Office for National Statistics

Article

Mortality in England and Wales: past and projected trends in average lifespan

We look at three measures of average lifespan: life expectancy at birth, median age at death and modal age at death to understand patterns of mortality from 1841 to 2020 in England and Wales. We also consider future prospects for mortality using projections of life expectancy for 2021 to 2070.

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Release date:
5 July 2022

Next release:
To be announced

Table of contents

1. Main points

2. Approaches to measuring lifespan

3. Changing patterns of deaths by age

4. Chances of survival

5. Future prospects for life expectancy

6. Mortality in England and Wales: past and projected trends in average lifespan data

7. Glossary

8. Data sources and quality

9. Related links

1 . Main points

- In 2020, period life expectancy at birth in England and Wales was 78.6 years for males and 82.6 years for females; this is 1.2 years lower for males and 0.9 years lower for females than in 2019, reflecting very high mortality in 2020 during the coronavirus (COVID-19) pandemic.
- Since 1841, period life expectancy at birth has approximately doubled for both males and females; period life expectancy at birth increased by around 11 years for males and around 8 years for females over the 50 years to 2019, prior to the impact of coronavirus.
- In 2020, the most common age or "modal age" at death was 87.1 years for males and 89.3 years for females in England and Wales.
- Over the last 50 years, modal age at death has risen substantially, with a greater rise for males than for females; deaths are increasingly concentrated in a smaller age range around the modal age at death.
- Over the next 50 years, period life expectancy at birth in England and Wales is projected to increase by approximately 6.6 years for males and 5.5 years for females.
- Improvements in mortality have slowed since 2011 and this is reflected in slower improvements in projected period life expectancies; it is too early to say with any certainty what impact coronavirus may have on long-term mortality trends.

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2 . Approaches to measuring lifespan

Life expectancy and measures of lifespan are used for measuring the health of the population and health differences within the population. They feed into important policy decisions, including pension policy and the setting of the State Pension age. Measures of how long we live vary with factors such as age, sex, where we live and occupation.

This article looks at various approaches to examining how lifespans have changed over time. We look at measures such as period and cohort life expectancy, median age at death and modal age at death, which can provide different insights into the trends in average lifespan over the last 180 years.

Improvements in medicine and healthcare have compressed mortality into a shorter age interval and deaths are now more concentrated at older ages. The improvement in mortality has slowed in recent years, and we look at how this feeds into projections of future improvements in life expectancy.

Trends in average lifespan, 1841 to 2020

Life expectancy is one of the most commonly used measures of lifespan for a given population. There are two different types of life expectancy: period and cohort.

Period life expectancy is the average number of additional years a person can expect to live if they experience the age-specific mortality rates of the given area and time period for the rest of their life.

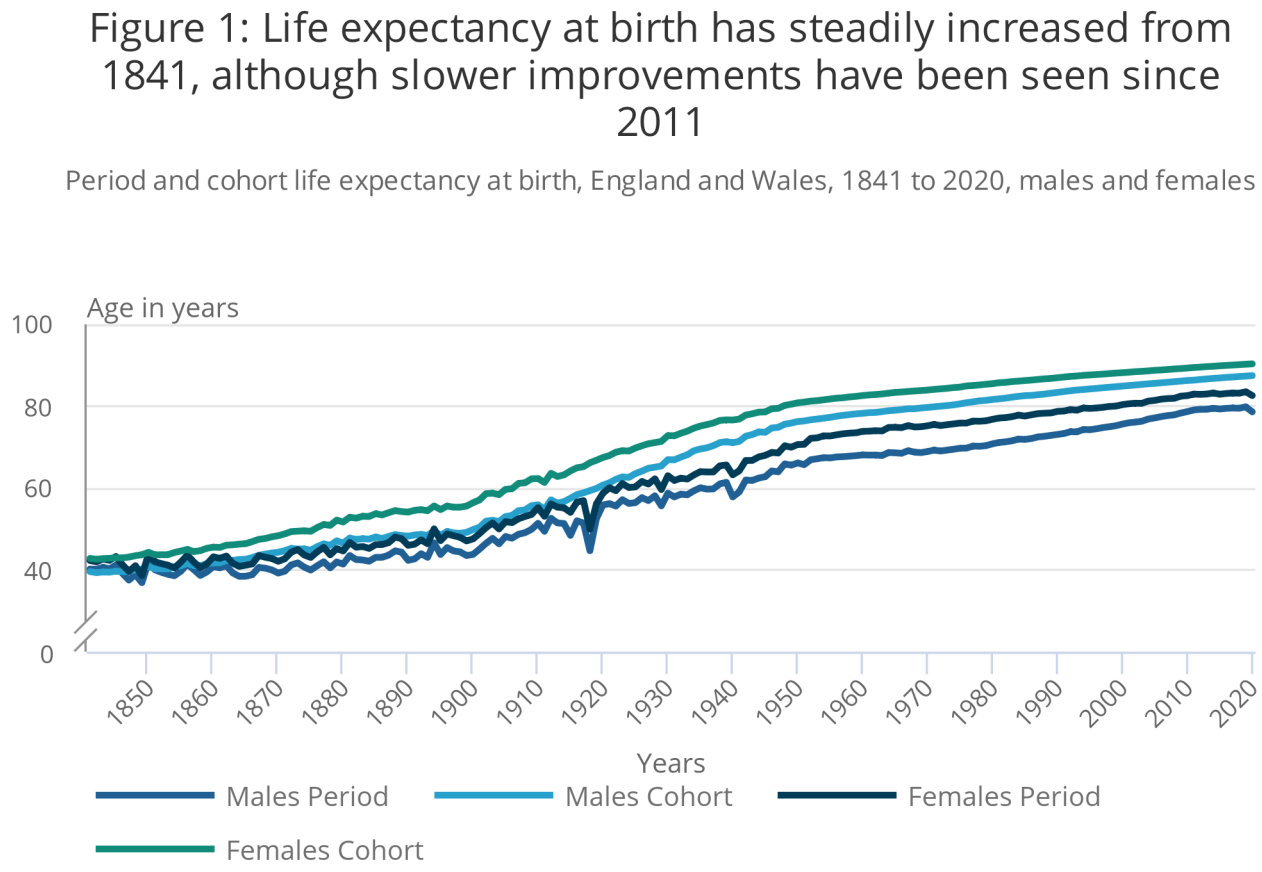
Cohort life expectancy provides the life expectancy of a cohort, or group of people with the same year of birth, and takes into account observed and projected changes in mortality for the cohort throughout its lifetime.

Further explanation of each appears in Section 7: Glossary.

Period and cohort life expectancy for males and females have increased significantly since 1841 in England and Wales, although the increase in period life expectancy has slowed considerably since 2011, as shown in Figure 1. This reflects that mortality rates have been improving, that is to say, they have been declining at most ages over time. Cohort life expectancy takes into account observed and projected future improvements in mortality and is therefore higher than period life expectancy.

Figure 1: Life expectancy at birth has steadily increased from 1841, although slower improvements have been seen since 2011

Period and cohort life expectancy at birth, England and Wales, 1841 to 2020, males and females



Source: Office for National Statistics - Life tables, principal projection, England and Wales

Period life expectancy for both males and females in 2020 was lower than in 2019 because of increased mortality in 2020 during the coronavirus (COVID-19) pandemic. Life expectancy at birth fell by 1.2 years for males and 0.9 years for females compared with 2019, in which the highest-ever values of life expectancy at birth were recorded.

While most deaths happen at older ages, a small number of deaths do occur to younger people, and notably, the number of deaths between age 0 and 1 is higher than at other ages in childhood. Expectation of life at birth is affected by these deaths at younger ages, so it can be informative to look at other measures that are less affected.

The median age at death is the middle value, if all ages at death in a population in a given year were lined up in numeric age order. This is a useful measure, as it is less affected by deaths in infancy and childhood than period life expectancy. The median age at death was 81.8 years for males and 85.5 years for females in 2020, a fall of 1.3 years for males and 0.9 years for females from 2019.

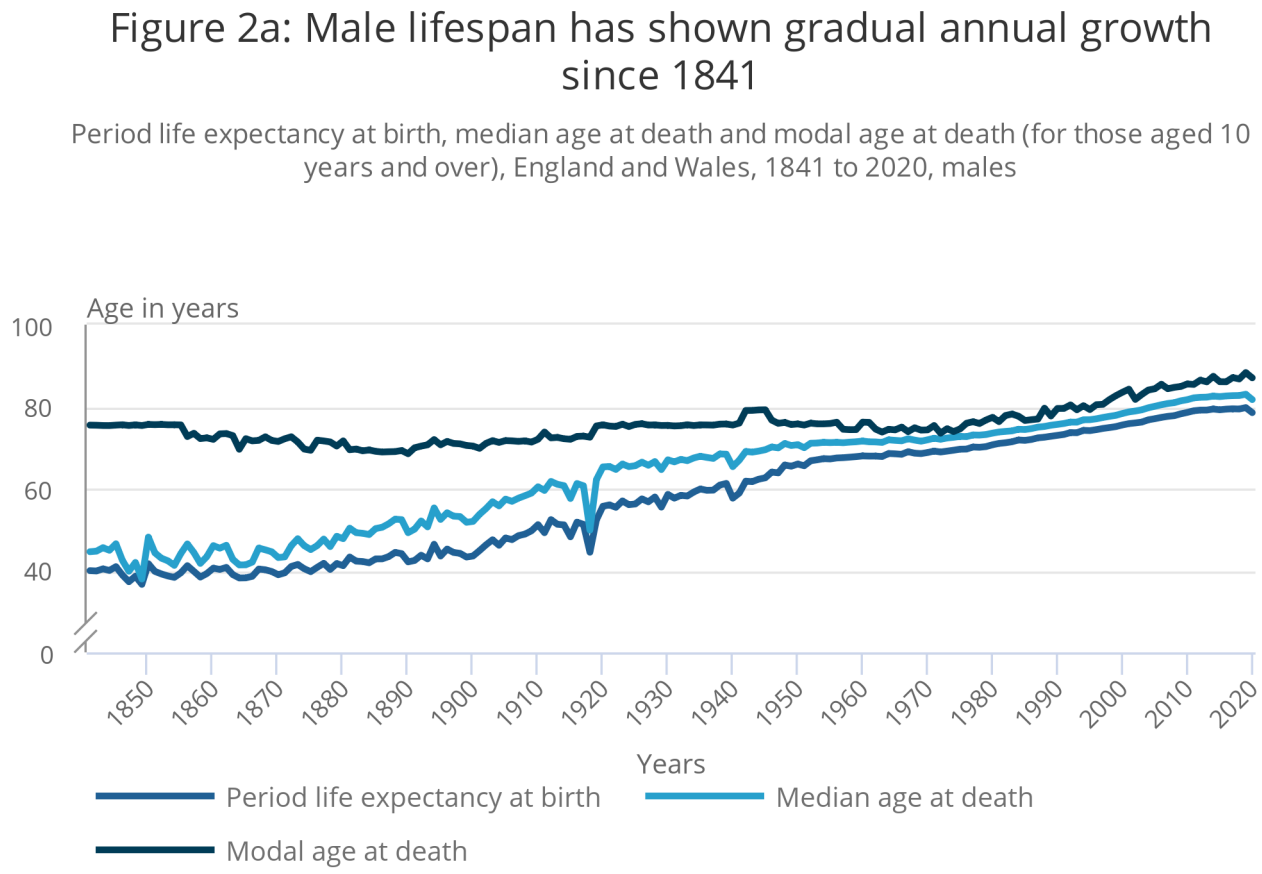
The modal age at death is the most common age at which people die in a given year. Using modal age at death for those aged 10 years and over is particularly useful for measuring adult mortality, as it is not influenced by deaths of children at young ages and can tell us whether we are really living longer lives and how much this has changed historically.

Further explanation of each appears in Section 7: Glossary.

In Figure 2, we have used modal age at death for those aged 10 years and over, to give a representative reflection of lifespan before 1950, as childhood mortality was much greater before this date. In 2020, the most common age at death was 87.1 years for males and 89.3 years for females in England and Wales, for those aged 10 years and over.

Figure 2a: Male lifespan has shown gradual annual growth since 1841

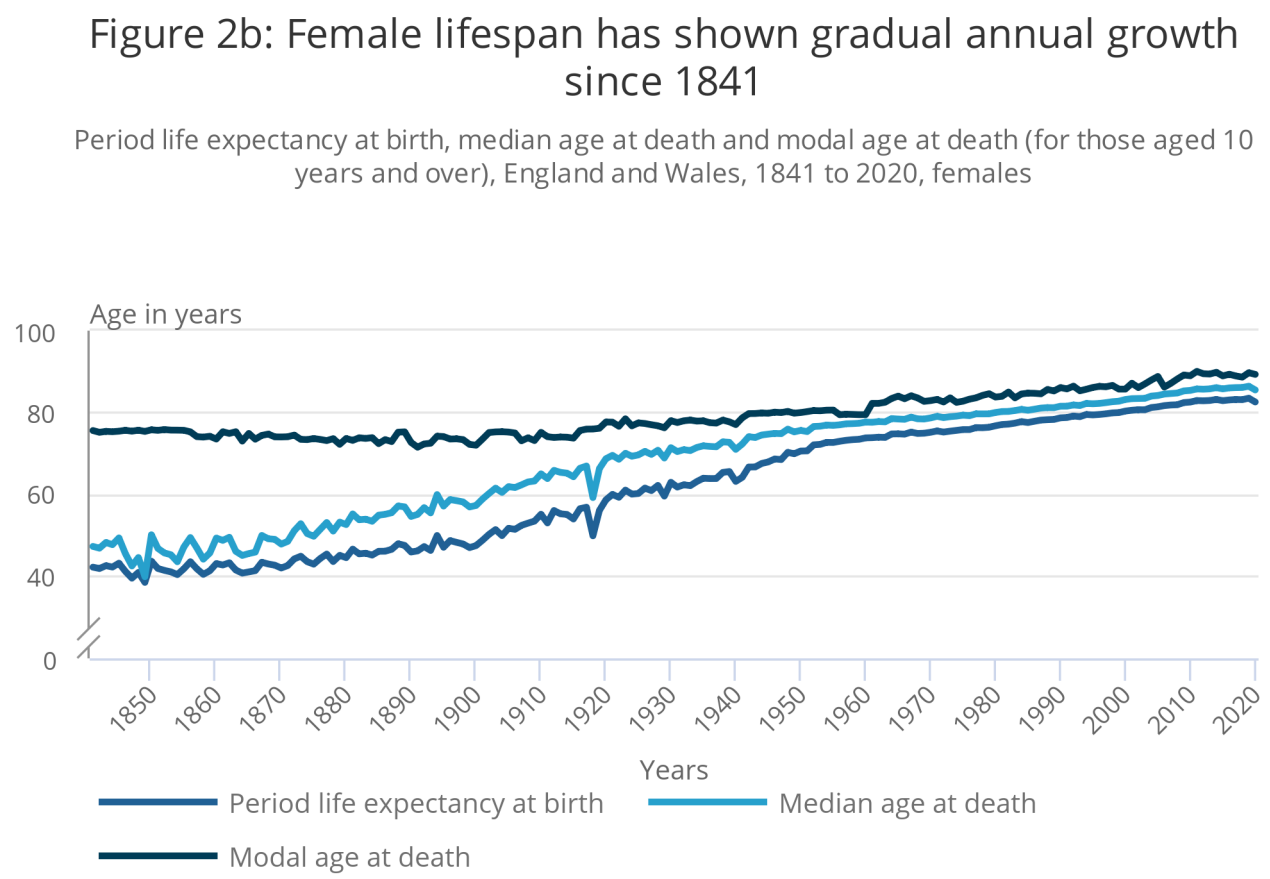
Period life expectancy at birth, median age at death and modal age at death (for those aged 10 years and over), England and Wales, 1841 to 2020, males



Source: Office for National Statistics - Life tables, principal projection, England and Wales

Figure 2b: Female lifespan has shown gradual annual growth since 1841

Period life expectancy at birth, median age at death and modal age at death (for those aged 10 years and over), England and Wales, 1841 to 2020, females



Source: Office for National Statistics - Life tables, principal projection, England and Wales

The three measures in Figure 2 show how lifespan has increased in England and Wales. Both period life expectancy at birth and median age at death have approximately doubled between 1841 and 2020 for males and females, with period life expectancy increasing from 40.2 years to 78.6 years for males, and from 42.3 years to 82.6 years for females.

The most common (modal) age at death, for those aged 10 years and over, in 1841 was 75.6 years for both males and females; that is, roughly 35 years greater than period life expectancy in the same year. This discrepancy is almost wholly explained by the number of deaths at young ages. Childhood mortality skewed life expectancy downwards until the 1940s to 1950s, when childhood vaccinations reduced, and in certain cases, eventually eliminated, childhood illnesses. As the mortality rate for young children has fallen, so too has the gap between life expectancy and modal age at death.

Modal age at death does not capture historical changes in mortality patterns in the same way as life expectancy and median age at death. This is seen in Figure 2, where life expectancy and median age at death show the effect of historical events on lifespans, as well as social and environmental changes. For example, by the middle of the 19th century, large numbers of people were migrating from rural to urban areas to work in the rapidly expanding manufacturing sector. The environment was much more hazardous in urban areas, with air pollution, poor sanitation and higher prevalence of infectious diseases. As more people moved to towns and cities and experienced worse living conditions, so life expectancy fell.

Looking at how life expectancy has changed over time, by the late 19th and early 20th century, life expectancy was improving rapidly. This reflects improvement in living standards and medical developments, which led to falling mortality particularly among young children. Modal age at death remained steady during this period, indicating that lifespans of adults were not increasing in length. Given life expectancy was increasing, this implies that the number of deaths at young ages was falling and that the measure was becoming less skewed.

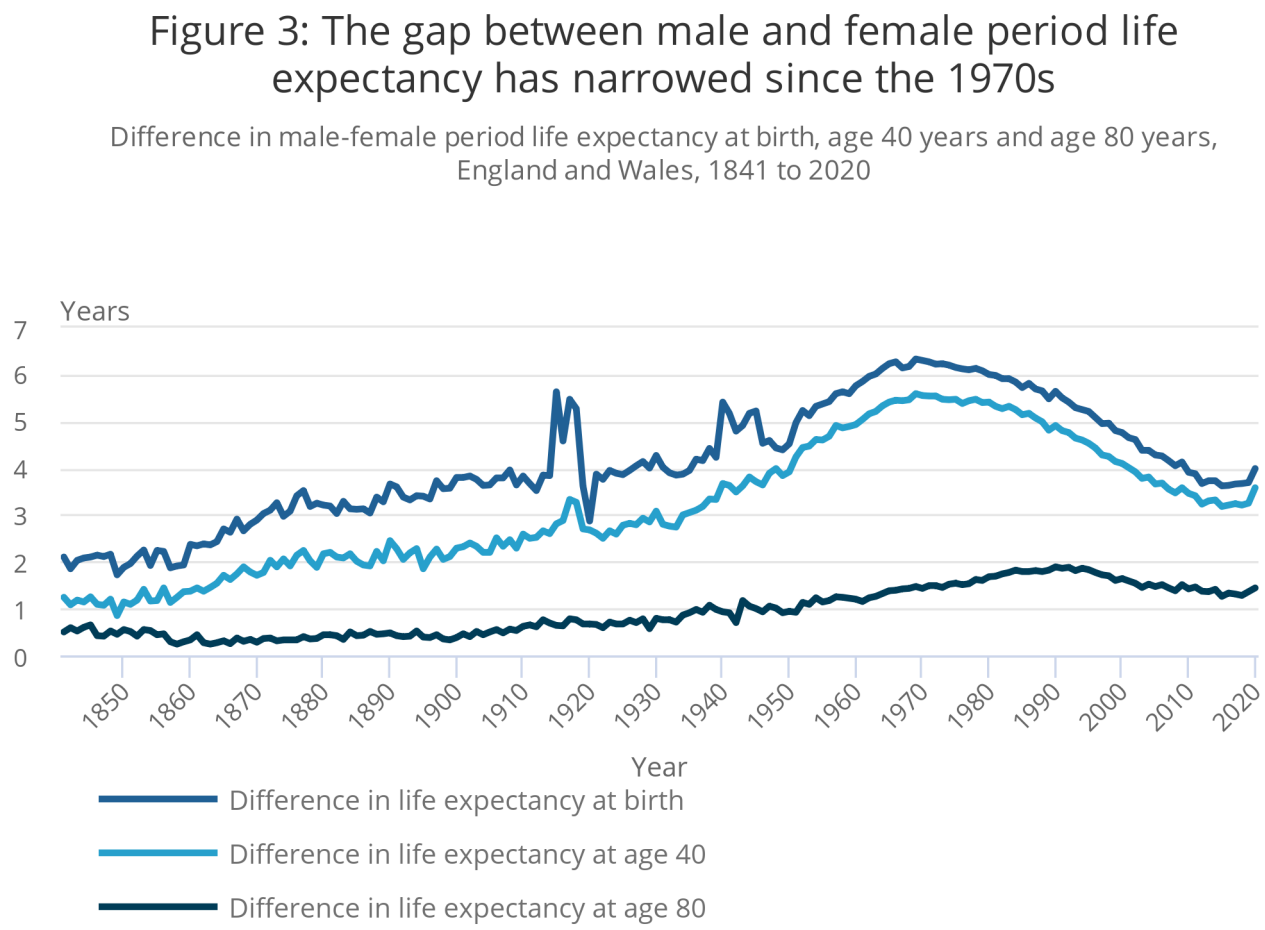
World War One and the Spanish flu pandemic disproportionately affected younger people, and life expectancy dramatically fell in 1918. After a further two decades of improvement, life expectancy fell again, to a lesser extent, at the start of World War Two. From around the 1960s to 2010, all three measures showed steady growth, including modal age at death, which until the mid-20th century had shown relatively little change. In the last 50 years, period life expectancy at birth has increased by 11 years for males and 8 years for females.

Figure 3 shows the gap in period life expectancy between males and females at different ages. Life expectancy at birth has been greater for females than for males since 1841. While life expectancy improved for both sexes, the gap between male and female life expectancy grew wider. This divergence can mainly be attributed to differences in behaviours between males and females.

However, by the turn of the 21st century, male health behaviours had changed to more closely resemble those of females, resulting in the gap of 6.3 years difference between male and female life expectancy at birth in 1970 narrowing to 3.7 years in 2019, as described in our past and projected 2020-based life tables release. In 2020, we see a small uptick in the gap between male and female period life expectancy. This reflects the greater increase in age-standardised mortality rates for males in 2020 compared with females because of the impact of the coronavirus (COVID-19) pandemic (see Section 5: Future prospects for life expectancy).

Figure 3: The gap between male and female period life expectancy has narrowed since the 1970s

Difference in male-female period life expectancy at birth, age 40 years and age 80 years, England and Wales, 1841 to 2020



Source: Office for National Statistics - Life tables, principal projection, England and Wales

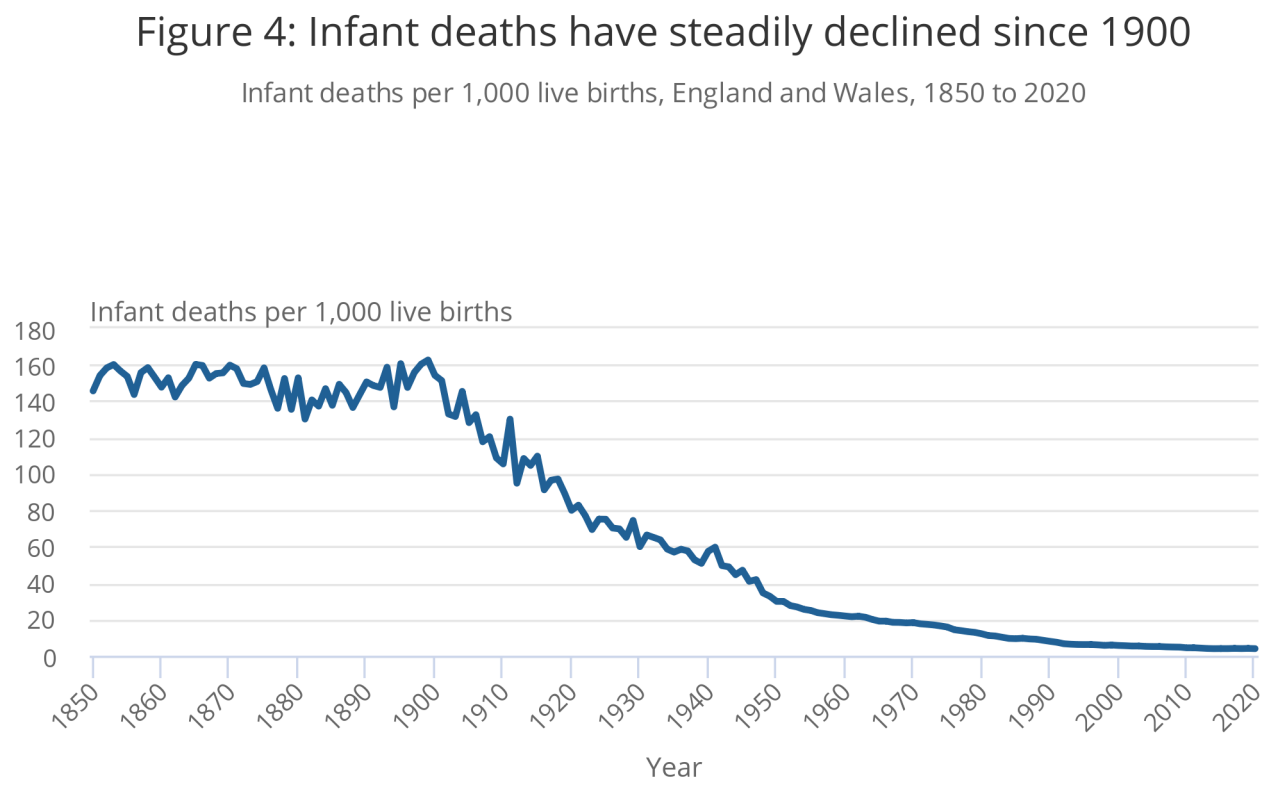
3 . Changing patterns of deaths by age

When comparing patterns of mortality over a long time period, it is important to bear in mind that the size and structure of the population has changed considerably over that time. In 1850, the estimate of the population of England and Wales was 17.8 million; by 2020 this had grown to 59.7 million, and the age structure was much older. The overall number of deaths each year has increased accordingly over time as the population has grown, and lower mortality rates at younger ages means that deaths are more concentrated at older ages.

Infant mortality rates in England and Wales were particularly high from 1850 to 1900 and have steadily declined since 1900 (see Figure 4). Before the early 1950s, infant deaths (the death of those aged under 1 year) exceeded the number of deaths at the modal age at death in adults for males and females.

Figure 4: Infant deaths have steadily declined since 1900

Infant deaths per 1,000 live births, England and Wales, 1850 to 2020



Source: Office for National Statistics - Vital statistics in the UK

Figure 5 shows how the pattern of deaths by age has changed from 1841 to 2020 for ages 10 years and above, using a life table (see Section 7: Glossary). Starting at age 10 years excludes the very high levels of infant and child mortality in the years before 1950 and allows us to see the distribution of deaths over time at older ages more clearly.

A life table is a demographic tool used to analyse mortality at different ages, by applying mortality rates by age to a hypothetical cohort of 100,000 people. Figure 5 shows the number of people out of the cohort of 100,000 expected to die between exact ages, for example, between 70 and 71 years, for selected years between 1841 and 2020.

The data for 1841 and 1900 show that deaths in England and Wales were more widely distributed across all ages during the 19th and early 20th century than they are now, although, if we exclude infant and child mortality, they still peaked at higher ages.

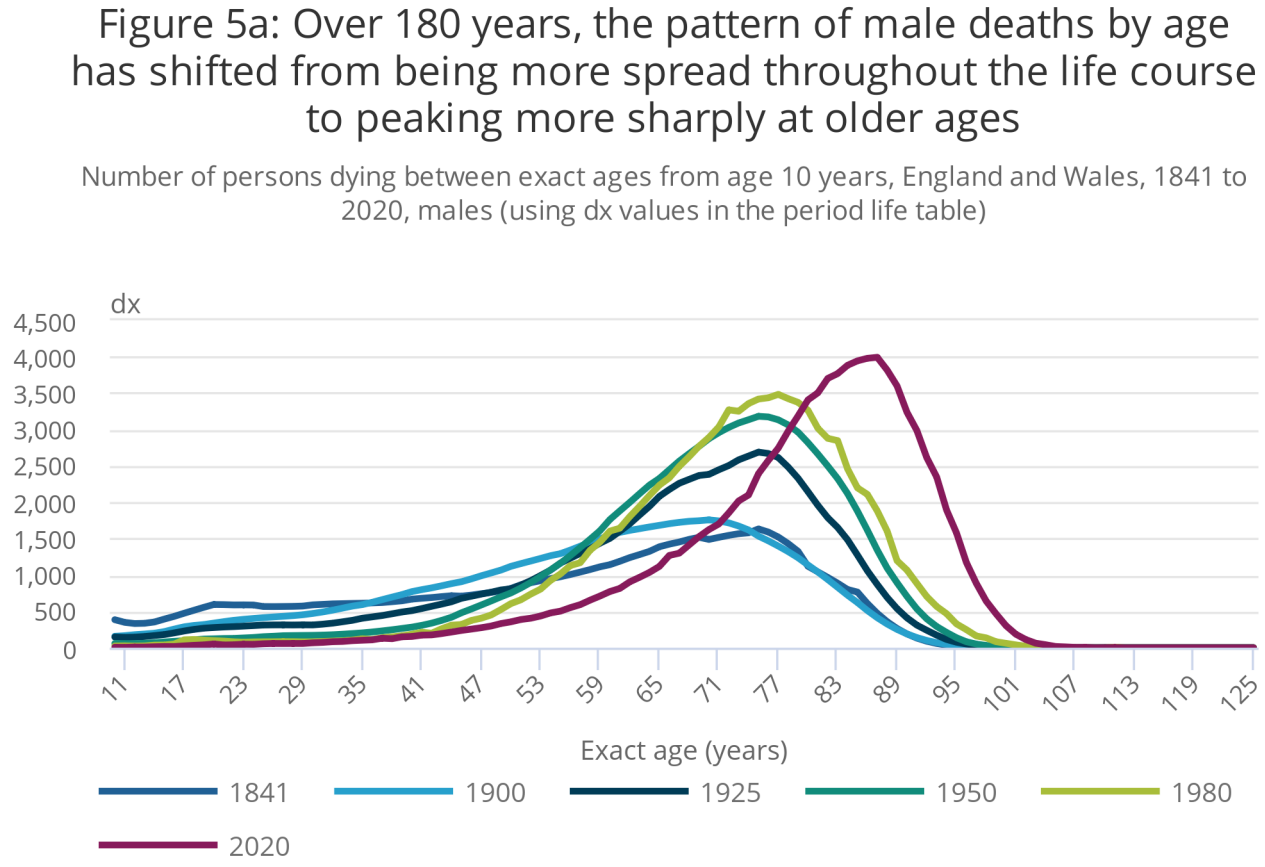
As healthcare systems improved, the proportion of premature deaths between the ages of 10 and 50 years declined. However, this did not result in longer lifespans - assessed by the modal age at death - until around 1950 for females and 1960 for males. Previous avoidable deaths were replaced by deaths at later ages from causes such as dementia and cancer. As a result, more people died at or around the modal age at death; the height of the line in Figure 5 can be seen to increase, reflecting the higher number of deaths at these ages.

From the mid-20th century, mortality improved further in part because of advances in healthcare and public health measures, which improved air quality and working conditions. As lifespan increases, we see the peak of the curve in Figure 5 start to move rightwards as the modal age at death increased.

The concentration of deaths around the modal age at death is evidence of compression of mortality, where a higher proportion of deaths take place in a shorter age interval. It reflects a move from mortality associated with infectious diseases to age-related non-infectious diseases associated with lifestyles and environmental factors.

Figure 5a: Over 180 years, the pattern of male deaths by age has shifted from being more spread throughout the life course to peaking more sharply at older ages

Number of persons dying between exact ages from age 10 years, England and Wales, 1841 to 2020, males (using dx values in the period life table)



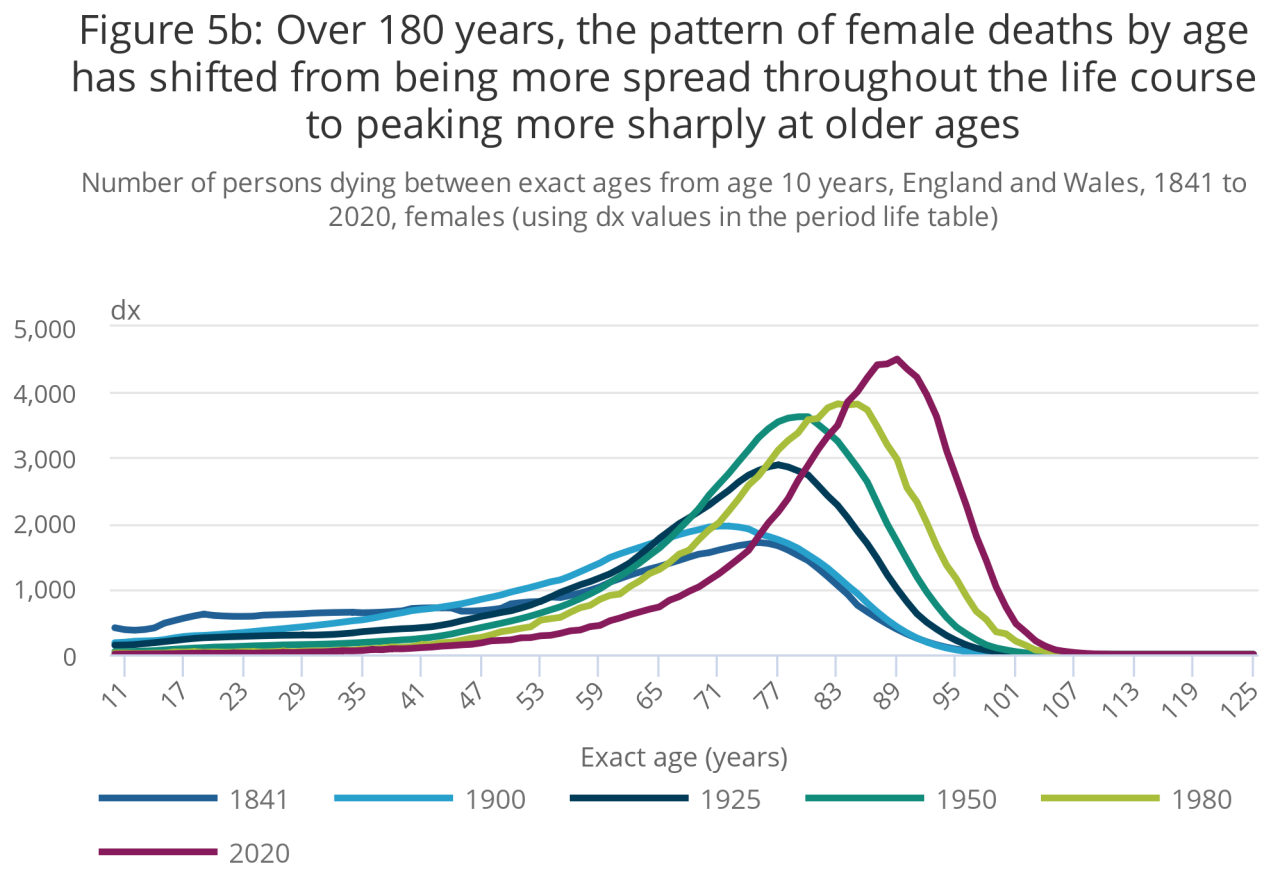
Source: Office for National Statistics - Life tables, principal projection, England and Wales

Notes:

1. dx is the number of deaths between exact age x and (x+1) from a hypothetical cohort of 100,000 live births in a given year.

Figure 5b: Over 180 years, the pattern of female deaths by age has shifted from being more spread throughout the life course to peaking more sharply at older ages

Number of persons dying between exact ages from age 10 years, England and Wales, 1841 to 2020, females (using dx values in the period life table)



Source: Office for National Statistics - Life tables, principal projection, England and Wales

Notes:

1. dx is the number of deaths between exact age x and (x+1) from a hypothetical cohort of 100,000 live births in a given year.

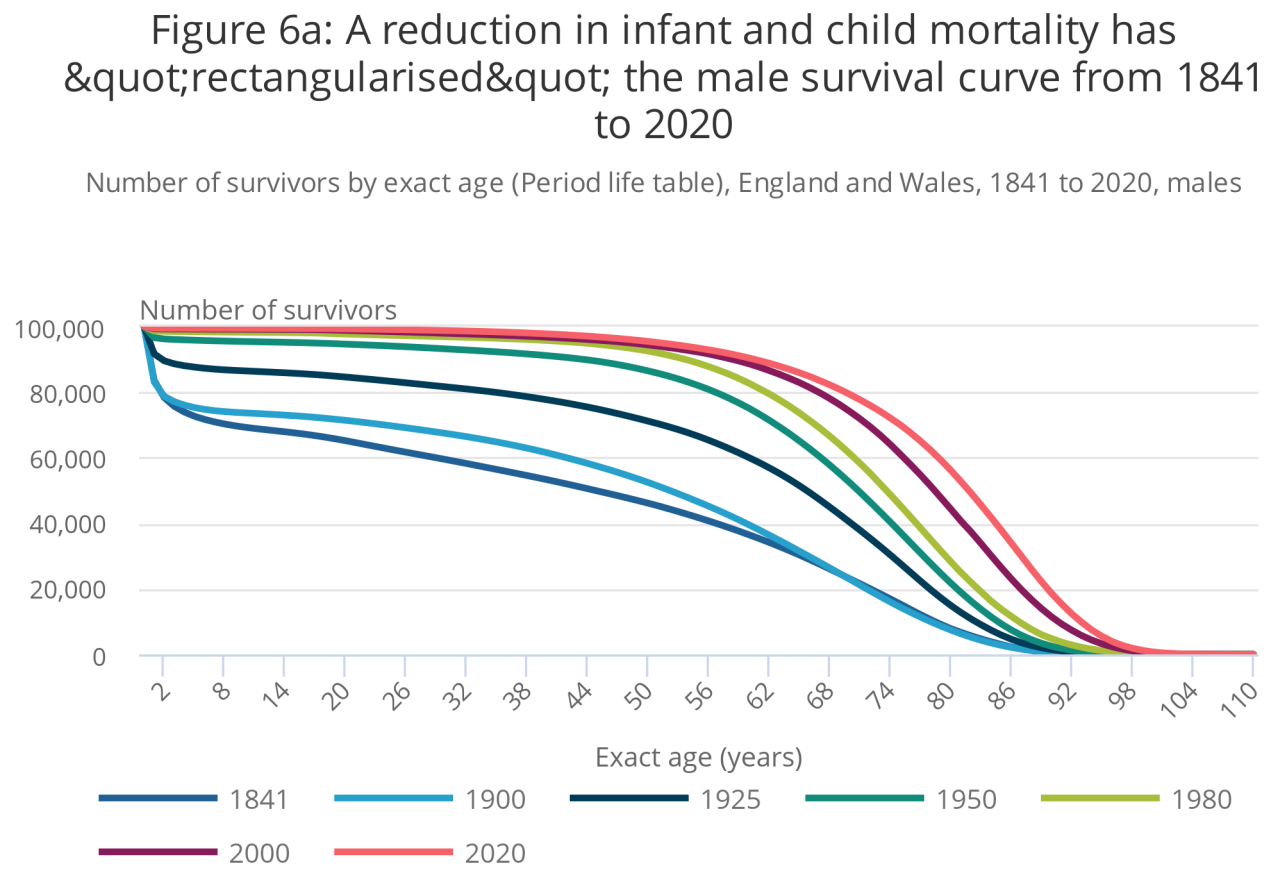
4 . Chances of survival

Another approach to measuring lifespan is to examine the chances of survival. Survival curves are calculated from a life table and show the number of people surviving to a given age out of a hypothetical cohort of 100,000 people, based on mortality rates by age for a given year. Figure 6 shows survival curves for England and Wales, for selected years from 1841 to 2020.

In 1870, 17.4% of male deaths and 14.5% of female deaths were to those aged under 1 year. By 2020, just 0.4% and 0.3% of all male and female deaths, respectively, were infant deaths. This change in Figure 6 is referred to as the "rectangularisation" of the survival curve (further explanation appears in Section 7: Glossary). As infant deaths decrease and the majority of deaths concentrate in later life, the curve gradually resembles a rectangular shape, rather than a rounded curve.

Figure 6a: A reduction in infant and child mortality has "rectangularised" the male survival curve from 1841 to 2020

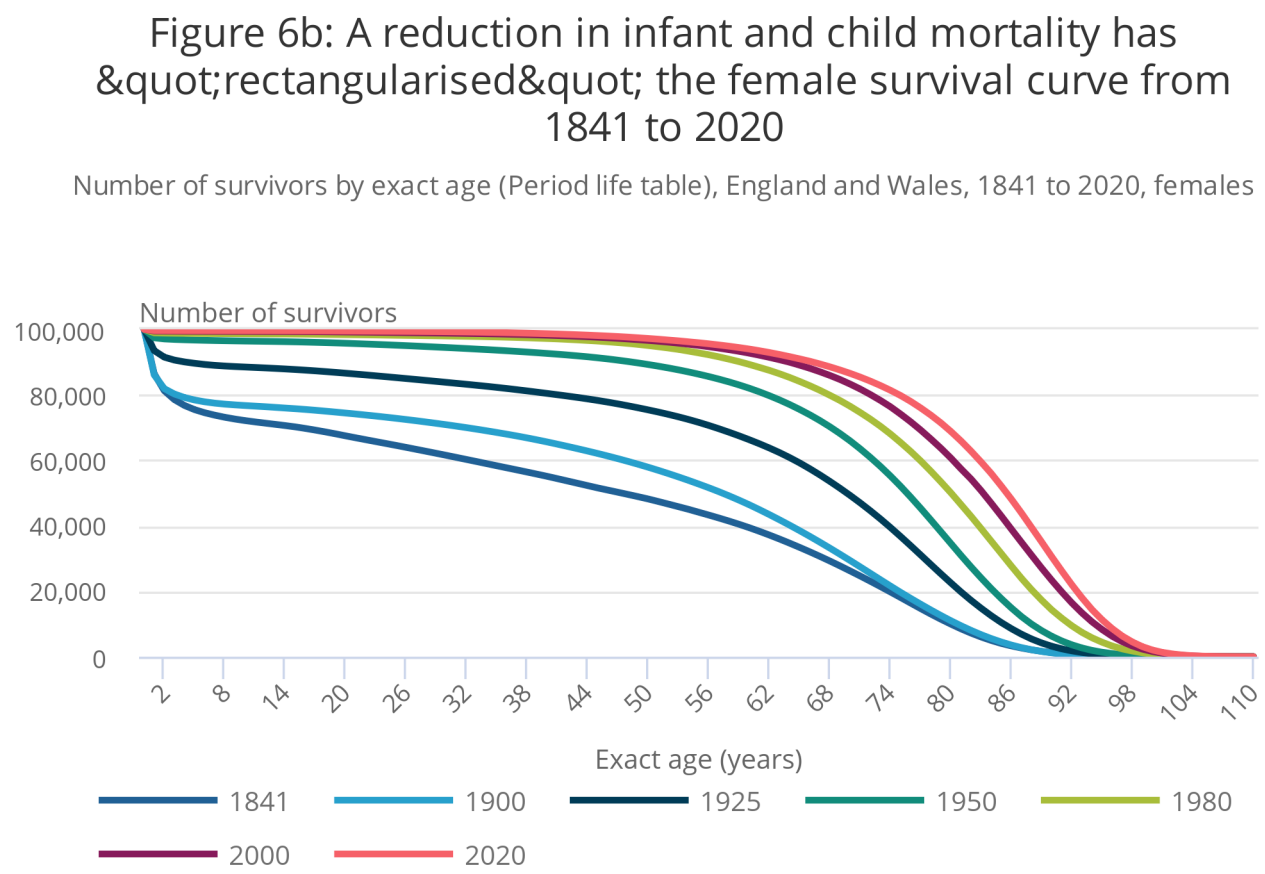
Number of survivors by exact age (Period life table), England and Wales, 1841 to 2020, males



Source: Office for National Statistics - Life tables, principal projection, England and Wales

Figure 6b: A reduction in infant and child mortality has "rectangularised" the female survival curve from 1841 to 2020

Number of survivors by exact age (Period life table), England and Wales, 1841 to 2020, females



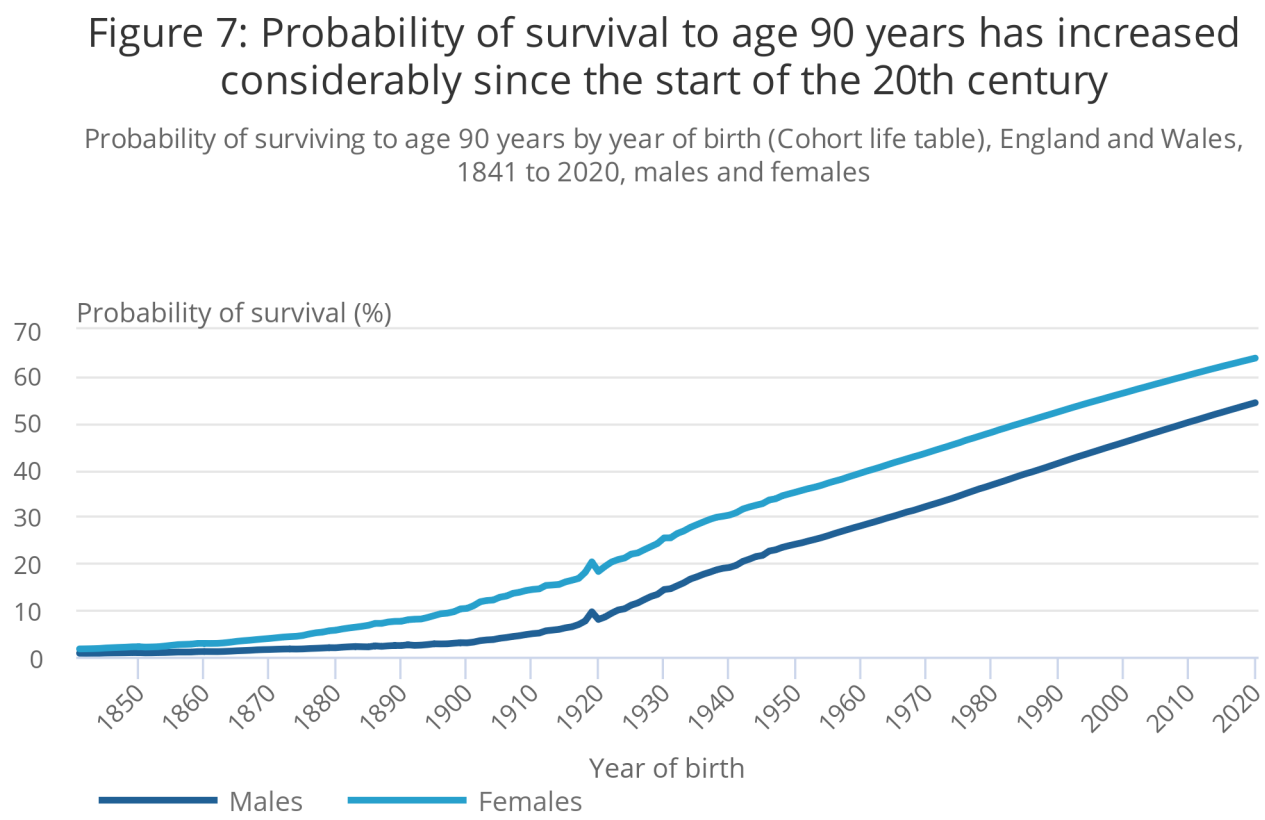
Source: Office for National Statistics - Life tables, principal projection, England and Wales

Figure 7 shows the probability of survival to age 90 years for different years of birth using cohort life expectancies. For example, we can look at the likelihood of someone born in 1841 surviving to age 90 years. We use cohort life expectancies here as they take account of improvement in mortality over time.

From 1841 to 1900, there was little change in the probability of survival to age 90 years. But while in 1900, the chances of survival to age 90 years for those aged 0 years was 3% and 10.3%, for males and females respectively, this had improved to 54.3% and 63.8% for those born in 2020.

Figure 7: Probability of survival to age 90 years has increased considerably since the start of the 20th century

Probability of surviving to age 90 years by year of birth (Cohort life table), England and Wales, 1841 to 2020, males and females



Source: Office for National Statistics - Life tables, principal projection, England and Wales

Notes:

1. In calculating cohort life expectancy, an assumption is made that births are evenly distributed throughout the year. Following World War One, this was not the case. There were more births in the second half of 1919 than in the first half, and more births in the first half of 1920 than in the second half. These birth patterns have reduced mortality rates for the 1919 birth cohort, resulting in an artificially raised estimate of the chance of reaching age 90 years, as shown in Figure 7.

5 . Future prospects for life expectancy

Since the 2010s, there has been a slowdown in improvements in mortality rates in England and Wales. The improvements in period life expectancy seen since the mid-20th century have been replaced by slower growth in this measure in the last decade. Period life expectancy at birth increased by 1.2 years for males and 1 year for females between 2010 and 2019; for comparison, increases of 2.7 years for males and 2.1 years for females were seen between 2000 and 2009.

Furthermore, the start of the coronavirus (COVID-19) pandemic in 2020 led to a significant increase in mortality rates in that year. In England and Wales, in 2020 there was a 14.5% increase in the number of deaths registered compared with 2019. Age-standardised mortality rates (ASMRs), which take into account the population size and age structure, increased significantly in England and Wales, by 14.6% for males and 11.9% for females in 2020 compared with 2019, using deaths registered in England and Wales. In 2020, period life expectancy at birth was 78.6 years for males and 82.6 years for females, a fall of 1.2 years for males and 0.9 years for females from 2019.

Period life expectancies assume that the increased mortality rates seen in 2020 will continue. They should be viewed as a measure of mortality for a given time period, rather than a prediction of future lifespan, and do not necessarily mean that someone born in that year will live a shorter life. To understand the impact of the pandemic on life expectancy we need to look at cohort life expectancies, which incorporate projected future improvements in mortality.

National life expectancy estimates conceal the variation seen in life expectancy at a sub-national level. Within England, there are sizeable differences in life expectancy between local areas for males and females, although these differences are smaller for females. Looking at life expectancy by national deprivation deciles, there are also large differences in life expectancy between the least deprived and most deprived areas in England, and between males and females within those areas.

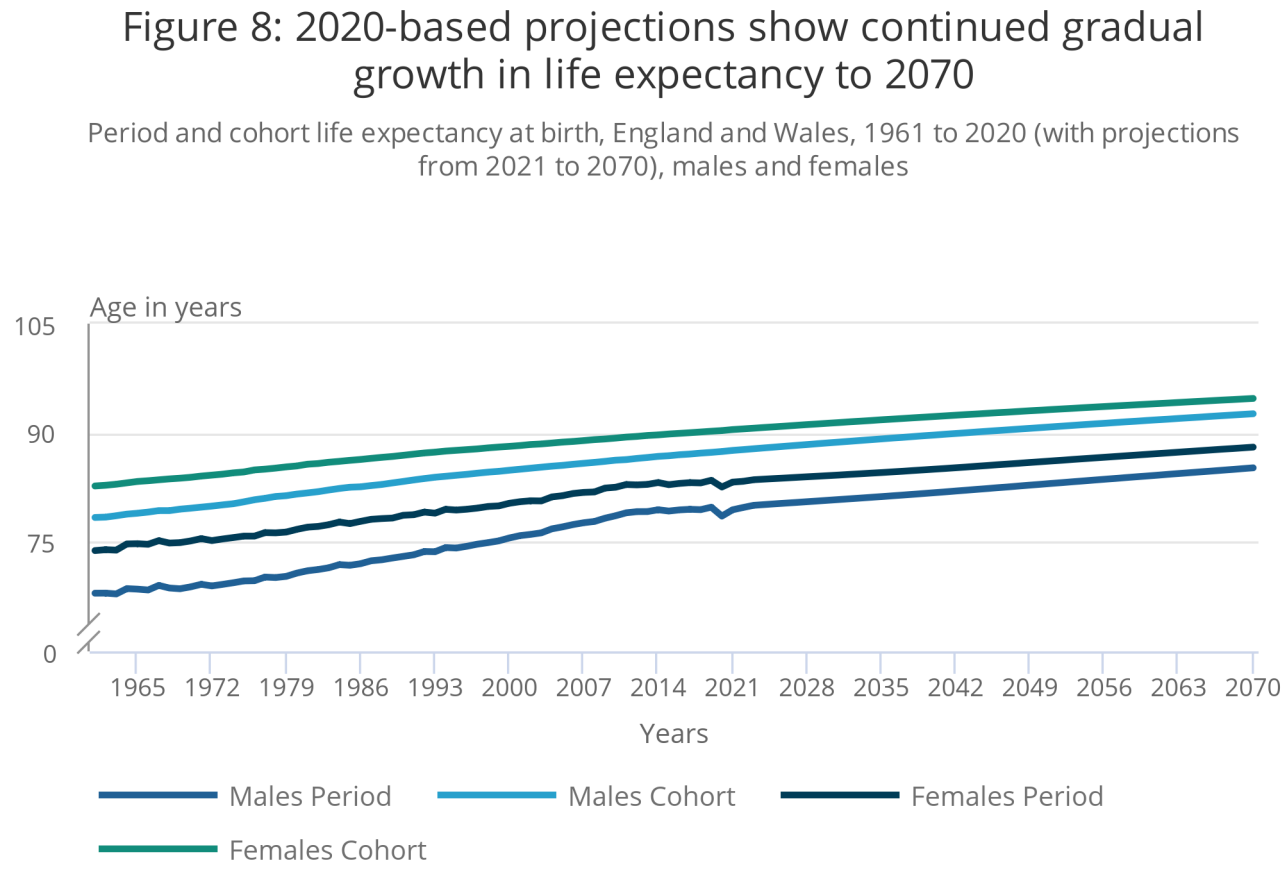
In January 2022, the Office for National Statistics (ONS) published the 2020-based past and projected life tables using a set of mortality assumptions produced for the 2020-based interim National Population Projections (NPPs).

Figure 8 shows period and cohort life expectancy at birth extended to 2070 using figures from the projected life tables. They show a slower increase in life expectancy over the next 50 years. By 2070, males have a projected period life expectancy at birth of 85.2 years and females to 88.1 years, an increase of 6.6 years and 5.5 years respectively.

The rate of improvements in mortality over the next 50 years are projected to be slower than we have seen over the last 50 years. This reflects the recent slowdown in mortality improvements that has been widely observed around the world, as well as increased mortality in 2020 and 2021 because of the coronavirus pandemic. It is very uncertain at this stage what the long-term impact will be of coronavirus on mortality. We plan to publish 2021-based national population projections with updated demographic assumptions, including for mortality, in the second half of 2023. We have also published a population statistics and sources guide, which lists the different population estimates that we intend to publish in 2022 and 2023.

Figure 8: 2020-based projections show continued gradual growth in life expectancy to 2070

Period and cohort life expectancy at birth, England and Wales, 1961 to 2020 (with projections from 2021 to 2070), males and females



Source: Office for National Statistics - Expectation of life, principal projection, England and Wales

6 . Mortality in England and Wales: past and projected trends in average lifespan data

Expectation of life, principal projection, England and Wales
Dataset | Released 12 January 2022
Period and cohort expectation of life in England and Wales using the principal projection by single year of age 0 to 100.

Life tables, principal projection, England and Wales
Dataset | Released 12 January 2022
Life tables for England and Wales, period and cohort, from the principal projection, single year of age 0 to 100. Historical data before 1961 are not National Statistics.

Numbers surviving at exact age (lx), principal projection, England and Wales
Dataset | Released 12 January 2022
Period and cohort numbers surviving at exact age (lx) in England and Wales using the principal projection by single year of age 0 to 100.

Vital statistics in the UK: births, deaths and marriages
Dataset | Released 3 December 2021
Annual UK and constituent country figures for births, deaths, marriages, divorces, civil partnerships and civil partnership dissolutions.

7 . Glossary

Age-specific mortality rate

Age-specific mortality rates are used to allow comparisons between specified age groups.

Age-standardised mortality rates

Age-standardised mortality rates (ASMRs) are used to allow comparisons between populations that may contain different proportions of people of different ages. The 2013 European Standard Population is used to standardise rates.

Cohort life expectancies

These make allowances for future changes in mortality by taking into account observed and projected improvements in mortality for the cohort throughout its lifetime. For example, cohort life expectancy at age 65 years in 2018 would be worked out using the observed mortality rate for age 65 years in 2018 and the projected mortality rates for age 66 years in 2019, for age 67 years in 2020 and so on. We have published a detailed article Period and cohort life expectancy explained explaining the differences between period and cohort life tables. A cohort refers to a group of people, all born within the same specified time period; in life tables a cohort refers to a group of people born in the same year.

Infant death

The death of a person aged under 1 year.

Life expectancy

Life expectancy is the average number of additional years a person can be expected to live for. Using life table methodology, this is calculated by dividing the total number of years lived from a given age by people in a population (Tx) by the number of people at that age in the population (lx).

Life table

A life table is a demographic tool used to analyse death rates and calculate life expectancies at various ages. We calculate life tables separately for males and females because of their different mortality patterns.

Median age at death

The age at which half of deaths occur before, and half of deaths occur after in a given year.

Modal age at death

The most common age at death in a given year.

Period life expectancies

These 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 subsequent changes to mortality rates would not be taken into account. A period life expectancy is therefore 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.

Rectangularisation of the survival curve

The survival curve becomes more rectangular in shape when deaths are concentrated in the later years of life.

8 . Data sources and quality

This release uses observed deaths data up to 2020 and mid-year population estimates up to mid-2020, as well as projected population and deaths data from the 2020-based interim National population projections. The results presented do not incorporate any data from the 2021 Census. Our National Life Tables Quality and Methodology Information Report and our National population projections Quality and Methodology Information Report contain important information:

- the strengths and limitations of the data and how they compare with related data
- uses and users
- how the life tables output was created
- the quality of the life tables output, including the accuracy of the data

9 . Related links

Life expectancy calculator
Updated 12 January 2022
Use our interactive calculator to find out your life expectancy and your chance of living to 100 years old.

Past and projected period and cohort life tables: 2020-based, UK, 1981 to 2070
Bulletin | Released 12 January 2022
Life expectancy (e), probability of dying (q) and number of persons surviving (l) from the period and cohort life tables, using past and projected mortality data from the 2020-based interim national population projections (NPPs), for the UK and constituent countries.

Avoidable mortality in Great Britain: 2020
Bulletin | Released 7 March 2022
Deaths from causes considered avoidable, treatable or preventable given timely and effective healthcare or public health interventions in those aged under 75 years.

Deaths registered in England and Wales: 2021
Bulletin | Released 1 July 2022
Registered deaths by age, sex, selected underlying causes of death and the leading causes of death. Contains death rates and death registrations by area of residence and single year of age.