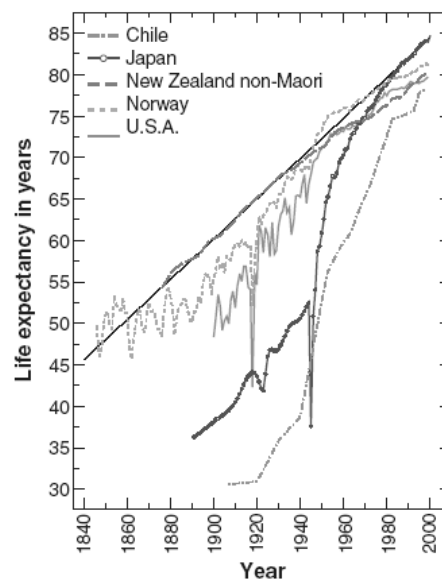


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The prospects for continued longevity

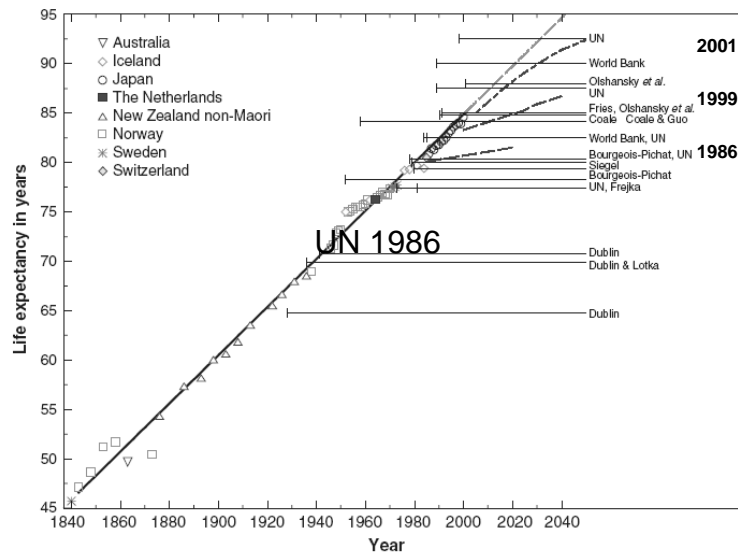
Kay-Tee Khaw

Female life expectancy in selected countries compared with trend in record life expectancy



Oeppen & Vaupel Science 2002

Changing female life expectancy observed and projected over time

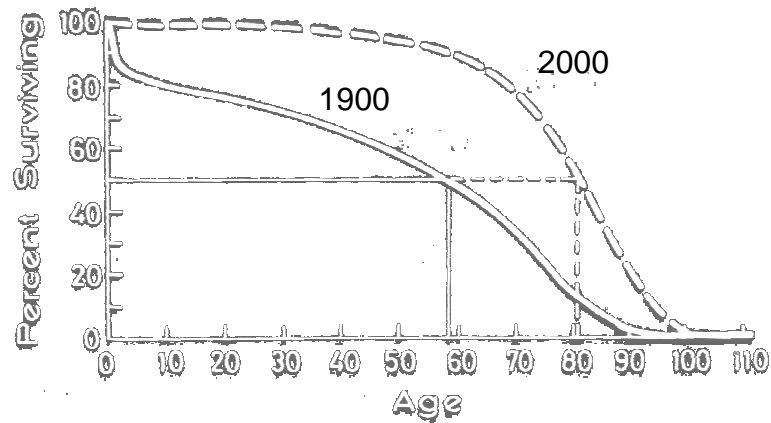


Oeppen & Vaupel Science 2002

What are the likely influences and constraints for continuing longevity in the general population?

What can we learn from individual risk prediction?

Proportion of persons surviving to successive ages, UK 1900 and 2000



Khaw 1999

Major influences on gains in life expectancy

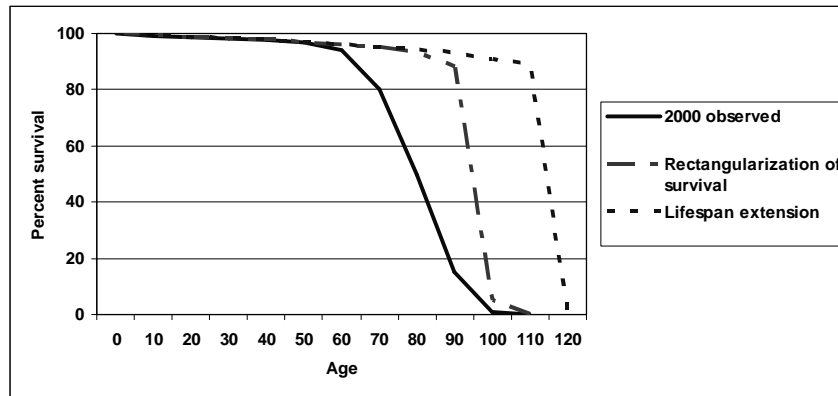
Early 20th century

Reduction in mortality rates in early life and young adults (infectious diseases, poor nutrition, violent death)

Late 20th century

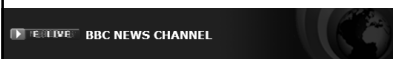
Reduction in mortality rates in older adults (chronic diseases)

Observed and theoretical population survival patterns



Prospects for lifespan extension?
Prospects for rectangularization of survival?

What are the opinions? What is the evidence?



Last Updated: Friday, 3 December, 2004, 00:01 GMT
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'We will be able to live to 1,000'

By Dr Aubrey de Grey
University of Cambridge

Life expectancy is increasing in the developed world. But Cambridge University geneticist Aubrey de Grey believes it will soon extend dramatically to 1,000. Here, he explains why.

Ageing is a physical phenomenon happening to our bodies, so at some point in the future, as medicine becomes more and more powerful, we will inevitably be able to address ageing just as effectively as we address many diseases today.

I claim that we are close to that point because of the SENS (Strategies for Engineered Negligible Senescence) project to prevent and cure ageing.



Aubrey de Grey: "The first person to live to 1,000 might be 60 already"

EMBO
reports

viewpoint

Science fact and the SENS agenda

What can we reasonably expect from ageing research?

Huber Warner^a, Julie Anderson¹, Steven Austad², Ettore Bergamin³, Dale Bredeberg⁴, Robert Butler⁵, Bruce A. Carnes⁶, Brian F. C. Clark⁶, Vincent Cristofalo⁷, John Faulkner⁸, Leonard Guarente⁹, David E. Harrison¹⁰, Tom Kirkwood¹¹, Gordon Lithgow¹², George Martin¹³, Ed Masoro¹⁴, Simon Melov¹⁵, Richard A. Miller¹⁶, S. Jay Olshansky¹⁷, Linda Partridge¹⁸, Olivia Pereira-Smith¹⁹, Tom Perls²⁰, Arlan Richardson²¹, James Smith²², Thomas von Zglinicki²³, Eugenia Wang²⁴, Jeanne Y. Wei²⁵ & T. Franklin Williams²⁶

....none of de Grey's therapies
"has ever been shown to extend
the lifespan of any organism, let
alone humans" EMBO 2005

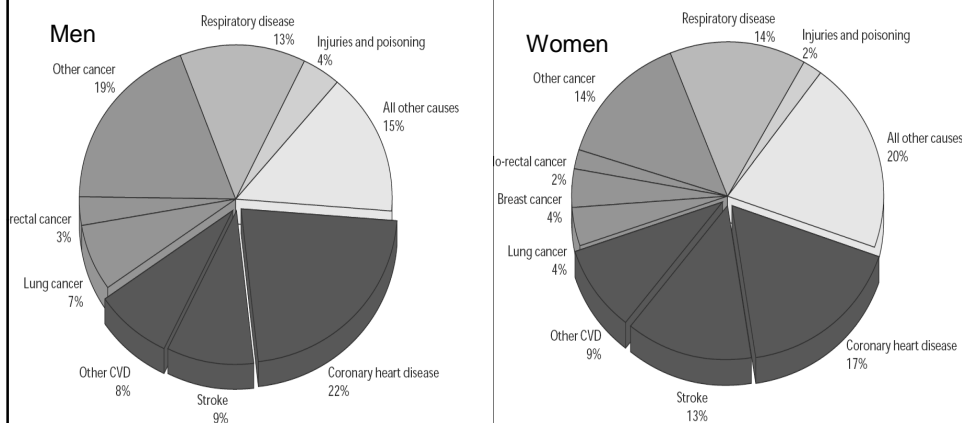
Prospects for maximum lifespan extension
for humans?

regenerative medicine etc.....

Prospects for declining mortality rates over
later years up to maximum lifespan

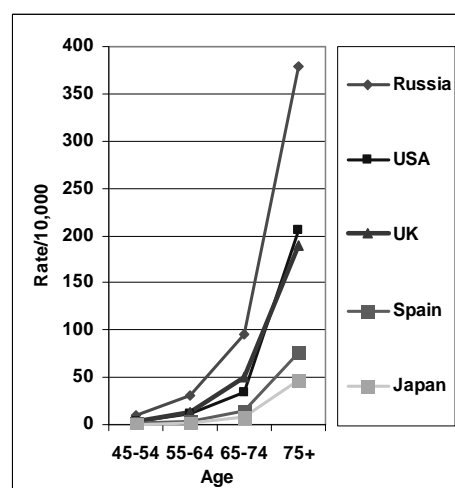
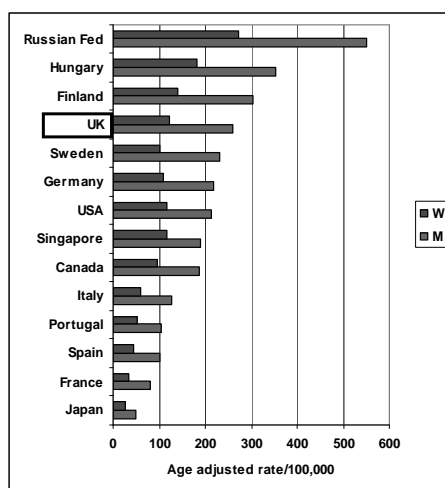
reduction in death rates for
major causes of death in later life
cardiovascular disease, cancer

Leading causes of death in men and women in UK

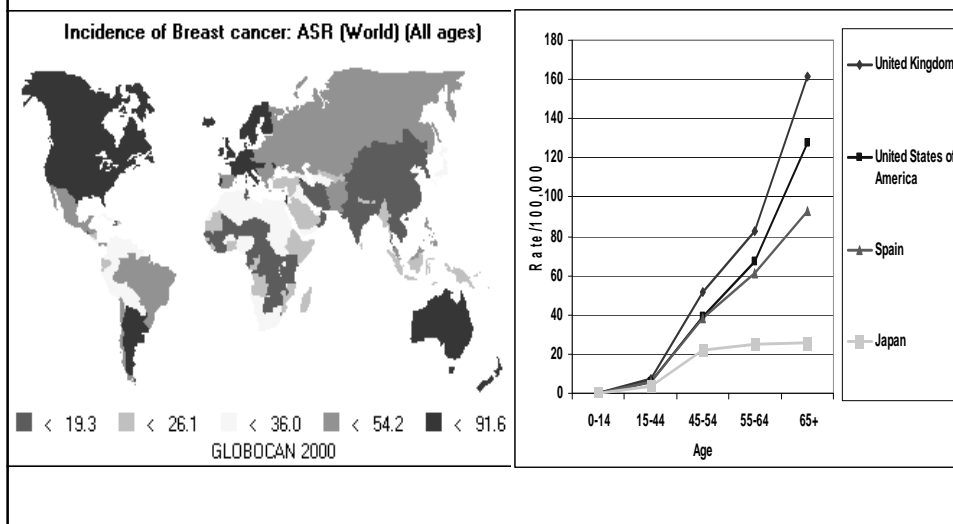


Potential for reduction of mortality rates in later life?

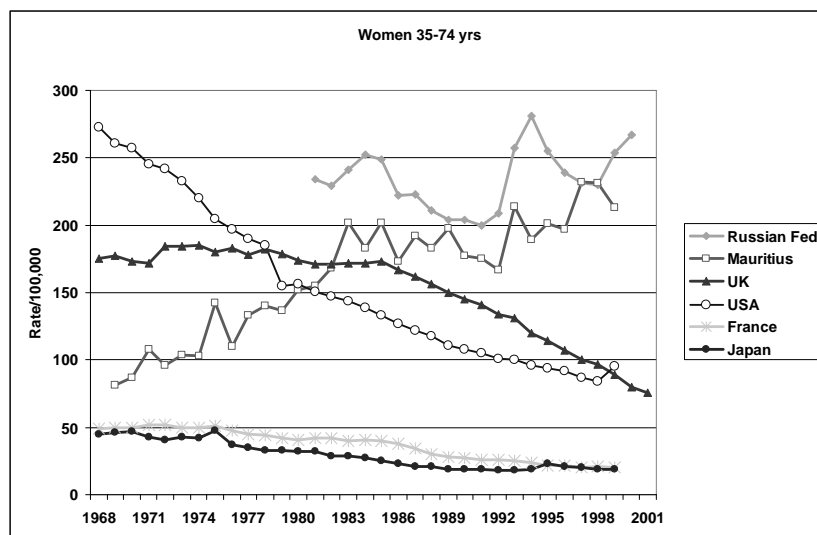
International variation in coronary heart disease and rates with age in selected countries



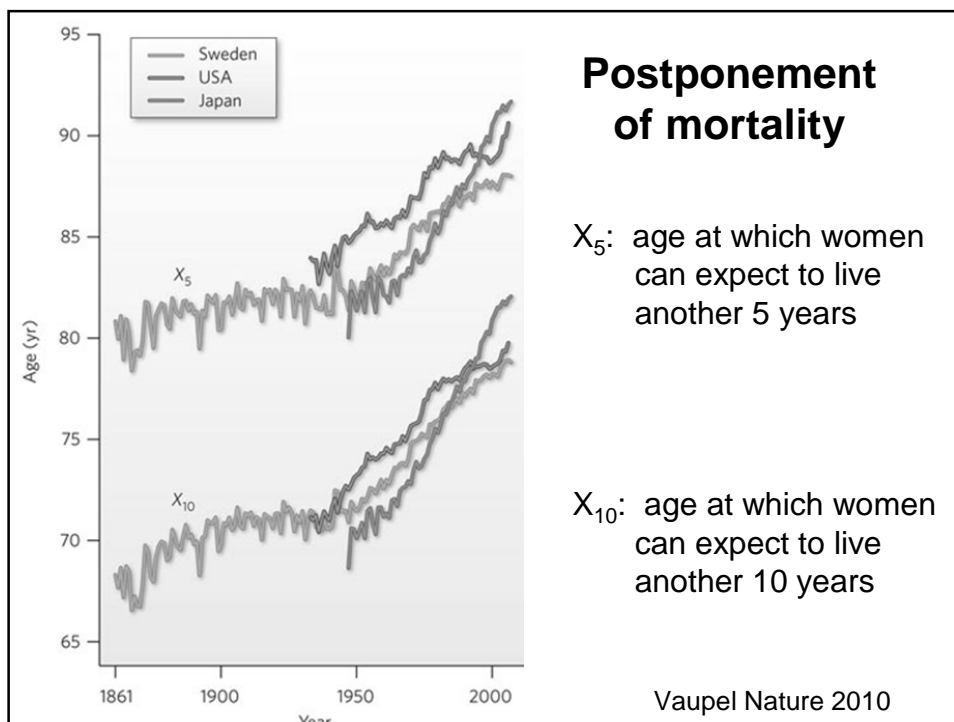
International variation in breast cancer incidence and mortality rates by age in selected countries



Time trends in age standardized coronary heart disease mortality rates 1968-2000 in selected countries in women 35-74 years



Evidence of declining mortality rates at older ages?



Probability of dying for men and women in selected countries, age 80 and 90 yr

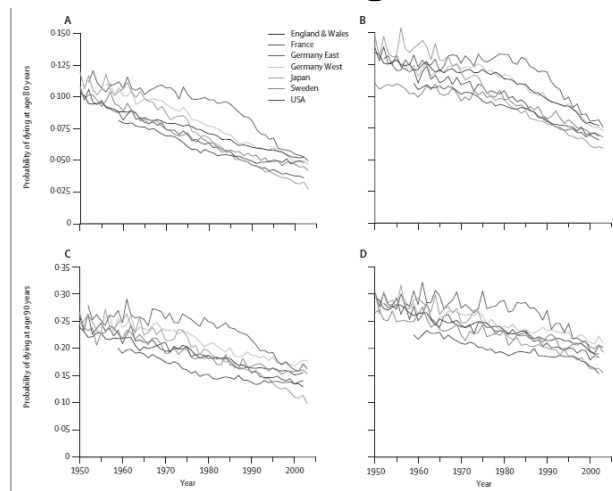
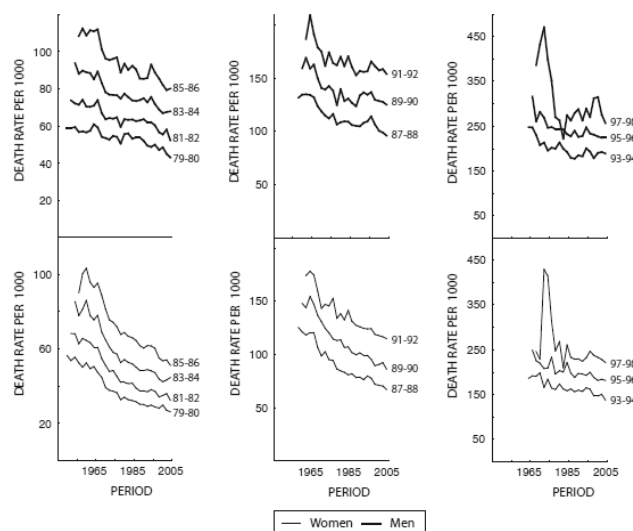


Figure 2: Probability of dying for elderly men and women in selected countries from 1950 to 2003
(A) Women aged 80 years. (B) Men aged 80 years. (C) Women aged 90 years. (D) Men aged 90 years. Data from reference 27.

Vaupel Lancet 2009

Crude death rates for Danish women and men aged 79-98 from 1949-2006



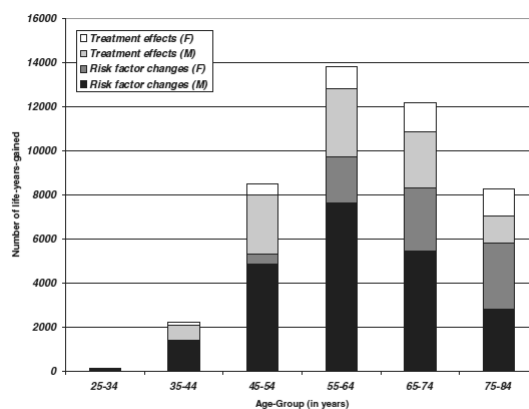
Jacobsen R Eur J Epid 2008

How likely are such trends to continue?

Incidence of chronic disease is the major driver of mortality

Major determinants of chronic disease incidence?

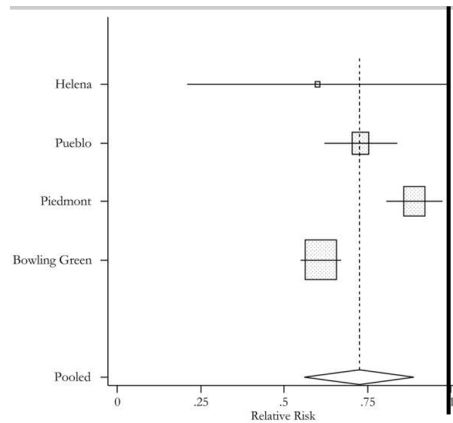
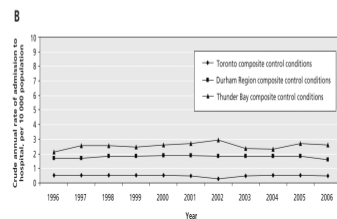
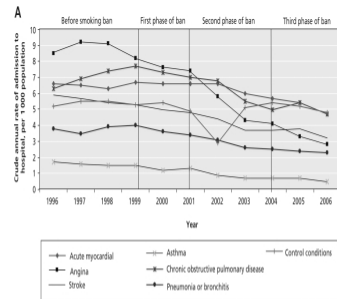
Estimated number of life years gained from CHD treatments and population risk factor changes 1985-2000 by age and sex Ireland



Number of life-years gained from coronary heart disease treatments and population risk factor changes between 1985 and 2000, by age and sex.

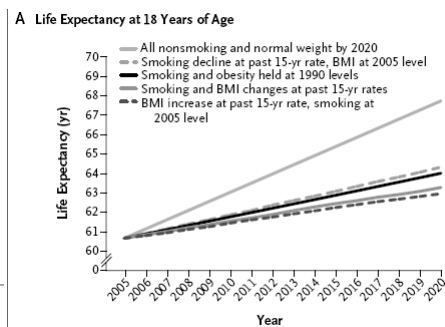
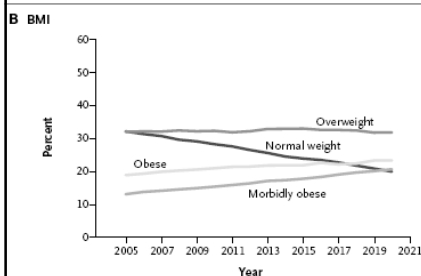
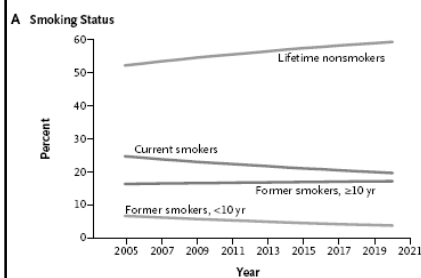
Kabir et al Eur J Pub Health 2006

Smoking ban and admissions for CVD and lung diseases Toronto, and pooled estimates of acute MI reduction following smoking ban



Dinno et al Prev Med 2007

Forecast distribution of smoking and obesity in US 2005-2021 and projected impact on life expectancy at 18



Eliminating smoking and obesity net gain 3.7 years life expectancy at 18 years of age estimated

Stewart et al NEJM 2009

Substantial evidence that age specific mortality rates are still declining in later life –
greater proportion of people surviving to older ages close to maximum lifespan

Major influences: reduction in chronic diseases
primarily cardiovascular diseases
Largely public health: diet, reduced infective causes,
decline in smoking

Some further potential for continuing rectangularization of the population survival curve

No evidence for extension of maximum lifespan


What can we learn from individual risk prediction within a population?


Personalised medicine: the future?






Perceived age biomarker of ageing? Studies of identical twins





In identical twins >70 years, those assessed as looking older had worse biological parameters and about 2-3x subsequent mortality

Guyuron B Plast Recons Surg 2009

Christensen et al BMJ 2009
Gunn et al PLOS One 2009

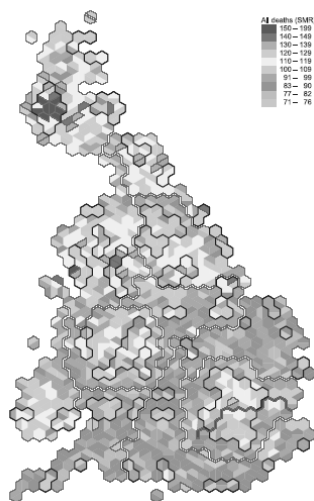
No single genes found for ageing
Most chronic disease multiple genes
Poor prediction
Environmental influences predominate

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People live 14 years longer in affluent areas



Average age at death in years

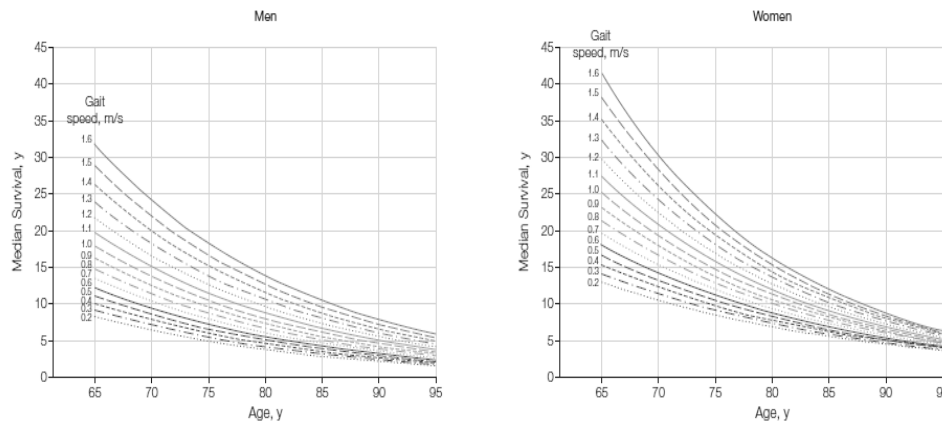
Britain 74.4

Glasgow Easterhouse 66.4

Eastbourne West 80.4

<http://sasi.group.shef.ac.uk/publications/reaper/>

Predicted median life expectancy by age and gait speed



Studenski S et al JAMA 2011

EPIC*-Norfolk population study

<http://www.epic-norfolk.org.uk>



Aims: to identify major determinants of health in middle and later life

30,000 men and women 40-79 years living in Norfolk, United Kingdom

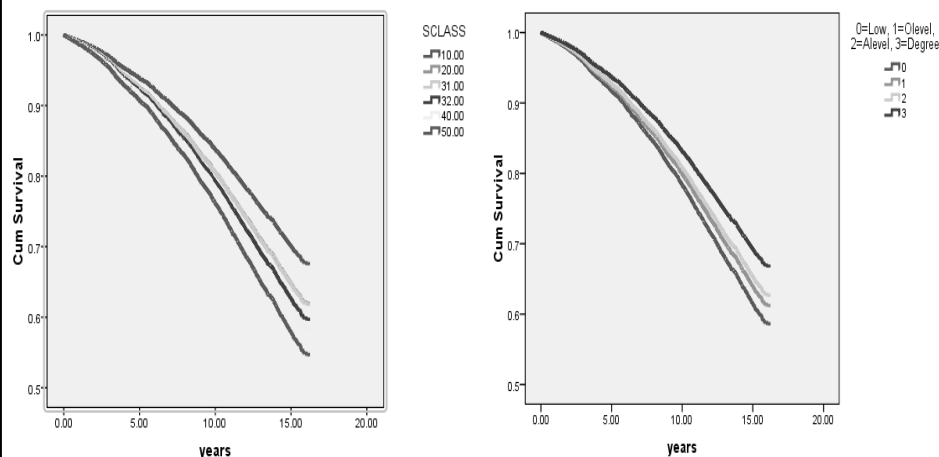
First seen 1993-1997

Extensive lifestyle and biologic information

Followed up for health to present

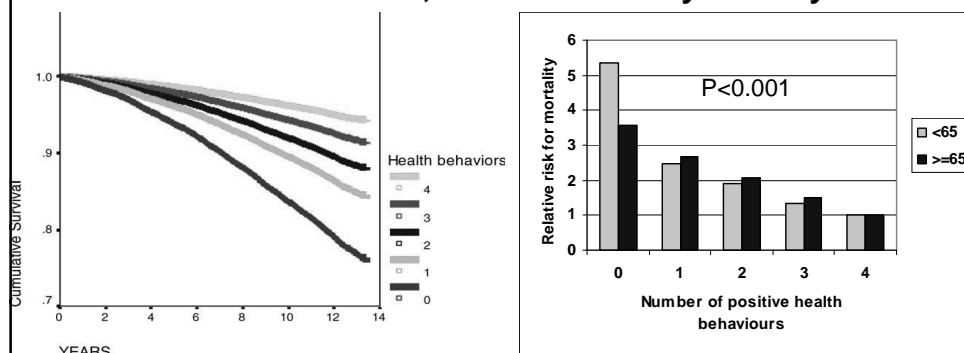
* Part of European Prospective Investigation into Cancer: a 10 country collaboration with 500,000 participants

Survival in men and women aged 65yrs+ in EPIC Norfolk by social class and education 1992-2008



McFadden E et al Eur J Epid 2008

Four simple health behaviours and mortality in 20244 men and women aged 40-79 years, EPIC-Norfolk 1993-2007, RR in those <65y and 65y+



Score 0-4

Equivalent 14 years
chronological age

Adjusted for age, BMI, social class

- 1 Non smoker
- 1 Alcohol >0 <14 units/wk
- 1 Not inactive
- 1 Blood vitamin C >50 umol/l
(5 servings fruit and vegetable daily)

Khaw et al PLOS Medicine 2008

Prospects for continuing longevity?

Maximum lifespan extension unlikely

Substantial potential still for declining mortality rates in later life up to maximum lifespan and further rectangularization of survival curves

Trends highly dependent on continuing improvements in public health

