Healthy Life Expectancy – past, present and future

Carol Jagger
Professor of Epidemiology
Outline

♦ Context for healthy life expectancy
♦ What is the best measure of health?
♦ X-sectional versus longitudinal data
♦ Future potential for healthy life expectancy?
LE at birth (Europe)
Rationale for HLE

- Continued increases in life expectancy even at older ages
- Quantity of remaining life not sufficient – need measure of quality
- Developed to answer question of whether increases in LE were healthy years
Living longer but healthier?

♦ Keeping the sick and frail alive
  – *expansion of morbidity* (Kramer, 1980).

♦ Delaying onset and progression

♦ Somewhere in between: more disability but less severe
  – *dynamic equilibrium* (Manton, 1982).
Quality or quantity of life?

Health expectancy
♦ partitions years of life at a particular age into years healthy and unhealthy
♦ adds information on quality
♦ is used to:
  - monitor population health over time
  - compare countries (EU Healthy Life Years)
  - compare regions within countries
  - compare different social groups within a population (education, social class)
Terminology of health expectancies

Health Expectancy

Healthy LE (self rated health) = *HLE*
Disability free LE = *DFLE*
Dementia free LE = *DemFLE*

Limiting longstanding illness = IADL/ADL

Many measures of health = many health expectancies!
### HLE* at age 65 UK 2001-2004

<table>
<thead>
<tr>
<th>Years of life</th>
<th>Men</th>
<th>Women</th>
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<tbody>
<tr>
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<td>4.0</td>
<td>11.9</td>
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</tr>
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</tr>
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<td>5.0</td>
<td>14.0</td>
</tr>
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<td>5.1</td>
<td>14.0</td>
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<tr>
<td>2003</td>
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<td>14.3</td>
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<table>
<thead>
<tr>
<th>%HLE/LE</th>
<th>2001</th>
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<tr>
<td>Men</td>
<td>74.7</td>
<td>75.1</td>
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<td>73.6</td>
<td>73.3</td>
<td>74.2</td>
<td>74.4</td>
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*HLE based on good or fairly good self-rated health. Source: ONS
DFLE* at age 65  UK 2001-2004

<table>
<thead>
<tr>
<th>Years of life</th>
<th>Men</th>
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<tbody>
<tr>
<td>2001</td>
<td>7.1</td>
<td>8.8</td>
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<td>7.1</td>
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<td>2003</td>
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<td>9.4</td>
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<td>6.7</td>
<td>9.9</td>
</tr>
<tr>
<td>2001</td>
<td>8.8</td>
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<tr>
<td>2002</td>
<td>8.8</td>
<td>10.3</td>
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<tr>
<td>2003</td>
<td>8.9</td>
<td>10.4</td>
</tr>
<tr>
<td>2004</td>
<td>8.8</td>
<td>10.7</td>
</tr>
</tbody>
</table>

%DFLE/LE  
Men: 55.2  55.9  57.4  59.6  
Women: 53.6  53.9  54.0  54.9

*DFLE based on free from limiting long-term illness. Source: ONS
Many health expectancies!

Proportion of life free of conditions at age 75

- personal care difficulty
- hearing difficulty
- vision difficulty
- mobility difficulty
- incontinence
- good self reported health
- cognitive impairment

proportion of life spent free of condition
What is the best measure?

♦ Depends on the question
♦ Need a range of severity
  - dynamic equilibrium
♦ Performance versus self-report
  - cultural differences
♦ Cross-national comparability
  - translation issues
Cross-sectional versus longitudinal data
The simplest method of calculating a health expectancy is Sullivan’s method (Sullivan 1971) with:

- prevalence of the health state from a cross-sectional survey
- a standard life table for the same period

Multi-state life tables require longitudinal data on transitions between health states and death
HE with cross-sectional data

Mortality data

Life table

Life expectancy

LE free of disability

LE with disability

Age specific prevalence of ill-health (e.g. disability)
HE with longitudinal data

Baseline

- No disability
- Disability

Follow-up

- No disability
- Disability
- Dead
X-sectional versus longitudinal

♦ Cross-sectional
  + easiest for trends
  - life tables not available for subgroups

♦ Longitudinal
  + explicitly estimates incidence and recovery providing better future forecasts
  - cost, attrition

*Not either/or but must include institutional population*
Example 1
Five centres
stratified random sample aged 65+
includes those in institutions
13004 interviewed at baseline in 1991
2, 6 (Cambridge only) and 10 year follow-ups
death information from ONS
Social inequalities at age 65

Mobility DFLE at age 65

Expected years of life

12+ 10,11 0-9
Women

13.2 11.8 10.5

12+ 10,11 0-9
Men

12.8 11.8 10.3

7.4 8.1 8.5

1.6 years

3.2 4.1 4.6

2.7 years

dfle  dle
Disability is dynamic
Mobility disability transitions OR* (95% CI)

*adjusted for age, comorbidity, MMSE
What drives relationship between education and disability?

♦ Blane* suggests 5 possible causal processes:
  - education is mediated through its influence on later occupation and income which themselves affect adult health
  - a further background variable affects both the capacity to complete education and maintain health
  - ill-health during childhood limits education and predisposes to later ill-health
  - the long-term effect of childhood circumstances on adult health
  - education impacts on the ability to take in and act upon health education messages

The Burden of Diseases on Disability-Free Life Expectancy in Later Life

Carol Jagger,1 Ruth Matthews,2 Fiona Matthews,2 Thompson Robinson,1 Jean-Marie Rotine,4 Carol Brayne,3 and the Medical Research Council Cognitive Function and Ageing Study Investigators

Departments of 1Health Sciences and 2Cardiovascular Sciences, University of Leicester, United Kingdom; 3Medical Research Council Population Health Research Unit, Institute of Public Health, University of Cambridge, United Kingdom; 4Equipe Démographie et Santé, Institut National de la Santé et de la Recherche Médicale, Montpellier, France; 5Institute of Public Health, University of Cambridge, United Kingdom.

Background. The consequences of disease in later life have been judged predominantly through mortality, resulting in an emphasis on the final rather than the survival disability conditions. We used a longitudinal analysis of follow-up at 2, 6, and 10 years to assess the impact of different diseases on both total life expectancy (TLE) and disability-free life expectancy (DFLE).

Methods. The Medical Research Council Cognitive Function and Ageing Study investigators interviewed 13,006 people aged 65 years and older from five U.K. centers starting in 1994. Persons aged 75 years and older were oversampled. Disability (cognitive, mobility, and memory) was assessed through basic Activities of Daily Living (ADL) and Instrumental ADL (IADL) tasks at baseline and at follow-up at 2, 6, and 10 years. TLE and DFLE were compared for persons with and without each of nine conditions.

Results. At age 65, 31% had TLE of 15.5 years of which 12.1 (39%) were free of any disability, whereas women of the same age had an average TLE of 19.6 years, 9.9 years (51%) disability-free. Men (women) aged 65 years without stroke had 6.9 (4.6) years of TLE and 5.1 (3.7) more years DFLE. Without diabetes, men (women) lived 4.4 (5.6) years longer and had 6.1 (5.1) years DFLE.

Conclusion. More disability-free years were gained than total life years in persons free of stroke, cognitive impairment, arthritis, and visual impairment at baseline. This finding suggests that estimation of these conditions would result in a reduction of disability.

The relative availability of mortality data makes this the usual means by which disease impact is measured in populations, though focus is then on fatal rather than nonfatal conditions. The increasing demand for healthy active life in old age is now changing the emphasis to outcomes such as disability that influence the quality of later life. The role of diseases on disability and functional decline in older people has been systematically reviewed (1,2). Conversely, evidence on the relative importance of different diseases remains scant, especially in the light of increases in 10-year life expectancy and the prevalence of certain diseases (3) yet decreasing trends in disability prevalence (4,5). A major reason for these contradictory trends is that most studies have viewed disability and mortality as separate outcomes but the size of study required to assess the contribution of both prevalence conditions in a further issue. Disability-free life expectancy (DFLE) summarizes loss mortality and disability together, positioning fatal and nonfatal outcomes on a common metric. Such population health indicators have been instrumental in exploring whether the extra years lived have been spent in good or poor health (5,6). It was first proposed as a means of assessing the potential gains in health through the elimination of diseases 20 years ago (6). Other such studies have followed (6,7), the most comprehensive being the Global Burden of Disease Study (7). The common approach in these studies has been based on disability prevalence data and cause-specific life tables. These methods are subject to a number of limitations: The accuracy of cause-of-death data is questionable and induces bias towards the major fatal diseases. Consistency, particularly prevalent in later life, is ignored; and the link between disease and disability has to be inferred, either through self-report of the major cause of disability or in the Global Burden of Disease study, through the opinions of health professionals (8).

Only a handful of studies have explicitly modeled transitions from disease through to disability and death with longitudinal data, and all have been limited to one or two diseases: heart disease (8), dementia (9,10), and diabetes (11). This article will be the first, to our knowledge, to use longitudinal data with 16 years of follow-up on both community-dwelling and institutionalized older people and to explore the impact of a range (size) of diseases and combinations on life expectancy with and without disability of differing severity levels.

Methode

The Medical Research Council Cognitive Function and Ageing Study (MRC CFA) is a population-based longitudinal study of health in the older population (http://www.mrc-cfa.ac.uk). Full methods have already been published (7), but relevant details are given here. Population-based samples, stratified to ages 65–74 years and 75 years and older, were taken from National Health Service primary care samples.
Change in LE at age 65

Difference in years between those with and those without disease

-1.0  0.0  1.0  2.0  3.0  4.0  5.0  6.0

WOMEN
- Arthritis
- Cog imp
- CHD
- Stroke

MEN
- Arthritis
- Cog imp
- CHD
- Stroke

15.6 years without vs 10.9 with stroke at baseline
Change in mild+DFLE at age 65

Difference in years between those with and those without disease
Change in mod+DFLE at age 65

Difference in years between those with and those without disease

More gains without arthritis when mild disability included
Future potential of HLE

♦ Are social and regional inequalities widening?
  - effect of greater access to education in new cohorts

♦ Diseases more or less disabling?
  - saving lives v reducing disability

♦ Living longer healthier?
  - new cohorts with more ethnic minority elders
Issues

♦ Must have total population including those in institutions
♦ Cultural differences in self-report?
♦ Accurate translation to underlying concepts for cross national comparability
Inequalities in healthy life years in the 25 countries of the European Union in 2005: a cross-national meta-regression analysis

Caroline Jago, David M. Fisher, Robert Morley, Caroline螺丝, and Jenifer M. Brown

Summary
Health differences across the European Union (EU) are increasing, with the major factor in terms of 30 years of age

Introduction
Life expectancy at birth and at 65 years of age in countries of the European Union (EU) have been gaining attention over the past decade, but in recent years, life expectancy has increased in all countries, and this is particularly true for those 65 years of age and older. In 2005, the average EU country had a life expectancy of 74.5 years, compared to 81 years in the United States. However, there is significant variation in life expectancy across the EU, with some countries having a life expectancy of over 80 years, while others have life expectancies below 70 years. The reasons for this variation are complex and include differences in healthcare systems, socioeconomic factors, and lifestyle choices.

Findings
The main findings of the study were as follows:

1. Life expectancy at birth and at 65 years of age is higher in countries with a higher GDP per capita and lower in countries with a lower GDP per capita.

2. Life expectancy at birth and at 65 years of age is higher in countries with a higher proportion of the population who have completed secondary education and lower in countries with a lower proportion of the population who have completed secondary education.

3. Life expectancy at birth and at 65 years of age is higher in countries with a lower prevalence of smoking and lower in countries with a higher prevalence of smoking.

4. Life expectancy at birth and at 65 years of age is higher in countries with a lower prevalence of obesity and lower in countries with a higher prevalence of obesity.

Conclusions
The study highlights the importance of addressing socioeconomic and health-related factors in order to improve life expectancy across the EU. It also highlights the need for further research to better understand the factors that contribute to the variation in life expectancy across the EU.

References
Healthy Life Years at 65: Women 2005

- France
- Italy
- Spain
- Finland
- Sweden
- Luxembourg
- Austria
- Belgium
- Germany
- Netherlands
- Ireland
- United Kingdom
- Portugal
- Malta
- Slovenia
- Greece
- Denmark
- Cyprus
- Poland
- Estonia
- Czech Republic
- Lithuania
- Latvia
- Hungary
- Slovakia

Bar chart showing the Healthy Life Years (HLY) and unhealthy life years (unHLY) for women in various countries in 2005.
Example 4

Projections of DFLE: early results from Modelling Ageing Populations to 2030 (MAP2030)
Mortality trends and their implications (WP1)

Changing family units & kinship structure (WP3)

Household & family resources (WP4)

Future disease patterns & their implications for disability in later life (WP2)

Projections of pensions, incomes, savings, care (paid & unpaid); expenditure on pensions & long-term care (WP5)
Simulation model

βs for onset and death from transition model*

CFAS disease prevalence

Trends in disease prevalence

Future popn by disability

New 65-66 yr olds

Population 2 yrs on

Propn dying or becoming disabled

Effects of treatments

Scenarios

♦ Ageing alone
  – Age-specific prevalence of diseases is constant
  – Prevention strategies and effective treatments simply offset the negative influences of obesity and other cohort trends
  – Incidence of and recovery rates to dependency remain the same with no further effect of treatments
  – Mortality rates continue as GAD principal projections
Scenarios

♦ Improving population health
  – decline in risk factors, particularly smoking and obesity
  – new treatments or technologies emerge to reduce the disabling effects of arthritis, dementia, stroke and CHD and make further gains in survival

♦ Poorer population health
  – obesity trends of 2% increase annually continue increasing prevalence of arthritis, stroke and CHD
  – Treatments continue to focus on reducing the mortality from diseases rather than reducing the disabling effects

♦ Disease specific
  – Reduction in prevalence of stroke, CHD, arthritis and cognitive impairment of 1% every 2 years
LE and DFLE at 65 in 2006 and 2026

<table>
<thead>
<tr>
<th>Year</th>
<th>%DFLE/LE</th>
<th>Ageing only</th>
<th>Poorer health</th>
<th>Improved health</th>
<th>All prevalence reduced 1%</th>
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<tbody>
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<td>2006</td>
<td>90%</td>
<td>16.7</td>
<td>1.8</td>
<td>16.7</td>
<td>1.8</td>
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<td>2026</td>
<td>86%</td>
<td>18.8</td>
<td>3.0</td>
<td>18.5</td>
<td>3.1</td>
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Expected years

- Ageing only: 16.7 (2006), 18.8 (2026)
- Poorer health: 1.8 (2006), 3.0 (2026)
- Improved health: 16.7 (2006), 18.5 (2026)
- All prevalence reduced 1%: 1.8 (2006), 3.1 (2026)
LE and DFLE at 85 in 2006 and 2026

Expected years

<table>
<thead>
<tr>
<th>Year</th>
<th>Ageing only</th>
<th>Poorer health</th>
<th>Improved health</th>
<th>All prevalence reduced 1%</th>
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<td>2006</td>
<td>4.2</td>
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<td>4.2</td>
<td>1.6</td>
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<td>5.1</td>
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%DFLE/LE

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<tr>
<td>73%</td>
<td>66%</td>
<td>72%</td>
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Leicester Nuffield Research Unit
Conclusions

Projecting HLE is more complex than LE:
- Different measures of health may have different trends
- Risk factors (or treatments/interventions) may act at different points in the process
- Multiple diseases (frailty) will become more common making single disease models too simplistic
Healthy Life Expectancy – past, present and future

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