The Global Perspective of Stroke

Bo Norrving

Department of Neurology
Lund University Hospital
Sweden

bo.norrving@med.lu.se

Teaching Course ”Stroke ABC”, September 22, 2013
World Congress of Neurology, Vienna, Austria

Disclosure statement

- Steering and endpoint committees, DSMB: Servier, Syngis, Photothera
- Honoraria for presentations: Allergan, Bayer, Boehringer-Ingelheim
- No conflicts of interest related to this presentation

Learning objective

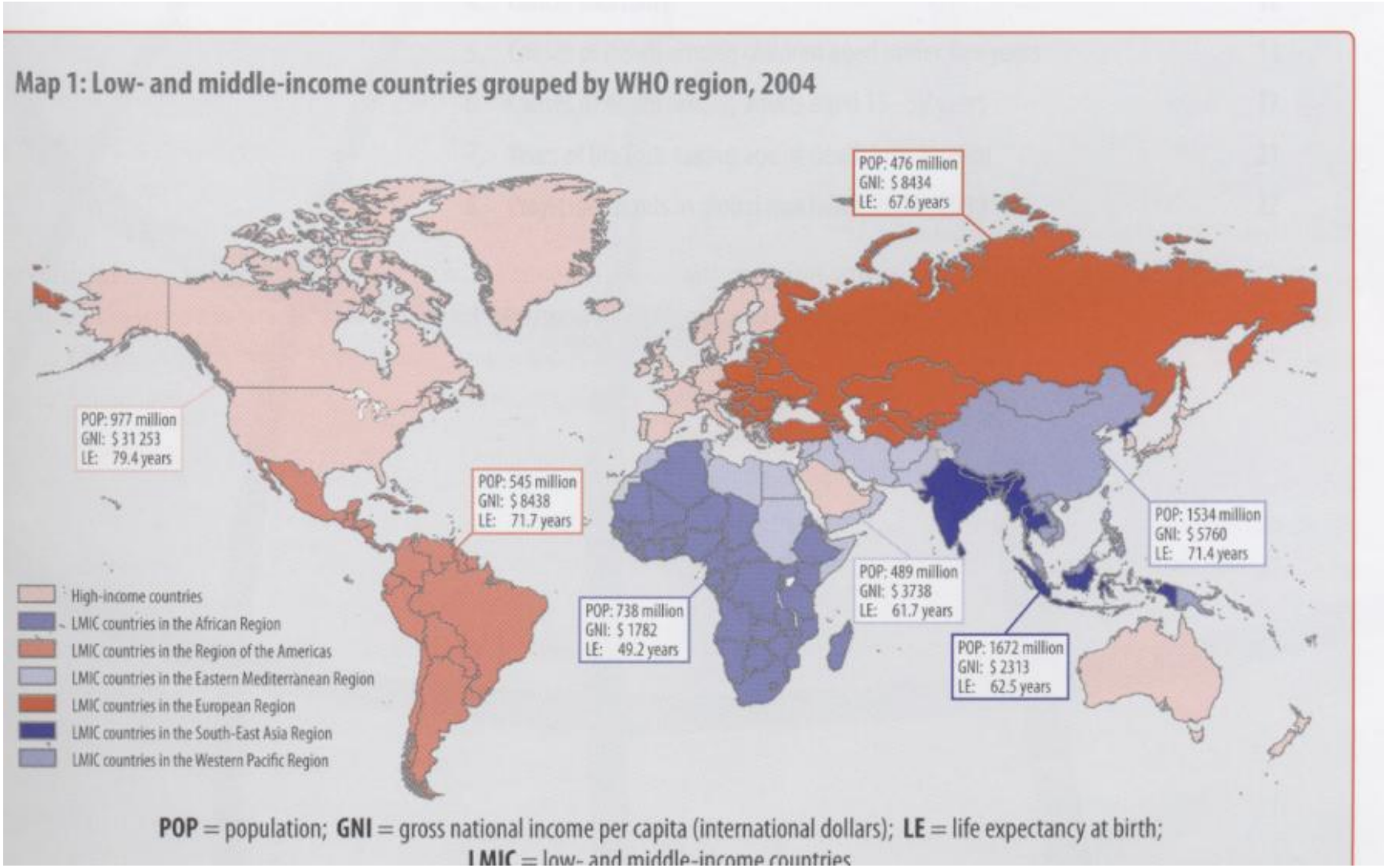
To know the recent developments in stroke mortality and morbidity world wide

To understand what is driving changes in stroke epidemiology

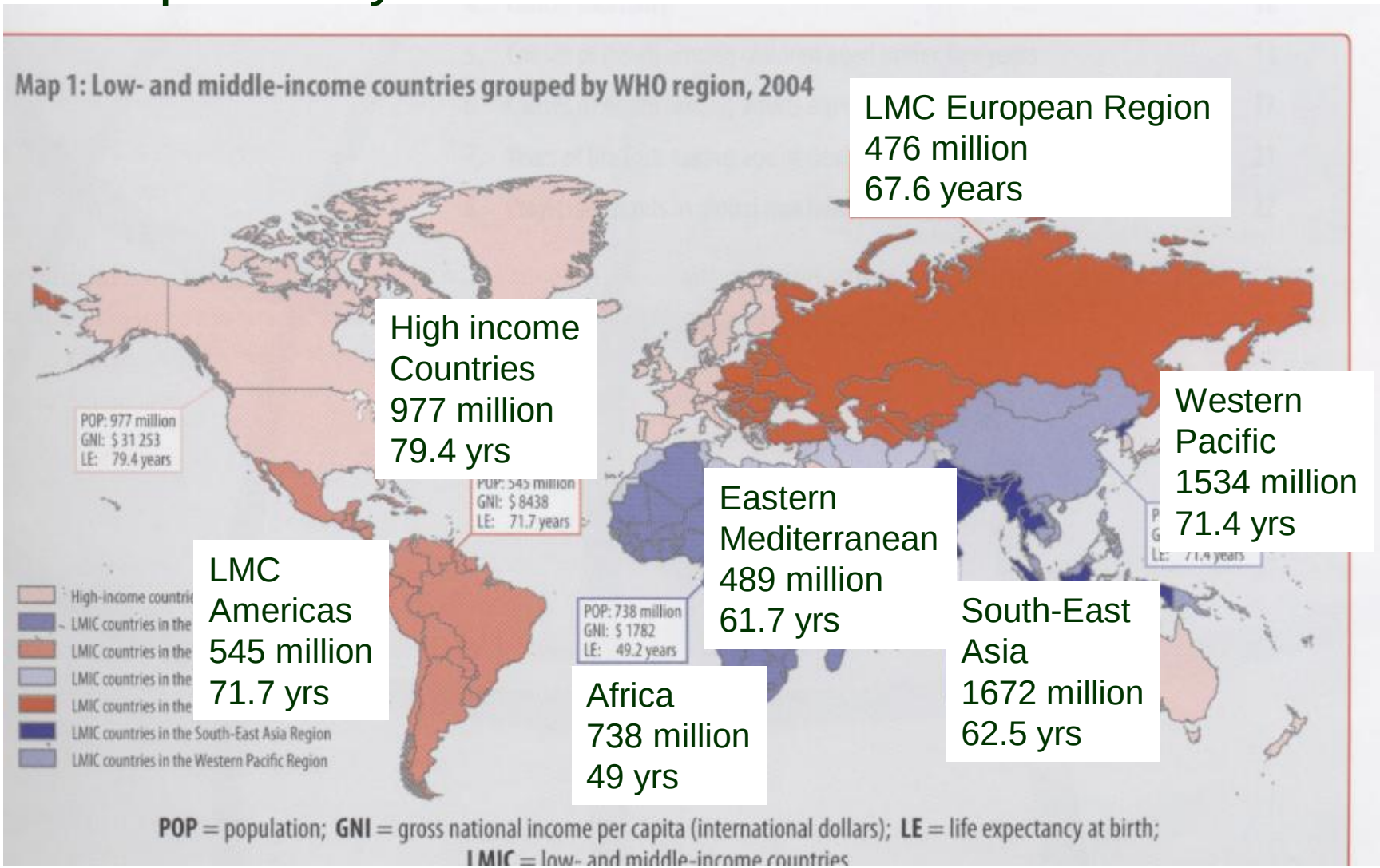
To understand basics concepts in disease and disability burden

To know current governmental actions to prevent stroke

The seven WHO regions



Differences in population size and life expectancy at birth



LMC European Region
476 million
67.6 years

High income Countries
977 million
79.4 yrs

Western Pacific
1534 million
71.4 yrs

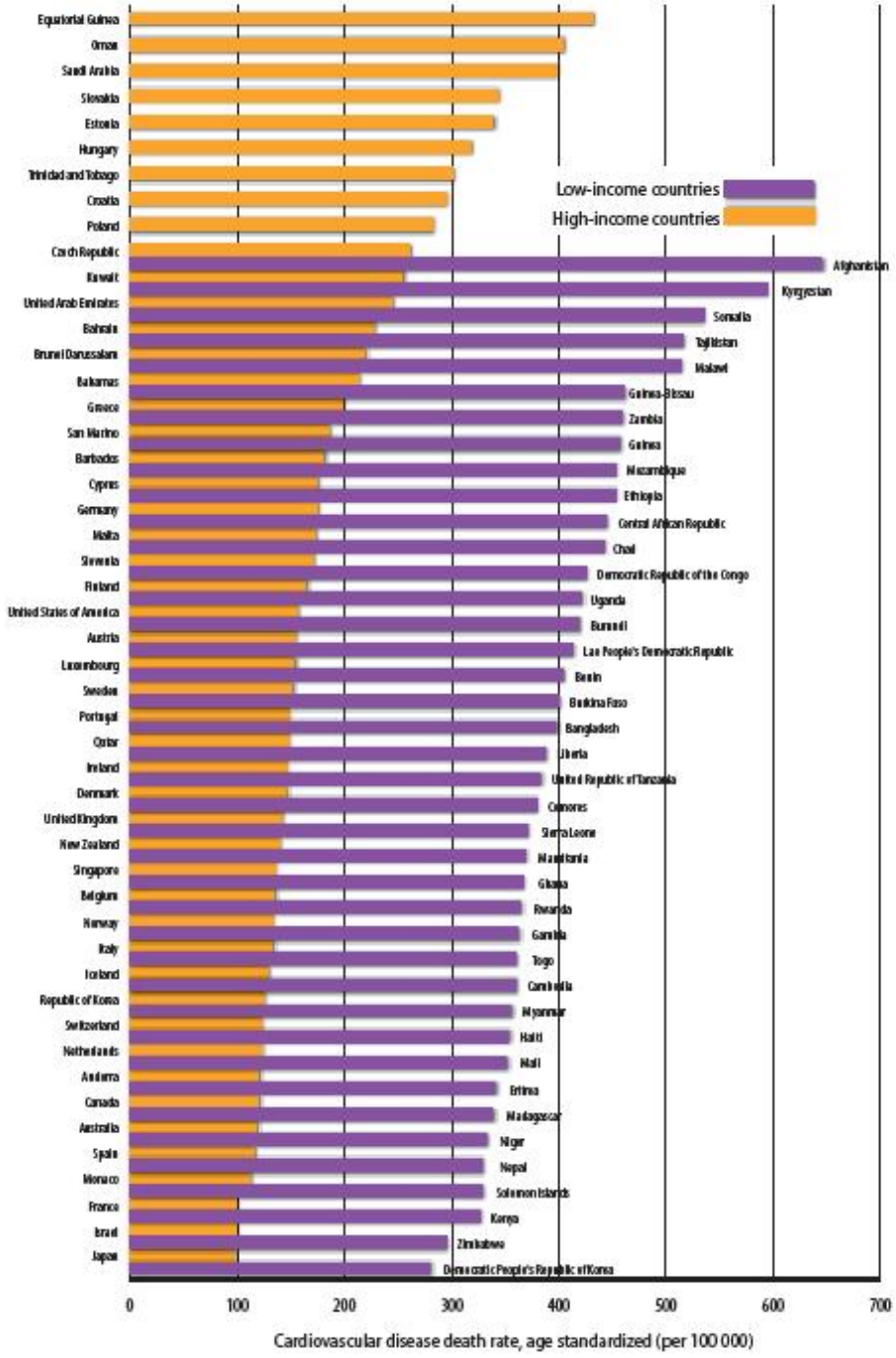
Eastern Mediterranean
489 million
61.7 yrs

LMC Americas
545 million
71.7 yrs

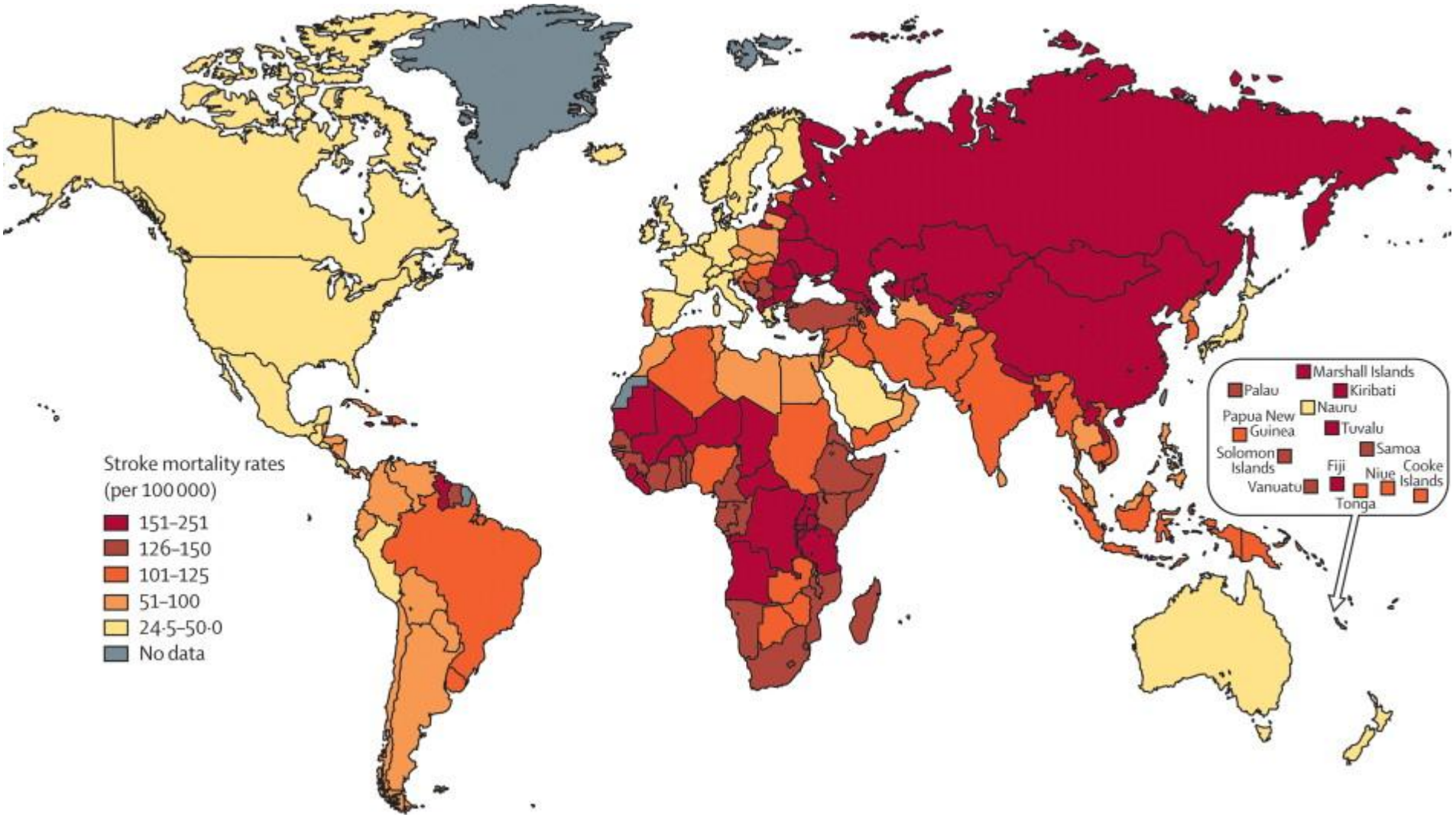
South-East Asia
1672 million
62.5 yrs

Africa
738 million
49 yrs

Figure 99 Mortality rates of CVDs in high income and low income countries (age standardized, 2008) (*1*, *6*).



Large variation in stroke burden and mortality



Johnston SC et al. Lancet Neurology 2009

Predictors of age adjusted mortality rate

	p-value
National income	<0.0001
Mean systolic BP	0.028
Tobacco use	0.041
Weight	0.017

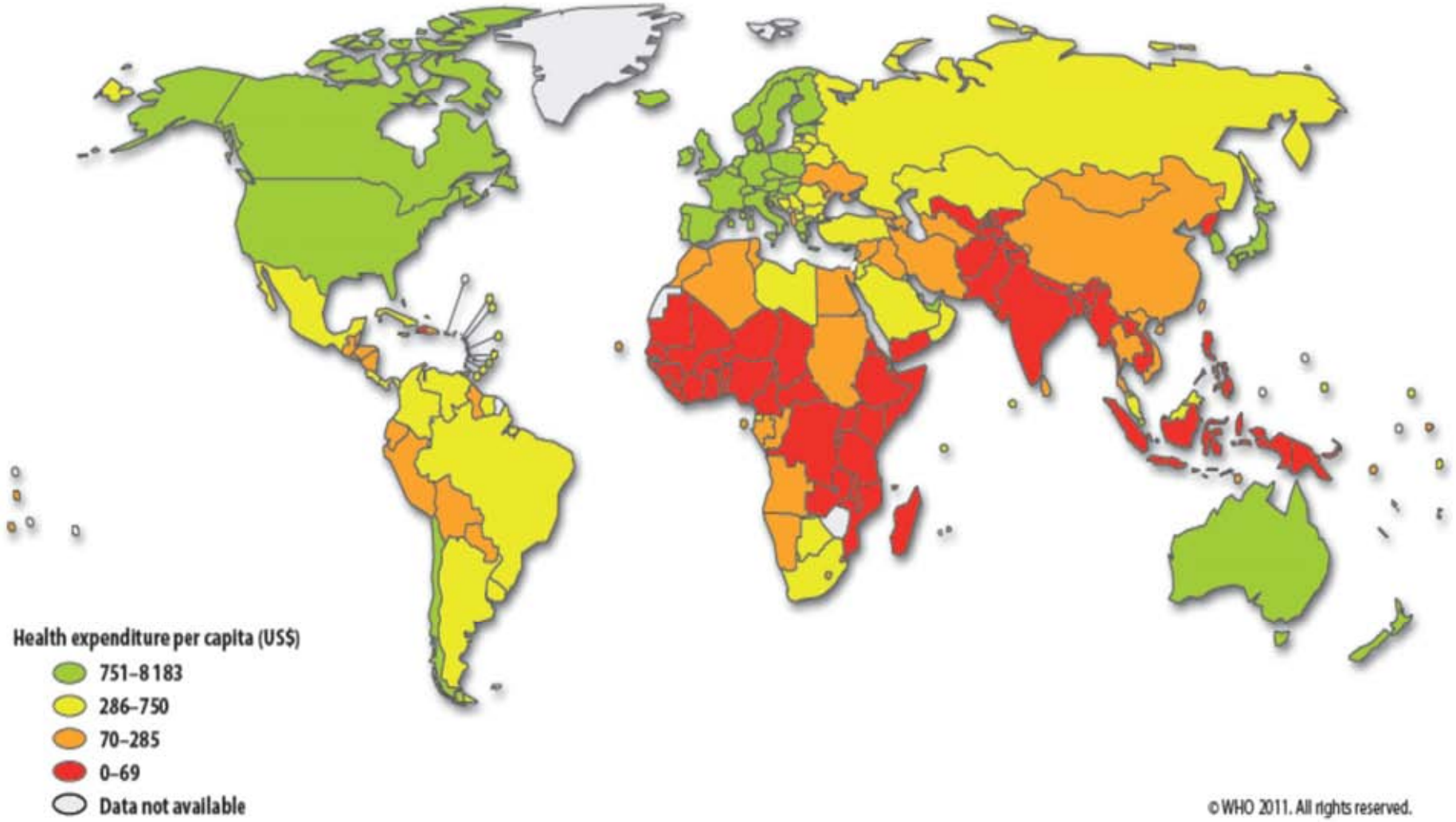
Predictors of age adjusted DALY

National income	<0.0001
Tobacco smoking	0.034

Links to strengths of health systems and primary care

Johnston SC et al. Lancet Neurology 2009

Figure 71 World map showing the per capita expenditure on health in 193 countries (*11*).



Global burden of disease

Global burden of disease study

- 1996 on data from 1990
- mortality and morbidity by age, sex and region

The Global Burden of Disease 2004 update

- WHO report published 2008
- revised back ground data
- projections for 2030

The Global Burden of Disease 2010 Study

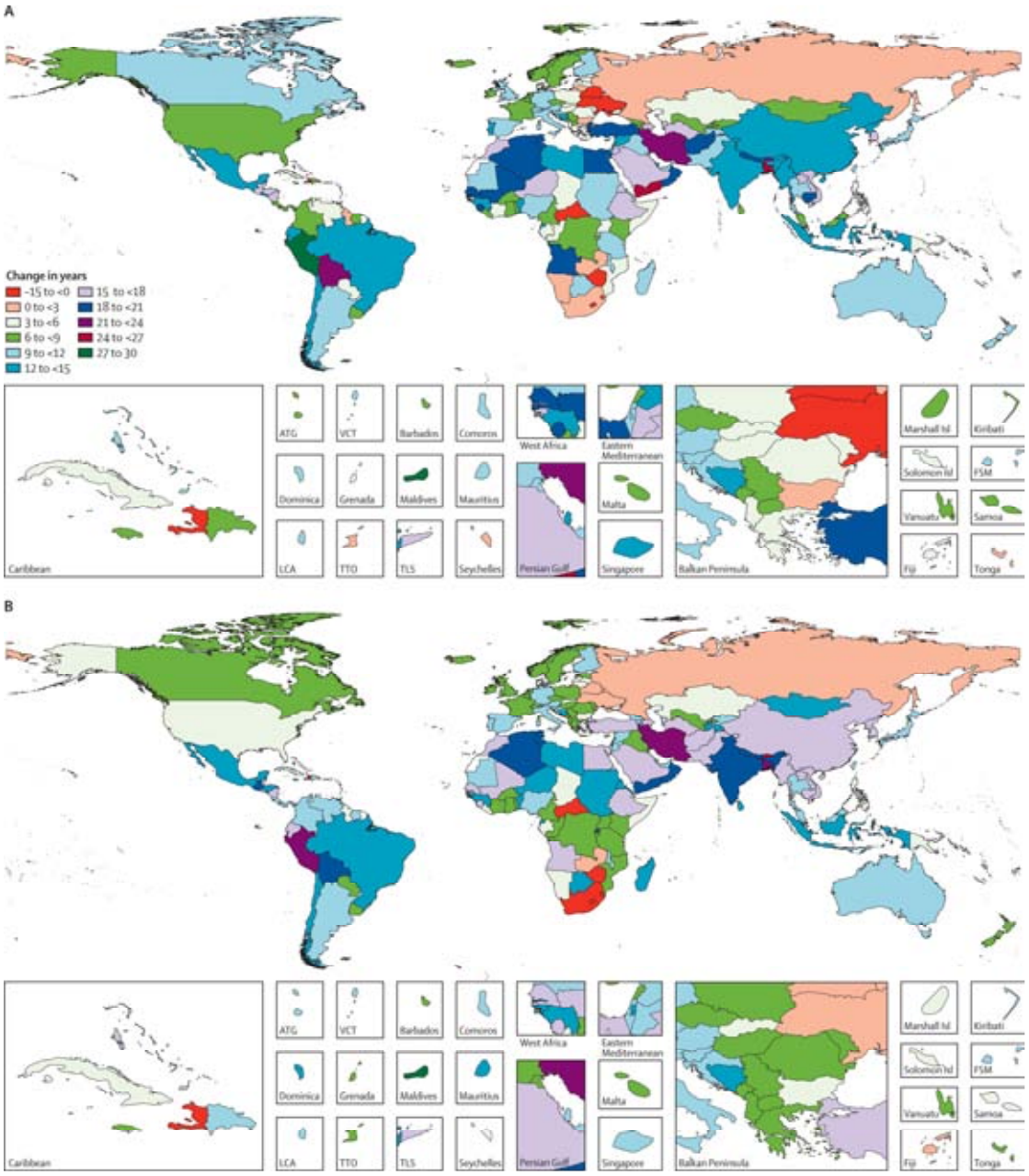
Global Burden of Disease 2010

Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: a systematic analysis for the Global Burden of Disease Study 2010

Rafael Lozano, Mohsen Naghavi, Kyle Foreman, Stephen Lim, Kenji Shibuya, Victor Aboyans*, Jerry Abraham*, Timothy Adair*, Rakesh Aggarwal*, Stephanie Y Ahn*, Mohammad A AlMazroa*, Miriam Alvarado*, H Ross Anderson*, Laurie M Anderson*, Kathryn G Andrews*, Charles Atkinson*, Larry M Baddour*, Suzanne Barker-Collo*, David H Bartels*, Michelle L Bell*, Emelia J Benjamin*, Derrick Bennett*, Kavi Bhalla*, Boris Bikbov*, Aref Bin Abdulhak*, Gretchen Birbeck*, Fiona Blyth*, Ian Bolliger*, Soufiane Boufous*, Chiara Bucello*, Michael Burch*, Peter Burney*, Jonathan Carapetis*, Honglei Chen*, David Chou*, Sumeet S Chugh*, Luc E Coffeng*, Steven D Colan*, Samantha Colquhoun*, K Ellicott Colson*, John Condon*, Myles D Connor*, Leslie T Cooper*, Matthew Corriere*, Monica Cortinovis*, Karen Courville de Vaccaro*, William Couser*

Lancet Dec 15, 2012

Global Burden of Disease 2010



Major changes in death rates and life expectancy from 1990 to 2010

Lancet Dec 15, 2012

Changes in life expectancy 1970 to 2010

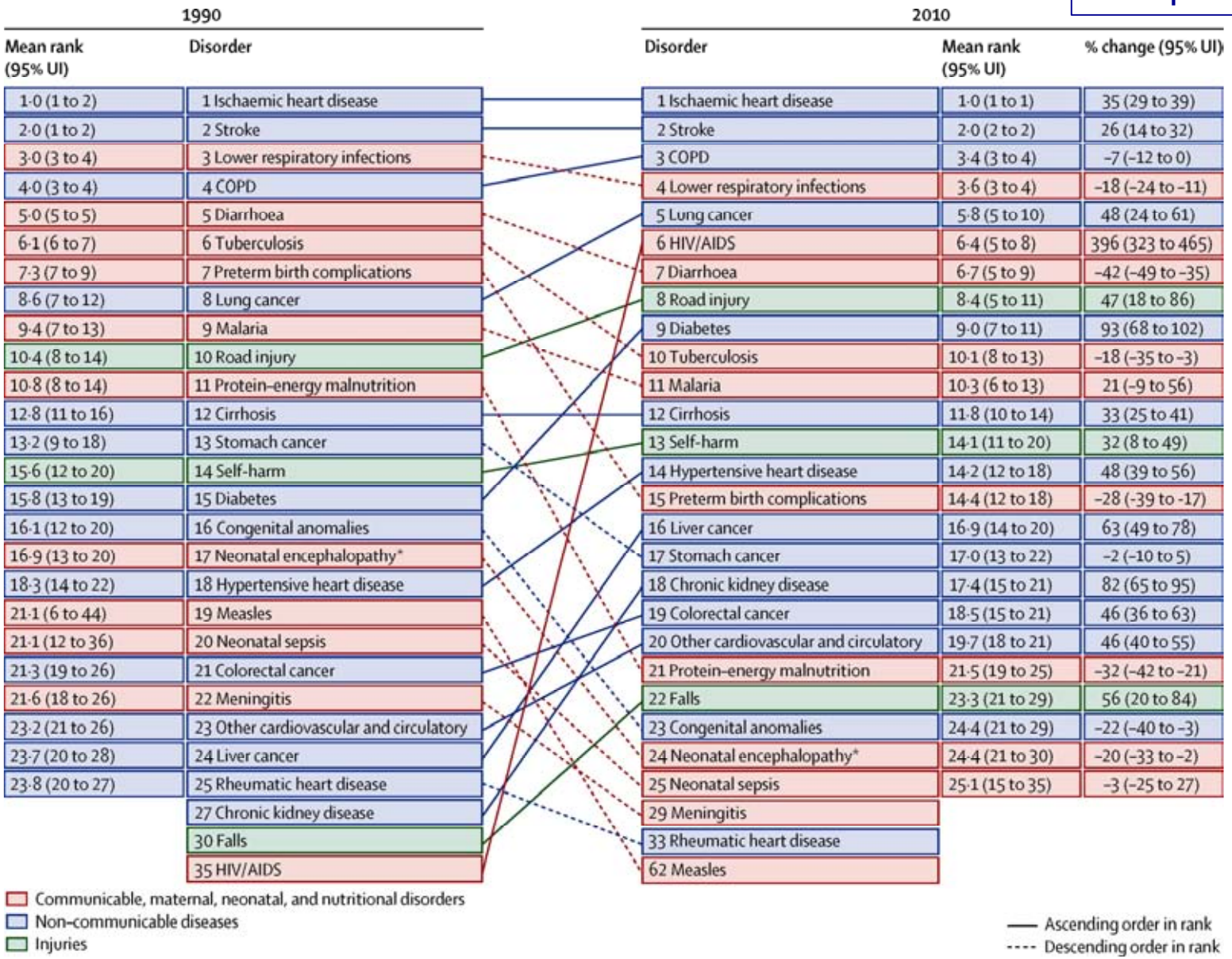
Males: increase from 56.4 years to 67.5 years

Females: increase from 61.2 years to 73.3 years

Lancet Dec 15, 2012

Global Burden of Disease 2010: mortality

Look at the blue parts….



Lancet Dec 15, 2012

Prevention of stroke

Commonality of risk factors for…

… stroke
… coronary heart disease
… peripheral vascular disease
… many types of dementia
… many types of cancer
… respiratory tract disorders
… diabetes
…

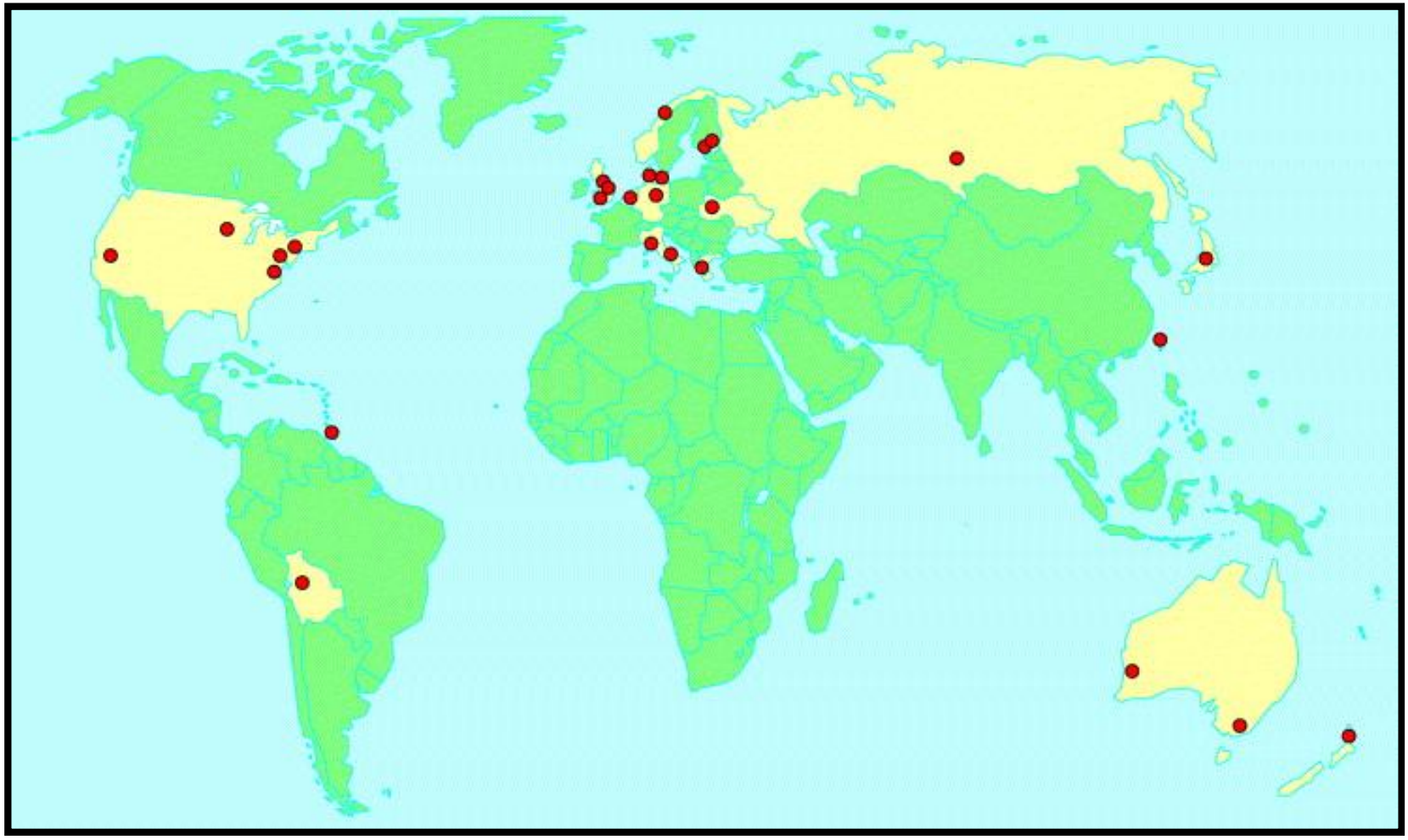
Need to
join hands

Non-communicable diseases (NCD)

Incidence of first-ever stroke

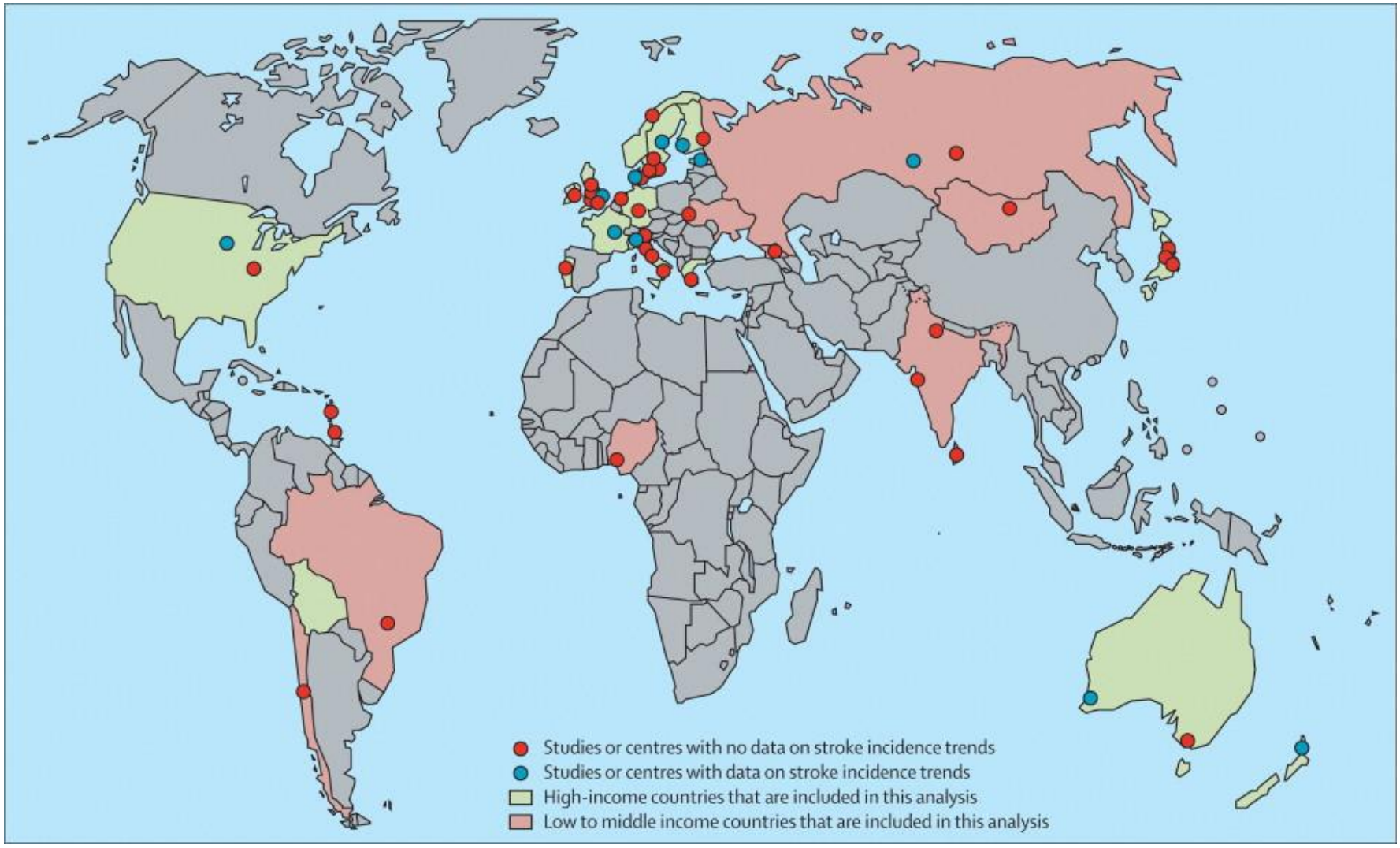
World	9.0 million
Africa	0.7
Americas	0.9
Eastern Mediterranean	0.4
Europe	2.0
South-East Asia	1.8
Western Pacific	3.3

World map of stroke incidence studies in the late 20th century



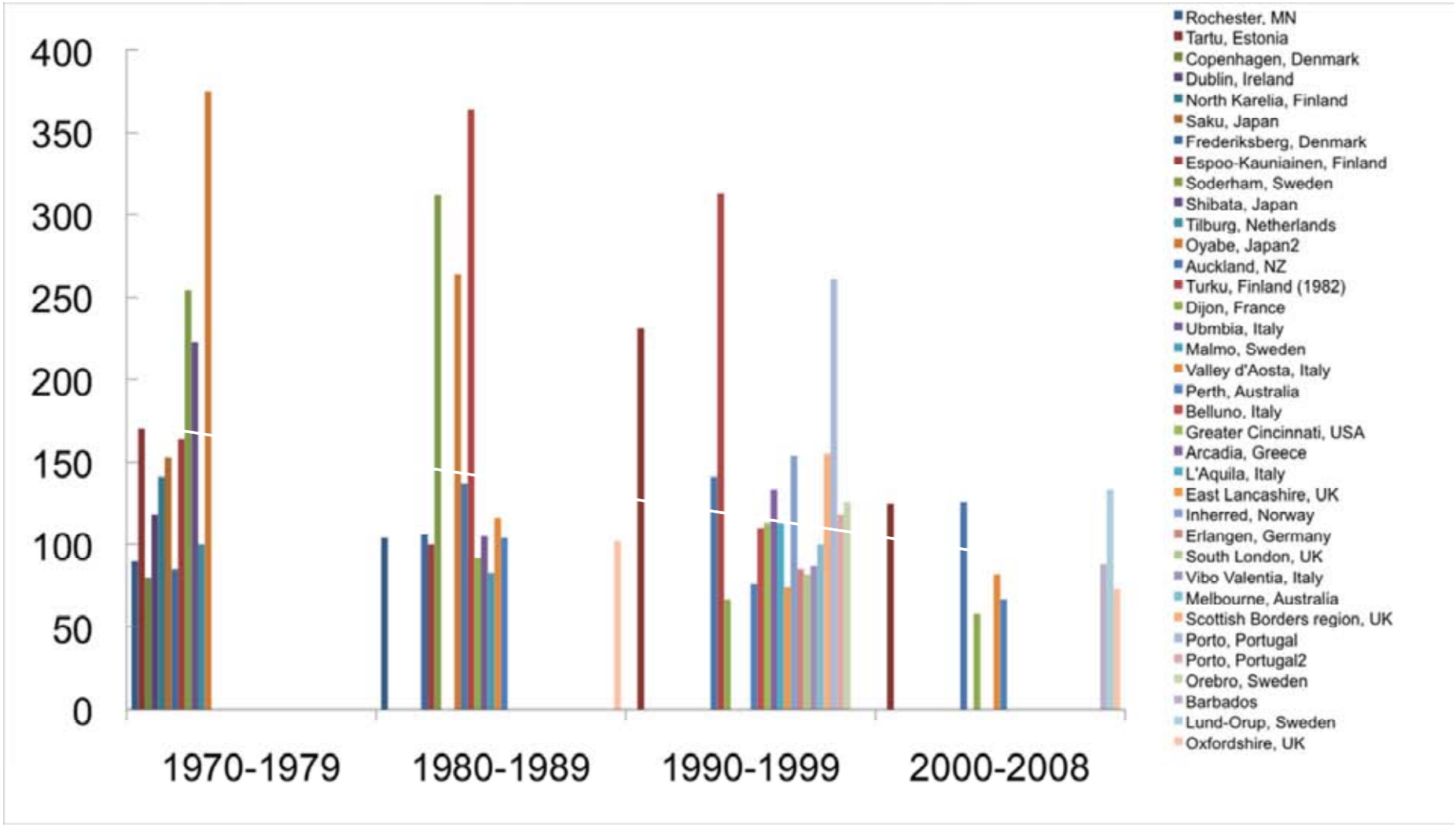
Feigin VL et al. Lancet Neurology 2003;2:43-53

Worldwide stroke incidence and early case fatality reported In 56 population-based studies: a systematic review.



Feigin et al. Lancet Neurology , 2009

Time trends in stroke 1970 to present



High-income countries: decrease 42 %

Feigin et al. Lancet Neurology, 2009

Stroke in young Fabry patients (sifap1)

DESIGN:
Prevalence, multicenter, multinational study, start April 1st, 2007; end either after having enrolled 5.000 pts. or not later than March 30th, 2009

PRIMARY AIM OF THE STUDY:
To establish the prevalence of Fabry disease in the unselected group of young patients with stroke.

SECONDARY AIM OF THE STUDY
To determine the overall causes, clinical characteristics, and imaging findings of stroke in the young.

5024 patients enrolled (15 countries, 47 centers)

59 % males, 41 % females

Mean age 44.6 years (men); 43.3 years (women)

Age	**Number of patients**	**%**
18-24	151	3.0
25-34	482	9.6
35-44	1395	27.8
45-55	2996	59.6

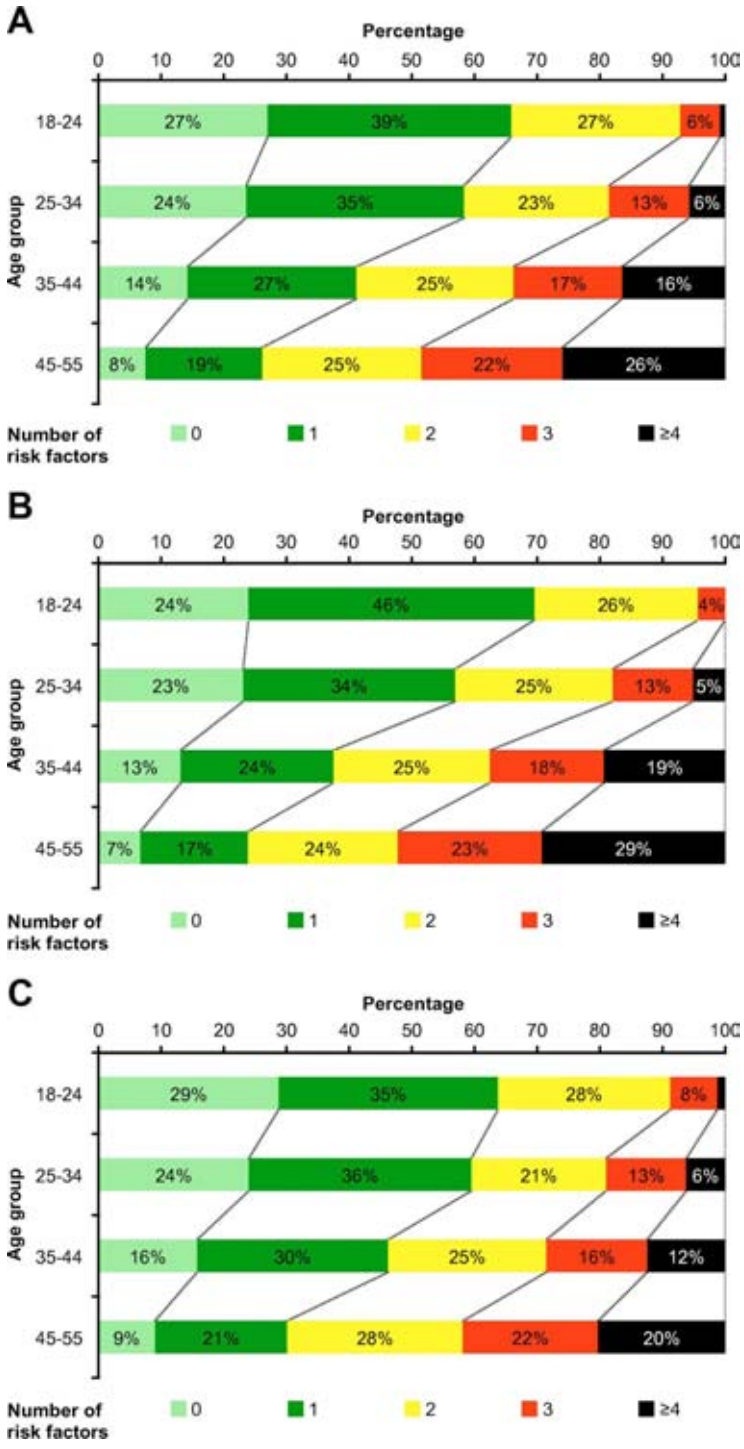
Qualifying cerebrovascular event

ischemic stroke	70.6 %
TIA	22.3 %
ICH	5.7 %
Other (e g venous thrombosis)	1.4 %

Stroke 2013;44:340-9

Risk factors	**%**
Hypertension	47 %
Smoking	41 %
Hyperlipidemia	34 %
Diabetes	10 %
Family history	
cardiovascular	41 %
cerebrovascular	37 %

Stroke 2013;44:340-9
Stroke 2013;44:119-25



Total

Men

Women

Proportion of patients with multiple risk factors

Message: there are clear prevention opportunities also in stroke in the young

Stroke 2013;44:340-9
Stroke 2013;44:119-25

Twenty-Four-Year Trends in the Incidence of Ischemic Stroke in Sweden From 1987 to 2010

Annika Rosengren, MD; Kok Wai Giang, MSc; Georgios Lappas, MSc; Christina Jern, MD; Kjell Torén, MD; Lena Björck, PhD

Background and Purpose—The incidence of stroke in Sweden increased between 1989 and 2000 among people aged ≤65 years, but more recent data on those aged >65 years are lacking.

Methods—Through the Swedish Hospital Discharge and Cause of Death registries, we identified all cases of nonfatal and fatal ischemic stroke (IS) among people aged 18 to 84 years during 1987–2010 in Sweden.

Results—Of the 391 081 stroke cases identified, 1.6% were 18 to 44 years, 16.7% were 45 to 64 years, and 81.7% were 65 to 84 years. Among people aged 18 to 44 years, there was a continuous increase in the incidence of stroke of 1.3% (95% confidence interval, 0.8%–1.8%) per year for men and 1.6% (1.0%–2.3%) per year for women. Among men and women aged 45 to 64 years, slightly declining rates were observed from the late 1990s, with a mean annual decrease of 0.4% (0.1%–0.7%) among men and 0.6% (0.2%–1.0%) among women. Among men aged 65 to 84 years, a decrease of 3.7% in IS (3.4%–4.0%) per year was observed from the late 1990s. This was more marked in women, where an initial decrease of 2.5% (2.1%–2.9%) per year was followed by an accelerated decrease of 5.1% (4.4%–5.8%) after 2005. Mortality from IS decreased markedly in all age groups.

Conclusions—The incidence of IS in elderly people in Sweden is now decreasing, whereas the decline in IS incidence in the middle-aged people is much less steep. The increasing incidence of stroke in the young, particularly if carried forward to an older age, is concerning. **(*Stroke*. 2013;44:2388-2393.)**

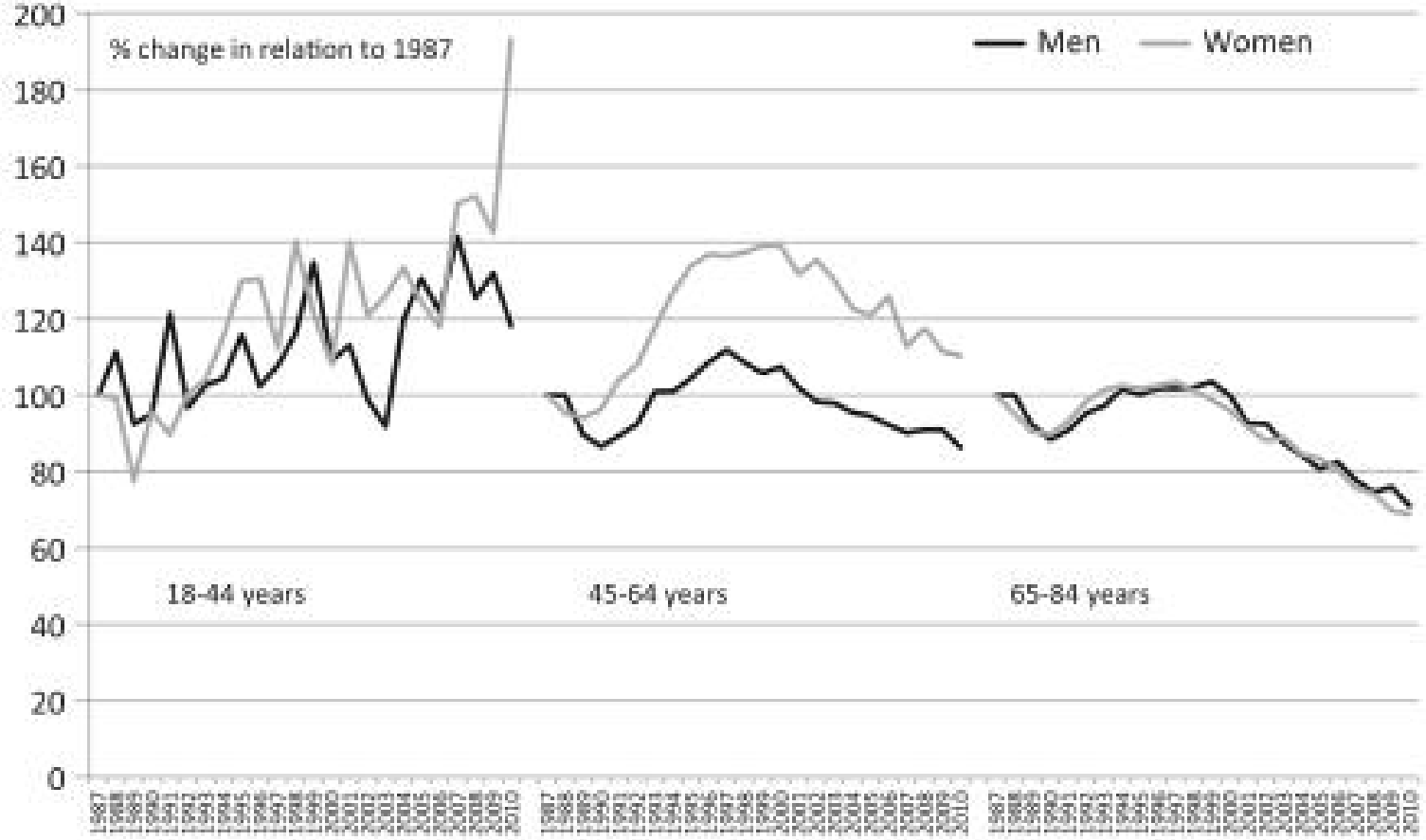
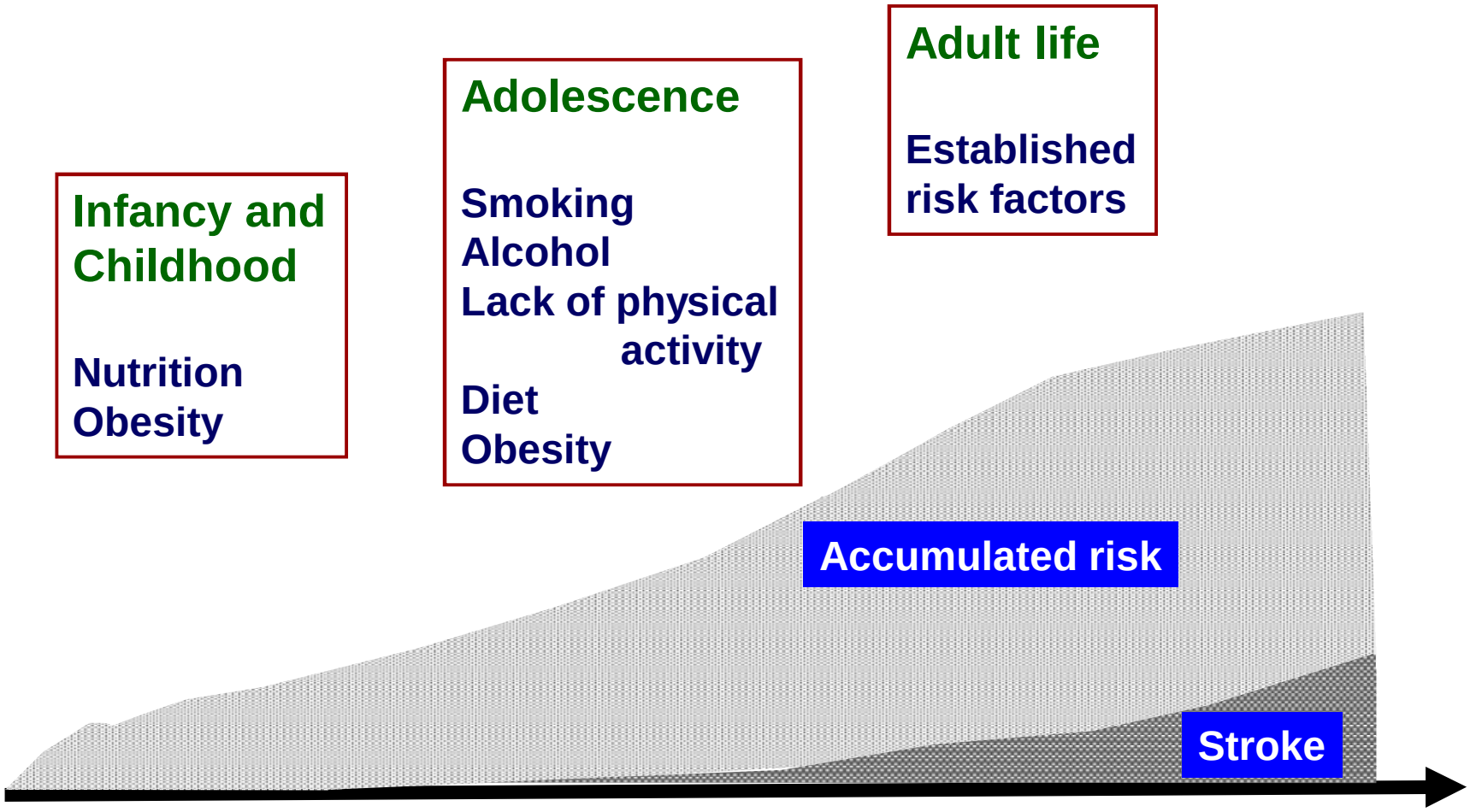
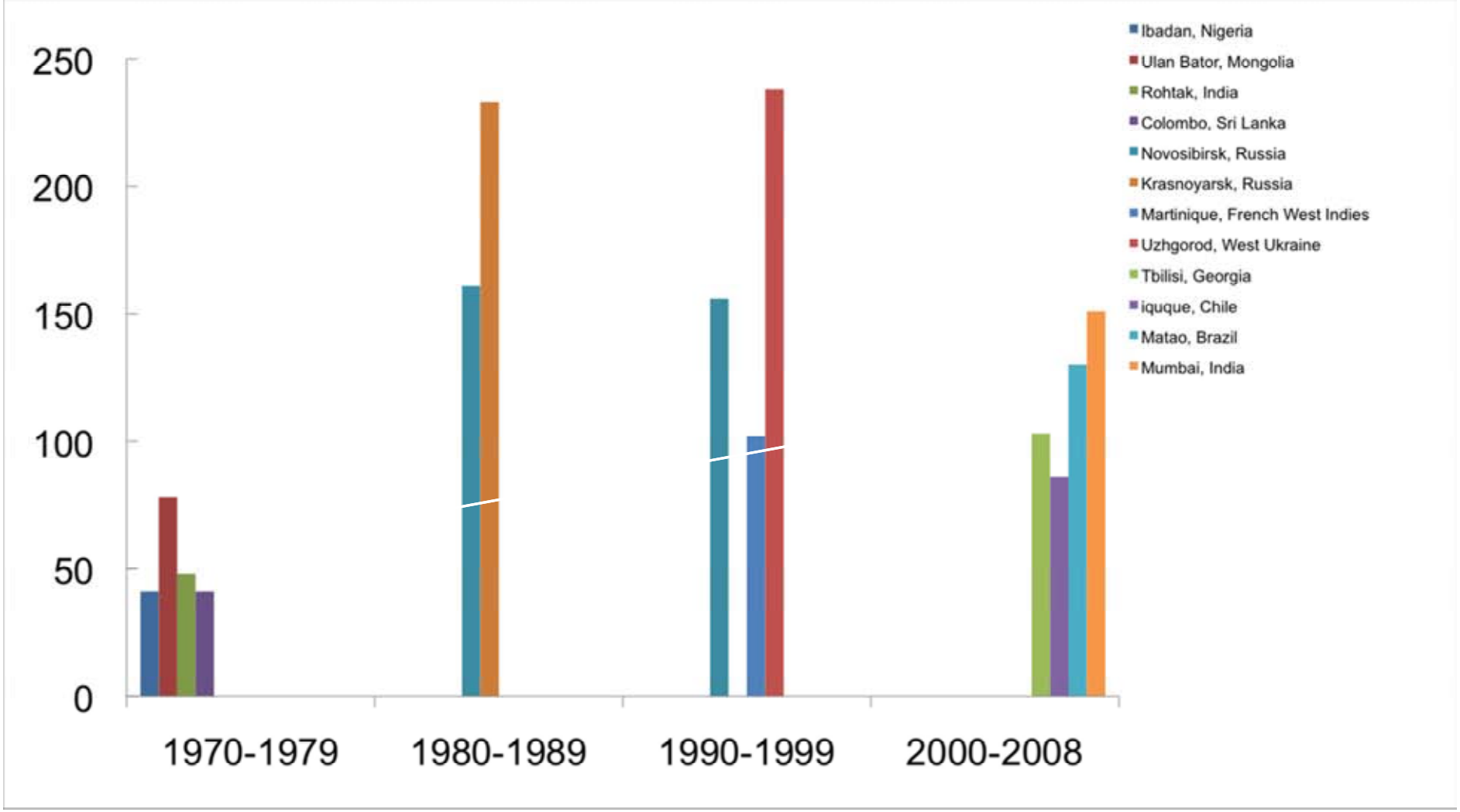


Figure 1. Relative percentage change in the incidence of ischemic stroke by sex and age group in people aged 18 to 84 years in Sweden from 1987 to 2010. Incidence of ischemic stroke in 1987 was set at 100%, and subsequent percentages are in relation to that year.

Stroke prevention – a life course approach



Time trends in stroke 1970 to present



Low-mid-income countries: more than doubled

Feigin et al. Lancet Neurology, 2009

Gross Domestic Product and Health Expenditure Associated With Incidence, 30-Day Fatality, and Age at Stroke Onset

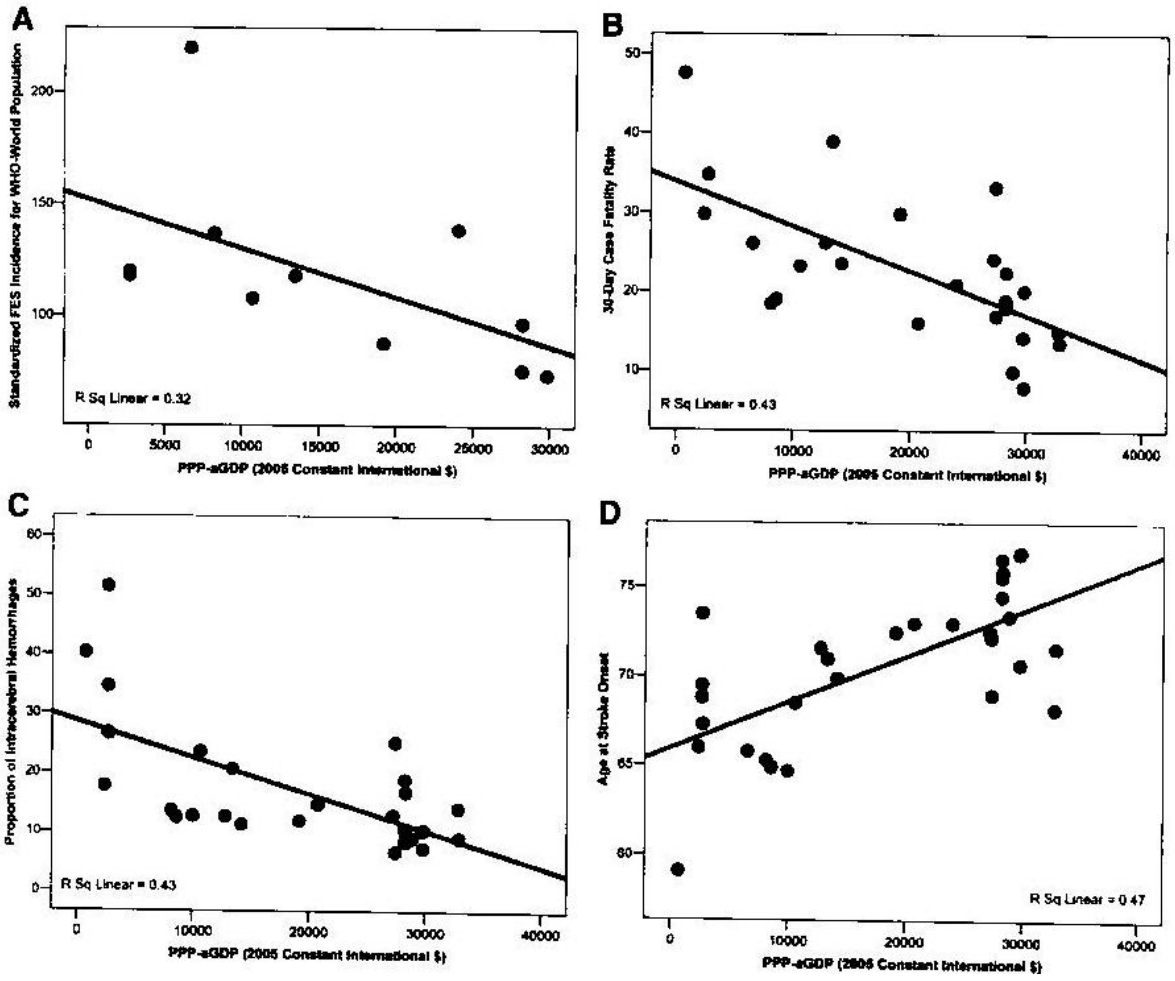
A Systematic Review

Luciano A. Sposato, MD, MBA; Gustavo Saposnik, MD, MSc, FAHA

Stroke 2011;43. Published online October 27, 2011

Per capita Gross Domestic Product adjusted for purchasing power parity

Incidence



30-days case fatality

Proportion of intracerebral hemorrhage

Age at stroke onset

Sposato & Saposnik. Stroke 2011;43, published online October 27 2011

Poorer control of risk factors, in particular hypertension, in populations with a low GDP

Reciprocal relathionship: vascular risk factors more prevalent and access to medical care more limited

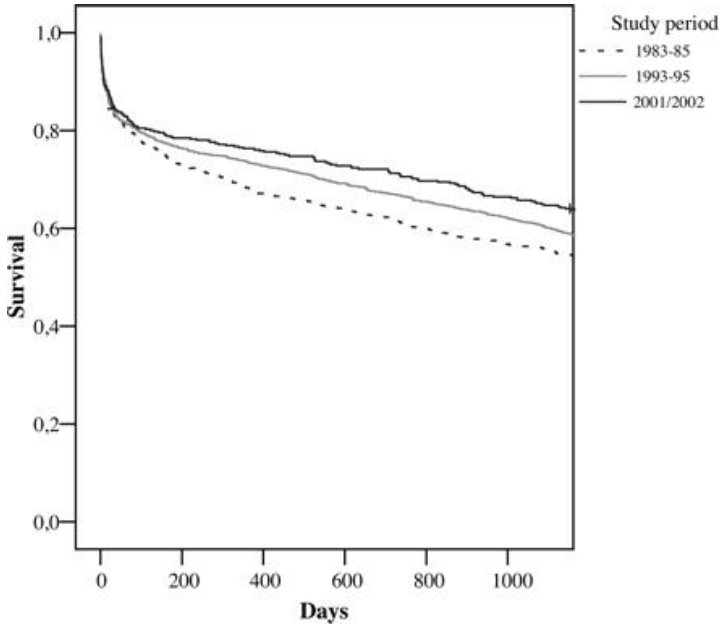
Incidence and prevalence of stroke

	Incidence	Prevalence
World	9.0 million	30.7 million
Africa	0.7	1.6
Americas	0.9	4.8
Eastern Mediterranean	0.4	1.1
Europe	2.0	9.6
South-East Asia	1.8	4.5
Western Pacific	3.3	9.1

Trends in long term survival

Continual increase

HR 2001/2002 vs 1983/85: 0.67



- **Improved life expectancy in the general population ?**
- **Improved secondary prevention ?**
- **Long-term effects of stroke unit care ?**
- **Improved management of comorbid conditions ?**

Estimated prevalence of moderate to severe disability

Table 9: Estimated prevalence of moderate and severe disability[a] (millions) for leading disabling conditions by age, for high-income and low- and middle-income countries, 2004

		High-income countries[b]		Low- and middle-income countries		World
	Disabling condition[c]	0–59 years	60 years and over	0–59 years	60 years and over	All ages
1	Hearing loss[d]	7.4	18.5	54.3	43.9	124.2
2	Refractive errors[e]	7.7	6.4	68.1	39.8	121.9
3	Depression	15.8	0.5	77.6	4.8	98.7
4	Cataracts	0.5	1.1	20.8	31.4	53.8
5	Unintentional injuries	2.8	1.1	35.4	5.7	45.0
6	Osteoarthritis	1.9	8.1	14.1	19.4	43.4
7	Alcohol dependence and problem use	7.3	0.4	31.0	1.8	40.5
8	Infertility due to unsafe abortion and maternal sepsis	0.8	0.0	32.5	0.0	33.4
9	Macular degeneration[f]	1.8	6.0	9.0	15.1	31.9
10	COPD	3.2	4.5	10.9	8.0	26.6
11	Ischaemic heart disease	1.0	2.2	8.1	11.9	23.2
12	Bipolar disorder	3.3	0.4	17.6	0.8	22.2
13	Asthma	2.9	0.5	15.1	0.9	19.4
14	Schizophrenia	2.2	0.4	13.1	1.0	16.7
15	Glaucoma	0.4	1.5	5.7	7.9	15.5
16	Alzheimer and other dementias	0.4	6.2	1.3	7.0	14.9
17	Panic disorder	1.9	0.1	11.4	0.3	13.8
18	Cerebrovascular disease	1.4	2.2	4.0	4.9	12.6
19	Rheumatoid arthritis	1.3	1.7	5.9	3.0	11.9
20	Drug dependence and problem use	3.7	0.1	8.0	0.1	11.8

COPD, chronic obstructive pulmonary disease.

[a] GBD disability classes III and above.

Stroke

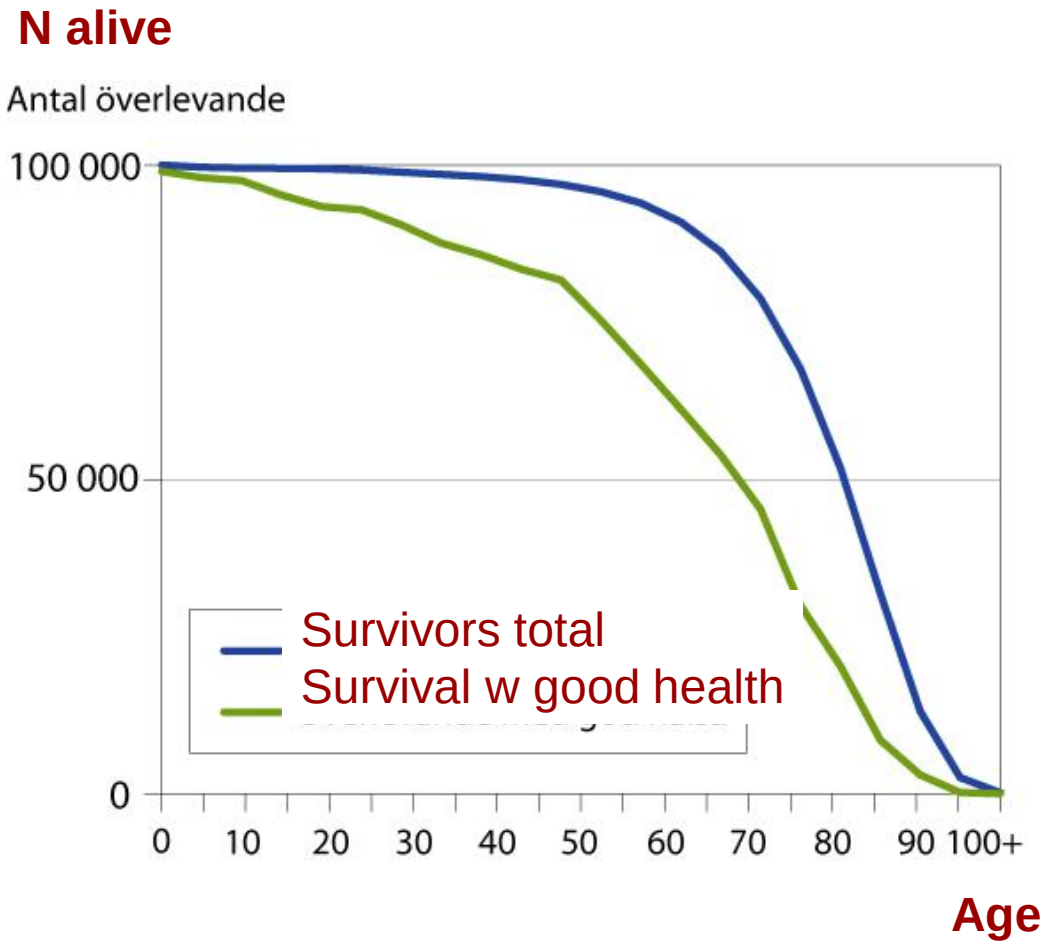
World all ages 12.6 million

High income countries
0-59 years 1.4 million
>60 years 2.2 million

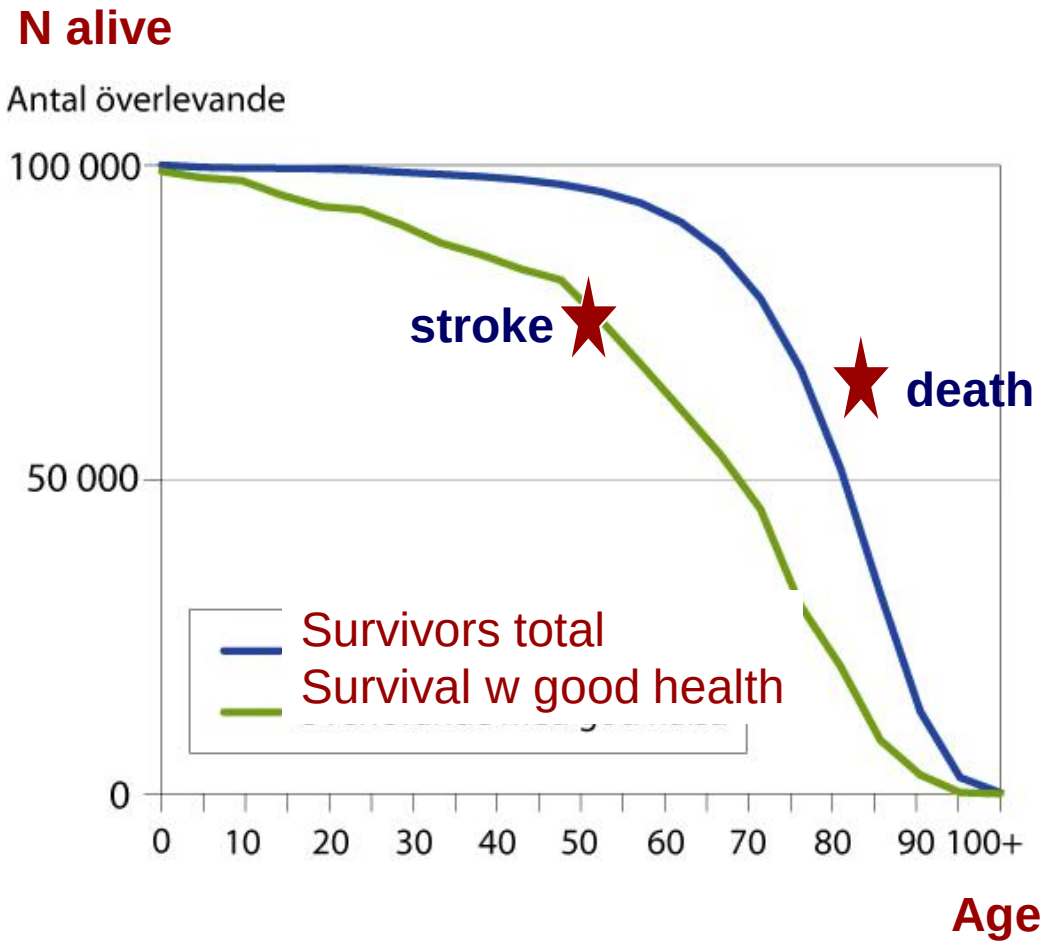
Low-middle income countries
0-59 years 4.0 million
>60 years 4.9 million

44 % of all with moderate to severe disability are <60 years

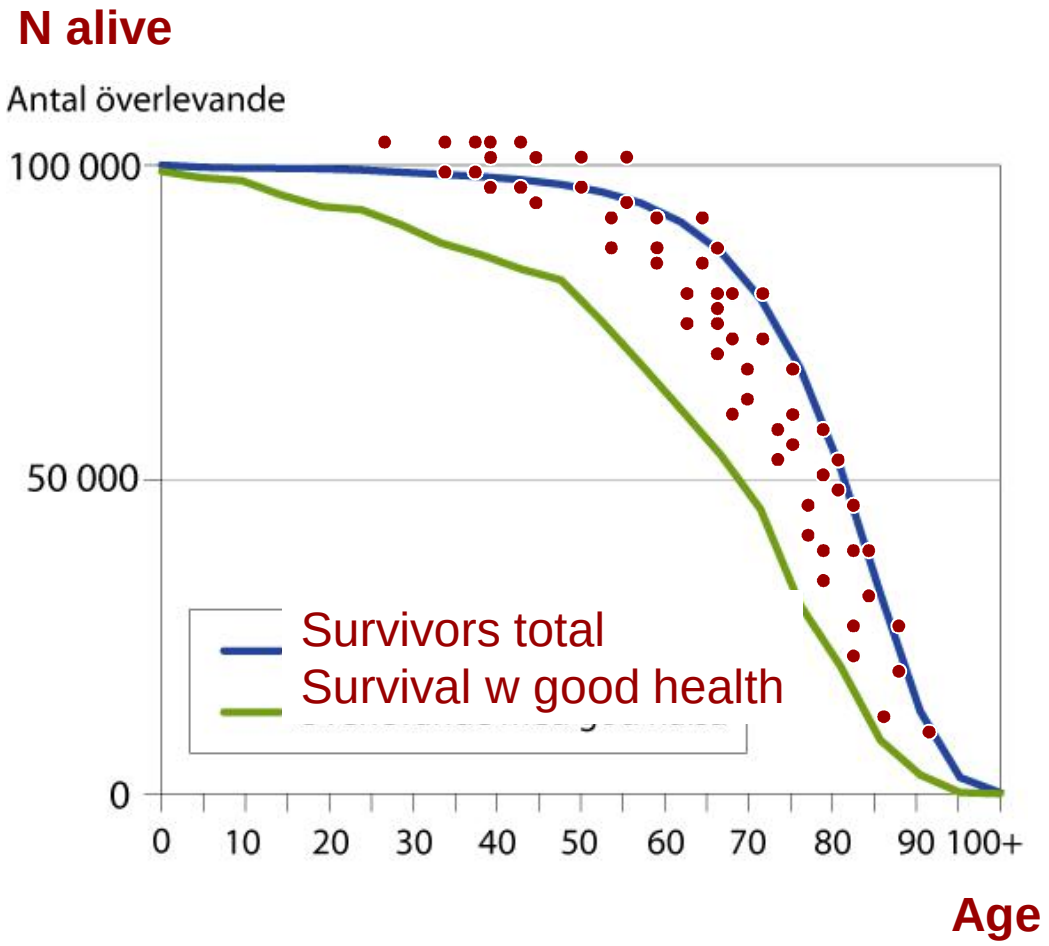
Burden of disease: death and disability



Burden of disease: death and disability



Burden of post-stroke disabilities



Disability Adjusted Life Years (DALYs)

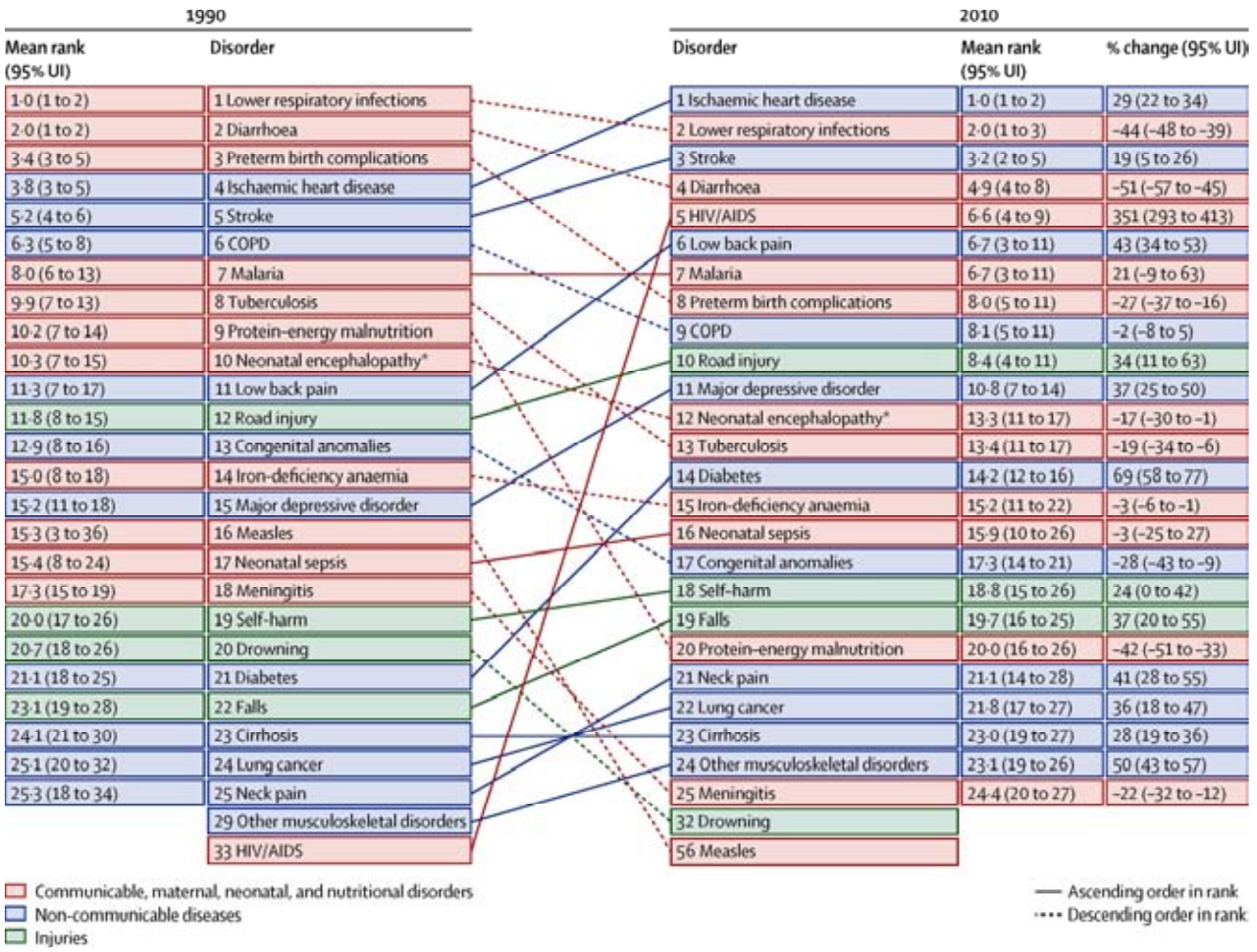
DALYs are the sum of

-Years of life lost from premature death

-Years lost due to disability

Number of cases x
duration of disease x
weight factor

Leading causes of burden of disease (DALYs), all ages, 1990 and 2010



Lancet Dec 15, 2012

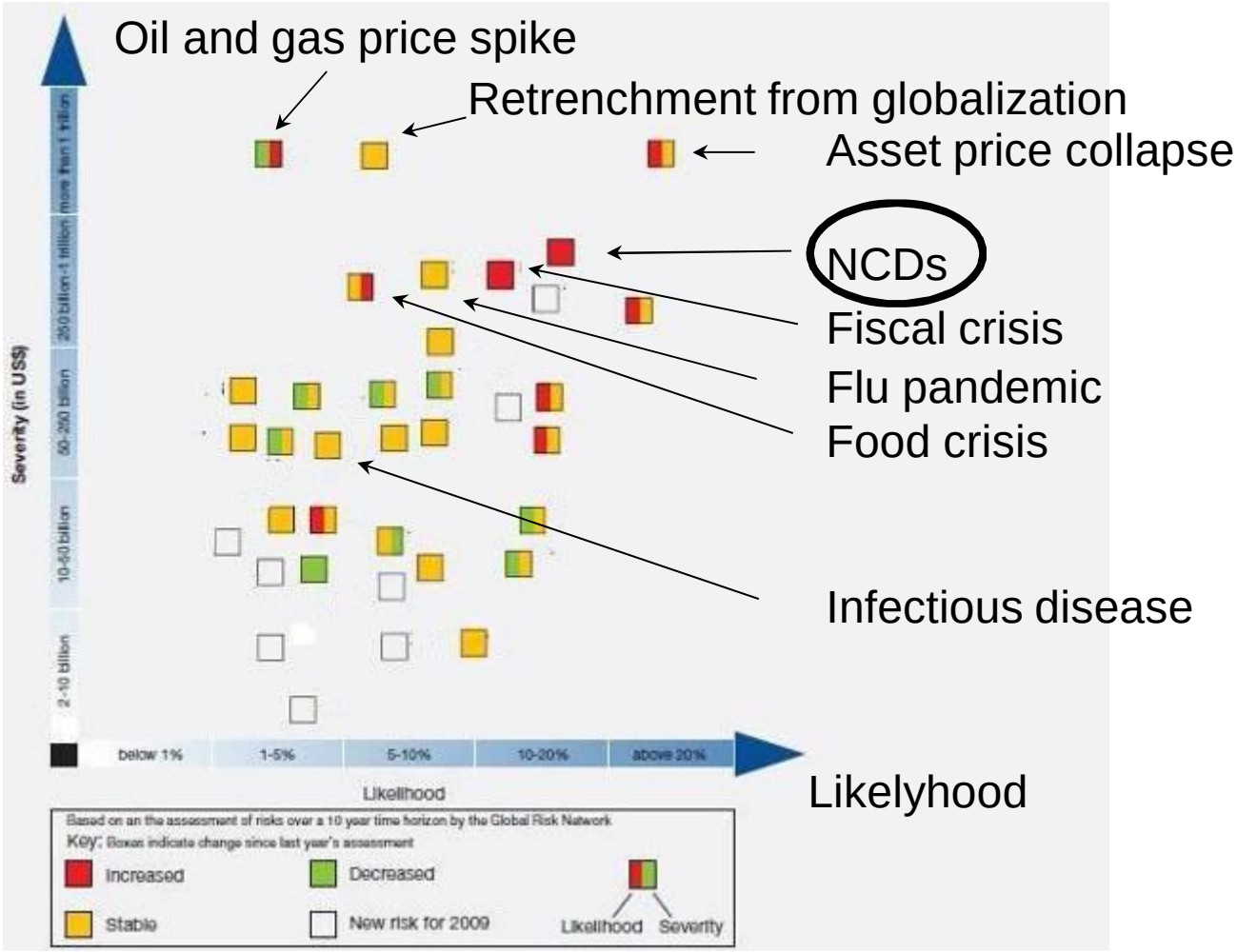
Global Burden of Disease 2010 Study
Years lived with disability (YLD) data 1990 and 2010

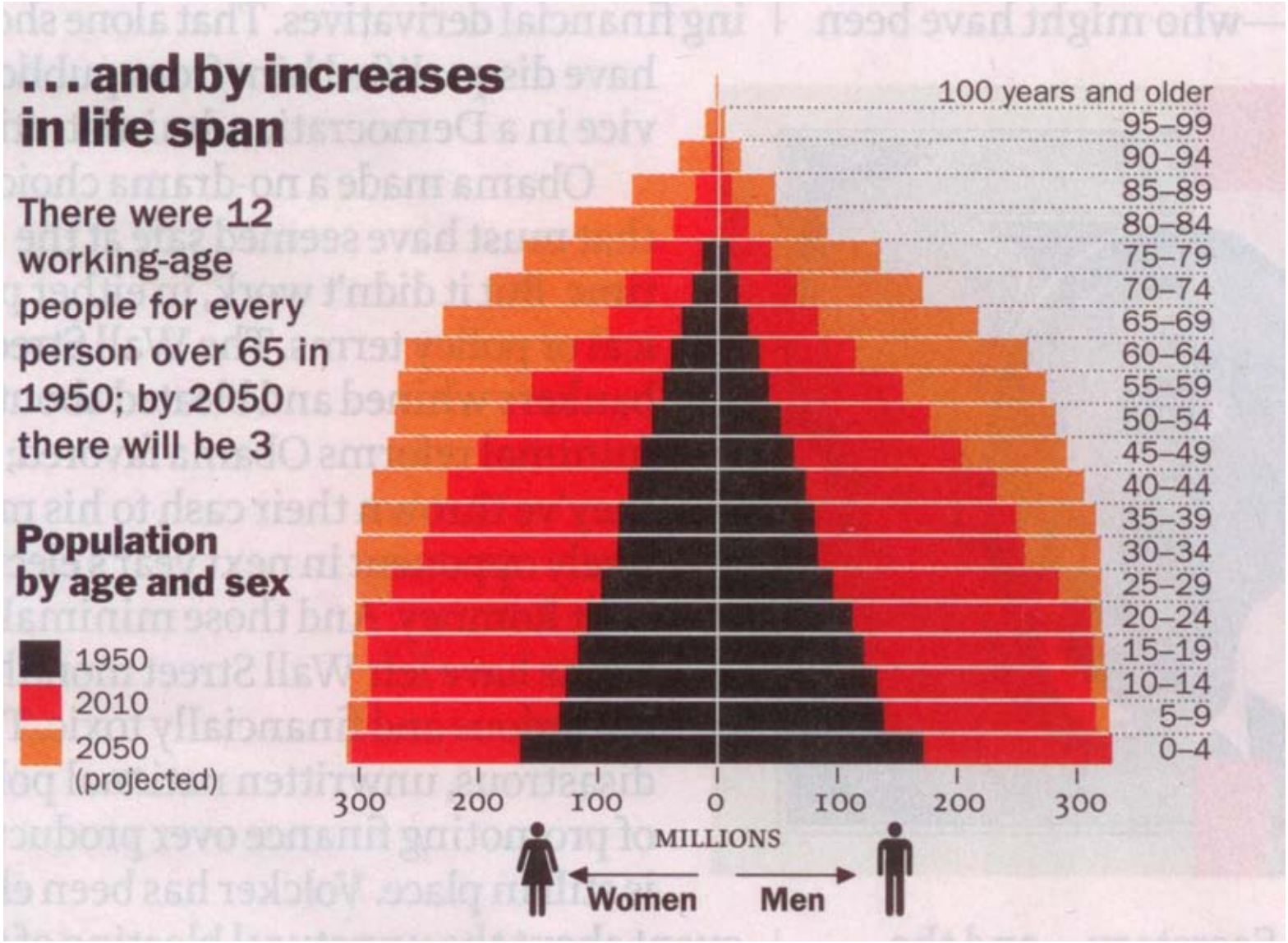
	All causes	Communicable, maternal, neonatal, and nutritional disorders	Non-communicable diseases	Injuries
1990 YLDs (thousands)	583 393	113 925	435 400	34 063
YLDs expected with 2010 population, 1990 population age structure, and 1990 YLD rates (thousands)	759 024	158 213	557 725	43 084
YLDs expected with 2010 population, 2010 population age structure, and 1990 YLD rates (thousands)	822 452	150 982	621 220	50 250
2010 YLDs (thousands)	777 401	119 164	611 075	47 162
Percentage change from 1990 due to population growth	30·1%	38·9%	28·1%	26·5%
Percentage change from 1990 due to population ageing	10·9%	−6·3%	14·6%	21·0%
Percentage change from 1990 due to change in YLD rates	−7·7%	−27·9%	−2·3%	−9·1%
Percentage change from 1990 to 2010	33·3%	4·6%	40·3%	38·4%

Lancet Dec 15, 2012

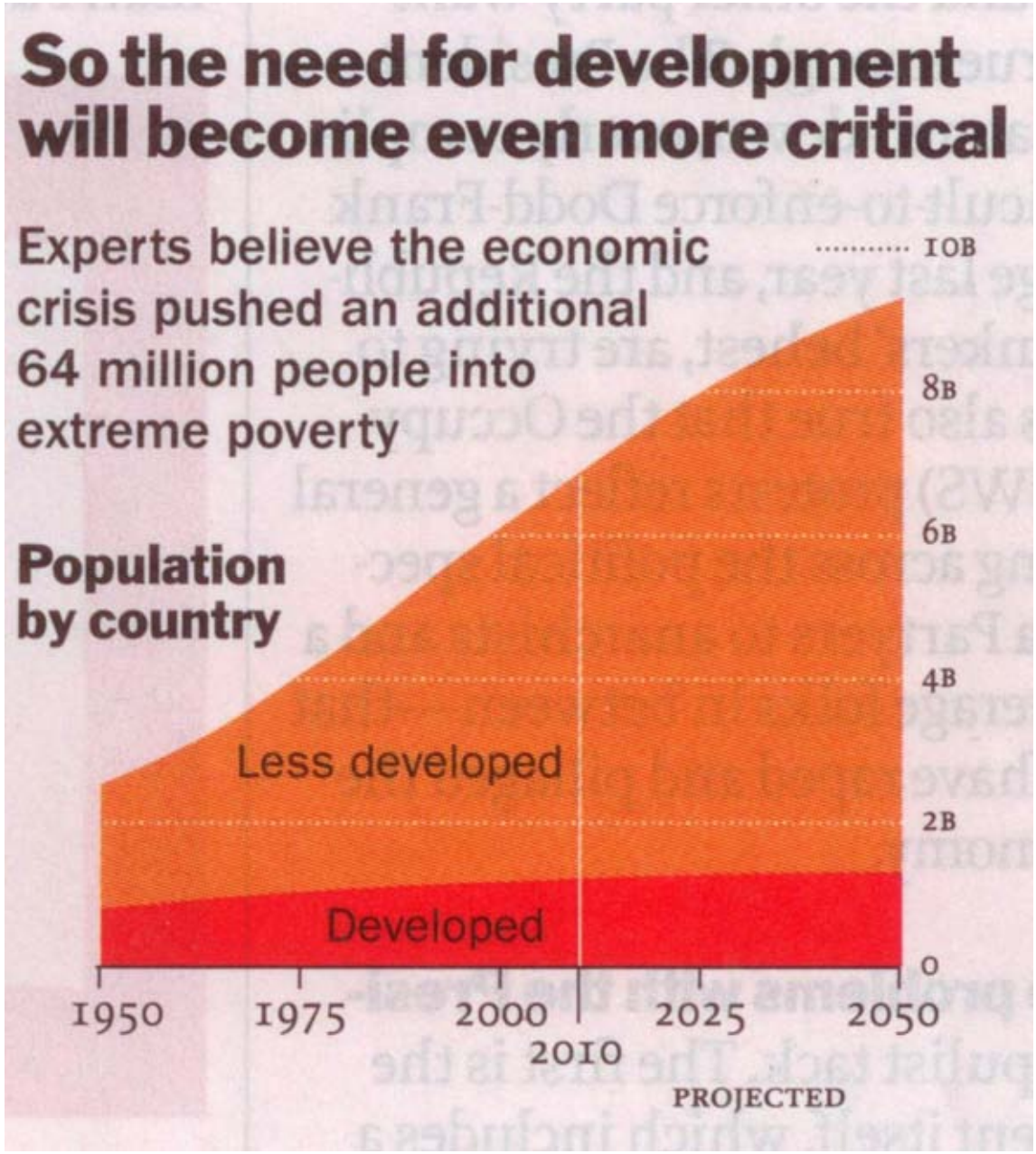
Socio-economic impact of non-communicable diseases (NCDs): a major threat to world economy

World Economic Forum: Global Risk Assessment 2009



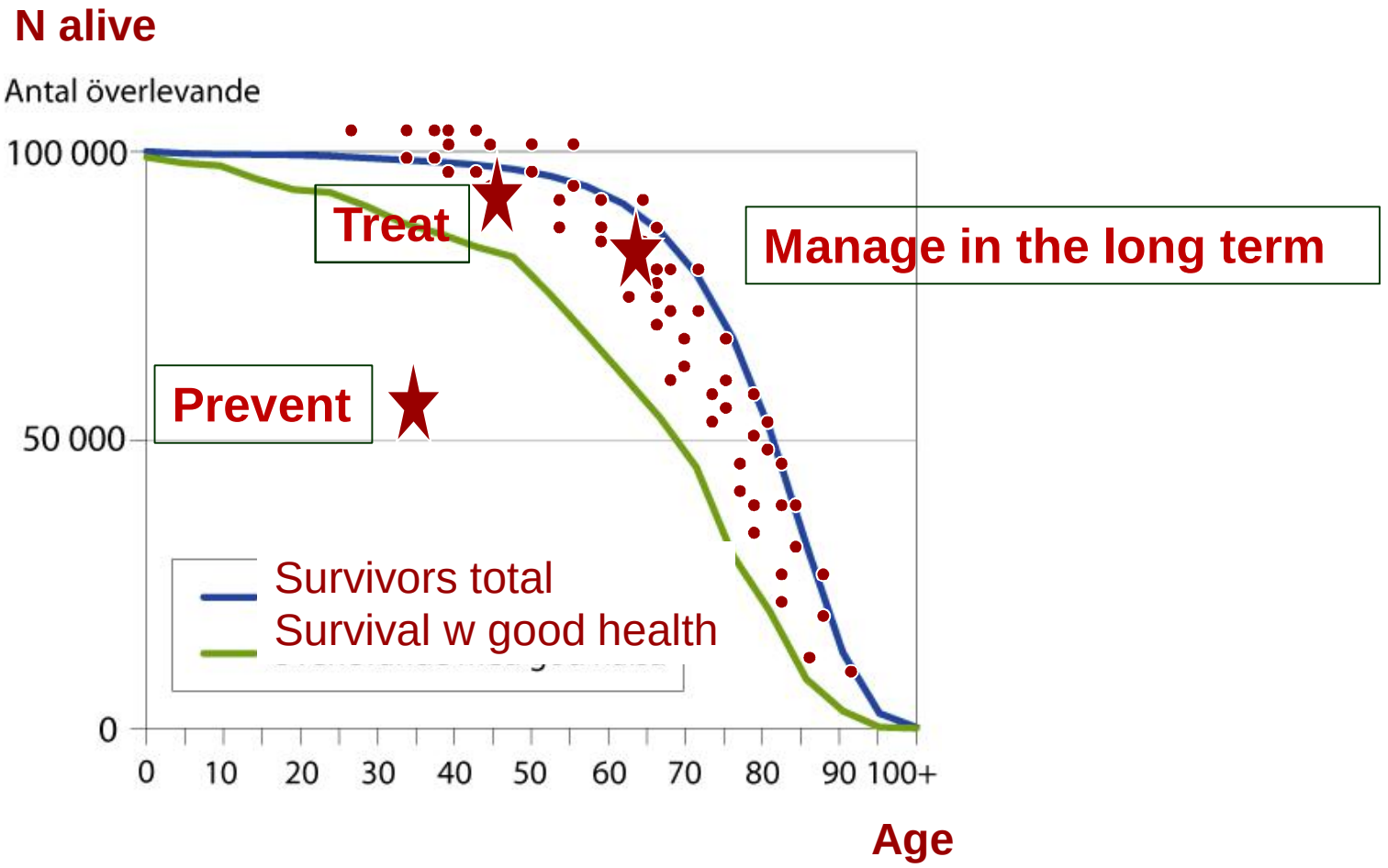


Times, October 31, 2011



Times, October 31, 2011

How can global burden of stroke be limited?



Priority actions for the non-communicable disease crisis

Robert Beaglehole, Ruth Bonita, Richard Horton, Cary Adams, George Alleyne, Perviz Asaria, Vanessa Baugh, Henk Bekedam, Nils Billo, Sally Casswell, Michele Cecchini, Ruth Colagiuri, Stephen Colagiuri, Tea Collins, Shah Ebrahim, Michael Engelgau, Gauden Galea, Thomas Gaziano, Robert Geneau, Andy Haines, James Hospedales, Prabhat Jha, Ann Keeling, Stephen Leeder, Paul Lincoln, Martin McKee, Judith Mackay, Roger Magnusson, Rob Moodie, Modi Mwatsama, Sania Nishtar, Bo Norrving, David Patterson, Peter Piot, Johanna Ralston, Manju Rani, K Srinath Reddy, Franco Sassi, Nick Sheron, David Stuckler, Il Suh, Julie Torode, Cherian Varghese, Judith Watt, for The Lancet NCD Action Group and the NCD Alliance

The UN High-Level Meeting on Non-Communicable Diseases (NCDs) in September, 2011, is an unprecedented opportunity to create a sustained global movement against premature death and preventable morbidity and disability from NCDs, mainly heart disease, stroke, cancer, diabetes, and chronic respiratory disease. The increasing global crisis in NCDs is a barrier to development goals including poverty reduction, health equity, economic stability, and human security. *The Lancet* NCD Action Group and the NCD Alliance propose five overarching priority actions for the response to the crisis—leadership, prevention, treatment, international cooperation, and monitoring and accountability—and the delivery of five priority interventions—tobacco control, salt reduction, improved diets and physical activity, reduction in hazardous alcohol intake, and essential drugs and technologies. The priority interventions were chosen for their health effects, cost-effectiveness, low costs of implementation, and political and financial feasibility. The most urgent and immediate priority is tobacco control. We propose as a goal for 2040, a world essentially free from tobacco where less than 5% of people use tobacco. Implementation of the priority interventions, at an estimated global commitment of about US$9 billion per year, will bring enormous benefits to social and economic development and to the health sector. If widely adopted, these interventions will achieve the global goal of reducing NCD death rates by 2% per year, averting tens of millions of premature deaths in this decade.

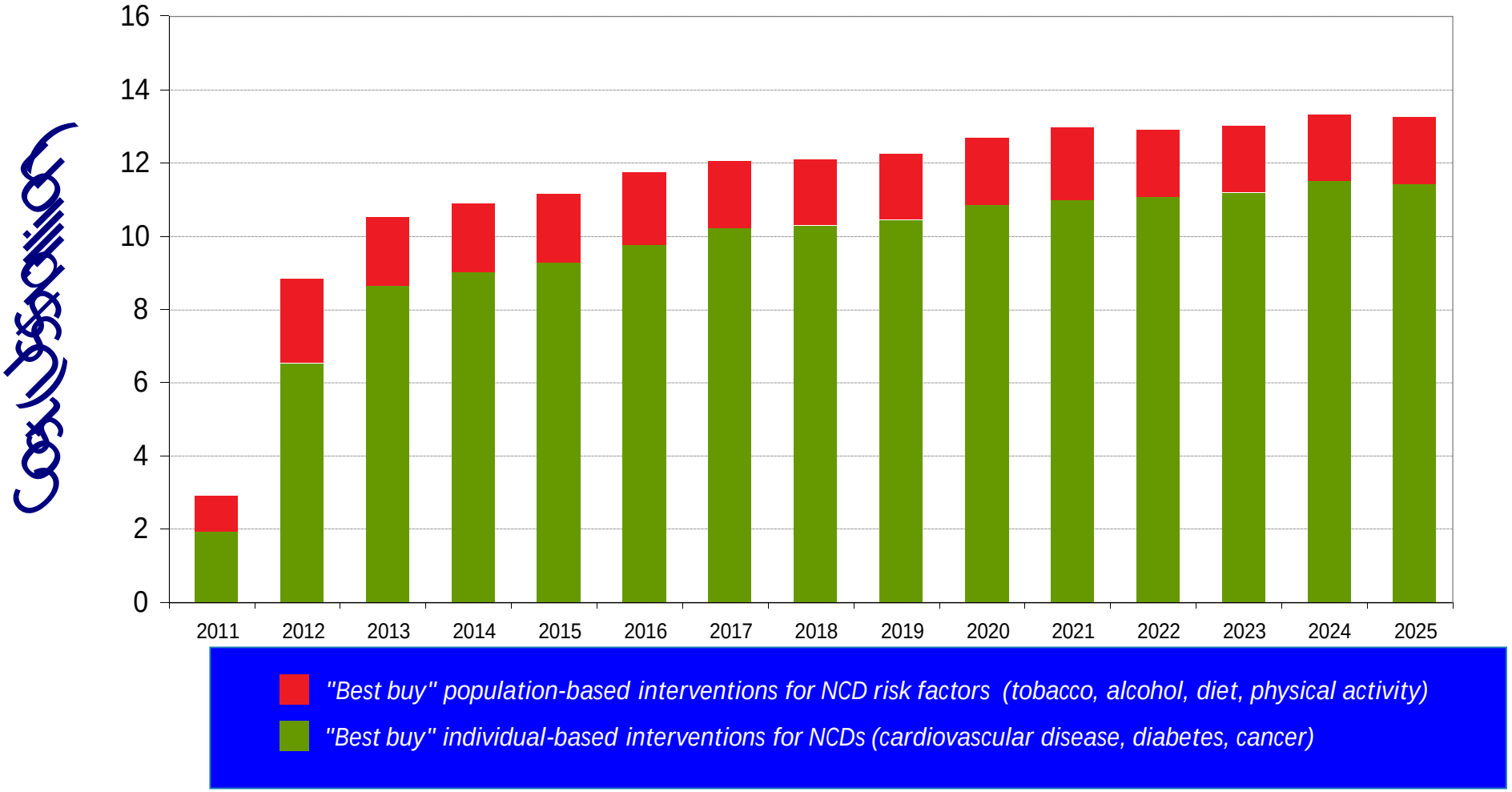
Published Online
April 6, 2011
DOI:10.1016/S0140-6736(11)60393-0

University of Auckland, Auckland, New Zealand (Prof R Beaglehole DSc, Prof R Bonita PhD); The Lancet, London, UK (R Horton FMedSci); NCD Alliance/Union for International Cancer Control, Geneva, Switzerland (C Adams MBA, J Torode PhD); Pan American Health Organization, Washington, DC, USA (G Alleyne MD, J Hospedales FFPH); School of Public Health, Imperial College

Table 1 Best buys for prevention and control of CVDs (*6*)

Risk factor/disease	Interventions
Tobacco use	■ Raise taxes on tobacco ■ Protect people from tobacco smoke ■ Warn about the dangers of tobacco ■ Enforce bans on tobacco advertising
Harmful use of alcohol	■ Raise taxes on alcohol ■ Restrict access to retailed alcohol ■ Enforce bans on alcohol advertising
Unhealthy diet and physical inactivity	■ Reduce salt intake in food ■ Replace trans-fat with polyunsaturated fat ■ Promote public awareness about diet and physical activity (via mass media)
CVD and diabetes	■ Provide counselling and multidrug therapy (including blood sugar control for diabetes mellitus) for people with medium-high risk of developing heart attacks and strokes (including those who have established CVD) ■ Treat heart attacks (myocardial infarction) with aspirin

Global Price Tag for scaling-up NCD 'best buys' in low- and middle-income countries



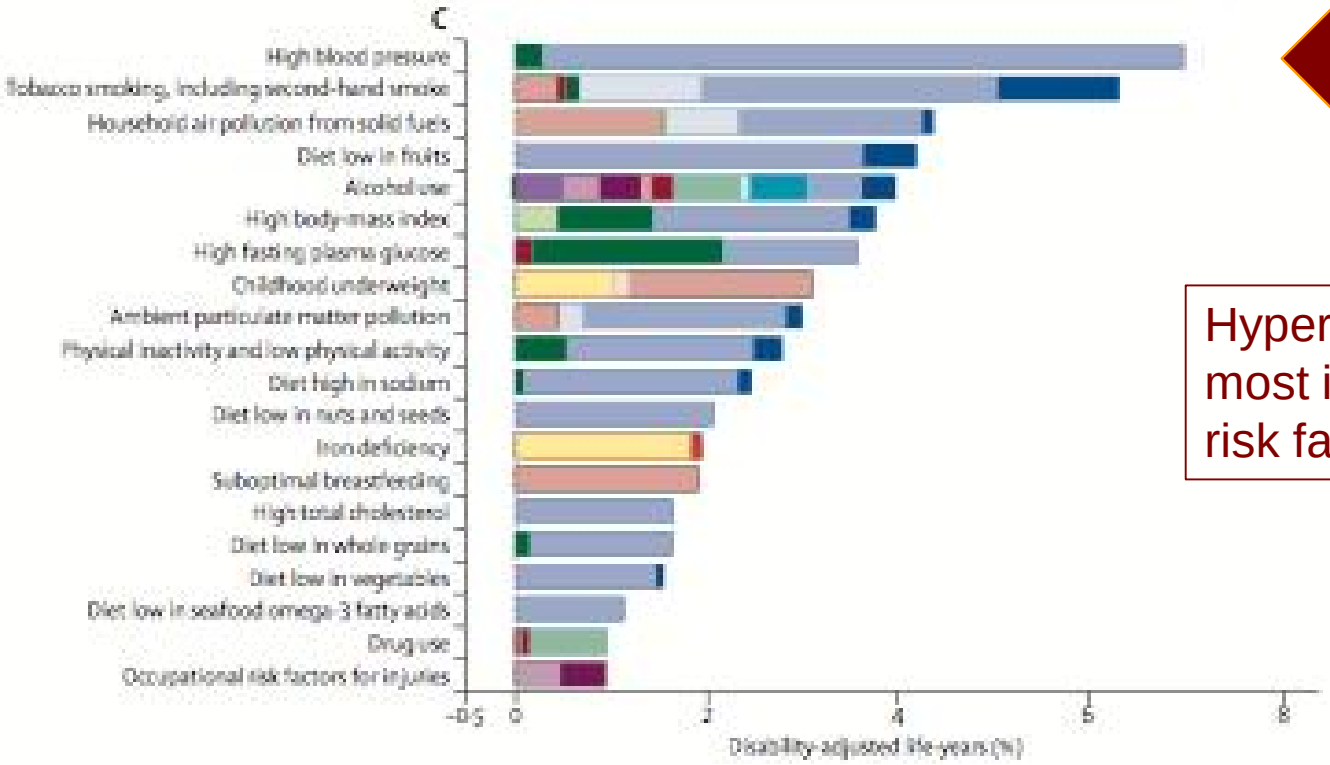
Global risk factor ranks 1990 and 2010

1990	2010	% change
Childhood underweight	High blood pressure	27 %
Household air pollution	Smoking	3 %
Smoking	Household air pollution	-32 %
High blood pressure	Low fruit	29 %
Suboptimal breest feeding	Alcohol use	32 %

Lancet Dec 15, 2012

The 2010 Global Burden of Disease Study

A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010



Hypertension the most important risk factor globally

Lancet Dec 15, 2012

INTERSTROKE: Population-attributable risk for common risk factors

Risk factor	Population-attributable risk, % (99% CI)
Hypertension	34.6 (30.4–39.1)
Smoking	18.9 (15.3–23.1)
Waist-to-hip ratio (tertile 2 vs tertile 1)	26.5 (18.8–36.0)
Dietary risk score (tertile 2 vs tertile 1)	18.8 (11.2–29.7)
Regular physical activity	28.5 (14.5–48.5)
Diabetes	5.0 (2.6–9.5)
Alcohol intake	3.8 (0.9–14.4)
Cardiac causes	6.7 (4.8–9.1)
Ratio of apolipoprotein B to A1 (tertile 2 vs tertile 1)	24.9 (15.7–37.1)
Psychological factors	
•Stress	4.6 (2.1–9.6)
•Depression	5.2 (2.7–9.8)

*For the protective factor of physical activity, the population-attributable risks are provided for individuals who do not participate in regular physical activity.

O'Donnell MJ et al. *Lancet* 2010; available at: http://www.thelancet.com.

INTERSTROKE: major findings

10 modifiable risk factors explain 90 % of stroke

The population attributable risk for hypertension was almost twice higher than for coronary heart Disease (INTERHEART); 34.8 % vs 18 %

Majority of interventions for stroke prevention don’t need lab tests

Global Milestones in Prevention and Control of NCDs:

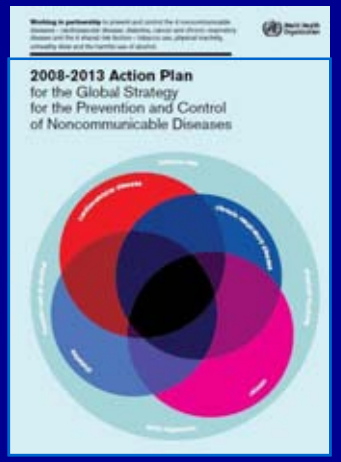
A long starting period up to the 2011 UN High Level Meeting

2000 — **Global Strategy for the Prevention and Control of Noncommunicable Diseases**

2003 — WHO Framework Convention on Tobacco Control

2004 — Global Strategy on Diet, Physical Activity and Health

2008 — Action Plan on the Global Strategy for the Prevention and Control of Noncommunicable Diseases



2011 United Nations High Level Meeting 19-21 September a landmark event

UN High Level Meeting Sept 2011

2nd time for medical topic at GA

34 heads of state present

133 member states made statements

>200 civil society representatives present

over 40 side events held

Building a global architecture to support national efforts

Global Action Plan for the Prevention and Control of NCDs 2013-2020

Comment

A milestone in the response to non-communicable diseases

On May 27, 2013, Ministers of Health of 194 WHO member states adopted the Global Action Plan for Prevention and Control of Non-communicable Diseases 2013–20.[1] The plan provides for implementation of the

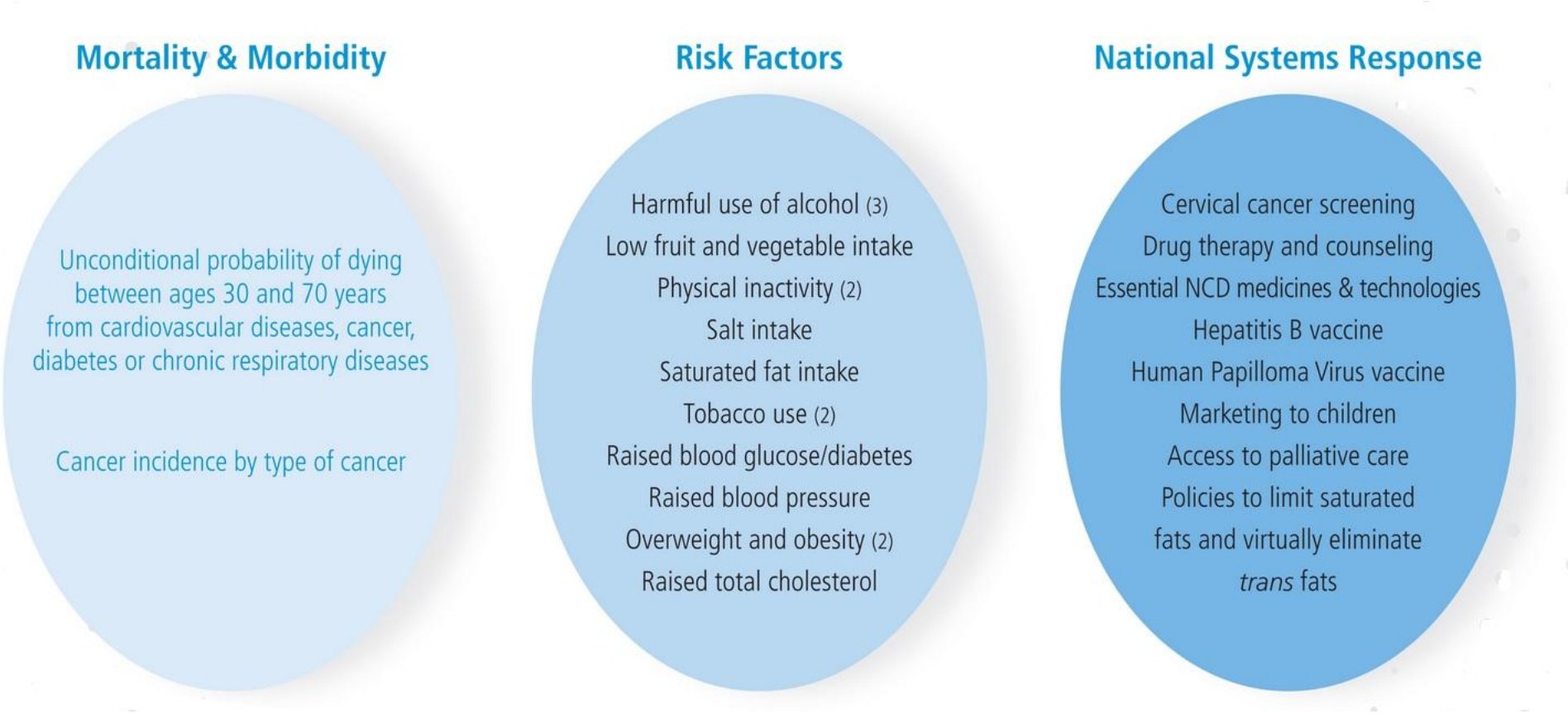
to monitor the trends and determinants of NCDs and evaluate progress in their prevention and control".[1]

One of the plan's strengths is that it has a set of specific and measurable global targets and a monitoring frame-

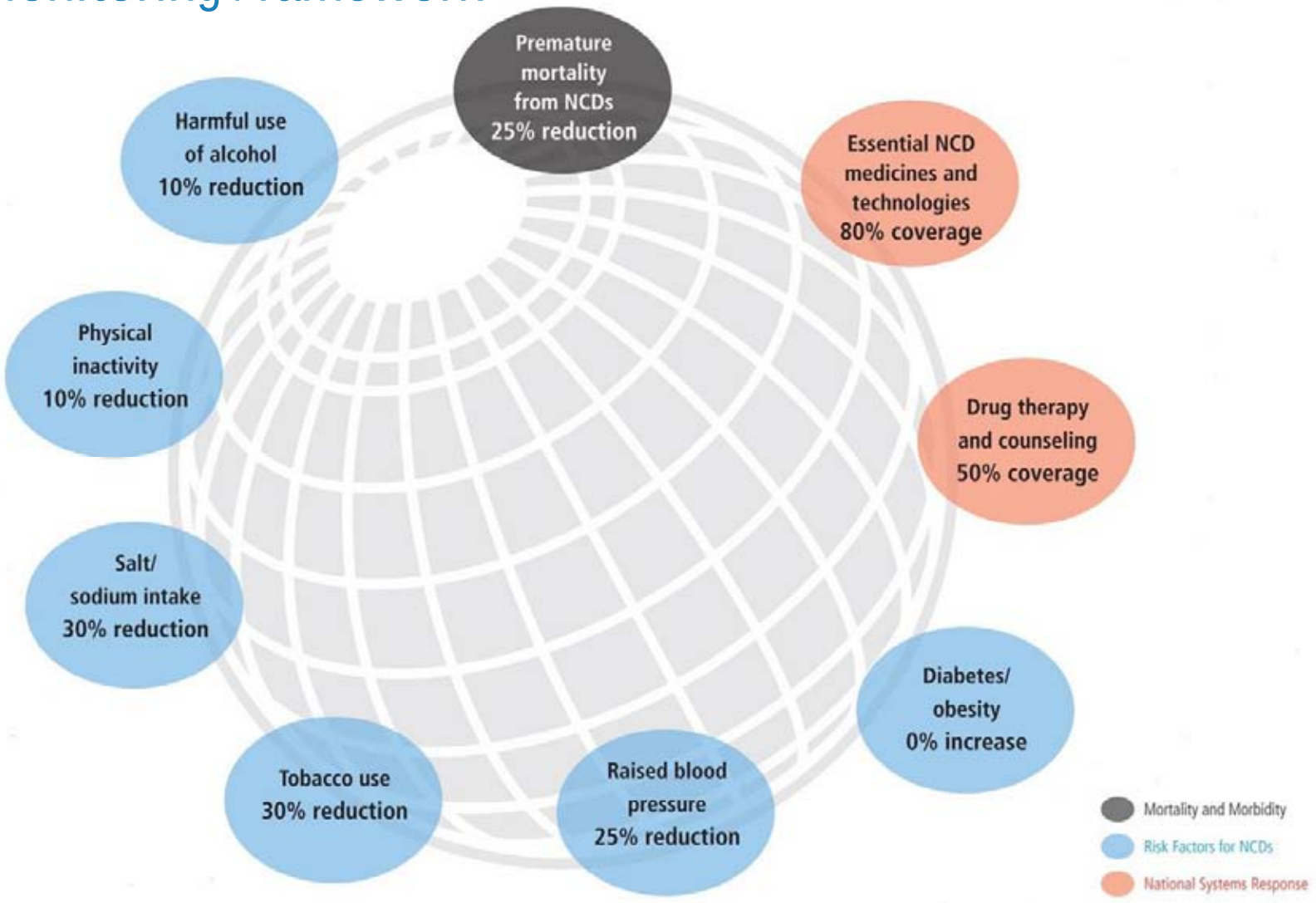
*Oleg Chestnov, *Shanthi Mendis, Douglas Bettcher*
World Health Organization, CH-1211 Geneva, Switzerland
mendiss@who.int

Lancet Aug 2013

Global Monitoring Framework



Global Monitoring Framework



UN High-level Meeting on Disability and Development
23 September 2013 New York

The post-2015 agenda

Key Messages

- **Sustainable development** as the "global guiding principle" for the post-2015 era
- Proposes **transformative action to improve health**
- Recognises **reducing the burden of NCDs as a priority** for health and development in post-2015.

Calls on Member States to:

- Accelerate momentum on MDGs
- Adopt a universal post-2015 agenda with sustainable development at its core
- Provide clarity on the road map to 2015

fication Systems

- Health classifications are a **core constitutional responsibility** of WHO, assigned by international treaty with 193 member countries
- ICD is oldest and historically most important
- One of WHO's earliest official actions was to publish ICD-6 in 1948

ICD-11

- Mandated by World Health Assembly
- ICD-10 completed in 1990; longest time without revision in history of ICD
- **Mental Health and Substance Abuse Department** responsible for revision of:
  - **Mental and Behavioural Disorders**
  - **Diseases of the Nervous System**
- Technical work to be completed 2013
- Final WHA approval, publication in **2015**

Neurology TAG Working Groups (WG)

- Cerebrovascular diseases
- Demyelinating disorders
- Epilepsy and seizures
- Headache and related disorders
- Infections of the nervous system
- Movement Disorders and neurodegenerative disorders
- Neuromuscular junction and muscle disorders
- Nutritional and toxic disorders of the nervous system
- Root, plexus and peripheral nerve diseases
- Other disorders of the nervous system, including disorders of consciousness, autonomic nervous system, others
- Disorders first recognized in infancy, childhood and adolescence
- Neoplasms of the nervous system
- Traumatic injuries of the nervous system
- Neurocognitive disorders (joint with Mental Health TAG)
- Signs and symptoms

Cerebrovascular Disease ICD-11 working group

- Bo Norrving, Sweden (chair)
- Valery Feigin, New Zealand
- Padma Gunaratne, Sri Lanka
- Vladimir Hachinski, Canada
- Michael Hennerici, Germany
- Ming Liu, China
- Peter Rothwell, UK
- Jeffrey Saver, USA

ICD-10

TIA G45	in Chapter VI Diseases in the nervous system
Stroke I60-69	in Chapter IX Diseases of the circulatory system
Silent brain infarct R90	in Chapter XVIII Abnormal findings on diagnostic imaging ..
Vascular dementia F01	in Chapter V Mental and behavioural disorders

Several areas of ”constant” misclassification

ICD-11 Proposal

Single block of ”Cerebrovascular Diseases” within Diseases of the Nervous System
Areas of misclassification cleared, improved clarity, improved clinical usefulness

ICD 11 categories
Cerebrovascular Diseases

Transient ischemic attack
Cerebral ischemic stroke
Intracerebral hemorrhage
Subarachnoid hemorrhage
Other nontraumatic intracranial bleed
Stroke not known if ischemic or hemorrhagic

Asymptomatic stenosis or occlusion of intracranial or extracranial artery
Cerebrovascular disease with no acute cerebral symptom

Other specified cerebrovascular diseases
Cerebrovascular abnormalities in diseases classified elsewhere

Hypoxic-ischaemic encephalopathy

Late effects of cerebrovascular disease

Cerebrovascular disease with no acute cerebral symptom

- Silent cerebral infarct
- Silent cerebral microbleed
- Silent white matter abnormalities associated with vascular disease

A major change in the ICD

Oct 29, 2006 merger of ISS (established 1989) and WSF (established 2004)

- individual members
- professional socities
- stroke support organisations

one voice
One World Voice for Stroke

Take home messages

Major changes in global burden of disease from 1990 to 2010, and beyond:

- A strong shift to NCDs and disability
- Stroke is one of the main drivers in the change
- Stroke is highly preventable

NCDs and stroke has entered the political arena, NCDs are not only a health issue but affects national development

”Single disease” framework challenged:

- commonality of risk factors for stroke and other NCDs
- role of co-morbidities underestimated

The WHO Global Action Plan 2013 to 2020 for NCDs and a monitoring framework has been developed

References

Feigin V et al. Worldwide stroke incidence and early case fatality reported in 56 population-based studies: a systematic review. Lancet Neurology 2009;8:355-69

Johnston SC, Mendis S, Mathers CD. Global variation in stroke burden and mortality: estimates from monitoring, surveillance, and modelling Lancet Neurology 2009;8:345-54

Norrving B and Kissella B. The global burden of disease and the need for a continuum of care. Neurology. 2013 Jan 15;80(3 Suppl 2):S5-12

Rosengren A et. Twenty-four year trends in the incidence of ischemic stroke in Sweden 1987 to 2010. Stroke 2013;44:2388-93

Lancet Dec 15 issue 2012: Global Burden of Disease Study

Global action plan for Prevention and Control of NCDs 2013-2020.

Available at www.who.int

Thank you for your attention!