Office for National Statistics

National population projections, mortality assumptions: 2024-based

The data sources and methodology used to produce mortality assumptions in the 2024-based national population projections.

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1 . Overview

This methodology article provides supporting information on the principal and variant mortality assumptions used in our 2024-based national population projections (NPPs).

Mortality assumptions are projections of future mortality trends. They are based on assumed annual percentage changes in mortality rates, known as "mortality improvements". We base these assumptions on analysis of mortality data and advice from the external NPP Mortality expert advisory panel and the UK Government Actuary's Department.

From 2049, the principal long-term annual mortality improvement rate for the UK and its constituent countries was set at 1.1% for both females and males aged 0 to 90 years (the same as our 2022-based projections). This was then reduced linearly from 1.1% to 0% between the ages of 91 to 110 years, and set at 0% for those aged 110 years and over.

Under the principal mortality assumptions, period life expectancy at birth in the UK for females is projected to increase from 83.27 years in 2024 to 85.95 years in 2049. For males in the UK, period life expectancy at birth is projected to increase from 79.38 years in 2024 to 82.40 years in 2049.

Future improvements in mortality are highly uncertain. The long-term annual mortality improvement rates for the high and low life expectancy variants have been set at 1.9% and 0.5%, respectively.

All figures in this article are presented on a calendar year basis, in line with the underlying deaths data. The NPPs are produced on a mid-year basis, so there may be small differences between the figures presented in this article and our National population projections datasets.

2 . Setting the mortality assumptions

General approach

To produce the mortality assumptions for the population projections, we model age-specific mortality improvements from the base year and assume they will converge to a long-term improvement rate 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 long-term rate for that age.

Age-Period-Cohort model

For the 2024-based mortality assumptions, we used an Age-Period-Cohort (APC) model. The model uses calendar year death registrations and mid-year population estimates to project future mortality rates and improvement rates by age and sex. We first used this model for the 2022-based mortality assumptions.

The model separates the contribution of age, period and cohort effects on mortality improvement.

The "age effect" is the baseline annual mortality improvement at age x, for example, to account for the observed improvement in mortality rates for females aged 70 years between 1975 and the base year of the projection.

The "period effect" is the mortality improvement in a given calendar year (period). This is a constant value for each calendar year and may be positive (denoting higher than average mortality rates), or negative (denoting lower than average mortality rates).

The "cohort effect" is the mortality improvement for a given birth cohort, that is, people with the same year of birth. It has been shown in the past that some birth cohorts experience higher mortality improvements than others.

The model is split into three parts: the APC model, the old age model, and the infant model.

APC model

The main APC model fits mortality improvement based on the age, period and cohort effects. It covers ages 1 year to years. The specific values of are chosen to allow for a smooth change in the mortality rates from the main model to the old age model and will be reviewed regularly. These are currently set to 90 years for females and 92 years for males.

Old age model

The old age model is for ages plus 1 year to 125 years. The old age model takes the form of a logistic model and models mortality rates rather than improvement rates. The use of a logistic model accounts for sparser data as age increases and ensures that mortality rates converge to a constant value as age increases.

Infant model

The third part of the model is for infants aged zero years. The infant model is the same as the main APC model, except that it does not include a period effect, and it uses estimates of the cohort effect from the main model.

We worked with academics from the University of Southampton and Warwick University on the development of the model. They have published an explanation outlining the model equations in the Scandinavian Actuarial Journal (PDF, 3.38KB). A specification of the model equations is also available on request from pop.info@ons.gov.uk.

Model parameters

We are able to adjust the following parameters within the APC model:

- long-term improvement rate
- speed of convergence to the long-term improvement rate
- weighting of input data
- mortality shock adjustment to partially or fully remove any mortality shocks that are judged to be short-term, which should not be projected forward

We make decisions on these parameters following guidance from the expert advisory panel (see Section 6. Expert advisory panel and National Population Projections Committee).

Projections for England, Scotland, Wales and Northern Ireland

Historically, we have produced separate base year and projected mortality improvement rates for Scotland and the rest of the UK, reflecting the different patterns of mortality observed in Scotland.

Following the advice of the expert advisory panel, for the 2024-based projections we have continued to run the APC model for Scotland separately from the rest of the UK. We have applied the same main assumptions (as detailed in Section 3: Mortality assumptions for the principal projection) to the Scotland data as we have for the rest of the UK.

We have run the model for England, Wales and Northern Ireland with these countries' data combined (referred to as the UK excluding Scotland).

For ages over 100 years, we used the base year mortality rates for the UK excluding Scotland for each country. For ages up to 100 years, to disaggregate to the individual countries, we derived ratios of observed mortality rates for each country by age and sex against the observed mortality rates for the UK excluding Scotland by age and sex. These ratios were smoothed over 10 years (2015 to 2024) and applied to the base year mortality rates for the UK excluding Scotland to produce base year mortality rates for the individual countries.

This is a change from the 2022-based projections, in which the ratios were based on three years of data. We chose to use 10 years of data to make the ratios less sensitive to recent mortality trends. The projected improvement rates for the UK excluding Scotland were then applied to these base year mortality rates to produce the projected mortality rates for each country.

The projected mortality rates (mx) for each country were converted to probabilities of dying (qx). These were then converted from a calendar year basis to a mid-year basis for use in the national population projections processing system. We constrained the qx values in the first year of the projection to observed deaths in the year to mid-2025.

3 . Mortality assumptions for the principal projection

We used data from 1975 to 2024 in our model for the 2024-based projections, with all years of input data given equal weighting.

The long-term rates of mortality improvement for the principal projection were derived based on analysis of historical data and feedback from our expert advisory panel. The panel provided views on the anticipated impacts on future life expectancy of a range of factors, as well as estimates of mortality improvements in 2049 (as detailed in Section 6: Expert advisory panel and National Population Projections Committee).

In the 2024-based projections, the long-term mortality improvement rates and the speed of convergence are the same as in the 2022-based projections. Overall, there was not strong enough evidence from the expert advisory panel to move away from these assumptions.

For the principal projection, the long-term rate of annual mortality improvement for 2049 onwards, for both females and males aged 0 to 90 years, is 1.1%. This reduces linearly between the ages of 91 and 110 years, from 1.1% to 0%. The long-term improvement rate is 0% for those aged 110 years and over. Long-term improvement rates are assumed to be the same for England, Wales, Scotland and Northern Ireland. We have assumed that 50% convergence to the long-term rate is achieved by the ninth year of the projection.

For the 2022-based projections, a small mortality shock adjustment was applied to account for the coronavirus (COVID-19) pandemic. On balance, the expert advisory panel suggested that a shock adjustment was not needed for the 2024-based projections, as mortality rates have generally recovered to pre-pandemic trajectories.

In the 2022-based projections, a post-modelling adjustment was applied to the projections for Scottish males aged 60 years and over because the model projected very rapid improvements in mortality rates for these cohorts. We did not see these rapid improvements when the model was run for the 2024-based projections, so no post-modelling adjustments were applied.

4 . Effects of the principal mortality assumptions on life expectancy

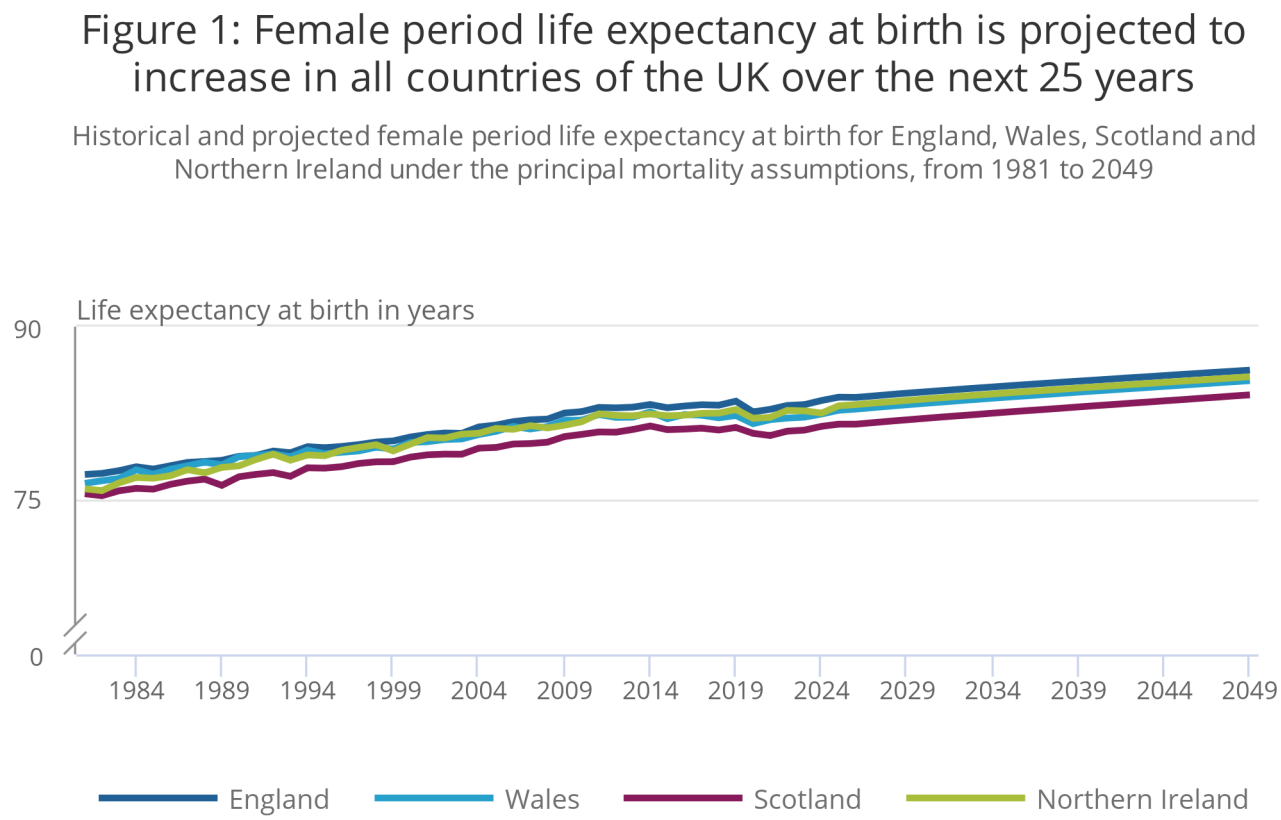
This section explores the effects of the principal mortality assumptions on projections of period life expectancy at birth and at 65 years. Life expectancy is calculated from mortality rates, with positive mortality improvements indicating increasing life expectancy.

Comparisons between UK countries

Under the principal mortality assumptions, period life expectancy at birth (Figures 1 and 2) and at 65 years (Figures 3 and 4) is projected to increase from current levels across all UK countries for both females and males. Life expectancy is projected to remain highest in England and lowest in Scotland. Life expectancy in Northern Ireland has been higher than in Wales for most of the last decade, and is projected to remain higher.

Figure 1: Female period life expectancy at birth is projected to increase in all countries of the UK over the next 25 years

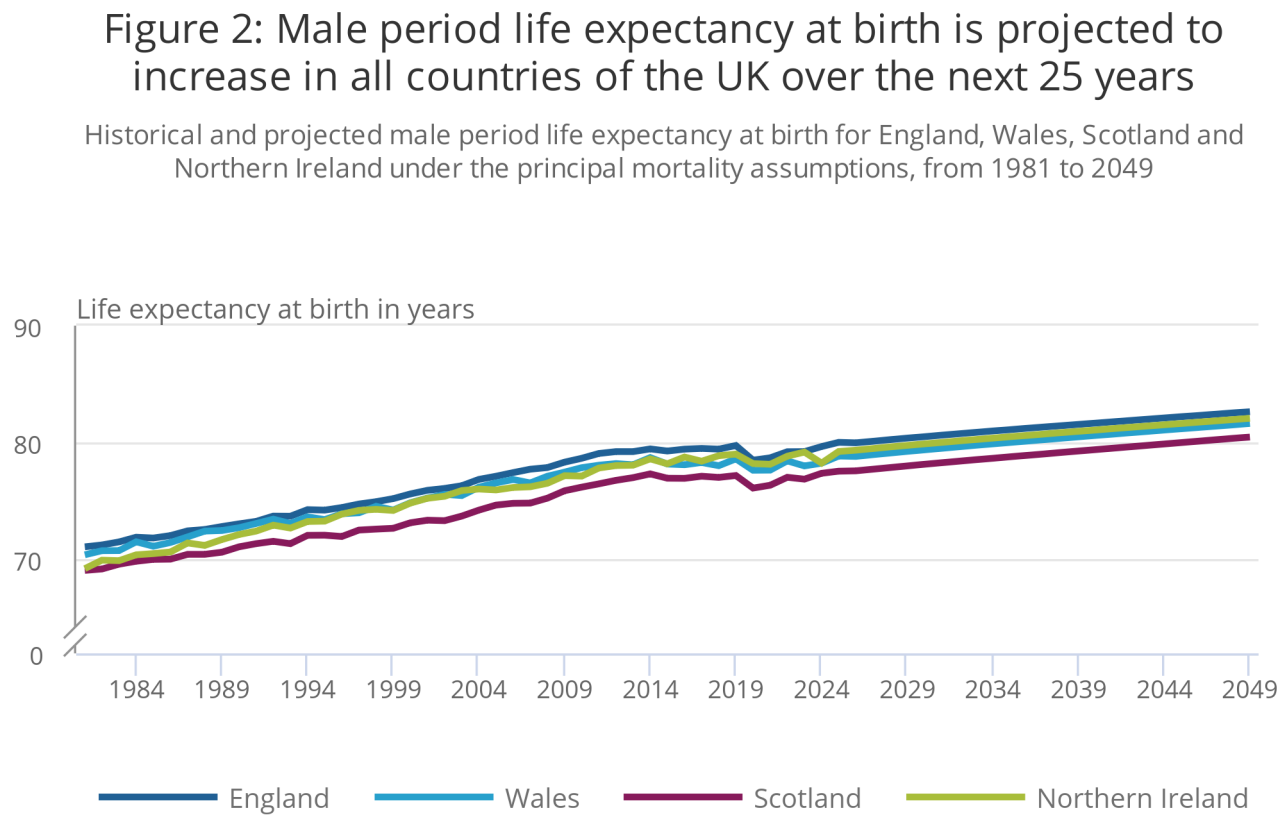
Historical and projected female period life expectancy at birth for England, Wales, Scotland and Northern Ireland under the principal mortality assumptions, from 1981 to 2049



Source: National population projections, mortality assumptions from the Office for National Statistics

Figure 2: Male period life expectancy at birth is projected to increase in all countries of the UK over the next 25 years

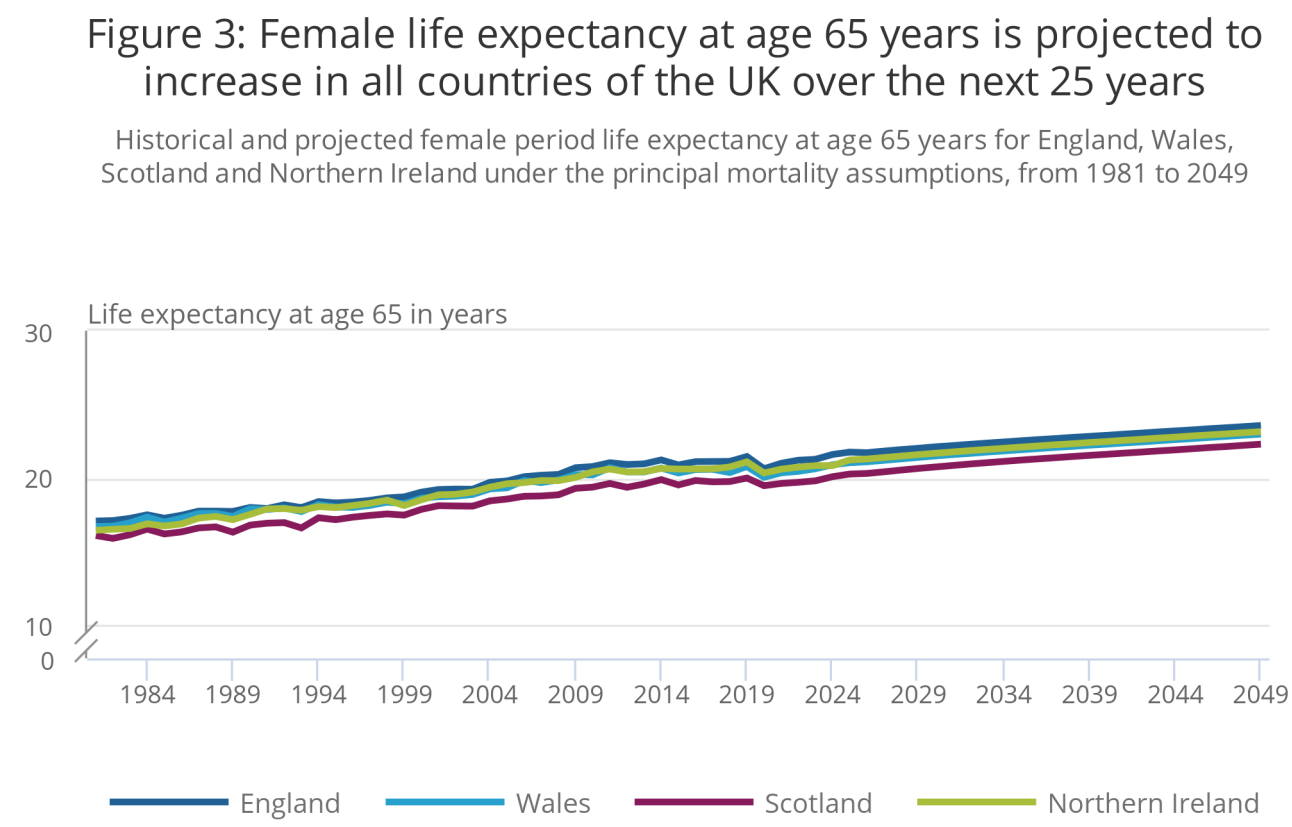
Historical and projected male period life expectancy at birth for England, Wales, Scotland and Northern Ireland under the principal mortality assumptions, from 1981 to 2049



Source: National population projections, mortality assumptions from the Office for National Statistics

Figure 3: Female life expectancy at age 65 years is projected to increase in all countries of the UK over the next 25 years

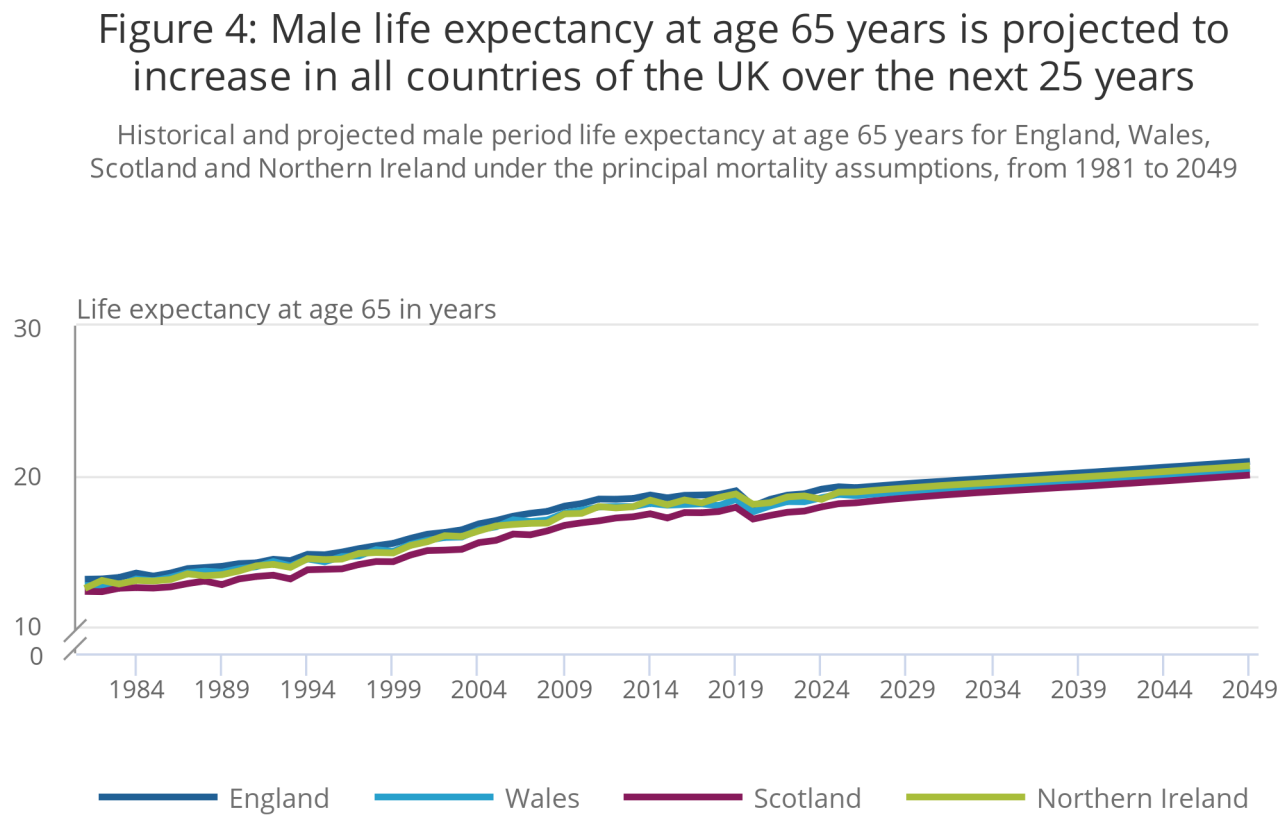
Historical and projected female period life expectancy at age 65 years for England, Wales, Scotland and Northern Ireland under the principal mortality assumptions, from 1981 to 2049



Source: National population projections, mortality assumptions from the Office for National Statistics

Figure 4: Male life expectancy at age 65 years is projected to increase in all countries of the UK over the next 25 years

Historical and projected male period life expectancy at age 65 years for England, Wales, Scotland and Northern Ireland under the principal mortality assumptions, from 1981 to 2049



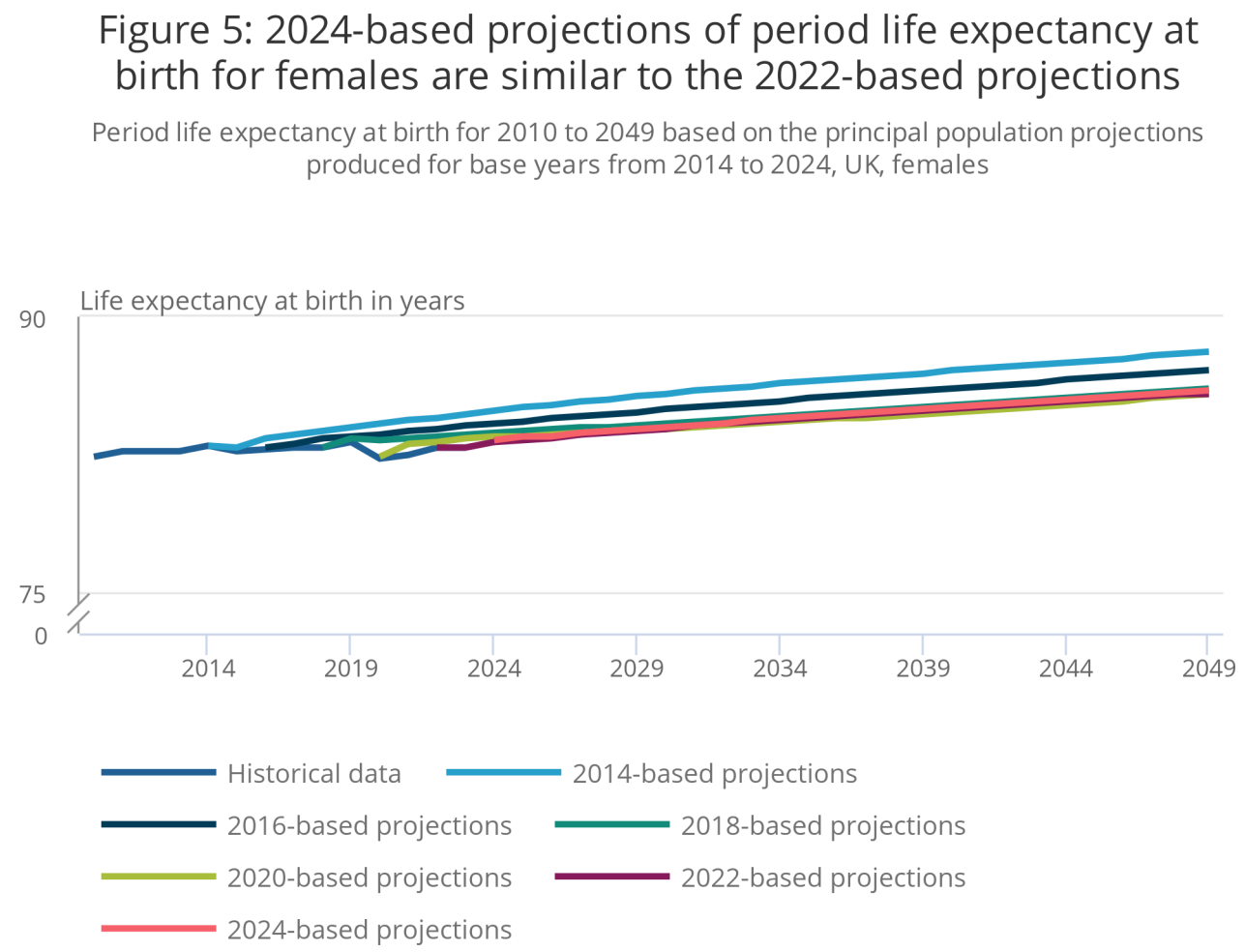
Source: National population projections, mortality assumptions from the Office for National Statistics

Comparisons with previous projections of life expectancy

For both females and males, the 2024-based life expectancy projections are similar to the 2022-based projections. However, these are lower than the 2014-based, 2016-based, 2018-based, and 2020-based (for males) projections. This reflects the slower increases in life expectancy observed in recent years.

Figure 5: 2024-based projections of period life expectancy at birth for females are similar to the 2022-based projections

Period life expectancy at birth for 2010 to 2049 based on the principal population projections produced for base years from 2014 to 2024, UK, females



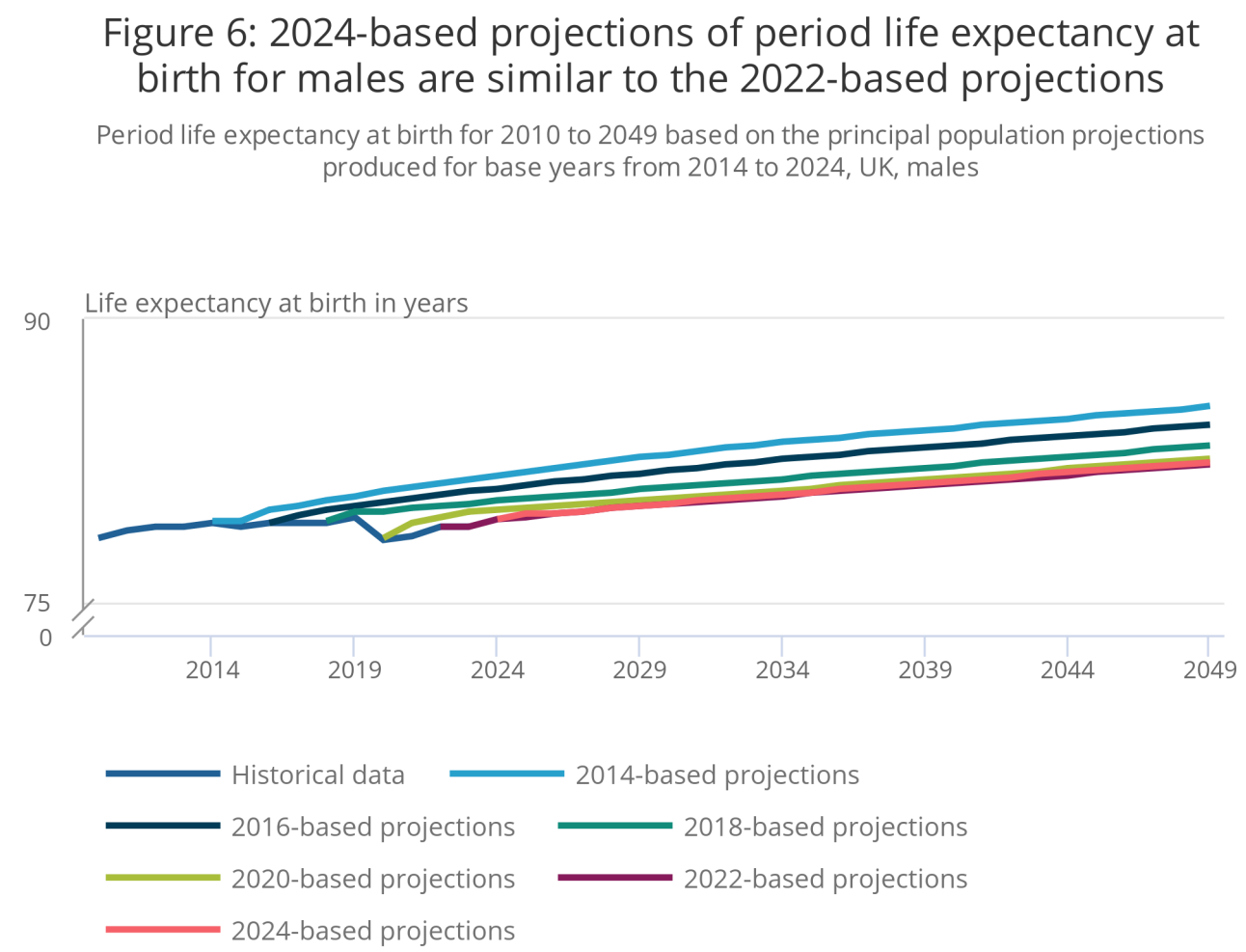
Source: National population projections, mortality assumptions from the Office for National Statistics

Notes:

1. Historical data in the chart are based on the latest deaths and population estimates, and may differ from life expectancy figures produced when the individual projections were set.

Figure 6: 2024-based projections of period life expectancy at birth for males are similar to the 2022-based projections

Period life expectancy at birth for 2010 to 2049 based on the principal population projections produced for base years from 2014 to 2024, UK, males



Source: National population projections, mortality assumptions from the Office for National Statistics

Notes:

1. Historical data in the chart are based on the latest deaths and population estimates, and may differ from life expectancy figures produced when the individual projections were set.

Across all UK countries, the 2024-based projections for period life expectancy at birth and at age 65 years are similar to the 2022-based projections, for both females and males.

Table 1: Life expectancy at birth and at 65 years in 2049
2024-based principal projections of female and male period life expectancy at birth and at 65 years in 2049 compared with the 2022-based principal projections, UK and UK constituent countries

	Females				Males			
	Age 0		Age 65		Age 0		Age 65	
	Proposed 2024-based LE	Change over 2022-based projection	Proposed 2024-based LE	Change over 2022-based projection	Proposed 2024-based LE	Change over 2022-based projection	Proposed 2024-based LE	Change over 2022-based projection
UK	85.95	0.10	23.38	0.08	82.40	0.12	20.83	0.09
England	86.21	0.11	23.56	0.09	82.66	0.14	20.96	0.10
Wales	85.30	0.05	22.97	0.09	81.66	-0.12	20.45	-0.02
Scotland	84.06	0.04	22.29	-0.02	80.50	0.14	20.05	0.03
Northern Ireland	85.64	-0.02	23.14	0.03	82.10	-0.13	20.67	-0.09

Source: National population projections, mortality assumptions from the Office for National Statistics

Notes

1. LE means life expectancy and it refers to the number of years a person is expected to live from a given age.

5 . Mortality assumptions for the variant projections

Variant projections illustrate how life expectancy might change under different future demographic scenarios. For example, the low life expectancy variant assumes lower levels of annual mortality improvement, and results in lower projected life expectancies over the projection period.

The variant projections are produced in the same way as the principal projection, but with different assumed long-term improvement rates, as follows:

- high life expectancy variant: long-term improvement rate of 1.9% for males and females aged 0 to 90 years, reducing linearly between ages 91 to 110 years to 0% for ages 110 years and over

- low life expectancy variant: long-term improvement rate of 0.5% for males and females aged 0 to 90 years, reducing linearly between ages 91 to 110 years to 0% for ages 110 years and over

- no long-term improvement variant: long-term improvement rate of 0% for males and females for all ages starting in 2049

The high life expectancy variant for the 2022-based projections used a 1.5% long-term improvement rate. We have increased this to 1.9% for the 2024-based projections, following advice from our expert advisory panel. This change reflects the continued uncertainty around future mortality trends and the possibility that long-term improvement rates could be substantially higher than in the principal projection. Note that the 0.5% (low variant) and 1.9% (high variant) assumptions do not represent lower and upper limits but, instead, provide a range to illustrate sensitivity.

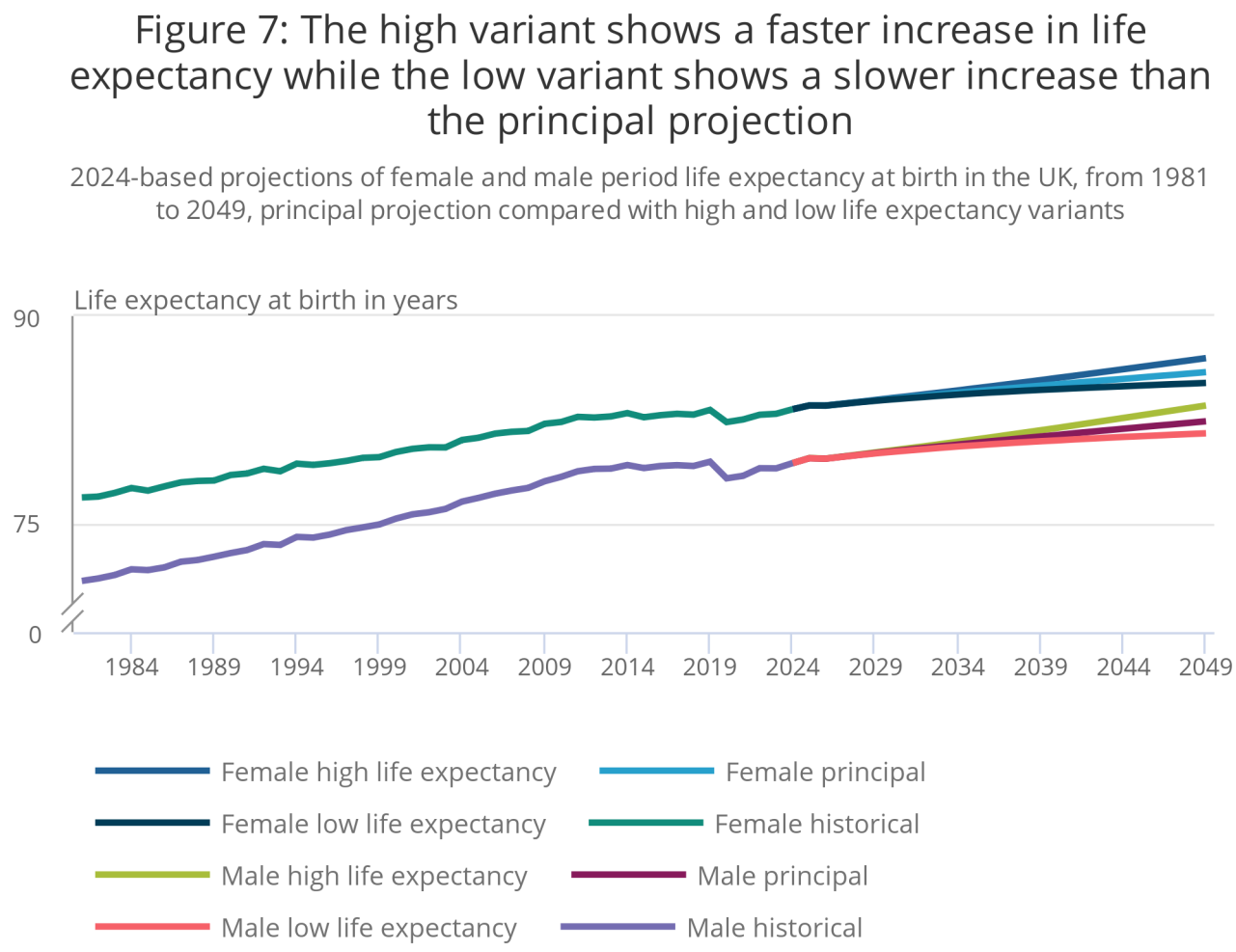
The low life expectancy and no long-term improvement variants are the same as the ones used in the 2022-based projections.

Figure 7 shows historical and projected period life expectancy at birth for females and males in the UK from 1981 to 2049, based on the principal projection and the high and low life expectancy variants.

Life expectancies under the no long-term improvement variant are not shown in the chart, but are available as part of our 2024-based population projection datasets and UK population projection explorer.

Figure 7: The high variant shows a faster increase in life expectancy while the low variant shows a slower increase than the principal projection

2024-based projections of female and male period life expectancy at birth in the UK, from 1981 to 2049, principal projection compared with high and low life expectancy variants



Source: National population projections, mortality assumptions from the Office for National Statistics

6 . Expert advisory panel and National Population Projections Committee

In November 2025, we convened an expert advisory panel of demographic experts to discuss their views on future trends in mortality in the UK and its constituent countries. This helped inform the process of setting the mortality assumptions used in the 2024-based population projections.

In advance of the meeting, panel members were sent a questionnaire asking for their views on:

- forces affecting mortality in the UK
- short-term and long-term trends in mortality in the UK
- country-specific assumptions
- UK period life expectancy in the short-term and long-term
- mortality variants
- any other factors to consider regarding future mortality trends

In the meeting, we outlined the method for setting the mortality assumptions and the recent trends in mortality and life expectancy, as well as discussing the panel's responses to the questionnaire. We then focused on these main points:

- the long-term rate of mortality improvement for the principal projection, by age and sex, for the UK and its constituent countries
- the speed of convergence from the base year to the long-term improvement rate
- the treatment of shocks in the projections
- specific considerations for individual UK countries
- suggestions for the high and low life expectancy variants

Following this meeting, we considered the range of views expressed by the panel to set the assumptions for the 2024-based mortality projections.

To preserve the stability and comparability of long-term projections, we only made changes from the 2022-based projections for which there was strong justification. The proposed assumptions were reviewed by the Government Actuary's Department and then signed off by the National Population Projections Committee, consisting of members from the ONS, National Records of Scotland, the Northern Ireland Statistics and Research Agency, and the Welsh Government.

Minutes from the panel meeting can be requested by emailing pop.info@ons.gov.uk.

7 . Definitions

Age-specific mortality rate (mx)

The number of deaths in the given year of people aged x last birthday divided by the mid-year population estimate for that age and year.

Fitted mortality rate

Mortality rate produced by the model for the back series. These modelled rates provide a smoother view of the overall trends in the observed data, which are subject to annual variability.

Mortality improvement rate

The percentage change in the age-specific mortality rate from one year to the next.

Period life expectancy

The average number of additional years a person would live if they experienced the age-specific mortality rates of a given area and time period for the rest of their life. This is calculated using the mortality rates for a particular calendar year and, unlike cohort life expectancy, does not allow for future assumed changes in mortality rates. We have published a full explanation of the differences between cohort and period life expectancy.

Probability of death (qx)

The probability that a person aged x exactly will die before reaching age (x plus 1).

8 . Related links

National population projections
Bulletin | Released 28 April 2026
The potential future population size of the UK and its constituent countries. These statistics are widely used in planning, including fiscal projections, health, education and pensions.

National population projections QMG
Methodology | Last revised 28 April 2026
What the national population projections statistics cover, how we produce them, and their quality and comparability. Includes definitions and latest, past and upcoming changes.

National life tables – life expectancy in the UK: 2022 to 2024
Bulletin | Released 10 December 2025
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.

Past and projected period and cohort life tables: 2022-based, UK, 1981 to 2072
Bulletin | Released 14 February 2025
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 2022-based national population projections (NPPs), for the UK and constituent countries.

Guide to interpreting past and projected period and cohort life tables
Methodology | Released 2 December 2019
Explanation and guidance on how to use the data published in the past and projected period and cohort life tables.

Life Expectancy releases and their different uses
Article | Released 29 November 2022
The different life expectancy releases and their potential uses.

9 . Cite this methodology

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