

S2 Appendix. Estimating actuarial healthy life years (HLY) for each age year from abridged HLY tables

Notation:

HLY_i : actuarial HLY for 5-year age groups i ($i \in \{50 - 54, 55 - 59, \dots, 80 - 84\}$), reported the Hungarian Central Statistical Office (HCSO)

HLY'_x : intermediate estimates of actuarial healthy life years for age x

HLY_x : estimated actuarial healthy life years for age x ($x \in \{50, 51, \dots, 84\}$)

HLY_{85} : estimated actuarial healthy life years for 85 years of age

$mHLY_{xi}$: mean HLY_x in age group i

TH'_x : intermediate estimates of cumulative healthy years lived from year x

TH_x : estimated cumulative healthy years lived from year x

l_x : the number of persons who reached age x , reported by the HCSO

H'_x : intermediate estimates of healthy years for the cohort aged x

H_x : smoothed estimates of healthy years for the cohort aged x

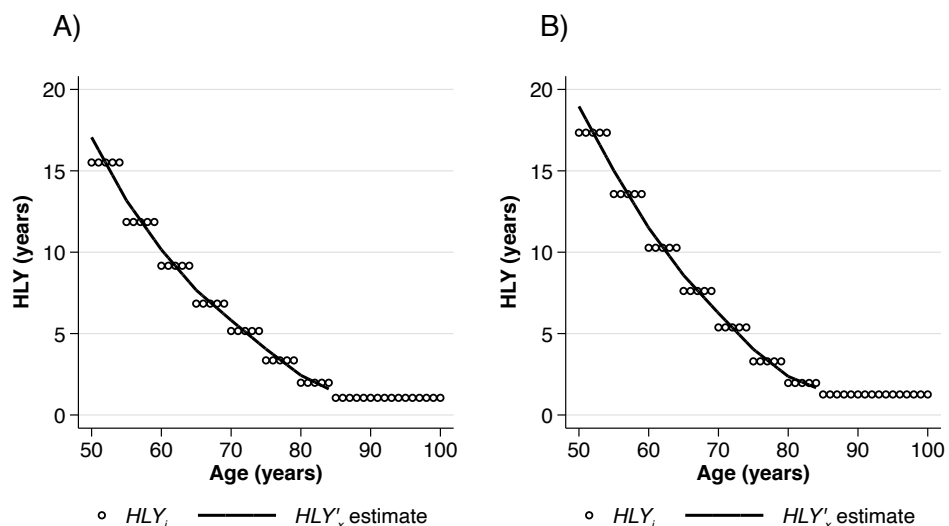
hq'_x : intermediate conditional probability estimates of becoming limited in age x given being healthy in year $x-1$. ($hq'_x < 1$)

hq_x : conditional probability estimates of becoming limited in age x given being healthy in year $x-1$. ($0 < hq_x < 1$)

Estimation procedure of HLY_x :

Step 1: we predicted HLY'_x by fitting a piecewise linear regression on HLY_i for age groups i ($i \in \{50 - 54, 55 - 59, \dots, 80 - 84\}$) for both sexes using a spline of age as predictor with knots in age-group boundaries (e.g., 50, 55, 80, 85).

Healthy life year estimates for age years 50-84 in A) men and B) women



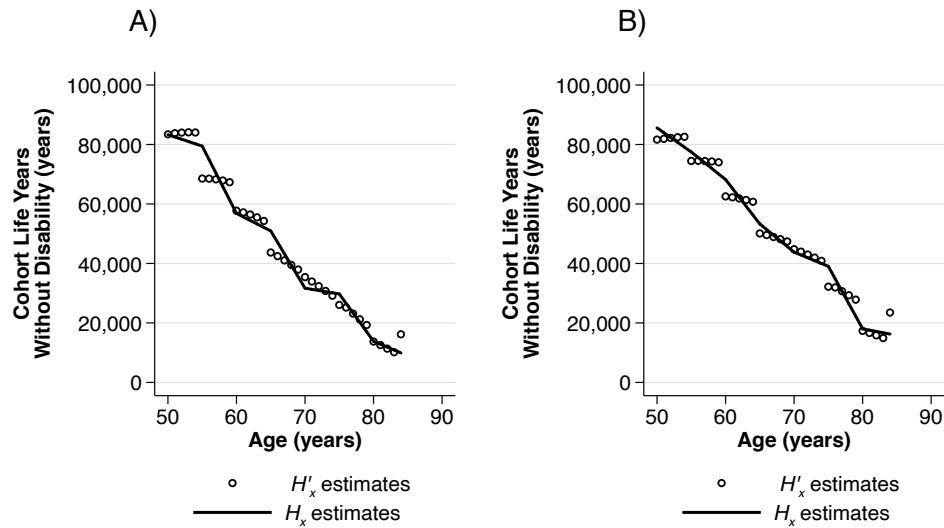
Step 2: by reversing calculations of the Sullivan method, from l_x of the life table, and HLY'_x from Step 1, we calculated TH'_x using the formula $TH'_x = l_x * HLY'_x$.

Step 3: we calculated H'_x for each age x via $H'_x = TH'_x - TH'_{x+1}$.

Step 4: we obtained hq'_x by using the formula $hq'_x = 1 - \frac{H'_x}{H'_{x-1}}$. Since we identified negative hq'_x values, we considered H'_x estimates implausible.

Step 5: we estimated H_x by smoothing H'_x via a piecewise regression using the age spline of Step 1.

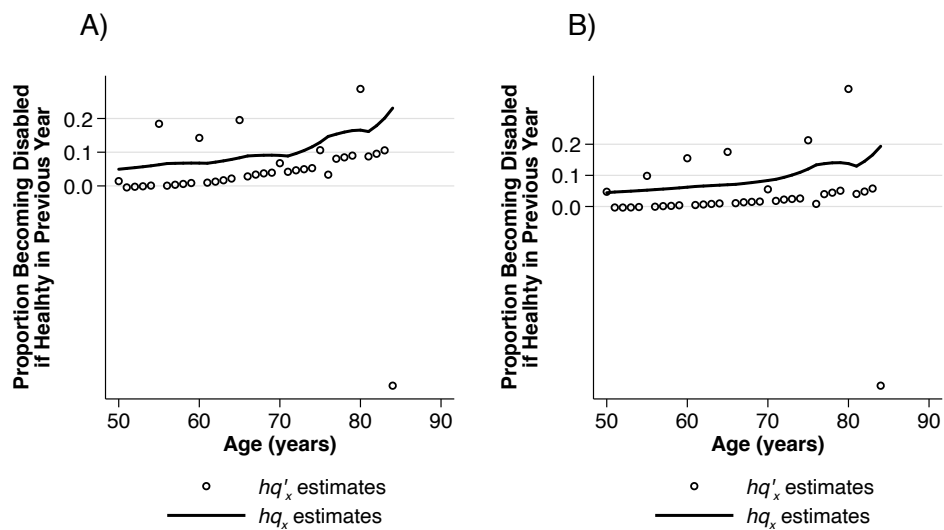
Cumulative cohort healthy life years (H_x) estimates for age years 50-84 in A) men and B) women



Step 6: we obtained TH_x by the formula $TH_x = \sum_{n \geq x} H_n$.

Step 7: we obtained hq_x by using the formula $hq_x = 1 - \frac{TH_x}{TH_{x-1}}$ and verified the plausibility of H_x estimates by observing for each hq_x that $0 < hq_x < 1$.

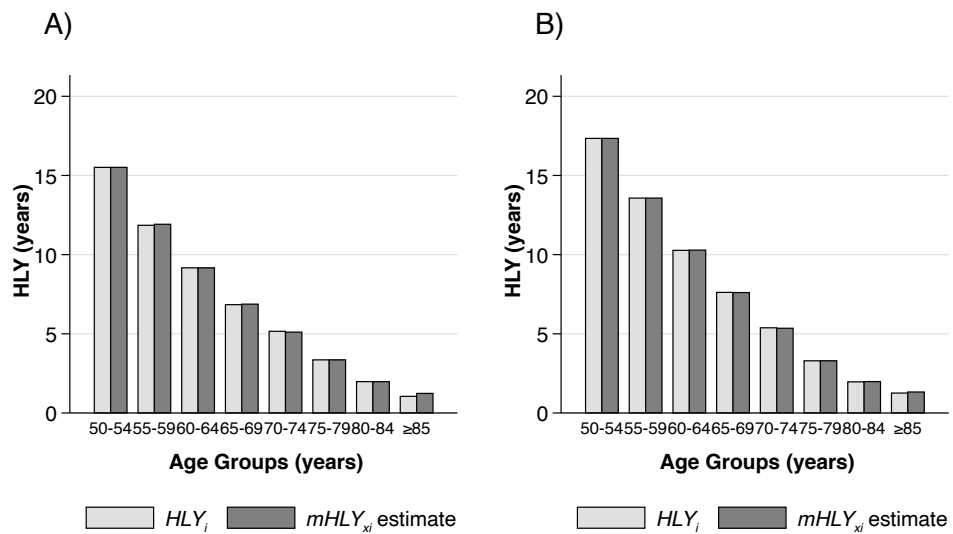
Proportion becoming limited (hq_x), if being healthy in preceding year in A) men and B) women



Step 8: we obtained HLY_x via the Sullivan calculation using H_x from Step 5: $HLY_x = \frac{\sum_{n \geq x} H_n}{l_x}$.

Step 9: we estimated HLY_{85} as follows: since HLY_i represents the average healthy life expectancy for the entire 85+ age-group (HLY_{85+}), assuming that $HLY_{85} = HL Y_{85+}$ would underestimate healthy life expectancies in all ages $x \geq 85$ years. Therefore, we used $HLY_{85} = HL Y_{85+} + d$ in the model and determined d via numeric optimisation so that the squared difference between HLY_i and $mHL Y_{xi}$ was set to minimum.

Healthy life years by 5-year age groups (HLY_i) and means of yearly healthy life year estimates by 5-year age groups ($mHL Y_{xi}$) in A) men and B) women



Step 10: we obtained $HLE_x = HL Y_x + x$ for all ages x from 50 to 85 years.