

LIFE EXPECTANCY: A Brief International Comparison

Bernard F. Pettingill, Jr., Ph.D., David I. Goldenberg, Ph.D., and Federico R. Tewes

Abstract

Life-expectancy data are essential to many fields, notably demography, health care, insurance, military recruiting, and forensic economics. Professionals using global rankings find life expectancy data misleading. Policymakers need a standard protocol to measure and track life expectancies. A case study comparing four countries' life-expectancy data against the U.S. found skewed population data caused by different definitions and different formulas across different countries. Only the U.S. Life-Expectancy Tables made adjustments for both infant mortality and fertility rates. Absent a standard protocol to measure and track life expectancies, policymakers will continue to reach wrong conclusions. A worldwide standard protocol would require all countries to define life-expectancy data in the same way, calculate life expectancy values in the same way, and uniformly adjust for rates of both infant mortality and fertility. The significant changes called for will not come quickly, but we surely can suggest a starting basis.

Introduction:

Modern government policymakers compare life-expectancy data across countries as a firstorder attempt to analyze the overall health of a nation. Business policymakers in healthcare and other industries routinely make such comparisons. Both, however, rely on a variety of reasonably strong facilitating assumptions regarding time horizons and different constants. For instance, a longer life is presumed to correlate positively with the quality and quantity of healthcare services provided. However, our findings indicate that the underlying calculations are markedly different among the four countries we compared against the U.S., namely, Canada, Finland, Japan and Mexico.¹ A primary assumption in statistical and demographic studies is that a given group of people experience the same event at the same time in the same or similar geographic location. That defining premise binds a group of subjects sharing the same perspective. All the individuals of a given gender and nationality born in a given year, the traditional definition for life at birth, are one such group. Assuming that the defining characteristic remains unchanged brings symmetry to the population studied, which may include millions of individuals. But this symmetry ensures that the arithmetic mean represents the most frequent age at which all the individuals from a geographic location are expected to live. National life expectation at birth [LEB] figures assume all individuals in a given geographic region are

exposed from birth until death to the same health conditions that cause the mortality rates observed in a particular country, but that is patently false

Comparing national statistics across countries requires altering the geographic location upon which national LEB values base their defining characteristics, such as the health decrement associated with diseases within a particular region or the definition of a live birth recorded plus the probabilities that such a person at birth will survive its first year. None of these defining characteristics hold steady across countries and time, but are assumed to do so. We found that each of the four countries studied relied on a uniquely skewed data set. See Table I below

Ideally, policymakers would like an accurate answer to the question: "At what age do people frequently die if they are born in a given year?" Our suggestion to policymakers is to implement a global methodology, for a standardized calculation that takes advantage of comprehensive, simplified statistics already collected by the World Bank, the United Nations, and the World Health Organization. For example, we recommend all countries take health statistics such as the infant mortality rate and the total fertility rate explicitly into consideration when calculating life expectancies.

- The infant mortality rate represents the number of deaths under one year of age per 1,000 live births occurring among the population of the given geographical area during the same year.
- The total fertility rate represents the total number of children a woman would need to reproduce herself by bearing a child who survives to childbearing age
- A median average is a numerical value that splits the data set into two equal parts; one part has all the data points with values smaller than the median value while the other part has all the data points with values higher than the median value.
- The modal average is the most frequently occurring value of the data. It also is potentially troublesome in two respects. A modal average usually will have a higher error than the median. In other words, a median value invariably will be closer in size to the real mean of a distribution than the mode. The mode also can be zero if the two or more data points are equal.

Table 1: Selected Life Expectancy Data

Land / Data	Life Expectancy	LEo Rank	Infant Mortality Rate	Fertility Rate
	[LEo Years]		[Per 1,000]	[Per 1,000]
United States	78.6	43	5.7	1.821
Canada	82.3	18	4.6	1.543
Finland	81.4	30	1.9	1.570
Japan	84.0	2	1.9	1.440
Mexico	77.1	95	12.2	2.184
World	72.1	"103.5"	30.3	2.441

Source: CIA World Factbook 2016

Both definitions assume the sharing of a familiar location, which is a binding and defining trait. Therefore, the most frequent value is the arithmetic mean. The symmetry of the population ensures 4 that because the subjects share the same perspective, location and time. We urge policymakers to seek more accurate estimates by implementing a global methodology for calculating LEB by using standardized Life-Expectancy Tables instead of relying on a simple, fatally flawed arithmetic mean.

Creating an international standard measure of life expectancies means that policymakers will have to agree to use the same rules. Here are a few helpful facts about their options and the five possible measures covering different aspects of life-expectancy data. Three of the five (geometric mean, Beta average, and Gamma average) are too challenging to implement on a multi-national basis than the others.

The simplified arithmetic mean created unbalance values, which forces policymakers to choose between the median or modal average. Policymakers need to know how these two options are defined, measured, and note their merits and demerits.

Choosing a measure of life expectancies will depend on both the merits and demerits of alternative means and the perceived long-term circumstances. Any choice will have a lasting consequence at the national and international levels. However, that may or may not be so at the standards of the firm or industry operating flexibly with a shorter-term time horizon.

Life-Expectancy and Life-Expectancy Tables in the United States:

The United States Department of Health and Human Services defines life expectancy at birth [LEB] as “the average number of years of life remaining for persons who have attained a given age (x).” By definition, the U.S. utilizes the arithmetic average as the measure of life expectancy.² A review of the literature found that the data series is skewed, unbalanced to the point that the arithmetic mean is no longer close to the most common value within the distribution. Some policymakers might argue that a difference of 1.5 years between the arithmetic mean and mode of the skewed distribution always is insignificant and so can still be ignored. Consider, for example, the difference in life expectancy between the mean LEB of the U.S. and Mexico. It is only 1.5 years, respectively, 78.6 versus 77.1 years at birth. But when converted to global ranks, the 1.5 difference explodes to a 52-point gap. This gap represents a difference between Mexico as 95th in the world versus the U.S. at 43rd.³

Our findings come to the following conclusion, as shown in Table I. Beyond any doubt, skewness is present in the underlying data. First, Mexicans live 1.5 years less than North Americans, and have a 52-point gap in the ranking. Second, Finns live 2.8 years longer than North Americans but only

have a 13-point deficit in the corresponding rankings. Third, Canadians live 3.7 years longer and have a 25-point difference in the rankings. Fourth, the Japanese are the healthiest of the group with 5.4 years of longer life than the Americans, and have a 41-point gap in the rankings.

This list above follows a specific order: The United States has a life expectancy of 78.6 years. Notice the difference in years against the U.S. grows incrementally: -1.5 years, +2.8 years, +3.7 years, and +5.4 years. Instead, the difference in the global ranking against the U.S. does not increase gradually:

52-point, 13-point, 25-point, and 41-point. Policymakers cannot see any trend, nor can they depend on this information to answer this question: "At what age do people most frequently die if they are born in a given year?"

Making matters worse, comparing national LEB statistics across lands eliminates the same perspective towards the probability of surviving a live birth within the first year, the same outlook towards health decrements associated with diseases, and the same medical skillsets provided by medical schools within the same geographic area.

We think policymakers should insist that these flaws in global rankings be corrected with a comprehensive methodology to standardize the calculation of Life-Expectancy Tables. We found that the most realistic values come from the U.S. Life-Expectancy Tables, which are driven by four separate functions: survival function, decrement function, person-years lived calculation function, and personyears lived at and above a fixed age (X).

This article focuses on explaining the survival function because it would most heavily impact infant mortality rates and total fertility rates data as provided by the World Bank. Their correlations to LEB are described next. In practice, the three other functions would be treated similarly.

Preterm births lead to fewer deaths, which can also lend itself to lower infant mortality rates, which directly correlates to LEB. This correlation automatically results in a higher global ranking. A smaller number of live births over a woman's lifetime directly lowers infant mortality rates, which inversely correlates to longer LEB, and automatically raises global rankings. Because LEB is highly sensitive to infant mortality rates

and fertility rates, most national and international organizations created another measure: Life Expectancy at Age 5, which excludes mortality rates in early childhood.

Changing Definition of Live Birth Affects Infant Mortality Measurements:

A global survival function requires a standardized definition of live births. The definition of that term presently varies country by country, which directly affects the measurement of infant mortality. For example, different gestation ages for infants born before 22 weeks are recorded differently in Finland, Sweden, and Norway.⁴ Consequently, these Scandinavian countries report some of the lowest infant mortality rates in the world. The U.S. performs much better which measuring infant mortality than most European countries, but after the gestational age of 37 weeks, the U.S. has the highest infant mortality rates of all these countries.⁵ Evidence reports that from day zero until day 30, infant mortality is lower in the U.S. than in many European and Scandinavian countries. Furthermore, live birth statistics for infants weighing less than 500 grams are entirely excluded by Finland, Norway and Denmark, even though birth weight is a standard indicator of survivability, and influences calculations of the four functions used internally in the U.S. Life-Expectancy Tables.⁶

Homogeneity of a Population Alters Fertility Rate Measurement:

The total fertility rate also affects the survival function. The United Nations' Population Division estimates that 2.1 children per woman are the replacement-level fertility rate sustainable over a sufficiently long period for each generation to exactly replace itself without any need for a country to balance the population either by encouraging migration from one land to another or to encourage or discourage bearing children. The World Bank (2016) LEB global rankings identify Japan as having the most homogenous population, with 98.5% of its people native Japanese. Japan has measured birthrates since 1899. In 2016, the rate dropped below 1.4, well below the historic world fertility rate of 4.9.7 Such a low fertility rate may seem unimportant, but it matters to Japanese policymakers as current Japanese population trends indicate that by 2055, the working age population of Japan will have shrunk by 30 million (from 127 million today); there also

will be 10 million more elderly. That future would have each worker supporting more than one retiree.⁸ Finland had the lowest fertility rate, 1.6, of the five countries we analyzed. Its population was 96.5% native Finns, giving it one of the lowest rates of foreign citizens in the European Union.

Two of the four countries studied had higher fertility rates associated with heterogeneous populations. Two others had much lower fertility rates associated with homogeneous populations. Mexico, our southern neighbor, reports that three groups of people (indigenous, white, and mestizo) make up 98.5% of the total population (21.5%, 47%, and 30%, respectively). Canada, our northern neighbor, lists 32% of its population as native Canadians. The United States reports that three groups account for 89.4% of its people, with 16.3% attributed to Hispanic immigration.⁹ Comparable fertility rates for Canada, the U.S., and Mexico were 1.6, 1.8, and 2.1, respectively. Alert policymakers surely want to avoid having to deal with the problem Japan faces after 2055 of getting a declining labor force to support an increasing number of retirees. If the underlying population is unbalanced, then its arithmetic mean no longer represents either its most frequent value or its median value. That signals undesirable limits on the options available to decision-makers. The European Union (EU) is approaching this problem. It has nearly 27 million people aged 80 or over in its population, and most of them have almost ten years' life expectancy, according to Eurostat, the EU's statistical bureau.¹⁰

A particularly severe influenza season hit the U.S. in 2014-2015. Over 35 million U.S. residents got the flu, and approximately 56,000 people died, including 148 children.¹¹ Policymakers seeking to protect North Americans rely upon U.S. Life-Expectancy tables because this type of decrement function captures the decrement of health among the American population. Additionally, declines in life expectancy in the U.S. differ from those in other countries in that they are more concentrated at younger ages (0-65 years) and primarily driven by increases in drug overdose mortality related to the on-going opioid epidemic. Many high-income countries rebounded in the next year. Their gains in life expectancy during 2015-2016 were significant enough to offset the previous year's declines. But the United States did not recover, and continues to face adverse conditions.¹² No

other country uses Life Expectancy Tables as realistic as those of the United States. Our study found no evidence that non-American Life-Expectancy Tables take into account both the probability of survival and the decrement of health. If a replay of the 2014-2015 influenza season that killed 56,000 people in the U.S. occurred in Japan, Finland, Canada or Mexico, then their reliance on the arithmetic mean approach to life expectancy calculations would leave them blindsided.

Policymakers in the nations studied would not be able to tell if there was a recovery in 2015- 2016, let alone a substantial enough improvement to offset the previous year's declines. This information is vitally important for policymakers in government and business.

Summary and Conclusion:

If policymakers wish to make effective decisions based on general data about life expectancies, they must unify their current calculation methods. Although global rankings exist, absent corrective measures like the inclusion of infant mortality and total fertility rate, the rankings are too sensitive to small changes in life expectancy years. As we pointed out, a slight difference of 1.5 years between life expectancies of the U.S. versus Mexico explodes to a 52-spot difference between the United States' rank of 43rd and Mexico's 92nd rank in the world.

Ideally, policymakers want an accurate answer to their question: "At what age do people most frequently die if they were born in a given year?" We suggest implementing a standardized calculation method around the world. It would maintain the same perspective towards the probability of surviving a live birth within the first year, the same outlook towards health decrements associated with diseases and a note regarding fertility rates in a population. Demographic studies require a population's defining traits to remain stable so one can observe the consequences of allowing a few variables of interest to fluctuate. At the moment, national LEB statistics across countries eliminate the same perspective towards the probability of surviving a live birth within the first year of life and size for weight babies that often do not show age in the studies.

As globalization continues, the need for more realistic and comparable life-expectancy measures will grow. The current system has each country

calculating life expectancy values in different ways according to varying definitions of critical factors. If policymakers recognize the need for more accurate and comparable data, they should start modernizing the calculation of Life-Expectancy Tables to include four separate functions: survival function, decrement function, person-years lived calculation function, and person-years lived at and above a fixed age (X), guided by the statistics in the United States

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