The prospects for continued longevity

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

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

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?

Science fact and the SENS agenda

"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
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?

Postponement of mortality

$X_5$: age at which women can expect to live another 5 years

$X_{10}$: age at which women can expect to live another 10 years

Vaupel Nature 2010
Probability of dying for men and women in selected countries, age 80 and 90 yr

Women

Men

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

Kabir et al Eur J Pub Health 2006
Smoking ban and admissions for CVD and lung diseases in Toronto, and pooled estimates of acute MI reduction following smoking ban


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

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

- 62 years
- 53 years
- 70 years
- 62 years
- 53 years

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

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: Non smoker
Equivalent 14 years chronological age
Adjusted for age, BMI, social class

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