

National population projections, mortality assumptions: 2020-based interim

The data sources and methodology used to produce mortality assumptions in the 2020-based interim national population projections.

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Notice

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An error has been corrected in figures 6a and 6b. The previous versions used data for the 2018-based projections, which had not been updated.

Table of contents

1. [Main points](#)
2. [Introduction](#)
3. [Methodological approach](#)
4. [Mortality assumptions](#)
5. [Previous projections of life expectancy](#)
6. [Related links](#)

1 . Main points

- Period life expectancy at birth for UK males is projected to increase from 78.4 years in 2020 to 82.2 years in 2045; for UK females, period life expectancy at birth is projected to increase from 82.4 years in 2020 to 85.3 years in 2045.
- The assumed long-term rate of mortality improvement in 2045 for the UK and each of its countries has been set at 1.2% for those aged 0 to 90 years; lower improvements are assumed for those aged 91 years and over.
- The 2020-based interim principal projection of UK period life expectancy at birth in 2045 is 0.6 years lower for males and 0.4 years lower for females than the 2018-based assumptions.
- For this national population projections (NPP) release, only a principal projection has been produced; there are no variant projections.
- This set of NPPs have been developed to meet core user needs, and variant projections are not available as part of the release because of both uncertainty in our mid-year population estimates (the basis of our projections) and uncertainty in setting long-term demographic assumptions following the coronavirus (COVID-19) pandemic.

2 . Introduction

This article details the mortality assumptions used in the 2020-based interim national population projections (NPPs). It provides an overview of the assumption setting process and our rationale for setting the long-term mortality improvement rates by age and sex. It also provides details of how we have adjusted our short-term assumptions to account for the effect of the coronavirus (COVID-19) pandemic on mortality. This NPP release consists of a principal projection only; there are no variant projections so there is only a principal mortality assumption. For more information on why this is the case [please see Background, methodology and assumption setting](#).

Mortality and improvement rates in this article are presented on a calendar year basis. The mortality assumptions underlying the population projections are on a mid-year basis so there may be small differences between the figures presented in this article and the [NPP published datasets](#).

Table 1: Life expectancy at birth and at age 65 years in 2045
2020-based projection of period life expectancy at birth and at age 65 years compared with 2018-based projection, UK and UK constituent countries, 2045

	Males		Males		Females		Females	
	Age 0	Age 0	Age 65	Age 65	Age 0	Age 0	Age 65	Age 65
	Change		Change		Change		Change	
	2020- based EoL	from 2018- based projection	2020- based EoL	from 2018- based projection	2020- based EoL	from 2018- based projection	2020- based EoL	from 2018- based projection
UK	82.17	-0.65	20.62	-0.38	85.34	-0.38	22.74	-0.22
England	82.47	-0.63	20.77	-0.39	85.62	-0.34	22.93	-0.20
Wales	81.43	-0.71	20.18	-0.48	84.75	-0.48	22.37	-0.27
Scotland	80.14	-0.83	19.71	-0.32	83.42	-0.70	21.51	-0.37
Northern Ireland	81.68	-0.59	20.32	-0.35	84.92	-0.34	22.45	-0.22

Source: Office for National Statistics – National population projections

3 . Methodological approach

The mortality assumptions are projections of future mortality trends. We derive age-specific mortality improvements in the base year and assume they will converge to a target rate of improvement in the 25th year of the projection. All future years' mortality improvements by age beyond the 25th year are assumed to be at the level of the target rate for that age and are held constant to the end of the projections.

Mortality improvements are assumed annual percentage changes in mortality rates by age and sex. Positive mortality improvements indicate lower mortality rates and may lead to a rise in life expectancy. The opposite is true if mortality improvements are given as a negative value. All life expectancy figures within this article are period life expectancies. These are calculated based on the mortality rates for a particular calendar year and, unlike cohort life expectancy, do not allow for future assumed changes in mortality rates. The Office for National Statistics (ONS) has published a full explanation of [the differences between cohort and period life expectancy](#). We have published both period and cohort life tables in [Past and Projected period and cohort life tables, 2020-based, 1981 to 2070](#).

Expert views on mortality

A panel of experts on mortality in the UK was formed to discuss views on future mortality rates. The experts were provided with information on recent trends in mortality and responded to a questionnaire to gather their views and advice on:

- annual mortality improvement in the short term (up to 2024) by age and sex to account for the impact of the coronavirus (COVID-19)
- target rate of mortality improvement by 2044 by age and sex
- method and speed of convergence of improvements between the base year and target year
- mortality improvement at the oldest ages
- how mortality improvement for each country of the UK might differ
- underlying factors that may influence future mortality

The national population projections' (NPPs) expert advisory panel discussion was held virtually in May 2021. The meeting covered the methods used in setting the assumptions, recent mortality trends, a summary of the experts' questionnaire results and a discussion of responses given and predictions on future mortality rates. This advice informs the setting of the mortality assumptions. For more information on the expert advisory process we follow for NPPs, [please see Background, Methodology and assumption setting](#).

Standard methodology

For the 2020-based interim NPPs, we initially followed our standard mortality assumptions methodology, and then adjusted these to account for the increased mortality observed during the coronavirus pandemic.

Rates of mortality improvement by age and sex for 2020 (the base year of the projections) were first derived by projecting trends in mortality improvements observed from population and deaths data for the period 1961 to 2019. These data were also used to derive assumed age- and sex-specific mortality rates for 2020 for the UK.

Target rates of mortality improvement were then set for 2045, the 25th year from the base year of the projections. Assumptions were also made on the method and speed of convergence from the base year improvement rates to the target rates and on levels of mortality improvement after the 25th year, based on analysis of past trends and expert advice.

Projecting for the UK's constituent countries

To assess whether it is reasonable to use the assumed base year improvement rates for the UK for each of the countries of the UK, comparisons of past trends in mortality improvement for each country of the UK and those for the UK as a whole were carried out. Following this comparison, the initial improvement rates were adjusted for Scotland for both males and females at some ages. The improvement rates for the UK at these ages were then adjusted to produce base year improvement rates for the UK excluding Scotland. The same long-term rates of improvement were assumed for all countries. The resulting projected improvement rates for the UK excluding Scotland were assumed to apply to England, Wales and Northern Ireland.

Adjusting for the impact of coronavirus on mortality

For those aged under 30 years, where coronavirus has had little or no effect on mortality rates, the projected improvement rates were not adjusted from those derived assuming no effect from coronavirus on mortality.

For those aged 30 years and over, we derived mortality rates by age and sex for 2019 for England and Wales, Scotland, and Northern Ireland. The mortality expert group had been asked to give their estimates of average annualised rates of mortality improvement between 2019 and 2024 by broad age group and sex for the UK. There was no consensus as to the size of the overall improvement by age group, so the average improvement across the experts estimates for each age group was taken as the estimated improvement overall for that age group for the five-year period.

We then adjusted the improvement rates for 2019 to 2024 as follows:

- between the calendar years 2019 and 2020, we adjusted the improvement rates to reflect observed increases in mortality during this period
- between the calendar years 2020 and 2021, improvement rates were derived by comparing the estimated number of deaths in 2021 (based on the number of deaths registered to the end of Week 36 (week ending 10 September 2021) plus the number of deaths experienced in 2019 from Week 37 onwards) with the number of deaths in 2020, by broad age group
- between the calendar years 2021 and 2022, improvement rates were initially assumed to be those required to bring the projected mortality rates for 2022 to be broadly in line with those assumed for 2019, that is so that the cumulative improvement in mortality rates between 2019 and 2022 is 0%
- for all ages, improvement rates between the calendar years 2022 and 2023, and 2023 to 2024 are assumed to be the same as those before adjustments for COVID-19 were applied (this is also the case for all subsequent years of the projection)
- the improvement rates between the calendar years 2021 and 2022 were further adjusted to provide cumulative improvement rates over the period 2019 to 2024 that were in line with the average of those suggested by the experts, by age group

The improvement rates assume that the increases in mortality rates experienced in 2020 for those aged 30 years and over will be largely reversed by 2022. After 2022, improvements will be in line with those projected assuming COVID-19 had not occurred. An adjustment is made to the improvement rates derived between the calendar years 2021 and 2022 such that the overall improvement rates between 2019 and 2024 are broadly in line with the average improvement derived from the expert's opinions by age group, after applying some smoothing by age. In particular, it has been assumed that there will not be a step change in future mortality improvement rates as a result of COVID-19.

This method was applied separately for England and for Wales using deaths data for England and Wales combined, for Scotland using deaths data for Scotland and for Northern Ireland using deaths data for Northern Ireland. The same UK-based cumulative improvement rates over the period 2019 to 2024 by age group were used to derive the final improvement rates for each country between the calendar years 2021 and 2022. The resulting annual improvement rates were then applied successively to the base mortality rates for 2019 derived from the analysis of past trends to obtain mortality rates for years 2020 to 2024.

Projected country-specific mortality improvement rates for England and Wales, Scotland, and Northern Ireland were initially applied to projected UK mortality rates. Those mortality rates were then multiplied by conversion factors for each constituent country, which were based on comparisons of mortality rates for each country to those for the UK, by age and sex, derived from the national life tables. This produced projected mortality rates for England, Wales, Scotland, and Northern Ireland.

4 . Mortality assumptions

Mortality improvements

For the 2020-based interim national population projections (NPPs), annual rates of mortality improvement are assumed to converge to 1.2% for ages 0 to 90 years by 2045 and remain constant thereafter. Annual improvement rates are set to decline linearly from 1.2% to 0% between ages 91 and 109 years. For ages above 110 years, a 0% improvement rate is assumed, as there is little historical evidence of past mortality improvements at the oldest ages.

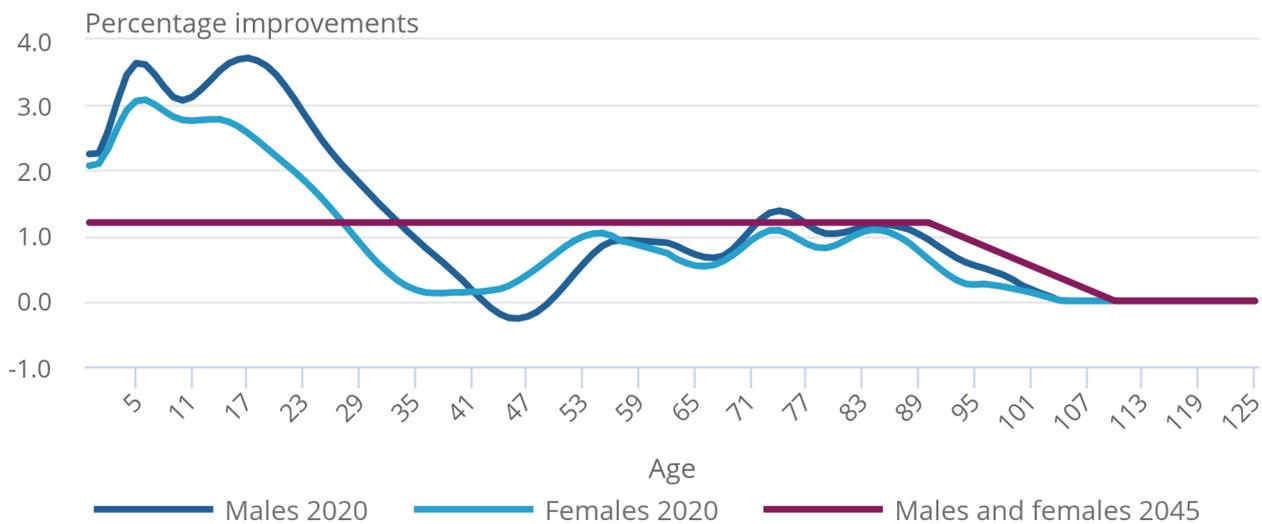
Figure 1 shows the projected annual mortality improvement rates for males and females in 2020 for the UK before adjusting for the impact of coronavirus (COVID-19), set against the assumed long-term target rate of mortality improvement in 2045. The improvement rates for 2020 were generally set to be lower than were projected in the 2018-based NPPs. This is because of lower improvement rates being observed at many ages between 2018 and 2020 than projected in the 2018-based projections.

Figure 1: The projected annual mortality improvement is 1.2% for most ages for both sexes by 2045

Projected 2020-based annual mortality improvement rate in 2020 (before COVID-19 adjustment) and assumed long-term improvement rates in 2045, males and females, UK

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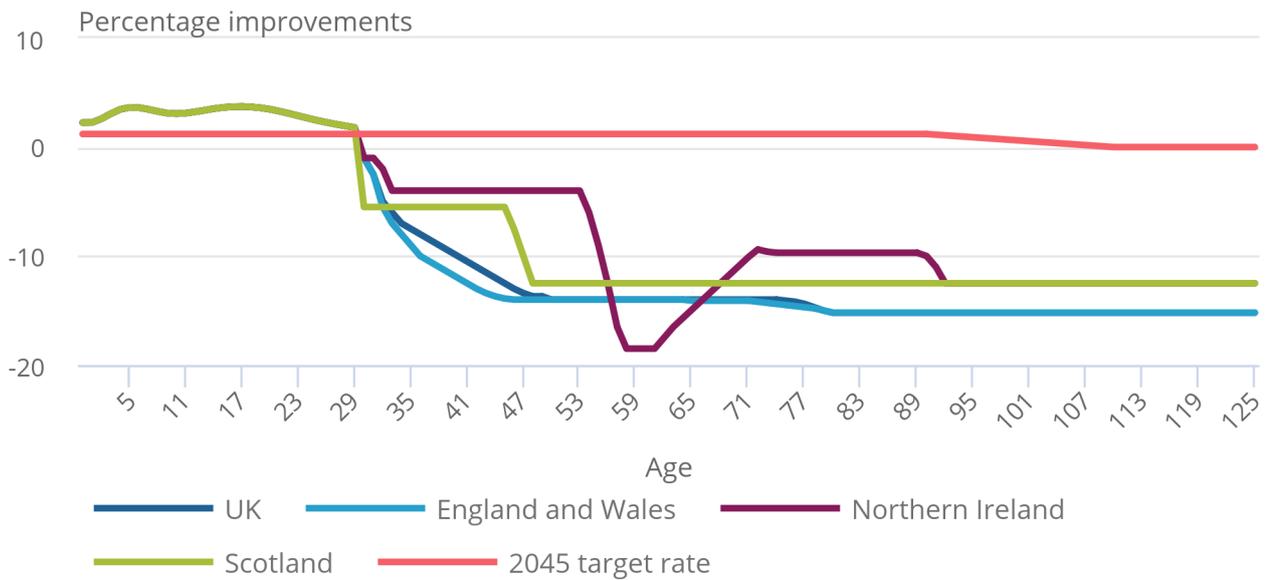
Source: Office for National Statistics – National population projections

Figure 2a. Adjustment for the impact of coronavirus (COVID-19) on mortality results in lower improvement rates in the base year for males aged 30 years and over

Projected 2020-based annual mortality improvement rate in 2020 (after COVID-19 adjustment) and assumed long-term improvement rates in 2045, males, UK and UK constituent countries

Figure 2a. Adjustment for the impact of coronavirus (COVID-19) on mortality results in lower improvement rates in the base year for males aged 30 years and over

Projected 2020-based annual mortality improvement rate in 2020 (after COVID-19 adjustment) and assumed long-term improvement rates in 2045, males, UK and UK constituent countries



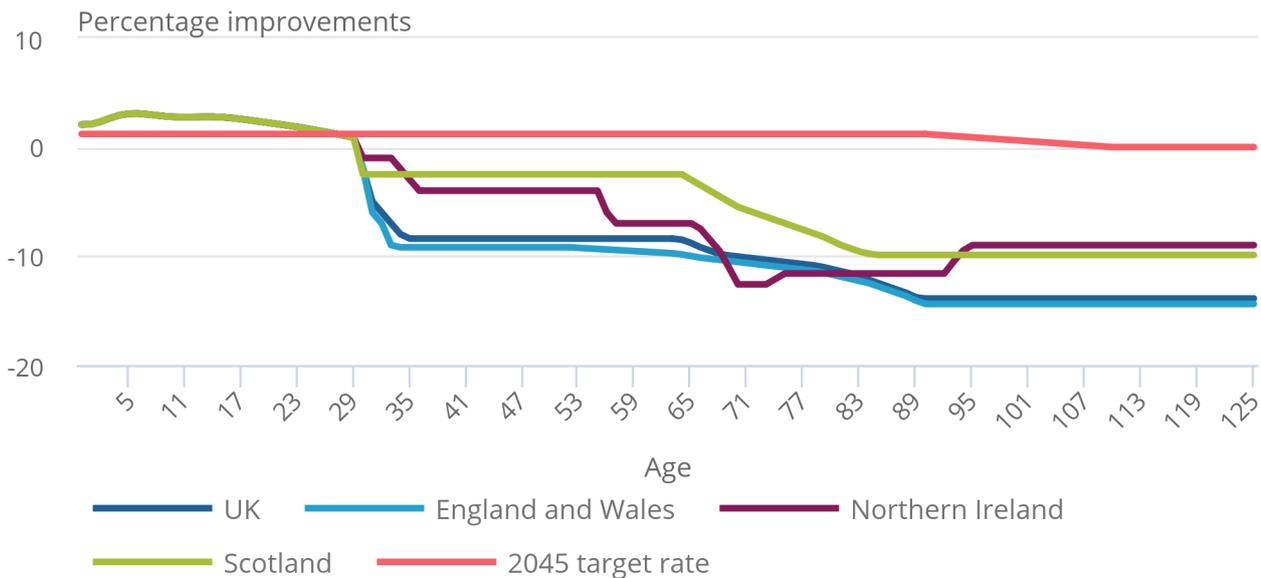
Source: Office for National Statistics – National population projections

Figure 2b. Adjustment for the impact of coronavirus (COVID-19) on mortality results in lower improvement rates in the base year for females aged 30 years and over

Projected 2020-based annual mortality improvement rate in 2020 (after COVID-19 adjustment) and assumed long-term improvement rates in 2045, females, UK and UK constituent countries

Figure 2b. Adjustment for the impact of coronavirus (COVID-19) on mortality results in lower improvement rates in the base year for females aged 30 years and over

Projected 2020-based annual mortality improvement rate in 2020 (after COVID-19 adjustment) and assumed long-term improvement rates in 2045, females, UK and UK constituent countries



Source: Office for National Statistics – National population projections

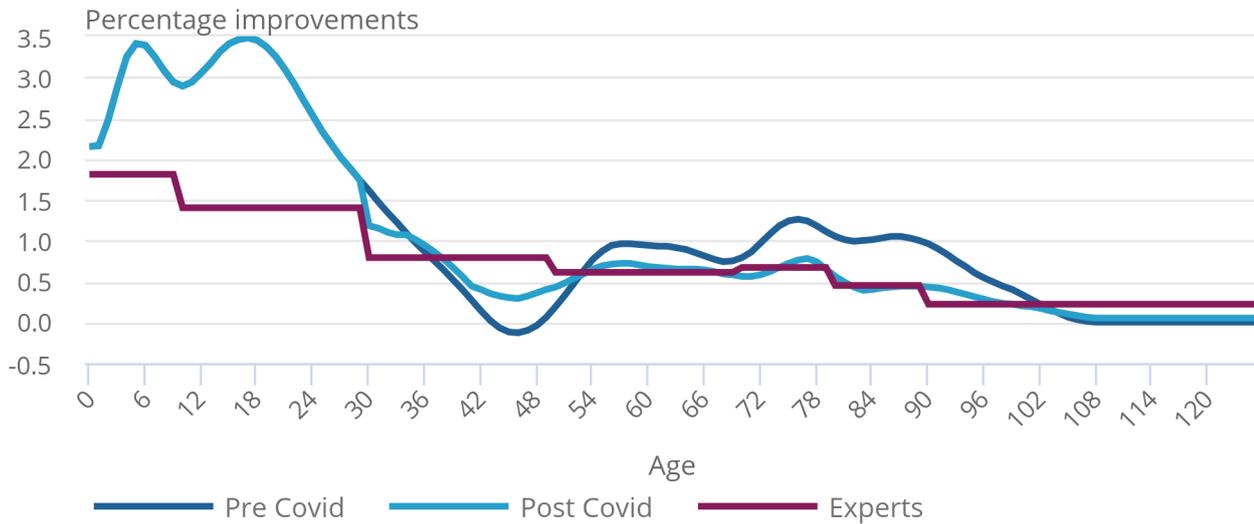
Figures 2a and 2b show the projected 2020-based annual mortality improvement rates for males and females in 2020 for the UK and constituent countries after adjustment for COVID-19, set against the unchanged long-term target improvement rate for 2045. Lower mortality improvements are projected in the adjusted rates for 2020 from age 30 years for both males and females in the UK and all constituent countries. For the UK, the lowest improvements occur at older ages (negative 15.2% for males aged 80 years and over, negative 13.9% for females aged 90 years and over).

Figure 3a: Coronavirus (COVID-19) is assumed to generally reduce the cumulative mortality improvements between 2019 and 2024 for males aged 30 years and over

Projected annualised improvements before and after adjustment for COVID-19, 2019 to 2024, Males, UK

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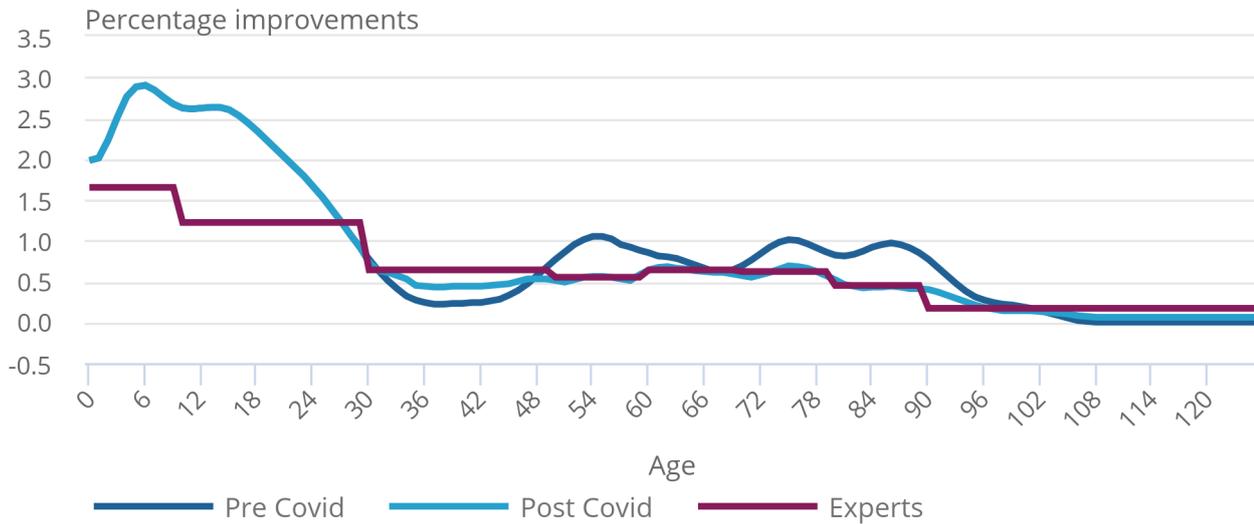
Source: Office for National Statistics – National population projections

Figure 3b: Coronavirus (COVID-19) is assumed to generally reduce the cumulative mortality improvements between 2019 and 2024 for females aged 30 years and over

Projected annualised improvements before and after adjustment for COVID-19, 2019 to 2024, Females, UK

Figure 3b: Coronavirus (COVID-19) is assumed to generally reduce the cumulative mortality improvements between 2019 and 2024 for females aged 30 years and over

Projected annualised improvements before and after adjustment for COVID-19, 2019 to 2024, Females, UK



Source: Office for National Statistics – National population projections

Figures 3a and 3b show projected cumulative mortality improvements for the UK for 2019 to 2024 before and after adjustment for COVID-19, alongside the cumulative mortality improvements for the same period suggested by the NPP's expert advisory panel (calculated as an average of the experts' estimates for this measure). The improvement rates after adjustment for COVID-19 have been set to match as closely as possible to the experts' estimates. They are the same as the unadjusted improvement rates for those aged under 30 years and are generally lower than the unadjusted improvement rates for those aged 30 years and over. Where the improvement rates adjusted for COVID-19 are higher than the unadjusted improvement rates, this reflects the experts' estimates and will not have a big impact on projected life expectancies as this only occurs at younger ages where mortality rates are relatively low.

Life expectancy

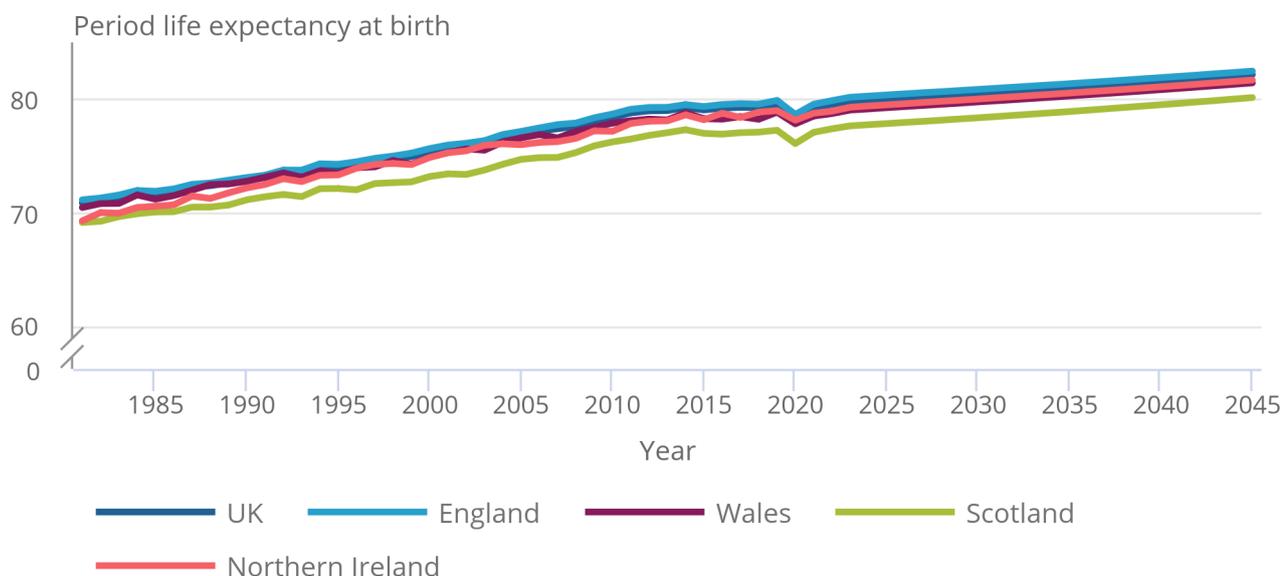
Figures 4a and 4b show how period life expectancy at birth is projected to increase under the principal 1.2% long-term improvement rate for the UK and constituent countries.

Figure 4a: Male life expectancy is projected to increase in all countries of the UK over the next 25 years, despite an initial decline because of the impact of coronavirus (COVID-19)

Historical and projected male period life expectancy at birth for UK and constituent countries under the principal 1.2% long-term improvement rate, 1981 to 2045

Figure 4a: Male life expectancy is projected to increase in all countries of the UK over the next 25 years, despite an initial decline because of the impact of coronavirus (COVID-19)

Historical and projected male period life expectancy at birth for UK and constituent countries under the principal 1.2% long-term improvement rate, 1981 to 2045



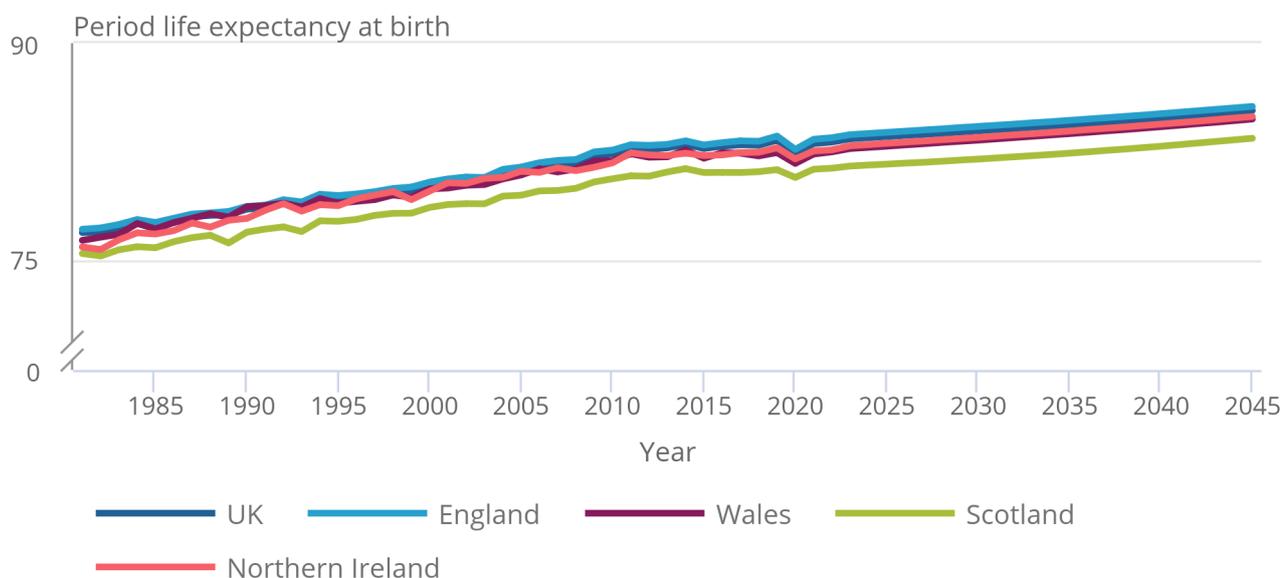
Source: Office for National Statistics – National population projections

Figure 4b: Female life expectancy is projected to increase in all countries of the UK over the next 25 years, despite an initial decline because of the impact of coronavirus (COVID-19)

Historical and projected female period life expectancy at birth for UK and constituent countries under the principal 1.2% long-term improvement rate, 1981 to 2045

Figure 4b: Female life expectancy is projected to increase in all countries of the UK over the next 25 years, despite an initial decline because of the impact of coronavirus (COVID-19)

Historical and projected female period life expectancy at birth for UK and constituent countries under the principal 1.2% long-term improvement rate, 1981 to 2045



Source: Office for National Statistics – National population projections

Figures 4a and 4b show that between 2020 and 2045, period life expectancy at birth in the UK is projected to increase by 3.8 years for males and 2.9 years for females. The short-term impact of COVID-19 on period life expectancy at birth can be seen in the years 2020 and 2021, after which the projected improvements in life expectancy return to a similar trajectory to the improvements observed prior to the pandemic, albeit at slightly lower rates than assumed in the 2018-based projections.

Mortality assumptions for Scotland

The recent historical rates of mortality improvement in the UK's constituent countries, compared with the UK as a whole, suggest that the same assumed initial rates of improvement by age and sex for 2020 can be adopted for each individual country, except for Scotland. Scotland has historically experienced higher mortality rates at all but the very youngest ages, compared with the UK.

Figures 5a and 5b show the mortality improvement rates for the UK and Scotland in 2020 for males and females before adjusting for the impact of COVID-19. The differences between Scotland and the rest of the UK following adjustment for COVID-19 were shown in Figures 2a and 2b, which indicate that COVID-19 had slightly less of an impact on mortality improvements in Scotland than in other parts of the UK. Although projected mortality rates in Scotland generally remain higher than the rest of the UK in 2020 at most ages.

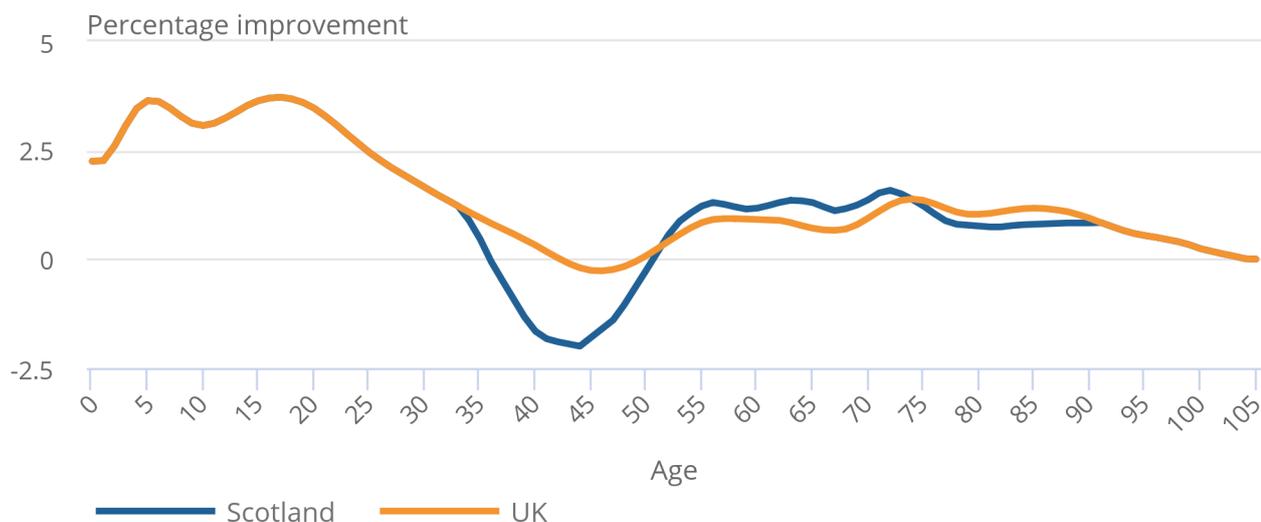
Before adjusting for the impact of COVID-19, the UK base improvement rates were assumed for Scotland for males until age 33 years and for females until age 31 years, after which differing improvement rates derived for Scotland were assumed up to age 90 years for both males and females.

Figure 5a: Before adjustment for coronavirus (COVID-19), mortality improvements were lower for males in their 30s and 40s in Scotland than for the UK as a whole

Comparison of 2020-based UK and Scotland mortality improvements (before adjustment for COVID-19), 2020, males

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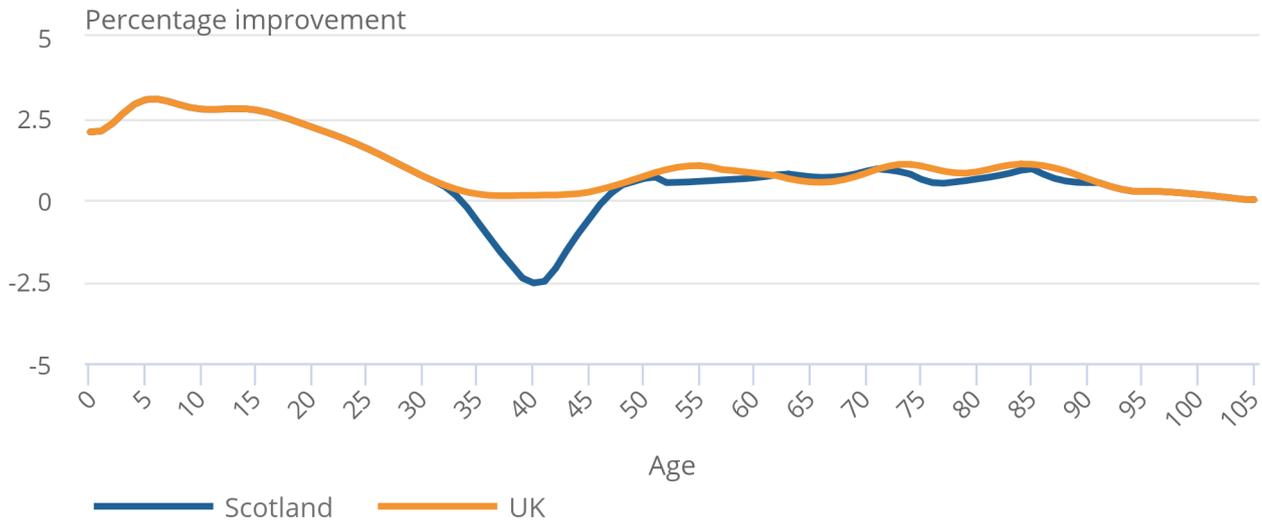
Source: Office for National Statistics – National population projections

Figure 5b: Before adjustment for coronavirus (COVID-19), mortality improvements were lower for females in their 30s and 40s in Scotland than for the UK as a whole

Comparison of 2020-based UK and Scotland mortality improvements (before adjustment for COVID-19), 2020, females

Figure 5b: Before adjustment for coronavirus (COVID-19), mortality improvements were lower for females in their 30s and 40s in Scotland than for the UK as a whole

Comparison of 2020-based UK and Scotland mortality improvements (before adjustment for COVID-19), 2020, females



Source: Office for National Statistics – National population projections

5 . Previous projections of life expectancy

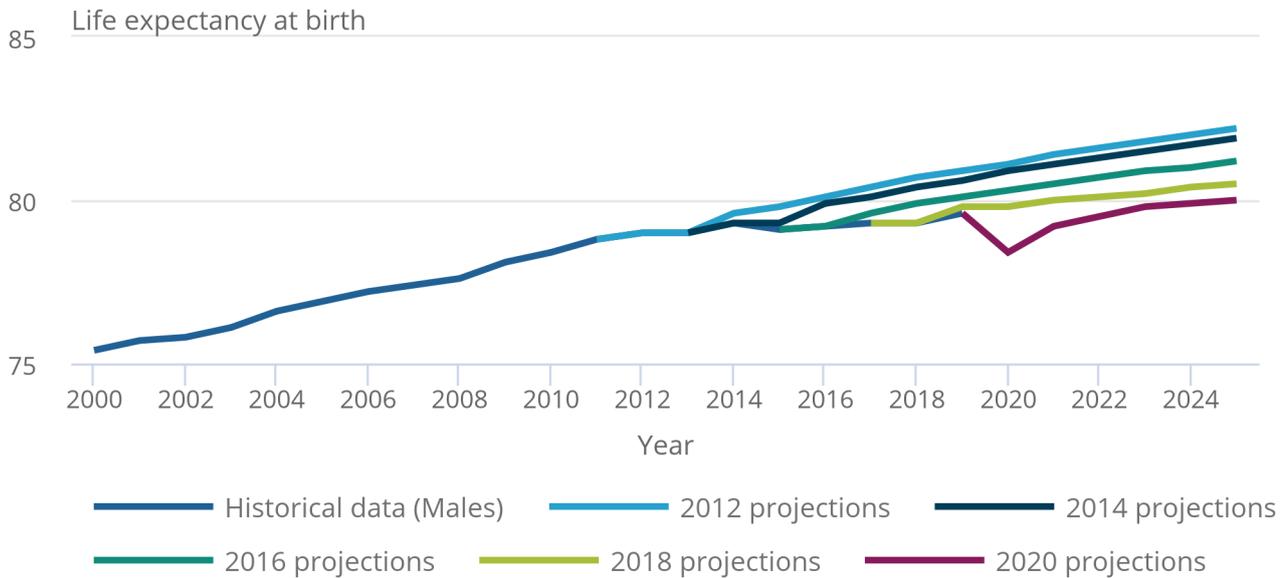
Figures 6a and 6b show previous Office for National Statistics (ONS) principal projections of period life expectancy at birth for males and females respectively, together with the current 2020-based interim projection. The figures show that lower life expectancies have been projected in successive sets of projections since the 2012-based set, reflecting periods of higher mortality and slower increases in life expectancy in recent years. The 2020-based projections also indicate the projected impact of coronavirus (COVID-19) on period life expectancy. This is shown by the marked decrease in period life expectancy at birth in the UK for males and females in 2020.

Figure 6a: Mortality rates in years before the base year combined with the impact of COVID-19 mean that life expectancy projections are lower initially but then follow a similar trend

Historic trend and principal projection of period life expectancy at birth: changes between 2012-based and 2020-based projections, UK, males

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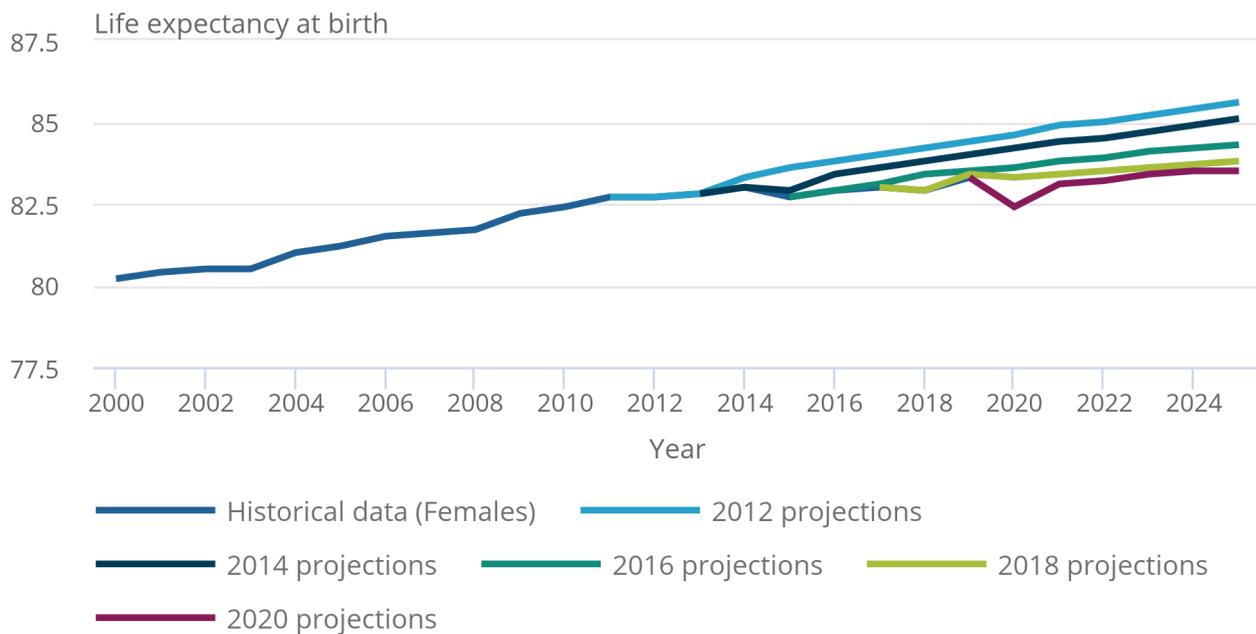
Source: Office for National Statistics – National population projections

Figure 6b: Mortality rates in years before the base year combined with the impact of COVID-19 mean that life expectancy projections are lower initially but then follow a similar trend

Historic trend and principal projection of period life expectancy at birth: changes between 2012-based and 2020-based projections, UK, females

Figure 6b: Mortality rates in years before the base year combined with the impact of COVID-19 mean that life expectancy projections are lower initially but then follow a similar trend

Historic trend and principal projection of period life expectancy at birth: changes between 2012-based and 2020-based projections, UK, females



Source: Office for National Statistics – National population projections

The ONS has produced additional guidance on mortality releases which is available in the [User guide to mortality statistics](#) and [Life Expectancy releases and their different uses](#) publications.

6 . Related links

[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, for the UK and constituent countries.

[National life tables - life expectancy in the UK: 2018 to 2020](#)

Bulletin | Released 23 September 2021

Trends in period life expectancy, a measure of the average number of years people will live beyond their current age, analysed by age and sex for the UK and its constituent countries.