

2016-based national population projections

Update note – mortality assumptions

Papers regarding the proposed fertility, mortality and migration assumptions for the 2016-based national population projections were issued in June 2017 to key stakeholders. Consultation meetings were held during June by ONS, National Records of Scotland (NRS) and the Northern Ireland Statistics and Research Agency (NISRA) to discuss the proposals. In addition, the Welsh Government (WG) invited key stakeholders within Wales to comment on the proposed assumptions by correspondence.

As a result of this exercise, the following changes to the original mortality proposals were agreed by the NPP committee and should be noted when reading the attached paper. Where no update is provided, the original proposals were agreed.

Proposal	Reference	Change agreed
ONS to undertake further research to determine which method will be used to produce the mortality assumptions for the 2016-based projections. This will either be the current method, as used to produce the 2014-based projections (ONS method), or the new methodology developed by the University of Southampton (UoS method).	Throughout paper	Following the consultation and further testing of the University of Southampton (UoS) model it was decided the ONS method will be retained to produce the mortality assumptions for the 2016-based projections. Further testing and development of the UoS model will be carried out over the next two years with a view to transitioning to the model for the 2018-based projections.
Long-term rates of improvement for the high and low life expectancy variants	Throughout paper	The long-term rate of improvement for the high life expectancy variant has been reduced from 2.4% to 1.9%. The low life expectancy variant has been retained at the levels described in the paper (1.2

		<p>percentage points lower (but with a minimum of 0%) than assumptions for the principal projection.</p> <p>Two further variants, moderately high and moderately low life expectancy variants, also produced with long-term assumed improvement rates of 1.6% per annum and 0.6% per annum respectively to meet the needs of stakeholders.</p>
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Following the consultation meeting with Scotland, a revised set of age and sex specific mortality improvement rates in the base year (2016) for Scotland were agreed. This resulted in changes to the assumed rates of mortality improvement in the base year for England, Wales and Northern Ireland as well, in order that the assumed improvement rates in the base year for the UK as a whole did not change from those initially proposed. As a result of these changes, and potential small rounding differences, there will be differences between some of the figures in the consultation paper and those used in the projections.

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NATIONAL POPULATION PROJECTIONS CONSULTATION

2016-based national population projections: mortality



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Contents:

	Page
Executive Summary	
1. Introduction	7
2. Proposed methodology	7
3. Proposed assumptions for the United Kingdom	10
3.1 Base mortality rates in 2016 and rates of mortality improvement in 2015/16	10
3.2 Target rates of mortality improvements in 2041	15
3.2.1 Rates of mortality improvement 2016 to 2041	19
3.2.2 Rates of mortality improvement after 2041	19
3.2.3 Reductions in mortality over the projection period 2016-2091	20
3.2.4 Alternative target rates of improvement for 2041	27
4. Comparison of proposed 2016-based assumptions with 2014-based assumptions	29
5. International comparisons	31
5.1 Expectations of life in other countries	31
5.2 Eurostat, United Nations and variant projections	34
6. UK variant assumptions	36
Annex A NPP Expert Advisory Panel	38
Annex B Background – Recent trends in mortality	39
Annex C Country specific assumptions	49

Executive Summary

A review of the methodology for projecting mortality rates was commissioned from the University of Southampton at the time of the 2014-based projections. This review concluded that the current ONS methodology included desirable features such as:

- Basing the projections on the mortality improvement rates;
- Projecting differential mortality improvement for those cohorts with observed experience, but not attempting to forecast cohort-specific mortality improvements for future cohorts;
- Using a model to estimate mortality at higher ages.

However, the review also identified potential areas for improvement and the University of Southampton have developed a new model for projecting mortality which is currently being tested by ONS.

ONS is currently dual running the 2016-based projections using the current method (referred to as the ONS method in this paper), as used to produce the 2014-based projections, and the new methodology developed by the University of Southampton (UoS) (referred to as the UoS method in this paper); more information on both methodologies is available in section 2. Further research is underway to decide which method will be used in the 2016-based projections; the proposed assumptions that would be used in each of the methods, if adopted and preliminary results for both methods are presented in this paper.

Comparisons of the proposed 2016-based assumptions and results are made with those used in the previous 2014-based projections and with those from the most recent United Nations and Eurostat projections. The annexes provide a summary of the discussion on mortality at the Expert Advisory Panel meeting, an analysis of past trends in mortality rates, expectations of life, the differentials between males and females and the proposed assumptions for the UK constituent countries.

ONS method

Under the current ONS method it is proposed to adopt broadly the same assumptions as used in the 2014-based projections as follows:

- (i) The assumed rates of mortality improvement in the 'target' year 2041 (the target year is the 25th year of the projection period) will be 1.2% per year for both males and females, for those born in 1924 and later. For those born before 1924 the target rate is assumed to decline from 1.1% to 0.1% for those born in 1906 and earlier. This differs slightly from the 2014-based projections where for those born before 1939 the improvement rate was assumed to increase to a peak of 2.5% for those born in 1931 and 1932 declining back to 1.0% for those born in 1922 and earlier.

- (ii) The rates of improvement after the target year will be the same as those assumed for the target year, projected by year of birth for those born before 1960 and by age for those born in 1960 or later. This is in line with the change adopted for the 2006-based and later projections.

These proposed assumptions result in the projected period expectations of life at birth and at age 65 for the UK shown in Table 1(a) (the figures in brackets are the projected expectations of life for the same years from the 2014-based projections under the current methodology).

Table 1(a) Period expectation of life resulting from the 2016-based proposed assumptions for the UK (Current ONS method)

	2016	2021	2031	2041
Expectation of life at birth				
Males	79.6 (79.9)	80.5 (81.1)	82.2 (83.0)	83.5 (84.4)
Females	83.1 (83.5)	83.8 (84.4)	85.1 (86.0)	86.2 (87.2)
Expectation of life at age 65				
Males	18.8 (19.1)	19.4 (20.0)	20.6 (21.5)	21.6 (22.5)
Females	21.1 (21.4)	21.6 (22.2)	22.6 (23.5)	23.5 (24.4)

Figures in brackets from the proposed 2014-based projections

Compared to the 2014-based projections, the resulting period expectations of life at birth are around 0.3 years lower for males (0.4 years lower for females) in 2016, rising to 0.9 years lower (1.0 years lower for females) by 2041. There are similar differentials in the period life expectancy at age 65, of 0.3 years lower in 2016 for both males and females, rising to 0.9 years lower in 2041.

UoS method

Under the UoS method it is proposed to adopt the following assumptions:

The age-specific assumed rates of mortality improvement in the 'target' year 2041 (the target year is the 25th year of the projection period) will be 1.2% per year for both males and females across all ages.

As a result, for the target year and after, those born in 2016 or later years are projected to experience uniform rates of improvement the same as those assumed for the target year (1.2%) per year from 2041. Those born prior to 2016 will continue to show varying levels of mortality improvement beyond 2041 as an additional cohort improvement rate is also applied (which depends on year of birth). Hence the target rates of improvement are not 1.2% for all ages in 2041 (or later years).

These proposed assumptions result in the projected period expectations of life at birth and at age 65 for the UK shown in Table 1(b) (the figures in brackets are the projected expectations of life for the same years from the 2014-based projections under the current methodology).

Table 1(b) Period expectation of life resulting from the 2016-based proposed assumptions for the UK (UoS method)

	2016	2021	2031	2041
Expectation of life at birth				
Males	79.4 (79.9)	80.4 (81.1)	82.0 (83.0)	83.3 (84.4)
Females	83.0 (83.5)	83.8 (84.4)	85.4 (86.0)	86.8 (87.2)
Expectation of life at age 65				
Males	18.9 (19.1)	19.7 (20.0)	21.0 (21.5)	21.8 (22.5)
Females	21.1 (21.4)	21.8 (22.2)	23.2 (23.5)	24.3 (24.4)

Figures in brackets from the proposed 2014 based projections

Compared to the 2014-based projections, the resulting period expectations of life at birth are around 0.5 years lower for males in 2016 rising to 1.1 years lower by 2041. Although the differential for females is the same in 2016 (0.5 years lower), the pattern for future years is different with the differential increasing slightly to 0.6 years before reducing to 0.4 years by 2041. For period life expectancy at age 65, those for males are 0.2 years lower in 2016, increasing to 0.7 years lower by 2041. The differential for females is 0.3 years lower in 2016, increasing slightly to 0.4 years before reducing to 0.1 years in 2041.

Comparison of ONS and UoS method results

Table 1(c) shows the resulting period life expectancies from the 2016 ONS method and proposed assumptions and the UoS method and proposed assumptions.

Table 1(c) Period expectation of life resulting from the 2016-based proposed assumptions for the UK – ONS and UoS methods

	2016	2021	2031	2041
Expectation of life at birth				
Males	79.6 (79.4)	80.5 (80.4)	82.2 (82.0)	83.5 (83.3)
Females	83.1 (83.0)	83.8 (83.8)	85.1 (85.4)	86.2 (86.8)
Expectation of life at age 65				
Males	18.8 (18.9)	19.4 (19.7)	20.6 (21.0)	21.6 (21.8)
Females	21.1 (21.1)	21.6 (21.8)	22.6 (23.2)	23.5 (24.3)

Figures in brackets are from the proposed 2016 UoS method

Comparing the 2016 based projections for ONS and UoS methods the ONS method projects period life expectancies at birth that are slightly higher for males up to 2041. For females the ONS results are slightly higher in 2016 but reduce to be 0.6 years lower by 2041.

Period expectations of life at age 65 follow different trends, with the ONS projecting lower life expectancies throughout the period. For males the ONS method projections start 0.1 years lower, increasing to 0.4 years then reducing to 0.2 years lower by 2041. The expectations of life at age 65 for

females are equal in 2016 but differentials increase steadily with the ONS projections being 0.2 years lower in 2021 and 0.8 years lower in 2041.

The proposed assumptions for the 2016-based projections under both methodologies and their derivation are discussed in more detail in Section 3. It is acknowledged that the choice of the rate of improvement in the target year (referred to in this paper as 'target rate of improvement') is somewhat subjective; however it is informed by expert opinion.

Variant projections based on higher and lower assumptions of fertility, mortality and migration will be prepared at UK and individual country level for the 2016-based projections, with variants prepared on a consistent basis for each of the individual countries. It is proposed that the mortality variants will assume, respectively, improvements in mortality which are 1.2 percentage points higher, or lower (but with a minimum of 0%), than those assumed in the principal projection at all ages in 2041 and years thereafter compared to those assumed in the principal projection. The differentials at the oldest ages may be different. Initial analysis suggests that the variants proposed for the 2016-based projections would give a range of expectations of life at birth in 2041 for the UK of about plus or minus 1.9 years for males and plus or minus 1.7 years for females using the current ONS method and plus or minus 1.7 years for males and 1.5 years for females under the UoS method. The differences in expectations of life at age 65 are slightly smaller. These differences are broadly similar to the effects of the variant assumptions in the 2014-based variant projections.

1. Introduction

A review of the methodology for projecting mortality rates was commissioned from the University of Southampton at the time of the 2014-based projections. This review concluded that the current ONS methodology included desirable features such as:

- Basing the projections on the mortality improvement rates;
- Projecting differential mortality improvement for those cohorts with observed experience, but not attempting to forecast cohort-specific mortality improvements for future cohorts;
- Using a model to estimate mortality at higher ages.

However, the review also identified potential areas for improvement and the University of Southampton have developed a new model for projecting mortality which is currently being tested by ONS.

This paper describes the results of using the current ONS methodology and the University of Southampton methodology being considered for projecting mortality rates for the 2016-based population projections together with the main assumptions proposed for the United Kingdom and their derivation. Comparisons of the proposed 2016-based assumptions are made with those used in the previous 2014-based projections and with those from the most recent United Nations and Eurostat projections. The annexes provide a summary of the discussion on mortality at the Expert Advisory Panel meeting, an analysis of past trends in mortality rates, expectations of life, the differentials between males and females and the proposed assumptions for the UK constituent countries.

2. Proposed methodologies

Current ONS methodology

A general introduction to the current ONS methodology employed in determining the mortality rate assumptions is given in the 2010-based projection reference volume, Chapter 4¹. For the proposed assumptions presented in this paper, annual rates of percentage change in mortality, referred to as mortality improvement rates, were calculated for the UK using the smoothed mortality rates derived from data for the period 1961 to 2015 and age ranges 0 to 100 for males and 0 to 105 for females. Mortality rates have been smoothed using two-dimensional p-splines².

The age-specific mortality improvement rates for 2013 (calculated from the smoothed age-specific mortality rates for 2012 and 2013) were projected forward to 2016 by assuming that the same rates of improvement apply in

¹ 2010-based National population projections. Series PP2, 2012.
<http://www.ons.gov.uk/ons/rel/npp/national-population-projections/2010-based-reference-volume--series-pp2/mortality.html>

² Splines are interpolation tools – they fit smooth curves through existing values.

2014, 2015 and 2016. This projection is carried out by year of age for those born in 1960 and later and by cohort for those born before 1960. Improvement rates in 2016 for the ages where this methodology does not give an assumed rate due to the change from projecting by year of age to cohort were derived by interpolation.

Assumed age specific mortality rates for the 2016 base year were then obtained by applying the resulting assumed rates of improvement for 2014, 2015 and 2016 successively to the smoothed age-specific mortality rates obtained for 2013. These were adjusted at the oldest ages by fitting a regression line to the values of the function $\log q_x/(1-q_x)$ (where q_x = the probability of someone aged x dying before reaching age $x+1$) from ages 85 to 93 for males and 85 to 95 for females and extrapolating beyond, then converting the extrapolated values of $\log q_x/(1-q_x)$ back to values of m_x , the death rate at age x (in general, for the purposes of this paper the death rate at age x is derived by dividing the deaths aged x last birthday during a calendar year by the mid-year population estimate).

The rates of improvement derived for 2016 are then projected into the future, and are assumed to converge to the target rates of improvement by age and sex in 2041. The resulting projected rates of improvement are then applied successively to the assumed rates of mortality by age and sex for the base year 2016 to provide projected age and sex specific mortality rates in each future year of the projection period. Further adjustments are made to ensure that the projected curves of mortality rates appear reasonable and that male mortality rates do not generally fall below those for females for the same age and year.

Projected mortality for constituent countries

As for the 2014-based projections, assumptions on the future rates of improvement will be set for each country individually after a comparison of the experience of that country to the UK as a whole. For the 2014-based projections, the same rates of mortality improvement were assumed for England, Wales and Northern Ireland; for Scotland different, generally lower, rates of improvement were assumed for some ages for males and for females. It is proposed that this will also be the case for the 2016-based projections. Having derived rates for Scotland, the rates of improvement derived for the other constituent countries are then adjusted so that the weighted rates of improvement assumed for 2016 for the countries combined are the same as those initially derived for the UK as a whole.

The base mortality rates in 2016 for each constituent country are derived by adjusting those derived for the UK as a whole in line with recent mortality experience in each country compared to that for the UK. As the base mortality rates vary by age and sex between each country, an assumption of common rates of future improvement would mean the relative base year differentials would be carried forward into future years of the projections with a slight convergence over time.

UoS methodology

The UoS methodology models mortality improvement rates using a generalised additive model, using a smoothed combination of age, age-specific improvement, period and cohort effects, with the relative size of each determined by the input data (Dodd et al., 2017).

The model can be expressed as

$$\log \mu_{xt} = s_{\mu}(x) + s_{\alpha}(x)t + \kappa_t + s_{\gamma}(t - x).$$

where:

μ_{xt} = mortality rates at age x in year t

α_x = baseline annual mortality improvement at age x

κ_t = age-specific year on year mortality improvement

$\gamma(t - x)$ = cohort differences in mortality improvement

and s denote arbitrary smooth functions.

The UoS approach presents a number of advantages compared to the current ONS method. It makes fuller use of the long time series of mortality data, is less subjective than the current method and more efficient and cost effective for ONS to implement. Longer term the approach can be extended into a probabilistic methodology if this is something ONS wishes to develop in the future.

For the proposed assumptions in this paper under the UoS methodology, annual mortality rates for ages 1 to 92 for males and 1 to 90 for females were calculated by fitting the above model to the observed mortality rates. Separate models are fitted for infant mortality and old-age mortality. The transition age for males and females from the main model to the old-age model are currently undergoing further testing and may be subject to change.

For all three models a negative binomial error distribution is assumed. Mortality rates are constrained so that, after a specified age (100 years has been used), the difference in male and female rates does not diverge.

As in the current ONS methodology, the UoS model incorporates expert opinion to constrain the outputs. Year-on-year (“age effect”) improvement rates for males and females at all ages are assumed to converge 25 years from the base year to a target mortality improvement rate informed by experts.

Projected mortality for constituent countries

Under the UoS method the model is fitted separately for Scotland, with improvement rates driven by the input data, and fitted to UK minus Scotland data to derive improvement rates and mortality rates for England, Wales and Northern Ireland combined. The mortality rates will then be adjusted in line

with recent mortality experience for England, Wales and Northern Ireland compared to that for those countries combined to produce projected mortality rates for England, Wales and Northern Ireland.

Variant projections

As in past projections, for either methodology the principal projections will be supplemented by variant projections. These are discussed in more detail in Section 6.

3. Proposed assumptions for United Kingdom

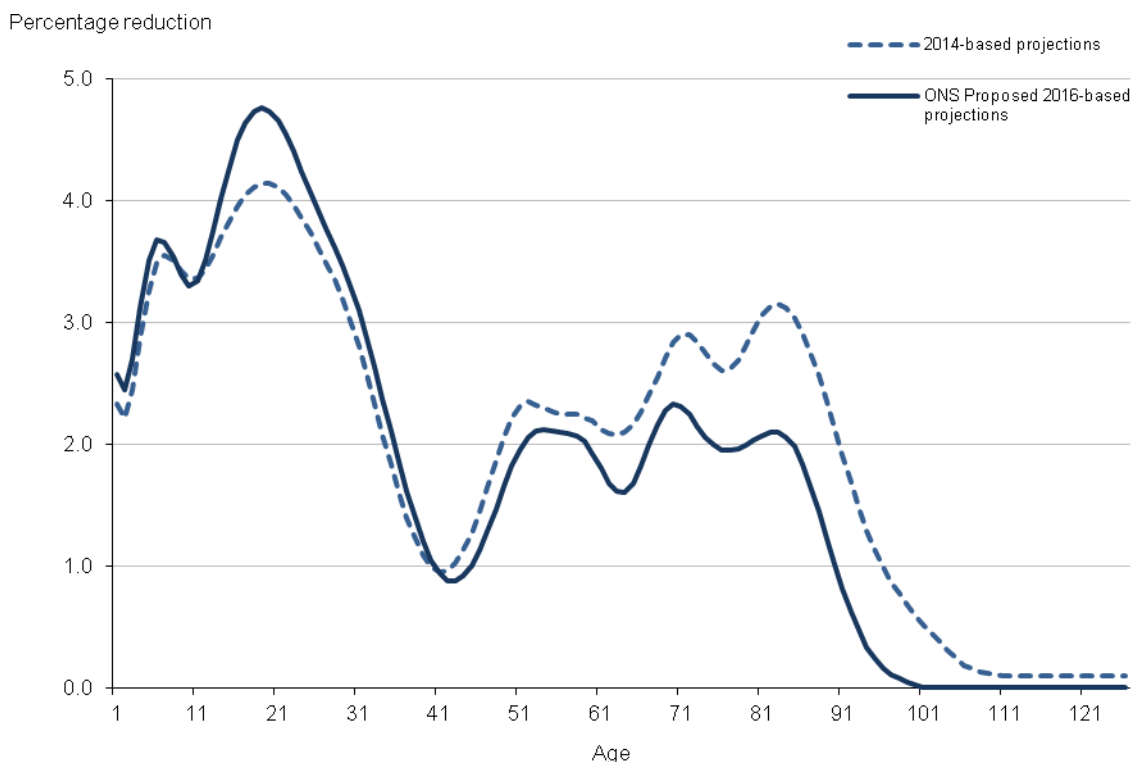
3.1 Base mortality rates in 2016 and Rates of mortality improvement in 2015/16

ONS method

Figures 1(a) and 1(b) show the assumptions for the smoothed reductions in death rates by age for 2015/16 proposed for use as the base improvement factors in the ONS method 2016-based projections, together with the assumed reductions for 2015/16 used in the 2014-based projections.

Figure 1(a), Comparison of projected smoothed percentage reductions in death rates by age, United Kingdom, ONS method, 2015-2016

(a) Males

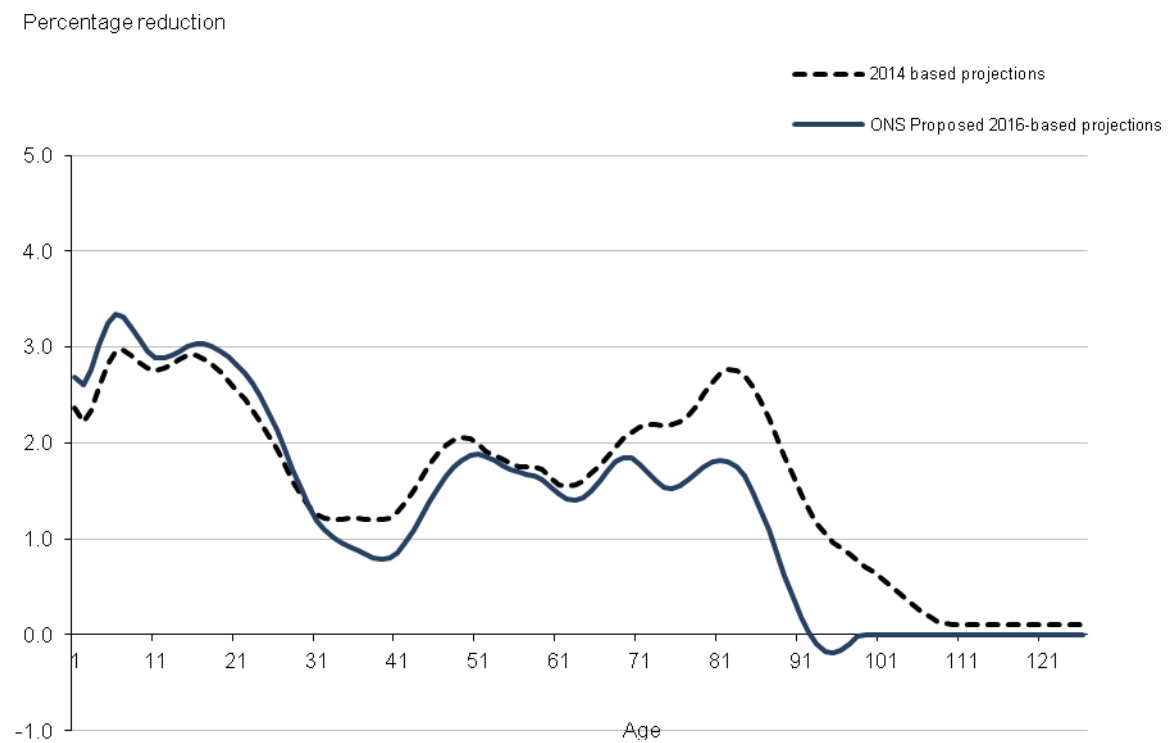


The proposed mortality improvement rates for males in 2015-16 for the 2016-based projections under the current ONS method are broadly similar to those projected for 2015-16 in the previous 2014-based projections for ages up to 40 but lower for older ages. The shape of the improvements is very similar with peaks and troughs at roughly the same ages.

The high rates of improvement noted for previous projections for the cohorts born around 1931 (aged around 85 in 2016) have continued although the peak is now for a slightly younger cohort.

Figure 1(b), Comparison of projected smoothed percentage reductions in death rates by age, United Kingdom, ONS method, 2015-2016

(b) Females



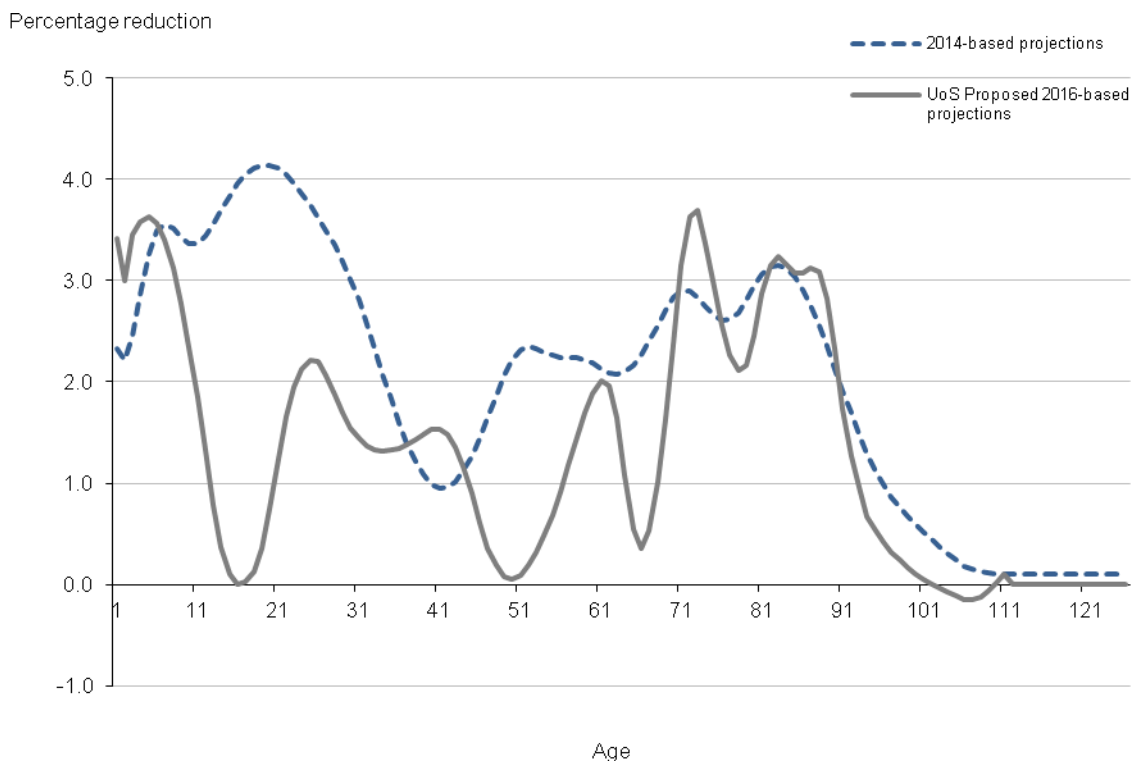
The proposed mortality improvement rates for females in 2015-16 for the 2016-based projections under the current ONS method are broadly similar to those projected for 2015-16 in the previous 2014-based projections for ages below 70 and, as for males, lower at older ages. Also, as for males, the shape of the improvements is very similar with peaks and troughs at roughly the same ages.

UoS method

Figures 2(a) and 2(b) show the assumptions for the smoothed reductions in death rates by age for 2015/16 proposed for use as the base improvement factors in the UoS method 2016-based projections, together with the assumed reductions for 2015/16 used in the 2014-based projections.

Figure 2(a), Comparison of projected smoothed percentage reductions in death rates by age, United Kingdom, UoS method, 2015-2016

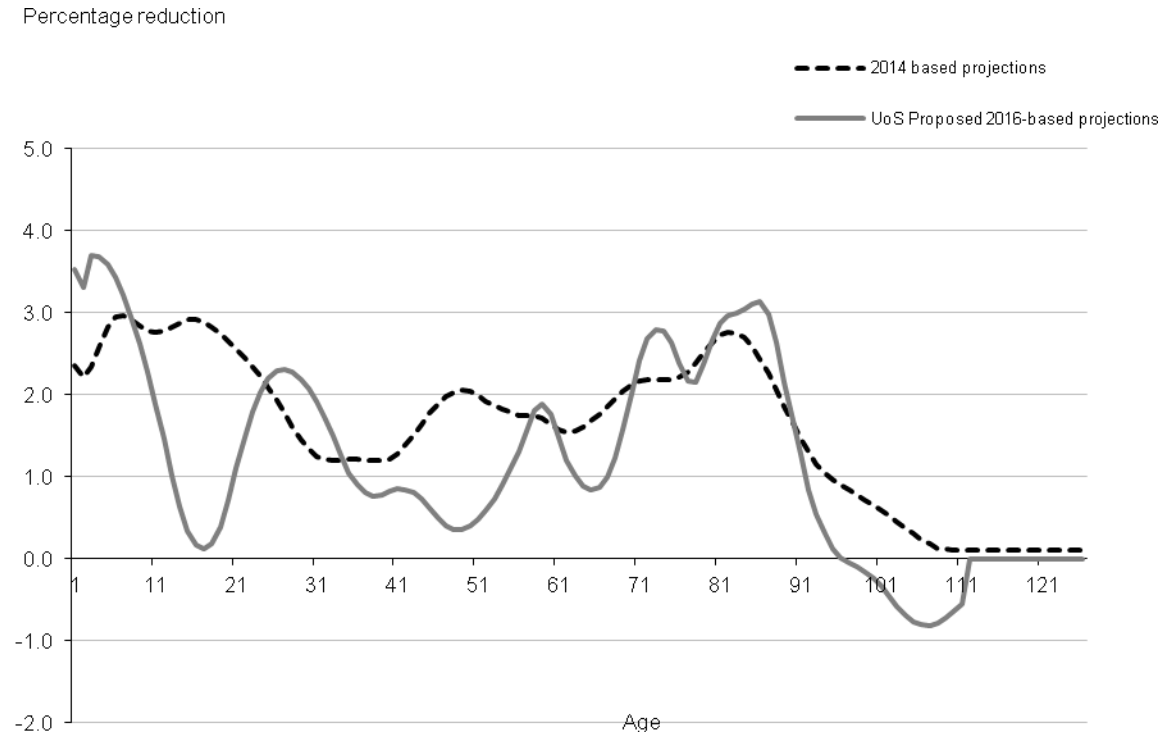
(a) Males



There are noticeable differences between the proposed mortality improvements rates in 2015-16 for the 2016-based projections under the UoS method and those projected for 2015/16 from the 2014-based projections for males. Although starting from a broadly similar point, the improvement rates for the younger ages are substantially lower under the UoS method at most ages up to around 70 except in the late 30s, early 40s and around age 60. At older ages the improvements rates are relatively close to those projected in the 2014-based projections up to ages in the early 90s and lower at older ages, with peaks and troughs at broadly the same ages.

Figure 2(b), Comparison of projected smoothed percentage reductions in death rates by age, United Kingdom, UoS method, 2015-2016

(b) Females



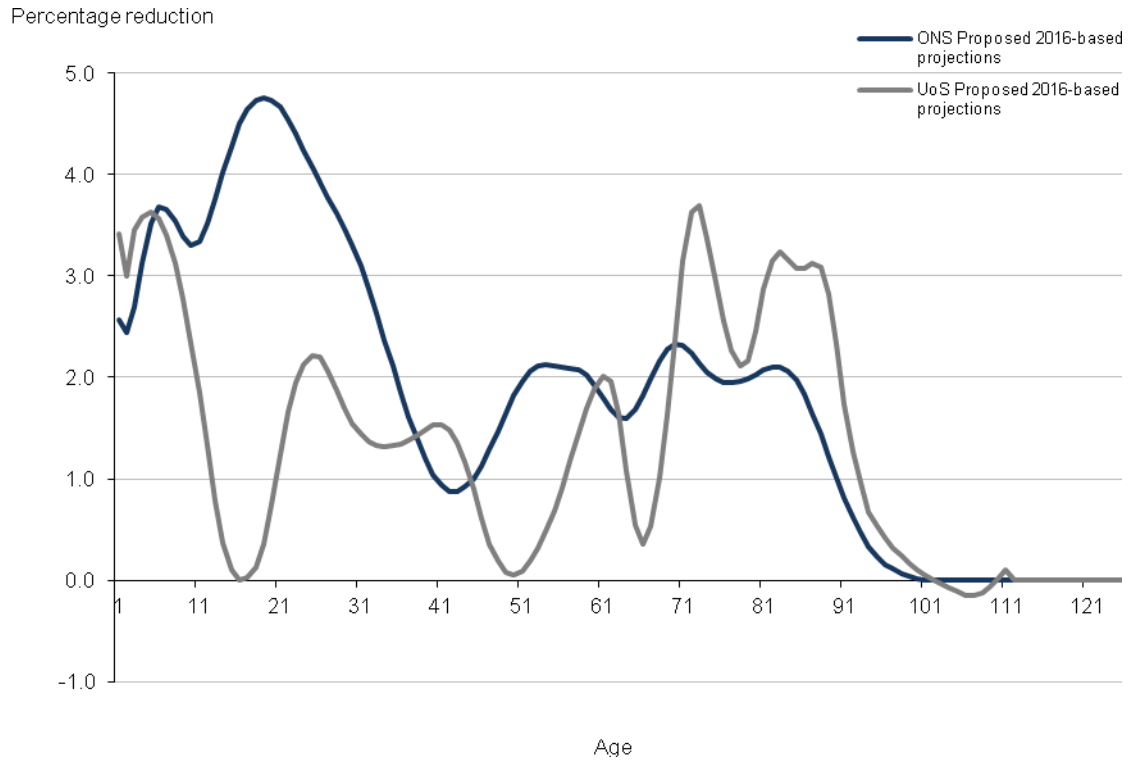
Similarly, there are noticeable differences between the proposed mortality improvements rates in 2015-16 for the 2016-based projections under the UoS method and those projected for 2015/16 from the 2014-based projections for females and with broadly similar patterns of differences. As for males, the UoS improvement rates are generally lower for ages up to around 70; at older ages the improvements rates are relatively close to those projected in the 2014-based projections up to ages in the early 90s and lower at older ages, with peaks and troughs at broadly the same ages.

Comparison of results from ONS and UoS method

Figures 3(a) and 3(b) compare the assumptions for the smoothed reductions in death rates by age for 2015/16 proposed for use as the base improvement factors in the ONS and UoS method 2016-based projections.

Figure 3(a), Comparison of projected smoothed percentage reductions in death rates by age, United Kingdom, 2015-2016, ONS and UoS methods

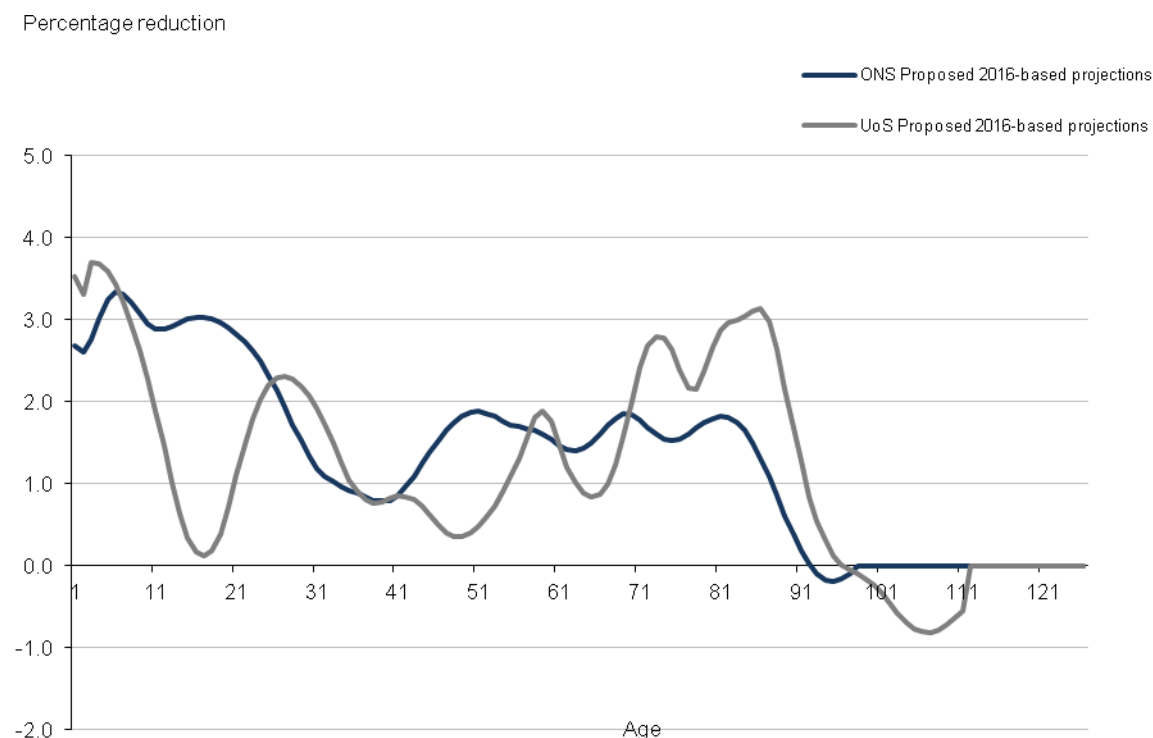
(a) Males



There are noticeable differences between the proposed mortality improvements rates in 2015-16 for the 2016-based projections between the ONS and UoS methods for males. Although starting from a slightly higher point, the improvement rates for the younger ages are generally substantially lower under the UoS method at most ages up to around 70 except in the late 30s, early 40s and around age 60. Conversely, at older ages the improvements rates are higher and with peaks and troughs at slightly different ages.

Figure 3(b), Comparison of projected smoothed percentage reductions in death rates by age, United Kingdom, 2015-2016, ONS and UoS methods

(b) Females



Similarly, there are noticeable differences between the proposed mortality improvements rates in 2015-16 for the 2016-based projections under the ONS and UoS methods for females. The improvement rates under the UoS method have a slightly higher starting point then show a significantly lower rate of improvement for most ages up to age 70, except for ages 25-40 and around age 60. The UoS method then has generally higher rates of improvement for ages 70 to 95 when compared to the current ONS method.

3.2 Target rates of mortality improvements in 2041

Targets rate of improvement at some future year are required for both the ONS and UoS methods; in both cases the target year is the 25th year of the projection period i.e. 2041 for the 2016-based projections.

The target rates of mortality improvements for recent projections have been determined by considering:

- Analysis of historic changes in mortality rates over differing periods of time and setting assumptions which produce similar improvements over the same periods in the future;
- Analysis of the past and likely future drivers of mortality change to inform the choice of assumptions to allow for known or likely future changes; and

- The views expressed at the meeting of the Expert Advisory Panel (see Annex A).

This approach has been followed again.

The age standardised rates of improvement for the age group 0 to 99 using the assumed rates of improvement by age for 2015-16 shown in Figures 1a and 1b for the current ONS method are around 2.2% per year for males and around 1.9% per year for females. The improvements for the age group 50 to 89 are around 1.9% per year for males and 1.6% females. Under the UoS method the age standardised rates of improvement for the age group 0 to 99 using the assumed rates of improvement by age for 2015-16 shown in Figures 2a and 2b are 1.7% for males and 1.6% for females. Whether the recent average annual rates of improvement will remain at similar levels in the future or increase or decrease is difficult to determine.

There continues to be considerable debate amongst demographers as to whether the recent decline in life expectancy is the start of a new trend or whether this is just a blip in a trend of continuous improvement. For instance, factors such as lifestyle (e.g. the potential continuing rise in obesity levels), a slowing down in medical advances, increases in dementia and Alzheimers diseases and the possible emergence of new diseases and increases in anti-microbial resistance may cause the recent decline to continue.

As set out in Table B2, Annex B, the average annualised rate of improvement in age standardised mortality rates in England and Wales for ages 0 to 99 over the period 1910-12 to 2013-15 was around 1.2% per year for males and 1.1% a year for females. Over the 83 year period 1930-32 to 2013-15 the average annualised rate of improvement was around 1.3% per year for both males and females. Over the 53 year period 1960-62 to 2013-15, the rates of improvement were around 1.6% per year for males and 1.3% per year for females. The average rate of improvement over successive decades since 1930-32 remained relatively constant for females, apart from the last decade, whereas for males Table B2 shows a relatively constant lower rate over the period 1930-32 to 1970-72 followed by a period of increasing mortality improvement until the last few years.

Table B3 shows the average annualised rates of improvement in the smoothed mortality rates for the United Kingdom used as the basis for analysing and projecting trends for various periods between 1975 and 2015. The annualised improvements in the standardised mortality rates between 1975 and 2015 were around 1.9% per year for males and 1.4% per year for females. The improvement rates for males were similar to those for females in the first half of the period, but higher than for females in the second half. Improvements in mortality rates were generally higher for males than females at older ages before the early 1970s and it may be that there has been an element of 'catching up' to the lower levels of male mortality. Relatively high numbers of men who started smoking earlier in the 20th century have now given up, with smoking prevalence lowest for the oldest age groups. Changes in the patterns of male employment, such as reduction in levels of

employment in heavy industry over the course of the last century, may have had some effect. Future gains in longevity from such changes are less likely as the numbers who may be potentially affected are now much smaller.

The figures in Table B3 are influenced by the cohorts born around 1931 who have until very recently consistently exhibited higher rates of improvement than those born either side. As these particular cohorts become centenarians over the next 20 year period, the contribution of their lower mortality to the overall rate of improvement will lessen considerably and hence, other things remaining equal, it might be expected that the overall age standardised rates of improvement would decline in future compared to the recent past as these cohorts become very old, even if this differential persisted into very old ages.

The average annualised improvement over a longer period is considered to be a more reliable indicator of the general level in mortality improvement for males than that for the most recent past. The average annualised rates of improvement over the last 80 or 100 years suggest that the average future rates of improvement over a long period of somewhere between 1.2% and 1.3% per year would be reasonable for both males and females. This is also in line with the rates of improvement for 2041 suggested by members of the NPP Expert Advisory Panel, which, where given, ranged from 1.0% to 1.2% for males and females.

Almost all members (7 out of 8) of the expert advisory panel (see Annex A) felt that the improvement rate for a given age should be the same for both males and females with the remainder favouring a higher rate for males than females.

For the current ONS method the 2006-based projections introduced higher rates of improvements for those born between 1923 and 1938 (as well as reduced ones for those born before 1901). However, these differentials appear to have reduced or disappeared in the data for the most recent years. Until recently, the clearest cohort effects were for those born in the early 1930s who will be centenarians in 2041; high rates of improvement are likely to be too optimistic an assumption based on current evidence. In the Expert panel meeting there were mixed views on this point; some experts thought that the relatively higher improvement rates for these cohorts would continue whilst others expected the higher rates to reduce in the next 5 to 25 years. Taking all this into consideration, it is proposed to no longer retain the assumption of higher target rates of improvements for these cohorts for future years. The effect of this is relatively small reducing period life expectancies at birth for both males and females by around 0.1 year in 2041.

Since the proposed rates of mortality improvement for 2016 are higher for males than females at many ages, this results in male mortality rates which converge towards those for females of the same age over future years. If the target rates for females were assumed to be lower than for males, the convergence would be accelerated and could result in male mortality rates falling below those for females of the same age in future years. There is little evidence for assuming higher improvement rates for females compared to

males in 2041 and beyond. Hence the same target rates have been assumed for males and females of the same age in 2041 and thereafter.

For the ONS method it is proposed that the assumed rates of mortality improvement in the target year 2041 (the 25th year of the projection period) will be 1.2% per year for both males and females, for those born in 1924 and later. For those born before 1924 target rates are assumed to decline from 1.1% to 0.1% for those born in 1906 and earlier. This differs slightly from the 2014-based projections where for those born before 1939 the improvement rate was assumed to increase to a peak of 2.5% for those born in 1931 and 1932 declining back to 1.0% for those born in 1922 and earlier.

For the UoS method it is proposed that the age-specific assumed rates of mortality improvement in the 'target' year 2041 (the target year is the 25th year of the projection period) will be 1.2% per year for both males and females across all ages.

As a result, for the target year and after, in the UoS method those born in 2016 or later years are projected to experience uniform rates of improvement the same as those assumed for the target year (1.2%) per year from 2041. Those born prior to 2016 will continue to show varying levels of mortality improvement beyond 2041 as an additional cohort improvement rate is also applied (which depends on year of birth). Hence the target rates of improvement are not 1.2% for all ages in 2041 (or later years).

It may be argued that the average annualised rates of improvement for the UK shown in Table B3 suggest higher target rates. However, because of the high rates of improvement assumed in the first year of the projections, and the method of convergence assumed from the base rates to the target rates in the 25th year of the projections, the equivalent average annualised rates of improvement in age standardised projected mortality rates for ages 0 to 99 over the first 25 years of the projection are around 1.5% and 1.3% per year for males and females respectively. These are lower than the average annual rate of improvement over the last 25 years for males and females, 2.2% and 1.4% respectively.

Table B3 Annual rates of improvement in standardised UK mortality rates

Period	Decrease in standardised UK mortality rate			
	Ages 0-99		Ages 50-89	
	Males	Females	Males	Females
1975-2015	1.9%	1.4%	2.1%	1.7%
1975-1995	1.4%	1.3%	1.6%	1.5%
1995-2015	2.3%	1.5%	2.6%	1.8%
1990-2015	2.2%	1.4%	2.4%	1.7%

3.2.1 Rates of mortality improvement 2016 to 2041

ONS method

Under the current ONS method the rates of improvement by age and sex for the years 2017 to 2040 are obtained by interpolating exponentially between the rate of improvement assumed for 2016 and the rate assumed for 2041. The rate of convergence is assumed to be the same for males and females with half the fall (or increase) to the target rate occurring by the 11th year of the projection period. These assumptions are the same as those used in the 2014-based projections.

UoS method

In the UoS method the rates of improvement by age and sex are obtained through fitting the infant, main and old age models to male and female input data separately as described in section 2. Convergence to the target mortality improvement is incorporated within the model using the following convergence function.

$$\hat{\alpha}^e_{x,t+1} = \begin{cases} \alpha^e + (\hat{\alpha}_x - \alpha^e) \left[1 + 2 \left(\frac{t}{25} \right)^3 - 3 \left(\frac{t}{25} \right)^2 \right], & t = 0, 1, \dots, 24; \\ \alpha^e, & t = 25, 26, \dots \end{cases}$$

3.2.2 Rates of mortality improvement after 2041

ONS method

Under the current ONS method the rates of improvement after 2041 are assumed to remain constant at the rate assumed for 2041 for each year thereafter, by year of birth for those born before 1960 and by age for those born later. For the 2016-based projections those born during the period 1923 to 1938 will no longer be assumed to continue to experience higher rates of improvement as they age beyond 2041. Any similar cohort effects for other years of birth are also assumed to have disappeared by 2041. Since the assumed long term rates of improvement will be lower at most ages than those currently being experienced, this will result in lower increases in life expectancies in the long term compared to those projected for the immediate future.

UoS method

Under the UoS method the rates of improvement after 2041 are assumed to remain constant at the rate assumed for 2041 for each year thereafter for those born in 2016 or later. Those born prior to 2016 will continue to show varying levels of mortality improvement beyond 2041 as the 1.2% target rate of improvement only applies to the year-on-year improvements by age; an additional cohort improvement rate which depends on year of birth and may be negative is also applied.

3.2.3 Reductions in mortality over the projection period 2016-2091

As discussed earlier, the age-specific rates of improvement in age standardised mortality rates assumed in the first year of the projections, which are higher than the long-term assumed improvements of 1.2% per year at most ages, mean that over the 100 years of the official projection period, the average rate of improvement will be higher than 1.2% per year. In fact, the assumed average annual rate of improvement in age standardised mortality for ages 0 to 99 over the next 100 years is around 1.3% per year for males and 1.2% for females. This compares to average rates of improvement in age standardised mortality over the 100 years prior to 2016 of around 1.2% per year for males and for females under both the ONS and UoS methodologies. Thus the ONS and UoS proposed assumptions produce slightly higher average annualised rates of aggregate mortality improvement for males and similar rates for females over the next 100 years than was experienced over the last 100 years.

Tables 2(a) and 2(b) show the proposed reductions in death rates for various ages in selected future years for the ONS and UoS methods respectively, the total reduction over the 25 years from 2016 and the equivalent annualised reduction over the same period. The figures shown in italics in the last column are the corresponding reductions over the 25 year period 2014 to 2039 assumed in the 2014-based projections.

For the ONS method, a continuing significant feature for those cohorts born in 1946 and earlier is that some generations have consistently shown particularly light mortality when compared with their predecessors or successors. This is especially the case for the generation born around the early 1930s. Analysis of the data for recent projections suggested that cohort effects may also be emerging for more recent years of birth. This still appears to be the case. Therefore, as in the previous projections, changes in mortality will be projected on a cohort basis for those born before 1960, as can be seen to some extent in Table 2(a). These cohorts were aged 57 and over in 2016. These cohort features are also evident in the UoS projections.

In general, the resulting projected reductions for the period 2016-41 for the ONS method are lower for females at most ages than for the same period for the 2014-based projections and a little lower for males from around age 40. For the UoS method, the projected reductions are generally higher at the youngest and oldest ages and around age 42 and lower at other ages.

Table 2(a), ONS Assumed percentage reduction in death rates, m_x , between consecutive calendar years in the projection period and the total reduction over 25 years

Percentages

Age	2016 to 2017	2020 to 2021	2030 to 2031	2040 to 2041	Reduction over 25 yrs	Equivalent annual reduction	Reduction 2016-2041 (2014 projections)
Males							
0	2.50	2.25	1.66	1.20	36.4	1.80	34.0
2	2.63	2.35	1.70	1.20	37.3	1.85	34.8
12	3.63	3.15	2.05	1.20	44.3	2.31	41.8
22	4.25	3.65	2.27	1.20	48.2	2.60	44.1
32	2.56	2.29	1.68	1.20	36.9	1.82	34.0
42	0.90	0.96	1.09	1.20	23.4	1.06	24.7
52	2.07	1.90	1.50	1.20	33.1	1.60	34.0
62	1.66	1.87	1.49	1.20	32.3	1.55	33.2
72	2.19	1.93	1.49	1.20	32.4	1.56	34.8
82	2.06	1.78	1.52	1.20	32.6	1.57	37.1
92	0.65	1.38	1.45	1.20	29.2	1.37	38.4
Females							
0	2.62	2.34	1.70	1.20	37.3	1.85	37.4
2	2.69	2.39	1.72	1.20	37.8	1.88	37.2
12	2.84	2.52	1.77	1.20	38.9	1.95	40.3
22	2.55	2.29	1.67	1.20	36.8	1.82	37.3
32	1.03	1.06	1.14	1.20	24.6	1.12	29.5
42	1.10	1.12	1.16	1.20	25.2	1.15	31.7
52	1.79	1.67	1.41	1.20	30.9	1.47	34.2
62	1.41	1.54	1.35	1.20	29.3	1.38	33.1
72	1.67	1.66	1.35	1.20	29.6	1.40	34.1
82	1.78	1.57	1.40	1.20	29.9	1.41	35.9
92	0.08	0.93	1.36	1.20	25.3	1.16	30.7

Table 2(b), UoS Assumed percentage reduction in death rates, m_x , between consecutive calendar years in the projection period and the total reduction over 25 years

Percentages

Age	2016 to 2017	2020 to 2021	2030 to 2031	2040 to 2041	Reduction over 25 yrs	Equivalent annual reduction	Reduction 2016-2041 (2014 projections)
Males							
0	3.53	3.29	2.02	1.21	43.62	2.27	34.0
2	3.26	3.05	1.93	1.21	41.83	2.14	34.8
12	1.18	2.22	1.68	1.21	35.07	1.71	41.8
22	1.54	0.73	0.93	1.21	10.59	0.45	44.1
32	1.39	1.84	0.81	1.02	14.68	0.63	34.0
42	1.58	1.83	2.50	0.51	36.11	1.78	24.7
52	0.24	0.41	2.22	2.62	33.91	1.64	34.0
62	2.03	1.58	0.41	2.14	27.08	1.26	33.2
72	3.77	1.02	1.33	0.20	24.01	1.09	34.8
82	3.22	1.91	0.50	1.04	35.11	1.71	37.1
92	1.20	2.78	1.36	0.30	40.46	2.05	38.4
Females							
0	3.64	3.40	2.06	1.21	44.39	2.32	37.4
2	3.45	3.22	1.99	1.21	43.10	2.23	37.2
12	1.29	2.03	1.55	1.21	33.40	1.61	40.3
22	1.51	0.08	1.19	1.21	18.81	0.83	37.3
32	1.72	2.14	0.08	1.16	22.12	0.99	29.5
42	0.86	0.86	2.25	0.02	28.76	1.35	31.7
52	0.59	0.38	0.97	2.30	24.12	1.10	34.2
62	1.25	1.96	0.49	1.00	23.35	1.06	33.1
72	2.80	1.41	2.07	0.47	29.37	1.38	34.1
82	3.04	2.09	1.18	1.91	37.86	1.89	35.9
92	0.74	2.15	1.54	1.01	37.79	1.88	30.7

Results

It is difficult to encapsulate the effects of the mortality assumptions in a simple way. One method often used, and which has been adopted in recent NPP papers, is to look at the expectations of life for future calendar years on a period basis. These are calculated using the projected mortality rates at each age for the calendar year in question. Period expectations of life at birth for recent years are shown in Annex B, Table B1.

ONS method

The projected period expectation of life at birth in 2041 for the UK is around 0.9 years lower for both males and females compared to those proposed for 2041 in the 2014-based projections (see Table 1(a)). This is mainly a result of the differences in initial rates of mortality improvement and base mortality

rates assumed for 2016 compared to those projected for 2016 in the 2014-based projections and the change in target rates of improvement for those born between 1923 and 1938, slightly offset by moving target year two years forward. After 2041 the life expectancies for males continue to diverge from those in the 2014-based projections to around 1.2 years lower for males and around 1.3 years lower for females by 2100.

Figures 4 and 5 shows future period expectations of life based on the proposed assumptions (together with those used for the 2014-based projections for comparison).

As can be seen from Figure 4, the period expectation of life at birth has been increasing more rapidly for males than for females in recent years and the resulting sex difference has been falling, having peaked at about 6 years in 1981. It has been below 5 years since 1999. Under the current ONS method projected period expectations of life at birth are assumed eventually to reach 89.1 years for males and 91.3 years for females by 2089. Under the proposed death rate assumptions the sex difference will fall from around 3.6 years in 2015 to 2.2 years in 2089.

Similarly, as seen in Figure 5, the expectation of life at age 65 has also been increasing more rapidly for males than for females in recent years and the resulting sex difference has fallen from around 3.9 years in 1981 to 2.3 years in 2015. Under the ONS method projected expectations of life at 65 are assumed eventually to reach 26.1 years for males and 27.8 years for females by 2089. The sex difference is projected to continue to fall reaching around 1.7 by 2089.

Figure 4 Period expectation of life at birth, actual and proposed projections, United Kingdom (ONS method)

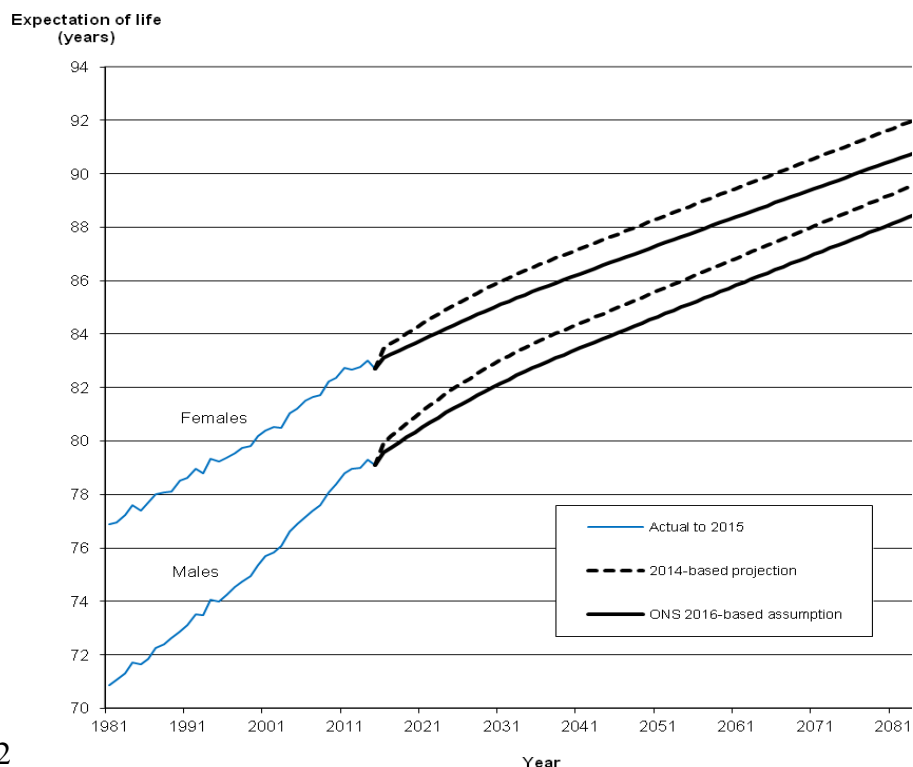
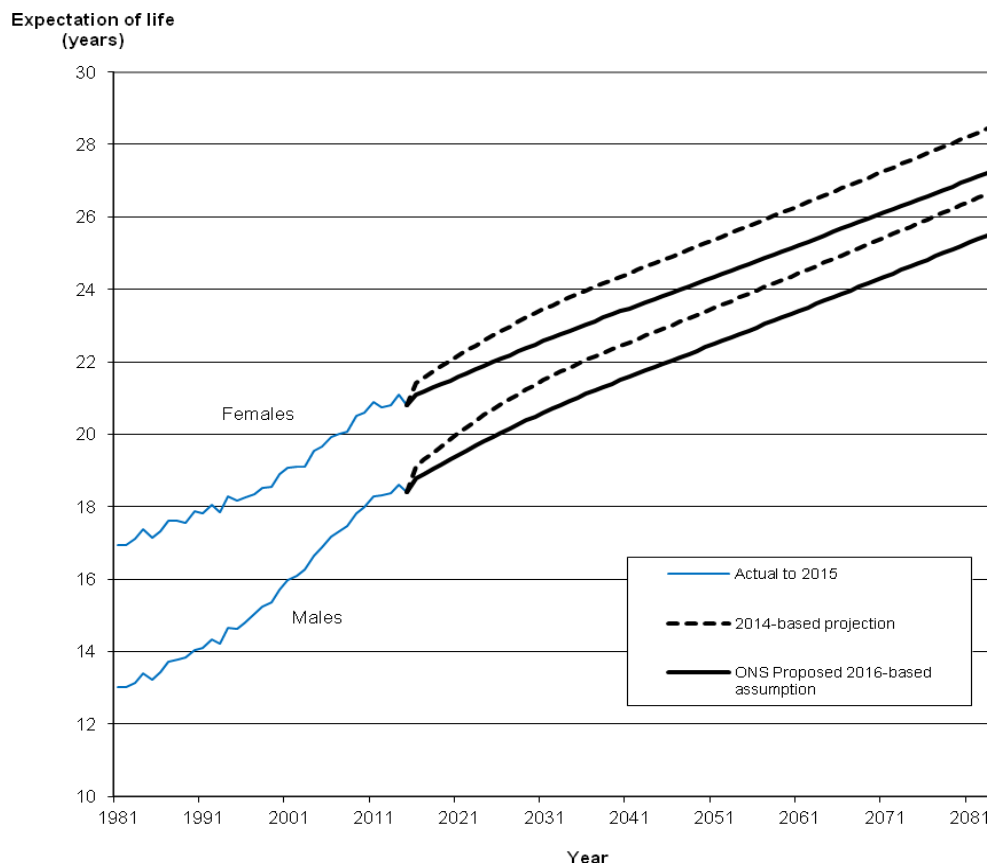


Figure 5 Period expectation of life at age 65, actual and proposed projections, United Kingdom (ONS Method)



Over the last 25 years period expectation of life at birth has increased on average by around 2.5 years per decade for males and 1.7 years per decade for females. The future period expectations of life at birth for males are projected to have a higher annual increase than for females in the early years of the projection. However the rate of increase then reduces before broadly levelling out at an increase of around 0.12 years per year for males, and slightly lower for females at 0.11 years per year, from around 2039 to give average annual increases in period life expectancy at birth over the first 25 year period of the projections of around 1.6 years per decade for males and 1.2 years per decade for females.

Period expectation of life at age 65 increased on average by around 1.8 years per decade for males and 1.2 years per decade for females. The projected period expectations of life at age 65 for males are projected to have a higher annual increase than for females in the early years of the projection. However the rate of increase then reduces before levelling out at an increase of around 0.09 years per year for both males and females, to give average annual increases in period life expectancy at birth over the first 25 year period of the

projections of around 1.1 years per decade for males and 1.0 years per decade for females.

UoS method

These assumptions under the UoS approach combined with the use of the new methodology results in a period expectation of life at birth in 2041 for the UK around 1.1 years lower for males and 0.5 years lower for females compared to those projected for 2041 in the 2014-based projections (see Table 1(b)). This is a higher decrease for males and lower decrease for females than the differentials under the ONS current method. The ages contributing to these differentials are also different between the two methodologies. In the ONS method, the differences are nearly all accounted for by increases in mortality rates at ages 65 and over, whereas for the UoS method, there are also increases in mortality rates at ages below 65 and lower increases at ages 65 and over, as can be seen by comparing the differentials in period life expectancy at birth and at age 65. By 2100 the difference in life expectancy at birth for males has reduced to around 0.8 years lower whilst for females the difference in life expectancy has grown to 0.9 years lower.

Figures 6 and 7 shows future period expectations of life at birth and 65 respectively for the UoS method based on the proposed assumptions under the new proposed method (together with those used for the 2014-based projections under the current ONS method for comparison).

Under the UoS method, Figure 6 shows that projected period expectations of life at birth are assumed eventually to reach 89.6 years for males and 91.9 years for females by 2089. Under the proposed death rate assumptions the sex difference will fall from around 3.6 years in 2015 to 2.3 years in 2089.

Similarly, Figure 7 shows that projected expectations of life at 65 are assumed eventually to reach 27.0 years for males and 28.6 years for females by 2089. The sex difference is projected to continue to fall reaching around 1.6 by 2089.

Figure 6 Period expectation of life at birth, actual and proposed projections, United Kingdom (UoS method)

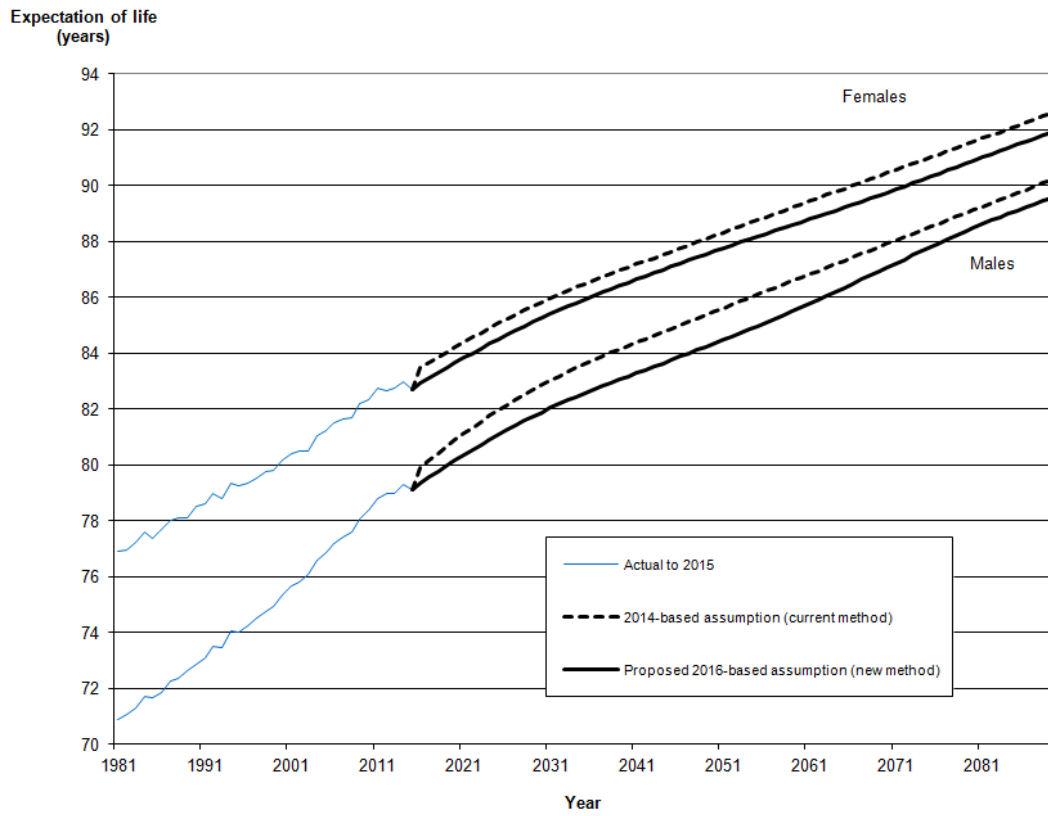
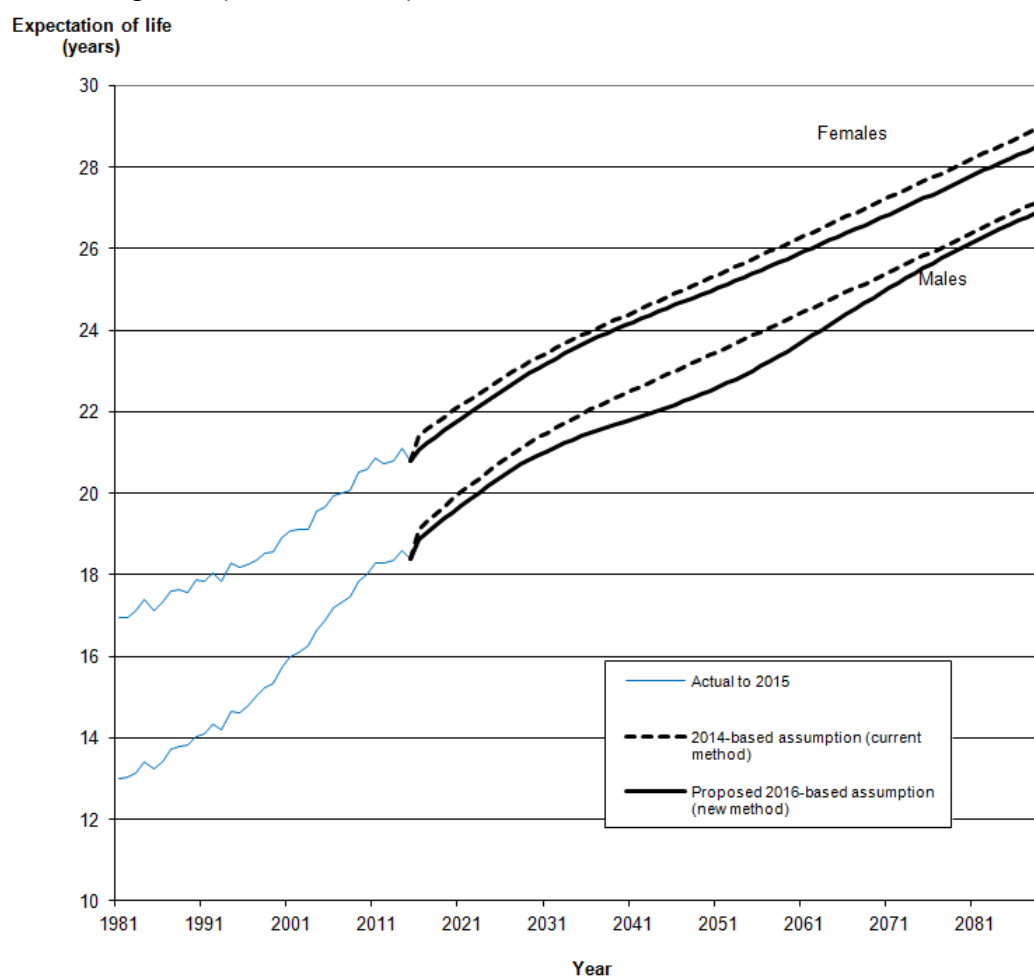


Figure 7 Period expectation of life at age 65, actual and proposed projections, United Kingdom (UoS Method)



The projected period expectations of life at birth for males show slightly higher annual increases than females in the early years of the projection. The rates of increase then reduce thereafter levelling out at an increase of around 0.12 years per year for males, and slightly lower at 0.11 for females from 2037.

Similarly, the projected period expectations of life at birth for males show slightly higher annual increases than females in the early years of the projection. The rate of increase then reduces thereafter to an increase of 0.08 years per year for males, and 0.09 years for females in 2089.

3.2.4 Alternative target rates of improvement for 2041

Table 3(a) shows projected life expectancies at birth and at age 65 for 2041 and 2091 calculated on alternative assumed target rates of improvement in 2041. For these alternative assumptions, the target rates of 1.2% per year for both males and females are replaced by 0.8%, 1.0% and 1.4% for those born after 1912, 1922 and 1924 respectively.

As can be seen the alternatives have relatively little effect on projected period life expectancy over the next 25 years but have a much greater impact over the long term. Also, the higher the assumed target rate the narrower the projected sex differential in life expectancy over time. These alternative scenarios are provided to inform debate, not as suggested alternatives to the proposed assumptions.

Table 3(a) Projected period expectations of life for alternative target mortality improvement rate assumptions (ONS method)

Target rate assumption	Projected period life expectancy			
	At birth in 2041		At birth in 2091	
	Males	Females	Males	Females
2041				
0.80%	82.91	85.74	86.82	89.29
1.00%	83.19	85.99	88.06	90.42
1.20%	83.47	86.25	89.30	91.55
1.40%	83.75	86.50	90.52	92.68
	At age 65 in 2041		At age 65 in 2091	
	Males	Females	Males	Females
0.80%	21.15	23.07	24.21	25.99
1.00%	21.37	23.27	25.23	26.96
1.20%	21.58	23.48	26.25	27.93
1.40%	21.79	23.68	27.29	28.92

Projected life expectancies for alternative assumed target rates of improvement in 2041 have also been calculated for the UoS method in Table 3(b). As can be seen the alternatives again have relatively little effect on projected period life expectancy over the next 25 years but have a greater impact over the long term. Also, the higher the assumed target rate the narrower the projected sex differential in life expectancy over time.

Table 3(b) Projected period expectations of life for alternative target mortality improvement rate assumptions (UoS method)

Target rate assumption	Projected period life expectancy				
	2041	At birth in 2041		At birth in 2091	
		Males	Females	Males	Females
0.80%		82.74	86.16	87.06	89.69
1.00%		83.02	86.41	88.42	90.89
1.20%		83.30	86.66	89.77	92.10
1.40%		83.58	86.90	91.12	93.30
		At age 65 in 2041		At age 65 in 2091	
		Males	Females	Males	Females
0.80%		21.40	23.81	24.89	26.68
1.00%		21.60	24.01	25.99	27.70
1.20%		21.82	24.20	27.11	28.73
1.40%		22.03	24.40	28.24	29.78

4. Comparison of proposed 2016-based assumptions with 2014-based assumptions

ONS method

Comparisons of the proposed assumptions for the smoothed reductions in death rates by age for 2015/16 for use as the base improvement factors in the 2016-based projections under the current ONS method with the assumed reductions for 2015/16 used in the 2014-based projections are shown in Figures 1(a) and 1(b) in Section 3.

Figures 4 and 5 show the differences in projected period life expectancies at birth and at age 65.

Table 4 shows the values of the period expectations of life at birth and at age 65 for the UK for males and females for selected years, calculated on the assumptions for future mortality rates detailed in Section 3, together with the difference with comparable figures calculated from the base assumptions used in the 2014-based projections (before re-aggregation after adjustment for each constituent country).

As can be seen from Table 4(a), compared to the 2014 projections the expectations of life at birth are 0.4 years lower for males and 0.3 years lower for females in 2016. The differentials increase over time rising to just under 1.2 years lower (1.3 years for females) by the end of the projection period in 2091. Period expectation of life at age 65 is also projected to be lower for all

years of the projection period for both males and females (around 0.3 years lower in 2016 for both males and females and increasing to 1.2 to 1.3 years lower by 2091 for males and for females). As mentioned earlier, the very close similarities in the differentials in period life expectancy at birth and at age 65 suggest that the changes are being driven mainly by projected higher mortality rates at ages 65 and over.

Table 4(a) Period expectations of life compared with 2014-based projection figures, United Kingdom (ONS method)

Year	Males				Females			
	Age 0		Age 65		Age 0		Age 65	
	2016- based proposed EOL	Change over 2014- based projection#	2016- based proposed EOL	Change over 2014- based projection#	2016- based proposed EOL	Change over 2014- based projection#	2016- based proposed EOL	Change over 2014- based projection#
2016	79.56	-0.36	18.77	-0.34	83.13	-0.34	21.09	-0.33
2026	81.39	-0.77	20.03	-0.79	84.47	-0.76	22.08	-0.77
2041	83.47	-0.92	21.58	-0.95	86.25	-0.94	23.48	-0.96
2066	86.41	-1.04	23.88	-1.06	88.92	-1.10	25.68	-1.11
2091	89.30	-1.16	26.25	-1.18	91.55	-1.27	27.93	-1.28

Comparison with initial base rates calculated for UK before adjustment for individual countries

Table 4(b) shows for the UoS method, the values of the period expectations of life at birth and at age 65 for the UK for males and females for selected years, calculated on the assumptions for future mortality rates detailed in Section 3, together with the difference with figures calculated from the base assumptions used in the 2014-based projections under the current ONS method (before re-aggregation after adjustment for each constituent country).

Table 4(b) Period expectations of life compared with 2014-based projection figures, United Kingdom (UoS method)

Year	Males				Females			
	Age 0		Age 65		Age 0		Age 65	
	2016- based proposed EOL	Change over 2014- based projection#	2016- based proposed EOL	Change over 2014- based projection#	2016- based proposed EOL	Change over 2014- based projection#	2016- based proposed EOL	Change over 2014- based projection#
2016	79.35	-0.57	18.86	-0.25	82.95	-0.51	21.08	-0.34
2026	81.27	-0.89	20.45	-0.36	84.67	-0.57	22.55	-0.30
2041	83.30	-1.09	21.82	-0.71	86.66	-0.53	24.20	-0.24
2066	86.49	-0.95	24.40	-0.54	89.32	-0.69	26.39	-0.40
2091	89.77	-0.69	27.11	-0.33	92.10	-0.72	28.73	-0.49

Comparison with initial base rates calculated for UK before adjustment for individual countries

As can be seen from Table 4(b), compared to the 2014 projections the expectations of life at birth are 0.6 years lower for males and 0.5 years lower for females in 2016. These are slightly higher than the differentials observed between the 2014 and 2016 ONS method projections for the 2016 base year (of 0.4 years for males and 0.3 years for females). For females the differentials increase over time to around 0.7 years lower by the end of the projection period in 2091 (compared to a reduction of 1.3 years for the 2016 ONS method). For males the differentials increase to around 1.1 years lower in 2041, but then decrease to around 0.7 years lower by 2091. This is a different pattern to the differentials between the 2014 and 2016 ONS methods. There are similar patterns for the differentials in period life expectancy at age 65, although here the magnitude of the differentials in the UoS method are all lower than in the ONS method. Unlike for the ONS method the differentials are not the same order of magnitude for period life expectancy at birth and at age 65. The smaller differentials at age 65 suggest that parts of the differentials are being driven by higher mortality rates at younger ages.

5. International comparisons

5.1 Expectation of Life in other countries

Tables 5 and 6 give an indication of mortality in the United Kingdom relative to the other main European countries, the USA, Australia and Japan. Over the first half of the 20th century the UK experienced, along with the other countries shown, rapid improvements in mortality. By the middle of the century life expectancies were converging and the rate of improvement slowed. Male life expectancy improvements have slowed recently and have lagged behind all countries shown other than Denmark, Germany, France, USA and Poland. Likewise female life expectancy in the UK now only exceeds Denmark, USA and Poland. The high figures for Japan for both males and females can, in part, be attributed to differences in lifestyle and diet and perhaps illustrates some of the potential scope for mortality improvement.

One of the reasons for the lower projected life expectancies is the relatively small improvement in mortality in the UK in 2012 and 2013 followed by a decline in 2015. The data for other countries suggests that the reasons for this may not necessarily have been solely due to UK specific factors; there were small decreases in life expectancy for males in France, Italy, the Netherlands, Spain, Sweden, Switzerland and Poland and females in Denmark, France, Italy, the Netherlands, Spain, Sweden and Switzerland.

Table 5 Period life expectancy at birth for selected countries

Females	1970	1980	1990	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Denmark	75.9	77.3	77.7	79.1	80.3	80.5	80.5	80.7	80.8	81.2	81.6	81.9	81.9	82.7	82.8
France	75.9	78.4	81.0	82.8	83.7	84.1	84.4	84.4	84.5	84.8	85.0	84.8	85.0	85.4	85.1
Germany		76.1	78.4	81.0	82.1	82.3	82.4	82.4	82.5	82.6	82.7	82.8	82.9	83.1	83.1
Italy	74.9	77.2	80.1	82.3	83.5	83.9	83.9	83.9	84.0	84.3	84.4	84.4	84.6	84.9	84.6
Netherlands	76.5	79.2	80.1	80.6	81.6	81.9	82.3	82.3	82.6	82.7	82.8	82.8	83.0	83.3	83.1
Spain	74.8	78.6	80.5	82.5	83.5	84.2	84.1	84.3	84.6	84.9	85.0	85.1	85.6	85.7	85.4
Sweden	77.1	78.8	80.4	81.8	82.4	82.9	83.0	83.1	83.3	83.5	83.7	83.5	83.7	84.5	84.0
Norway	77.5	79.2	79.8	81.4	82.5	82.7	82.7	83.0	83.1	83.2	83.5	83.4	83.6	84.1	84.2
Switzerland	76.1	78.8	80.8	82.6	83.9	84.0	84.2	84.4	84.4	84.6	84.7	84.7	84.8	85.2	84.9
UK	75.0	76.6	78.5	80.2	81.2	81.5	81.6	81.7	82.2	82.4	82.7	82.7	82.8	82.7	82.7
Australia	74.5	78.3	80.4	82.4	83.3	81.6	83.7	83.7	83.9	84.0	84.2	84.3	84.3	84.4	84.5
USA	74.7	77.4	78.8	79.7	80.4	79.7	80.4	80.6	80.9	81.0	81.1	81.2	81.2	81.2	81.9
Japan	74.7	78.8	81.9	84.6	85.5	81.2	86.0	86.1	86.4	86.3	85.9	86.4	86.6	86.8	86.8
Poland	73.3	74.4	75.2	78.0	79.4	82.4	79.7	80.0	80.1	80.6	80.9	81.0	81.1	81.6	81.6
Males	1970	1980	1990	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Denmark	70.7	71.2	72.1	74.4	75.8	75.9	76.0	76.3	76.5	77.1	77.3	77.9	78.0	78.5	78.6
France	68.4	70.2	72.8	75.3	76.7	77.2	77.5	77.6	77.8	78.1	78.4	78.5	78.7	79.2	79.0
Germany		69.6	72.0	75.0	76.6	76.9	77.2	77.1	77.3	77.5	77.7	77.7	77.9	78.1	78.2
Italy	69.0	70.5	73.6	76.5	78.0	78.4	78.6	78.7	78.9	79.3	79.5	79.6	79.8	80.2	80.1
Netherlands	70.8	72.5	73.8	75.5	77.2	77.6	78.0	78.3	78.5	78.8	79.2	79.1	79.4	79.9	79.7
Spain	69.2	72.5	73.4	75.6	77.0	77.7	77.8	78.2	78.5	78.9	79.2	79.4	79.9	80.1	79.9
Sweden	72.2	72.8	74.8	76.9	78.0	78.7	78.9	79.1	79.3	79.5	79.8	79.9	80.1	80.4	80.3
Norway	71.2	72.3	73.4	76.0	77.7	78.1	78.2	78.3	78.6	78.9	79.0	79.4	79.7	80.0	80.4
Switzerland	70.1	72.3	74.0	76.9	78.7	79.1	79.4	79.7	79.8	80.2	80.3	80.5	80.5	81.0	80.7
UK	68.7	70.5	72.9	75.4	76.9	77.2	77.4	77.6	78.1	78.4	78.8	79.0	79.0	79.3	79.0
Australia	67.8	71.2	74.3	77.0	78.5	78.7	79.0	79.2	79.3	79.5	79.7	79.9	80.1	80.3	80.4
USA	67.1	70.0	71.8	74.3	75.2	75.1	75.4	75.6	76.0	76.2	76.3	76.4	76.4	76.4	76.4
Japan	69.3	73.4	75.9	77.7	78.6	79.0	79.2	79.3	79.6	79.6	79.4	79.9	80.2	80.5	80.5
Poland	66.6	66.0	66.2	69.7	70.8	70.9	71.0	71.3	71.5	71.2	72.4	72.7	73.1	73.8	73.6

Source: See sources for Table 6

Italy, Norway, Australia, Japan, Sweden and Switzerland have all exceeded 80 years for male life expectancy at birth, with Spain dropping below this figure after previously exceeding it in 2014. Of the countries shown in the table, the highest life expectancy for males at birth was Switzerland and at age 65 was Australia. For females the highest life expectancies at these ages are for Japan. Under the proposed assumptions, period life expectancy at birth would reach that currently experienced in Switzerland by 2019 for males and in Japan by 2036 for females. The period life expectancy at age 65 would reach that currently experienced in Australia by 2017 for males and in Japan by 2036 for females.

Table 6 Period life expectancy at age 65 for selected countries

Males	1970	1980	1990	2000	2005	2010	2011	2012	2013	2014	2015
Denmark		13.8	14.1	15.0	16.0	16.9	17.1	17.3	17.4	18.2	18.5
France				16.7	17.7	18.6	18.9	18.8	19.0	19.3	19.1
Germany	11.9	12.8	14.0	15.8	16.5	17.3	17.5	17.4	17.6	17.7	17.7
Italy		13.4	15.0	16.5	17.4	18.2	18.3	18.3	18.6	18.9	18.7
Netherlands	13.3	13.7	14.1		16.0	18.0	18.3	18.3	18.4	18.9	18.6
Spain		14.6	15.5	16.7	17.1	18.4	18.6	18.5	18.9	19.1	18.8
Sweden	14.3	14.3	15.3	16.7	17.4	18.2	18.4	18.4	18.7	18.9	18.9
Norway	13.8	14.3	14.6	16.1	17.1	17.9	18.0	18.2	18.4	18.7	18.8
Switzerland	13.3	14.3	15.3	17.0	18.1	18.9	19.0	19.1	19.1	19.4	19.2
UK	12.1	12.9	14.0	15.8	17.0	18.2	18.5	18.5	18.7	18.6	18.4
Australia	12.2	13.8	15.4	17.2	18.1	18.9	19.1	19.1	19.2	19.4	19.5
USA	13.1	14.1	15.1	16.0	16.8	17.7	17.8	17.9	17.9	18.0	18.0
Japan	12.5	14.6	16.2	17.5	18.1	18.7	18.7	18.9	19.1	19.3	

Females	1970	1980	1990	2000	2005	2010	2011	2012	2013	2014	2015
Denmark		17.7	17.9	18.1	19.0	19.6	19.8	20.0	20.1	20.9	21.1
France				21.4	22.0	22.7	23.0	22.8	23.0	23.3	23.0
Germany	14.9	16.3	17.7	19.6	19.9	20.6	20.7	20.7	20.8	20.9	20.9
Italy		17.0	18.7	20.4	21.1	21.7	21.8	21.8	22.0	22.3	21.9
Netherlands	16.1	18.0	18.6		19.6	21.2	21.3	21.2	21.4	21.6	21.4
Spain		17.8	19.3	20.6	21.1	22.4	22.6	22.4	22.9	22.9	22.7
Sweden	17.1	18.1	19.0	20.1	20.6	21.0	21.2	21.0	21.2	21.5	21.4
Norway	16.8	18.2	18.6	18.6	18.6	21.0	21.2	21.0	21.2	21.5	21.5
Switzerland	16.3	18.2	19.4	20.7	21.6	22.2	22.2	22.1	22.1	22.4	22.2
UK	16.0	16.8	17.9	19.0	19.8	20.8	21.0	20.9	21.2	21.1	20.8
Australia	15.9	18.0	19.3	20.7	21.4	21.8	22.0	22.0	22.1	22.2	22.3
USA	17.0	18.3	18.9	19.0	19.5	20.3	20.3	20.5	20.5	20.5	20.6
Japan	15.3	17.7	20.0	22.4	23.2	23.8	23.7	23.8	24.0	24.2	

Sources: ONS (UK), Eurostat, Statistics Denmark, Australian Bureau of Statistics, National Centre for Health Statistics (USA), Ministry of Health, Labour & Welfare (Japan), INSEE (France), Destatis (Germany), ISTAT (Italy), CBS Statistics Netherlands, National Statistics Institute Spain, Statistics Sweden, Statistics Norway, Swiss Statistics, CSO Poland.

5.2 Eurostat, United Nations and other projections

Figures 8 and 9 compare projected period expectations of life at birth for the UK using the proposed assumptions for the principal 2016-based projection³ and those suggested for the high and low life expectancy variants (discussed in Section 6), with the most recent projections published by the United Nations and Eurostat.

As can be seen, the proposed assumptions for the 2016-based principal projection would produce projected period expectations of life at birth which are higher than those in the most recent Eurostat and United Nations projections for the UK.

³Comparisons with projections from the current ONS method only have been shown as differences between in results between the UoS method and ONS method are small here.

Figure 8, Projected period life expectancy at birth, Males, United Kingdom, 2014 to 2064

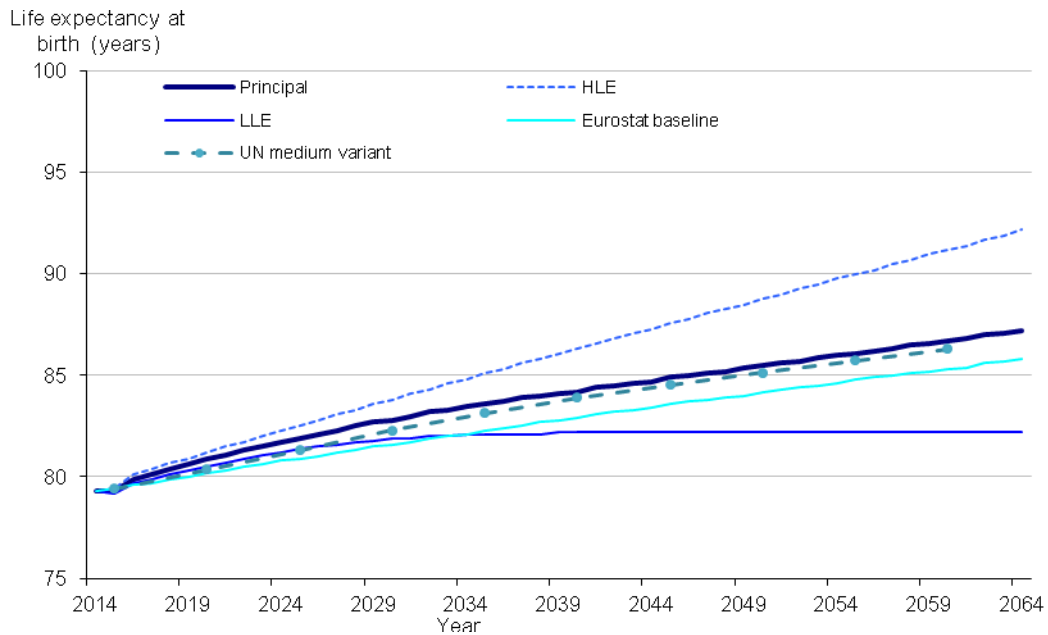


Figure 9 Projected period life expectancy at birth, Females, United Kingdom, 2014 to 2064

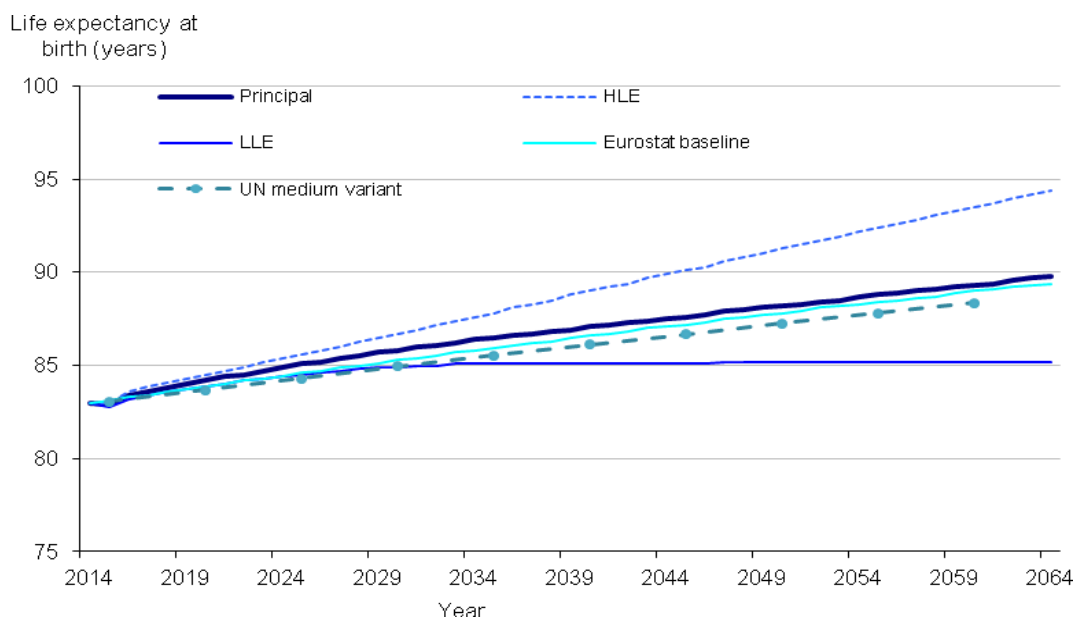


Table 7 provides a comparison of the projected period expectation of life at birth in 2060 from the latest official projections for a selection of countries for which these data are readily available with those proposed for the principal 2016-based UK projections.

Table 7 Projected period expectations of life at birth in 2060 – latest official projections for selected countries

Country	Males	Females
UK	85.7	88.3
Norway	87.2	89.2
The Netherlands	87.0	89.9
Sweden	86.7	89.1
Denmark (2059)	87.3	89.4
France	88.5	91.7
Switzerland	86.0	90.0
Canada (2062/3)	87.6	89.2
USA	84.0	87.1
Australia (medium 2060/1)	85.2	88.3

*Proposed assumptions of mortality improvement for 2016-based UK projections, ONS method

Source: Latest published projections from each country's National Statistics website

Only Australia and the USA have lower projected life expectancy at birth in 2060 for males than the UK. The projected life expectancy at birth for females in 2060 in the UK is higher than the USA and equal to Australia. However, it should be noted that the base mortality rates from which these are projected will often be higher in the UK than the other countries (i.e. a lower starting life expectancy in the UK) suggesting that a greater overall gain in life expectancy is being projected for the UK in several cases.

6. UK variant assumptions

Variant projections based on higher and lower assumptions of fertility, mortality and migration were prepared at UK and individual country level for the 2014-based projections and this will be repeated for the 2016-based projections, with variants prepared on a consistent basis for each of the individual countries. It is likely that the mortality variants will assume, respectively, improvements in mortality which are 1.2 percentage points higher, or lower (but with a minimum of 0%), than those assumed in the principal projection at all ages in 2041 and years thereafter compared to those assumed in the principal projection. The differentials at the oldest ages may be different. Initial analysis suggest that the variants proposed for the 2016-based projections would give a range of expectations of life at birth in 2041 for the UK of about plus or minus 1.9 years for males and plus or minus 1.7 years for females using the current ONS method. Using the UoS method the difference for expectations of life at birth is about plus or minus 1.7 years for

males and 1.5 years for females. The differences in expectations of life at age 65 are slightly smaller, plus or minus 1.3 years for males and 1.2 years for females under both the ONS method the UoS method. These differences are broadly similar to the effects of the variant assumptions in the 2014-based variant projections.

Demographic Analysis Unit
PSD
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ANNEX A

NPP Expert Advisory Panel

The NPP Expert Advisory panel (eight demographic experts convened by ONS) met in April 2017. In an accompanying questionnaire, each member of the panel was asked for their opinions on likely future expectations of life at birth in the UK and on six forces with the potential to have either an upwards or downwards influence on future improvements in mortality.

The expert panel were mostly in agreement around a central estimate of life expectancy at birth. The average response by the panel of experts for period expectation of life at birth in 2040 was 84.4 years for males and 87.5 years for females. These compare with the proposed projection for 2040 of 83.4 years for males and 86.1 years for females under the ONS method, and 83.2 years for males and 86.5 years for females under the UoS method.

Most experts were of the opinion that the target rates of improvement in male mortality should remain at 1.2% per year although there was a suggestion from two experts that the rate should be lower at 1.0%. The opinions on rates of improvement in female mortality were similar, with the majority of experts agreeing with increases of 1.2% per year but again with some suggestions of lower rates. Two experts were of the opinion that the target improvement rates for females should be lower than for males.

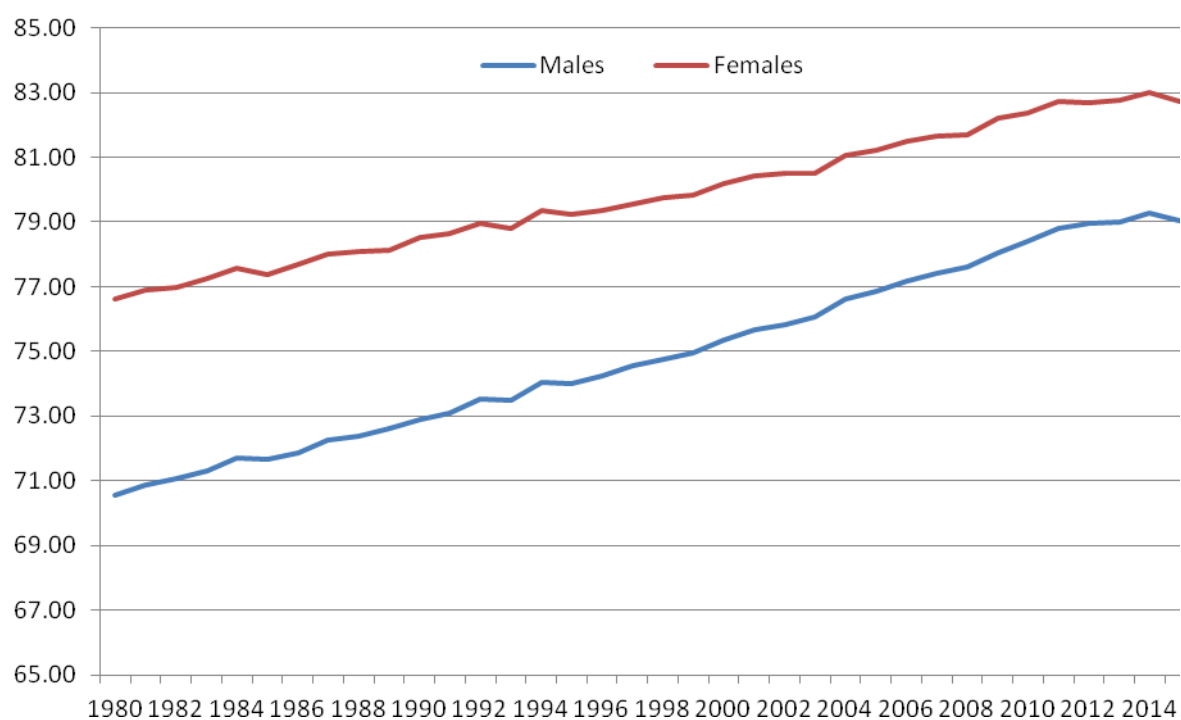
The majority of responses on the likely influences of the six suggested forces that might have an effect on future life expectancies were either small upwards or downwards changes or little or no change. Biomedical technology was the only force estimated to have a large upward change but by one expert only. Alongside biomedical technology, behavioural changes related to health was also generally estimated to have a small upwards influence on future life expectancy at birth. The remaining four forces, the effectiveness of care systems, the emergence of new diseases/resurgence of old diseases, environmental changes and changes in population composition were all generally considered to have a small downwards influence on future life expectancy at birth. Obesity levels were thought to either remain broadly similar or increase in the UK over the next 25 years, but overall it was considered that they would have little effect on future mortality.

ANNEX B

BACKGROUND – Recent trends in mortality

Period expectations of life at most ages have continued to improve over the second half of the 20th century and into the 21st century. However, in 2015 period expectations of life at birth decreased for the first time this century for males (-0.21 years) and the third time this century for females (-0.29 years) (see Figure B1). Expectations of life at birth for males last decreased in 1995 and have steadily improved since, by an average of 0.25 years per year. Over the same time period female expectations of life increased, by an average of 0.17 years per year.

Figure B1 Period expectations of life at birth, for Males and Females, UK



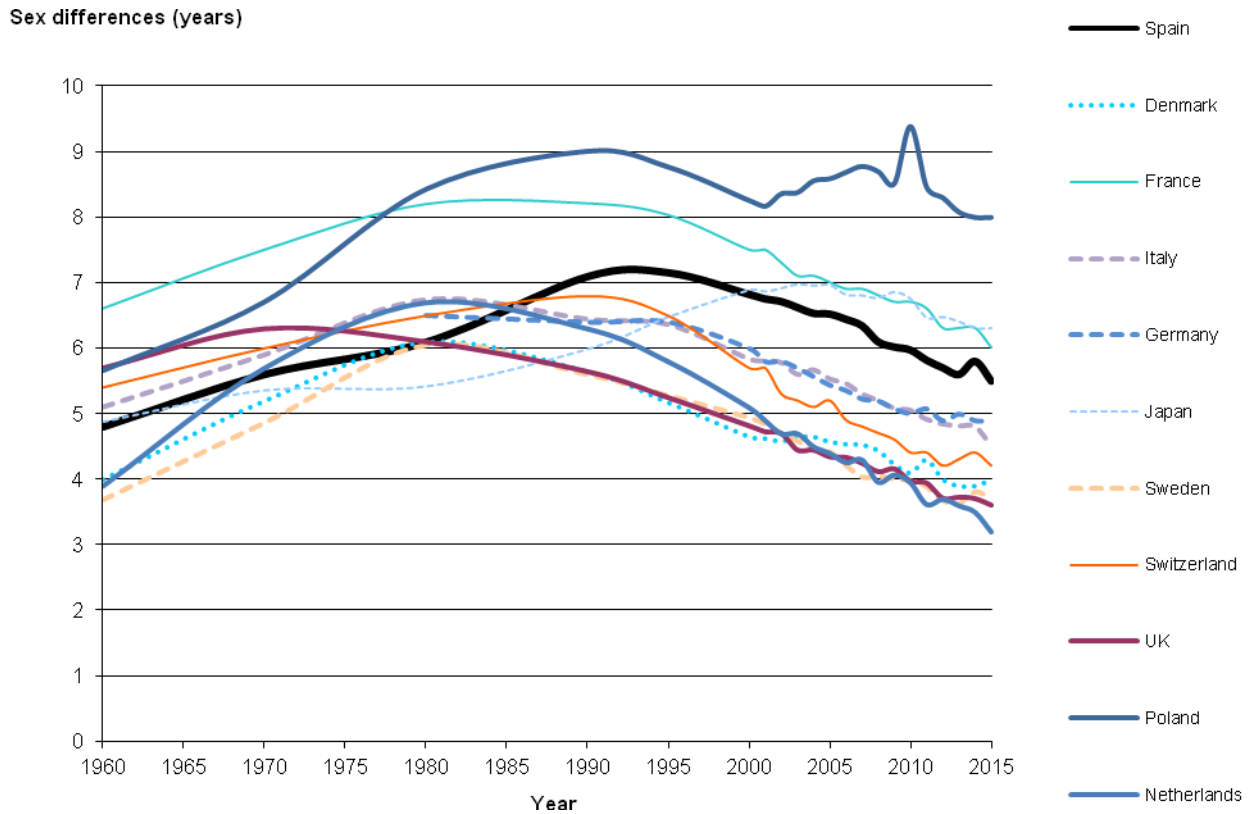
Period expectations of life at age 65 followed the same trends, declining for both males (-0.18 years) and females (-0.33 years) in 2015. Since a decrease in 1995, expectations of life for those aged 65 have increased by an average of 2.3 months a year for males and 1.6 months a year for females.

Figure B2 shows sex differences for period expectations of life at birth in the UK peaked at 6.3 years, in 1970. The gap between the sexes generally converged to 4.8 years in 2000, 4.0 in 2010 and 3.7 in 2015, although the difference has varied from year to year.

The same trend can be seen across other developing countries, with only Denmark experiencing an increase in the gender gap between 2014 and 2015. In general, the sizes of the sex differentials are currently higher in

other countries than in the UK, with Netherlands the only one lower at 3.2 years. The highest difference observed was in Poland, at 8 years.

Figure B2 Sex differences in period expectation of life at birth, selected countries, 1960-2015



A similar pattern can be seen for the difference in period life expectancy at age 65 (see Figure B3 & Table B1), which rose from 3.3 years in 1965 peaking at just below 4 years in 1983. Over the next 20 years the difference has generally converged to 3.2 years at the turn of the century and is at its closest point of 2.3 years in 2015. Whether this convergence will continue to happen is a topic for debate with some experts suggesting that the greater mortality improvements for males observed in the previous decade may have run their course and will not continue.

Figure B3 Sex differences in period expectations of life - United Kingdom
1961-2015

Sex differences (years)

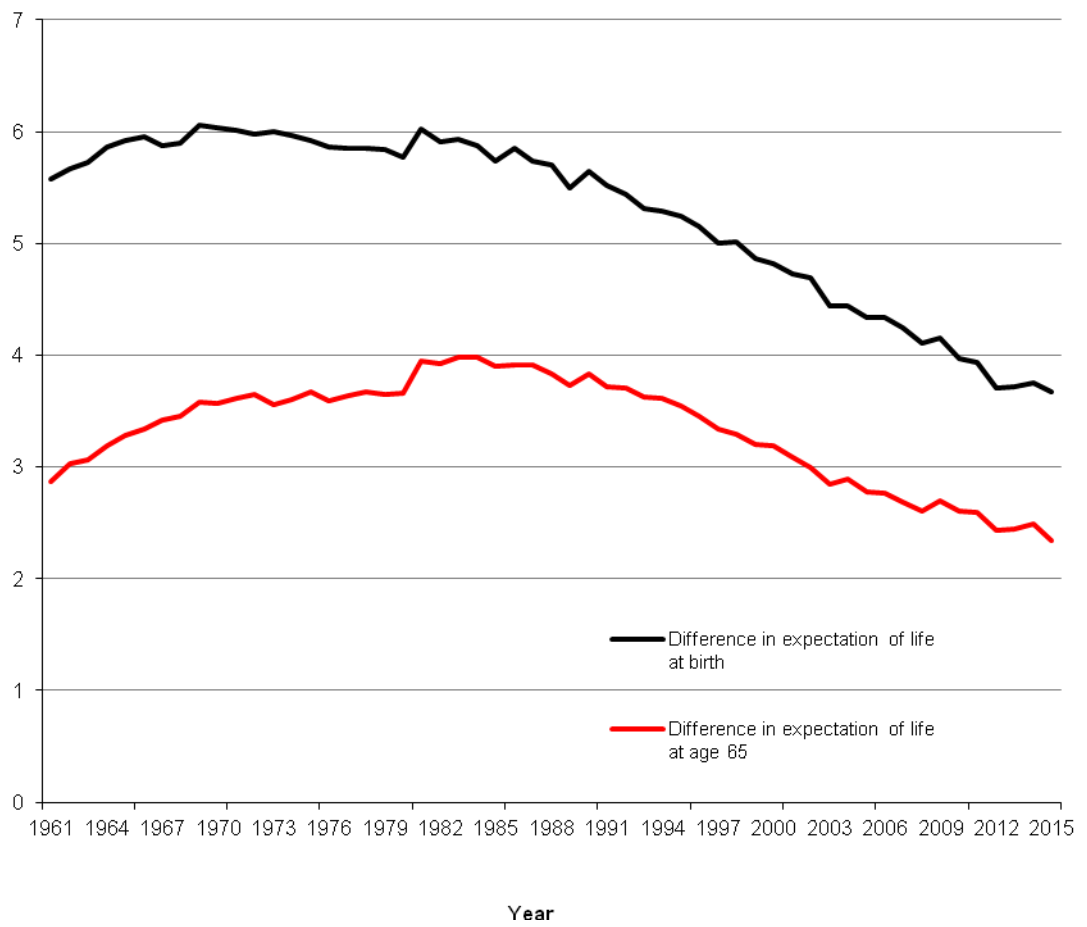


Table B1 Sex differences in period expectations of life - United Kingdom, 1981-2015

Year	Period expectation of life at birth (years)			Period expectation of life at age 65 (years)		
	Male	Female	Sex difference	Male	Female	Sex difference
1981	70.87	76.90	6.02	13.00	16.95	3.94
1982	71.05	76.96	5.90	13.03	16.95	3.92
1983	71.30	77.23	5.93	13.12	17.11	3.99
1984	71.71	77.58	5.87	13.40	17.38	3.98
1985	71.65	77.39	5.74	13.23	17.13	3.90
1986	71.85	77.70	5.85	13.41	17.33	3.92
1987	72.26	77.99	5.73	13.71	17.62	3.91
1988	72.38	78.09	5.71	13.79	17.62	3.84
1989	72.62	78.12	5.50	13.82	17.56	3.73
1990	72.88	78.52	5.65	14.03	17.86	3.84
1991	73.10	78.63	5.52	14.11	17.83	3.72
1992	73.53	78.97	5.44	14.33	18.04	3.71
1993	73.47	78.79	5.32	14.21	17.84	3.63
1994	74.05	79.34	5.28	14.65	18.27	3.62
1995	74.00	79.25	5.25	14.62	18.17	3.55
1996	74.22	79.37	5.15	14.79	18.24	3.45
1997	74.54	79.54	5.00	15.02	18.36	3.33
1998	74.74	79.76	5.02	15.23	18.52	3.30
1999	74.95	79.82	4.87	15.35	18.56	3.21
2000	75.37	80.18	4.81	15.70	18.89	3.19
2001	75.68	80.41	4.72	15.98	19.07	3.09
2002	75.82	80.52	4.70	16.10	19.10	3.00
2003	76.06	80.51	4.44	16.25	19.10	2.85
2004	76.60	81.05	4.44	16.65	19.55	2.90
2005	76.87	81.21	4.34	16.87	19.65	2.77
2006	77.17	81.51	4.33	17.17	19.93	2.76
2007	77.40	81.64	4.24	17.33	20.01	2.68
2008	77.59	81.70	4.11	17.46	20.06	2.60
2009	78.06	82.22	4.16	17.82	20.52	2.69
2010	78.39	82.36	3.97	18.00	20.60	2.61
2011	78.79	82.73	3.94	18.28	20.88	2.60
2012	78.97	82.68	3.71	18.30	20.74	2.44
2013	79.05	82.77	3.72	18.53	20.97	2.44
2014	79.26	83.01	3.75	18.60	21.09	2.49
2015	79.05	82.72	3.67	18.42	20.76	2.34

Trends in mortality improvements

Rates of improvement in standardised mortality rates for England and Wales for ages 0 to 99 inclusive have been calculated using figures from the English Life Tables (ELT) for 1910-12 onwards and the 2013-15 National Life Tables. Standardised rates of improvement in overall smoothed mortality rates have

also been calculated for the UK for ages 0 to 99 inclusive for each calendar year from 1973 to 2015 inclusive. The resulting average annual rates of decrease in mortality for various periods and age groups are given in Tables B2 and B3.

Table B2 shows that the average annualised rate of improvement in age standardised mortality rates for ages 0 to 99 over the 99-year period 1910-12 to 2013-15 was around 1.2% per year for males and around 1.1% per year for females. Over the 80 year period 1930-32 to 2013-15 the average annualised rate of improvement was 1.3% per year for both males and females. Over the 50 year period 1960-62 to 2013-15, the rates of improvement were 1.6% per year for males and 1.3% per year for females. The average rate of improvement over successive decades since 1930-32 remained relatively constant for females until 1990-92 when it began to fluctuate. For males the table shows a relatively constant lower rate over the period 1930-32 to 1970-72 followed by a period of increasing mortality improvement.

Table B2 also indicates the large differences in mortality improvement for differing age groups over differing periods and the 'ageing of mortality improvement' in the UK. In the first half of the 20th century, the highest rates of improvement were seen at the younger ages. However, from 1960-62 to the end of the century, excluding children and teenagers, the ages at which the highest rates of improvement were seen, has gradually been getting older (e.g. 40-49 over 1970/72 to 1980/82, 50-59 over 1980/82 to 1990/92 and 60-74 over 1990/2 to 2000/2. This trend ends for males between 2000/2 to 2013/15 which sees the highest rates of improvement for 20-24 year olds; females have a joint highest improvement rate of 3.3% for 20-24 year olds and 70-79 year olds.

A more detailed analysis of the pattern of changes in smoothed mortality rates over the period 1961 to 2015 also shows that these 'cohort effects' have been exhibited at older ages, with those born in the late 1920s and early 1930s consistently exhibiting greater improvements in mortality than those born either side for both males and females until the most recent years. The patterns of improvements and in particular whether there are cohort patterns are less clear for those in their 40s and 50s.

Death rates for men in their 20s and 30s rose in the mid-1980s and over the 1990s, partly attributable to deaths related to AIDS and from suicides and accidents. However, this trend has since reversed with mortality rates at most of these ages now declining and at relatively high rates at some ages, in recent years. There was also relatively little improvement for females in their 20s and early 30s during the late 1980s and early 1990s, but as for males, at these ages the rates of improvement have increased in recent years.

Table B2 Percentage annualised rate of mortality improvement for age-standardised aggregate mortality rates (using mx values from successive English Life Tables, 1910-12 to 2000-02 and Interim Life Table for England and Wales for 2013-15)

Age group	1910-12 to 1920-22	1920-22 to 1930-32	1930-32 to 1950-52	1950-52 to 1960-62	1960-62 to 1970-72	1970-72 to 1980-82	1980-82 to 1990-92	1990-92 to 2000-02	2000-02 to 2013-15	1910-12 to 2013-15
Males										
0-4	3.1%	2.8%	4.8%	3.0%	2.1%	4.3%	4.2%	3.2%	2.6%	3.5%
5-9	1.5%	2.2%	6.1%	3.1%	1.6%	4.0%	3.4%	4.7%	2.6%	3.5%
10-14	0.5%	2.0%	4.9%	3.0%	1.2%	2.6%	2.3%	3.2%	3.2%	2.8%
15-19	0.1%	0.9%	4.8%	0.1%	0.3%	1.0%	1.9%	2.5%	4.1%	2.1%
20-24	0.1%	1.3%	4.3%	1.8%	1.3%	1.4%	-0.2%	1.0%	3.7%	2.0%
25-29	0.5%	2.0%	4.0%	3.5%	1.4%	0.7%	-0.4%	0.1%	2.7%	1.9%
30-34	1.0%	2.7%	3.8%	2.7%	1.6%	1.4%	-0.2%	-0.6%	2.0%	1.8%
35-39	1.4%	2.3%	3.6%	2.2%	1.0%	1.8%	-0.1%	0.5%	1.0%	1.7%
40-44	1.8%	1.6%	2.9%	2.0%	-0.1%	2.2%	1.4%	0.9%	0.7%	1.6%
45-49	2.3%	0.5%	2.0%	1.8%	-0.4%	2.1%	2.5%	1.0%	1.5%	1.5%
50-54	2.0%	0.7%	1.0%	1.3%	0.2%	1.6%	3.0%	2.2%	1.8%	1.5%
55-59	1.9%	0.7%	0.3%	0.6%	0.9%	1.2%	3.1%	2.7%	2.0%	1.4%
60-64	1.3%	0.6%	0.1%	0.2%	0.8%	1.4%	2.3%	3.2%	2.3%	1.3%
65-69	0.9%	0.2%	0.2%	0.1%	0.3%	1.7%	1.8%	3.6%	2.9%	1.3%
70-74	0.6%	-0.1%	0.4%	0.2%	0.1%	1.5%	1.8%	2.8%	3.1%	1.1%
75-79	0.3%	-0.3%	0.4%	0.5%	0.4%	0.9%	1.8%	2.2%	3.2%	1.1%
80-84	0.1%	-0.4%	0.2%	0.9%	0.7%	0.5%	1.7%	1.9%	2.4%	0.9%
85-89	0.1%	-0.7%	0.0%	1.3%	0.8%	0.5%	1.4%	1.1%	1.7%	0.7%
90-94	0.0%	-0.8%	-0.1%	1.6%	0.6%	0.8%	0.8%	0.7%	0.9%	0.4%
95-99	-1.7%	-0.8%	0.1%	1.8%	-0.1%	1.2%	-0.2%	0.4%	0.5%	0.1%
0-99	0.9%	0.3%	0.7%	0.8%	0.5%	1.1%	1.8%	2.1%	2.3%	1.2%

Age group	1910-12 to 1920-22	1920-22 to 1930-32	1930-32 to 1950-52	1950-52 to 1960-62	1960-62 to 1970-72	1970-72 to 1980-82	1980-82 to 1990-92	1990-92 to 2000-02	2000-02 to 2013-15	1910-12 to 2013-15
Females										
0-4	3.4%	3.1%	4.9%	3.0%	2.1%	4.3%	4.2%	2.9%	2.5%	3.5%
5-9	1.5%	3.3%	7.2%	3.4%	1.5%	3.7%	3.1%	3.0%	2.6%	3.6%
10-14	0.3%	2.7%	6.5%	4.1%	1.1%	1.7%	2.4%	3.0%	2.1%	3.0%
15-19	0.2%	1.2%	6.2%	5.4%	-0.4%	1.8%	1.1%	1.5%	2.9%	2.7%
20-24	-0.4%	1.4%	5.5%	6.4%	0.6%	2.0%	1.1%	1.1%	2.5%	2.6%
25-29	0.0%	1.8%	4.8%	6.2%	2.0%	1.4%	1.7%	0.7%	1.3%	2.4%
30-34	0.9%	2.1%	4.3%	4.5%	2.1%	1.6%	1.5%	0.6%	1.1%	2.3%
35-39	1.8%	2.0%	3.7%	2.9%	1.7%	2.0%	1.3%	0.9%	0.9%	2.1%
40-44	2.3%	1.7%	3.0%	2.1%	0.7%	2.4%	2.0%	0.9%	1.1%	1.9%
45-49	2.4%	1.2%	2.5%	1.8%	-0.1%	2.2%	2.3%	1.1%	1.7%	1.7%
50-54	2.0%	1.2%	2.0%	1.7%	-0.1%	1.3%	2.6%	1.3%	1.8%	1.6%
55-59	2.1%	0.9%	1.8%	1.6%	0.3%	0.6%	2.3%	2.1%	1.7%	1.5%
60-64	1.5%	0.8%	1.6%	1.5%	0.8%	0.5%	1.4%	2.9%	1.8%	1.4%
65-69	1.2%	0.6%	1.3%	1.3%	1.0%	1.0%	0.9%	2.8%	2.3%	1.4%
70-74	1.0%	0.4%	1.1%	1.3%	1.1%	1.4%	1.1%	2.0%	2.5%	1.3%
75-79	0.6%	0.1%	0.8%	1.4%	1.2%	1.5%	1.5%	1.4%	2.5%	1.2%
80-84	0.3%	-0.1%	0.5%	1.4%	1.4%	1.2%	1.9%	1.1%	1.8%	1.0%
85-89	-0.1%	-0.5%	0.3%	1.2%	1.3%	0.8%	2.1%	0.5%	1.3%	0.8%
90-94	-0.1%	-0.6%	0.2%	0.8%	1.1%	1.0%	1.5%	0.0%	0.8%	0.5%
95-99	-0.4%	-0.6%	0.6%	0.2%	0.2%	2.1%	0.3%	-0.3%	0.4%	0.3%
0-99	0.8%	0.3%	1.1%	1.3%	1.1%	1.2%	1.6%	1.1%	1.6%	1.1%

Table B3 shows the average annualised rates of improvement in the smoothed mortality rates for the United Kingdom used as the basis for analysing and projecting trends for various periods between 1975 and 2015. The annualised improvements in the standardised mortality rates between 1975 and 2015 were around 1.9% per year for males and 1.4% per year for females. The rate of improvement over the latter half of this period was higher than over the first half, particularly for males. These figures are similar to those derived from ELT mortality rates in Table B2. There are some differences because the data relate to the UK rather than England & Wales and also use revised population estimates following the 2001 and 2011 censuses, whereas the English Life Table data for 1990-92 and 2002-02 are based on pre-revision population estimates.

Table B3 Annualised rates of improvement in standardised smoothed UK mortality rates

Period	Decrease in standardised smoothed UK mortality rate			
	Ages 0-99		Ages 50-89	
	Males	Females	Males	Females
1975-2015	1.9%	1.4%	2.1%	1.7%
1975-1995	1.4%	1.3%	1.6%	1.5%
1995-2015	2.3%	1.5%	2.6%	1.8%
1990-2015	2.2%	1.4%	2.4%	1.7%

Mortality by cause of death

Figures B4 and B5 show the age standardised mortality rates for the five leading causes of death in England and Wales for males and females respectively between 2001 and 2015. Improvements in mortality are shown to have been driven by more effective prevention and treatment of Ischaemic heart disease for which the age standardised mortality rate fell by 52% and 57% for males and females respectively. Age standardised rates for Cerebrovascular disease for both males and females have also dropped by 53% and 52% respectively over this time period. In the last few years the significant decline in mortality from circulatory diseases appears to have slowed down. Whether this will continue in the future is difficult to predict.

From 2001 males have seen a drop in the age standardised mortality rates for chronic lower respiratory diseases and lung cancers by around 15% and 27% respectively. Another factor for the recent decrease in the expectations of life gender gap is females not experiencing these declines over the last 15 years. Over the same time period they have seen increases of 17% and 7% respectively.

Figure B4 and B5 also shows that from the turn of the century up until 2010 rates of dementia and Alzheimer's have been slowly increasing. Since 2011, the rate of this increase has accelerated, with dementia and Alzheimer's overtaking Ischaemic heart diseases as the leading cause of death in 2015. Elizabeth McLaren from the Vital Statistics Outputs Branch at ONS stated that "In 2015, dementia and Alzheimer's disease became the leading cause of death in part because people are simply living longer but also because of improved detection and diagnosis. An updating of the international rules for determining the underlying cause of death is also a factor, with the increase in cases attributed to these conditions accompanied by falls in other causes." ¹

Figure B4 Male age-standardised mortality rates for England and Wales, top five leading causes of death, 2001 to 2015

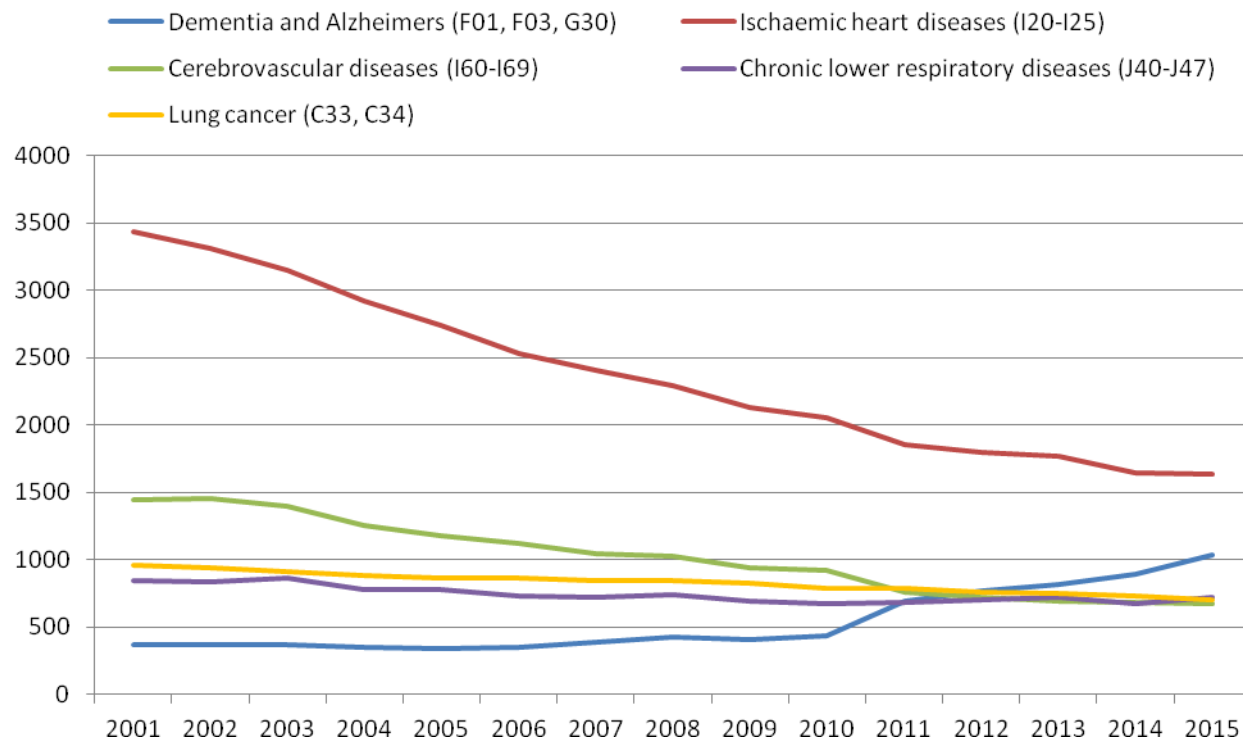


Figure B5 Female age-standardised mortality rates for England and Wales, for top 5 leading causes of death, 2001 to 2015

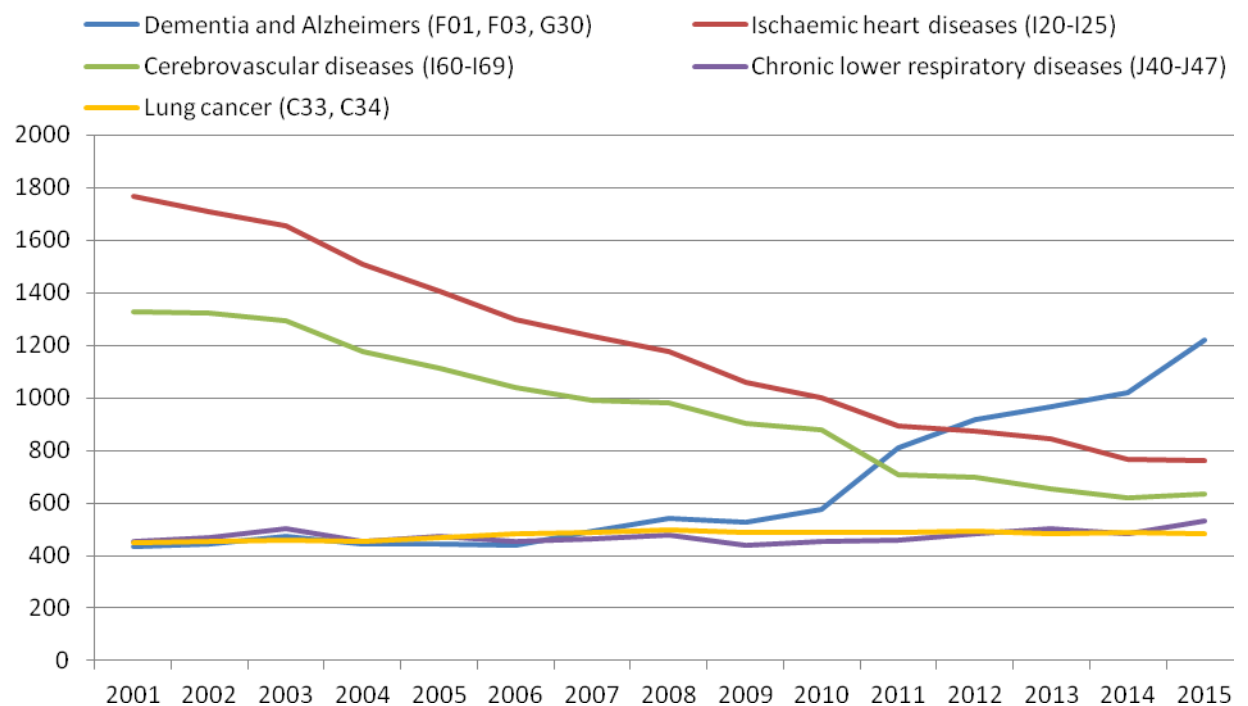
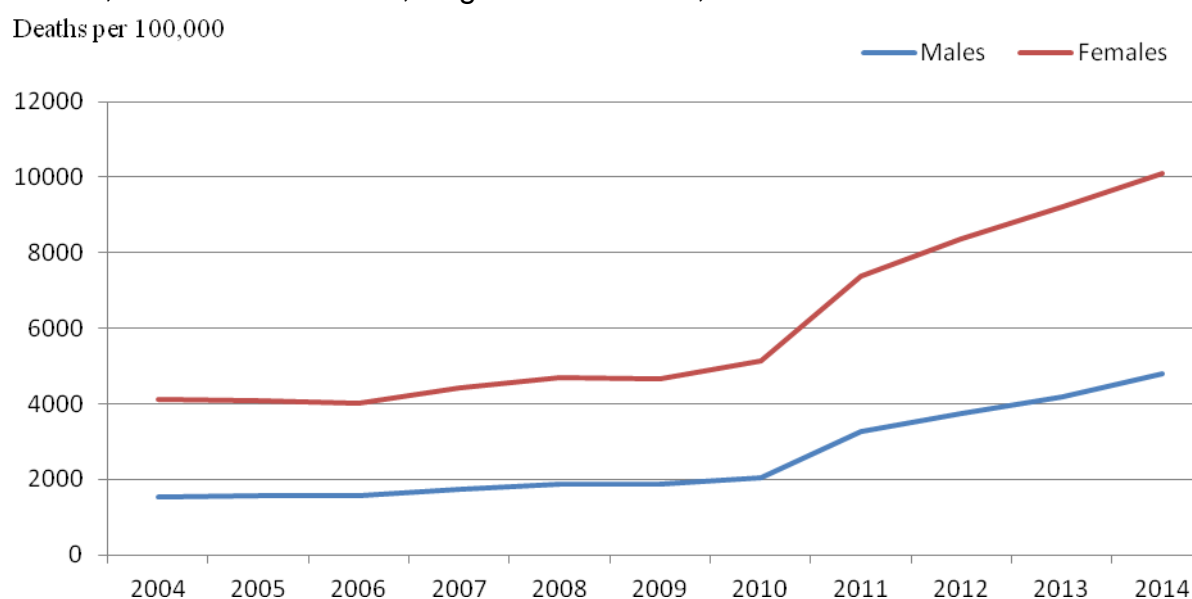


Figure B6 shows the registered deaths attributed to dementia and Alzheimers for males and females in England and Wales, for the years 2004-2014. The rates remained relatively steady between the years 2004-2010, however between 2010-2014 rates increased dramatically by 134% and 93% for males and females respectively.

This trend is not just restricted to England and Wales. A recently published article examining the evidence of modifiable risk factors for cognitive decline and dementia, estimated that in 2015, 47 million people worldwide were living with dementia and this number is projected to triple by 2050². It also points out that currently there is an absence of a disease modifying treatment or cure. If this persists and the numbers of registered deaths continue to increase at the rate we have seen in the last 5 years, then dementia and Alzheimer’s will have increasingly larger affects on overall mortality figures and should be monitored very closely.

Figure B6 – Death rates for registered deaths from Dementia and Alzheimer’s disease, Males and Females, England and Wales, 2004-2014



Obesity

The impact of obesity levels on future mortality has not, to date, been clear. The main opinion from the Expert Group Panel was that the level of obesity will increase in the future but have little or no effect on life expectancy.

It is unlikely that any possible negative effects of obesity on mortality will be seen within this next 25 year projection period; however, it will be important to continue the monitoring of trends in deaths from cardiovascular diseases and diabetes to inform future projections.

ANNEX C

ASSUMPTIONS FOR THE CONSTITUENT COUNTRIES OF THE UNITED KINGDOM - ENGLAND

ONS method

For each individual country of the United Kingdom the projections will be made using the same projected mortality rate reductions as are assumed for the United Kingdom, adjusted according to the relative experience for that country compared to that for the UK as a whole, as appropriate. These reduction factors are applied successively to the age-specific base mortality rates for the calendar year 2016 for each country. To obtain the 2016 base mortality rates for each constituent country, the derived United Kingdom death rates for 2016 are adjusted at each age in proportion to that country's experience relative to the United Kingdom during 2013-2015, the latest three year period for which mortality data by age and sex are available.

The basic analysis of past trends in mortality rates on which the assumptions of future mortality improvement are based is carried out initially on UK data. Having done this analysis at UK level, assumptions on the future rates of improvement are set for each country individually after a comparison of the experience of that country to the UK as a whole. It is proposed to use the same age and sex-specific rates of mortality improvement for England, Wales and Northern Ireland; for Scotland different, generally lower, rates of improvement are proposed for years before 2041 for some ages for males and for females. Having derived improvement rates for Scotland, the rates of improvement derived for the other constituent countries are then adjusted so that the weighted rates of improvement assumed for 2016 for the countries combined are the same as those initially derived for the UK as a whole.

UoS method

Under the UoS method the model is fitted separately for Scotland, with improvement rates driven by the input data, and fitted to UK minus Scotland data to derive improvement rates and mortality rates for England, Wales and Northern Ireland combined. The mortality rates will then be adjusted in line with recent mortality experience for England, Wales and Northern Ireland compared to that for those countries combined to produce projected mortality rates for England, Wales and Northern Ireland.

The resulting proposed assumptions for England are given in the following pages.

Comparisons of mortality experience between England and the UK

Figures C1a and C2a show the differences in the expectations of life for the UK and the corresponding figures for England. The expectations of life are calculated using data for single calendar years for the UK and for England.

The charts show that for males, after a period of almost unchanging differentials since the early 1980s, the differentials have been increasing in recent years. In particular the differential in life expectancy at birth, which dipped in 2014, increased considerably in 2015. For females, the differentials have been relatively constant over the whole period since the early 1980s although there is similar evidence of increasing differentials in 2015.

For males the differentials are higher at lower ages and decrease with age, for females the differentials at ages 20, 40 and 60 were the same in 2014 and 2015.

Although there is some evidence that higher rates of mortality improvement might be assumed for England than for the UK as a whole for younger ages, these have relatively little effect on the projections. It is proposed to assume the same rates of improvement for England as for the UK, after any adjustments made to allow for changes made for other countries.

Figure C1a Difference between life expectancy in the UK and England at selected ages, Males

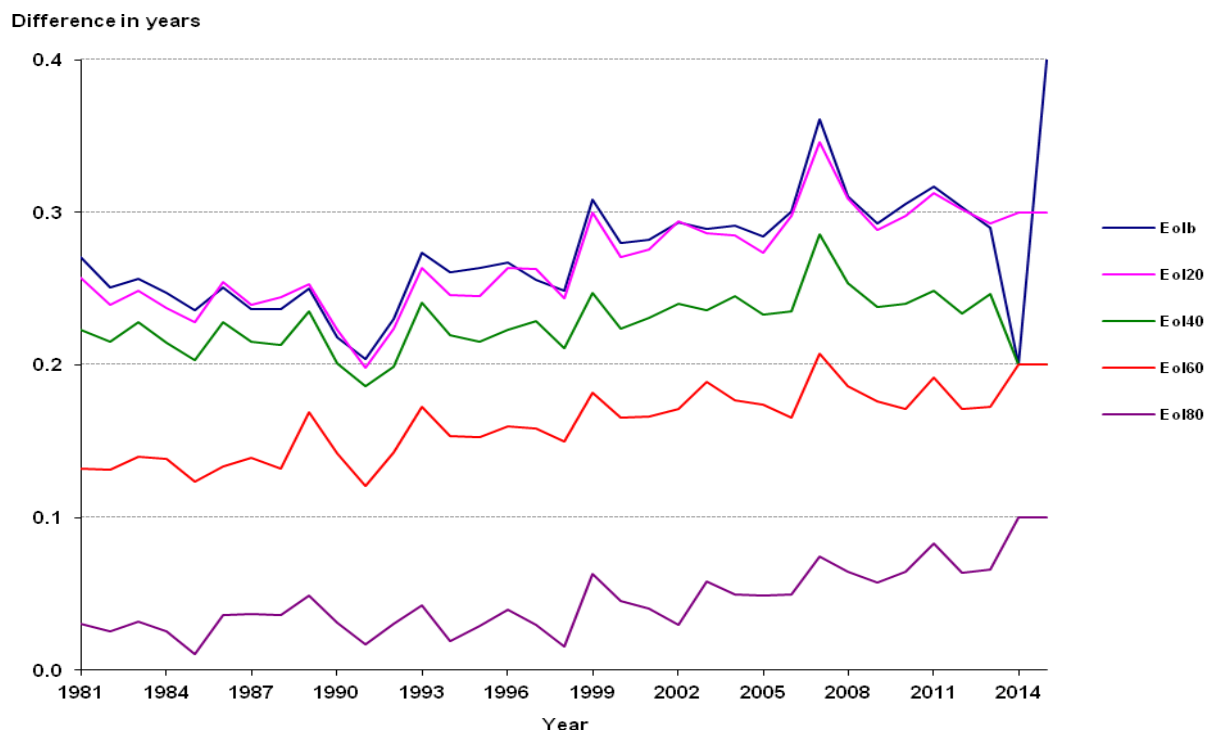
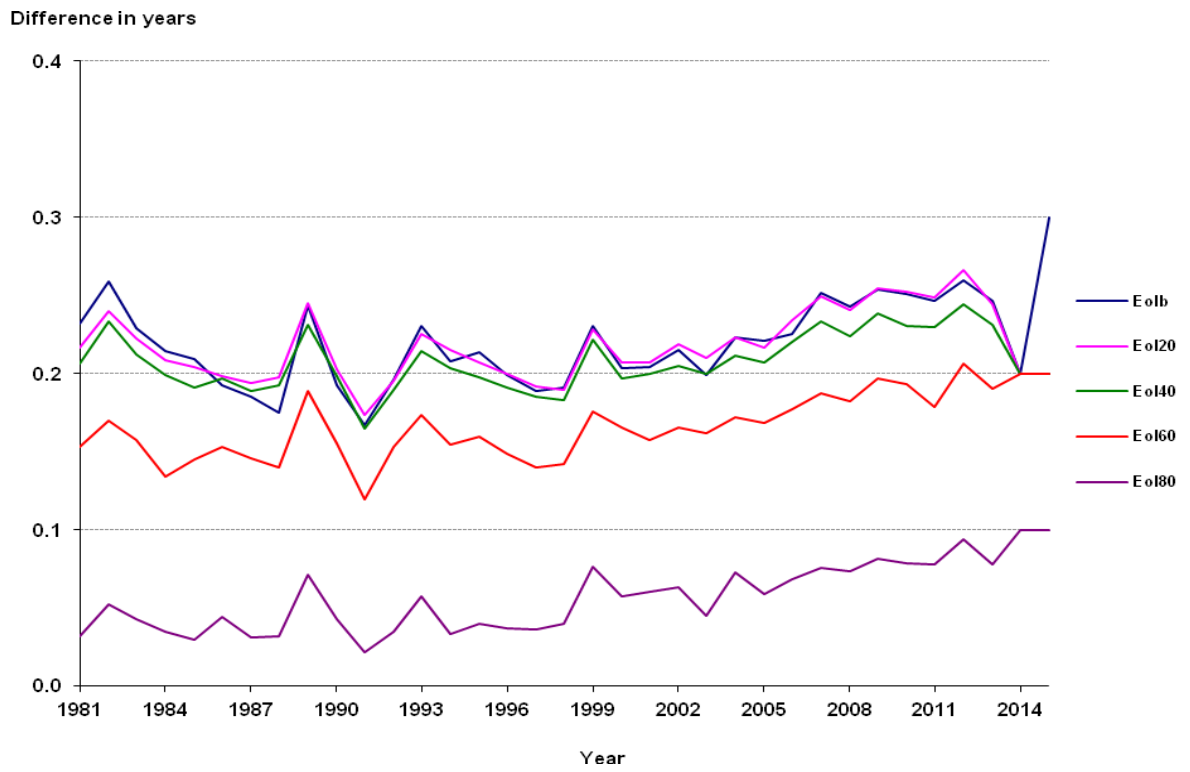


Figure C2a Difference between life expectancy in the UK and England at selected ages, Females



Comparisons of the proposed 2016-based assumptions for England with those from the 2014-based projections for England for the current ONS method are shown in Figures C3a C4a and Table C1a.

Figure C3a 2014-based and proposed 2016-based period expectation of life at birth, England

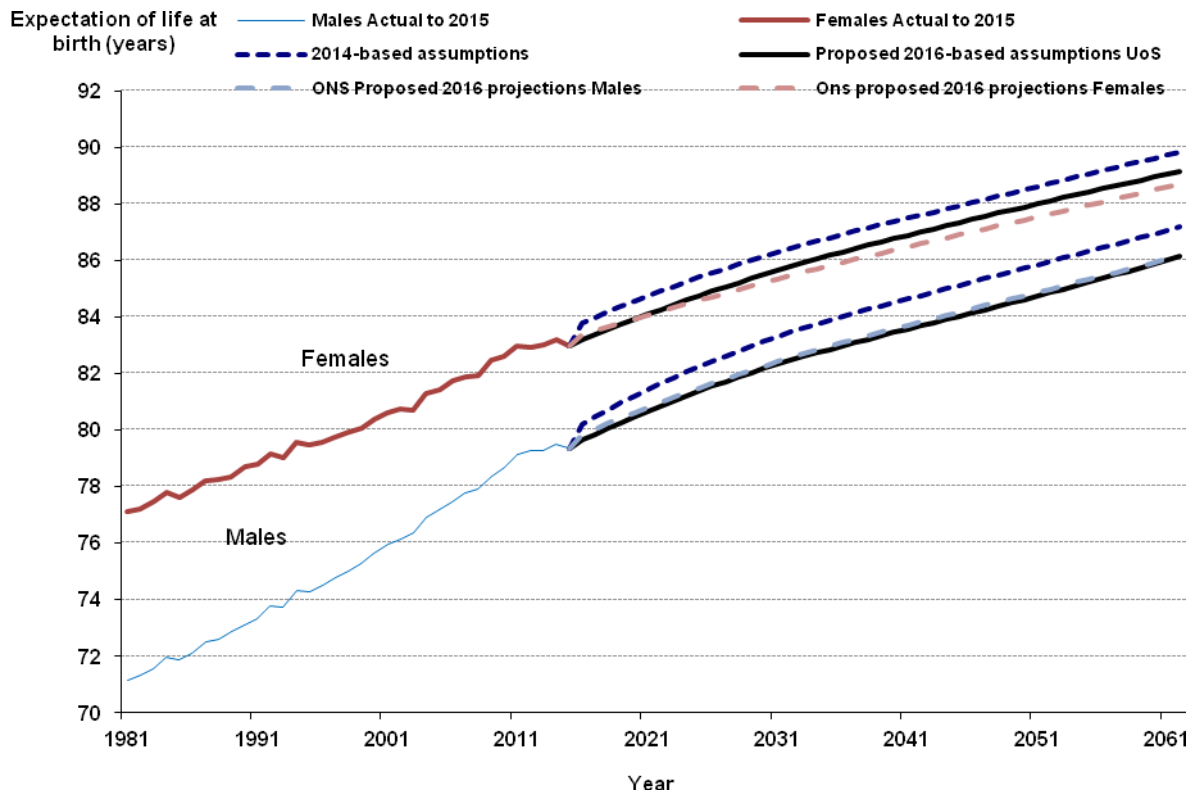


Figure C4a 2014-based and proposed 2016-based period expectation of life at age 65, England

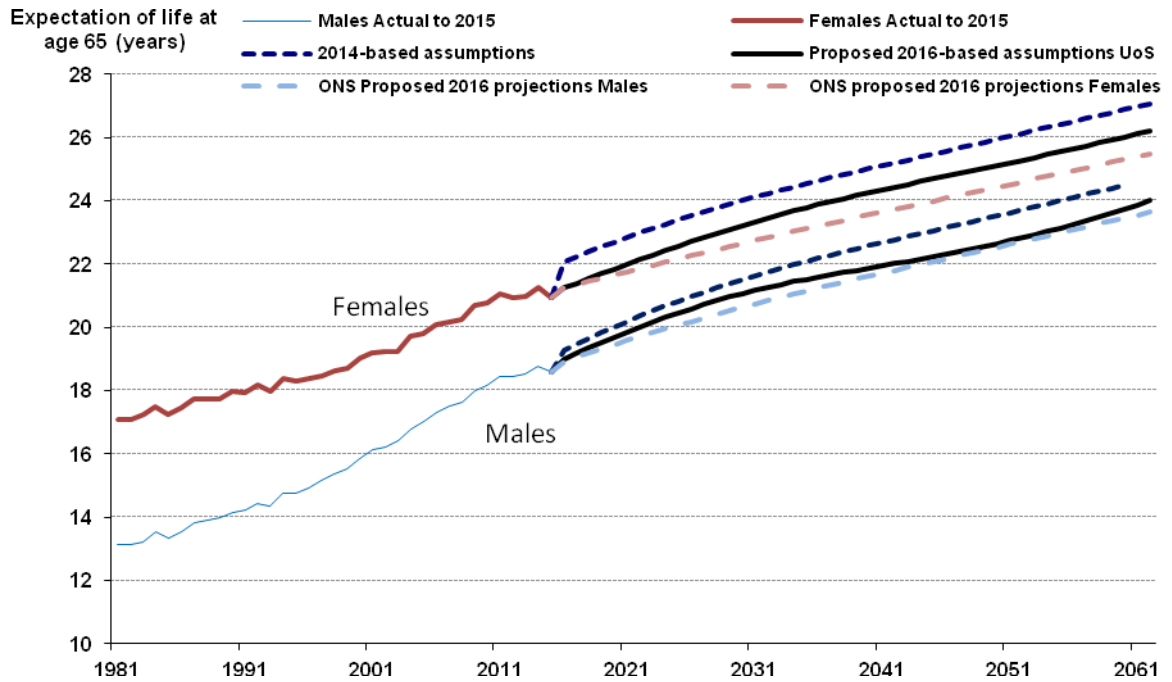


Table C1a 2016-based proposed expectation of life compared with 2014-based projection figures – England, ONS method

Year	Males				Females			
	Age 0		Age 65		Age 0		Age 65	
	Proposed 2016 based EoL	Change over 2014-based projection	Proposed 2016 based EoL	Change over 2014-based projection	Proposed 2016 based EoL	Change over 2014-based projection	Proposed 2016 based EoL	Change over 2014-based projection
2016	79.84	-0.38	18.92	-0.34	83.37	-0.43	21.26	-0.83
2026	81.64	-0.79	20.18	-0.50	84.71	-0.84	22.25	-1.27
2041	83.70	-0.93	21.71	-0.77	86.47	-1.01	23.64	-1.46
2051	84.87	-0.98	22.62	-0.81	87.54	-1.07	24.51	-1.52

Comparisons of the proposed 2016-based assumptions for England for the UoS method with those from the 2014-based projections for England are shown in Figures C3a C4a and Table C2a.

Table C2a 2016-based proposed expectation of life compared with 2014-based projection figures, England, UoS method

Year	Males				Females			
	Age 0		Age 65		Age 0		Age 65	
	Proposed 2016 based EoL	Change over 2014-based projection	Proposed 2016 based EoL	Change over 2014-based projection	Proposed 2016 based EoL	Change over 2014-based projection	Proposed 2016 based EoL	Change over 2014-based projection
2016	79.64	-0.58	19.00	-0.26	83.20	-0.60	21.24	-0.84
2026	81.56	-0.87	20.59	-0.09	84.91	-0.65	22.71	-0.82
2041	83.57	-1.07	21.94	-0.54	86.89	-0.60	24.34	-0.76
2051	84.74	-1.12	22.74	-0.69	88.00	-0.61	25.20	-0.84

Comparison of ONS and UoS projections

Overall the UoS method projects lower period life expectancies at birth than the ONS method for males of between 0.1 and 0.2 years over the 35 year period shown, whereas the period life expectancy at age 65 are higher (by between 0.1 and 0.4 years). For females the period life expectancies at birth and at age 65 are higher under the UoS method, apart from 2016, with the projected UoS life expectancies increasing faster than the ONS projections and more so at age 65 than at birth.

The patterns and magnitude of the differences are similar to those exhibited for the projections for Wales and for Northern Ireland.

ANNEX C

ASSUMPTIONS FOR THE CONSTITUENT COUNTRIES OF THE UNITED KINGDOM - WALES

ONS method

For each individual country of the United Kingdom the projections will be made using the same projected mortality rate reductions as are assumed for the United Kingdom, adjusted according to the relative experience for that country compared to that for the UK as a whole, as appropriate. These reduction factors are applied successively to the age-specific base mortality rates for the calendar year 2016 for each country. To obtain the 2016 base mortality rates for each constituent country, the derived United Kingdom death rates for 2016 are adjusted at each age in proportion to that country's experience relative to the United Kingdom during 2013-2015, the latest three year period for which mortality data by age and sex are available.

The basic analysis of past trends in mortality rates on which the assumptions of future mortality improvement are based is carried out initially on UK data. Having done this analysis at UK level, assumptions on the future rates of improvement are set for each country individually after a comparison of the experience of that country to the UK as a whole. It is proposed to use the same age and sex-specific rates of mortality improvement for England, Wales and Northern Ireland; for Scotland different, generally lower, rates of improvement are proposed for years before 2041 for some ages for males and for females. Having derived improvement rates for Scotland, the rates of improvement derived for the other constituent countries are then adjusted so that the weighted rates of improvement assumed for 2016 for the countries combined are the same as those initially derived for the UK as a whole.

UoS method

Under the UoS method the model is fitted separately for Scotland, with improvement rates driven by the input data, and fitted to UK minus Scotland data to derive improvement rates and mortality rates for England, Wales and Northern Ireland combined. The mortality rates will then be adjusted in line with recent mortality experience for England, Wales and Northern Ireland compared to that for those countries combined to produce projected mortality rates for England, Wales and Northern Ireland.

Comparisons of mortality experience between Wales and the UK

Figures C1b and C2b show the differences in the expectations of life for the UK and the corresponding figures for Wales. The expectations of life are calculated using data for single calendar years for the UK and for Wales. The charts show that during the 1980s there was a convergence of expectations of life with those of the UK at most ages followed by a rapid fall in the early 1990s back to the differentials seen in the early 1980s. Since the mid 1990s the differentials with the UK have varied around relatively constant levels for males until 2006 after which there appears to have been an increase in the differentials. For females there was a continuing divergence during the late 1990s, but the differentials appear to have remained at relatively constant levels since during the 21st century. Overall there appears to be little firm evidence that different assumptions should be used for Wales than for England or for the UK. Therefore, it is proposed to assume the same rates of improvement for Wales as for the UK, after any adjustments made to allow for changes in made for other countries.

Figures C3b and C4b and Table C1b give comparisons of the proposed 2016-based assumptions for Wales with those from the 2014-based projections for Wales.

Figure C1b Difference between life expectancy in the UK and Wales at selected ages, Males

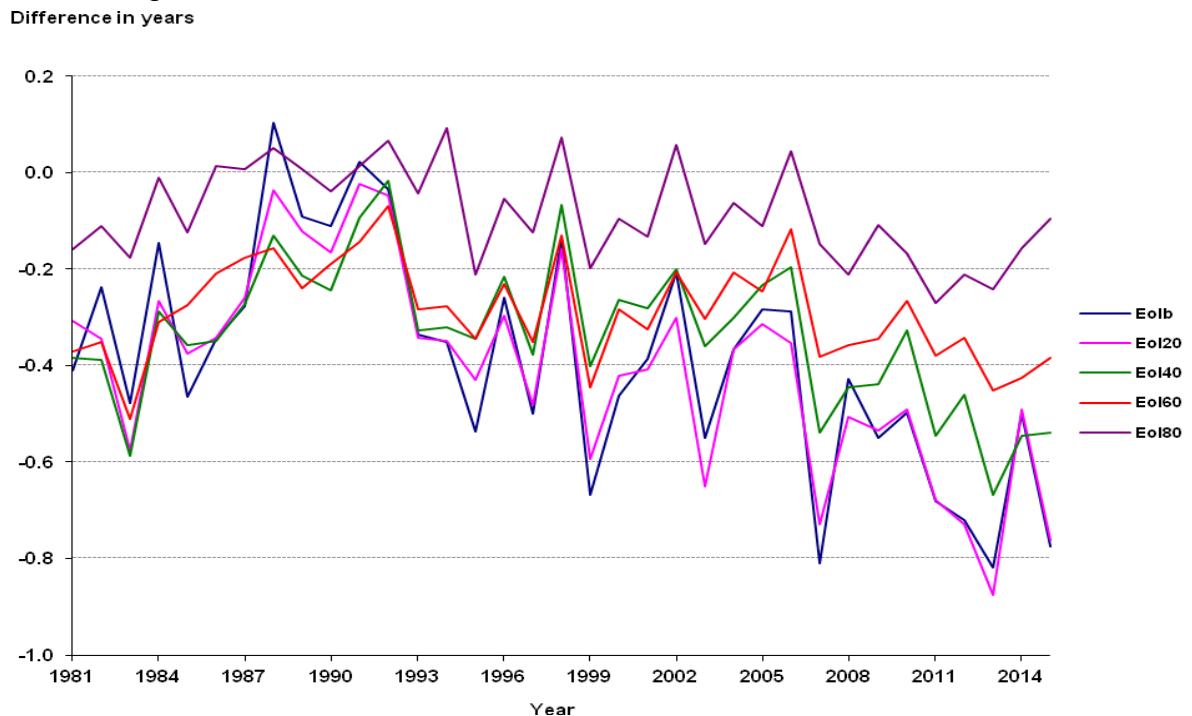
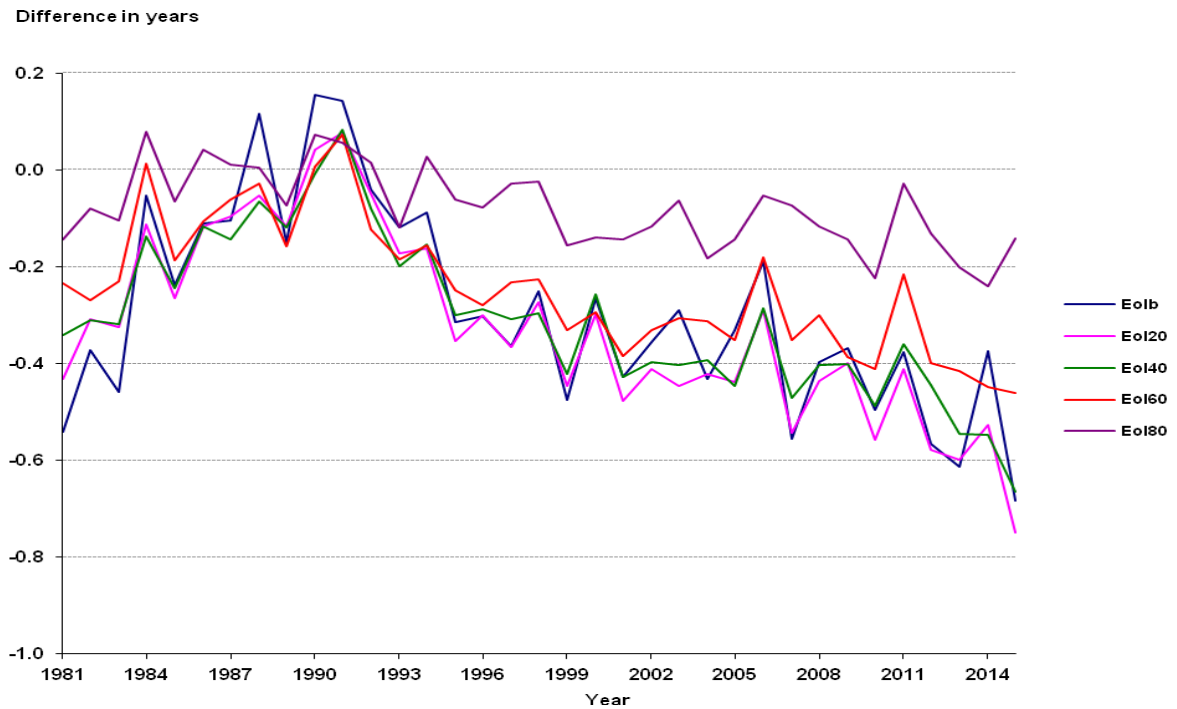


Figure C2b Difference between life expectancy in the UK and Wales at selected ages, Female



Figures C3b and C4b and Table C1b give comparisons of the proposed 2014-based assumptions for Wales with those from the 2016-based projections for Wales.

Figure C3b 2014-based and proposed 2016-based period expectation of life at birth

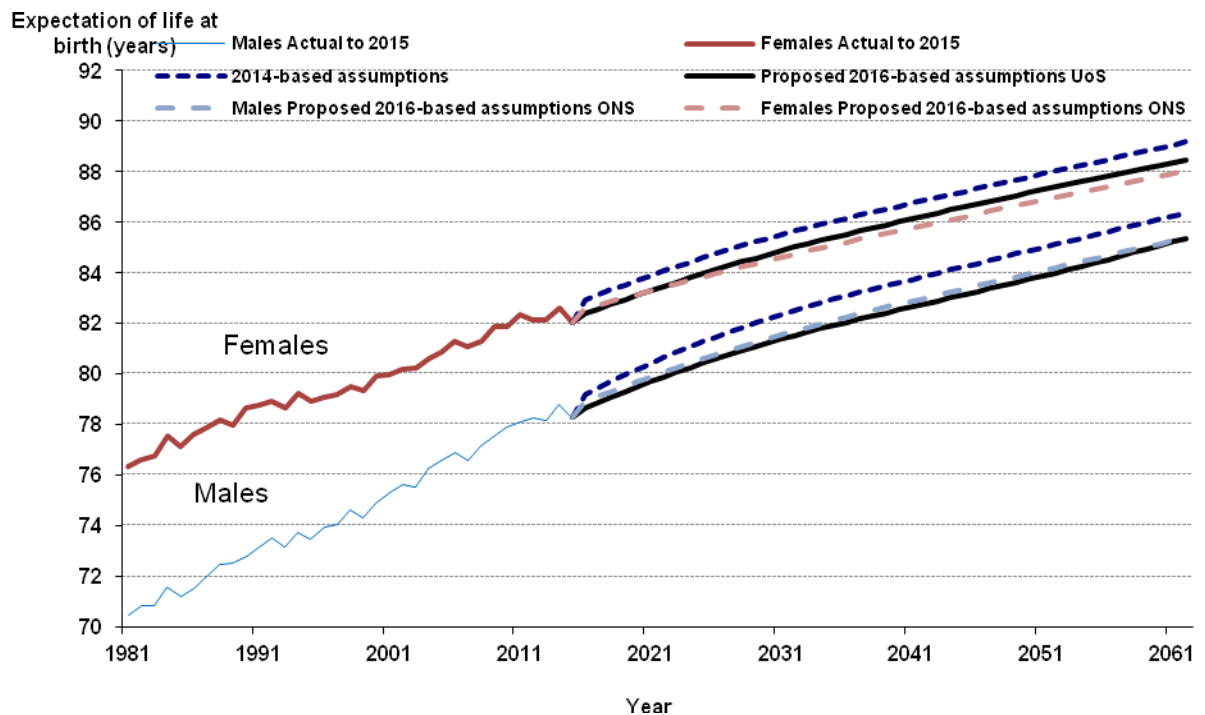


Figure C4b 2014-based and proposed 2016-based period expectation of life at age 65

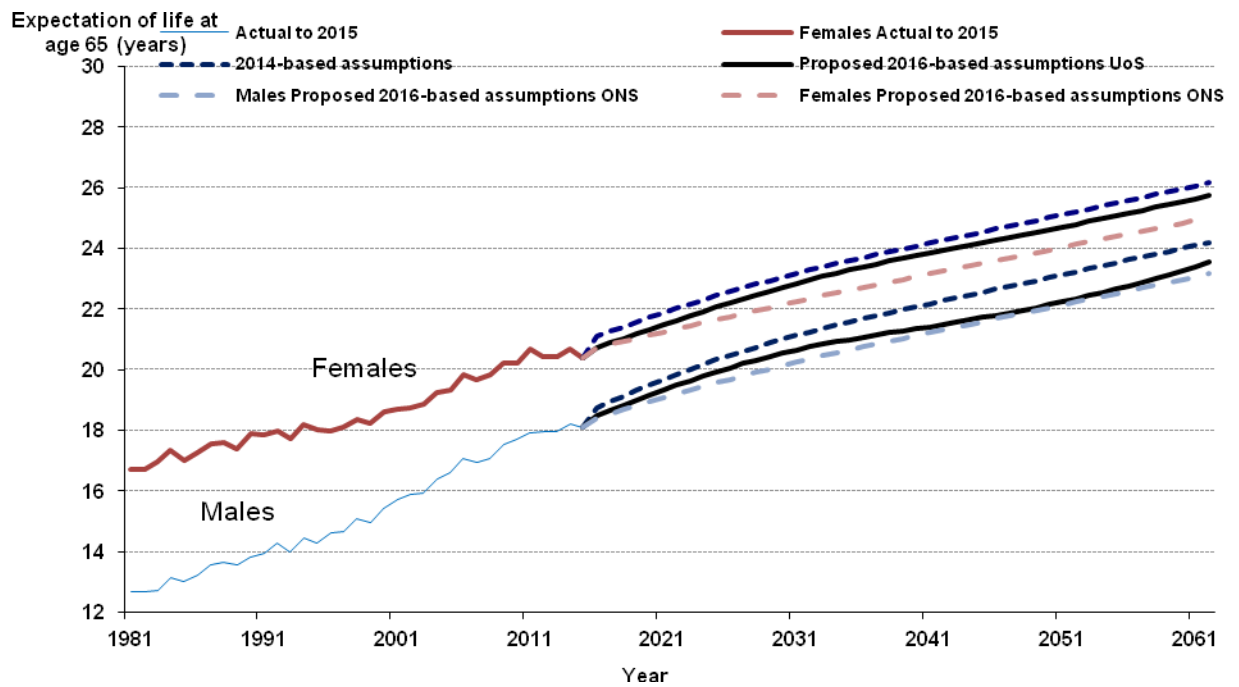


Table C1b ONS 2014-based proposed expectation of life compared with 2016-based projection figures – Wales, ONS method

Year	Males				Females			
	Age 0		Age 65		Age 0		Age 65	
	Proposed UoS 2016 based EoL	Change over 2014-based based projection	Proposed UoS 2016 based EoL	Change over 2014-based based projection	Proposed UoS 2016 based EoL	Change over 2014-based based projection	Proposed UoS 2016 based EoL	Change over 2014-based based projection
2016	78.90	-0.29	18.41	-0.35	82.59	-0.34	20.74	-0.37
2026	80.76	-0.71	19.68	-0.79	83.98	-0.78	21.75	-0.81
2041	82.88	-0.86	21.23	-0.95	85.78	-0.98	23.16	-1.01
2051	84.09	-0.91	22.14	-0.99	86.87	-1.04	24.04	-1.07

Table C2b 2014-based proposed expectation of life compared with 2016-based projection figures – Wales, UoS method

Year	Males				Females			
	Age 0		Age 65		Age 0		Age 65	
	Proposed UoS 2016 based EoL	Change over 2014-based projection	Proposed UoS 2016 based EoL	Change over 2014-based projection	Proposed UoS 2016 based EoL	Change over 2014-based projection	Proposed UoS 2016 based EoL	Change over 2014-based projection
2016	78.65	-0.54	18.48	-0.28	82.40	-0.54	20.72	-0.38
2026	80.60	-0.86	20.07	-0.39	84.13	-0.63	22.21	-0.36
2041	82.66	-1.08	21.42	-0.75	86.14	-0.61	23.85	-0.32
2051	83.88	-1.12	22.24	-0.89	87.29	-0.62	24.71	-0.40

Comparison of ONS and UoS projections

Overall the UoS method projects lower period life expectancies at birth than the ONS method for males at around 0.2 years over the 35 year period shown, whereas the period life expectancy at age 65 are higher (by between 0.0 and 0.4 years). For females the period life expectancies at birth and at age 65 are higher under the UoS method, apart from 2016, with the projected UoS life expectancies increasing faster than the ONS projections and more so at age 65 than at birth.

The patterns and magnitude of the differences are similar to those exhibited for the projections for England and for Northern Ireland.

ANNEX C ASSUMPTIONS FOR THE CONSTITUENT COUNTRIES OF THE UNITED KINGDOM - SCOTLAND

ONS method

For each individual country of the United Kingdom the projections will be made using the same projected mortality rate reductions as are assumed for the United Kingdom, adjusted according to the relative experience for that country compared to that for the UK as a whole, as appropriate. These reduction factors are applied successively to the age-specific base mortality rates for the calendar year 2016 for each country. To obtain the 2016 base mortality rates for each constituent country, the United Kingdom death rates are adjusted at each age in proportion to that country's experience relative to the United Kingdom during 2013-2015, the latest three year period for which mortality data by age and sex are available.

The basic analysis of past trends in mortality rates on which the assumptions of future mortality improvement are based is carried out initially on UK data. Having done this analysis at UK level, assumptions on the future rates of improvement are set for each country individually after a comparison of the experience of that country to the UK as a whole. It is proposed to use the same age and sex-specific rates of mortality improvement for England, Wales and Northern Ireland; for Scotland different, generally lower, rates of improvement are proposed for years before 2041 for some ages for males and for females. Having derived improvement rates for Scotland, the rates of improvement derived for the other constituent countries are then adjusted so that the weighted rates of improvement assumed for 2016 for the countries combined are the same as those initially derived for the UK as a whole.

UoS method

Under the UoS method the model is fitted separately for Scotland, with improvement rates driven by the input data, and fitted to UK minus Scotland data to derive improvement rates and mortality rates for England, Wales and Northern Ireland combined. The mortality rates will then be adjusted in line with recent mortality experience for England, Wales and Northern Ireland compared to that for those countries combined to produce projected mortality rates for England, Wales and Northern Ireland.

The resulting proposed assumptions for Scotland are given in the following pages.

Comparisons of mortality experience between Scotland and the UK

Figures C1c and C2c show the differences in the expectations of life for the UK and the corresponding figures for Scotland. The expectations of life are calculated using data for single calendar years for the UK and for Scotland. Expectations of life for males in Scotland have generally continued to diverge from those in the UK since 1981 until around 2008. In general, the rate of divergence appeared to have been higher for younger ages than older ages, although there has been some convergence in recent years at young ages. The differentials are lower at the older ages. Thus, there is some evidence of a continuing divergence in mortality experience of Scottish males compared to the UK at younger ages and middle ages, but less so at older ages. It is proposed to assume different, usually lower, rates of improvement in the first 25 years of the projections for males at some ages compared to the assumptions for the UK, as has been done in previous projections. For females, differentials were generally stable in the 1980s and 1990s but began to diverge from the UK from the late 1990s, since then there has been some convergence in the most recent years. Recent projections have assumed lower rates of improvement for some ages for Scotland than for the UK. It is likely that this will be the case again for the 2016-based projections, but this requires further investigation and discussion with National Records of Scotland.

A set of improvement rates for Scottish males and females has been derived using the methodology adopted in recent past ONS projections and the figures in this Annex are based on those assumptions. However, the final assumptions to be adopted will be decided in consultation with National Records of Scotland (NRS).

Figure C1c Difference between life expectancy in the UK and Scotland at selected ages, Males

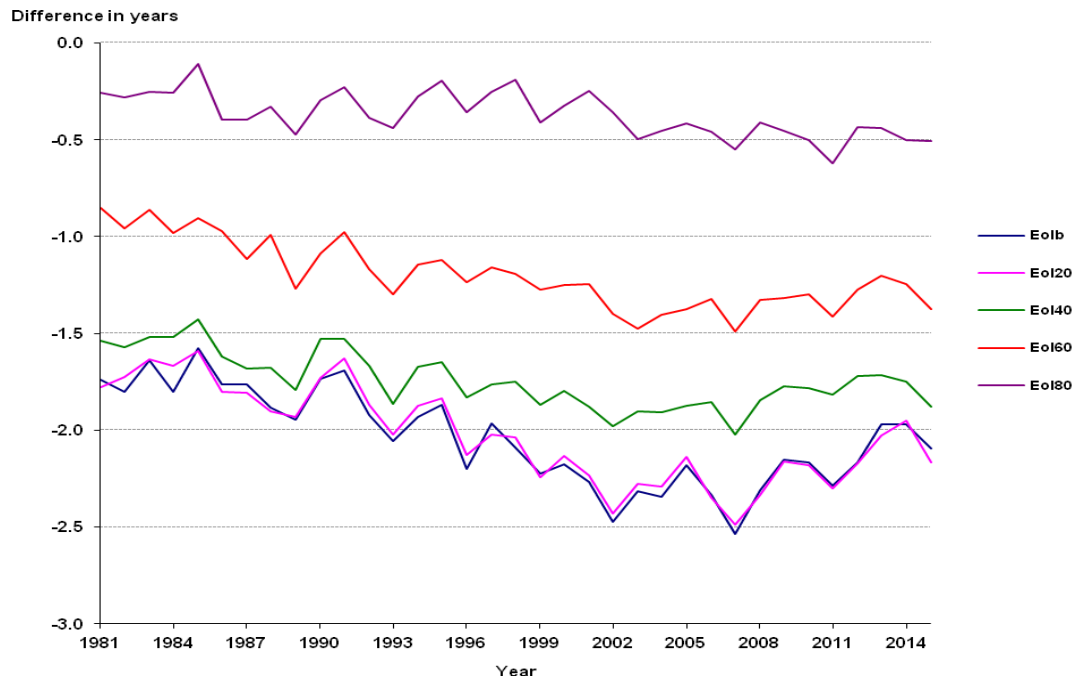
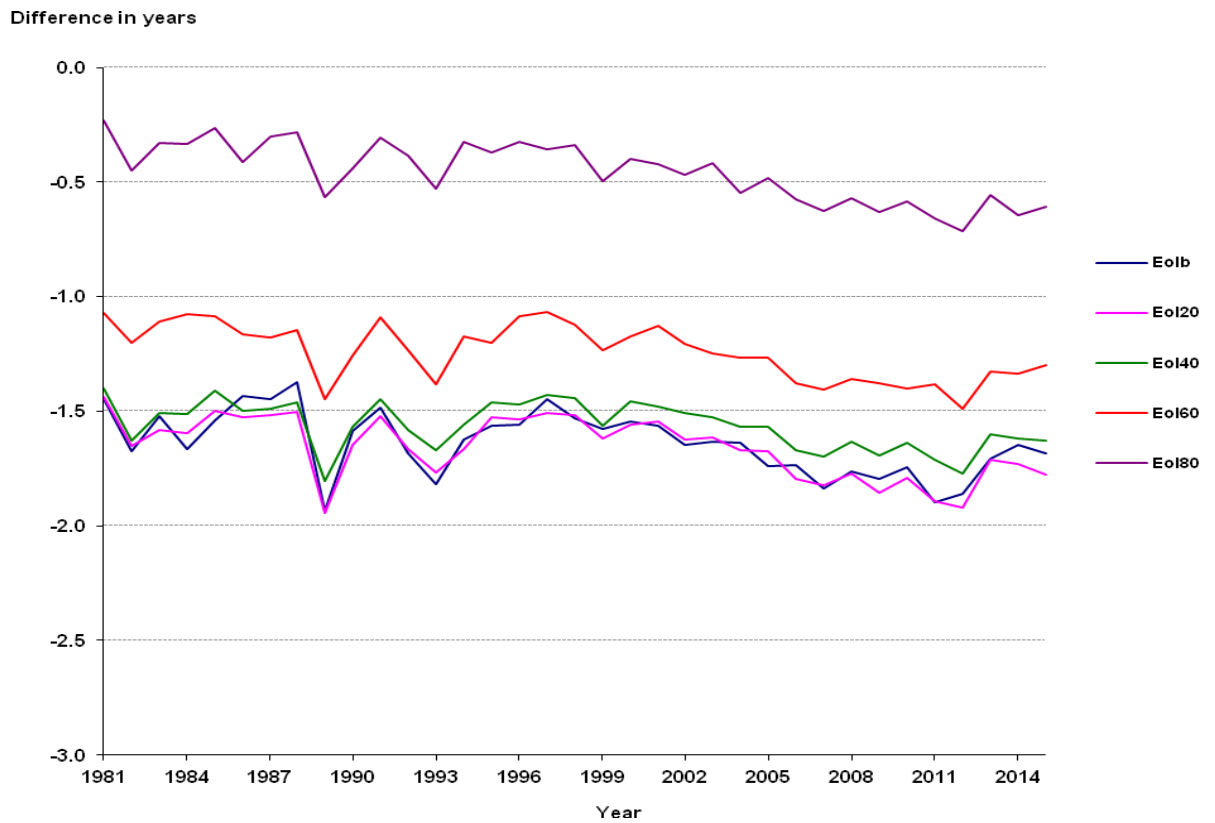


Figure C2c Difference between life expectancy in the UK and Scotland at selected ages, Females



Figures C3c and C4c and Table C1c give comparisons of the proposed 2016-based assumptions for Scotland under the ONS method with those from the 2014-based projections for Scotland.

Figures C3c and C4c and Table C2c give comparisons of the proposed 2016-based assumptions for Scotland under the UoS method with those from the 2014-based projections for Scotland. The proposed assumptions for Scotland will be revised following consultation with NRS

Figure C3c 2014-based and proposed 2016-based period expectation of life at birth

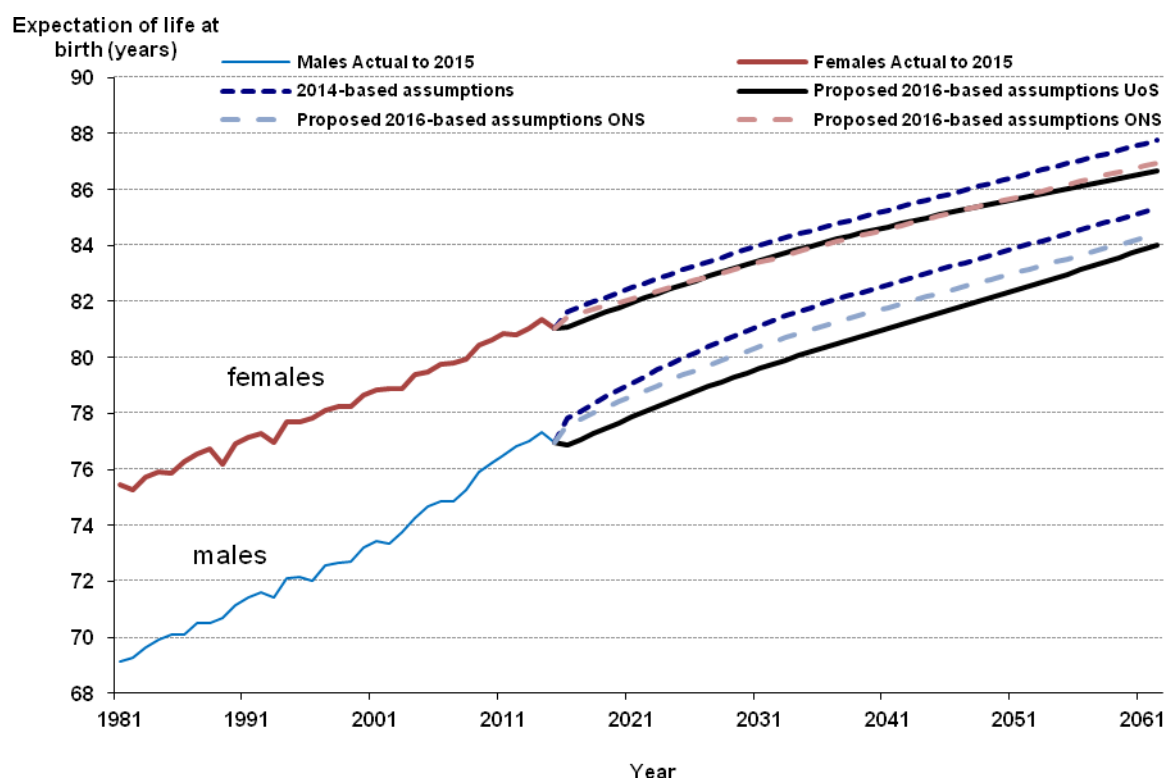


Figure C4c 2014-based and proposed 2016-based period expectation of life at age 65

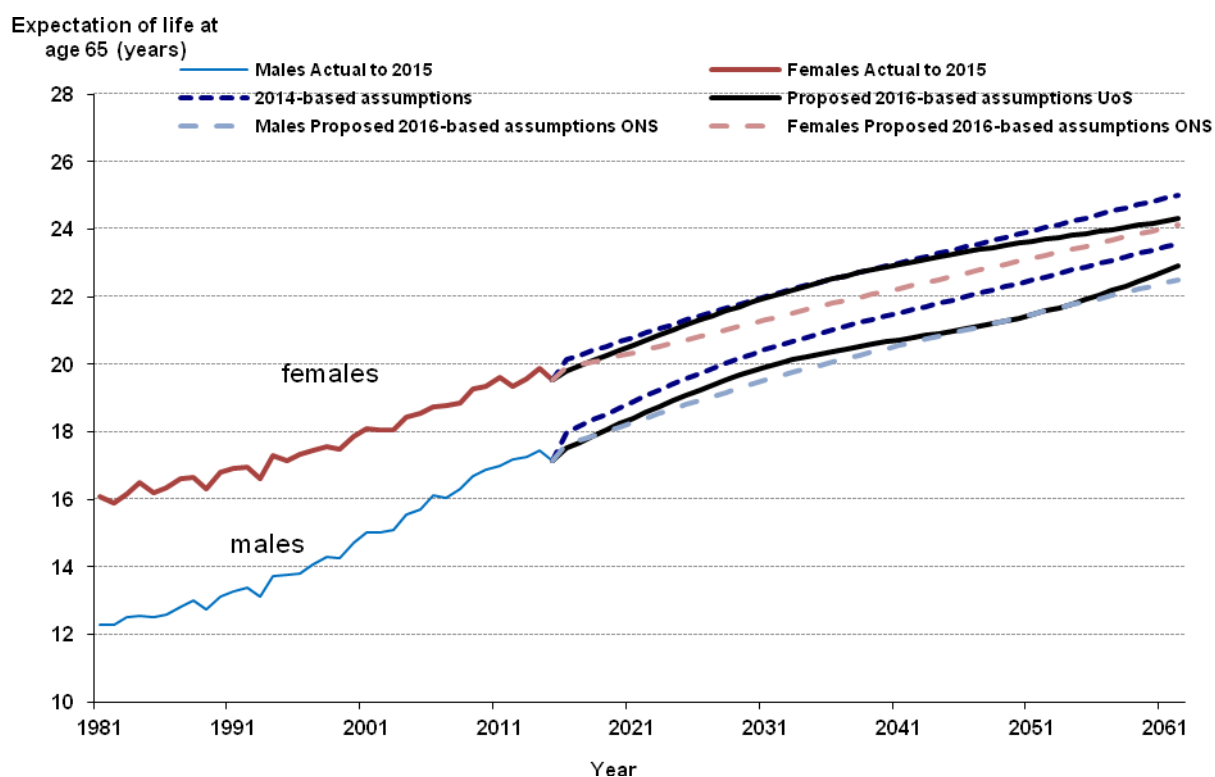


Table C1c 2016-based proposed expectation of life compared with 2014-based projection figures – Scotland, ONS Method

Year	Males				Females			
	Age 0		Age 65		Age 0		Age 65	
	Proposed UoS 2016 based EoL	Change over 2014-based projection	Proposed UoS 2016 based EoL	Change over 2014-based projection	Proposed UoS 2016 based EoL	Change over 2014-based projection	Proposed UoS 2016 based EoL	Change over 2014-based projection
2016	77.59	-0.22	17.62	-0.35	81.47	-0.17	19.90	-0.23
2026	79.54	-0.65	18.92	-0.80	82.75	-0.52	20.82	-0.61
2041	81.79	-0.81	20.56	-0.96	84.60	-0.66	22.25	-0.76
2051	83.03	-0.87	21.48	-1.01	85.72	-0.73	23.14	-0.81

Table C2c 2016-based proposed expectation of life compared with 2014-based projection figures – Scotland, UoS Method

Year	Males				Females			
	Age 0		Age 65		Age 0		Age 65	
	Proposed UoS 2016 based EoL	Change over 2014-based projection	Proposed UoS 2016 based EoL	Change over 2014-based projection	Proposed UoS 2016 based EoL	Change over 2014-based projection	Proposed UoS 2016 based EoL	Change over 2014-based projection
2016	76.85	-0.96	17.51	-0.46	81.10	-0.53	19.79	-0.34
2026	78.78	-1.41	19.24	-0.47	82.75	-0.53	21.30	-0.12
2041	81.05	-1.55	20.73	-0.73	84.67	-0.59	22.97	-0.04
2051	82.41	-1.50	21.47	-1.01	85.67	-0.78	23.64	-0.32

Comparison of ONS and UoS projections

Overall the UoS method projects lower period life expectancies at birth than the ONS method for males of between 0.6 and 0.8 years over the 35 year period shown, whereas the period life expectancy at age 65 are broadly similar under the two methods. For females the period life expectancies at birth are broadly similar, apart from 2016, whereas those at age 65 are generally higher under the UoS method than the ONS method.

ANNEX C

ASSUMPTIONS FOR THE CONSTITUENT COUNTRIES OF THE UNITED KINGDOM - NORTHERN IRELAND

ONS method

For each individual country of the United Kingdom the projections will be made using the same projected mortality rate reductions as are assumed for the United Kingdom, adjusted according to the relative experience for that country compared to that for the UK as a whole, as appropriate. These reduction factors are applied successively to the age-specific base mortality rates for the calendar year 2016 for each country. To obtain the 2016 base mortality rates for each constituent country, the derived United Kingdom death rates for 2016 are adjusted at each age in proportion to that country's experience relative to the United Kingdom during 2013-2015, the latest three year period for which mortality data by age and sex are available.

The basic analysis of past trends in mortality rates on which the assumptions of future mortality improvement are based is carried out initially on UK data. Having done this analysis at UK level, assumptions on the future rates of improvement are set for each country individually after a comparison of the experience of that country to the UK as a whole. It is proposed to use the same age and sex-specific rates of mortality improvement for England, Wales and Northern Ireland; for Scotland different, generally lower, rates of improvement are proposed for years before 2041 for some ages for males and for females. Having derived improvement rates for Scotland, the rates of improvement derived for the other constituent countries are then adjusted so that the weighted rates of improvement assumed for 2016 for the countries combined are the same as those initially derived for the UK as a whole.

UoS method

Under the UoS method the model is fitted separately for Scotland, with improvement rates driven by the input data, and fitted to UK minus Scotland data to derive improvement rates and mortality rates for England, Wales and Northern Ireland combined. The mortality rates will then be adjusted in line with recent mortality experience for England, Wales and Northern Ireland compared to that for those countries combined to produce projected mortality rates for England, Wales and Northern Ireland.

The resulting proposed assumptions for Northern Ireland are given in the following pages.

Comparisons of mortality experience between Northern Ireland and the UK

Figures C1d and C2d show the differences in the expectations of life for the UK and the corresponding figures for Northern Ireland. The expectations of life are calculated using data for single calendar years for the UK and for Northern Ireland.

The charts show that the large differentials which existed for males in the early 1980s reduced fairly rapidly by the early 1990s. During the 1990s the differences have varied within a range of 0 to minus 0.7 years, with alternating periods of convergence and divergence into the 21st Century. However, the most recent year shows a divergence away from life expectancy figures for the UK as a whole, especially at younger ages. Female differentials also reduced rapidly over the 1980s followed by alternating periods of convergence and divergence. During the 1990s and in recent years the differentials have generally varied within a range of 0 to minus one year, for any given year in that period. In recent years the general trend for females appears to be a convergence between expectations of life in Northern Ireland and the United Kingdom. Given the relatively small numbers involved compared to the UK as a whole, and no continual strong pattern of either convergence or divergence to the UK over recent years, it is proposed to assume the same rates of improvement for Northern Ireland as for the UK, after any adjustments made to allow for changes in made for other countries.

Figures C3d and C4d and Table C1d give comparisons of the proposed 2016-based assumptions for Northern Ireland with those from the 2014-based projections for Northern Ireland.

Figure C1d Difference between life expectancy in the UK and Northern Ireland at selected ages, Males

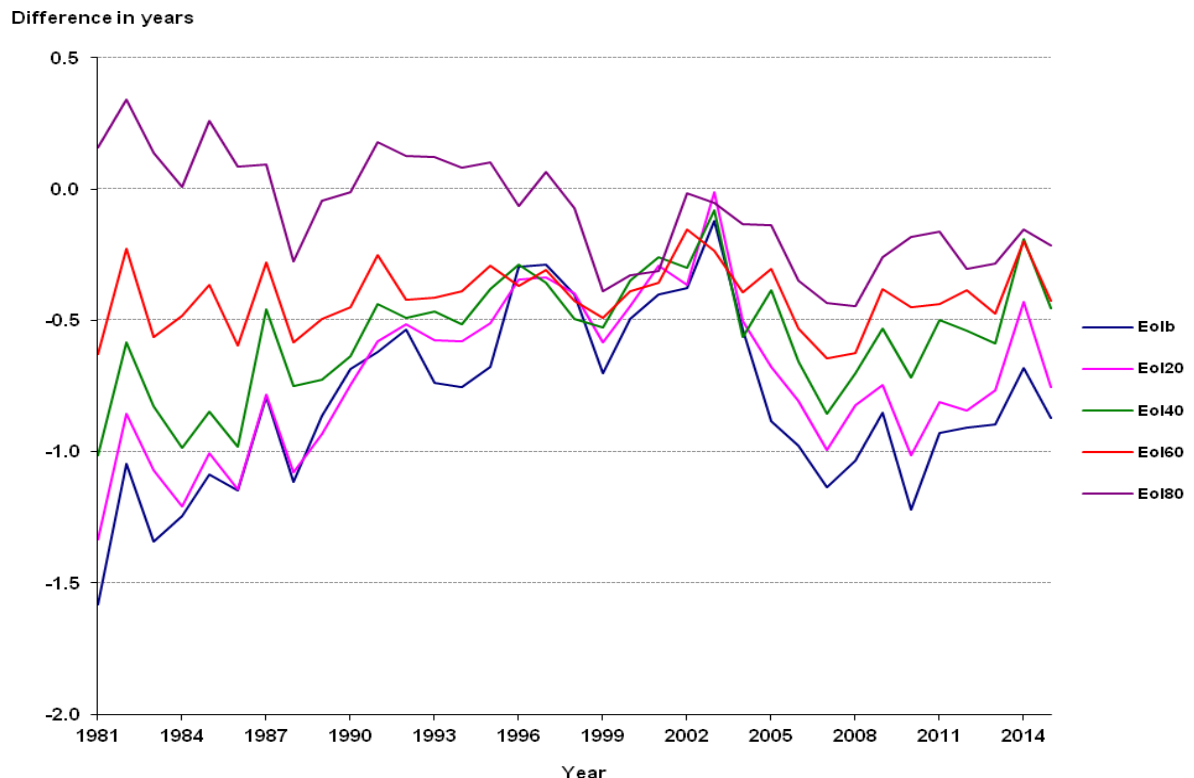
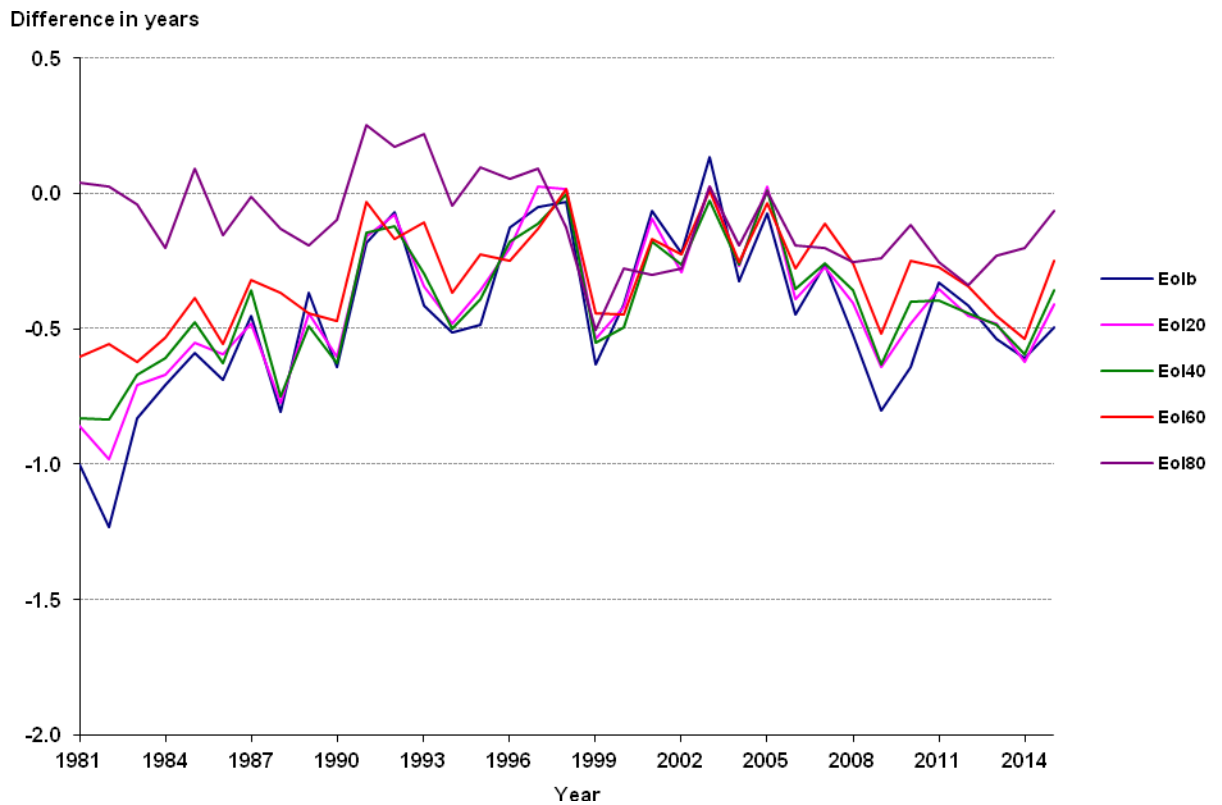


Figure C2d Difference between life expectancy in the UK and Northern Ireland at selected ages, Females



Figures C3d and C4d and Tables C1d and C2d give comparisons of the proposed 2016-based assumptions for Northern Ireland with those from the 2014-based projections for Northern Ireland for both the current ONS method and the UoS method.

Figure C3d 2014-based and proposed 2016-based period expectation of life at birth

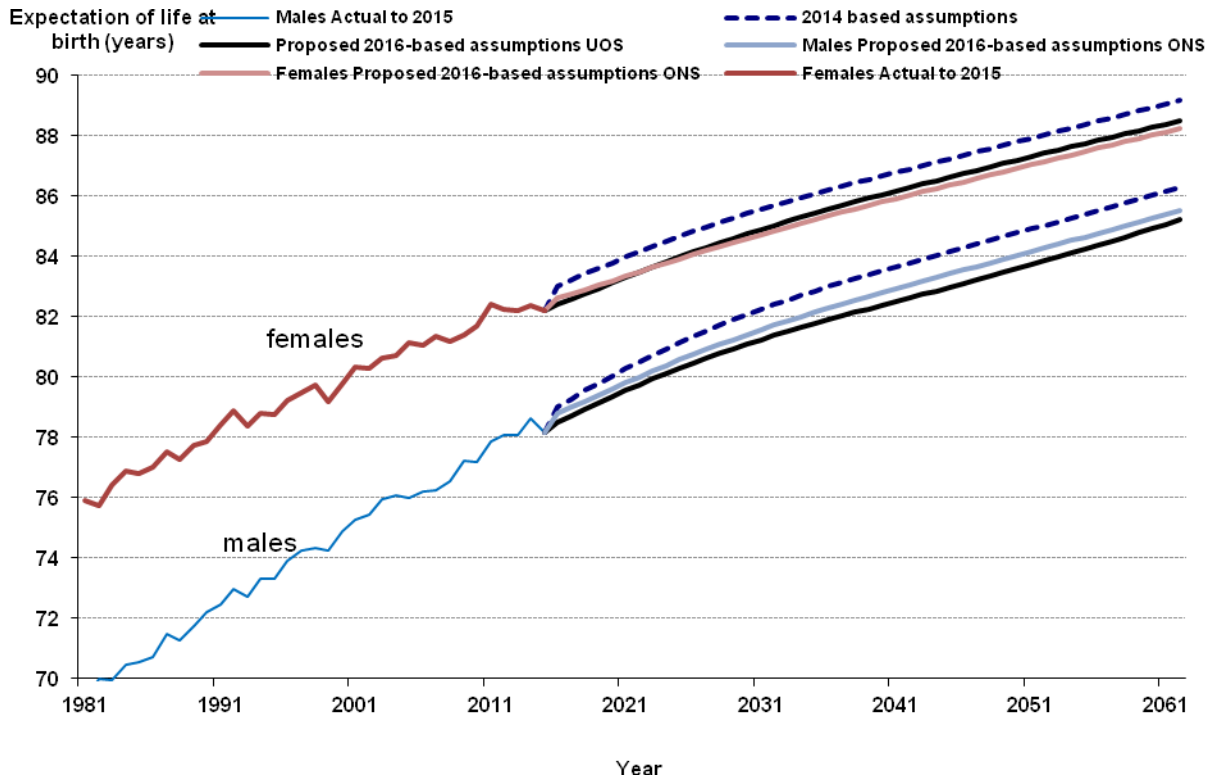


Figure C4d 2014-based and proposed 2016-based period expectation of life at age 65

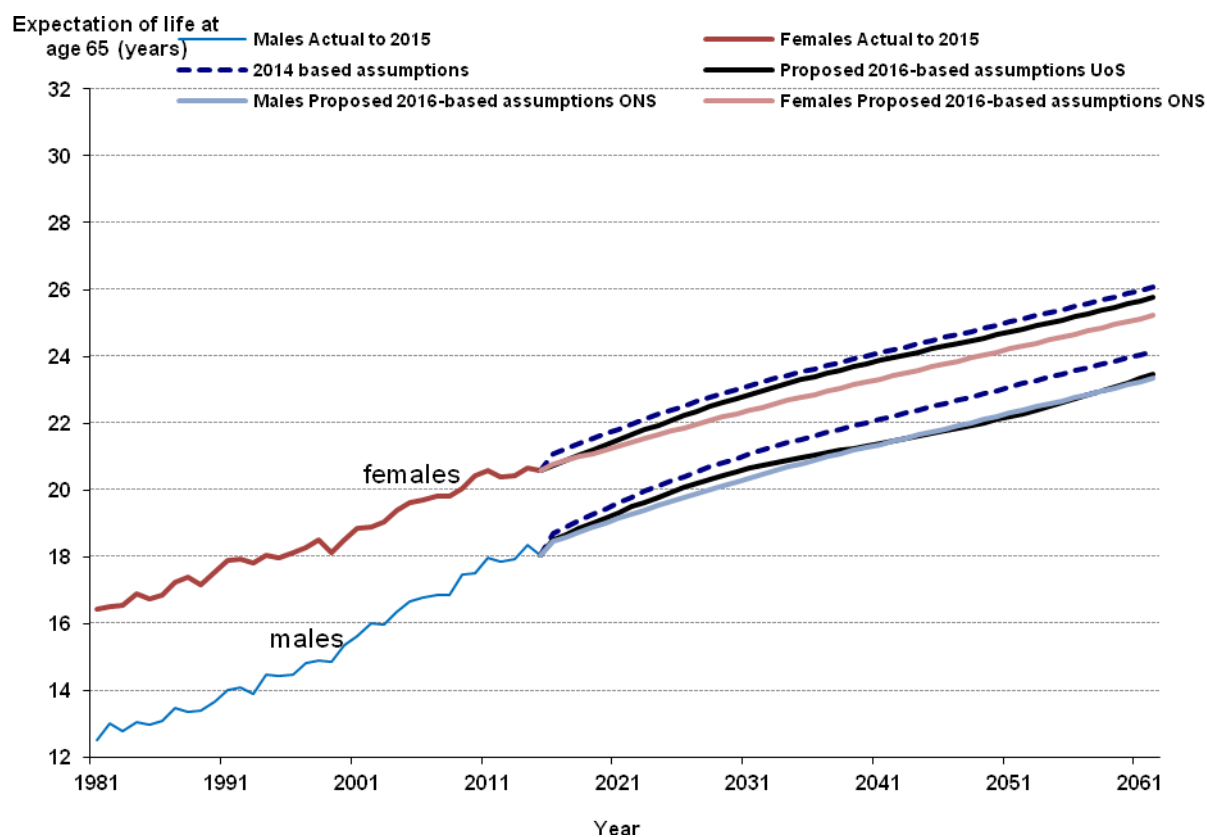


Table C1d 2016-based proposed expectation of life compared with 2014-based projection figures – Northern Ireland (ONS current method)

Year	Males				Females			
	Age 0		Age 65		Age 0		Age 65	
	Proposed ONS 2016 based EoL	Change over 2014-based projection	Proposed ONS 2016 based EoL	Change over 2014-based projection	Proposed ONS 2016 based EoL	Change over 2014-based projection	Proposed ONS 2016 based EoL	Change over 2014-based projection
2016	78.79	-0.24	18.46	-0.23	82.62	-0.42	20.79	0.00
2026	80.70	-0.59	19.73	-0.67	84.01	-0.76	21.61	-0.65
2041	82.86	-0.78	21.28	-0.84	85.83	-0.96	23.04	-0.88
2051	84.07	-0.83	22.19	-0.88	86.92	-1.00	23.92	-0.92

Table C2d 2016-based proposed expectation of life compared with 2014-based projection figures – Northern Ireland (UoS method)

Year	Males				Females			
	Age 0		Age 65		Age 0		Age 65	
	Proposed UoS 2016 based EoL	Change over 2014-based projection	Proposed UoS 2016 based EoL	Change over 2014-based projection	Proposed UoS 2016 based EoL	Change over 2014-based projection	Proposed UoS 2016 based EoL	Change over 2014-based projection
2016	78.51	-0.52	18.67	-0.02	82.40	-0.63	20.90	-0.17
2026	80.47	-0.84	20.20	-0.20	84.15	-0.68	22.09	-0.15
2041	82.51	-1.12	21.46	-0.66	86.17	-0.63	23.78	-0.14
2051	83.73	-1.18	22.29	-0.79	87.31	-0.61	24.64	-0.21

Comparison of ONS and UoS projections

Overall the UoS method projects lower period life expectancies at birth than the ONS method for males of between 0.3 and 0.4 years over the 35 year period shown, whereas the period life expectancy at age 65 are higher (by between 0.1 and 0.5 years). For females the period life expectancies at birth and at age 65 are higher under the UoS method, apart from 2016, with the projected UoS life expectancies increasing faster than the ONS projections and more so at age 65 than at birth.

The patterns and magnitude of the differences are similar to those exhibited for the projections for England and for Wales.