

Compendium

# Variants



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# 1 . Introduction

We produce population projections as a basis for understanding possible changes in the structure of the population. They're based on assumptions considered to best reflect demographic patterns at the time they're adopted. However, because of the inherent uncertainty of demographic behaviour, any projection will inevitably differ to a greater or lesser extent from actual future population change.

Because of the uncertainty surrounding our projections, in addition to the principal projection we also produce variant projections based on alternative assumptions of fertility, mortality and migration. These provide an indication of uncertainty and sensitivity to alternative assumptions but don't represent upper or lower limits of future demographic behaviour.

On 26 October 2017, we published nine standard types of variant projection, which look at the effect of varying one or more assumptions. They are grouped as follows:

- six single component variants, which observe the effect of varying one assumption, such as fertility, while keeping other assumptions in line with the principal projection
- two combination variants, which look at the effect of varying two or more assumptions, such as the high population scenario (high fertility, high life expectancy and high migration)
- one special case variant, which looks at a zero net migration scenario

We have also produced eight additional variants to meet the specific requirements of stakeholders.

Table 6.1 summarises the assumptions underlying each variant. A further description of the new additional variants can be found in the appendix.

A small number of extra variants will be published on 28 November 2017.

This chapter summarises the results of the standard variant projections for the UK.



**Table 6.1: List of variants available for the 2016-based national population projections**

<b>Table reference 1</b>	<b>Variant</b>	<b>Geography</b>	<b>Fertility assumption</b>	<b>Life expectancy assumption</b>	<b>Migration assumption</b>
A	Principal	UK, Great Britain, England and Wales, England, Wales, Scotland, Northern Ireland	Principal	Principal	Principal
<b>Standard Single Variants</b>					
B	High fertility	UK, England, Wales, Scotland, Northern Ireland	High	Principal	Principal
C	Low fertility	UK, England, Wales, Scotland, Northern Ireland	Low	Principal	Principal
D	High life expectancy	UK, England, Wales, Scotland, Northern Ireland	Principal	High	Principal
E	Low life expectancy	UK, England, Wales, Scotland, Northern Ireland	Principal	Low	Principal
F	High migration	UK, Great Britain, England, Wales, Scotland, Northern Ireland	Principal	Principal	High
G	Low migration	UK, Great Britain, England, Wales, Scotland, Northern Ireland	Principal	Principal	Low
J	Zero net migration	UK, Great Britain, England, Wales, Scotland, Northern Ireland	Principal	Principal	Zero
<b>Standard Combination Variants</b>					
H	High population	UK, England, Wales, Scotland, Northern Ireland	High	High	High
I	Low population	UK, England, Wales, Scotland, Northern Ireland	Low	Low	Low
<b>New requested variants</b>					
XA	Moderately high life expectancy	UK, England, Wales, Scotland, Northern Ireland	Principal	Moderately high	Principal
XB	Moderately low life expectancy	UK, England, Wales, Scotland, Northern Ireland	Principal	Moderately low	Principal
XC	0% future EU migration	UK, Great Britain, England, Wales, Scotland, Northern Ireland	Principal	Principal	0% future EU migration from year ending mid-2019 onwards
XD	50% future EU migration	UK, Great Britain, England, Wales, Scotland, Northern Ireland	Principal	Principal	50% future EU migration from year ending mid-2019 onwards
XE	150% future EU migration	UK, Great Britain, England, Wales, Scotland, Northern Ireland	Principal	Principal	150% future EU migration from year ending mid-2019 onwards
XF	Northern Ireland medium high migration	Northern Ireland	Principal	Principal	Net long-term migration 3,000 per year

XG	Northern Ireland medium low migration	Northern Ireland	Principal	Principal	Net long-term migration negative 1,500 per year
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Source: Office for National Statistics

Note:

1. The table reference letter is included in the numbering of tables published on the website

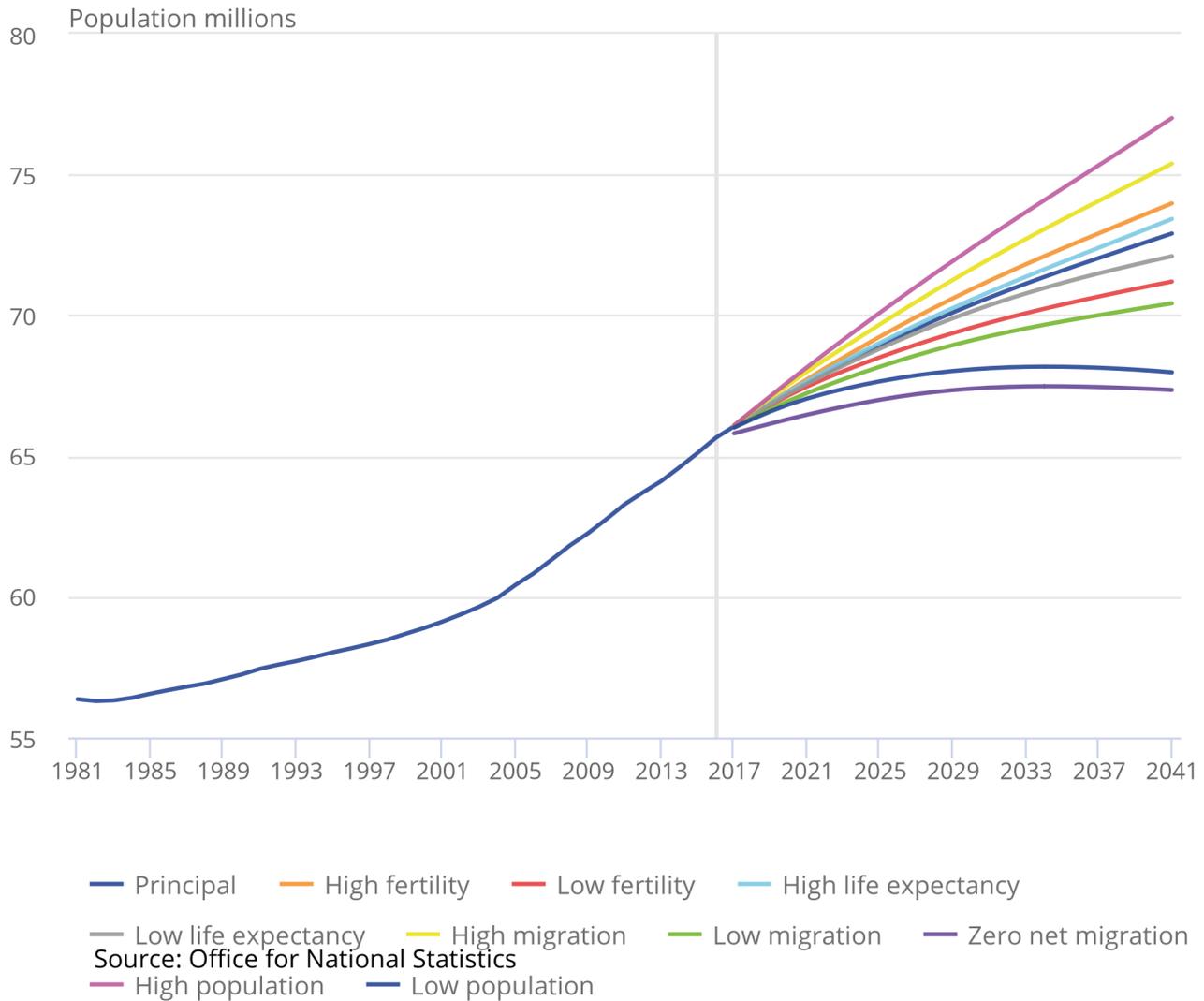
## 2 . General overview of variants

In this section, we present a general overview of the different variants and compare them with the principal projection. In particular, we compare projected population sizes for mid-2041 and growth rates over the period from mid-2016 to mid-2041.

Figure 6.1 and Table 6.2 show the differences in projected population size for the UK for the principal projection and under alternative variant scenarios.

**Figure 6.1: Estimated and projected total population, UK, mid-1981 to mid-2041**

Figure 6.1: Estimated and projected total population, UK, mid-1981 to mid-2041



Source: Office for National Statistics

**Table 6.2: Projected population increase, UK, mid-2016 to mid-2041**

<b>Variants</b>	<b>Mid-2041 population (millions)</b>	<b>Population change (millions)</b>	<b>Percentage change</b>
Principal	72.9	7.3	11.1
High fertility	74.0	8.3	12.7
Low fertility	71.2	5.5	8.5
High life expectancy	73.4	7.8	11.8
Low life expectancy	72.1	6.5	9.8
High migration	75.4	9.7	14.8
Low migration	70.4	4.8	7.3
Zero net migration	67.3	1.7	2.6
High population	77.0	11.4	17.3
Low population	68.0	2.3	3.5

Source: Office for National Statistics

## Fertility variants

Projecting a course for fertility is important for government planning. For example, changes in fertility rates are critical to determining resource allocation to services such as childcare and education. Therefore, in addition to the principal projection, we also produce two alternative variant scenarios for fertility, one assuming a higher total fertility rate and one with a lower rate. For the 2016-based variant projections, we assumed a long-term total fertility rate for the UK of 1.84 in the principal projection, 1.94 in the high fertility variant and 1.64 in the low fertility variant. Assumptions for generations who have not yet entered childbearing ages, or who have done so only recently, are necessarily highly speculative.

In the principal projection we project the UK population to grow by 11% between mid-2016 and mid-2041, reaching 72.9 million by mid-2041. In the high fertility scenario, the population is projected to increase to 74.0 million by mid-2041. In the low fertility variant, growth is projected to be lower than in the principal, with a projected population of 71.2 million in mid-2041.

## Life expectancy variants

Changes in mortality help us to understand prospects for future longevity, which is especially relevant for government planning in terms of pensions planning and care in old age. For this reason, we also produce four mortality variants, two of which are covered in this chapter. These help give an indication of uncertainty to alternative assumptions, which are based on varying long-term improvement rates. For the 2016-based projections, the principal projection has an annual improvement rate of 1.2% from mid-2041; over the same time period the high life expectancy variant has an annual improvement of 1.9% in mortality rate, while in the low life expectancy variant this rate is 0%. Over the period up to mid-2041 the mortality rates converge to these rates.

In the principal projection, the UK population reaches 72.9 million by mid-2041. In the high life expectancy variant, growth is higher than in the principal, with the population increasing to 73.4 million. In the low life expectancy variant, growth is lower than in the principal population, with a projected population of 72.1 million. Overall, over the period from mid-2016 to mid-2041, the life expectancy variants have a small effect on the original projection and much less of an impact than the fertility variants.

## Migration variants

Changes in international migration help us to think in the longer term about the population structure and the consequent impact on government planning. In the 2016-based principal projection, the long-term assumption for international net migration to the UK is 165,000 each year from the year ending mid-2023 onwards. We also produce high and low migration variants, in which we assume annual net migration to be 40,000 higher or lower than the principal projection in the first year. For all subsequent years we assume net migration to be 80,000 higher or lower. This results in the high and low annual net migration assumptions to the UK being 245,000 and 85,000 people per year, respectively.

In the principal projection, the population is projected to reach 72.9 million by mid-2041. In the high migration scenario, population growth is considerably higher than in the principal, with the population projected to increase to 75.4 million by mid-2041. In the low migration scenario, growth is lower than in the principal, with the population set to reach 70.4 million by the end of the reporting period. Overall, the migration variants have the largest effect on the principal projection, when compared with the fertility and life expectancy variants.

## Combined variants

For particular applications, users may also be interested in combining two or more of these variant scenarios. For example, we produce two combined scenarios including a high population variant, in which we assume high fertility, high life expectancy and high migration, and a low population variant, which is the reverse of the former assumptions. For example, in the principal projection the population is projected to grow by 11% from mid-2016, reaching 72.9 million by mid-2041. In the high population variant, growth is projected to be 6.2 percentage points higher than in the principal, with the population expected to reach 77.0 million by mid-2041. In the low population variant, growth is projected to be 7.5 percentage points lower than in the principal, with the population expected to reach 68.0 million by mid-2041.

## Special case variants

For some of our users, it can be useful to project special case scenarios or “what if” projections to illustrate the consequences of a particular set of assumptions. For this reason, we also produce a number of special case variants. The only standard special case variant in this release is the zero net migration variant which explores a scenario under which international immigration and emigration and cross-border inflows and outflows are balanced, resulting in no net gain or loss. In Figure 6.1, we can see this variant clearly results in the lowest population growth and lowest total size by mid-2041 compared with all the other projection scenarios. In the principal projection we project the UK population to reach 72.9 million, while in the zero net migration variant growth we project the population to reach 67.3 million by mid-2041.

## 3 . Projected population by age

When we vary the assumptions feeding into the projections, this affects the future age structure of the population. For example, a high fertility assumption will increase the number of children in the short-term, and will subsequently increase the number of people of working age and the number of women of childbearing age, resulting in increased births.

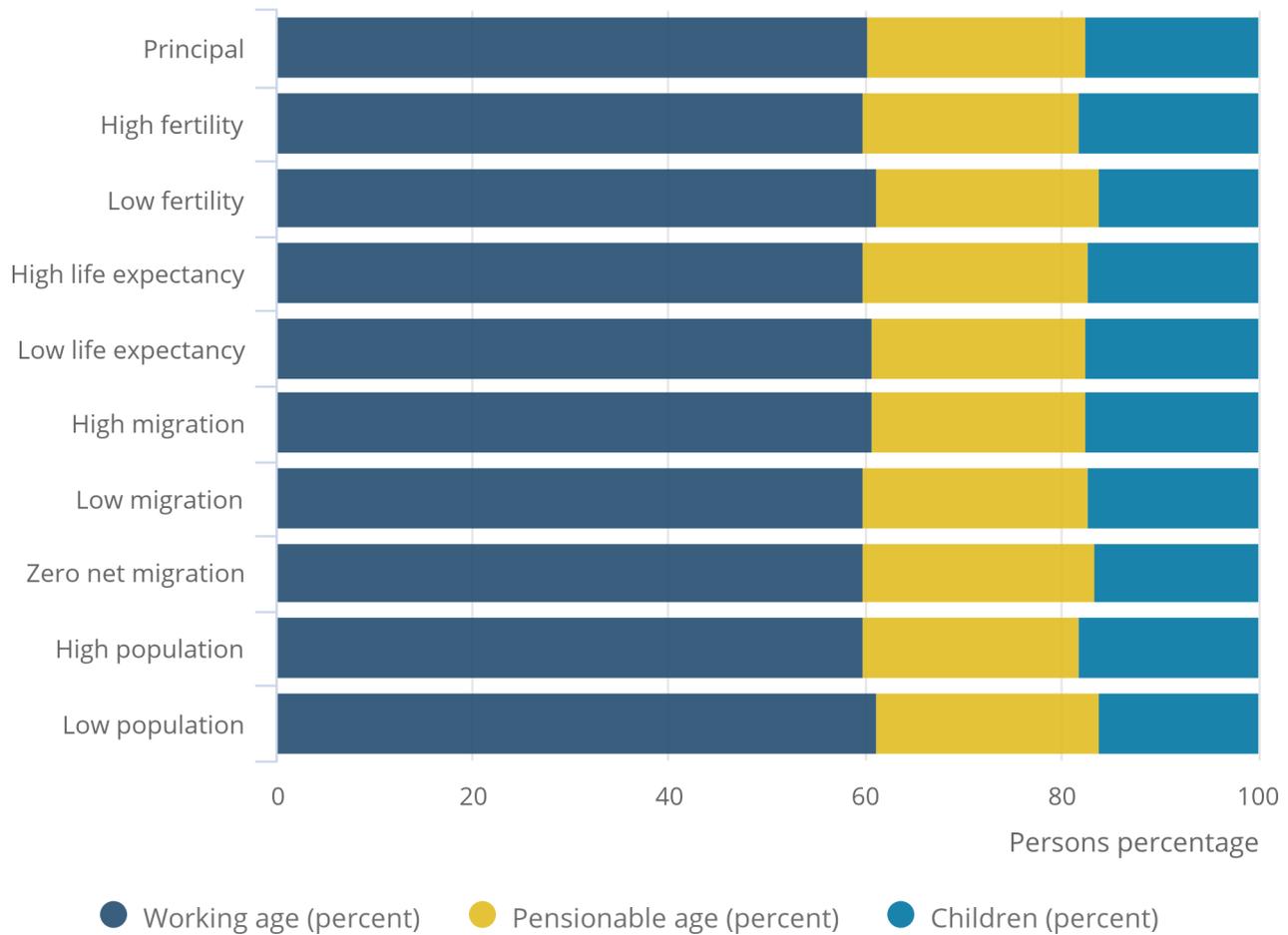
The [interactive population pyramid](#) allows comparisons of the age and sex structure of the main (principal) and variant projections through time.

In Figure 6.2, we compare the projected proportion of children, people of working age, and the population of State Pension age (SPA), 25 years on from the mid-2016 estimate under different projection scenarios.

Children are defined as those aged 0 to 15. Working age and pensionable age populations are based on SPA for the stated year.

**Figure 6.2: Projected proportion of children, people of working age and State Pension age, UK, mid-2041**

Figure 6.2: Projected proportion of children, people of working age and State Pension age, UK, mid-2041



Source: Office for National Statistics

**Source: Office for National Statistics**

**Notes:**

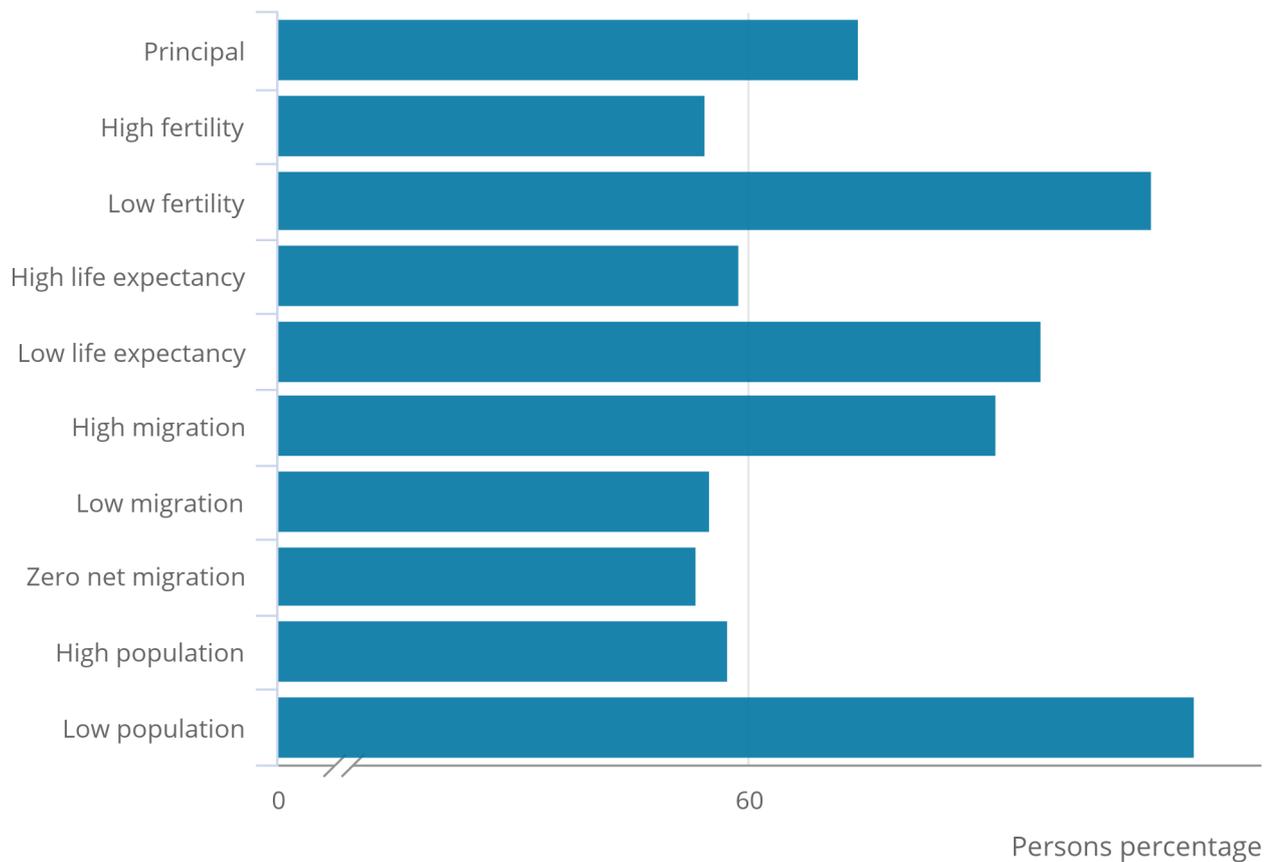
1. Children are defined as those aged 0 to 15. Working age and pensionable age populations are based on State Pension age (SPA) for the stated year. Under current legislation SPA in mid-2041 will be 67 for both sexes.

## **4 . Working age population and births: examining different variant scenarios**

Changes to fertility, life expectancy and migration assumptions affect the demographic characteristics of the UK population and, consequently, impact upon the makeup of our society and economy. Therefore, it can be particularly helpful to national and local policymakers to compare how different projection scenarios could affect the population structure. In this section, we look at how different variants affect the size of the working age population and the number of births in the UK.

**Figure 6.3: Projected percentage of people of working age under different scenarios, UK, mid-2041**

Figure 6.3: Projected percentage of people of working age under different scenarios, UK, mid-2041



Source: Office for National Statistics

Source: Office for National Statistics

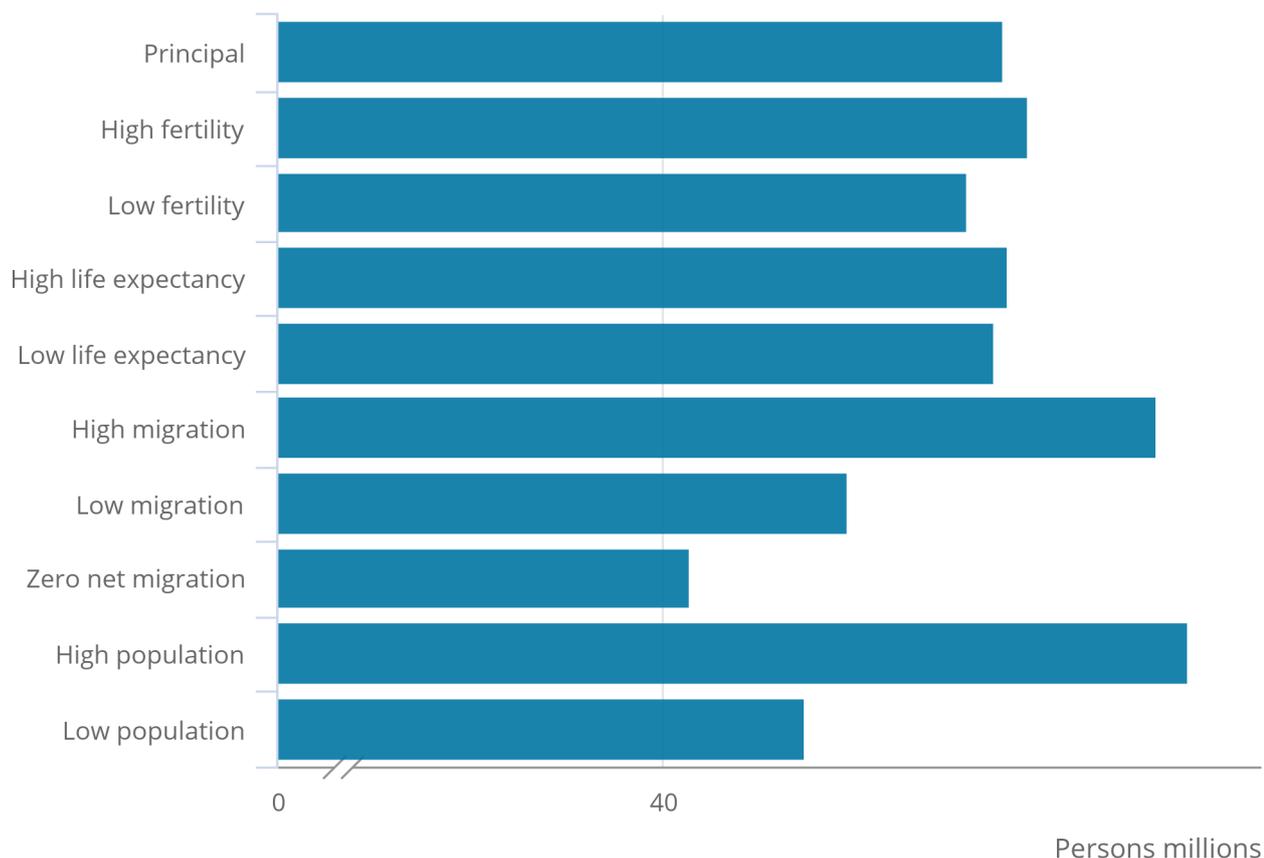
**Notes:**

1. Working age population is based on State Pension age (SPA) for the stated year. Under current legislation all those under the age of 67 will be of working age for both sexes.

In mid-2016, there were an estimated 40.8 million working age individuals in the UK, accounting for around 62.2% of the total population. By mid-2041, all of the scenarios project a decrease in the proportion of working age individuals making up the UK population (see Figure 6.3). The biggest drop is expected under zero net migration assumptions (minus 2.3%) and the smallest drop is recorded in the low population variant (negative 0.9%).

**Figure 6.4: Projected number of people of working age under different scenarios, UK, mid-2041**

Figure 6.4: Projected number of people of working age under different scenarios, UK, mid-2041



Source: Office for National Statistics

**Source: Office for National Statistics**

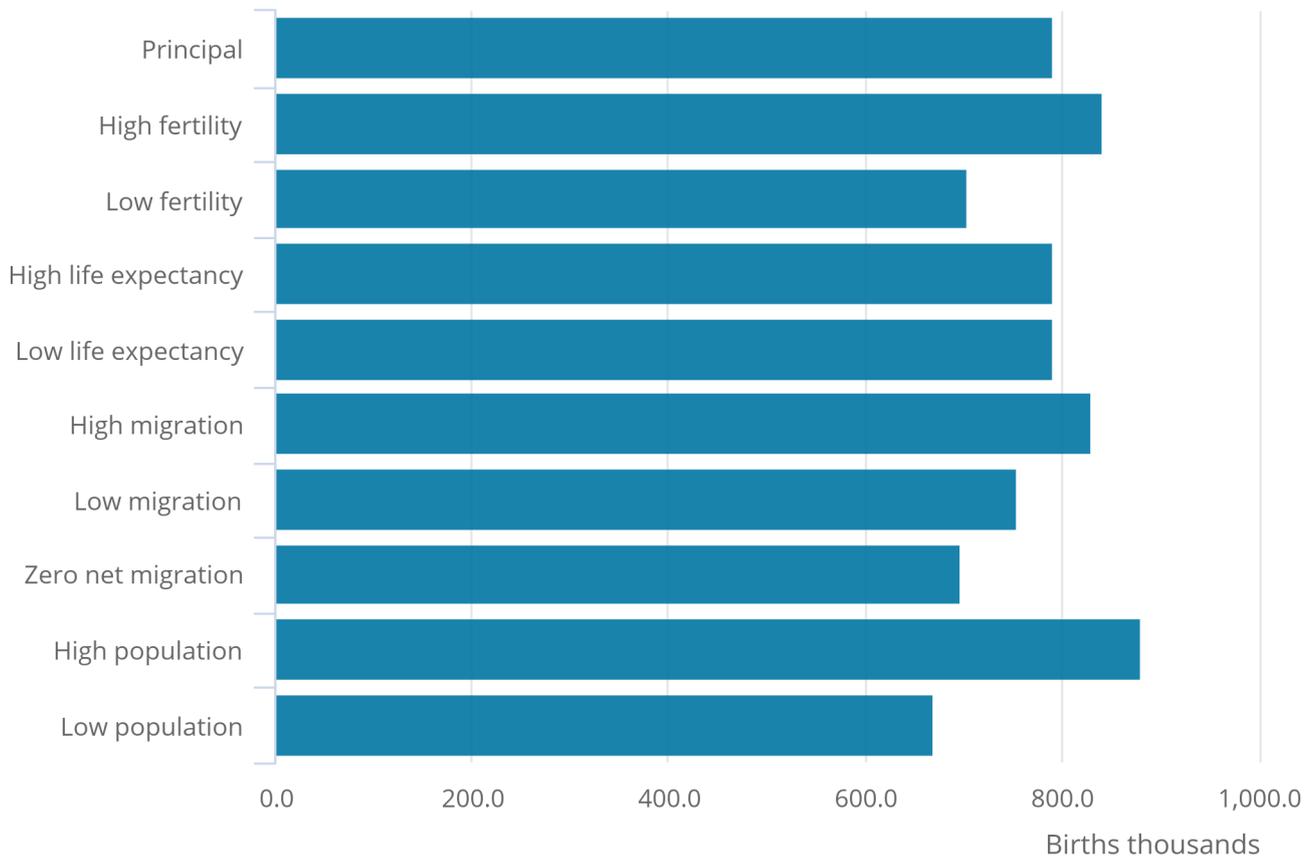
**Notes:**

1. Working age population is based on State Pension age (SPA) for the stated year. Under current legislation all those under the age of 67 will be of working age for both sexes.

It's also interesting to compare the numbers of working age individuals across the different scenarios (see Figure 6.4). In the principal projection, we project the working age population to reach 44.0 million by mid-2041; this is 60.3% of the total population. In the high and low migration variants we project the working age population to reach 45.8 million (60.7%) and 42.2 million (59.9%) respectively. When comparing the percentages we see that the differences aren't as great as the numbers may suggest. One factor is that more migrants also means more migrant women of childbearing age, resulting in more births and hence an increased number of children. In Figure 6.5, we compare the different variant scenarios and the principal projection's effect on the number of UK births 25 years on from the original estimate. The provisional estimate of the number of births in the UK in 2016 is 775,000.

**Figure 6.5: Projected number of births under different scenarios, UK, year ending mid-2041**

Figure 6.5: Projected number of births under different scenarios, UK, year ending mid-2041



Source: Office for National Statistics

**Source: Office for National Statistics**

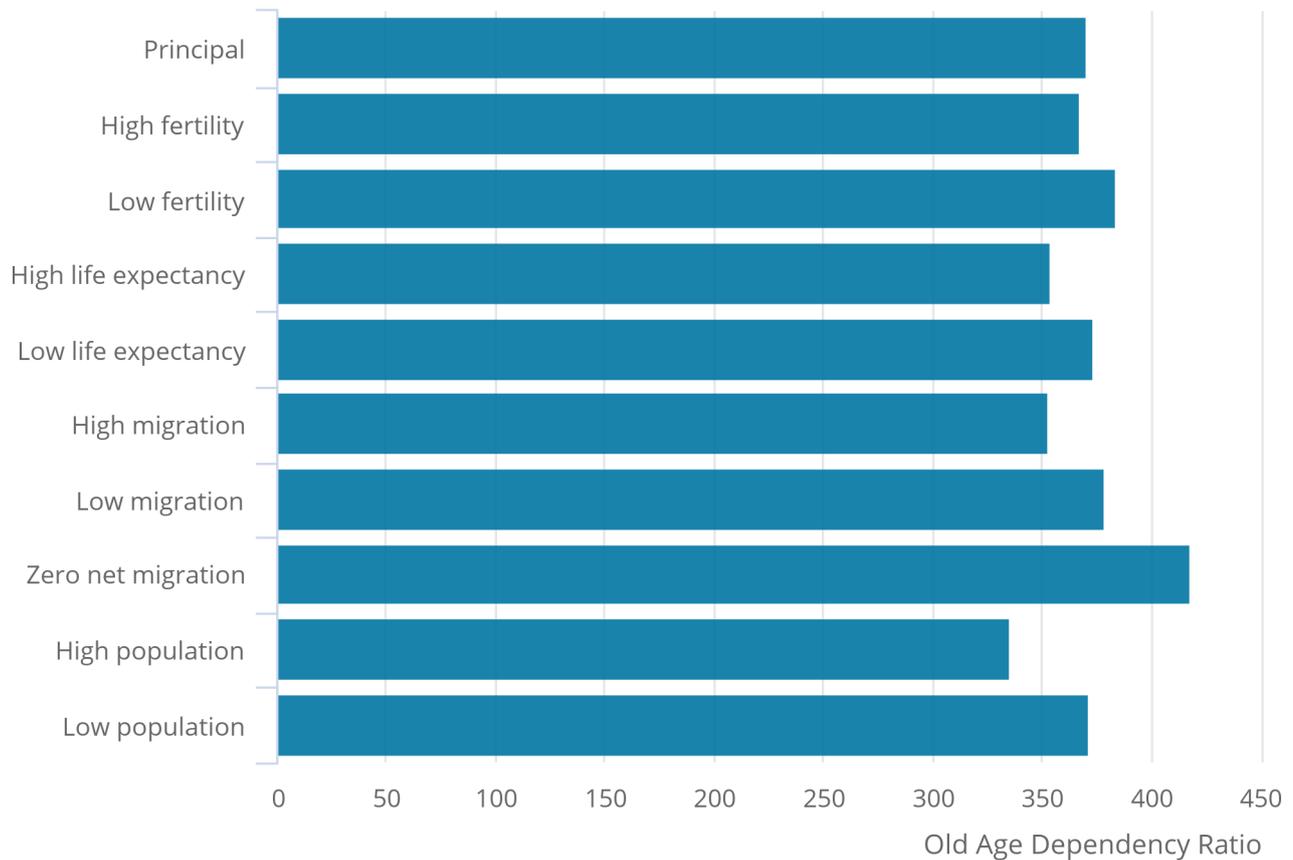
In the principal projection, we project births to reach close to 792,000 by mid-2041, an increase of 2.2% from 2016 estimate. By mid-2041, there is a decrease of 13.7% in the low population variant which is the lowest figure observed compared with the other variants. Births for the zero net migration variant also decreased by 10.0%. The high population variant increased by 13.6%, the highest scenario observed.

## 5 . Ageing society: examining different variant scenarios

The [latest trends in the UK population](#) show that the number of older people is growing. In the principal projection, we expect the proportion of those aged 85 and over to double over the next 25 years. In light of the ageing population, it could be interesting to see how the different variants affect the number of those of pensionable age and the old age dependency ratio (OADR). The OADR is defined as the number of people of pensionable age for every thousand people of working age.

**Figure 6.6: Projected old age dependency ratio (OADR) under different scenarios, UK, mid-2041**

Figure 6.6: Projected old age dependency ratio (OADR) under different scenarios, UK, mid-2041



Source: Office for National Statistics

**Source: Office for National Statistics**

**Notes:**

1. The old age dependency ratio is defined as the number of people of pensionable age for every thousand people of working age.
2. Working age and pensionable age populations are based on State Pension age (SPA) for the stated year. Under current legislation SPA in mid-2041 will be 67 for both sexes.

In Figure 6.6, we compare the projected OADR for the UK across the principal projection and different variants by mid-2041. This is 25 years on from mid-2016 estimates, in which there were an estimated 12.4 million people of pensionable age (18.9% of the total population) with an OADR of 305. In the principal projection, the pensionable population is projected to grow by 31% over the 25 year period, reaching 16.3 million by mid-2041 with an OADR of 370. In all scenarios, the pensionable population and OADR is projected to increase noticeably from the original estimate for mid-2016. For example, even in the low life expectancy variant the population of State Pension age is projected to grow by 26.0%, reaching 15.6 million with an OADR of 355 by mid-2041. The highest change is found in the zero net migration variant, in which the pensionable age population rises to 16.0 million and the OADR is 396.

## 6 . Quality and methodology

The national population projections [Quality and Methodology Information document](#) contains important information on:

- the strengths and limitations of the data and how it compares with related data
- uses and users of the data
- how the output was created
- the quality of the output including the accuracy of the data

We have also published a number of other [methodological documents](#), and more background detail on each of fertility, mortality and migration assumptions ([consultation papers](#)).

## 7 . Appendix

### Definitions of additional variants

0% future EU migration, which uses the principal fertility, mortality and cross-border migration assumptions. The international migration figures have been created by proportionally reducing the principal assumptions, based on the proportion of migration which was by (non-UK) EU citizens between 2014 and 2016, to reflect a scenario of no future migration to and from the UK by EU citizens, from the year ending mid-2019 onwards. This projection is provided to fulfill specific stakeholder requirements and does not have National Statistics status.

50% future EU migration, which uses the principal fertility, mortality and cross-border migration assumptions. The international migration figures have been created by proportionally reducing the principal assumptions, based on the proportion of migration which was by (non-UK) EU citizens between 2014 and 2016, to reflect a scenario of 50% future migration to and from the UK by EU citizens, from the year ending mid-2019 onwards. This projection is provided to fulfill specific stakeholder requirements and does not have National Statistics status.

150% future EU migration, which uses the principal fertility, mortality and cross-border migration assumptions. The international migration figures have been created by proportionally increasing the principal assumptions, based on the proportion of migration which was by (non-UK) EU citizens between 2014 and 2016, to reflect a scenario of increasing the level of future migration to and from the UK by EU citizens by 50%, from the year ending mid-2019 onwards. This projection is provided to fulfill specific stakeholder requirements and does not have National Statistics status.

Moderately high life expectancy, which combines principal fertility and migration assumptions with rates of mortality improvement higher than the principal but lower than the high life expectancy assumption.

Moderately low life expectancy, which combines principal fertility and migration assumptions with rates of mortality improvement higher than the low life expectancy assumption but lower than the principal.

Northern Ireland medium high migration (available for Northern Ireland only), which assumes long term net international migration to Northern Ireland of 3,000 per year.

Northern Ireland medium low migration (available for Northern Ireland only), which assumes long term net international migration from Northern Ireland of negative 1,500 per year.