

# Period and cohort life expectancy explained: December 2019

Guide to the two types of life table – cohort and period – used to calculate past and projected life expectancy.

Contact:  
Edward Morgan  
pop.info@ons.gov.uk  
+44 (0) 1329 444661

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# 1 . What is life expectancy?

Life expectancy is a statistical measure of the average time someone is expected to live, based on the year of their birth, current age and other demographic factors including their sex. It is used to assess and set a number of important policies that impact on everyday life, for example, setting the State Pension age and targeting health policy initiatives.

To calculate life expectancy, we use a life table. This shows, for each age, what the probability is that a person will die before his or her next birthday.

There are two different types of life table: cohort and period. This article explains the concept behind these and how they should each be used and interpreted.

## 2 . What are cohort life expectancies?

A cohort life table shows the probability of a person from a given cohort dying at each age over the course of their lifetime. In this context, a cohort refers to a group of people with the same year of birth.

The cohort life table is based on age-specific probabilities of death, which are calculated using observed deaths (mortality) data from the cohort. A cohort life table uses a combination of observed mortality rates for past years and projections about mortality rates for the cohort in future years. For example, cohort life expectancy at age 65 years in 2016 would be worked out using the mortality rate for age 65 years in 2016, for age 66 years in 2017, for age 67 years in 2018 and so on. This uses observed mortality rates up to 2018 and projected mortality rates from the most recently published projections for 2019 onwards.

The cohort life table takes into account observed and projected improvements in mortality for the cohort throughout its lifetime. Cohort figures are therefore regarded as a more appropriate measure of how long a person of a given age would be expected to live on average than the alternative measure, known as period life expectancy, which is calculated using mortality rates for a fixed period in time.

For example, a period life expectancy at age 65 years in 2018 would use the mortality rates for 2018 for ages 65, 66 and 67 years and so on. Period life expectancy would match cohort life expectancy only if there were no change in age-specific mortality rates over time; this is an extremely unlikely scenario, as these change from year to year.

## 3 . How much uncertainty is there in the cohort life expectancy projections?

The cohort life expectancy for men born in the UK in 2018 is 87.6 years and for women it is 90.2 years. This means that on average, we would expect someone born in 2018 to live to those ages. Some will die before those ages and some will live to be older; these numbers are an average for the cohort and do not take into account any person-specific factors such as lifestyle choices.

It is important to understand that these are projections and not forecasts. As we do not know what the future will hold, we make assumptions about how mortality rates will change in the future. Information on how mortality rates have changed in the past is used to estimate the current rate of mortality improvement by age and sex and to make assumptions about improvements in mortality in the future.

Expert judgement is applied to decide how long historical trends will continue into the future. Some demographers argue that future improvements in mortality rates will not be as rapid as historical improvements, partly as no more than a minority of the population will adopt a healthy lifestyle. External factors, such as the emergence of new diseases or antibiotic resistance, might also serve to offset future mortality improvements.

For the 2018-based projections, we set a target mortality improvement rate of 1.2% per year for males and females at most ages in 2043 (the 25th year of the projection) and all future years.<sup>1</sup> Improvement rates for earlier years are obtained by interpolating between the current mortality improvement rate and the target rate. The resulting improvement rates are used to produce projected future mortality rates for each year of the projection. These in turn are used to produce projected life expectancies.<sup>2</sup>

These projected life expectancies are what would happen if the assumptions were to hold true. Although the assumptions best reflect demographic patterns at the time they are adopted, the inherent uncertainty in demographic behaviour means that they will inevitably be proved wrong to a greater or lesser extent.

We reflect this inherent uncertainty by publishing [variant projections](#) using alternative plausible assumptions, which allow for higher and lower mortality improvements in the future. These are intended to provide an indication of the uncertainty and the sensitivity of the projections. For example, the high life expectancy variant assumes a target improvement rate of 1.9% across most ages from 2043, while the low life expectancy variant assumes a target improvement rate of 0.0% across most ages from 2043. A further variant, the no mortality improvement variant, assumes that the combined age- and sex-specific mortality rates remain constant at the values assumed for the first year of the principal projection. It differs from the low mortality assumption in that no mortality improvement assumes an improvement rate of 0.0% from the base year, whereas the low mortality assumption converges to an improvement rate of 0.0% by 2043.

The principal projection for life expectancy for 2043 projects that men born in 2043 will have a cohort life expectancy of 90.4 years and women will have a cohort life expectancy of 92.6 years. The low variant assumption projects life expectancy to be approximately a decade lower, with men born in 2043 projected to have a cohort life expectancy of 80.9 years and women 84.1 years in the same year. The high variant projects cohort life expectancy of 96.3 years for men born in 2043 and 98.1 years for women (Figure 1).

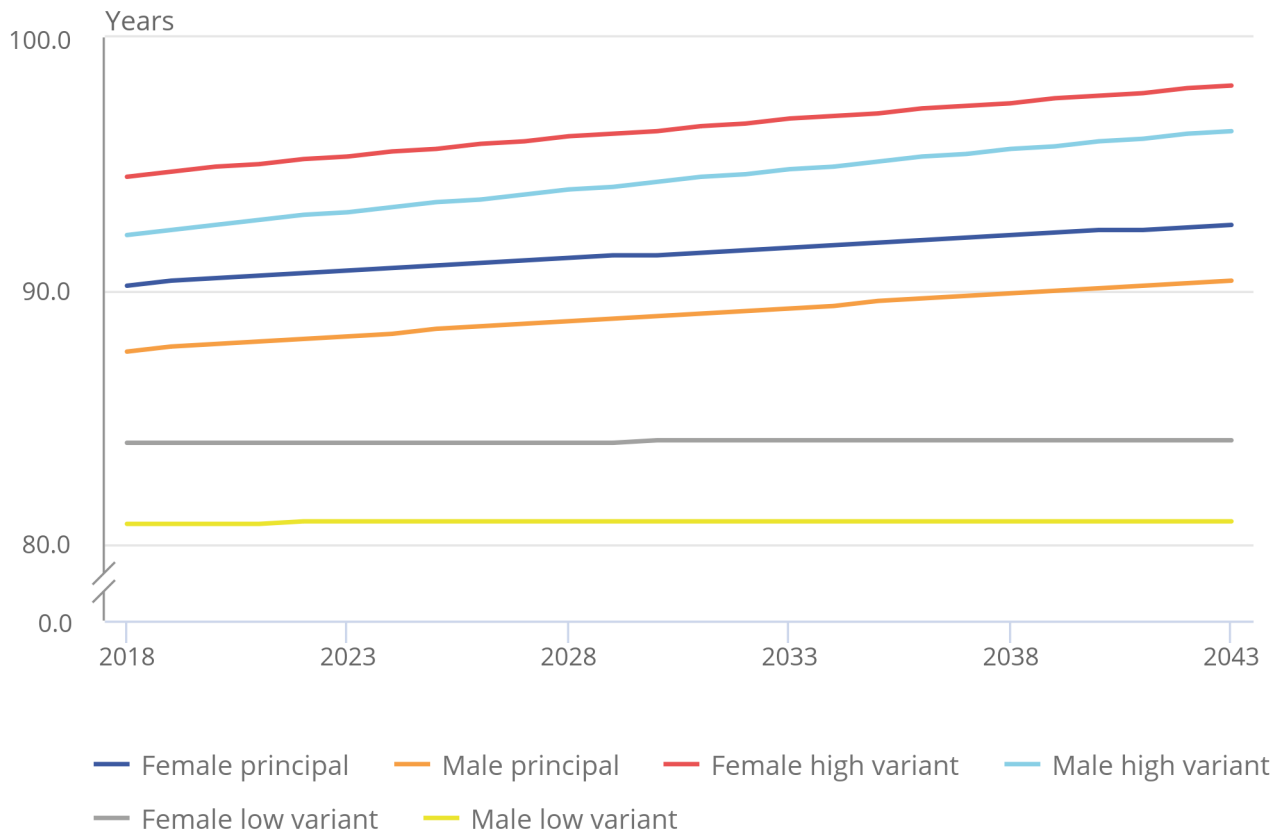
We do not believe that the high, low or no mortality improvement variants are the most likely course, nor are the variants intended to represent upper and lower limits of future demographic behaviour. They simply illustrate broadly plausible ways in which life expectancy could change for men and women born over the next 25 years under different sets of assumptions.

**Figure 1: Cohort life expectancy at birth by sex: principal, high and low variant**

UK, 2018 to 2043

Figure 1: Cohort life expectancy at birth by sex: principal, high and low variant

UK, 2018 to 2043



Source: Office for National Statistics – Period and cohort life expectancy

As shown in Figure 1, the difference in life expectancy between the low and high variants increases over time. While there is considerable uncertainty in the different projections, it is important to remember that these relate to men and women born in the year of interest and so include projections a long way into the future. The further we look into the future, the less certain we can be about what will happen.

**Notes for: How much uncertainty is there in the cohort life expectancy projections?**

1. This improvement rate is broadly equivalent to the average annual improvement rate in mortality over the last 100 years.
2. The detailed methodology for setting the assumptions is explained in [National population projections, mortality assumptions: 2018-based](#).

## 4 . What are period life expectancies?

A different way of looking at life expectancies is the use of period life expectancies, rather than the cohort life expectancies that we have looked at so far. Period life expectancies use mortality rates from a single year (or group of years) and assume that those rates apply throughout the remainder of a person's life. This means that any future changes to mortality rates would not be taken into account.

Period life expectancies are a useful measure of mortality rates experienced over a given period. They can provide a baseline against which to benchmark cohort life expectancies. For past years, they provide an objective way of comparing trends in mortality over time, between areas of a country and with other countries. Official life tables in the UK and in other countries that relate to past years are generally period life tables for these reasons.

Cohort life expectancies, even for past years, usually require projected mortality rates for their calculation and so, in such cases, involve an element of subjectivity. Many other types of life expectancy that allow you to make comparisons for different population sub-groups, or to look at how long people might expect to live in good health (healthy life expectancy), are calculated on a period basis.

## 5 . How much difference is there between period and cohort life expectancies?

Period life expectancies tend to be lower than cohort life expectancies because they do not include any assumptions about future improvements in mortality rates.

Figure 2 shows period and cohort life expectancy at birth for males and females from 1841 to 2018. The period life expectancy figures use observed historical mortality rates, while the cohort life expectancy figures use a combination of observed and projected mortality data. The earlier the year of birth, the more observed data there are for any given cohort.<sup>1</sup>

This analysis shows that for cohorts born around 1950, the gap for both males and females between cohort and period life expectancy has been around 9 to 10 years. This means that if period life expectancies had been used for these cohorts in 1950, we would have underestimated their life expectancy by this many years (as a result of not taking into account improvements in mortality rates since then and projected future improvements).

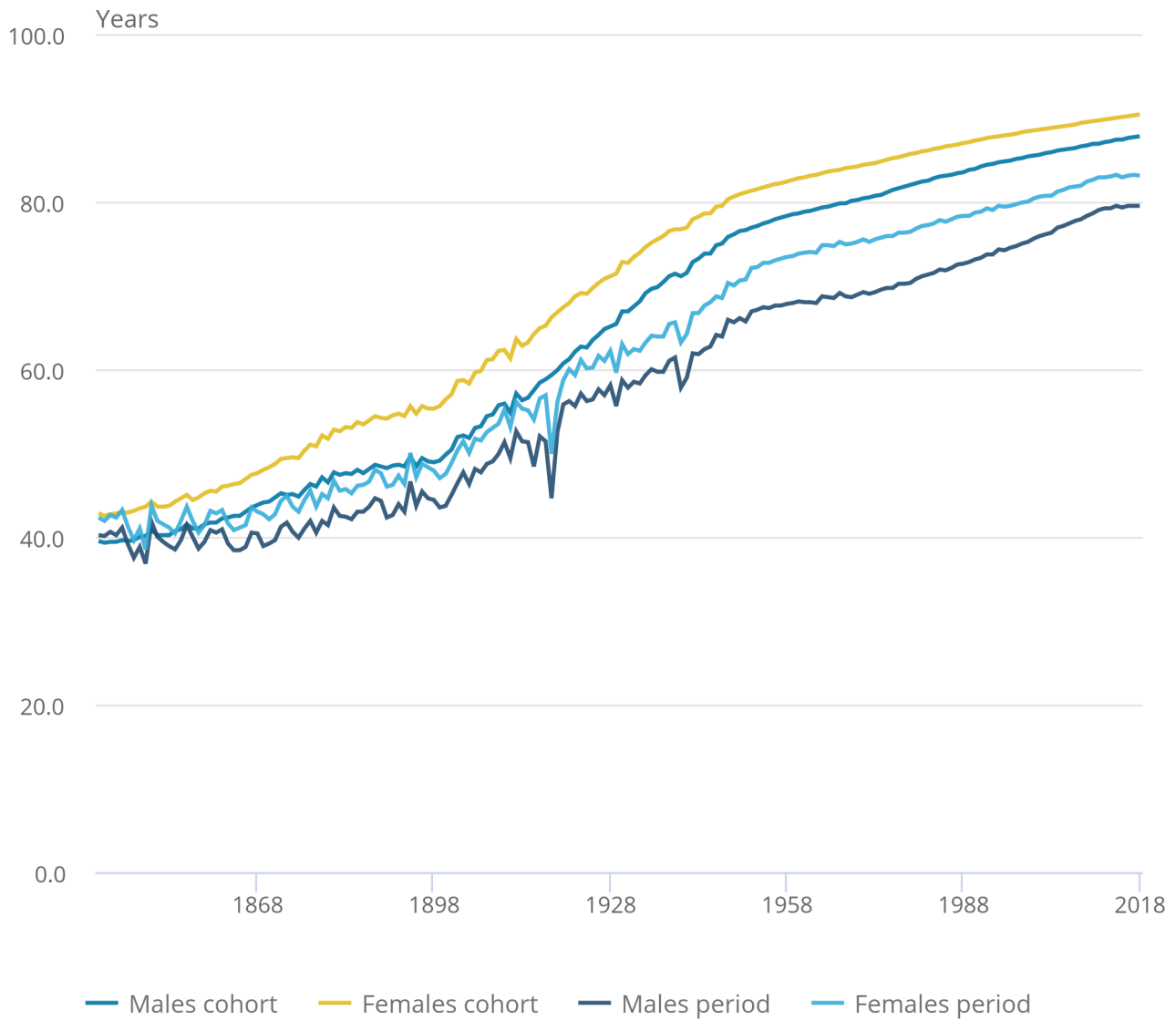
In the 2018-based projections, future cohort life expectancy at birth is typically around 7 to 8 years higher than the respective period life expectancy at birth. Therefore, although cohort life expectancies continue to be projected to be noticeably higher than the corresponding period life expectancy, the differences between period and cohort expectancies are comparable with historical ones.

## Figure 2: Period and cohort life expectancy at birth

England and Wales, 1841 to 2018

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England and Wales, 1841 to 2018



Source: Office for National Statistics – Period and cohort life expectancy

## 6 . What estimates of life expectancy do we produce?

We produce life tables annually for the UK and its constituent countries, using past mortality rates. The most current [life tables](#) provide users with life expectancy at each single year of age for 2016 to 2018 <sup>1</sup>; these are calculated on a period basis and are based on past mortality experience. We also produce [life tables](#) that provide projected life expectancies for future generations.

The most recent set of projections are 2018-based and are calculated from previous mortality improvements and expert opinion on future mortality improvements.

To find out more about life expectancy, please see the related publications or email [pop.info@ons.gov.uk](mailto:pop.info@ons.gov.uk).

### Notes for: What estimates of life expectancy do we produce?

1. The life tables are based on three consecutive years' worth of data to reduce the effect of annual fluctuations in the number of deaths caused by seasonal events such as flu.