The Crossover Between Life Expectancies and Their Record Values

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Life expectancy

• Life expectancy at birth is the most frequently used and best-known measure of the length of life of a population.

• Its use as a summary indicator of population health was propagated in the 1920s and 1930s.

(Dublin 1923; Dublin and Lotka 1934)
Life Expectancy for Countries Included in the HMD, 1751–2007.
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Life expectancy

- However:

Life expectancy at birth is heavily dependent on events in early life. Its time series alone is not well suited for studying the length of life for aging populations, because potentially important stages of mortality change can not be distinguish.

Kannisto (2001)
Life expectancy at age “x” is defined as “the average number of *additional* years that a survivor to age x will live beyond that age”.

(Preston et al. 2001)
Figure 1. Life Expectancy by Age for the Icelandic Total Population in 2000.

“As a rule, the expectation of life decreases as age increases, with the exception of the first year of life where the reverse is true because of the high mortality during the first year.”

Chiang (1984: 118)
Figure 1. Life Expectancy by Age for the Icelandic Total Population in 1860, 1900, 1950 and 2000.

Research Interest

1. Relation between the functions of the life table at the crossing in life expectancies.

2. The timing of the crossing in life expectancies: comparison between and within populations.
Five data bases:

1. Human Mortality Database
2. Berkeley Mortality Database
5. CDC, USA life tables 1980-2006
Life expectancy

\[ e_0(t) = e_1(t) ? \]
Figure 2. Life Expectancies at Birth (e0) and at Age One (e1) for the Swedish Total Population from 1850 to 2005.

Life expectancy

\[ e_0(t) = e_1(t) \]

\[ \frac{1}{m_o(t)} = e_1(t) \]
Figure 2. Life Expectancies at Birth (e0) and at Age One (e1) and the Inverse of the Infant Mortality (1/1m0) for the Swedish Total Population from 1850 to 2005.

Source: Human Mortality Database (2008). Only values of inverse infant mortality below 90 are shown.
Research Interest

2. The timing of the crossing in life expectancies: comparison between and within populations.

Results

1) Common trends in crossing in life expectancies
2) Current situation in the world
3) Record maximum remaining life expectancy
4) Subpopulations comparison in the USA
Figure 3. Life Expectancy at Birth at Year of the First Crossing with Life Expectancy at Age One, Total Population by Country.

Source: Human Mortality Database (2008); Table 1 has the countries 3-letter digits.
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Figure 5a. Infant Mortality Rate and Life Expectancy at Birth for Countries Members of the WHO and UN, and Not Included in the HMD, Latest Available Information from WHO and UN.

Source: United Nations (2008) and World Health
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Figure. Country Holders of the Female Record Life Expectancy at Birth and the Best Fitting Line from 1840-2005.

Source: Human Mortality Database; Note: AUS=Australia, BLR=Belarus, Can=Canada, DNK=Denmark, ISL=Iceland, JPN=Japan, NOR=Norway, NZL=New Zealand, SWE=Sweden, CHE=Switzerland.

Oeppen & Vaupel (2002)
Figure 1. Life Expectancy by Age for the Icelandic Total Population in 1860, 1900, 1950 and 2000.

Figure 2. Two life expectancy measures, Finland 1878–2007: life expectancy at birth (e0) and maximum remaining life expectancy (ex)
Record LE, $e_0$

$$e_0(t) = \max_i [e_0^i(t)]$$
\[ e_m(t) = \max_i [e^i_m(t)] \]
Figure 4. Difference between record life expectancy at birth ($e_0$) and record remaining life expectancy ($e_{rx}$).
Figure 5. Countries holding the record life expectancy at birth ($e_0$) and the record total expected longevity ($e_T$) for the total population.
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Figure 6. Infant Mortality and Life Expectancy at Birth for American Females and Males by Race (White & Black), 1968.

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Figure 6. Infant Mortality and Life Expectancy at Birth for American Females and Males by Race (White & Black), 1968-1973.

Figure 6. Infant Mortality and Life Expectancy at Birth for American Females and Males by Race (White & Black), 1968-1977.

Figure 6. Infant Mortality and Life Expectancy at Birth for American Females and Males by Race (White & Black), 1968-1996.

Figure 6. Infant Mortality and Life Expectancy at Birth for American Females and Males by Race (White & Black), 1968-2003.

To assess the mortality situation of a population it is important to consider several measures of mortality in conjunction, e.g. the level of $e_0$ respect to $e_1$ or with infant mortality. Following the latter relationship the physical quality-of-life index (infant mortality, $e_1$ and education) is more suited for comparison than the more popular Human Development Index ($e_0$, education and GDP).
During the demographic transition mortality between ages one and five declined before mortality in the first year of life, followed by a second phase of decline where mortality in infancy declined faster than in the later childhood years (Hill 1995). This historical process of mortality reductions, is well captured in this research of life expectancies at different ages and the convergence of the two record expectancy measures.
Our findings show that a substantial difference between and the maximum lifespan (e0 and at other ages) existed throughout most of the 19th and 20th centuries both in individual countries and for the global record holders.
Basing the “best-practice” designation on a measure so dependent on mortality in the first year of life as life expectancy may be problematic. However, the fact that the same group of countries also holds the record remaining life expectancy offers some support to the “best-practice” idea originated by Oeppen and Vaupel (2002).
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Thank you!