ABOUT MORTALITY DATA FOR ICELAND

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GENERAL

Habitation of Iceland started around 870 AD when Norwegians began arriving with families and slaves from Ireland and Scotland (Goyer and Draaijer, 1992). In 930 AD, a society formed and a National Assembly (*Althing*) was established. In 1262, Iceland lost its independence to the Kingdom of Norway, and it remained a Norwegian colony until 1380 when both Norway and Iceland came under dominion of the Danish Crown. In 1918, Iceland was declared a sovereign state in union with Denmark, and in 1944 it became an independent republic.

Similar to other Nordic countries, the population statistics for Iceland offer exceptionally rich data over an extended period of time. Before the middle of the seventeenth century, population data are scarce (Larusson, 1936; Steffensen, 1968), offering “little more than educated guesses” (Tomasson, 1977). The earliest account of the Icelandic population is provided by the Book of Settlements *(Landnámabók*), which was written in the middle of the twelfth century (Translated by Pálsson and Edwards, 1972) and mentioned about 3,500 people and about 1,500 place names. Before this, in 1097, the Bishop of Iceland, Gissur Ísleifsson, ordered enumeration of farmers for the implementation of tithes. Estimates of the total population can thus be produced for the late eleventh century by multiplying the number of farms by the average household size (of course there is uncertainty about the average household size at that time). In 1311, another enumeration of all farms in Iceland was carried out, again for taxation purposes. Several other accounts of the population at various points in time are available from parish ministers (*prestatöl*) and churches (*kirknatöl*) (Jónsson and Magnússon, 1997). The year 1703 was a turning point for Icelandic population statistics. In this year, two prominent Icelanders, Professor Árni Magnússon and Vice-Lawman Páll Vídalín, conducted what is now cited as the first modern census in the world (Jónsson and Magnússon, 1997). Iceland experienced severe famines in the years preceding this event, and consequently, the King of Denmark commissioned these two leading

Icelanders to travel throughout the country in order to provide an account of the current situation. This census covered the entire population of Iceland (50,358 people) and recorded the names of individuals. Only a short summary of this census was published in 1780, and for many years the records were considered lost. It was rediscovered *in toto* in the Danish National Archives in 1914 and published by the Statistical Bureau of Iceland in the years 1924–1947 (Tomasson, 1977).

During the period 1769–1901, censuses for Iceland were conducted by the Danish government along with the Danish censuses. The only exception was the census of 1785, which was taken two years earlier in Iceland than in Denmark because of the need to investigate devastation caused by the Laki volcano eruption. As of 1910, Icelandic censuses were conducted and processed exclusively in Iceland. The census of 1910 was conducted by the Department of Finance, and subsequent censuses were carried out by Statistics Iceland. A complete list of censuses is given in Appendix II.

Another turning point in Icelandic population statistics occurred in 1952. Just as Iceland was the first country to conduct a modern census, so it was the first country to abandon censuses. In this year, the National Population Register was established in Iceland. A special census on October 16th, 1952, together with the general census of December 1st, 1950, served as a basis for the population register. After that, the process of collecting population statistics became continuous. This register is updated by means of notices of address changes, the reporting of births, marriages, deaths and other events. Starting with 1953, population estimates have been published based on tabulations from the population register.

The collection of vital statistics in Iceland began in the seventeenth century. As in other Nordic countries, parish registers (*kirkjubækur*) have been kept in some parishes since the late seventeenth century. In 1735, collection of vital statistics became compulsory. The two Icelandic bishops were required to collect annual records of births and deaths from all parishes. In 1746, detailed instructions to maintain parish registers (*prestsþjónustubækur*) (e.g. how the registration of births, confirmations, marriages, and

deaths was to be carried out) were distributed to all parsons. Together with parish registers, the parishes were required to maintain catechetical registers (*sóknarmannatöl,* formerly *húsvitjanabækur*) where the names, ages, literacy, and general Christian knowledge of the parishioners were recorded. Vital statistics were first published in the journal *Rit þess íslenska lærdómslistafélags* over the years 1786–96. Theublication of the vital statistics was sporadic until 1858 when the data became available from *Skýrslur um landshagi* on a regular basis. More information on the sources of population and vital statistics can be found in Jónsson and Magnússon (1997).

Specific Episodes in Iceland Demographic History

An overview of Icelandic demography from the time of settlement to the late 20th century is provided by Tomasson (1977). It seems that the settlement of Iceland took place in a favorable climatic period, and over the first few centuries of settlement the population increased. This growth, however, was frequently interrupted by famines and other natural calamities. Several references to such "bad years" are included in the Book of Settlement (*Landnámabók*). In 975–76, for example, there was "a great famine winter in Iceland in heathen days, the severest there has been in Iceland. Men ate ravens then and foxes, and many abominable things were eaten which ought not to be eaten, and some had the old and helpless killed and thrown over cliffs." In 1057–58, there was "another year of dearth", and in 1118 "there was a great famine in Iceland". There are also references to the harsh years in the Icelandic Saga and in various historical documents dating from the twelfth and thirteenth centuries.

Starting in the late thirteenth century (around the time when Iceland came under the dominion of the Norwegian Crown), there was a period of worsening climate and long-term population decline. It would not be an exaggeration to say that over the next few centuries Icelanders barely managed to survive. The size of the population was largely determined by how well the grass grew. The worsening climatic conditions resulted in less fodder for cattle, which in turn led to more frequent famine.

According to Sigurdur Thorarinsson (1944), the period of 1270–1390 was characterized by a particularly high frequency of harsh years. Shortly afterwards, in 1402, the epidemic of the bubonic plague (the Black Death) finally reached Iceland, killing about two-thirds of the population (Ziegler, 1969). Three hundred years later, another great disaster, the smallpox epidemic of 1707, swept over the country. About one-third of the entire population (about 18,000 people) died. The total population of Iceland is believed to have declined to 33,000 people, the lowest number ever since the island was settled (Tomasson, 1977).

The remainder of the eighteenth century brought even more suffering and distress. It is considered the worst century among all eleven centuries of Icelandic history. According to Magnús Stephensen (1808), "During this century Iceland experienced 43 years of distress due to cold winters, ice floes, failure of fisheries, shipwrecks, inundations, volcanic eruptions, earthquakes, epidemics and contagious diseases among men and animals which often came separately, but often in connection with and as a result of one another."

The summer of 1783 brought the third worst catastrophe in Icelandic history. On June 8th, 1783, a 25-kilometers-long basaltic fissure, with 130 craters opened at Laki (*Lakagígar*). This eruption is thought to be one of the biggest, or even the biggest, eruption in historical times. It produced about 14.7 km^3 of basalt lava covering approximately 565 km^2. The volume of tephra emission was about 12.3 km^3. Clouds of ashes and gas reached the Faroe Islands, and even mainland Europe. Haze resulting from the eruption was observed as far away as Lisbon and Budapest. The aerosol build-up caused the average temperature in the Northern Hemisphere to drop by as much as 1^{o}C, resulting in extremely cold winters following the eruption (Thordarson and Self, 1993; Wikipedia, 2004).http://en.wikipedia.org/wiki/Lakagigar An account of these days is provided by the parish priest, Jón Steingrímsson, who became famous because of his so-called *fire sermon* in the village of Kirkjubæjarklaustur located near the Laki eruption:

"*This said week, and the two prior to it, more poison fell from the sky than words can describe: ash, volcanic hairs, rain full of sulfur and salt peter, all of it mixed with sand. The snouts, nostrils, and feet of livestock grazing or walking on the grass turned bright yellow and raw. All water went tepid and light blue in color and gravel slides turned gray. All the earth's plants burned, withered and turned gray, one after the another, as the fire increased and neared the settlements*." (Steingrímsson and Kunz, 1998).

The immediate effect of this disaster on the population of Iceland was the destruction of about 37 farms, leaving about 400 people without shelter. As the eruption continued, the situation worsened. Most of the grasslands were destroyed by volcanic ash and acid rain, leading to a great loss of livestock caused mainly by fluorine poisoning. By the end of 1784, approximately 77% of all horses had perished, as did 53% of all cattle, and about 82% of all sheep. The resulting famine and diseases claimed the lives of 9,336 persons in 1784 and 1785, about one-fifth of the total population (Stephensen, 1808; Thorarinson, 1944). The aftermath from the Laki eruption was so horrendous that the Danish government conducted a special census in 1785 and seriously considered evacuation of the remaining Icelanders to the heathlands of the Jutland Peninsula (http://encarta.msn.com/text_761551693__1/Iceland.html). According to the 1785 census, the total population of Iceland dropped to 40,623, one of the lowest figures in Icelandic history.

The mortality situation began to improve in the middle of the nineteenth century. Natural catastrophes became less frequent, population was steadily growing and life expectancy at birth began an almost uninterrupted increase. Nonetheless, epidemics of infectious diseases, claiming the lives of infants and children, were still very common. One of the deadliest outbreaks was a measles epidemic that swept the country in 1846, raising the infant mortality rate to an unprecedented level of 611 deaths per thousand live births. In 1869, epidemics of diphtheria and croup struck the country causing life expectancy level at birth to drop to about 20 years of age (estimate from the Human Mortality Database). These diseases were more dangerous for children than for infants, and at that time, the two illnesses (diphtheria and croup) were grouped under a common name, *barnaveiki,* due to problems of diagnosis. Another outbreak of measles in 1882 was the main reason for the extremely high infant mortality rate in that year

(0.439) (Guttormsson and Garðarsdóttir, 2002). Together with the following year, 1883, this period was perhaps the last severe mortality crisis of the nineteenth century. In 1882–83, in addition to the measles epidemic, ice off the Icelandic coast significantly lowered the temperature, causing famine accompanied by a cholera epidemic (Tomasson, 1977).

At the end of the nineteenth century, a rapid transition to lower mortality took place. Over the period from 1870 to 1915, infant mortality rates dropped to record low levels, and by 1915 they were comparable with the lowest rates observed in Europe at that time (Guttormsson and Garðarsdóttir, 2002). Life expectancy gains were also extraordinarily high. Several decades later — for a few years in the 1940s, 1950s, and 1960s, and especially during the decade of 1974—1984 — Iceland became a world leader in life expectancy at birth (Oeppen and Vaupel, 2002).

Iceland has experienced large swings in foreign migration during the 1990s and 2000s. The country became a member of the European Economic Area (EEA) in 1994, which facilitated immigration of EU countries' citizens (Eydal and Guðbjörg, 2009). Beginning in 2004, a large influx of persons migrated to Iceland to take advantage of the economic boom and as a response to labour demand for the construction of large industry plants (Ministry of Social Affairs, 2007; Roto and Rasmussen, 2010). According to the OECD, the net flow of foreign migration peaked in 2006-2007 before declining in the following years due to the financial crisis that hit the country particularly hard at the end of the 2000s. During years 2009-2011, net migration was negative but it became positive again in 2012.

Sources of Data

Most of the raw data on population size were received directly from Statistics Iceland. Population estimates by single year of age from December 31st, 1840 to December 31st, 1995 are also available from a publication by Jónsson and Magnússon (1997). These estimates are completely consistent with the data received from Statistics Iceland except for the years 1952–1961 when minor differences are found. The source of these

discrepancies is currently being investigated. No information has been found regarding how these estimates were derived. This is particularly a concern for historical periods when data on deaths are only available aggregated by five-year age groups, and the original population counts are based on censuses. For recent years, population estimates are available from electronic publications, which are disseminated via the web site of Statistics Iceland (http://www.statice.is).

Data on deaths were also received directly from Statistics Iceland. Death data for the years 1838–1980 are available by five-year age groups only, and they appear to be identical to the data provided on the CD-ROM accompanying the publication by Jónsson and Magnússon (1997). Data for later years are provided by single year of age and by year of birth. Death counts are generally consistent with those provided by Jónsson and Magnússon (1997) except for several small differences.

Death counts for years 2016-2021 have been processed using a combination of data from Eurostat and from Statistics Iceland. Eurostat provides aggregated death counts by single year of age, birth cohort and year of registration for ages 0-99 and deaths in the open age interval 100+ years while Statistics Iceland provides aggregated death counts by single year of age and year of registration but not by birth cohort up to 110. We have thus used the Eurostat data for all ages below 100 and data from Statistics Iceland for ages 100+ years. The same method has been used retroactively to the 2016 mortality data. This is the procedure that is likely to be used in the foreseeable future, as Statistics Iceland declined to process such individual data requests, given it already shares the data directly with Eurostat for dissemination to third party audiences.

TERRITORIAL COVERAGE

There were no significant territorial changes in Iceland during the period covered by the Human Mortality Database.

DEATH COUNT DATA

Coverage and Completeness

Since it is required by law to register vital events, the registration of deaths is considered virtually complete.

POPULATION COUNT DATA

Coverage and Completeness

Population estimates for Iceland are available from censuses and later from the population register. Both censuses and the population register provide estimates of resident (*de jure*) population (see also below). The National Population Register includes Icelandic personnel of Icelandic embassies abroad but excludes embassy personnel in Iceland and the NATO base staff and their families (Jónsson and Magnússon, 1997). As of 2022, Statistics Iceland also publishes data on the non-binary population. Because the non-binary population constitutes .04% of the overall population, they are not included in the Human Mortality Database population estimates. The population estimates do include those that are registered within the Nation Registry, meaning refugees are likely included in these estimates. Population estimates, and especially those based on the population register, are considered to be of very good quality.

BIRTH COUNT DATA

Coverage and Completeness

Since it is required by law to register vital events, the registration of births is considered virtually complete.

DATA QUALITY ISSUES

Before publication of the data, the quality of the estimated death rates is assessed and the estimates calculated for the Human Mortality Database (HMD) (e.g., e_0, q_0) are compared with those available from external sources. One of the problems currently present in the data for Iceland is the exceptionally high male life expectancy at age 100 in some early years (as shown in the figure below for 1871):

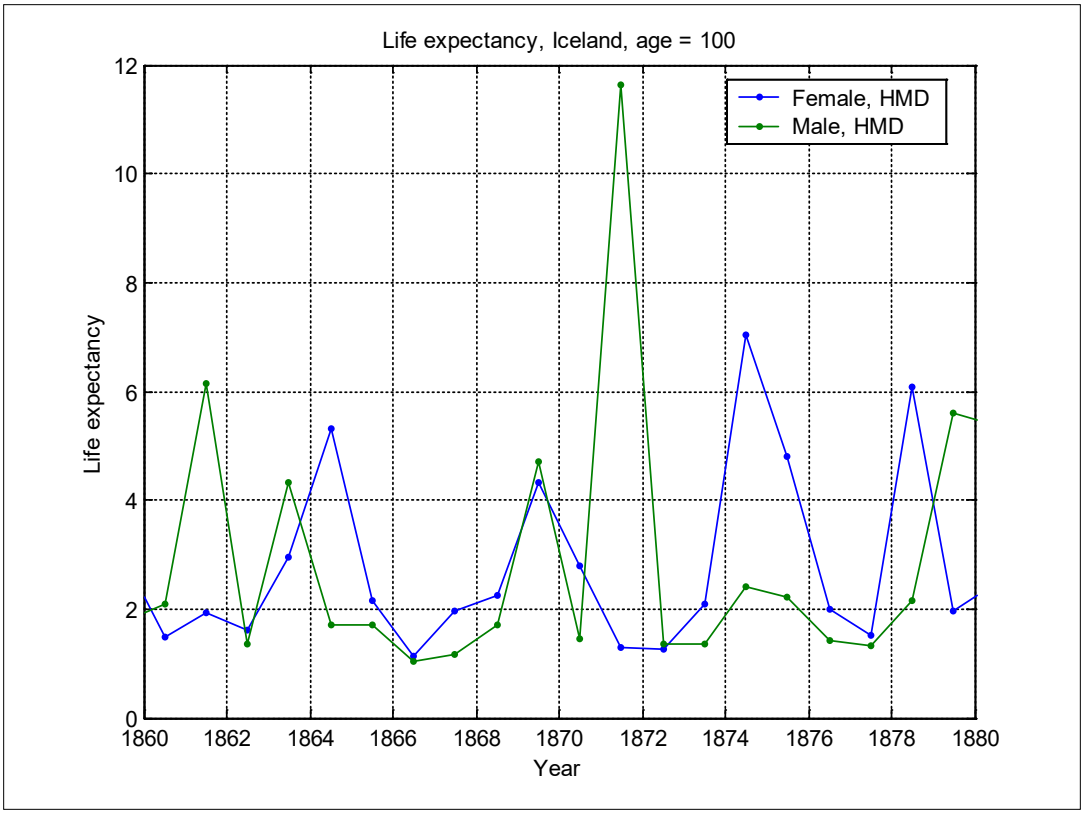

Figure 1. Life expectancy at age 100, Iceland, males and females

This implausible estimate results from the application of the procedure to smooth death rates at ages 80 and over. For populations with a very small number of deaths at such advanced ages (e.g., in this case, there are only 11 deaths above age 80 and none above age 90), the observed death rates can be highly variable. When combined with age misstatement at older ages, this creates issues of identification for the parameters in the smoothing model. In the particular case of Iceland, the smoothing procedure returns a constant mortality curve with a mortality level of 0.085. The remaining life expectancy is consequently e(100) = 1/0.085 = 11.8 years. Another side effect of this smoothing procedure, exaggerated by age overstatement, is that certain years (1844, 1845, 1861, 1863, 1869, 1871, 1879, 1884, 1890, 1894, 1902 for males; 1852,1864,1878, 1882 for females) show a constant hazard, implying a constant remaining life expectancy after age 80.

More plausible results could be produced by applying the smoothing procedure to a broader age group (it is currently 80 and over), on 5-year grouped ages, to a range of years instead of single calendar years, or using weighted least squares estimation instead of MLE. This is not attempted as it is not in accordance with the current HMD Methods Protocol. Applying a uniform set of methods across all countries helps to ensure that HMD estimates are comparable across time and across countries. Yet, it may present problems in special cases such as this one. The HMD technical team is working to devise a methodological solution that will help resolve this problem.

REVISION NOTES

Changes with the February 2018 revision:

Death counts: The February 2018 update includes death counts for the years 2014-2016. Information for the years 2014 and 2015 combines data from Eurostat and Statistics Iceland (see RefCode 36), that is we used the death counts by calendar year, sex, single year of age and birth cohort available from Eurostat for ages 0-99 and the death counts by calendar year, sex, single year of age from Statistics Iceland (with no birth cohort information) for ages 100 and above. Death counts for 2016 were extracted from the Statistics Iceland website and are not cross-tabulated by birth cohort. The current update is provisional and will be revised once more detailed mortality data become available from Statistics Iceland at the high ages.

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 a0, the mean age at death for children dying during the first year of life and 2) the use of birth-by-month data (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 protocol (Version 5) remain available at v5.mortality.org but will not be updated in the future.

Changes with the April 2024 revision:

Population: 2011-2022 intercensal population estimates have been revised by the NSO in March 2024 on the basis of the 2021 census.

Changes with the April 2025 revision:

Births: Births from 2011-2022 were updated because Statistics Iceland revised the stillbirth figures for the overall period and for some of the years.

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APPENDIX I: DESCRIPTION OF THE ORIGINAL DATA USED FOR HMD CALCULATIONS

DEATHS

Period	Type of Data	Age Groups	Comments	**RefCode(s)**†
1838–1854	Deaths by sex and age group to 100+	0, 1-2, 3-4, 5-9, … 100+	Includes deaths to the *de jure* population. Data received directly from Statistics Iceland.	7
1855–1980	Deaths by sex and age group to 100+	0, 1…, 4, 5-9, … 100+		7
1981–2013	Deaths by sex, cohort and single year of age	0, 1, …	Data have been received directly from Statistics Iceland.	1, 2, 16, 20, 23, 25, 28, 29, 33
2014-2023	Deaths by sex, cohort and single year of age	0, 1, …	Combines data from Eurostat (0-99), with information by birth cohort and Statistics Iceland (100-110) with no birth cohort	36, 41, 45, 46, 47, 51, 52, 56, 57, 61, 62, 66

† The reference code is used in the raw data files (Input Database) to link data with sources.
max=maximum age attained; unk=deaths of unknown age

POPULATION

Period	Type of Data	Age Groups	Comments	**RefCode(s)**†
1840–2010	Annual December 31st population estimates	By single year of age	Resident population	6, 5, 11, 4, 9, 10, 13, 24
2011-2024	Annual January 1st population estimates	By single year of age	Resident population	58, 63

BIRTHS BY SEX

Period	Type of Data	Comments	RefCode(s)†
1838-2023	Annual number of live births by sex		8, 15, 35, 14, 17, 21, 26, 27, 64

BIRTHS BY MONTH

Period	Type of Data	Comments	RefCode(s)†
1853-2023	Annual number of live births by month		31, 65

APPENDIX II CENSUSES IN ICELAND

Information on Icelandic censuses with a brief description of each census can be found in Goyer and Draaijer (1992). Here, the most relevant information is reproduced.

1	1703	*It was the first modern census in the world.*
2	1729	*There was a census of only three districts in this year, the purpose of which was to aid officials in the ongoing Danish resettlement of Greenland.*
3	1769	*It was taken along with a census of Denmark. However, no publications with results have been located.*
4	1785	*Only one table with results from this census is available: counts by age and sex and by county.*
5	1801, 1835	*These censuses were conducted by the Danish government.*
6	1840	*No publications were found from this census.*
7	1845	
8	1850	*De jure census. The publication also contains vital statistics for 1827-1849.*
9	1855	*The conduct and scope of this census was the same as that of 1850. Vital statistics were updated to 1854.*
10	1860, 1870	
11	1880, 1890	*Copies of the publication with results from these censuses have not been found.*
12	1901	*This was the last of the series of Icelandic censuses that were conducted by the Danish Government. It was de jure with the de facto total number of inhabitants only.*
13	1910	*This was the first census conducted by the Statistical Bureau of Iceland; it continued to be de jure with the de facto total number of inhabitants.*
14	1920, 1930, 1940	

15	1950	*The census was conducted by the Statistical Bureau of Iceland.*
16	1960	The results were electronically tabulated.

See also: http://www.ssb.no/vis/fob/historikk.html.

Recently published statistics are based on the National Population Register.