Healthy life expectancy based on self-perceived health

Method

In order to calculate the indicator, it is necessary to choose a method for calculation of health expectancies. Several methods exist.

- The multistate life table method enables to calculate such indicators and has the particularity of taking into account reversible transitions between good health and one or more disability states.
- The second method called double decrement life table method assumes that the disability state, as well as death, is irreversible. The only possible transition is the one from disability to death. This is then a special case of the first method for which the remission rate for the state of less than full health is assumed to be zero.
- However, the most common method used to calculate health expectancies is the Sullivan method which has been developed around 1970.

As the general scientific consensus on the topic as well as WHO and Euro-Reves recommend, the Sullivan method is also used by Eurostat. Because of the way the method is constructed, health expectancies calculated following Sullivan's method gives the number of years in good perceived health that a person can still expect to live if and only if the patterns of current prevalence stay stable during a whole life time. The method is based on two main parts:

1. a life table that enables calculation of the life expectancy for each age x_i (or age category i in the case of an abridged life table)
2. observed prevalence of the population in healthy or unhealthy status.

The following decisions are taken:

- the maximum age class (open-ended) is set at 85+ for all countries, both sexes and all years
- deaths are assumed to occur halfway through the year except for age 0 (see formula)

First, the death rate (mx_i) corresponding to each x_i is calculated by dividing the number of deaths to the average population. Then, the death rate is used in calculating the probability of dying at age x_i (qx_i):

$qx_i = mx_i / [1+(1-ax_i)mx_i]$

where mx_i is the death rate and ax_i is the fraction of the year that a person has lived in addition to the x_i complete years (with the second decision above, $ax_i = 0.5$ but for age 0 the coefficient $ax_i = 0.2$)

With this probability qx_i we calculate the number lx_i of people still alive at age x_i.

$lx_{i+1} = (1-qx_i) * lx_i$

For the first age, lx_i is fixed at 1.

Based on the assumption that people dying at age x_i will actually live in average half of the year between age x_i and age x_{i+1} except for age 0, the total number of years Lx_i that survivors of age x_i will live between age x_i and x_{i+1} can be calculated.

$$Lx_i = (lx_{i+1} + lx_i) / 2$$

$$Lx_0 = 0.2 * lx_0 + 0.8 * lx_1$$

For the last age ω, $L_\omega = l_\omega / m_\omega$. ($\omega = 85$)

Then, the formula for the total number of years that the survivors of age x_i will still live before dying is as follows:

$$Tx_i = \sum_{x_i}^{\omega} Lx_i$$

In the case of an abridged life table, some transformations must be made. To obtain the number of years L_i lived in an age category i, the sum of the living years for each age of this category from the unabridged table has to be done. This gives the following formula in the case of age category of 5 years long.

$$L_i = L\,x_i + L\,x_{i+1} + L\,x_{i+2} + L\,x_{i+3} + L\,x_{i+4}$$

For an age x_i, by summing those remaining years to live for ages from x_i onwards, we obtain the total number of years that the survivors of age x_i will still live before dying.

$$Tx_i = Lx_i + Lx_{i+1} + Lx_{i+2} + \ldots$$

(or $T_i = L_i + L_{i+1} + L_{i+2} + \ldots$ in the case of an abridged table)

By dividing this number of years by the number of survivors at age x_i, we obtain the life expectancy e_i for a person still alive at age x_i.

$$ex_i = Tx_i / lx_i \text{ and } ex_{85} = 1/m_{85}$$

(or $e_i = T_i / l_i$ in the case of an abridged table)

The next step (described here for an abridged table) uses the observed prevalence of less than good perceived health (π) at each age in the current population at a given point in time. The prevalence are used to divide the hypothetical years of life lived by people at different ages into years with and without good perceived health. It consists in applying the prevalence $\pi_i(j)$ of each of the different states of health in an age category i on the years lived L_i in this age interval. Indeed, by multiplying the proportion $\pi_i(j)$ of being in state of health j by L_i, it is obtained the number $L_i(j)$ of person years spent by survivors of age x_i in health state j in the age interval. The proportions $\pi_i(j)$ should be obtained, e.g., survey sources (see below).

$$L_i(j) = L_i * (1 - \pi_i(j))$$

For each age categories, by summing all the $L_k(j)$ from this interval to the eldest one, it results the total number $T_i(j)$ of person years still to spend in state of health j for persons alive at age x_i.

$$T_i(j) = \Sigma L_k(j) \qquad \text{where } k \geq i$$

Finally, the life expectancy in state j at age x_i is obtained by dividing the total number of person years spent in state j by the number of survivors at age x_i.

$$e_i(j) = T_i(j) / l_i$$

The interest of the Sullivan's method lies in its simplicity, the availability of its basic data and its independence of the size and age structure of the population.

Data

Because of its simplicity, the Sullivan's method requires few data. Only mortality data and prevalence data are needed.

Concerning mortality data, the population and the number of deaths for each age, given by the Eurostat reference database in theme Population and Social conditions, Demography are used. These data are used in calculating the "simple" life expectancy.

However, since health expectancy is a combination of life expectancy and a concept of health, there are potentially as many health expectancies as there are concepts of health. It is then necessary to define the proportion of the population in good health (prevalence data) on strongly harmonised and widely accepted health concepts and comparable data.

From 2004 onwards (for some Member States from 2005 or 2006 onwards), the following question from the annual European Statistics on Income and Living Conditions survey (EU-SILC) is used for obtaining the prevalence data:

PH 010: How is your health in general? Is it ...
1. very good
2. good
3. fair
4. bad
5. very bad

The prevalence of having less than good perceived health[1] π_i (j) is then obtained by age categories of 5 years.

Finally, some assumptions have been necessary in order to proceed to calculations. The prevalence for the first age group, 16-19, has been applied to the 15-19 population group. Another assumption has been to consider that prevalence of people before the age of 15 years is the half of the prevalence of the next age interval (16-19 years).

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[1] "Less than good perceived health" is based on the answer category 4 (bad) and 5 (very bad).