University of Leicester

Leicester Nuffield Research Unit

Healthy Life Expectancy – past, present and future

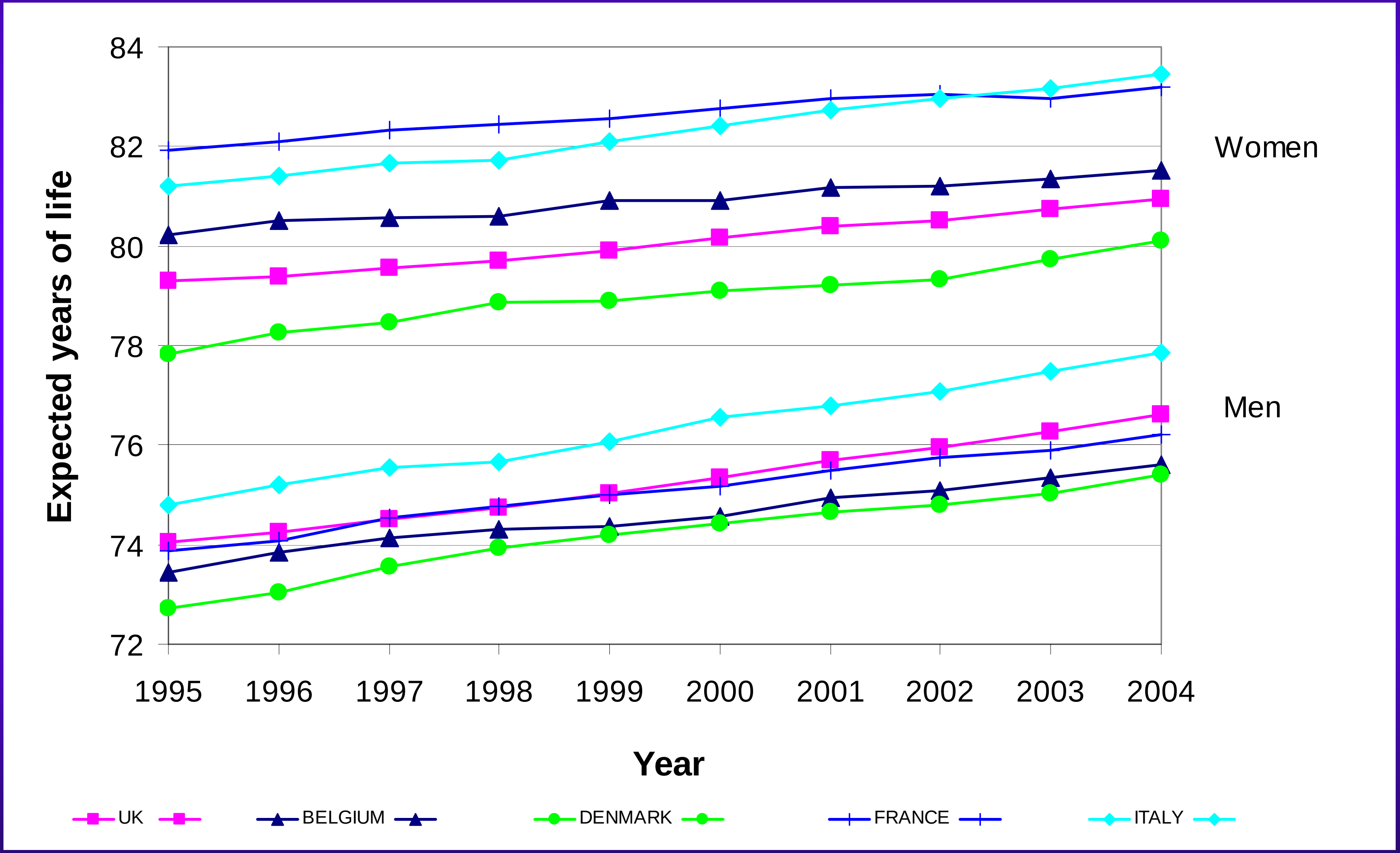
Carol Jagger

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
  - *compression of morbidity* (Fries, 1980, 1989).
- 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

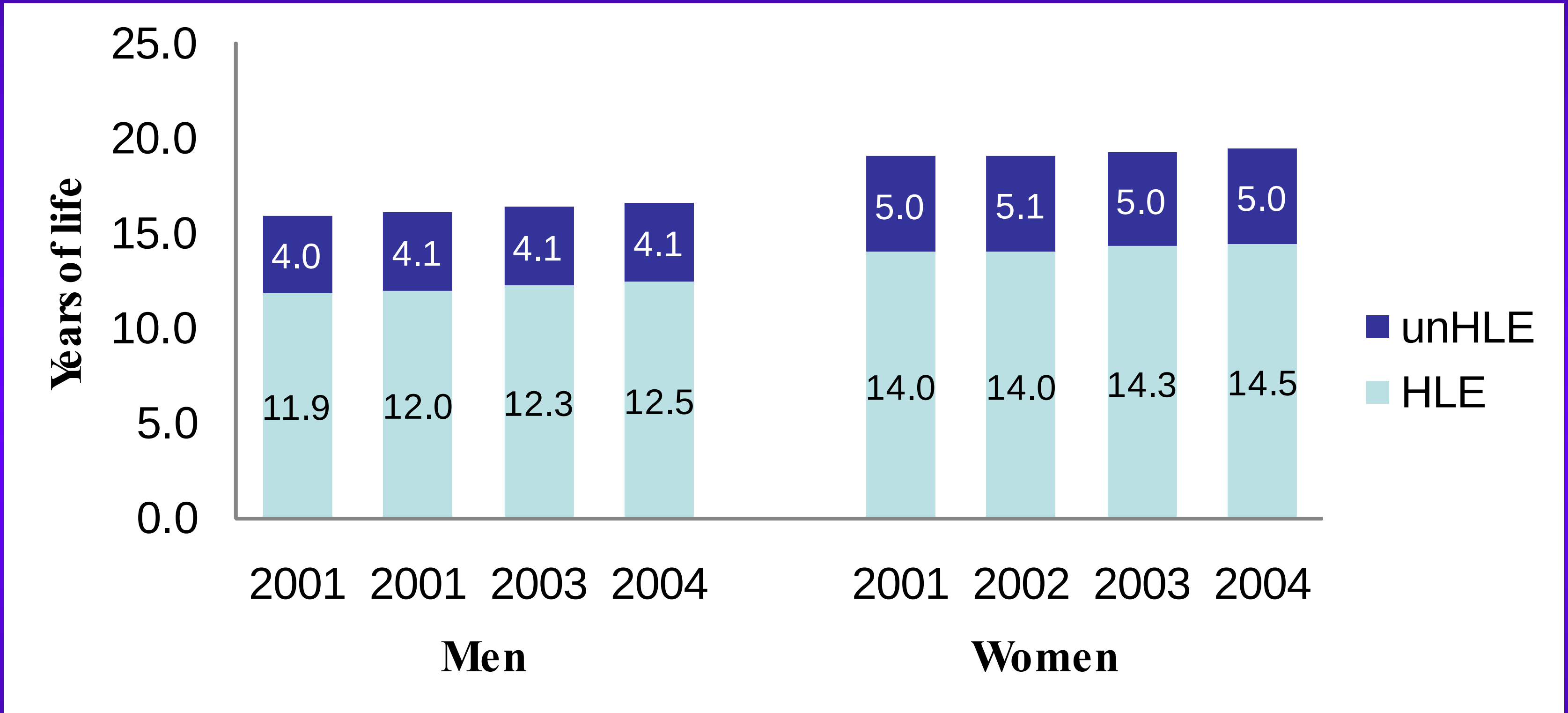
Disability free LE
DFLE

- Limiting longstanding illness
- IADL/ADL

Dementia free LE
DemFLE

Many measures of health = many health expectancies!

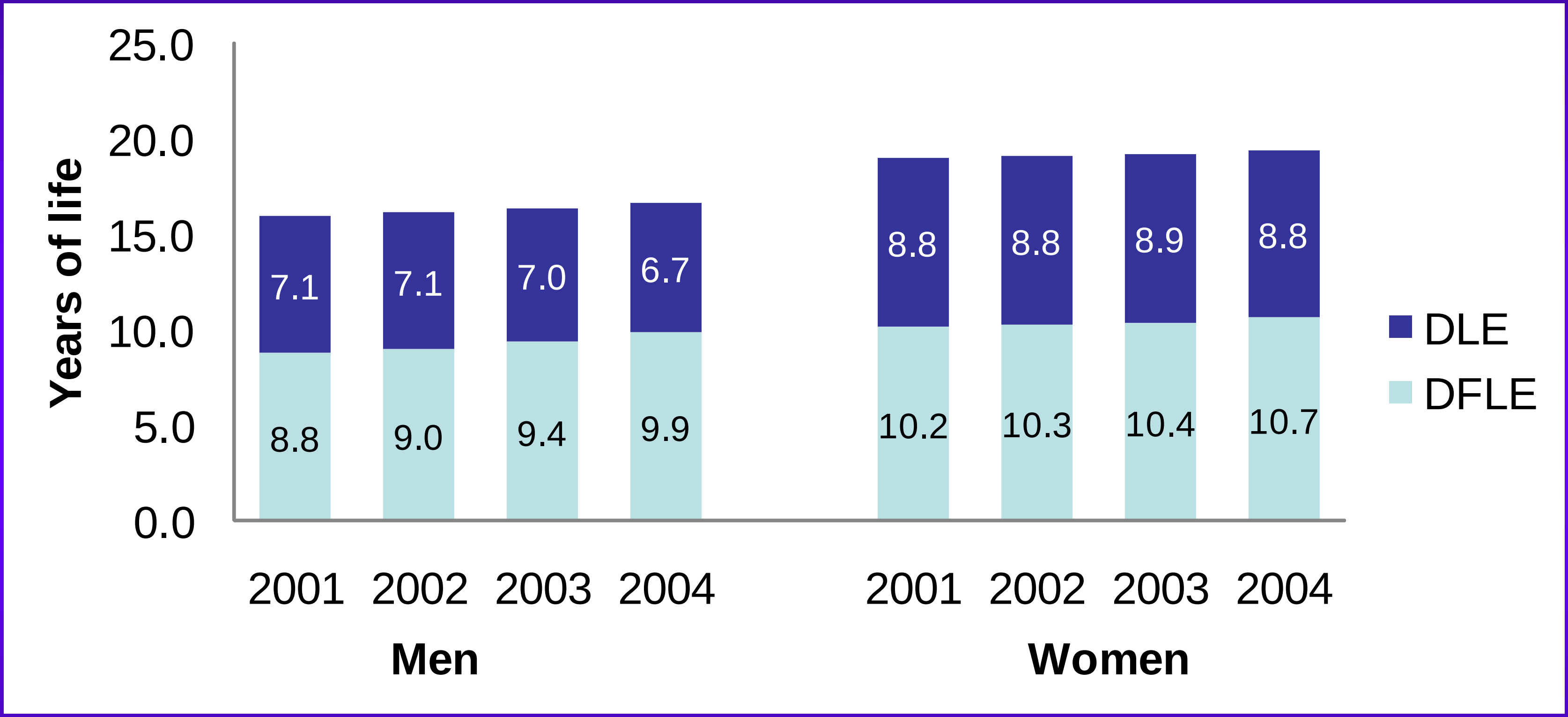
HLE* at age 65 UK 2001-2004



%HLE/LE	74.7	74.4	75.1	75.2	73.6	73.3	74.2	74.4

**HLE based on good or fairly good self-rated health. Source: ONS*

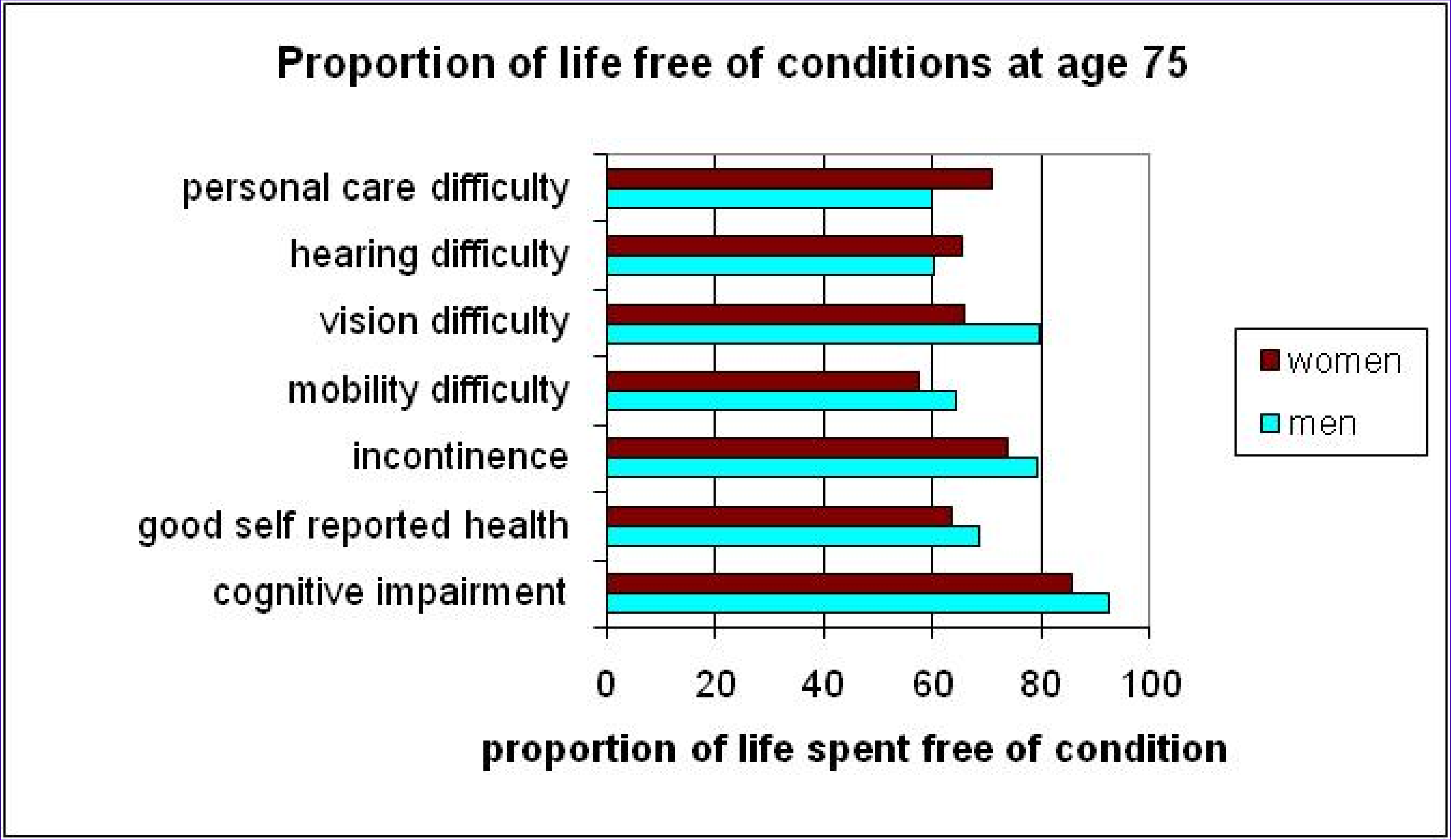
DFLE* at age 65 UK 2001-2004



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

**DFLE based on free from limiting long-term illness. Source: ONS*

Many health expectancies!



What is the best measure?

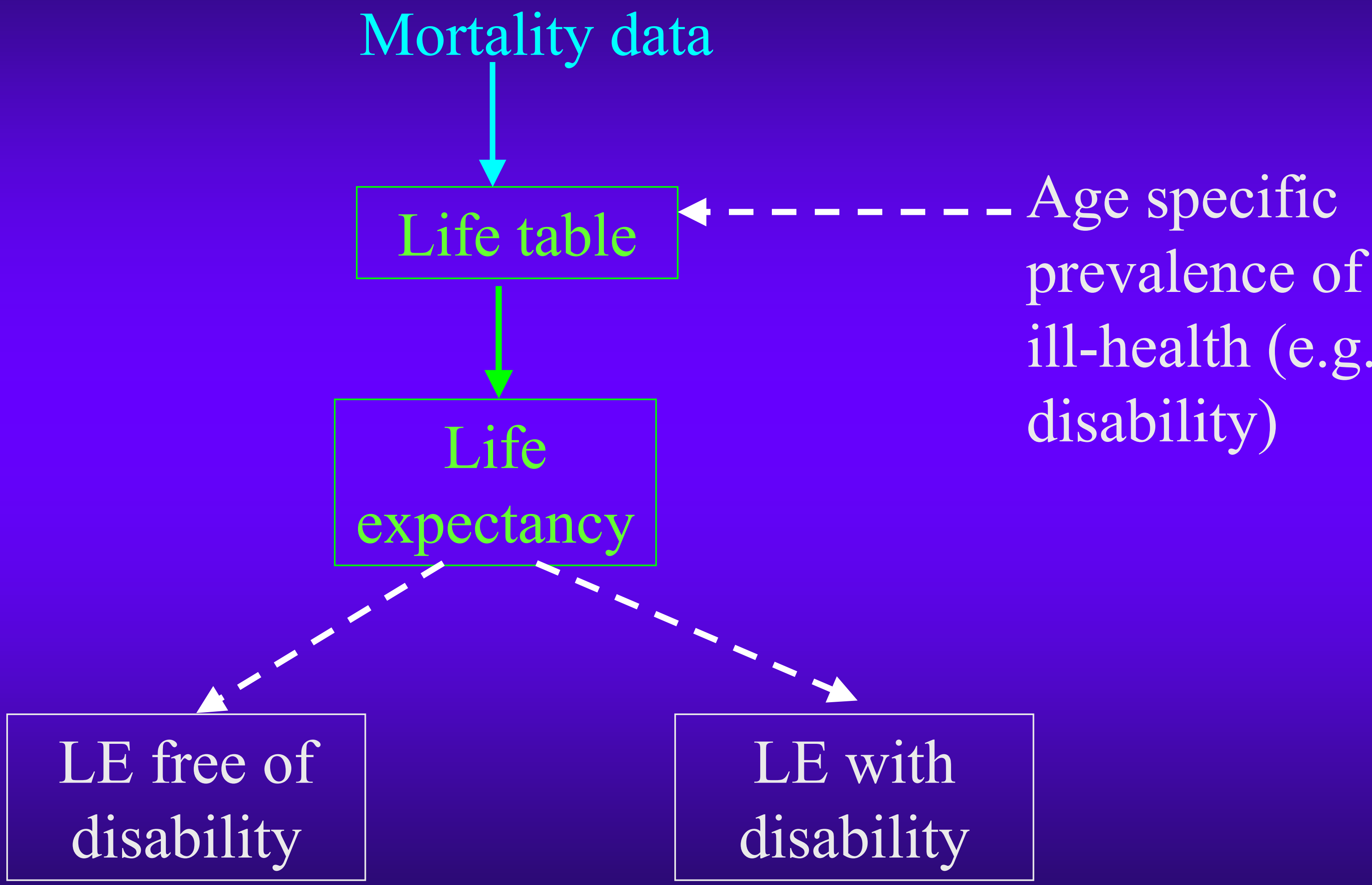
- Depends on the question
- Need a range of severity
  - dynamic equilibrium
- Performance versus self-report
  - cultural differences
- Cross-national comparability
  - translation issues

Cross-sectional versus longitudinal data

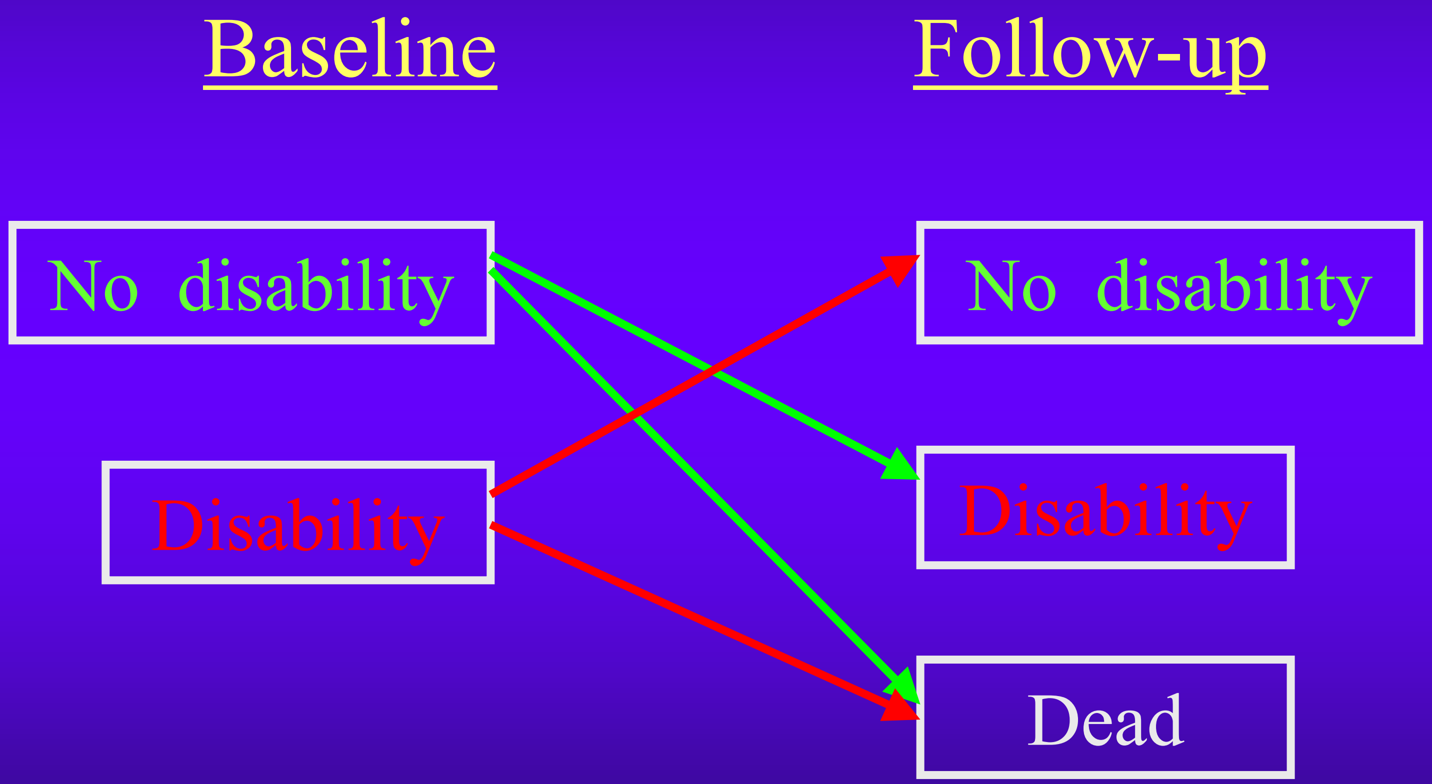
X-sectional versus longitudinal data

- 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



HE with longitudinal data



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

Int. J. Epidemiol. Advance Access published January 25, 2007

Published by Oxford University Press on behalf of the International Epidemiological Association
International Journal of Epidemiology 2007;1–8
doi:10.1093/ije/dyl307

Educational differences in the dynamics of disability incidence, recovery and mortality: Findings from the MRC Cognitive Function and Ageing Study (MRC CFAS)

Carol Jagger,[1]* Ruth Matthews,[1] David Melzer,[2] Fiona Matthews,[3] Carol Brayne[4] and MRC CFAS[5]

Accepted 18 December 2006

Background This study aims to establish the extent of educational differences in the disability transitions of incidence, recovery and mortality in people aged 65 years and over, whether these can be explained by differentials in disease burden and their relative contribution to educational differences in prevalence and disability-free life expectancy (DFLE).

Methods A stratified random sample of 13004 participants in five areas in England and Wales were interviewed in 1991–94 and followed up at 2, 6 (one centre only) and 10 years. Two levels of disability were analysed: mobility difficulty and activities of daily living (ADL) disability. We fitted logistic regression models to model educational differences in disability prevalence, incidence, recovery and mortality transitions. DFLE was calculated to assess the combined effect of the dynamic transitions.

Results Those with ≤9 years education had higher ADL and mobility disability prevalence and higher incidence and lower recovery of mobility disability. Differences in disability incidence remained after adjustment for comorbidity. Women with the lowest education had shorter life expectancies (1.7 years less at the age of 65 years) than the most educated and had even shorter DFLE (1.9 years free of ADL disability and 2.8 years free of mobility difficulty at the age of 65 years).

Conclusions Differentials in education continue to contribute to prevalence of disability at ages beyond 65 years in both men and women and independently of diseases. These appear to be driven predominantly by differentials in disability incidence that also compound to produce greater differentials in DFLE between education groups than in total years lived.

Keywords MRC CFAS, socioeconomic factors, disability, old age, self-report, activities of daily living

Introduction

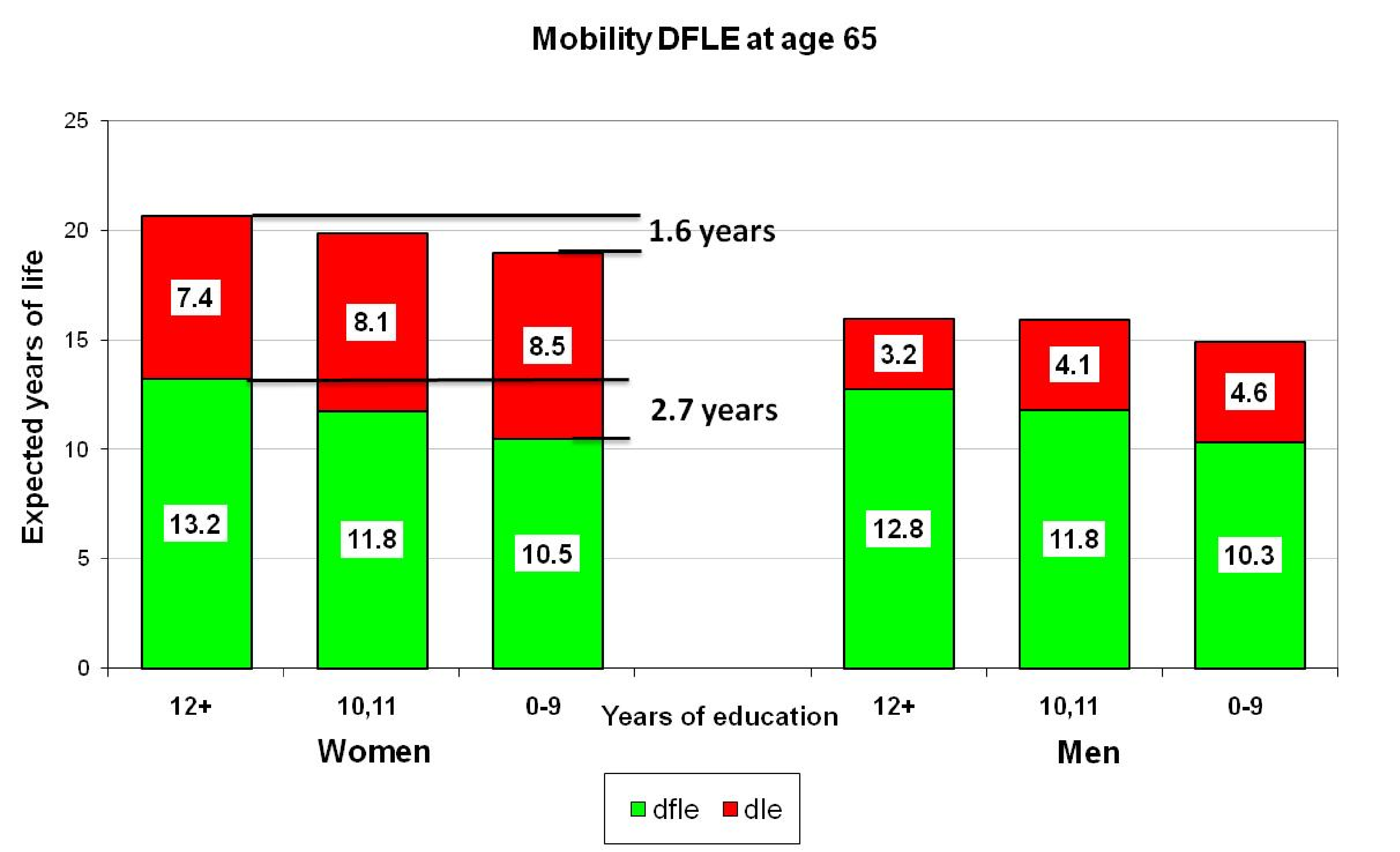
The nature of the links between less privileged socio-economic status and health have been extensively studied in middle aged populations, but rather less so in older people, especially in the UK. For mortality, strong links have been demonstrated between socio-economic status and overall survival in older people.[1] Higher prevalence rates of disability (having difficulty undertaking everyday activities) have also been linked to

[1] Leicester Nuffield Research Unit, Department of Health Sciences, University of Leicester.
[2] Epidemiology and Public Health Group, Peninsula Medical School, Exeter.
[3] MRC Biostatistics Unit, Cambridge.
[4] Department of Public Health and Primary Care, University of Cambridge.
[5] Medical Research Council Cognitive Function and Ageing Study http://www.cfas.ac.uk
* Corresponding author. Leicester Nuffield Research Unit, Department of Health Sciences, University of Leicester, 22-28 Princess Road West, Leicester LE1 6TP, UK. E-mail: cxj@le.ac.uk

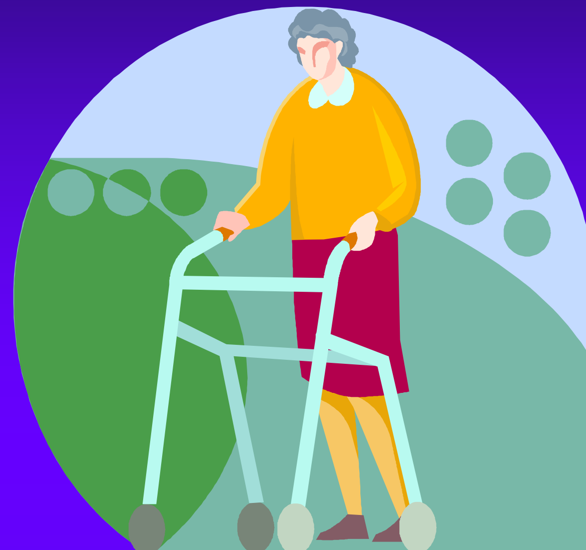
MRC CFAS

- 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



Disability is dynamic



Incidence

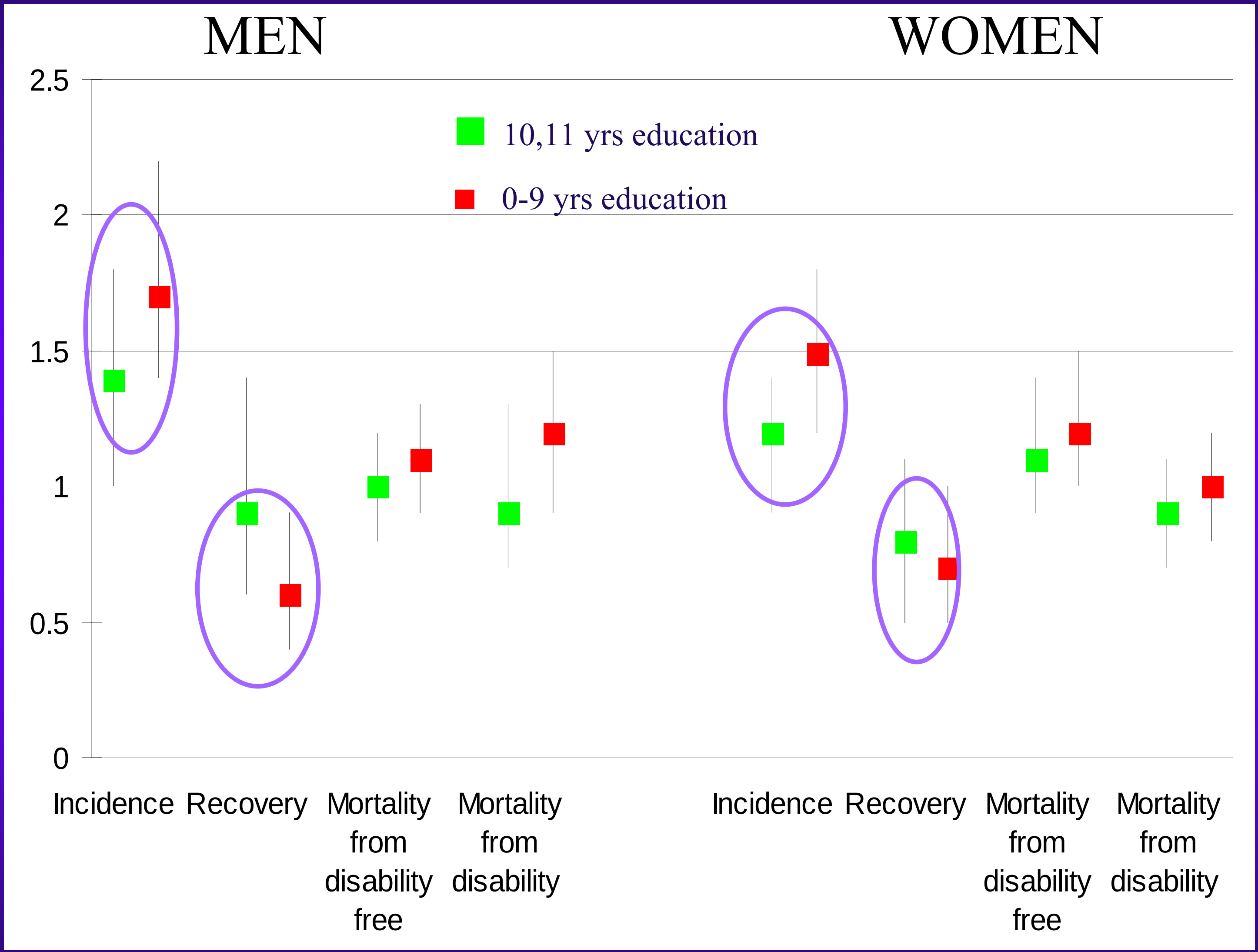
Recovery

Death

EDUCATION

EDUCATION

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

*Blane D. Commentary: Explanations of the difference in mortality risk between different educational groups. International Journal of Epidemiology 2003; 32:355-6.

Example 2

Journal of Gerontology: MEDICAL SCIENCES
2007, Vol. 62A, No. 4, 408–414

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

Carol Jagger,[1] Ruth Matthews,[1] Fiona Matthews,[2] Thompson Robinson,[3] Jean-Marie Robine,[4] Carol Brayne,[5] and the Medical Research Council Cognitive Function and Ageing Study Investigators

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

Background. The consequences of diseases in later life have been judged predominantly through mortality, resulting in an emphasis on the fatal rather than the nonfatal disabling conditions. We use a longitudinal study with follow-ups 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 13,004 people aged 65 years and older from five U.K. centers starting in 1991. Persons aged 75 years and older were over-sampled. Disability (mild, moderate, and severe) was assessed through basic Activities of Daily Living (ADL) and Instrumental ADL (IADL) scales at baseline and at follow-ups at 2, 6, and 10 years. TLE and DFLE were compared for persons with and without each of nine conditions.

Results. At age 65, men had a TLE of 15.3 years of which 12.1 (79%) were free of any disability, whereas women of the same age had an average TLE of 19.4 years, 11.0 years (57%) disability-free. Men (women) aged 65 years without stroke had 4.8 (4.6) more years of TLE and 6.5 (5.8) more years DFLE. Without diabetes, men (women) lived 4.4 (5.6) years longer and had 4.1 (5.1) years disability-free.

Conclusions. More disability-free years were gained than total life years in persons free of stroke, cognitive impairment, arthritis, and/or visual impairment at baseline. This finding suggests that elimination of these conditions would result in a compression 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 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 less prevalent conditions is a further issue.

Disability-free life expectancy (DFLE) summarizes 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 (5–7). It was first proposed as a means of assessing the potential gains in health through the elimination of diseases 20 years ago (8). Other such studies have followed (9–12), the most comprehensive being the Global Burden of Disease Study (13). The common approach in these studies has been based on disability prevalence data and cause-deleted life tables. These methods are subject to a number of limitations: The accuracy of cause-of-death data is questionable and induces a bias towards the major fatal diseases; comorbidity, 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 (13).

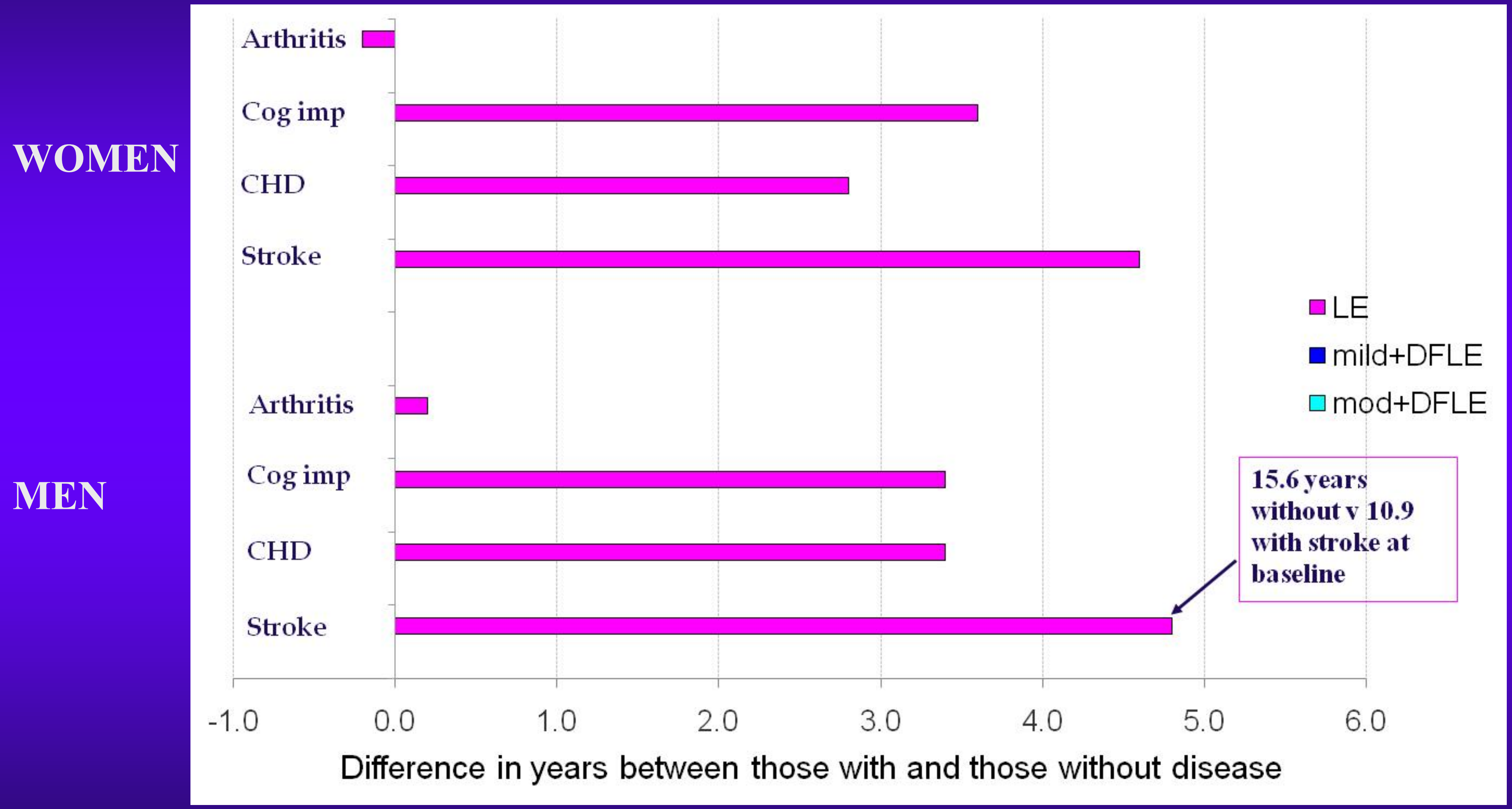
Only a handful of studies have explicitly modeled transitions from disease through to disability and death with longitudinal data, and all have been limited to one or two diseases: heart disease (14), dementia (14,15), and diabetes (16). This article will be the first, to our knowledge, to use longitudinal data with 10 years of follow-up on both community-dwelling and institutionalised older people and to explore the impact of a range (nine) of diseases and impairments on life expectancy with and without disability of differing severity levels.

Methods

The Medical Research Council Cognitive Function and Ageing Study (MRC CFAS) is a population-based longitudinal study of health in the older population (http://www.cfas.ac.uk). Full methods have already been published (17), 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

408

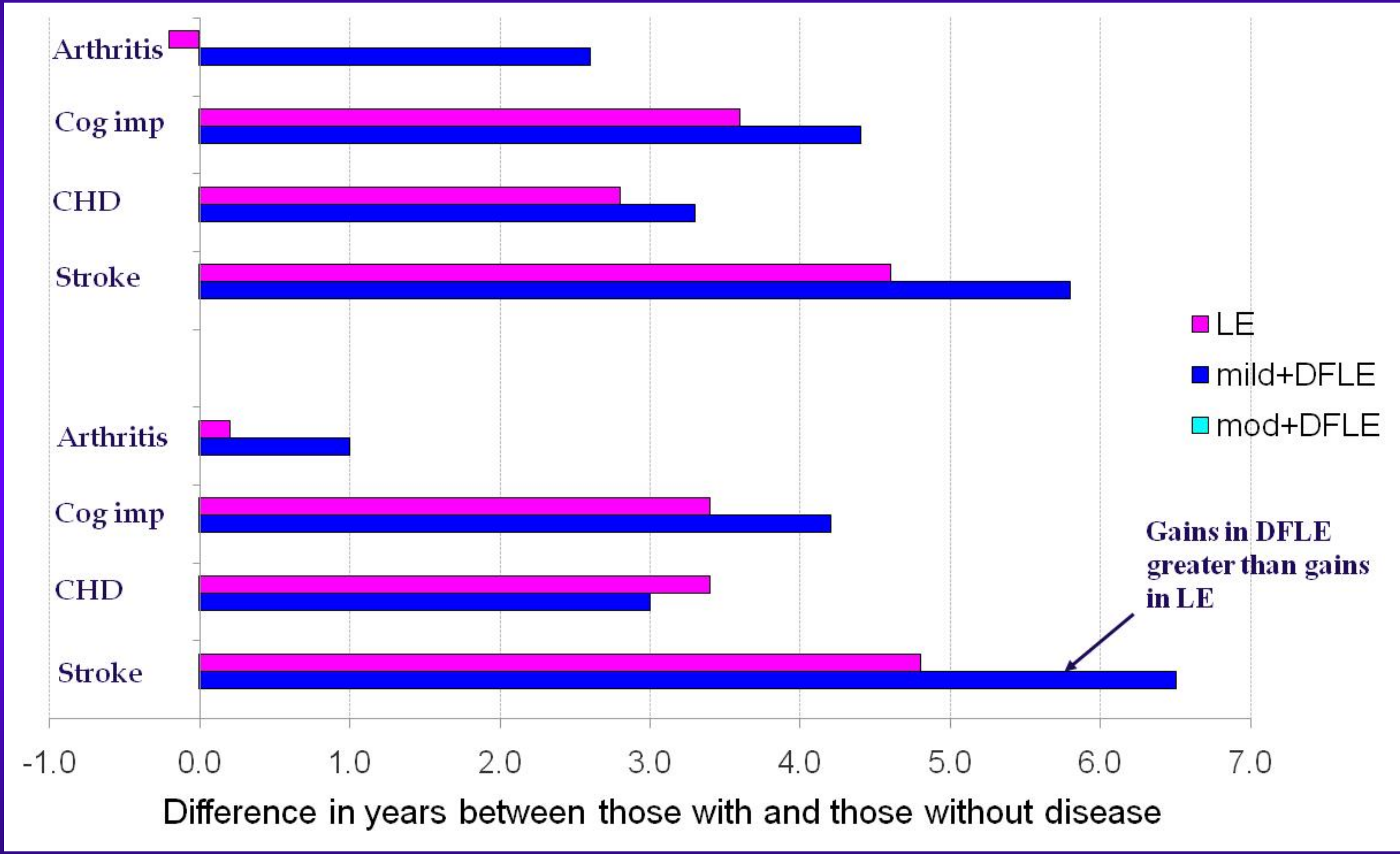
Change in LE at age 65



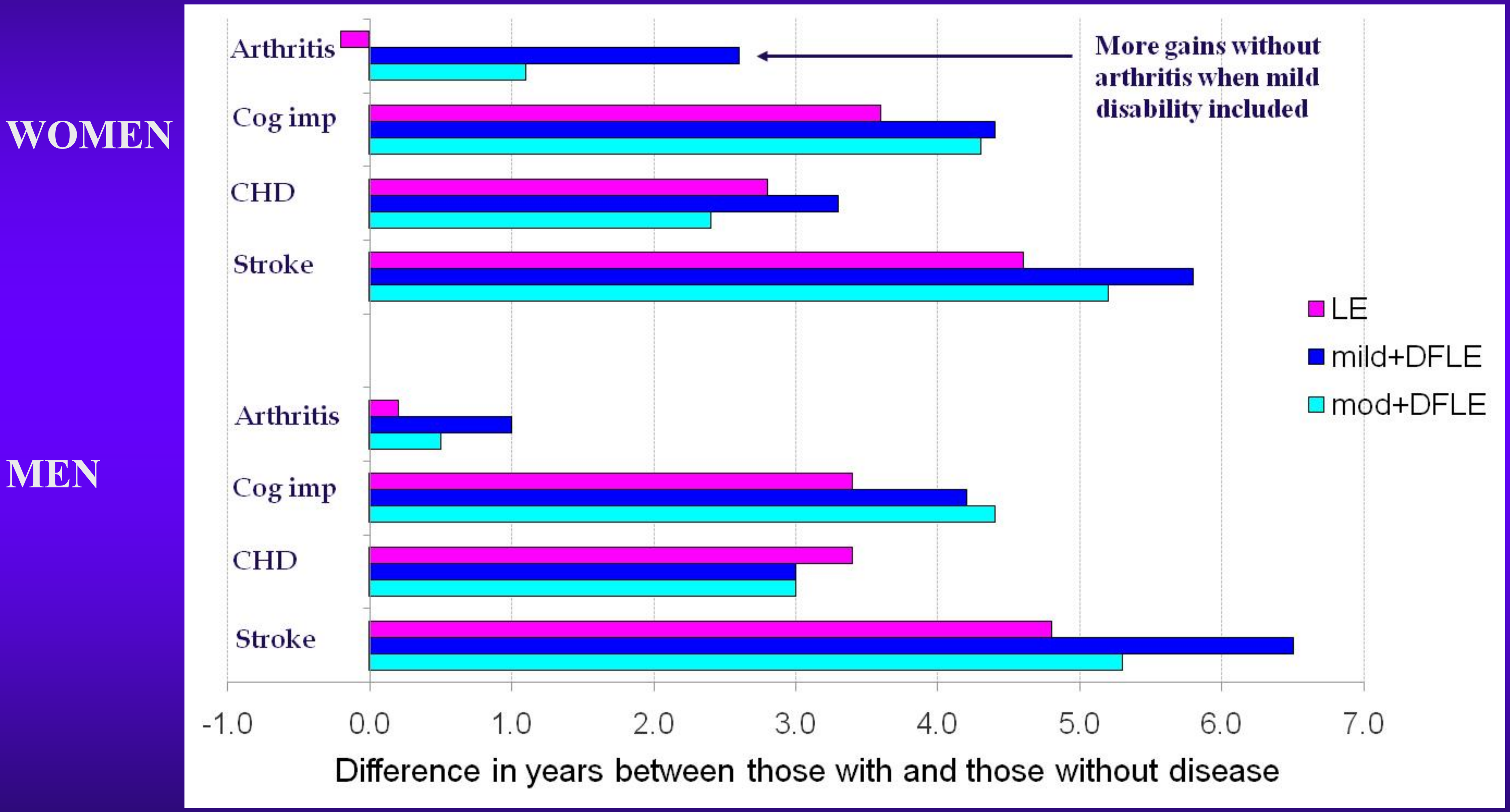
Change in mild+DFLE at age 65

WOMEN

MEN



Change in mod+DFLE at age 65



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

Example 3

Inequalities in healthy life years in the 25 countries of the European Union in 2005: a cross-national meta-regression analysis

Carol Jagger, Clare Gillies, Francesco Moscone, Emmanuelle Cambois, Herman Van Oyen, Wilma Nusselder, Jean-Marie Robine, and the EHLEIS team

Lancet 2008; 372: 2124–31
Published Online November 17, 2008
DOI:10.1016/S0140-6736(08)61594-9

See Editorial page 2088
See Comment page 2090
See Department of Error page 2114

Department of Health Sciences (Prof C Jagger PhD, C Gillies PhD) and Department of Economics (F Moscone PhD), University of Leicester, Leicester, UK; French Institute for Demographic Studies, INED, Paris, France (E Cambois PhD); Scientific Institute of Public Health, Brussels, Belgium (Prof H Van Oyen PhD); Erasmus Medical Center, University Medical Center Rotterdam, Rotterdam, Netherlands (W Nusselder PhD); and French Institute of Health and Medical Research, INSERM, Montpellier, France (J-M Robine DED)

Correspondence to: Prof Carol Jagger, Department of Health Sciences, University of Leicester, 22–28 Princess Road West, Leicester LE1 6TP, UK
cxj@le.ac.uk

Summary

Background Although life expectancy in the European Union (EU) is increasing, whether most of these extra years are spent in good health is unclear. This information would be crucial to both contain health-care costs and increase labour-force participation for older people. We investigated inequalities in life expectancies and healthy life years (HLYs) at 50 years of age for the 25 countries in the EU in 2005 and the potential for increasing the proportion of older people in the labour force.

Methods We calculated life expectancies and HLYs at 50 years of age by sex and country by the Sullivan method, which was applied to Eurostat life tables and age-specific prevalence of activity limitation from the 2005 statistics of living and income conditions survey. We investigated differences between countries through meta-regression techniques, with structural and sustainable indicators for every country.

Findings In 2005, an average 50-year-old man in the 25 EU countries could expect to live until 67·3 years free of activity limitation, and a woman to 68·1 years. HLYs at 50 years for both men and women varied more between countries than did life expectancy (HLY range for men: from 9·1 years in Estonia to 23·6 years in Denmark; for women: from 10·4 years in Estonia to 24·1 years in Denmark). Gross domestic product and expenditure on elderly care were both positively associated with HLYs at 50 years in men and women ($p<0·039$ for both indicators and sexes); however, in men alone, long-term unemployment was negatively associated ($p=0·023$) and life-long learning positively associated ($p=0·021$) with HLYs at 50 years of age.

Interpretation Substantial inequalities in HLYs at 50 years exist within EU countries. Our findings suggest that, without major improvements in population health, the target of increasing participation of older people into the labour force will be difficult to meet in all 25 EU countries.

Funding EU Public Health Programme.

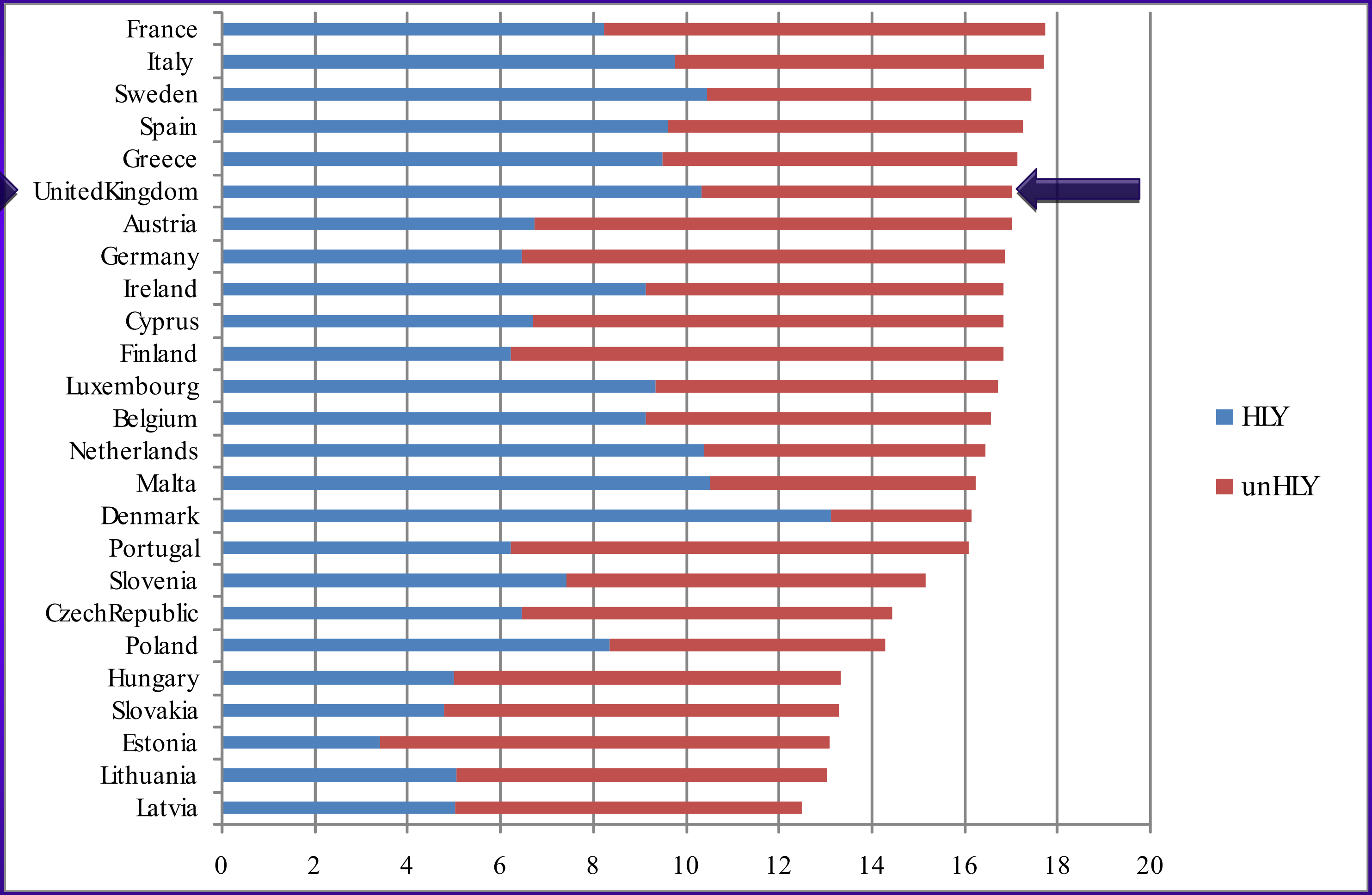
Introduction

Life expectancy at birth and at 65 years of age in countries of the European Union (EU) has risen greatly, suggesting not only that greater numbers of individuals are reaching old age but also that elderly people are themselves living longer. However, populations are not ageing uniformly in all European countries; notably, the gap in life expectancy between eastern and western European countries, which began to converge in the second half of the 20th century, has been widening over the past decades.[1] Different trends have also been recorded within western Europe. Mortality in old age has decreased consistently in France, England, and Wales between the 1950s and 1990s, whereas declines have remained constant in Denmark and the Netherlands.[2]

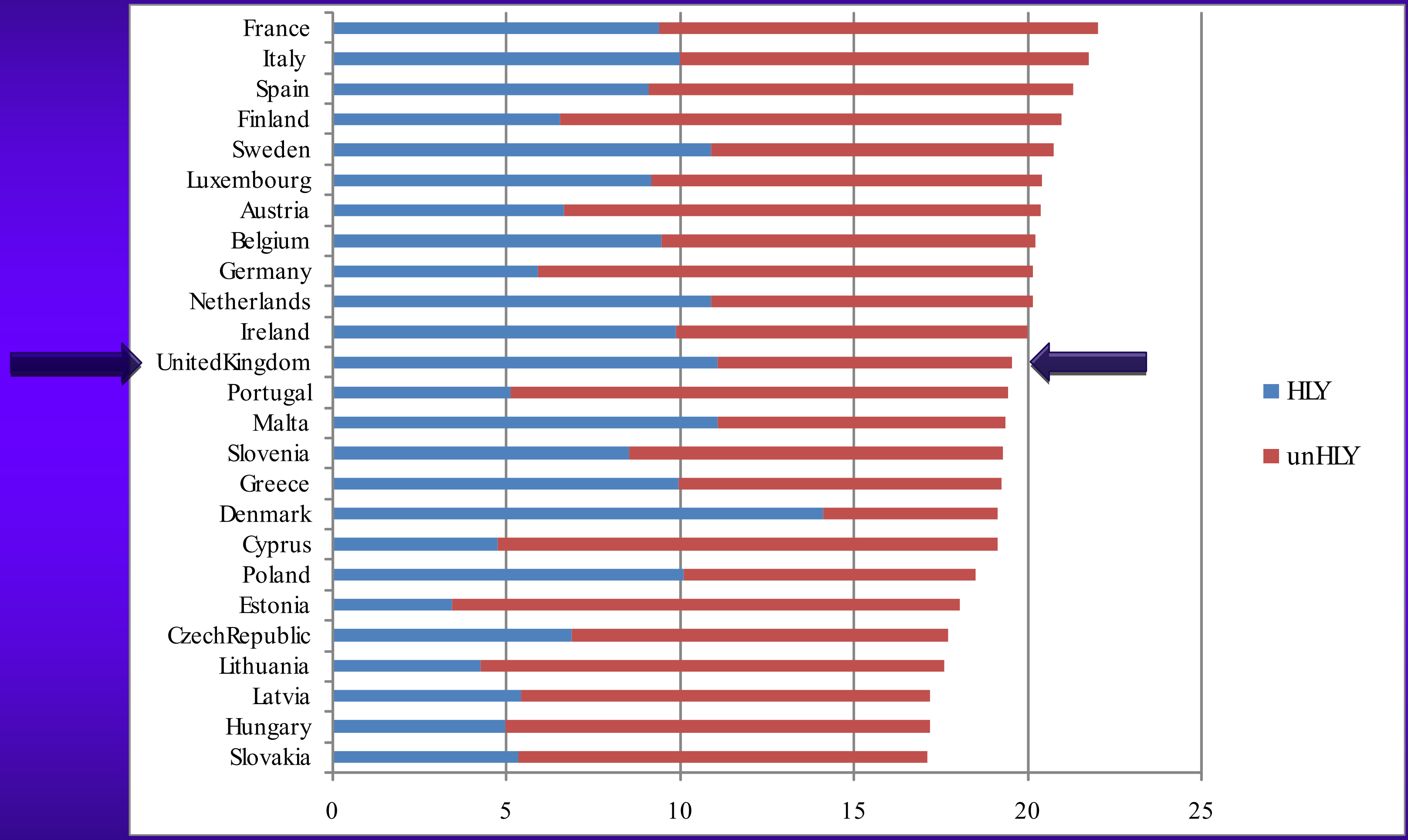
Increasing life expectancy does not in itself mean a healthier population. Health expectancies were developed to bring a quality-of-life dimension to life expectancy,[3] and to establish whether the yearly increases in life expectancy are accompanied by decreases in unhealthy life years (known as the compression of morbidity hypothesis),[4] increases in unhealthy life years (expansion of morbidity),[5] or intermediate scenarios such as dynamic equilibrium in which the increases in years spent unhealthy are offset by a decrease in the mean level of severity of the prevalent disability.[6] An ageing population in poor health has important implications for future medical and care requirements and pension provision, whereas an ageing population in good health has mainly long-term consequences for pension provision.

One of the targets added to the Lisbon Strategy by the European Council in 2001, is that the employment rate for older workers (aged 55–64 years) should reach 50% by 2010. Recent pension reforms in several European countries have extended working lives and begun to offset the rising trends in early retirement. The main arguments supporting extensions of working life seem to be the evidence of gains in life expectancy and an assumption of decreasing disability in old age. However, as with life expectancy, trends of disability in old age are far from uniform across European countries, with clear evidence of decrease in only four (Denmark, Finland, Italy and Netherlands) of the eight European countries studied by the Organisation for Economic Co-operation and Development (OECD).[7] In 2004, the European Commission added a measure of health expectancy to

Healthy Life Years at 65: Men 2005



Healthy Life Years at 65: Women 2005

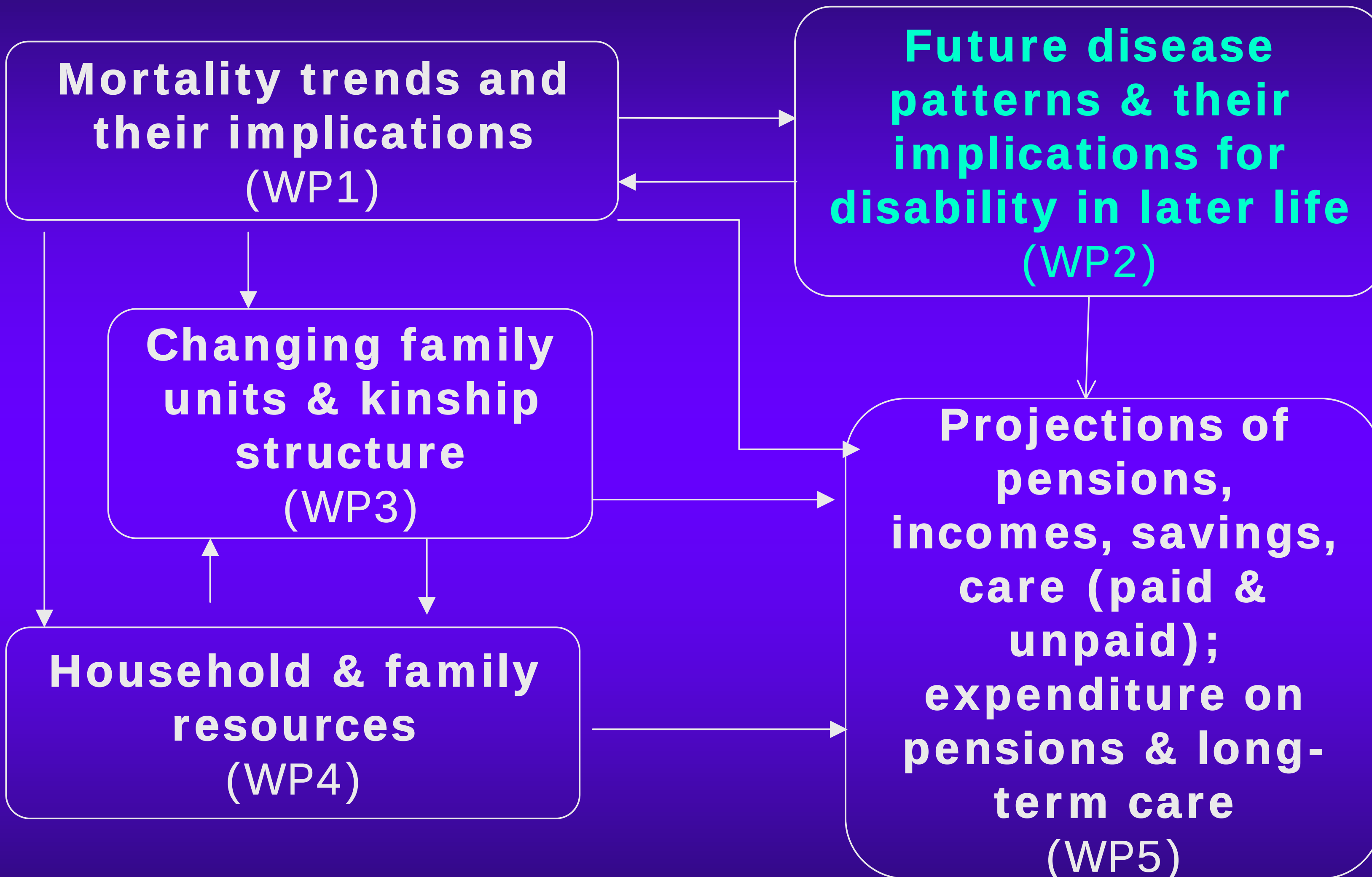


Example 4

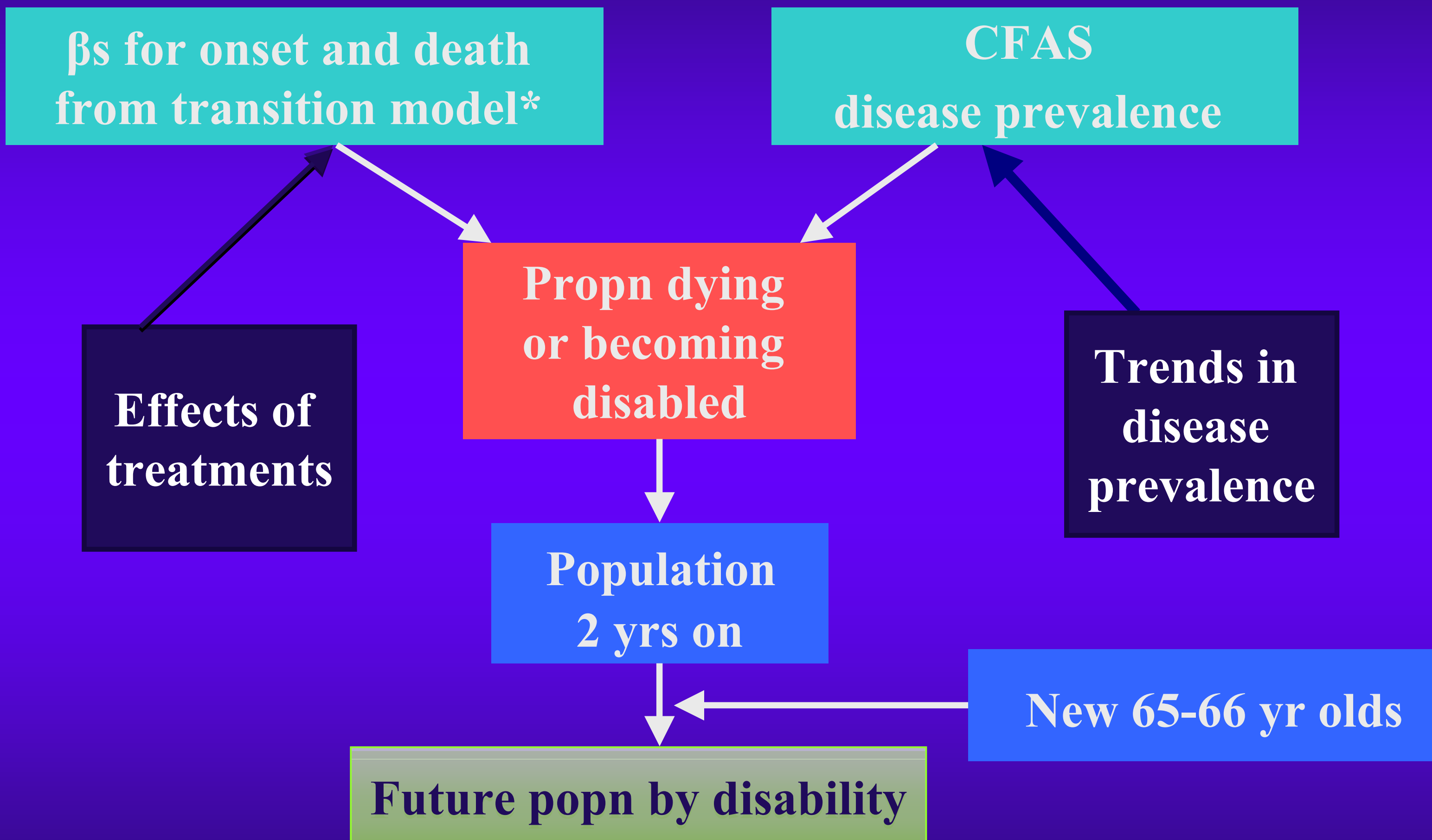
Projections of DFLE: early results from Modelling Ageing Populations to 2030 (MAP2030)

MAP2030
Modelling Ageing Populations to 2030

nda PROGRAMME
new dynamics of ageing
a cross-council research programme



Simulation model



Spiers NA et al. J Gerontol Med Sci 2005

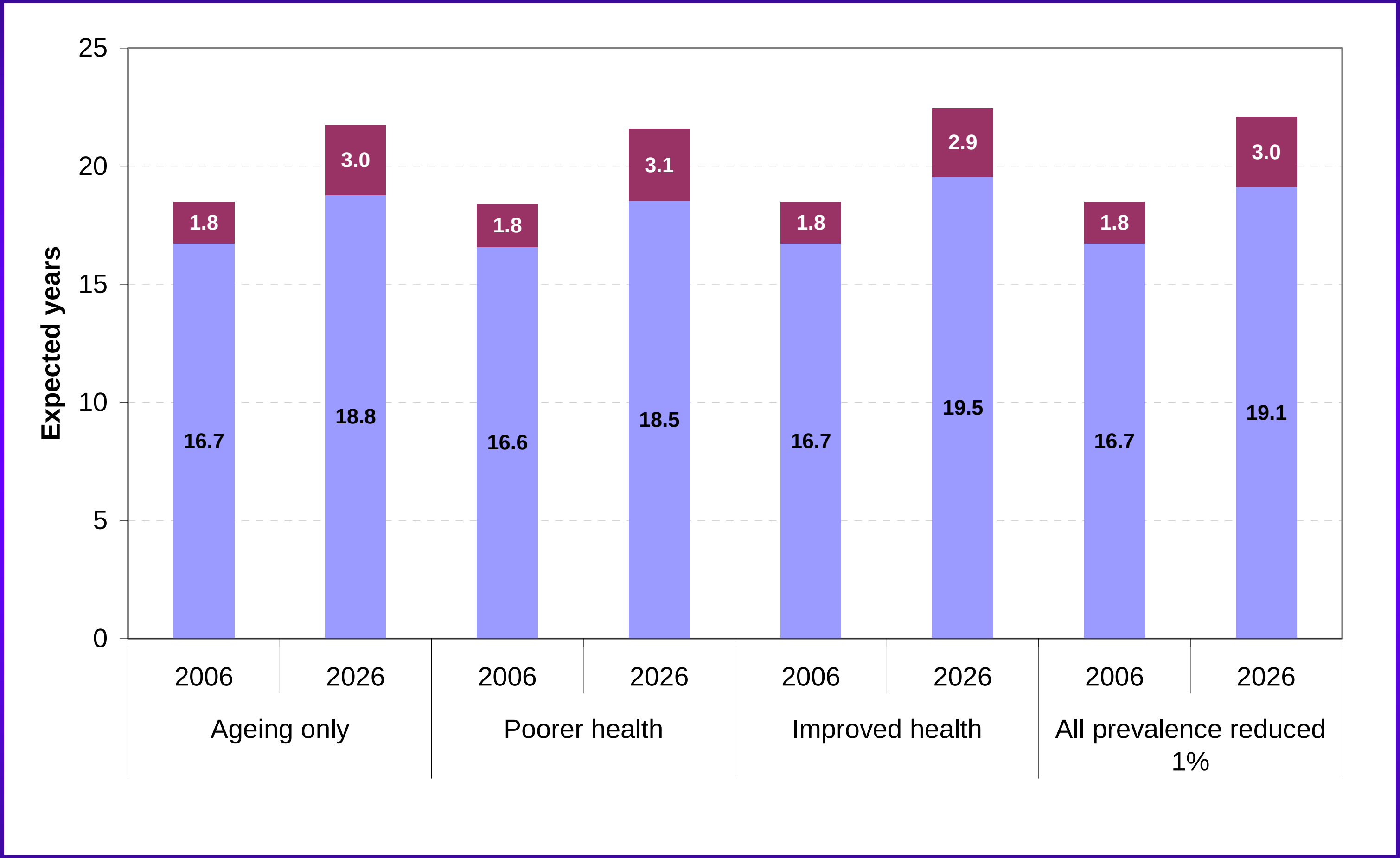
Scenarios

- 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

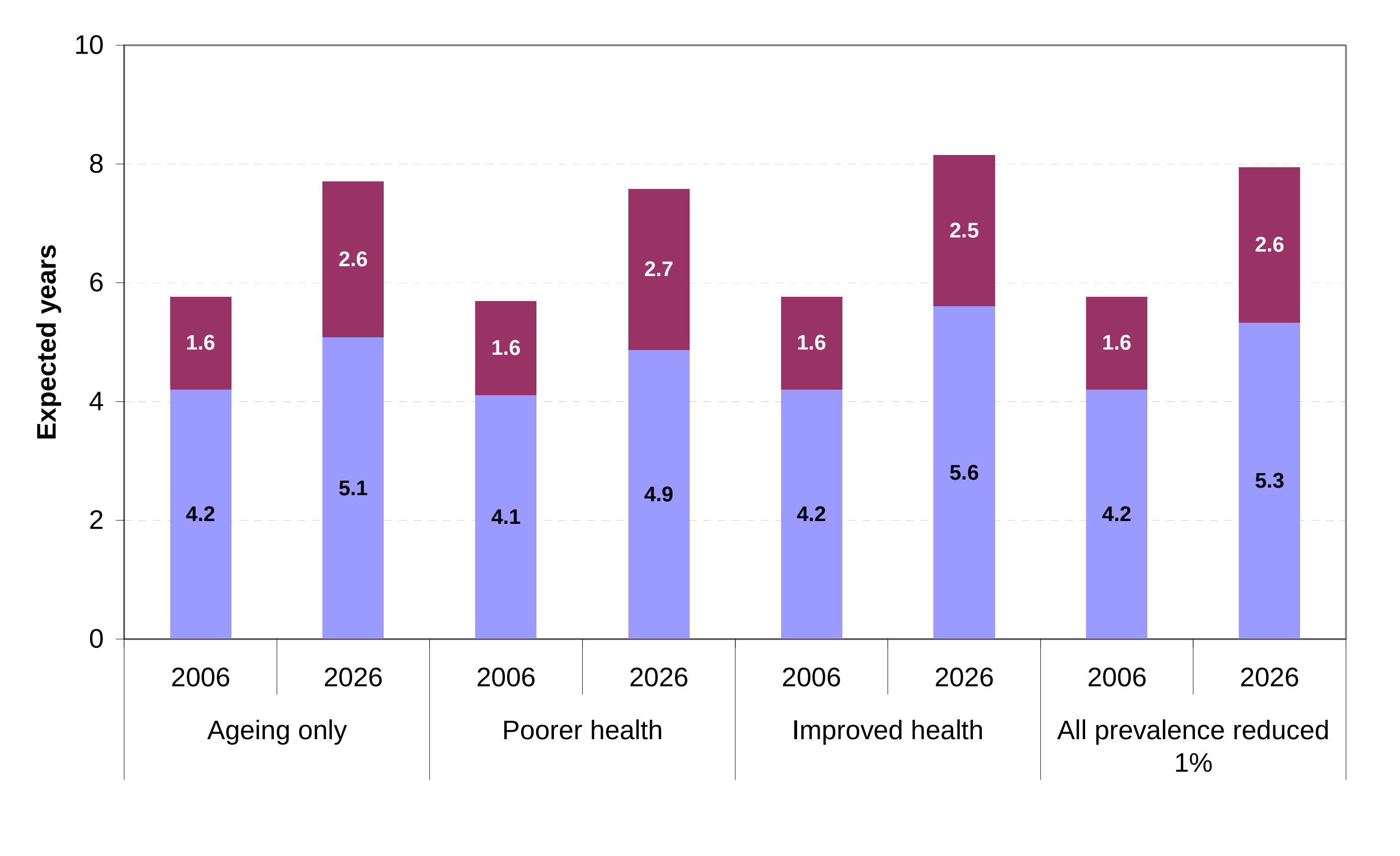
- Improving population health
  - decline in risk factors, particularly smoking and obesity
  - new treatments or technologies emerge to reduce the disabling effects of arthritis, dementia, stroke and CHD and make further gains in survival
- Poorer population health
  - obesity trends of 2% increase 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



%DFLE/LE	90%	86%	90%	86%	90%	87%	90%	86%

LE and DFLE at 85 in 2006 and 2026



%DFLE/LE 73% 66% 72% 64% 73% 69% 73% 67%

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

University of Leicester

Leicester Nuffield Research Unit

Healthy Life Expectancy – past, present and future

Carol Jagger
(cxj@le.ac.uk)