CSI 1: Are we living longer?

Summary

- Life expectancy at birth is continuing to rise for both men and women
- The gap in life expectancy between men and women has recently started to narrow
- Declines in infant and child mortality have been major drivers of the overall improvement in life expectancy, as well as declines in mortality from cardio-vascular disease and lung cancer
- Another of the remarkable achievements in the progress in life expectancy has been the overall reduction in the inequalities of lifespans – average life spans are becoming more equal, not less equal across individuals, with the vast majority living into old age.
- Disability-free life expectancy is considerably lower than overall life expectancy but has also shown improvement over the most recent decade. For men, the improvement has kept pace with improvements in overall life expectancy, while rates of improvement were slower for women compared with men.

Introduction

The significant improvement in longevity over the course of the twentieth century in the UK has been a key milestone of social progress. As Figure 1 illustrates, life expectancy at birth in the UK has increased steadily and smoothly for both sexes since the 1940s, rising from around 66.7 years in 1942 to 83.3 years in 2014 for women, and from 60.6 years to 79.5 years over the same period for men. The rate of improvement for men since the late 1990s and early 2000s has been faster than for women, resulting in a narrowing of the gap between men and women.

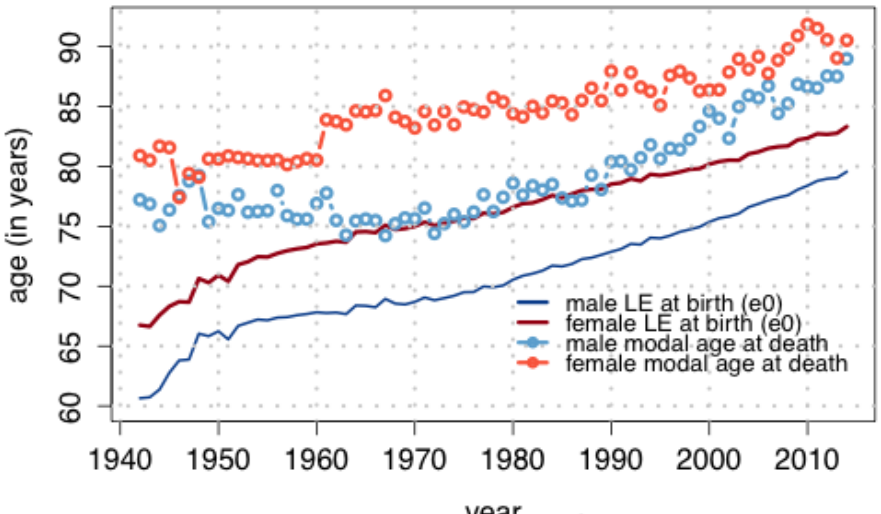


Figure 1: Life expectancy at birth and modal age of death improved steadily in the UK, 1942 – 2014.
Source: UK Period Life tables (ONS) and Human Mortality Database (HMD)[i].

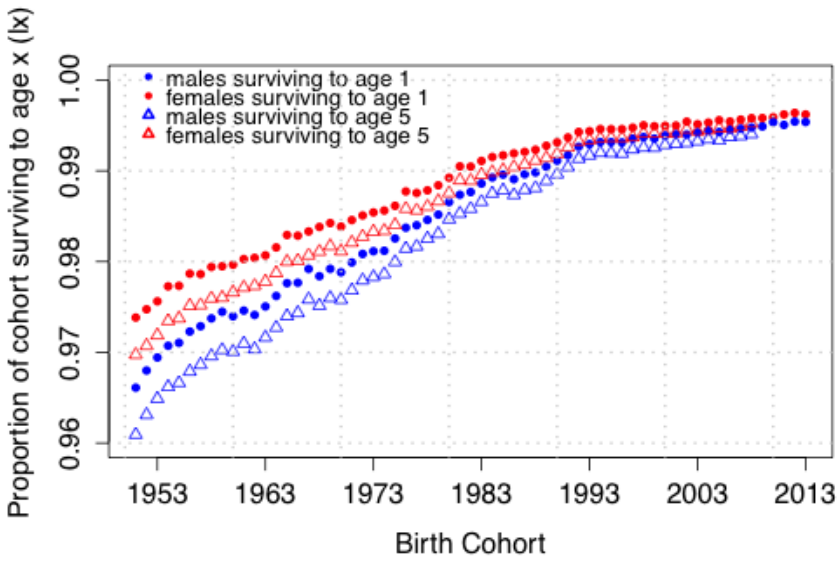


Figure 2: Infant and child mortality improved for birth cohorts from 1953 to 2013.
Source: UK Cohort life tables (ONS).

What explains increasing life expectancy at birth?

A significant contributor, starting in the 1940s, was the decline in child mortality (1-5 year olds) followed by subsequent decline in infant mortality (0-1 year olds). Up until 1978, the first year of life was in fact the riskiest in an average life span, and remaining life expectancy

for the UK population was actually higher at age 1 than at birth. Figure 2 shows the proportion of the birth cohort surviving to age 1 and those surviving to age 5. About 2.5% of girls and just over 3% of boys born in the 1950s in the UK did not survive until their first birthday. By 2013, this figure had fallen to 0.4% for both boys and girls.

The standard measure of life expectancy at birth is strongly influenced by mortality rates at very young ages as it averages mortality conditions across all ages. Just how sensitive it is to mortality at younger ages is revealed by the difference between the two trend lines reported in Figure 1. While the solid line shows trends in life expectancy at birth, the dashed line shows trends in the adult modal age at death over the same period. This highlights the most common age at death each year for deaths occurring after age 10. The most common age at death was already around 80 years in the 1950s for women and around 75 for men. What is clear is how the modal age at death is consistently higher than life expectancy at birth.

The second biggest contributor to life expectancy gains is the reduction in cardiovascular disease mortality in the middle- to older-ages, with the most significant reductions in this cause of death experienced by men in their 60s. Reduction in cancer mortality, especially lung cancer, as well as reduction in other respiratory disease mortality was also responsible for life expectancy advances.[ii] The decline in the male/female gap has also been attributed to morbidity reductions in causes of death such as cardiovascular disease and lung cancer, which tend to be more concentrated among men, alongside increases in female smoking behaviour resulting in higher female morbidity from smoking-related causes of death.[iii]

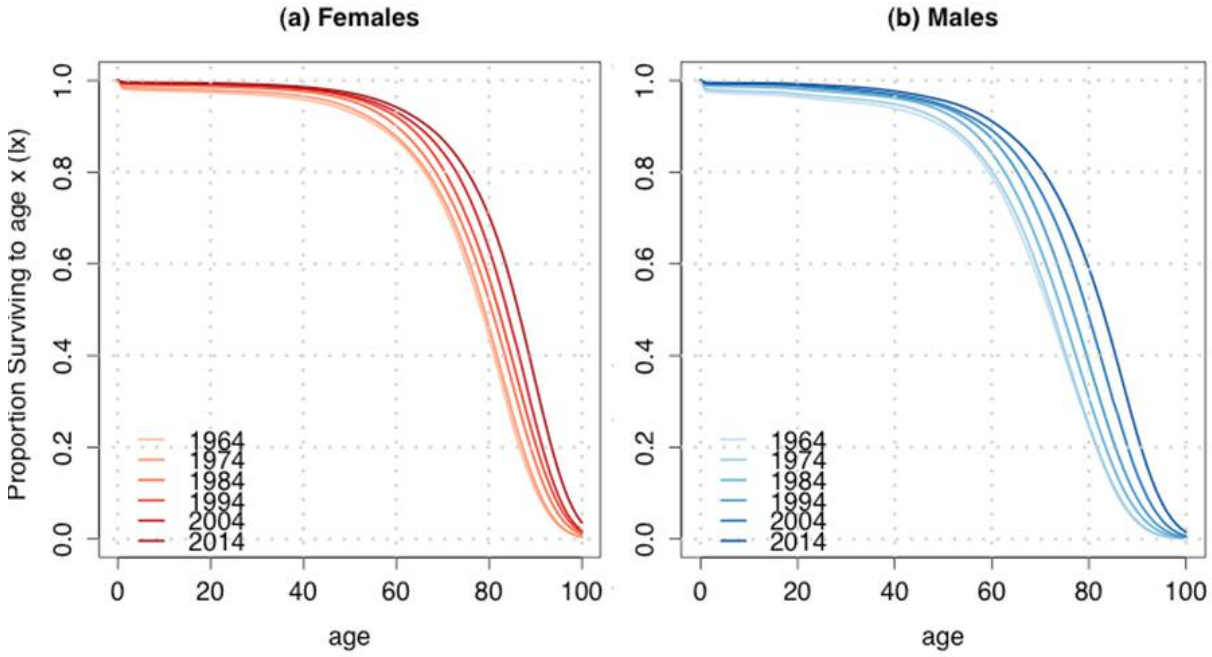


Figure 3: Proportions surviving (y-axis) by age (x-axis) assuming age-specific mortality risks of that year continued over the lifespan. 1964 - 2014. *Source: Period life tables, UK, ONS.*

The improvements in middle- and old-age mortality risks have effectively helped 'postpone' death to older ages for the vast majority of the population, and variability in ages at death for the population seen across the whole lifespan has declined significantly since the 1940s. Figure 3 highlights these improvements in female and male survival to older ages respectively by showing the proportion of a *hypothetical* cohort that would survive to a particular age (shown on the horizontal axis) if the age-specific mortality probabilities of that year were to continue.[iv] The curve clearly shifts to the right with each passing decade starting 1964 until 2014, indicating that greater proportions of men and women are alive at older ages. Life expectancy increases in recent decades are now almost exclusively driven by mortality reductions at older ages unlike previous decades when gains were made due to improvements at younger ages.

Lessening Inequalities in Lifespans; Growing Variability at Older Ages

One of the remarkable achievements in the progress in life expectancy has been the overall reduction in the inequalities of lifespans. In the past more people were living lives that were longer or shorter than the average, whereas now the great majority of people can expect to live into old age and are much more likely to die at an age close to the average. Figure 4 reports a measure of the inequality or dispersion of life spans. Seen over the whole lifespan dispersion in the age of death has significantly declined since the 1940s. However, as mortality selection from the younger ages has declined, among those who have reached age 65 or 75, dispersion appears to have slightly increased.[v] The remaining variability in the ages of death are now largely concentrated in the older ages. Postponing death to older ages for the vast majority of the population implies growing heterogeneity in the old age population. Figure 4 indicates that women appear to experience less dispersion in ages at death seen across the entire life span compared with men, but greater dispersion at older ages of 65 and above, as they also have higher probabilities of survival to older ages (as Figure 3 indicates).

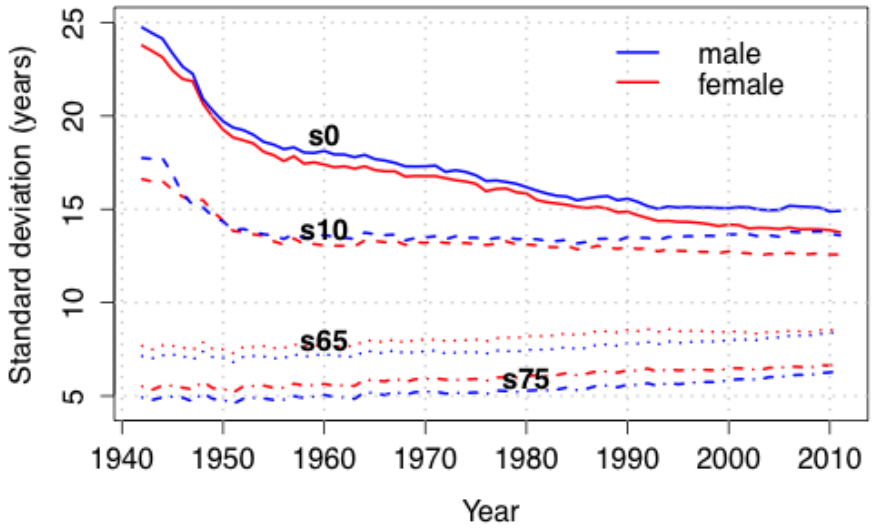


Figure 4: Dispersion in ages at death has declined at younger ages but increased slightly at older ages

Standard deviations in age at death over the whole lifespan (s0), conditional on survival to age 10 (s10), to age 65 (s65) and to age 75 (s75). Source: HMD Period life tables

Measurement issues

The major sources for estimating life expectancy are the Period Life tables (UK) from the Office for National Statistics (ONS) and the Human Mortality Database (HMD). They are derived from vital registration data and thus cover all deaths, not just a sample. Life expectancy, calculated from period life tables and defined as the 'average number of additional years that a survivor to an age x will live beyond that age' is the most commonly reported measure of improvements in longevity[vii]. Life expectancy can be measured at any age, but the most commonly reported is life expectancy at birth or e0, which can be interpreted as the average life span an individual would have if she continued to experience the prevailing mortality rates of that period throughout her life. To measure the dispersion or inequality of life spans we report the standard deviation in the age of death conditional on survival to that age at a few select ages. This measure is calculated from life tables and the results reported were calculated from UK life tables from the HMD.

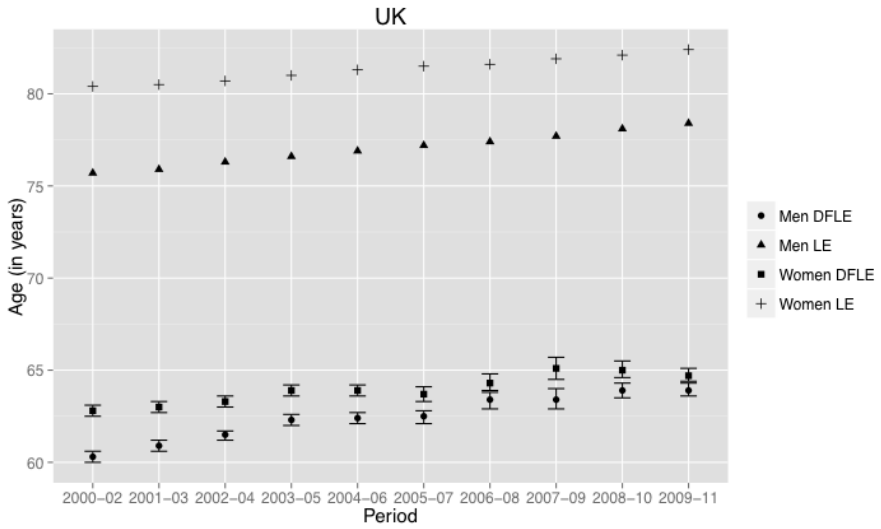
Disability-free life expectancy (DFLE) estimates the average number of years spent by individuals free from limiting persistent illness or disability based upon a self-rated assessment. Unlike life expectancies, DFLE relies on a sample survey, the General Lifestyle Survey (GLF) of ONS used for estimates for England, Wales and Scotland and for Northern Ireland the Continuous Household Survey (CHS) was used for 2009 data and the Health Survey Northern Ireland (HSNI) was used for 2010-11 data. Since these derive from surveys, 95% confidence intervals are shown in Figure 5. These survey data are used to factor in the age-specific disability prevalence rates into life expectancy calculations for a period, and assume that age-specific mortality and age-specific disability prevalence rates of that period continue into the future. Data from the 2001 Census were used to estimate disability prevalence in the communal population.

Are we living healthily?

The data reported in the previous sections unanimously show that we are living longer, but are those extra years lived spent living healthily? One such measure that adds a quality dimension to standard measures of longevity such as life expectancy is disability-free life expectancy (DFLE). Figure 5 shows DFLE and LE estimates (both at birth) for men and women in the UK for the period covering 2000 to 2011. Period life expectancy at birth for men in the UK increased by 2.7 years over this period from 75.7 to 78.4 years. Over the same period, DFLE at

birth increased significantly by 3.6 years from 60.3 years to 63.9 years or about 81.5 per cent of an average male lifespan. An average adult female in the UK born in 2010 could roughly expect about 82 years of life, of which about 64.7 years or 78.5 % of her life would be spent free from any limiting disability. This was a statistically significant increase from DFLE of 62.8 years in 2000. For men, improvements in DFLE at birth slightly outpaced improvements in LE at birth between 2000 and 2011. The rates of improvement over the period were slower for women compared with men, with female improvements in DFLE just about keeping pace with improvements in LE. Even though women have higher LE and DFLE than men, the data suggest they spend a greater proportion of their lifespan with disability compared with men.

Figure 5: The rate of improvement in disability-free Life Expectancy (DFLE) at birth and Life Expectancy at birth (LE) was greater for men than women in the past decade, 2000-02 to 2009-11. *Source: ONS and GLF.*[vi]



Were these improvements in DFLE at birth due to improvements at older ages? Between 2000-2011, men's improvements in self-reported health at age 65 appear to have outpaced their gains in remaining life expectancy at age 65. For women, gains in health at older ages were slower than their gains in life expectancy at older ages. At the beginning of the 2000s women had greater DFLE at birth and at age 65 than men, but in recent years men appear to have caught up with women due to their faster improvements in health and survival. Although women are continuing to live longer, they appear to be more vulnerable to spending a greater proportion of their old age in disability.

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[i] Human Mortality Database. University of California, Berkeley (USA), and Max Planck Institute for Demographic Research (Germany). Available at www.mortality.org or www.humanmortality.de (data downloaded on October 9, 2014

[ii] Vallin, Jacques, and France Meslé. Convergences and divergences in mortality. A new approach to health transition. *Demographic Research* 2.2 (2004): 10-43.

[iii] Pampel, Fred C. Declining sex differences in mortality from lung cancer in high-income nations, *Demography* 40.1 (2003): 45-65; Waldron, Ingrid. Contributions of biological and behavioral factors to changing sex differences in ischaemic heart disease mortality, in A. D. Lopez, G. Caselli, and T. Valkonen (eds.), Adult Mortality in Developed Countries: From Description to Explanation. (1995) Oxford: Clarendon Press, pp. 161-178.

[iv] Unlike the survivorship trends shown in Figure 2 which rely on cohort life tables following actual not hypothetical members of a cohort, use of cohort life tables until old ages requires us to wait until all members of the cohort die. As a result, period measures are generally preferred although the period trends tend to lag behind cohort trends. See Goldstein, Joshua R., and Kenneth W. Wachter. Relationships between period and cohort life expectancy: Gaps and lags. *Population Studies* 60.3 (2006): 257-269.

[v] This trend has also been noted in other industrialized societies. See Engelman, Michal, Vladimir Canudas- Romo, and Emily M. Agree. The implications of increased survivorship for mortality variation in aging populations. *Population and Development Review* 36.3 (2010): 511-539.

[vi] Office of National Statistics, Health Expectancies at Birth and at Age 65 in the United Kingdom. Available at: https://.ons.gov.uk%2fons%2frel%2fdisability-and-health-measurement%2fhealth-expectancies-at-birth-and-age-65-in-the-united-kingdom%2f2009-11%2frft-table-1.xls.

[vii] See Preston, Samuel H., Patrick Heuveline, and Michel Guillot. *Demography: measuring and modeling population processes*. Malden, MA: Blackwell (2000), p. 39