

Article

# Changing trends in mortality: an international comparison: 2000 to 2016

Analysis of period life expectancies and age-standardised mortality rates in selected countries globally from 2000 to 2016.

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# 1 . Main points

- Until 2011, life expectancy in the UK had been increasing for a number of decades; however, in the second decade of the 21st century, the UK along with several other countries has seen a notable slowdown in these improvements in both male and female mortality.
- Between 2011 and 2016, the UK experienced one of the largest slowdowns in improvements in life expectancy at birth and at age 65 years for both males and females out of the countries analysed.
- The slowdown in improvements in mortality was observed most widely across the countries analysed for 65-to-79-year-olds, while females have been more affected overall by the slowdown than males.
- Japan has come through a period with low life expectancy gains and has recently experienced an acceleration of mortality improvements.

## 2 . Statistician comment

“The slowdown in life expectancy improvements that has been observed in the UK since 2011, is also evident in a number of countries across Europe, North America and Australia. However, the UK has experienced one of the largest slowdowns in life expectancy at birth and at age 65 years for males and females.

“By contrast, Japan has come through a period with low life expectancy gains and has recently experienced an acceleration of mortality improvements, showing that even after a period of slow growth in life expectancy, a country may again return to faster improvements.”

Alan Evans – Office for National Statistics

## 3 . Introduction

Throughout the 20th century the UK experienced steady improvements in life expectancy at birth. This was attributed to improvements in treating infectious diseases, health improvements in the population as it ages, advances in medical care such as heart disease treatments and behavioural changes such as a reduction in the rate of smoking in the population<sup>1</sup>.

It has been widely reported that improvements (decreases) in UK mortality rates – the number of deaths divided by the population – have been slowing since around 2011. Most notably there was a sharp increase in deaths in 2015, which led to the first reduction in UK life expectancy at birth of the 21st Century.

We have [recently published research](#) that shows there has been a statistically significant change in trend in the long-term improvements in age-standardised mortality rates for England and Wales around the 2010s. We have also published an article examining [mortality trends in the UK and its constituent countries](#) in more detail. This reports that the slowdown in mortality improvements at older ages is seen across the UK countries, but the trends are more complex at younger ages, varying by sex and country.

This article compares recent trends in mortality in 20 countries for which relatively up-to-date data from the [Human Mortality Database \(HMD\)](#) are available (see Table 1 in the Quality and methodology section) and asks whether the slowdown we are seeing in the UK is unique. The figures quoted in this article are taken from the HMD to allow international comparisons to be made, and UK figures are not the same as those published by Office for National Statistics (ONS).

Since the populations of different countries vary in terms of size and age structure, we have standardised the mortality data to the European Standard Population 2013; this accounts for differences in the size and age structure of the populations over time and also allows for comparisons between males and females.

This article presents analysis of period life expectancies and age-standardised mortality rates to identify in which countries, and to what extent, the slowdown in mortality improvements has occurred. In addition to age, we have compared mortality rates by sex since women tend to have longer life expectancies than men. This allows us to discover whether there are specific subgroups of the population influencing the overall trends.

## Notes for introduction:

1. For more information, please see [How has life expectancy changed over time?](#)

## 4 . Life expectancy improvements have slowed in recent years

The years from 2000 to 2011 saw a marked increase in life expectancy for the majority of the 20 countries studied in this article. Life expectancy at birth for males and females is shown for selected countries in Figures 1 and 2. Throughout the period 2000 to 2011, the average improvement in life expectancy at birth for the countries shown was 13.1 weeks per year for males and 9.4 weeks per year for females. The years 2011 to 2016 saw a slowing in improvements. Life expectancy for males on average improved by 10.4 weeks per year and for females by 6.7 weeks per year.<sup>1</sup>

### Figures 1 and 2: Life expectancy at birth, selected countries, in years, males, 2000 to 2016

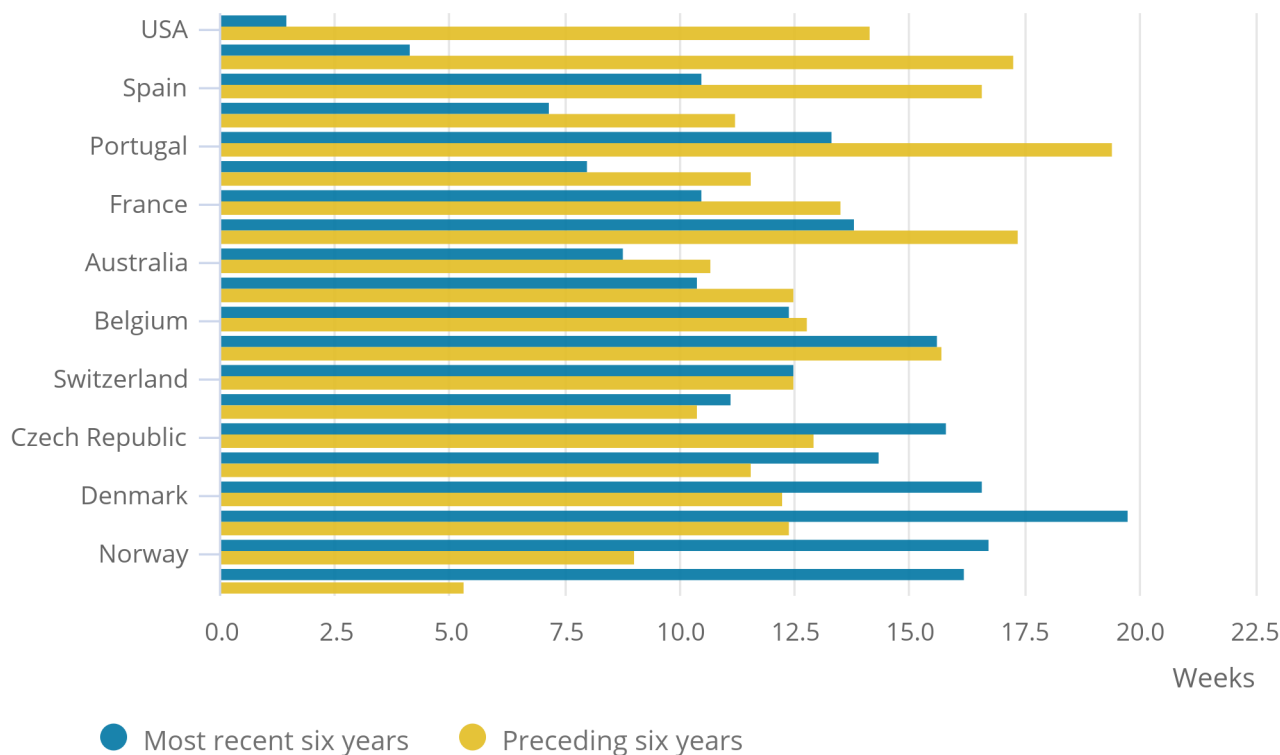
Figures 3 and 4 show average annual increases in life expectancy at birth in weeks for males and females, comparing the most recent six years of data for each country with the preceding six years of data<sup>2</sup>. The countries are ranked in descending order, that is, the country with the largest percentage slowdown between the two periods is at the top and the smallest is at the bottom.

The greatest slowing in life expectancy at birth for males was experienced by the US, dropping almost 90% from 14.1 weeks per year from 2005 to 2010 to 1.5 weeks per year from 2010 to 2015. Next was the UK, where improvements dropped by nearly 76%, from 17.3 weeks per year from 2006 to 2011 to 4.2 weeks per year from 2011 to 2016. This large drop is partly due to the UK experiencing a relatively large increase in male life expectancy from 2001 to 2011. The other countries that saw a large slowdown were those with relatively high life expectancies at birth; Spain (37%), Germany (36%), Portugal (32%) and Sweden (31%).

Switzerland, however, which had the highest life expectancy at birth for males and the third highest for females in 2016, did not see a slowdown. It experienced 12.5 weeks per year improvements in both reference periods for males and a slight reduction from 7.3 weeks to 6.2 weeks per year for females.

**Figure 3: Average annual increase in period life expectancy at birth, selected countries, males**

Figure 3: Average annual increase in period life expectancy at birth, selected countries, males



**Source: Office for National Statistics analysis of Human Mortality Database data**

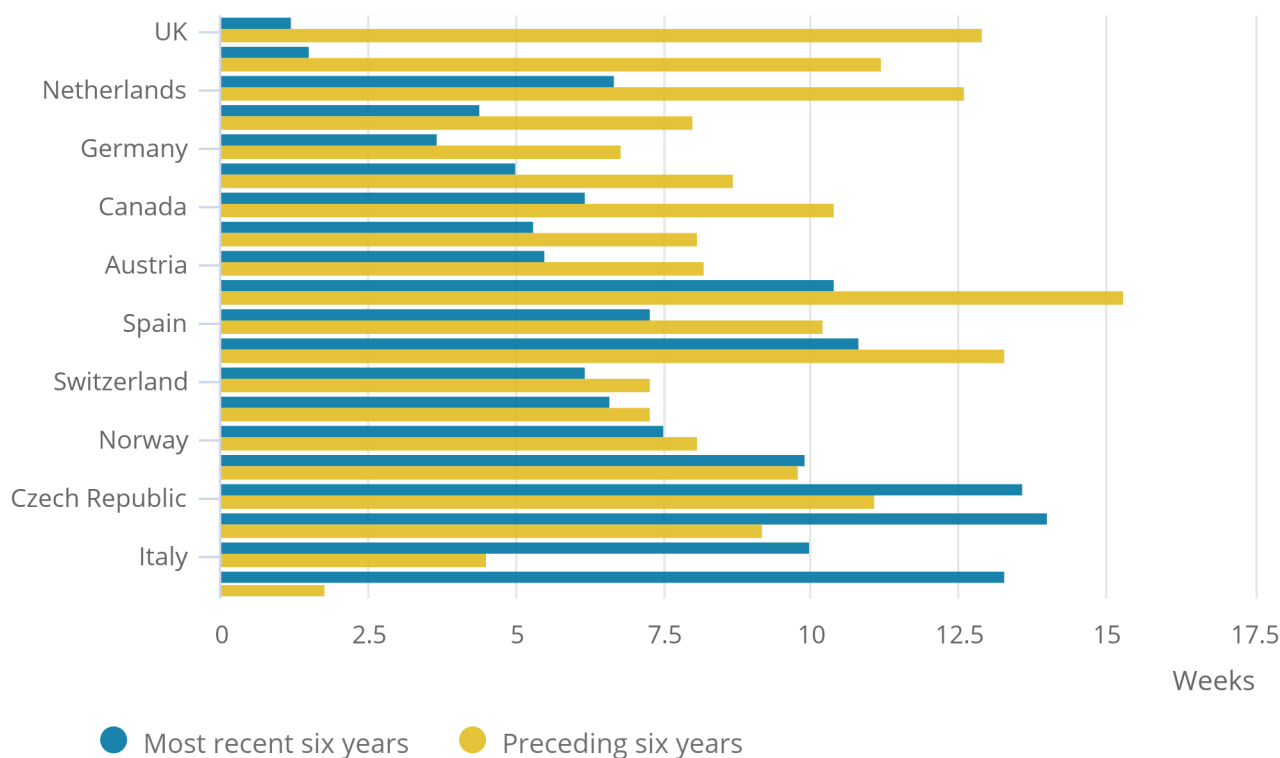
Overall, the slowdown in life expectancy improvements was more pronounced for females than for males. Females in the UK saw the greatest slowing, with improvements reducing by 90% (from 12.9 weeks to 1.2 weeks per year). Improvements in life expectancy in the US were down marginally less (by 87%, to 1.5 weeks per year from 11.2 weeks, the second lowest improvements of all countries in their last six years of data). There were five other countries where females experienced a slowdown of 40% or higher; the Netherlands (47%), Sweden (45%), Germany (45%), France (43%) and Canada (40%).

There were, however, some countries that saw greater improvements in the second period than the first; Japan had the largest increase in improvements in life expectancy at birth between the two time periods for both males (5.3 weeks to 16.2 weeks per year) and females (1.8 weeks to 13.3 weeks per year).<sup>3</sup>This may indicate that Japan is in a slightly advanced position compared with other countries in its demographic trends, having experienced a slowdown between 2006 and 2011, and is now seeing greater improvements in recent years.

The majority of Nordic countries, excluding Sweden, did not experience a slowdown in improvements in life expectancy at birth. Norway saw a large increase in improvements between the two periods for males (9.0 weeks to 16.7 weeks per year) and a small decrease for females (8.1 weeks to 7.5 weeks per year). Denmark saw improvements rise for males (12.3 weeks to 16.6 weeks per year) and females (9.2 weeks to 14.0 weeks per year); while Finland had a large increase in improvements for males (12.4 weeks to 19.8 weeks per year) and a slight improvement for females (9.8 weeks to 9.9 weeks per year).

**Figure 4: Average annual increase in period life expectancy at birth, selected countries, females**

Figure 4: Average annual increase in period life expectancy at birth, selected countries, females



Source: Office for National Statistics analysis of Human Mortality Database data

Since the largest number of deaths occur at the older ages, changes in trend for these ages are a strong contributor to overall mortality trends. As such, the following sections look at different age groups, starting with the oldest ages, and compare the data for different countries for males and females separately to see how the effects vary between countries.

**Notes for: Life expectancy improvements have slowed in recent years**

1. The averages were calculated using countries for which data were available for each year. For a breakdown of the countries used, see the Quality and methodology section.
2. These six-year periods vary slightly between the countries due to data availability. See Table 1 in the Quality and methodology section for a complete list of the periods used by country.
3. Japan experienced an increase in mortality rates in 2011, due to the Tsunami and Fukushima nuclear disaster. Taking account the impact of this on subsequent years' improvements, Japan has still experienced accelerated levels of improvements in mortality rates.

## **5 . Globally, countries experienced a slowdown in mortality improvements for those aged 80 years and over although some countries have seen improvements accelerate**

Age-standardised mortality rates for males and females aged 80 years and over for selected countries are shown in Figures 5 and 6. The mortality rates shown are per 100,000 population and have been standardised to the European Standard Population 2013 (ESP 2013). This allows for differences in the size and age structure of the populations over time and enables valid comparisons to be made between countries. The ESP is the same for males and females so rates may also be compared between the sexes. The trendline for age-standardised mortality rates from 2001 to 2011 extended to 2016 is also shown in Figures 5 and 6 and gives an indicator of likely levels of mortality rates from 2011 to 2016, had the rates of improvement seen prior to this continued.

Analysis of age-standardised mortality rates compares data from 2001 to 2011 with data from 2011 to the latest year available for each country. See Table 1 in the Quality and methodology section for years used for each country.

Out of all the countries studied, males aged 80 years and over in the UK experienced the largest relative improvement in mortality rates between 2001 and 2011, improving around 21% over the period. Between 2011 and 2016, mortality rates for males aged 80 years and over in the UK plateaued, improving by 2% over the six-year period.

Out of the 20 countries studied, only three have seen the same or less of an improvement than the UK in the second period. France also saw mortality rates decline by 2%, Germany experienced no improvement and Portugal experienced a rise of 1%.

Males aged 80 years and over in Japan experienced a different trend. Between 2001 and 2011, age-standardised mortality rates for Japan decreased by 5%, improvements then accelerated and mortality rates decreased by 10% between 2011 and 2016.

### **Figures 5 and 6: Age-standardised mortality rates for males and females aged 80 years and over, selected countries, 2001 to 2016**

Females in the UK also had one of the highest rates of improvements between 2001 and 2011, improving by 17% over this period. France (19%), Finland (18%) and the Netherlands (18%) were the only other countries to experience a larger improvement than the UK, while Portugal also experienced a 17% improvement in the first decade of the 21st century.

Mortality improvements in the UK for females aged 80 years and over notably slowed between 2011 and 2016, having almost no change over this period. Belgium also had no change between 2011 and 2015, while age-standardised mortality rates in Germany and France increased by 1% and mortality rates in Portugal increased by 3%.

Similar to males, females aged 80 years and over in Japan experienced similar improvements in age-standardised mortality rates in almost half the time in the most recent period. Over the 11-year period between 2001 and 2011, Japan saw a 10% improvement and over the six-year period between 2011 and 2016, it experienced a 9% improvement.

## **6 . Higher number of countries experienced a slowdown in life expectancy for 65-to-79-year-olds than any other age group**

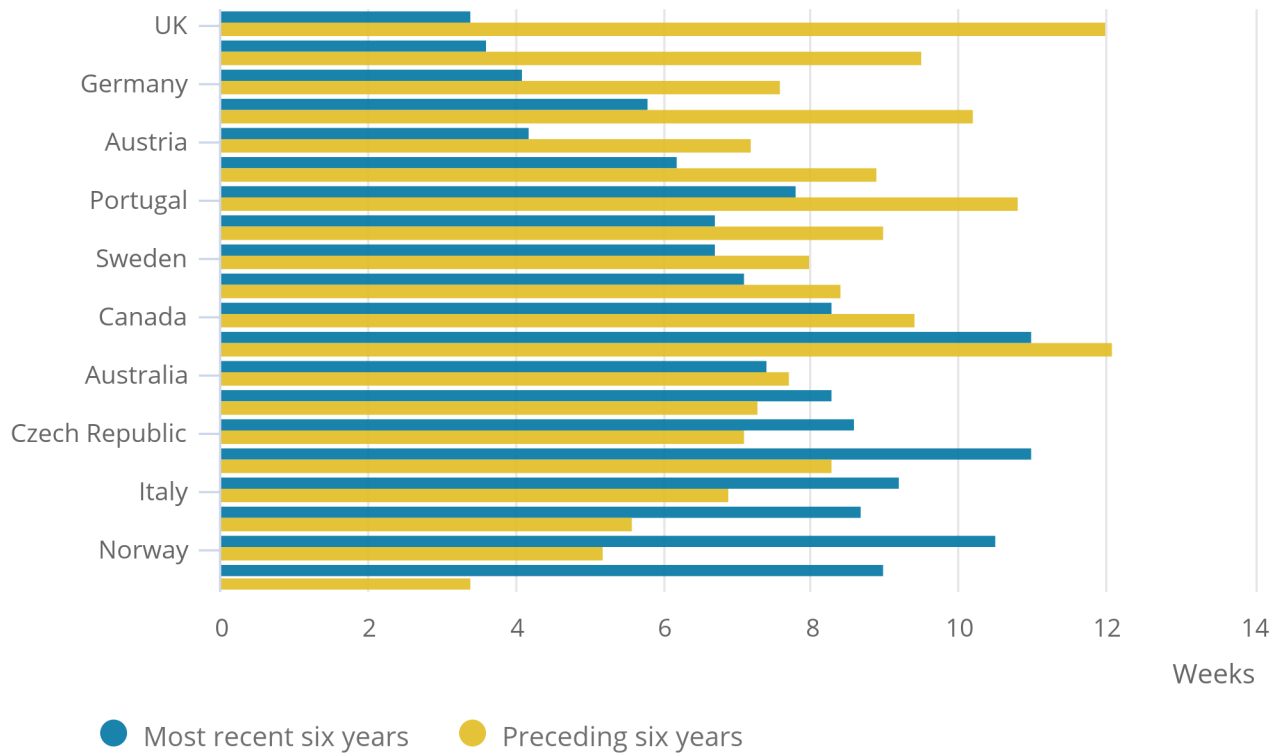
Figures 7 and 8 show the male and female average annual increases in life expectancy at age 65 years in weeks comparing the most recent six years of data for each country with their preceding six years of data. As in the earlier section, they are displayed in descending order with the countries with the greatest slowdown between their two reference periods at the top.

As for life expectancy at birth, the UK and US once again experienced the greatest slowdown in life expectancy improvements for both males and females at age 65 years. For males, life expectancy improvements reduced from 12.0 weeks to 3.4 weeks per year (71% reduction) and 9.5 weeks to 3.6 weeks per year (62% reduction) respectively between the two periods. For females, the UK saw a 90% reduction in improvements whilst the US saw a 66% reduction.

Out of the 20 countries analysed, for males, 13 had experienced a slowing of improvements since 2011, with eight of those experiencing a slowing of 25% or more. For females, 15 countries experienced a slowing of improvements, with 13 of those experiencing a slowing of 25% or more.

**Figure 7: Average annual increase in period life expectancy at age 65 years, males, selected countries**

Figure 7: Average annual increase in period life expectancy at age 65 years, males, selected countries

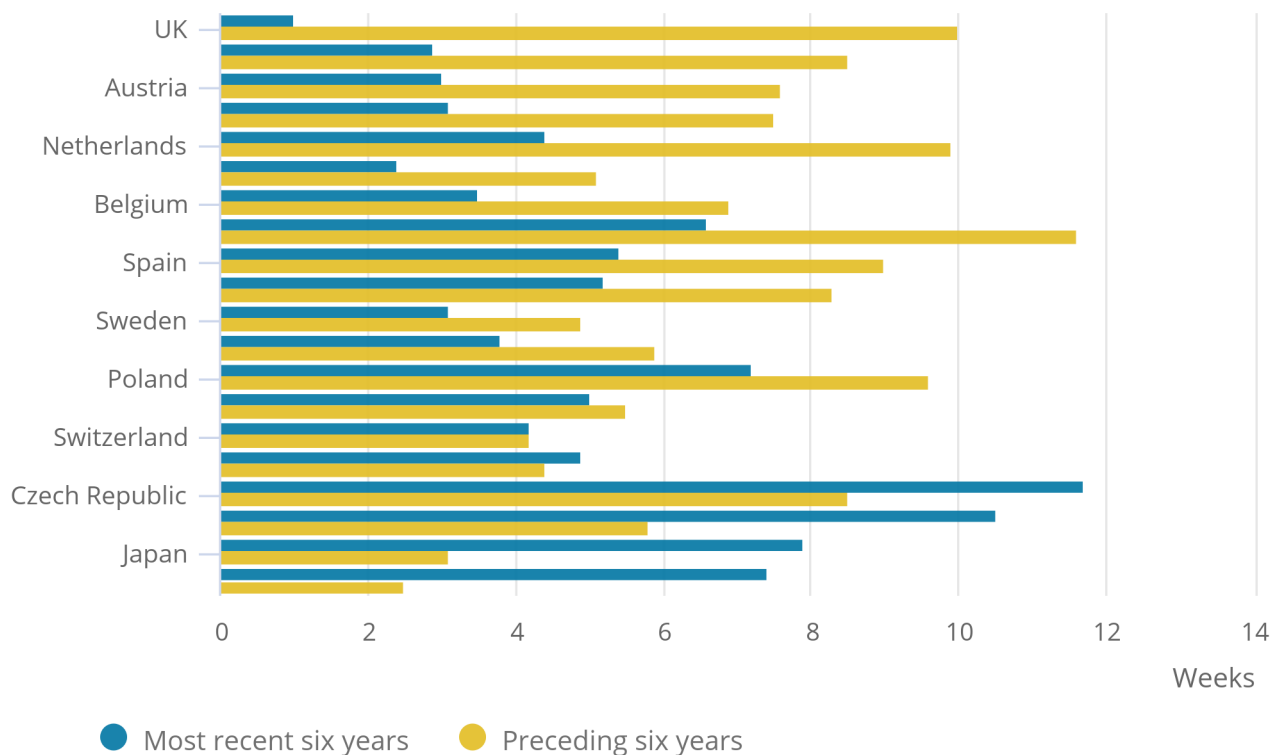


Source: Office for National Statistics analysis of Human Mortality Database data



**Figure 8: Average annual increase in period life expectancy at age 65 years, females, selected countries**

Figure 8: Average annual increase in period life expectancy at age 65 years, females, selected countries



**Source: Office for National Statistics analysis of Human Mortality Database data**

Age-standardised mortality rates for 65-to-79-year-old males and females for selected countries are shown in Figures 9 and 10.

A slowdown in mortality improvements was experienced by more countries for males and females aged 65 to 79 years than at any other age, with most countries seeing a slowdown around 2011.

Over the 11-year period from 2001 to 2011, the UK experienced one of the largest improvements in male age-standardised mortality rates, decreasing by 31% over this period. Only the Netherlands saw a larger decrease over this period (32%). By contrast, over the six-year period between 2011 and 2016, UK males aged 65 to 79 years only experienced an improvement of 5%. The only other countries to see equivalent or lower improvements since 2011 were the US (2%), Germany (3%), Belgium (5%) and France (5%).

By contrast, age-standardised mortality rates in Japan stayed on a steady downward trend throughout 2001 to 2016, although their trend in improvements was less rapid over the period than other countries. Japan did experience a slight plateau between 2009 and 2011, but this was short-lived and in 2016 Japan had one of the lowest age-standardised mortality rates for males of the countries analysed.

There were only five countries that experienced an improvement of over 5% in mortality rates for females since 2011; Italy (6%), Spain (6%), Portugal (9%), Denmark (10%) and Japan (13%).

## **Figures 9 and 10: Age-standardised mortality rates for males and females aged 65 to 79 years, selected countries, 2001 to 2016**

### **7 . The US was the only country to experience an increase in male and female mortality rates for those aged 40 to 64 years**

Age-standardised mortality rates for 40-to-64-year-old males and females for selected countries are shown in Figures 11 and 12.

UK males aged 40 to 64 years experienced a 21% improvement in age-standardised mortality rates between 2001 and 2011; this was the same as Sweden, Denmark and Spain. Only Norway (22%), Italy (25%) and the Netherlands (27%) experienced greater improvements over this period. The US saw the least improvement of all the countries studied, experiencing an 11% improvement over the same period.

Japan had the second lowest improvements between 2001 and 2011, just ahead of the US, with improvements of 14% over the period. However, Japan did have a notably lower mortality rate than the US in 2001.

Similar to males, UK females aged 40 to 64 years experienced some of the largest improvements (18%) in age-standardised mortality rates between 2001 and 2011. Only Norway (18%), Sweden (20%), Portugal (23%) and Denmark (24%) experienced a similar or larger relative improvement over this period.

Out of the countries studied, only in the US did age-standardised mortality rates increase for both males and females, rising by 1% and 2% respectively between 2011 and 2016. The UK experienced a notable slowing of improvements in age-standardised mortality rates for those aged 40 to 64 years, experiencing an improvement of 1% between 2011 and 2016 for both males and females.

Most of the countries studied experienced a slowdown in mortality improvements for those aged 40 to 64 years to some extent; the only countries to see improvements accelerate between 2011 and 2016 were Japan and Finland. Japan experienced improvements of 17% and 16% for males and females respectively from 2011 to 2016 and Finland experienced improvements of 15% and 13% for males and females respectively over that period.

## **Figures 11 and 12: Age-standardised mortality rates for males and females aged 40 to 64 years, selected countries, 2001 to 2016**

### **8 . The US has seen a 2% improvement in age-standardised mortality rates for 15-to-39-year-olds since 2001**

Age-standardised mortality rates for 15-to-39-year-old males and females for selected countries are shown in Figures 13 and 14.

The UK experienced a notable slowing of improvements in age-standardised mortality rates since 2011 for both males and females aged 15 to 39 years. Between 2011 and 2016, male aged-standardised mortality rates declined by 1% while females increased by 1%.

Between 2001 and 2011, males aged 15 to 39 years in the US experienced the second lowest improvements in age-standardised mortality rates of all the countries studied, decreasing by 11%. However, between 2011 and 2015, these improvements were almost completely reversed with age-standardised mortality rates increasing by 9%. This resulted in the lowest overall male improvement of all countries studied, with an improvement of 2% between 2001 and 2015.

There is a similar story for females aged 15 to 39 years in the US. Between 2001 and 2011, age-standardised mortality rates declined by 8%, but from 2011 to 2015 they increased by 8%, resulting in almost no change to age-standardised mortality rates between 2001 to 2015.

Similar to older age groups, 15-to-39-year-old males and females in Japan have seen an acceleration of improvements since 2011. Between 2001 and 2011, male age-standardised mortality rates improved by 9% and female rates improved by 11%. Then, from 2011 to 2016, improvements increased to 21% for males and 29% for females. This is on top of Japan having one of the lowest 15-to-39-year-old age-standardised mortality rates for both males and females, of the countries studied.

## **Figures 13 and 14: Age-standardised mortality rates for males and females aged 15 to 39 years, selected countries, 2001 to 2016**

## **9 . Next steps**

This article follows on from previous analysis, [Changing trends in mortality in England and Wales: 1990 to 2017](#), which established there had been a statistically significant slowdown in the long-term improvement in age-standardised mortality rates for England and Wales in the early 2010s.

This article continues a series of analytical reports exploring recent mortality trends in more detail. Here we have analysed life expectancy trends for different countries to discover whether the slowdown in the UK is unique or not. This article does not provide an explanation of why these trends in life expectancy have been occurring or enable us to predict what will happen in the future.

Today we have also published [Changing trends in mortality: A cross-UK comparison, 1981 to 2016](#). This analysis identified what has been happening at different age groups in the UK and in each of the UK countries and compared this against recent trends in broad causes of death by age group.

Later in this series of analysis, we also expect to look at the trend in life expectancy by the National Statistics Socioeconomic Classification to encompass the period 2012 to 2016.

## **10 . Quality and methodology**

Table 1 provides details of the countries analysed and the years used for each country.

**Table 1: Countries and periods analysed**

Country	Years analysed for age standardised mortality rates	Periods analysed for life expectancy
Australia	2001 to 2014	2006 to 2011 and 2011 to 2016
Austria	N/A	2006 to 2011 and 2011 to 2016
Belgium	2001 to 2015	2005 to 2010 and 2010 to 2015
Canada	N/A	2004 to 2009 and 2009 to 2014
Czech Republic	N/A	2006 to 2011 and 2011 to 2016
Denmark	2001 to 2014	2005 to 2010 and 2010 to 2015
Finland	2001 to 2016	2005 to 2010 and 2010 to 2015
France	2001 to 2015	2005 to 2010 and 2010 to 2015
Germany	2001 to 2015	2005 to 2010 and 2010 to 2015
Italy	2001 to 2014	2004 to 2009 and 2009 to 2014
Japan	2001 to 2016	2006 to 2011 and 2011 to 2016
The Netherlands	2001 to 2014	2004 to 2009 and 2009 to 2014
Norway	2001 to 2014	2006 to 2011 and 2011 to 2016
Poland	N/A	2006 to 2011 and 2011 to 2016
Portugal	2001 to 2015	2005 to 2010 and 2010 to 2015
Spain	2001 to 2014	2006 to 2011 and 2011 to 2016
Sweden	2001 to 2016	2006 to 2011 and 2011 to 2016
Switzerland	N/A	2005 to 2010 and 2010 to 2015
UK	2001 to 2016	2006 to 2011 and 2011 to 2016
USA	2001 to 2015	2005 to 2010 and 2010 to 2015

Source: Office for National Statistics

In this article period life expectancies have been used. A period life expectancy is the average number of additional years a person would live if he or she experienced the age-specific mortality rates of the given area and time period for the rest of their life. Information on how life expectancies are produced can be found in the [National life tables Quality and Methodology Information \(QMI\) report](#).

Figures 2 and 3 averages were calculated using countries with available data. The countries used for each year were:

- the average for 2001 to 2014 included all countries
- the average for 2015 excluded Italy, the Netherlands and Canada
- the average for 2016 excluded Italy, the Netherlands, Canada, Belgium, Finland, Portugal, Germany and Denmark

We have presented the most up-to-date data from the [Human Mortality Database \(HMD\)](#) for each country to allow users to see the longest time series of mortality data for each country. However, this means that the data period analysed varies slightly between the countries. The exact period used may have an effect on the percentage changes reported, for example, the percentage change for 2010 to 2015 may be different to that for 2011 to 2016 for a given country.

Life expectancies and mortality rates were obtained from the [Human Mortality Database \(HMD\)](#). Deaths, population estimates, mortality rates and life tables are provided for most countries by single years of age up to 109 years, with an open age interval for 110 years and over. These data are sometimes the product of aggregate raw data (for example, five-year age groups, open age intervals), which have been split into single years of age. Further explanation of the methods used to produce these data can be found in [HMD Method protocol](#).

All deaths data used in this analysis relate to death registrations. In this analysis age-standardised mortality rates have been calculated using single year of age mortality rates. Office for National Statistics usually produce age-standardised mortality rates using five-year age bands, as such the results may slightly differ.