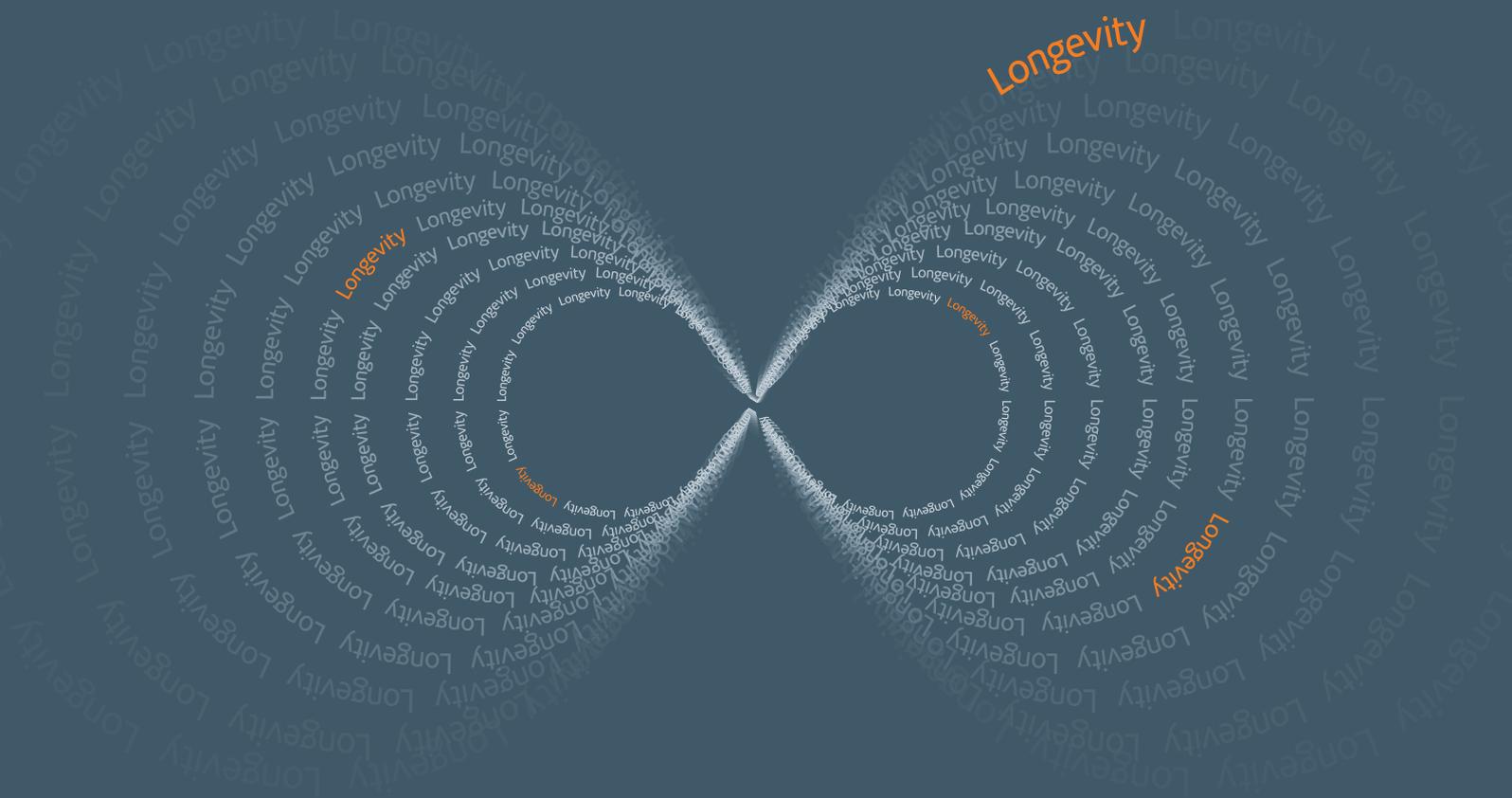


The Actuarial Profession
making financial sense of the future

Longevity Bulletin

From the Institute and Faculty of Actuaries



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Introduction

by the President of the Institute and Faculty of Actuaries,
Philip Scott

I have great pleasure in introducing the fourth issue of the *Longevity Bulletin*. I'd like to thank Carol Jagger, AXA Professor in Epidemiology of Ageing at the Institute for Ageing and Health at Newcastle University, for producing such an interesting issue.

This Bulletin focuses on the important issue of health expectancy, a natural extension of life expectancy – defined as the remaining years at a particular age spent healthy. The adoption of Healthy Life Years (HLY) as the first EU Structural Indicator on health has given impetus to research on health expectancies.

This issue summarises the main statistical sources and draws some conclusions relevant to the key questions for governments and policymakers – in particular, whether the extra years of life which populations are now experiencing are predominantly healthy ones.

We hope that this issue will be read with interest by all those with a technical, professional or personal interest in the topic of healthy life expectancy.

Best wishes,



Philip Scott
President, Institute and Faculty of Actuaries

1. Editorial:

Longer life – in better health?

longevity *n.*

Pronunciation: /lɒn'dʒɛvɪti/

Long life; long duration of existence (Oxford English Dictionary)

Beliefs that today's older people are healthier than those of previous generations are commonly held. Nevertheless they are often based solely on the fact that life expectancy has increased, even at older ages. Health expectancy, a natural extension of life expectancy and defined as the remaining years at a particular age spent healthy, was first proposed in the 1970s to address the burning question of whether the extra years of life were being spent in good health (compression of morbidity) or bad health (expansion of morbidity). Over the last decade work on health expectancies has flourished, particularly since the adoption of Healthy Life Years (HLY) as the first EU Structural Indicator on health.

The *Focus* article in this issue of *Longevity Bulletin* introduces the concept of health expectancy and how, alongside life expectancy, it can determine whether trends fit the scenario of compression or expansion of morbidity. We use the most recent sub-national healthy life expectancy estimates for England and Wales and for European countries as examples and highlight the best sources of information on health expectancies for the UK and Europe.

Longevity Bulletin aims to provide a regular guide to the prospects for long lives. It presents and explains actuarial perspectives on population longevity and looks outside the profession for statistics, research and the latest thinking on related subjects. It is not intended as a comprehensive guide to everything new in longevity research but rather as a helpful companion for those interested in a most intriguing subject.

We hope the *Bulletin* is read by actuaries, users of actuarial services and anyone with a technical, professional or personal interest in longevity.

To receive future issues of *Longevity Bulletin*,
email: longevitybulletin@actuaries.org.uk.

2. Focus on: Healthy Life Expectancy

Historically, period life expectancy has been used to monitor population health, not least since mortality data is readily obtainable and generally comparable across countries. This assumption was reasonable when acute, infectious diseases formed the main burden of ill-health but there has been a shift to more long-standing, chronic diseases, and mortality rates no longer correlate as well with the burden of ill-health in the population. New measures are therefore needed and one such is health expectancy, which captures the quality as well as the quantity of life.

This *Focus* article:

- Describes health expectancy, how it is estimated and why it is important.
- Considers time trends in healthy life expectancy for the UK and Europe and whether the extra years of life are healthy ones.
- Shows the size of disparities in healthy life expectancy within Europe and the UK and discusses possible explanations and the implications for future population health.
- Provides the main sources of information on health expectancy estimates.

Health expectancy – what it is and why it is important

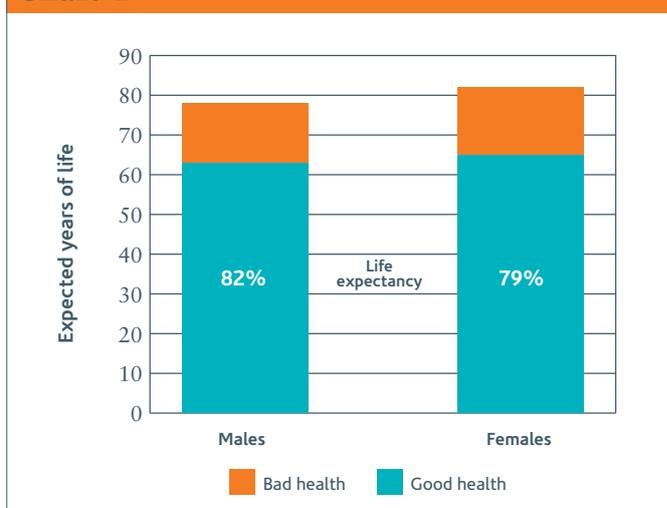
“Increased longevity without quality of life is an empty prize. Health expectancy is more important than life expectancy.”

Dr Hiroshi Nakajima, Director-General WHO 1997

Period life expectancies (LE) are the average number of years of life remaining at a particular age, assuming current mortality rates do not change. Health expectancies divide period LE into years lived in different health states (Chart 1) and therefore are the average number of remaining years spent in health states. As they are based on period LE, health expectancies do not exactly relate to how long an average life is (see *Longevity Bulletin 02*). It cannot be assumed that all the ill health happens at the end of life. However, just as period LE are a useful snapshot summary of average mortality in a population, so health expectancies are helpful indicators of average morbidity.

One might question what extra information is brought by health expectancies, since the level of ill-health in a population is often measured by its prevalence. Nonetheless, overall

Chart 1



Illustrative example of presentation of health expectancies

prevalence may increase in a population without individuals being more at risk of ill-health than previously because of population ageing and the fact that older people are more likely to suffer from disability and ill-health. Health expectancies take into account both changes in living with ill-health and the changes in mortality responsible for increasing life expectancy, and are therefore a powerful tool to identify the interaction between health, ill-health, and mortality.

So far we have talked as if health were a single measure. There are many measures of health and thus many measures of health expectancies. The most common health expectancies reported for the UK are Disability-Free Life Expectancy (DFLE), based on a question on limiting long-standing illness, and Healthy Life Expectancy (HLE), based on the self-rated health question (Box 1). Both questions have been included in censuses and in national surveys so there are long time trends as well as sub-national estimates. A disability-free life expectancy known as Healthy Life Years (HLY) and HLE are also available for the EU27 countries, based on a Global Activity Limitation Index (GALI) and self-rated health question respectively (see Box 1 for the underlying questions). Longitudinal studies in the UK and studies in the US often use ability to perform activities of daily living (ADL) as the measure of disability, though in the US it is often termed Active Life Expectancy rather than DFLE.

Box 1:

Questions underlying main health expectancies in UK and Europe

UK Census 2001 questions	EU questions
General Health	Self-rated health
Over the last 12 months would you say your health has on the whole been: Good, Fairly good or Not good?	How is your health in general: Very good, Good, Fair, Bad or Very bad?
Limiting Long-term Illness	Activity limitation (GALI)
Do you have any long-term illness, health problem or disability which limits your daily activities or the work you can do? Include problems which are due to old age. Yes/No.	For the past 6 months or more have you been limited in activities people usually do because of health problems? Yes strongly limited, Yes limited, No not limited

There have also been a number of “disease-free” life expectancies estimated, for example, dementia-free life expectancy (Roelands, Van Oyen et al. 1994; Perenboom, Boshuizen et al. 1996; Sauvaget, Tsuji et al. 1997), life expectancy free of cognitive impairment (Matthews, Jagger et al. 2009), life expectancy without diabetes (Jonker, De Laet et al. 2006), and life expectancy without cardiovascular disease (Mamun, Peeters et al. 2004; Crimmins, Hayward et al. 2008).

Calculating health expectancies

The notion of health expectancy was first introduced by Sanders in 1964 (Sanders 1964), and five years later Sullivan documented their calculation (Sullivan 1971). In essence what is needed is the age and sex-specific prevalence of ill-health from a survey (usually within five or ten year age groups) and a period life table for the same time period as the survey. The prevalence of ill-health is applied to the person-years lived (L_x) to produce the years lived in bad health and the life table calculation continues as usual with the end product being life expectancy in bad health. Life expectancy in good health is formed from the total life expectancy at a particular age minus the life expectancy in bad health. As the period prevalence of ill-health has been estimated by the observed prevalence, this is only an approximation of true period conditions but the Sullivan estimator is unbiased and consistent under assumptions of stationarity (Imai and Soneji 2007).

Examples of the Sullivan method usually show just two states: health and ill-health. However more than two states can be accommodated, for example: no activity limitation, some limitation, severe limitation. However this is still essentially a binary weighting system (zero or one) for the health state. It is possible to include a weighting system based on severity levels, similar to that of Quality Adjusted Life Years (QALYs), thus obtaining a disability-adjusted life expectancy (DALE) or health-adjusted life expectancy (HALE), of which the disability-adjusted life years (DALY) is the most well-known (Murray and Lopez 1997).

Health expectancies using the Sullivan method have now been calculated for over 60 countries, many by members of the International Network on Health Expectancy and the Disability Process (REVES) (<http://reves.site.ined.fr/en/home>). The European indicator Healthy Life Years (HLY) also uses this method.

Further information on the Sullivan method:

- Full details of the Sullivan method, with a training manual (Jagger 1999) and Excel spreadsheets, are available online at www.eurohex.eu under ‘Training Material’.
- A Bayesian formulation of the Sullivan method has also been developed (Lynch and Brown 2005).

The obvious benefits of the Sullivan method are the relative availability of data and it is also the preferred method for assessing trends in health expectancies over time. However the greater availability of longitudinal studies has meant that more countries are using multistate methods which explicitly estimate the incidence rates to and from ill-health and to death (these are implicit within the prevalence in Sullivan's method).

Trends in health expectancy - are the extra years of life healthy ones?

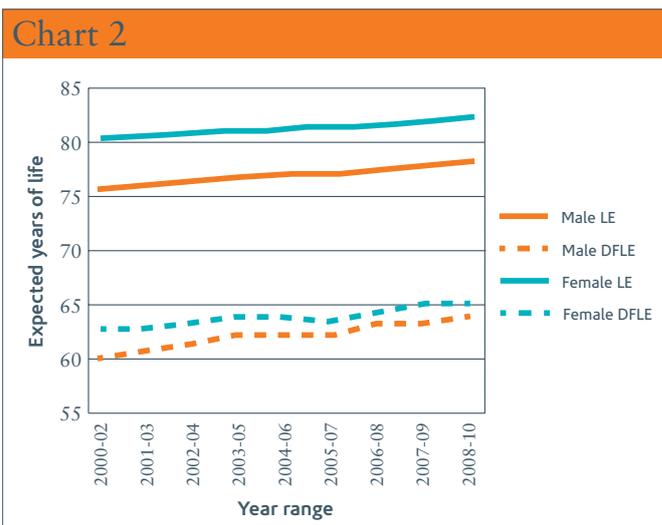
The key question for governments and societies is whether the extra years of life are predominantly healthy years. This is not a new question but debates on the relationship between the quantity and quality of remaining life began in the 1970s and two main views emerged: the pessimistic (expansion of morbidity) and the optimistic (compression of morbidity).

The pessimistic view (Kramer 1980) maintained that increases in life expectancy resulted from medical technology prolonging the life of the frail and sick who would previously have died, resulting in an expansion of morbidity. More optimistically Fries (1980), suggested that prevention could delay the onset of disease and disability and push these closer to death, though this was predicated on there being a natural limit to life expectancy, a limit he proposed was normally distributed throughout the population, with a mean of 85 and a standard deviation of 7 years.

If Fries' hypothesis were true, we would expect that the pace of improvement in life expectancy would be slower in countries with the highest life expectancies, as they were approaching the limit. So far this has not been observed. Nevertheless the relationship between health expectancies and life expectancies over time are important to determine which of these scenarios are playing out in our populations (see (Nusselder 2003) for a mathematical definition of the conditions between LE and DFLE for these and other scenarios). A third, intermediate scenario gaining importance is that of dynamic equilibrium, where reductions in mortality may result in disability, but the disability is of a less severe level (Manton 1982).

The UK is one of the few countries that have long, regular time series on DFLE. Over the previous decade LE at birth increased at a relatively constant rate, rising by 2.4 years for men and 1.7 years for women, with the gender gap in LE closing slightly (Chart 2). Trends in DFLE are much less consistent. Over the same period DFLE has increased by 3.6 years for men and 2.3

years for women, fitting a compression of morbidity scenario, although the latest figures for women suggest the DFLE increase is not being maintained. That the gender gap in DFLE is much less than that for LE demonstrates the almost universal finding that women live longer at all ages but have more absolute years and spend a greater proportion of their remaining years with disability than men.



Male and female period life expectancy and disability-free life expectancy at birth between 2000 and 2010 for the United Kingdom

Source: ONS (2012)

Disparities in healthy life years

Europe

Comparing DFLE between different countries has been hampered by the lack of consistency in the underlying measure of disability. Since 2004/5 however the European Union has made considerable efforts to address this by introducing a global disability measure, the Global Activity Limitation Index (GALI), into the European Statistics of Income and Living Conditions (EU-SILC) survey in order to estimate the Healthy Life Years (HLY) indicator, a disability-free life expectancy, for all EU countries.

Chart 3 shows the latest (2009) values for male and female LE and HLY at age 50 for the 27 EU countries, ranked by LE. Two points are worthy of note. Firstly countries with the highest LE

are not necessarily those with the most HLY. Secondly there is a difference between the highest and lowest LE between EU countries of 8.5 years for men and 6.9 years for women but a difference of 14.6 years for men and 15.3 years for women in HLY. Part of the variation in HLY could still be due to suboptimal harmonisation of the health measure. Nevertheless these figures suggest that using differences in life expectancy to measure health disparities across Europe could result in underestimation of the actual size of health differences. Finally, if we look at HLY in relation to a retirement age of age 65, or 15 years after age 50, we see that for seven countries the current male HLY at age 50 are below 15 years. Extending working life in these countries will require very different strategies and policies than in countries like Sweden where the average age of onset of activity limitation is closer to age 75.

Investigation of potential explanations for these disparities was undertaken on the 2005 HLY value for the then, 25 countries of the EU using meta regression, with GDP and education contributing most to the differences (Jagger, Gillies et al. 2008).

United Kingdom

Disparities in health are also present within the United Kingdom. In 2008-10 DFLE at birth for males in the UK was 63.9 years (81.9 per cent of LE) whilst female DFLE was 65.0 years (79.2 per cent of LE) (Table 1). DFLE at birth for males was significantly higher in England than in Scotland whilst for both males and females DFLE was significantly higher in England than in Northern Ireland. Period LE at age 65 for males in the UK was 10.4 years (58.3 per cent of remaining life) free from disability, with DFLE at age 65 for females in the UK being

Chart 3



Life expectancy with activity limitation and HLY at age 50 in 2009, by gender

Source: EurOhex database, www.eurohex.eu

11.2 years (54.6 per cent of remaining life). The significant disparities in DFLE at birth between England and Scotland and Northern Ireland are still evident at age 65 (Table 1).

Similar results are found for Healthy Life Expectancy (HLE) based on good or very good self-rated health. ONS (2012) note:

“the period 2005-07 to 2008-10 broadly reflected a period of compression of morbidity, with people spending longer periods of their longer lives in very good or good health and free from a limiting persistent illness or disability. For Scotland and Northern Ireland however, the picture was generally one of expanding morbidity between 2005-07 and 2008-10, particularly for males. These findings indicate that Scotland and Northern Ireland may face proportionally greater future demands on health services than England and Wales due to the well established link between self-rated health and subsequent mortality and health service use.”

Greater evidence of disparity in DFLE between geographical areas in the UK is evident at lower level geographies, Government

Office Regions (GORs), local authorities or wards, although certain of these analyses are available only at census points. Male DFLE at birth (1999-2003) was lowest in the North East (57.1 years) and highest in the South East (64.7 years) with a gap of 7.6 years, well over twice the gap in LE (2.7 years). The north-south divide in health and deprivation is well-known but does deprivation account for all of this variation? To answer this question Rasulo, Bajekal and Yar (2007) used the Carstairs deprivation score, based on four indicators of material disadvantage: household overcrowding, male unemployment, low social class and car ownership. In 2001 the gap in DFLE at birth between the most and least deprived twentieth groups of wards was 14.1 years for males compared to a 7.6 years gap in LE (Rasulo, Bajekal et al. 2007). However there were regional variations. In the most materially advantaged wards, DFLE at birth was similar regardless of region. But in the most materially disadvantaged wards in the north of England, DFLE was lower than in equivalently classed wards in southern regions, by 4.9 years for male DFLE (Rasulo, Bajekal et al. 2007).

Table 1:

Male and female life expectancy and disability-free life expectancy at birth and age 65 for the United Kingdom and constituent countries, 2008-10 (Source: ONS)

At birth		Males			Females		
		LE	DFLE	DFLE/LE (%)	LE	DFLE	DFLE/LE (%)
	United Kingdom	78.1	63.9	81.9	82.1	65.0	79.2
	England	78.4	64.8	82.7	82.4	65.5	79.5
	Scotland	75.8	59.3	78.3	80.3	64.5	80.3
	Wales	77.5	63.6	82.1	81.7	64.2	78.6
	Northern Ireland	77.0	60.2	78.2	81.4	61.3	75.3
At age 65							
	United Kingdom	17.8	10.4	58.3	20.4	11.2	54.6
	England	18.0	10.7	59.3	20.6	11.3	54.8
	Scotland	16.6	9.0	54.2	19.2	11.1	57.7
	Wales	17.5	10.3	58.9	20.2	11.3	56.0
	Northern Ireland	17.3	9.2	53.3	20.1	9.4	46.9

Source: ONS (2012)

Worldwide

Reliable and long chronological trends in health expectancies are, however, still limited to only a few countries. The last comprehensive review of evidence for national patterns of compression or expansion of morbidity noted that there was no consensus for a single pattern (Robine and Michel 2004). Existing data on trends suggested a possible relationship between the initial value of life expectancy at age 65 and change in health expectancies with expansion of disability being more common in countries with the highest life expectancy and compression of morbidity in countries with the lowest. Of the three countries outside the United States with the longest chronological series of health expectancies, each supported one of the possible scenarios: expansion of morbidity in Australia between 1981 and 1998; dynamic equilibrium in Great Britain between 1981 and 1999; and compression of morbidity in Austria between 1978 and 1998.

The United States has seen strong evidence for compression of morbidity in the past, with most of the increases in LE in the 1980s being years free of disability. However a recent review has suggested that the picture is less positive (Crimmins and Beltrán-Sánchez 2011). Although increases in the years free of disability have been found, consistent with compression of morbidity, there was no change in the age of disability onset. Thus there is stronger evidence for dynamic equilibrium and Crimmins and Beltrán-Sánchez conclude:

“The compression of morbidity is a compelling idea. People aspire to live out their lives in good health and to die a good death without suffering, disease, and loss of functioning. However, compression of morbidity may be as illusory as immortality. We do not appear to be moving to a world where we die without experiencing disease, functioning loss, and disability.”

Sources of information on health expectancies

The main source of information for estimates of health expectancy for European countries is the EurOhex website (www.eurohex.eu/). The site includes a database for life and health expectancies at any age based on EU SILC, the Survey of Health and retirement in Europe (SHARE), Eurobarometer and others. The raw prevalence data are also available for users to make their own calculations. A section on training material includes Excel spreadsheets, SAS, STATA and SPSS code for the Sullivan method. There is a useful ‘Useful Links’ section listing other European websites presenting or using health expectancies, including Eurostat.

The International Network on Health Expectancy and the Disability Process (REVES) site is hosted by the French National Institute of Demography (<http://reves.site.ined.fr/>). A listing of all REVES members worldwide is available as well as presentations and abstracts from past REVES meetings (held annually). A key resource is the bibliography of publications on health expectancies which is searchable by keywords.

The Office for National Statistics (www.ons.gov.uk/) has a section on national and sub-national UK health expectancies under the theme ‘Health and Social Care’ topic of ‘Disability and Self-Reported Health’. This includes video summaries of publications and regional profiles, a list of publications, UK data and methodological notes.

A new project entitled Inequalities in Healthy Active Life Expectancy (InHALE) has been funded by the Economic and Social Research Council to provide further understanding of the likely causes of disparities at Local Authority level for England and Wales. The project will also evaluate methods for calculating health expectancies from longitudinal data and will run methods workshops. Details can be found on the project website (<http://research.ncl.ac.uk/InHALE/>)

Summary of this Focus article:

- Health expectancies add a quality dimension to life expectancy.
- Differences in health expectancy between countries and regions are often much greater than differences in life expectancy so measuring health disparities by life expectancy differences may underestimate disparities.
- The difference between the highest and lowest period life expectancy at age 50 in the EU27 countries is 8.5 years for men and 6.9 years for women. Healthy Life Years differ by 14.6 years for men and 15.3 years for women.
- The UK as a whole appears to be going through a period of compression of disability with disability-free life expectancy at birth rising faster than life expectancy, at least for men, though Scotland and Northern Ireland are experiencing an expansion.
- Recent trends in the US are more consistent with a scenario of dynamic equilibrium, with more years free of disability but no increase in the age of onset of disability.

3. Longevity research news

This section highlights some recently published research. Each item is selected for its relevance to longevity knowledge and interest to *Bulletin* readers. Check the links and Sources section at the end of this *Bulletin* to follow up on a reference.

Bayesian probabilistic national population projections have been produced.

Projections of the size and composition of a country's future population are widely used for planning and policy. Generally projections are based on deterministic models and therefore no probabilistic measures of precision are provided. A recent paper in the proceedings of the National Academy of Sciences proposes a method using Bayesian hierarchical models and United Nations population data for all countries (Raftery, Li et al. 2012). They illustrate the method on five countries in different demographic stages and also note that the results show a rapid decline in the dependency ratio (persons aged 20-64 per person aged 65+) for many countries over the coming decade.

Risk factors for mortality.

The literature on risk factors for mortality is vast but some key papers have been published in 2012 based on meta-analyses and long-running longitudinal studies. The Lancet Physical Activity Series Working Group calculated the population attributable fractions (PAFs) for major chronic diseases and

mortality that are associated with physical inactivity. They estimate that physical inactivity causes 6% of the burden of coronary heart disease, 10% of breast cancer and 9% of premature mortality. They estimate that elimination of physical inactivity would produce a gain in life expectancy of 0.68 years (range 0.41 – 0.95) years (Lee, Shiroma et al. 2012).

A meta-analysis of 29 cohorts has clarified the association between waist circumference (WC), Body Mass Index (BMI) and mortality in older people (de Hollander, Bemelmans et al. 2012). They report that increased WC infers an increased risk of mortality across BMI categories.

The Kungsholmen Study, a longitudinal study of Swedish older people with 18 years of follow-up, confirm in the *BMJ* that good lifestyle behaviours, such as not smoking and physical activity, are associated with longer survival after age 75 (Rizzuto, Orsini et al. 2012). Moreover, these associations were also present, though attenuated, in the very old (aged 85+) and in those with chronic conditions.

WHO European review of social determinants in health and the health divide.

The *Lancet* have published an article based on the executive summary of this report led by Sir Michael Marmot (Marmot, Allen et al. 2012).

4. News from the Institute and Faculty of Actuaries

Sessional Research Event: Mortality improvement by socio-economic circumstances in England (1982 to 2006). Presented 24 September 2012

This paper by Joseph Lu, Wun Wong and Madhavi Bajekal analyses mortality trends by socio-economic circumstances to assess how mortality rates have changed. The paper may be downloaded from: www.actuaries.org.uk/research-and-resources/pages/sessional-research-programme

A video of the event is available for viewing at: openchannel.multichanneltv.com/the-actuarial-profession/mortality-improvements/

CMI report

The Continuous Mortality Investigation (CMI) carries out research into the mortality and morbidity experience of insurance portfolios and pension schemes in the UK market. The collated research is available publicly, along with its mortality and morbidity tables which have been adopted by the UK profession: see the CMI section of the Actuarial Profession's website.

The CMI Mortality Projections Committee now intends to release the next version of the CMI Mortality Projections Model, CMI_2012, in February 2013 to avoid any potential distortion from the revision to population estimates arising from the 2011 Census for England and Wales.

The CMI published an overview of the impact of the 2011 Census on high age mortality rates in August 2012. The overview may be downloaded from the CMI section of the website at: www.actuaries.org.uk/research-and-resources/documents/proposed-methodology-and-timing-production-cmi2012

Mortality and morbidity review

In May 2012 Council set up a working group to make recommendations on how the Institute and Faculty of Actuaries should respond to the challenges and opportunities of demographic experience analysis, covering longevity, mortality and morbidity. The group has confirmed that there is a significant volume of activity associated with demographic experience analysis within the membership, including the work of the *Continuous Mortality Investigation (CMI)* and initiatives from working parties. The working group is now conducting a consultation which aims to build a complete picture of current initiatives and collate views on what activities the Profession should seek to undertake in the future. The consultation aims to gather views from a wide spectrum of stakeholders and other interested parties. For further information on the consultation see: www.actuaries.org.uk/news/articles/consultation-paper-mortality-and-morbidity-studies-institute-and-faculty-actuaries

British Actuarial Journal

The *British Actuarial Journal* is published in partnership with Cambridge University Press. It contains the sessional research programme of the Institute and Faculty of Actuaries along with transcripts of the discussions and debates, Presidential addresses, memoirs and papers of interest to practitioners. Three parts are published annually in March, July and September. The back catalogue (from 1995), latest issues and *FirstView* articles can be found at <http://journals.cambridge.org/BAJ>.

Annals of Actuarial Science

The *Annals of Actuarial Science* is also published in partnership with Cambridge University Press. It contains original research, review papers, case studies and book reviews covering all areas of actuarial science. It is published, twice yearly, in the spring and autumn. Papers are a mix of theoretical and applied work. The back catalogue (from 2006), latest issues and *FirstView* articles can be found at <http://journals.cambridge.org/AAS>.

For your diary

Mortality Seminar Series

The Mortality Research Steering Committee is planning a series of small multidisciplinary events/workshops around the theme of 'views of the future'. Each event will be interactive with the key questions captured and fed into the Profession's future research strategy. The events will culminate in a major conference in autumn 2014:

28 November 2012: Dementia (Chair: Tom Dening, Professor of Dementia Research, Institute of Mental Health, University of Nottingham)

- March 2013: Socio-demographics
- October 2013: Frailty
- March 2014: Resource limitation.

Presentations on mortality and morbidity research projects

In early 2013 an event will showcase presentations of three mortality and morbidity research projects funded by the Profession:

- University of Southampton and Barnett Waddingham LLP – Bayesian modelling of mortality projection uncertainty;
- Heriot-Watt University – Mortality models for multiple populations using covariates;
- King's College London – Genetic risk profiling for common diseases

More information on the Profession's events can be found at:
www.actuaries.org.uk/events

Further links

For further information on mortality research and events at the Institute and Faculty of Actuaries see:

www.actuaries.org.uk/research-and-resources/pages/mortality

For an international round-up of research by the Mortality Working Group of the International Actuarial Association, see:

www.actuaries.org/index.cfm?lang=EN&DSP=CTTEES_TFM&ACT=INDEX

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