

ABOUT MORTALITY DATA FOR ESTONIA

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The *Background and Documentation* file for Estonia is still in progress. For a description of the original data used to estimate the mortality surface for Estonia, see Appendix 1.

DATA QUALITY ISSUES

There were two major problems related to the quality of population estimates. First, there is under-coverage of the two most recent censuses. Statistics Estonia found that 30,762 or 2.3% of all permanent residents were not enumerated in the 2011 census (Tiit, 2014). After additional checks using linkages to Population Register and other registers, Statistics Estonia confirmed that 1) these people were indeed permanent residents of Estonia in the Population Register; 2) their families did not report any emigration to other countries; 3) their activity in Estonia can be traced using other registers such as tax or health insurance registers (Tiit, 2014). Although the official census figures were not modified by Statistics Estonia, the published adjustments for census under-coverage were used within the HMD to produce a new sets of inter-censal (2001-2011) and post-censal (2012 onwards) population estimates.

Second, in spite of a documented impact of international migration on population change during the inter-censal period 2001-2010, Statistics Estonia has determined that some Estonian residents who moved to other countries are still included in the Population Register. Due to concerns about the quality of migration statistics, Statistics Estonia actually stopped using international migration figures for its annual population estimates. International migration was instead assessed for the inter-censal period 2001-2010 by Statistics Estonia from the 2011 census after adjusting for under-count. These adjustments were made assuming that:

1. At the beginning of the inter-censal period, unregistered migration is the same size as registered migration;
2. During the inter-censal period, the ratio of registered migration to unregistered migration gradually increases in favour of registered migration;
3. The age distribution of unregistered migrants is generally the same as that of registered migrants with one exception: the share of unregistered migrants of working age (20 years and older) is somewhat larger than for registered migrants (with a ratio of 55:45) (Source: Tiit, 2014).

Using births, deaths, and the revised migration figures for 2001-2010 as well as the adjusted (for the census under-count) population estimate for 2011 as the basis, Statistics Estonia recalculated population estimates for the inter-censal period 2001-2010. These revised inter-censal population estimates replace previously published post-censal population estimates (which did not account for both recorded and unrecorded international migration). Following this re-estimation procedure, Statistics Estonia found a discrepancy between the 2000 census and the corresponding re-estimated population figure for the same year. This discrepancy (2.1%) was attributed to the under-coverage of the 2000 census.

As a result of the above adjustments, Statistics Estonia published a new set of pre-censal (2000 and 2011), inter-censal (2001-2010), and post-censal (2012 onwards) population estimates. Because previously published inter-censal population estimates for 1990-1999 are based on the unadjusted 2000 census data, there is a notable jump in population estimates between 1999 and 2000 (Figure 1). In order to overcome such a notable discontinuity, we implemented our own adjustment for the census under-coverage using a non-standard method. This method process census under-count in the same way as a migration error which should be redistributed across the ten years of the inter-censal period (1991-2000). We used cumulative proportions starting from adding 10% of the error to the population estimates for 1991 and finishing with adding 90% of the error to the population estimates for 1999. The official published population estimate for 2000 corresponds to the full adjustment (100%) for this error. Because age-specific figures of census under-coverage were not available, we added estimated errors for each inter-censal year (1991-1999) as additional population counts with unknown age. In the final stage, these additional population counts were redistributed across ages using the Human Mortality Database methodology. Figure 1 comparing official (Input DB) and newly derived adjusted (Lexis DB) population estimates for adult males suggest that our adjustments produces plausible results showing no disruption between the series of population estimates for 1990-1999 and 2000-2015. However, we strongly recommend that population estimates for the 1990-1999 period be used with caution.

Starting with January 1st 2016, Statistics Estonia estimates population on the basis of the Population Register of Estonia using the Residency Index concept (Tiit and Maasing, 2016). According to Tiit and Maasing (2016), the value of the index is calculated for all persons assigned to the so called “extended total population” including a) verified permanent residents and b) residents with uncertain residential status (for example, persons who are *de facto* abroad but who did not report their departure to the Estonian authorities). This information is obtained via the Estonian Population Register containing the so called “passive section” which includes persons with uncertain migration status. The residency index is assigned to every person included in the Population Register. The index ranges between 0 (certainly not a resident) to 1 (certainly resident). All values in between these two extremes correspond to the uncertain residency status. For persons assigned to this category, the final decision about their residency status and inclusion into the official population counts is made based on a threshold: all persons with an index above the threshold are considered permanent residents, whereas all persons with an index below the threshold are considered non-residents (Tiit and Maasing, 2016). The exact value of the residency index is defined using the “signs of life” method designed for tracing each person with an uncertain residence status through several administrative registers, such as the health insurance register, the pension insurance register, the educational register, the tax register, and others. In 2015, a total of 27 administrative registers were used to check for activity (“signs of life”) including the payment of taxes and the use of various administrative services. The residency index was calculated depending on the outcomes of these checks (for a more precise description of the method, see Tiit and Maasing, 2016).

Figures 2 and 3 suggest that although the residency index helps to account for unregistered migration from/to Estonia and improve estimates of international migration, the method does not produce any visible impact or disruptions in the series

of aggregated or even age-specific population counts. It should be noted that the slight population increase observed from 2016 onwards corresponds to a real increase in immigration (mostly from Estonians returning from abroad, including those who never reported their departure to the authorities). Overall, it is estimated that the introduction of this new method led to 0.3% increase in total population (if compared to the previous estimation without applying the residency index method).

Figure 1. Official population estimates (Input DB) and adjusted HMD population estimates (Lexis DB) for Estonian adult males (ages 5 to 64).

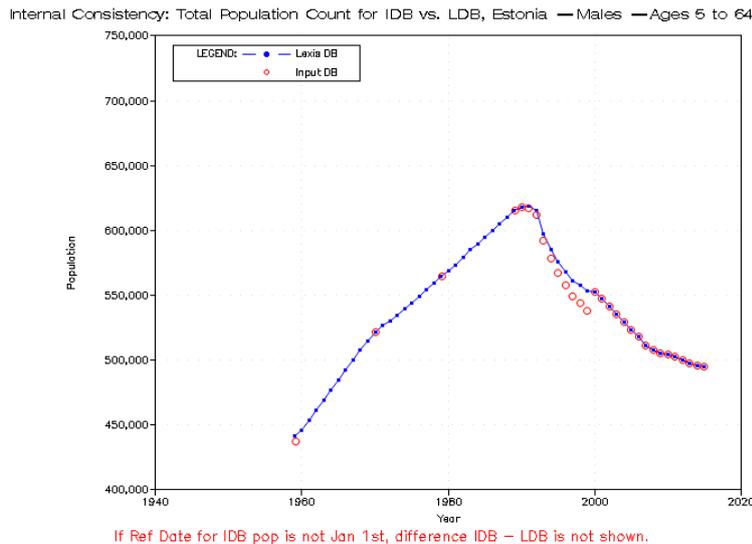
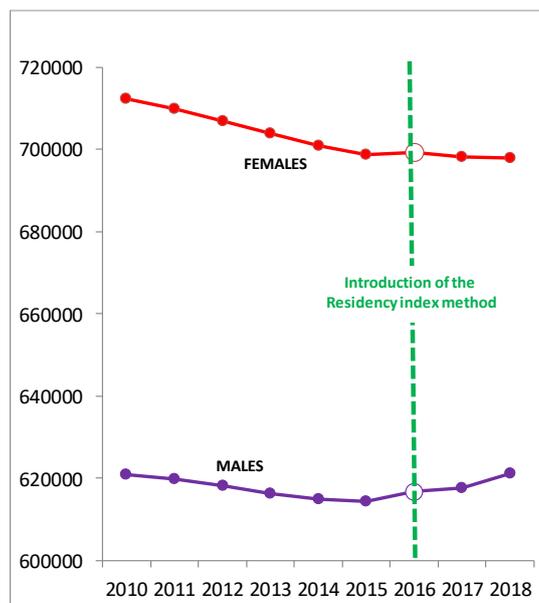
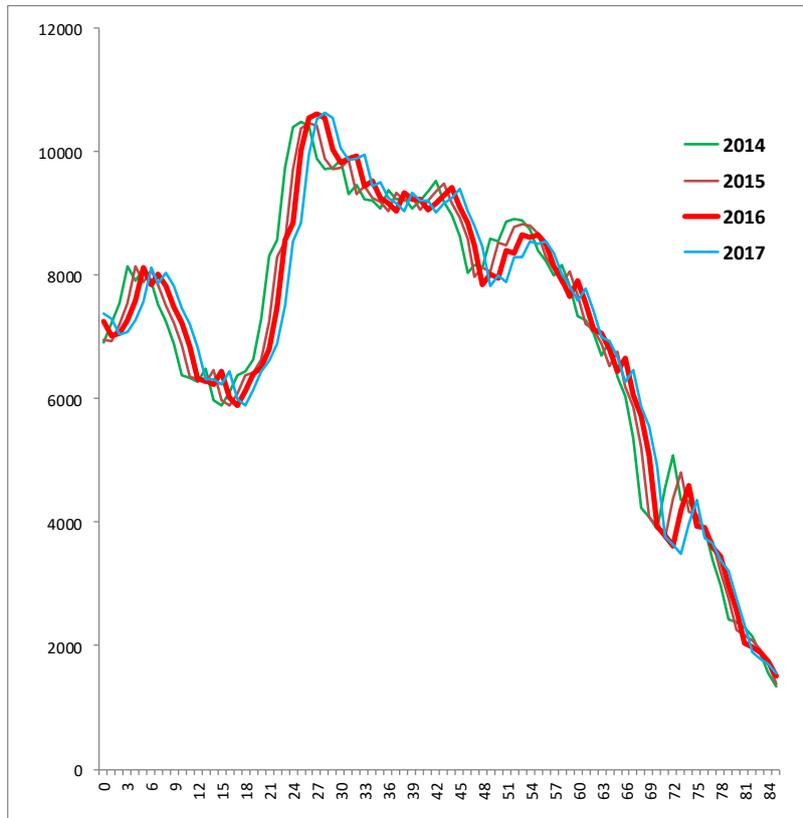


Figure 2. Official total male and female population counts (as of January 1st) before (2010-2015) and after (2016-2018) introducing the residency index concept.



Source: Statistics Estonia, 2018.

Figure 3. Official age-specific male population counts (as of January 1st) by single age before (2014-2015) and after (2016-2017) introducing the residency index concept.



Source: Statistics Estonia, 2018

REVISION HISTORY

Changes with the September 2018 revision:

- **Life tables:** All life tables have been recalculated using a modified methods protocol. The revised protocol (Version 6) includes two changes: 1) a more precise way to calculate a_0 , the mean age at death for children dying during the first year of life and 2) the use of birth-by-month data (where and when available) to more accurately estimate population exposures. These changes have been implemented simultaneously for ALL HMD series/countries. For more details about these changes, see the revised Methods Protocol (at <http://www.mortality.org/Public/Docs/MethodsProtocol.pdf>), particularly section 7.1 on Period life tables and section 6 and Appendix E, on death rates. The life tables calculated under the prior methods (Version 5) remain available at v5.mortality.org but they have not been, and will not be, updated.
- **Population estimates for 2012-2015:** previously published official population estimates up to the last open-ended age interval 85+ have been replaced by more detailed population estimates up to the last open-ended age interval 100+. The total population counts remained the same.

REFERENCES

Tiit E.-M. (2014). "On the methodology of demographic statistics." Pp.93-99 in: *Quarterly Bulletin of Statistics Estonia*. Tallin, Estonia: Statistics Estonia.

Tiit E.-M., Maasing E. (2016). "Residency index and its applications in censuses and population statistics." Pp.53-60 in: *Quarterly Bulletin of Statistics Estonia*. Tallin, Estonia: Statistics Estonia.

Statistics Estonia (2018). Statistical database. Retrieved 17 September 2018 (<http://www.stat.ee>).

APPENDIX 1:

Description of the original data used for HMD calculations

DEATHS

Period	Type of Data	Age grouping	Comments	RefCode(s)
1959-1988	Annual number of deaths by sex and single year of age (1x1 rectangle).	0, 1, ..., 99, 100+, unknown		3, 13
1989-2019	Annual number of deaths by sex, single year of age, and year of birth (triangle).	0, 1, ..., 99, 100+, unknown		4, 12, 16, 19, 21, 24, 27, 33, 37, 43

POPULATION

Period	Type of Data	Age grouping	Comments	RefCode(s)
1959, 1970	Census counts of population by sex and single year of age as of January 15. Actually present (<i>de facto</i>) population.	0, 1, ..., 99, 100+, unknown		5, 6
1979, 1989	Census counts of population by sex and single year of age as of 17 January 1979 and as of 12 January 1989. Permanent resident (<i>de jure</i>) population.	0, 1, ..., 99, 100+, unknown		7 8
1990-1999	Annual January 1 st population estimates by sex and single year of age. Resident population.	0, 1, ..., 84, 85+	Inter-censal population estimates (revised according to the 2000 census)	9

POPULATION (continued)

Period	Type of Data	Age grouping	Comments	RefCode(s)
2000	January 1 st population estimates by sex and single year of age. Resident population.	0, 1, ..., 84, 85+	Pre-censal population estimate corrected for the 2000 census under-count	29
2001-2011	Annual January 1 st population estimates by sex and single year of age. Resident population.	0, 1, ..., 84, 85+, unknown	Revised inter-censal population estimates	22
2012-2015	Annual January 1 st population estimates by sex and single year of age. Resident population.	0, 1, ..., 99, 100+, unknown	Revised post-censal population estimates (adjusted for the 2011 census undercount)	38
1991-1999	Estimated error due to the under-coverage of the 2000 census.	Unknown		30
2016-2020	Annual January 1 st population estimates by sex and single year of age. Resident population.	0, 1, ..., 99, 100+, unknown	Official post-censal population estimates derived using the residency index method.	39, 42

BIRTHS

Period	Type of Data	Comments	RefCode(s)
1959-2019	Annual counts of births by sex.	No adjustment has been made for underestimation	1, 2, 14, 17, 20, 25, 26, 32, 35, 40

BIRTHS BY MONTH

Type of data: Annual live birth counts by month.

Period covered: 1959-2019.

RefCode(s): 31, 36, 41