MRC-HPA Centre for Environment and Health
Imperial College London

Global Health: Cardiovascular Disease

Paul Elliott

Dept Epidemiology & Biostatistics

Imperial College London

FEATURE

Grand challenges in chronic non-communicable diseases

The top 20 policy and research priorities for conditions such as diabetes, stroke and heart disease.

Abdallah S. Daar[1], Peter A. Singer[1], Deepa Leah Persad[1], Stig K. Pramming[2], David R. Matthews[3], Robert Beaglehole[4], Alan Bernstein[5], Leszek K. Borysiewicz[6], Stephen Colagiuri[7], Nirmal Ganguly[8], Roger I. Glass[9], Diane T. Finegood[10], Jeffrey Koplan[11], Elizabeth G. Nabel[12], George Sarna[6], Nizal Sarrafzadegan[13], Richard Smith[14], Derek Yach[15] and John Bell[16]

Chronic non-communicable diseases (CNCDs) are reaching epidemic proportions worldwide[1–3]. These diseases — which include cardiovascular conditions (mainly heart disease and stroke), some cancers, chronic respiratory conditions and type 2 diabetes — affect people of all ages, nationalities and classes.

The conditions cause the greatest global share of death and disability, accounting for around 60% of all deaths worldwide. Some 80% of chronic-disease deaths occur in low- and middle-income countries. They account for 44% of premature deaths worldwide. The number of deaths from these diseases is double the number of deaths that result from

R. CANDIA/AP

P. PARKS/AFP/GETTY

Poor diet and smoking are two factors that contribute to the millions of preventable deaths that occur each year.

with known behavioural and pharmaceutical

meet the challenges, and brings new talent

Ten leading causes of death worldwide in 1990

Rank	Cause of deaths	Number of deaths (X 10^3)
	All causes	50 467
1	Coronary heart disease	6260
2	Cerebrovascular disease	4381
3	Lower respiratory infections	4299
4	Diarrhoeal diseases	2946
5	Perinatal disorders	2443
6	Chronic obstructive pulmonary disease	2211
7	Tuberculosis (HIV seropositive excluded)	1960
8	Measles	1058
9	Road traffic accidents	999
10	Trachea, bronchus, and lung cancer	945

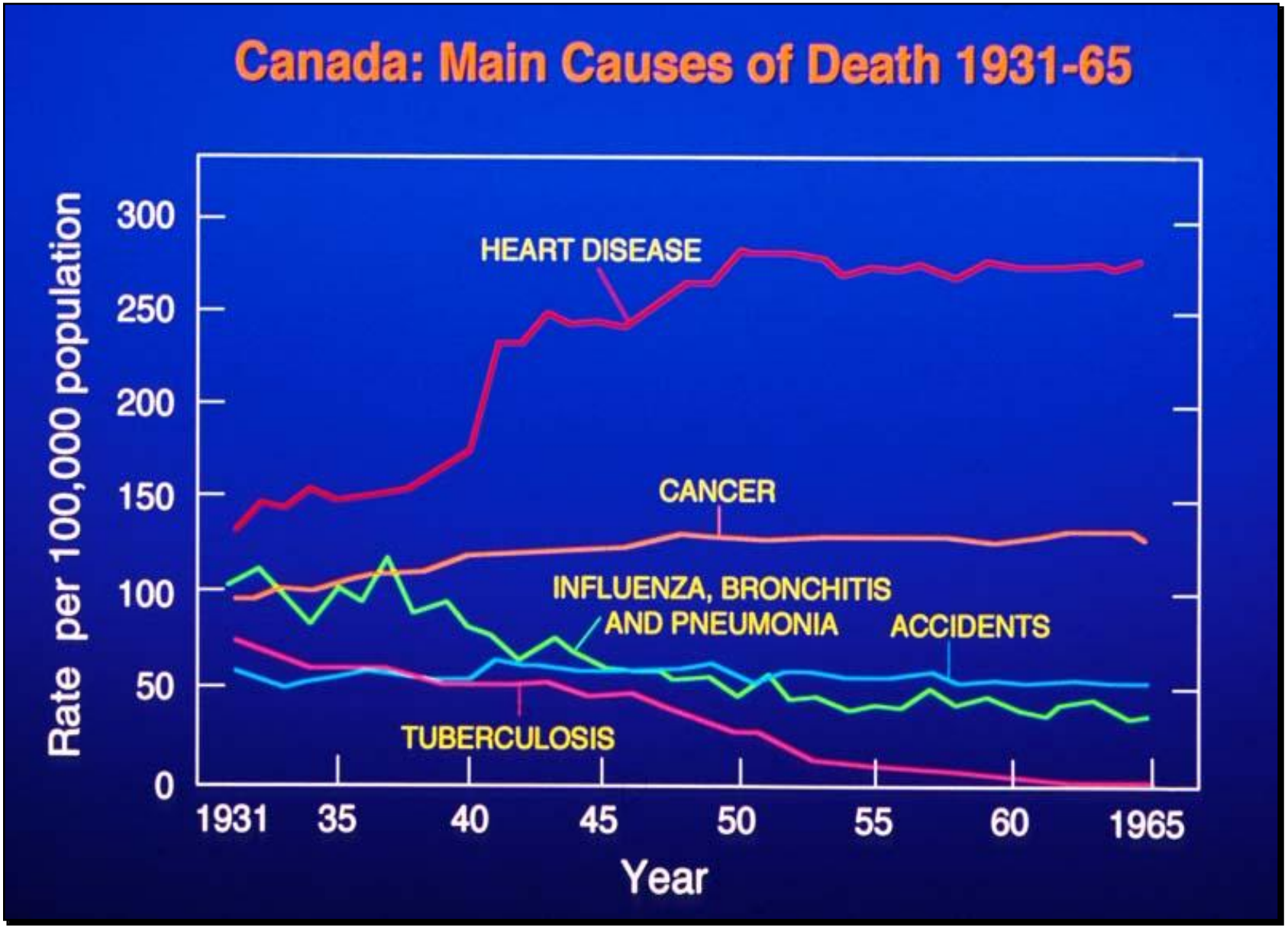
Murray CJL, Lopez AD. Lancet 1997; 349: 1269-76

- Clinical medicine is concerned with *cases of disease* and the disease burden for the *individual patient*
- Epidemiology is concerned with *disease rates* and the burden of disease in *populations*

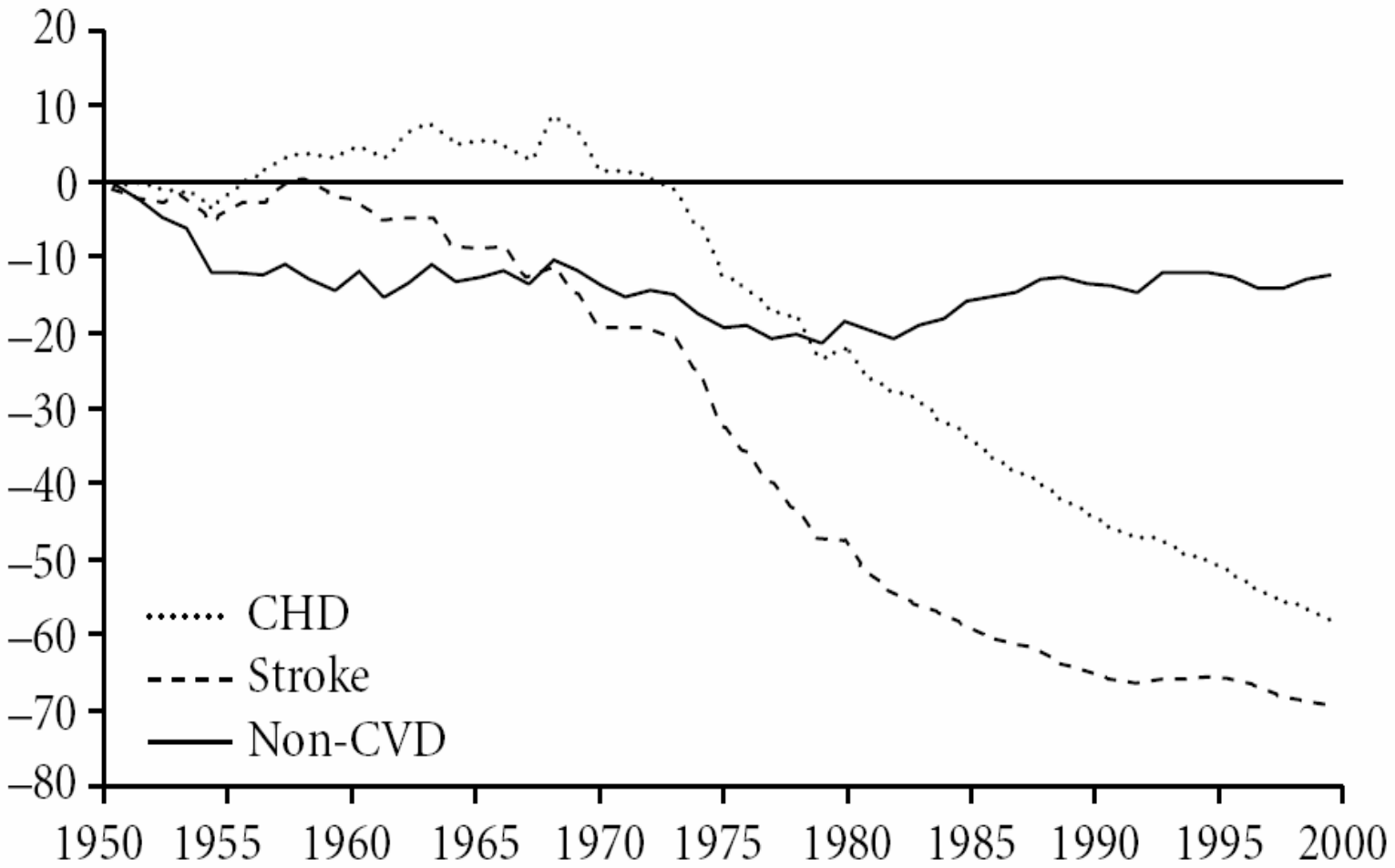
- Clinical medicine is concerned with *cases of disease* and the disease burden for the *individual patient* [Numerator]
- Epidemiology is concerned with *disease rates* and the burden of disease in *populations* [Numerator/ Denominator]

Cardiovascular diseases Trends

- Time
- Person
- Place


Canada: Main Causes of Death 1931-65
Rate per 100,000 population
300
250
200
150
100
50
0
HEART DISEASE
CANCER
INFLUENZA, BRONCHITIS
AND PNEUMONIA
ACCIDENTS
TUBERCULOSIS
1931
35
40
45
50
55
60
1965
Year

Change in age-adjusted death rates, USA, 1950-2000



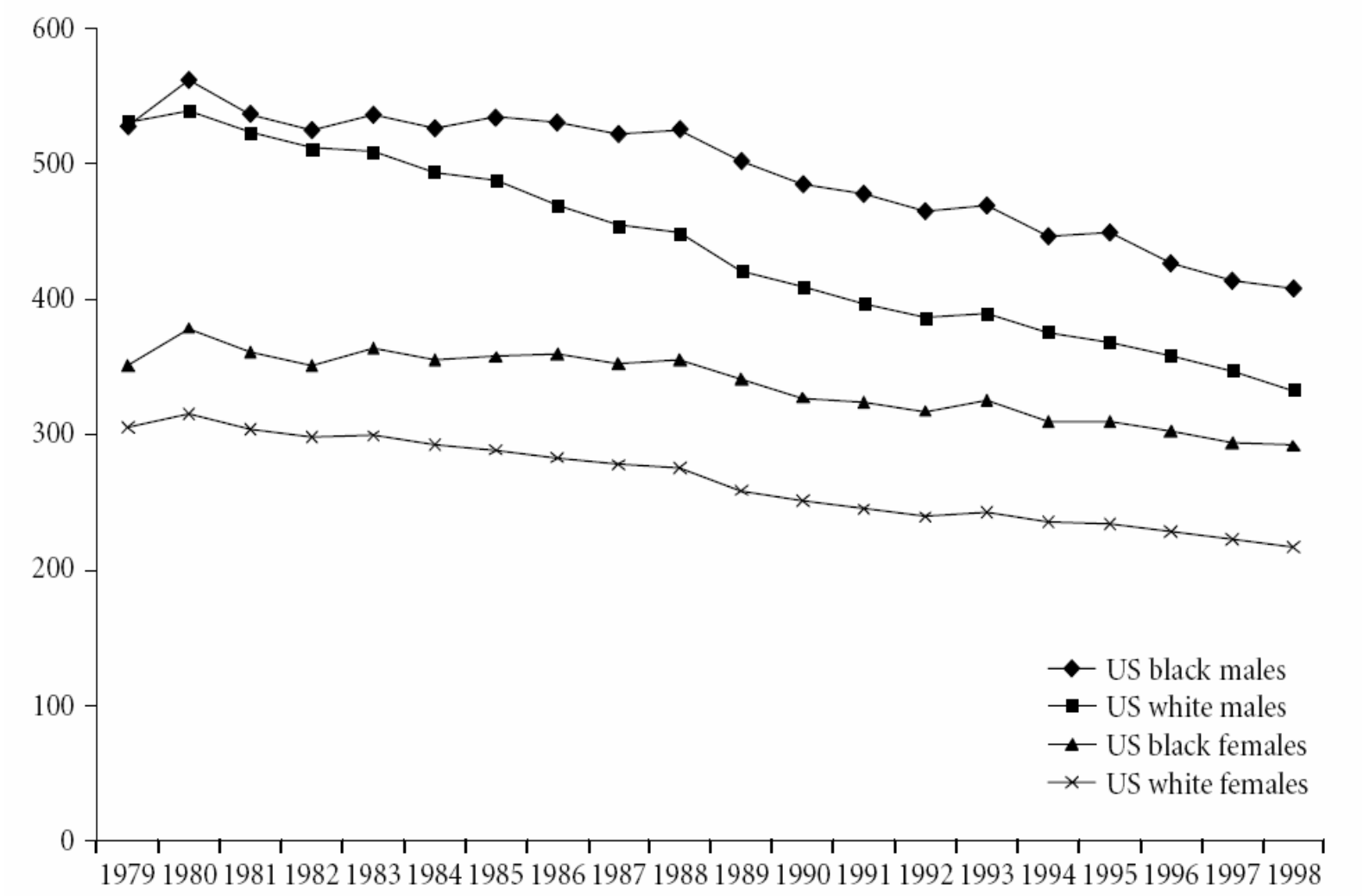
Data from NHLBI Morbidity and Mortality 2002 Chart Book

Luepker R. US trends. In: M Marmot & P Elliott (eds). Coronary Heart Disease Epidemiology. From Aetiology to Public Health, 2005, Oxford University Press, Oxford, UK, pp73-82.

Cardiovascular diseases Trends

- Time
- Person
- Place

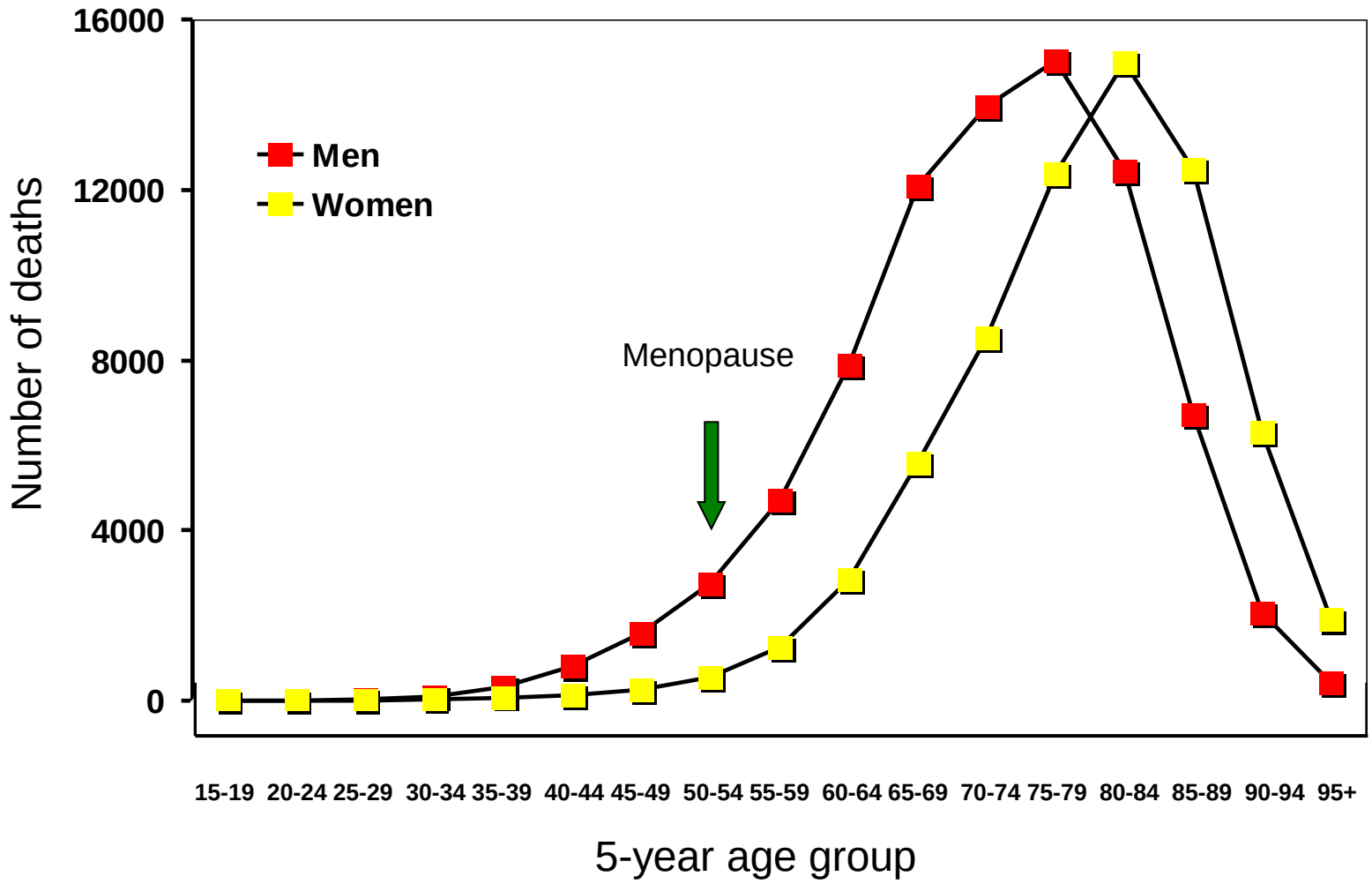
Heart disease mortality by race and gender, US, 1979-98 (per 100 000)



Data from CDC Wonder 2003

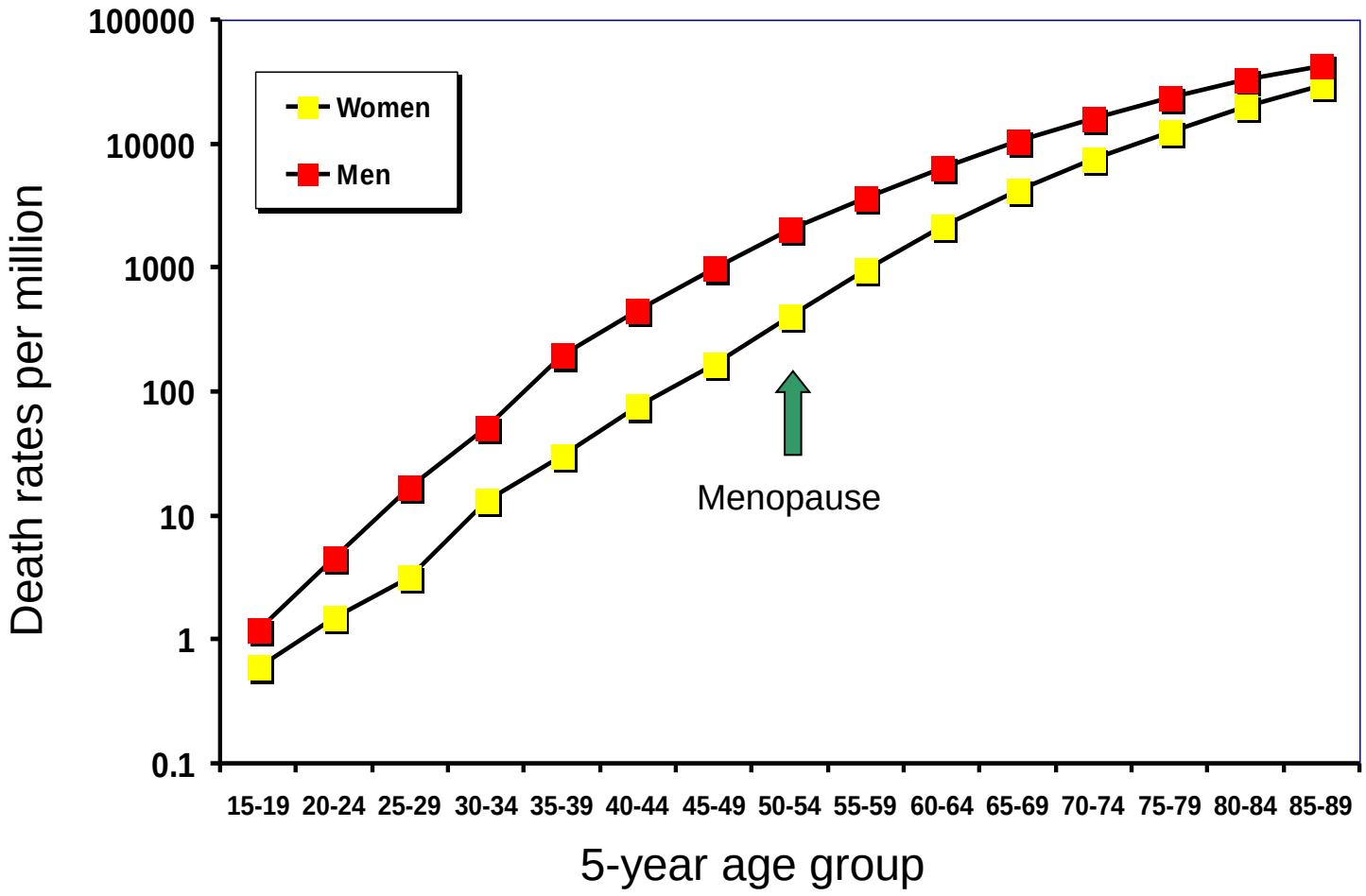
Cooper RS. Coronary heart disease among persons of African origin. In: M Marmot & P Elliott (eds). Coronary Heart Disease Epidemiology. From Aetiology to Public Health, 2005, Oxford University Press, Oxford, UK, pp73-82.

Number of deaths from CHD by age and sex in England & Wales, 1989-93



Tunstall Pedoe H. Lancet 1998; 351: 1425-27

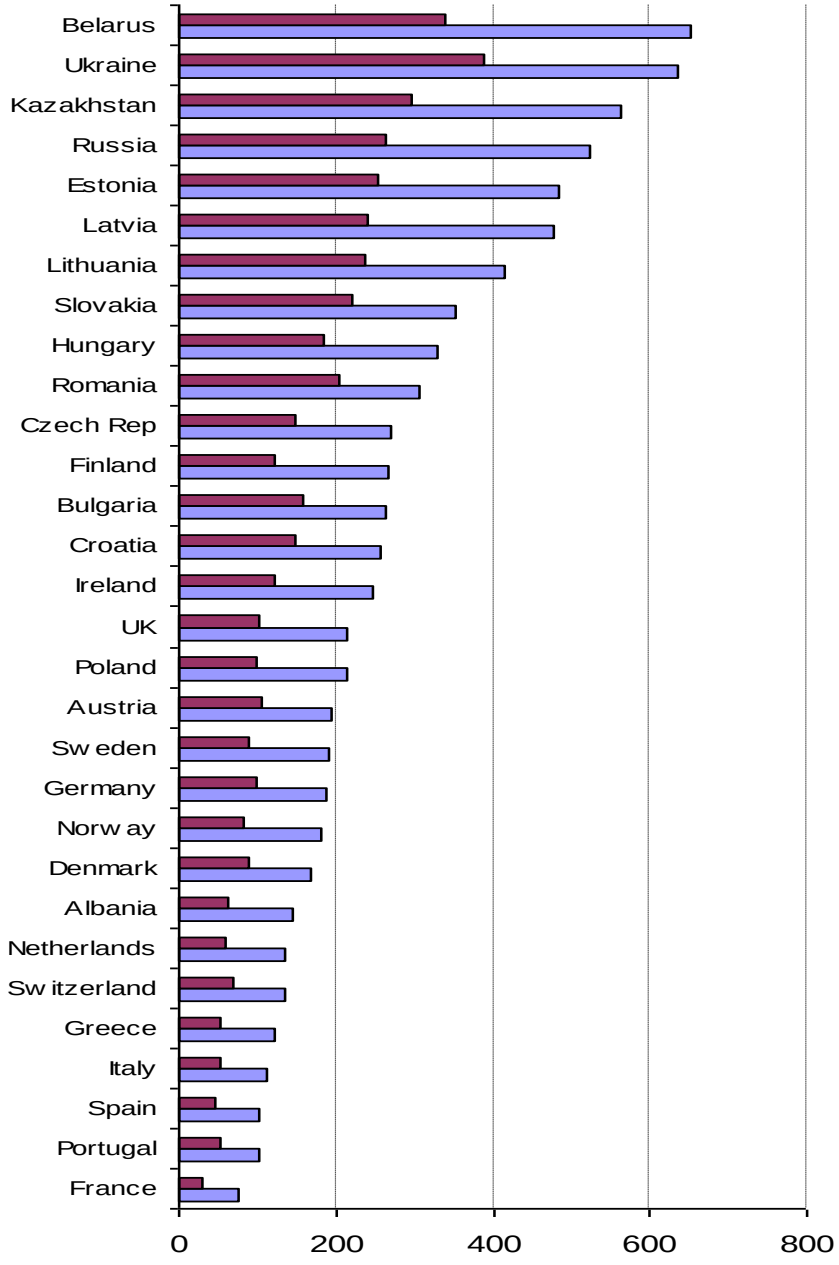
Death rates from CHD per million by age and sex in England & Wales, 1989-93



Tunstall Pedoe H. Lancet 1998; 351: 1425-27

Cardiovascular diseases Trends

- Time
- Person
- Place

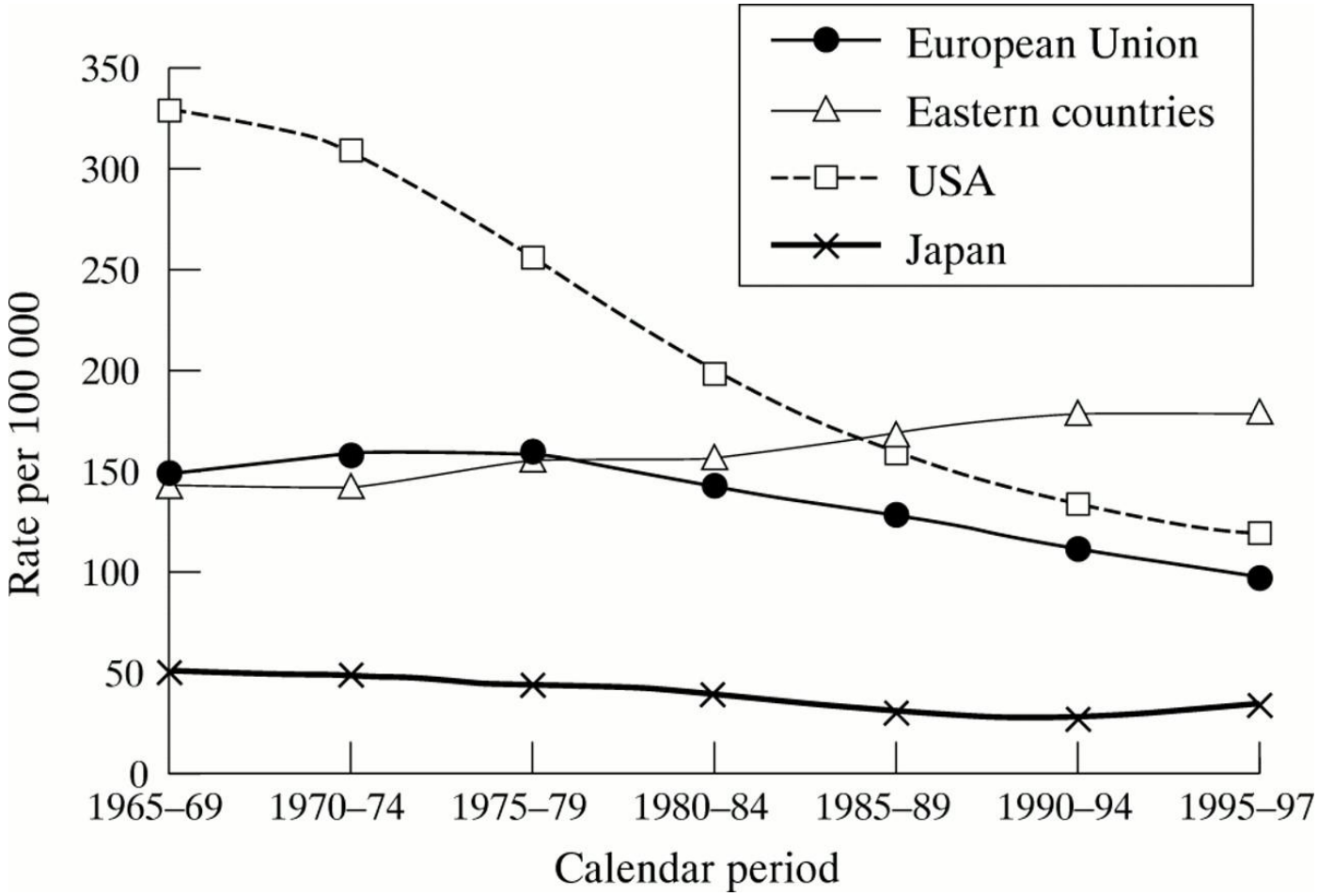


Age-standardized mortality from CHD per 100 000 in European countries in 2000 or the latest available year

Data from the WHO Health for All database

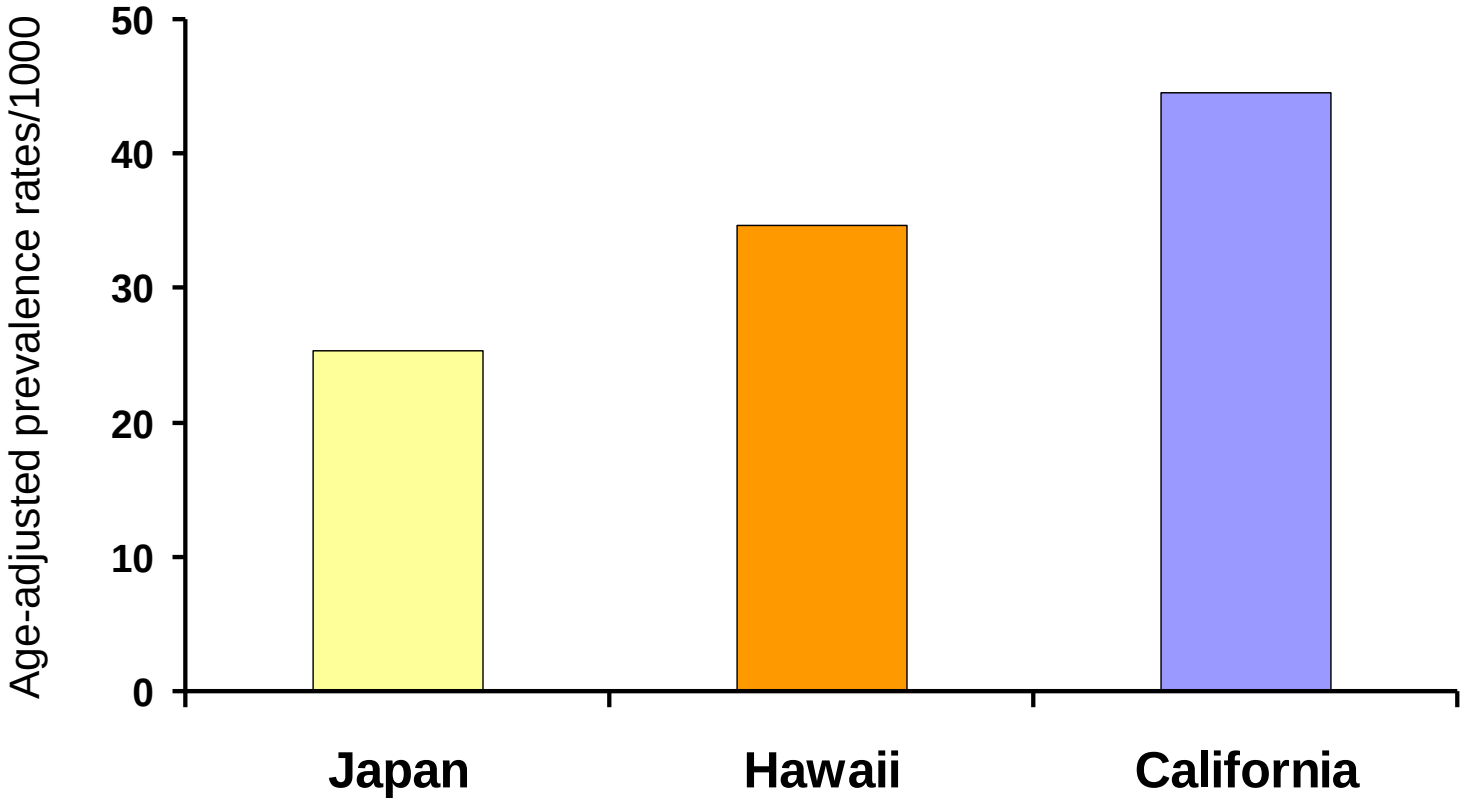
Bobak M, Marmot M. Central and Eastern Europe and the Former Soviet Union. In: M Marmot & P Elliott (eds). Coronary Heart Disease Epidemiology. From Aetiology to Public Health, 2005, Oxford University Press, Oxford, UK, pp 83-101.

Age standardised death rates from coronary heart diseases in men, all ages from the European Union, eastern European countries (Bulgaria, Czech Republic, Hungary, Poland, Romania, and Slovakia), USA, and Japan, 1965-1997



Levi, F et al. Heart 2002;88:119-124

Age-adjusted prevalence rates of definite + possible CHD identified for 11,900 men by ECG

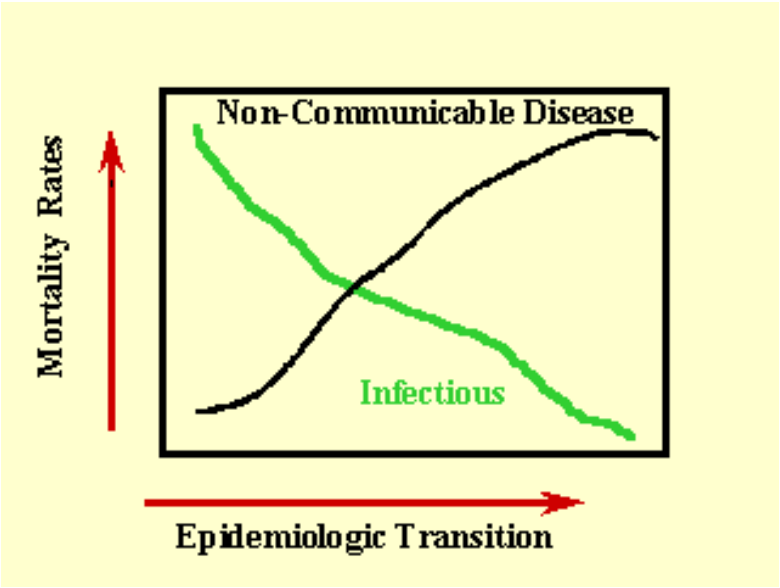


Country of residence of men of Japanese ancestry aged 45-69 yrs

Marmot MG et al. Am J Epidemiol 1975; 102: 514-25

Epidemiologic transition and the Global Burden of Disease

During the epidemiologic transition, a long-term shift occurs in mortality and disease patterns whereby pandemics of infection are replaced by degenerative and man-made diseases….



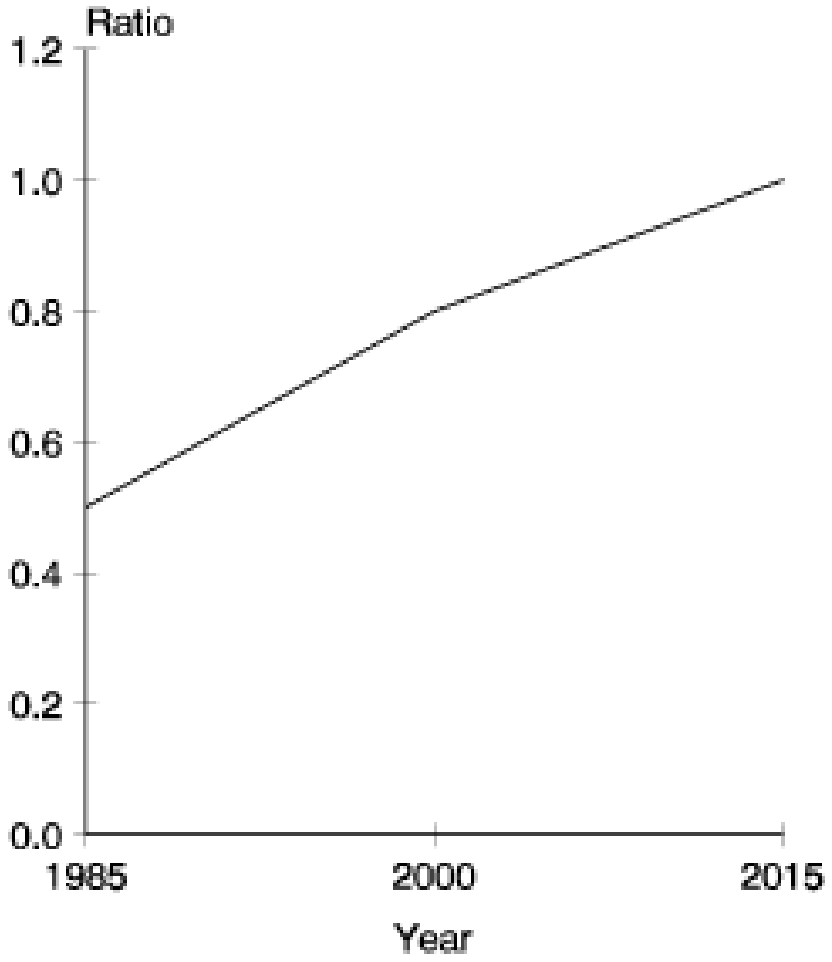


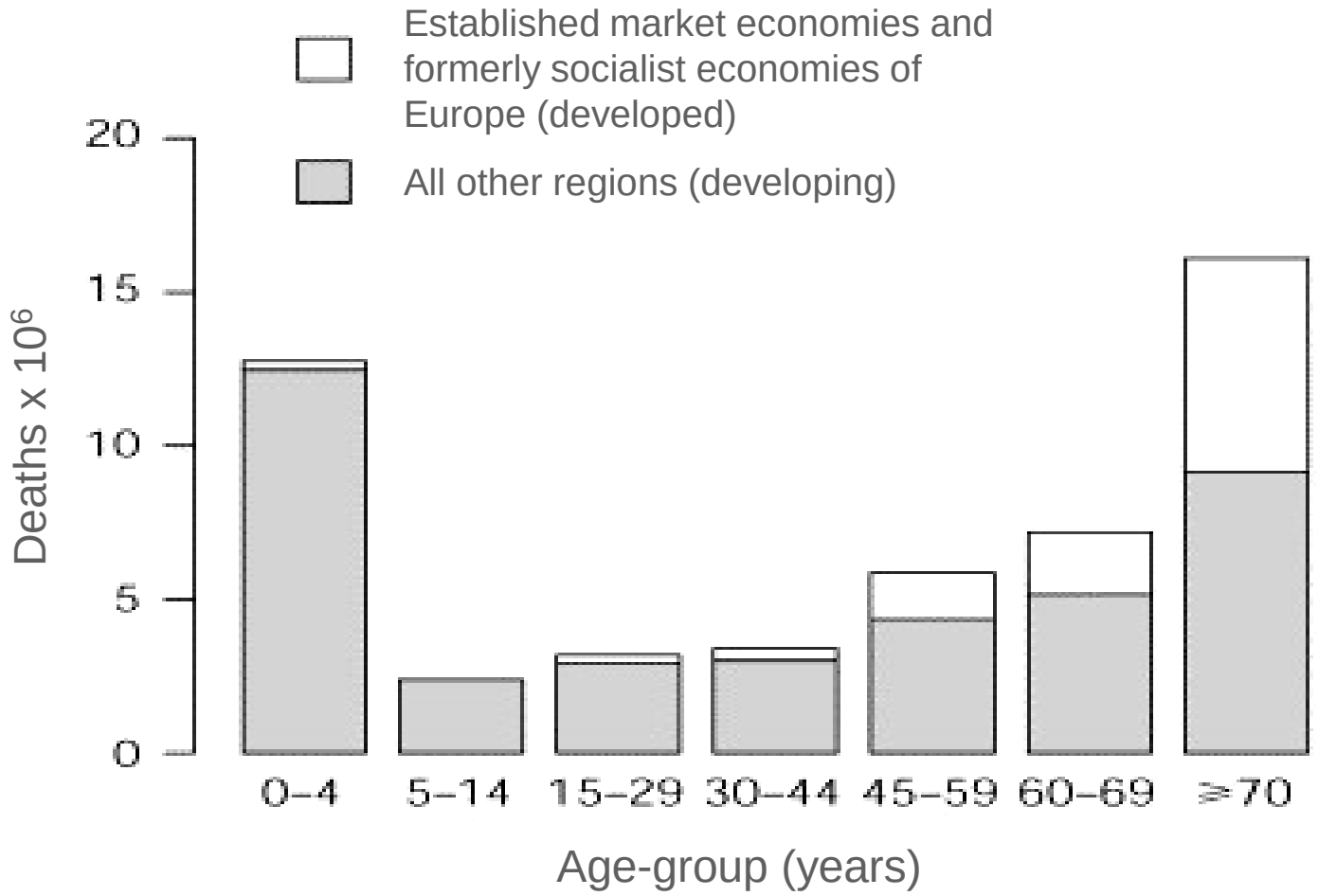
Figure 3 **Changing cause-of-death structure in the Eastern Mediterranean Region (ratio of deaths from cardiovascular diseases to deaths from infectious and parasitic diseases)**
Source: World Bank (1993)

Distribution of deaths from all causes and cardiovascular diseases in developing and developed countries in 1990

	Deaths ($X 10^3$)		
	Developed	**Developing**	**World**
Cardiovascular diseases	5245	9082	14 327
All causes	10 912	39 554	50 467

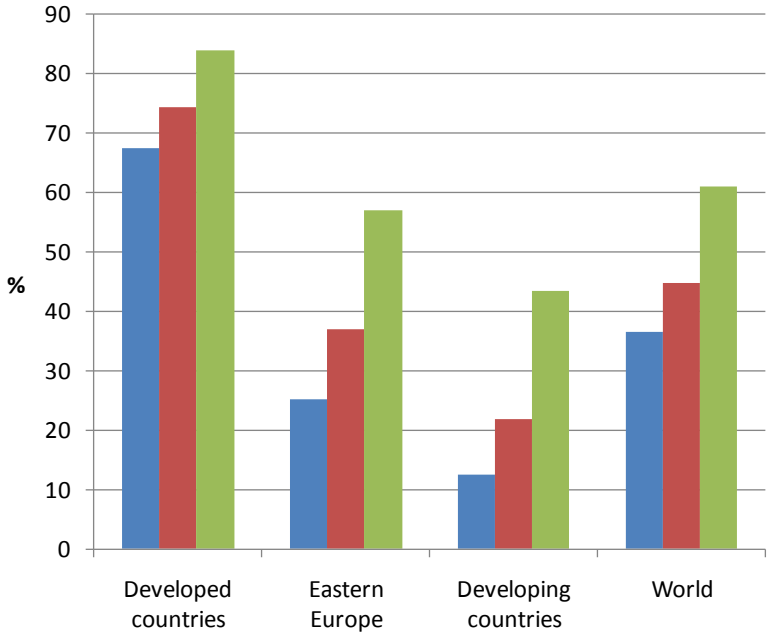
Murray CJL, Lopez AD. Lancet 1997; 349: 1269-76

Distribution of deaths worldwide by age group in study regions



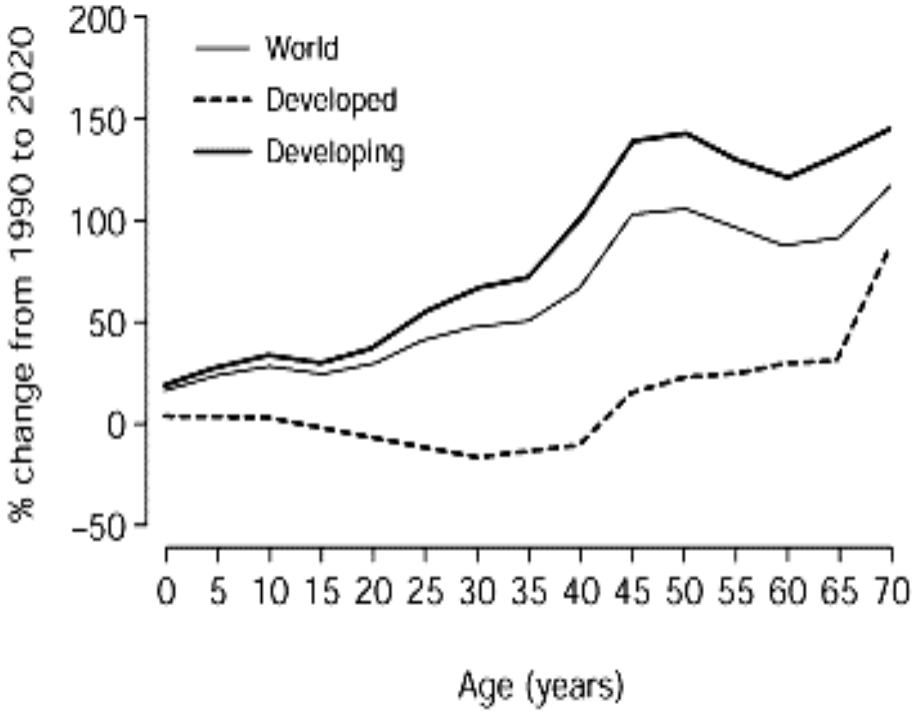
Murray CJL, Lopez AD. Lancet 1997; 349: 1269-76

% Living in urban settings: 1970, 1994, & 2025 (projected)

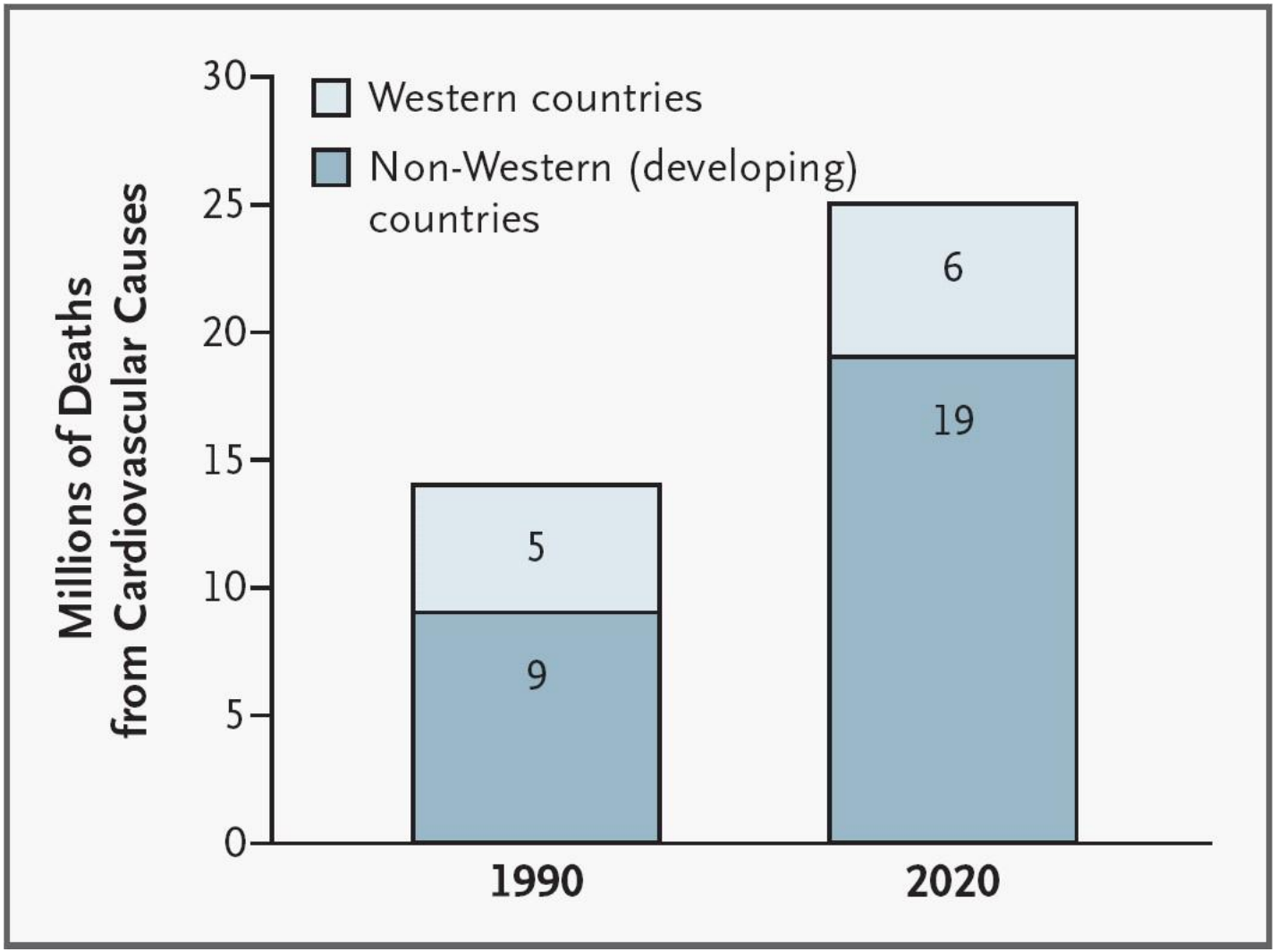


Source: Yusuf S, *Circulation* 2001;104:2746-2753

Projected change in global population 1990 to 2020



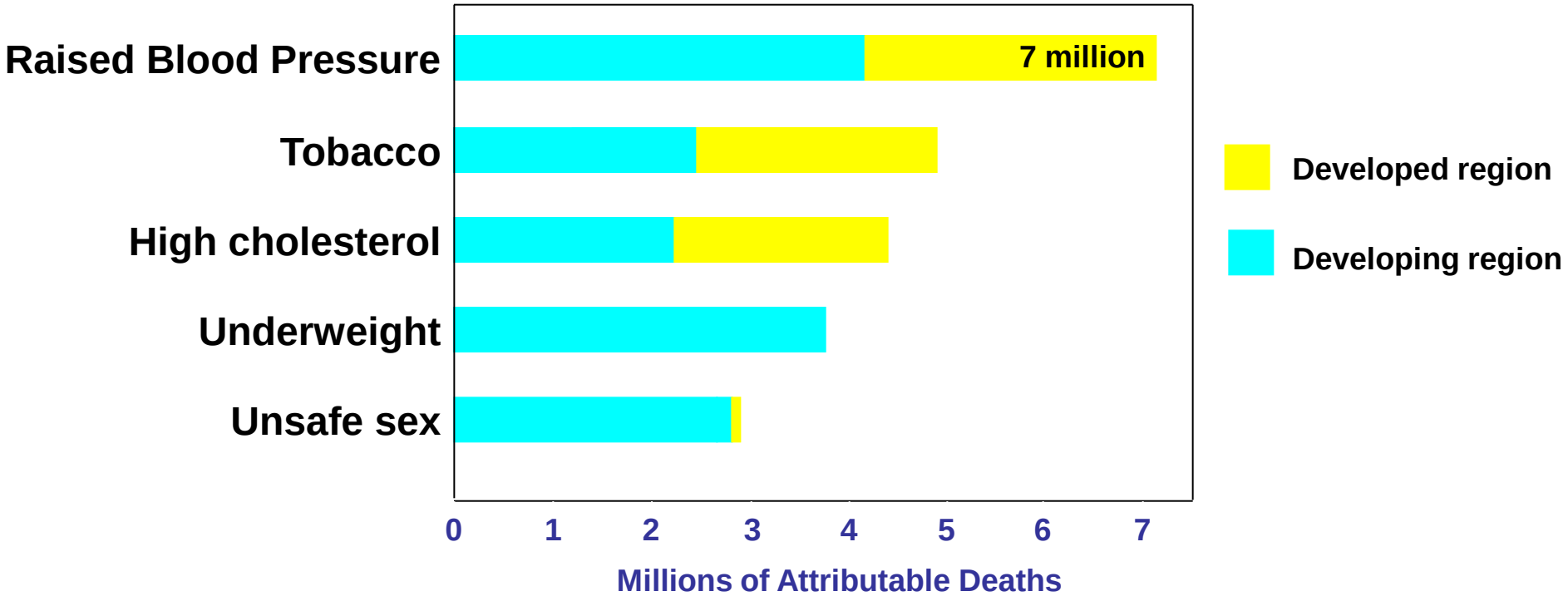
Murray CJL, Lopez AD Lancet 1997;349:1498-1504



Deaths from cardiovascular causes, worldwide, in 1990 and estimated for 2020. Data from Global Burden of Disease study
Source: Reddy KS, *NEJM* 2004;350:2438-2440

Risk factors for cardiovascular disease

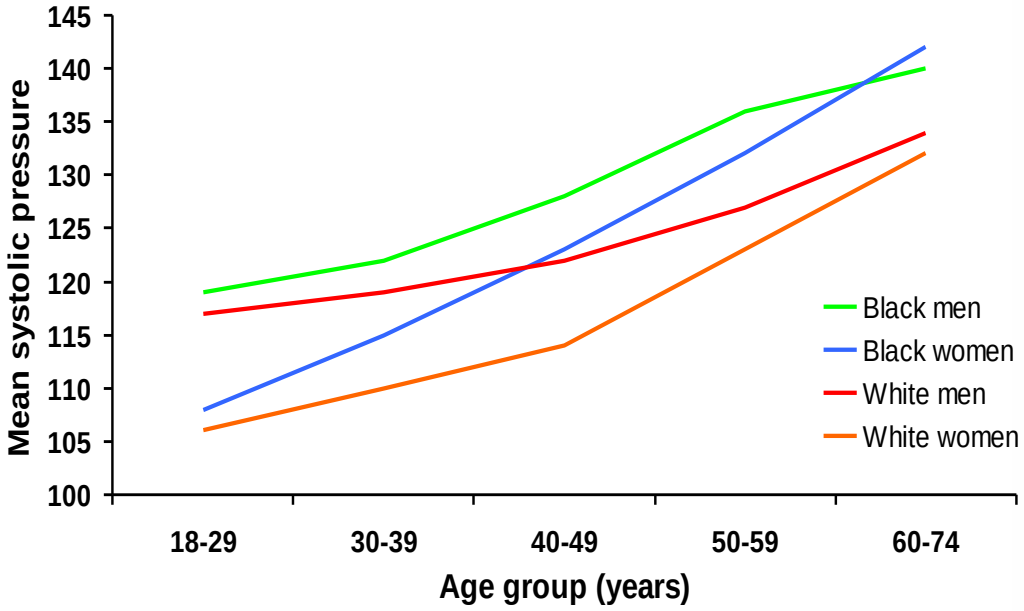
Major Risk Factors for Death Worldwide



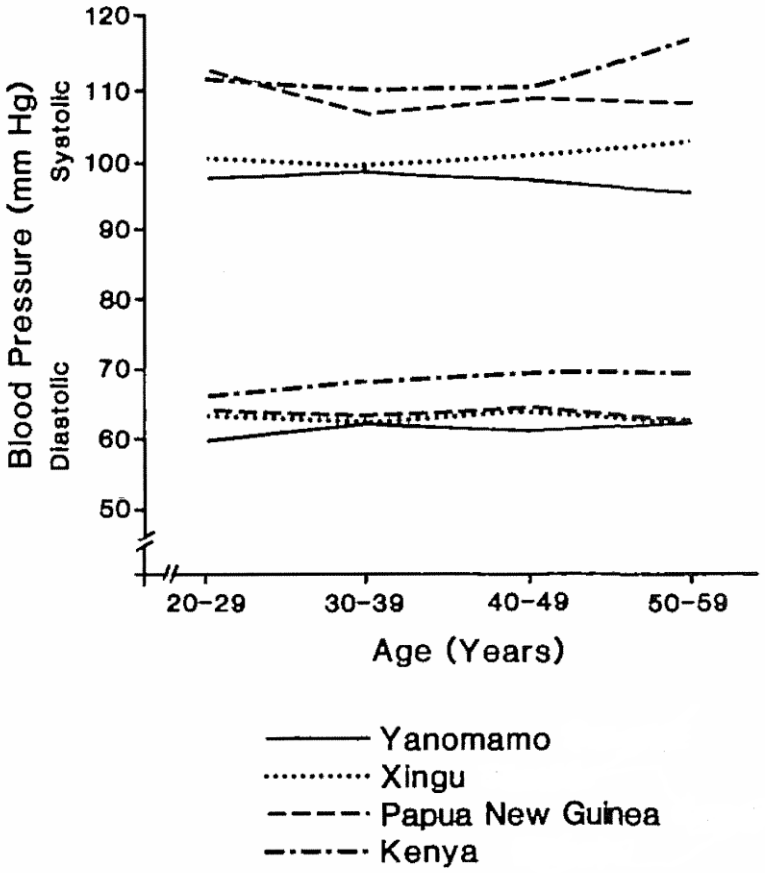
62% of all Strokes and 49% of all Heart Disease attributable to raised BP

Lancet 2002; 360: 1347-60

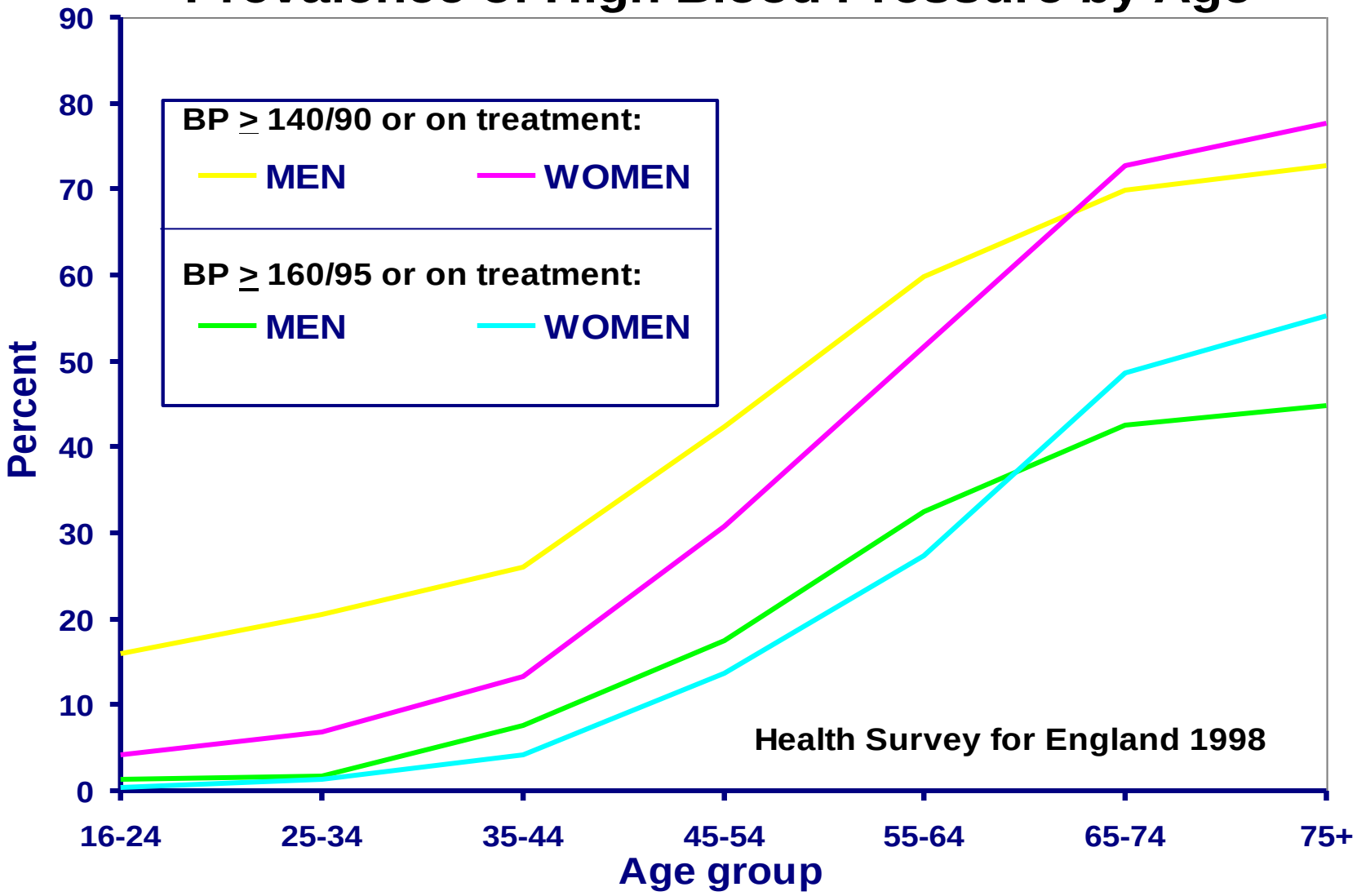
Mean systolic blood pressure (mmHg), US population, NHANES III Phase I (1988-1991) by age, ethnic group and gender



INTERSALT: Four low BP populations



Prevalence of High Blood Pressure by Age

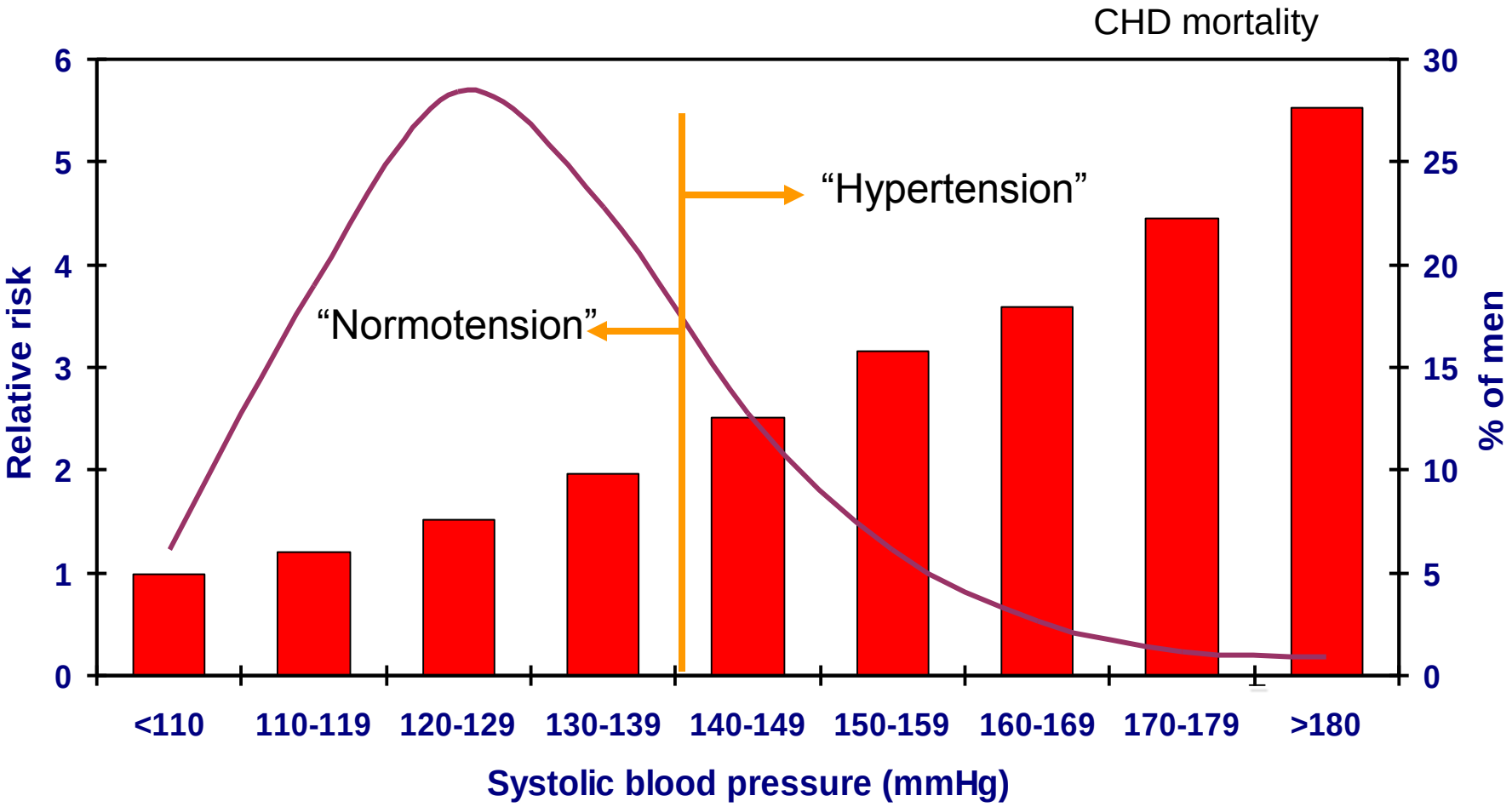


Hypertension

“Essential hypertension is a type of disease not hitherto recognised in medicine in which the defect is quantitative not qualitative. It is difficult for doctors to understand because it is a departure from the ordinary process of binary thought to which they are brought up. Medicine in its present state can count up to two but not beyond”

Pickering 1968

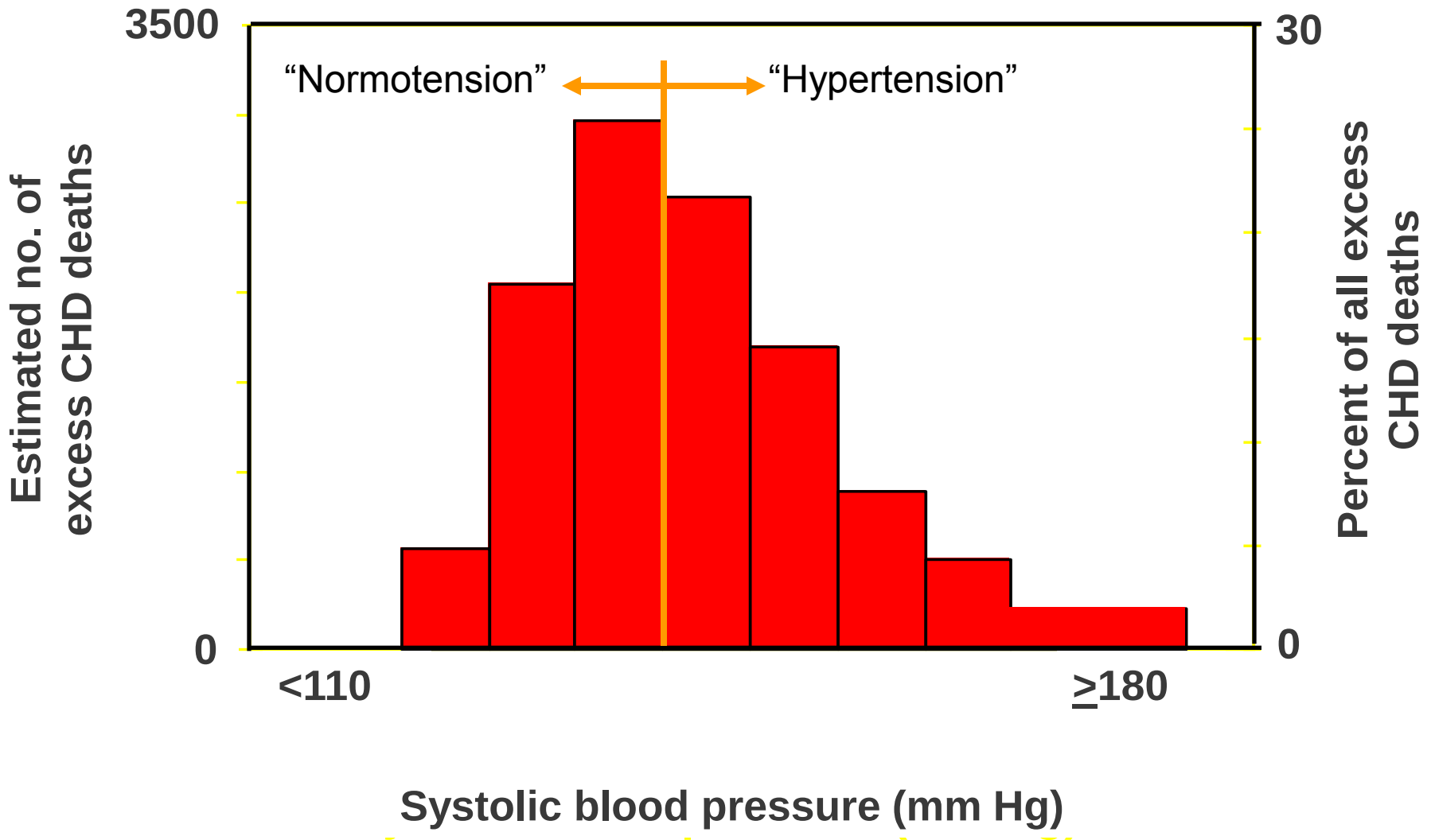
MRFIT blood pressure distribution and risk of death at 25 years follow-up



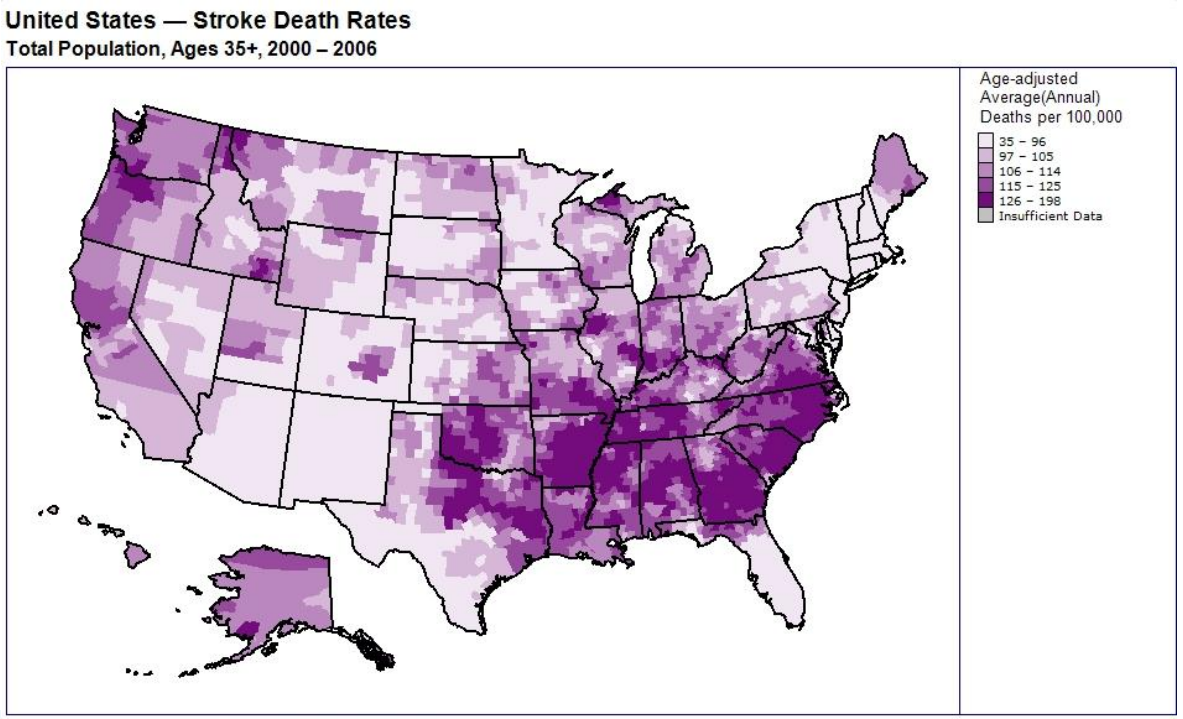
347,978 men ages 35-57 at baseline

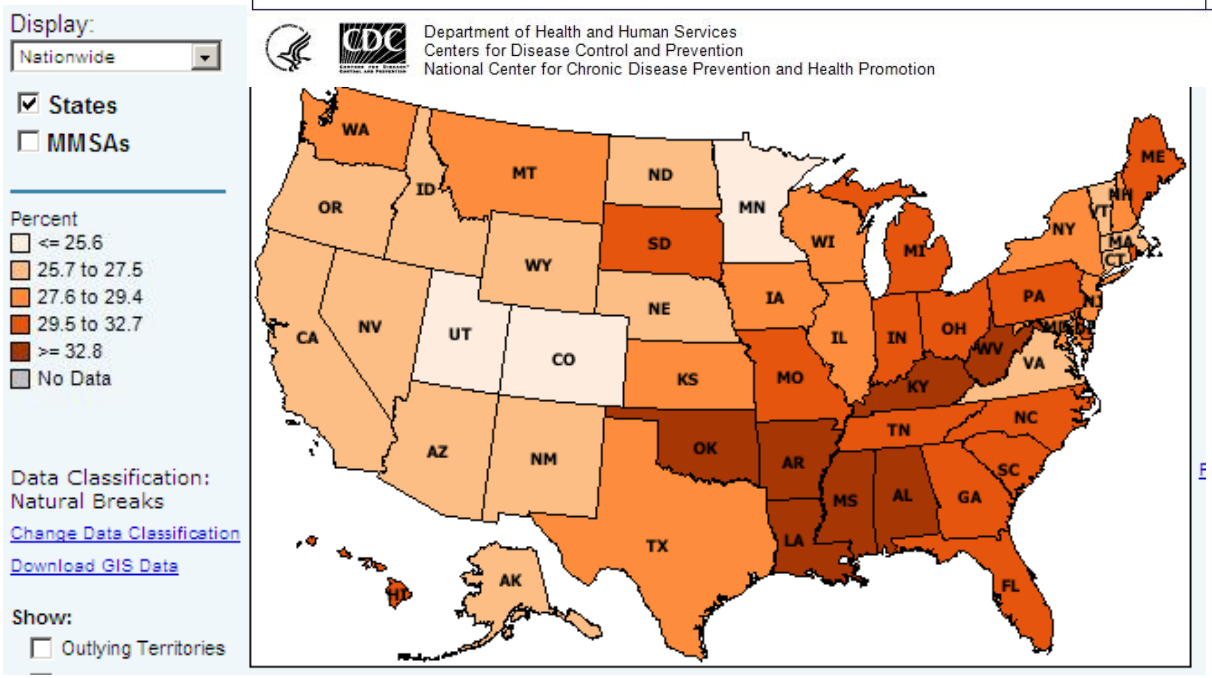
Adapted from Elliott & Stamler 2005

MRFIT 25-year follow-up: Numbers and proportions of excess CHD deaths by SBP



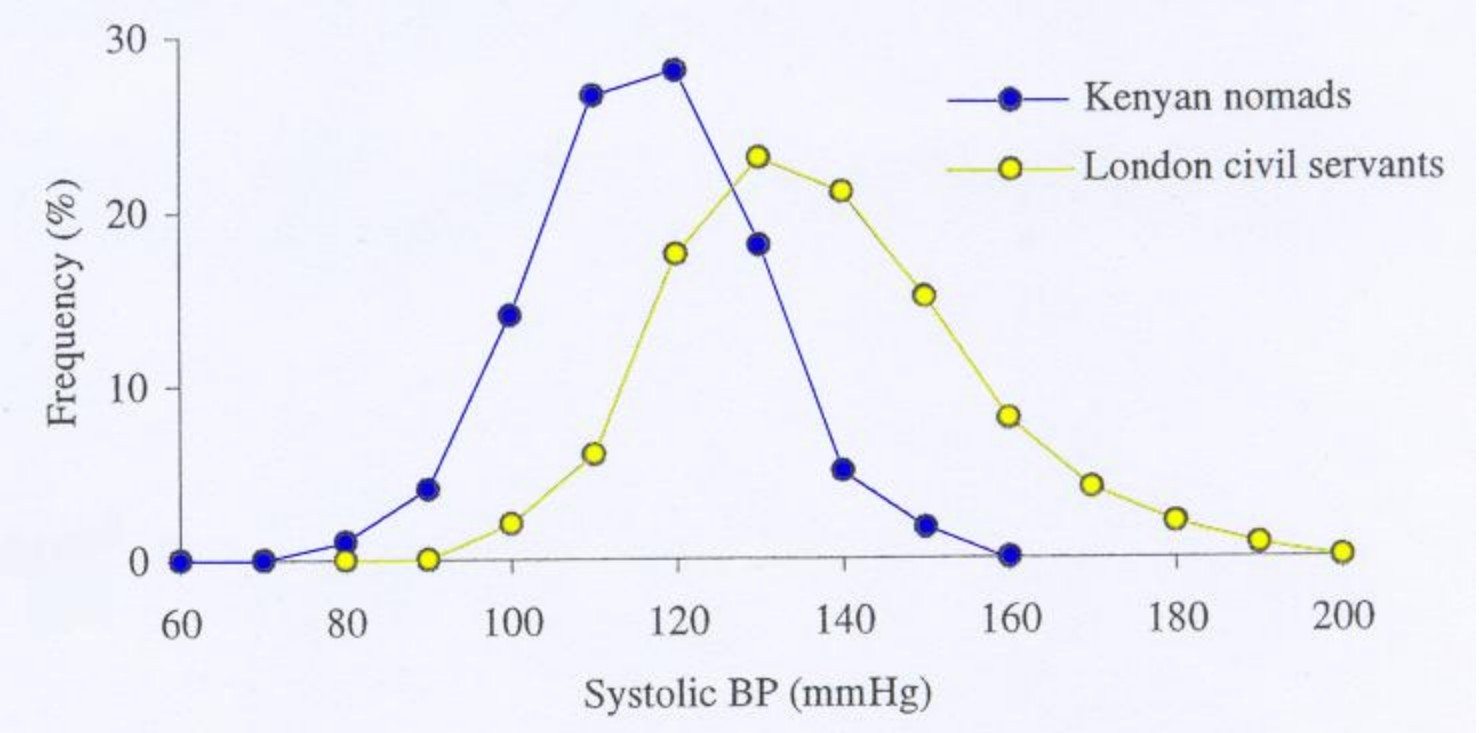
Adapted from Elliott & Stamler 2005





Percent reporting hypertension

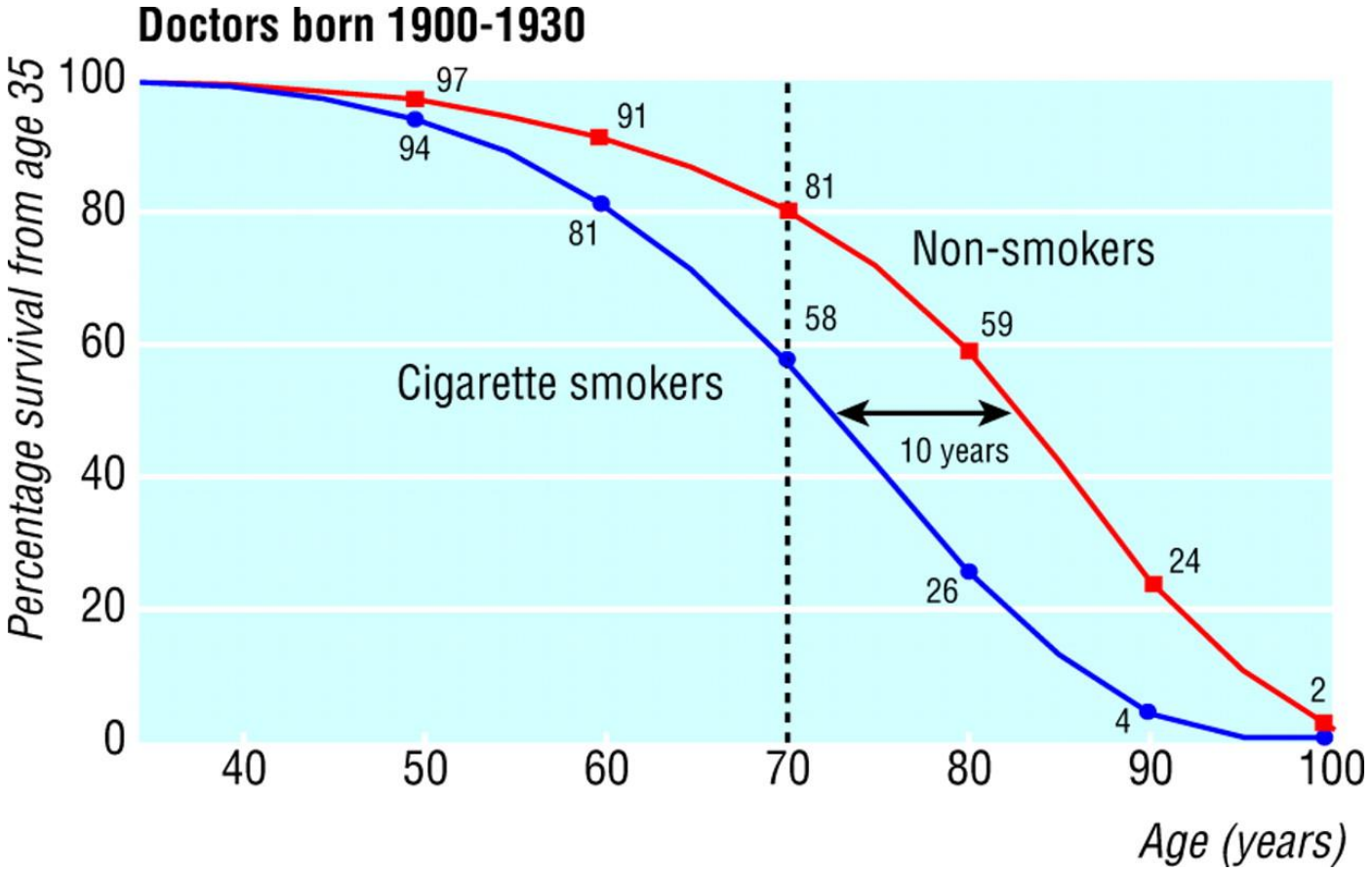
BP Distributions in Different Populations



Lifestyle factors – especially diet – are key in explaining differences between populations in the rise in BP with age and the consequent prevalence of high BP at older ages

Adapted from Rose *Int J Epidemiol* 1985; 14: 32-38

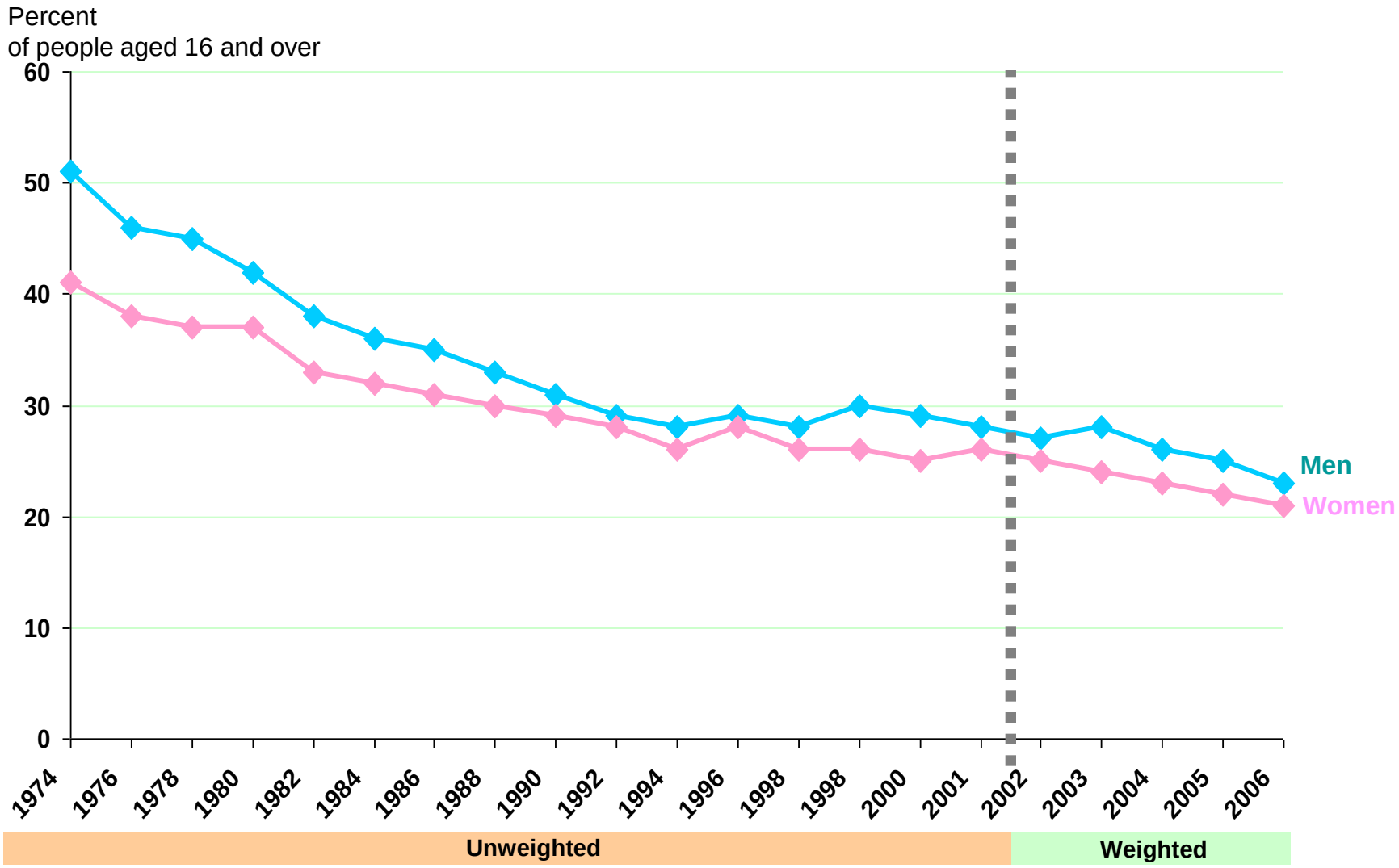
Survival from age 35 for continuing cigarette smokers and lifelong non-smokers among UK male doctors born 1900-1930



Doll, R. et al. BMJ 2004;328:1519

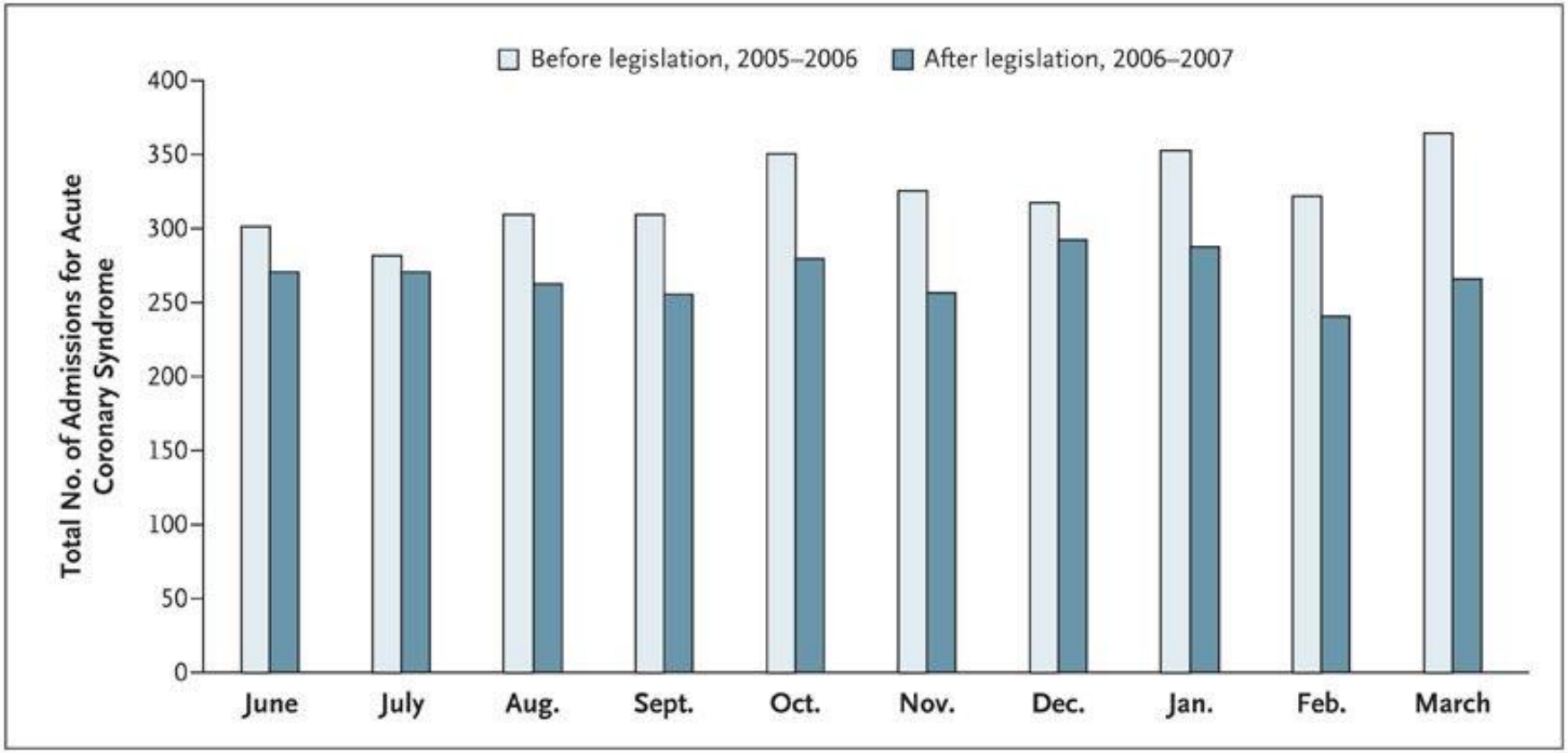
Smoking Prevalence

by gender, Great Britain



Source: ONS, 'Living in Britain': General Household Survey

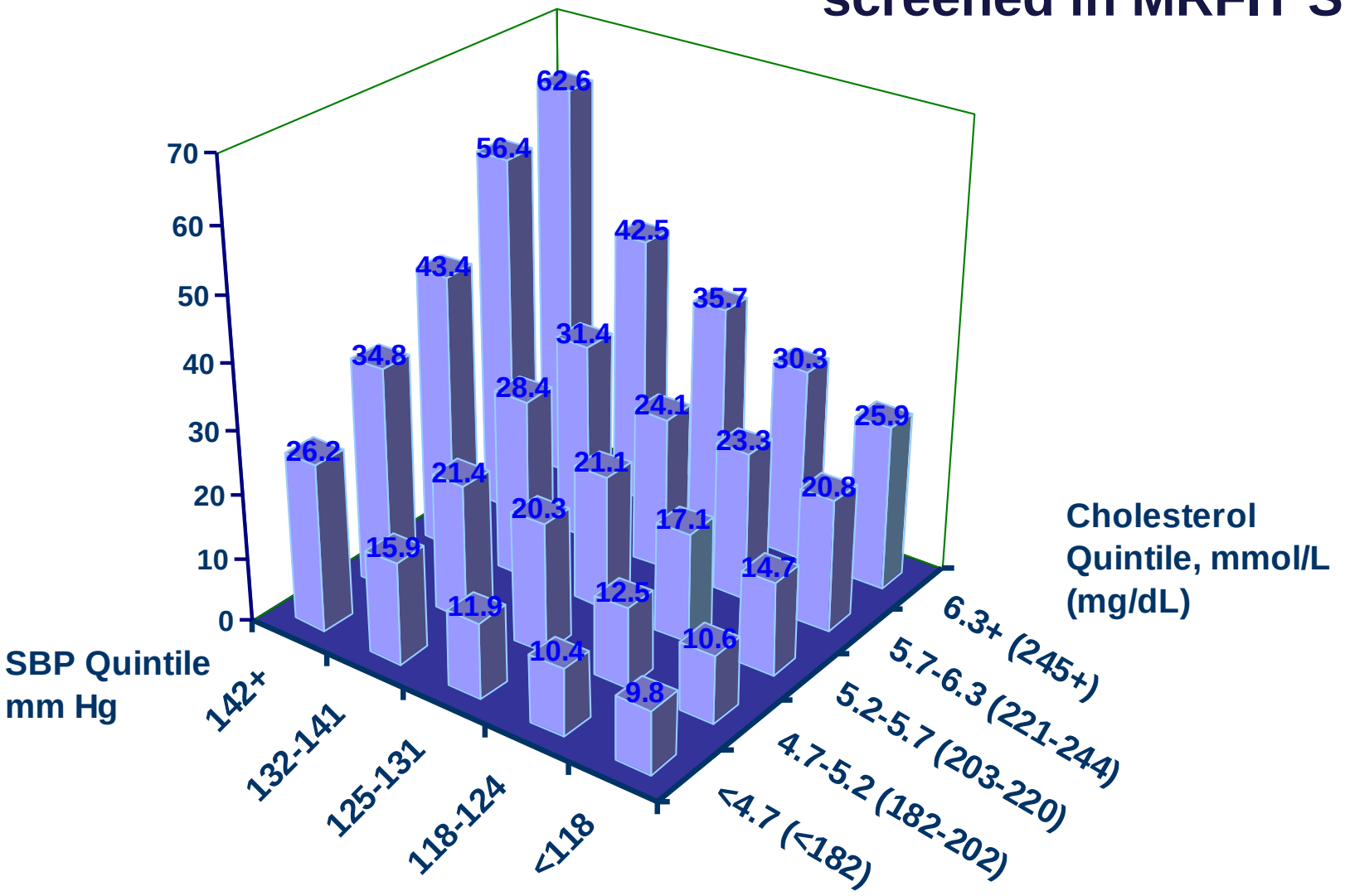
Smoking ban in Scotland



Admissions for Acute Coronary Syndrome According to Month before and after Smoke-free Legislation

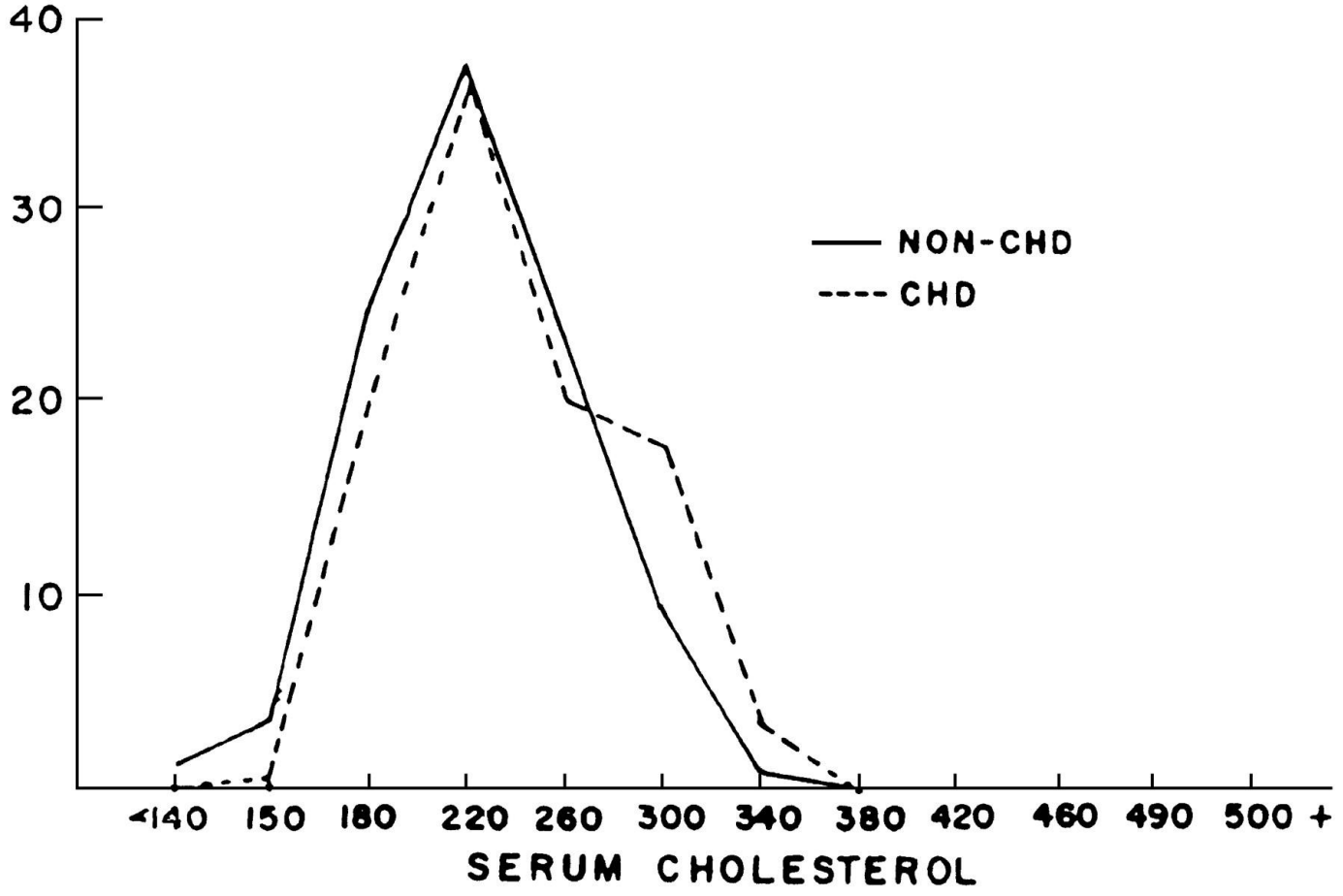
Pell J *et al. NEJM* 2008; 359:482-491

Age-adjusted CHD death rates per 10 000 person-years by level of serum cholesterol and SBP for cigarette smokers screened in MRFIT Study



Neaton JD et al. Arch Intern Med 1992; 152: 56-64

Percentage distribution of serum cholesterol levels (mg/dl) in men aged 50-62 who did or did not subsequently develop coronary heart disease (Framingham Study)



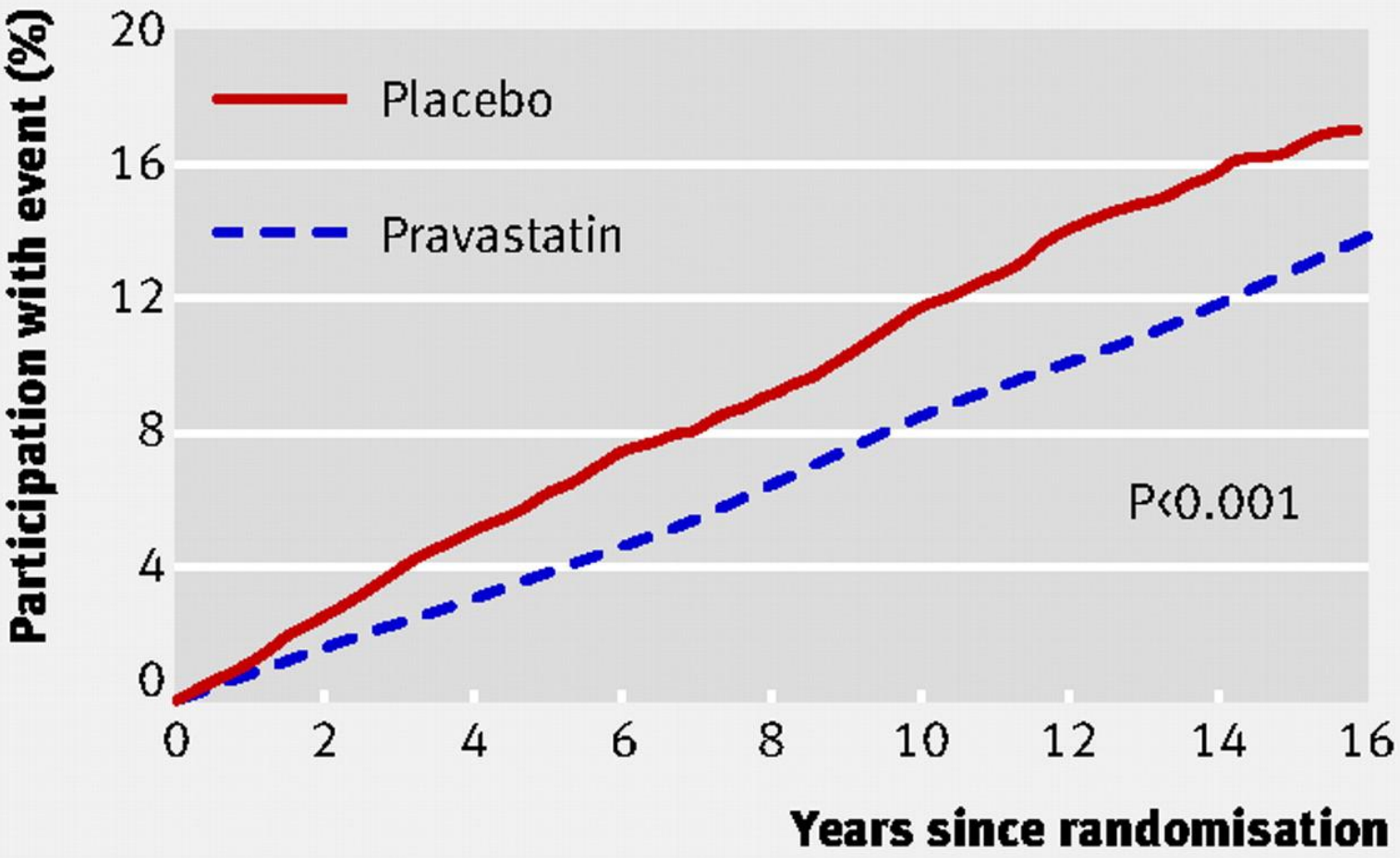
Rose, G. Int. J. Epidemiol. 1985 *Sick individuals and sick populations*

International Journal of Epidemiology

Serum Cholesterol

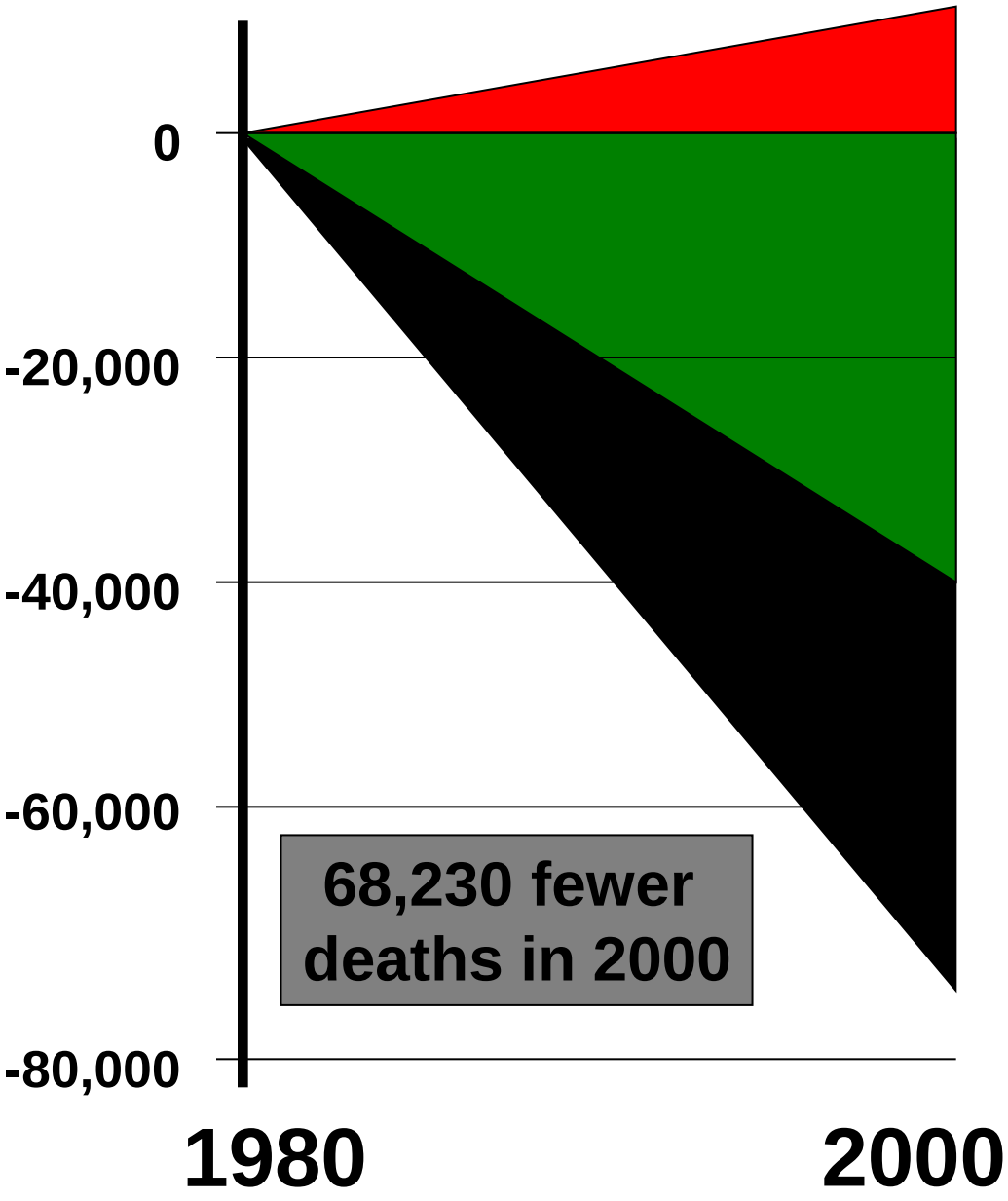
- Cholesterol is a good predictive marker
- Well–measured, so that a single measure characterises the population reasonably well
- Longitudinal studies show prognostic validity
- However poor ability to discriminate between cases and non-cases of heart disease

EFFECT OF PRAVASTATIN ON DEATH FROM CHD OR NON-FATAL HEART ATTACK



Adapted from *N Engl J Med* 2007;357:1477-86

Deaths averted



Risk factors worse	**+13%**
Obesity	+3.5%
Diabetes	+4.8%
Less physical activity	+4.4%

Risk factors better	**-71%**
Smoking	-41%
Cholesterol	-9%
Popul'n BP fall	-9%
Deprivation	-3%
Other factors	-8%

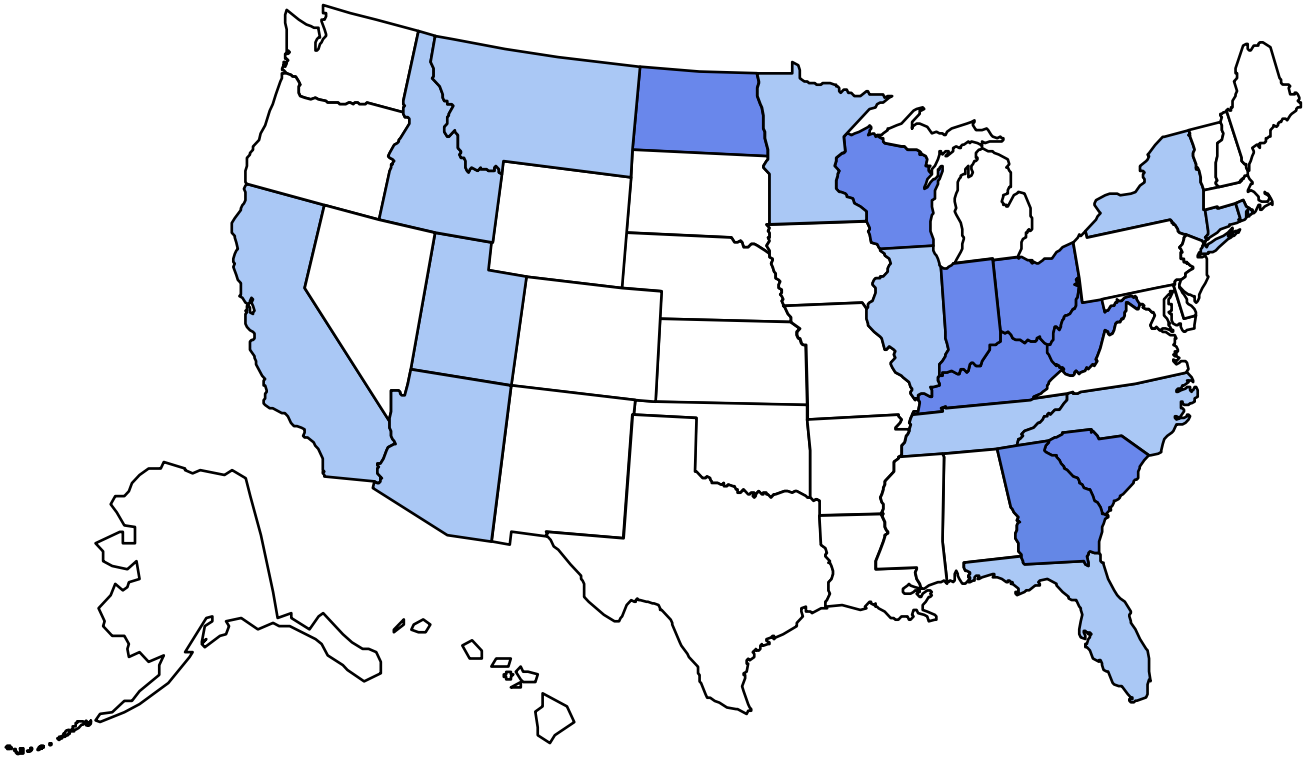
Treatments	**-42%**
AMI treatments	-8%
Secondary prevention	-11%
Heart failure	-12%
Angina: CABG/PCI	-4%
Angina: drugs	-5%
BP treatment	-3%

Redrawn from Capewell and colleagues

Obesity Trends* Among U.S. Adults

BRFSS, 1985

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)



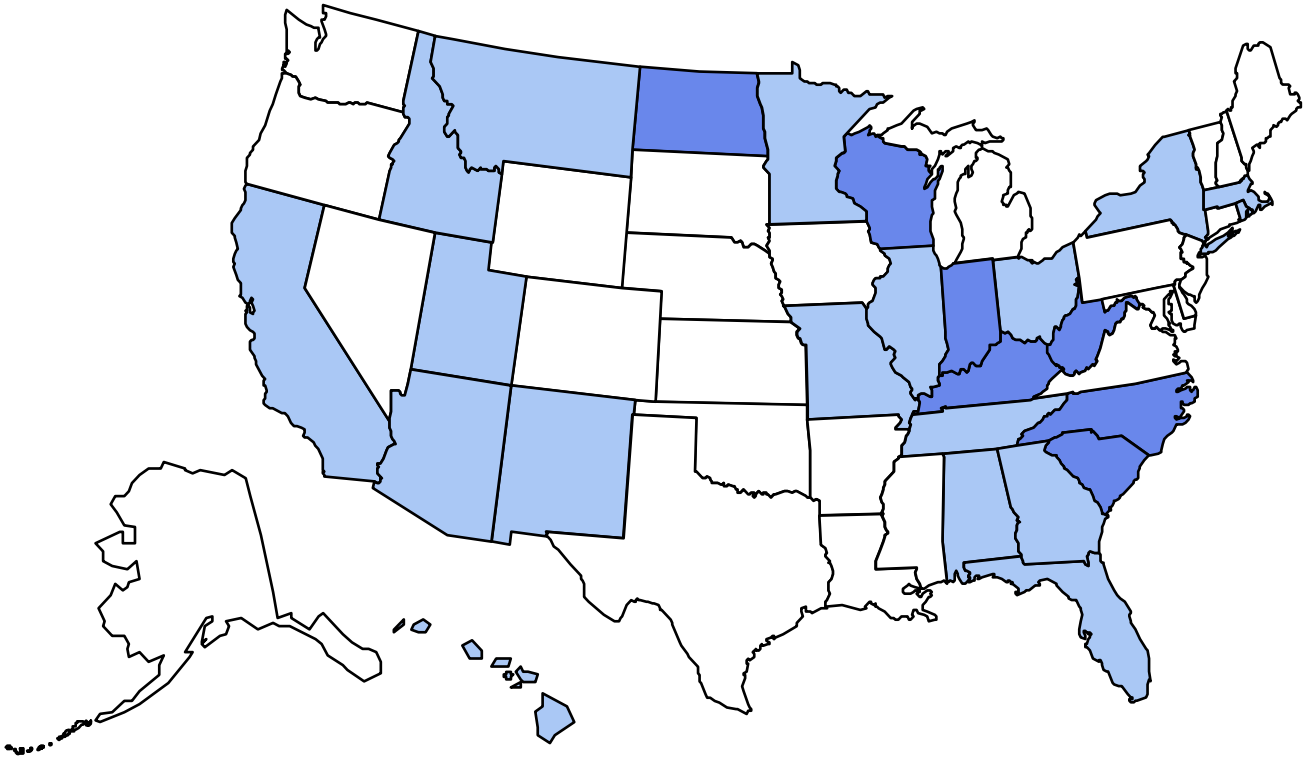
No Data | <10% | 10%–14%

Source: Behavioral Risk Factor Surveillance System, CDC.

Obesity Trends* Among U.S. Adults

BRFSS, 1986

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)



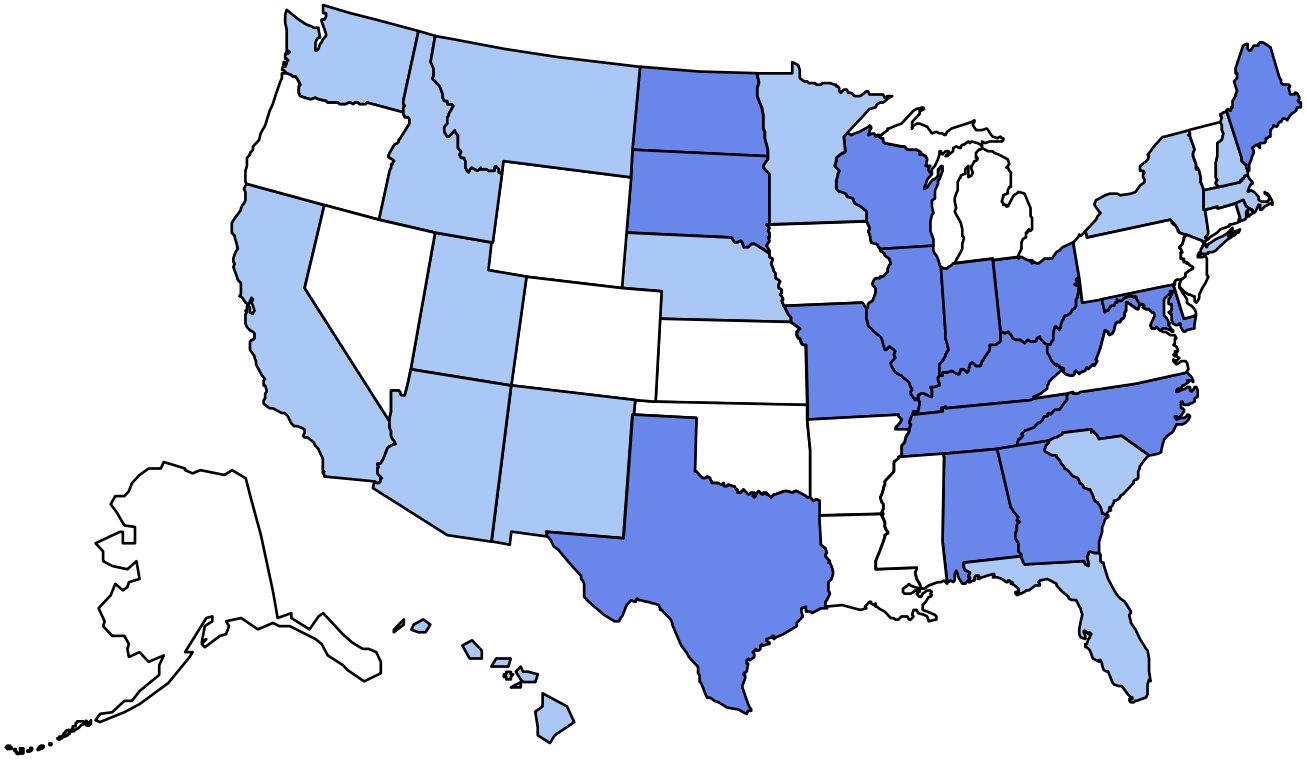
No Data | <10% | 10%–14%

Source: Behavioral Risk Factor Surveillance System, CDC.

Obesity Trends* Among U.S. Adults

BRFSS, 1987

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)



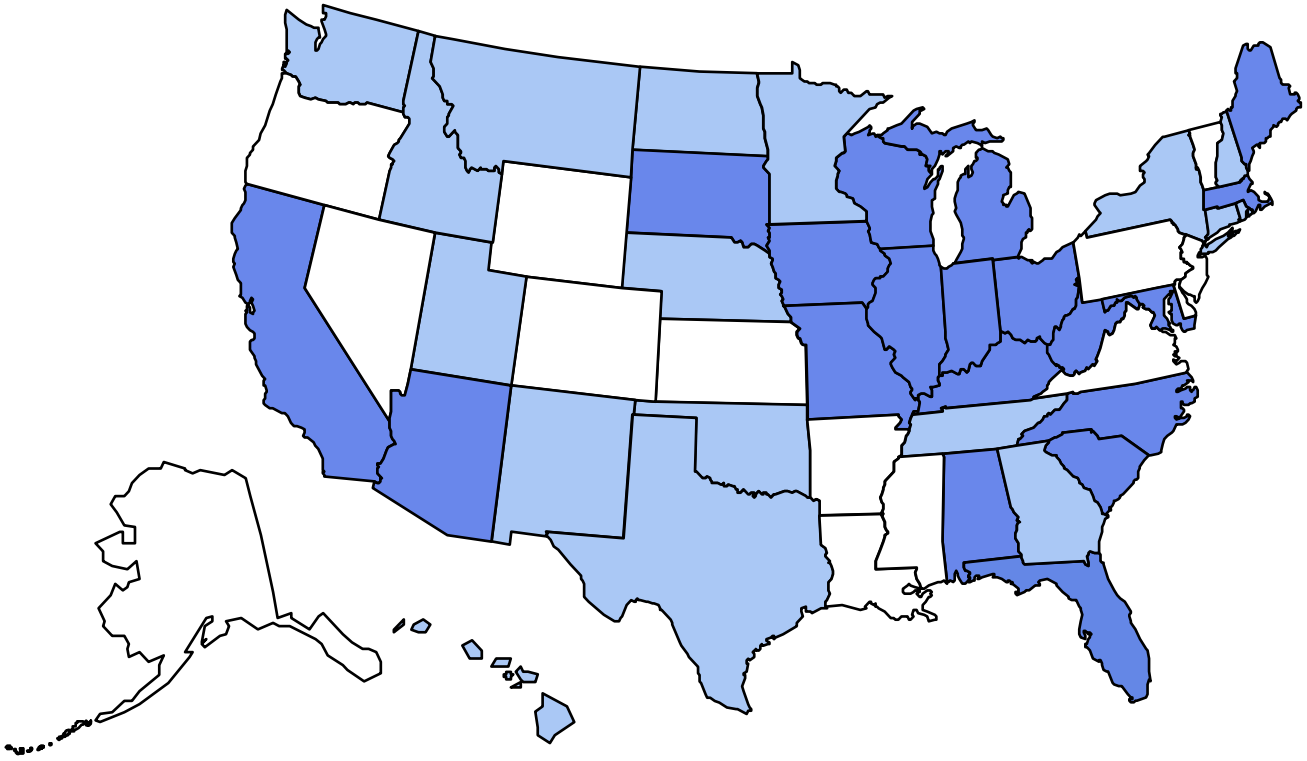
No Data | <10% | 10%–14%

Source: Behavioral Risk Factor Surveillance System, CDC.

Obesity Trends* Among U.S. Adults

BRFSS, 1988

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)



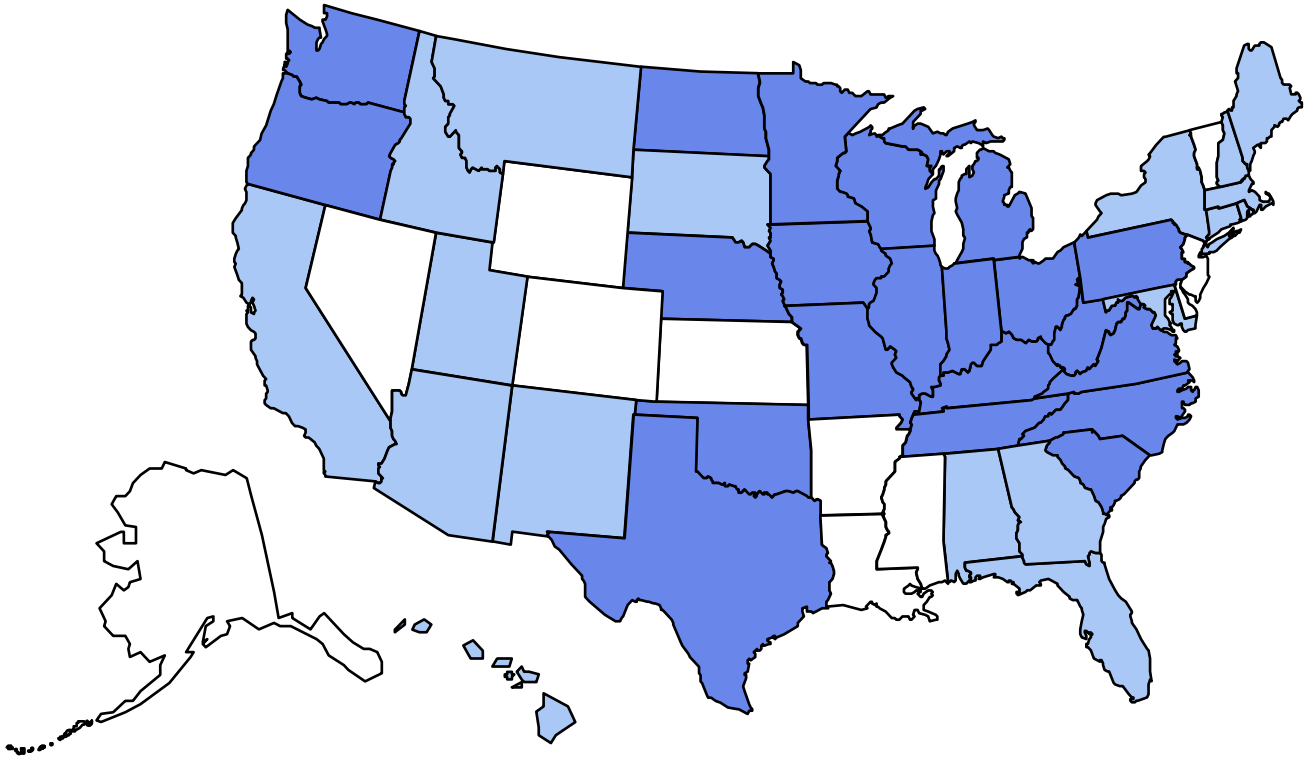
No Data | <10% | 10%–14%

Source: Behavioral Risk Factor Surveillance System, CDC.

Obesity Trends* Among U.S. Adults

BRFSS, 1989

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)



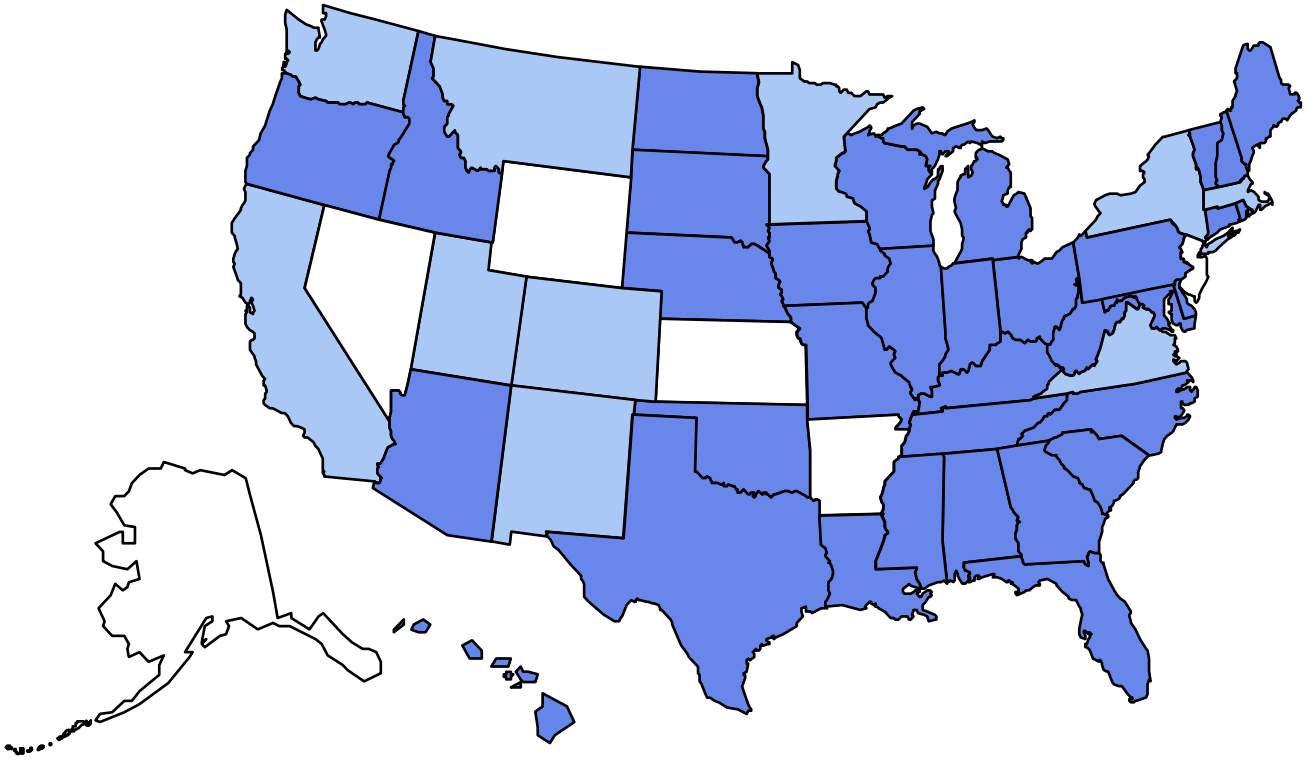
No Data | <10% | 10%–14%

Source: Behavioral Risk Factor Surveillance System, CDC.

Obesity Trends* Among U.S. Adults

BRFSS, 1990

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)



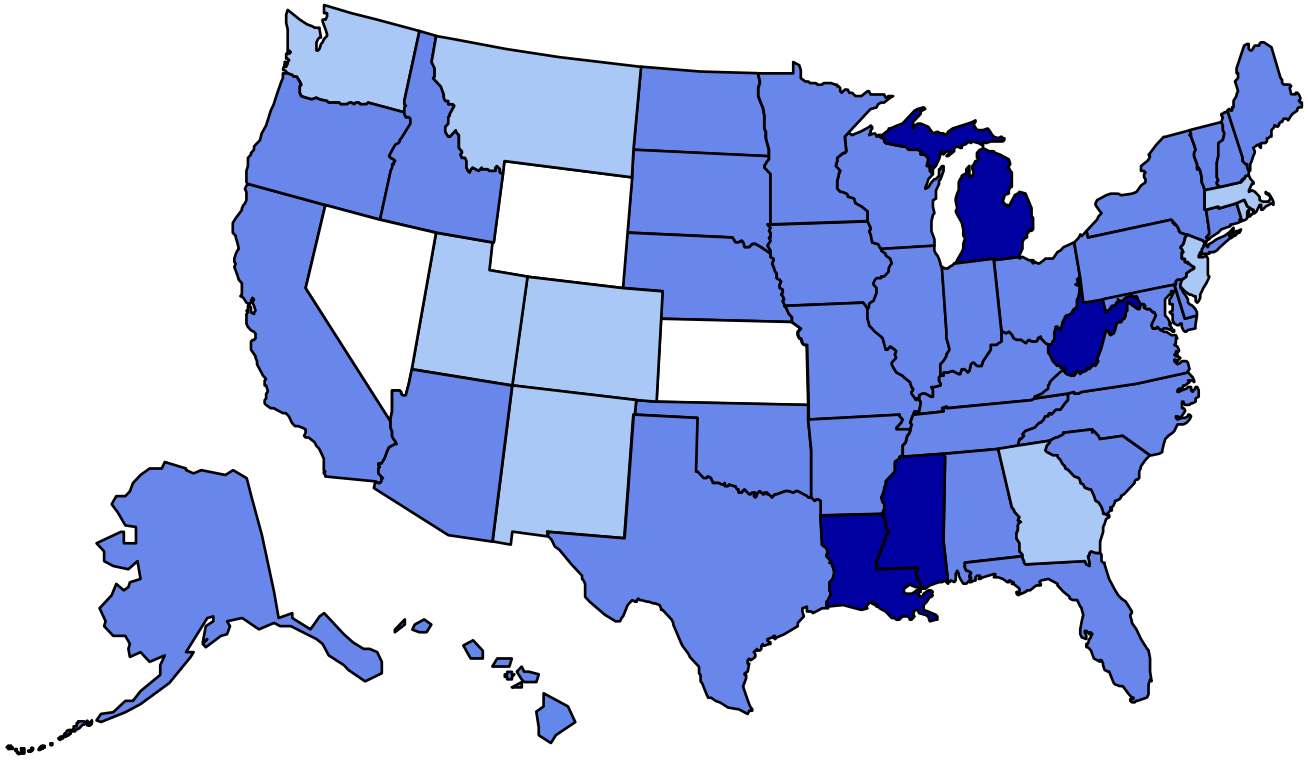
No Data | <10% | 10%–14%

Source: Behavioral Risk Factor Surveillance System, CDC.

Obesity Trends* Among U.S. Adults

BRFSS, 1991

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)



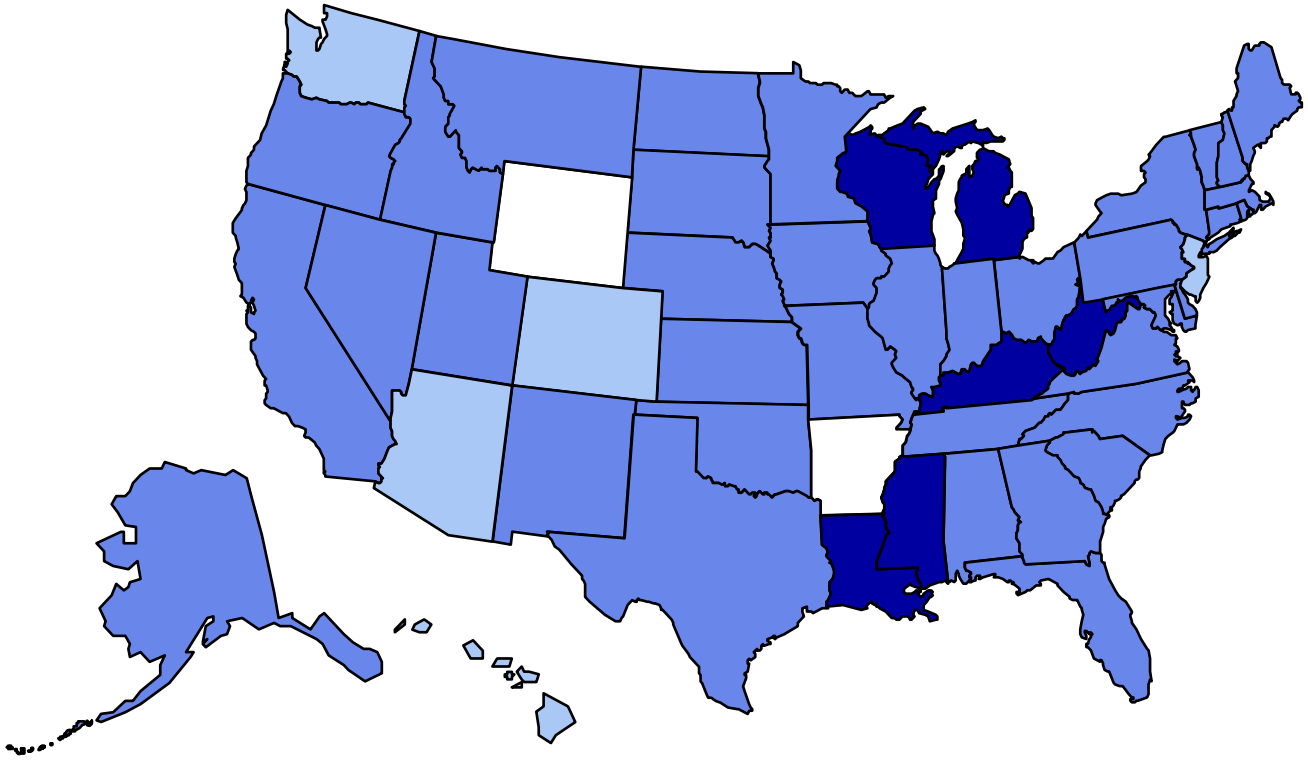
No Data | <10% | 10%–14% | 15%–19%

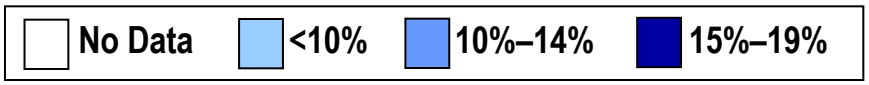
Source: Behavioral Risk Factor Surveillance System, CDC.

Obesity Trends* Among U.S. Adults

BRFSS, 1992

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)



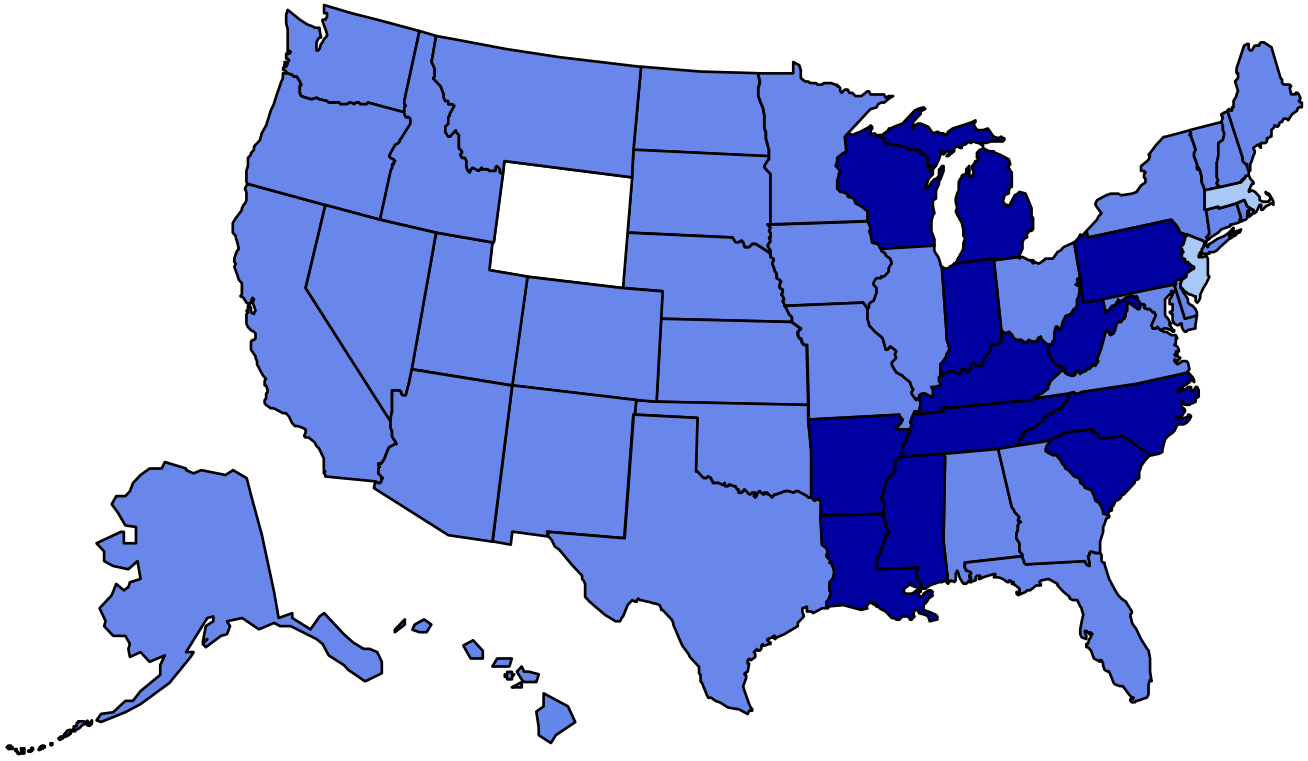


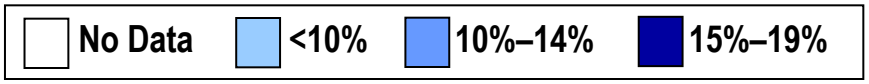
Source: Behavioral Risk Factor Surveillance System, CDC.

Obesity Trends* Among U.S. Adults

BRFSS, 1993

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)



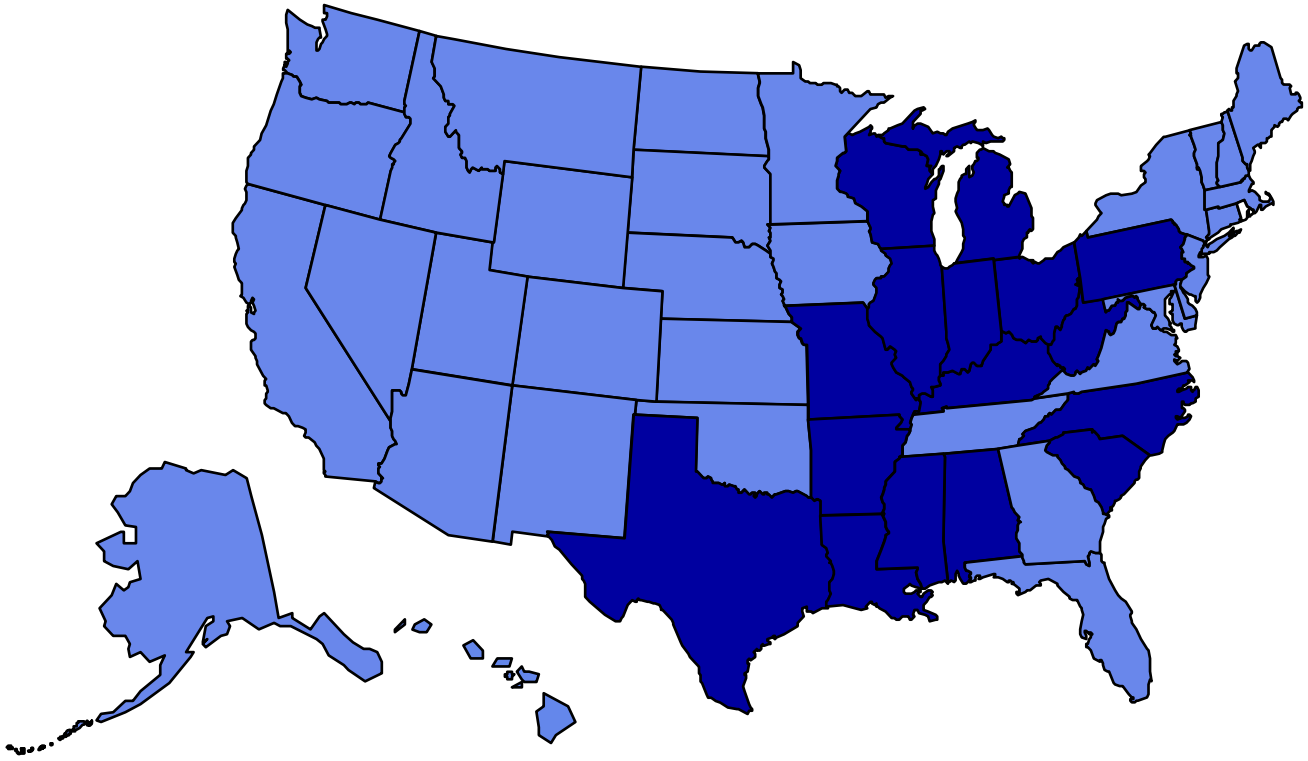


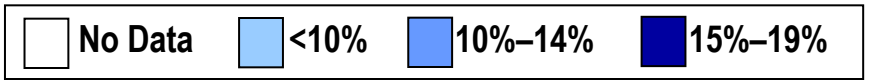
Source: Behavioral Risk Factor Surveillance System, CDC.

Obesity Trends* Among U.S. Adults

BRFSS, 1994

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)



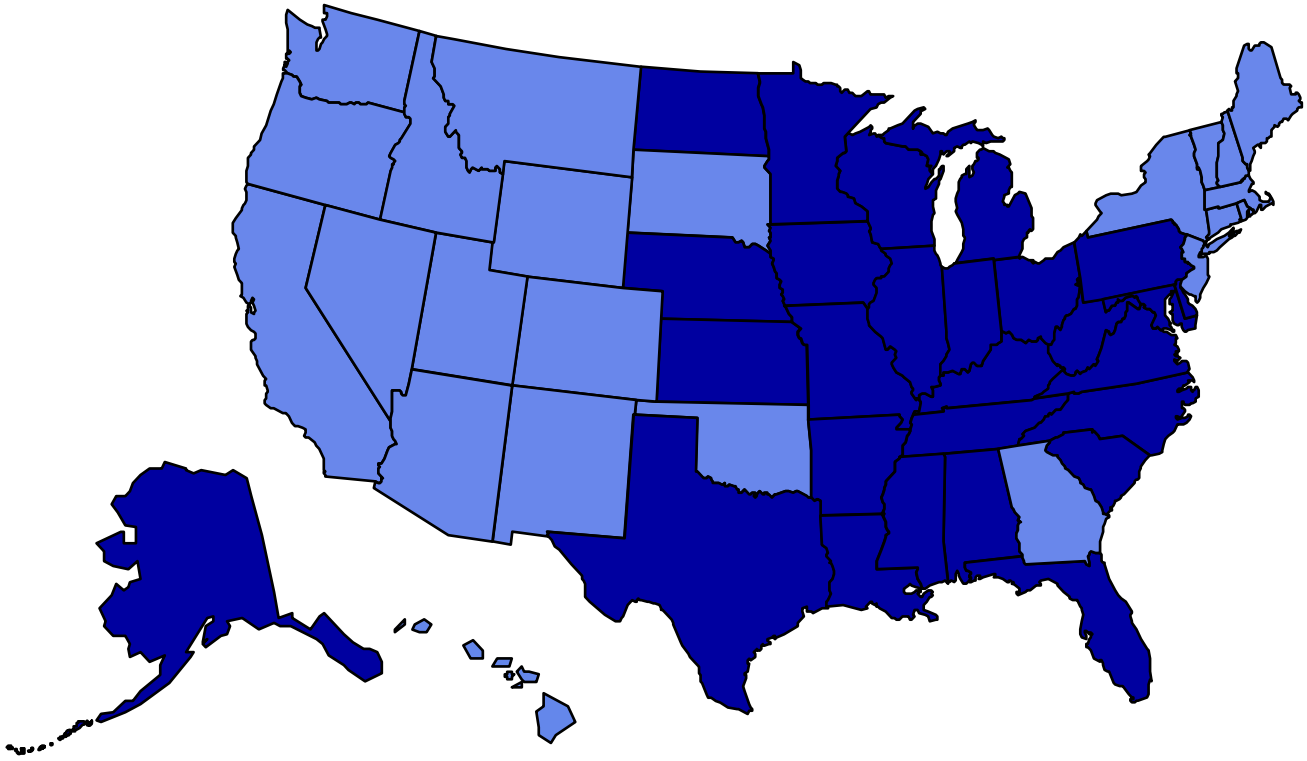


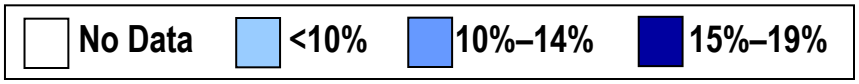
Source: Behavioral Risk Factor Surveillance System, CDC.

Obesity Trends* Among U.S. Adults

BRFSS, 1995

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)



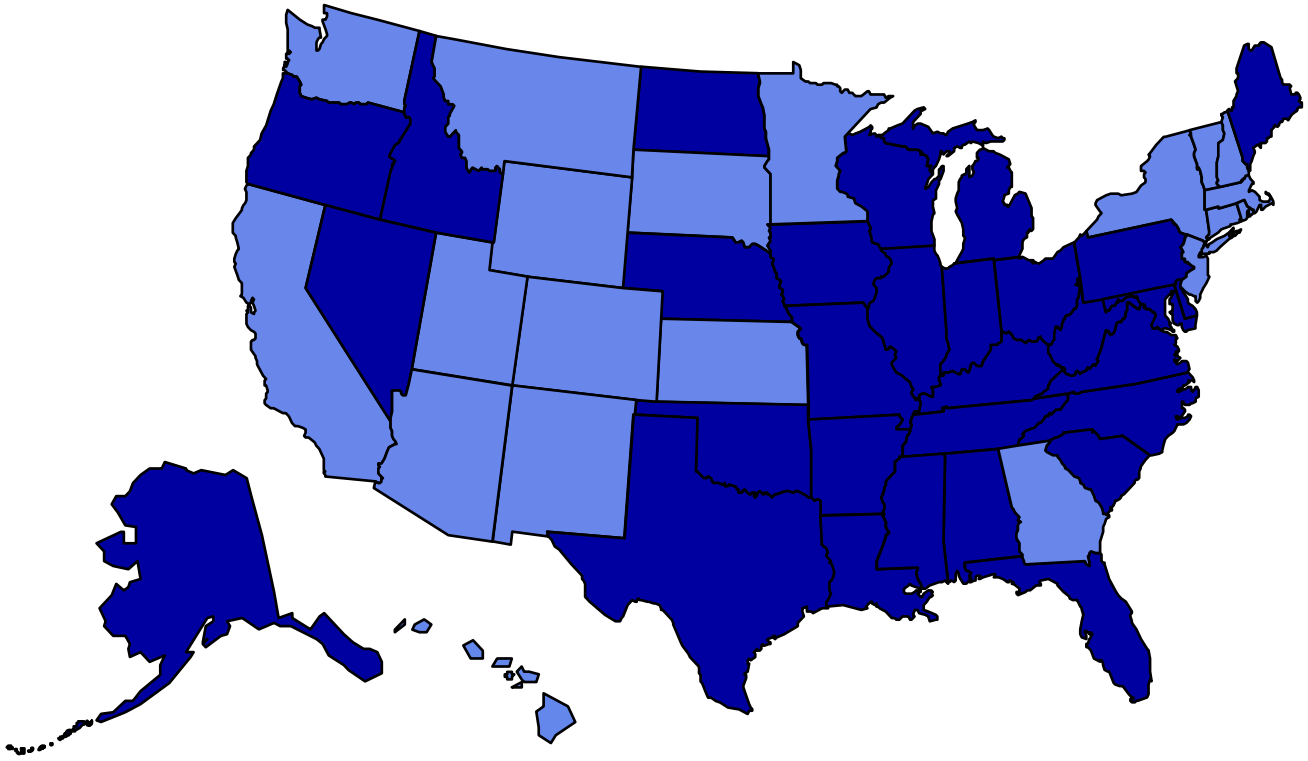


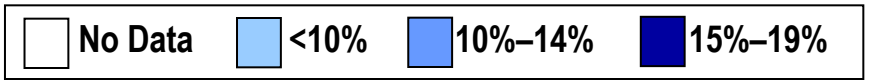
Source: Behavioral Risk Factor Surveillance System, CDC.

Obesity Trends* Among U.S. Adults

BRFSS, 1996

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)



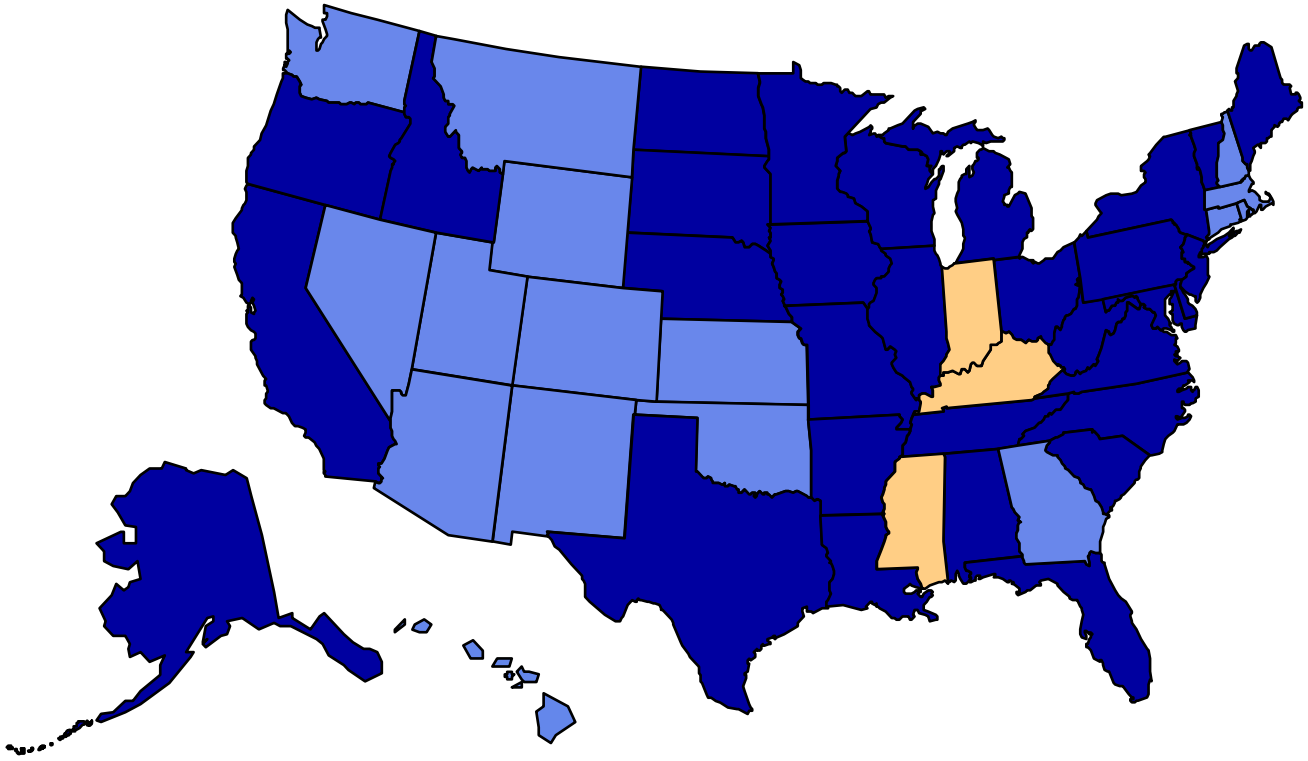


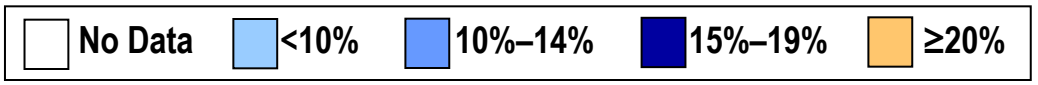
Source: Behavioral Risk Factor Surveillance System, CDC.

Obesity Trends* Among U.S. Adults

BRFSS, 1997

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)



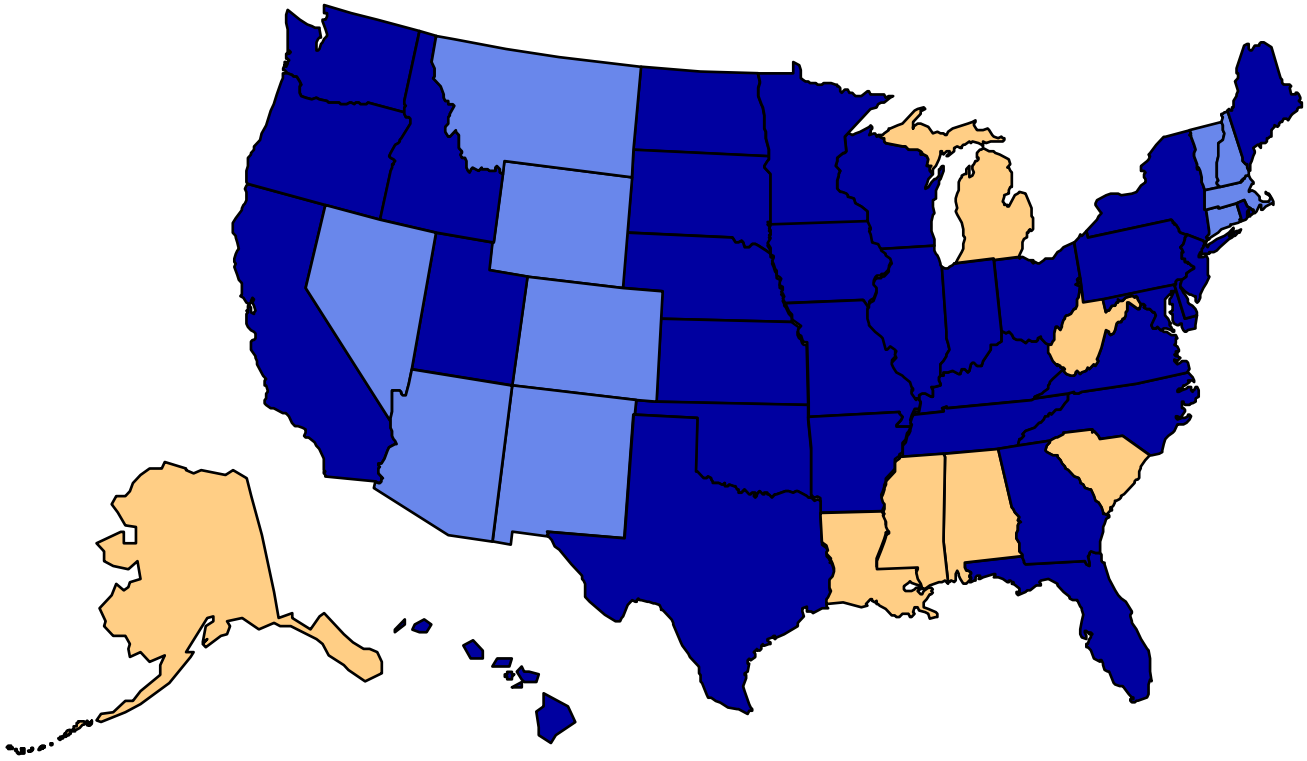


Source: Behavioral Risk Factor Surveillance System, CDC.

Obesity Trends* Among U.S. Adults

BRFSS, 1998

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)



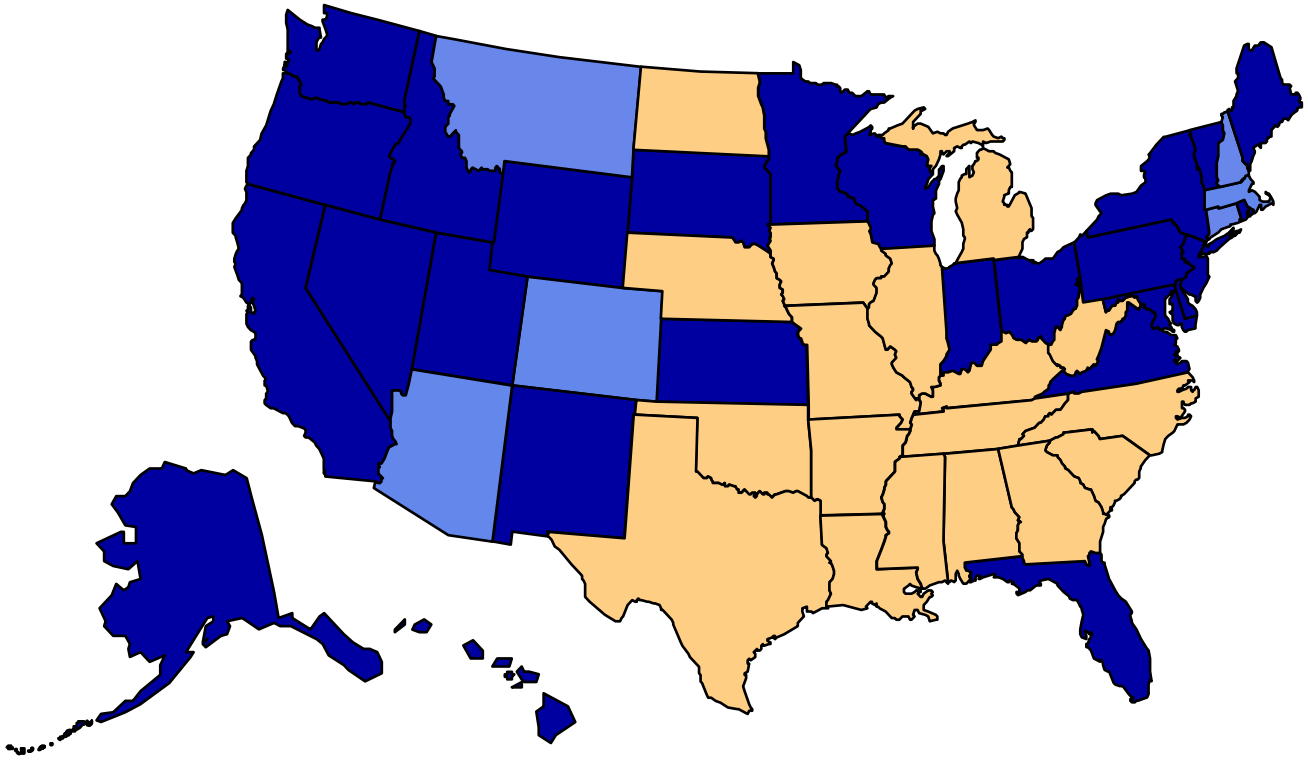
No Data	<10%	10%–14%	15%–19%	≥20%

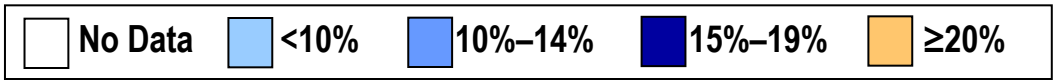
Source: Behavioral Risk Factor Surveillance System, CDC.

Obesity Trends* Among U.S. Adults

BRFSS, 1999

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)



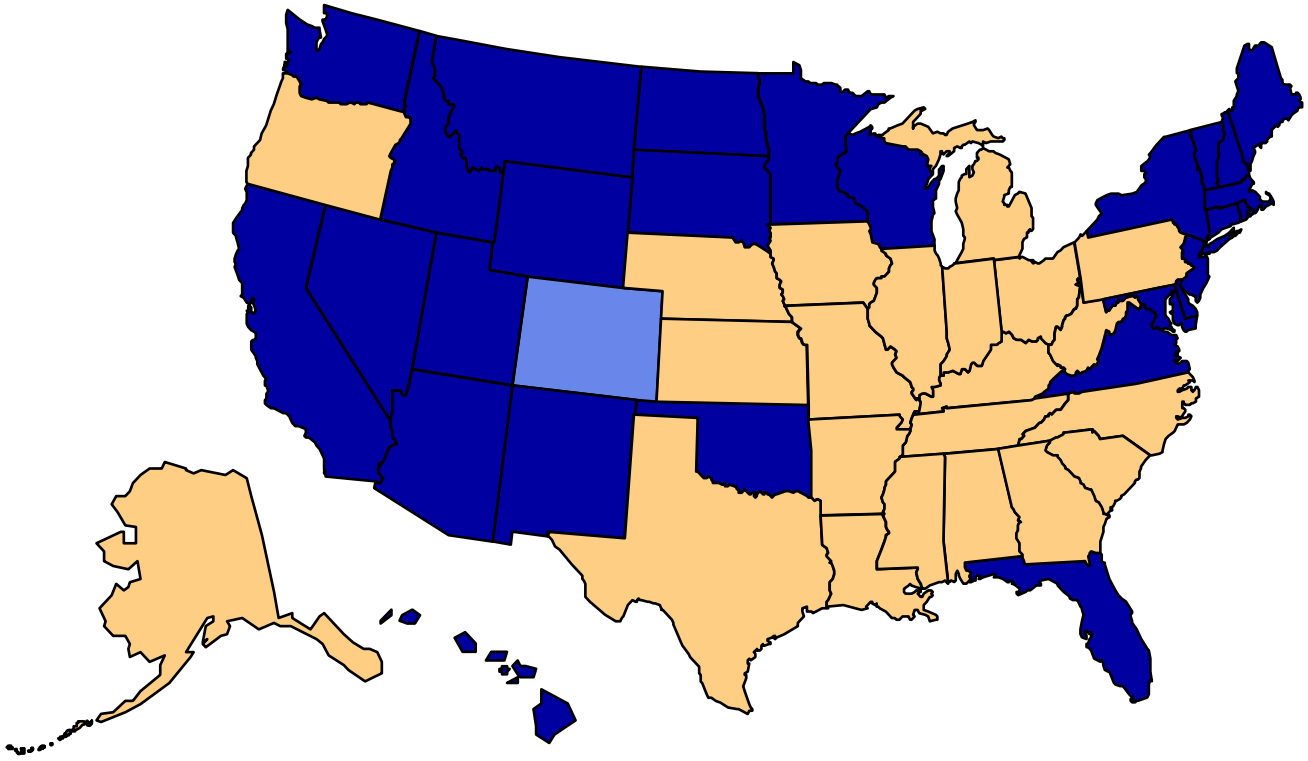


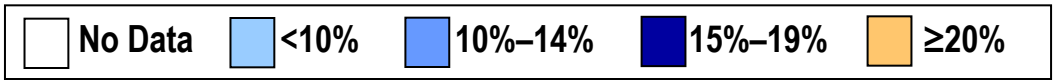
Source: Behavioral Risk Factor Surveillance System, CDC.

Obesity Trends* Among U.S. Adults

BRFSS, 2000

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)



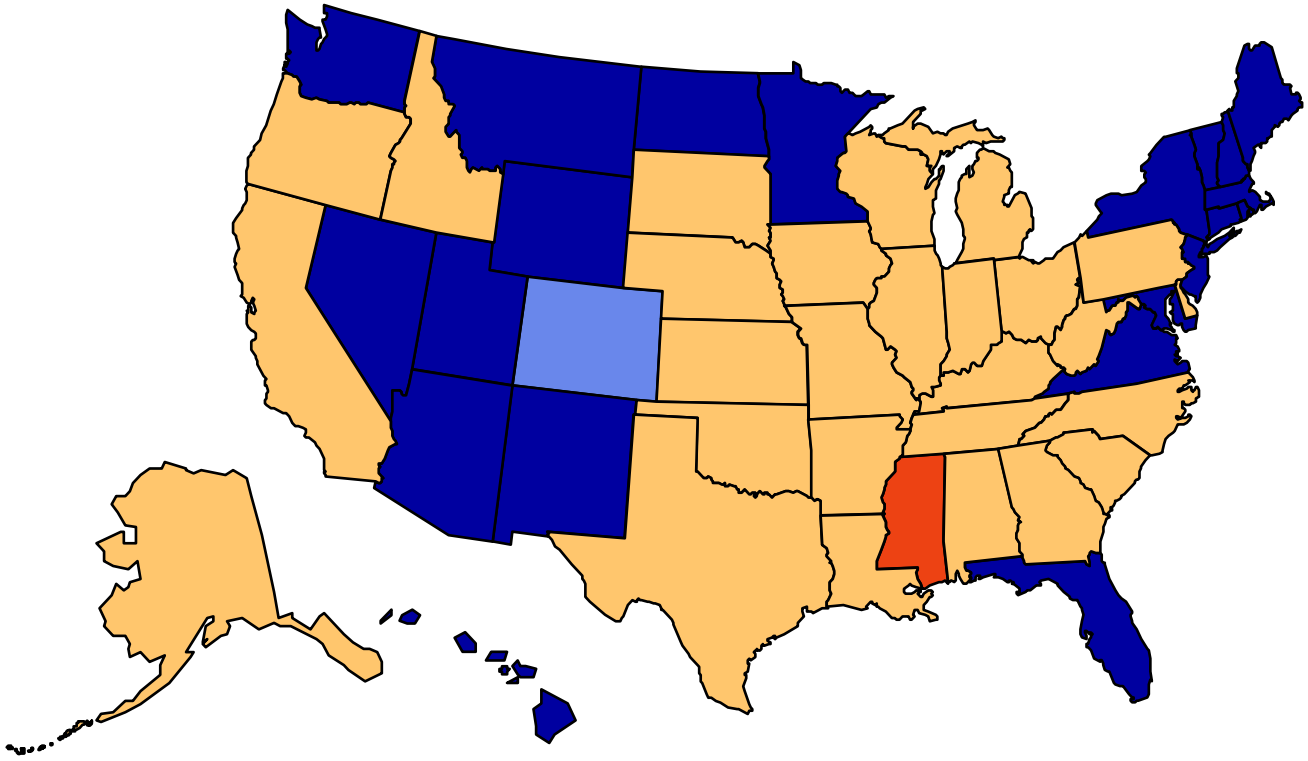


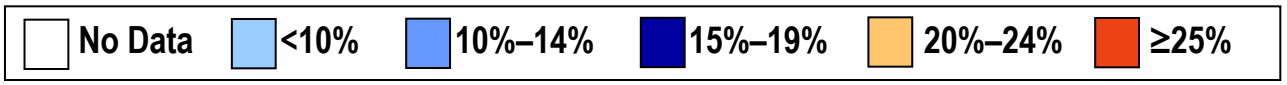
Source: Behavioral Risk Factor Surveillance System, CDC.

Obesity Trends* Among U.S. Adults

BRFSS, 2001

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)



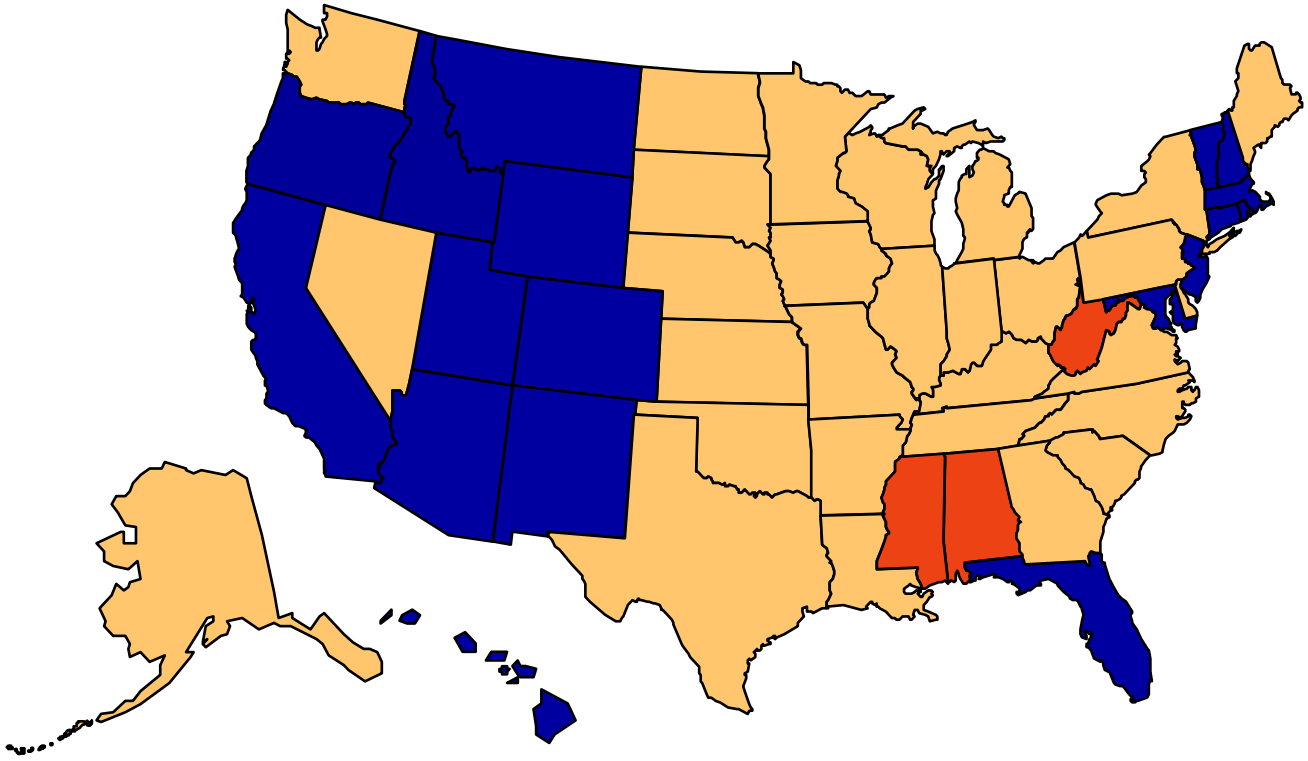


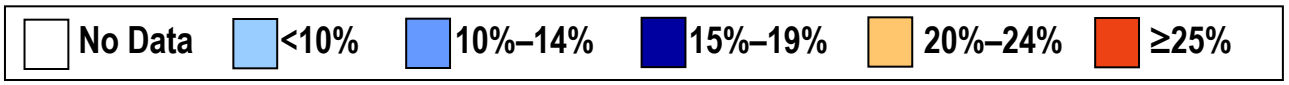
Source: Behavioral Risk Factor Surveillance System, CDC.

Obesity Trends* Among U.S. Adults

BRFSS, 2002

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)



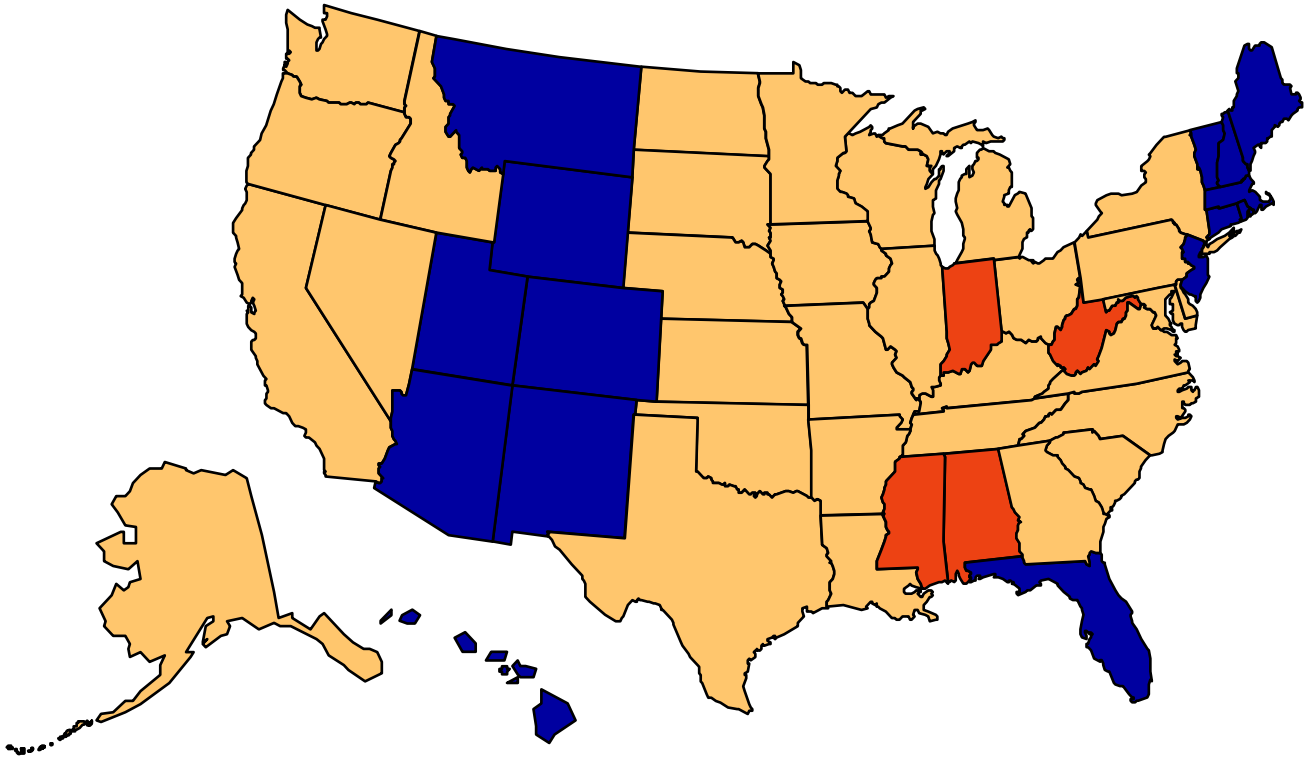


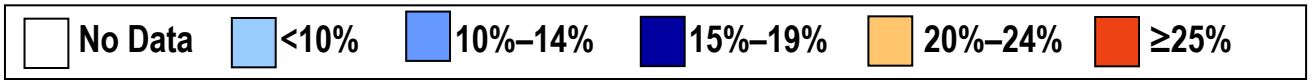
Source: Behavioral Risk Factor Surveillance System, CDC.

Obesity Trends* Among U.S. Adults

BRFSS, 2003

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)



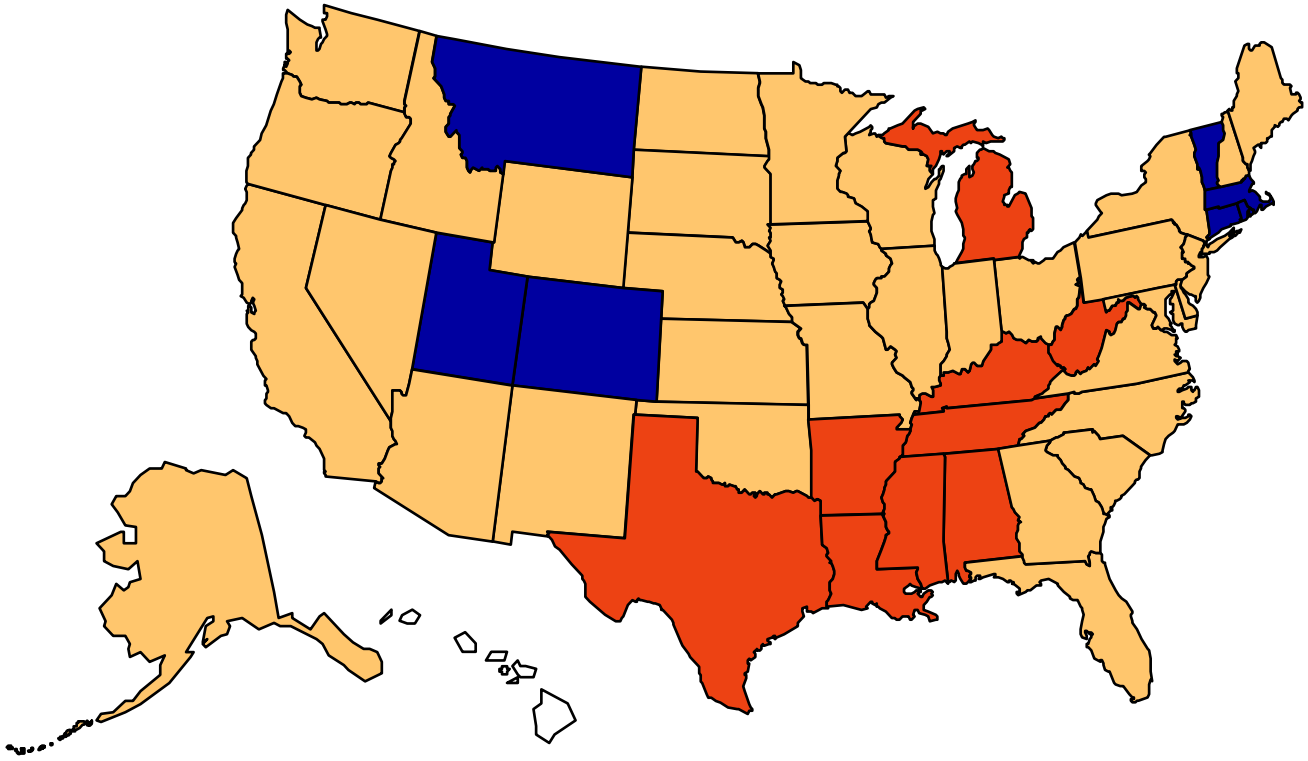


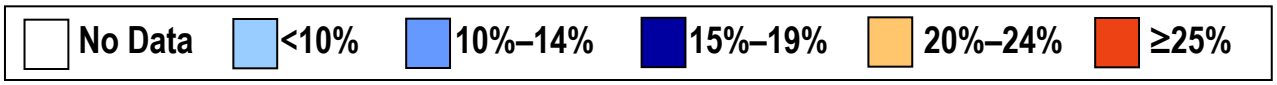
Source: Behavioral Risk Factor Surveillance System, CDC.

Obesity Trends* Among U.S. Adults

BRFSS, 2004

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)



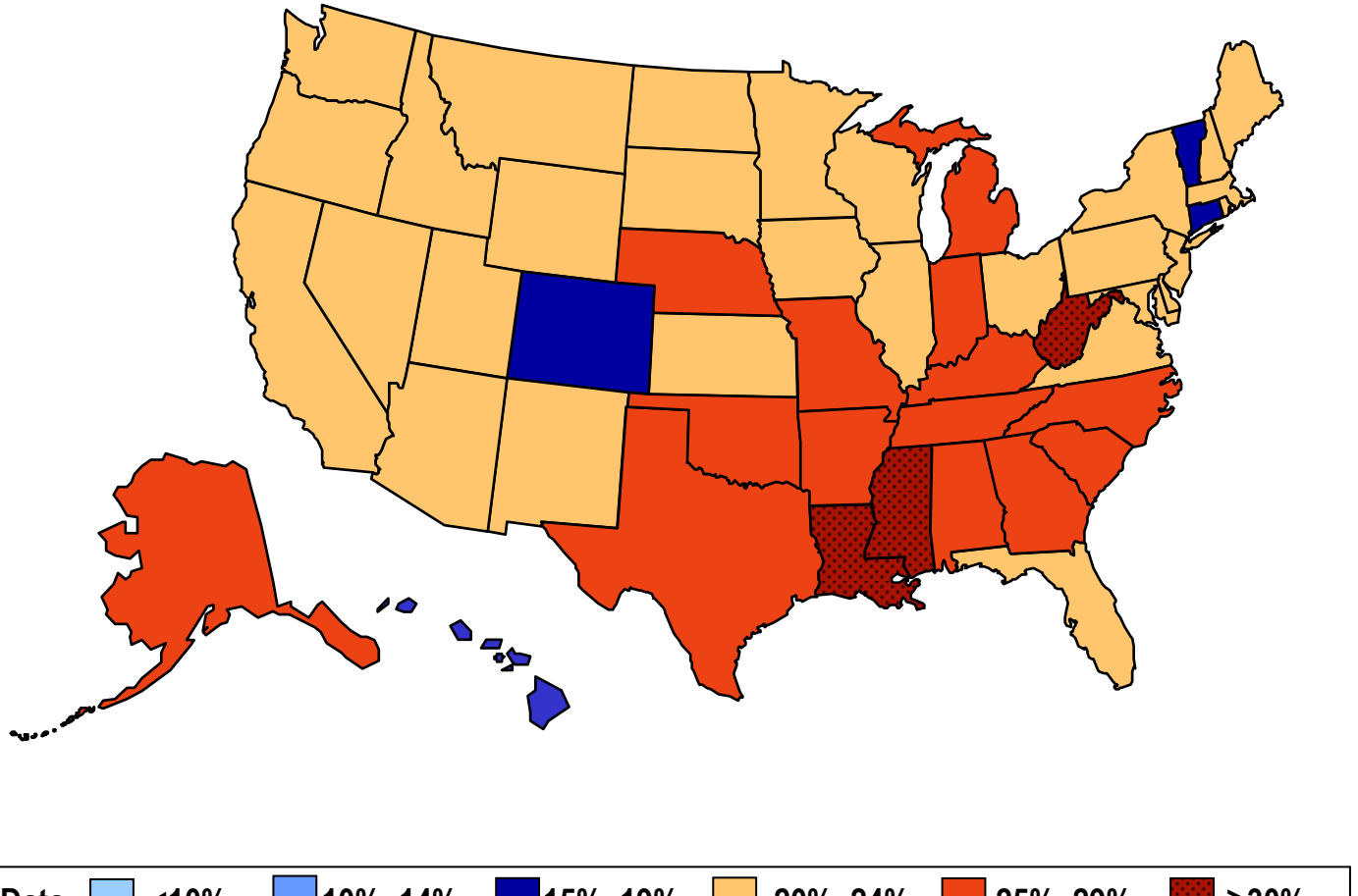


Source: Behavioral Risk Factor Surveillance System, CDC.

Obesity Trends* Among U.S. Adults

BRFSS, 2005

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)

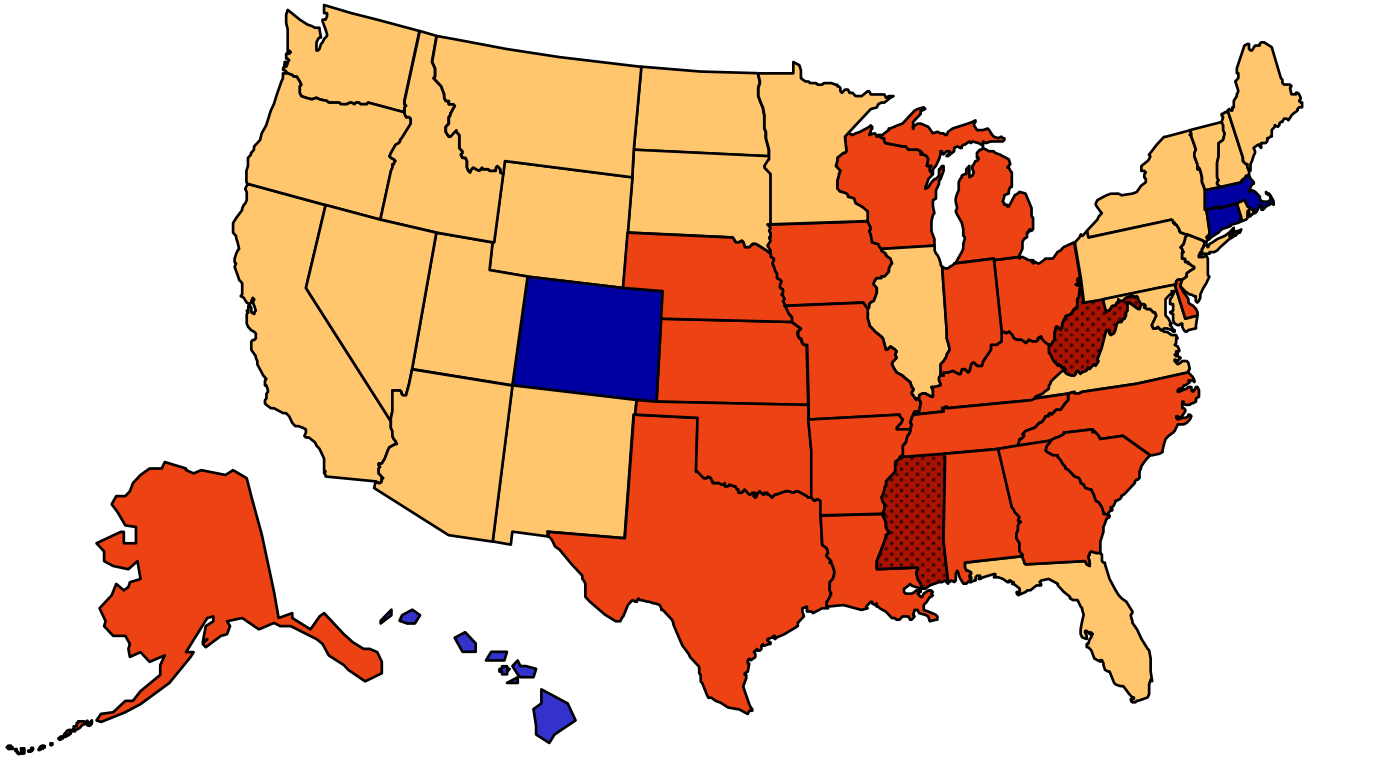


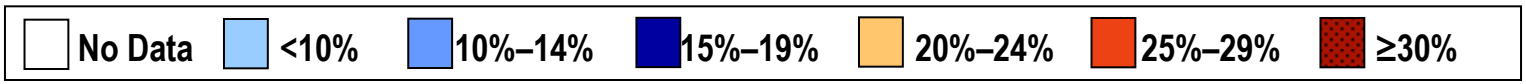
Source: Behavioral Risk Factor Surveillance System, CDC.

Obesity Trends* Among U.S. Adults

BRFSS, 2006

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)



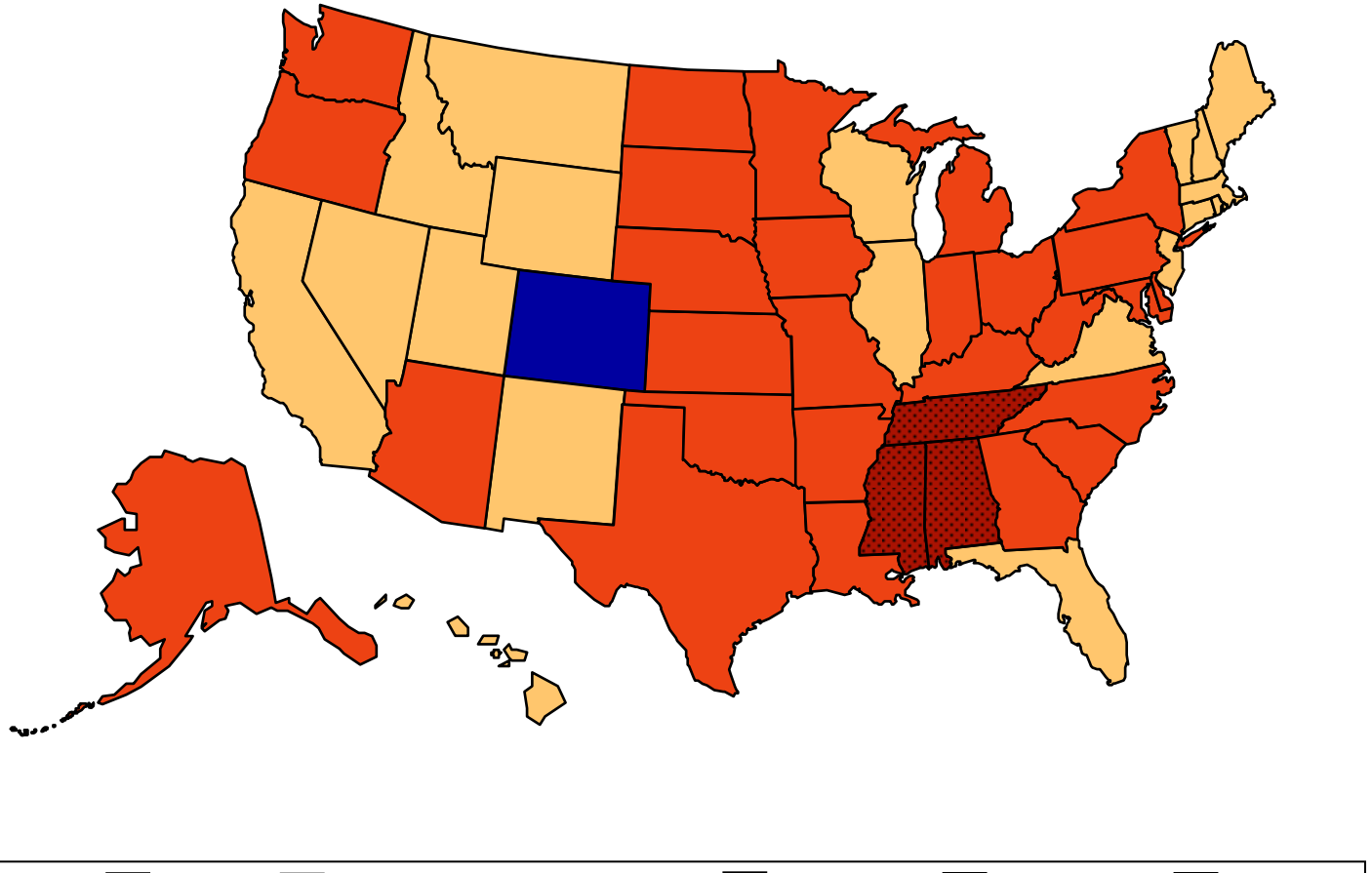


Source: Behavioral Risk Factor Surveillance System, CDC.

Obesity Trends* Among U.S. Adults

BRFSS, 2007

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)

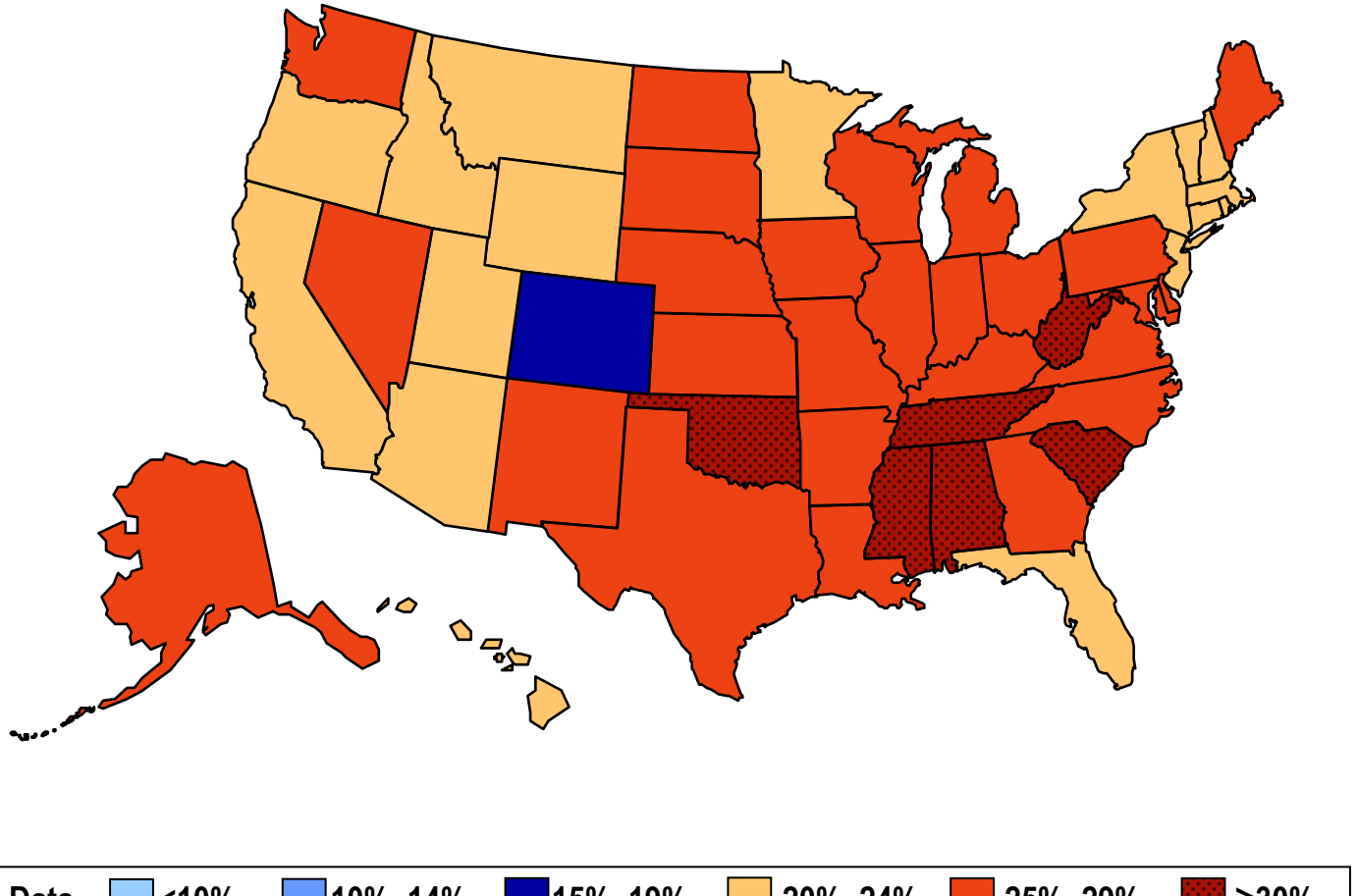


Source: Behavioral Risk Factor Surveillance System, CDC.

Obesity Trends* Among U.S. Adults

BRFSS, 2008

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)

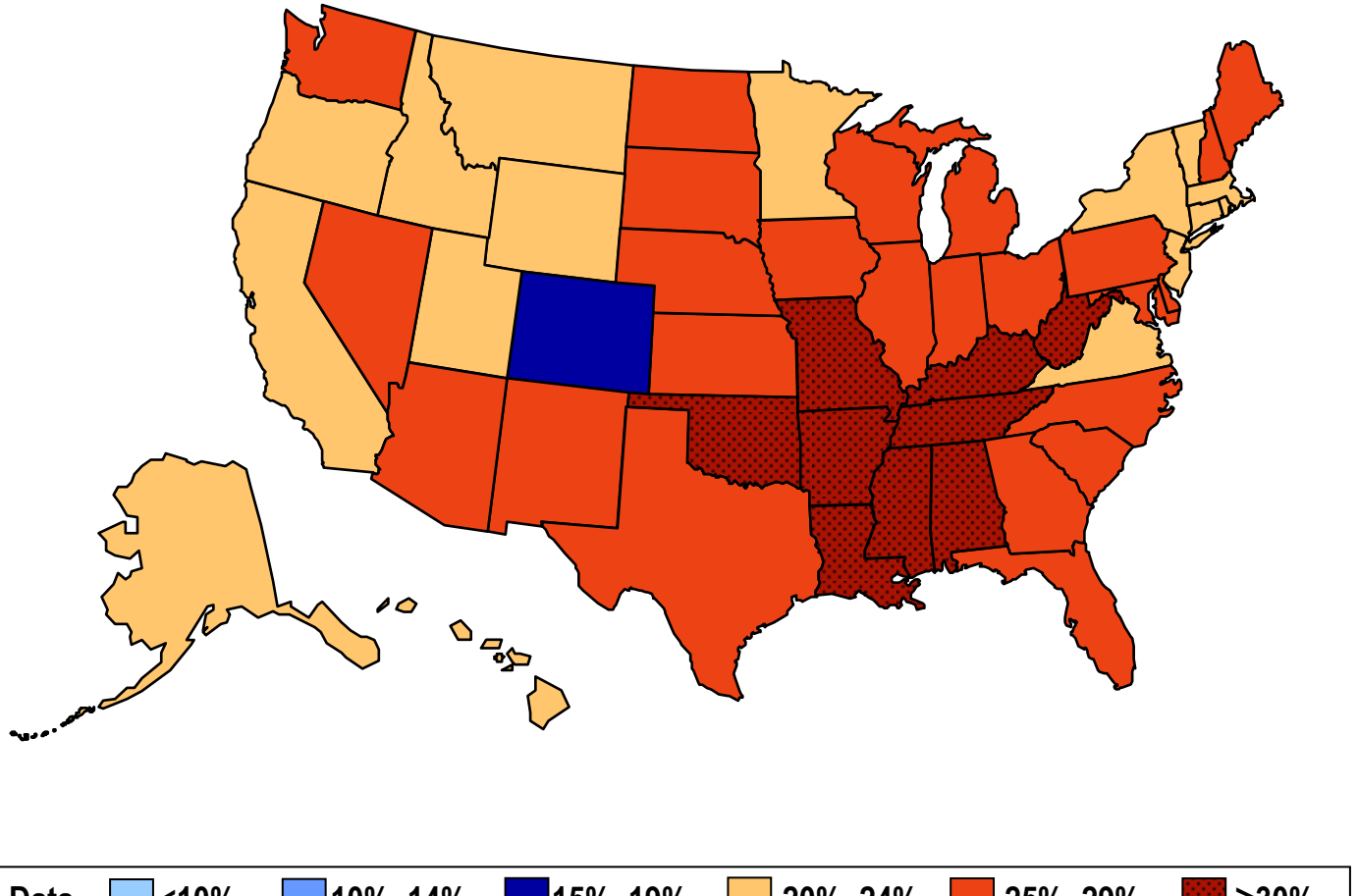


Source: Behavioral Risk Factor Surveillance System, CDC.

Obesity Trends* Among U.S. Adults

BRFSS, 2009

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)

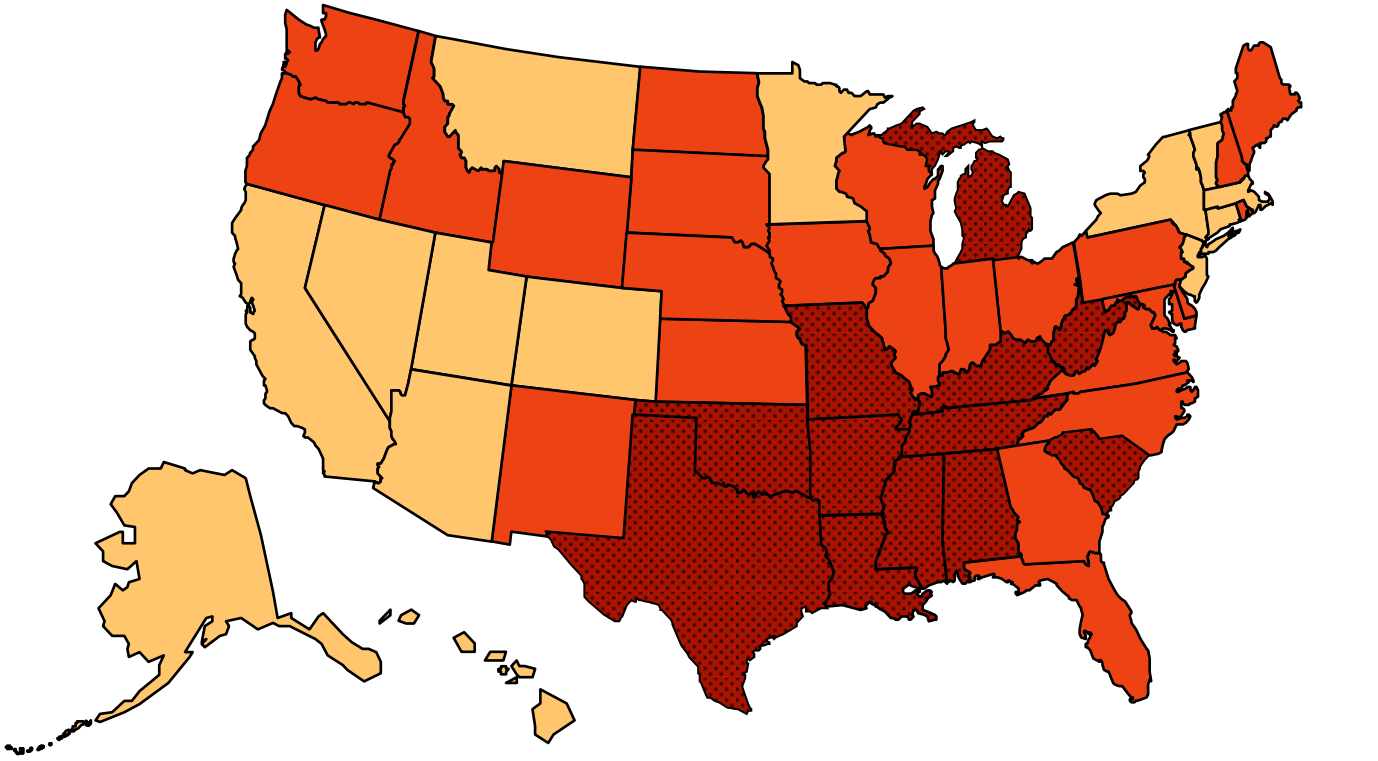


Source: Behavioral Risk Factor Surveillance System, CDC.

Obesity Trends* Among U.S. Adults

BRFSS, 2010

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)

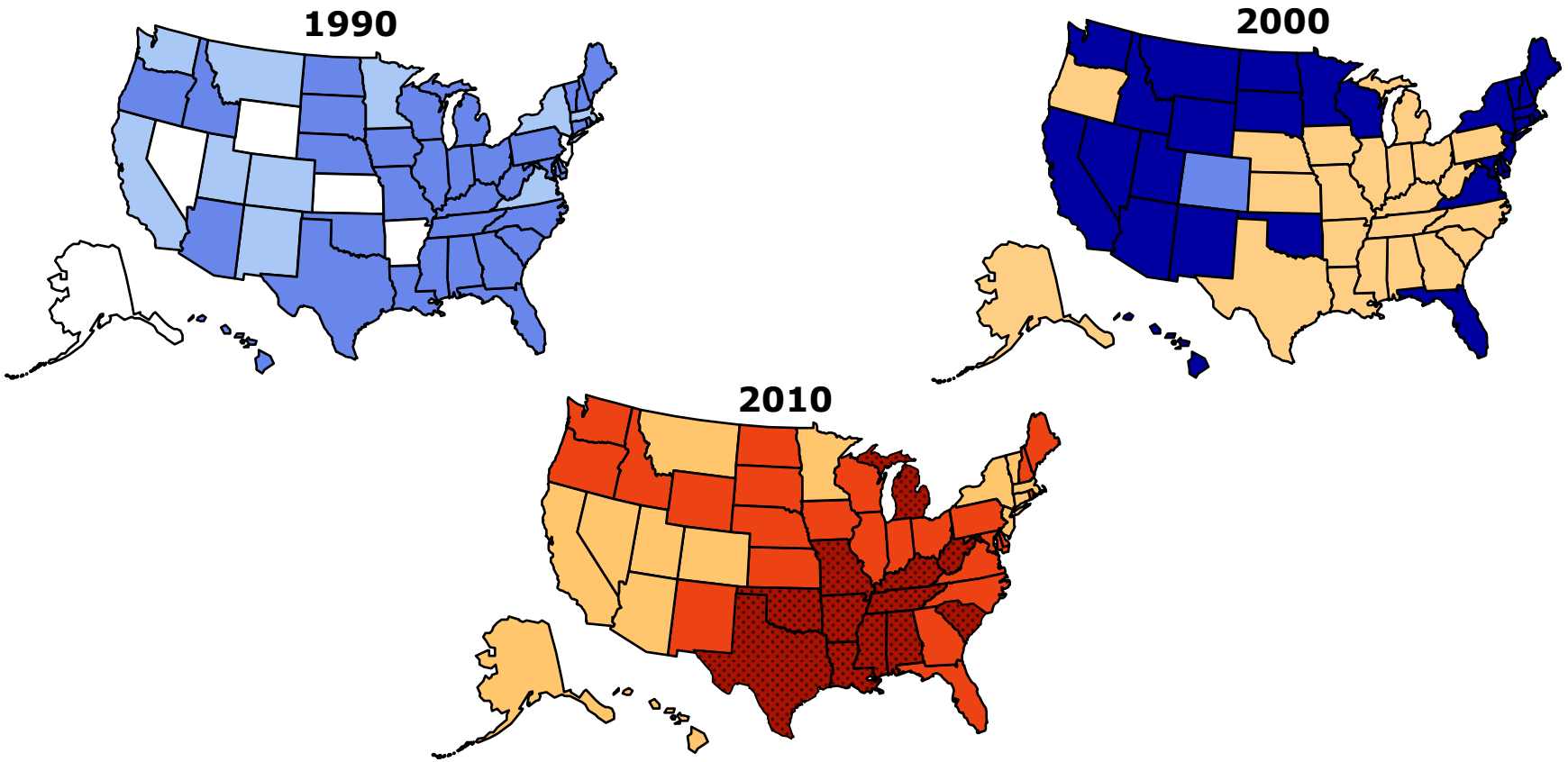


Source: Behavioral Risk Factor Surveillance System, CDC.

Obesity Trends* Among U.S. Adults

BRFSS, 1990, 2000, 2010

(*BMI ≥30, or about 30 lbs. overweight for 5'4" person)



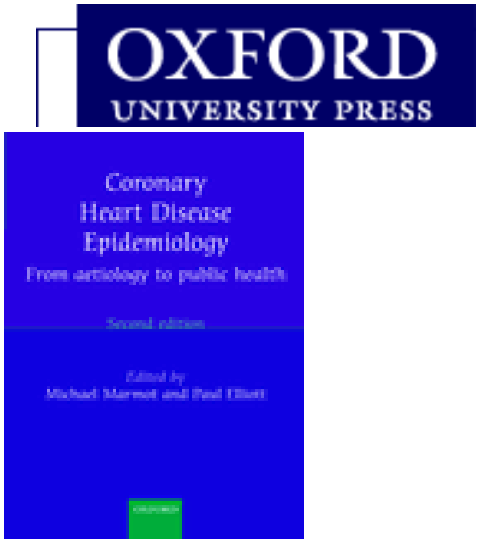
Source: Behavioral Risk Factor Surveillance System, CDC.


THE BEST THING YOU CAN DO IS GIVE UP SMOKING, DRINKING AND FRIED FOOD
WHAT'S THE SECOND BEST?

NEW EDITION
***This is probably the most complete and authoritative text now available* - BMJ**

Coronary Heart Disease Epidemiology From aetiology to public health

Second Edition

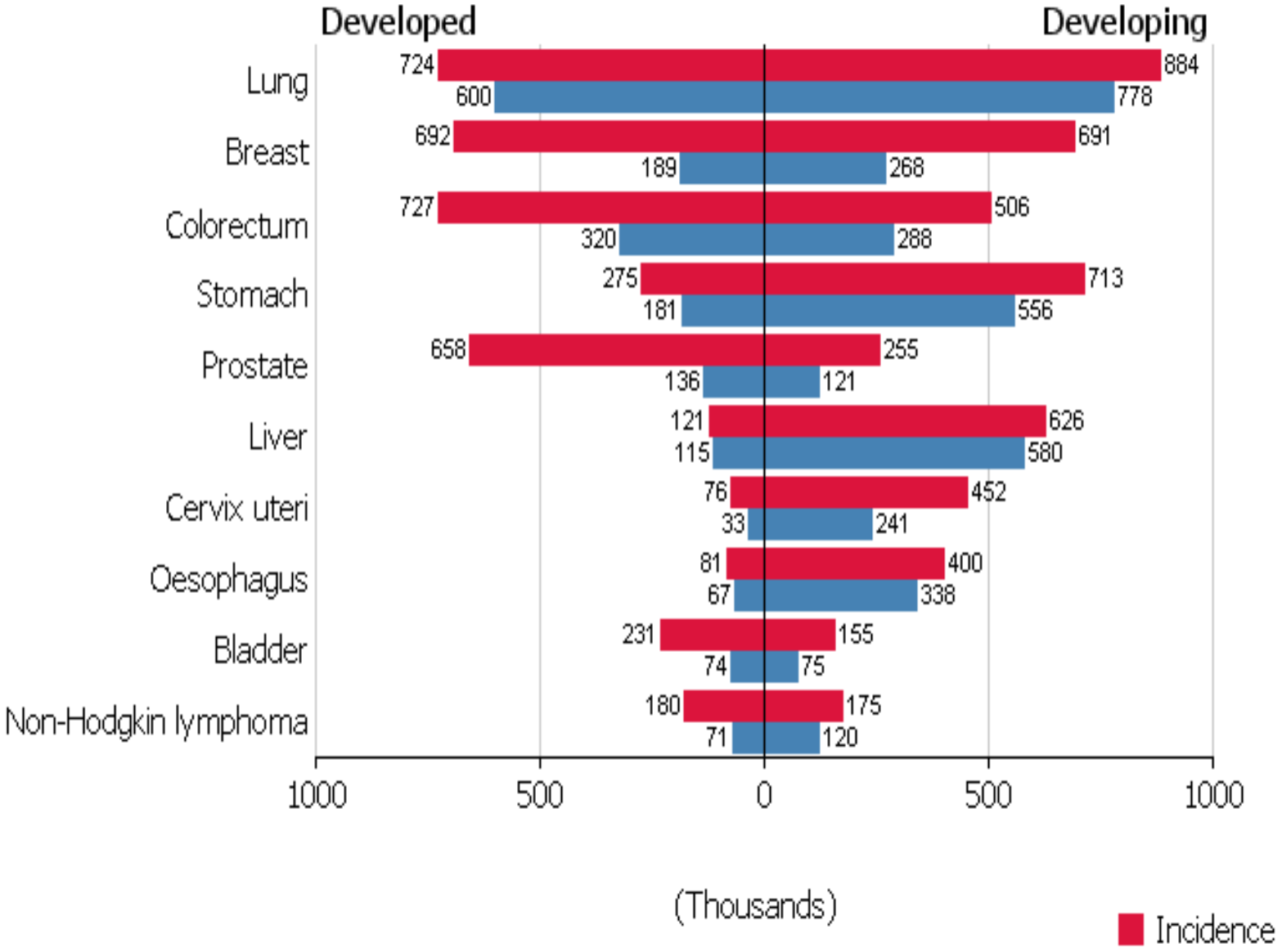


Edited by
Michael Marmot
and Paul Elliott
Price: £39.50
(Paperback)
0-19-852573-7
Publication date: 30 June 2005
692 pages, 2 halftones, numerous tables, graphs and line drawings, 240mm x 168mm

The global epidemiology of cancers

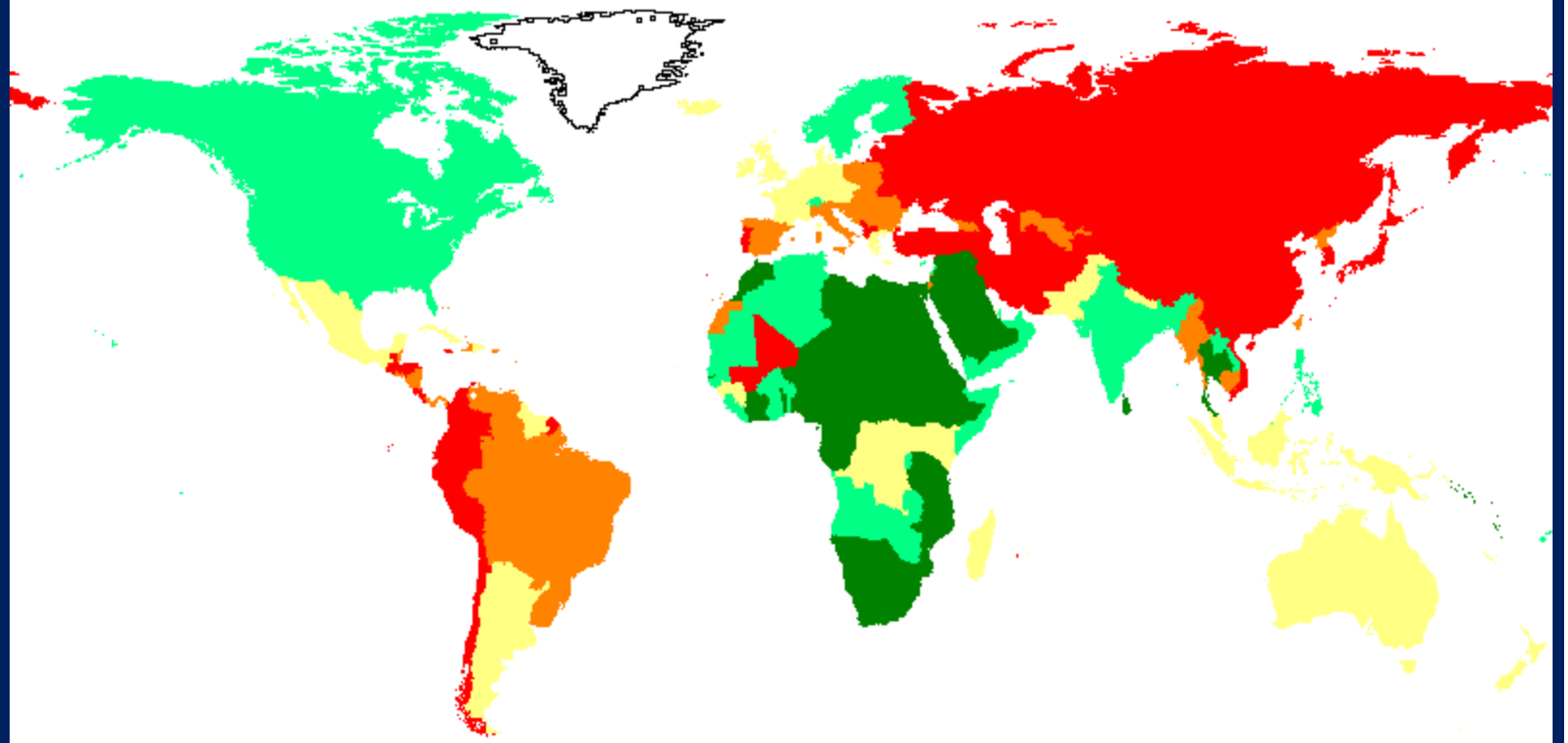
Majid Ezzati
MRC-HPA Centre for Environment and Health
School of Public Health
Imperial College London

Leading cancers by site in 2008



Estim
Color

Estimated age-standardised incidence rate per 100,000
Stomach: male, all ages



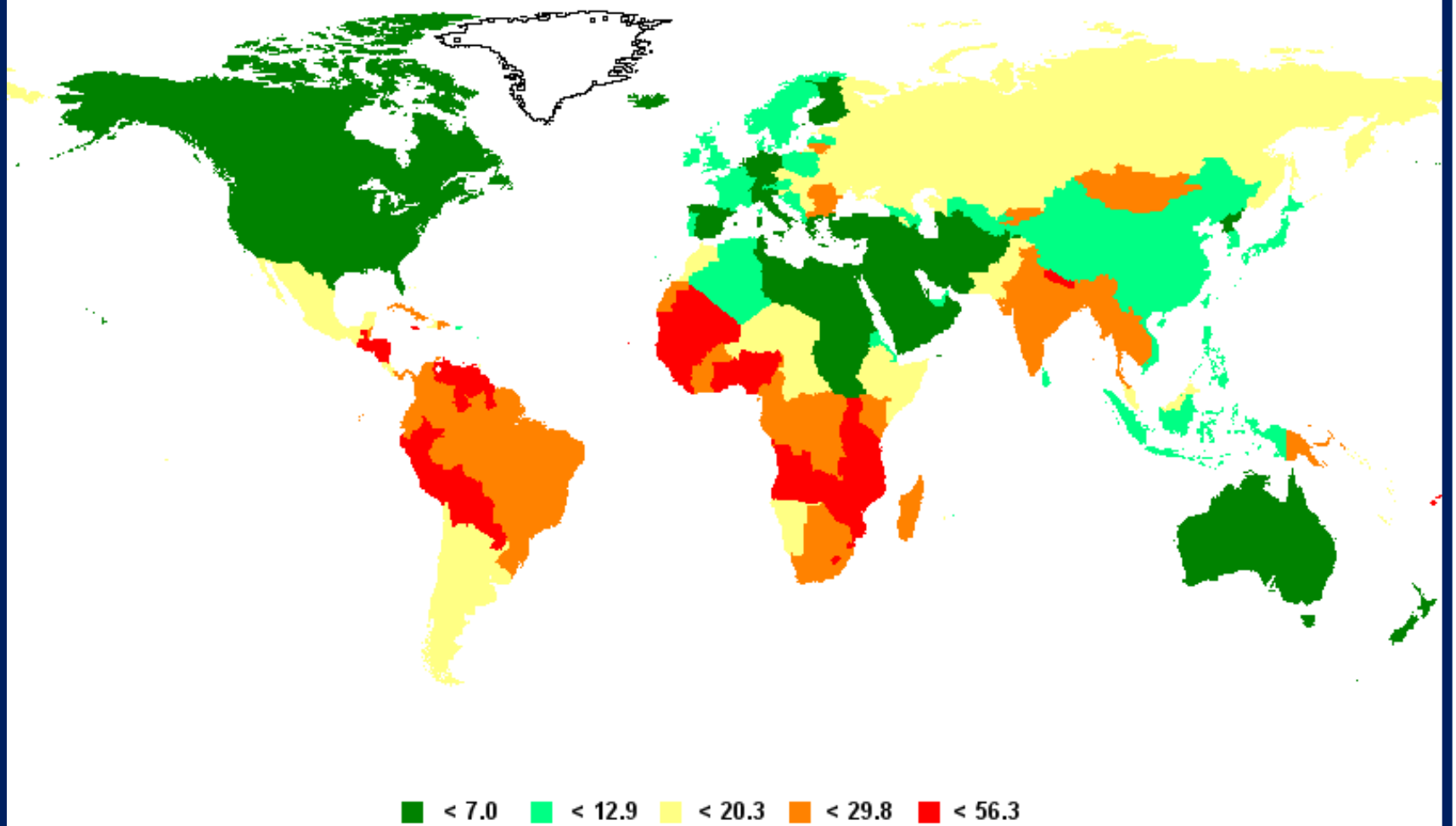
< 4.5 < 7.3 < 10.7 < 18.7 < 62.2

GLOBOCAN 2008 (IARC) - 30.7.2010

Estimated age-standardised incidence rate per 100,000

Brea

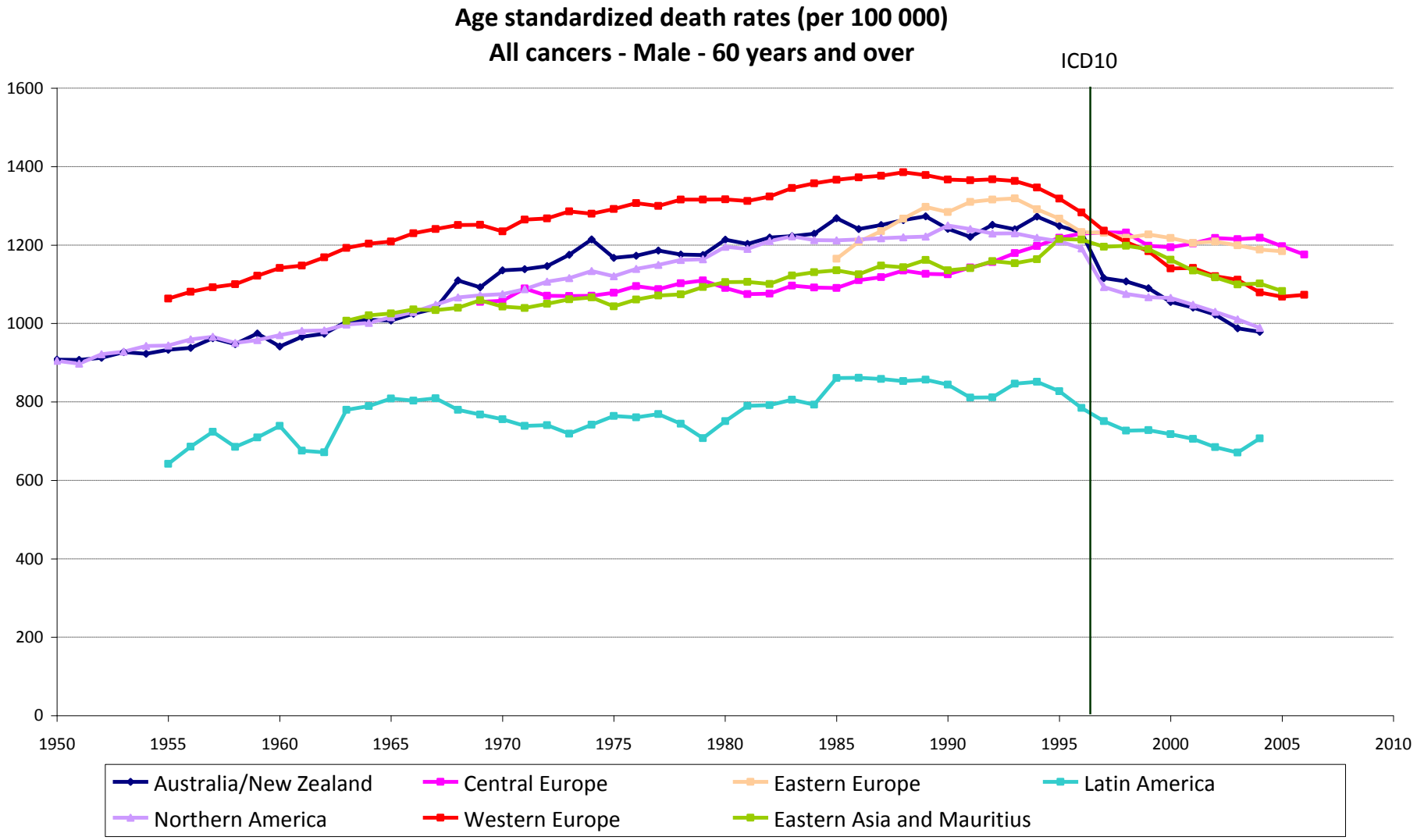
Estimated age-standardised incidence rate per 100,000
Cervix uteri (C53), all ages



GLOBOCAN 2008 (IARC) - 26.4.2010

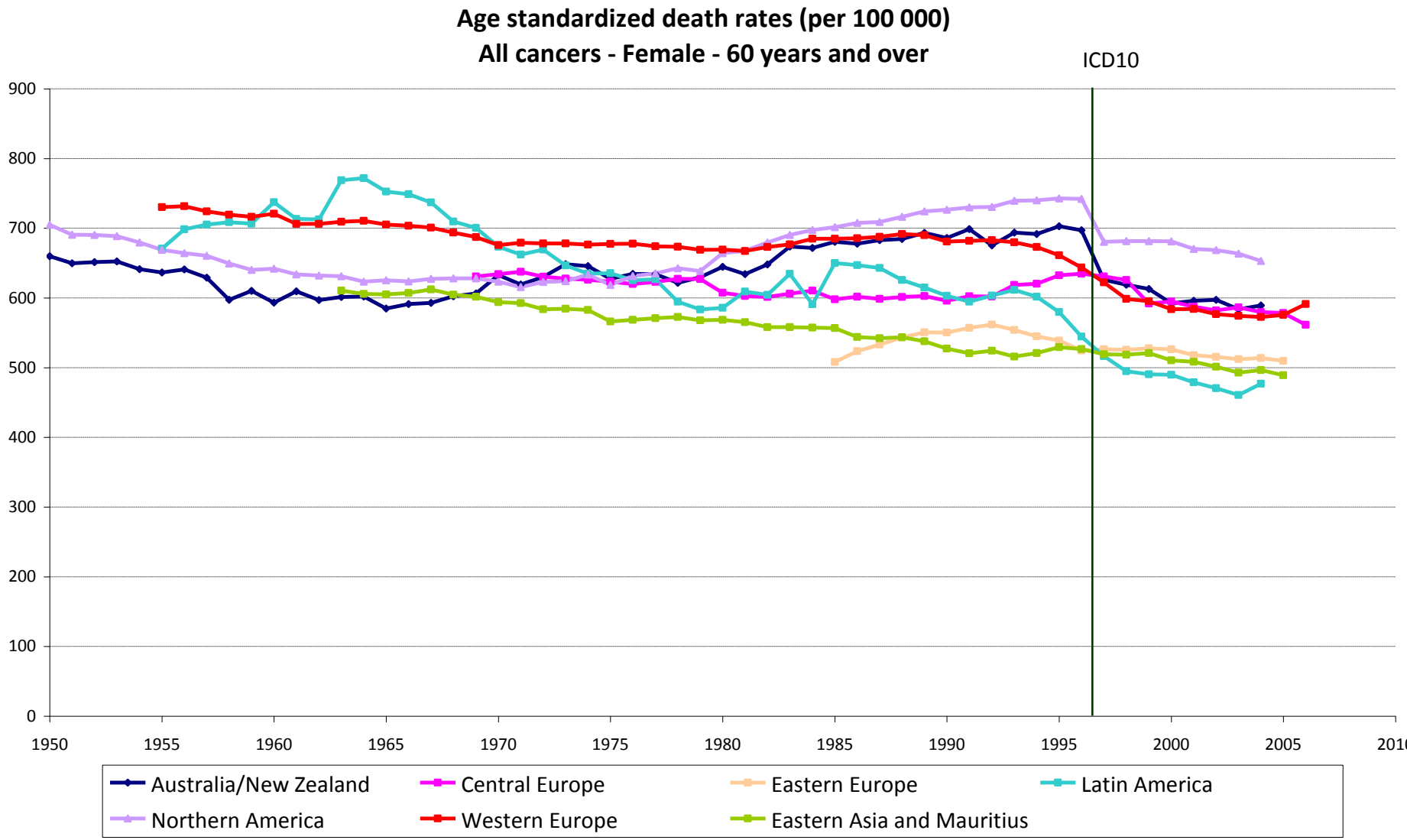
GLOBOC

Trends in cancer mortality by region



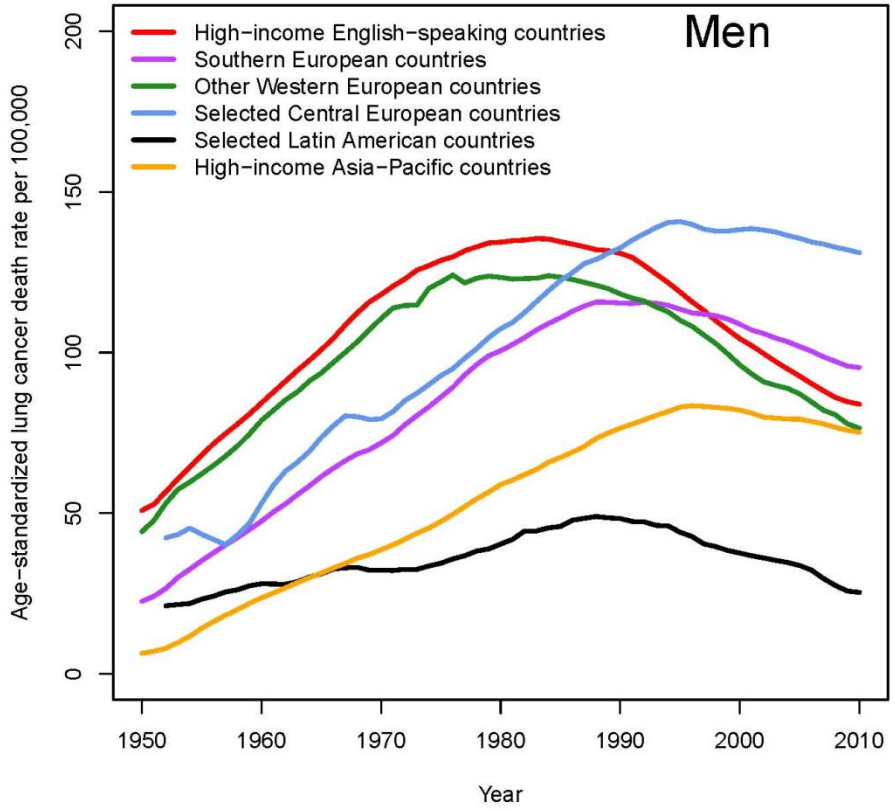
Source: WHO

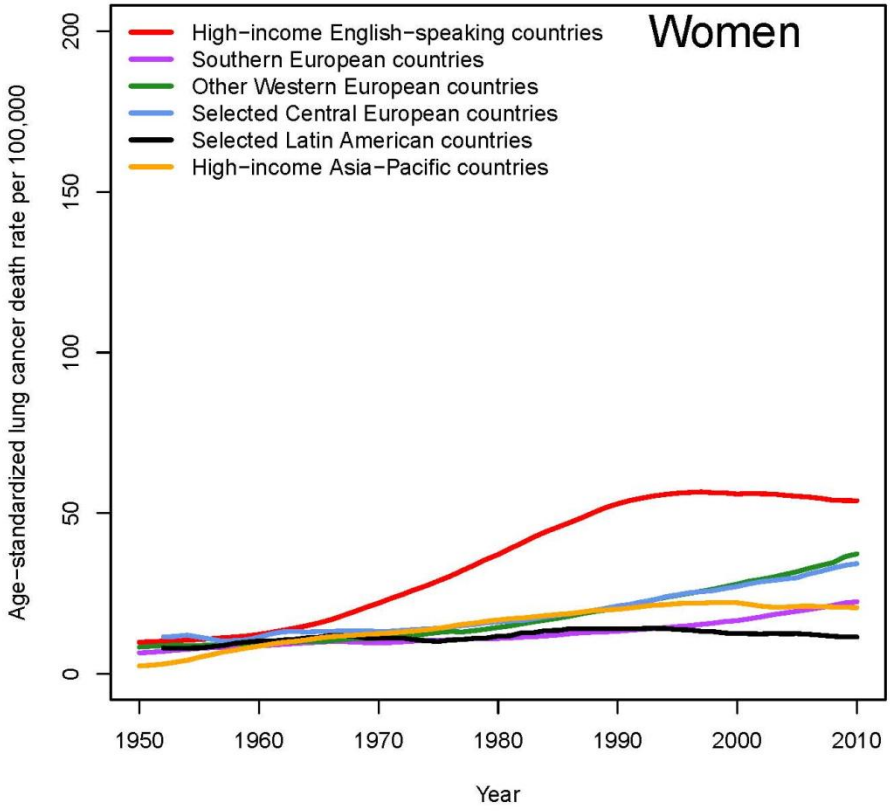
Trends in cancer mortality by region



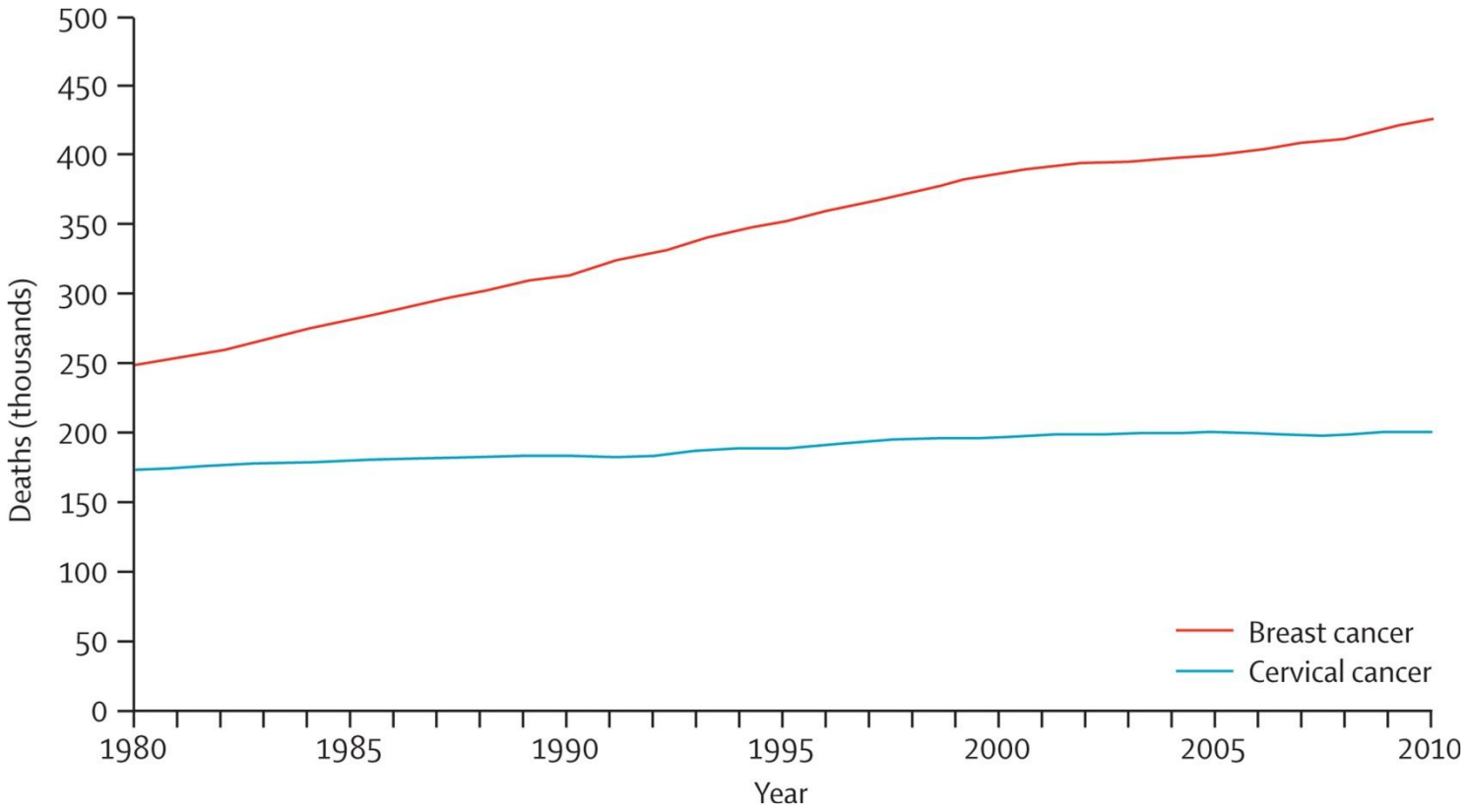
Source: WHO

Trends in lung cancer mortality by region



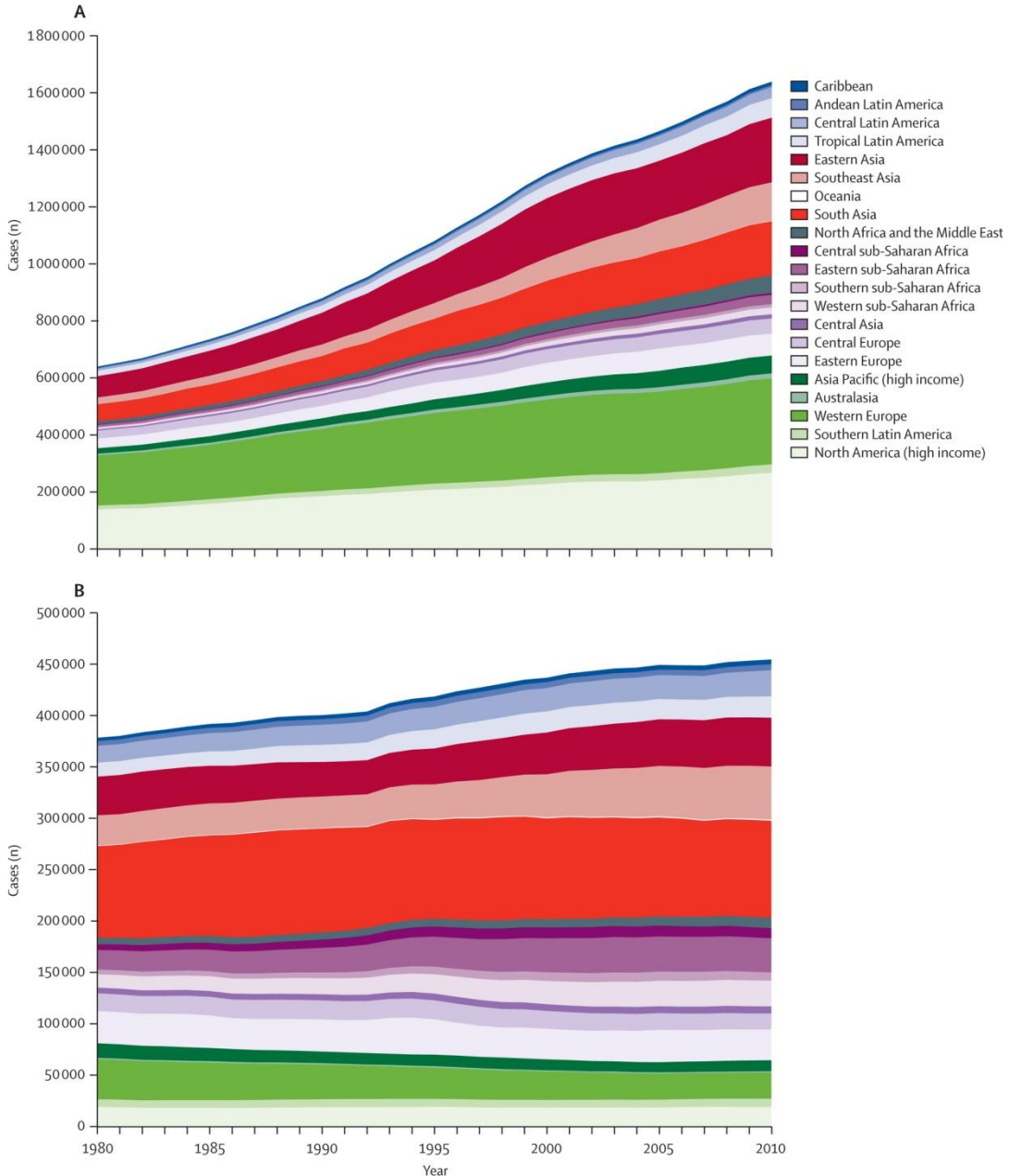


Global trends in breast and cervical cancer deaths



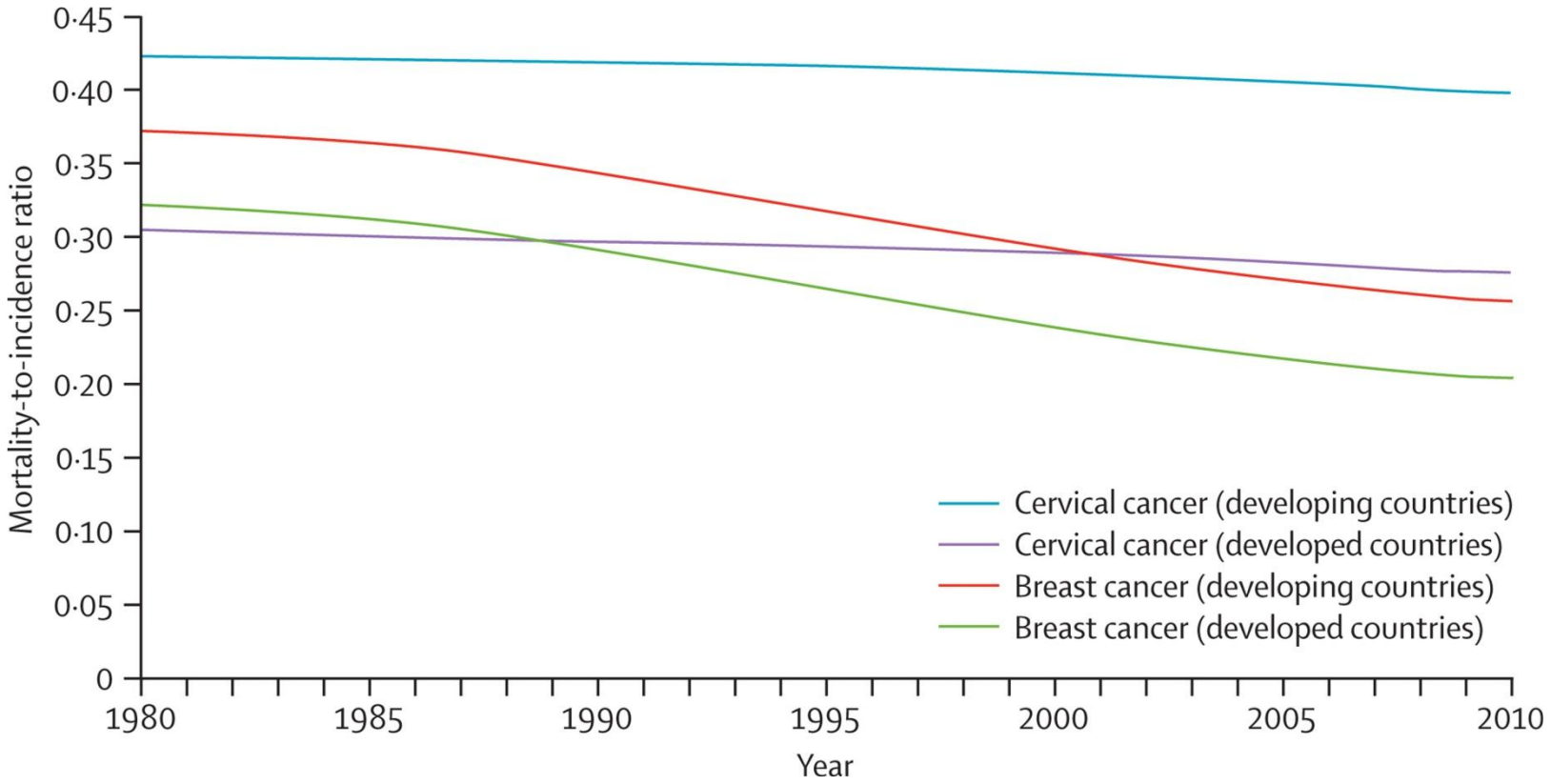
Forouzanfar et al. *Lancet* 2011

Breast and cervical cancer incidence trends



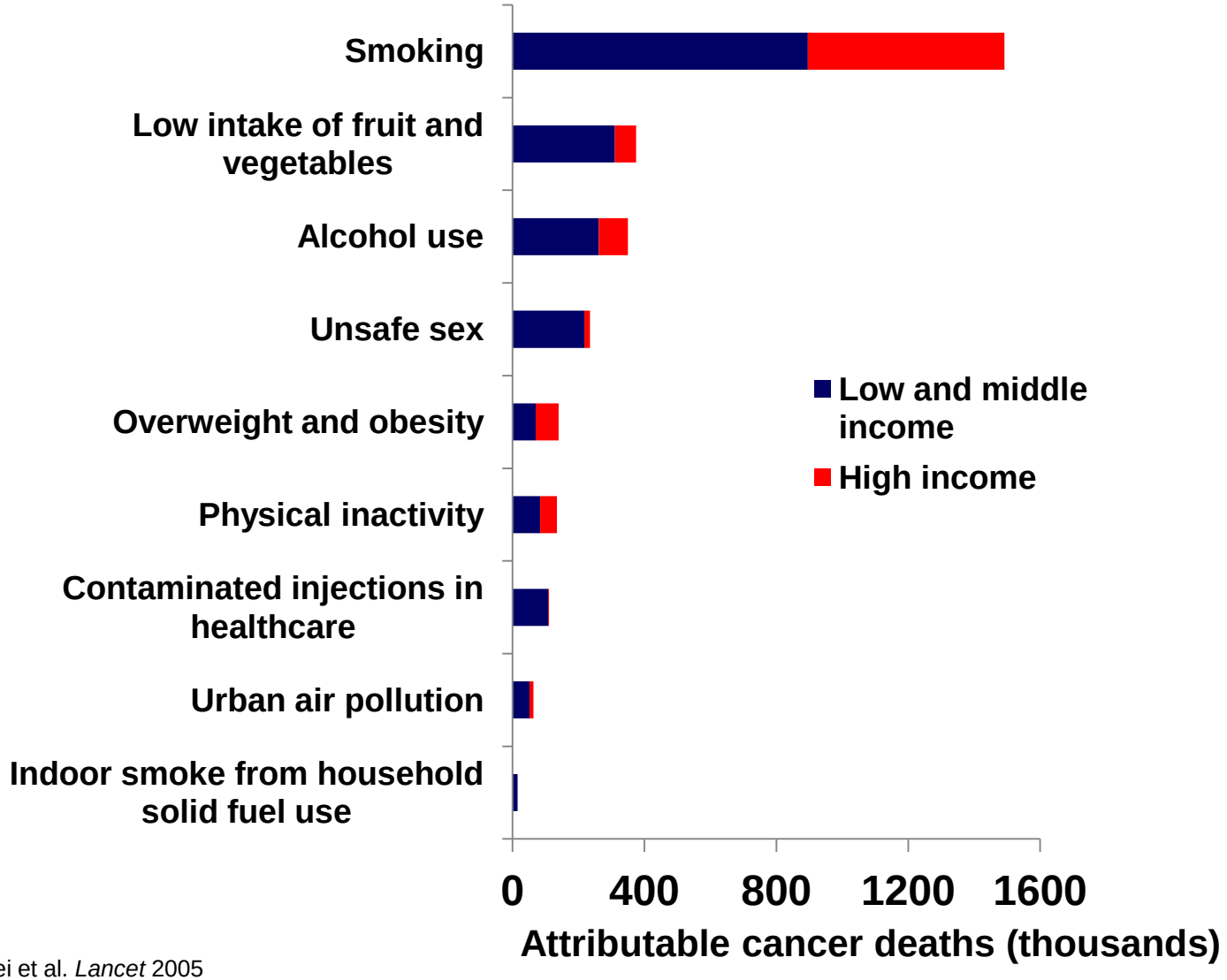
Forouzanfar et al. *Lancet* 2011

Age-standardized mortality-to-incidence ratio for breast and cervical cancers



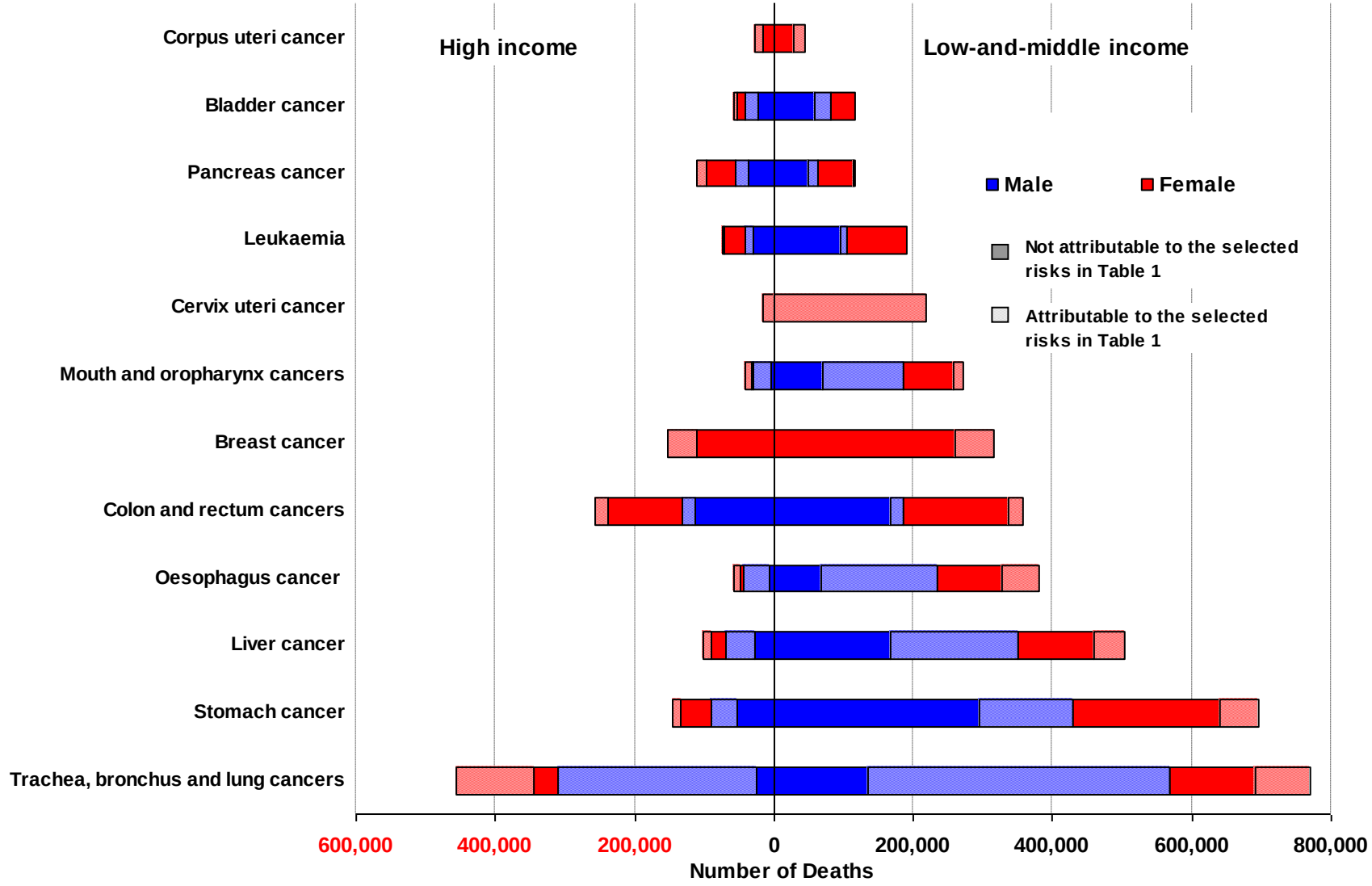
Forouzanfar et al. *Lancet* 2011

Cancer deaths attributable to 9 major risks



Danaei et al. *Lancet* 2005

Cancer deaths attributable to nine major risks, by site

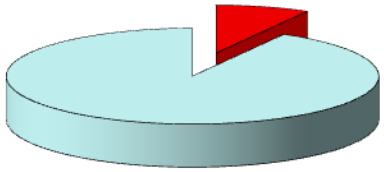


Danaei et al. *Lancet* 2005

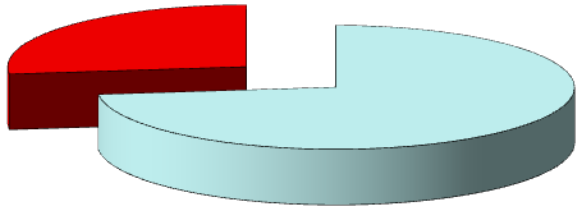
Cancer deaths due to infections

Agent	No. deaths	Sites	% total
Hepatitis viruses (B,C)	597,000	Liver	7.9
H. pylori	475,000	Stomach (468,000) Lymphoma(7,000)	6.3
HPV	305,000	Cervix, ano-genital sites oral & pharyngeal	4.0
EBV	68,000	N.P.C.(50,000) Hodgkin L.(14,000) B.L. (4000)	0.9
HIV & HHV-8	52,000	KS(29,000) NHL(23,000)	0.7
Schistosomes	4,000	Bladder	0.1
HTLV I	2,000	ATLL	
Liver flukes	3,000	Liver	0.01
Total	**1,517,000**		**19.8**

Cancer deaths attributable to infection (2008)

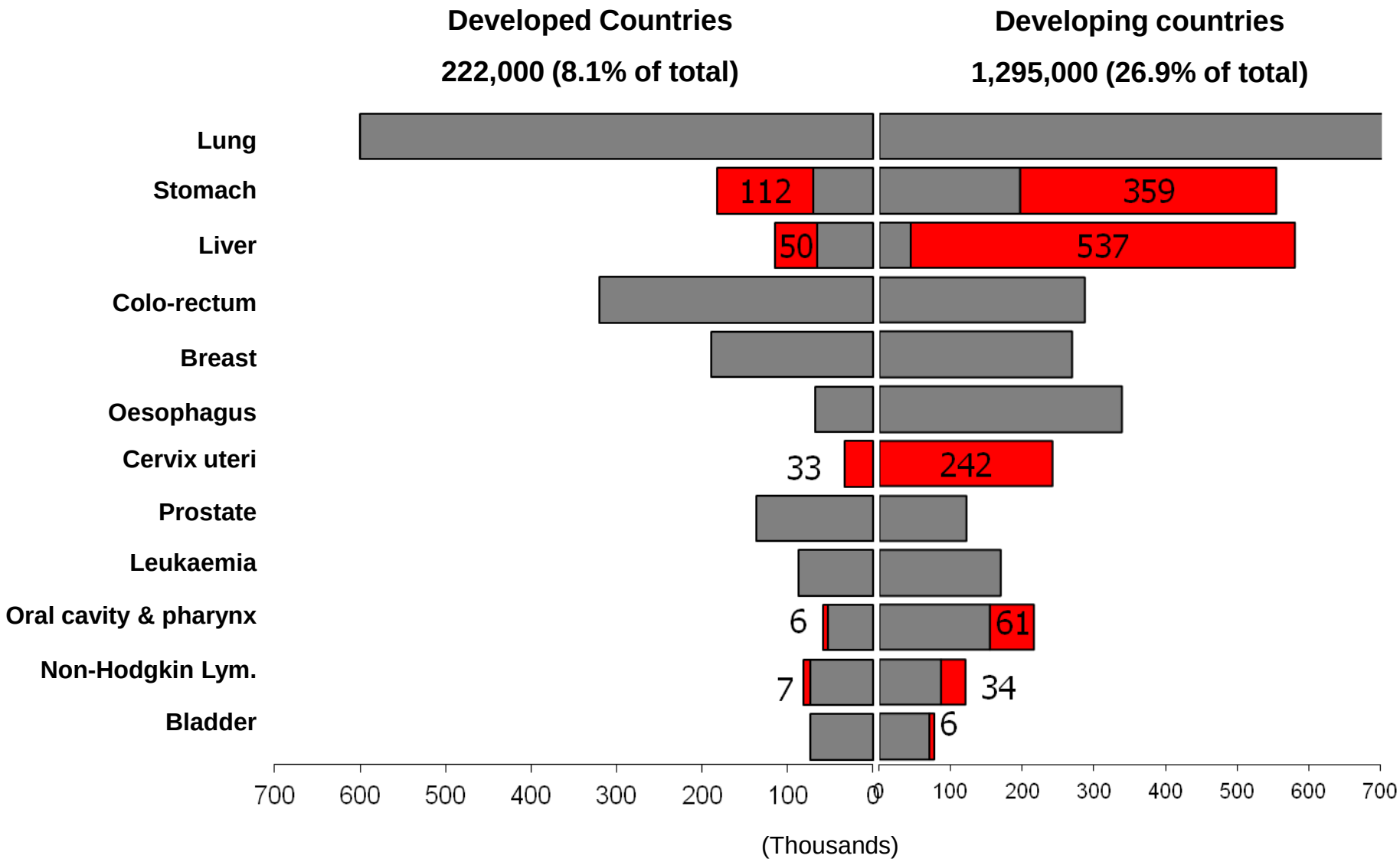


Developed countries: 8.1% of all cancer deaths (222,000)

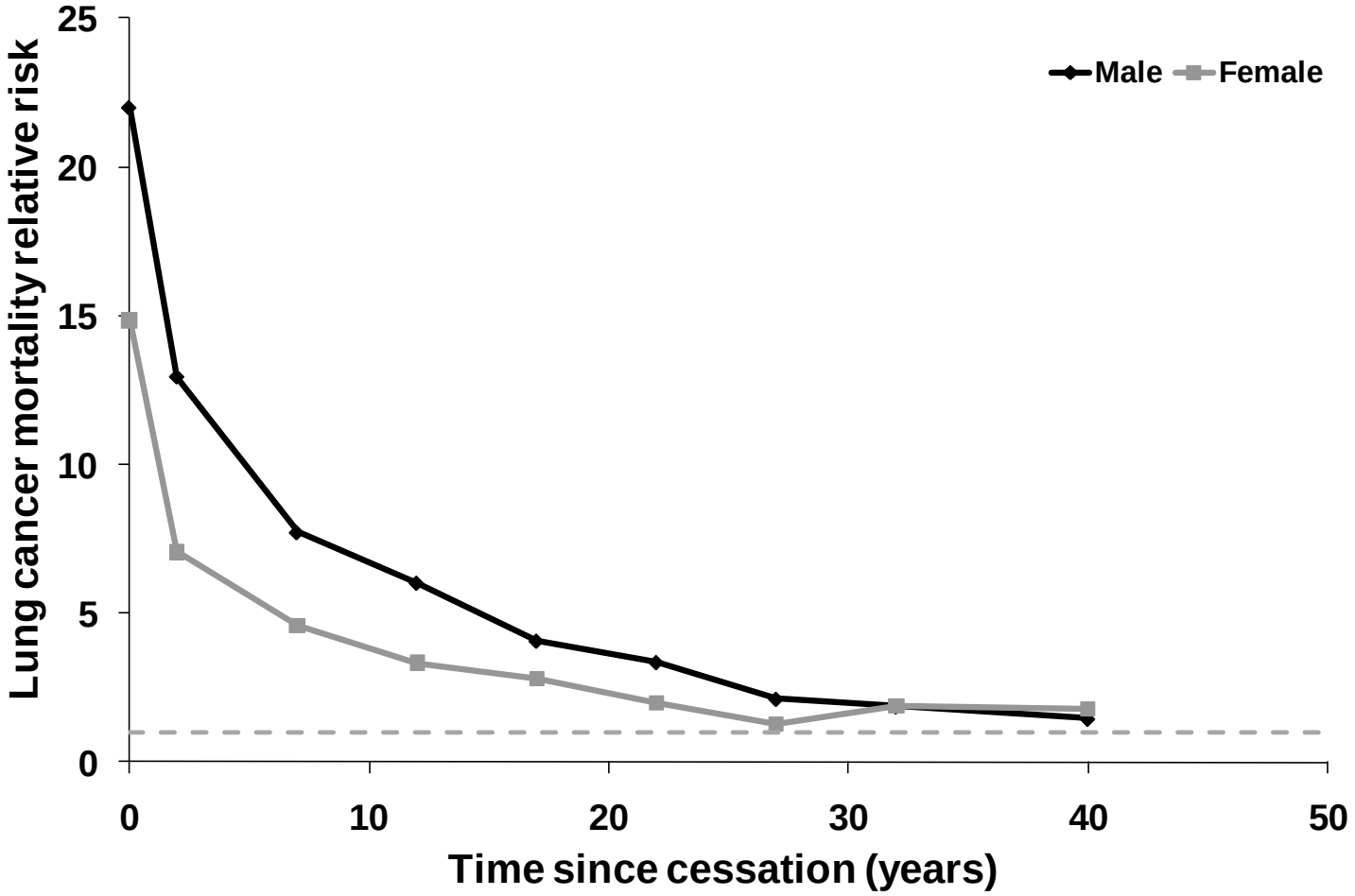


Developing countries: 26.9% of all cancer deaths (1,295,000)

Cancer deaths attributable to infection (thousands) 2008

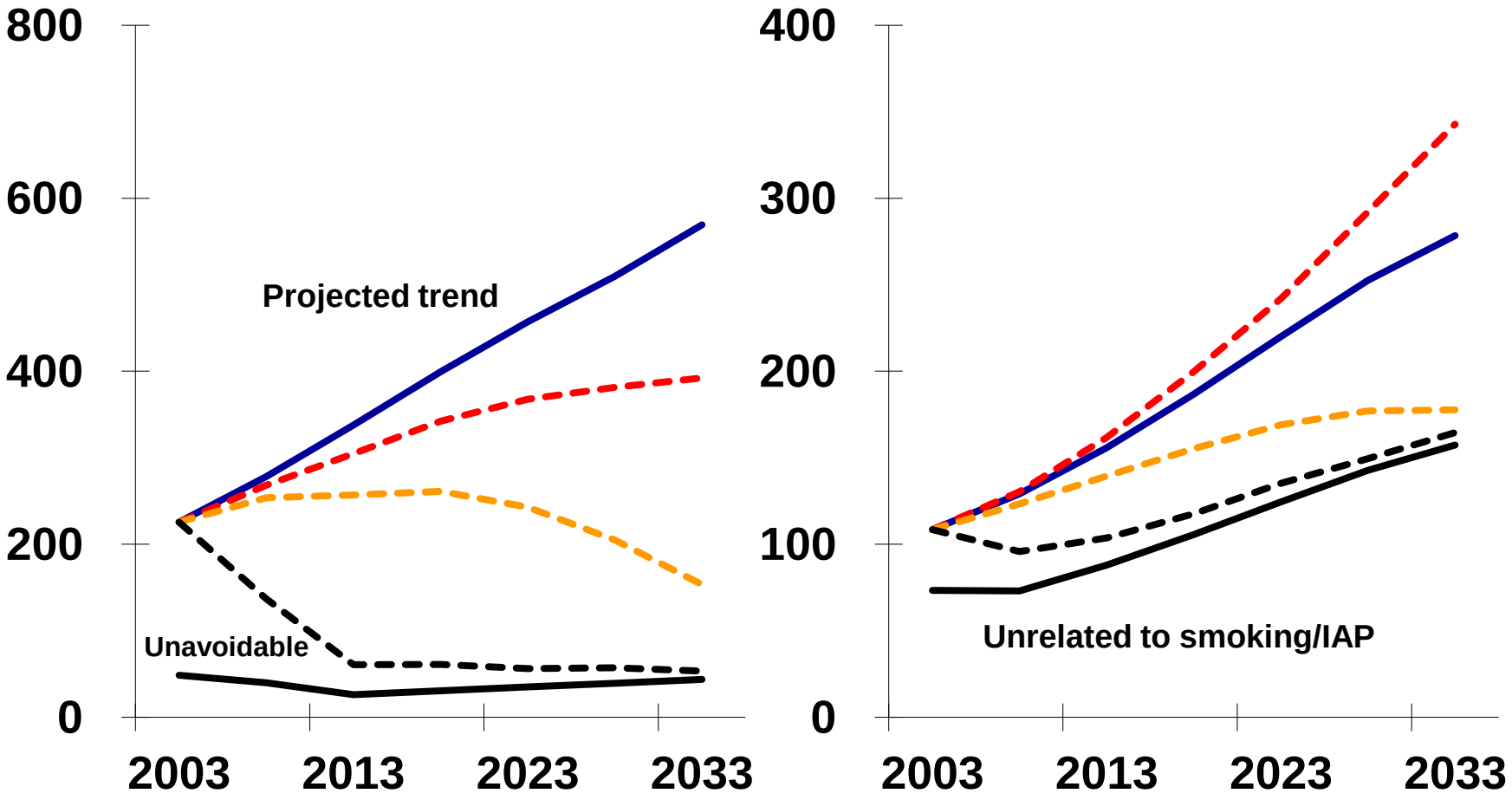


Can cancer risk be reversed? Relative risk of lung cancer among former smokers



Oza et al. *Preventive Medicine* 2011

Smoking, household fuel use, and avoidable lung cancer mortality in China



Lin et al. *Lancet* 2008