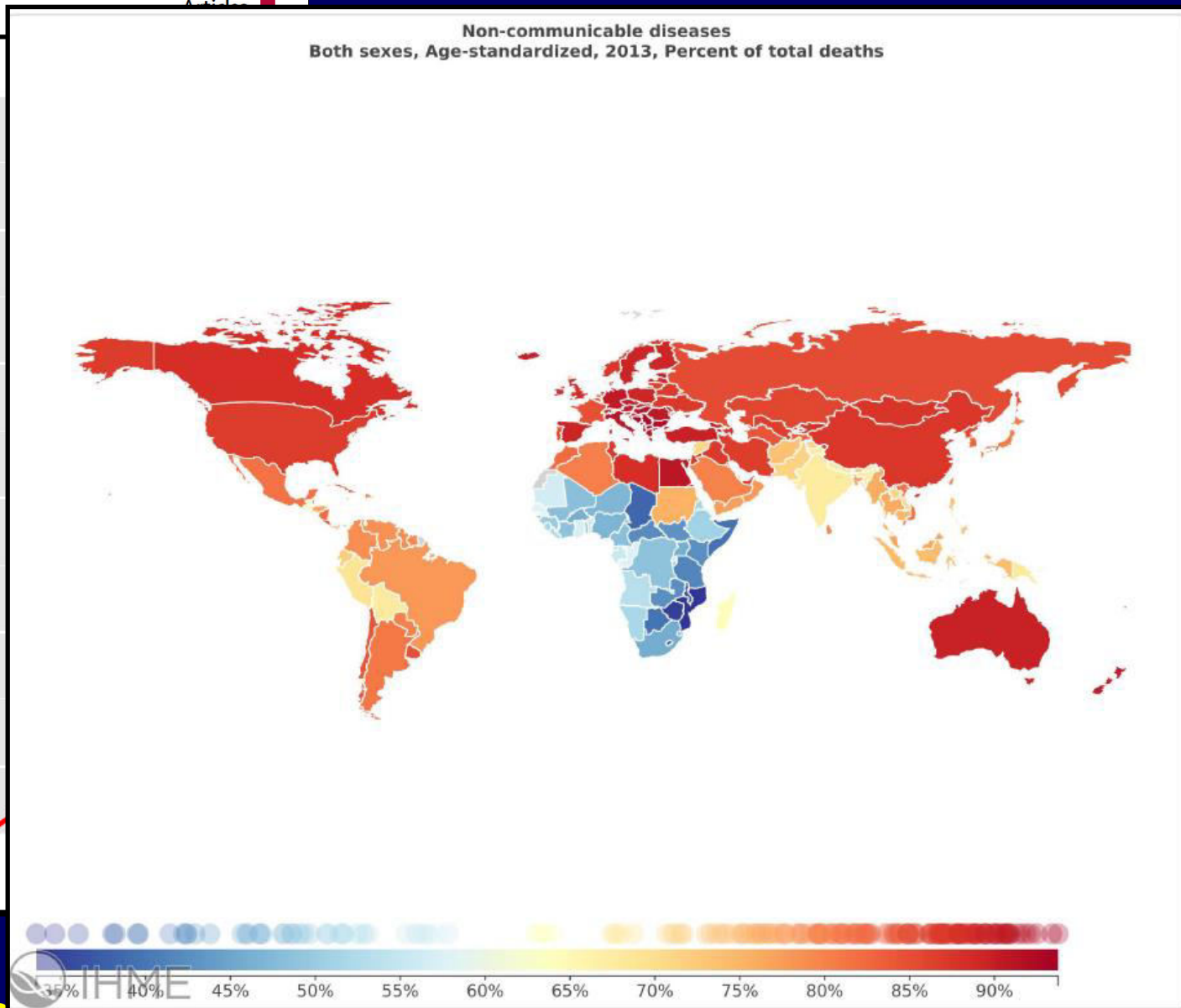
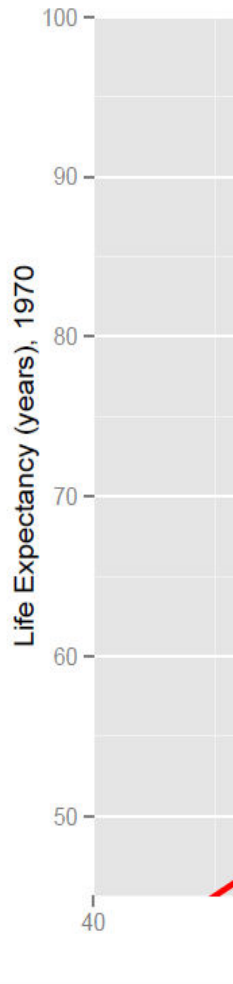
**Methods** We used the published GBD 2013 estimates of life expectancy (LE), and years lived with disability (YLDs), and years lived with disability (YLLs) for 188 countries. We calculated uncertainty in age-specific death rates (ASDRs) for 306 causes for each country as the sum of the uncertainty in the ASDRs for each cause. We quantified patterns of the epidemiologic transition by comparing the patterns of the ASDRs for each cause with the mean age of the population. We decomposed variance related to the

**Findings** Worldwide, from 1990 to 2013, life expectancy at birth (LEA) increased from 65.0 to 71.5 years (54.5–59.1) to 62.3 years (59.7–64.9). The number of people aged 65 and older fell by 26.7% (24.4–29.0). DALY numbers, crude rates, and standardized DALY rates declined for most specific non-communicable diseases, including food-borne trematodes, and leishmaniasis. Leading causes of DALYs were ischaemic heart disease, stroke, and road injuries. Social and over time for diarrhoea, lower respiratory infections, neonatal disorders, nutritional deficiencies, musculoskeletal disorders; and other causes. Predictably, increased sociodemographic declines in YLLs and increases in substance use disorders. In most countries, HALE increased. Leading causes of DALYs and

**Interpretation** Global health is improving. Crude rates have remained relatively stable. The notion of an epidemiologic transition is associated with sociodemographic changes in DALYs and HALE to appropriately

**Funding** Bill & Melinda Gates Foundation

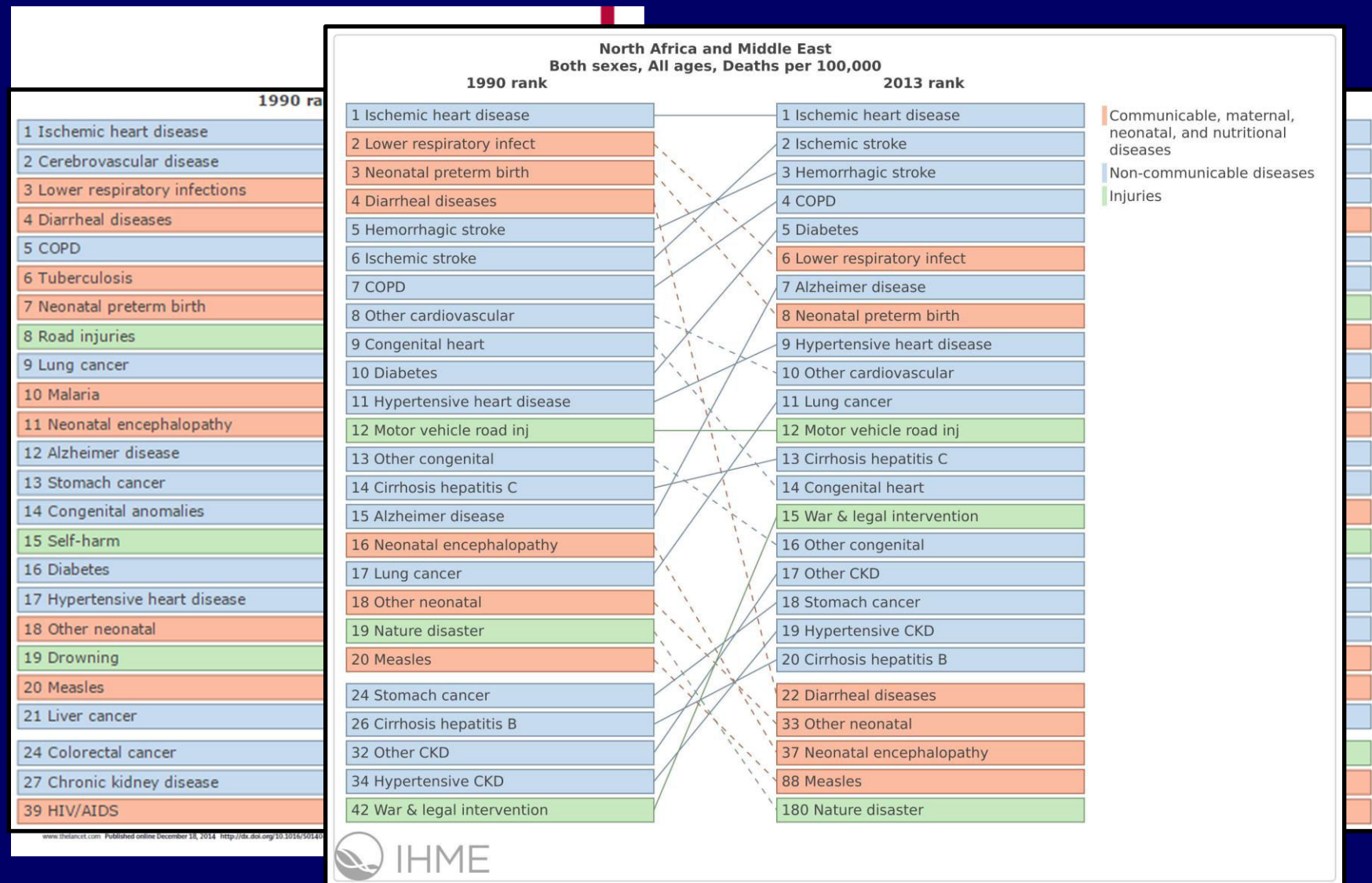
www.thelancet.com Published online August 2015



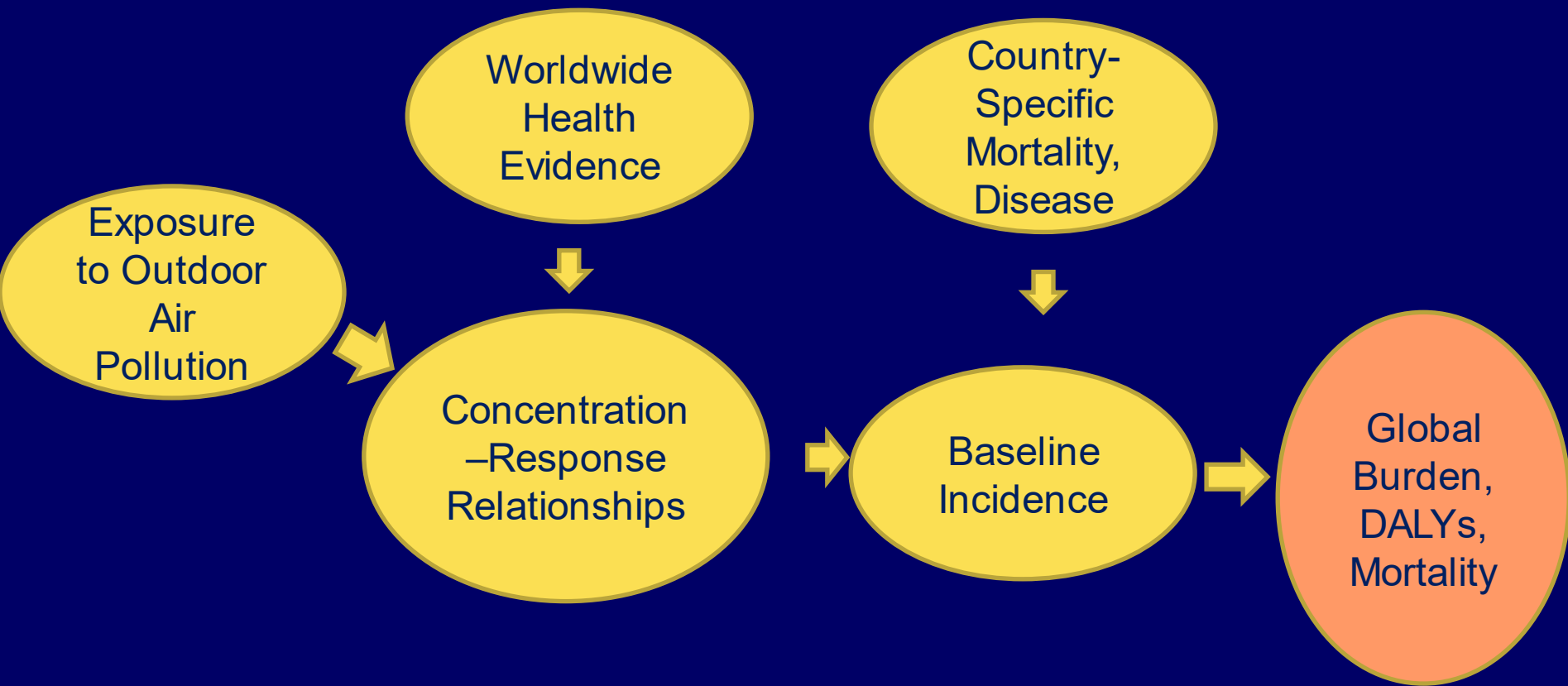
GBD 2013 DALYs and

Institute for Health Metrics and Evaluation (IHME). GBD Compare. Seattle, WA: IHME, University of Washington, 2015. Available from <http://vizhub.healthdata.org/gbd-compare>. (Accessed 10/29/15)

# Leading Global and North African/Middle Eastern Causes of Death 1990-2013



# Estimating the Global Burden of Disease due to Ambient Air Pollution



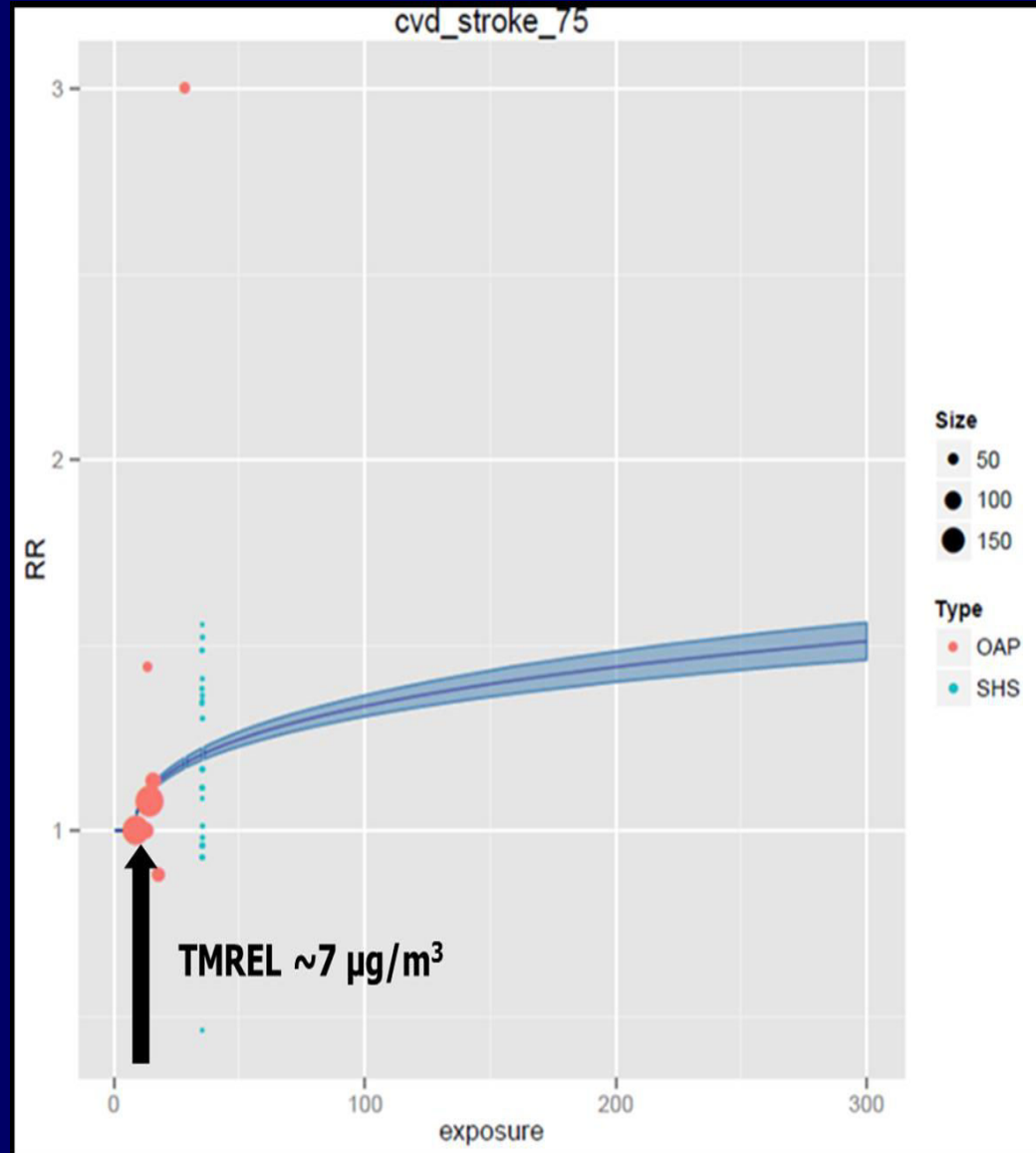
# **A Mortality Risk Model for the Global Burden of Ambient PM<sub>2.5</sub>**

- **Nearly all epidemiologic studies of long-term exposure to PM<sub>2.5</sub> and mortality from chronic disease have been conducted in the US and Western Europe at PM<sub>2.5</sub> 5µg/m<sup>3</sup> to 30µg/m<sup>3</sup>**
- **Need new models to estimate risk over the entire global range up with annual average PM<sub>2.5</sub> greater than 100 µg/m<sup>3</sup> in East and South Asia and other regions**
- **Estimate risk across the full global range of PM<sub>2.5</sub> concentrations by integrating epidemiologic evidence on risk of mortality from major sources of exposure to PM<sub>2.5</sub>**
  - **active smoking**
  - **second-hand smoke**
  - **household burning of solid fuels**
  - **ambient PM<sub>2.5</sub>**
- **Key assumption: risk is a function of PM<sub>2.5</sub> inhaled dose regardless of PM source**



# GBD 2013 IER Risk Models

- Risk models for IHD, stroke, lung cancer, and COPD mortality in adults include 13 epidemiologic studies of ambient PM<sub>2.5</sub> air pollution
- CVD risk models are nonlinear, with a steep increase in risk at low exposures and flattening out at higher exposures. Lung cancer risk models are more nearly linear
- Counterfactual level (TMREL)  $\sim 7 \mu\text{g}/\text{m}^3$  - based on evidence from multiple large epidemiologic studies
- Uncertainty in risk model parameters, estimated using Bayesian methods, contributes to total uncertainty in air pollution burden estimates along with uncertainty in estimated exposure and baseline mortality rates



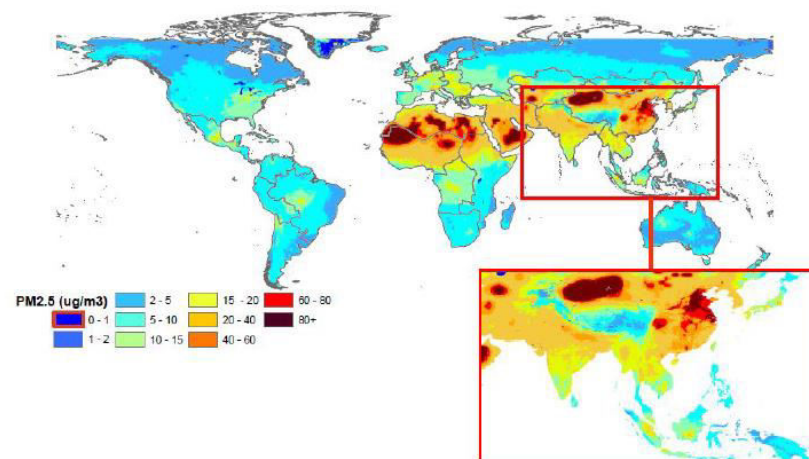


# GBD 2010

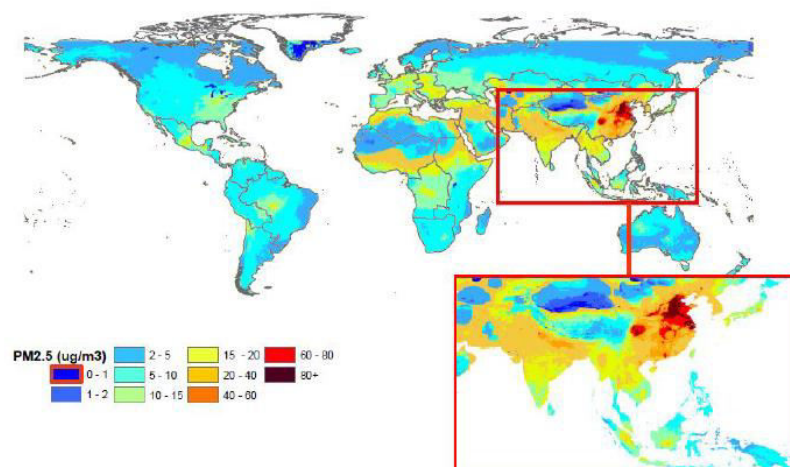
## Regional dust sensitivity analysis (Lim et al. *The Lancet* 2012)

- Sensitivity analysis with an alternative theoretical-minimum-risk exposure distribution that included the effect of regional dust particulate matter. Dusty grid cells were identified as those with an ambient air concentration of PM<sub>2.5</sub> of 36 µg/m<sup>3</sup> or more and where the dust fraction from the TM5 chemical transport model was 50% or more
- Global burden (DALYs) decreased by 2% but larger reductions in NA/MER
- Not repeated for GBD 2013

Estimated 2005 annual average PM<sub>2.5</sub> concentrations (µg/m<sup>3</sup>)



Estimated 2005 annual average PM<sub>2.5</sub> concentrations (µg/m<sup>3</sup>) – No Dust



# Global and North African/Middle Eastern Mortality Risk Factors 1990-2013

Global, regional, and country-level estimates of 79 behavioural, metabolic, and environmental risk factors for 1990-2013. Disease Status

GBD 2013 Risk Factors Collaborators

## Summary

**Background** The Global Burden of Diseases (GBD) Study provides annual updates of the leading causes of death and disability to update the comparative risk assessment of the leading risk factors.

**Methods** Attributable deaths and disability-adjusted life expectancy (DALYs) have been estimated using explicit evidence of the causal link between risk factors and health outcomes, relative to a counterfactual world in which the risk factor was absent. The next detail provided at least one of the following: smoking, sex, and low glomerular filtration rate (GFR) regression method, meta-regressions of combined risk factors, and other risks such as low GFR.

**Findings** All risks contributed to 40-1-43-0 of DALYs to a low of 0% for 2013, six risks or conditions contributed to 241-4 million deaths and 143-5 million DALYs. In sub-Saharan Africa, sanitation, and handwashing practices, and high blood pressure or high cholesterol in the Middle East, Europe, and South Africa.

**Interpretation** Behavioural and more than one attributable burden of risk factors, behavioural, and environmental prevention and primary prevention.

**Funding** Bill & Melinda Gates Foundation

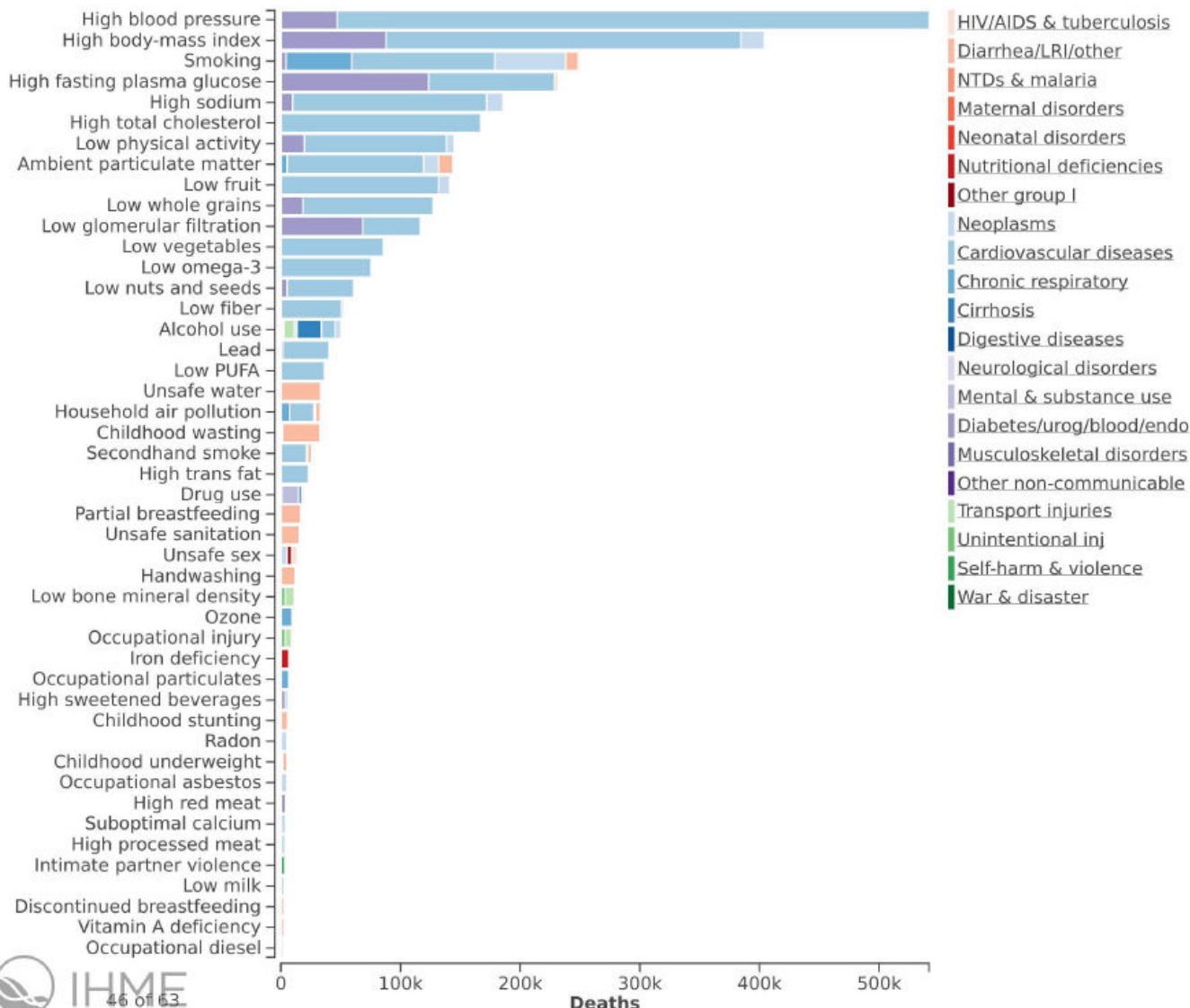
www.thelancet.com

1990 rank

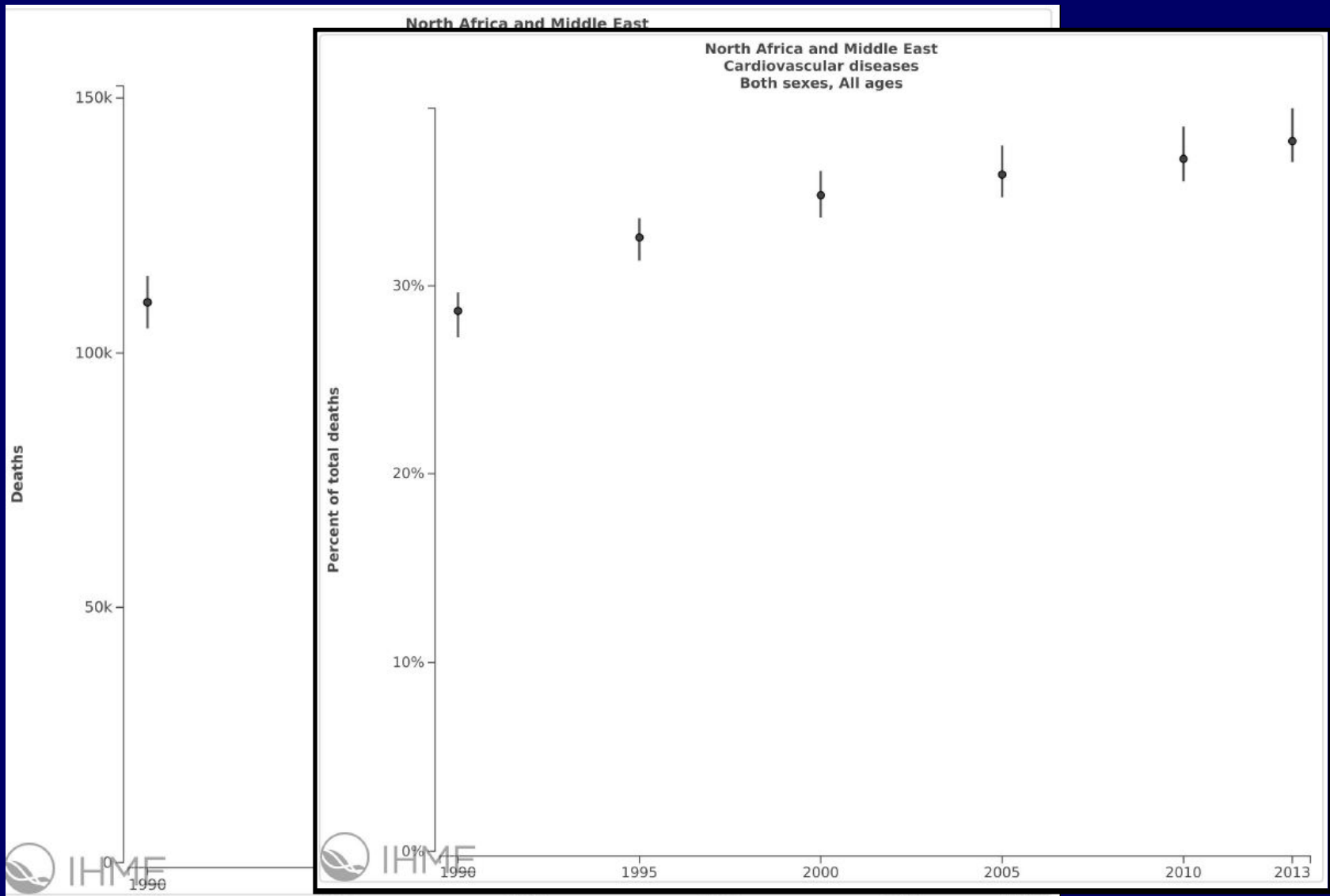
- 1 High systolic blood pressure
- 2 High body-mass index
- 3 Childhood wasting
- 4 Smoking
- 5 High fasting plasma glucose
- 6 Unsafe water source
- 7 Diet high in sodium
- 8 Ambient particulate matter
- 9 High total cholesterol
- 10 Diet low in fruits
- 11 Non-exclusive breastfeeding
- 12 Low physical activity
- 13 Diet low in whole grains
- 14 Unsafe sanitation
- 15 Low glomerular filtration rate
- 16 Diet low in vegetables
- 17 Diet low in seafood omega-3 fatty acids
- 18 Household air pollution
- 19 Secondhand smoke
- 20 No handwashing with soap
- 21 Diet low in nuts and seeds
- 22 Childhood stunting
- 23 Alcohol use
- 24 Diet low in fiber
- 26 Lead exposure
- 28 Diet low in polyunsaturated fatty acids

North Africa and Middle East

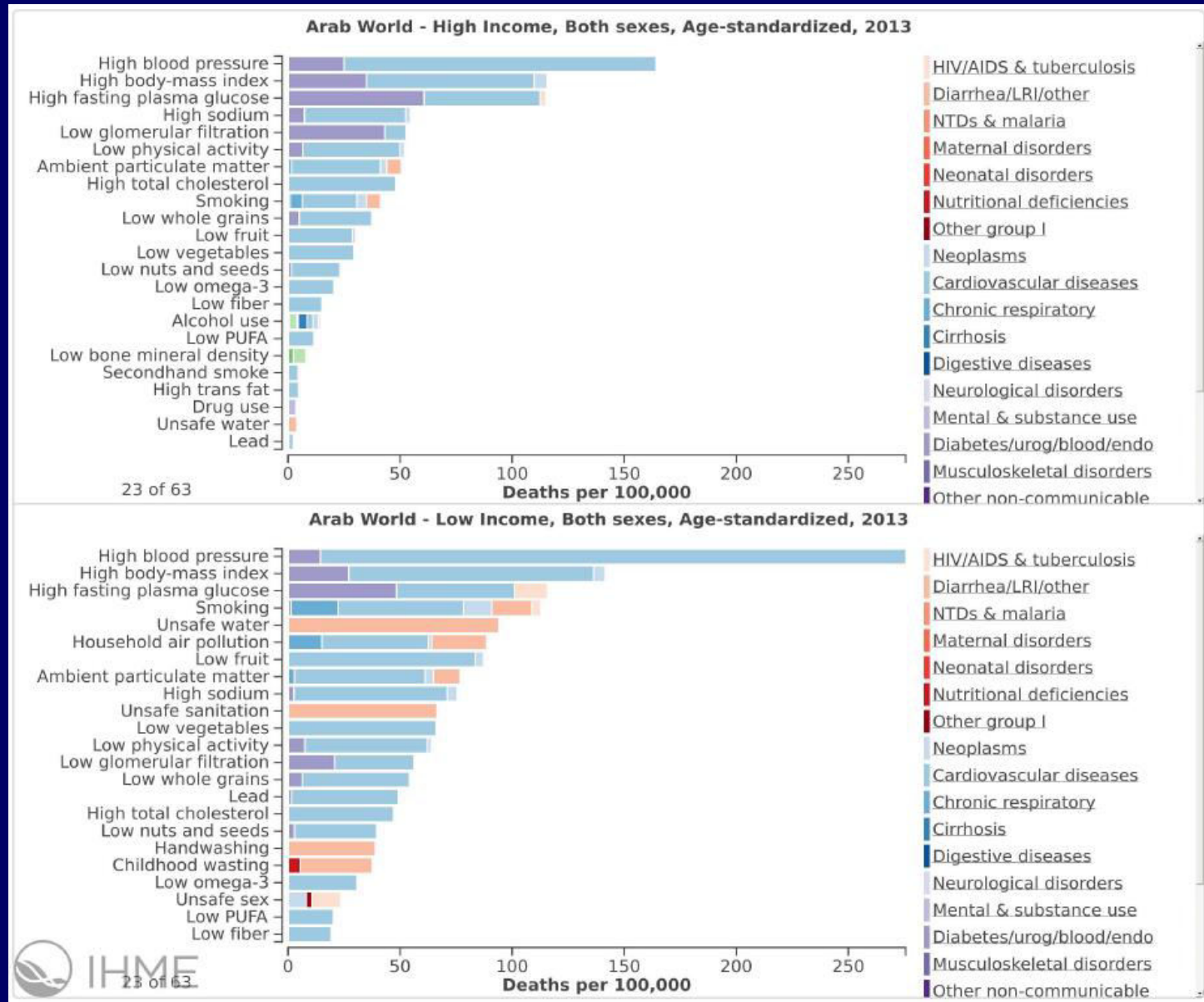
North Africa and Middle East, Both sexes, All ages, 2013



# Increasing Burden of Disease 1990-2013



# Top Mortality Risk Factors in 2013 by National Income in the Arab World



# Summary

- **Cardiovascular disease and other diseases affected by air pollution are among the top causes of mortality and lost years of healthy life in the region**
- **PM<sub>2.5</sub> air pollution is an important source of disease burden in the region and its importance has increased in the last two decades, driven by both increasing levels of exposure and cardiovascular disease**
- **Populations of low-income Arab countries have almost twice the age-adjusted rate of mortality due to PM<sub>2.5</sub> exposure than high-income Arab countries, and household air pollution contributes significantly to burden in low-income Arab countries**

# Thank You!

! شكرا

**For more information on the GBD  
Collaboration contact:**

**Aaron Cohen at HEI**

***[acohen@healtheffects.org](mailto:acohen@healtheffects.org)***

**Institute for Health Metrics and  
Evaluation**

***<http://www.healthdata.org/gbd>***