

In addition to the inclusion of new data that have informed the revision of the population estimates and projections, the following updates were made to the methodology used in the 2019 revision:

Fertility

- The model to project the level of fertility has been updated to include the experience of a larger number of countries currently with low levels of fertility. In the 2019 revision, the projection of fertility in countries with fertility levels below 2.1 live births per woman is now based on the experiences of 40 countries or areas¹ that have had: 1) fertility below this level; and 2) an increase in the level of fertility over at least two consecutive five-year periods after reaching their minima. The number of low-fertility countries that experienced such a recovery in the level of fertility has risen since the 2017 revision, when 36 countries or areas met both criteria, and the 2012 revision, when 25 met both criteria.
- The model used to project the age patterns of fertility was also updated to include new empirical evidence. The projection model combines past national trends of the age pattern of fertility with a trend leading towards a global model age pattern of fertility. The global model pattern is an unweighted average of the proportionate age-specific fertility rates with seven five-year age groups (from 15-19 to 45-49). This global model pattern was updated to include a larger number of countries with fertility below 2.1 live births per woman that have experienced a recovery over at least two consecutive five-year periods after having reached their minima and where the mean age at childbearing reaches 30 years or above in 2015-2020. In the 2019 revision, 24 countries² were used to compute the global model pattern (nine were used in the 2017 revision).
- In five countries with fertility below 2.1 live births per woman (Finland, Italy, Japan, Luxembourg and Ukraine), the level of fertility projected for 2020-2025 and 2025-2030 was adjusted to smooth the transition between a recent downward trend in fertility and an expected future increase. For each of these countries, a recent downward trend in total fertility followed a period of sustained increase. The recent decline in the estimation period contrasted with an immediate increase starting in the projection period.

Mortality

- Due to several factors (political crisis, conflict, public health issues, etc.), twenty countries³ have experienced a recent slow-down or reversal in progress in life expectancy at birth for one or both sexes. In the projection of life expectancy at birth, the 2019 revision assumed that these countries would experience slower progress for the next 5-10 years, after which they would resume a 'normal' trajectory of progress in life expectancy.
- As in past revisions, the 2019 revision made explicit modelling assumptions to incorporate the demographic impact of the HIV/AIDS epidemic on mortality for 21 countries where HIV prevalence

¹ In Eastern and South-Eastern Asia: China, China - Hong Kong SAR, China - Macao SAR, China - Taiwan Province of China, Japan, Singapore, Viet Nam; In Latin America and the Caribbean: Aruba, Barbados; In Europe and Northern America: Armenia, Austria, Belarus, Belgium, Bulgaria, Channel Islands, Czechia, Denmark, Estonia, Finland, France, Germany, Hungary, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Republic of Moldova, Romania, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, Ukraine, United Kingdom, United States of America.

² Austria, Belgium, Channel Islands, China - Hong Kong SAR, China - Macao SAR, China - Taiwan Province of China, Czechia, Denmark, Estonia, Finland, France, Germany, Italy, Japan, Luxembourg, Malta, Netherlands, Norway, Singapore, Slovenia, Spain, Sweden, Switzerland, and United Kingdom.

³ Albania, Austria, Barbados, Canada, Chile, Cuba, France, Fiji, French Guyana, Grenada, Jamaica, Lebanon, Mayotte, Mexico, Seychelles, United Kingdom, United States of America, Venezuela (Bolivarian Republic of), Viet Nam, and Yemen.

among persons aged 15 to 49 was at least 4 per cent at some point between 1980 and 2018. The 2019 revision took, however, a different approach than in previous revisions and used model life tables accounting for the effect of HIV on mortality (Sharrow, Clark and Raftery, 2014) recalibrated using the latest UNAIDS epidemiological data. The age-specific mortality patterns up to 2015-2020 were estimated as a function of adult HIV prevalence, child mortality, adult mortality, and treatment of both children and adults.

- For the projection of the levels of mortality for the 58 countries or areas having ever experienced adult HIV prevalence of 1 per cent or more (either among males or females) during the period 1980 to 2018, the 2019 revision used a different approach compared to the 2017 revision. The levels of life expectancy at birth were projected using the existing Bayesian probabilistic life expectancy projection methods (United Nations, 2017) extended to account for past and expected levels and trends in HIV prevalence and adult ART coverage (Goodwin and Raftery, 2017).
- For the countries that have experienced adult HIV prevalence of 4 per cent or more at any point between 1980 and 2018, the age patterns of mortality were projected using a model of typical age-specific patterns of mortality improvement by level of mortality estimated from individual country experiences included in the Human Mortality Database (HMD) (Andreev, Gu, and Gerland, 2013).

International migration

- The 2019 revision assumed that the international migration from 2050 to the end of the 21st century would remain constant at the level projected in 2045-2050. In the previous revision, it was assumed that the international migration would reach by 2095-2100 half the level projected for 2045-2050.

For further details on the methodology used by the Population Division, please see the 2019 revision report on the *Methodology of the United Nations Population Estimates and Projections* that will soon be available.

References

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Prepared by the Population Division of the United Nations Department of Economic and Social Affairs. Further information about the *World Population Prospects 2019* is available online at <https://population.un.org/wpp/>. More work of the Population Division is available at www.unpopulation.org