Halving premature death

**Richard Peto, CTSU,
University of Oxford**

Halving premature death
(ie, death before age 70)
worldwide

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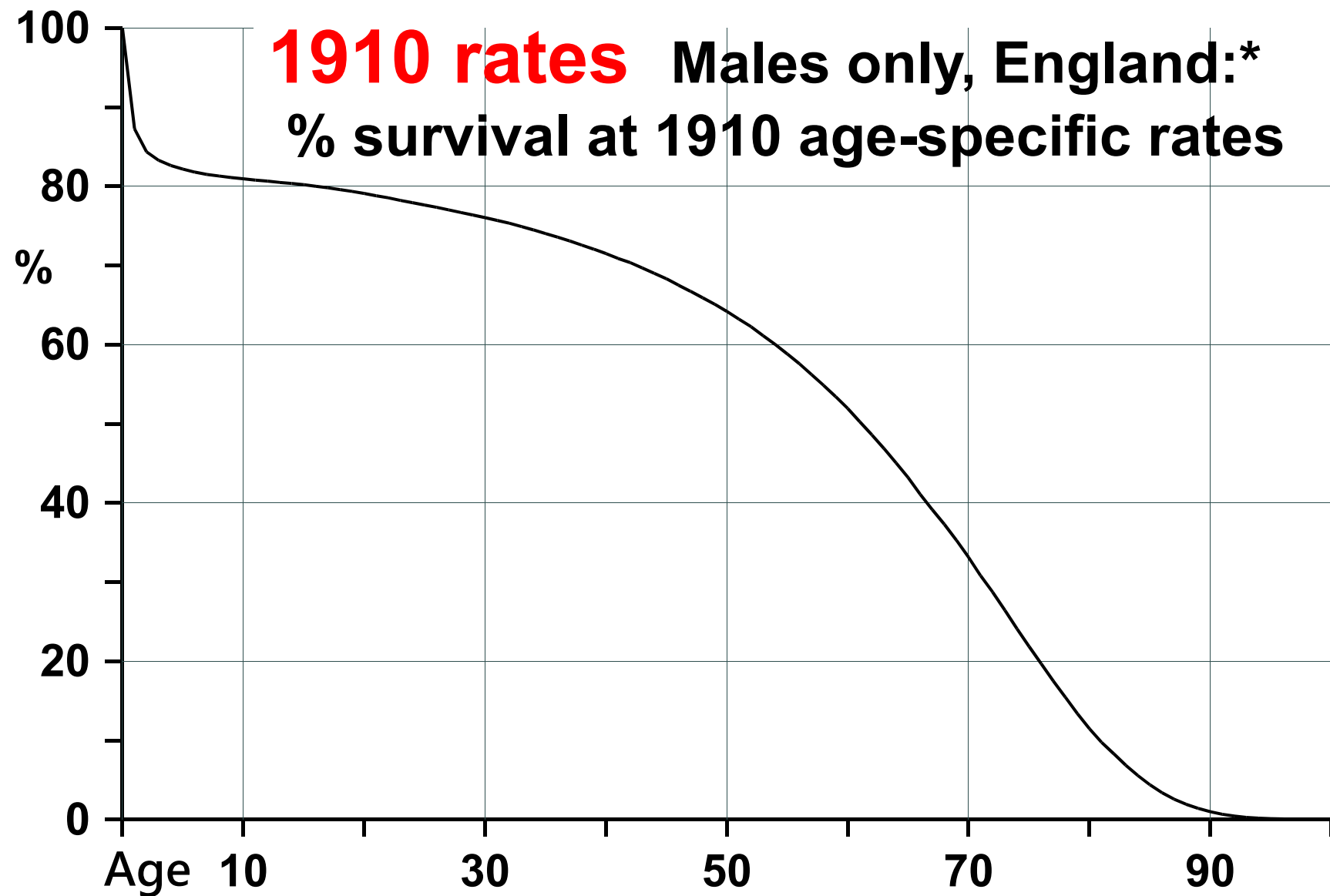# Death in old age is inevitable, but death before old age is not

Death in old age is inevitable, but death before old age is not

Consider separately 3 age ranges in which the main causes differ

(eg, ages 0-4, 5-49, 50-69: the exact cut-points don't matter)

Mortality in England in 1910, 1960 and 2010

Note risks by ages 5, 50 & 70

1910 rates Males only, England:*
% survival at 1910 age-specific rates
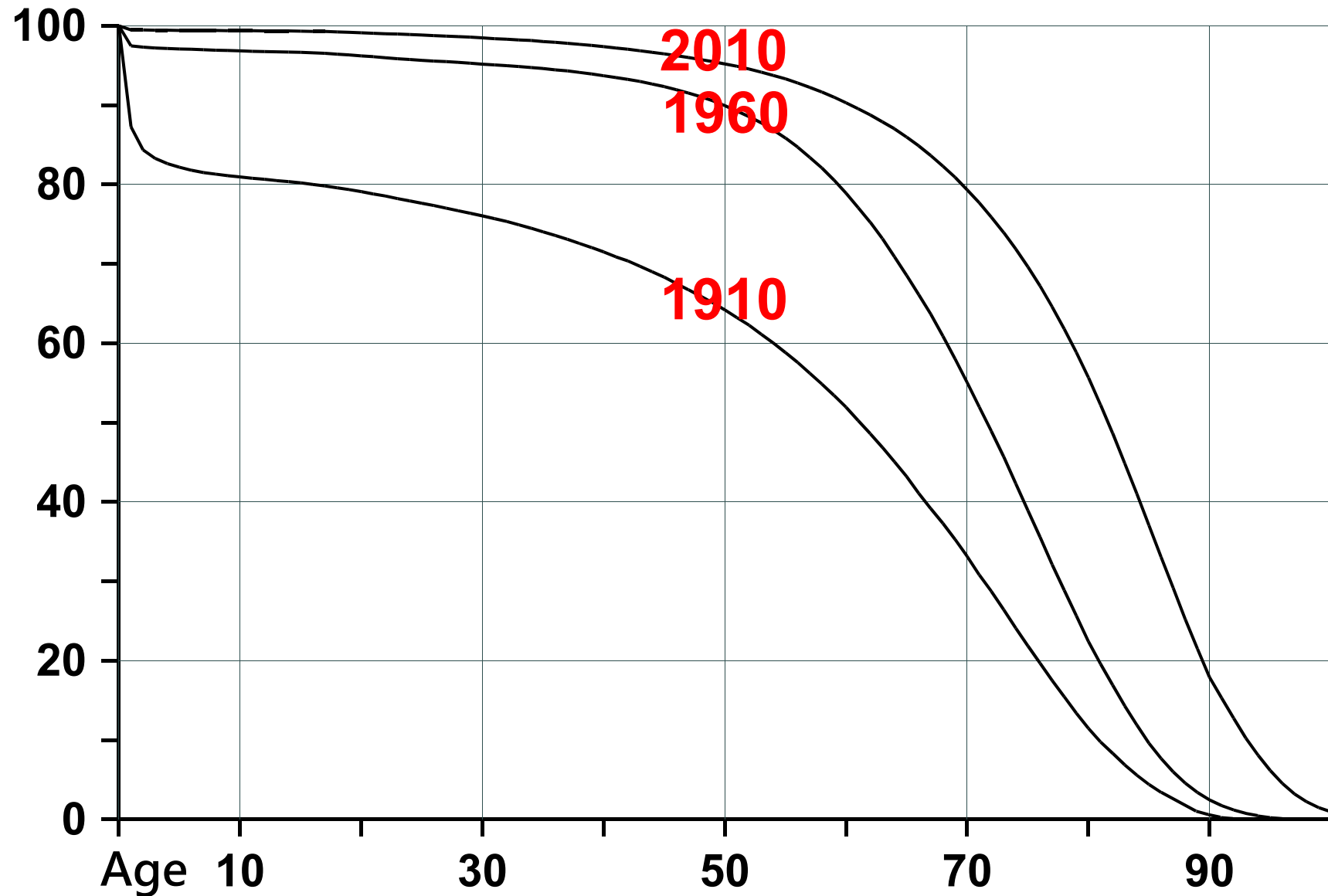
* England + Wales: Gary Whitlock, CTSU, from Registrar-General & Human Mortality Database

1960 rates Males, England:
% survival at period rates

England + Wales. Gary Whitlock, CTSU, from Registrar-General & Human Mortality Database

100 —

%

80 —

60 —

40 —

20 —

0 —

2010 rates **Males, England:**
% survival at period rates

Age 10   30   50   70   90

England + Wales. Gary Whitlock, CTSU, from Registrar-General & Human Mortality Database

Males, England: % survival at period rates

2010

1960

1910
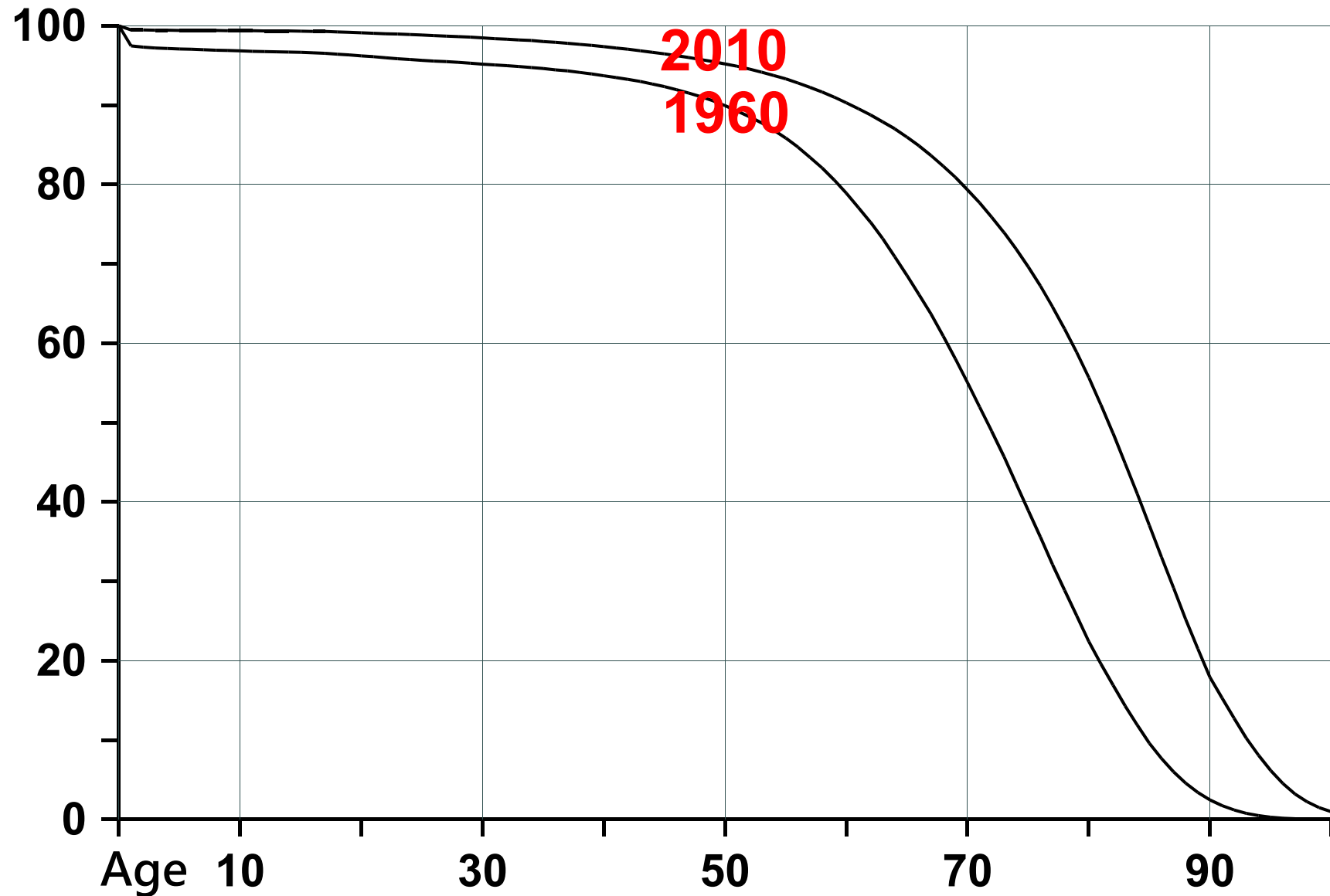
England + Wales. Gary Whitlock, CTSU, from Registrar-General & Human Mortality Database

Males, England: % survival at period rates

2010

1960

100

80

60

40

20

0

Age 10   30   50   70   90

England + Wales. Gary Whitlock, CTSU, from Registrar-General & Human Mortality Database

**Population risk of a 35−year−old dying at ages 35−69
from smoking (shaded) or from any cause (shaded and white)**

*eg, at year 2010 male death rates, out of 100 men aged 35, 19 would
die before age 70 (with 4 of these deaths attributed to smoking)

MALE

Year		
1960	19	42%
1970	19	41%
1980	15	37%
1990	11	31%
2000	6	24%
2010*	4*	19%*
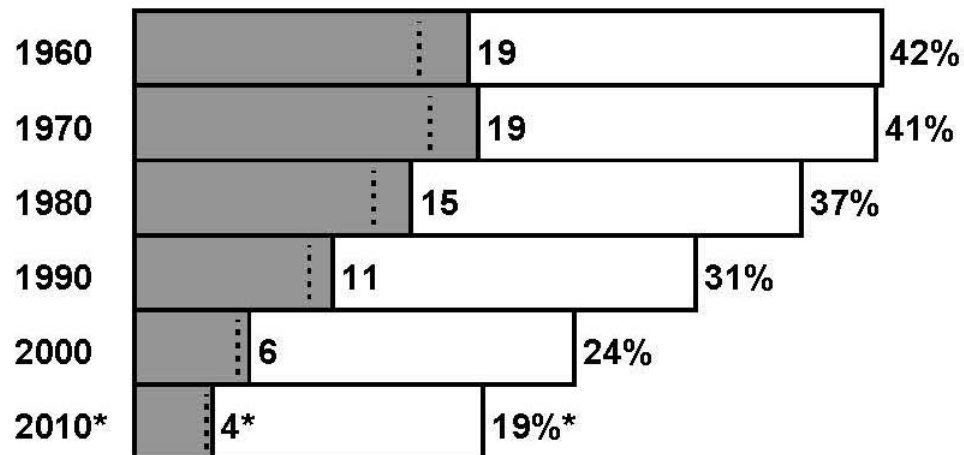
Note: Most of those killed by smoking would otherwise have survived beyond age 70,
but a minority (shaded area to right of dotted line) would have died by 70 anyway

Female

Male

2010 rates by sex, England:
% survival at period rates

100

%

80

60

40

20

0

Age 10   30   50   70   90
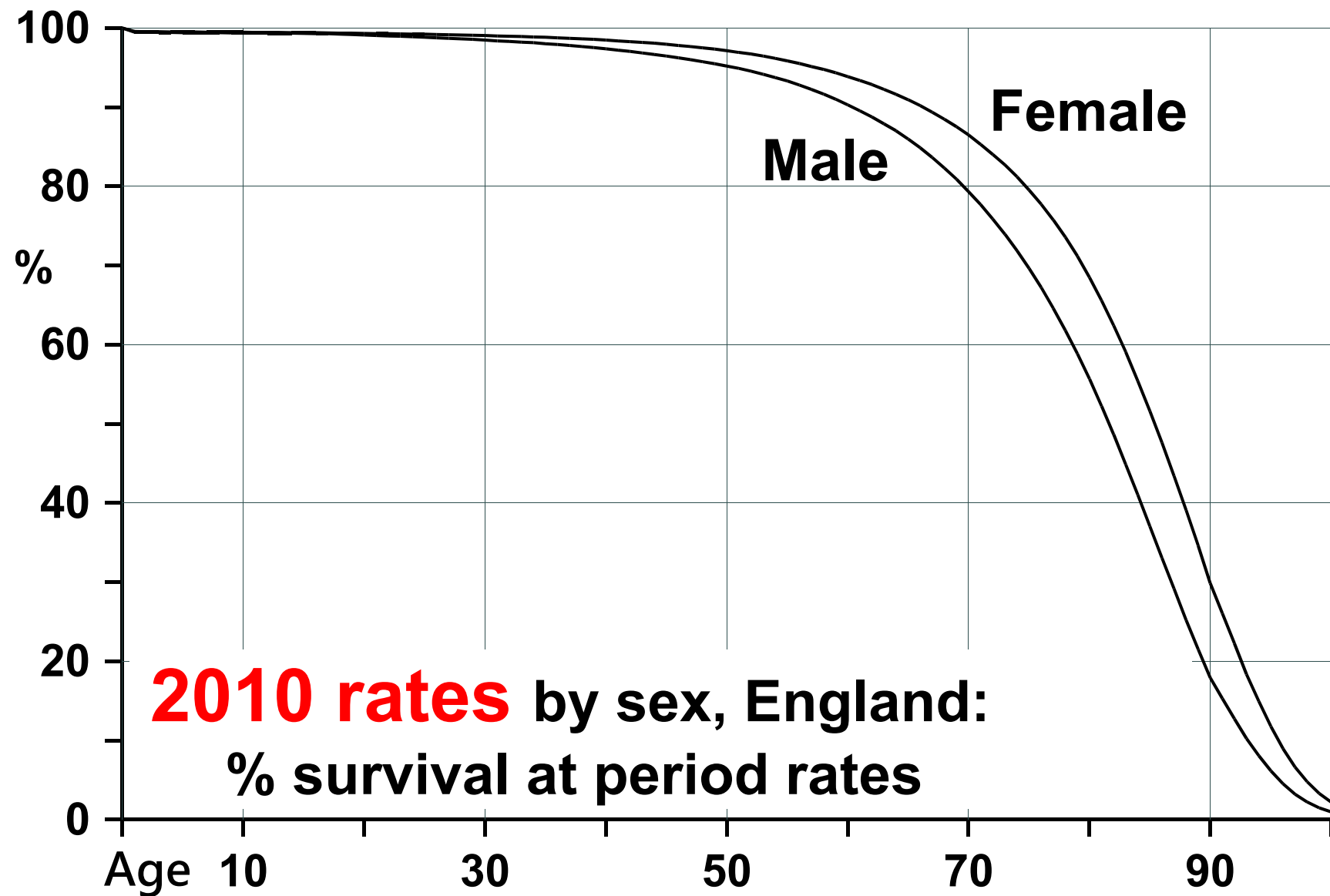
England + Wales. Gary Whitlock, CTSU, from Registrar-General & Human Mortality Database

Worldwide childhood mortality (age<5) decreasing, 1950-2010

Year	Approximate <5 mortality
1950	25%
1970	14%
1990	9%
2010	5%*
	(* 7M deaths/ ~130M births)

Sources: Lancet (AD Lopez, online 10 Sep 2009, & GBD for 2010)

World, 1970 & 2010: Risk of death by age, both sexes
(Red: risks in England & Wales, 1910 and 2010)

World 1970

World 2010

Risk

Age
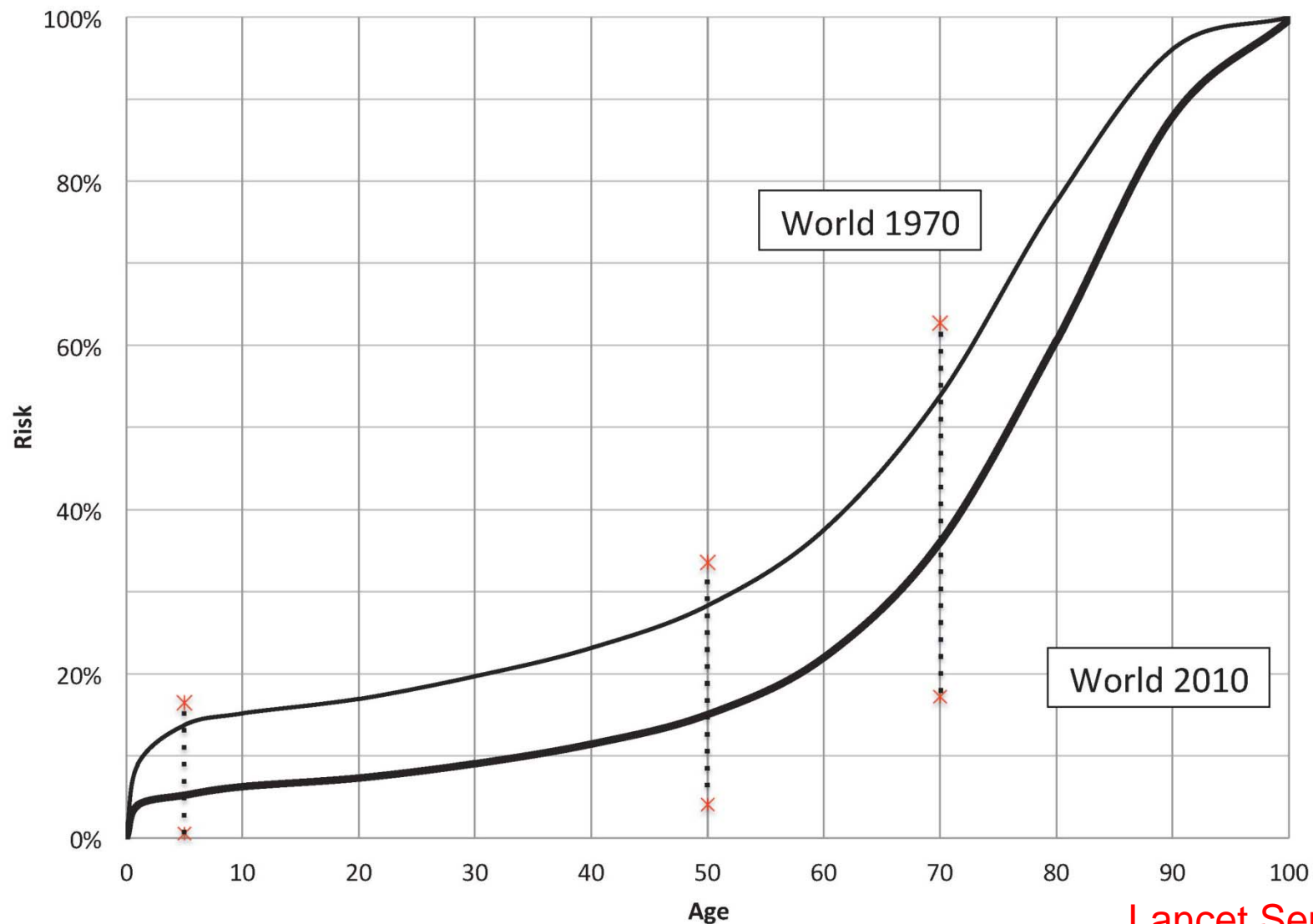
Lancet Sep19, 2014

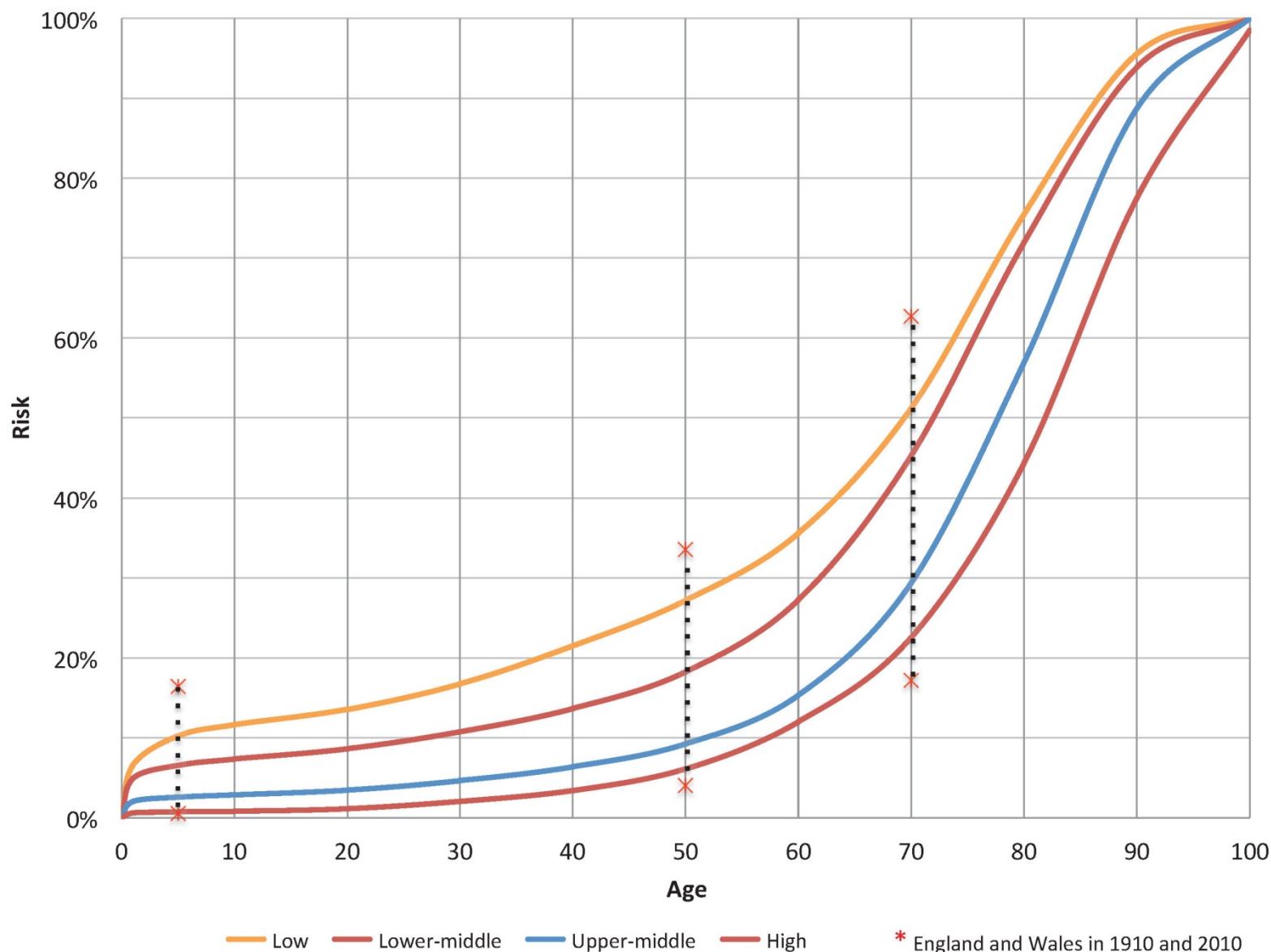# 40-year trends, 1970-2010 (● = 2010), in risk of dying in selected age ranges
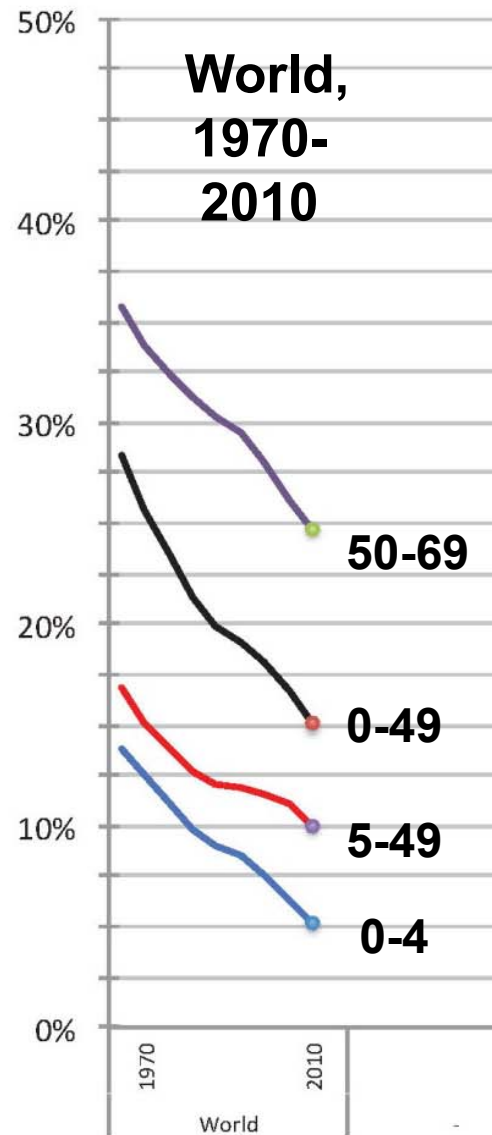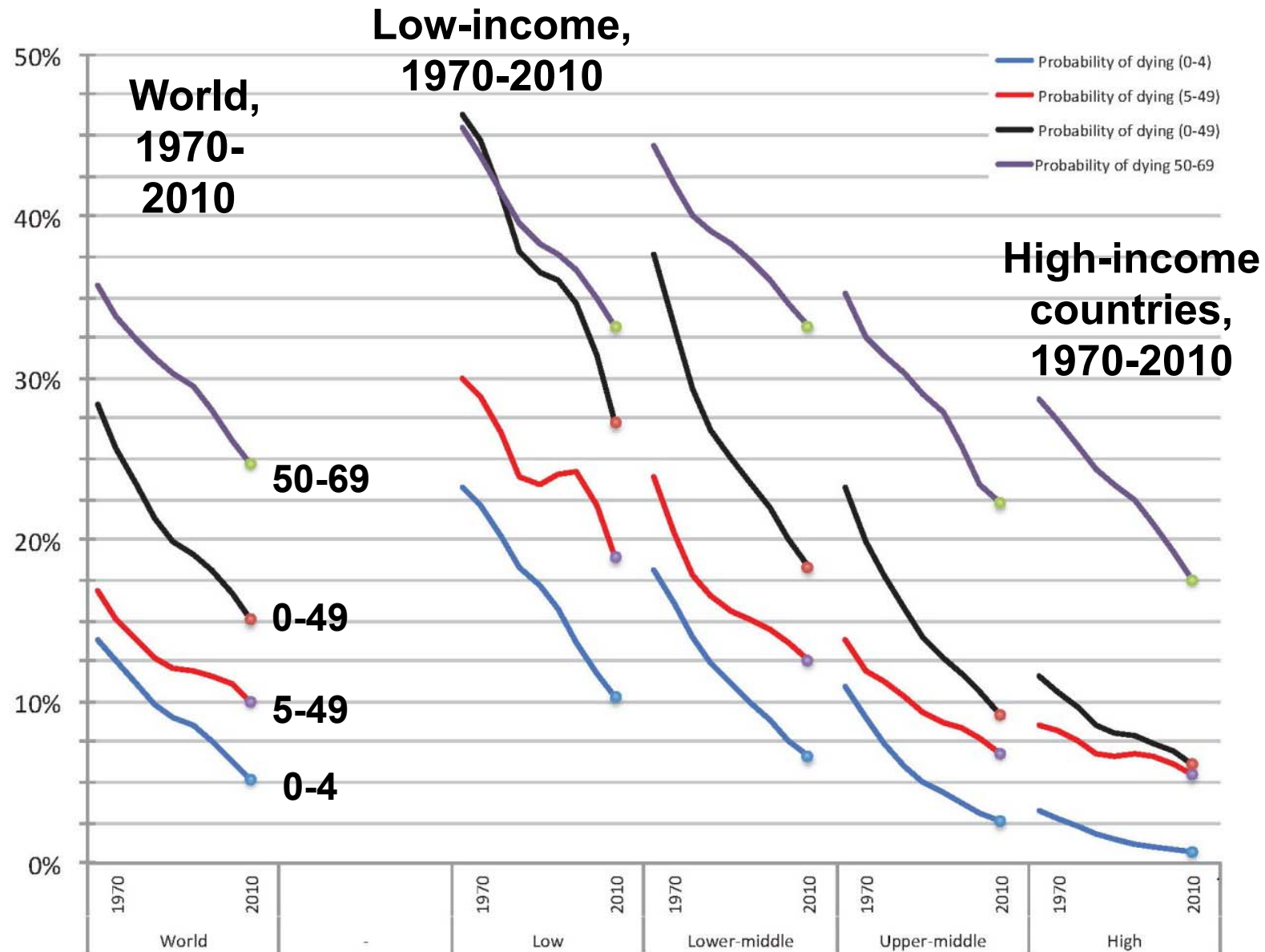
Mortality by age, in poor countries and in rich countries

Low, lower-middle, upper-middle and high-income countries, 2010: Risk of death by age, both sexes

Legend: — Low — Lower-middle — Upper-middle — High * England and Wales in 1910 and 2010

40-year trends, 1970-2010 (● = 2010), in risk of dying in selected age range

Low-income, 1970-2010

World, 1970-2010

High-income countries, 1970-2010

Legend:
- Probability of dying (0-4)
- Probability of dying (5-49)
- Probability of dying (0-49)
- Probability of dying 50-69

50-69

0-49

5-49

0-4

1970 ... 2010 — World

1970 ... 2010 — Low

1970 ... 2010 — Lower-middle

1970 ... 2010 — Upper-middle

1970 ... 2010 — High

25 most populous countries (75% of world population):

Trends in mortality rates, 1970-2010, by age
(0-4, 5-49, 50-69)

25 biggest countries: Trend, 1970-2010, in risk of death at ages 0-4 (both sexes, sorted by 2010 risk)
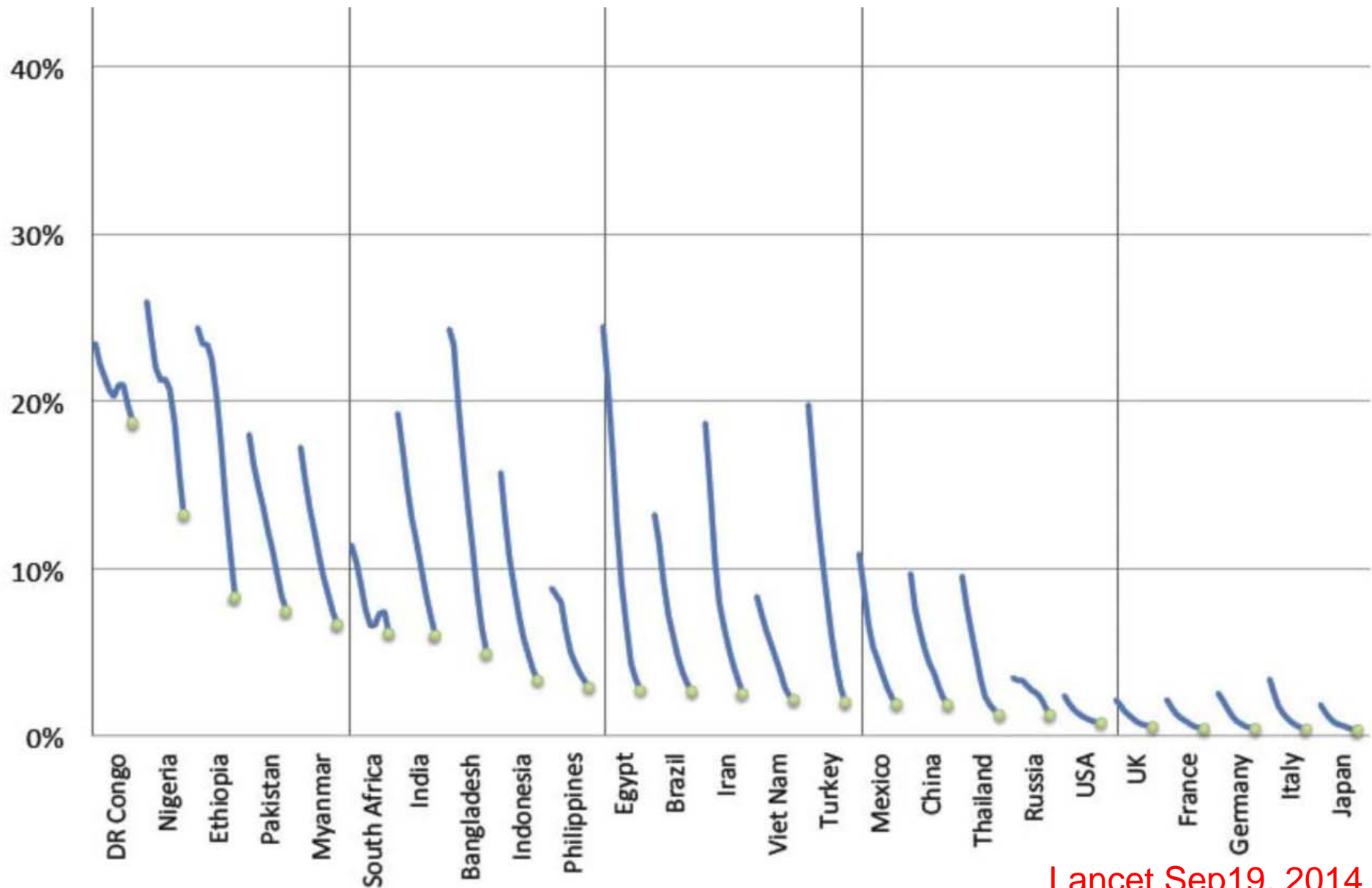
Lancet Sep19, 2014

25 biggest countries: Trend, 1970-2010, in risk of death at ages 0-4 (both sexes, sorted by 2010 risk)

Mainland China M&F ages 0-4, 1970-2010

25 biggest countries: Trend, 1970-2010, in risk of death at ages 5-49 (both sexes, sorted by 2010 risk)

25 biggest countries: Trend, 1970-2010, in risk of death at ages 5-49 (both sexes, sorted by 2010 risk)

Mainland China M&F ages 5-49, 1970-2010

25 biggest countries: Trend, 1970-2010, in risk of death at <u>ages 50-69</u> (both sexes, sorted by 2010 risk)

Mainland China M&F ages 50-69, 1970-2010
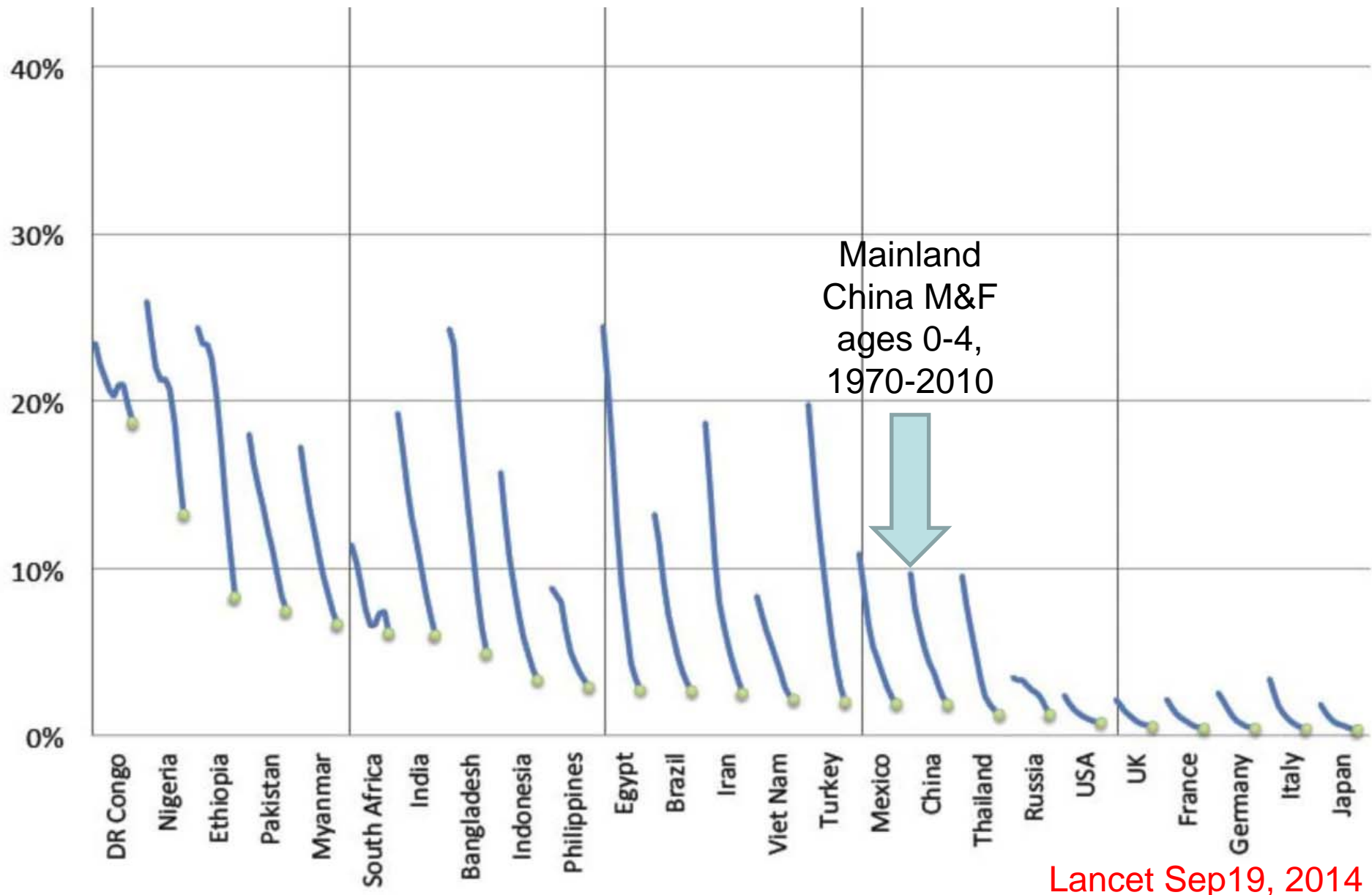
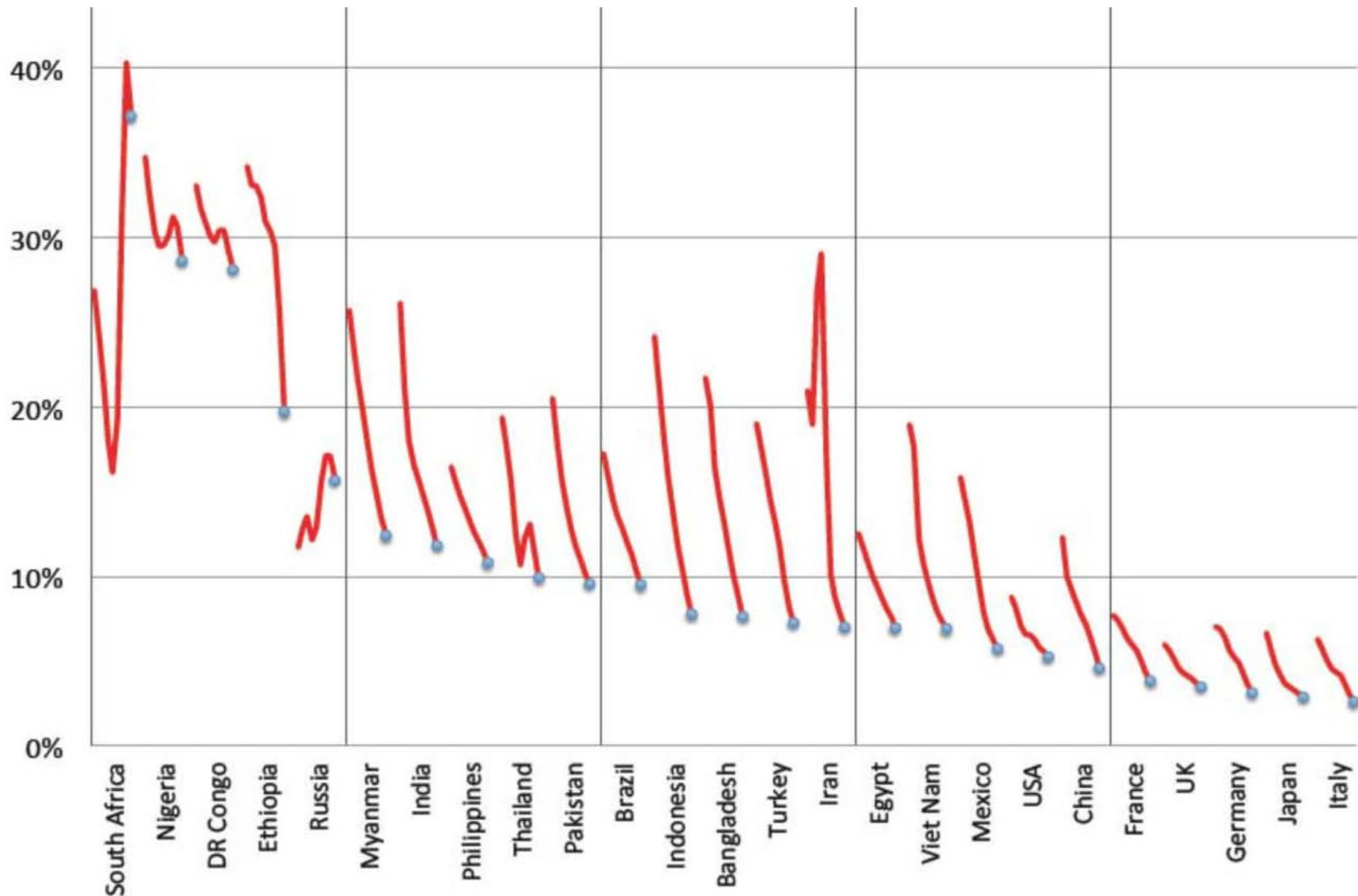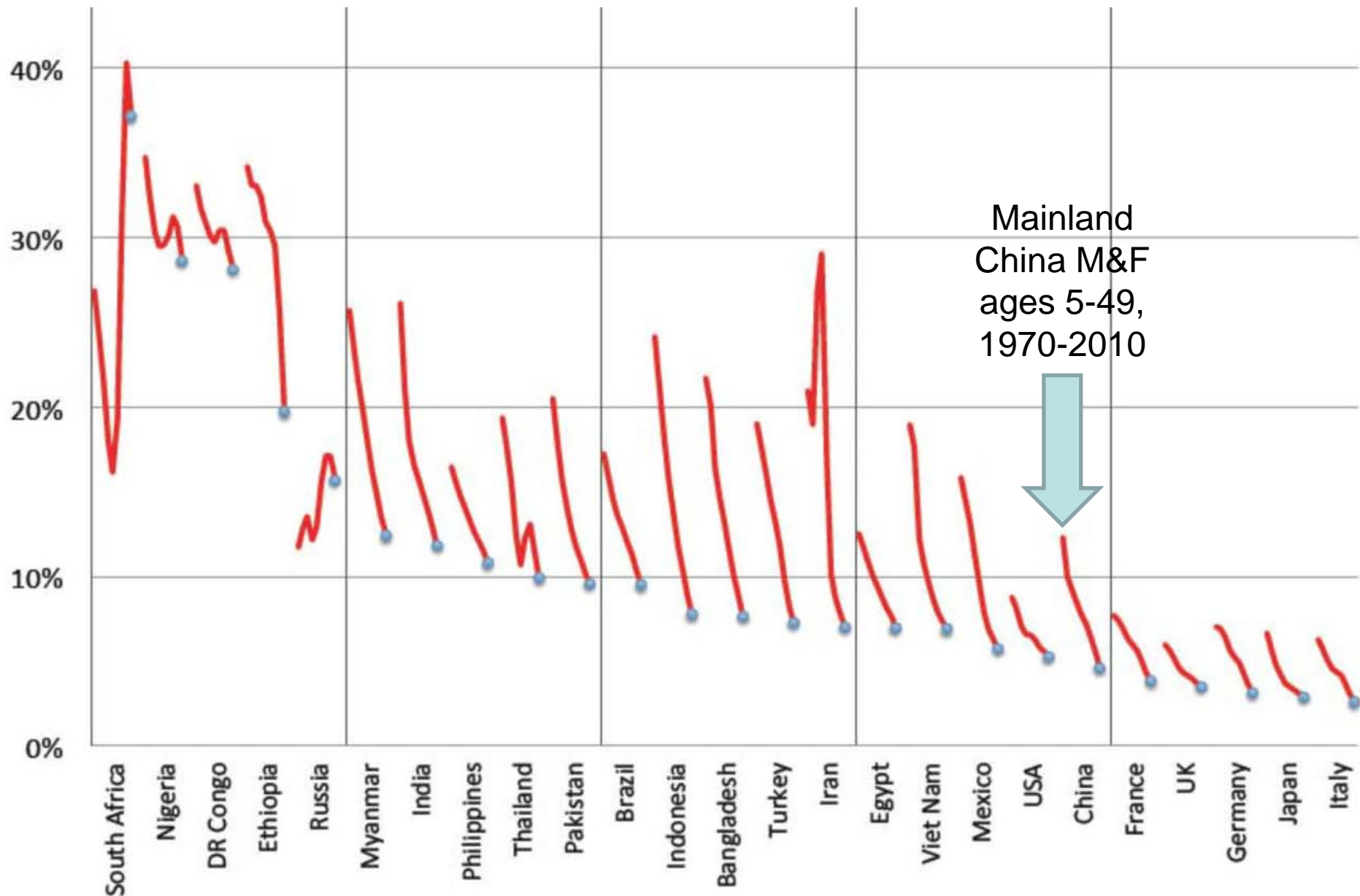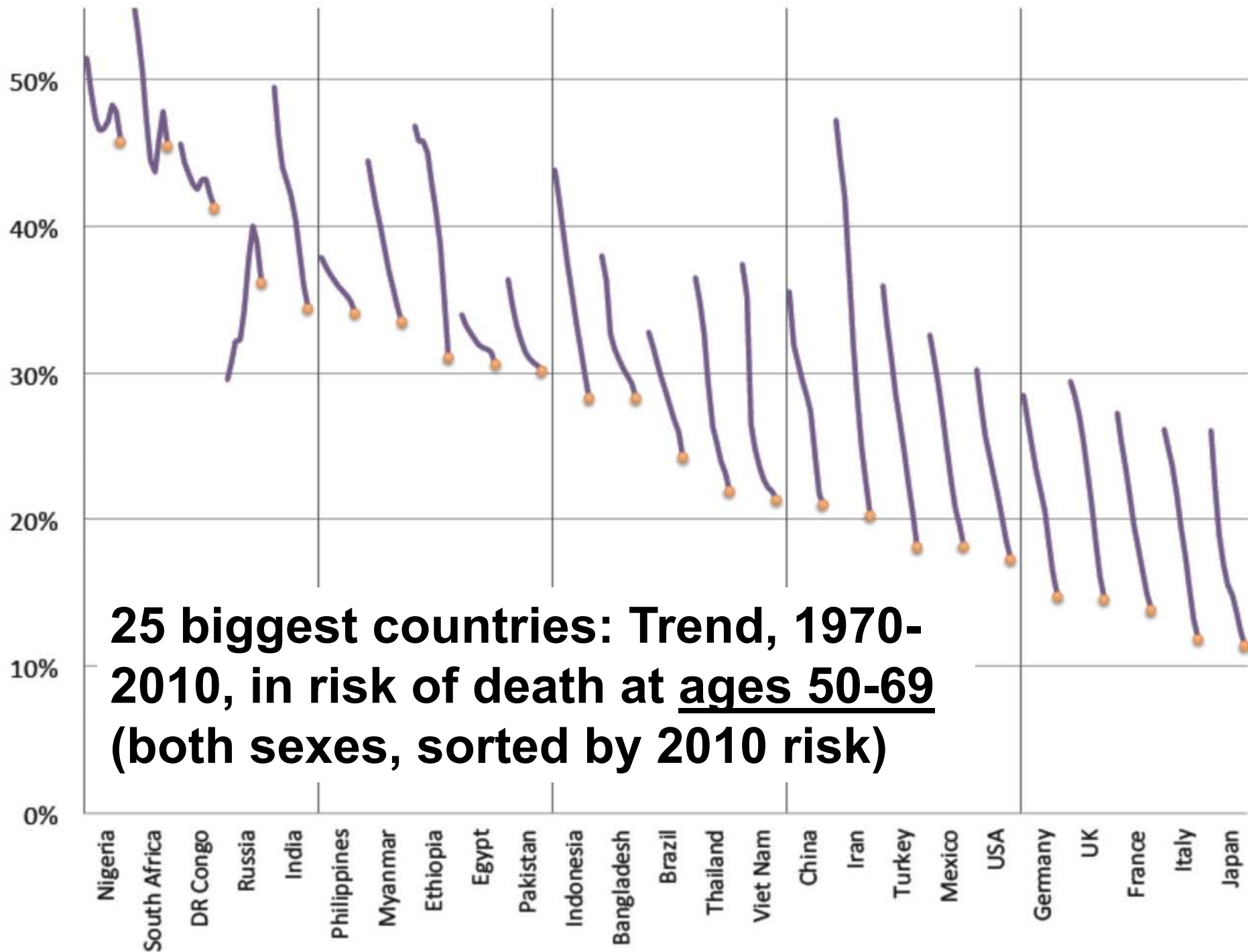**25 biggest countries: Trend, 1970-2010, in risk of death at <u>ages 50-69</u> (both sexes, sorted by 2010 risk)**
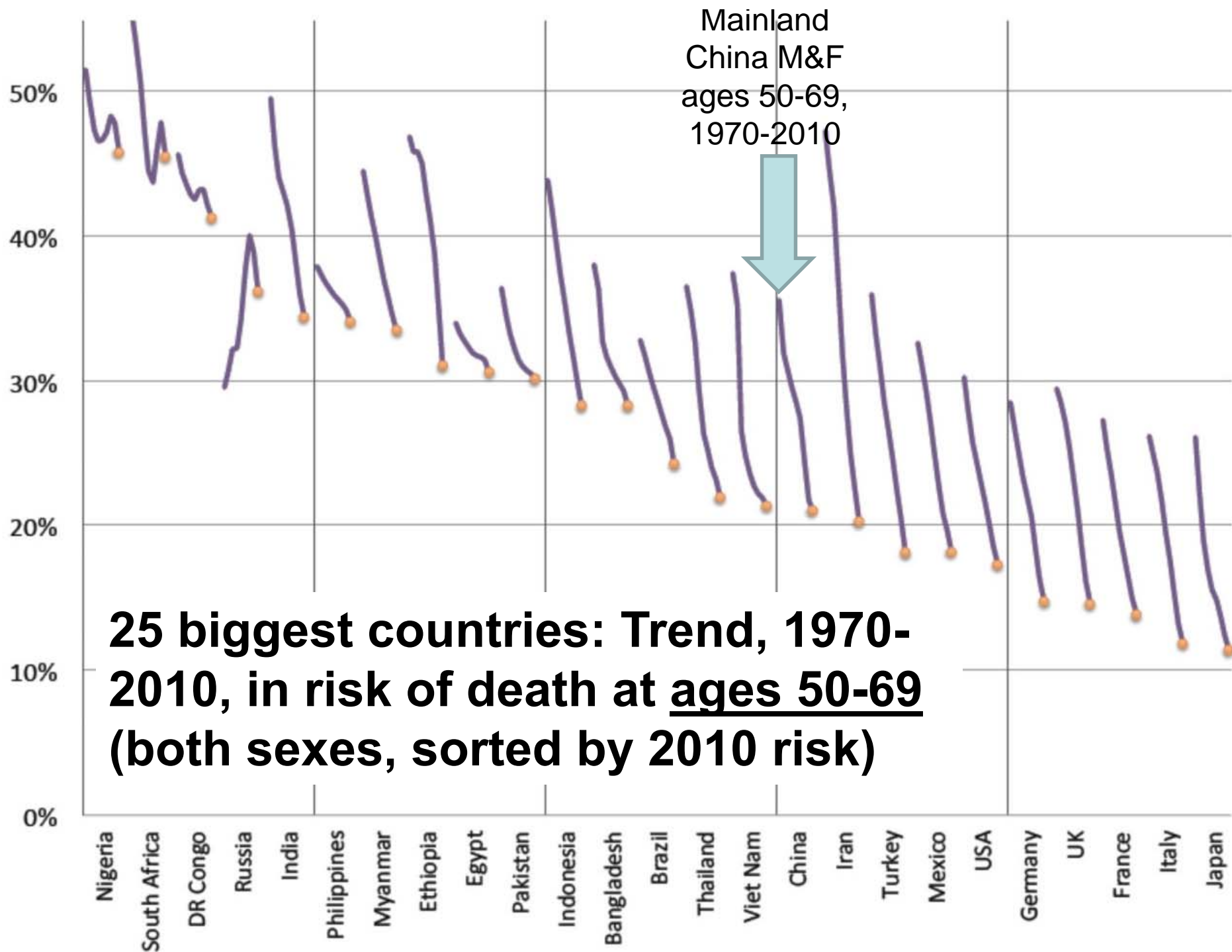
25 biggest countries: Trend, 1970-2010, in risk of death at ages 5-49 (by sex, sorted by 2010 risk)

Male

Mainland China, M
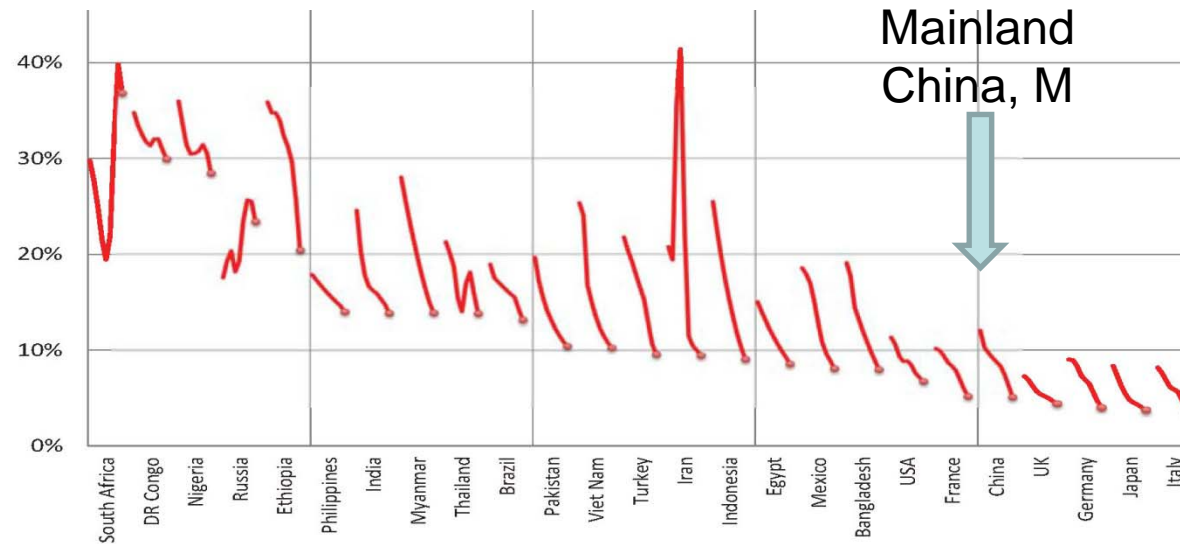
FEMALE risk of dying, ages 5-49: 1970-2010 trends in 25 most populous countries, sorted by 2010 risk (marked)

Female
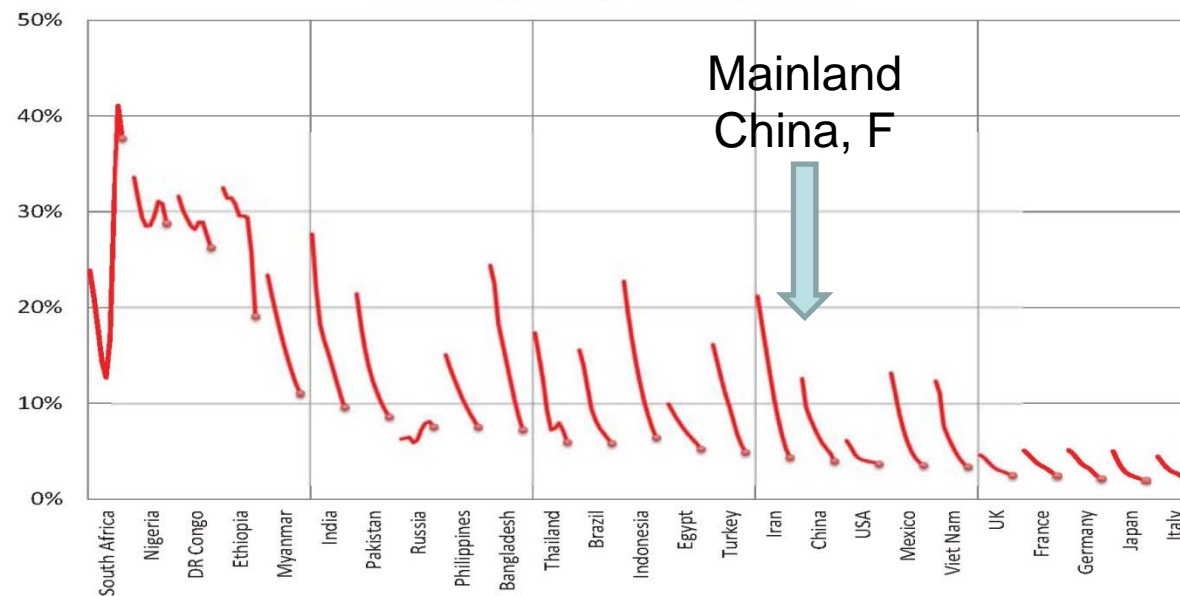
Mainland China, F

Worldwide, HIV, TOBACCO, ALCOHOL, OBESITY & WAR

are the only big causes of death that have increased substantially since 1990 in some large populations,

after allowing for population growth

UK: tobacco causes far more deaths than alcohol

Russia is <u>different</u>

All-cause mortality, males aged 15-54,
in Russia 1980-2012 and UK
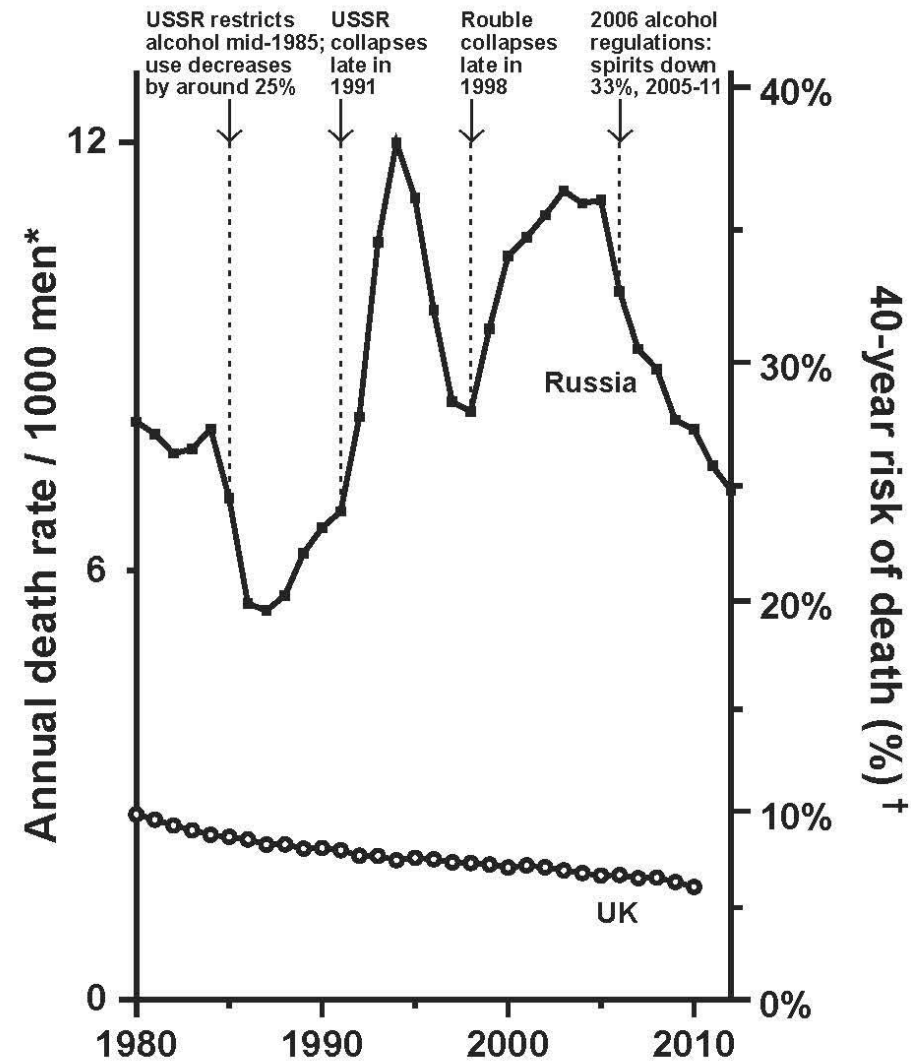
USSR restricts alcohol mid-1985; use decreases by around 25%

USSR collapses late in 1991

Rouble collapses late in 1998

2006 alcohol regulations: spirits down 33%, 2005-11

Russia

UK

Source: WHO mortality & UN population estimates

* Mean of age-specific death rates in the eight
component 5-year age groups (15-19 to 50-54)

† Probability a 15-year-old would die before age 55,
if exposed over next 40 years to age-specific death
rates of one particular calendar year

Annual death rate / 1000 men*

40-year risk of death (%) †

**Source: Lancet
31 January 2014**

Russian male death rate ratios,
~1 bottle vodka/day vs <1 bottle/week:

2 x disease mortality

4 x traffic accident
6 x other accident

8 x suicide
10 x murder

World, 2010: ~53 M deaths/year (including 30M at ages 0-69)

Age range	Deaths per year
0-4	~7M
5-34	~5M
35-69	~18M
(70+)	(~23M)

M = Million

World, 2010: main causes of the 7M deaths per year at ages 0-4

2M	Perinatal
1M	Acute respiratory
1M	Diarrhoea
1M	Malaria
+2M	Total, many others

Source: Global Burden of Disease for 2010

World, 2010: main causes of the 5M deaths per year at ages 5-34

2M injuries
(accident/violence/suicide)

1M HIV disease

+2M other disease

Source: Global Burden of Disease for 2010

World, 2010: main causes of the 18M deaths per year at ages 35-69

5M vascular
4M cancer
(+4M other NCD)

3M communicable
2M injury

Source: Global Burden of Disease for 2010

Can we halve vascular mortality and cancer mortality?

UK: Vascular mortality decreasing fast, due to both prevention and treatment

UNITED KINGDOM 1950–2010: Males & Females
All vascular mortality at ages 35–69
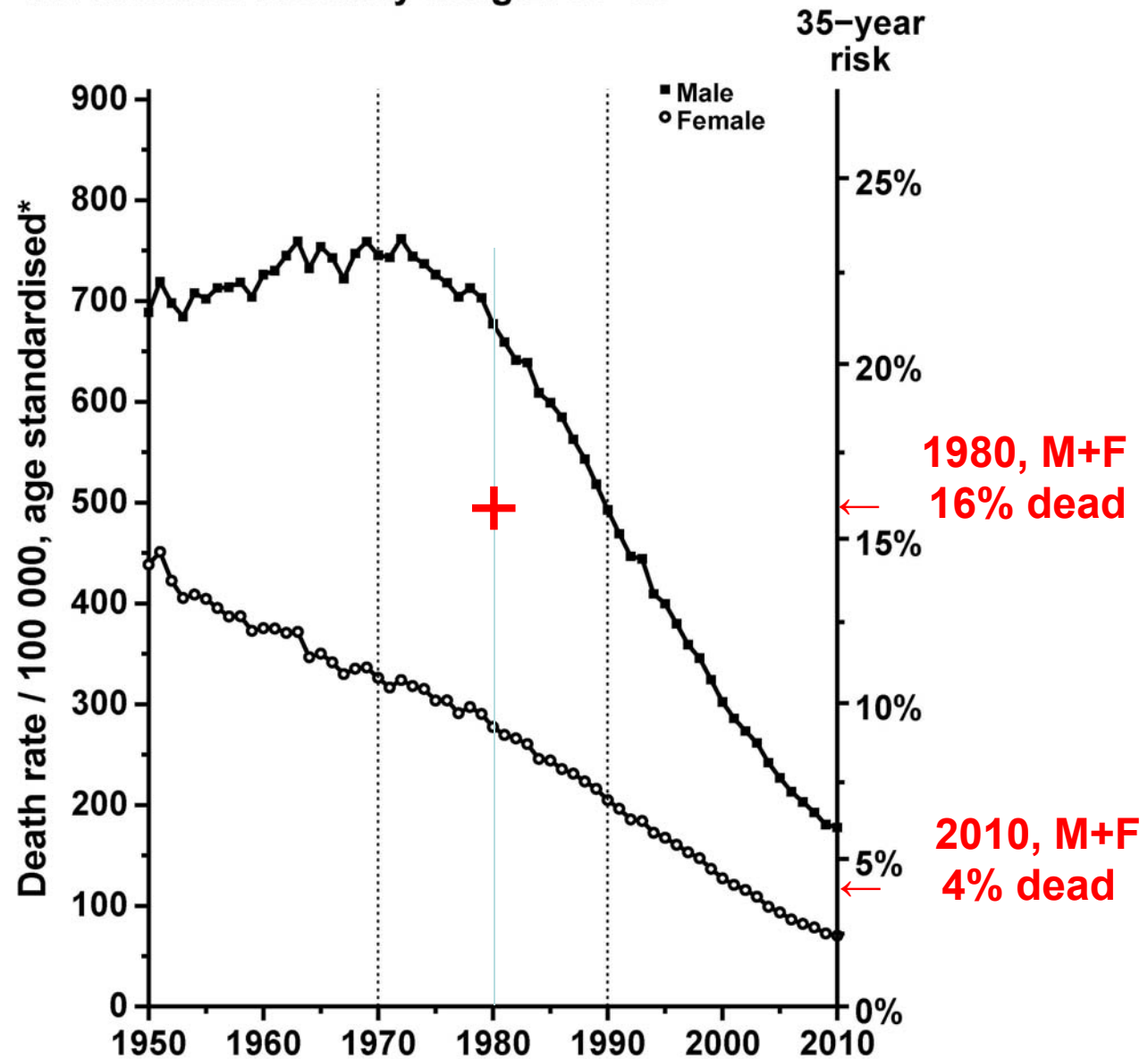
35-year risk

900
800
700
600
500
400
300
200
100
0

Death rate / 100 000, age standardised*

■ Male
○ Female

25%
20%
15%
10%
5%
0%

1980, M+F
16% dead

2010, M+F
4% dead

1950 1960 1970 1980 1990 2000 2010

*Mean of annual rates in the seven
component 5-year age groups

Source: WHO mortality &
UN population estimates

Big, modifiable determinants of vascular mortality

Tobacco

Blood pressure

Blood lipids

Obesity

Treatment

THE UK MILLION WOMEN STUDY

Vascular mortality, by amount smoked

Coronary heart disease — Relative Risk (95% CI) vs Cigarettes/day: 1.0 at 0, 3.2 at ~8, 4.6 at ~15, 5.9 at ~22

Cerebrovascular disease — Relative Risk (95% CI) vs Cigarettes/day: 1.0 at 0, 2.3 at ~8, 3.2 at ~15, 3.8 at ~22
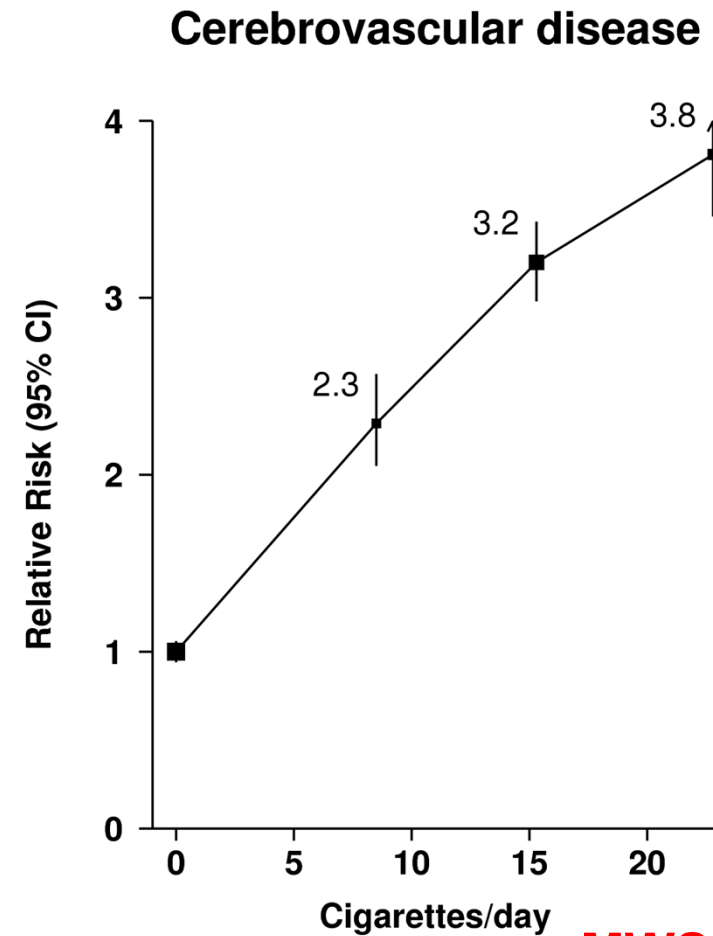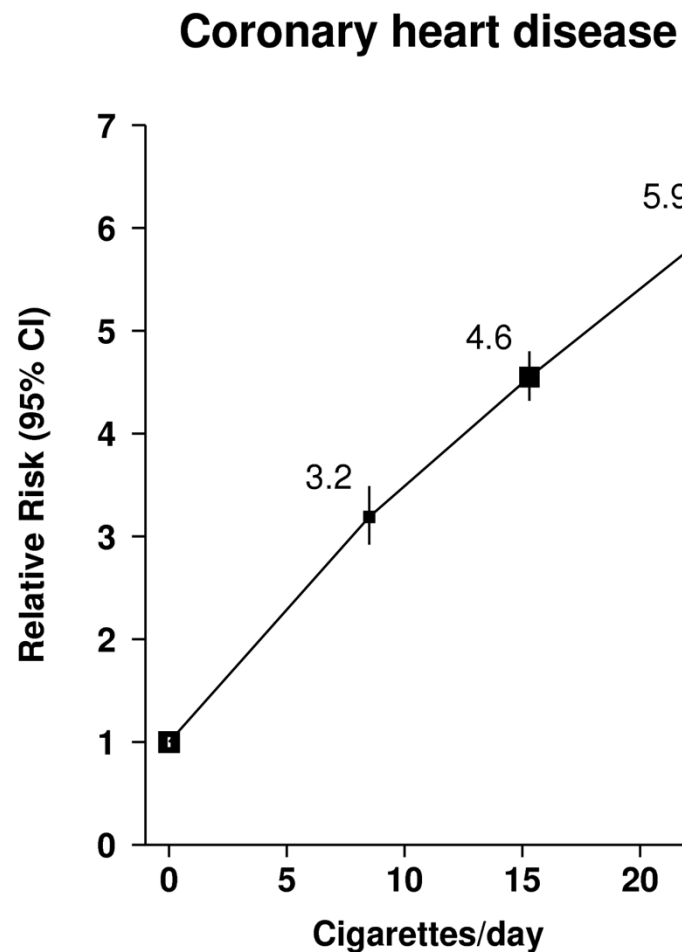
How important is blood pressure to vascular death?

20 mmHg systolic BP halves vascular mortality at 35-69

Prospective Studies Collaboration (1 million adults)

How important are blood lipids?

**Good statin regimen reduces
LDL cholesterol by 2 mmol/L
and vascular risk by 40%**

(Non-vascular mortality is unaffected)

How important is obesity to vascular mortality?

If overweight, 10 units BMI about <u>halves</u> MI & stroke

Reducing vascular mortality by treatment

Secondary prevention works in high-income countries & could in middle income: statins, aspirin, BP lowering, vascular surgery, etc

Halving <u>cancer</u> mortality

Prevention, screening and treatment

UNITED KINGDOM 1950−2010:
Breast cancer mortality at ages 35-69
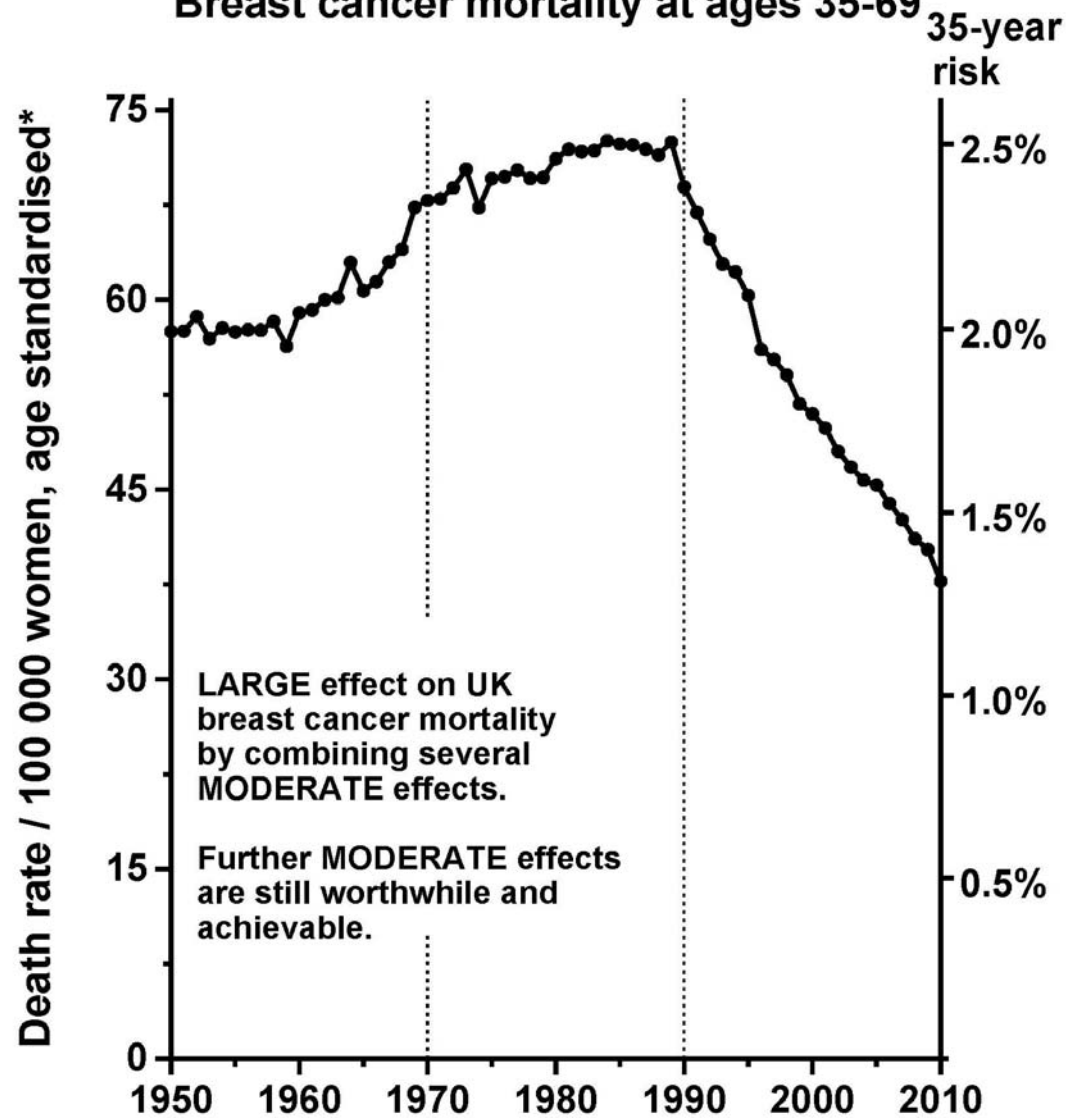
35-year risk

Death rate / 100 000 women, age standardised*

LARGE effect on UK breast cancer mortality by combining several MODERATE effects.

Further MODERATE effects are still worthwhile and achievable.

*Mean of annual rates in the seven component 5-year age groups

Source: WHO mortality & UN population estimates

Cancer prevention: major causes

Chronic infection *eg,* hepatitis B/C, H. pylori, liver fluke, schistosome, EBV, HPV

Dietary *eg,* obesity, aflatoxin

Environ. *eg* coal smoke, radiation, asbestos

Alcohol and, particularly, <u>TOBACCO</u>

Overall UK cancer mortality trends are dominated by tobacco

UK cancer mortality 1950-2010 attributed to smoking, or not: Males only, 35-year risk of death at ages 35-69 (%)
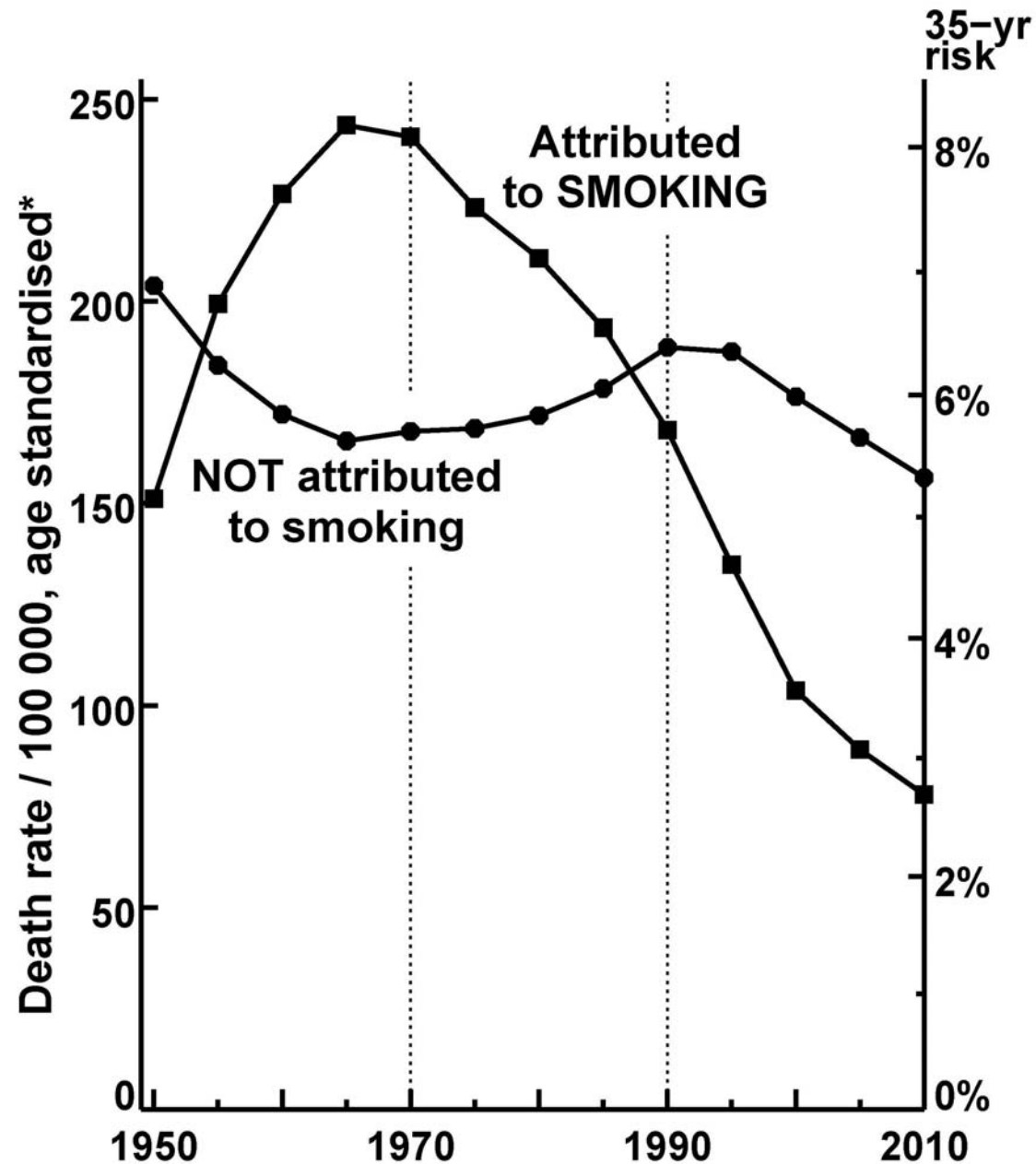
THE UK MILLION WOMEN STUDY
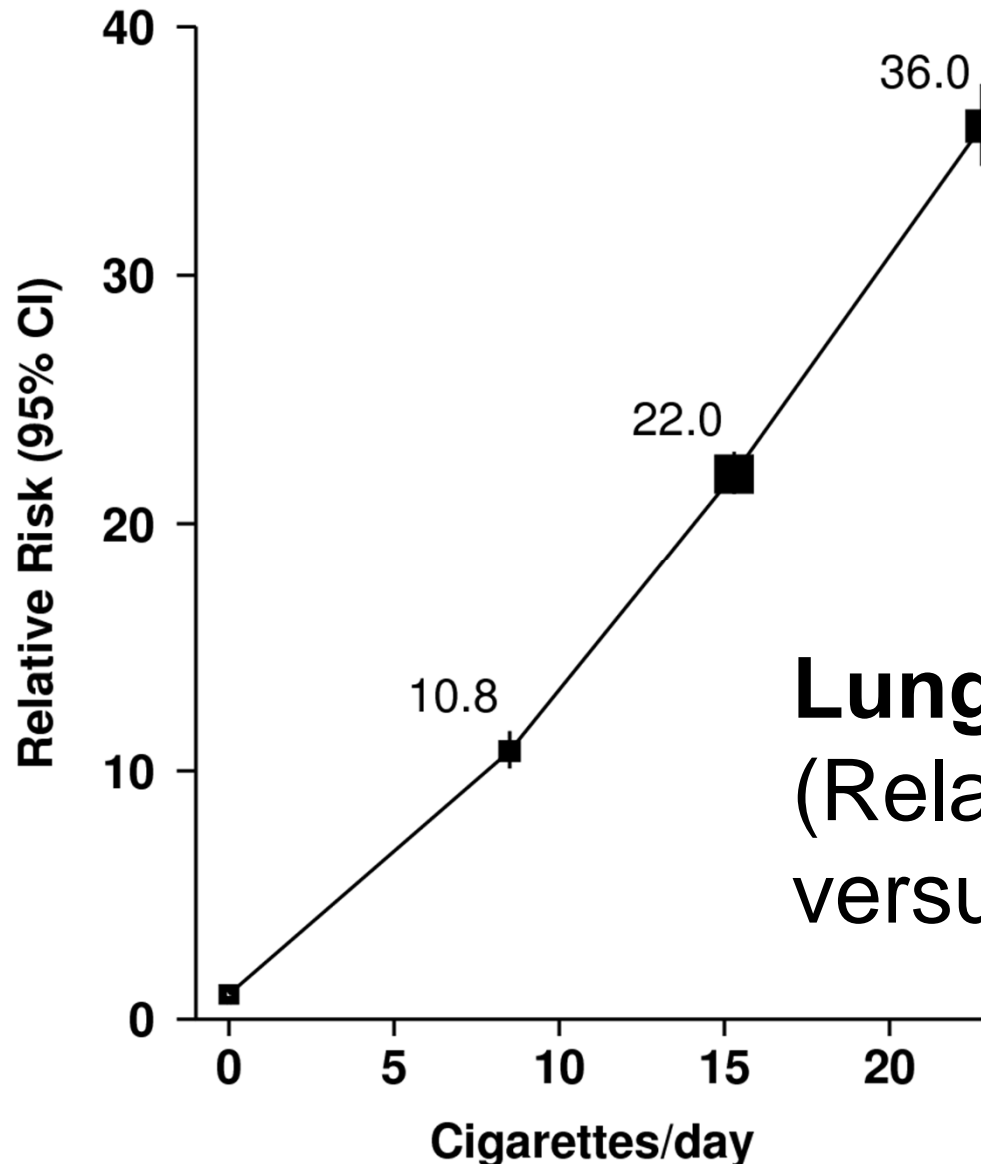
Lung cancer mortality: RR
(Relative Risk, smoker
versus never-smoker)

THE UK MILLION WOMEN STUDY

All-cause mortality: RR (Relative Risk, smoker versus never-smoker)
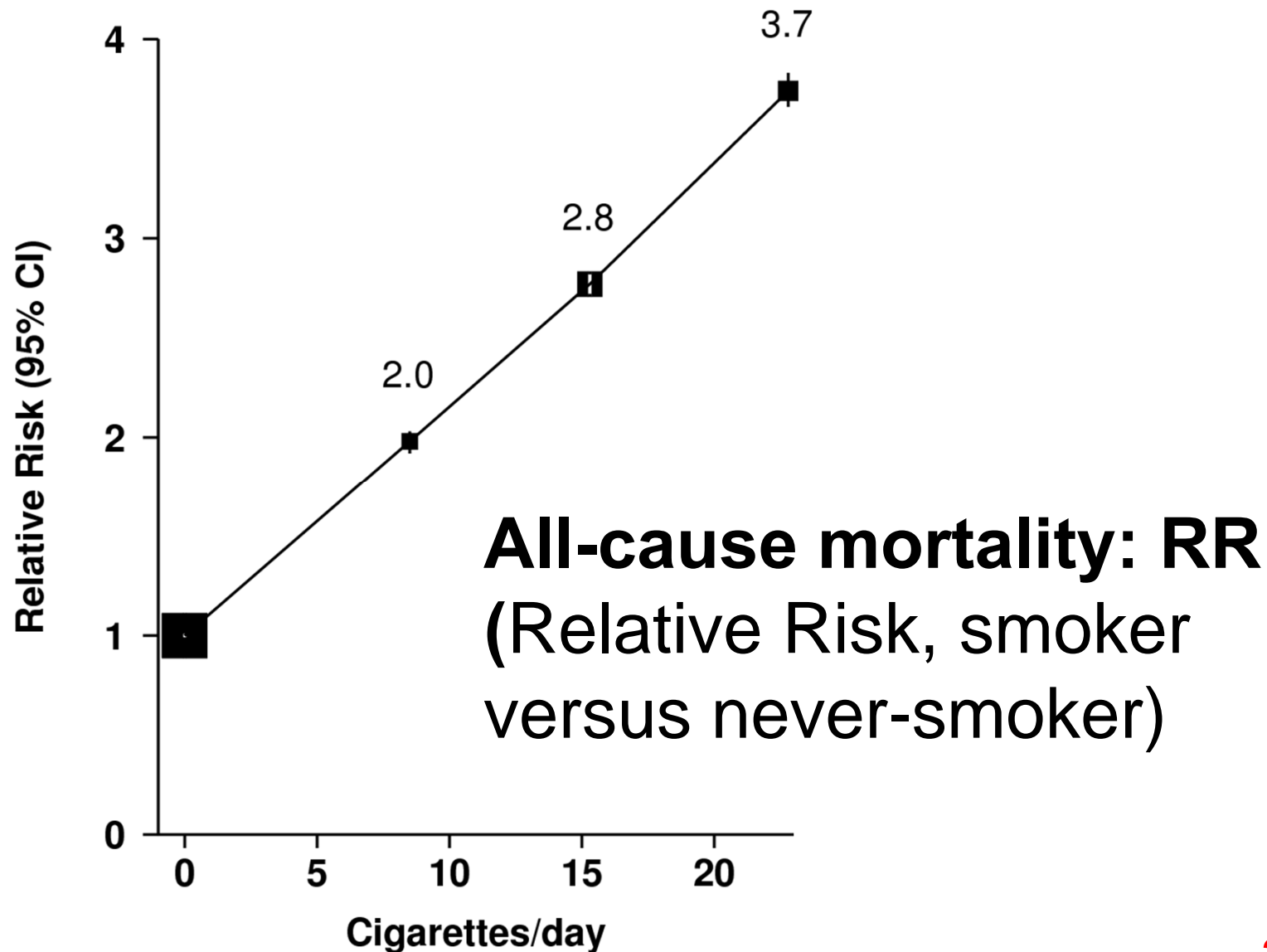
THE UK MILLION WOMEN STUDY

- Big risk in smokers

**- Stopping before age 40
(better well before 40!)
avoids >90% of the risk**

THE UK MILLION WOMEN STUDY

Ex-smoker all-cause mortality,

by age at stopping

Relative Risk (95% CI)

3.0 — current smokers

1.56

1.20

1.05

1.01

never smokers

20   30   40   50

Ex-smokers, by age at stopping
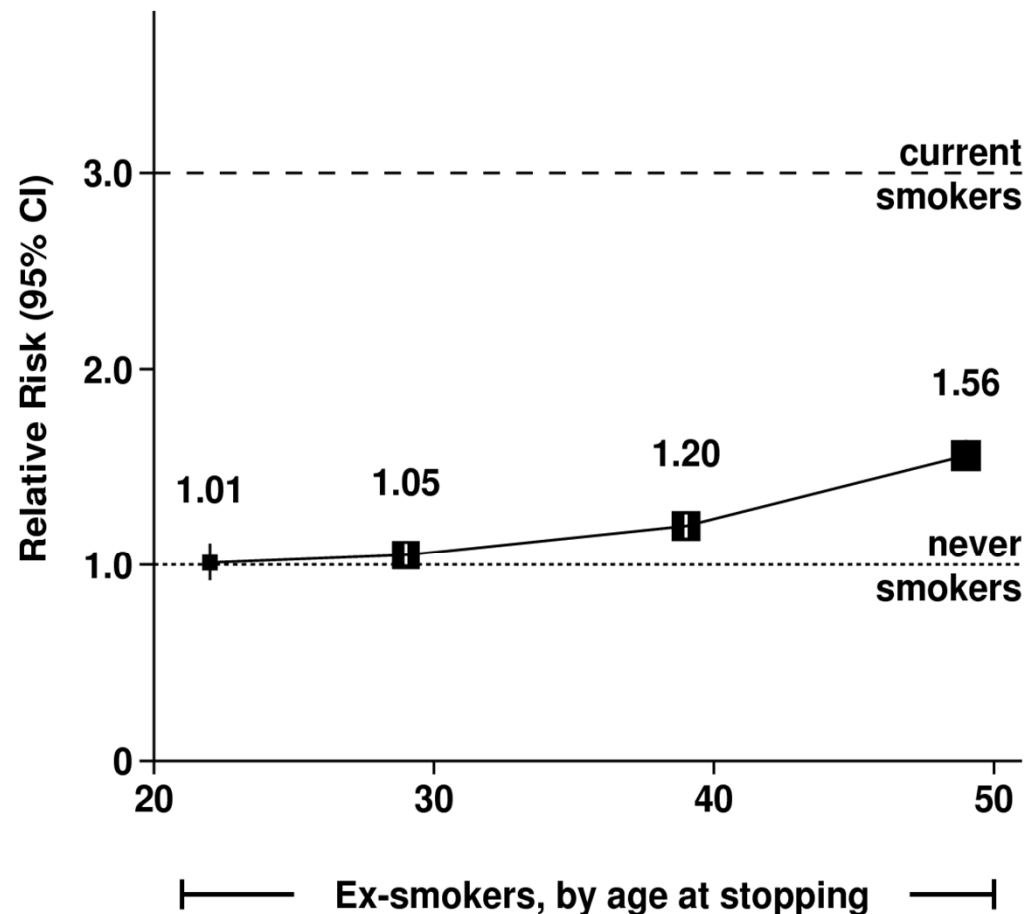
Age at stopping (mean), years	<25 (22)	25-34 (29)	35-44 (39)	45-54 (49)
Number of deaths	481	1523	1814	2095
RR (95% CI)	1.01 (0.92-1.11)	1.05 (1.00-1.11)	1.20 (1.14-1.26)	1.56 (1.49-1.64)

Adjusted for age, region, deprivation & BMI

Cigarette price and consumption

**UK: 2 biggest price increases (1947 and 1981)
caused the 2 biggest decreases in smoking**

**France, 1990-2005: "Triple, halve, double"
- price <u>tripled</u>, smoking <u>halved</u>, and the
French Government tax yield <u>doubled</u>**

FRANCE, 1990-2005: "Triple, halve, double"

- Cigarette price <u>tripled</u>;

- Smoking <u>halved</u>;

- Government income from tobacco <u>doubled</u>, from €6B to €12B/year

Government income from tobacco,

Billions, 2007 euros
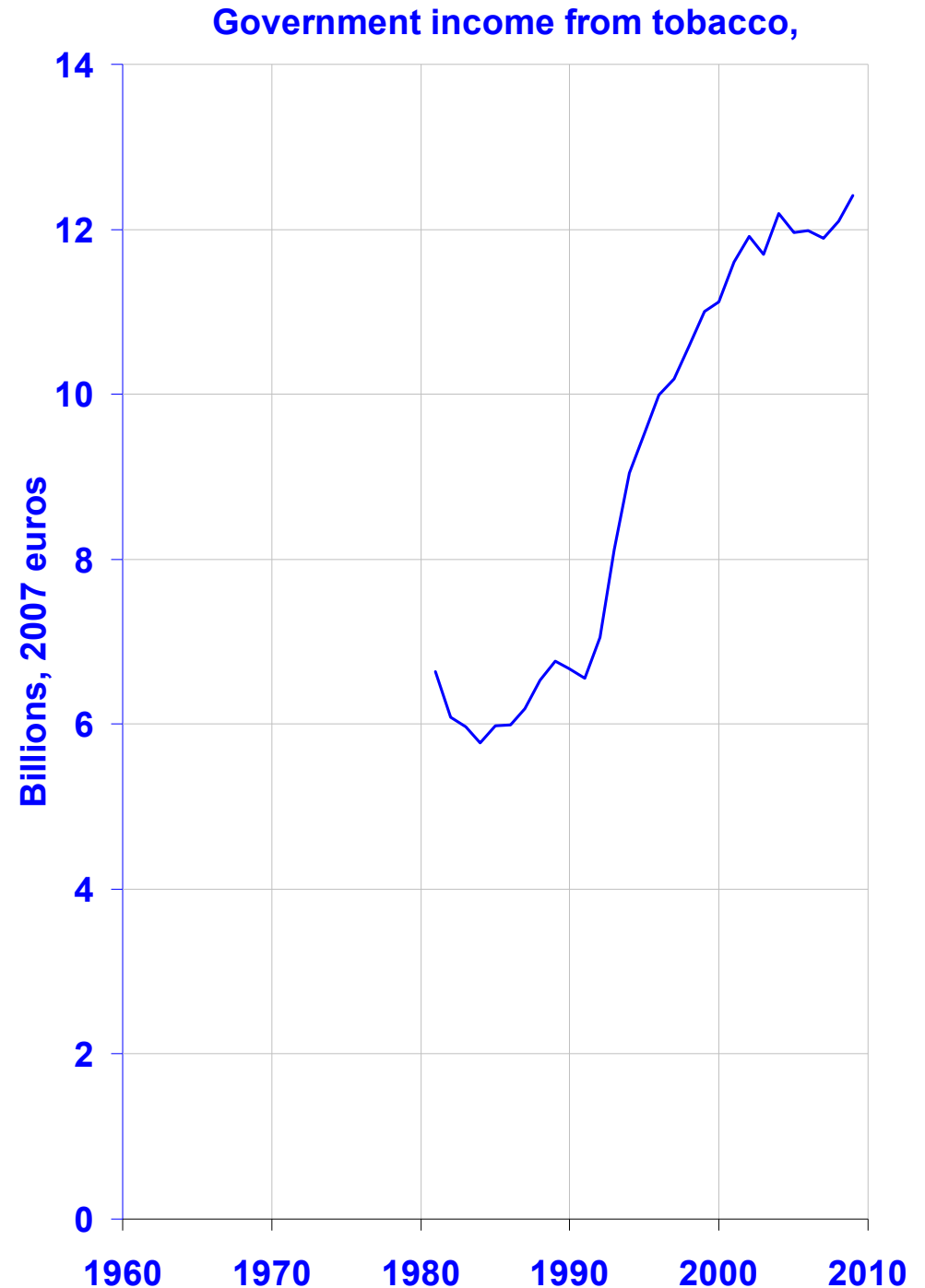
Western Europe and North America: cigarette sales decreasing

China: cigarette sales increasing, and % of male deaths from smoking increasing
1990 ~12%
2010 ~20%
2030 ~30%
(Hong Kong 1998 33%;
BMJ 2001 323: 1-6)

Annual Chinese cigarette production, 1952-2011
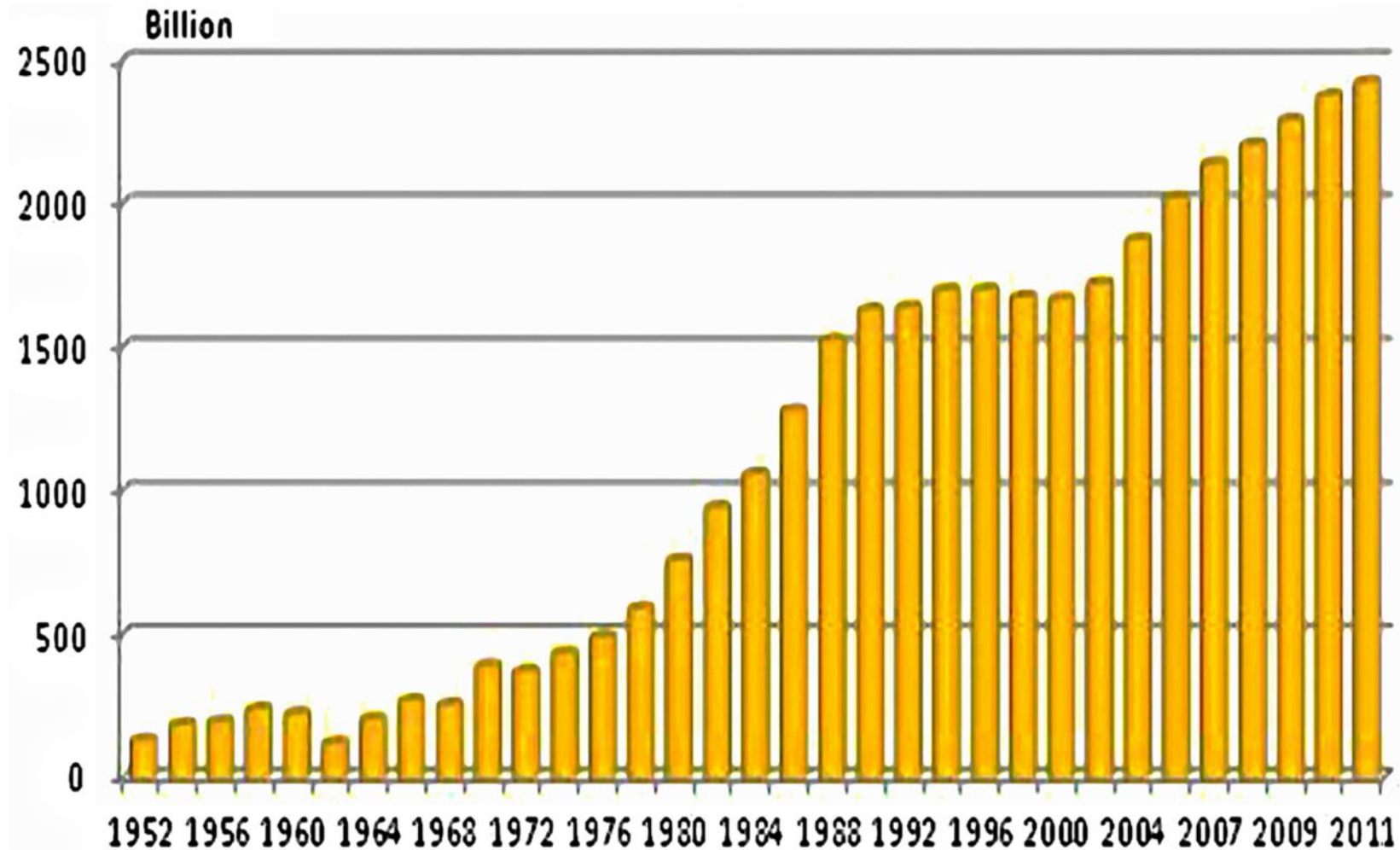
Yang G Tob Control 2014;23:167-172

Millions of smokers, by country
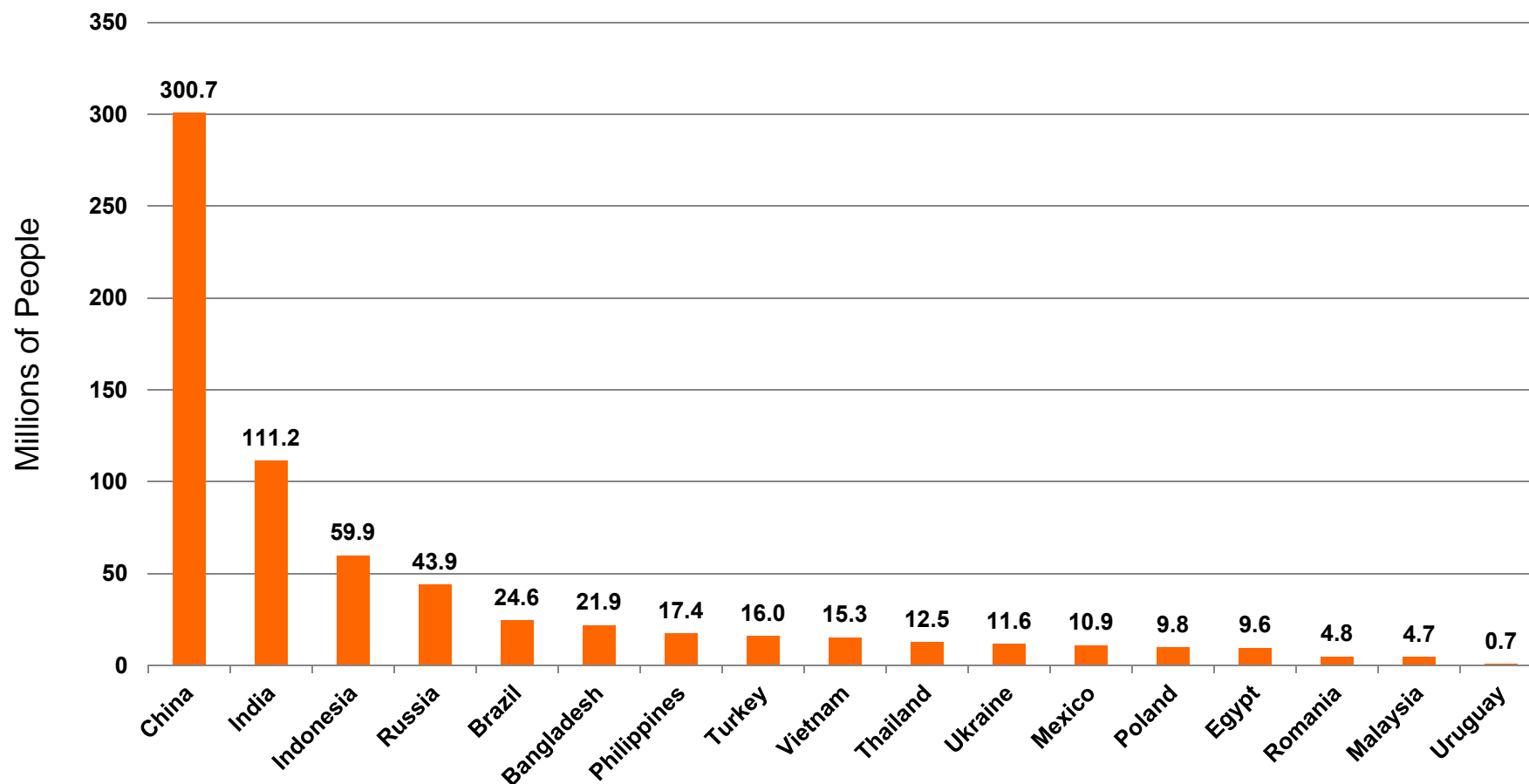
Source: Global Adult Tobacco Survey, 2008-2012

China: >1/8 smokers have stopped, and only 2% of women smoke: good

But, ~60% of men still smoke, with ~6 million new smokers/year; half will be killed by tobacco, unless they stop

World annual tobacco deaths

Developed countries ~2M
China ~1M
India ~1M

World ~6M, but rising
to ~10M by mid-century

World tobacco deaths,
if current smoking patterns continue

2010-2049   ~400M

2050-2099   >500M

2000-2099   ~1000M
                   (1 billion)

World tobacco deaths,
if current smoking patterns continue

2010-2049	**~400M**
2050-2099	**>500M**
2000-2099	**~1000M** **(1 billion)**
1900-1999	~100M (0.1 billion)

Preventing children starting to smoke can prevent many tobacco deaths **after** 2050

Widespread adult cessation can prevent many tobacco deaths **before** 2050

A culture where adult cessation is usual also helps today's children

Worldwide, government profit & tax on tobacco now about US $300 billion/year

WHO target: 30% less smoking by 2025

If real price <u>stays constant</u>, & smoking ↓ 1/3, governments <u>lose</u> about $ 100 billion / year

But, if real price <u>doubles</u>, & smoking ↓ 1/3, governments <u>gain</u> about $ 100 billion / year

Worldwide, HIV, TOBACCO, ALCOHOL, OBESITY & WAR

are the only big causes of death that have increased substantially since 1990 in some large populations.

Death in old age is inevitable,

but death before old age is not

M = millions of deaths in 2030, if the 2010 death rates applied to the 2030 population (& previous decrease/decade, 2010 vs 2000)

	Age 0-49	Age 50-69
Communicable, perinatal, maternal	10M (-31%)	3M (-25%)
Non-communicable	6M (-15%)	17M (-14%)
Injuries	4M (-14%)	1M (-9%)
Total	20M (-24%)	21M (-15%)

NB Stratification for income would change 41 into 44 million at ages 0-69

Millions of premature deaths (0-49 or 50-69) in 2030				
	- if the 2010 death rates unchanged	- if 2000-10 proportional falls persist*	- with the UN-targeted gains †	- if the 2010 death rates are halved
Age 0-49	21.2	13.0	10.7	10.6
Age 50-69	22.7	16.7	14.9	11.4
Age 0-69 **% change, 2010-2030**	43.9 **0**	29.7 **-33**	25.6 **-40**	22.0 **-50**

* Stratified for age and World Bank country income group

† 2/3 lower child, maternal, HIV, TB and malaria mortality rates; and
1/3 lower non-communicable disease, other disease, and injuries
(which reduces mortality by half at ages 0-49 and by ~1/3 at 50-69)

OPINION

Halving premature death

Death in old age is inevitable, but death before old age is not. Except where HIV or political disturbances predominated, mortality rates have been decreasing for decades, helped by sanitation, health care, and social changes. Even in low-income countries, at current death rates, three-quarters of newborn infants would survive to age 50, and half would survive to age 70. If disease control keeps progressing and economic development proceeds, then within the next few decades—except where disasters or new epidemics supervene—under-50 mortality should fall to less than half of today's 15% global risk, and under-70 mortality should be less than one in six.

World under-5 mortality decreased from 14% of all live births in 1970 to 5% in 2010. It could reach 2% by 2030, with continued attention to female education, perinatal care, vaccination, adequate nutrition, curative treatment, and other key child survival determinants. World under-50 mortality halved from 28% in 1970 to 15% in 2010 (5% under-5 plus 10% later), but varies 10-fold between countries, with further inequalities within countries. Its main causes, apart from maternal and perinatal mortality, include communicable diseases, undernutrition, and fatal injuries (suicide, homicide, and, particularly, accidents). They also include alcohol, a major cause of injuries, and tobacco.

Noncommunicable diseases (NCDs), such as cancer, stroke, heart disease, and emphysema, cause a quarter of all deaths before age 50, plus four-fifths of those at ages 50 to 69. The most important external factor is smoking, which still causes about a quarter of all cancer deaths in the European Union and a third of all cancer deaths in the United States, plus comparable numbers of deaths from other diseases. Smoking also causes many deaths in China, India, Russia, and worldwide (totaling about 5 million deaths a year, and rising). Fortunately, quitting works; smokers who stop before age 40 (and preferably well before 40) avoid over 90% of the risk. Each year, governments make US$300 billion directly or indirectly from tobacco, so at constant prices, a one-third reduction would lose governments $100 billion. But if tax increases double the current prices and thereby reduce smoking by one-third, this would save just as many lives and gain governments $100 billion a year.

The World Health Organization's recent resolution on NCDs calls for reducing smoking by a third by 2025, decreasing hazardous alcohol drinking, and halting the increase in obesity. It also supports the wide use of generic drugs such as statins and antihypertensives to prevent NCD recurrence.

If 2010 mortality rates continue unchanged (which they will not, as death rates are already falling), then in 2030 there would be about 20 million deaths before age 50, and 20 million more at ages 50 to 69. For many countries, halving their 2010 under-50 mortality rate by 2030 would be a feasible target; worldwide, it would avoid 10 million of the 20 million deaths projected above for 2030. Adoption of this target would reinforce current successful efforts to reduce maternal and child mortality and death from HIV, tuberculosis, malaria, and other communicable diseases, but would also require serious and successful efforts to substantially reduce accidents and NCD mortality.

Changes in mortality at ages 50 to 69 are dominated by NCD mortality, where some important control measures may take decades to have their full effects. Although reductions of about one-quarter or one-third could well be seen by 2030, halving global mortality in this age range will take longer. But even if the ultimate goal is to substantially reduce under-70 mortality, halving under-50 mortality would be a more immediate target and could be achieved worldwide by 2030 (or in the 2030s). With additional gains in later middle age, some 40% of all premature deaths would be avoided.

Public health and medicine do not offer eternal life, but do offer a more comfortable life and an increasingly good chance of avoiding premature death. Still, however, almost all of us will die before 100.

– Richard Peto, Alan D. Lopez, and Ole F. Norheim

World mortality, 1970 and 2010

Decreasing risk of premature death
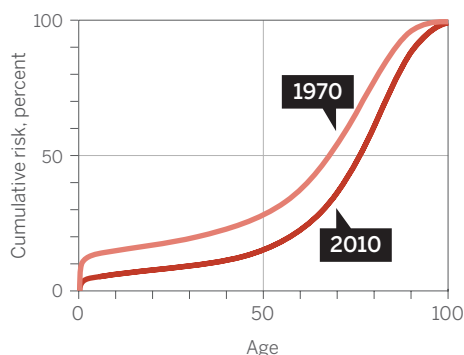
"For many countries, halving their 2010 under-50 mortality rate by 2030 would be a feasible target..."

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Ole F. Norheim is a professor in the Department of Global Public Health and Primary Care, University of Bergen, Bergen, Norway. E-mail: ole.norheim@igs.uib.no

Avoiding 40% of the premature deaths in each country, 2010–30: review of national mortality trends to help quantify the UN Sustainable Development Goal for health

Ole F Norheim, Prabhat Jha, Kesetebirhan Admasu, Tore Godal, Ryan J Hum, Margaret E Kruk, Octavio Gómez-Dantés, Colin D Mathers, Hongchao Pan, Jaime Sepúlveda, Wilson Suraweera, Stéphane Verguet, Addis T Woldemariam, Gavin Yamey, Dean T Jamison, Richard Peto

Summary

Background The UN will formulate ambitious Sustainable Development Goals for 2030, including one for health. Feasible goals with some quantifiable, measurable targets can influence governments. We propose, as a quatitative health target, "Avoid in each country 40% of premature deaths (under-70 deaths that would be seen in the 2030 population at 2010 death rates), and improve health care at all ages". Targeting overall mortality and improved health care ignores no modifiable cause of death, nor any cause of disability that is treatable (or also causes many deaths). 40% fewer premature deaths would be important in all countries, but implies very different priorities in different populations. Reinforcing this target for overall mortality in each country are four global subtargets for 2030: avoid two-thirds of child and maternal deaths; two-thirds of tuberculosis, HIV, and malaria deaths; a third of premature deaths from non-communicable diseases (NCDs); and a third of those from other causes (other communicable diseases, undernutrition, and injuries). These challenging subtargets would halve under-50 deaths, avoid a third of the (mainly NCD) deaths at ages 50–69 years, and so avoid 40% of under-70 deaths. To help assess feasibility, we review mortality rates and trends in the 25 most populous countries, in four country income groupings, and worldwide.

Methods UN sources yielded overall 1970–2010 mortality trends. WHO sources yielded cause-specific 2000–10 trends, standardised to country-specific 2030 populations; decreases per decade of 42% or 18% would yield 20-year reductions of two-thirds or a third.

Results Throughout the world, except in countries where the effects of HIV or political disturbances predominated, mortality decreased substantially from 1970–2010, particularly in childhood. From 2000–10, under-70 age-standardised mortality rates decreased 19% (with the low-income and lower-middle-income countries having the greatest absolute gains). The proportional decreases per decade (2000–10) were: 34% at ages 0–4 years; 17% at ages 5–49 years; 15% at ages 50–69 years; 30% for communicable, perinatal, maternal, or nutritional causes; 14% for NCDs; and 13% for injuries (accident, suicide, or homicide).

Interpretation Moderate acceleration of the 2000–10 proportional decreases in mortality could be feasible, achieving the targeted 2030 disease-specific reductions of two-thirds or a third. If achieved, these reductions avoid about 10 million of the 20 million deaths at ages 0–49 years that would be seen in 2030 at 2010 death rates, and about 17 million of the 41 million such deaths at ages 0–69 years. Such changes could be achievable by 2030, or soon afterwards, at least in areas free of war, other major effects of political disruption, or a major new epidemic.

Introduction

The Millennium Development Goals (MDGs) for 2015, adopted actively by governments in 2000, have mobilised action on development issues.[1–3] During 2015, the UN will formulate 2016–30 Sustainable Development Goals, of which one (SDG3) will relate to health.[1] Some MDGs defined quantifiable targets that allowed progress to be assessed within regions and countries, such as MDG4 (reduce under-5 mortality from 1990 to 2015 by two-thirds) and MDG5 (reduce maternal mortality from 1990 to 2015 by three-quarters). Neither goal will be realised by 2015, although child and maternal mortality

will have approximately halved, but both have helped accelerate progress.[4–8] The MDGs successfully engaged national leaders, with progress toward the goals reviewed at annual summits. High-level policy makers have limited time, and their engagement was facilitated by some targets being quantifiable and (eventually) attainable.

The current draft of the 2016–30 SDGs includes 17 overarching goals;[1] 16 are not health goals, although they may affect health indirectly. The draft health goal, SDG3, is to "ensure healthy lives and promote well-being for all at all ages" (panel 1). Its 13 subtargets include

two numerical ones that might be achievable (if current progress improves): about two-thirds less maternal mortality and a third less non-communicable disease (NCD) mortality. They also include, however, ending preventable newborn and under-5 deaths; ending HIV/AIDS, tuberculosis, malaria, and neglected tropical diseases; substantially reducing death and illness from pollution; halving traffic deaths (which are currently increasing); universal access to sexual and reproductive services; and universal health coverage, with financial risk protection.

Although a few such aspirations would by 2015 have been replaced in the final SDG3 by feasible 2030 targets, there are drawbacks to retaining any implausible ones.[15] An alternative is to accompany SDG3 by an overarching numerical target that could with serious extra effort be feasible (by 2030 or the 2030s), stimulating sustainable progress and potentially attracting endorsement from all governments, despite their differing economic and health circumstances.

Global life expectancy is now (2010) about 70 years. We have defined premature death somewhat arbitrarily as death before age 70 years, but considered mortality in the three age ranges 0–4, 5–49, and 50–69 years largely separately, since the predominant causes differ between them. We have also considered different countries separately, since the predominant causes (and available resources) vary greatly between countries. But, all countries share an appreciable risk of death before age 70 years, reduction of which could be an appropriate quantitative target. Subtargets could concern particular causes of death, but an overarching universal target for all countries should include potentially feasible reductions in premature death as a whole.

Based on recent trends, this target could be: "Avoid 40% of all premature deaths in each country (ie, of the deaths before 70 years that would be seen in its 2030 population if its 2010 death rates persisted—which they will not, since mortality is already generally decreasing), and improve health care at all ages". This paper is mainly about the first part of this target (avoid 40% of

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Panel 1: Post-2015 global health goals[1,9–14]

A UN intergovernmental Open Working Group (OWG), established following the 2012 UN Sustainable Development Conference, is drafting 2016–30 SDGs. One overarching goal will be health-related, SDG3, and various UN initiatives have discussed what it and its subtargets could be:

High-Level Panel of Eminent Persons
This panel, chaired by the Indonesian, Liberian, and UK premiers, recommended for SDG3 "To ensure healthy lives", with five targets: under-5 mortality ≤2% in all income quintiles, plus non-numerical targets on vaccination coverage; maternal deaths; sexual and reproductive health and rights; and HIV/AIDS, tuberculosis, malaria, NTDs and priority NCDs.

The Sustainable Development Solutions Network
Initiated by economist Jeffrey Sachs, it recommended "Health and wellbeing at all ages", with three numerical targets: under-5 mortality ≤2%; maternal mortality ≤40 deaths per 100 000 livebirths; and under-70 NCD mortality reduced by ≥30%.

The UN Global Compact
This group, involving businesses in global development, proposed two targets for 2010–30: maternal mortality reduced by 75%; and under-5 mortality reduced by 67%.

Global Thematic Consultation on Post-2015 Health Agenda
After wide consultation (100 submitted papers and 14 international hearings with 1600 participants), it recommended: build on and accelerate the MDG agenda, reduce the NCD burden, and ensure universal health coverage and access.

UNICEF's Promise Renewed
UNICEF proposed each country commit to scale up high-impact strategies to make 2035 under-5 mortality ≤2%.

The WHO World Health Assembly NCD Resolution
This resolution targeted reducing premature death from NCDs (ie, the uniformly age-standardised mortality rates at ages 30–69 years) by 25% from 2010 to 2025.

***The Lancet* Commission on Investing in Health (not UN)**
Chaired by economists Lawrence Summers and Dean Jamison, it proposed that health-system strengthening plus scale-up of proven, affordable health interventions and suitable research and development could achieve a "grand convergence in global health by 2035"—reducing infectious, maternal, and child deaths in low or lower-middle income countries to current best levels in middle-income countries. 2030 targets for such countries are: under-5 mortality ≤2% (neonatal mortality ≤1·1%); maternal deaths ≤94 per 100 000 livebirths; and annual mortality per 100 000 ≤4 for tuberculosis and ≤3 for AIDS.

The July 2014 OWG proposal for SDG3
The proposal to "ensure healthy lives and promote wellbeing for all at all ages" had 13 subtargets: maternal mortality ≤70 deaths per 100 000 livebirths; end preventable newborn and under-5 deaths; end the epidemics of HIV/AIDS, tuberculosis, malaria, NTDs, and other infections; reduce premature NCD mortality by a third; halve traffic accident morbidity and mortality; strengthen treatment and prevention of substance abuse; universal access to sexual and reproductive health services; substantially reduce morbidity and mortality from air, water, and soil pollution; strengthen tobacco control and capacity to tackle health risks; support health research and development; finance health workforces; achieve universal health coverage with financial risk protection.

SDG=Sustainable Development Goals. NTDs=neglected tropical diseases. NCDs=non-communicable diseases.

premature deaths), which could be universal. For the second part (improve health care), the targets would have to be appropriately country-specific.

40% fewer premature deaths would be important even in high-income, low-mortality countries, but the absolute gain from it would be greater in countries with higher death rates.

Substantial reductions in premature death can be achieved everywhere (and, importantly, could be monitored in many populations).[16–18] Placing the main emphasis on premature death and improved health care does not ignore disability, since many causes of disability are treatable, or are also important causes of death (and the main contributor to international variation in composite indices of death and disability, especially in lower-income countries, is premature death[19]).

Changes that reduce mortality in middle age also benefit older people (>70 years), since the main causes of death and disability at 50–69 years are similar to those at somewhat older ages. Moreover, strategies for reducing adult and, particularly, child mortality should also include wider availability of affordable, cost-effective health care, including mental health and sexual, reproductive, and perinatal health services.

From targeting premature death as a whole, appropriate national and regional risk-reduction priorities follow. These priorities vary from one country to another, depending on current mortality rates from various diseases and from injuries and the costs of effective action to reduce those rates, leading to population-specific prioritisation of appropriate diseases and age groups.[20,21]

Moreover, targeting premature death could establish a political precedent whose effects continue after 2030. This political precedent matters, since even if premature death decreases 40% by around 2030, 60% would remain to be dealt with later. Substantial further gains follow if appropriate priorities are adopted over the next decade or two. Effective programmes to reduce particular causes of death or expand access to health care take many years to establish but, once established, can be continued.

Although many premature deaths result from other causes, most are caused by NCDs. Some interventions can affect NCD mortality quite quickly (eg, treatment availability), but others take decades. For example, although adult smoking cessation produces fairly rapid benefits, reducing uptake rates produces major benefits only after many decades,[22] as does childhood vaccination against hepatitis B and papillomavirus to avoid liver and cervix cancer. For governments to value such measures appropriately, long-term targeting of premature death should be institutionalised within them, reducing 2030 mortality and laying foundations for substantial further reductions after 2030, when today's children and young adults will be passing through middle age.

If targets are to be pursued seriously, progress towards them needs to be monitored. For premature death this monitoring requires trends only in under-70 mortality (which are easier to monitor reliably than trends at older ages). Monitoring targets that involve expected life-years lost (or disability-adjusted life-years lost[23,24]) from particular causes, or overall life expectancy (or healthy life expectancy) require trends in mortality rates at older ages (and disability rates), so in many countries progress would be difficult or impossible to monitor reliably. Moreover, where life expectancy is already over 75 years, increasing it might be perceived as less interesting than reducing premature death. For robustness of measure and simplicity of communication, therefore, we shall, as the International Epidemiological Association recommended,[25] chiefly emphasise all-cause mortality rates, although at all ages health care and good health, including mental health,[26] also matter.

Except where HIV or war or other major political disturbances predominate, health and longevity are better now than they were 20, 40, or more years ago, and still improving. But, there are still many deaths before old age. Our analyses assess the substantial reductions in all-cause mortality from 1970 to 2010, the more recent changes in cause-specific mortality from 2000 to 2010, and the main remaining causes of death. In view of these mortality trends and levels, we consider what further reductions in premature death could be feasible by 2030, if its reduction was prioritised. We conclude that an ambitious but possibly realistic overarching target for 2030 is to avoid 40% of the premature deaths in every country where mortality in 2030 is not dominated by new epidemics, disturbances, or disasters.

Turning from national to global targets, a cost-effective way to reduce premature death in many countries is to continue reducing child and maternal mortality, tuberculosis, HIV, and malaria, partly because programmes for these reductions that took years to establish are already in place, and death rates are decreasing.[4–8,27] For these particular causes we propose subtargets of a reduction by two-thirds in global deaths in 2030, compared with numbers expected at 2010 death rates. This would require moderate further acceleration of current progress, which would require better health care and substantial political effort.

We also propose, based on the World Health Assembly resolution on under-70 mortality from NCDs,[28] subtargets of a reduction by a third in the global number of premature deaths not only from NCDs but also from the remaining causes at ages 5–69 years (other communicable diseases and injuries). These reductions by a third would again require substantial programmes, different for different diseases (and for fatal accidents), to accelerate current rates of progress moderately.

If achieved, these subtargets would halve under-50 mortality, reduce global deaths at 50–69 years by about a third (mostly by reducing NCDs), and hence reduce under-70 mortality by about 40%. Before further discussion, we review recent and current global and national mortality levels and trends.

Methods

Many populations lack vital registration (and things were worse in past decades), so mortality trend estimates for them are approximate. We used UN-based mortality estimates (which should suffice for our main purposes) to assess trends, but we also cite other sources. To estimate overall mortality rates and trends for the whole world; for the four World Bank income-based country groupings; for the 25 most populous countries (which include 75% of global 2010 population); and for the 164 countries with projected 2030 population greater than 1 million (appendix

See **Online** for appendix

A

B
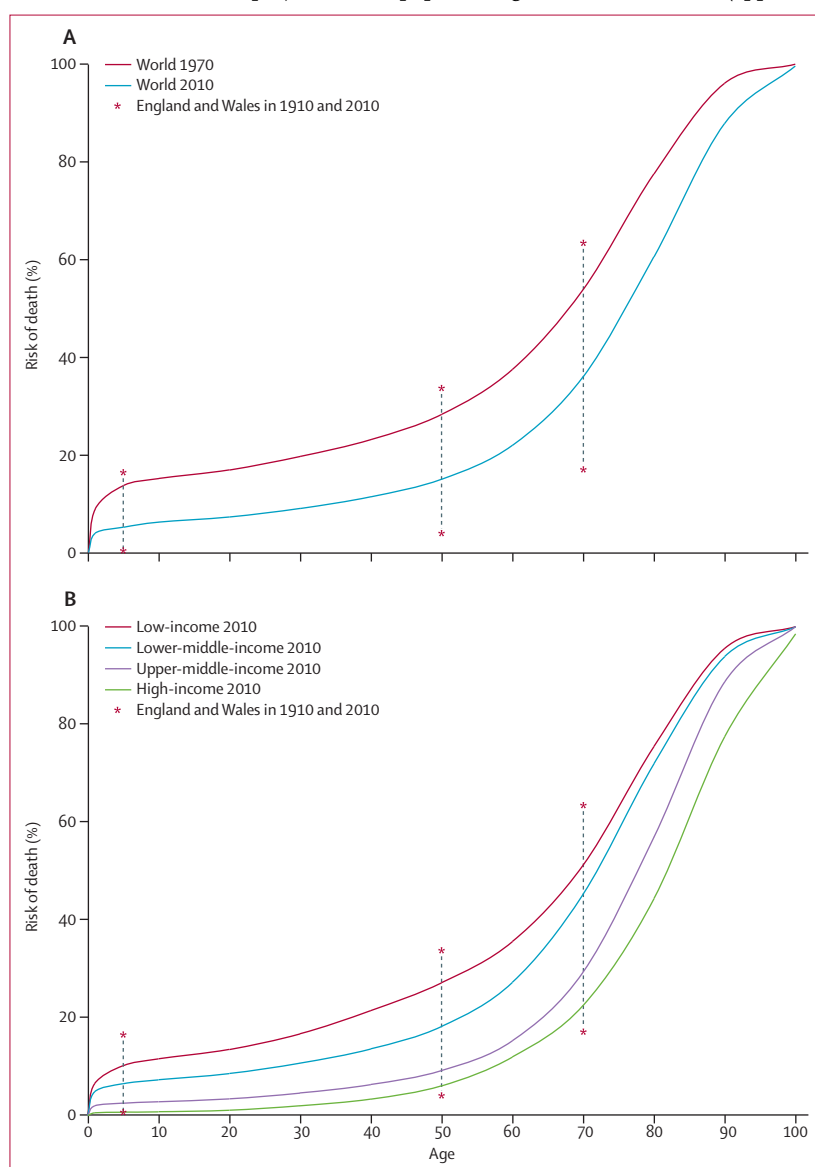
***Figure 1*: Risk of death versus age for the world in 1970 and 2010 (A) and for country income groupings in 2010 (B)**
(A) Risk of death versus age for world in 1970 and in 2010. (B) Risk of death versus age for low-income, lower-middle-income, upper-middle-income, and high-income countries in 2010. Results for both sexes are combined; appendix p 3 gives sex-specific results. 1970 risk is the mean of 1965–70 and 1970–75 risks, and the risk of 2010 is the mean of 2005–10 and projected 2010–15 risks. For historical comparison, the 1910 and 2010 risks for England and Wales are given.

pp 10–13), we chiefly used UN Population Division (UNPD) historical life tables.[29] These cover each five-year time period from 1950 to 2010, with medium-fertility projections for 2010–15. For every fifth year from 1970 to 2010, we estimated the death rates in it by averaging the age-specific risks in the 5-year periods before and after it (so our 1970 rates describe risks in 1965–75); this method smooths out any sudden mortality changes. For global under-5 mortality, we also cite the (broadly similar) estimates from the UN Inter-Agency working group.[6] Results for both sexes are combined, but the appendix gives sex-specific data.

From the historical life tables, we extracted for particular calendar years (1970–2010) the risks in the age ranges 0–4, 5–49, or 50–69 years, defining risk as the probability that someone who survived to the start of an age range dies in it. Although our main interest is in under-70 mortality, to describe approximate patterns of mortality up to age 100 years we took the death rates at 85–89, 90–94, and 95–99 years as the rate in the previous age group multiplied by the ratio of the rate at 80–84 to that at 75–79 years.

Cause-specific mortality rates for 2000 and 2010 for the world as a whole and for each of the four World Bank income groupings (appendix pp 14–17) were from the WHO Global Health Observatory.[30] Application of these 2000 and 2010 rates to the UNPD medium-fertility projection of the 2030 population yielded two numbers of deaths, comparison of which gave the change (% per decade); this is also the change in the death rate from 2000 to 2010, if standardised to the projected 2030 population being analysed. Such age-standardised comparisons avoid issues of competing risks.

Role of the funding source:

The funders had no role in study design, data collection, analysis interpretation, or writing of the report. OFN, PJ, and RP had full access to all data. OFN and RP had final responsibility for submitting for publication.

Results

Between 1970 and 2010, mortality decreased substantially, particularly in young children (figure 1A). From 1970 to 2010, under-5 mortality fell by almost two-thirds (from 14% to 5%, absolute difference 9%), under-50 mortality almost halved (from 28% to 15%, absolute difference 13%), and under-70 mortality fell by a third (54% to 36%, absolute difference 18%).

The World Bank groups countries as low, lower-middle, upper-middle, and high income.[31] Figure 1B describes 2010 mortality in these four groups, showing the excess premature mortality in lower-income countries (although even they now have lower mortality than the world as a whole in 1970).

With regard to mortality changes by age group between 1970 and 2010, the trends at 0–4 and 50–69 years were uniformly favourable, but the generally favourable trend at 5–49 years was slowed in the 1990s (and, in low-income countries, temporarily reversed) by HIV (figure 2).

The absolute 1970–2010 reductions in risk of death at ages 0–4 and 5–49 years were much steeper in low-income than in high-income countries. Still, however, substantial risk remains in low-income countries (low-income *vs* high-income risks: 10% *vs* <1% at 0–4 years and 18% *vs* 6% at 5–49 years). The risk of a person aged 50 years dying at ages 50–69 years decreased by a third (from 36% in 1970 to 24% in 2010), with similar absolute risk reductions in low-income and high-income countries.

Within each income group, different countries had different mortality patterns. Figures 3 and 4 show the 1970–2010 trends in risk at 0–4, 5–49, 50–69, 0–49, and 0–69 years in the 25 most populous countries, which include 75% of 2010 world population. The appendix (pp 6–9) gives separate results for male and female mortality rates, which differed little at 0–4 years but showed some sharp contrasts at older ages. Risks and trends are somewhat untrustworthy for countries without vital statistics, but nevertheless differences between countries are remarkable, as is the general decrease in mortality within each age range, except in the few countries where special factors (HIV, war, or vodka) supervened.

Figure 3A shows trends at 0–4 years. By 2010, there was a more than 50-fold variation in risk, from 18% in DR Congo to 0·3% in Japan and western Europe. War and political disruption affected 1970 (ie, 1965–75) risks in Bangladesh, China, DR Congo, Ethiopia, Nigeria, South Africa, and Vietnam. Over the past 20 years, however (apart from South Africa, where HIV supervened, and DR Congo, where political disruption supervened), the proportional decreases in under-5 mortality were substantial everywhere, with striking absolute reductions (≥15%) in Bangladesh, Egypt, Ethiopia, Iran, and Turkey. Since most under-5 deaths were in south Asia and sub-Saharan Africa, worldwide trends depend mainly on these regions.

Figure 3B shows trends at 5–49 years. By 2010, we noted a 10-fold variation, from nearly 40% in South Africa (where HIV predominates) to 4% in Japan and western Europe. There was a general decrease, except in South Africa and Russia. HIV caused the extreme South African fluctuation, and the fluctuation in Thailand.[27] The extreme Iranian fluctuation reflects 1980s war deaths, and the Russian pattern reflects mortality from spirits (decreasing since 2005 [appendix p 19], but still substantial).[32]

Figure 4A shows trends in the risk of a 50-year-old dying at 50–69 years. By 2010, we noted four-fold variation, with the highest rates in sub-Saharan Africa and Russia. Elsewhere, risk decreased. The decreases were slight in three countries (Philippines, Egypt, and Pakistan) and largest in Iran. In several high-income countries the risk halved during 1970–2010, helped since 1990 by reductions in tobacco deaths in the USA and Europe (appendix p 20–21).

Finally, figure 4B combines the foregoing trends at ages 0–4, 5–49, and 50–69 years to contrast the trends in under-50 mortality and in under-70 mortality. In 2010, under-70 mortality varied from two-thirds in sub-Saharan Africa (similar to England in 1910; figure 1) to only 14% in Japan and Italy. Where risks are high, however, under-70 mortality can obscure trends; eg, in South Africa and Iran the fluctuations due to HIV or war are notably less extreme at 0–69 years than at 0–49 years.

Trends during the past 10 years (2000–10) reflect more recent circumstances (and are unaffected by the large increase in HIV mortality before 2000, which ceased). Table 1 gives numbers of deaths at 0–4, 5–49, and 50–69 years expected in each country, or group of countries, in 2030 if its 2010 mortality rates still applied to its 2030 population. Death rates are falling, however, so numbers actually seen in 2030 will be lower. Hence, it also gives the change in mortality rates (% per decade) from 2000 to 2010. If such changes continue for another 20 years, deaths in 2030 would be reduced by almost twice the change per decade (final column of table 1; decreases per decade of 18% or 42% yield 20-year reductions of a third or two-thirds). Results are given separately for the world, four World Bank income groups, the EU, the 25 most populous countries (sorted by 2030 death numbers), and 164 countries with a population of more than 1 million (appendix pp 10–13).

Worldwide in 2030, 41 million premature deaths would be expected at 2010 death rates (7, 12, and 22 million at 0–4, 5–49, and 50–69 years). These numbers would be slightly increased by stratification
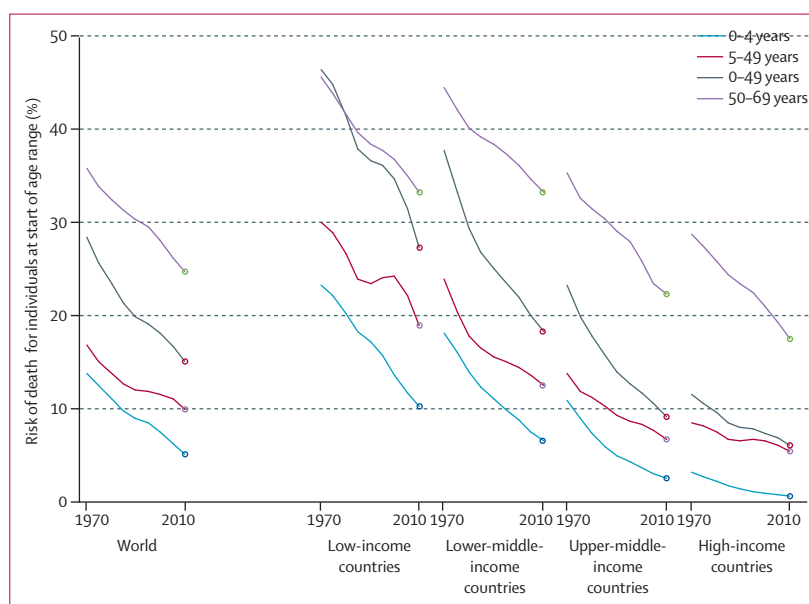
Figure 2: **40-year trends, 1970–2010, in risks of dying in selected age ranges for the world (left), and (right) four World Bank groupings of countries (low-income to high-income)**
Risks are for those who have already survived to the start of the relevant age range. Results for both sexes are combined; appendix p 5 gives sex-specific results. Risks average previous and subsequent 5-year time periods (so 1970 risk is the mean of 1965–70 and 1970–75 risks; 2010 risk is the mean of 2005–10 risks and UNPD projection for the 2010–15 risks), smoothing any sudden changes. Details of these graphs are tabulated in the appendix (pp 25–26). 2 billion deaths at ages 0–69 years were recorded from 1965 to 2010.
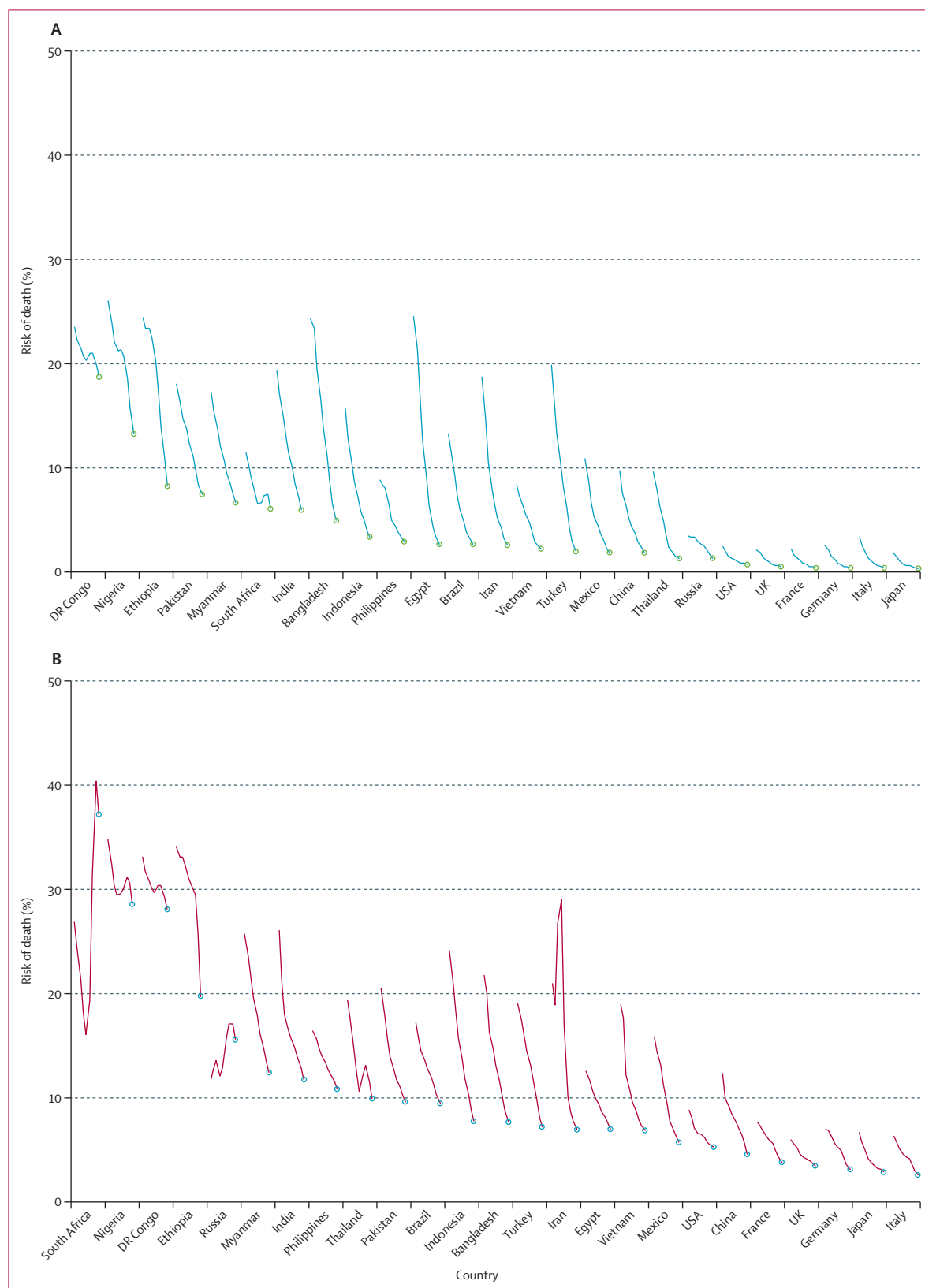
Figure 3: 40–year trend lines, 1970–2010, for 25 most populous countries in risks of dying in selected age ranges
(A) Risk of death at ages 0–4 years. (B) Risk, at age 5 years, of death at ages 5–49 years. Results for both sexes are combined; appendix pp 6–7 give sex-specific results. Risks average the previous and subsequent 5-year time periods (so the 1970 risk is the mean of the 1965–70 and 1970–75 risks), smoothing any sudden changes.
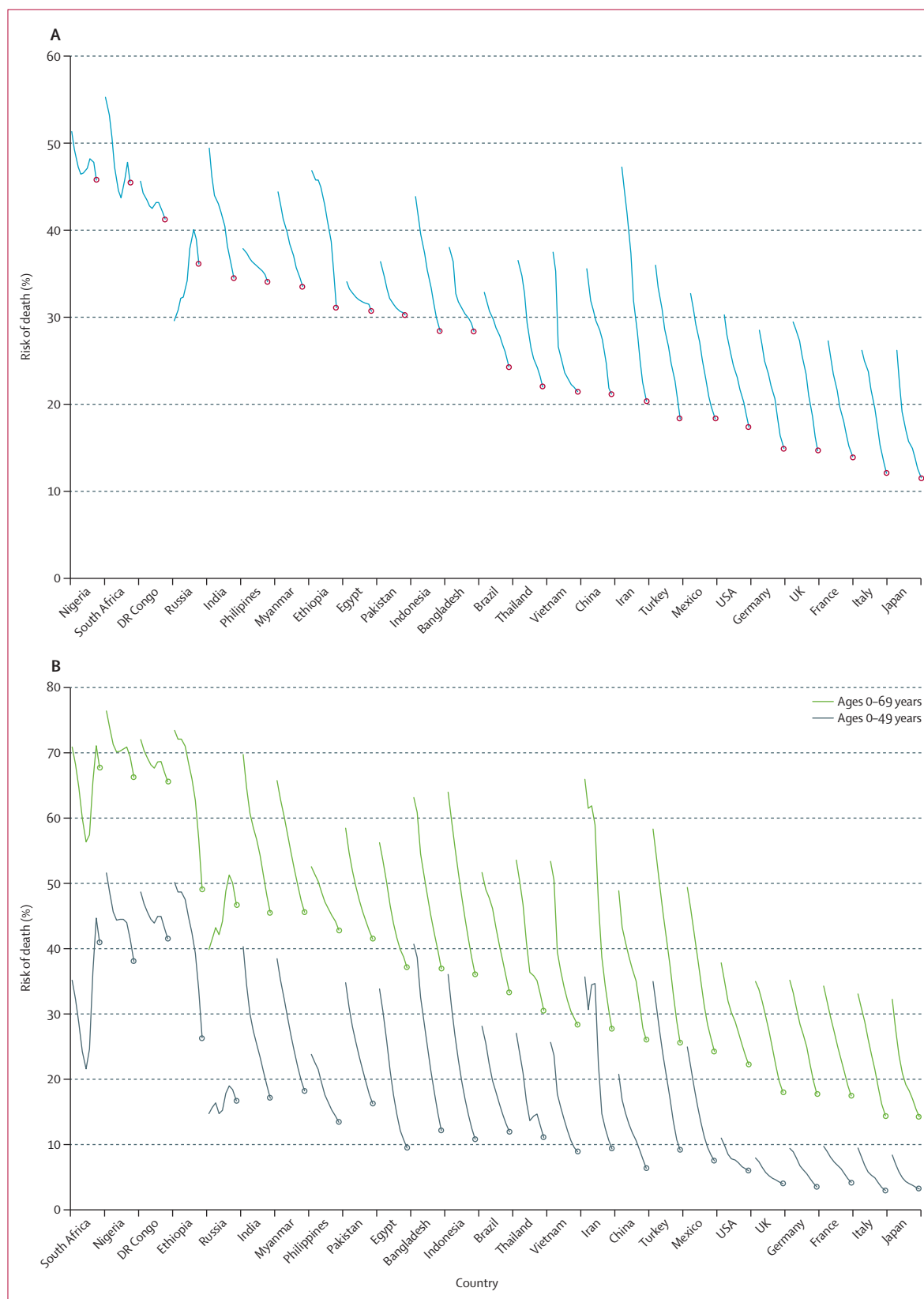
Figure 4: **40–year trend lines, 1970–2010, for 25 most populous countries in risks of dying in selected age ranges**
(A) Risk, at age 50 years, of death at ages 50–69 years. (B) Risks, ages 0–49 years and 0–69 years. Results for both sexes are combined; appendix pp 8–9 give sex-specific results. Risks average the previous and subsequent 5-year time periods (so the 1970 risk is the mean of the 1965–70 and 1970–75 risks), smoothing any sudden changes.

by country income group (table 1). In 2000–10, under-5 mortality decreased by about a third per decade and mortality at 5–49 and 50–69 years decreased by about a sixth per decade. If similar decreases per decade continue (which they might not, without substantial effort), this would reduce 2030 under-70 deaths by about a third, to 27 million (3 million at 0–4 years, 8 million at 5–49 years, and 16 million at 50–69 years).

In low-income countries the proportion of premature deaths that are in childhood is still substantial, so a substantial absolute reduction in premature death is still possible. India, China, Nigeria, and Indonesia account for 20 million of the 41 million premature deaths in table 1; all are currently on track for a 2010–30 reduction of about a third (ie, 18% per decade). Next in absolute numbers of premature deaths are DR Congo and Pakistan, with

|	Age 0–4		Age 5–49		Age 50–69		Age 0–69		
	Deaths in 2030, millions	Change, % per decade*	Deaths in 2030, millions	Change, % per decade*	Deaths in 2030, millions	Change, % per decade*	Deaths in 2030, millions	Change, % per decade*	(Implied % change per 20 years†)
Most populous 25 countries‡									
2 India	1·49	–30%	2·72	–15%	5·05	–12%	9·26	–17	(–31%)
3 China	0·28	–36%	0·92	–30%	4·71	–15%	5·91	–19	(–34%)
1 Nigeria	1·36	–31%	1·30	–12%	0·63	–7%	3·29	–20	(–37%)
2 Indonesia	0·14	–37%	0·34	–25%	0·95	–10%	1·42	–17	(–32%)
1 DR Congo	0·72	–13%	0·50	–11%	0·21	–7%	1·42	–12	(–22%)
2 Pakistan	0·34	–22%	0·34	–14%	0·52	–2%	1·20	–12	(–22%)
3 Russia	0·02	–46%	0·33	–7%	0·77	–11%	1·12	–11	(–21%)
3 Brazil	0·07	–30%	0·32	–17%	0·66	–15%	1·05	–16	(–30%)
4 USA	0·04	–12%	0·25	–9%	0·76	–18%	1·04	–15	(–28%)
1 Ethiopia	0·30	–43%	0·43	–38%	0·22	–25%	0·95	–37	(–61%)
1 Bangladesh	0·14	–44%	0·22	–27%	0·51	–4%	0·86	–19	(–35%)
3 South Africa	0·06	–21%	0·39	22%	0·24	–1%	0·70	+8	..
2 Philippines	0·08	–24%	0·20	–10%	0·35	–4%	0·63	–9	(–17%)
3 Mexico	0·04	–36%	0·12	–17%	0·27	–15%	0·43	–18	(–33%)
2 Egypt	0·05	–38%	0·11	–17%	0·28	–4%	0·43	–13	(–24%)
2 Vietnam	0·02	–30%	0·11	–11%	0·28	–1%	0·41	–6	(–11%)
1 Myanmar	0·05	–20%	0·12	–15%	0·24	–7%	0·41	–12	(–22%)
3 Thailand	0·01	–33%	0·09	–24%	0·25	–8%	0·34	–14	(–26%)
3 Iran	0·03	–39%	0·10	–20%	0·20	–20%	0·33	–22	(–39%)
3 Turkey	0·02	–53%	0·09	–26%	0·17	–19%	0·29	–26	(–45%)
4 Japan	<0·01	–29%	0·04	–15%	0·19	–18%	0·24	–18	(–32%)
4 Germany	<0·01	–23%	0·03	–27%	0·20	–20%	0·23	–21	(–38%)
4 UK	<0·01	–20%	0·03	–14%	0·13	–23%	0·17	–22	(–38%)
4 France	<0·01	–26%	0·03	–25%	0·12	–17%	0·16	–19	(–34%)
4 Italy	<0·01	–38%	0·02	–30%	0·12	–23%	0·14	–24	(–43%)
Total, 25 most populous countries	5·3	–30%	9·2	–17%	18·0	–13%	32·4	–17	(–32%)
European Union§	0·03	–30%	0·25	–22%	1·2	–19%	1·5	–20	(–36%)
World Bank grouping									
1 Low-income	3·0	–34%	3·9	–22%	2·7	–12%	9·6	–24	(–43%)
2 Lower-middle	3·9	–31%	6·3	–11%	9·4	–10%	19·6	–16	(–29%)
3 Upper-middle	0·6	–43%	2·8	–20%	8·2	–20%	11·6	–22	(–38%)
4 High-income	0·1	–26%	0·6	–16%	2·4	–15%	3·1	–15	(–28%)
Total, four World Bank groupings	7·6	..	13·6	..	22·7	..	43·9	..	..
World, at global mortality rates ¶	7·2	–34%	12·4	–17%	21·7	–15%	41·3	–19	(–35%)

*The death rates of exact year 2000 and the (lower) death rates of exact 2010 were applied to the 2030 population (UNPD medium-variant projection), yielding 2 numbers of 2030 deaths; change (% per decade) compares them. This change is identical to the change in the age-standardised death rate from 2000 to 2010, if both rates are standardised to the age distribution of the relevant 2030 population. †Change (%) over 20 years (2010–30) if the rate of change (% per decade) during 2000–10 were to continue. ‡Country name, and World Bank income grouping: 1=low, 2=lower-middle, 3=upper-middle, 4=high income. §All 28 states that were EU members in 2010, regardless of their status in the year 2000. ¶No allowance for population changes in income distribution, so numbers lower than totals for the 4 World Bank groups.

Table 1: 25 most populous countries, and various groupings of countries: numbers of premature deaths in 2030 by age (years), if 2010 rates applied to 2030 populations, and current rate of change (% per decade, 2000–10) in age-standardised death rates

political disruption and shallower rates of decline, Russia, where much premature mortality is from vodka consumption and tobacco use (hence avoidable), and the USA and Brazil, where current trends suggest 20-year decreases nearer 30% than 40%. The greatest decrease was in Ethiopia, and the only increase was in South Africa. In sub-Saharan Africa, large reductions in premature death would be possible with political stability and HIV control.

Some causes of death are much more susceptible to control than others. Table 2 breaks down the global numbers by cause and age; the appendix (pp 14–18)

shows these data for each income group. The age distributions of different causes help explain why rates of decrease are steeper at 0–49 years than at 50–69 years. In the subtotals (table 2; table 3), projected deaths in 2030 from communicable, neonatal, maternal, and nutritional causes number 10 million at 0–49 years and 2 million at 50–69 years. By contrast, those from non-communicable diseases number 6 million at 0–49 years and 18 million at 50–69 years. As rates of decrease are twice as great for communicable disease as for other causes, under-50 mortality is falling particularly rapidly.

	Age 0–49		Age 50–69		Age 0–69		(Age ≥70)
	Deaths in 2030, millions	Change, % per decade*	Deaths in 2030, millions	Change, % per decade*	Deaths in 2030, millions	Change, % per decade*	Deaths in 2030, millions
Communicable, perinatal, maternal, or nutritional							
Neonatal†	2·6	–23%	..	..	2·6	–23%	..
Respiratory infection	1·5	–35%	0·7	–17%	2·2	–31%	(2·2)
HIV/AIDS	1·7	–14%	0·3	–19%	2·0	–15%	(0·0)
Diarrhoea	1·1	–40%	0·4	–25%	1·5	–37%	(0·6)
Tuberculosis	0·5	–39%	0·6	–41%	1·0	–40%	(0·5)
Malaria	0·6	–30%	<0·1	–19%	0·7	–30%	(0·0)
Nutritional deficiencies	0·4	–24%	0·1	–28%	0·5	–24%	(0·3)
Meningitis	0·4	–29%	0·1	–13%	0·4	–27%	(0·1)
Childhood cluster‡	0·3	–67%	..	..	0·3	–67%	..
Maternal	0·3	–37%	..	..	0·3	–37%	..
Other communicable	0·8	–22%	0·4	–8%	1·1	–18%	(0·5)
Non-communicable diseases							
Vascular or diabetic	1·8	–17%	8·4	–16%	10·1	–17%	(21·1)
Neoplastic	1·4	–14%	5·0	–9%	6·4	–10%	(6·8)
Chronic respiratory	0·3	–30%	1·7	–28%	2·0	–28%	(4·8)
Cirrhotic	0·3	–14%	0·8	–11%	1·1	–12%	(0·4)
Other digestive	0·3	–21%	0·6	–19%	0·9	–20%	(1·1)
Renal	0·3	–14%	0·5	–2%	0·8	–7%	(1·0)
Congenital	0·6	–11%	..	..	0·6	–11%	(0·0)
Other non-communicable	0·7	+3%	0·7	+12%	1·4	+7%	(2·0)
Injuries							
Non-road-traffic accidents	1·7	–17%	0·8	–8%	2·4	–14%	(1·2)
Road traffic accidents	1·0	+2%	0·4	+15%	1·4	+5%	(0·3)
Suicide	0·6	–23%	0·3	–25%	0·9	–24%	(0·2)
Homicide or war	0·5	–20%	0·1	–29%	0·6	–22%	(0·0)
Subtotals: cause categories							
Communicable, perinatal, maternal or nutritional	10·2	–31%	2·6	–25%	12·8	–30%	(4·1)
Non-communicable diseases	5·8	–15%	17·5	–14%	23·3	–14%	(37·2)
Injuries	3·6	–14%	1·6	–9%	5·2	–13%	(1·7)
World total: All causes	19·6	–24%	21·7	–15%	41·3	–19%	(43·0)

*The death rates of exact 2000 and the (lower) death rates of exact 2010 were applied to the 2030 population (UNPD medium-variant projection), yielding two numbers of 2030 deaths; change (% per decade) compares them. NB: This change is identical to the change the age-standardised death rate from 2000 to 2010, if both rates are standardised to the age distribution of the world population in 2030. †Conditions arising in the perinatal period (ICD-10 P00-P96); mostly avoidable. NB: Excludes congenital malformations. ‡Diphtheria, pertussis, tetanus, poliomyelitis, measles; all are vaccine-preventable.

Table 2: Worldwide numbers of premature deaths by cause and age (years) in 2030, if 2010 rates applied to 2030 world population, and current rate of change (% per decade, 2000–10*) in age-standardised death rates

	Age 0–4	Age 5–49	Age 50–69
Neonatal or maternal	··/2·5	0·2/0·3	··
HIV	··/0·1	1·0/1·5	0·2/ 0·3
TB and malaria	··/0·5	0·3/0·5	0·4/ 0·7
Other communicable*	··/2·8	0·6/1·9	0·5/ 1·6
Non-communicable†	··/0·9	1·6/4·9	5·8/17·5
Fatal injuries‡	··/0·4	1·1/3·3	0·5/1·6
All deaths, by age§	4·8/7·2	4·9/12·4	7·5/21·7
Cumulative deaths, starting from birth	··	Ages 0–49: 9·7/19·6	Ages 0–69: 17·3 /41·3

Data are targeted reduction/number at 2010 rates. *Includes malnutrition, but, mostly pneumonia and diarrhoea (before and after age 5 years). †At ages 0–4 years, most NCD deaths are from congenital disease. ‡Most fatal injuries are accidents, rather than suicide or homicide. §All deaths, by summation over four income-based groups of countries: ages 0–4 years, 5·0 million/7·6 million; ages 5–49 years, 5·4 million/13·6 million; ages 50–69 years, 8·1 million/22·7 million. Target of two-thirds reduction in under-5 mortality as a whole is not subdivided by cause.

Table 3: Premature deaths (million) in 2030 population at unaltered 2010 death rates, and targeted reductions that would be avoided by reductions of two-thirds in child, maternal, tuberculosis, HIV, and malaria deaths, and of a third in other deaths

Subdividing further, there was no material increase from 2000 to 2010 in any major cause except traffic accidents. Mortality from communicable diseases decreased rapidly (except that HIV rose for a few years, then fell). Mortality from non-communicable diseases decreased moderately (except that chronic respiratory disease decreased rapidly). Mortality decreased more slowly from injuries than from disease; although suicide and homicide (which includes war deaths) decreased, increased traffic deaths were only just outweighed by decreases in other fatal accidents.

For some populations, striking trends in all-cause, cancer or vascular mortality (appendix pp 19–24) illustrate vividly the importance of particular factors—HIV, tobacco, alcohol, vascular medication, or under-5 mortality. Where death rates remain high, substantial absolute risk reductions are possible.

Discussion

In old age death is inevitable, but death before old age is not.[33] World life expectancy is now just over 70 years, and most deaths before that age are avoidable. In some countries with reliable data, under-50 mortality is lower than 5%, under-70 mortality is lower than 20%, and both are still falling. In many countries, however, substantial risks remain, and there are substantial unmet health-care needs. Mortality and morbidity can be combined into composite indices such as healthy life expectancy (HALE) or disability-adjusted life-years (DALYs), but such indices are difficult to monitor in low-resource environments, and correlate closely with premature death.[19,34]

Even mortality rates and trends are not known exactly (as many high-mortality countries lack reliable vital statistics), and our estimates of them, based only on UN and WHO statistics, could be made somewhat more reliable by seeking further evidence.[4–8,35,36] The present evidence is, however, reliable enough to help formulate reasonable mortality reduction targets. Generally, mortality rates have been falling for decades, particularly in childhood, despite sharp fluctuations in some populations due to HIV or direct or indirect effects of political disruption. Both the 40-year trends in figures 1–4 and the 10-year trends in tables 1–2 are of interest. We noted a larger decrease during 2000–10 than in the 1990s, due partly in the past few years to efforts to achieve the MDGs,[4–8,27,37] and our proposed targets (panel 2) build on the progress already being achieved.

Still, however, malaria, HIV, tuberculosis, and maternal and child mortality would, at 2010 death rates, cause about 9 million deaths in 2030 (7 million at 0–4 years plus 2 million at 5–49 years, out of a total of about 20 million under-50 deaths; table 3). If existing efforts to control them and expand health care are intensified in epidemiologically efficient ways (which may involve some strategies that reflect transmission patterns, and not just passive service provision), then from 2010 to 2030 it could be possible to reduce mortality from them by two-thirds; they fell by about a third per decade from 2000 to 2010.

This will, however, be a challenging target even in areas free from conflict. Reducing malaria mortality by a third during the past decade required substantial, complex efforts, and global commitment, and continuing to reduce it by about a third per decade could be increasingly difficult. Likewise, to continue successful control of HIV and tuberculosis, major political commitment will be needed, even if improved diagnostics and treatments can be widely deployed.[13]

For maternal mortality, the decrease noted in table 2 is 37% per decade, but this estimated decrease is steeper than other studies suggest.[6,7] If the current annual decrease is about 30% per decade, and this decrease can be maintained for 20 years, maternal mortality would be halved. Hence, the rate of decrease would have to steepen substantially by 2020 to achieve a two-thirds reduction by 2030. This ambitious target would mean a reduction to 77 per 100 000 livebirths, comparable with the targets of 70 and 94 suggested by others (panel 1).[1,13]

Finally, under-5 mortality accounts for the largest number of MDG-targeted deaths. Both MDG4 and our suggested target relate to under-5 mortality as a whole, since this is more reliably measurable than particular components of under-5 mortality. But, these particular components are of separate interest. The steepest decrease is the 67% fall within just one decade in mortality from the childhood cluster of vaccine-preventable diseases, illustrating the importance of national and international vaccination programmes. Although mortality rates from many other infective causes are also decreasing steeply (eg, 30–40% per decade), neonatal causes of death are not.[5,13,38–40] These

causes arising in the neonatal period are largely preventable or curable (and do not include congenital causes). But, serious adoption of the target of a two-thirds reduction in under-5 mortality from 2010 to 2030, if backed by appropriate resources, would accelerate progress. Achievement of this target would reduce under-5 mortality to just below 20 per 1000 livebirths, comparable with targets suggested by others (panel 1).[9–13]

For mortality at 5–69 years from the remaining communicable diseases (chiefly diarrhoea and pneumonia), the rate of decrease during 2000–10 was not as steep, so a smaller rate of reduction should perhaps be targeted. A reduction of a third over 20 years would represent moderate acceleration of the decrease during previous decade. This reduction would require substantially improved health-care delivery to the subpopulations who are still at relatively high risk of death from curable infections.

If communicable disease mortality falls substantially, NCDs and injuries will increasingly predominate. Hence, without substantial extra efforts to reduce them, all-cause mortality is unlikely to decrease as rapidly in future decades as in the past decade. The reduction actually achieved in NCD mortality will be a key determinant of the reduction in overall mortality (particularly at 50–69 years, where NCDs cause more than 80% of all premature deaths), and UN/WHO initiatives are already addressing NCD control.[28,41,42]

The 2012 WHO 25×25 resolution targeted a 25% reduction from 2010–25 in NCD mortality at ages 30–69 years, specifying as 2025 subtargets changes in various NCD determinants.[28] The most important was 30% reduction in smoking, which in 2010 caused about a quarter of all cancer deaths in Europe and America (plus even more deaths from other diseases), and is already a major cause of death in China, India, and elsewhere in Asia. Fortunately, quitting works; smokers who stop before age 40 years (preferably well before 40) avoid more than 90% of the risk.[22] Hence, the 25×25 resolution supported the Framework Convention on Tobacco Control, whose many recommendations include major increases in specific excise taxes. Governments make about US$300 billion per year directly or indirectly from tobacco. If increases in excise tax were to double real current cigarette prices, particularly affecting cheaper brands, this would reduce smoking by about a third, yet increase what governments make from tobacco to about US$400 billion per year, in today's dollars.[43] The 25×25 resolution also targeted dangerous patterns of alcohol consumption (the predominant cause of premature death in Russia; appendix p 19); halting the present rise in obesity; and secondary prevention (effective, affordable treatment of those already identified as having disease, mainly with safe generics that do not require tertiary care). The global decrease of 15% per decade in NCD mortality during 2000–10 should be somewhat exceeded during

the 2020s if there is good compliance with the 25×25 resolution over determinants of NCD mortality, with even greater effects thereafter.

Table 3 shows the importance, particularly at 5–49 years, of fatal injuries (mainly accidents, but also suicide and homicide). Alcohol is a major cause of accidents and other fatal injuries, and the main cause of premature death in some populations. With political commitment, practicable restrictions on alcohol pricing, advertising and convenience of purchase could in some populations substantially reduce these risks. Successful programmes to reduce mortality from suicide (within wider mental health programmes), homicide and, particularly, road accidents and the (more frequent) other accidents will be as complex to plan and carry through as those for disease control, and should include establishment of sustainable systems to register details of fatal injuries. More generally, if mortality targets and subtargets are adopted, appropriate epidemiological systems will be needed to monitor overall and cause-specific mortality in representative populations.[16–18]

Panel 2: Research in context

Previous studies

Millennium Development Goals targeted reductions from 1990 to 2015 in maternal, child, HIV, tuberculosis, and malaria mortality, and WHO has targeted 2010–25 reductions in premature (under 70 years of age) NCD mortality. To help quantify the 2010–30 UN Sustainable Development Goal for health (SDG3), we re-analysed data from the UN and WHO for recent global mortality trends to 2010.

What this study adds

Maternal, child, HIV, tuberculosis, and malaria mortality are falling so fast that reduction by two-thirds during 20 years (2010–30) could feasibly be targeted. Other under-70 mortality is falling half as fast, suggesting a reduction by a third could feasibly be targeted. Achievement of both targets would reduce premature deaths by about 40%. Country-specific results suggest 40% reduction is feasible in many populations, but would be challenging to achieve by 2030.

A quantitative target to accompany SDG3:
Avoid 40% of premature deaths, and improve health care at all ages

- Overarching target for mortality: avoid 40% of the premature deaths in each country (the deaths before age 70 years that would occur in that country's 2030 population at its 2010 death rates).
- Overarching target for health care at all ages: extend access to cost-effective, affordable treatment, including mental health and sexual, reproductive and perinatal services (with targets that are appropriately country-specific)
- Subtargets for global mortality from specific causes:
    Avoid two-thirds of child and maternal deaths;
    Avoid two-thirds of HIV, tuberculosis, and malaria deaths;
    Avoid a third of premature deaths from other communicable diseases or injuries;
    Avoid a third of the premature deaths from NCDs.

Achievement of these subtargets would halve under-50 mortality (avoiding 10 million of the 20 million deaths before age 50 years that would occur in the 2030 population at 2010 death rates), as well as reducing global premature deaths by about 40% (avoiding 17 million of the 41 million deaths before age 70 years that would occur in the 2030 population at 2010 death rates).

NCDs=non-communicable diseases.

Since national and international programmes to reduce mortality from the problems targeted by the MDGs are already working, continuation of these programmes is an important, cost-effective way to reduce overall mortality, as is substantial expansion of affordable health care, including sexual, reproductive, and perinatal health services. For communicable, maternal, and child mortality, a grand downward convergence between rates in different countries could be largely achieved through health-system strengthening plus scale-up of proven, affordable health interventions and relevant research and development.[13,21]

Although the targeted reductions in particular causes improve only moderately on current rates of progress, they will not be achieved without sustained effort, targeted programmes, and additional finance for health care. If achieved, they avoid about 10 million of the 20 million deaths at 0–49 years (halving under-50

Panel 3: Ethiopia[4,6,39,44]

Ethiopian health has progressed remarkably since 1990: the number of new HIV infections declined by 90% and under-5 mortality by 67%. The reasons (apart from ending armed conflict and its consequences) include health-care reforms with, as key factors, community empowerment and ownership through the flagship Health Extension Program (HEP); sustained political commitment at all levels; innovative solutions to problems like task-shifting; emphasis on building a resilient health system by leveraging domestic and international support; and ensuring equity of access to primary health care, providing key priority services and ensuring the worse off are not left behind.

In 1990, under-5 mortality 20·4%, mortality from tuberculosis, malaria, and HIV was high, and life expectancy was 45 years. Health policy decisions in 1993 articulated the changes needed to reverse the deteriorating health situation by treatment plus health promotion and disease prevention. 10 years later, the HEP was implemented at scale in all regions. HEP is supported by 38 000 rural and urban government-salaried Health Extension Workers, trained and equipped to support implementation of 16 "health promotive, disease preventive and basic curative health service packages" and brings services to the door-steps of each household, which makes it differ from conventional health-care delivery, where people go with their problems to health facilities.

HEP is coupled with accelerated expansion of health facilities (health posts, health centers, and hospitals), human resources (nurses, midwives, laboratory and pharmacy professionals, and doctors) and transformational change in the pharmaceutical funding and supply system. Health, and health reform, has been greatly helped by social changes involving peace, avoidance of famines, economic growth, education, safe drinking water, and clean energy. Health indicators have improved profoundly since 1990: under-5 mortality fell to 6·8% (surpassing MDG4 3 years early); tuberculosis and malaria mortality halved, and life expectancy rose to 65 years. The mortality decreases were particularly steep during the past decade (2000–10; table 1, figure 3). If recent past achievements predict future attainments, during 2010–30 Ethiopia will roughly halve the remaining risks of premature death, especially with its plans for coordinated and sustained mitigation of mortality and morbidity from injuries and NCDs.

Panel 4: Mexico[46-54]

From 1970 to 2010, Mexican mortality fell six-fold at ages 0–4 years (from 12% to 2%), three-fold at ages 5–49 years (from 17% to 6%), and two-fold at ages 50–69 years (from 33% to 17%). These substantial decreases, which are similar to those in several other countries, were about as steep before as after the 1990s health-care reforms (figure 3).

Although other factors also had an important role, the major Mexican health-system strengthening initiatives and special programmes of the past three decades must have reduced mortality. In the 1990s, Mexico expanded the health-care infrastructure in poorer states and increased regular access of the poor to 12 essential interventions (Extension of Coverage Program), and in 2004 Congress extended social protection in health to the non-salaried. The supply of safe water and sanitation improved, and community-based interventions targeted malnutrition and common childhood infections (eg, National Program to Control Diarrheal Diseases [1984], Universal Immunization Program [1991] and Fair Start in Life [2002]). Vaccines were given during national health weeks, along with promotion of oral rehydration. In 1997, a conditional cash transfer programme began, enhancing the capabilities of families in extreme poverty.

Will premature mortality continue to decline steeply? As shown in table 1, under-5 mortality is still decreasing by a third per decade and premature mortality is now mainly at ages 50–69 years, where NCDs predominate and the World Health Assembly 25 × 25 resolution on NCDs applies (panel 1). Secondary prevention, a 30% reduction in smoking and a halt to the rise in adiposity are needed. In urban Mexico, 20% smoke, a difficult-to-quantify proportion drink hazardously, and by middle-age 32% are obese, 16% are diabetic, and half have high blood pressure or cholesterol, mostly undiagnosed or under-treated. The new National Strategy for Control of Obesity and Diabetes [2013] includes (1) health promotion, NCD prevention and monitoring; (2) early risk factor identification, including diabetes; and (3) fiscal policies for health, including new taxes (eg, US$0·07 per L on sugary drinks and 8% on high-calorie junk food). Likewise, Mexican taxes are only 62% of cigarette prices; raising this to 75% could reduce numbers of people smoking by a few million yet generate tens of billions of pesos in annual revenue. Despite all these major issues, however, Mexican death rates have never been lower, and are still falling steeply.

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mortality), and about 17 million (40%) of the 41 million deaths at 0–69 years (table 3). They do not, however, greatly change global population growth in old age, which is driven more by intergenerational demographic changes than by the moderate proportional changes in the probability of reaching old age seen in figure 1A. Likewise, moderate proportional increases in the probability of surviving childhood would have little direct effect on the dynamics of population growth, and may well help limit reproduction rates.[23]

Reducing premature death is a flexible target that can be pursued in different ways in different countries, according to their mortality patterns and resources. In low-income countries, the number of premature deaths in 2030 at 2010 death rates will be three times as great before age 50 years (6 million) as at 50–69 years (2 million), whereas in upper-middle-income plus high-income countries the opposite is true (4 million before age 50 years *vs* 11 million at 50–69 years; appendix pp 14–18).

Countries with high under-50 mortality (such as Ethiopia, panel 3) can prioritise reducing mortality from communicable, perinatal, and maternal causes, and mortality from injuries (mainly accidents rather than suicide or homicide). Investing in cost-effective health care to achieve this yields economic returns and substantially improves life expectancy.[13,45] (The Disease Control Priorities Project keeps a wide range of health-related interventions under review to determine their feasibility and cost-effectiveness.[21])

Countries with low under-50 mortality (such as Mexico, panel 4) might prioritise controlling mortality from NCDs, which predominate in the 50–69 year age group; NCD control also reduces disability. Where social inequalities within countries strongly affect mortality, emphasis on overall mortality and affordable access should promote equity by targeting those at highest risk.[55] China's recently introduced nationwide health insurance system now covers 20% of the world's population and should improve equity.

Returning to the 2016–30 SDG for health, whatever is proposed should balance aspiration with technical feasibility,[15] and should engender better vital statistics.[16–18] The current proposal for SDG3 (panel 1) could be accompanied by something that is in part quantitative, feasible and measurable, such as "Avoid 40% of the premature deaths in each country, and improve health care at all ages", especially if this is accompanied by appropriate subtargets (panel 2).

Indeed, in some populations the subtarget of "Halve under-50 mortality" might be given much greater emphasis than the main target,[56] whereas in others "Avoid a third of premature deaths from NCDs" might do so. In all cases, however, reduction in fatal injuries (as well as in medical causes of death) would also be important. If the total number of premature deaths is to be reduced, current national age-specific, cause-specific mortality patterns should be major determinants of national priorities.

Even in upper-income, low-mortality countries, avoiding about 40% of the deaths before age 70 years would be important, and should be achievable. In countries with higher risks of death in childhood and early adult life, avoiding 40% of the premature deaths yields larger absolute gains, and should be more easily achievable, at least in areas free of political disruption and war.

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Supplementary appendix

This appendix formed part of the original submission and has been peer reviewed. We post it as supplied by the authors.

Appendix to:
Quantifying the over-arching 2030 Sustainable Development Goal for health: avoiding 40% of the premature deaths in each country

Contents list: click on an item to jump directly to it

Web Figure 1a: Risk of death versus age at worldwide age-specific mortality rates of 1970 and of 2010 – males, females and combined

1970 risk is mean of 1965-70 and 1970-75 risks, and 2010 risk is mean of 2005-10 risk and UNPD projection for the 2010-15 risk.

MALES: Risk of death versus age at worldwide E
age-specific mortality rates of 1970 and of 2010E

— World 19701 ▬ World 20101

FEMALES: Risk of death versus age at worldwide E
age-specific mortality rates of 1970 and of 2010 E

— World 19701 ▬ World 20101

COMBINED (M+F): Risk of death versus age at worldwide E
age-specific mortality rates of 1970 and of 2010 E

— World 19701 ▬ World 20101   * England and Wales in 1910 and 20101

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Web Figure 1b: Risk of death versus age at worldwide age-specific mortality rates of 2010 in low-income, lower-middle, upper-middle and high-income countries – males, females and combined

MALES: Risk of death versus age at worldwide age-specific mortality rates of E 2010 in low-income, lower-middle, upper-middle and high-income countries E

FEMALES: Risk of death versus age at worldwide age-specific mortality rates of E 2010 in low-income, lower-middle, upper-middle and high-income countries E

COMBINED (M+F): Risk of death versus age at worldwide age-specific E mortality rates of 2010 in low-income, lower-middle, upper-middle and E high-income countries E

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Web Figure 2: **40-year trends, 1970-2010, in risks of death in selected age ranges for (a) World and (b) 4 groups of countries, low-income to high-income – males, females and combined**
Source: UNPD life tables. Risks are for survivors at the start of the age range. To smooth any sudden changes, risks average the previous and subsequent 5-year time periods (so 1970 risk is mean of 1965-70 and 1970-75 risks, and 2010 risk is mean of 2005-10 risk and UNPD projection for the 2010-15 risk).

MALES: 40-year trends, 1970-2010, in risks of death in selected age ranges E for World and 4 groups of countries, low-income to high-incomeE

FEMALES: 40-year trends, 1970-2010, in risks of death in selected age ranges E for World and 4 groups of countries, low-income to high-income E

COMBINED (M+F): 40-year trends, 1970-2010, in risks of death in selected E age ranges for World and 4 groups of countries, low-income to high-income E

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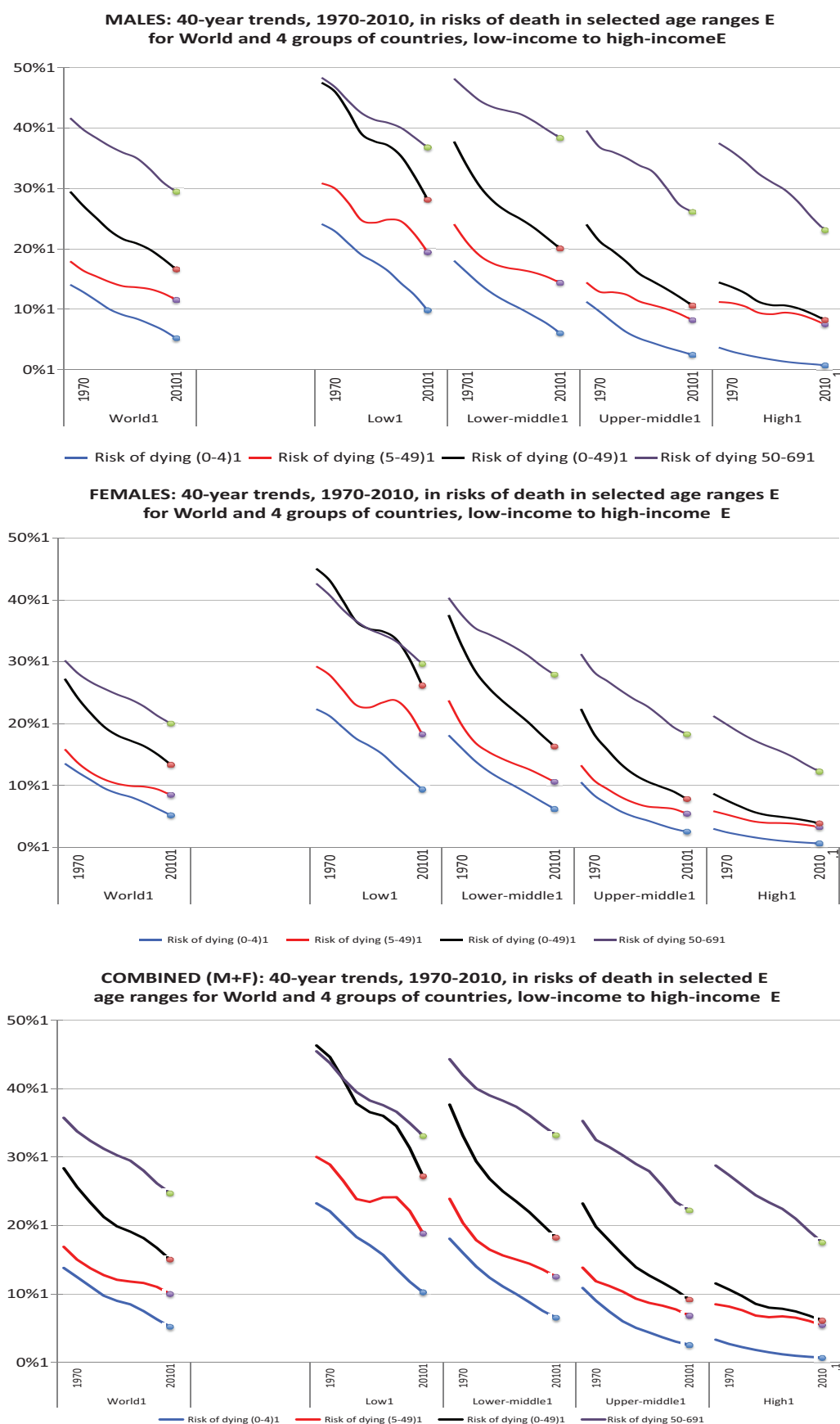
Web Figure 3: **40-year trends, 1970-2010, for the 25 most populous countries in risks of death in selected age ranges (Figures 3a-3b: ages 0-4, & 5-49) – males, females and combined**
To smooth any sudden changes, risks average the previous and subsequent 5-year time periods (so 1970 is mean of 1965-70 & 1970-75, etc).

Figure 3a: Risk of death at ages 0-4 years (under-5 mortality; world average combining male and female was 5% in 2010).

MALE risk of dying, ages 0-4: 1970-2010 trends in 25 most populous E countries, sorted by 2010 risk (marked)E

FEMALE risk of dying, ages 0-4: 1970-2010 trends in 25 most populous E countries, sorted by 2010 risk (marked)E

Combined (M+F) risk of dying, ages 0-4: 1970-2010 trends in 25 most E populous countries, sorted by 2010 risk (marked)E
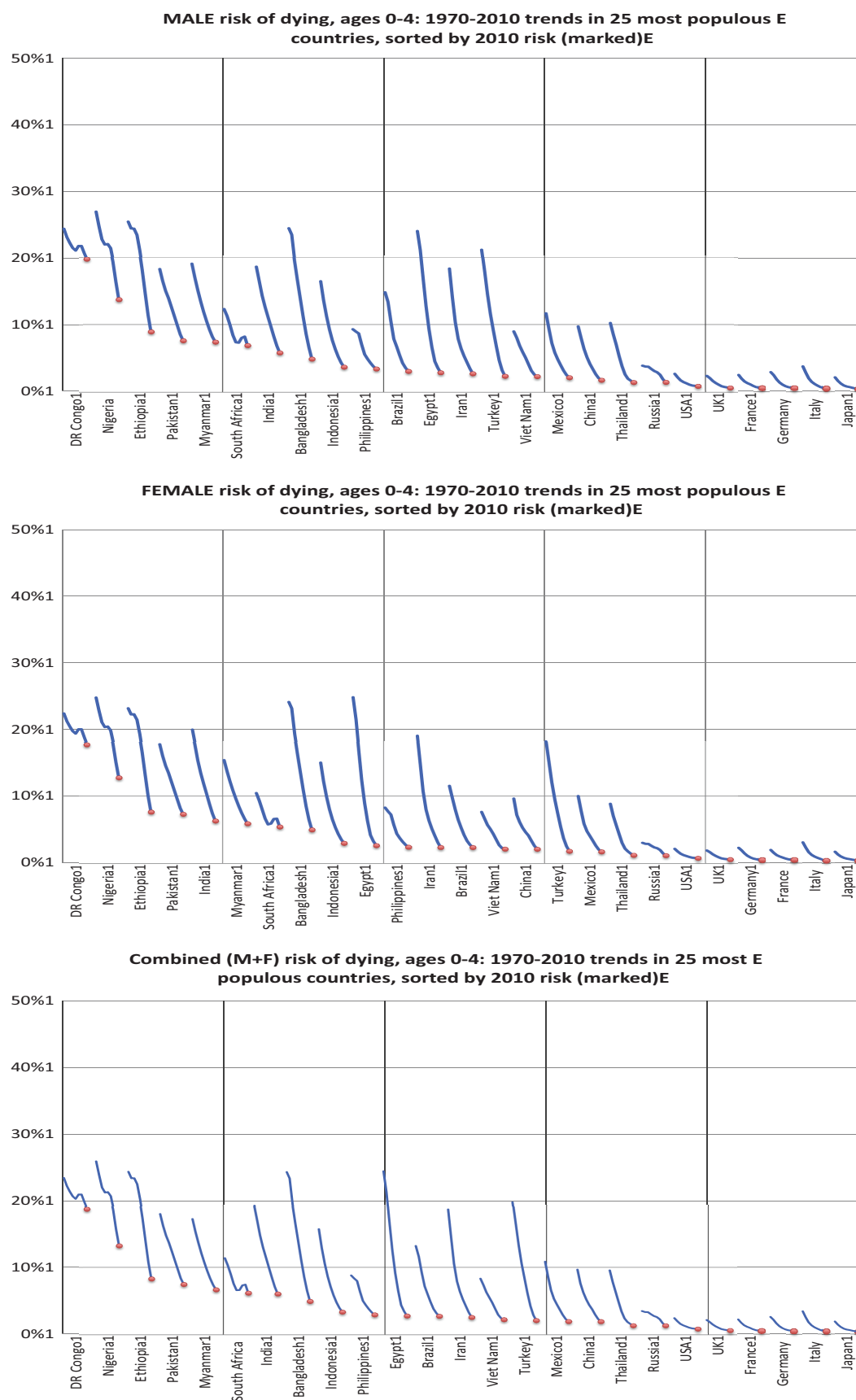
Figure 3b: Risk of death at ages 5-49 years (world average combining male and female was 10% in 2010) - males, females and combined

MALE risk of dying, ages 5-49: 1970-2010 trends in 25 most populous E countries, sorted by 2010 risk (marked)E
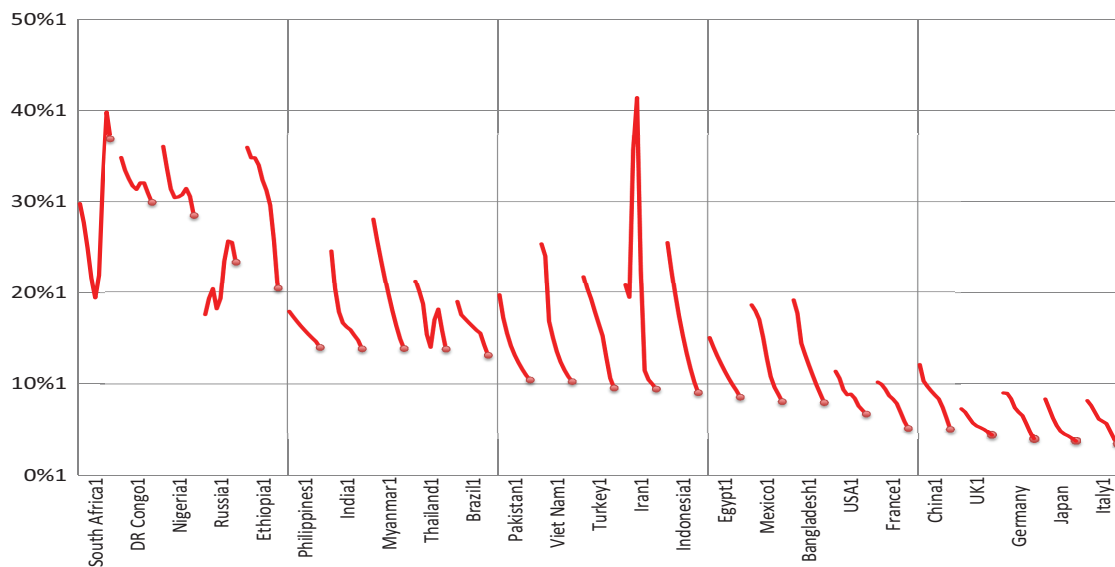
FEMALE risk of dying, ages 5-49: 1970-2010 trends in 25 most populous E countries, sorted by 2010 risk (marked)E
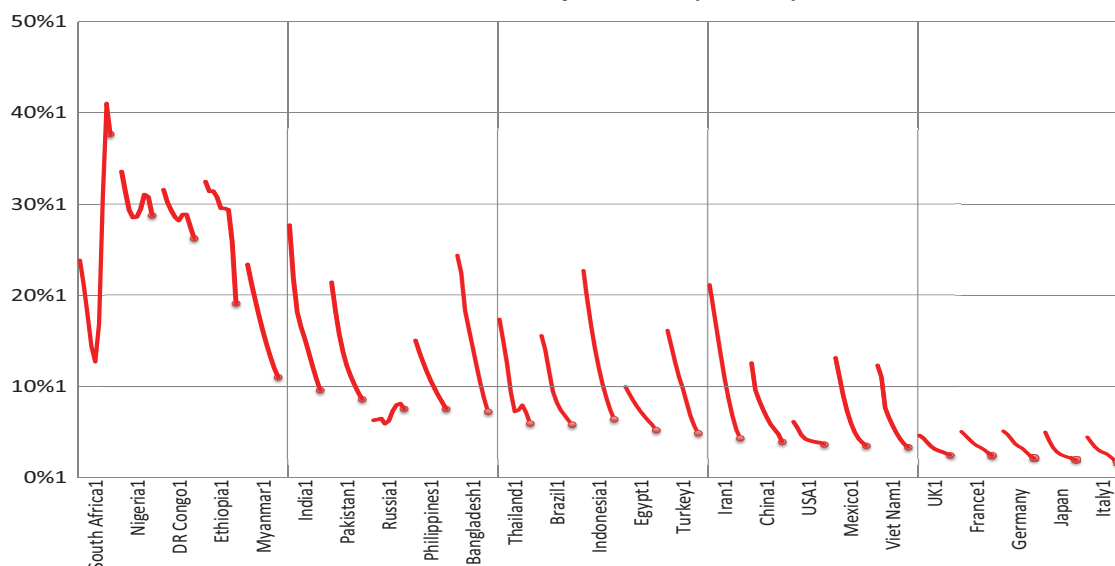
Combined (M+F) risk of dying, ages 5-49: 1970-2010 trends in 25 most E populous countries, sorted by 2010 risk (marked)E
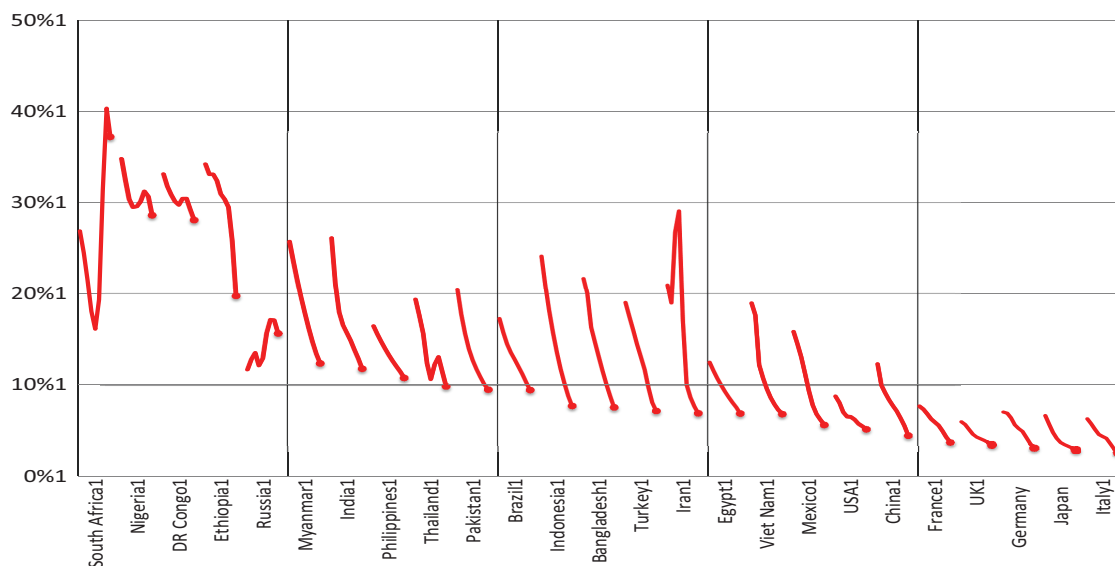
Web Figure 4: **40-year trends, 1970-2010, for the 25 most populous countries in risks of death in selected age ranges (Figures 4a-4b: ages 50-69, & 0-49+0-69) – males, females and combined**
To smooth any sudden changes, risks average the previous and subsequent 5-year time periods (so 1970 is mean of 1965-70 & 1970-75, etc).

Figure 4a: Risk of death at ages 50-69 years (world average combining male and female was 24% in 2010) - males, females and combined

MALE risk of dying, ages 50-69: 1970-2010 trends in 25 most populous E countries, sorted by 2010 risk (marked)E

FEMALE risk of dying, ages 50-69: 1970-2010 trends in 25 most populous E countries, sorted by 2010 risk (marked)E

Combined (M+F) risk of dying, ages 50-69: 1970-2010 trends in 25 most E populous countries, sorted by 2010 risk (marked)E

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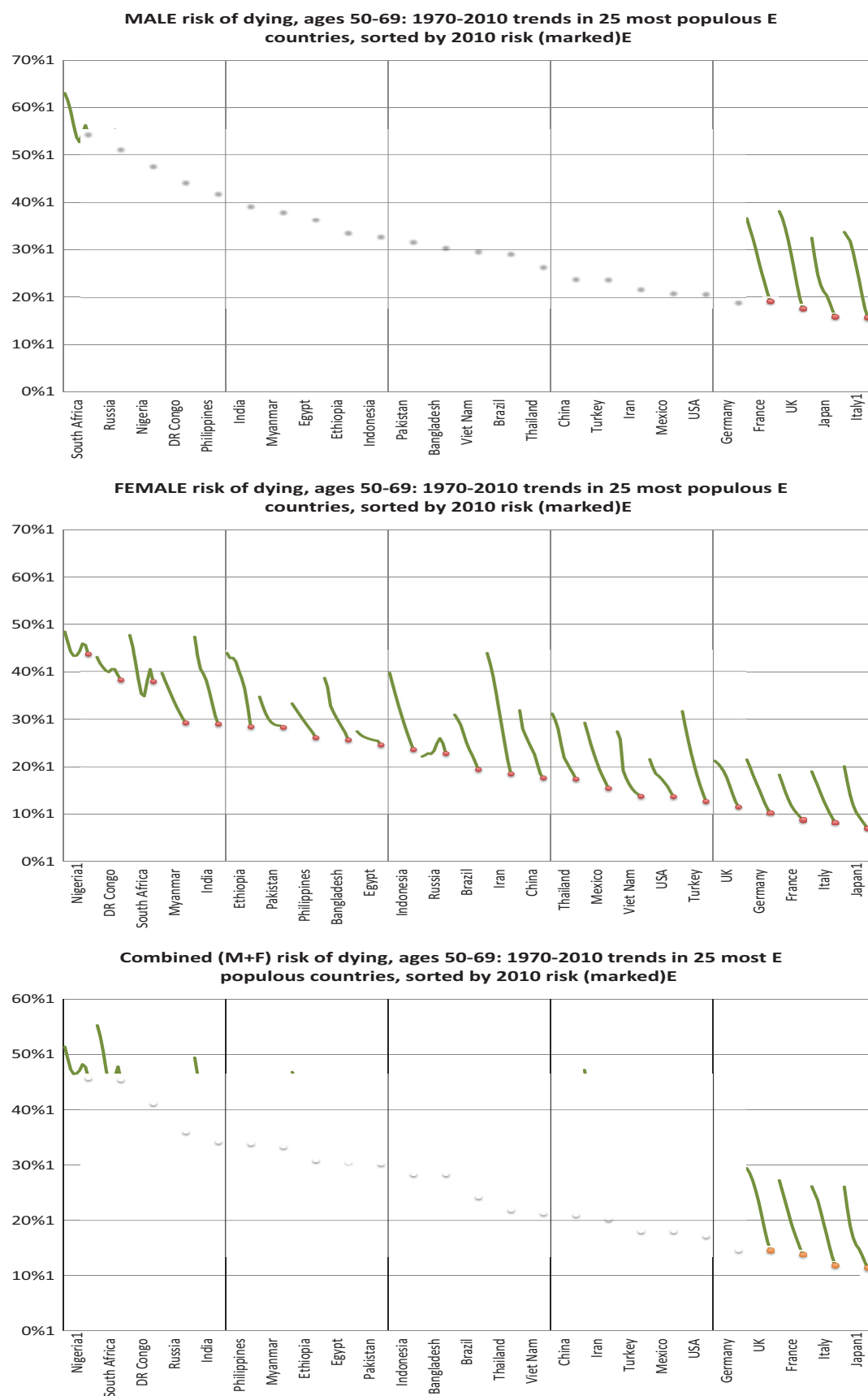
Figure 4b: Risk of death at ages 0-49 and at ages 0-69 - males, females and combined

MALE risk of dying, ages 0-49 and 0-69: 1970-2010 trends in 25 most E populous countries, sorted by (0-69) 2010 riskE

Risk of death (0-49)1   Risk of death (0-69)1

FEMALE risk of dying, ages 0-49 and 0-69: 1970-2010 trends in 25 most E populous countries, sorted by (0-69) 2010 riskE

Risk of dying (0-49)1   Risk of dying (0-69)1

Combined (M+F) risk of dying, ages 0-49 and 0-69: 1970-2010 trends in 25 E most populous countries, sorted by (0-69) 2010 riskE

Risk of dying (0-49)1   Risk of dying (0-69)1

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Webtable 1 (page 1 of 4): Mortality & trends by age: 164 countries with projected 2030 population > 1 million								
	Premature deaths in 2030, if the 2010 death rates applied to the 2030 population, and current rate of change (% per decade,* 2000-2010) in age-standardised death rate							
	All ages	**Age 0-4**		**Age 5-49**		**Age 50-69**		**Age 0-69**	
* # Notes on page 13	Population in 2030, millions #	Deaths in 2030, 1000s	Change, % per decade*	Deaths in 2030, 1000s	Change, % per decade*	Deaths in 2030, 1000s	Change, % per decade*	Deaths in 2030, 1000s	Change, % per decade*
Afghanistan	43	109	-33%	119	-25%	82	-13%	310	-25%
Albania	3	1	-35%	2	-33%	7	-10%	9	-17%
Algeria	49	27	-24%	54	-12%	125	-4%	205	-9%
Angola	35	212	-28%	168	-20%	59	-14%	440	-24%
Argentina	47	10	-30%	39	-13%	107	-12%	156	-14%
Armenia	3	1	-42%	3	-23%	11	-12%	14	-17%
Australia	28	2	-20%	11	-21%	36	-25%	49	-24%
Austria	9	<0.5	-25%	3	-30%	19	-24%	23	-25%
Azerbaijan	10	6	-31%	10	-30%	42	-3%	58	-13%
Bahrain	2	<0.5	-22%	1	-26%	3	-24%	4	-24%
Bangladesh	185	140	-44%	218	-27%	505	-4%	863	-19%
Belarus	8	1	-49%	15	-7%	50	-5%	66	-6%
Belgium	12	1	-29%	5	-24%	25	-16%	30	-17%
Benin	16	53	-23%	42	-17%	30	-9%	125	-18%
Bolivia	14	17	-30%	28	-16%	27	-10%	73	-18%
Bosnia & Herzegovina	4	<0.5	-3%	2	-12%	13	-8%	15	-8%
Botswana	2	2	-37%	37	60%	7	1%	46	39%
Brazil	223	73	-30%	323	-17%	658	-15%	1,053	-16%
Bulgaria	6	1	-35%	5	-15%	27	-9%	33	-11%
Burkina Faso	27	131	-23%	87	-21%	46	-12%	265	-21%
Burundi	16	87	-15%	74	-25%	27	-17%	188	-19%
Cambodia	19	22	-43%	42	-31%	34	-25%	98	-32%
Cameroon	33	129	-14%	159	-5%	62	-5%	350	-9%
Canada	41	3	-9%	17	-15%	73	-20%	92	-18%
Central African Rep.	6	30	-13%	43	-21%	15	-9%	87	-17%
Chad	21	134	-15%	107	-14%	33	-10%	273	-14%
Chile	20	2	-31%	12	-20%	42	-19%	56	-19%
China	1,453	278	-36%	921	-30%	4,713	-15%	5,912	-19%
China, Hong Kong SAR	8	<0.5	-12%	2	-21%	14	-19%	17	-20%
Colombia	57	20	-22%	77	-17%	128	-14%	226	-16%
Comoros	1	3	-20%	3	-13%	2	-6%	8	-14%
Congo	7	24	-18%	25	-25%	13	-14%	62	-20%
Costa Rica	6	1	-17%	4	-15%	10	-13%	15	-14%
Croatia	4	<0.5	-18%	2	-21%	14	-13%	16	-14%
Cuba	11	1	-33%	6	-21%	34	-15%	40	-16%
Cyprus	1	<0.5	-40%	<0.5	-18%	2	-13%	3	-14%
Czech Republic	11	<0.5	-45%	6	-23%	32	-23%	38	-23%
Côte d'Ivoire	29	119	-14%	180	-8%	82	-6%	381	-10%
DPR (North) Korea	27	11	-46%	32	-25%	129	-8%	172	-16%
DR Congo	104	716	-13%	502	-11%	206	-7%	1,424	-12%
Denmark	6	<0.5	-26%	2	-25%	14	-24%	17	-24%
Djibouti	1	2	-18%	4	-18%	3	-10%	8	-15%

	All ages	Age 0-4		Age 5-49		Age 50-69		Age 0-69	
				Premature deaths in 2030, if the 2010 death rates applied to the 2030 population, and current rate of change (% per decade,* 2000-2010) in age-standardised death rate					
* # Notes on page 13	Population in 2030, millions #	Deaths in 2030, 1000s	Change, % per decade*	Deaths in 2030, 1000s	Change, % per decade*	Deaths in 2030, 1000s	Change, % per decade*	Deaths in 2030, 1000s	Change, % per decade*
Dominican Rep.	12	6	-30%	18	-9%	29	-9%	53	-12%
Ecuador	20	8	-35%	25	-11%	31	-13%	64	-16%
Egypt	103	50	-38%	107	-17%	276	-4%	433	-13%
El Salvador	7	3	-25%	14	-8%	14	-10%	31	-11%
Equatorial Guinea	1	5	-20%	6	-12%	3	-9%	14	-14%
Eritrea	10	17	-36%	25	-32%	22	-17%	64	-29%
Estonia	1	<0.5	-56%	1	-34%	5	-19%	6	-23%
Ethiopia	138	298	-43%	432	-38%	219	-25%	950	-37%
Finland	6	<0.5	-26%	3	-18%	11	-17%	14	-17%
France	69	3	-26%	32	-25%	123	-17%	159	-19%
Gabon	2	4	-21%	8	-11%	4	-7%	16	-13%
Gambia	3	12	-21%	9	-14%	5	-9%	26	-16%
Georgia	4	1	-37%	3	-14%	14	-5%	18	-9%
Germany	80	3	-23%	29	-27%	200	-20%	232	-21%
Ghana	35	71	-22%	100	-20%	84	-10%	255	-18%
Greece	11	<0.5	-34%	4	-16%	23	-14%	28	-14%
Guatemala	23	20	-36%	42	-16%	26	-15%	88	-21%
Guinea	17	71	-26%	60	-12%	37	-6%	168	-18%
Guinea-Bissau	2	13	-15%	9	-6%	5	-6%	27	-11%
Haiti	13	19	-28%	39	-19%	30	-14%	89	-20%
Honduras	11	8	-23%	16	-15%	15	-12%	39	-16%
Hungary	10	1	-38%	9	-23%	39	-15%	49	-17%
India	1,476	1,492	-30%	2,716	-15%	5,048	-12%	9,257	-17%
Indonesia	293	143	-37%	335	-25%	946	-10%	1,423	-17%
Iran	91	30	-39%	103	-20%	202	-20%	334	-22%
Iraq	51	47	-18%	70	52%	90	21%	207	17%
Ireland	5	<0.5	-45%	2	-19%	9	-30%	12	-28%
Israel	10	1	-36%	3	-17%	11	-25%	15	-24%
Italy	61	2	-38%	17	-30%	117	-23%	136	-24%
Jamaica	3	1	-15%	4	-21%	7	-7%	13	-13%
Japan	121	3	-29%	38	-15%	194	-18%	236	-18%
Jordan	9	4	-23%	7	-18%	17	-10%	28	-14%
Kazakhstan	19	9	-39%	42	-13%	83	-21%	133	-20%
Kenya	66	163	-27%	260	-34%	105	-12%	528	-28%
Kuwait	5	1	-19%	3	-11%	8	31%	12	13%
Kyrgyzstan	7	6	-10%	11	-5%	24	9%	42	2%
Laos	9	9	-40%	14	-35%	19	-16%	42	-29%
Latvia	2	<0.5	-42%	3	-17%	9	-8%	12	-11%
Lebanon	5	1	-41%	2	-44%	9	-39%	12	-40%
Lesotho	2	5	-12%	26	13%	6	-2%	38	6%
Liberia	6	18	-46%	18	-20%	13	-8%	49	-30%
Libya	7	2	-39%	5	-26%	16	-17%	22	-21%

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	All ages	Age 0-4		Age 5-49		Age 50-69		Age 0-69	
				Premature deaths in 2030, if the 2010 death rates applied to the 2030 population, and current rate of change (% per decade,* 2000-2010) in age-standardised death rate					
* # Notes on page 13	Population in 2030, millions #	Deaths in 2030, 1000s	Change, % per decade*	Deaths in 2030, 1000s	Change, % per decade*	Deaths in 2030, 1000s	Change, % per decade*	Deaths in 2030, 1000s	Change, % per decade*
Lithuania	3	<0.5	-33%	4	-6%	14	6%	18	2%
Madagascar	36	68	-41%	88	-20%	65	-13%	221	-27%
Malawi	26	112	-32%	128	-33%	35	-7%	276	-30%
Malaysia	37	3	-41%	33	-12%	87	-10%	123	-12%
Mali	26	190	-22%	77	-22%	37	-14%	305	-21%
Mauritania	6	18	-8%	12	-11%	11	-5%	40	-8%
Mauritius	1	<0.5	-23%	1	-9%	5	-19%	7	-17%
Mexico	144	38	-36%	120	-17%	269	-15%	428	-18%
Mongolia	3	2	-42%	7	-14%	13	-20%	22	-21%
Morocco	39	24	-23%	43	-15%	116	-4%	184	-10%
Mozambique	39	174	-33%	270	11%	63	-12%	506	-12%
Myanmar	59	53	-20%	117	-15%	236	-7%	407	-12%
Namibia	3	3	-35%	12	-34%	7	-20%	22	-30%
Nepal	33	28	-43%	51	-33%	90	-18%	168	-28%
Netherlands	17	1	-26%	5	-26%	34	-23%	40	-24%
New Zealand	5	<0.5	-21%	2	-19%	8	-26%	11	-25%
Nicaragua	7	3	-39%	11	-19%	13	-22%	27	-23%
Niger	35	211	-40%	92	-18%	47	-7%	350	-32%
Nigeria	273	1,363	-31%	1,303	-12%	627	-7%	3,293	-20%
Norway	6	<0.5	-26%	2	-23%	9	-25%	12	-24%
Oman	5	1	-51%	5	-33%	7	-9%	13	-24%
Pakistan	232	342	-22%	342	-14%	516	-2%	1,200	-12%
Panama	5	2	-29%	5	-1%	8	-9%	15	-9%
Papua New Guinea	10	16	-21%	23	-21%	32	-12%	71	-17%
Paraguay	9	6	-17%	12	-11%	15	-11%	34	-12%
Peru	37	17	-41%	40	-17%	76	-15%	133	-20%
Philippines	128	78	-24%	204	-10%	346	-4%	627	-9%
Poland	37	2	-32%	33	-13%	123	-14%	158	-14%
Portugal	10	<0.5	-49%	6	-23%	24	-21%	30	-22%
Puerto Rico	4	<0.5	-23%	3	-22%	8	-15%	12	-17%
Qatar	3	<0.5	-31%	2	-19%	4	-16%	6	-17%
Rep. of (South) Korea	52	3	-26%	20	-42%	113	-37%	136	-38%
Rep. of Moldova	3	1	-31%	6	-8%	18	-2%	24	-4%
Romania	20	2	-40%	21	-23%	84	-15%	107	-17%
Russian Federation	134	17	-46%	332	-7%	773	-11%	1,122	-11%
Rwanda	18	42	-43%	53	-51%	28	-29%	122	-44%
Saudi Arabia	36	5	-45%	23	-33%	75	-19%	103	-24%
Senegal	22	54	-38%	48	-20%	33	-8%	135	-26%
Serbia	9	1	-23%	7	-14%	35	-7%	43	-9%
Sierra Leone	8	49	-26%	52	-30%	26	-25%	127	-28%
Singapore	7	<0.5	-37%	2	-21%	13	-25%	15	-25%
Slovakia	5	<0.5	-25%	4	-11%	20	-16%	24	-15%

* # Notes on page 13	All ages	Age 0-4		Age 5-49		Age 50-69		Age 0-69	
	Population in 2030, millions #	Deaths in 2030, 1000s	Change, % per decade*	Deaths in 2030, 1000s	Change, % per decade*	Deaths in 2030, 1000s	Change, % per decade*	Deaths in 2030, 1000s	Change, % per decade*
Slovenia	2	<0.5	-40%	1	-29%	5	-27%	7	-28%
Somalia	17	91	-18%	67	-13%	27	-7%	185	-15%
South Africa	58	62	-21%	393	22%	243	-1%	698	8%
South Sudan	17	73	-27%	78	-12%	36	-10%	187	-18%
Spain	48	2	-30%	18	-29%	91	-24%	111	-25%
Sri Lanka	23	4	-35%	21	-34%	69	-14%	94	-21%
State of Palestine	6	4	-18%	5	-19%	9	-8%	18	-13%
Sudan	55	140	-23%	152	-18%	98	-11%	391	-18%
Swaziland	2	4	-14%	16	16%	3	8%	22	8%
Sweden	11	<0.5	-27%	3	-21%	16	-21%	20	-21%
Switzerland	9	<0.5	-14%	3	-30%	14	-22%	18	-24%
Syria	30	11	-19%	22	-4%	41	-21%	73	-16%
TFYR Macedonia	2	<0.5	-31%	1	-14%	7	-8%	9	-9%
Tajikistan	11	21	-18%	15	-22%	26	-12%	62	-17%
Thailand	68	8	-33%	91	-24%	245	-8%	344	-14%
Timor-Leste	2	3	-44%	2	-45%	2	-22%	7	-40%
Togo	10	34	-16%	38	-7%	22	-3%	94	-10%
Trinidad and Tobago	1	<0.5	-17%	2	-6%	6	-10%	8	-9%
Tunisia	13	3	-35%	8	-18%	32	-9%	43	-13%
Turkey	87	24	-53%	92	-26%	175	-19%	291	-26%
Turkmenistan	6	6	-17%	13	-5%	23	1%	42	-4%
Uganda	63	220	-35%	261	-38%	83	-22%	564	-35%
Ukraine	40	5	-26%	89	3%	236	-5%	330	-3%
United Arab Emirates	12	1	-39%	10	-19%	20	-15%	30	-17%
United Kingdom	69	4	-20%	30	-14%	133	-23%	167	-22%
Tanzania	79	223	-42%	312	-35%	107	-21%	642	-36%
USA	363	36	-12%	246	-9%	760	-18%	1,041	-15%
Uruguay	4	1	-16%	2	-20%	9	-16%	12	-17%
Uzbekistan	34	30	-11%	54	-3%	109	0%	193	-3%
Venezuela	37	12	-20%	43	-12%	79	-12%	133	-13%
Viet Nam	102	24	-30%	108	-11%	280	-1%	412	-6%
Yemen	34	65	-20%	80	-10%	59	-6%	204	-13%
Zambia	25	110	-32%	117	-49%	39	-35%	266	-41%
Zimbabwe	20	33	-35%	204	-26%	27	-19%	263	-27%

* The death rates of 2000 and the (generally lower) death rates of 2010 were applied to the 2030 population (UNPD medium-fertility projection), yielding 2 numbers of 2030 deaths; change (% / decade) compares them.

Population size in 2030, UNPD medium-fertility projection

Webtable 2 (page 1 of 4): Mortality & trends by age and cause in 4 income groupings of countries

2.1: Low-income countries

* † ‡ Notes on page 18	Deaths by age in 2030, if 2010 death rates in each income grouping of countries applied to their 2030 population, and current rates of change (% per decade,* 2000-2010) in under-70 age-standardised death rates						
	Age 0-49		**Age 50-69**		**Age 0-69**		**Age 70+**
	Deaths in 2030, millions	Change, % per decade*	Deaths in 2030, millions	Change, % per decade*	Deaths in 2030, millions	Change, % per decade*	Deaths in 2030, millions
Communicable, Maternal, Perinatal and Nutritional							
Neonatal †	0.82	-22%	-	-	0.82	-25%	-
Respiratory infections	0.61	-32%	0.16	-18%	0.76	-27%	0.38
HIV/AIDS	0.83	-46%	0.09	-53%	0.92	-49%	0.01
Diarrhoea	0.48	-42%	0.07	-35%	0.55	-41%	0.09
Tuberculosis	0.16	-36%	0.16	-32%	0.32	-35%	0.11
Malaria	0.35	-38%	0.02	-10%	0.37	-36%	0.02
Nutritional deficiencies	0.22	-24%	0.06	-24%	0.28	-26%	0.10
Meningitis	0.17	-34%	0.03	-11%	0.19	-29%	0.02
Childhood cluster ‡	0.11	-74%	-	-	0.11	-75%	-
Maternal	0.19	-43%	-	-	0.19	-45%	-
Other communicable	0.29	-27%	0.06	-13%	0.35	-23%	0.05
Non-Communicable Diseases							
Vascular or diabetic	0.23	-15%	0.67	-6%	0.90	-10%	1.08
Neoplastic	0.20	-9%	0.38	-6%	0.58	-8%	0.24
Chronic respiratory	0.07	-29%	0.16	-16%	0.24	-20%	0.30
Cirrhotic	0.07	-13%	0.09	-4%	0.16	-9%	0.05
Other digestive	0.08	-22%	0.08	-18%	0.16	-21%	0.10
Renal	0.06	-16%	0.07	1%	0.13	-6%	0.09
Congenital	0.13	4%	-	-	0.13	-1%	0.01
Other non-communicable	0.19	2%	0.09	6%	0.27	2%	0.13
Injuries							
Non-road traffic accidents	0.59	20%	0.13	46%	0.71	26%	0.12
Road traffic accidents	0.16	3%	0.04	24%	0.19	8%	0.02
Suicide	0.08	-9%	0.03	-1%	0.10	-8%	0.02
Homicide or war	0.14	-42%	0.01	-44%	0.15	-44%	<0.01
Communicable, Maternal, Perinatal and Nutritional	**4.22**	**-39%**	**0.65**	**-30%**	**4.87**	**-38%**	**0.77**
Non-Communicable Diseases	**1.04**	**-12%**	**1.55**	**-7%**	**2.58**	**-10%**	**2.00**
Injuries	**0.95**	**-2%**	**0.20**	**23%**	**1.16**	**4%**	**0.16**
All causes	**6.21**	**-30%**	**2.40**	**-13%**	**8.62**	**-24%**	**2.93**

Webtable 2 (page 2 of 4): **Mortality & trends by age and cause in 4 income groupings of countries**

2.2: Lower-middle-income countries

* † ‡ Notes on page 18	Deaths by age in 2030, if 2010 death rates in each income grouping of countries applied to their 2030 population, and current rates of change (% per decade,* 2000-2010) in under-70 age-standardised death rates						
	Age 0-49		**Age 50-69**		**Age 0-69**		**Age 70+**
	Deaths in 2030, millions	Change, % per decade*	Deaths in 2030, millions	Change, % per decade*	Deaths in 2030, millions	Change, % per decade*	Deaths in 2030, millions
Communicable, Maternal, Perinatal and Nutritional							
Neonatal †	1.45	-20%	-	-	1.45	-21%	-
Respiratory infections	0.79	-35%	0.33	-17%	1.12	-28%	0.70
HIV/AIDS	0.64	8%	0.12	-15%	0.76	0%	0.01
Diarrhoea	0.60	-41%	0.29	-23%	0.89	-34%	0.44
Tuberculosis	0.26	-41%	0.38	-42%	0.65	-43%	0.28
Malaria	0.30	-28%	0.03	-23%	0.33	-28%	0.02
Nutritional deficiencies	0.14	-35%	0.05	-24%	0.19	-32%	0.09
Meningitis	0.18	-27%	0.04	-13%	0.21	-24%	0.03
Childhood cluster ‡	0.18	-66%	-	-	0.18	-66%	-
Maternal	0.18	-42%	-	-	0.18	-43%	-
Other communicable	0.41	-22%	0.18	-4%	0.59	-15%	0.16
Non-Communicable Diseases							
Vascular or diabetic	0.84	-16%	3.38	-9%	4.23	-11%	5.46
Neoplastic	0.51	-2%	1.19	-2%	1.70	-4%	0.80
Chronic respiratory	0.17	-26%	0.98	-15%	1.14	-17%	1.51
Cirrhotic	0.19	-7%	0.37	-3%	0.55	-5%	0.19
Other digestive	0.18	-25%	0.23	-20%	0.42	-22%	0.28
Renal	0.16	-13%	0.29	2%	0.45	-3%	0.33
Congenital	0.25	-14%	-	-	0.25	-15%	0.01
Other non-communicable	0.31	5%	0.25	17%	0.55	11%	0.32
Injuries							
Non-road traffic accidents	0.71	-22%	0.35	-12%	1.06	-19%	0.47
Road traffic accidents	0.39	6%	0.16	14%	0.56	8%	0.08
Suicide	0.31	-11%	0.08	-15%	0.39	-13%	0.03
Homicide or war	0.20	-6%	0.04	-10%	0.24	-8%	0.01
Communicable, Maternal, Perinatal and Nutritional	**5.14**	**-30%**	**1.41**	**-26%**	**6.56**	**-29%**	**1.72**
Non-Communicable Diseases	**2.61**	**-12%**	**6.69**	**-8%**	**9.29**	**-10%**	**8.90**
Injuries	**1.62**	**-12%**	**0.63**	**-7%**	**2.25**	**-11%**	**0.60**
All causes	**9.37**	**-22%**	**8.74**	**-11%**	**18.11**	**-16%**	**11.22**

2.3: Upper-middle-income countries

	Deaths by age in 2030, if 2010 death rates in each income grouping of countries applied to their 2030 population, and current rates of change (% per decade,* 2000-2010) in under-70 age-standardised death rates						
	Age 0-49		**Age 50-69**		**Age 0-69**		**Age 70+**
*† ‡ Notes on page 18	Deaths in 2030, millions	Change, % per decade*	Deaths in 2030, millions	Change, % per decade*	Deaths in 2030, millions	Change, % per decade*	Deaths in 2030, millions
Communicable, Maternal, Perinatal and Nutritional							
Neonatal †	0.25	-40%	-	-	0.25	-40%	-
Respiratory infections	0.13	-56%	0.15	-16%	0.29	-41%	0.62
HIV/AIDS	0.31	12%	0.10	39%	0.41	17%	0.01
Diarrhoea	0.06	-49%	0.02	-38%	0.08	-47%	0.03
Tuberculosis	0.06	-53%	0.08	-51%	0.14	-52%	0.06
Malaria	0.02	-	<0.01	-	0.02	-	<0.01
Nutritional deficiencies	0.02	-	0.02	-	0.04	-	0.07
Meningitis	0.03	-	0.01	-	0.03	-	0.01
Childhood cluster ‡	0.01	-	-	-	0.01	-	-
Maternal	0.02	-	-	-	0.02	-	-
Other communicable	0.06	-37%	0.08	-23%	0.14	-30%	0.09
Non-Communicable Diseases							
Vascular or diabetic	0.50	-22%	3.75	-20%	4.25	-22%	10.35
Neoplastic	0.45	-23%	2.24	-10%	2.69	-13%	3.20
Chronic respiratory	0.05	-45%	0.53	-49%	0.58	-49%	2.28
Cirrhotic	0.07	-28%	0.22	-23%	0.29	-25%	0.15
Other digestive	0.05	-25%	0.18	-25%	0.23	-26%	0.37
Renal	0.05	-28%	0.15	-13%	0.20	-17%	0.28
Congenital	0.11	-16%	-	-	0.11	-15%	0.01
Other non-communicable	0.13	-10%	0.20	2%	0.33	-3%	0.45
Injuries							
Non-road traffic accidents	0.31	-40%	0.26	-21%	0.57	-33%	0.33
Road traffic accidents	0.30	5%	0.19	29%	0.49	13%	0.13
Suicide	0.11	-50%	0.11	-45%	0.22	-48%	0.10
Homicide or war	0.16	-25%	0.04	-43%	0.20	-30%	0.01
Communicable, Maternal, Perinatal and Nutritional	**0.97**	**-35%**	**0.46**	**-22%**	**1.43**	**-32%**	**0.91**
Non-Communicable Diseases	**1.42**	**-23%**	**7.26**	**-21%**	**8.68**	**-22%**	**17.08**
Injuries	**0.88**	**-29%**	**0.60**	**-19%**	**1.47**	**-26%**	**0.58**
All causes	**3.27**	**-29%**	**8.33**	**-21%**	**11.60**	**-23%**	**18.58**

2.4: High-income countries

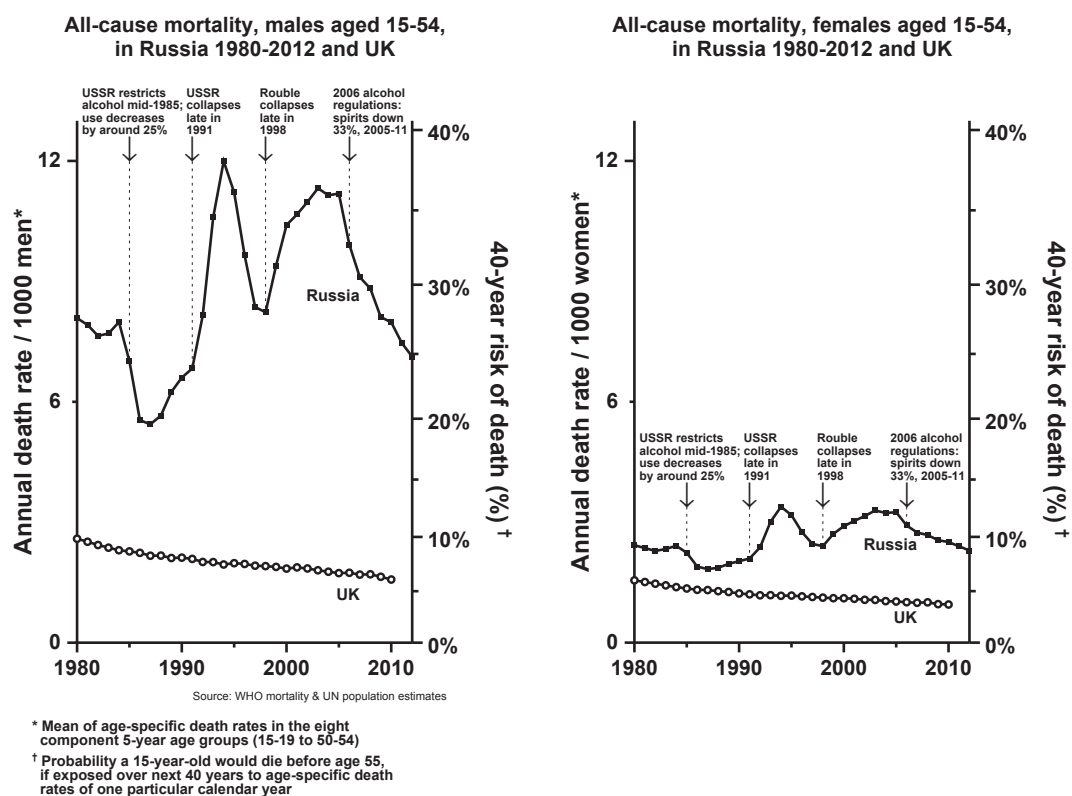| * † ‡ Notes on page 18	Deaths by age in 2030, if 2010 death rates in each income grouping of countries applied to their 2030 population, and current rates of change (% per decade,* 2000-2010) in under-70 age-standardised death rates						
	Age 0-49		**Age 50-69**		**Age 0-69**		**Age 70+**
	Deaths in 2030, millions	Change, % per decade*	Deaths in 2030, millions	Change, % per decade*	Deaths in 2030, millions	Change, % per decade*	Deaths in 2030, millions
Communicable, Maternal, Perinatal and Nutritional							
Neonatal †	0.03	-	-	-	0.03	-	-
Respiratory infections	0.01	-	0.04	-	0.05	-	0.48
HIV/AIDS	0.01	-	0.01	-	0.01	-	<0.01
Diarrhoea	<0.01	-	<0.01	-	<0.01	-	0.03
Tuberculosis	<0.01	-	<0.01	-	<0.01	-	0.01
Malaria	<0.01	-	<0.01	-	<0.01	-	<0.01
Nutritional deficiencies	<0.01	-	<0.01	-	<0.01	-	0.03
Meningitis	<0.01	-	<0.01	-	<0.01	-	<0.01
Childhood cluster ‡	<0.01	-	-	-	<0.01	-	-
Maternal	<0.01	-	-	-	<0.01	-	-
Other communicable	0.01	-	0.04	-	0.05	-	0.14
Non-Communicable Diseases							
Vascular or diabetic	0.15	-21%	0.67	-29%	0.82	-28%	4.30
Neoplastic	0.13	-21%	1.00	-12%	1.13	-13%	2.46
Chronic respiratory	0.01	-	0.11	-10%	0.12	-11%	0.73
Cirrhotic	0.02	-	0.08	-13%	0.10	-17%	0.06
Other digestive	0.01	-	0.06	-7%	0.07	-10%	0.31
Renal	0.01	-	0.04	0%	0.04	-3%	0.30
Congenital	0.02	-	-	-	0.02	-	-
Other non-communicable	0.06	5%	0.13	21%	0.19	15%	1.05
Injuries							
Non-road traffic accidents	0.05	-	0.06	0%	0.10	-10%	0.24
Road traffic accidents	0.05	-38%	0.03	-32%	0.08	-36%	0.03
Suicide	0.07	-1%	0.06	3%	0.13	1%	0.05
Homicide or war	0.02	-12%	0.01	-5%	0.02	-11%	<0.01
Communicable, Maternal, Perinatal and Nutritional	**0.06**	**-28%**	**0.09**	**-9%**	**0.16**	**-19%**	**0.71**
Non-Communicable Diseases	**0.42**	**-17%**	**2.09**	**-17%**	**2.51**	**-17%**	**9.23**
Injuries	**0.19**	**-20%**	**0.15**	**-7%**	**0.34**	**-15%**	**0.32**
All causes	**0.67**	**-20%**	**2.34**	**-16%**	**3.00**	**-16%**	**10.27**

Notes to Webtable 2:
Countries are classified according to the World Bank income groupings (World Bank list of economies, July 2012) as low, lower-middle, upper-middle or high-income.

* The death rates of 2000 and the (generally lower) death rates of 2010 were applied to the 2030 population (UNPD medium-variant projection), yielding two numbers of 2030 deaths; change (% per decade) compares them. NB This change is identical to the change the age-standardised death rate from 2000 to 2010, if both rates are standardised to the age distribution of the world population in 2030.

† Conditions arising in the perinatal period (ICD-10 P00-P96); mostly avoidable. NB Excludes congenital malformations.

‡ Diphtheria, pertussis, tetanus, poliomyelitis, measles; all are vaccine-preventable.

Web Figure 5: Russia: Alcohol and all-cause mortality trends, 1980-2012

All-cause mortality, males aged 15-54, in Russia 1980-2012 and UK

All-cause mortality, females aged 15-54, in Russia 1980-2012 and UK

Source: WHO mortality & UN population estimates

* Mean of age-specific death rates in the eight component 5-year age groups (15-19 to 50-54)

† Probability a 15-year-old would die before age 55, if exposed over next 40 years to age-specific death rates of one particular calendar year

Source: Zaridze D, Lewington S, Boroda A, Scélo G, Karpov R, Lazarev A, et al. Alcohol and mortality in Russia: prospective observational study of 151,000 adults. Lancet. 2014; 383 (9927): 1465-73. doi:10.1016/S0140-6736(13)62247-3.

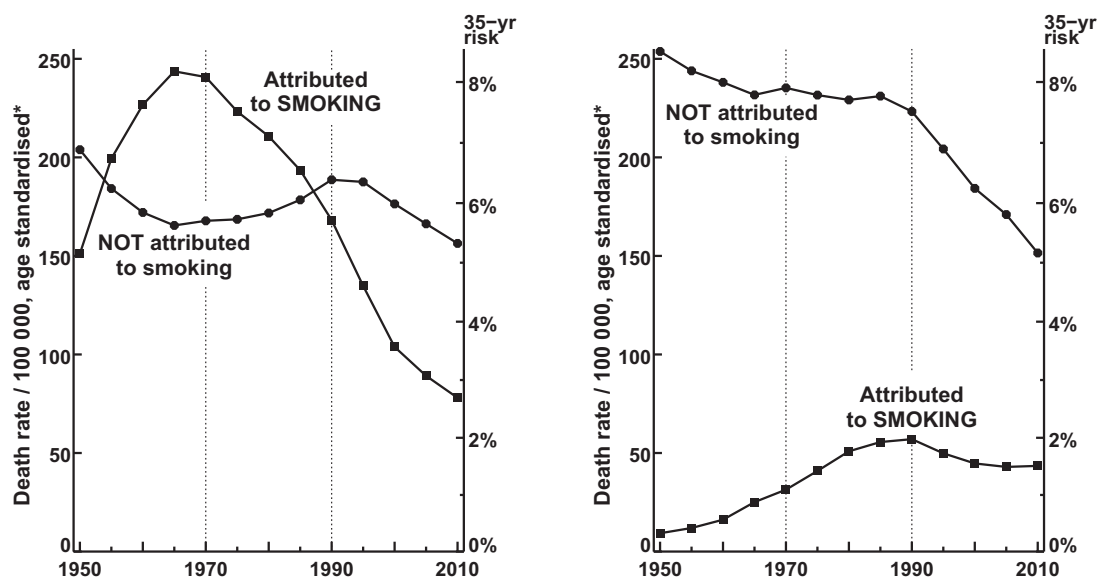**Web Figure 6:** US: Smoking and cancer mortality trends, 1950-2010

US cancer mortality 1950-2010 attributed to smoking, or not: Rates & 35-yr % risk at ages 35-69 (left – male, right – female)
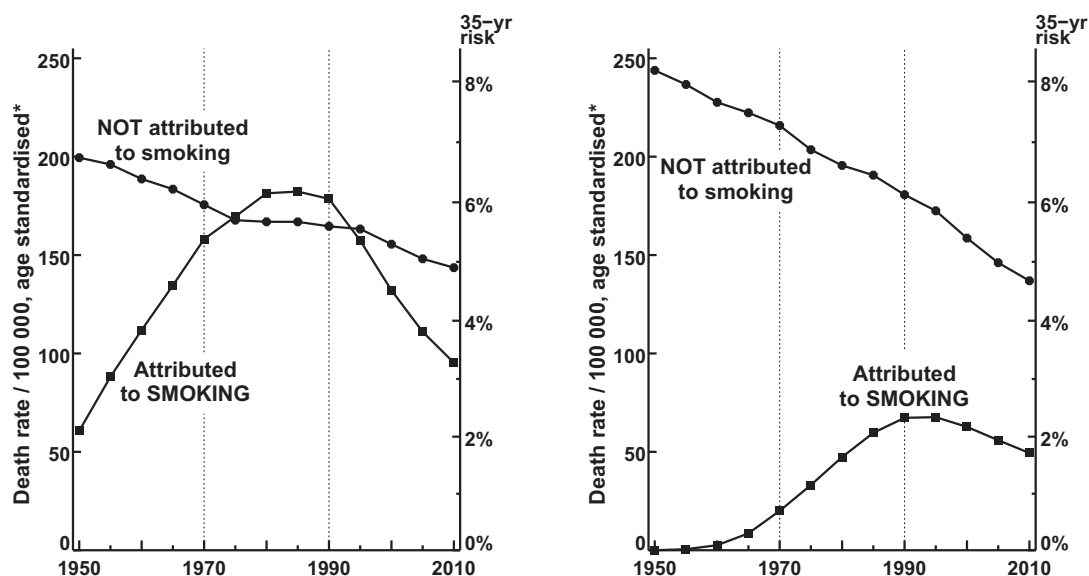
Source: Methods of Peto R, Lopez AD, Boreham J, Thun M, Heath C Jr. Mortality from tobacco in developed countries: indirect estimation from national vital statistics Lancet 1992; 339: 1268-78, applied to WHO mortality statistics and UN population estimates.

Web Figure 7: UK: Smoking and cancer mortality trends, 1950-2010

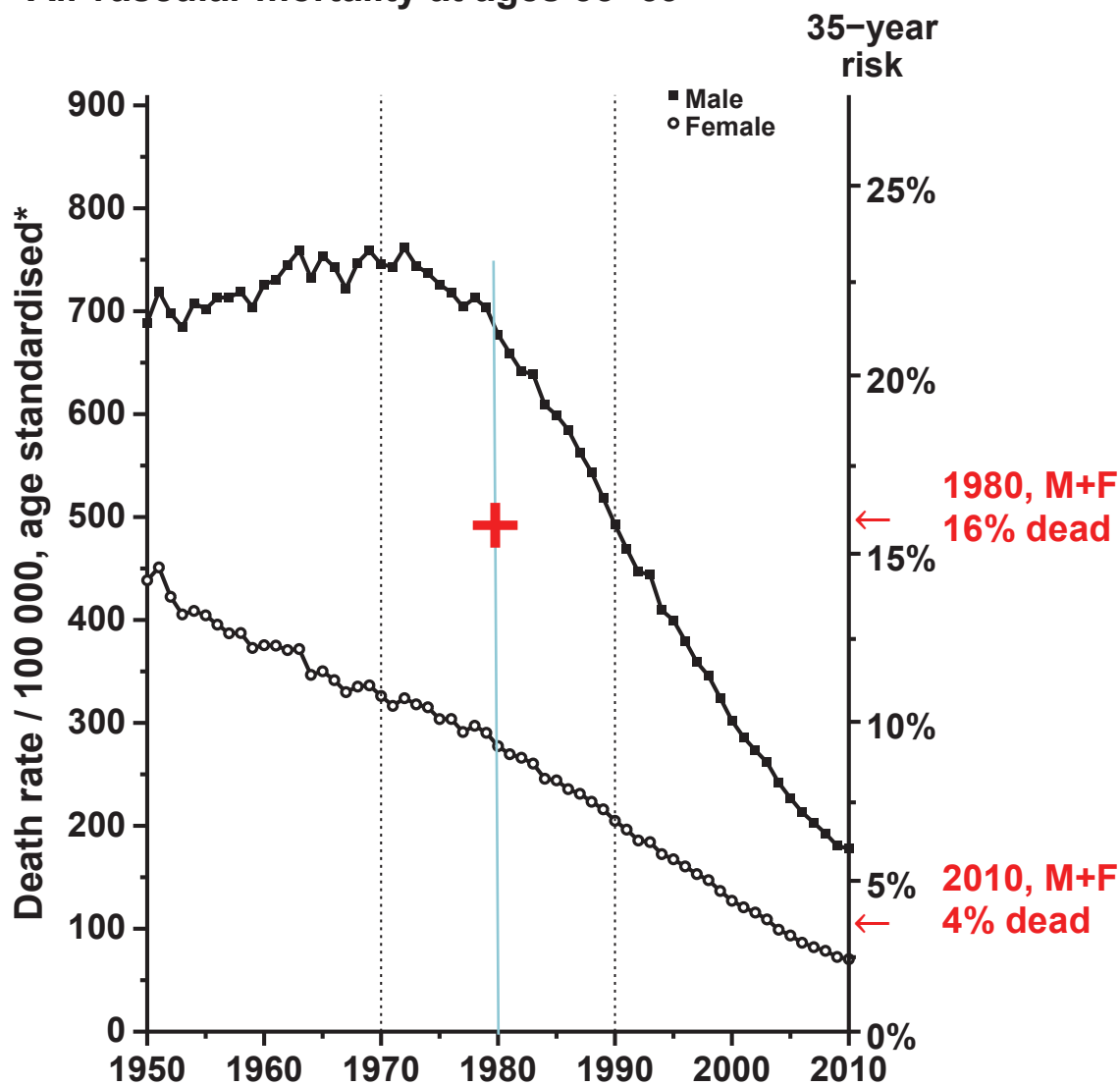## UK cancer mortality 1950-2010 attributed to smoking, or not: Rates & 35-yr % risk at ages 35-69 (left – male, right – female)

Source: Methods of Peto R, Lopez AD, Boreham J, Thun M, Heath C Jr. Mortality from tobacco in developed countries: indirect estimation from national vital statistics Lancet 1992; 339: 1268-78, applied to WHO mortality statistics and UN population estimates.

**UNITED KINGDOM 1950−2010: Males & Females
All vascular mortality at ages 35−69**

*Mean of annual rates in the seven component 5−year age groups

Source: WHO mortality & UN population estimates

Web Figure 9: England and Wales: all-cause mortality by age, 1910-2010

Males, England & Wales, % survival at period rates
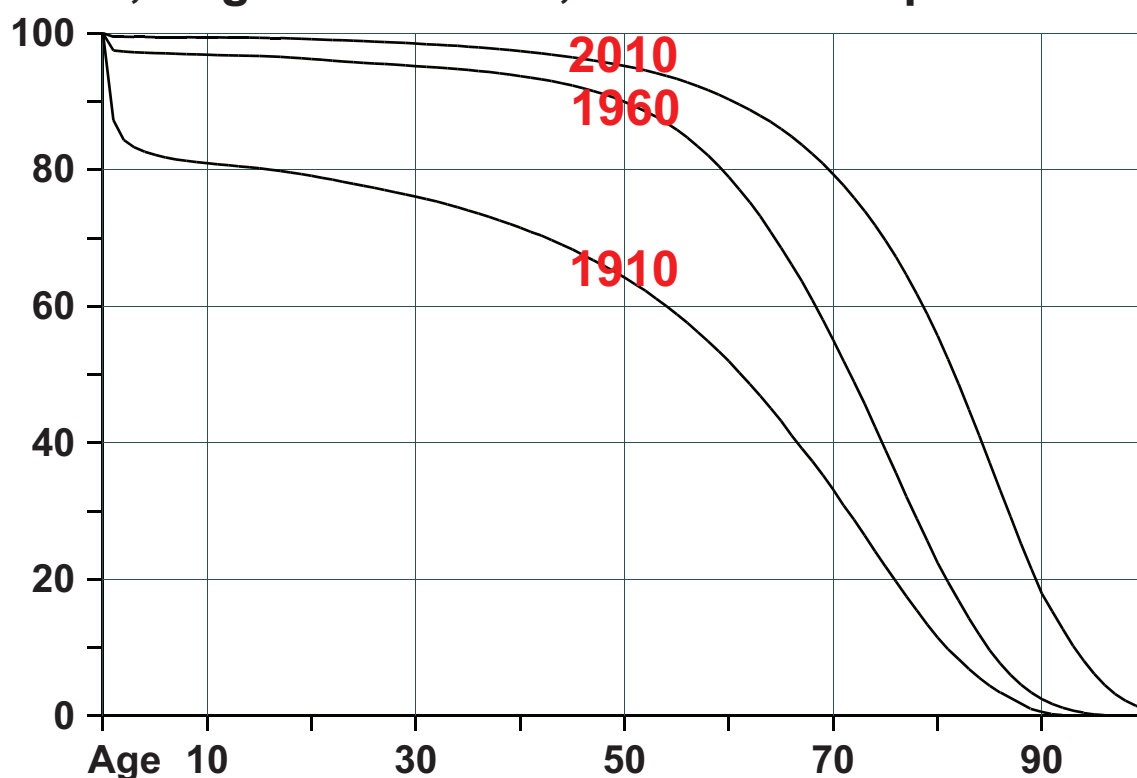
Females, England & Wales, % survival at period rates
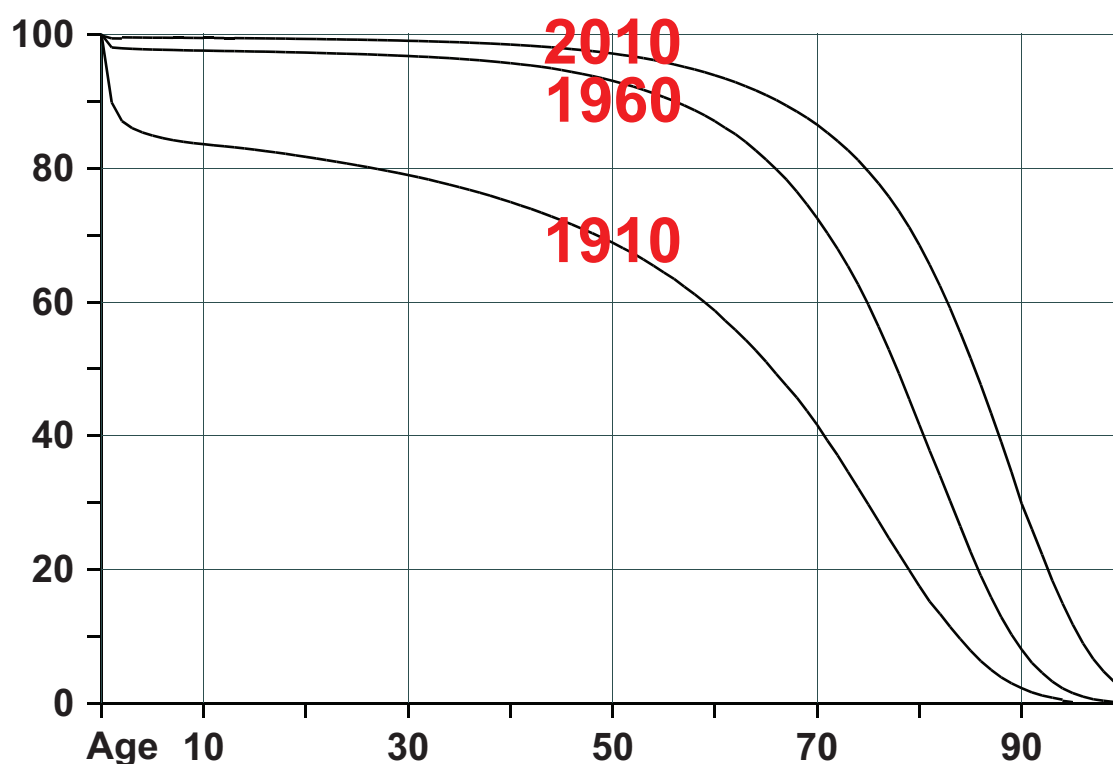
Source: Gary Whitlock, CTSU, from Registrar-General reports and Human Mortality Database

Web Figure 10: 6 selected countries (South Africa, Russia, Iran, India, China, USA): under-50 mortality (from webfig 4b), 1970-2010 – males and females

MALE under-50 mortality 1970-2010: 6 countriesE

C

FEMALE under-50 mortality 1970-2010: 6 countriesE

South 1

C

Webtable 3 (page 1 of 2): World and four groups of countries, low- to high-income: estimated risks of death at ages 0-4, 5-49 and 50-69 years at the death rates of about 1970, 2010, and intermediate years – males

Source: UNPD data underlying Web figure 2, but with under-5 mortality uncorrected, hence slightly higher than deaths/livebir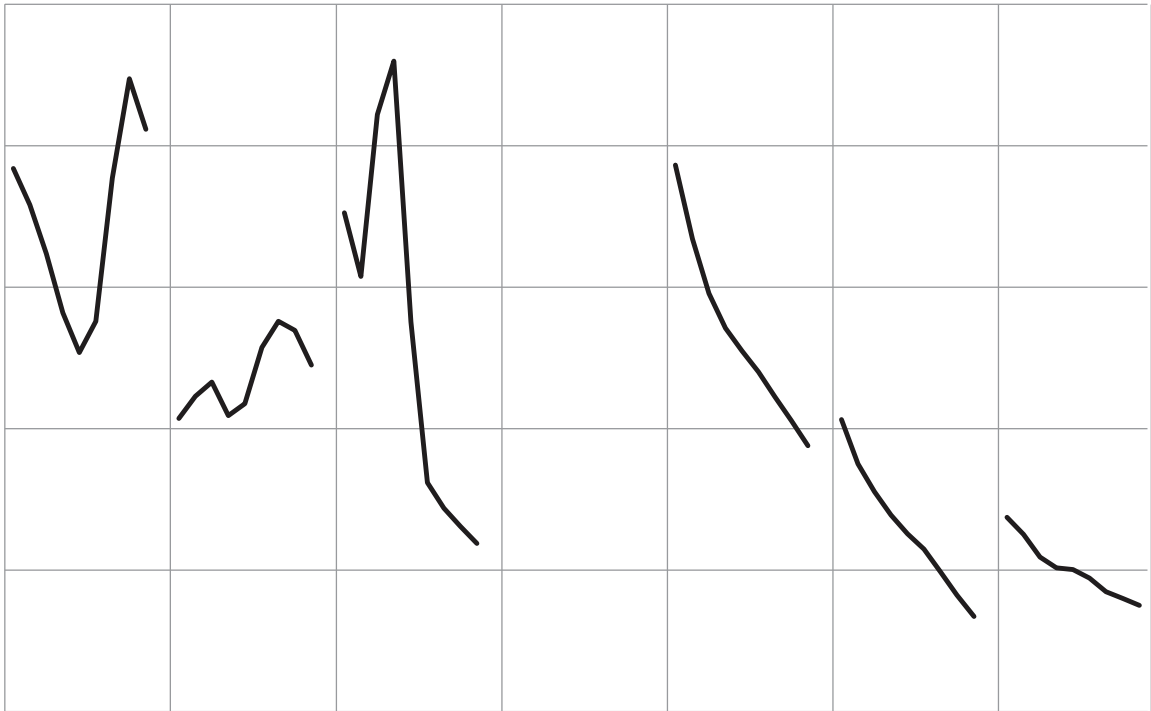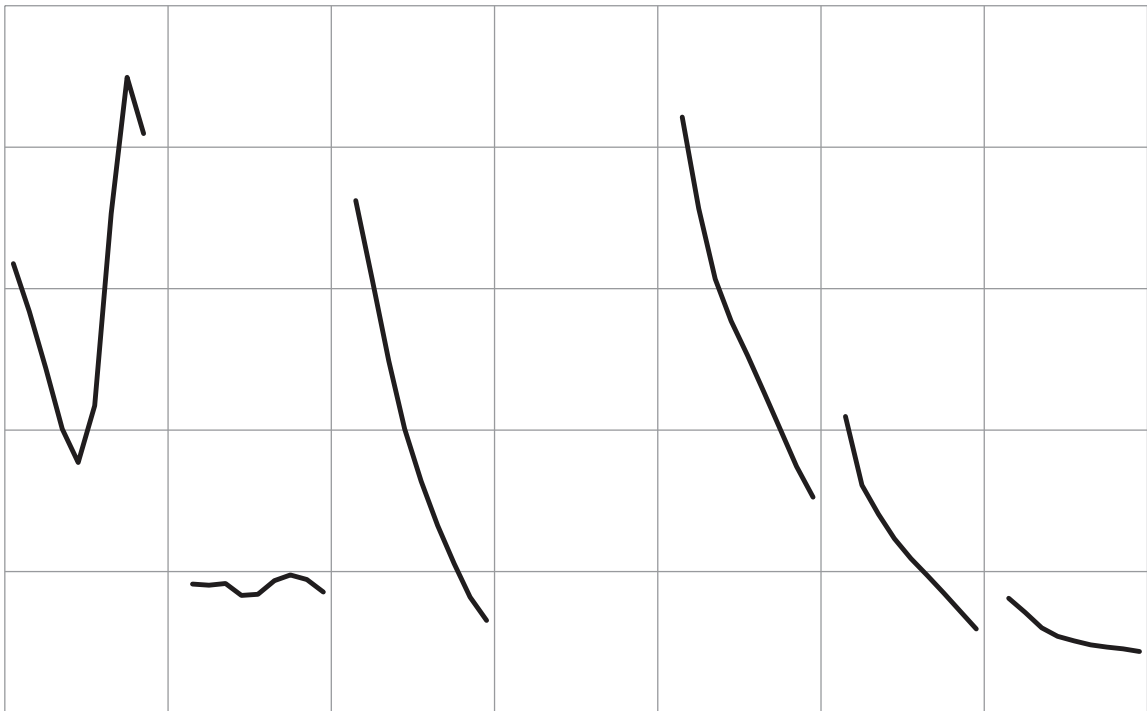ths. Risks are for survivors at the start of the age range. Risks average previous and subsequent 5-year time periods (so 1970 risk is the mean of 1965-70 and 1970-75 risks; 2010 risk is the mean of 2005-10 risks and UNPD projection for the 2010-15 risks), smoothing any sudden changes.

Males	Period	Risk of dying (0-4)	Risk of dying (5-49)	Risk of dying (50-69)	Risk of dying (0-49)	Risk of dying (0-69)
World	1970	0.14	0.18	0.42	0.29	0.59
	1975	0.13	0.16	0.40	0.27	0.56
	1980	0.11	0.15	0.38	0.25	0.54
	1985	0.10	0.14	0.37	0.23	0.51
	1990	0.09	0.14	0.36	0.22	0.50
	1995	0.08	0.14	0.35	0.21	0.49
	2000	0.08	0.13	0.33	0.20	0.47
	2005	0.07	0.13	0.31	0.18	0.44
	2010	0.06	0.12	0.29	0.17	0.41
Low-income	1970	0.24	0.31	0.48	0.48	0.73
	1975	0.23	0.30	0.47	0.46	0.71
	1980	0.21	0.28	0.44	0.43	0.68
	1985	0.19	0.25	0.42	0.39	0.65
	1990	0.18	0.24	0.41	0.38	0.64
	1995	0.16	0.25	0.41	0.37	0.63
	2000	0.14	0.25	0.40	0.35	0.61
	2005	0.12	0.22	0.38	0.32	0.58
	2010	0.11	0.19	0.37	0.28	0.55
Lower-middle-income	1970	0.18	0.24	0.48	0.38	0.68
	1975	0.16	0.21	0.46	0.34	0.64
	1980	0.14	0.19	0.44	0.30	0.61
	1985	0.12	0.18	0.43	0.28	0.59
	1990	0.11	0.17	0.43	0.26	0.58
	1995	0.10	0.17	0.42	0.25	0.57
	2000	0.09	0.16	0.41	0.24	0.55
	2005	0.08	0.15	0.40	0.22	0.53
	2010	0.07	0.14	0.38	0.20	0.51
Upper-middle-income	1970	0.11	0.14	0.40	0.24	0.54
	1975	0.10	0.13	0.37	0.21	0.50
	1980	0.08	0.13	0.36	0.20	0.49
	1985	0.06	0.12	0.35	0.18	0.47
	1990	0.05	0.11	0.34	0.16	0.44
	1995	0.04	0.11	0.33	0.15	0.43
	2000	0.04	0.10	0.30	0.13	0.40
	2005	0.03	0.09	0.27	0.12	0.36
	2010	0.03	0.08	0.26	0.11	0.34
High-income	1970	0.04	0.11	0.37	0.14	0.47
	1975	0.03	0.11	0.36	0.14	0.45
	1980	0.02	0.10	0.34	0.13	0.43
	1985	0.02	0.09	0.32	0.11	0.40
	1990	0.02	0.09	0.31	0.11	0.38
	1995	0.01	0.09	0.30	0.11	0.37
	2000	0.01	0.09	0.28	0.10	0.35
	2005	0.01	0.08	0.25	0.09	0.32
	2010	0.01	0.08	0.23	0.08	0.29

Webtable 3 (page 2 of 2): World and four groups of countries, low- to high-income: estimated risks of death at ages 0-4, 5-49 and 50-69 years at the death rates of about 1970, 2010, and intermediate years – females

Source: UNPD data underlying Web figure 2, but with under-5 mortality uncorrected, hence slightly higher than deaths/livebirths. Risks are for survivors at the start of the age range. Risks average previous and subsequent 5-year time periods (so 1970 risk is the mean of 1965-70 and 1970-75 risks; 2010 risk is the mean of 2005-10 risks and UNPD projection for the 2010-15 risks), smoothing any sudden changes.

Females	Period	Risk of dying (0-4)	Risk of dying (5-49)	Risk of dying (50-69)	Risk of dying (0-49)	Risk of dying (0-69)
World	1970	0.14	0.16	0.30	0.27	0.49
	1975	0.12	0.14	0.28	0.24	0.45
	1980	0.11	0.12	0.27	0.22	0.42
	1985	0.10	0.11	0.26	0.19	0.40
	1990	0.09	0.10	0.25	0.18	0.38
	1995	0.08	0.10	0.24	0.17	0.37
	2000	0.07	0.10	0.23	0.16	0.35
	2005	0.06	0.09	0.21	0.15	0.33
	2010	0.05	0.08	0.20	0.13	0.31
Low-income	1970	0.22	0.29	0.43	0.45	0.68
	1975	0.21	0.28	0.41	0.43	0.66
	1980	0.19	0.25	0.38	0.40	0.63
	1985	0.18	0.23	0.37	0.37	0.60
	1990	0.16	0.23	0.35	0.35	0.58
	1995	0.15	0.23	0.34	0.35	0.57
	2000	0.13	0.24	0.33	0.34	0.56
	2005	0.11	0.22	0.32	0.31	0.53
	2010	0.10	0.18	0.30	0.26	0.48
Lower-middle-income	1970	0.18	0.24	0.40	0.38	0.63
	1975	0.16	0.20	0.38	0.33	0.58
	1980	0.14	0.17	0.35	0.29	0.54
	1985	0.12	0.15	0.34	0.26	0.51
	1990	0.11	0.14	0.33	0.24	0.49
	1995	0.10	0.13	0.32	0.22	0.47
	2000	0.09	0.13	0.31	0.20	0.45
	2005	0.07	0.12	0.29	0.18	0.42
	2010	0.06	0.11	0.28	0.16	0.40
Upper-middle-income	1970	0.11	0.13	0.31	0.22	0.47
	1975	0.08	0.11	0.28	0.18	0.41
	1980	0.07	0.09	0.27	0.16	0.38
	1985	0.06	0.08	0.25	0.13	0.35
	1990	0.05	0.07	0.24	0.12	0.33
	1995	0.04	0.07	0.23	0.11	0.31
	2000	0.04	0.06	0.21	0.10	0.29
	2005	0.03	0.06	0.19	0.09	0.27
	2010	0.02	0.05	0.18	0.08	0.25
High-income	1970	0.03	0.06	0.21	0.09	0.28
	1975	0.02	0.05	0.20	0.08	0.26
	1980	0.02	0.05	0.19	0.07	0.24
	1985	0.02	0.04	0.17	0.06	0.22
	1990	0.01	0.04	0.16	0.05	0.21
	1995	0.01	0.04	0.16	0.05	0.20
	2000	0.01	0.04	0.15	0.05	0.19
	2005	0.01	0.04	0.13	0.04	0.17
	2010	0.01	0.03	0.12	0.04	0.16