The biology of poverty…….

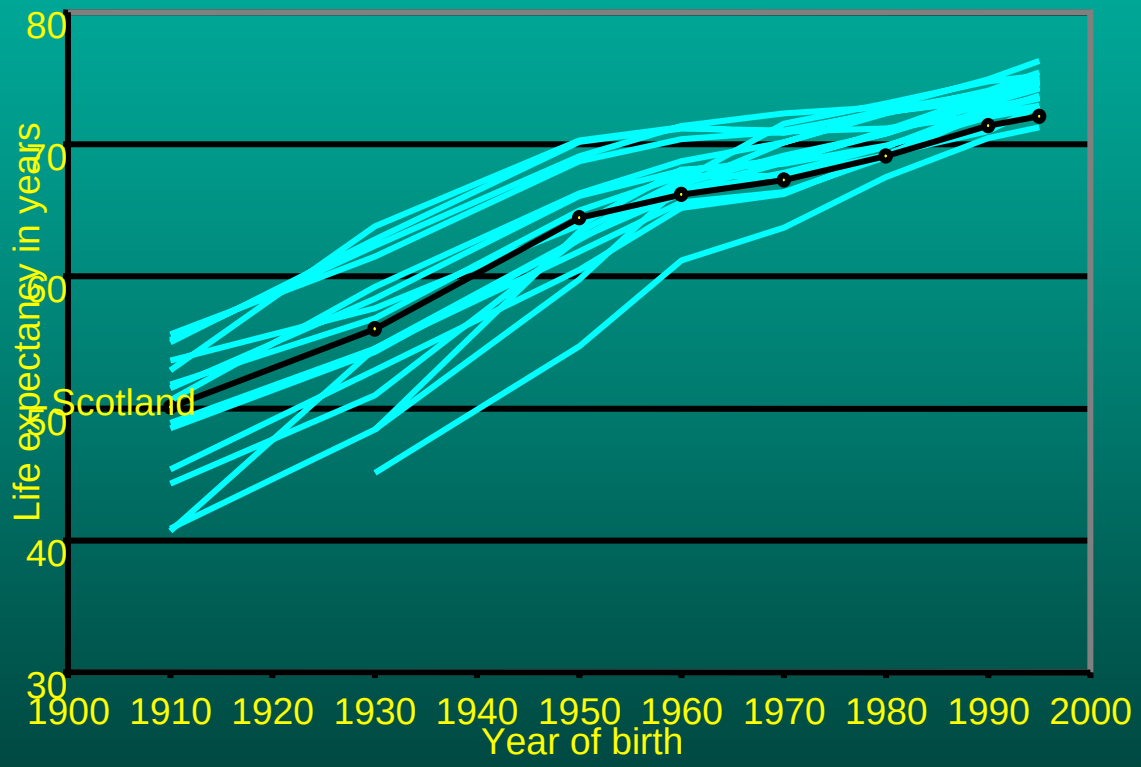
some thoughts on the association between deprivation and health

Belfast

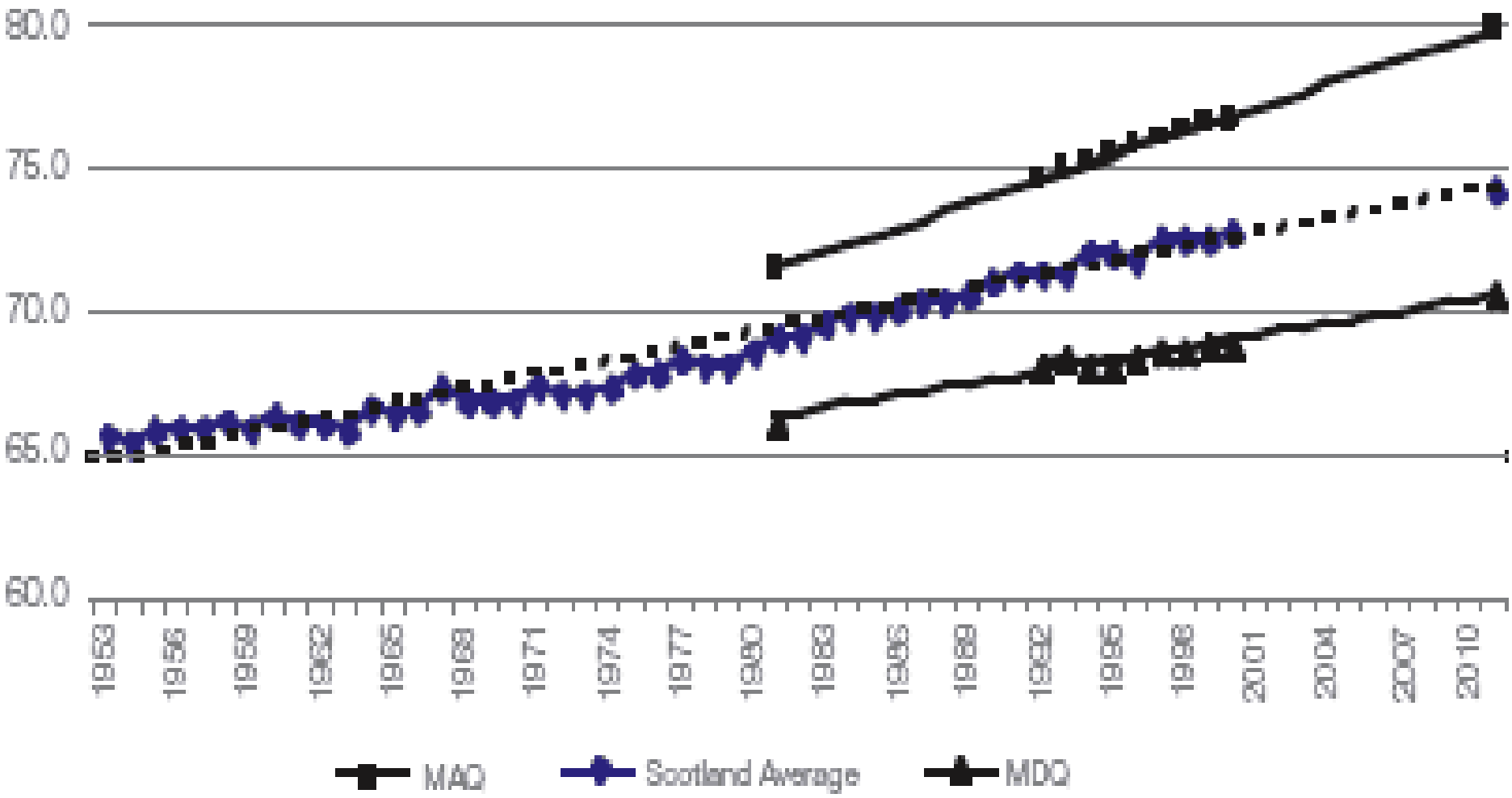
27th November 2007

20th century trends in life expectancy in Scotland and 16 other Western European countries

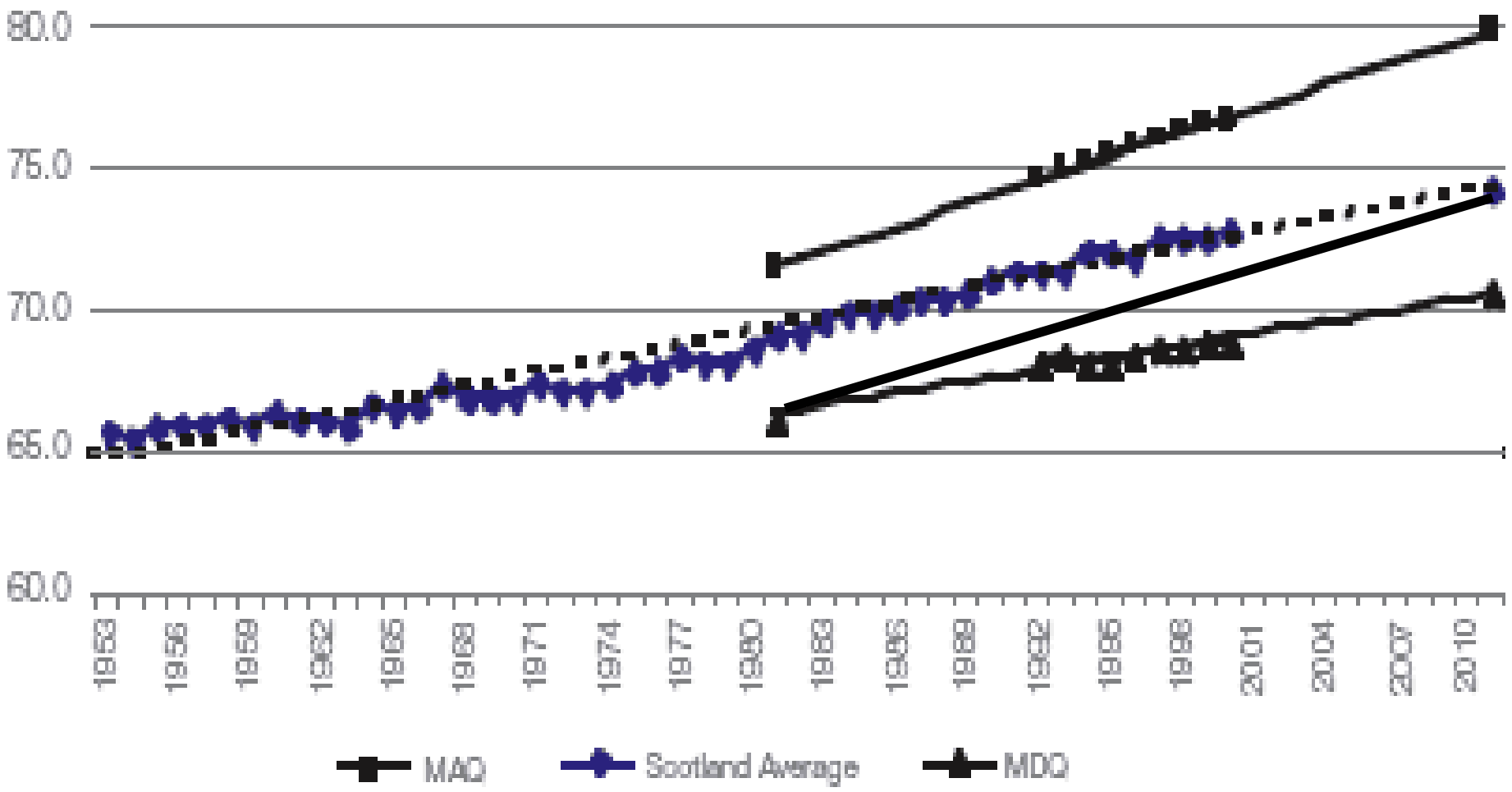
Males



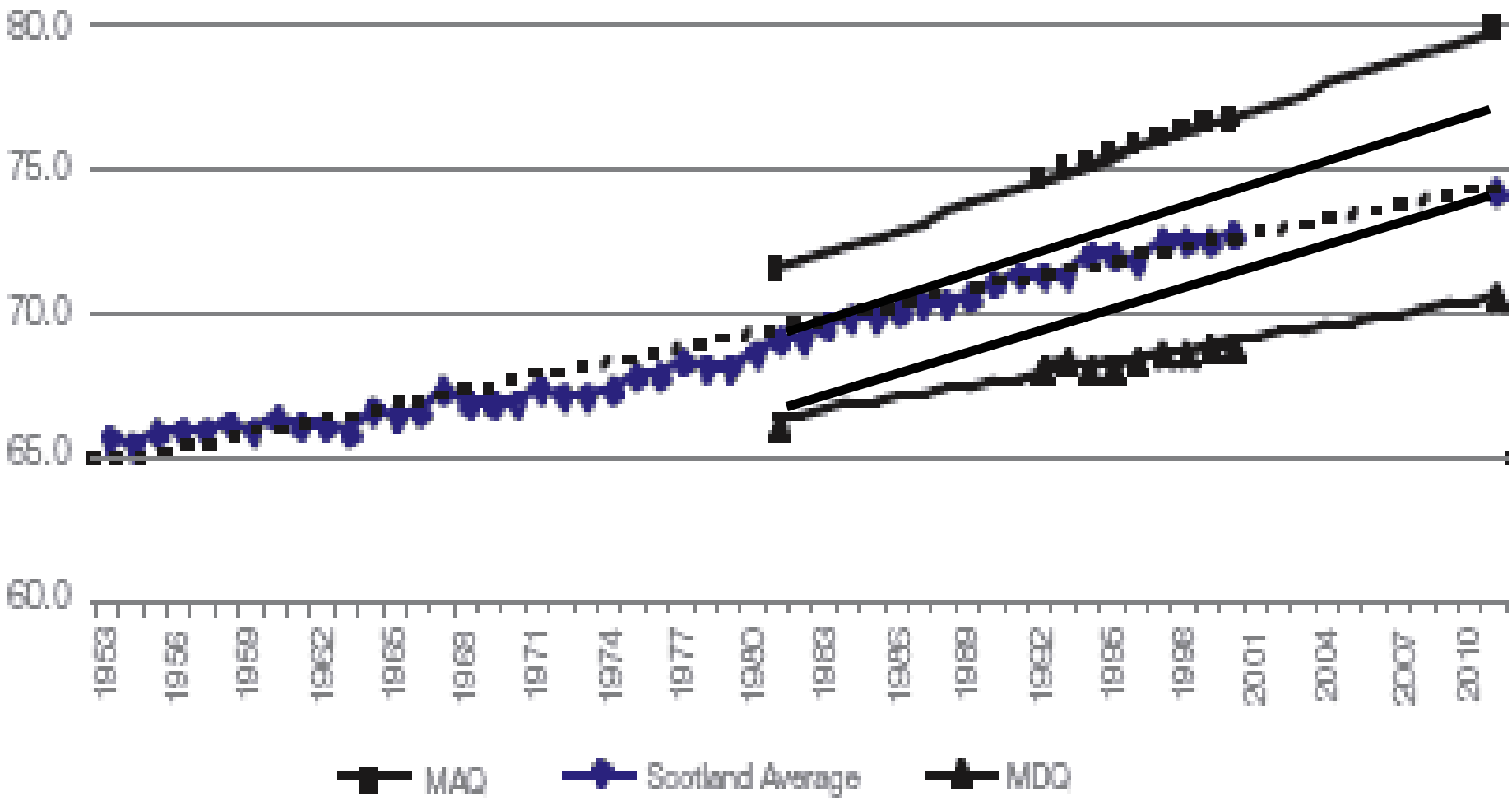
Trends in life expectancy - males



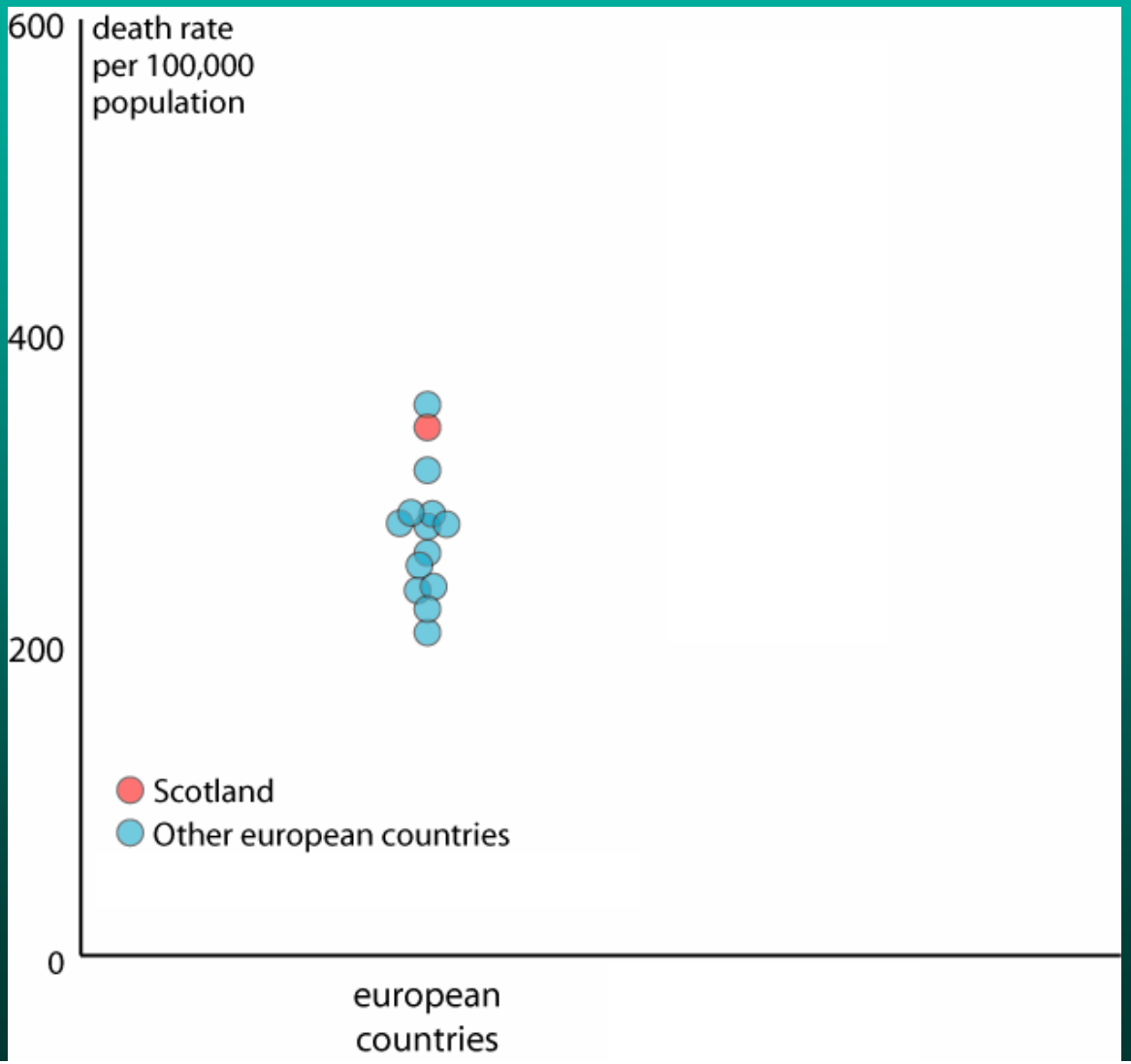
Improving Scottish life expectancy



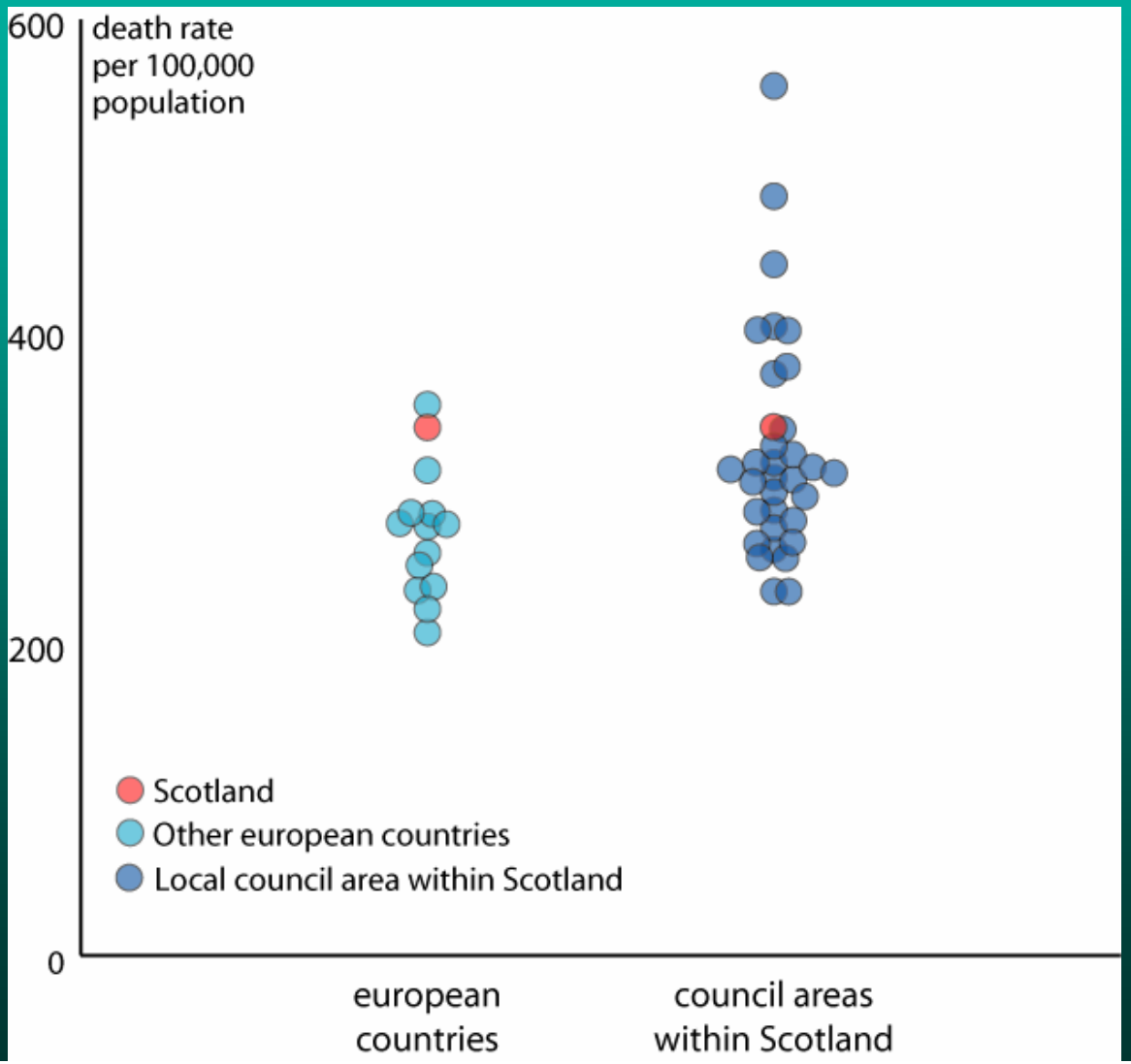
Improving Scottish life expectancy



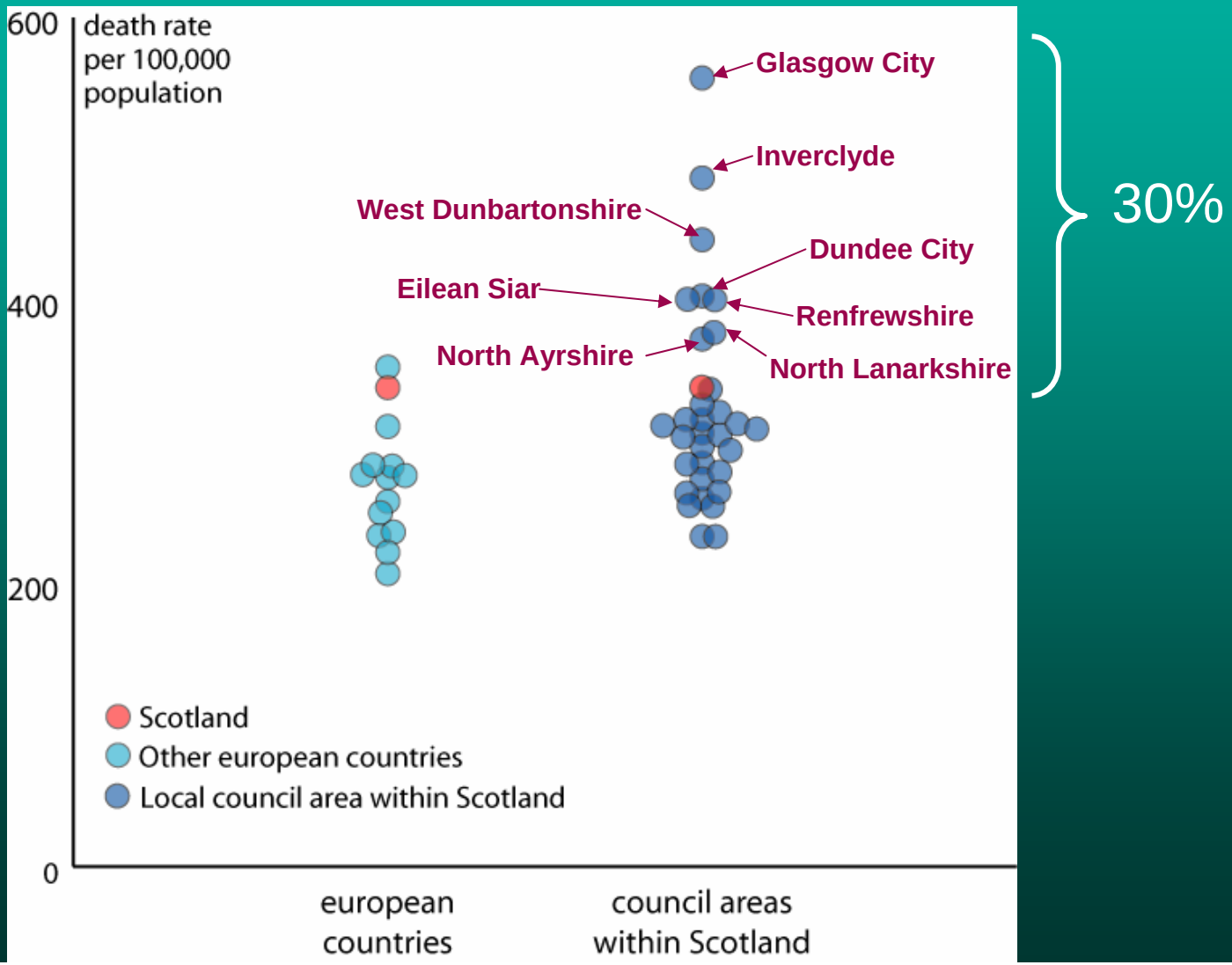
All cause death rates, M 0-64, 2001



All cause death rates, M 0-64, 2001



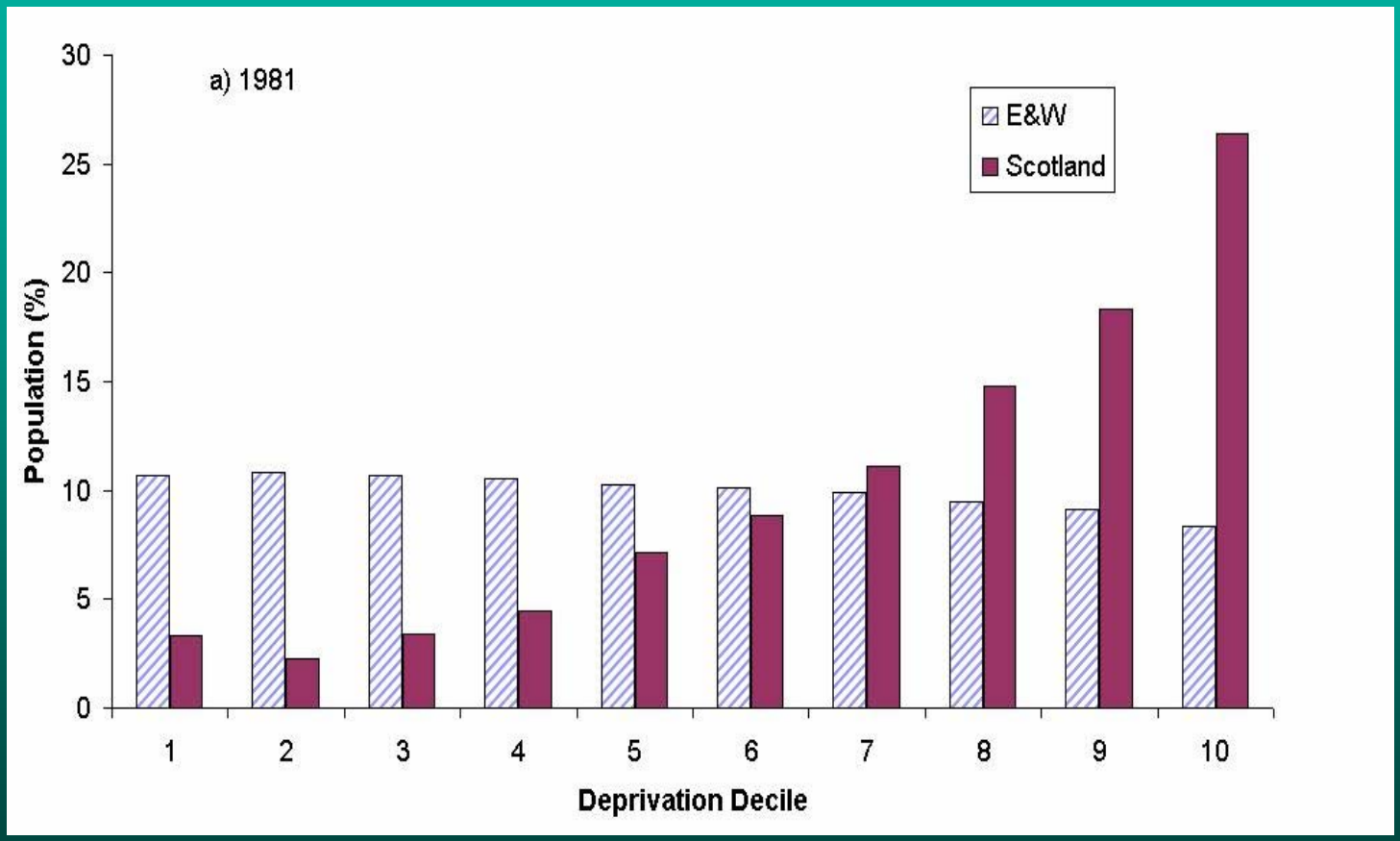
All cause death rates, M 0-64, 2001



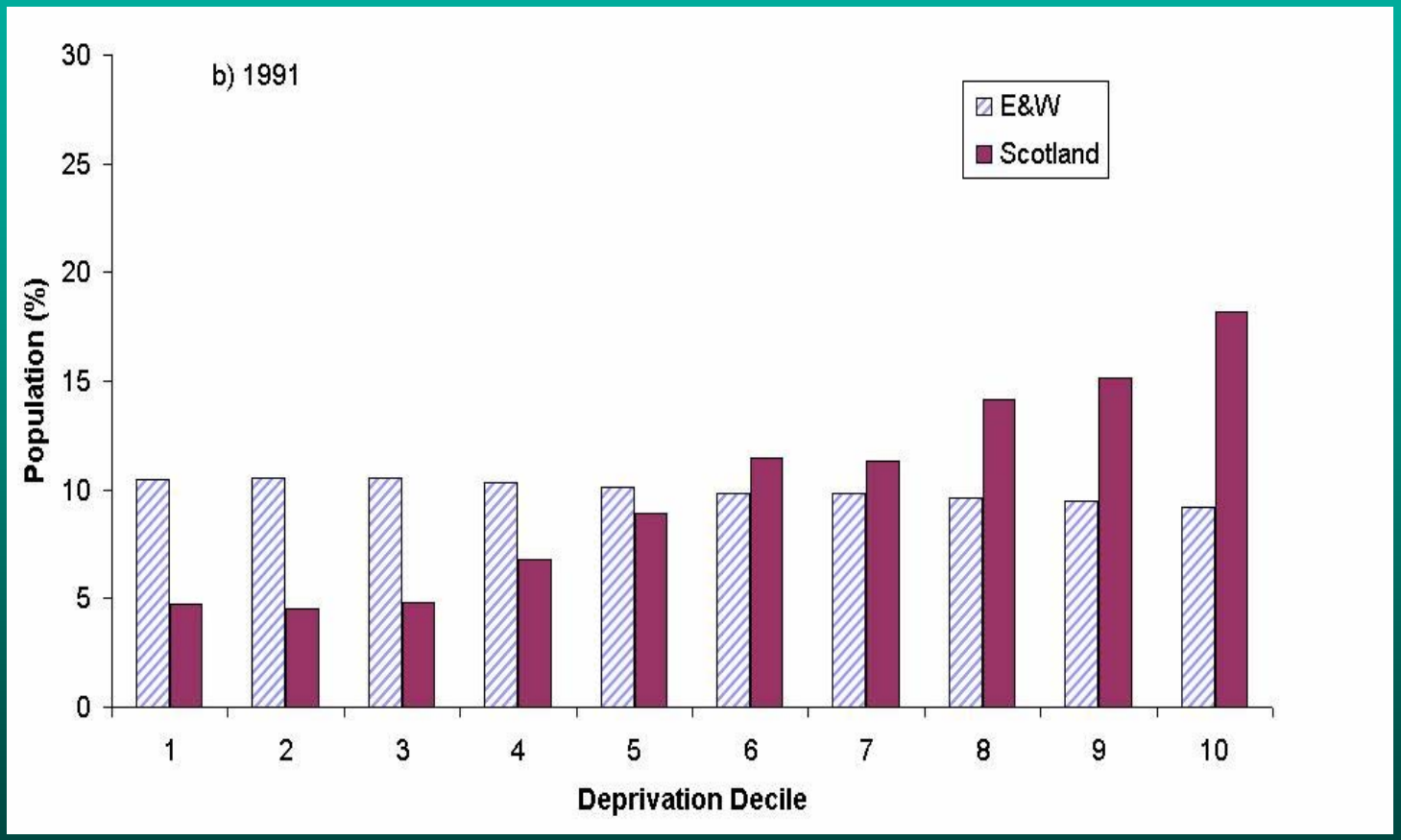
Social circumstances and health

“If we just deal with the poverty and the bad housing, health will get better anyway……”

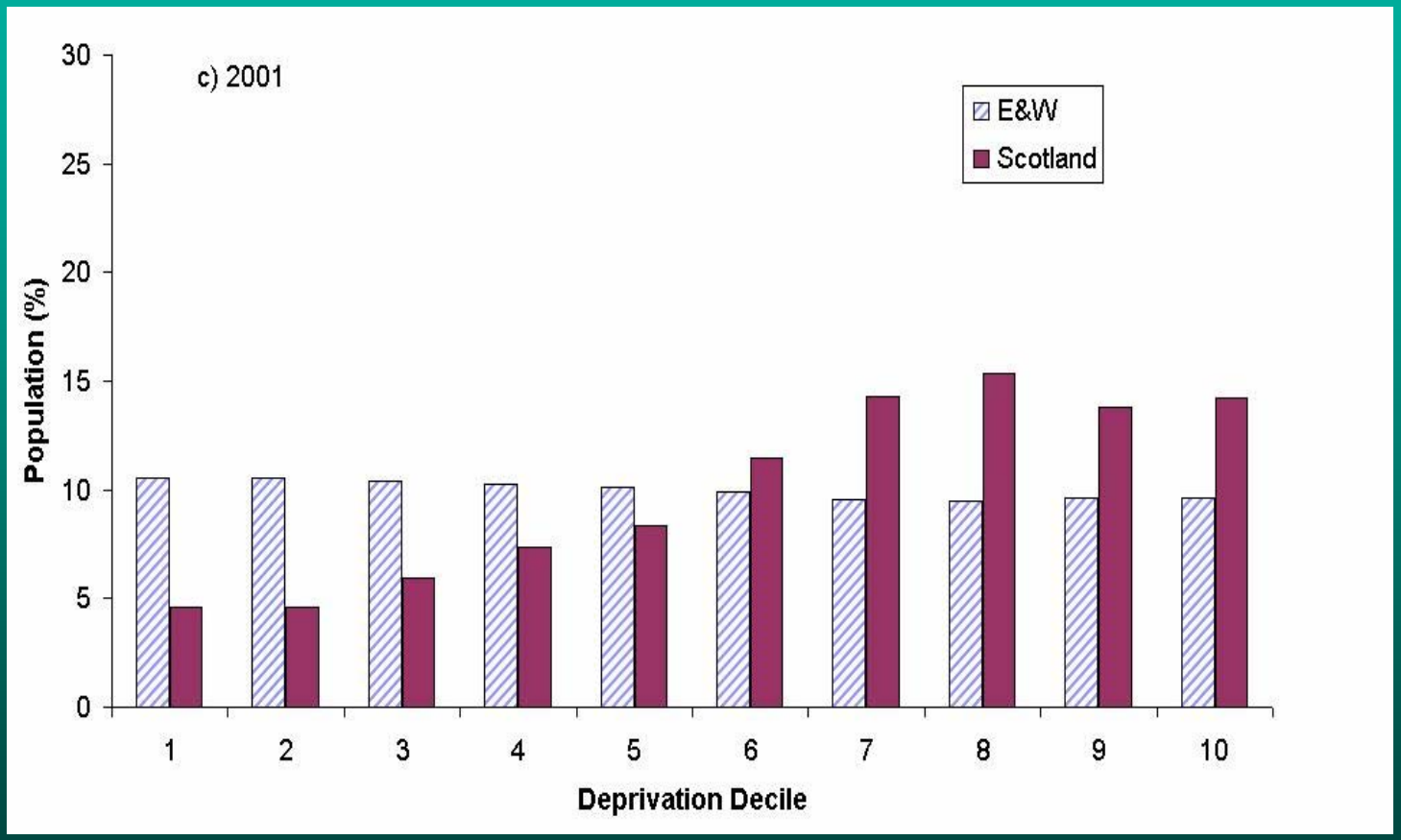
Deprivation in 1981



Deprivation in 1991

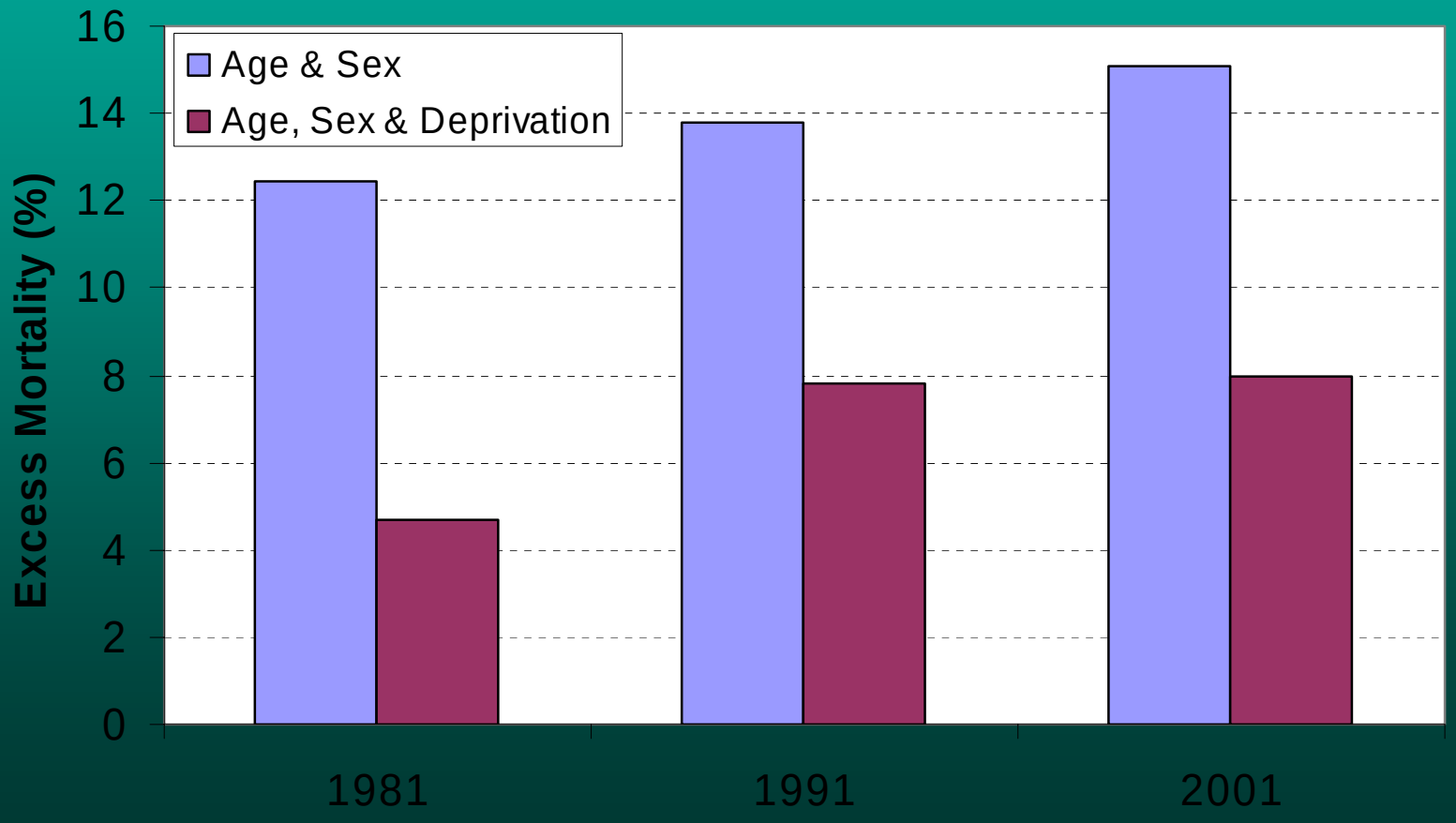


Deprivation in 2001



Excess Standardised Mortality not explained by deprivation

(Scotland v. E&W)

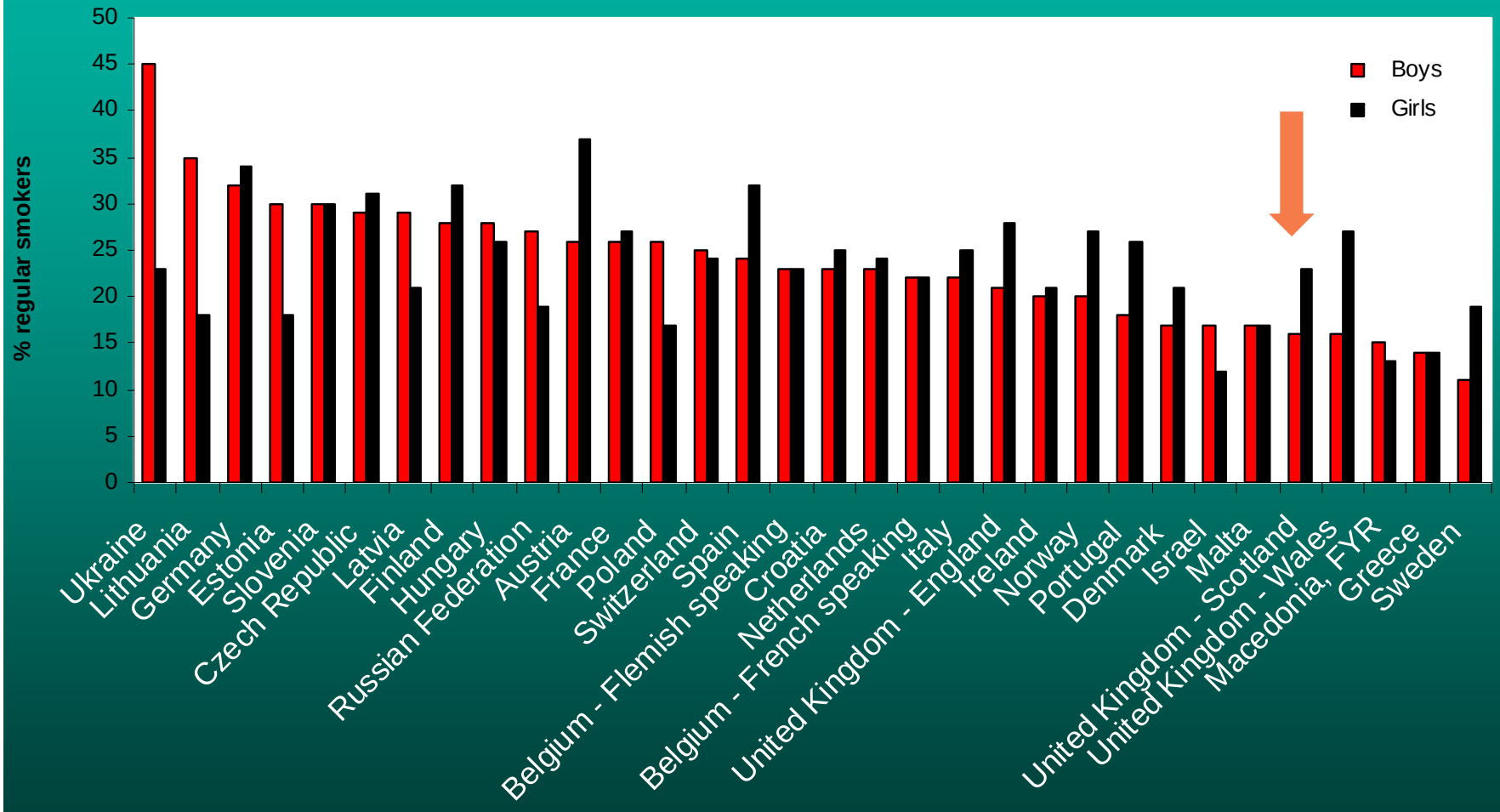


Past experiences:Castlemilk

- ≥ £244.5m spent over 10 yrs to 2000
- Major impact on physical environment
- Population decline – but stabilised
- 18% reduction of FTE jobs, though higher employment rate
- Rise in % with LLT illness (from 21% in ’91 to 32% in ’01). Glasgow figs 19% to 26%.

“Well, so many people in Scotland smoke. We’ve got to tackle smoking…..”

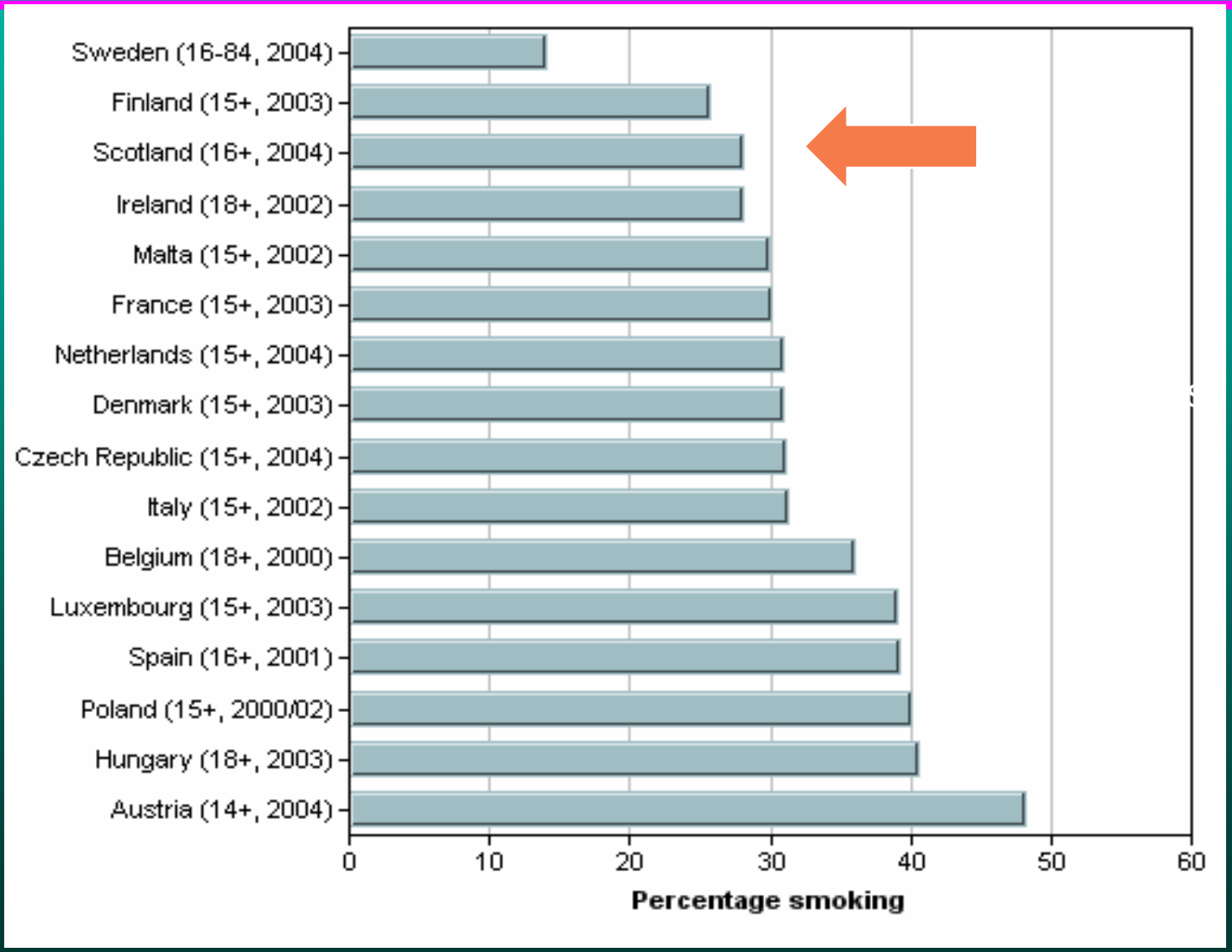
Prevalence of smoking by country, in 15 year olds by sex, 2000/01, Europe



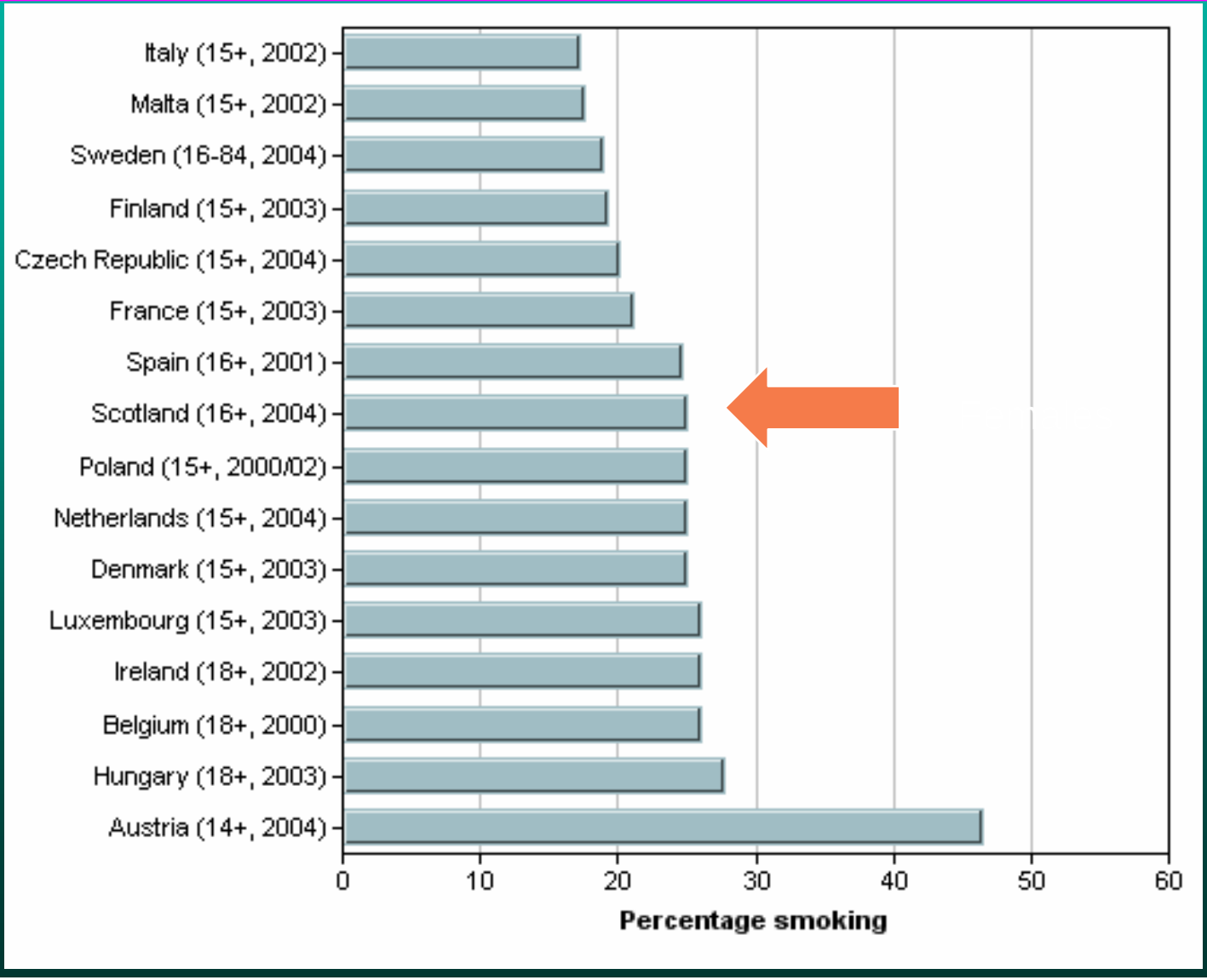
World Health Organization (1997 and 2003)

www.heartstats.org

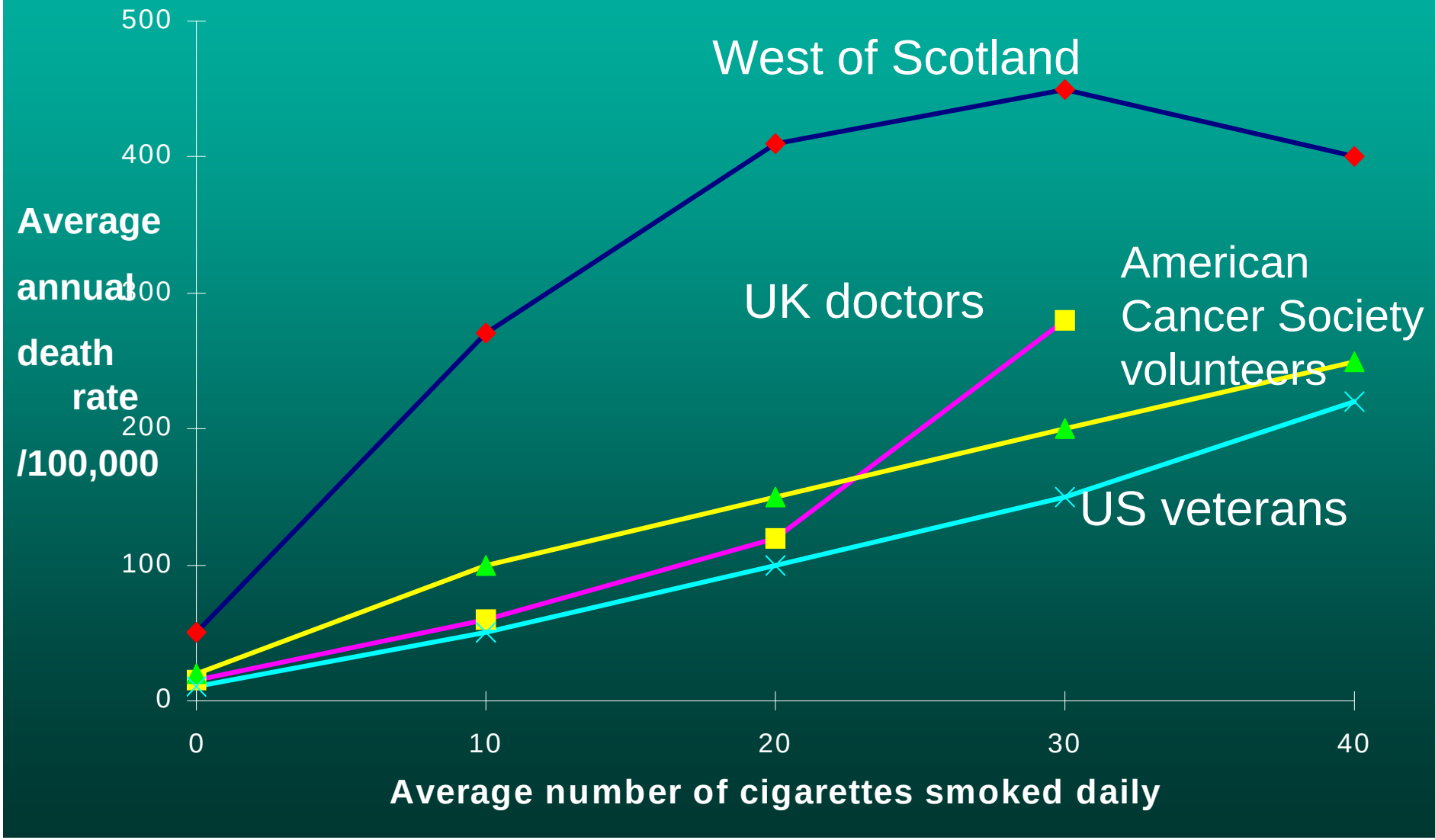
Smoking prevalence - Europe



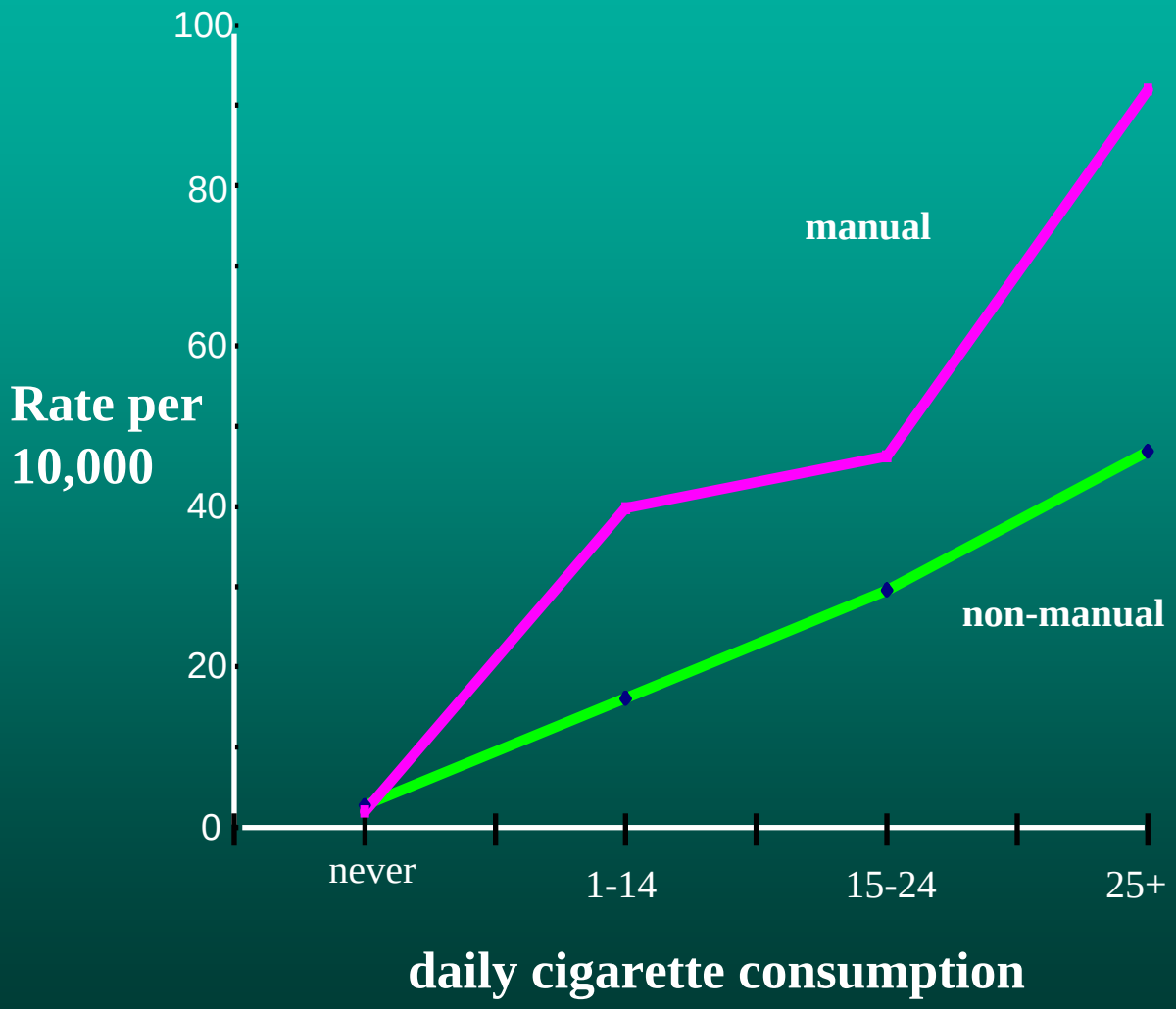
Smoking prevalence - Europe



Comparison of lung cancer mortality in West of Scotland and 3 major cohorts

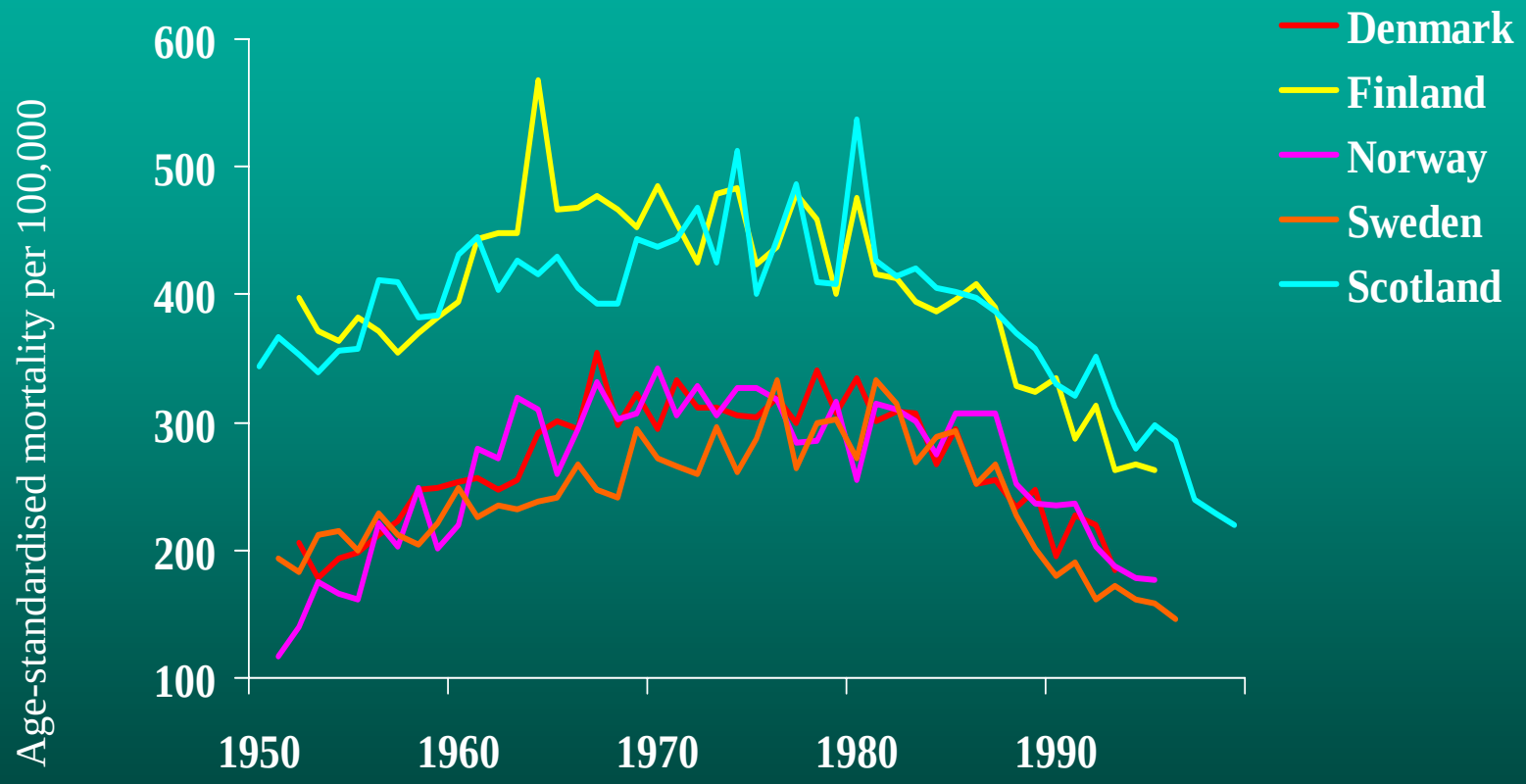


Lung cancer mortality by social class

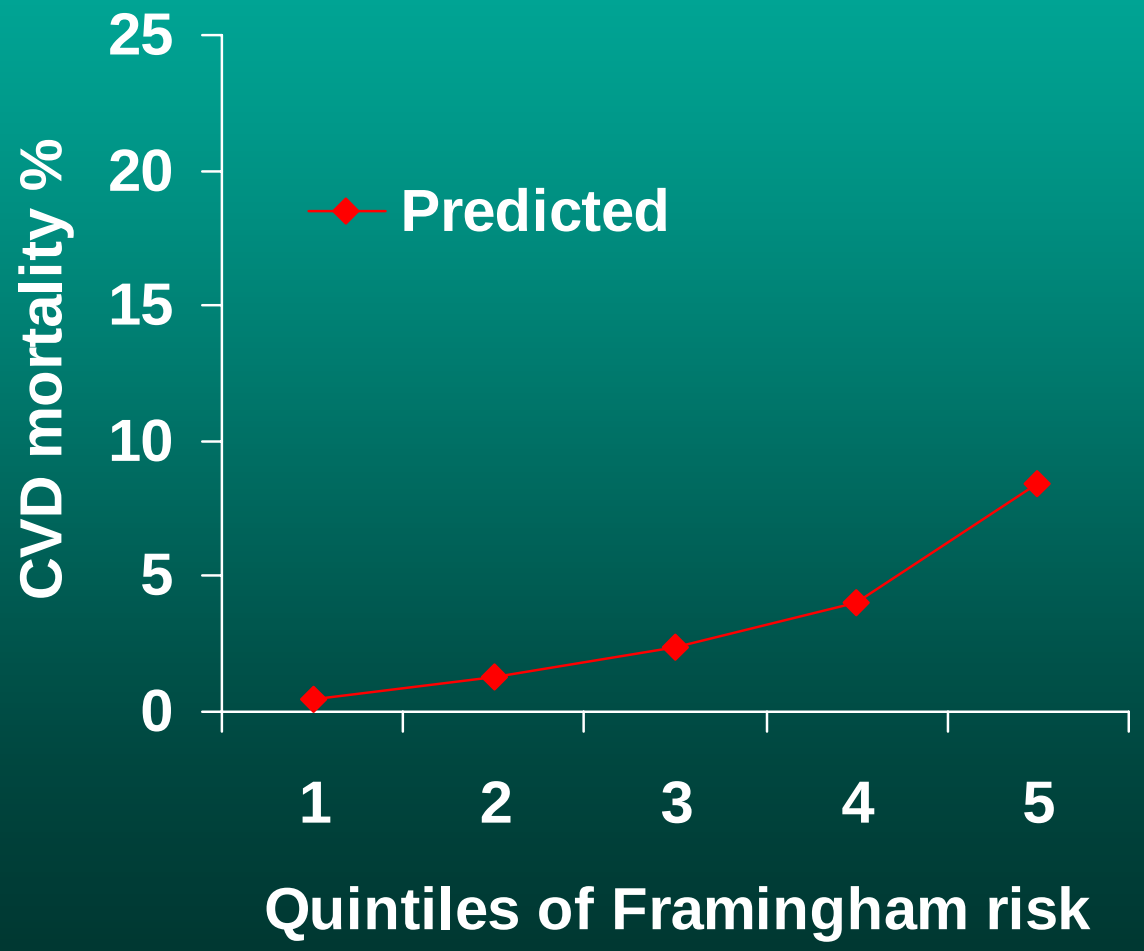


“It’s diet. That’s the problem. We’ve got to get people to reduce the fat content of their diet….”

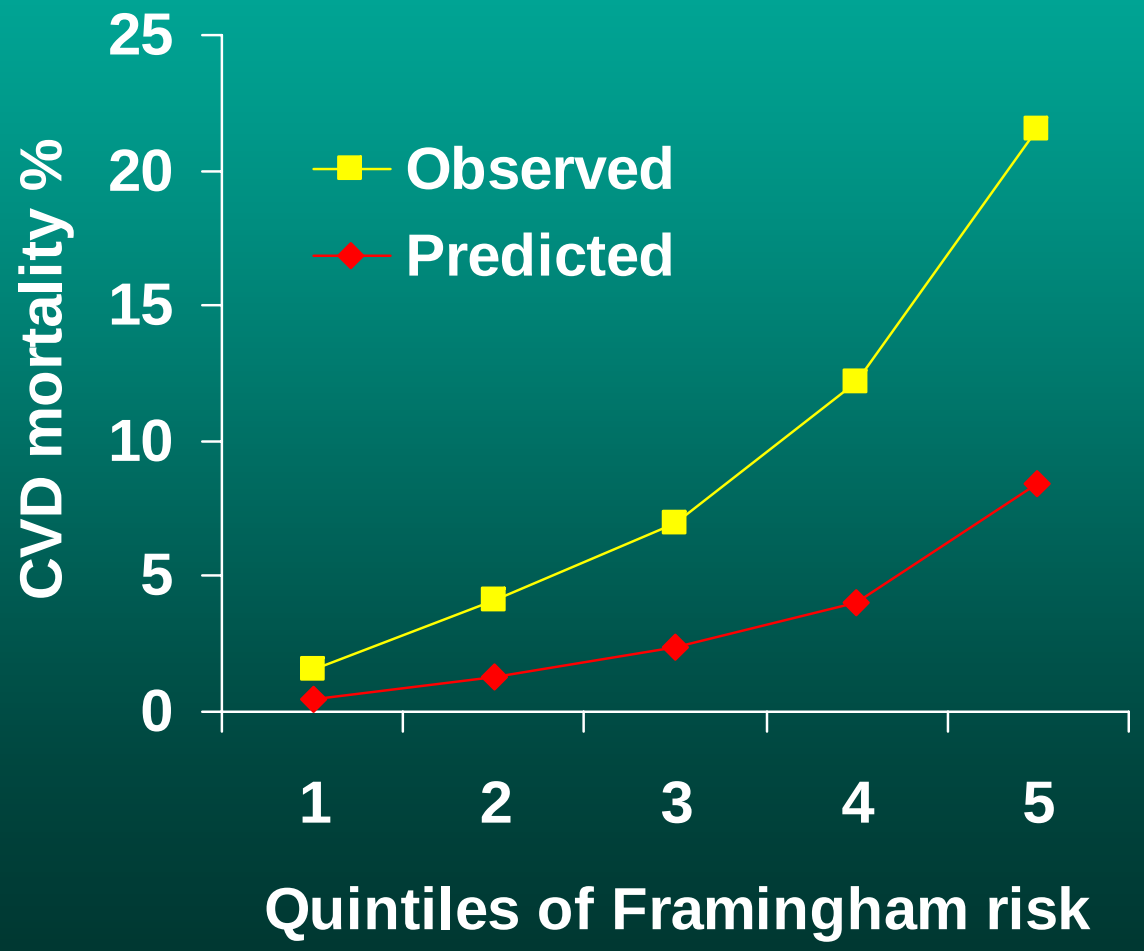
Coronary heart disease mortality
Men aged 15-74 years



PREDICTED HEART DISEASE DEATHS IN RENFREW PAISLEY (MIDSPAN)



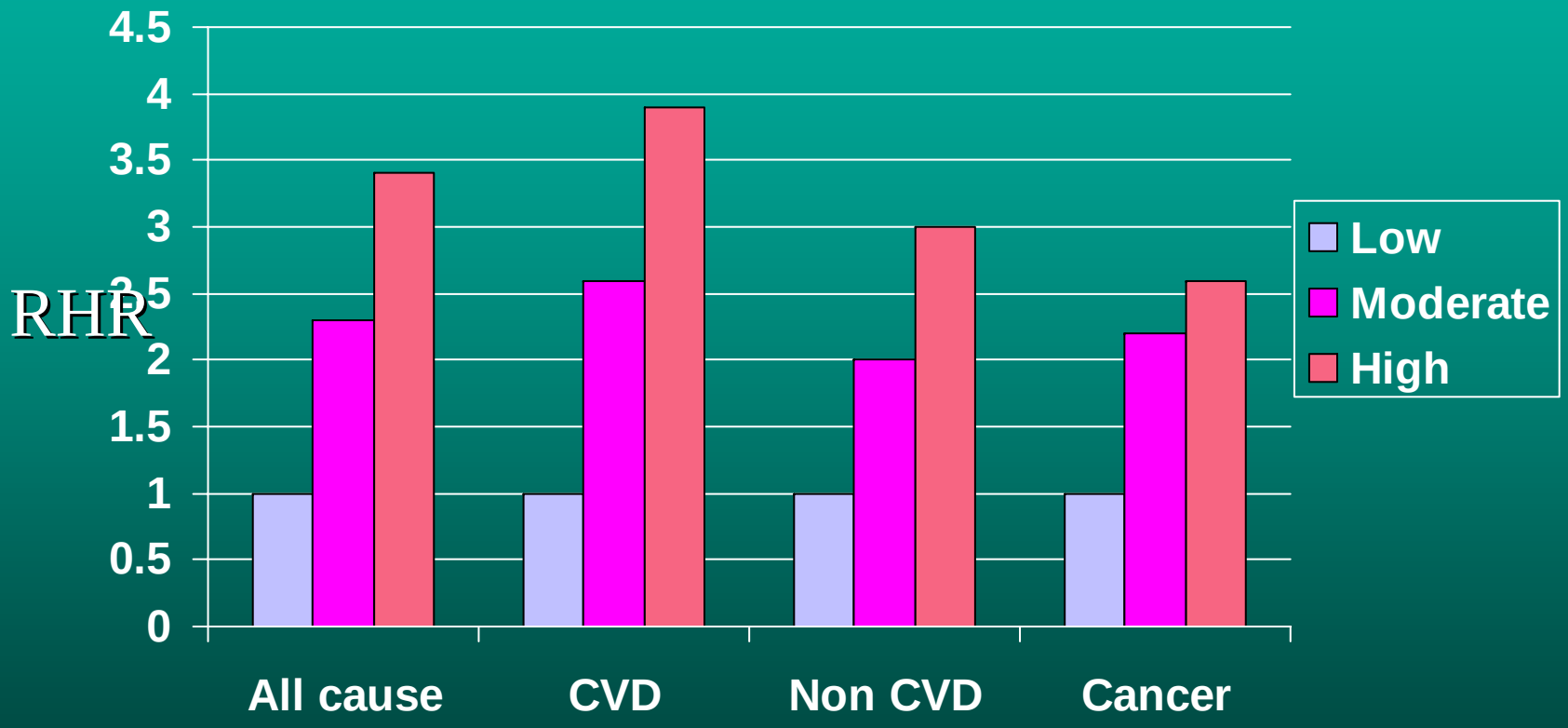
PREDICTED AND OBSERVED HEART DEATHS IN RENFREW PAISLEY (MIDSPAN)



“OK, smart Alec! What’s the missing factor in our concept of health?”

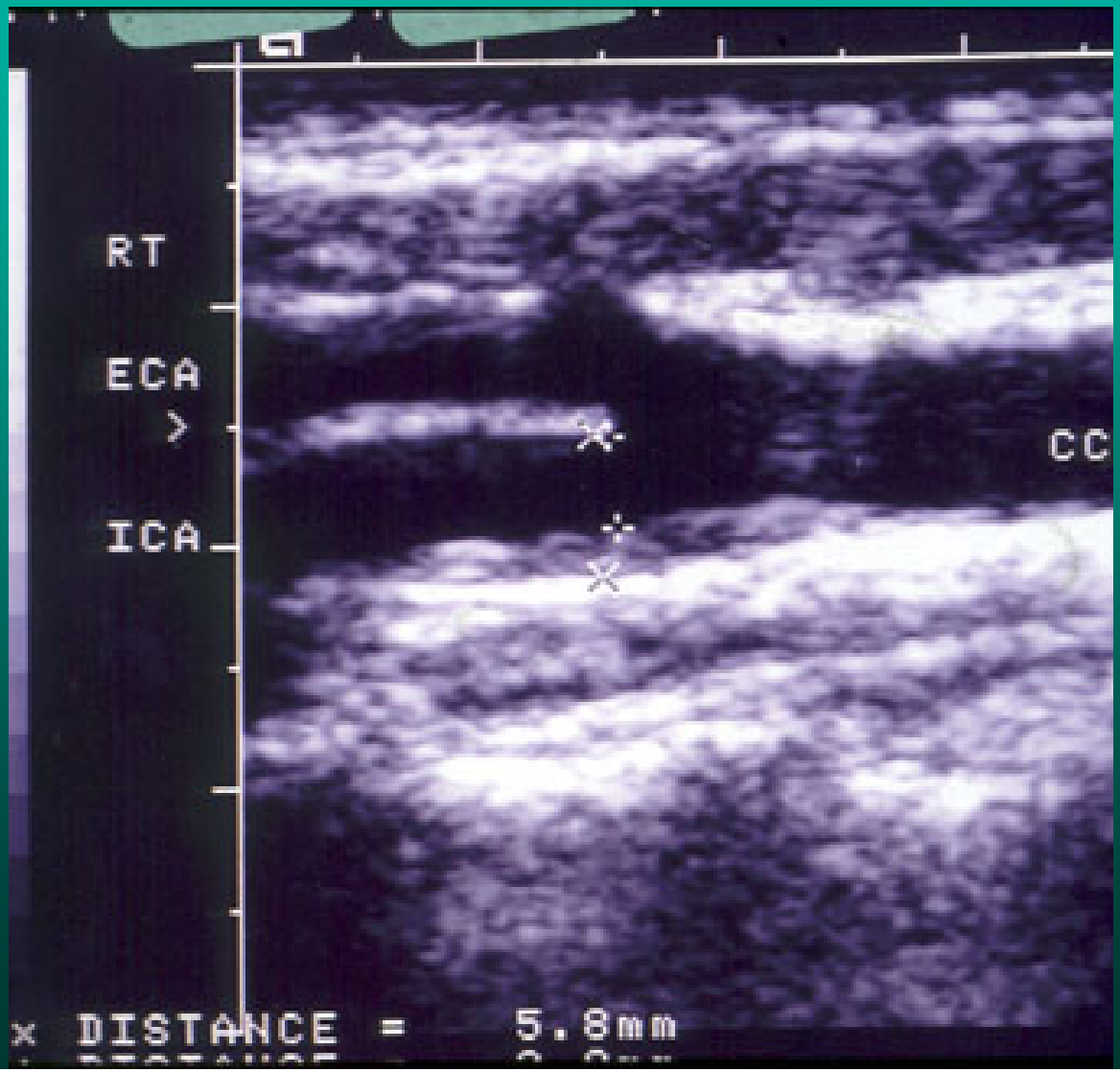
Risk of death

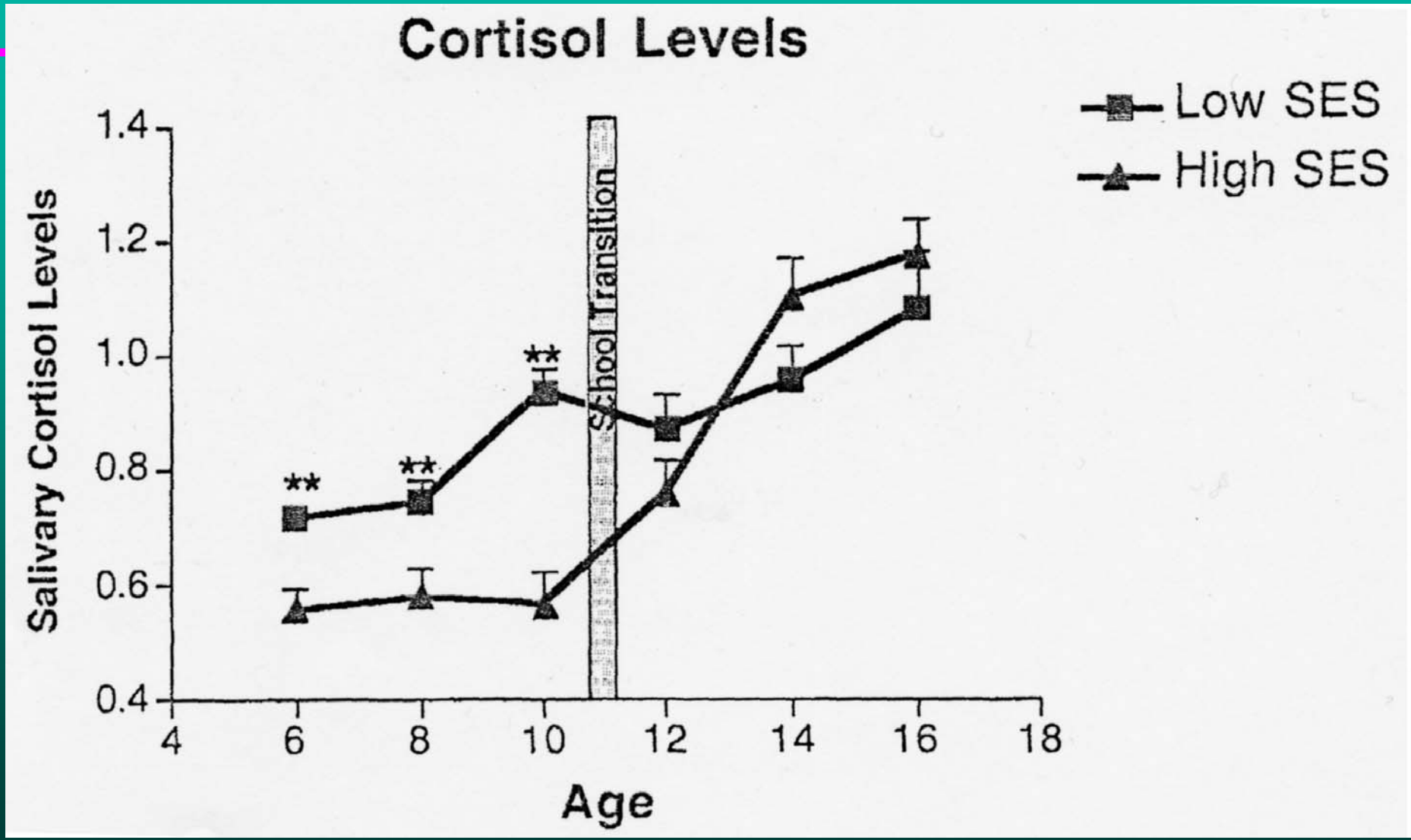
- by level of hopelessness



Everson et al 1996

Carotid artery thickening

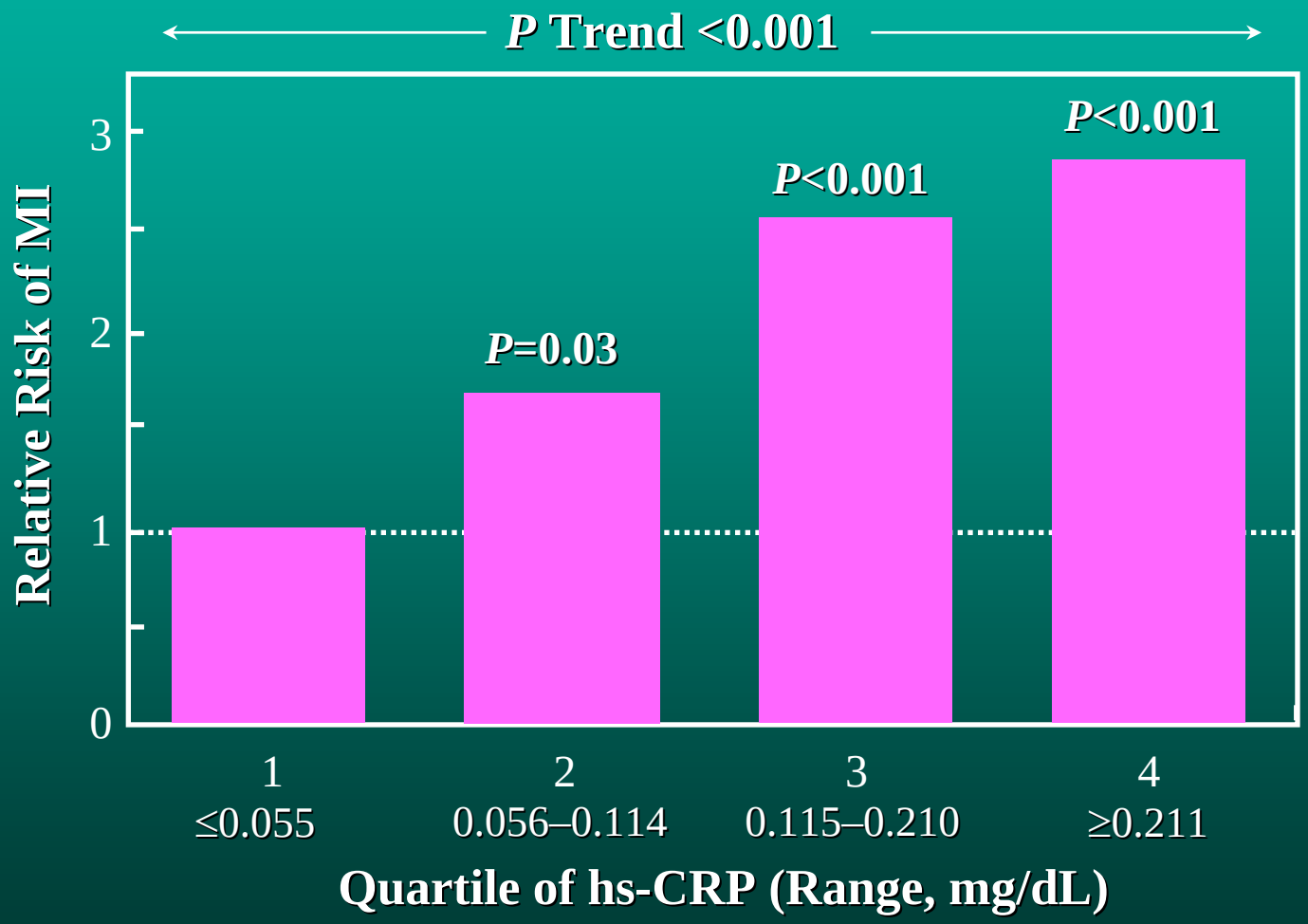



Cortisol Levels
Low SES
High SES
Salivary Cortisol Levels
1.4
1.2
1.0
0.8
0.6
0.4
School Transition
**
**
**
4
6
8
10
12
14
16
18
Age

Environmental determinants of inflammatory status

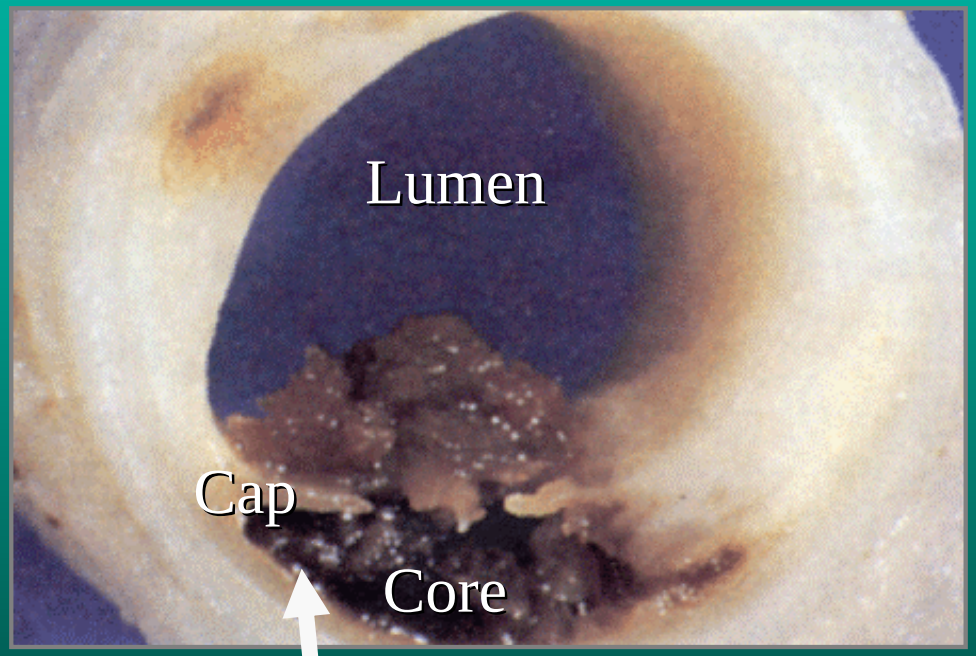
	Depcat	% smokers	CRP (median) mg/dl Never-smokers	Smokers
affluent	1	36.8	0.71	1.42
	2	35.9	1.00	2.34
	3	39.1	1.11	2.25
	4	44.1	1.21	2.44
	5	46.6	1.13	2.53
	6	49.3	1.25	3.07
deprived	7	55.5	1.48	3.29

hs-CRP and Risk of Future MI in Apparently Healthy Men



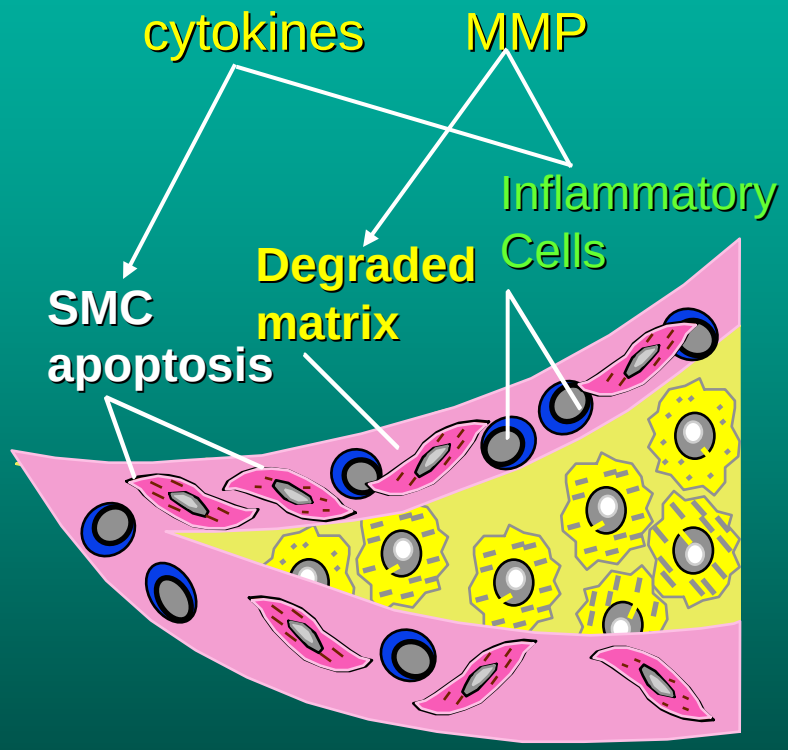
Ridker. *N Engl J Med.* 1997;336:973–979.

Inflammation in plaques



Inflammatory cells

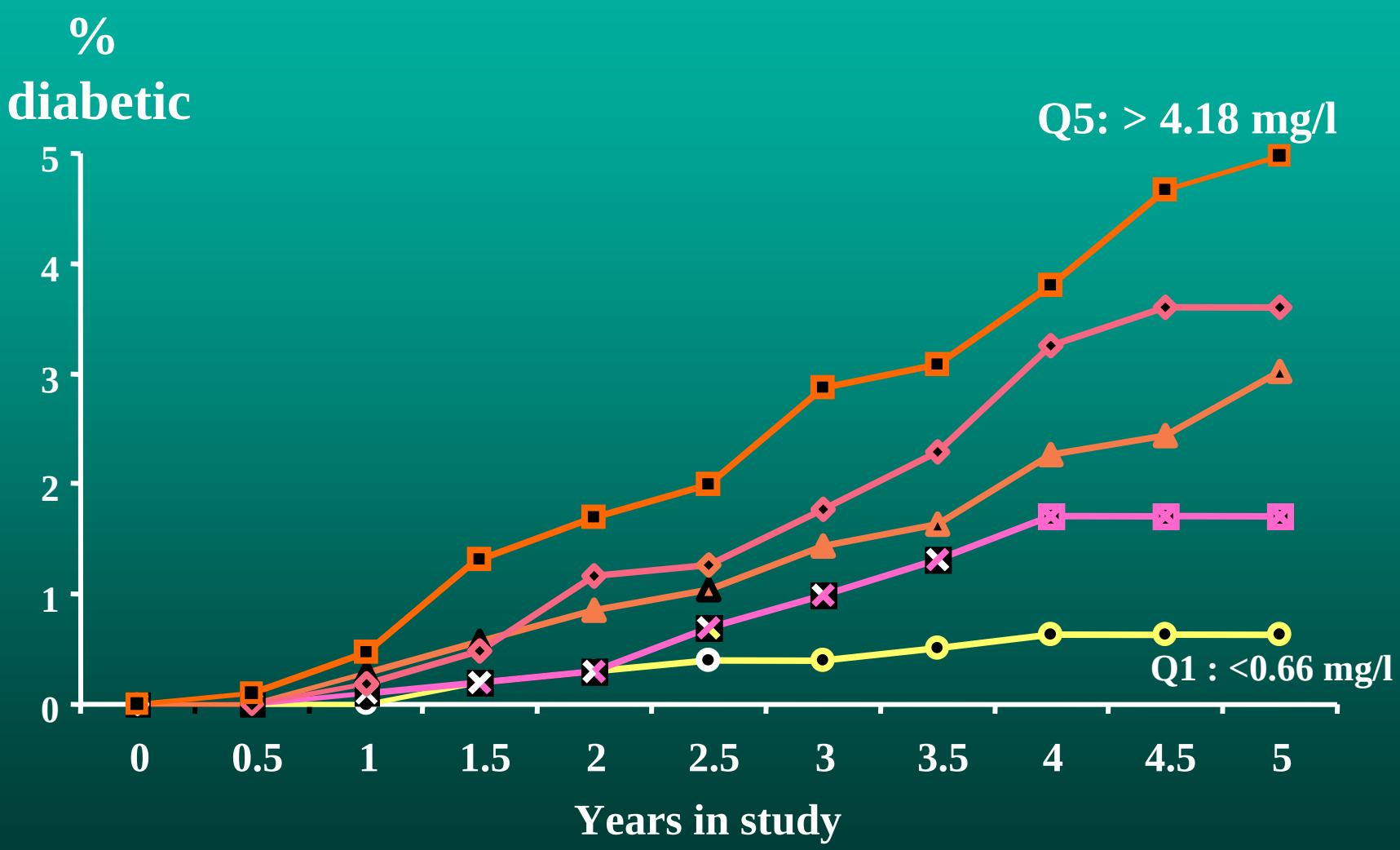
MMPs, IL-6,
IL-15, IL-18, CRP



Unstable

Thin
Fibrous Cap

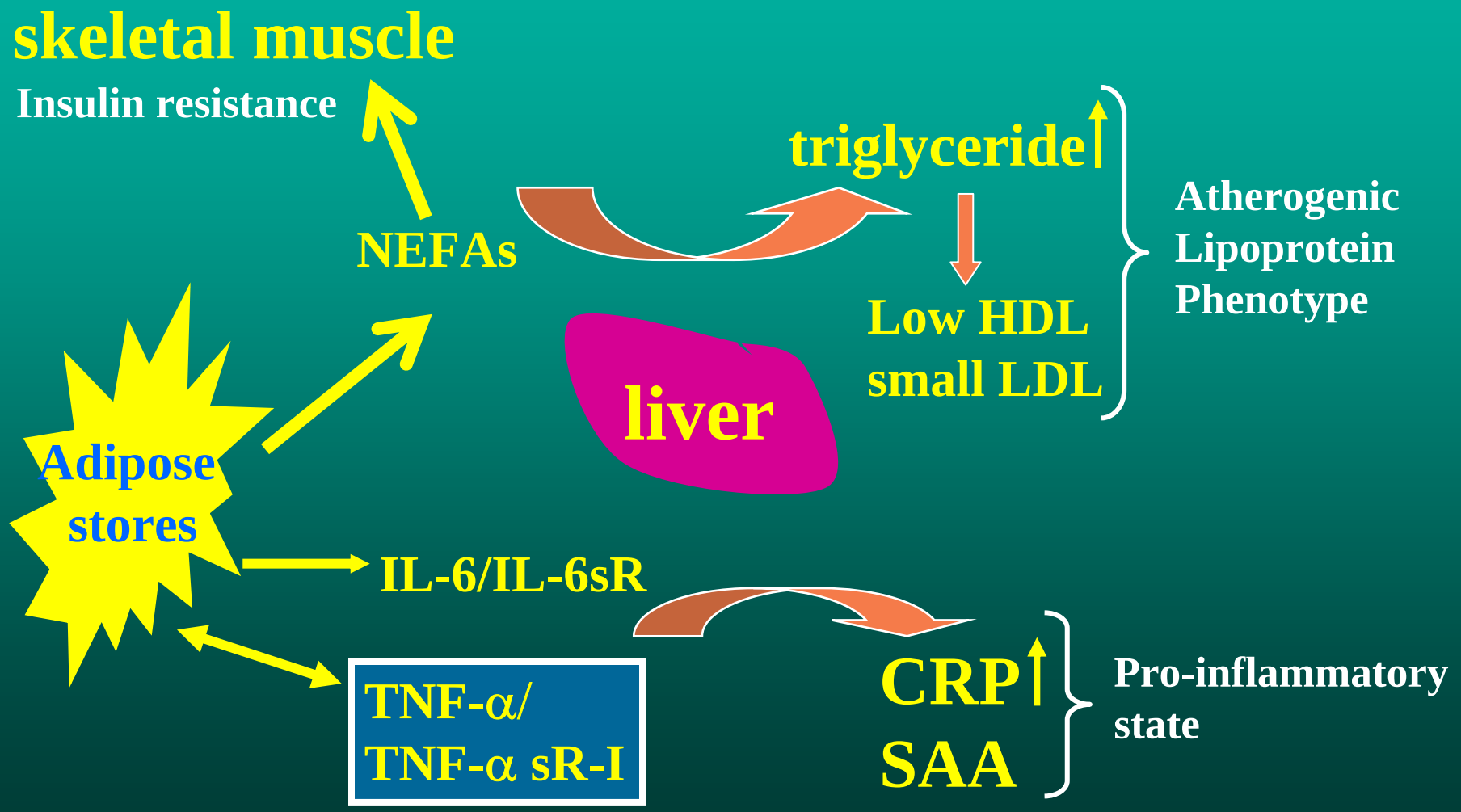
CRP and cumulative risk of type 2 diabetes



Freeman et al. Diabetes 2002,51;1596

Adipocyte programming

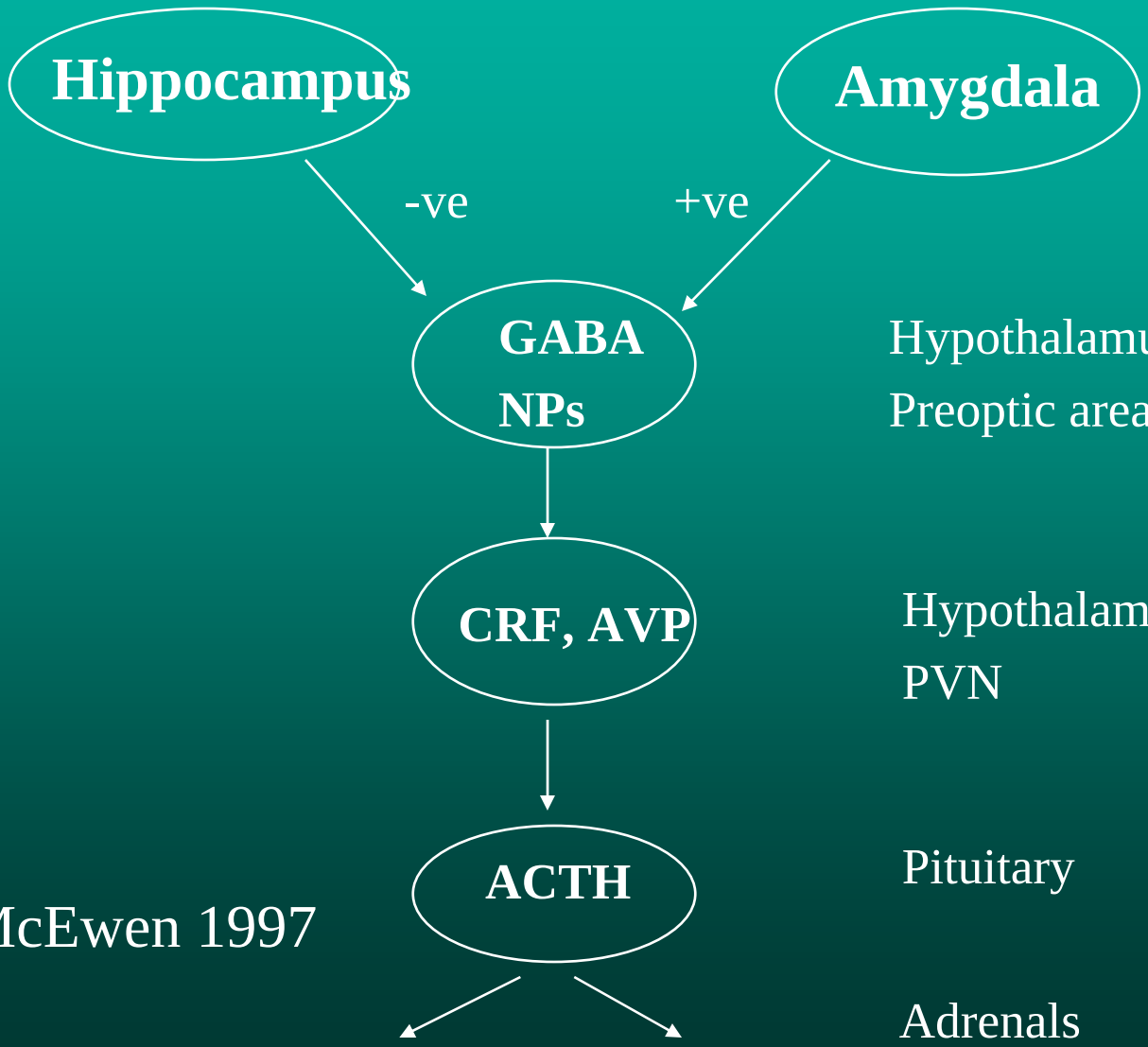
insulin resistance, inflammation and ALP



A classification of stress

- Positive – tolerable and short lived. Caused by everyday experiences such as meeting new people, frustration and coping with normal discipline
- Tolerable – could cause significant pathological effects but relieved by supportive relationships. Natural disasters, loss of a loved one
- Toxic – prolonged, highly active stress response. Associated with abuse, enduring maternal depression, neglect. Absence of continuing supportive relationships fails to build resilience

Neuroendocrine influences on stress response



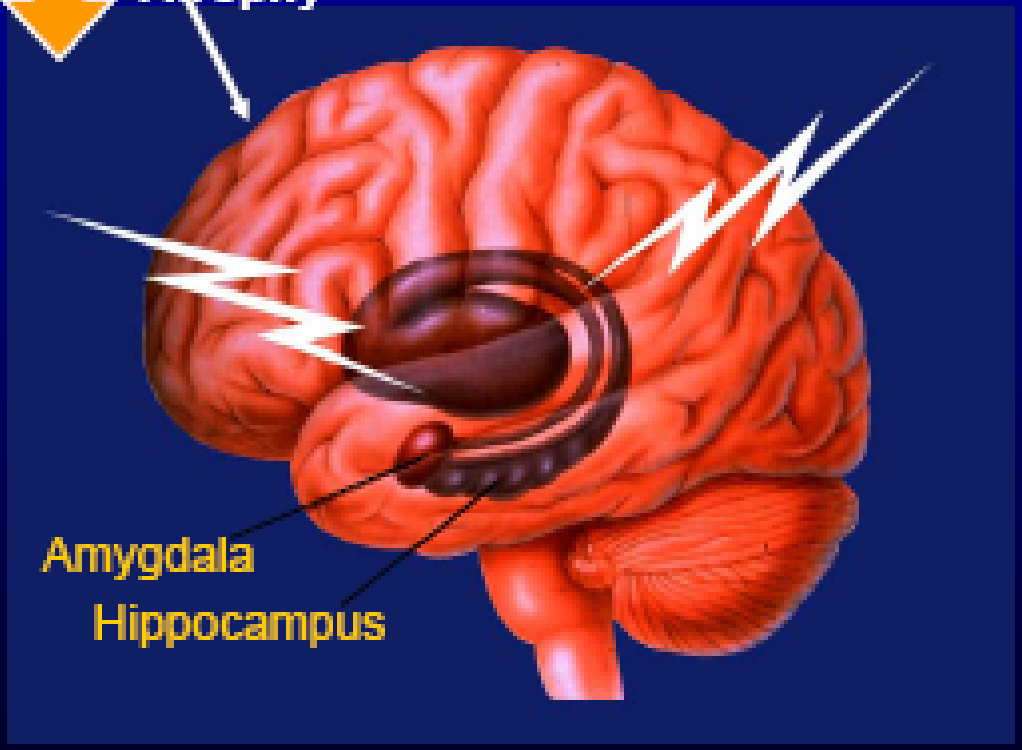
BS McEwen 1997

The Human Brain Under Stress:
key brain regions

Prefrontal cortex

Executive function, working memory

Atrophy



Hippocampus

Contextual, episodic, spatial memory

Atrophy

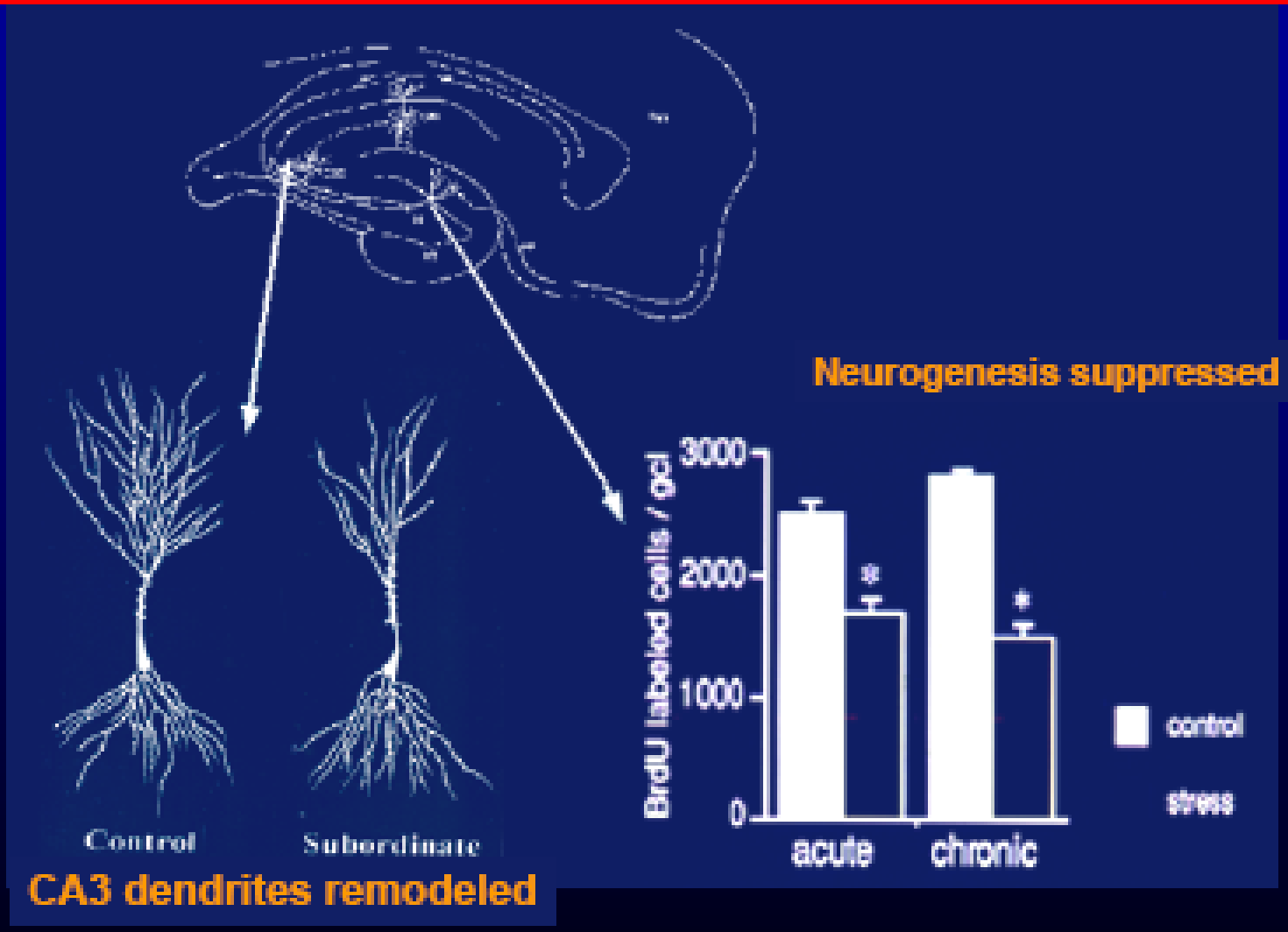
Amygdala

Emotion. fear, anxiety

Hypertrophy.

later atrophy

Chronic Confrontation with Dominant Causes Remodeling of Hippocampus



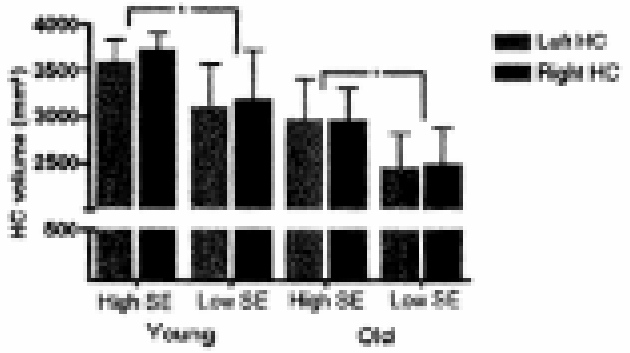
Is there a neurobiology of self esteem?

NeuroImage

Self-esteem, locus of control, hippocampal volume, and cortisol regulation in young and old adulthood

Jens C. Pruessner,[1,2,*] Mark W. Baldwin,[1] Katarina Dedovic,[2] Robert Renwick,[3] Naguib Khalili Mahani,[1,2] Catherine Lord,[4] Michael Meaney,[2] and Sonia Lupien[2]

Hippocampal volume as a function of self-esteem and age



The Dunedin cohort

- 1000 children recruited in late 1972/3
- At age 3, “at risk” children identified on the basis of chaotic circumstances, emotional behaviour, negativity and poor attentiveness
- As adults, those “at risk” were more likely to :
  - be unemployed
  - have criminal convictions (especially for violence)
  - been pregnant as a teenager
  - have a substance abuse problem
  - exhibit signs of insulin resistance and metabolic syndrome

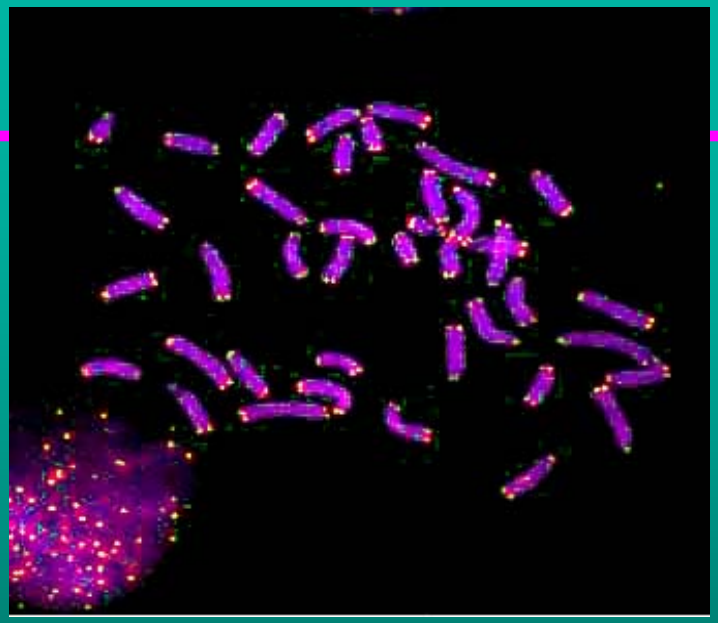
The Human Brain Under Stress:
key brain regions

spatial

iety

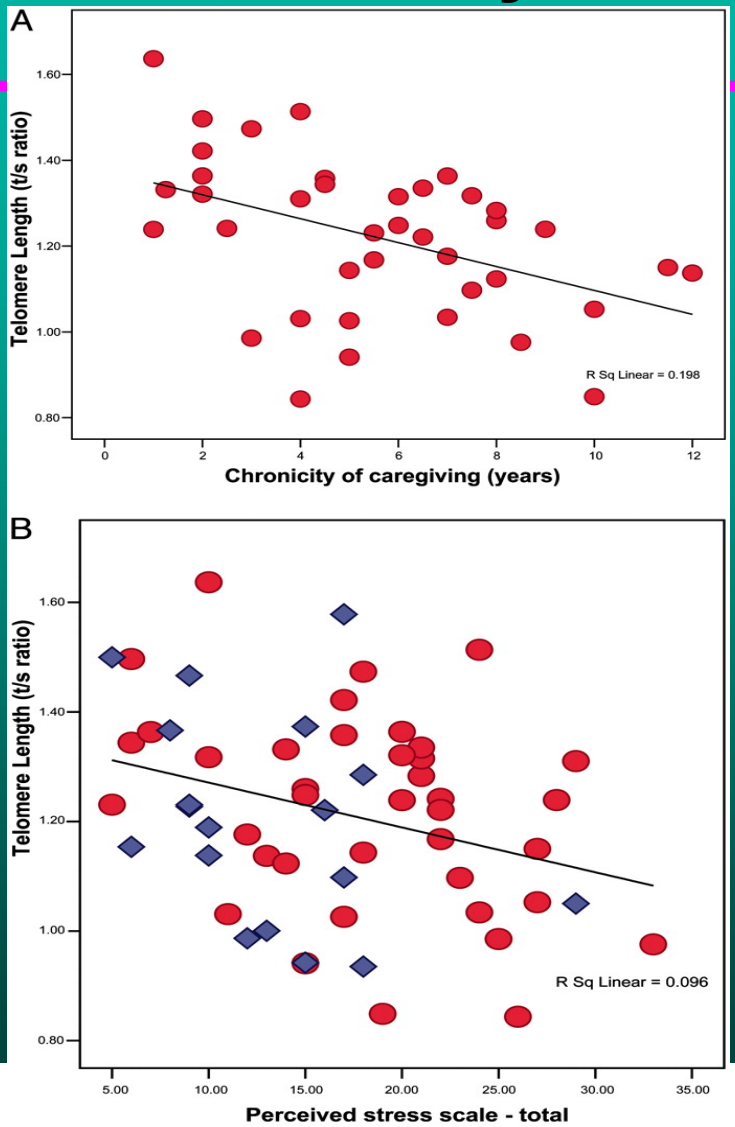
“Elevation of host responses to stress might be associated with increased risk of MI, stroke and diabetes but how does that explain the increased risk of cancer?”

Telomeres



- Ends of chromosomes
- Sense and signal damage
- Home of repair systems
- Integrate energy production and utilisation
- Anti-cancer
- Telomere length predictive for mortality

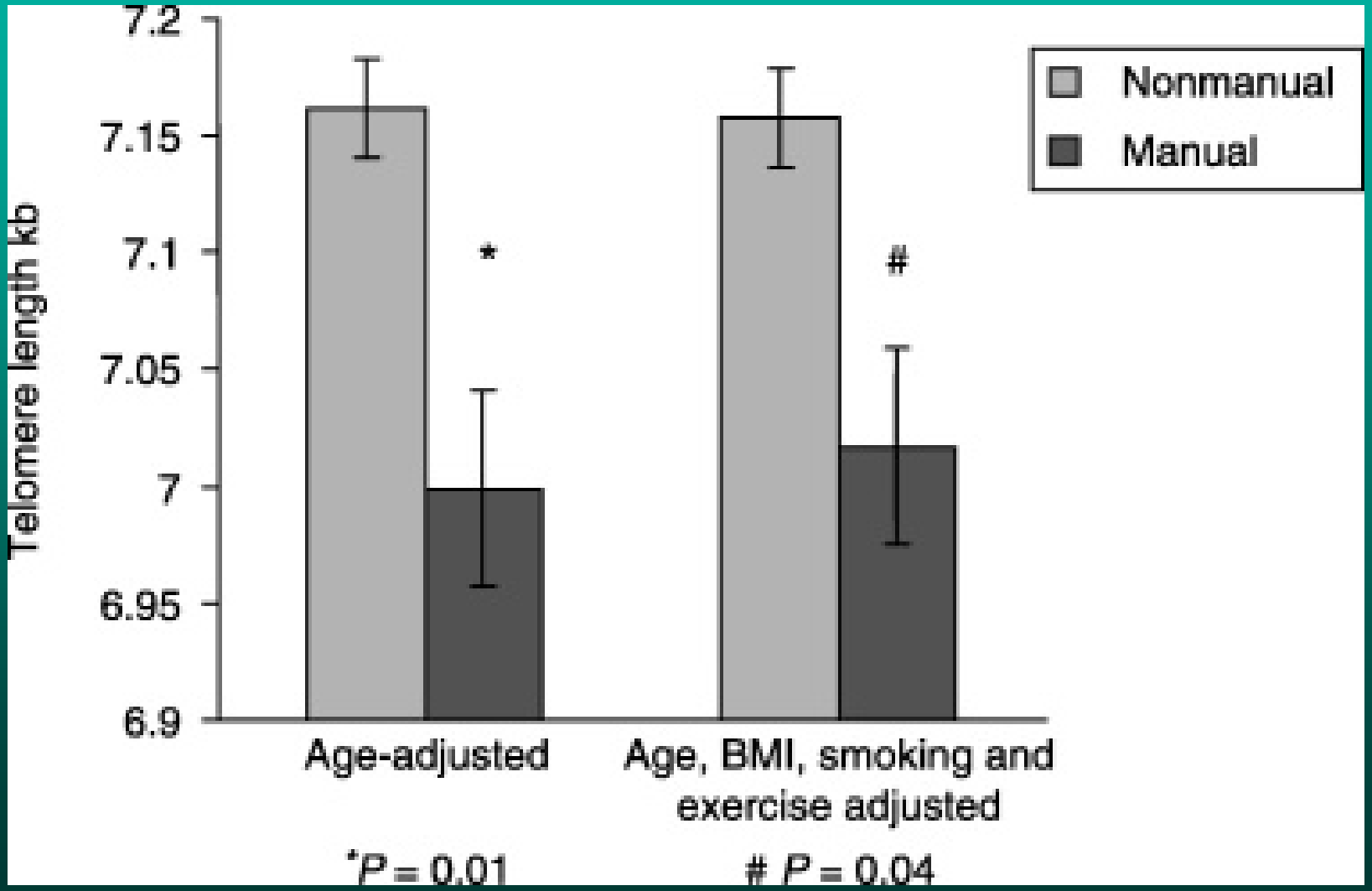
Chronicity of stress by telomere length and perceived stress by telomere length



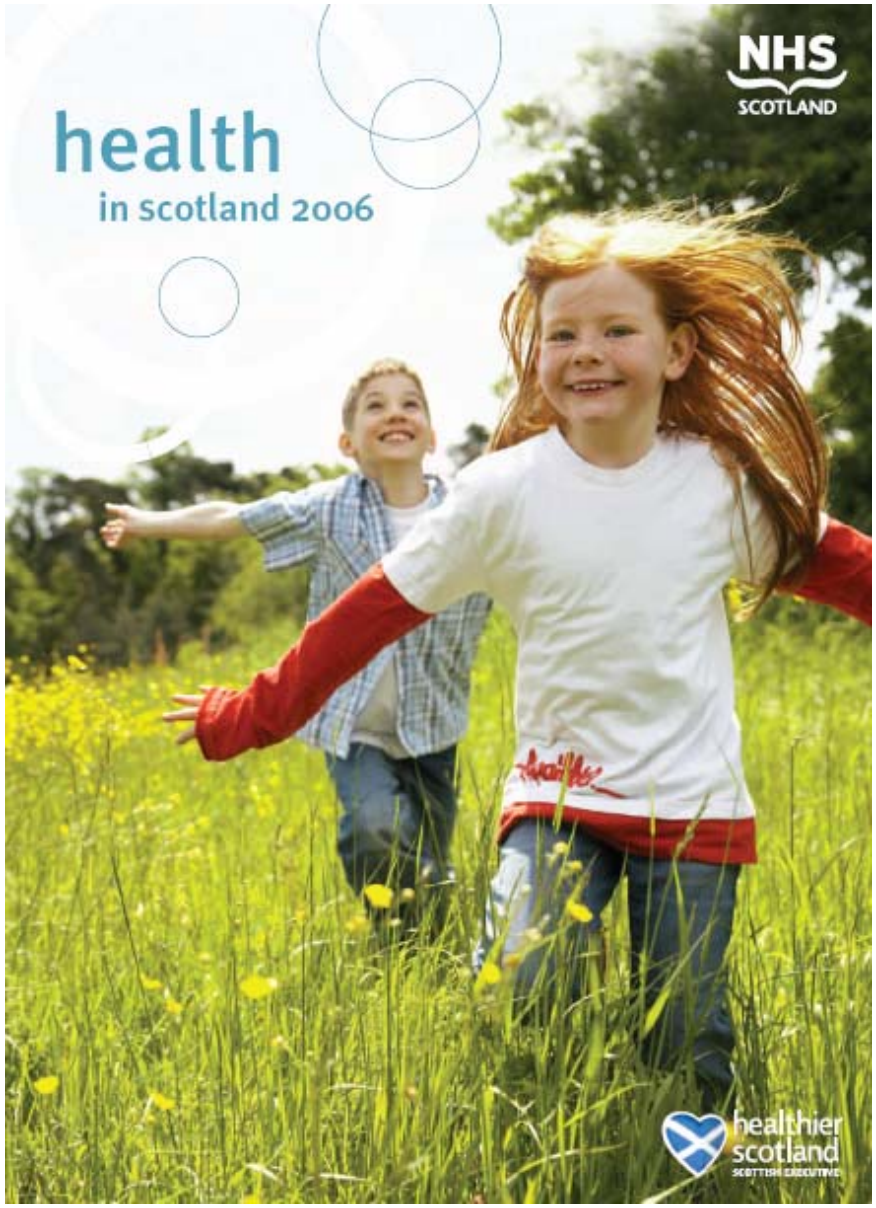
Epel, Elissa S. et al. (2004) Proc. Natl. Acad. Sci. USA 101, 17312-17315

PNAS

Telomere length in twins by occupation



Social circumstances and health



The Scottish Government

Some early years programmes

- Nurse Family Partnership
- Infant health and development programme
- Perry High/Scope project
- Early training project
- Carolina Abcderian project
- Milwaukee project
- The Experience Corps
- Pedagogues in Scandinavia
- Sure Start in England

Cost benefit of early intervention programmes

Programme	Type	Age at last follow-up	Programme cost per child ($)	Total benefits to society per child ($)	Net benefits to society per child ($)	Benefit-cost ratio
Follow-up to early adulthood						
Abecedarian	Combo	21	42,871	138,635	95,764	3.23
Chicago CPC	Combo	21	6,913	49,337	42,424	7.14
Perry Preshcool (excluding intangible crime costs)	Combo	27	14,830	76,426	61,595	5.15
Perry Preshcool (including intangible crime costs)	Combo	27	14,830	129,622	114,792	8.74
ECE for low-income three- and four-year-olds (meta analysis)	Combo	Varies	6,681	15,742	9,061	2.36
Follow-up to middle adulthood						
Perry Preschool	Combo	40	14,830	253,154	238,324	17.70

A Sinclair The Work Foundation 2007

Conclusions

- Clear evidence that adverse early life circumstances have distinct biological effects. These effects include upregulation of host defence mechanisms which ultimately harm the individual
- Some evidence that some early life support projects can improve health, social and economic prospects for children
- Projects are often poorly evaluated and reports seldom published in peer reviewed literature
- Would a network which shares experience of such programmes be worth pursuing?
- harry.burns@scotland.gsi.gov.uk