Assessing the impact of COVID-19 on the IA|BE 2020 mortality projections: a scenario analysis

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Working group mortality - IA|BE and LRisk - KU Leuven

November 23, 2020

KU LEUVEN
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IA|BE

Presenter + Q&A moderators

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(*) This presentation reflects the personal views of the author and not the views of his employer.

IA|BE 2020 is calibrated on

- European data over calibration period 1988 - 2018 (HMD + Eurostat) (EU2018)
- Belgian data from Statbel for 2019 (BE2019).

Hence, at European level 2019 - 2020 is not used in the calibration.

For Belgium, 2020 is not used.

Input data are $E_{x,t}$ (exposures) and $d_{x,t}$ (deaths, all causes) with x an integer age and t a year.

IA|BE 2020 is a best estimate prognosis, and does not include data from 2020.

About 358 092 deaths in Europe and about 15 522 deaths in Belgium allocated to COVID-19 pandemic.

COVID-19 (and the measures taken by governments) have impact on mortality in multiple ways.

Many uncertainties regarding future evolutions, including the frailty of COVID-19 survivors.

Numbers taken from Statista.com and COVID-19 dashboard by John Hopkins University on November 22, 2020.

"Collect and include data for 2019 and 2020, re-calibrate the IA|BE 2020 model and perform sensitivity analysis to acquire first insights in the impact of COVID-19 on IA|BE 2020."

Starting point is the IA|BE 2020 model, all assumptions, calibration and simulation details are documented in a technical note.

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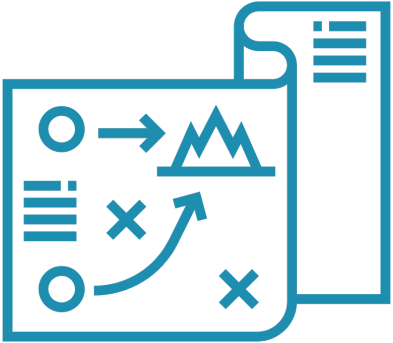


Plan of attack

References

- Duyck, J., Paul, J.-M., and Vandresse, M. (2020). Demografische vooruitzichten 2019-2070: Actualisering in het kader van de COVID-19-epidemie.

  Adjusted demographic outlook ('bevolkingsgroei') based on increased death counts and decreased international migration in 2020.

- Koninklijk Actuarieel Genootschap (2020). Prognosetafel AG2020. (Strategy followed in our impact analysis, but with different technical details.)

  Data from STMF, Eurostat and CBS, 5 age buckets, only Germany, UK, France, The Netherlands and Belgium.

- van Delft, L. and Huijzer, S. (2020). Impact of COVID-19 on Dutch mortality tables.

  Data from STMF, 5 age buckets, 13 EU countries (Ireland excluded), shocks on mortality rates $q_{x,t}$ compared to reference period 2015 - 2019, one-off shock.

Plan of attack

Principles (and limitations) of our approach

1. We use weekly exposures and death counts in age buckets from STMF (by HMD) and Eurostat, for the 13 (new!) EU countries from IA|BE 2020, Ireland is not included (no data).

2. We complete EU2018 and BE2019 with (virtual) data points $E_{x,t}$ and $d_{x,t}$ for 2019 and 2020 and find EU2020 and BE2020.

   2a. For 2020 we use data as observed on death counts in the first 26 weeks ($\sim$ first wave) and complete these along various scenarios ($\sim$ second wave).

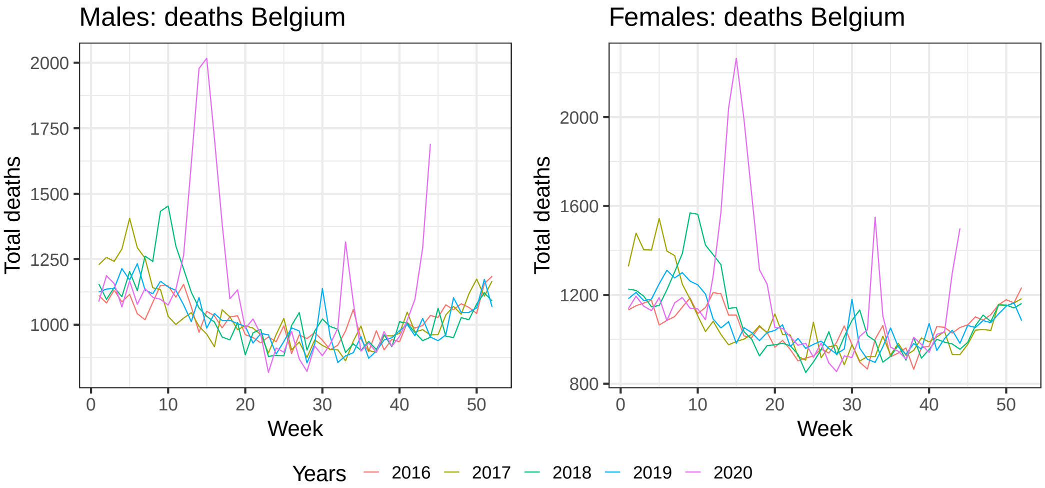
   2b. We apply a (newly!) designed technical protocol to go from the (large) age buckets to individual ages $x \in \{0, \ldots, 90\}$.

3. We recalibrate IA|BE 2020 on EU2020 / BE2020 with $E_{x,t}$ and $d_{x,t}$ for $x \in \{0, \ldots, 90\}$ and $t \in \{1988, \ldots, 2020\}$ and assess impact on (e.g.) period and cohort life expectancy.

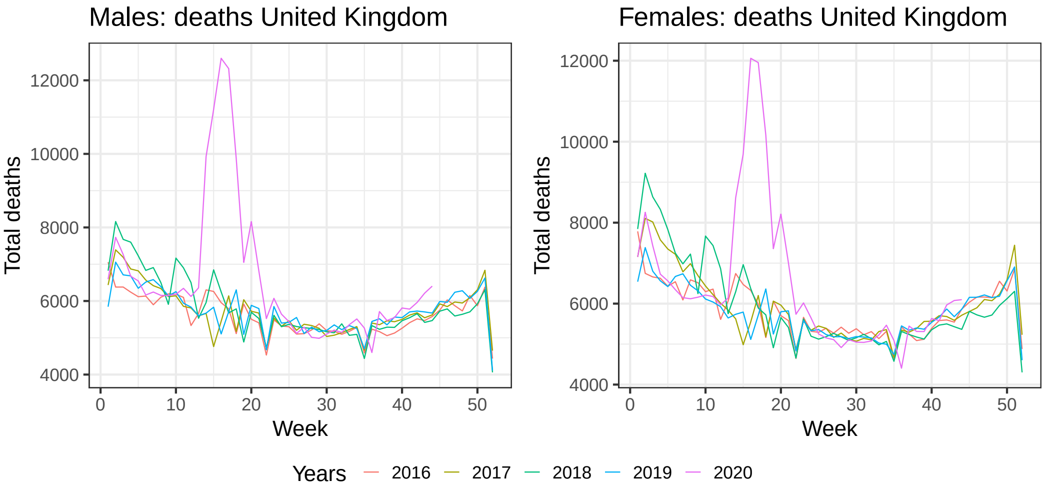
This approach stays - as close as possible to - the (modelling and updating) principles of IA|BE 2020. But is at the same time limited, e.g.

- no migration scenarios
- no scenarios assumed beyond 2020, no expert judgement.

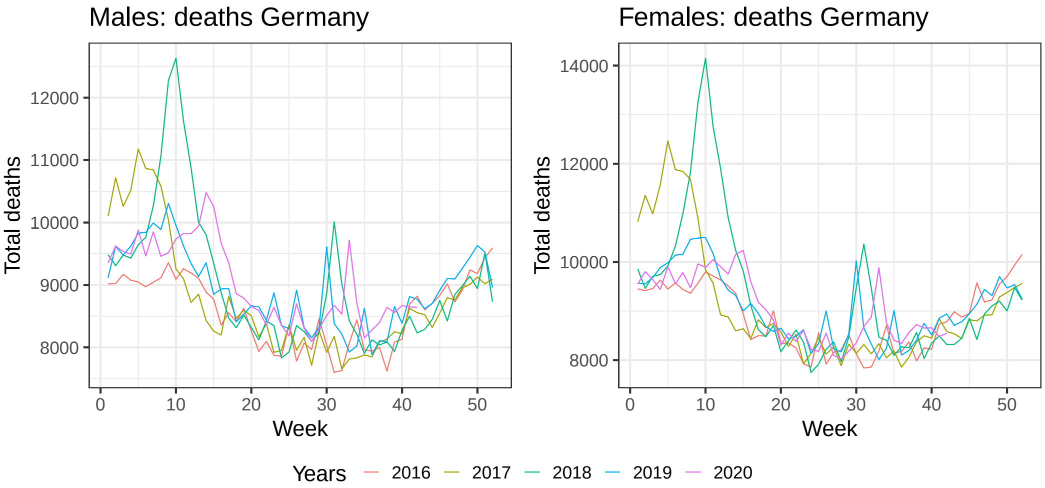
The data - weekly death counts Belgium, source: Eurostat



The data - weekly death counts UK, source: Eurostat



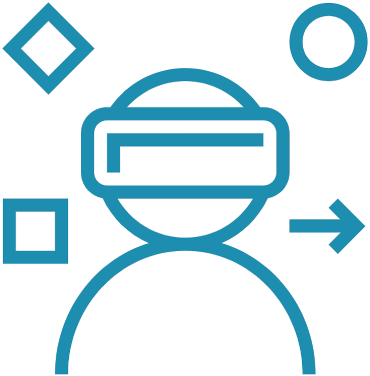
The data - weekly death counts Germany, source: STMF by HMD



The data - first 26 weeks 2020 deaths Belgium, in age buckets, source: Eurostat

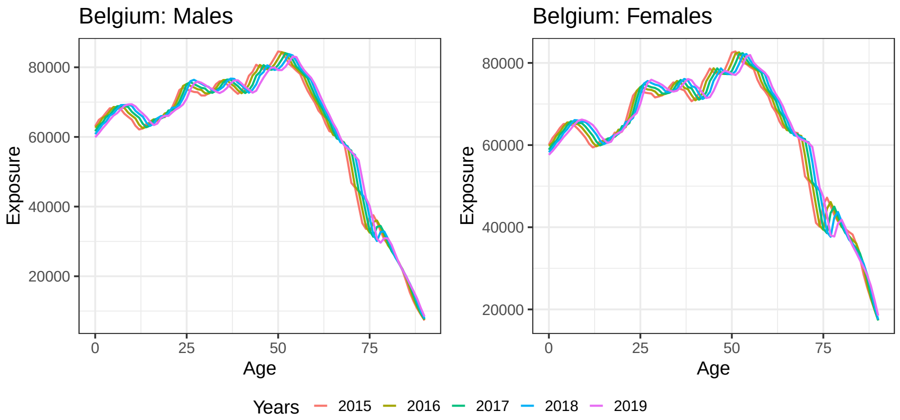
Age bucket	Male deaths	Female deaths
$[0, 4]$	41	36
$[5, 9]$	16	9
$[10, 14]$	8	21
$[15, 19]$	43	22
$\dots$	$\dots$	$\dots$
$[75, 79]$	3 787	2 830
$[80, 84]$	5 326	5 028
$[85, 89]$	5 721	7 518
$90+$	4 797	10 668

Age buckets on STMF are $[0, 14]$, $[15, 64]$, $[65, 74]$, $[75, 84]$ and $85+$.



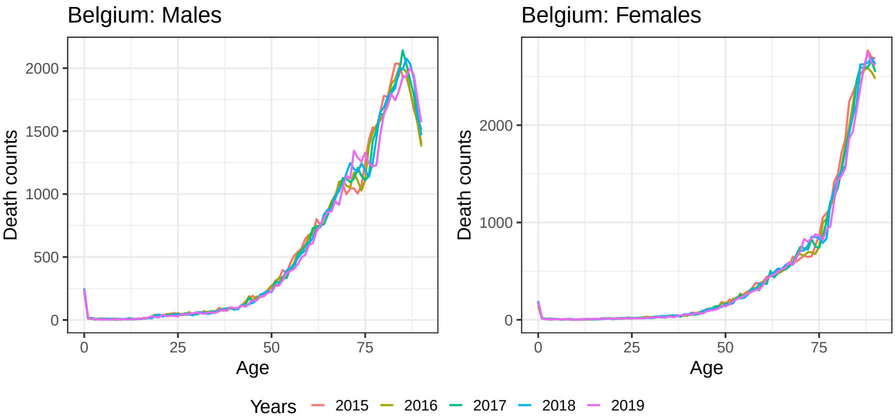
Virtual exposures and death counts

The creation of virtual exposures for 2019 and 2020 - starting point



Match this insight ('shift') with the exposures in age buckets reported by STMF for 2019 and 2020.

The creation of virtual death counts for 2019 and 2020 - starting point



First, we define two extreme scenarios, the optimistic S_0 and the (hopefully) worst scenario S_∞:

$$\hat{d}^{S_0}_{[x_i,x_j],2020} = \sum_{w=1}^{26} d_{[x_i,x_j],2020,w} + \sum_{w=27}^{52} \frac{d_{[x_i,x_j],2019,w}}{E_{[x_i,x_j],2019,w}} \cdot E_{[x_i,x_j],2020,w}$$

$$\hat{d}^{S_\infty}_{[x_i,x_j],2020} = 2 \cdot \sum_{w=1}^{26} d_{[x_i,x_j],2020,w}.$$

In S_0 death counts in second half of 2020 are as expected (along 2019 rates) (unrealistic), but in S_∞ death counts in second half are equal to first half (i.e. second wave similar to first wave).

Recall: (over recent years) more deaths in the first half compared to second half of the year.

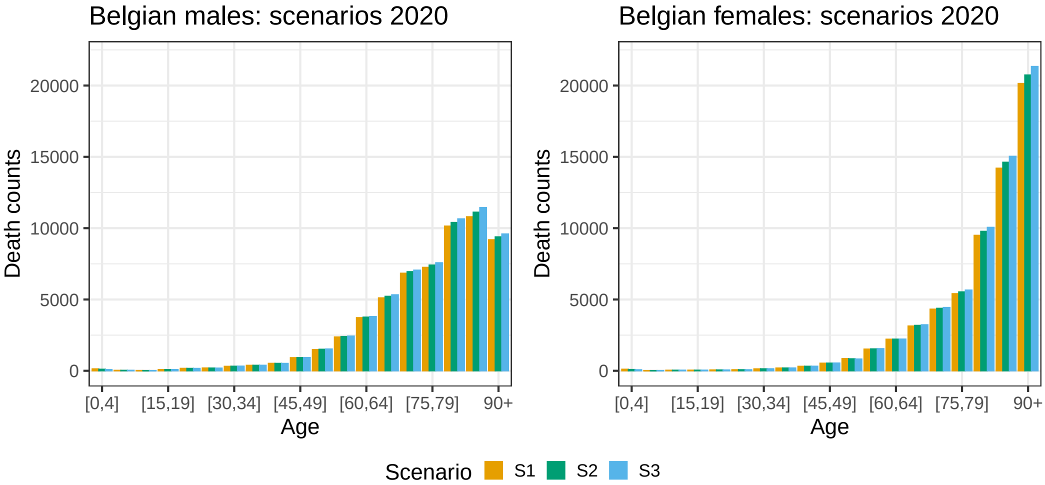
Next, we focus on three scenarios (for impact assessment): (second wave $\approx x\%$ of first wave)

$$\hat{d}^{S_1}_{[x_i,x_j],2020} = \hat{d}^{S_0}_{[x_i,x_j],2020} + 50\% \cdot \left(\hat{d}^{S_\infty}_{[x_i,x_j],2020} - \hat{d}^{S_0}_{[x_i,x_j],2020}\right)$$
$$\hat{d}^{S_2}_{[x_i,x_j],2020} = \hat{d}^{S_0}_{[x_i,x_j],2020} + 75\% \cdot \left(\hat{d}^{S_\infty}_{[x_i,x_j],2020} - \hat{d}^{S_0}_{[x_i,x_j],2020}\right)$$
$$\hat{d}^{S_3}_{[x_i,x_j],2020} = \hat{d}^{S_0}_{[x_i,x_j],2020} + 100\% \cdot \left(\hat{d}^{S_\infty}_{[x_i,x_j],2020} - \hat{d}^{S_0}_{[x_i,x_j],2020}\right) = \hat{d}^{S_\infty}_{[x_i,x_j],2020}.$$

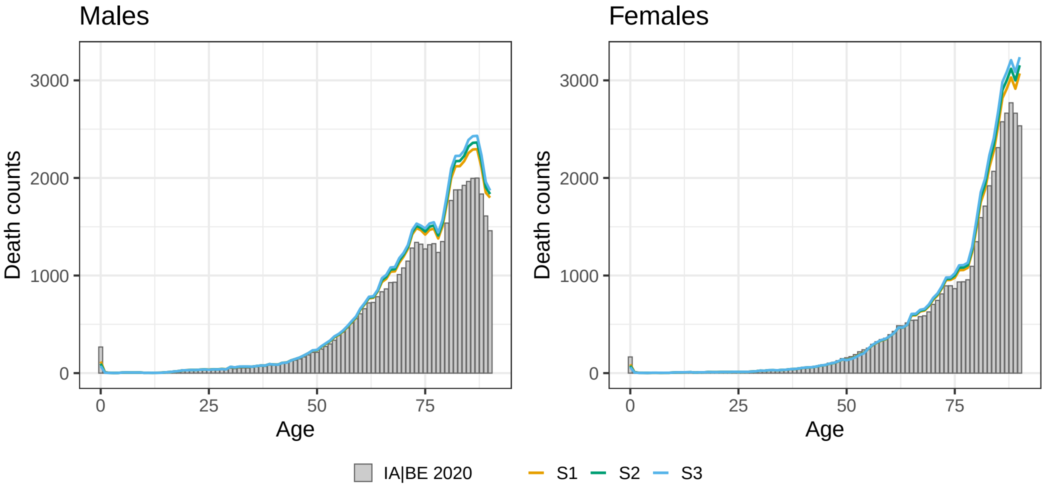
As a reference, currently 101 377 all cause deaths in Belgium (up to and including week 44). The scenarios above go from 122 335 (S_1) to 127 996 (S_3) deaths in 2020.

We apply these scenarios to all EU countries in the data set.

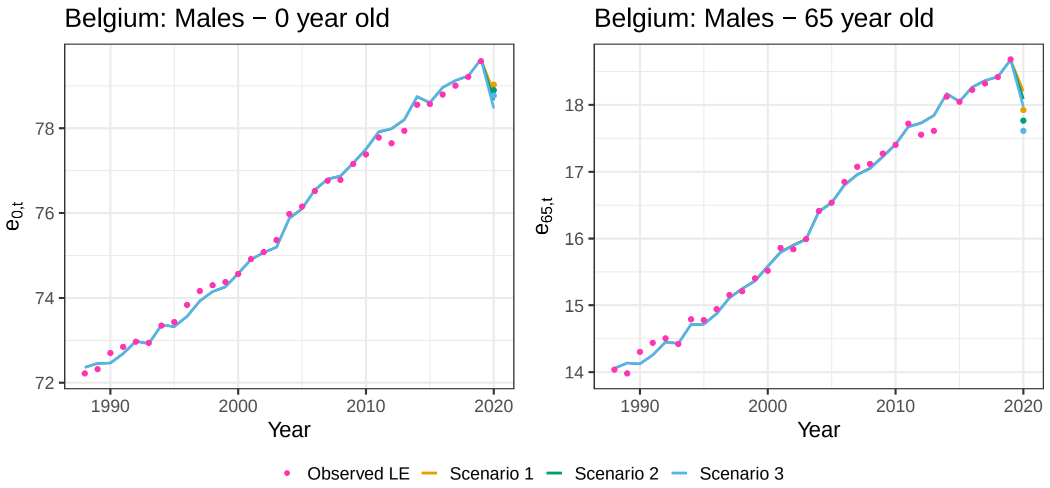
The creation of virtual death counts for 2020 - scenarios



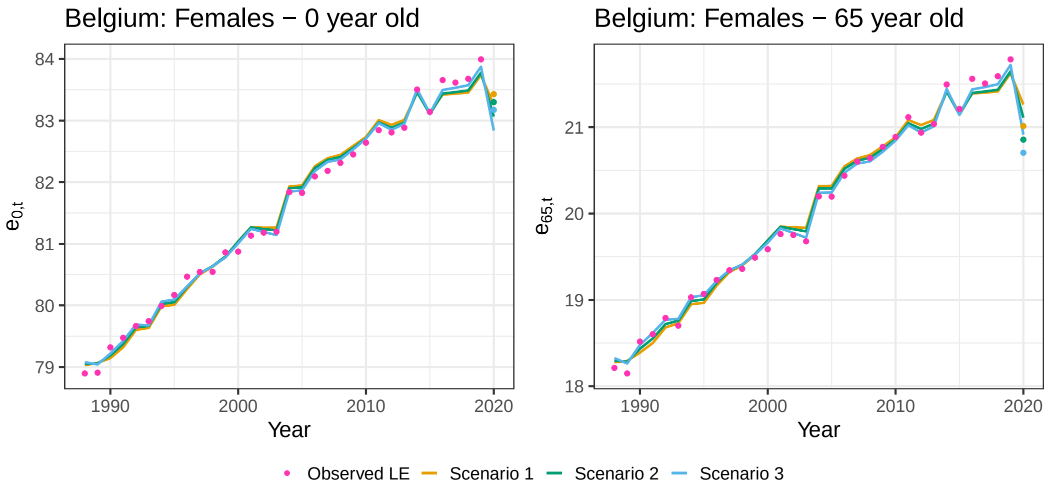
The creation of virtual death counts for 2020 - scenarios



Results of impact analysis


Belgium: Males − 0 year old
Belgium: Males − 65 year old
$e_{0,t}$
$e_{65,t}$
78
76
74
72
18
17
16
15
14
1990
2000
2010
2020
Year
Observed LE
Scenario 1
Scenario 2
Scenario 3

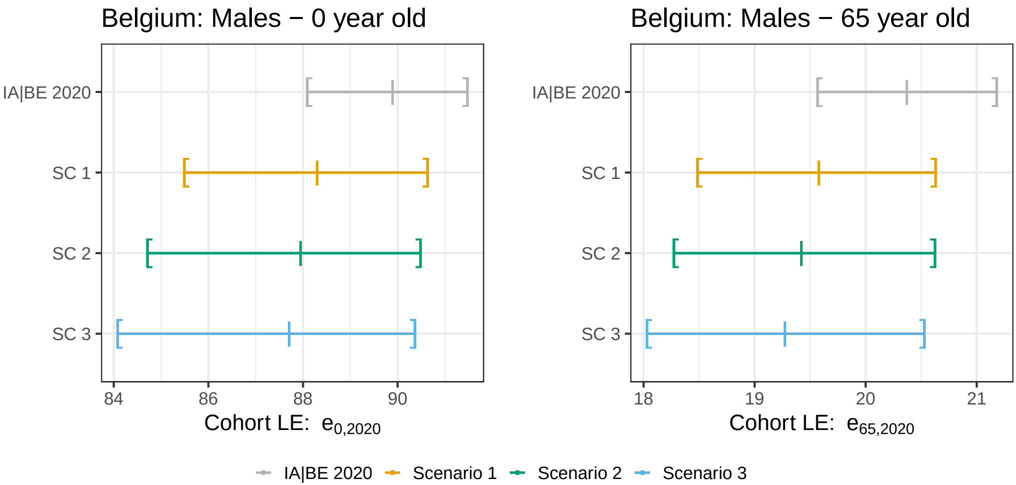
Recalibrating IA|BE 2020 - impact on period life expectancy



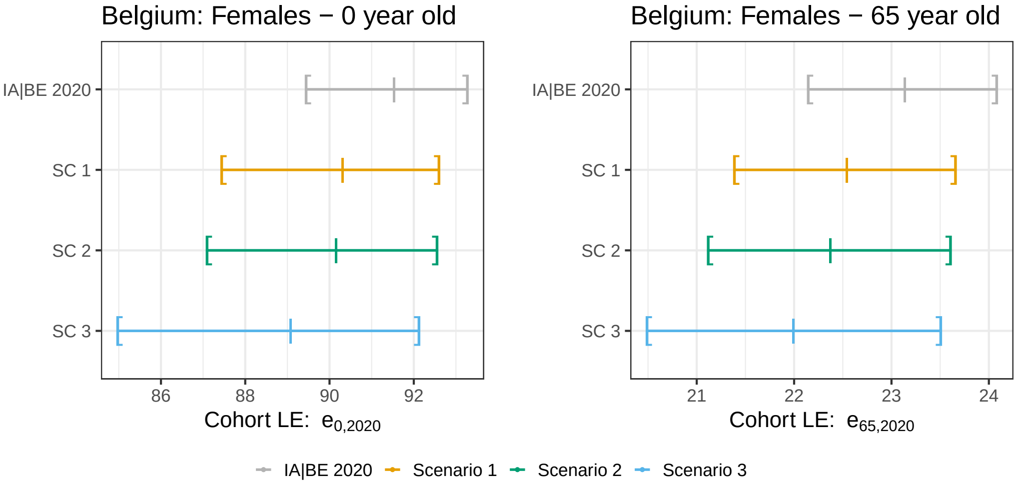
Period life expectancy in 2020		Males		Females	
		0	65	0	65
IA|BE 2020	Best. Est.	79.76	18.80	83.78	21.70
Scenario 1	Best. Est.	79.03	17.92	83.43	21.01
Scenario 2	Best. Est.	78.90	17.77	83.30	20.86
Scenario 3	Best. Est.	78.77	17.61	83.17	20.70

Period view, only using the (virtual) 2020 data points, no trend projected.

Recalibrating IA|BE 2020 - impact on cohort life expectancy



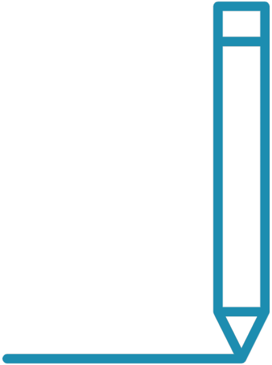
Recalibrating IA|BE 2020 - impact on cohort life expectancy



Recalibrating IA|BE 2020 - impact on cohort life expectancy

Cohort life expectancy in 2020		Males		Females	
		0	65	0	65
IA|BE 2020	Best. Est.	89.91	20.38	91.54	23.14
	$[q_{0.5}; q_{50}; q_{99.5}]$	[88.11; 89.89; 91.46]	[19.57; 20.37; 21.17]	[89.46; 91.53; 93.25]	[22.15; 23.14; 24.07]
Scenario 1	Best. Est.	88.31	19.58	90.31	22.54
	$[q_{0.5}; q_{50}; q_{99.5}]$	[85.51; 88.30; 90.62]	[18.49; 19.58; 20.62]	[87.46; 90.31; 92.58]	[21.40; 22.54; 23.65]
Scenario 2	Best. Est.	87.98	19.43	90.19	22.37
	$[q_{0.5}; q_{50}; q_{99.5}]$	[84.73; 87.95; 90.47]	[18.28; 19.42; 20.62]	[87.11; 90.16; 92.53]	[21.13; 22.37; 23.60]
Scenario 3	Best. Est.	87.71	19.27	89.07	22.00
	$[q_{0.5}; q_{50}; q_{99.5}]$	[84.10; 87.71; 90.35]	[18.04; 19.27; 20.52]	[84.99; 89.08; 92.10]	[20.50; 21.99; 23.50]

No expert judgement made about the 2020 observation; re-calibrated along the principles of IA|BE 2020.



That's a wrap!

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Period (in 2020) and cohort life expectancy are negatively impacted (as expected).

IA|BE 2020 reacts to the 2020 (virtual) data points, with (a.o.) a change in the trend K_t at EU level, the B_x then determines how sensitive age x reacts to this increase.

These numerical results do not take any expert judgement into account (e.g. leave out, smooth) regarding the 2020 virtual data points.

That's a wrap!

This scenario analysis gives a first impression of sensitivity of IA|BE 2020 to the shock in 2020. Handle with care, due to many uncertainties and modelling assumptions!

IA|BE 2020 is still our best estimate for future long-term mortality.

More future data points, more research will be necessary to assess the long-term impact of COVID-19 on mortality.

Thank you for your attention!