Avoidable mortality globally: the last 40 years and the next 40 years

Prabhat Jha
prabhat.jha@utoronto.ca
Twitter: @Countthedead

Centre for Global Health Research, St. Michael's Hospital
Dalla Lana School of Public Health, University of Toronto

St. Michael's
Inspired Care.
Inspiring Science.

UNIVERSITY OF TORONTO
DALLA LANA SCHOOL OF PUBLIC HEALTH

cghr

Conclusions

1. **Large reductions in** premature mortality have occurred over the last few decades (mostly driven by knowledge)

2. **Counting the dead and describing causes** is essential for future reductions in premature mortality: Three examples
   - **Child mortality**
   - **Vascular disease**
   - **Risk factors, most notably smoking**

cghr

World, 2015: ~55 M deaths/year

Age range	Deaths per year	
0-4	~6M	~30M
5-49	~10M	
50-69	~14M	
(70+)	(~25M)	

M = Million

Untied Nations, 2017

Future deaths among 130 M births/year in 2015

Age range	Deaths M in 2015	Expected deaths among 130M births
0-4	~6	~5
5-49	~10	~10
50-69	~14	~30

M = Million

cghr

Untied Nations, 2017

Global survival to age 70 years

- at 1970 rates: 40% male, 50% female

- at 2010 rates: 60% male, 70% female

- at 2030 rates: 75% male, 80% female?

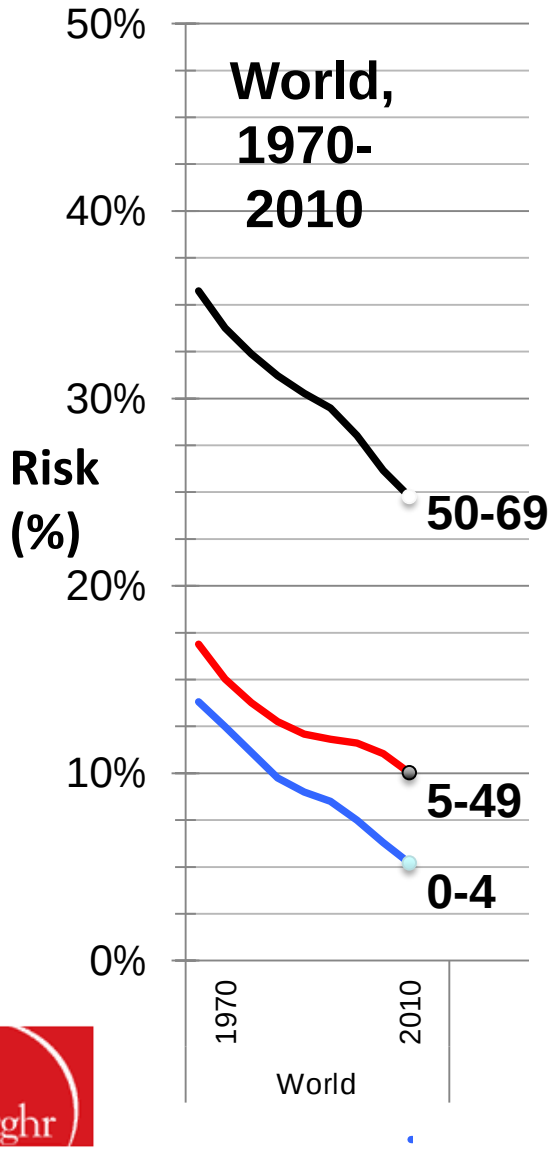
(proposed "Sustainable development goal"

of **40% cut in death rates in 2030 vs 2010**

cghr

Norheim, Jha, Addis et al, Lancet 2015

World mortality trends, 1970-2010: risks of dying in selected age ranges

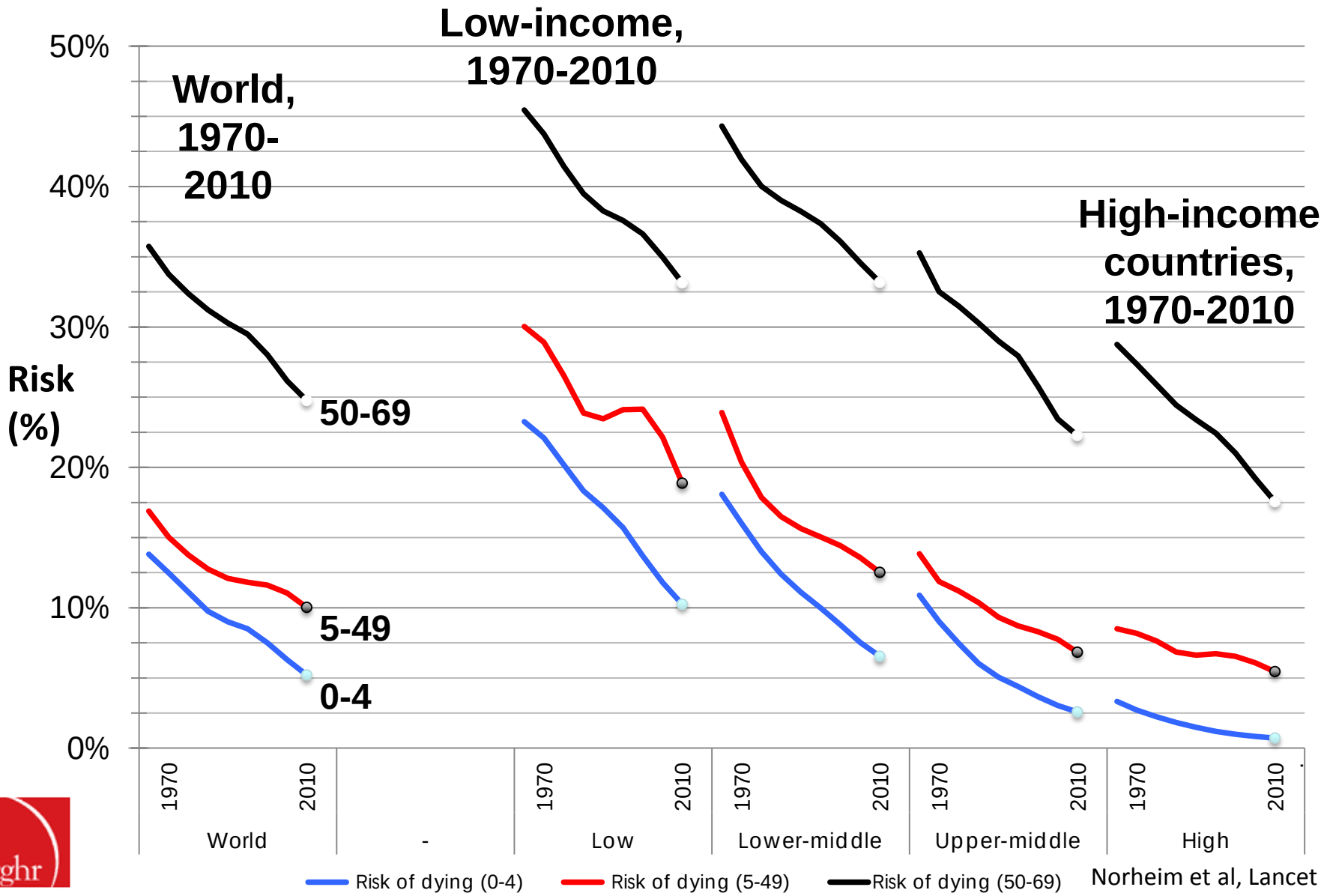


Lines give trends from 1970* (left) to 2010 (circles●)

* Mean, 1965-69 & 1970-74

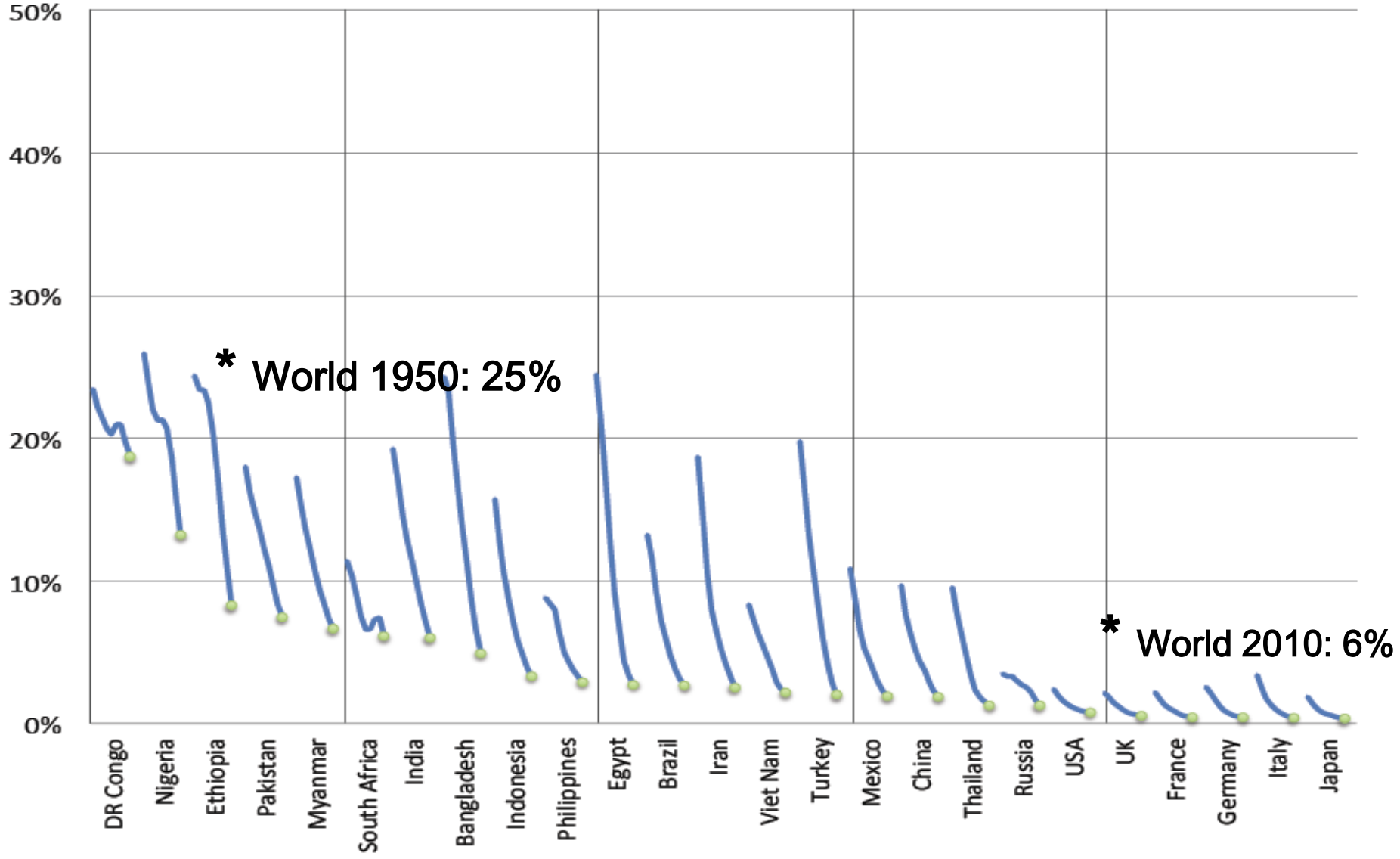
Norheim, Jha, Addis et al, Lancet 2015

World mortality trends, 1970-2010, by country income: risks of dying in selected age ranges



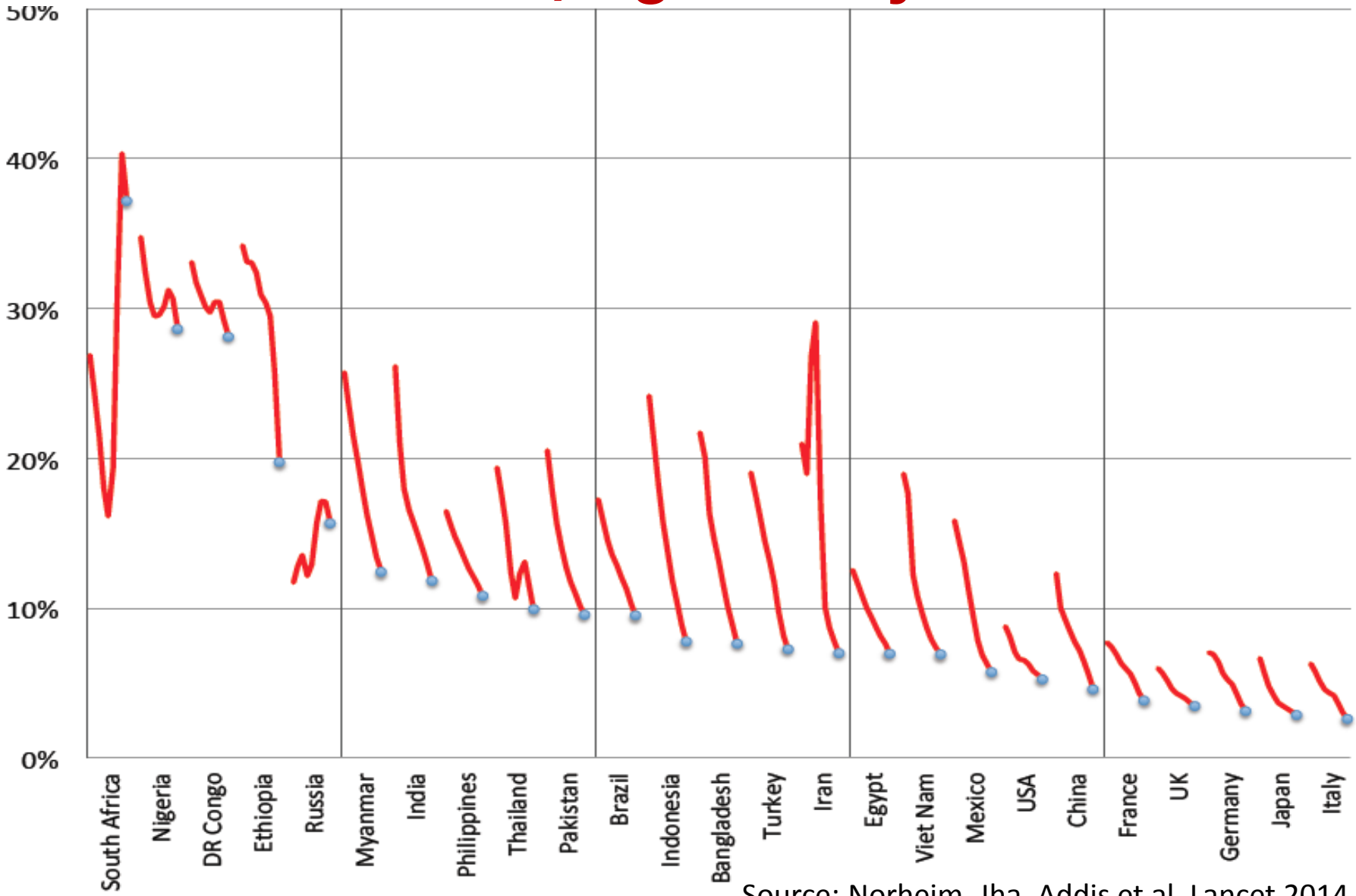
Norheim et al, Lancet 2015

1970-2010 trends in risk of death, 25 countries, age 0-4 years



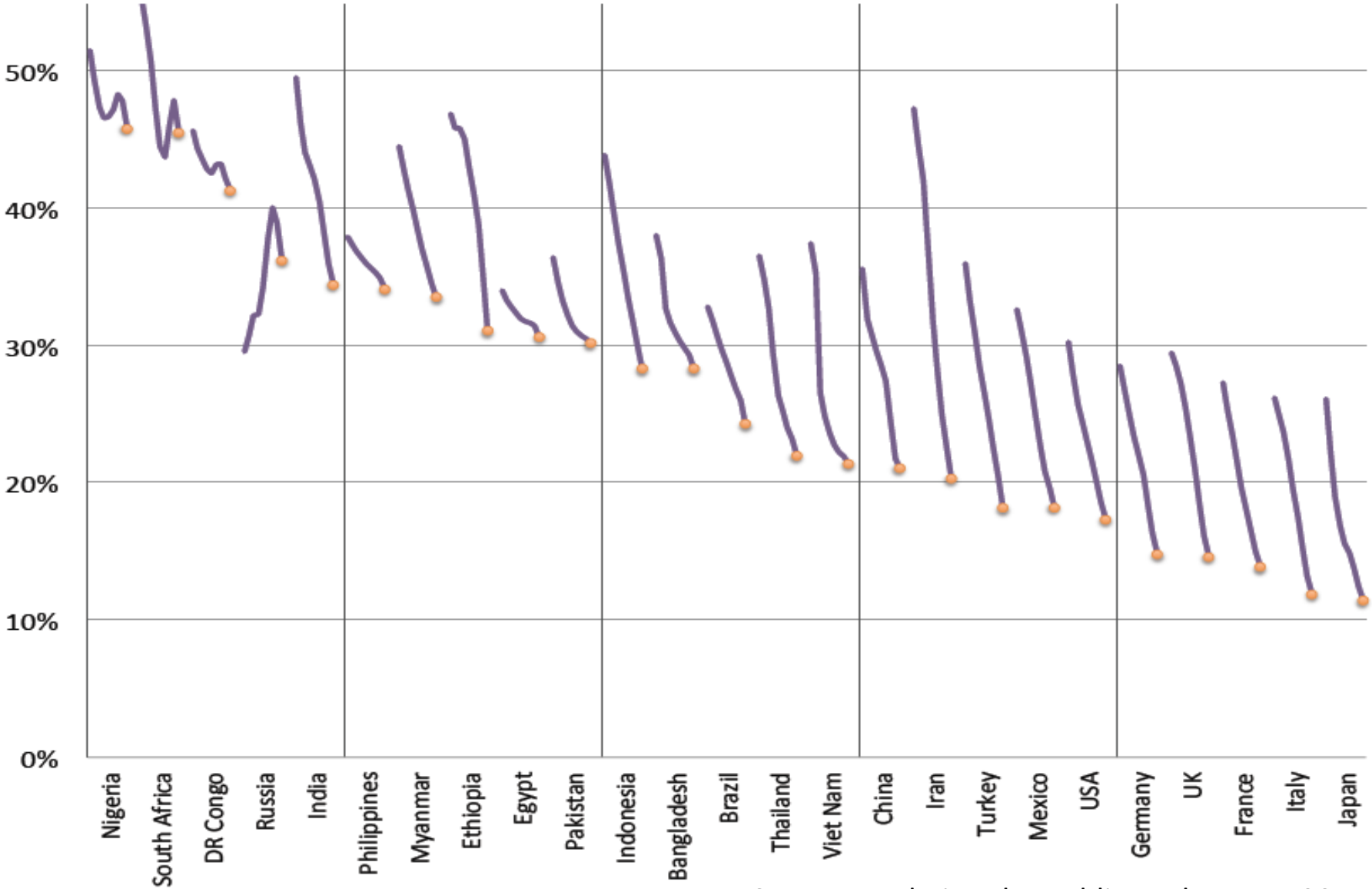
Source: Norheim, Jha, Addis et al, Lancet 2014

1970-2010 trends in risk of death, 25 countries, age 5-49 years

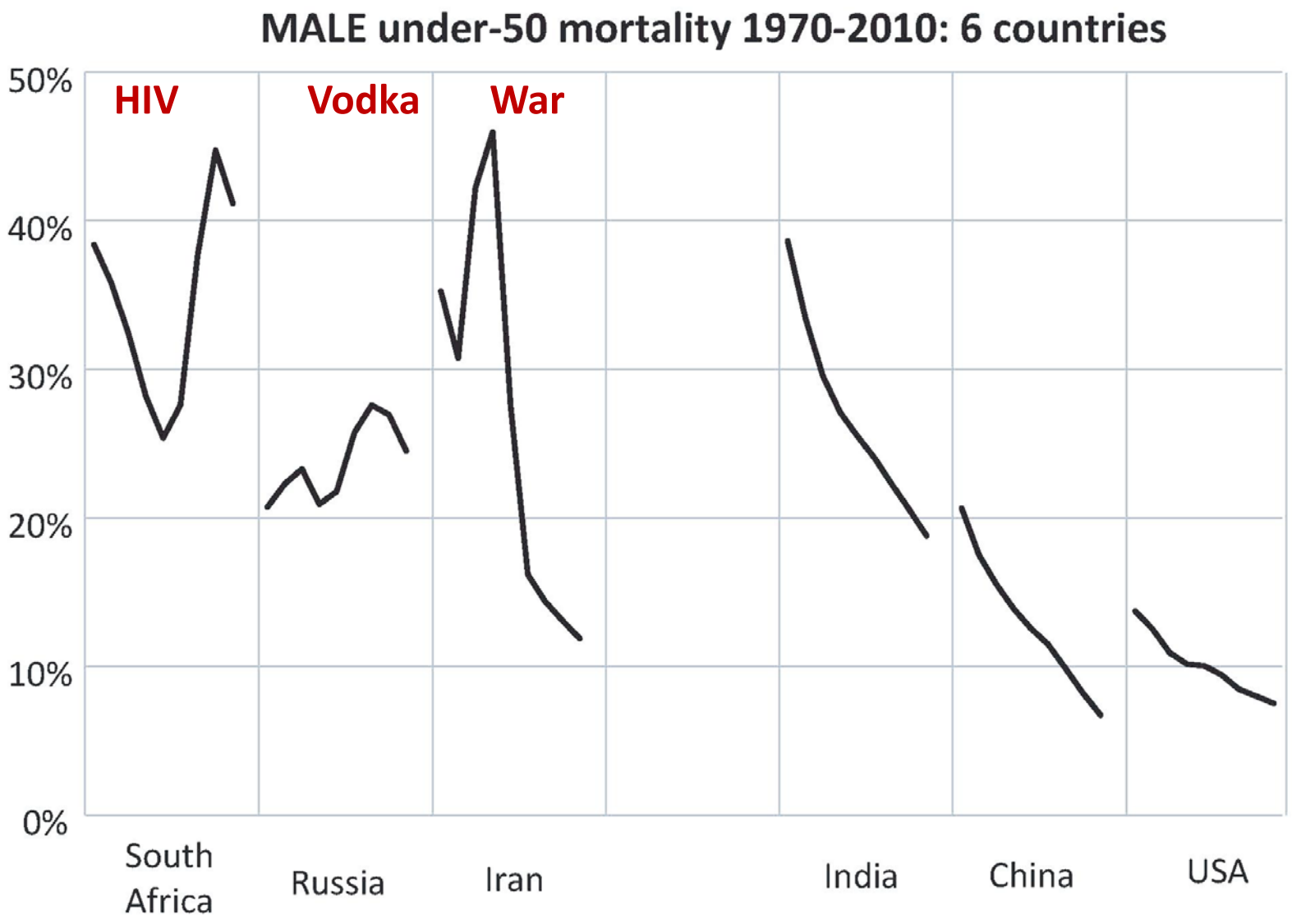


Source: Norheim, Jha, Addis et al, Lancet 2014

1970-2010 trends in risk of death, 25 countries, age 50-69 years



Source: Norheim, Jha, Addis et al, Lancet 2014



Norheim, Jha, Addis et al, Lancet 2015

Global deaths: approximate totals for selected causes

Ebola in West Africa	
total in 2015/16	~10,000
	Per week
Malaria (mostly children)	~10,000
Smoking	~100,000
Vascular disease	~350,000

cghr

"for sanitary purposes it is indispensable to know the relative mortality in small and, as far as possible, well-defined tracts to ascertain the death rates in each of these communities; to see how far this arises from preventable causes; and to apply the remedies"

Sanitary Commissioner of the Government of India, 1869

Nationwide Mortality Studies: Indian Million Death Study (MDS)

1. Visit 1.4 M homes ("true snapshot" of India) in the "SRS" with a recent death & ask standard questions **and** get a local language narrative (*adapted* WHO tool)
2. 900 non-medical surveyors (now electronic entry + GPS)
3. Web-based double coding by 400 doctors (guidelines, + adjudication and other strict quality control)
4. Study all diseases, work with RGI/census dept, keep costs <$1 per home
5. Indian totals to date: ~0.8M deaths

Statistical Alliance for Vital Events (SAVE) to expand to Sierra Leone, Ethiopia, Mozambique and elsewhere

Gomes et al, Health Affairs, 2017

INDIA: cause-specific mortality per 1000 live births from 2000 to 2015 based on 100,00 home interviews (not models)

NEONATAL

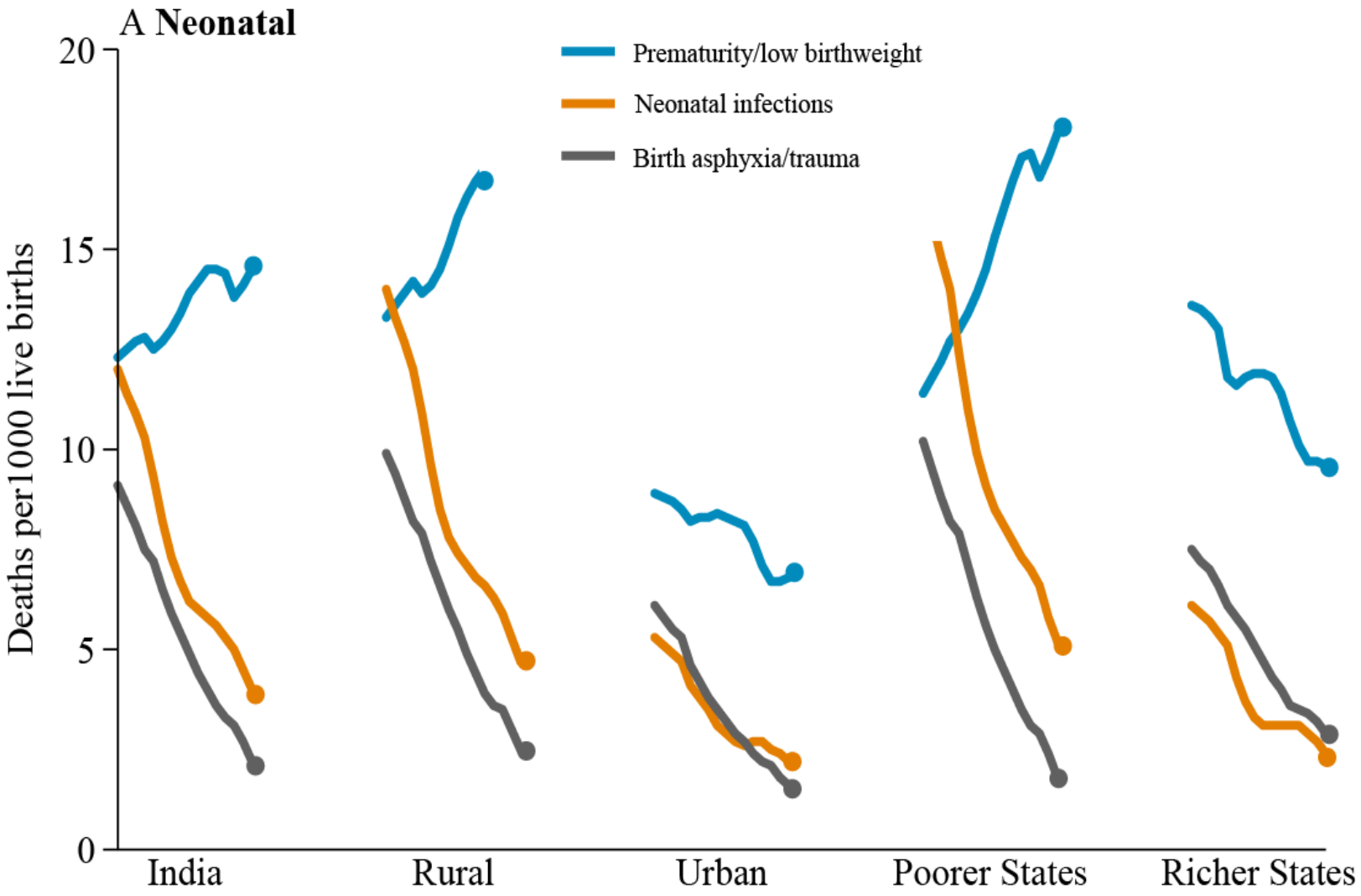
- **Neonatal infection fell by 66%**
- **Birth asphyxia or trauma fell by 76%**
- **Tetanus fell by >90%**
- **Prematurity/Low birth weight rose modestly** (mostly term births with low birth weight)

1-59 MONTHS

- **Pneumonia fell by 63%**
- **Diarrhoea fell by 66%**
- **Measles fell >90%**

MDS Collaborators, Lancet, 2017

Cause-specific mortality rates for neonates by type of region or state in India, 2000-2015



MDS Collaborators, Lancet, 2017

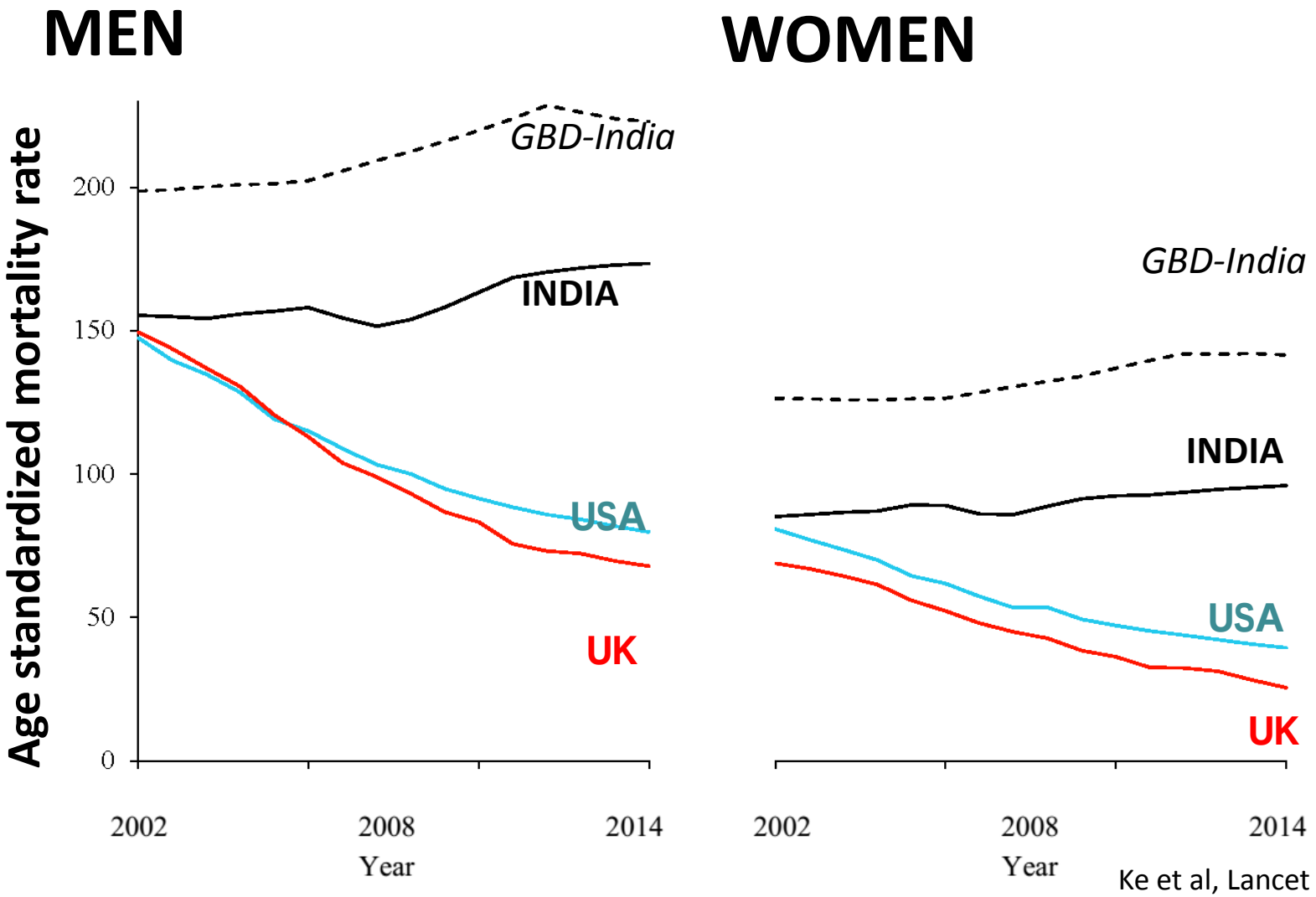
VASCULAR DISEASE: Risk of death at ages 30-69, 2000 and 2015, India

	2000	2015
Ischemic Heart Disease		
• Men	10%	13%
• Women	5%	7%
Stroke		
• Men	6%	5%
• Women	5%	4%

cghr

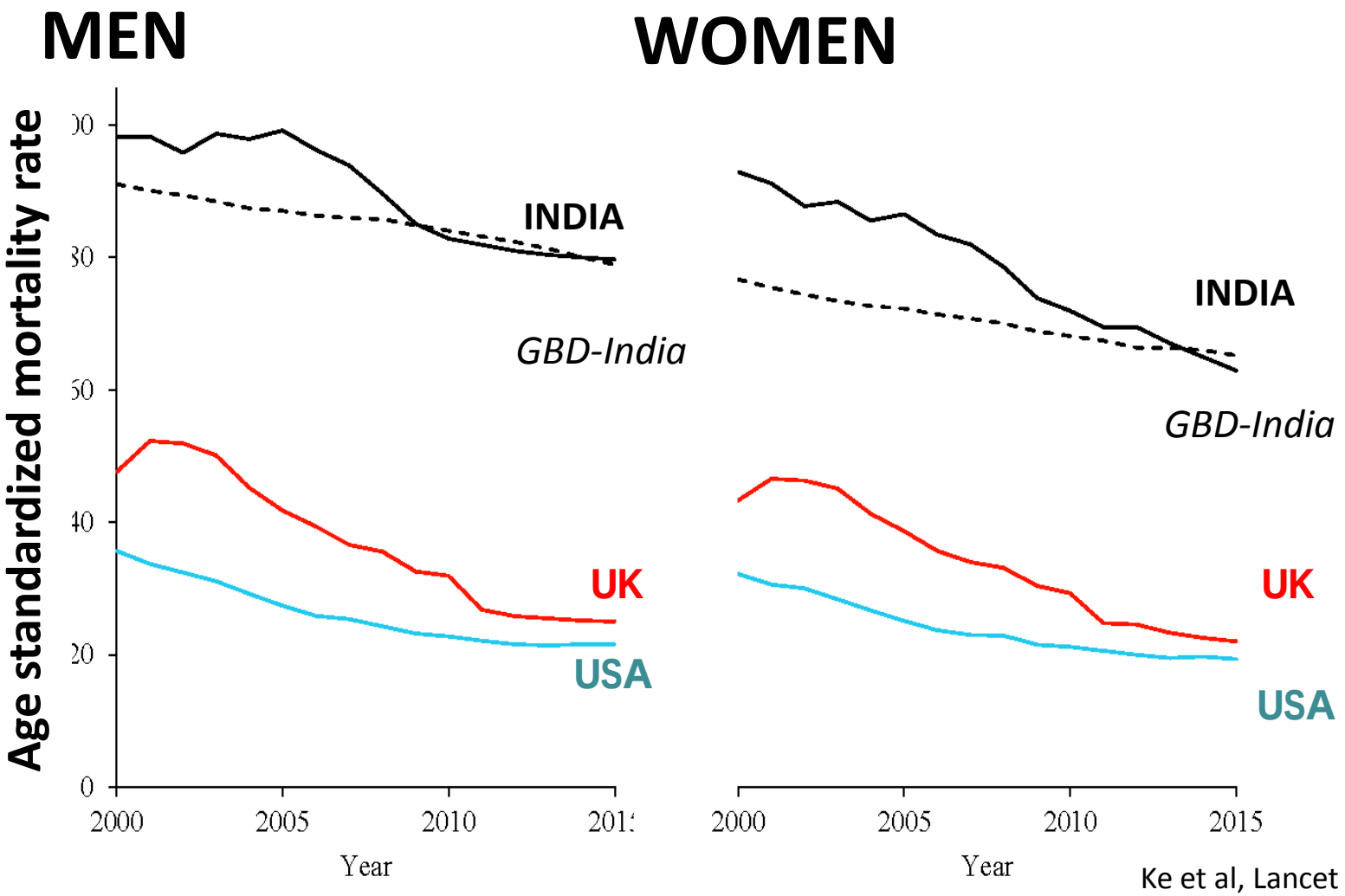
Ke et al, Lancet GH 2018

Trends in age-standardized mortality rates, all ages: ISCHEMIC HEART DISEASE (IHD), India, UK, USA, GBD- India



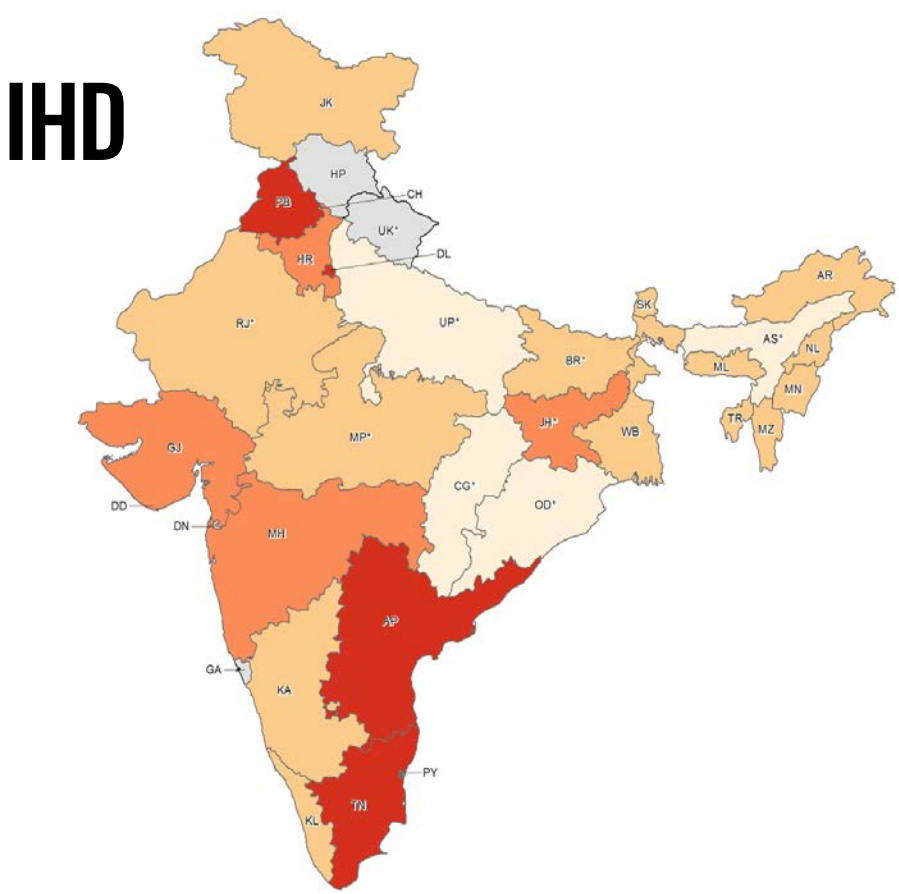
Ke et al, Lancet GH 2018

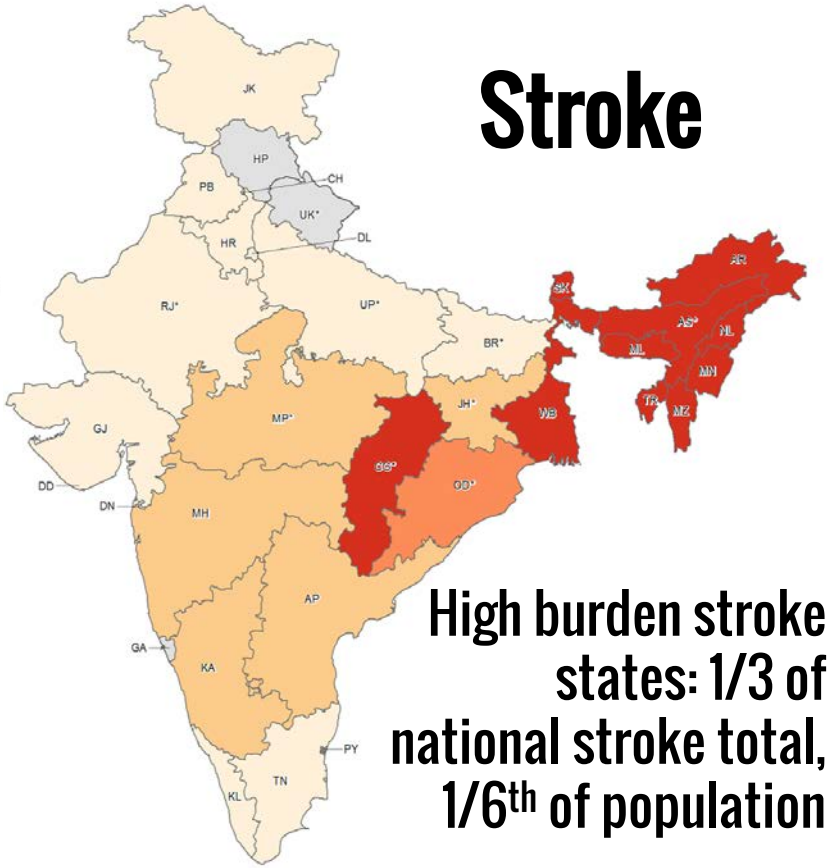
Trends in age-standardized mortality rates, all ages: STROKE, India, UK, USA, GBD- India



Ke et al, Lancet GH 2018

IHD vs. Stroke mortality ages 30-69, 2010-13: Distinctive patterns



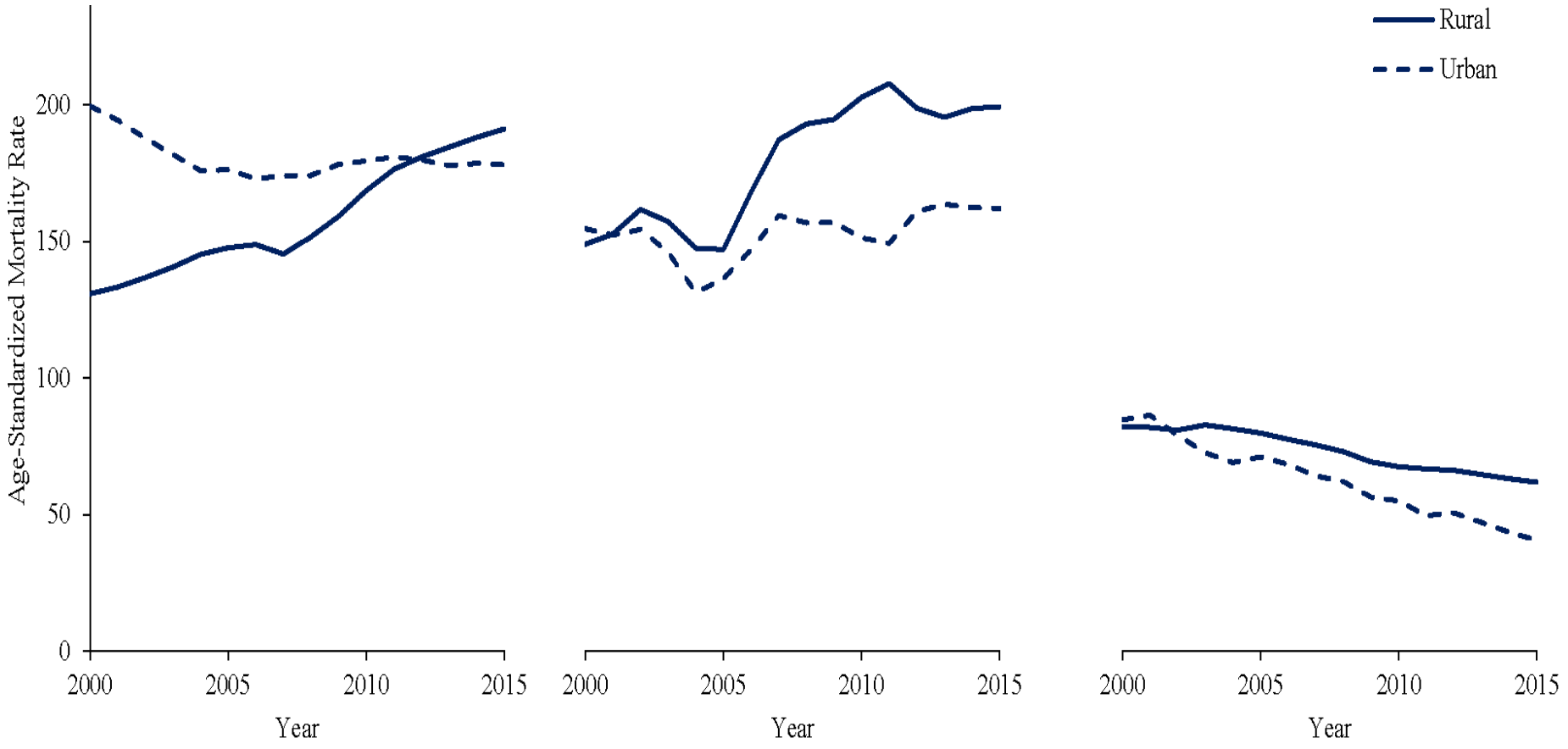


High burden stroke states: 1/3 of national stroke total, 1/6th of population

cghr

Ke et al, Lancet GH 2018

INDIA: Trends in age-standardized mortality rates by residence, 2000-2015, ages 30-69



cghr

Ke et al, Lancet GH 2018

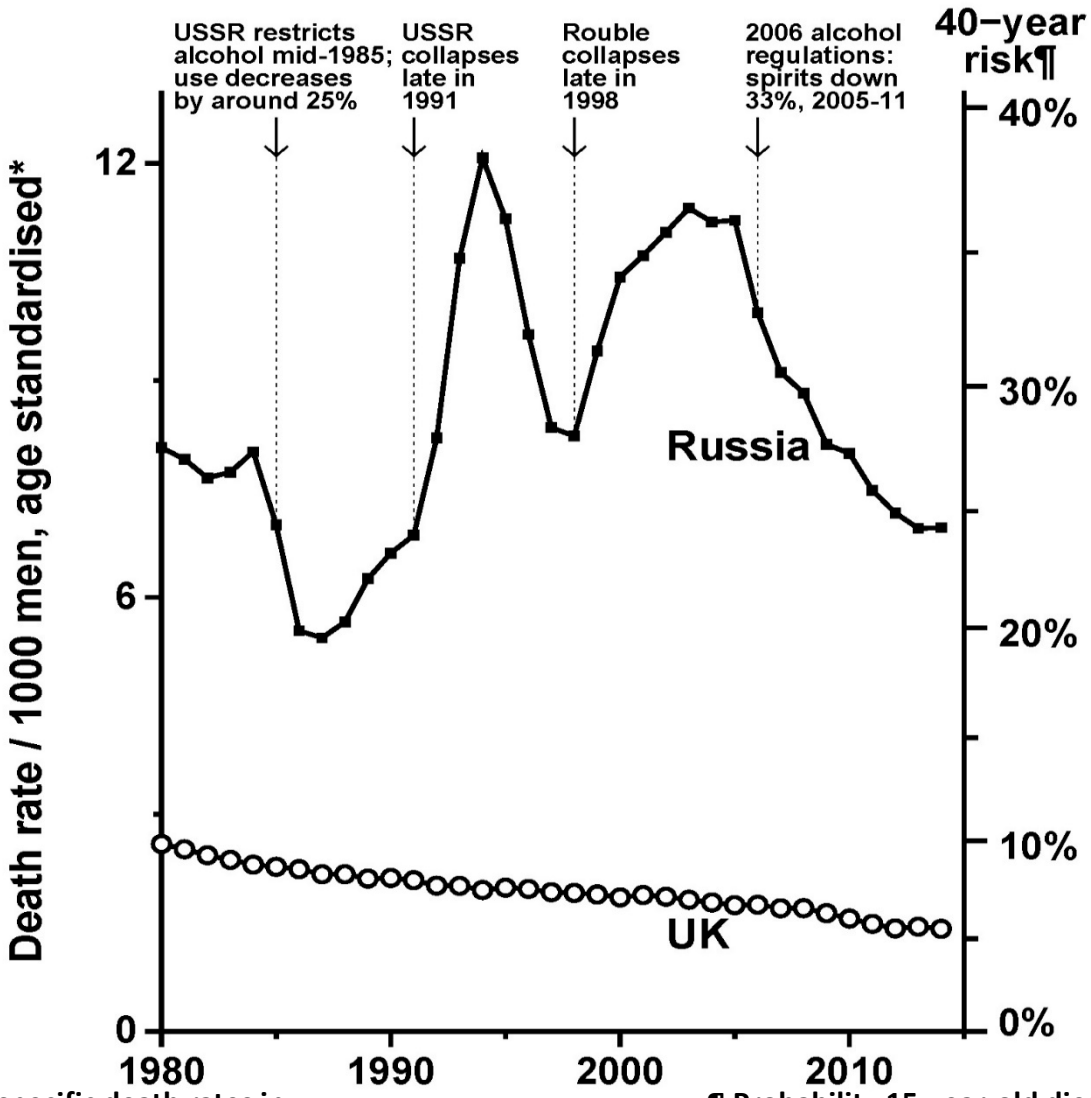
Worldwide no of smokers, drinkers and obese (B=billions, M=millions)

Exposure	No.	Annual deaths
Smoking	1.3 B	5-6 M
Drinking	2.0 B	2 M
Obese (BMI>30)	0.6 B	~ 1.5 M

cghr

WHO 2017

Russia and UK, 1980-2014, MALE: All-cause mortality at ages 15-54



*** Mean of the age-specific death rates in 8 component 5-year age groups of 15-54.**
WHO/Eurostat deaths, UNPD populations

¶ Probability 15-year-old dies before age 55, at death rates of a particular calendar year.
Courtesy of H Pan, CTSU, Oxford University

Russian 1990s male death rate ratios ~1 bottle of vodka/day vs <1 bottle/week

2 x any medical cause

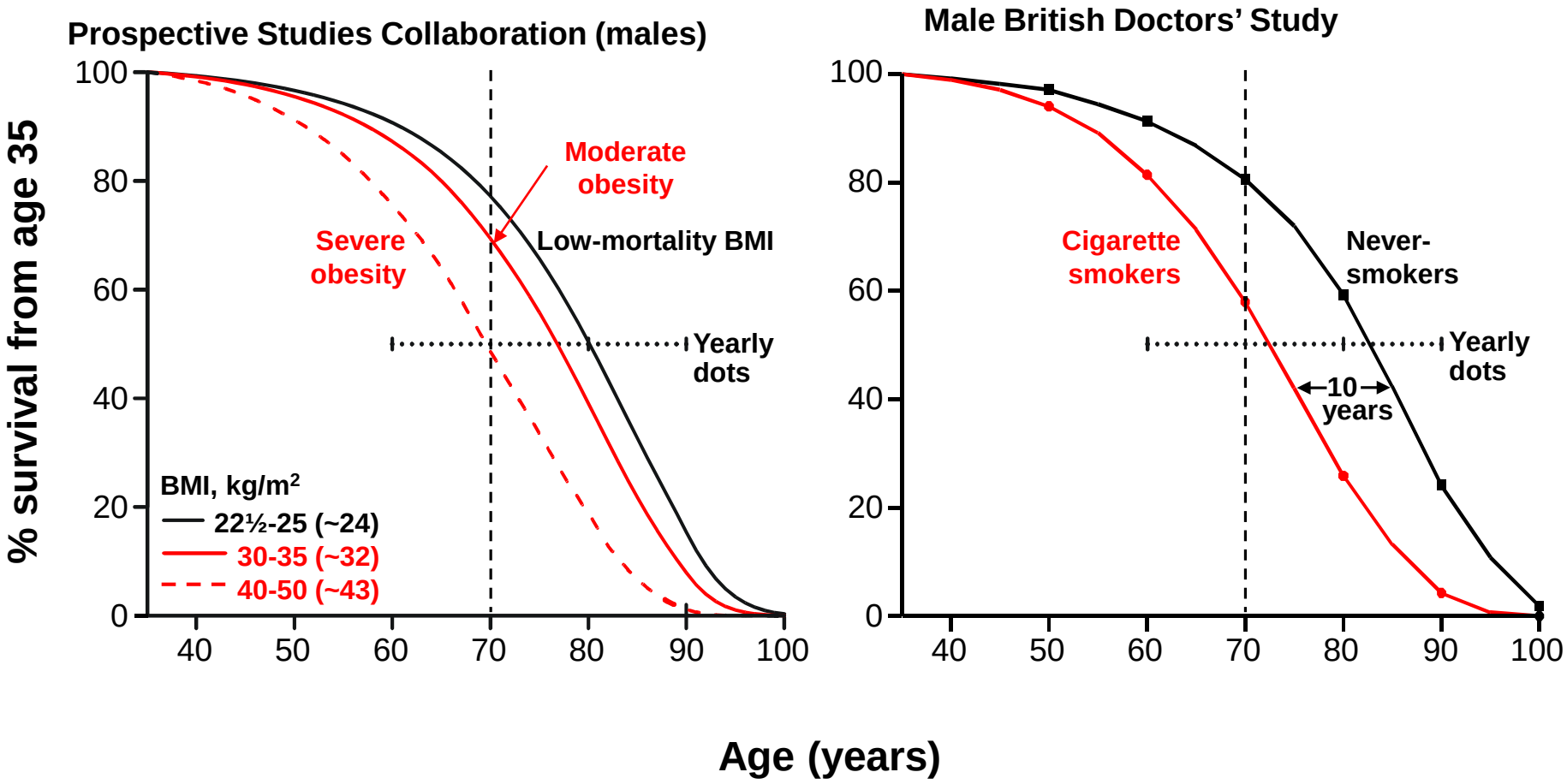
4 x road traffic accident
6 x any other accident

8 x suicide
10 x murder

Zaridze et al, Lancet 2009

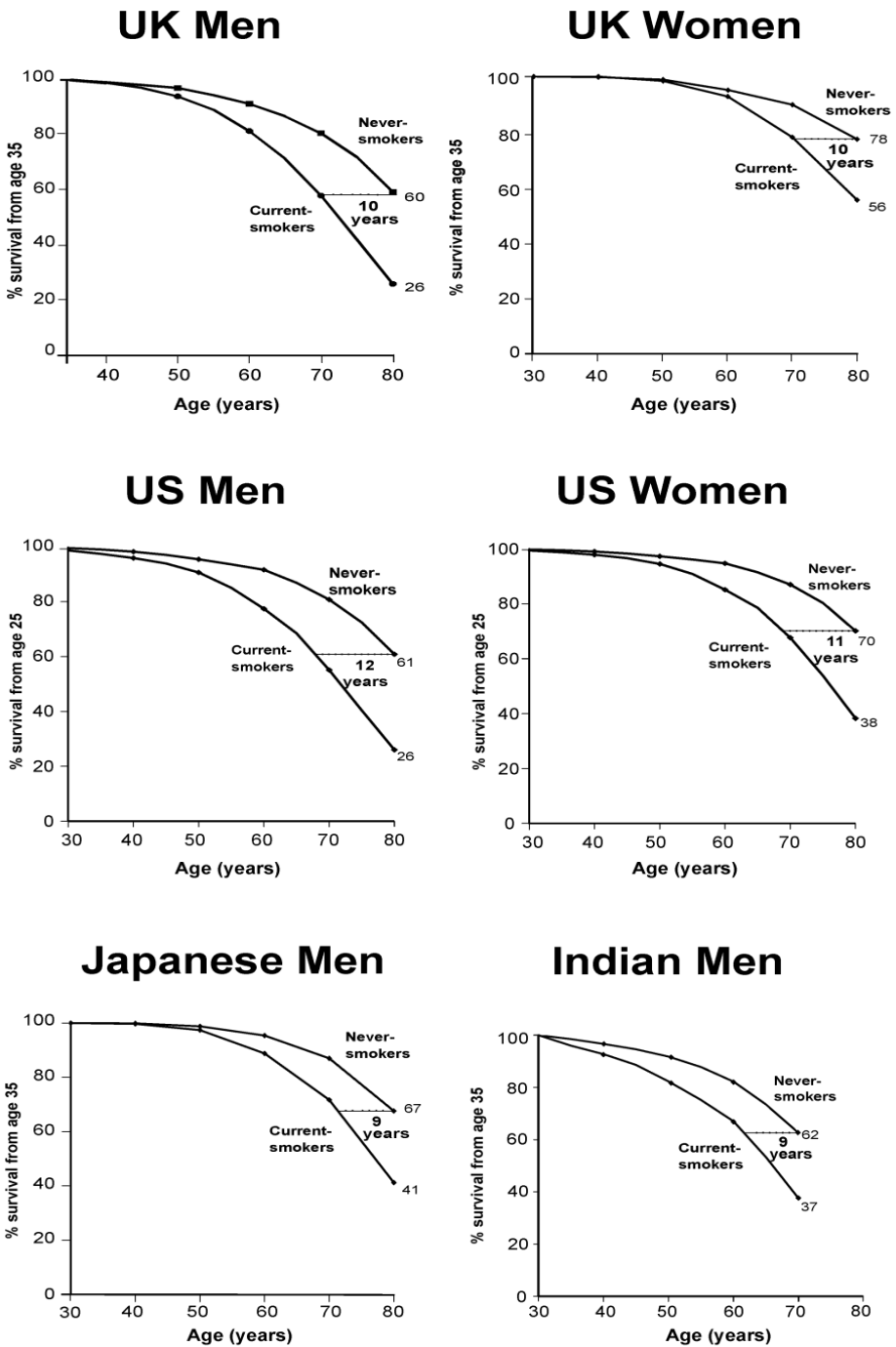
Life expectancy loss of 3 years with moderate obesity and 10 years with smoking

2 kg/m² extra BMI (if overweight) or 10% smoking prevalence shortens life by ~1 yr



Peto, Whitlock, Jha NEJM 2010

21st century hazards of cigarette smoking in 6 distinct populations

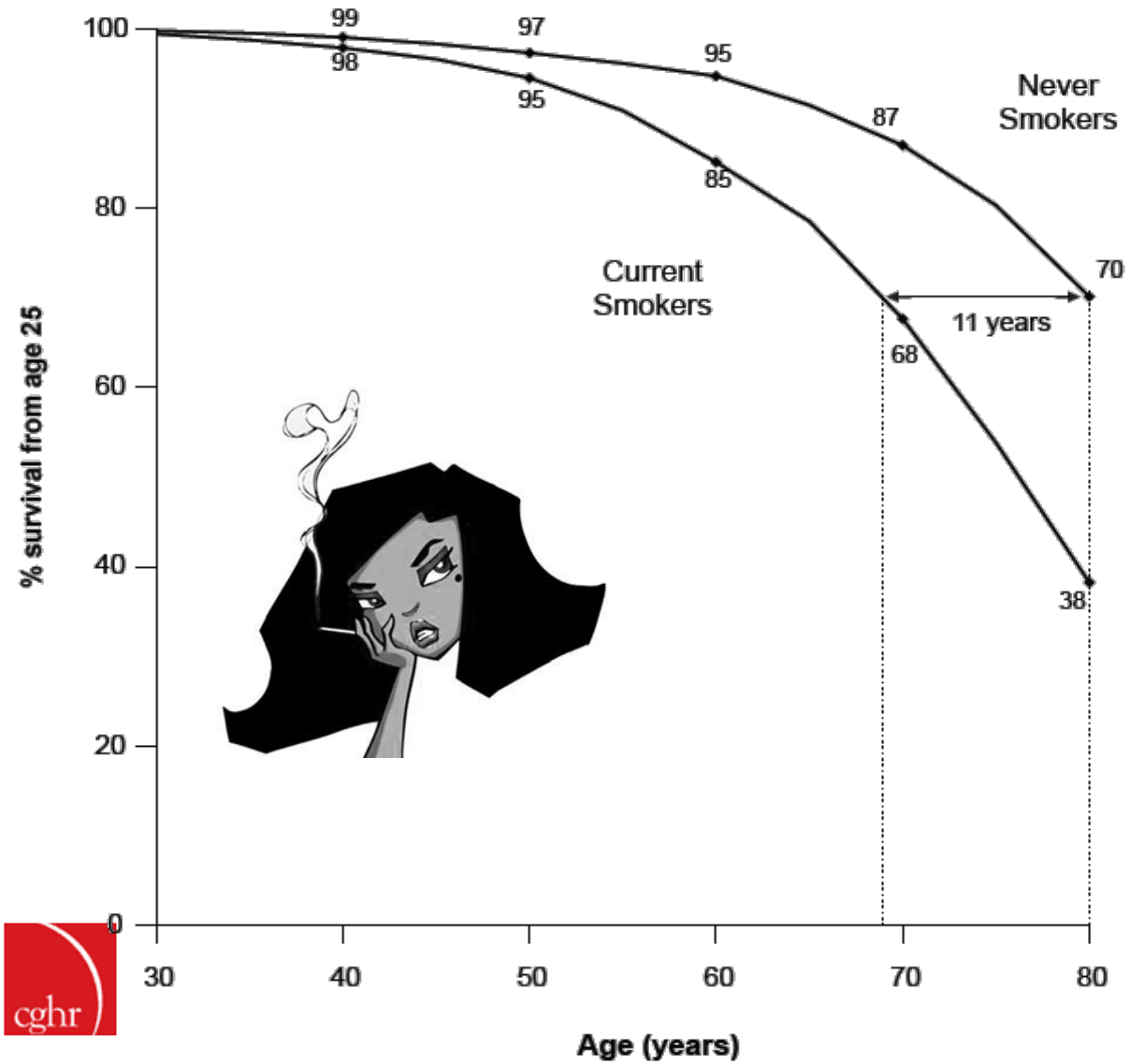


Jha and Peto, NEJM 2014


SLEEP
DEPRIVED

FEMALES: Survival probabilities

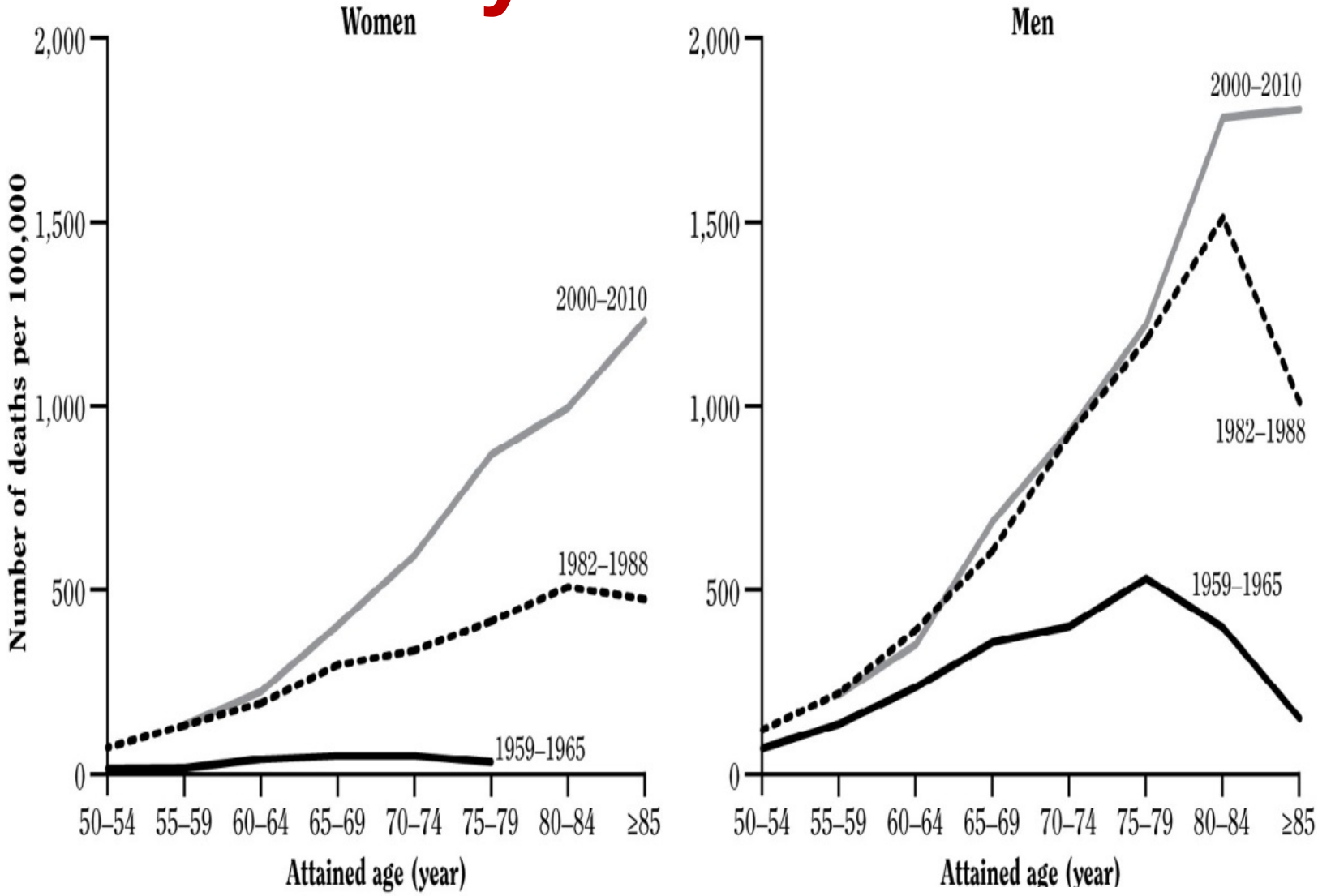
between ages 25 and 80 years among current and never-smokers in the US



HR adjusted for age, education, alcohol, adiposity (BMI), scaled to 2004 national rates, but comparable results if only actual cohort used

Jha et al, NEJM 2013

US smoker: non-smoker lung cancer mortality risks over time



Source: USSGR 2014

CHINA and INDIA : 1 million tobacco deaths each per year during the 2010s

Source: Chen et al, Lancet 2014; Jha et al, NEJM 2008

cghr

China: Proportion of deaths among middle-aged males from smoking

1990s	12%
2010	20%
	(25% urban, 15% rural)
1998 Hong Kong +	33%
2030s China	33%

+ Hong Kong male smokers started smoking seriously 20 years before

Source: Chen, Peto, Lancet, 2015, Li, Peto et al, 1998, Lam et al, 2001, Peto 2001

cghr

INDIA: Years of life lost
among 30 year old smokers* (MDS results)

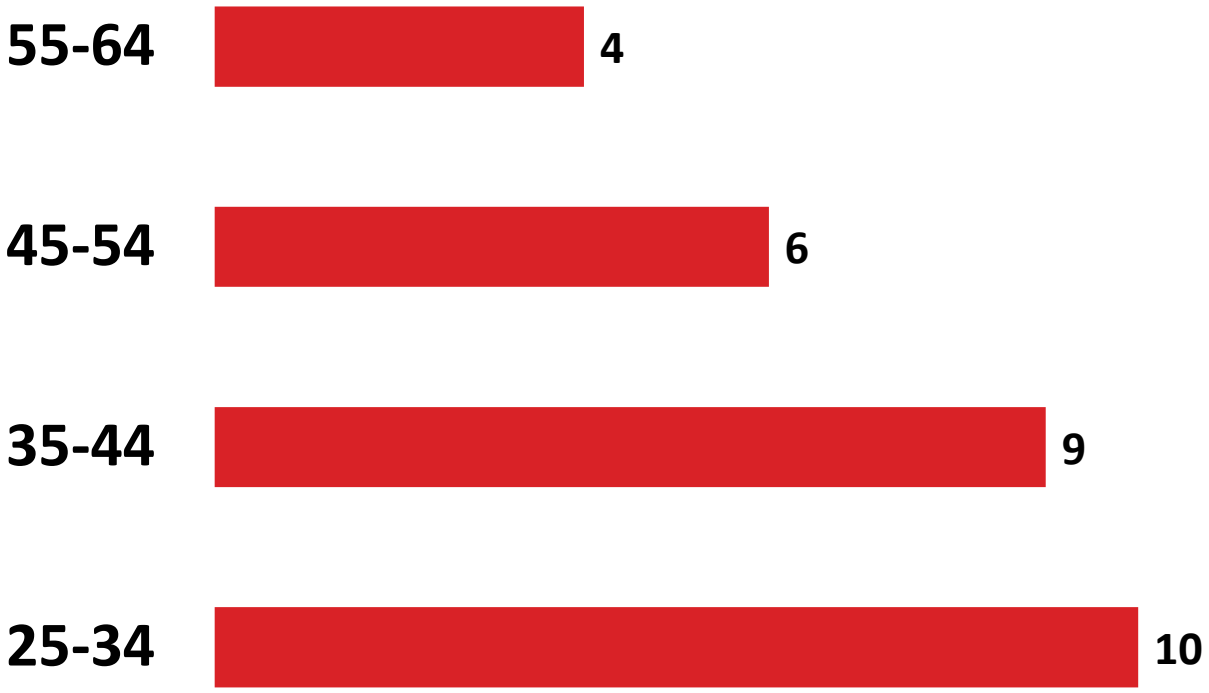
Men who smoke bidis	**6 years**
Women who smoke bidis	**8 years**
Men who smoke cigarettes	**10 years**

* At current risks of death versus non-smokers, adjusted for age, alcohol use and education (note that currently, few females smoke cigarettes)

cghr

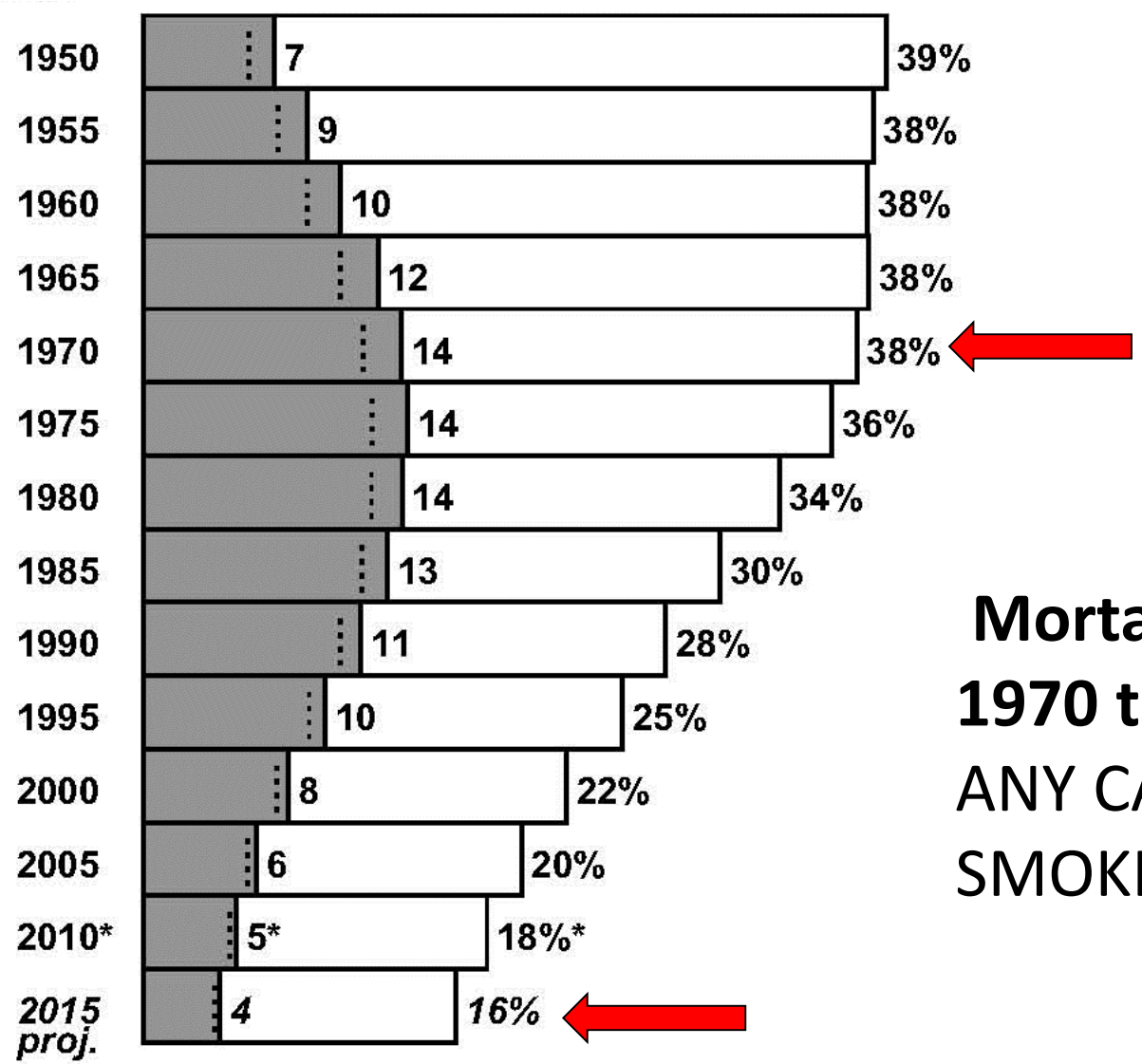
Jha et al, NEJM 2008

Years gained by quitting smoking by age



Jha et al NEJM, 2013

CANADA: Risk of a 35-year-old MAN dying by age 69 from smoking (shaded) or from any cause (shaded+white), 1950-2015



Mortality change: 1970 to 2015:

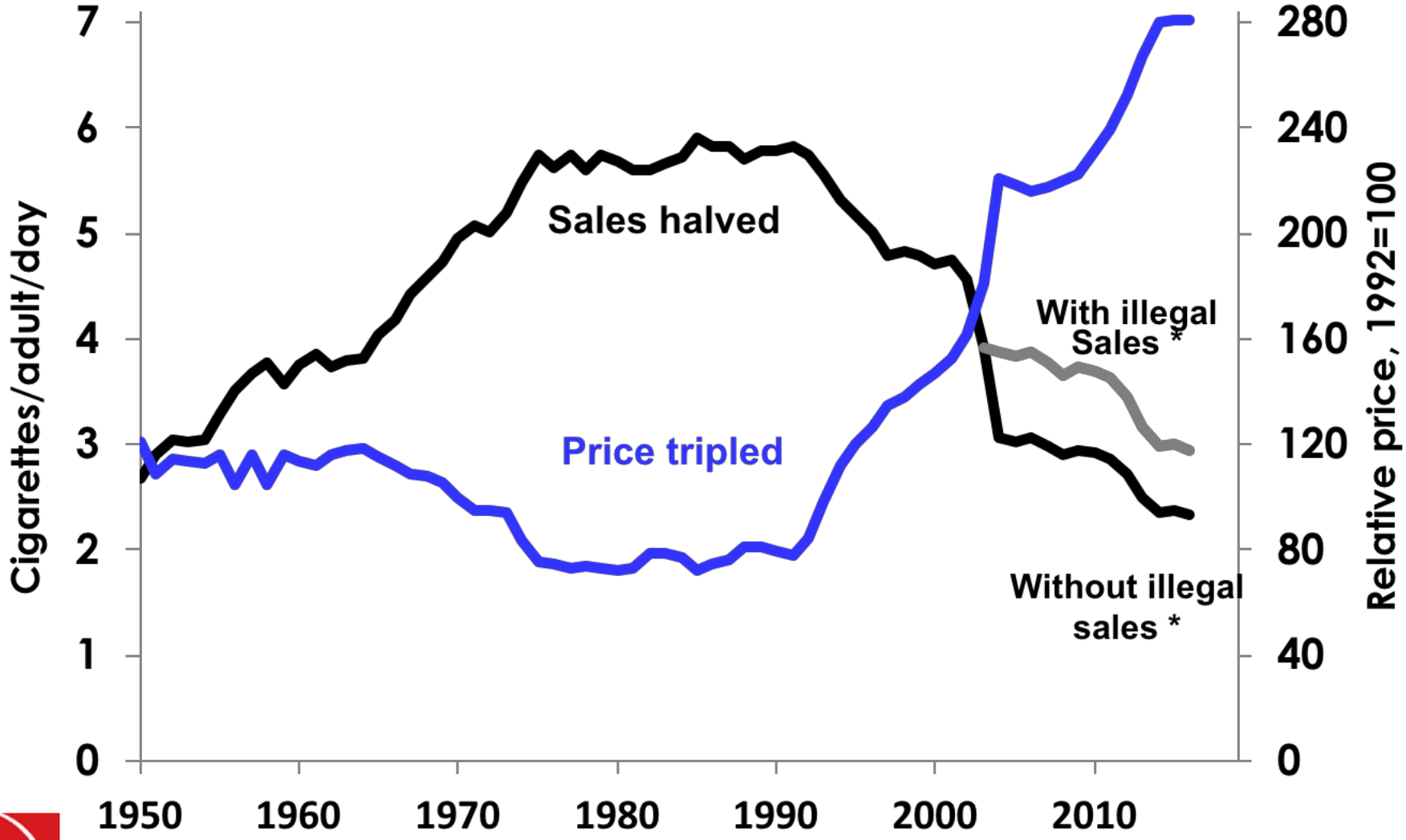
ANY CAUSE: ↓ 60%

SMOKING: ↓ 70%

Source: Peto et al, CTSU, 2016

cghr

Cigarette prices tripled, consumption halved, tax revenue doubled: FRANCE



* + cross border sales, contraband: Source Hill 2018

cghr

Implications

1. **Substantial expansion of UN role for measurement of levels and causes of adult mortality** (including adult mortality ref group)

2. **Low-cost nationwide mortality and risk factor SYSTEMS (e.g. MDS, COMSA) for direct evidence** (and to decrease reliance on models)

cghr

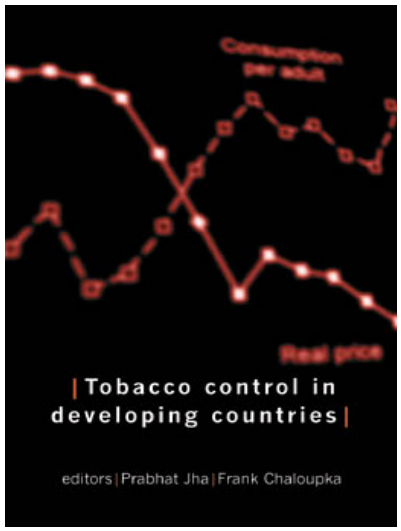
Conclusions

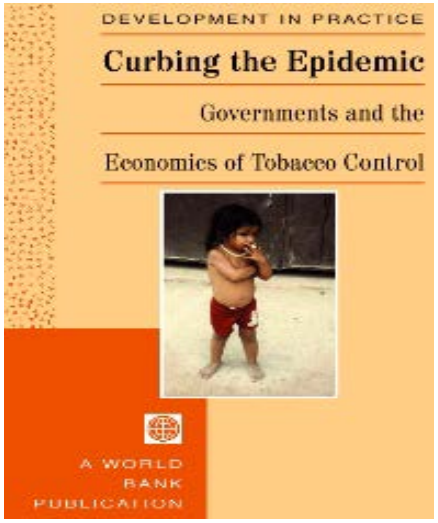
1. **Large reductions in** premature mortality have occurred over the last few decades (mostly driven by knowledge)

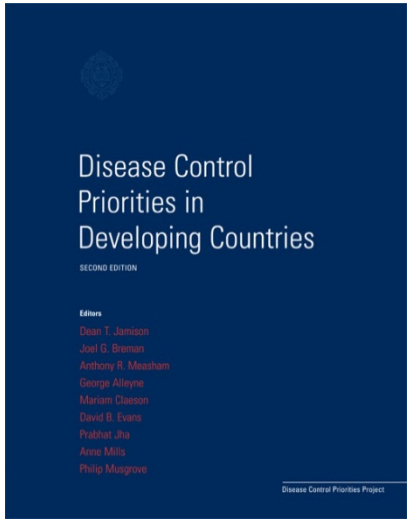
2. **Counting the dead and describing causes** is essential for future reductions in premature mortality: Three examples
   - **Child mortality**
   - **Vascular disease**
   - **Risk factors, most notably smoking**

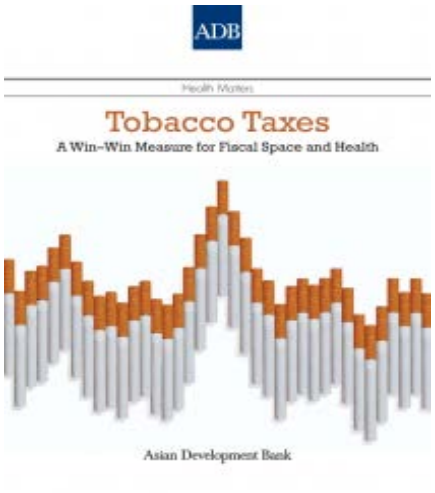
cghr

www.cghr.org
(Don't buy my books)





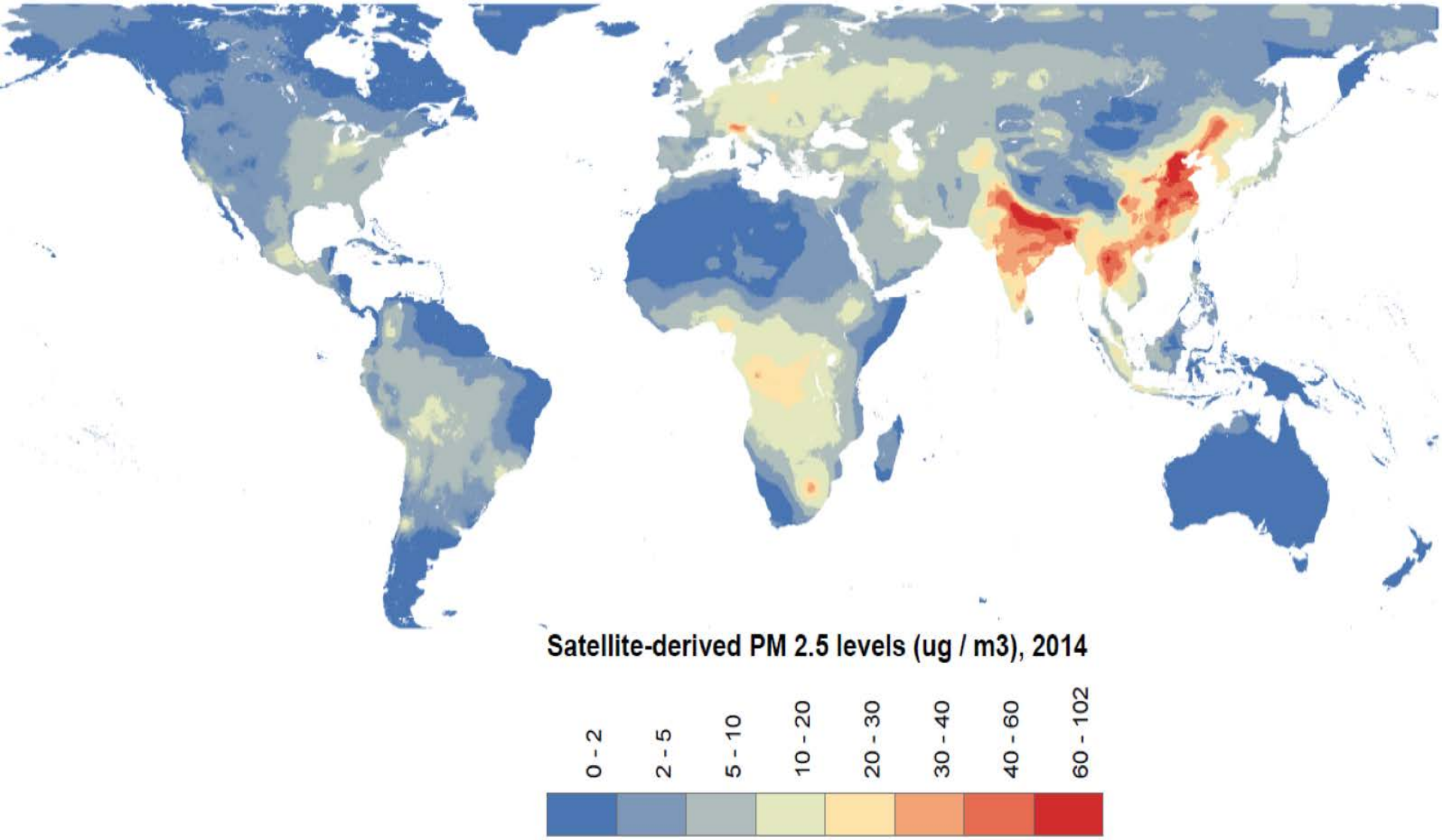




@countthedead

St. Michael's
Inspired Care.
Inspiring Science.

UNIVERSITY OF TORONTO



India reported 1.1 million deaths due to air pollution in 2015, says a global study

ENVIRONMENT

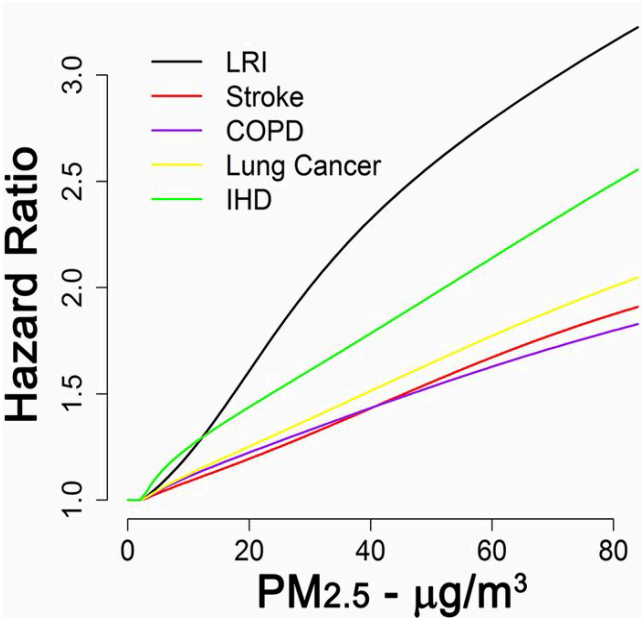
India overtook China in number of deaths due to pollution: Report

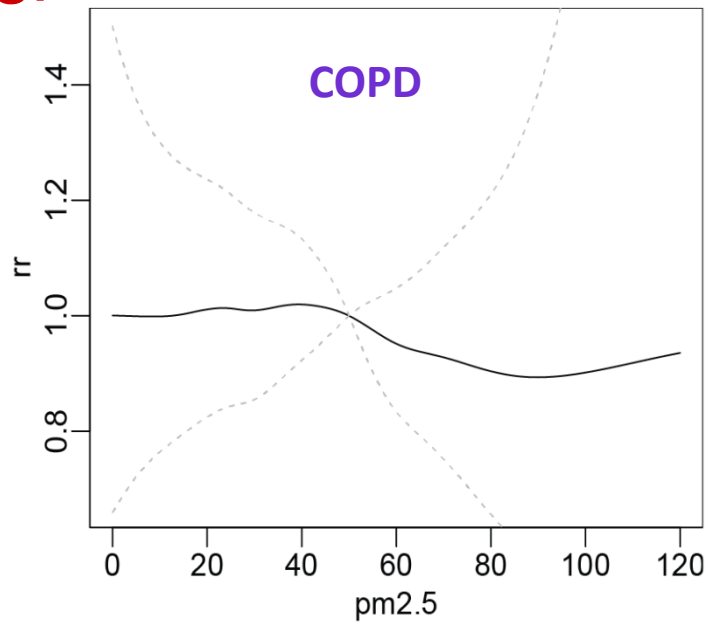
NEW DELHI NOVEMBER 16

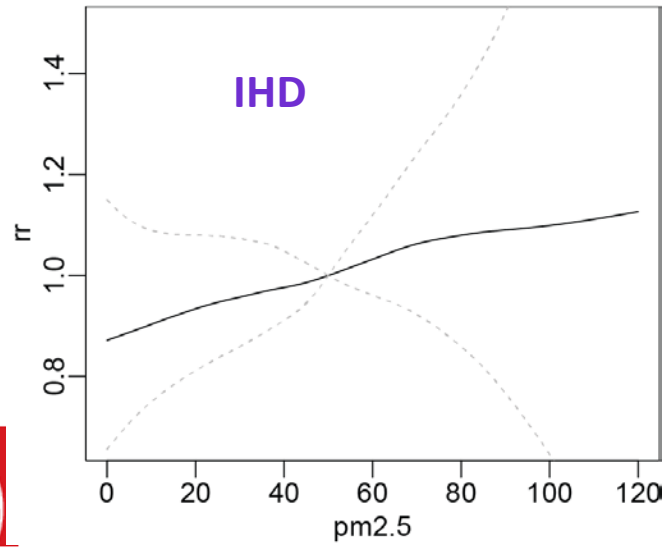
The Integrated Exposure Response (IER) forms the basis of the estimates of disease burden attributable to $PM_{2.5}$ (e.g., 4 million deaths in 2015) in the Global Burden of Disease, those of the World Health Organization and in the quantification of impacts of policy scenarios on projected improvements in population health burden and evaluation of air-quality standards.

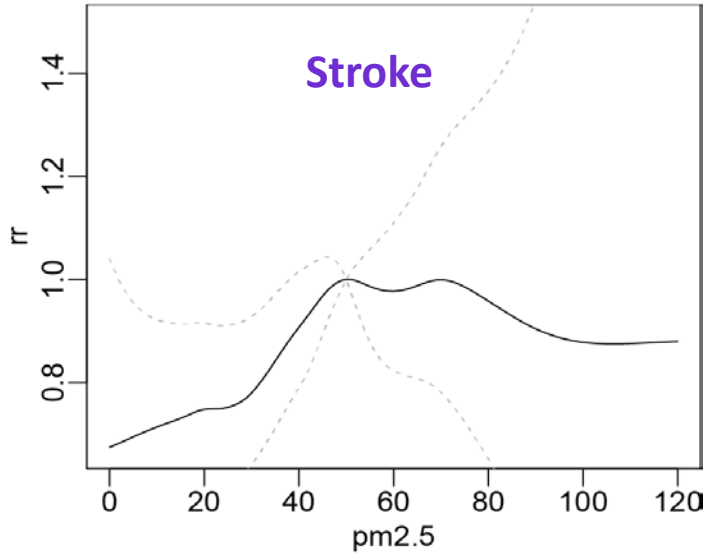
cghr

Risk ratios from ”IER” model of cohort studies, plus Second hand and active smoking, versus MDS direct estimates







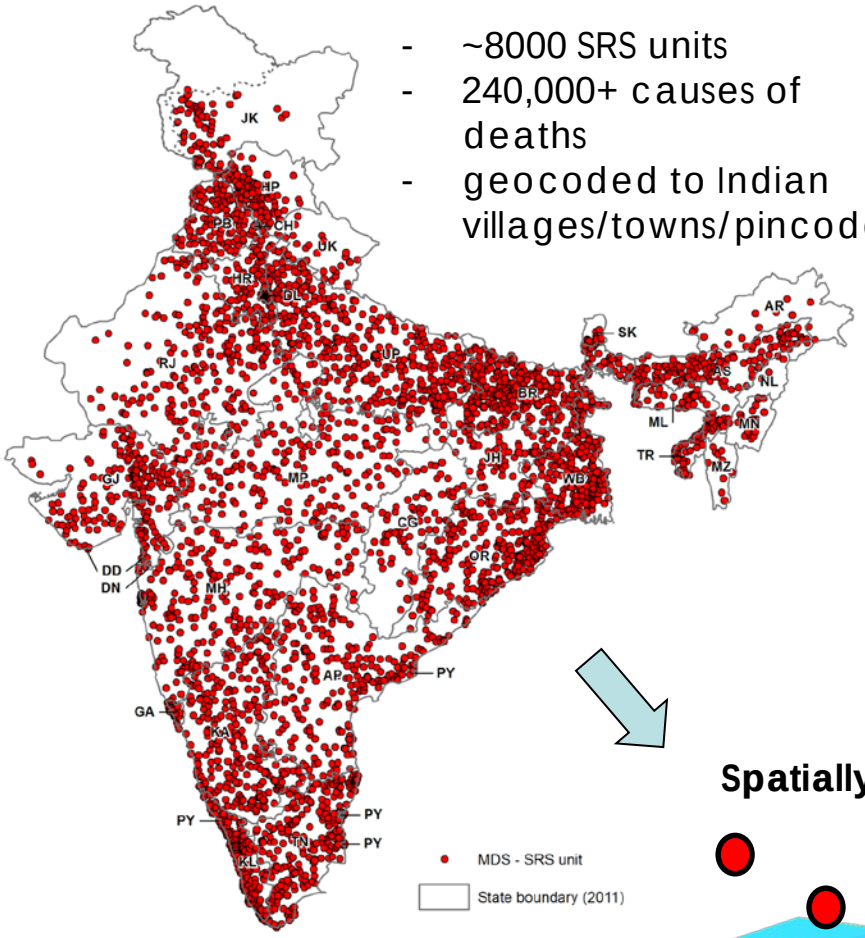


IER- Burnett et al. PNAS doi:10.1073/pnas.1803222115

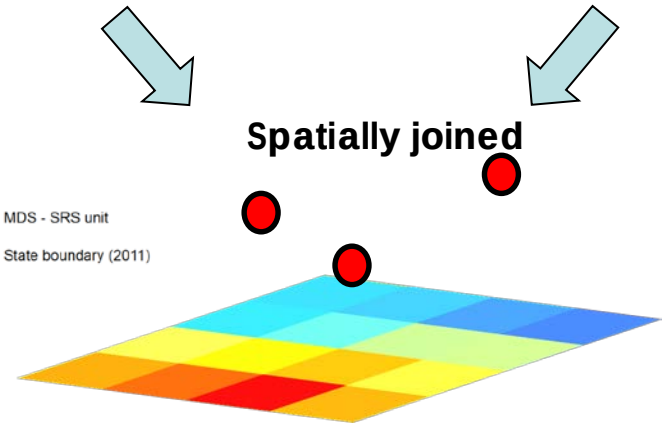
Data & Methods

Indian Million Death Study (MDS) 2001-13

- ~8000 SRS units
- 240,000+ causes of deaths
- geocoded to Indian villages/towns/pincodes

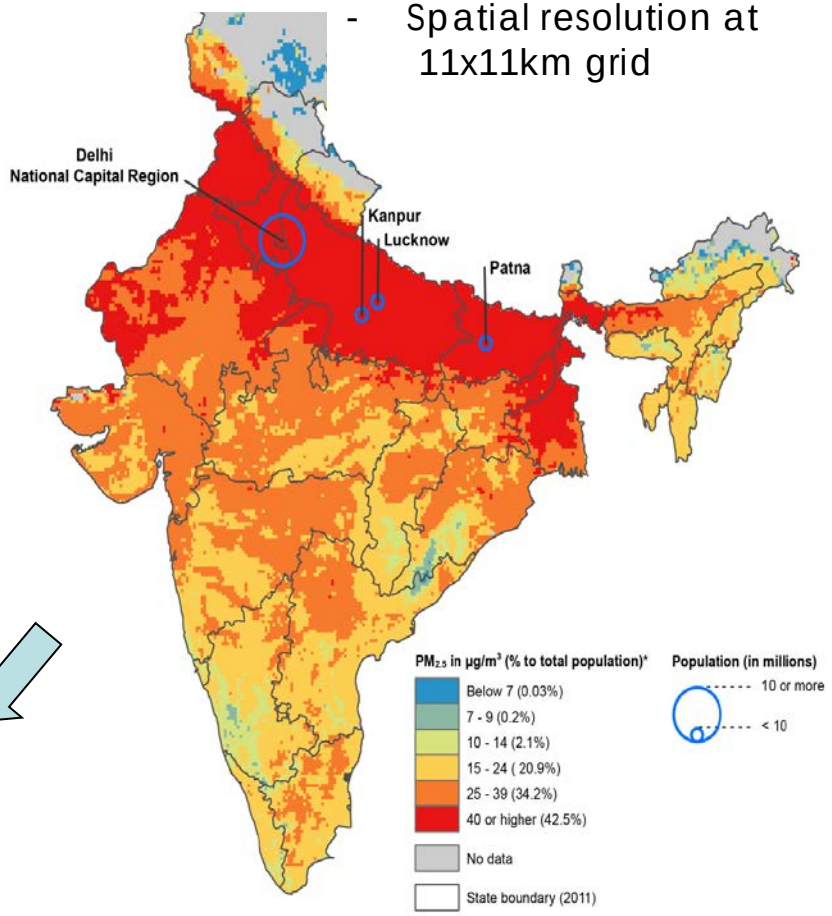


Spatially joined



Ambient $PM_{2.5}$, Brauer et al., 2012 (avg. 2010-12)

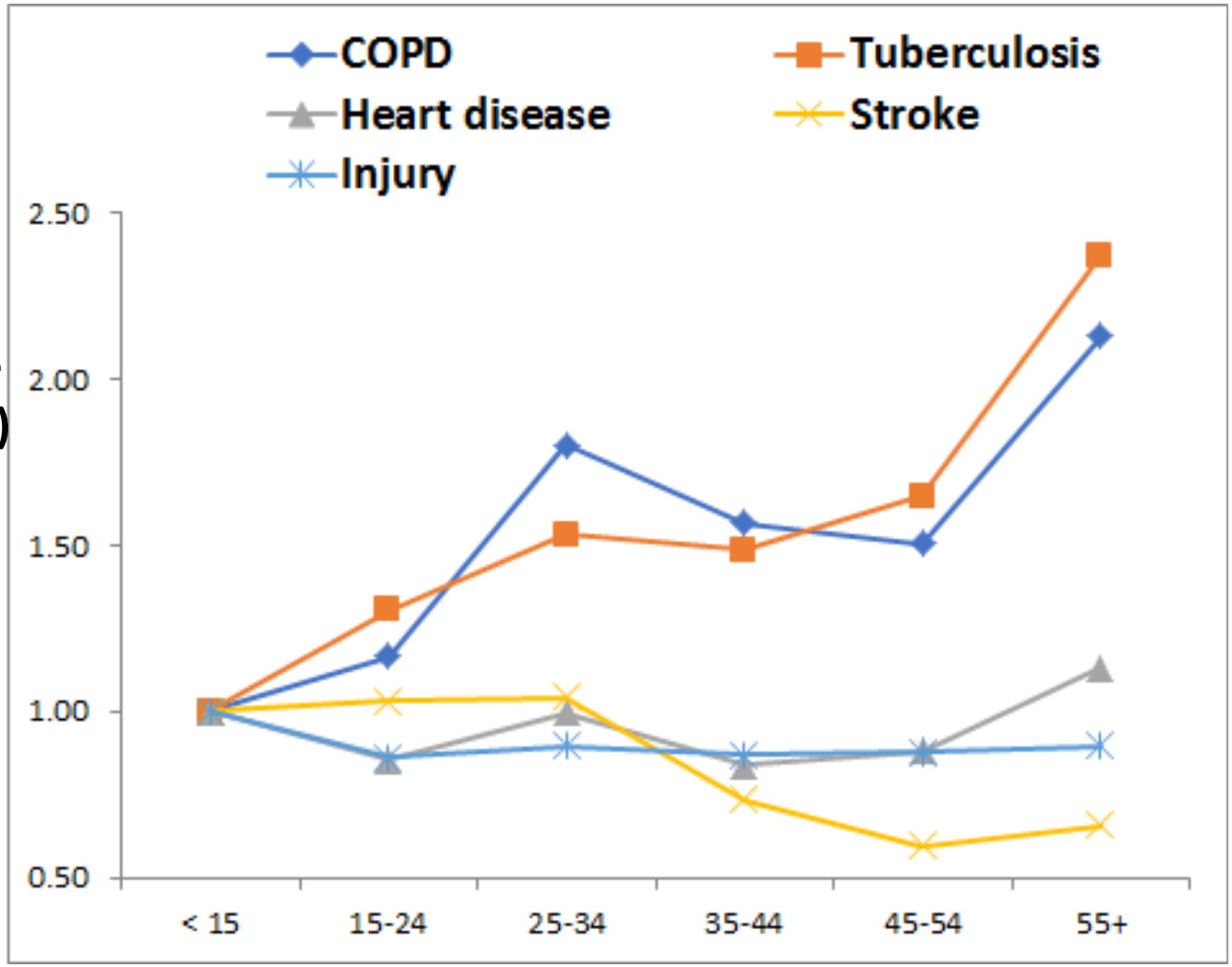
- Spatial resolution at 11x11km grid



cghr

Maher et al, CGHR

Method #1: 2001-3 age-standardized death rates by level of PM2.5 exposure in 1998



Death rate ratio (DRR)

PM 2.5

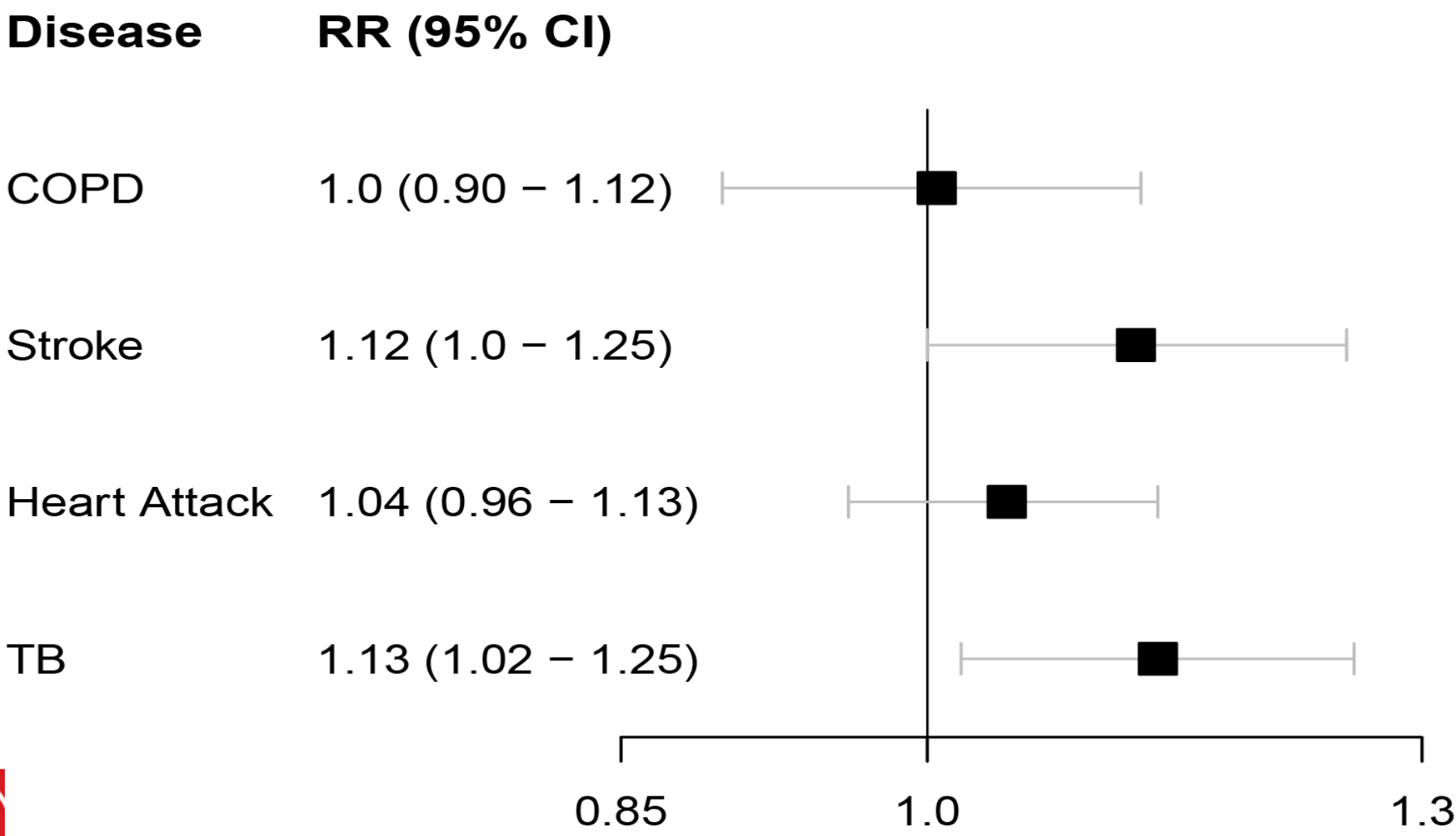
Maher et al, CGHR

Method #2

- Prospective study: PM 2.5 satellite measured 3 years (ranges 1-6 years) prior to deaths
- Nationally-representative causes of death (use subset of 2 doctors immediately use same diagnosis) 15-69 years
  - Cases: IHD, stroke, COPD, TB
  - Controls: Injury deaths excluding suicide (narrow or broad definitions)
- Adjustment for age, sex, rural/urban, smoking, female literacy, scheduled cast, religion, dominant language group **AND clustering** of PM 2.5 (e.g. north) and of disease (e.g. IHD more in south)
- Various sensitivity analyses of all key parameters

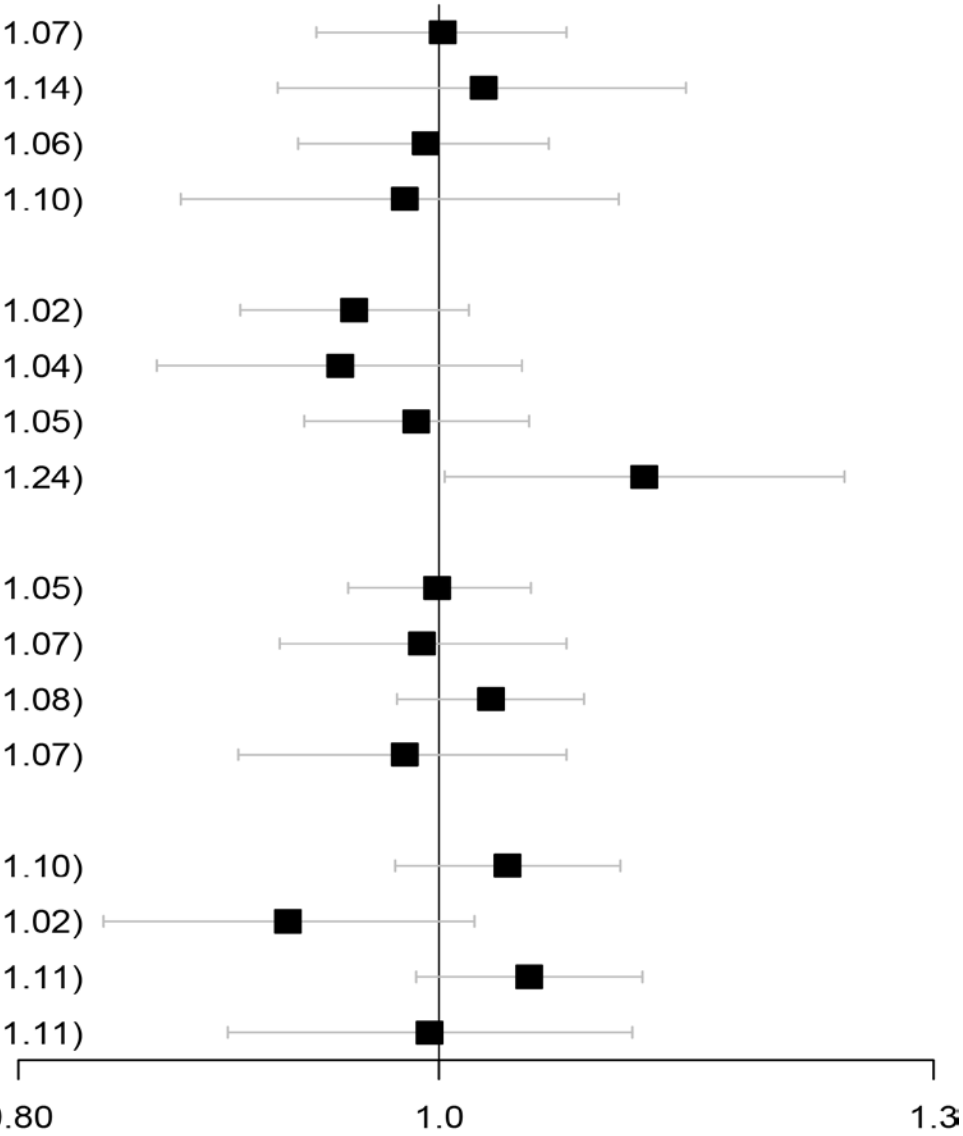
cghr

2001-13 deaths vs injury control deaths relative risk per 20 unit PM 2.5 increase: Males and females combined



Dose response relationship of causes of death and $PM_{2.5}$

Disease	($\mu g/m^3$)	RR (95% CI)
COPD		
	< 15	1.00 (0.94 – 1.07)
	15 – 24	1.02 (0.92 – 1.14)
	25 – 39	0.99 (0.93 – 1.06)
	40+	0.98 (0.87 – 1.10)
Stroke		
	< 15	0.96 (0.90 – 1.02)
	15 – 24	0.95 (0.86 – 1.04)
	25 – 39	0.99 (0.93 – 1.05)
	40+	1.12 (1.00 – 1.24)
Heart Attack		
	< 15	1.00 (0.95 – 1.05)
	15 – 24	0.99 (0.92 – 1.07)
	25 – 39	1.03 (0.98 – 1.08)
	40+	0.98 (0.90 – 1.07)
TB		
	< 15	1.04 (0.98 – 1.10)
	15 – 24	0.92 (0.84 – 1.02)
	25 – 39	1.05 (0.99 – 1.11)
	40+	1.00 (0.89 – 1.11)



Maher et al, CGHR

World, 2015: Future deaths among 130 M births/year

Age range	Deaths (in M)	Births (130M) and expected deaths
0-4	~6	~6
5-49	~10	~11
50-69	~14	~33
(70+)	(~25)	(~80)

M = Million

Untied Nations, 2017