

Compendium

# Mortality assumptions



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# 1 . Introduction

This report provides detailed information on the principal and variant mortality assumptions used in the 2014-based national population projections. The long-term mortality assumption for the UK projects life expectancy at birth to be 84.1 years for men and 86.9 years for women in 2039.

## 2 . Principal assumptions

The mortality rates for the first year of the projection, from mid-2014 to mid-2015, are based on the best estimates that could be made in the autumn of 2015 of the numbers of deaths in 2014 to 2015. Assumed improvements in mortality rates after 2014 to 2015 are based on trends in mortality rates before 2014.

The assumptions used in the 2014-based projections are that annual rates of improvement in mortality rates would converge to 1.2% for most ages in 2039 (the 25th year of the 2014-based projections) and remain constant at 1.2% a year thereafter.

However, those born after 1922 and before 1939 have exhibited greater rates of improvement over the last 25 years than those born on either side. There is currently no evidence that these differentials are declining. Similar cohort effects seen in other countries suggest that these differentials may persist well into the oldest ages. As a result, it is assumed that these cohorts will continue to experience higher rates of improvement after 2039 with the assumed rate of improvement in 2039 and beyond rising from 1.0% a year for those born in 1922 to a peak of 2.5% a year for those born in 1931 and 1932 and then declining back to 1.2% a year for those born in 1939 and later.

For those born before 1922, rates of improvement are assumed to be lower than 1.2% in 2039. Rates of improvement are assumed to decline further from 1.0% for those born in 1911 to 0.1% for those born in 1902 and earlier. These are the same assumptions for the rates of mortality improvement in the target year as those used in the 2012-based projections (where the target year was 2037).

Over the 51 year period between 1960 to 1962 and 2013 to 2014, the rates of improvement were around 1.6% per year for males and 1.4% per year for females. These rates of improvement are derived from aggregate mortality rates for ages 0 to 99 calculated using the 2011 population estimates for the UK as the standard population. The rate of improvement over the latter half of this period was higher than over the first half, particularly for males. This appears to be partly due to differential trends in smoking behaviour between males and females. Relatively higher numbers of men have now given up smoking and mortality rates for males at older ages have shown large rates of improvement in recent years.

The average annual rate of improvement over the whole of the 20th century was around 1.2% for both males and females although the improvement rates vary by age. There is considerable debate as to whether the impact of future technical, medical and environmental changes will have a greater or lesser effect on improvements in mortality in the future than they had over the 20th century.

The transition from current rates of mortality improvement by age and sex, derived from recent trends, to the assumed rates of 1.2% to 2.5% in 2039 is not assumed to take place linearly, but is assumed to converge to the proposed target rates at the same speed for males and females. There is growing evidence of generational effects for those born after 1940. Thus, in these projections, convergence to the assumed rate of improvement in 2039 has been calculated by cohort for all those born before 1960.

For those born in 1960 and later, for whom there is little evidence of generational effects, the changes in the rates of improvement to the target rate are projected by calendar year.

The rates of improvement after 2039 are assumed to remain constant (by cohort or by age, as described above) at the rate assumed in 2039 for each year thereafter. Taking account of the generally higher rates of improvement assumed prior to 2039, this produces average annualised rates of mortality improvement of around 1.4% for males and females over the projection period to 2089 (75 years), which is the same as those experienced over the past 75 years for both males and females.

The same future rates of improvements have been assumed for all countries of the UK except for some differences (generally, slightly smaller improvements) in the period to 2039 at some ages for males and females in Scotland, as has been done in recent past projections.

In 2039, period expectation of life at birth for the UK is around 0.2 years lower than in previous projections for males and 0.6 years lower for females compared to the previous projections. These differences are mainly due to a combination of the changes in initial rates of mortality improvement and base mortality rates, the change in the target year and the assumed interpolation of the rates of improvement between 2014 and 2039. After 2039, the life expectancies for males continue to diverge from those in the 2012-based projections to around 0.6 years lower, whilst those for females fall to around 1.0 years lower.

Period expectations of life at birth and at age 65, based on the projected mortality rates, are shown for selected future years in Table 4.1. A summary of the assumed percentage rates of mortality reduction for some specimen years and ages is shown in Tables 4.2 and 4.3.

**Table 4.1: Period expectation of life at birth and at age 65 according to mortality rates assumed for selected years, UK**

	Years							
	2014-15		2018-19		2028-29		2038-39	
	Males	Females	Males	Females	Males	Females	Males	Females
<b>Period expectation of life at birth</b>								
England	79.2	82.7	80.8	84.2	82.9	85.9	84.3	87.1
Wales	78.1	81.8	79.8	83.4	81.9	85.1	83.4	86.4
Scotland	76.6	80.7	78.5	82.0	80.7	83.6	82.3	85.0
Northern Ireland	78.2	82.1	79.7	83.5	81.8	85.2	83.3	86.5
United Kingdom	78.9	82.5	80.5	83.9	82.6	85.6	84.1	86.9
<b>Period expectation of life at age 65</b>								
England	18.5	20.8	19.7	22.0	21.3	23.3	22.4	24.4
Wales	18.0	20.3	19.2	21.5	20.8	22.9	21.9	23.9
Scotland	17.2	19.4	18.4	20.4	20.1	21.7	21.3	22.8
Northern Ireland	18.1	20.3	19.2	21.4	20.7	22.8	21.9	23.9
United Kingdom	18.4	20.7	19.6	21.8	21.2	23.2	22.3	24.2

Source: Office for National Statistics

**Table 4.2: Assumed percentage reduction in death rates (mx) between calendar years for England, Wales and Northern Ireland**

Age last birthday	Percentage									
	2014 to 2015		2018 to 2019		2028 to 2029		2038 to 2039		Reduction over 25 years	
	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females
0	2.38	2.42	2.15	2.18	1.61	1.63	1.20	1.20	35.5	35.8
2	2.52	2.39	2.26	2.16	1.66	1.62	1.20	1.20	36.5	35.6
12	3.68	2.91	3.19	2.58	2.07	1.80	1.20	1.20	44.6	39.4
22	4.10	2.40	3.53	2.17	2.22	1.62	1.20	1.20	47.3	35.7
32	2.67	1.39	2.38	1.35	1.71	1.27	1.20	1.20	37.7	27.7
42	1.06	1.59	1.09	1.51	1.15	1.34	1.20	1.20	24.8	29.3
52	2.33†	1.90†	2.11	1.77	1.60	1.45	1.20	1.20	35.1	31.8
62	2.02†	1.57†	1.96†	1.52†	1.56	1.40	1.20	1.20	33.7	30.1
72	2.85†	2.30†	2.57†	1.98†	1.53†	1.34†	1.20	1.20	36.6	32.2
82	3.21†	2.79†	2.77†	2.54†	1.80†	1.54†	1.20†	1.20†	39.7	36.6
92	1.30†	1.05†	2.10†	1.73†	2.11†	2.01†	1.20†	1.20†	38.8	35.8

Source: Office for National Statistics

Note:

1. Projections are made by calendar year. Except figures marked with a † where, projections are made by cohort

**Table 4.3: Assumed percentage reduction in death rates (mx) between calendar years for Scotland**

Age last birthday	Percentage									
	2014 to 2015		2018 to 2019		2028 to 2029		2038 to 2039		Reduction over 25 years	
	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females
0	2.38	2.42	2.15	2.18	1.61	1.63	1.20	1.20	35.5	35.8
2	2.52	2.39	2.26	2.16	1.66	1.62	1.20	1.20	36.5	35.6
12	3.68	2.91	3.19	2.58	2.07	1.80	1.20	1.20	44.6	39.4
22	4.10	2.40	3.53	2.17	2.22	1.62	1.20	1.20	47.3	35.7
32	0.62	-0.42	0.73	-0.10	1.00	0.63	1.20	1.20	20.9	10.9
42	0.63	1.02	0.74	1.05	1.00	1.14	1.20	1.20	21.0	24.5
52	2.77†	1.90†	2.46	1.77	1.75	1.45	1.20	1.20	38.4	31.8
62	3.17†	2.14†	2.64†	1.87†	1.79	1.40	1.20	1.20	39.8	32.0
72	2.63†	1.75†	2.62†	1.91†	1.83†	1.49†	1.20	1.20	39.7	32.4
82	2.69†	2.02†	2.39†	1.93†	1.82†	1.51†	1.20†	1.20†	38.2	32.6
92	1.30†	1.05†	1.88†	1.19†	1.94†	1.74†	1.20†	1.20†	36.6	32.0

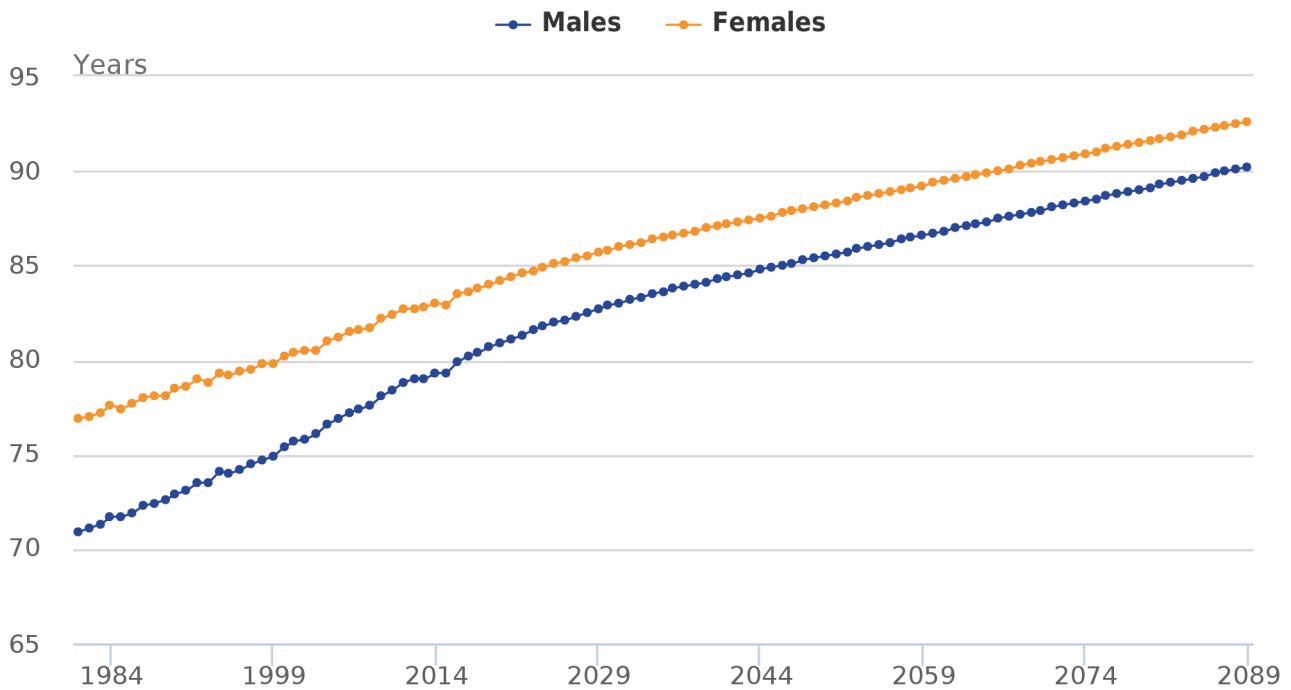
Source: Office for National Statistics

Note:

1. Projections are made by calendar year. Except figures marked with † where, projections are made by cohort

Figure 4.1 shows the estimated and projected period expectation of life at birth for males and females in the UK between 1981 and 2089.

**Figure 4.1: Estimated and projected period expectation of life at birth, UK, 1981 to 2089**



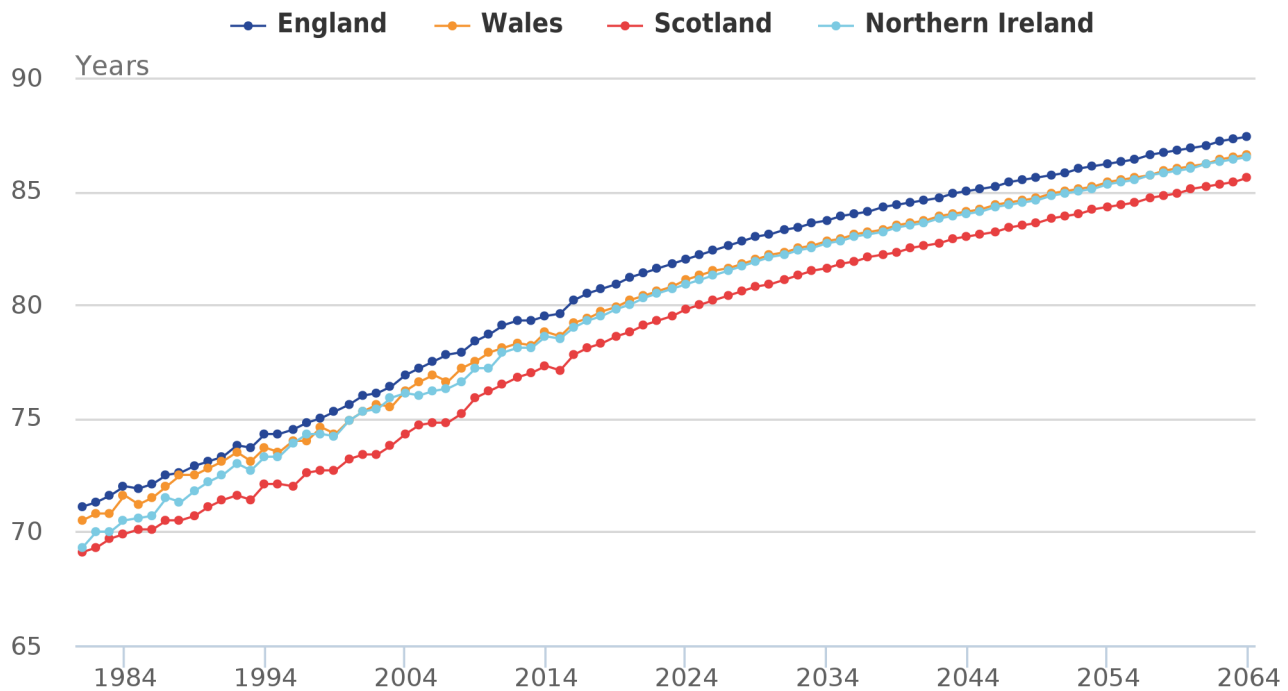
**Source: Office for National Statistics**

**Notes:**

1. Data are displayed on a calendar year basis

Figures 4.2 and 4.3 show estimated and projected period expectations of life at birth for males and females for the constituent countries of the UK between 1981 and 2064.

**Figure 4.2: Estimated and projected period expectation of life at birth, males, 1981 to 2064**

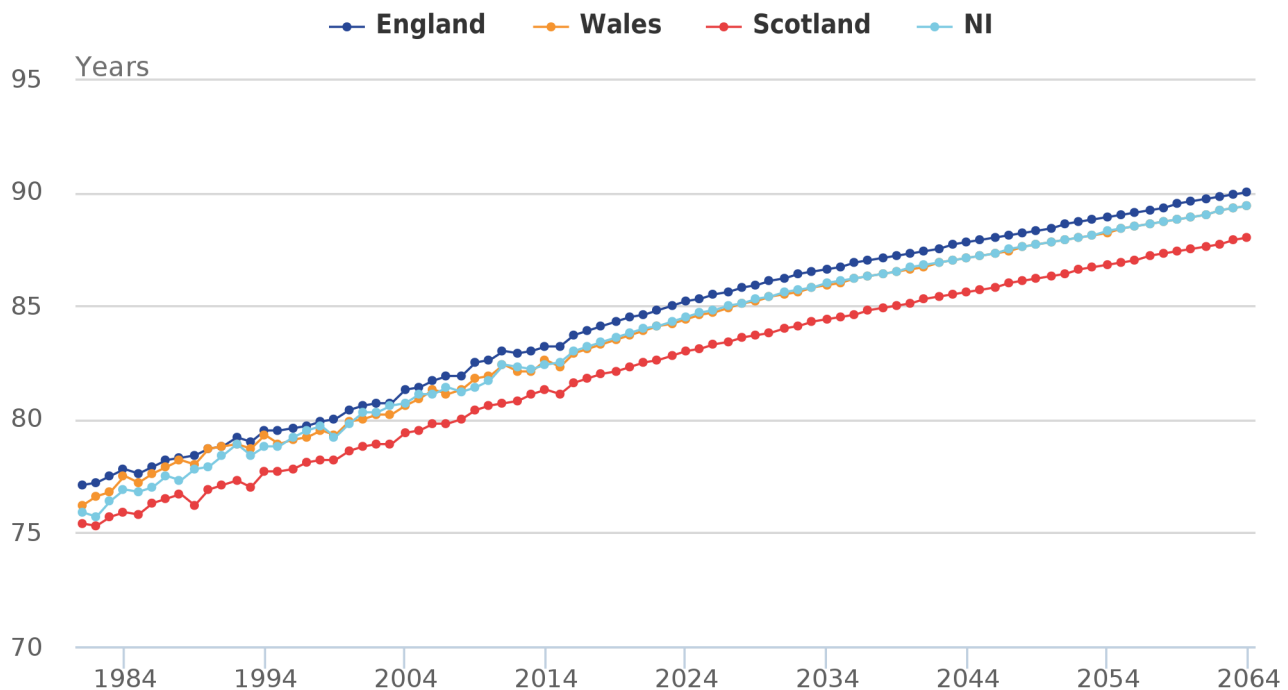


Source: Office for National Statistics

Notes:

1. Data are displayed on a calendar year basis

**Figure 4.3: Estimated and projected period expectation of life at birth, females, 1981 to 2064**



Source: Office for National Statistics

Notes:

1. Data are displayed on a calendar year basis

### 3 . Assumptions for mortality variants

Current annual improvements in mortality rates vary considerably by age and sex. For mortality, it is assumed that for most ages these improvements will gradually converge to common "target rates" of improvement, at each age and for both sexes, by the year 2039, and continue to improve at that constant rate thereafter. However, it is also assumed that those born in the years after 1922 and before 1939 (cohorts which have consistently experienced relatively high rates of mortality improvement over the last 25 years) will continue to experience higher rates of mortality improvement than the rest of the population.

The target rate assumptions are as follows:

- high variant: 2.4% annual improvement at 2039, thereafter annual improvement remaining at 2.4% for those born between 1925 and 1938 rates of annual improvement in and after 2039 will rise to a peak of 3.7% a year for those born in 1931 and 1932 and then decline back to 2.4% a year for those born in 1939 or later
- principal projection: 1.2% annual improvement at 2039, thereafter annual improvement remaining at 1.2% - for those born between 1925 and 1938 rates of annual improvement in and after 2039 will rise to a peak of 2.5% a year for those born in 1931 and 1932 and then decline back to 1.2% a year for those born in 1939 or later
- low variant: 0% annual improvement at 2039, thereafter mortality rates remaining constant - for those born between 1925 and 1938 rates of annual improvement in and after 2039 will rise to a peak of 1.3% a year for those born in 1931 and 1932 and then decline back to 0% a year for those born in 1939 or later

Table 4.4 shows period expectation of life at birth in 2039 that result from the principal and variant assumptions.

**Table 4.4: Period expectation of life at birth in the year ending mid-2039 for the standard variants, UK**

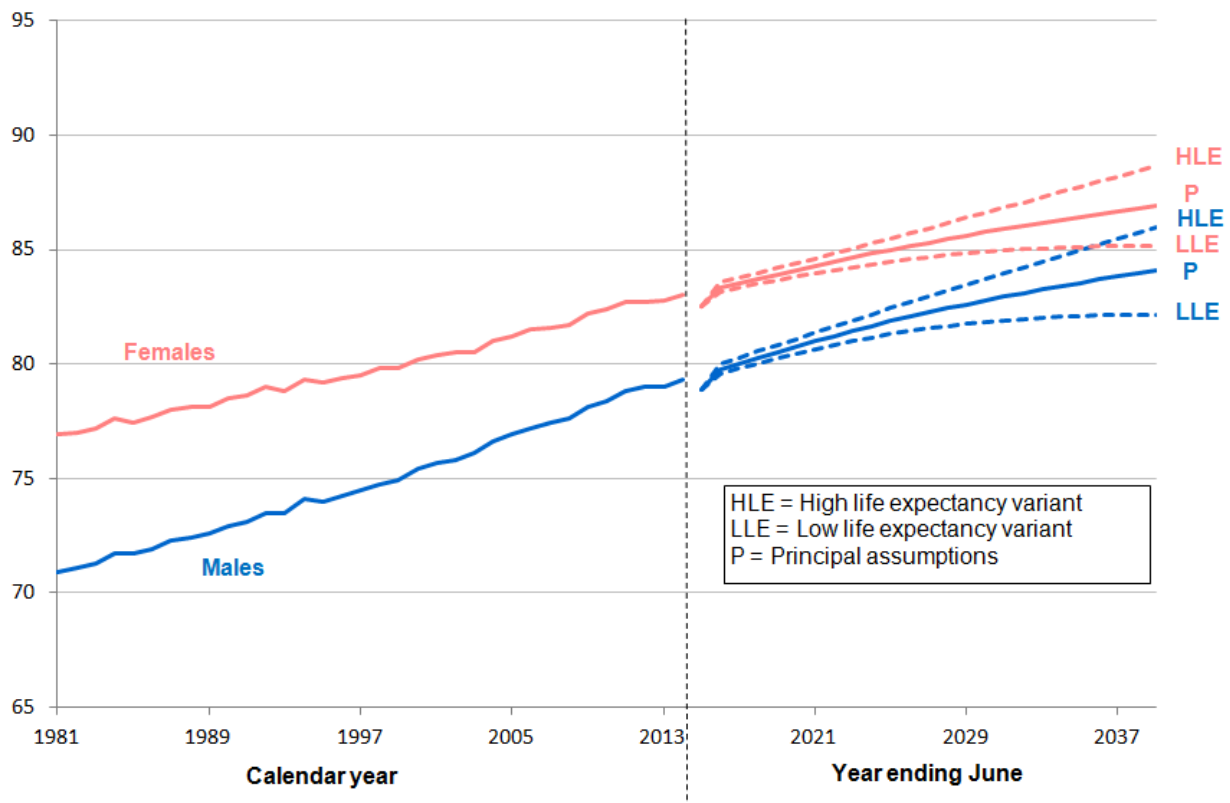
	High	Principal	Low
<b>Males</b>			
England	86.2	84.3	82.4
Wales	85.4	83.4	81.4
Scotland	84.3	82.3	80.2
Northern Ireland	85.3	83.3	81.3
United Kingdom	86.0	84.1	82.2
<b>Females</b>			
England	88.9	87.1	85.4
Wales	88.2	86.4	84.7
Scotland	86.8	85.0	83.1
Northern Ireland	88.2	86.5	84.7
United Kingdom	88.7	86.9	85.2

Source: Office for National Statistics

Figure 4.4 shows estimated and projected period expectation of life at birth for the UK between 1981 and 2039 for the principal projection and the high and low variants.

**Figure 4.4: Estimated and projected period expectation of life at birth, UK, 1981 to 2039**

Years



## 4. Background notes

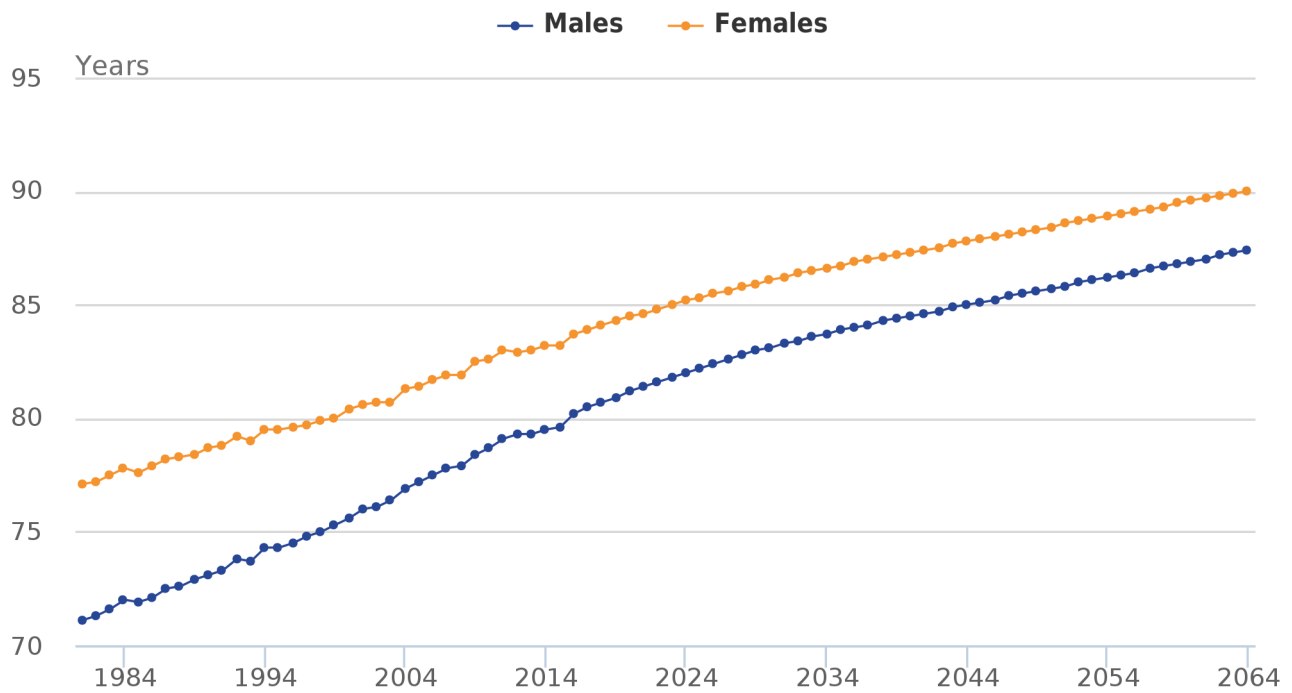
1. Discussion papers showing the background information used in setting the mortality assumptions are available.
2. Details of the policy governing the release of new data are available by visiting [www.statisticsauthority.gov.uk/assessment/code-of-practice/index.html](http://www.statisticsauthority.gov.uk/assessment/code-of-practice/index.html) or from the Media Relations Office email: [media.relations@ons.gsi.gov.uk](mailto:media.relations@ons.gsi.gov.uk)

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## 5. Appendix A: England charts

Figure 4.1a: Estimated and projected period expectation of life at birth, England, 1981 to 2064



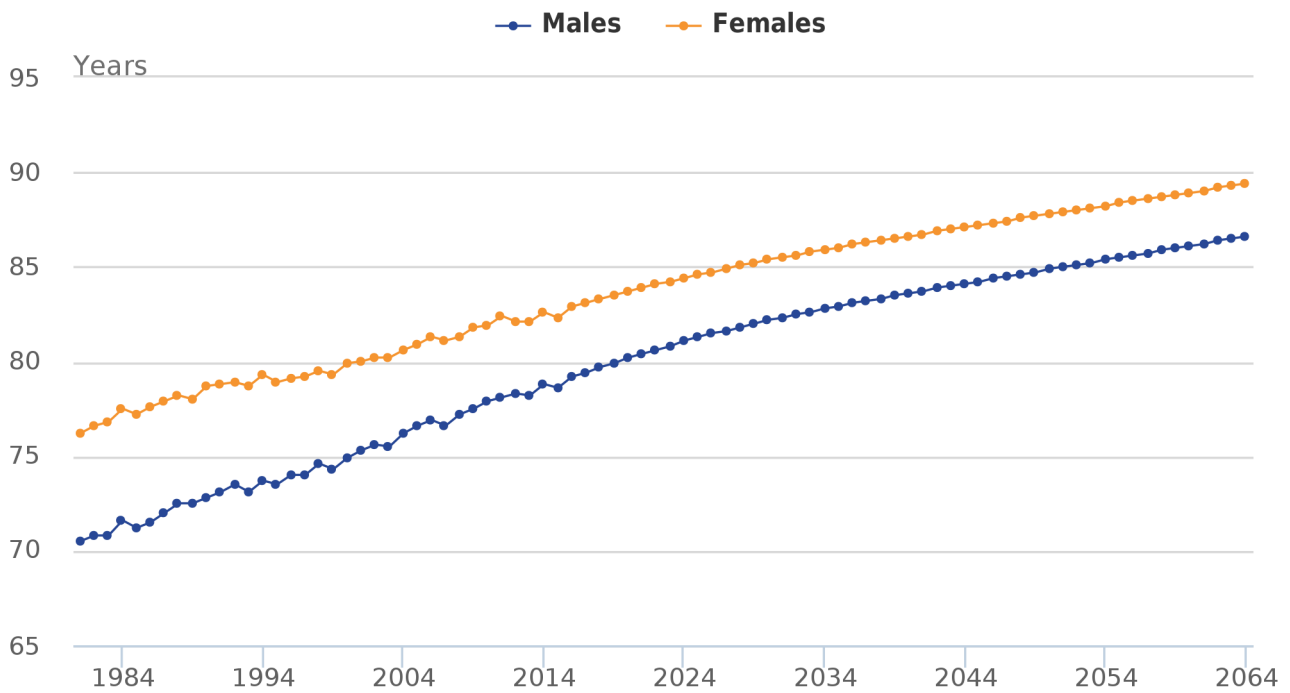
Source: Office for National Statistics

Notes:

1. Data are displayed on a calendar year basis

## 6. Appendix B: Wales charts

Figure 4.1b: Estimated and projected period expectation of life at birth, Wales, 1981 to 2064



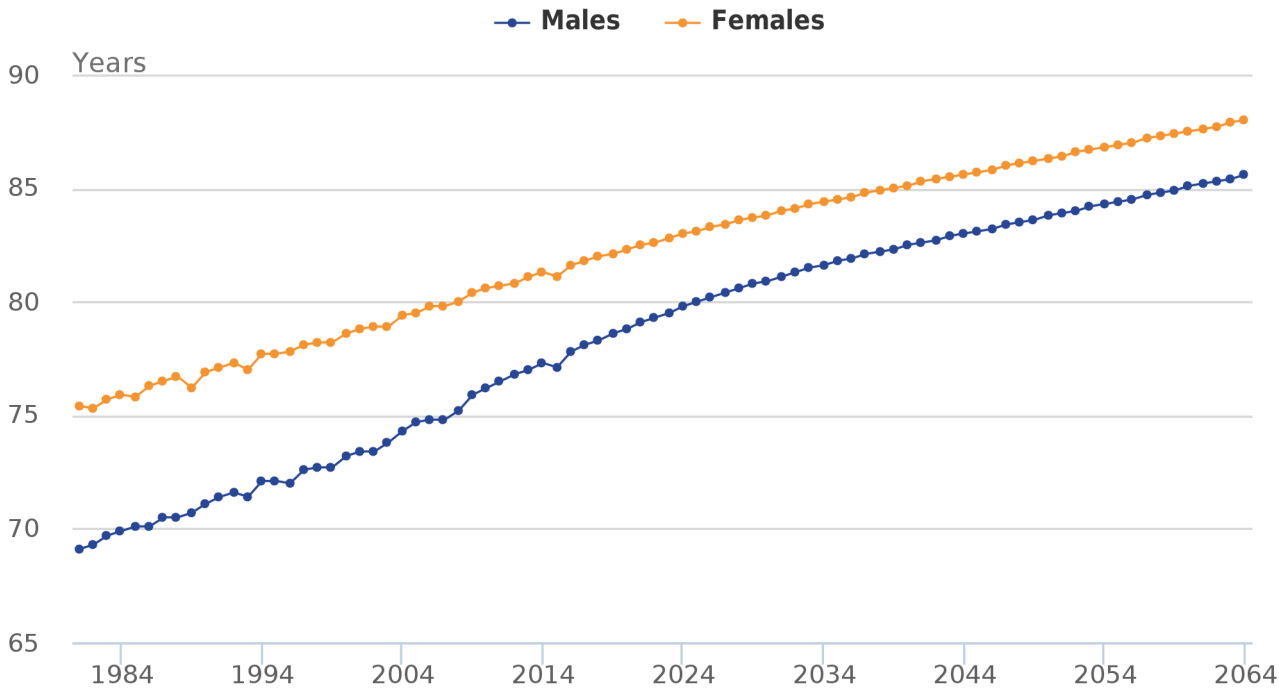
Source: Office for National Statistics

Notes:

1. Data are displayed on a calendar year basis

# 7. Appendix C: Scotland charts

Figure 4.1c: Estimated and projected period expectation of life at birth, Scotland, 1981 to 2064



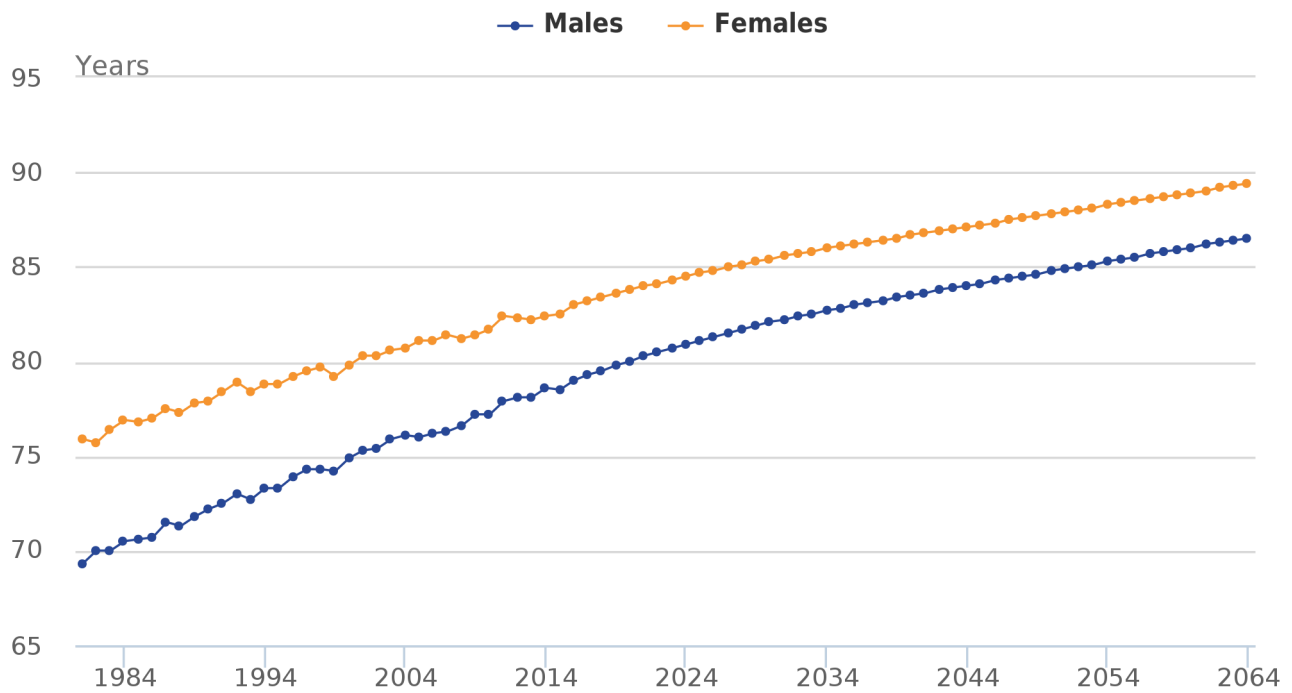
Source: Office for National Statistics

Notes:

- 1. Data are displayed on a calendar year basis

## 8. Appendix D: Northern Ireland charts

Figure 4.1d: Estimated and projected period expectation of life at birth, Northern Ireland, 1981 to 2064



Source: Office for National Statistics

Notes:

1. Data are displayed on a calendar year basis