

# Reconciliation of mid-year population estimates with Scotland's Census 2022

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This report compares rolled-forward population estimates from Scotland's Census 2011 with the official figures from Scotland's Census 2022.

This is an Official Statistics publication for Scotland.

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## 1. Purpose of this report

Each year the National Records of Scotland (NRS) produces mid-year population estimates for Scotland. These population estimates are based on the most recent census and are updated with current data on births, deaths and migration.

To compare the mid-year population estimates to the 2022 census, a corresponding rolled-forward estimate from mid-2021 to Census Day 2022 was produced. In this report, the rolled-forward estimate is directly compared to the 2022 census results. We seek to identify any differences between the census and rolled-forward estimate and, where differences are identified, consider possible reasons for these differences. This will facilitate future methodology improvements to mid-year population estimates. It will also better enable users of the mid-year population estimates to understand the strengths and limitations of the data.

### **Rolled-forward estimate**

This is the population estimate that we are comparing to Scotland's Census 2022. Each year, NRS estimates the population of Scotland at mid-year based on the latest census data (in this case, 2011). To enable comparison with the census results, the mid-2021 population estimates, based on the 2011 census, have been rolled-forward to Census Day, 20 March 2022. [More detail on this can be found in Section 3 of this report.](#)

### **Census data**

The census data used in this report is what was published on 14 September 2023. The figures used to produce this report were unrounded.

### **Accessing the data**

[Rounded versions of both sets of data](#) are available from the Scotland's Census website. They were published alongside the [census report](#) on 14 September 2023.

## 2. Main points

Scotland's Census 2022 estimated the population of Scotland to be **5,436,600** on 20 March 2022. The corresponding rolled-forward estimate was **5,498,800** people.

### 2.1 Key differences at the national level

- **The 2022 census population was 1.1% lower than the rolled-forward estimate.** This is a difference of 62,200 people. As a comparison, the 2011 census was 0.9% higher than the corresponding rolled-forward estimate.
- The difference between the census and rolled-forward estimate was made up of **22,400 females** and **39,800 males**.
- Differences across nearly all age groups are more pronounced for males than for females.
- **The greatest difference was seen in people aged 25 to 39**, where the census population was 78,900 lower than the rolled-forward estimate.

### 2.2 Potential reasons for differences at the national level

- **International migration:** migration is the most difficult part of population change to estimate. There is no comprehensive system that registers international migration in the UK, and so estimates rely on the best available proxy data. The largest differences between the census and rolled-forward estimate coincide with the age ranges that typically see the largest migration flows, and some of the biggest differences are seen in council areas that see large migration flows.
- **Cross-border migration:** moves between Scotland and the rest of the UK are recorded using GP registrations. Certain people, especially young adults (and males in particular), are less likely to do this in a timely manner. This can lead to issues with accurately recording cross-border migration.
- **The census confidence interval:** a confidence interval is a standard statistical method used to describe the uncertainty of an estimate. The 2022 census had a 95% confidence interval of +/- 27,900 people. The 2011 census had a 95% confidence interval of +/-23,000. This could explain a proportion of the difference. [More information on the quality of census data can be found in the Scotland's Census 2022 report.](#)

**Scotland's Census 2022** = Population as at 20 March 2022

**Rolled-forward estimate** = Population as at 20 March 2022 rolled forward from mid-2021 and based on the 2011 census

## 2.3 Key differences at the council area level

- **24 of the 32 council areas had a difference of less than +/- 2%** between the census and the rolled-forward estimate.
- **The largest difference was observed for the City of Edinburgh**, with the rolled-forward estimate being 3.7% larger than the census. This was followed by Moray (3.2%), Glasgow City (3.0%) and West Lothian (2.8%). **Inverclyde** had the biggest difference in the other direction, with the rolled-forward estimate being 2.5% smaller than the census.

## 2.4 Potential reasons for differences at the council area level

- **Migration within Scotland:** movement between council areas is estimated using registrations with GP practices. This can lead to issues with people being counted in the correct council area (i.e., they continue to be counted at their previous address due to not changing GP practices when moving).
- **International migration:** while council areas face the same issues in estimating the number of international migrants to and from their council area as those described at a national level, some council areas have far more international migration in and out of the area, so the impact may be higher. This is particularly true for the cities.
- **Special populations:** certain council areas have large numbers of people classed as special populations. These include military personnel and prisoners. Some differences exist in how these populations are defined in the census and the mid-year estimates.

### 3. Population estimates used in this report

In Scotland, Census Day was 20 March 2022. NRS population estimates are usually produced for mid-year (1 July to 30 June). Since these two dates do not align, the 2021 mid-year population estimates were rolled forward to Census Day to allow for direct comparison. In this report, this is referred to as the '**rolled-forward estimate**'.

To produce a population estimate for Census Day, the same techniques for the annual population estimates were applied to the smaller timescale (July to March, rather than July to June). The 2021 mid-year population estimates were aged-on by just under 9 months. Births and deaths across that timescale were included, as well as estimates for migration. This resulted in a population estimate at Census Day for comparison with the 2022 census data. Estimates were produced at a national and council area level.

The rolled-forward estimate has certain limitations. Finalised figures for migration between July 2021 and March 2022 were not available at the time of production, and so more estimation was used than for a typical mid-year estimate. However, the rolled-forward estimate is built upon over a decade of migration estimates, and so the effect on the resulting differences is expected to be minimal.

#### 4. Difference between census and rolled-forward estimate at the national level

Table 1 shows the total population for Scotland's Census 2022 and the rolled-forward estimate, and the difference between them. The census estimated 62,200 fewer people in Scotland than the rolled-forward estimate. This difference is made up of nearly twice as many males as females. Plotting the populations by 5-year age groups (Figure 1), we see that the census and rolled-forward estimate are aligned across most age groups. Much of the difference between the census and rolled-forward estimate occurs in 25 to 39 year olds.

$$\text{Difference} = \text{Census} - \text{Rolled-forward estimate}$$

**Table 1: There was a difference of 1.1% between the 2022 census and corresponding rolled-forward estimate, with a larger difference for males than females**

Total population by sex, Scotland

	<b>Census</b>	<b>Rolled-forward estimate</b>	<b>Difference</b>	<b>Percentage difference (%)</b>
<b>Persons</b>	5,436,600	5,498,800	-62,200	-1.1%
<b>Females</b>	2,794,900	2,817,200	-22,300	-0.8%
<b>Males</b>	2,641,800	2,681,600	-39,800	-1.5%

**Figure 1: The 2022 census and rolled-forward estimate generally showed similar populations by age at the national level**

Population by 5-year age group, Scotland

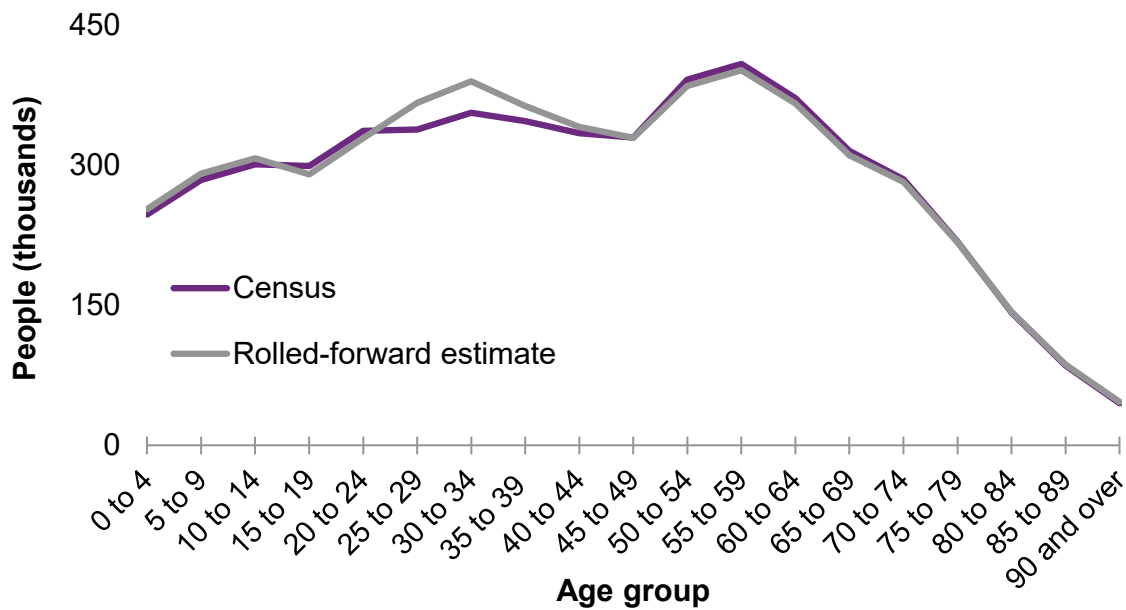
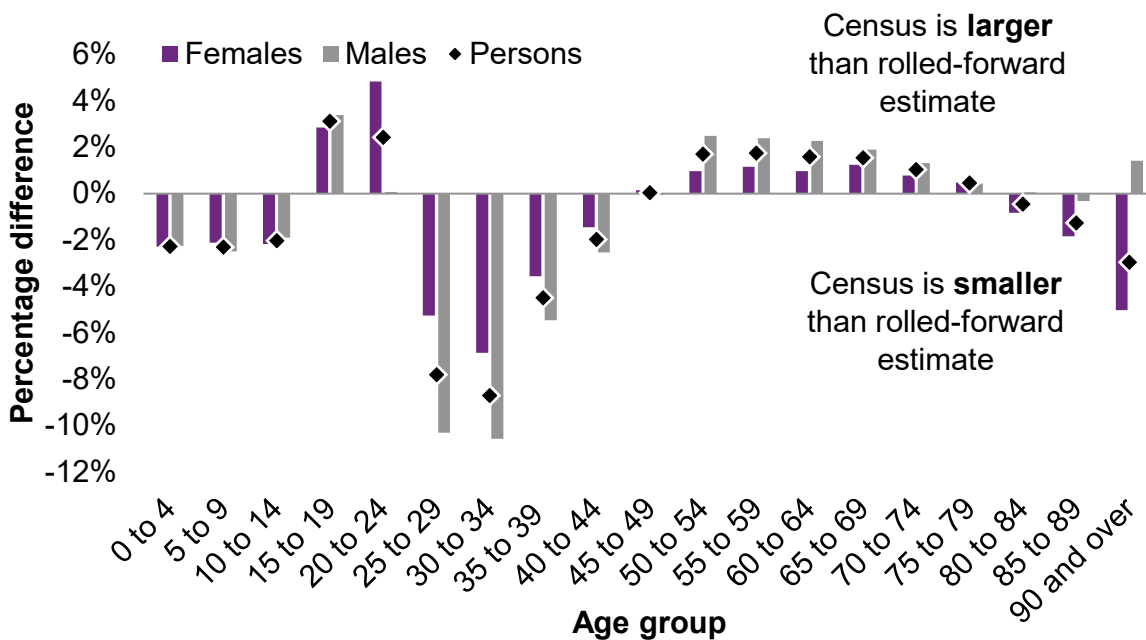


Figure 2 shows the percentage difference between the census and rolled-forward estimate by 5-year age group and sex. The greatest differences were seen in those aged 25 to 39. The difference is more pronounced for males in nearly all age groups; a notable exception to this is females aged 20 to 24 and females aged 85 and over.

**Figure 2: The largest differences were seen in people in their 20s and 30s**

Percentage difference by 5-year age group, Scotland





## What are the key differences by age group?

- The census estimated slightly lower numbers of children than the rolled-forward estimate.
- The census showed slightly higher numbers of 15 to 24 year olds; this encompasses older secondary-school pupils and those in higher education.
- The census was considerably lower than the rolled-forward estimate for those aged 25 to 39, particularly males.
- The census was slightly larger than the rolled-forward estimate for people aged 50 to 79. The difference is smaller for females than males.
- The census was smaller than the rolled-forward estimate for females aged 85 and over. Female life expectancy is higher than male life expectancy, so there are more females in this age group. As these ages comprise a small number of people, a small difference in absolute terms can result in a large percentage difference.

## 5. Potential reasons for differences between the census and rolled-forward estimate at the national level

Rolled-forward mid-year estimates are based on the latest census (in this case, Scotland's Census 2011) and are updated each year to account for population change from 1 July to 30 June. Population change is driven by two main components, natural change and net migration:

- **Natural change** is the number of births minus the number of deaths.
- **Net migration** is the number of people moving into an area minus the number of people leaving.

Therefore, the following variables must be considered when looking at the cause of differences between the census and rolled-forward estimate:

- Births
- Deaths
- Scotland's Census 2011
- Scotland's Census 2022
- International migration
- Migration between Scotland and other parts of the UK

The recording of births and deaths in Scotland is mandatory and therefore assumed to be highly accurate. The following sections consider the influence that the remaining variables might have on any differences between the census and rolled-forward estimate at national level.

## 5.1 Census confidence intervals

**Scotland's Census 2022** had a 95% confidence interval of +/- 0.51%, or +/- **27,900** people.

**Scotland's Census 2011** had a confidence interval of +/- 23,000.

This could therefore explain some of the difference of 62,200 people between the 2022 census and rolled-forward estimate.

## 5.2 International migration estimates

International migration is difficult to estimate, and estimation methods are in the process of being transformed. Age groups that see high international migration flows are also the age groups with large differences between the rolled-forward estimate and census.

### Methods for estimating international migration

There is no single system in place to measure all movements of people into and out of the UK, or to determine if they meet the definition of a long-term migrant. NRS rely on international migration estimates from the Office for National Statistics (ONS). A detailed description on how these statistical methods were used, and changes in methods over time, can be found on the [NRS website](#).

Prior to mid-2020, international migration estimates were formed using the following sources:

- International Passenger Survey (IPS);
- Information held by the Home Office; and
- Labour Force Survey.

The IPS was a face-to-face survey of a sample of passengers entering or leaving the UK. It was [based on a respondent's intended plans to move to or from the UK](#). It had long been acknowledged that the IPS had been stretched beyond its original purpose, so ONS has implemented new methods to estimate international migration.

In March 2020, the IPS was suspended due to the coronavirus (COVID-19) pandemic. [Statistical modelling](#) was instead used to estimate UK international migration for the remaining months to mid-2020 (March to June 2020). As of mid-2021, a new methodology has been implemented to estimate international migration. Administrative data (data collected for the purposes of services such as tax, benefits, and health systems) [is now being used to estimate international migration flows](#).

In future, the new methodology should improve the accuracy of the international migration statistics, and therefore the mid-year population estimates.

## Age and sex distribution of international migrants

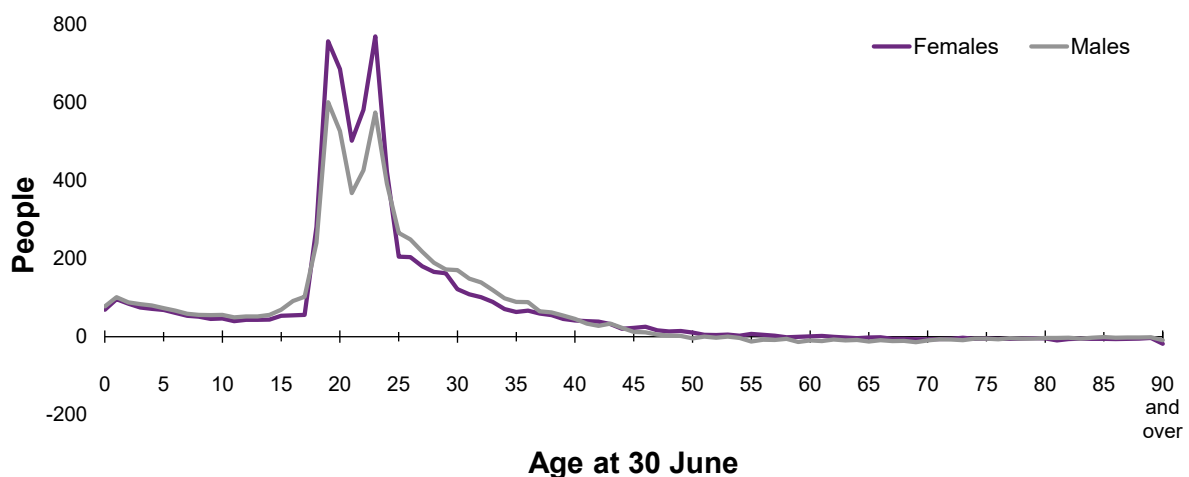
Long-term international migrants to Scotland are not uniformly distributed across age and sex, as shown in [Figure 3](#). These estimates carry some uncertainty but show that the majority of migrants that move to Scotland are aged 18 to 35, with peaks at age 19 and 23. This coincides with the age range for which we see the largest difference between the rolled-forward estimate and the census, and therefore suggests international migration is contributing to this difference. This is to be expected, as populations that move around a lot are inherently more difficult to estimate.

GP registrations have historically been used to estimate the age and sex of international migrant inflows. Due to different rates of interaction with health services across demographics, this results in some uncertainty, particularly around the sex of international migrants (see [Section 7.1](#) for more detail on the limitations of GP registration data). [New ONS methodology](#) will tackle this problem – administrative data that contains the age and sex of migrants is now being used to estimate international migration.

There is slightly higher estimated international migration seen for young children compared with other age groups, likely due to adults migrating to Scotland with their children. This could help to explain differences observed between the census and rolled-forward estimate for younger age groups.

**Figure 3: Net international migration was estimated to peak at ages 19 and 23, with slightly higher net migration for females**

Average yearly net international migration to Scotland by age and sex, mid-2011 to mid-2021



Source: [International Migration | National Records of Scotland \(nrscotland.gov.uk\)](https://nrscotland.gov.uk)

### 5.3 Moves between Scotland and the rest of the UK

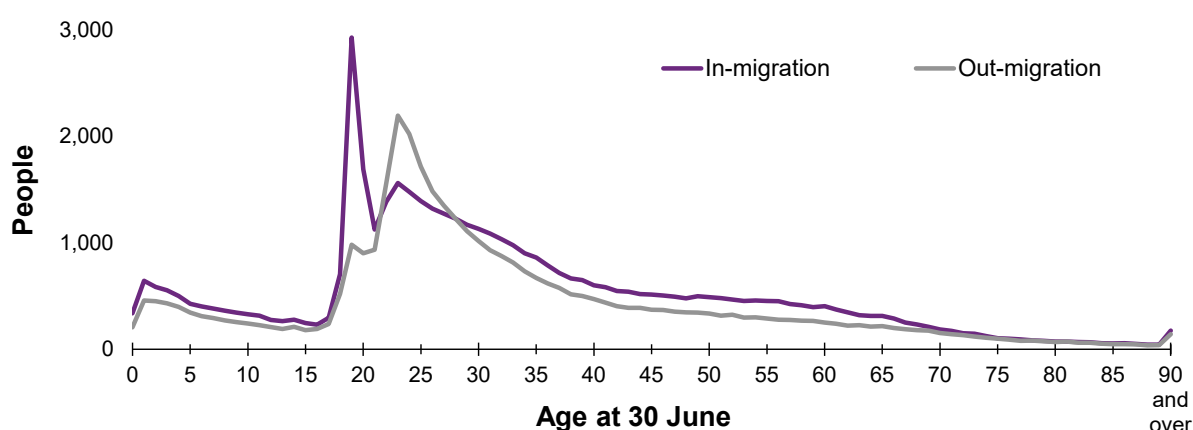
Each year, tens of thousands of people move between Scotland and the rest of the UK. From mid-2011 to mid-2021, an estimated [390,000 people left Scotland for elsewhere in the UK, with 476,000 people arriving in Scotland](#). Figure 4 shows that this migration is not uniform across age, with a large spike in inward migration to Scotland from the rest of the UK at age 19. This corresponds to undergraduate university students moving to Scotland to complete studies. We see a shallower spike in outward migration a few years later, likely corresponding to many of those students then leaving Scotland after their studies. These spikes in migration flows correspond to age groups that display large differences between the census and rolled-forward estimate.

These movements are recorded by [transferrals of patient records across UK borders](#). This system can be subject to inaccuracies, for instance, if people delay registering with a new GP after moving. This will particularly affect the age groups which see the largest in-/outflows with Scotland and the rest of the UK – young adults. Some young people may come to Scotland (e.g., to study) and leave without ever registering with a GP. These people will be picked up on the census and then aged on with the population, as they are not picked up by the annual mid-year estimates when they leave. This could lead to an over-estimate in certain age groups.

More detail on estimating moves between Scotland and the rest of the UK can be found in the [internal migration section \(7.1\)](#).

**Figure 4: Scotland saw positive net migration from the rest of the UK**

Average yearly migration between Scotland and the rest of the UK, mid-2011 to mid-2021



Source: [Rest of the UK Migration | National Records of Scotland \(nrscotland.gov.uk\)](#)

## 6. Difference between census and rolled-forward estimate at council area level

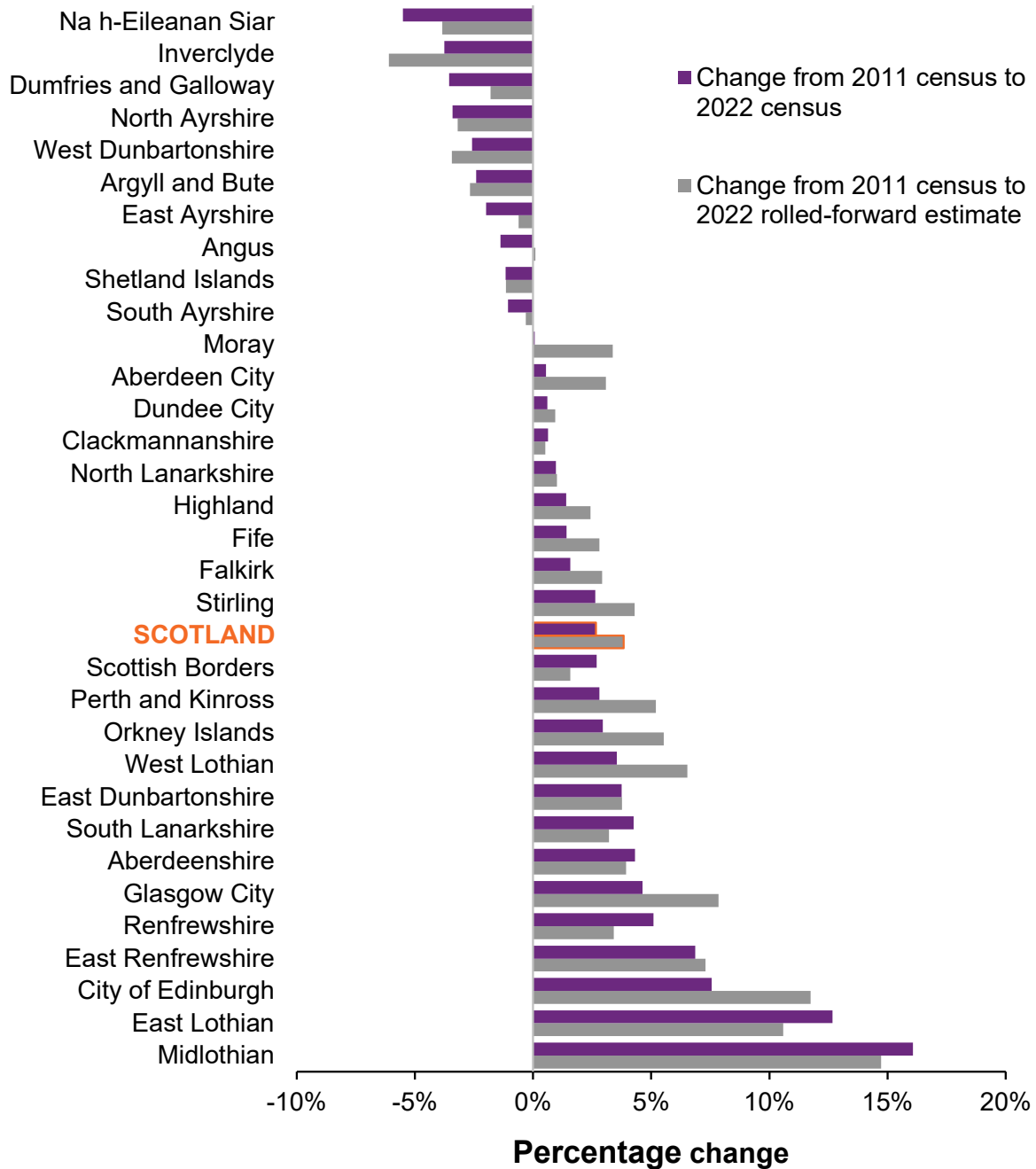
There are 32 council areas in Scotland. [Figure 5](#) shows how the populations of those council areas have changed from 2011 to 2022, as measured by the 2022 census and the rolled-forward estimate. In general, the rolled-forward estimate and the 2022 census showed similar trends in population growth/decline across most council areas.

[Figure 6](#) shows the percentage difference between the census and rolled-forward estimate for each council area. The largest differences were observed in **City of Edinburgh, Moray, Glasgow City, and West Lothian**; these councils all saw rolled-forward estimates larger than the census. The largest difference where the rolled-forward estimate was smaller than the census was **Inverclyde**.

Most council areas showed smaller differences for females than males. For ten council areas, the census was higher than the rolled-forward estimate. The remaining 22 had a higher rolled-forward estimate compared to the 2022 census.

**Figure 5: The rolled-forward estimate and 2022 census were generally aligned in capturing the growth/decline of council area populations from 2011 to 2022**

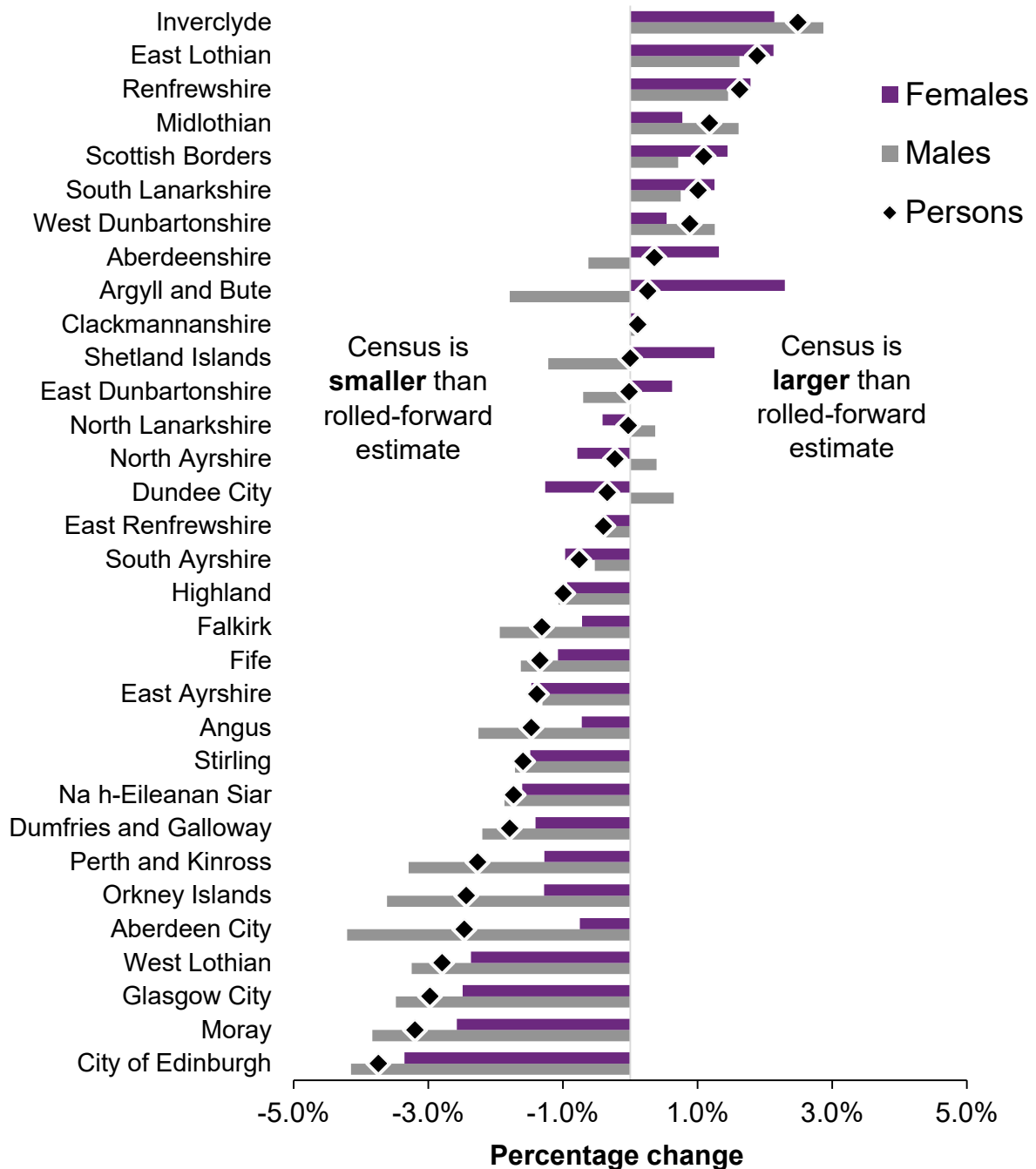
Percentage population change by council area, 2011 census to 2022 census/rolled-forward estimate



Ordered by ascending percentage population change.

**Figure 6: 24 of the 32 council areas saw a difference of less than 2%**

Percentage difference by sex and council area



Ordered by ascending percentage population change.

Figure 7 shows the percentage difference by age group between the eight council areas that saw more than a 2% difference between the census and rolled-forward estimate. The three largest cities in Scotland - Glasgow, Edinburgh, and Aberdeen - saw some of the greatest differences. The age profile of the differences seen in these cities are similar to that seen at the national level: the census is larger than the

rolled-forward estimate for 15 to 24 year olds, and smaller than the rolled-forward estimate for 25 to 44 year olds.

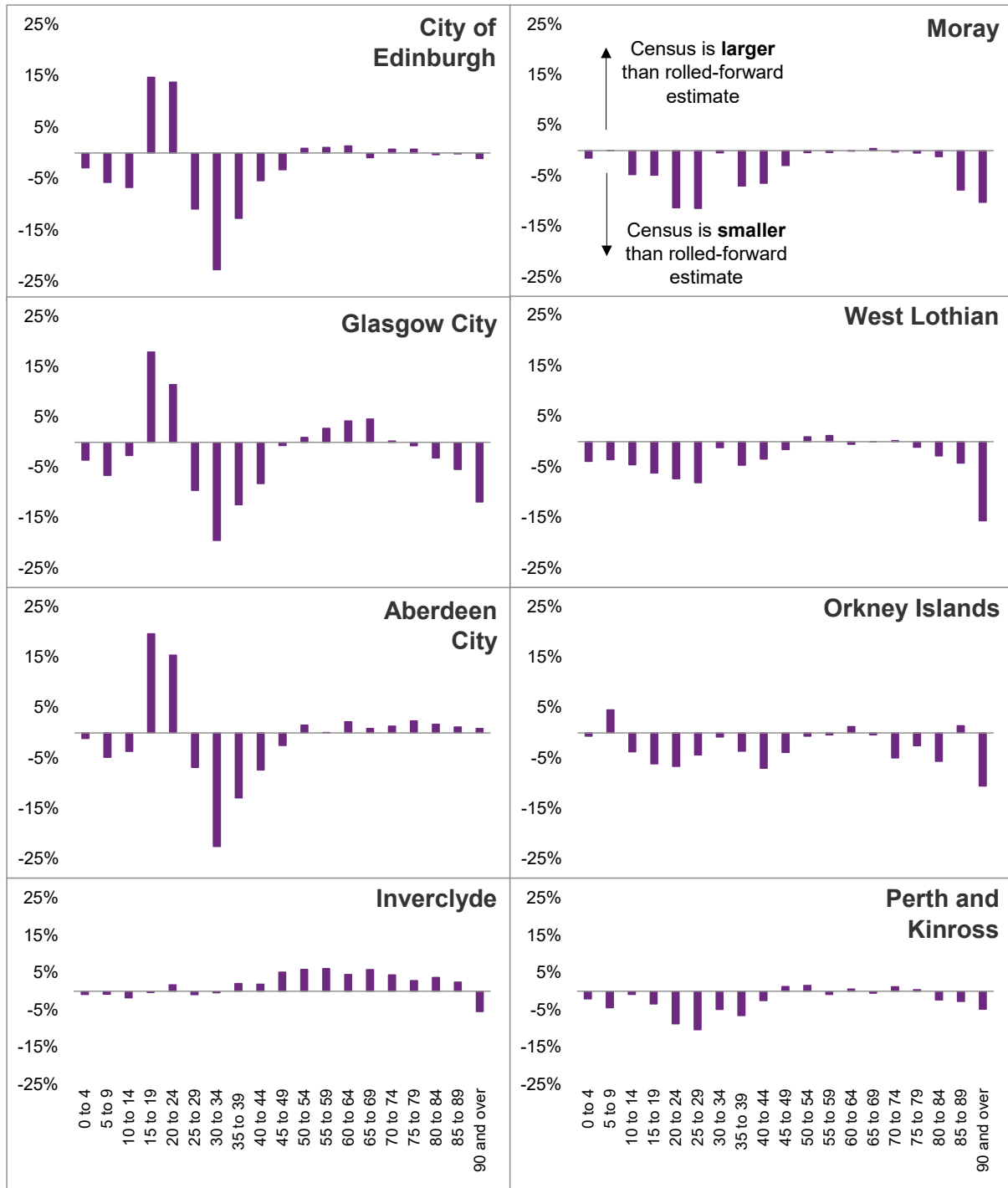
In Moray, West Lothian, Orkney Islands, and Perth and Kinross the rolled-forward estimates are larger than census across 15 to 44 year olds. This could be due to people moving away from these council areas (to other parts of Scotland, or another country) and their move not being recorded in the rolled-forward estimate. Migration within Scotland, and the difficulties in estimating it, are discussed in [Section 7.1](#).

Moray also has a large number of armed forces personnel stationed in the council area. This has potentially caused some of the difference between census and the rolled-forward estimate for this area, and is discussed further in [Section 7.3](#).



**Figure 7: City council areas show similar patterns to each other, which are different to the patterns seen in other parts of the country**

Percentage difference by 5-year age group for council areas with some of the largest differences



## 7. Potential reasons for differences between census and rolled-forward estimate at council area level

Estimating the population of council areas carries the same challenges as described at the national level above. Inaccuracies in the calculation of international and cross-border migration in the rolled-forward estimate will be carried down to the council area level. The impacts will be bigger for the council areas with larger amounts of migration in and out. Beyond this, two factors that can significantly influence council area populations are migration within Scotland and 'special' populations.

### 7.1 Migration within Scotland

People frequently move locations in Scotland, often for work or study. These moves do not affect the overall size of Scotland's population but do affect the distribution of the population. Therefore, inaccuracies in the estimation of migration within Scotland will result in differences between the rolled-forward estimates for council areas and the census results for those council areas.

Migration within Scotland, as well as cross-border migration (between Scotland and England, Wales and Northern Ireland), is estimated through the administrative recording of GP registrations. For example, if someone was to move from Glasgow to Edinburgh, they are expected to register with a new GP practice in their local area. This would then count as a move between the council areas.

There are established issues with using GP registrations to estimate moves, such as:

- People may not ever register with a GP at a particular address.
- People may delay registering with a GP meaning that migration is not measured at the time it occurs.

These issues are more pronounced for certain groups of people. For example, young adults generally interact less frequently with health services. Young males are even less likely to interact with health services than young females. This makes them less likely to register with a GP after moving. We therefore expect some difference between the rolled-forward estimate and the census for young adults, particularly males, in council areas that see large inflows/outflows of young adults. We observe this in university cities such as Edinburgh and Glasgow, where the census is considerably higher than the rolled-forward estimate for 15 to 24 year olds.

Similarly, people in their twenties and thirties moving away from cities (e.g., after finishing university) may take some time to re-register with a GP and remain counted in the rolled-forward estimates at a previous location. This likely contributes to the difference seen in cities such as Edinburgh and Glasgow for those aged 25 to 44.

The opposite is true for more rural council areas. Young people often leave rural areas to seek higher education and employment. The rolled-forward estimates are consistently higher than the census for younger age groups, suggesting these outward moves have not been captured in full.

Older populations generally see much greater interaction with GPs, and there are national screening programmes which begin at age 50. Therefore, GP records are likely to be more accurate for older age groups. In addition, people in this age group tend to move residence less frequently than young adults do. This is reflected in the data, with smaller differences generally observed in over-50s across council areas.

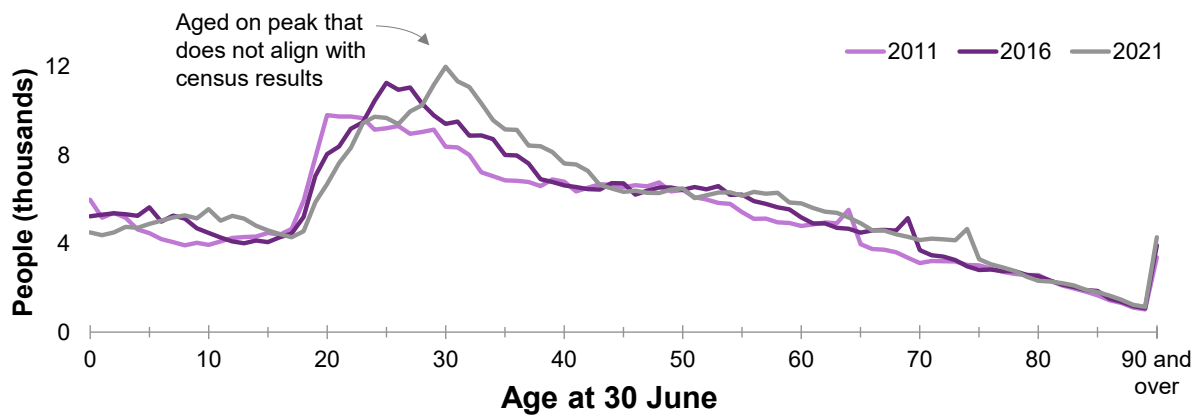
## 7.2 Missed outward migration from cities

Owing to difficulties in how international, cross-border and within Scotland migration is recorded, it is suspected that people leaving urban council areas are not being recorded in full.

Population estimates for Scottish cities, particularly Glasgow and Edinburgh, suggest that a proportion of their outward migration is not being captured. This is likely due to an underestimate of outward international migration, and lags in the recording of within Scotland and cross-border moves. As can be seen in [Figure 8](#), the population of Edinburgh shown in the rolled-forward estimates in 2011 peaked at age 20, as may be expected in a city with a large student population. However, by 2021 it peaked at age 30, and the peak had grown considerably. We expect many populations to age on naturally, however, in this case it is likely to be due to missed outward migration. The estimated peak is not reflected in the 2022 census (where the biggest peak was for university age groups), with the greatest difference between the census and rolled-forward estimate coinciding with the aged-on peak (visible for Edinburgh, Glasgow and Aberdeen in [Figure 7](#)). The difference between the census and rolled-forward estimate for ages 25 to 39 is 23,600 in Edinburgh, 25,900 in Glasgow City and 8,800 in Aberdeen City.

**Figure 8: Mid-year population estimates for Edinburgh display an unusual aged-on peak that suggests missed outward migration**

Mid-year population estimates for City of Edinburgh, 2011, 2016, and 2021



Source: [Mid-Year Population Estimates | National Records of Scotland \(nrsotland.gov.uk\)](https://nrsotland.gov.uk)

### 7.3 Special populations

Certain populations within Scotland are treated differently when creating rolled-forward estimates. These include armed forces personnel and prisoners. While these populations are small for Scotland as a whole, they are not distributed evenly across council areas, and so can have a considerable impact on the difference between the census and rolled-forward estimates in some areas. Armed forces and prisoners are classed as ‘static populations’, due to their fairly consistent age structure, and are therefore not aged-on with the rest of the population when producing rolled-forward estimates.

These populations can be difficult to place within the country, as the concept of a ‘usual residence’ is less straightforward to define for special populations. In some instances, the definitions have differed slightly between census and rolled-forward estimate.

#### Armed Forces

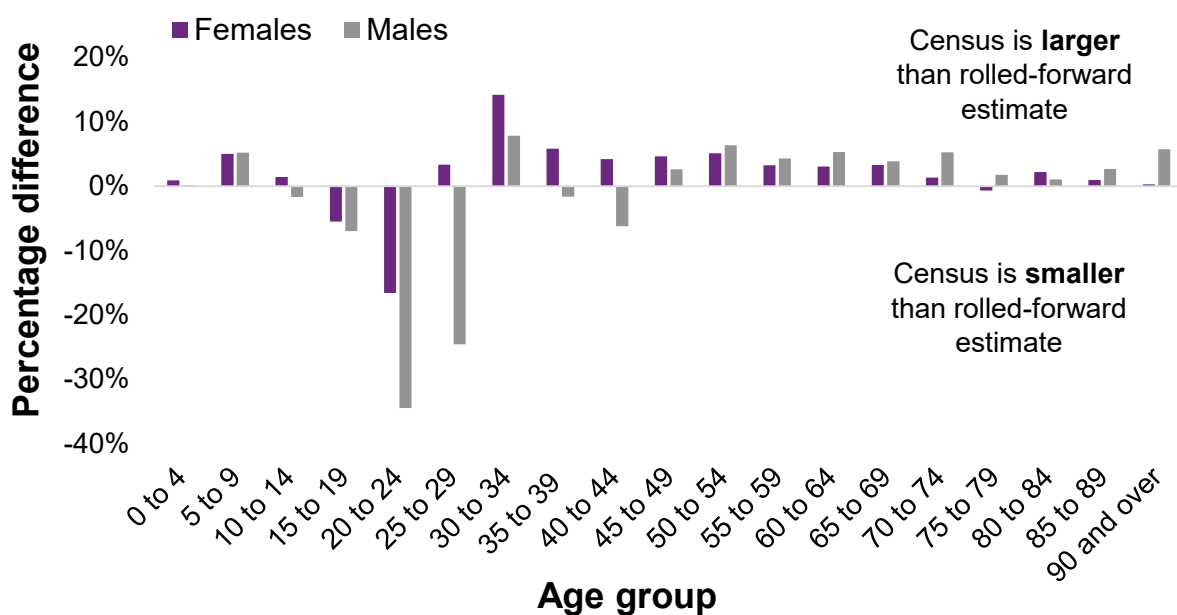
The [armed forces population](#) recorded in the rolled-forward estimate is based on the 2011 census and administrative data sources. The rolled-forward estimate for 2011 was adjusted to take into account differences in where armed forces personnel were instructed to complete their census forms and the standard definition of ‘usual residence’ used in the rolled-forward estimate.

To update the population each year, administrative data from Defence Statistics (part of the Ministry of Defence) is used to estimate numbers residing in each council area.

It was expected that some difference would be observed between the 2022 census and rolled-forward estimate as a result of this. [Figure 9](#) highlights the large differences observed in 20 to 29 year old males in Argyll and Bute, likely as a result of armed forces bases in the council area. A similar pattern is observed in Moray (visible in [Figure 7](#)); the census is 16% smaller than the rolled-forward estimate for males aged 20-24, and 13% smaller for males aged 25-29. This helps to explain why Moray saw the second largest percentage difference between the census and rolled-forward estimate.

**Figure 9: Argyll and Bute had a difference of 34% between the census and rolled-forward estimate for males aged 20 to 24, likely due to armed forces presence in the council area**

Percentage difference by age group and sex, Argyll and Bute



### Prisoners

The [average daily prison population in Scotland in 2021-22](#) was 7,504. This population is spread out across several councils, but it could have a small impact on the differences between the census count and the rolled-forward estimate in some areas.

## 8. Links to related statistics

[Scotland's Census 2022 – Rounded population estimates](#) are available from the Scotland's Census website.

The [statistical quality assurance report for the rounded population estimates](#) is available from the Scotland's Census website.

The [data used in the above quality report](#) is available from the Scotland's Census website.

[Mid-2021 population estimates](#) for Scotland (based on 2011 census) are available on the NRS website.

[A methodology report](#) for the 2021 mid-year estimates can be found on the NRS website.

[A methodology report on migration](#), including international migration, can be found on the NRS website.

The [reconciliation of mid-year population estimates with Census 2021 \(England and Wales\)](#) can be found on the Office for National Statistics website.

The [reconciliation of mid-year population estimates with Census 2021 \(Northern Ireland\)](#) can be found on the Northern Ireland Statistics and Research Agency (NISRA) website.

The [reconciliation of mid-year population estimates with Scotland's Census 2011](#) can be found on the NRS web archive.

## 9. Background notes

### National Records of Scotland

We, the National Records of Scotland, are a non-ministerial department of the devolved Scottish Administration. Our aim is to provide relevant and reliable information, analysis and advice that meets the needs of government, business and the people of Scotland. We do this as follows:

Preserving the past – We look after Scotland's national archives so that they are available for current and future generations, and we make available important information for family history.

Recording the present – At our network of local offices, we register births, marriages, civil partnerships, deaths, divorces and adoptions in Scotland.

Informing the future – We are responsible for the Census of Population in Scotland which we use, with other sources of information, to produce statistics on the population and households.

You can get other detailed statistics that we have produced from the [Statistics](#) section of our website. Scottish Census statistics are available on the [Scotland's Census](#) website.

We also provide information about [future publications](#) on our website. If you would like us to tell you about future statistical publications, you can register your interest on the Scottish Government [ScotStat website](#).

You can also follow us on social media [@NatRecordsScot](#)

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