

EXCESS MORTALITY DURING THE FIRST AND SECOND WAVE OF THE COVID-19 EPIDEMIC IN BELGIUM

(data from 10 March 2020 to 14 February 2021)

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Be-MOMO (Belgian Mortality Monitoring) Surveillance of COVID-19 mortality

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EXECUTIVE SUMMARY

What was the link between COVID-19 and all-cause mortality?

COVID-19 mortality was strongly correlated with excess all-cause mortality during the first two waves of the epidemic. All-cause mortality thus validated the results of COVID-19-specific mortality surveillance in Belgium during the epidemic. An excess mortality due to influenza can be excluded as the flu epidemic ended on 15 March 2020 and was non-existent thereafter.

What was the weekly proportion of COVID-19 deaths to all-cause mortality?

46% of weekly deaths were caused by COVID-19 in the first wave peak (week 15), and 39% in the second wave peak (weeks 45 and 46). The proportion increased with age group. Considering the many other possible causes of death in persons over 65 years of age, COVID-19 stood out as a major cause of death during each wave.

What was the excess mortality in the first wave?

During the period of statistically significant excess mortality (20 March – 28 April 2020), 7,893 deaths in excess were observed (64.3% of excess mortality) and 7,578 persons died of COVID-19.

During the week of the peak, the excess mortality reached 100%. Week 15 corresponds to the peak of excess mortality (670 deaths on 10 April) and COVID-19 mortality (322 deaths on 8 April). In the first four weeks of the rising excess mortality curve (weeks 12 to 15), 747 additional deaths cannot be attributed to COVID-19 or were missed by the surveillance.

What was the excess mortality in the second wave?

During the period of statistically significant excess mortality (20 October – 24 December 2020), 8,350 deaths in excess were observed (41.6% of excess mortality) and 8,686 persons died of COVID-19.

During the week of the peak, the excess mortality reached 78%. Week 45 corresponds to the peak of excess mortality (560 deaths on 7 November) and week 46 to COVID-19 mortality peak (219 deaths on 10 November). In the first three weeks of the rising excess mortality curve (weeks 43 to 45), 446 additional deaths cannot be attributed to COVID-19 or were missed by the surveillance.

Which wave had the highest excess mortality?

Compared with the second wave, the first wave showed higher excess mortality (69.9% versus 39.6%), higher number of deaths in excess per week (1,501 versus 844) and higher number of COVID-19 deaths per week (1,442 versus 893) (comparing weeks 13-17 and weeks 43-52). Persons 85 years and older were heavily affected during both waves.

What was the excess mortality in 2020?

During 2020, 18,765 deaths in excess were observed, 17.5% excess mortality. Analysis by age group showed 8,833 deaths in excess among 85+ years (18.7% excess mortality), 8,856 deaths in excess among 65-84 years (19.9% excess mortality) and 1,638 deaths among those aged 15-64 (11.1% excess mortality). Analysis by sex showed that women aged 85 and over and men aged 65-84 were the most affected in terms of number of deaths in excess.

Did the year 2020 diverge from the historical evolution of mortality in Belgium?

The year 2020 was an outlier, with an excess mortality eight times higher than the average of the last five years. The COVID-19 epidemic reminds us that it is not unusual for epidemics of respiratory infectious diseases to be major lethal events, of rapid onset in a susceptible and vulnerable population. Analysis encompassing entire winter seasons is more accurate for flu, which often spreads over several winter months, spread over two calendar years. It provides very different results than a typical annual analysis from January to December.

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ABBREVIATIONS

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Be-MOMO	Belgian Mortality Monitoring
COVID-19	Coronavirus disease 2019
ECDC	European Centre for Disease Prevention and Control
RT-PCR	Real-time polymerase chain reaction
WHO	World Health Organisation

INTRODUCTION

The first case of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection in Belgium occurred on February 3, 2020 in an asymptomatic patient. The first wave of the COVID-19 epidemic occurred between 1 March and 21 June 2020, and the second wave between 31 August 2020 and 14 February 2021, each of these waves showing exceptional excess mortality. Finally, there was a third period of excess mortality in August 2020 related to a heat wave.

This report describes the excess mortality during the first two waves of the COVID-19 epidemic in Belgium, and makes comparisons between data from all-cause mortality surveillance and epidemiological surveillance of COVID-19 deaths. Finally, mortality in 2020 is compared with historical mortality (absolute number and rate) in Belgium since 1841. Results for the regions can be found in the annexes.

METHODS

1. All-cause mortality

All-cause mortality by day is provided weekly by the National Register to the Infectious Diseases Epidemiology Unit of Sciensano in the framework of the Be-MOMO project (the Belgian Mortality Monitoring, <https://epistat.sciensano.be/momo>) [1]. Residents who die abroad are excluded because of the need to assess the effect of a public health threat on the territory. Deaths are classified by region according to the deceased's place of death. Be-MOMO is designed to serve as a tool for early detection and quantification of unusual mortality that could result from disease outbreaks or extreme environmental conditions. Observed death counts are compared to expected deaths and a threshold defining excess mortality, both of which are obtained by modelling the past five years of mortality data. Expected deaths are the model predictions and represent normal/average mortality levels. They are used for the calculation of the excess number of deaths (observed – expected). The threshold defining excess mortality is the upper limit of the prediction interval for expected mortality, calculated by a 2/3-power transformation to correct for skewness in the Poisson distribution [2]. Threshold values represent critical mortality levels and are used to detect unusual or statistically significant excess mortality. The confidence level for the upper threshold is chosen as the optimal compromise between sensitivity and specificity of alert detection. It is set at 99.5% for daily mortality data. To model the complete five years' time series and reduce random variation in the predicted baseline for daily-level data, a sine and cosine wave component is added to capture the seasonal pattern of mortality. Due to the high excess mortality in 2020, the 2020 observations were removed from the model fit. The observed 2020 data were replaced in the model with the expected 2020 data (as estimated at the end of 2019). The methodology of Be-MOMO is described by Cox et al. [3]. Daily all-cause mortality was extracted on 12 June 2021.

2. COVID-19 mortality

Daily COVID-19 numbers of deaths were reported by Sciensano, the Scientific Institute of Public Health in Belgium using reports from hospitals, long-term care facilities (including mainly nursing homes, residence services for elderly persons, facilities for disabled persons), and general practitioners. For each death, the diagnostic status (confirmed by RT-PCR or chest CT scan and possible cases) was specified. Possible cases were those who met the clinical criteria for the disease but did not undergo a diagnostic test, or whose diagnostic tests were inconclusive or negative, whether or not there was an epidemiological link to a COVID-19 confirmed case. For both possible and confirmed cases, if a clear alternative cause of death that cannot be linked to COVID-19 (e.g. trauma) was identified, the death was not included in the surveillance. The mortality surveillance methodology followed the ECDC and WHO guidelines [4, 5]. However, the definition of a probable case

was not used because this definition, at first, concerned people with an inconclusive test, which was infrequently observed in Belgium. Radiologically-confirmed cases were added because of the imperfect sensitivity of the RT-PCR tests, and periods of limited access to testing due to shortage of reagent or swab or delay in obtaining results. Details of the COVID-19 mortality surveillance in Belgium is described by Renard et al. [6] and Peeters et al. [7]. The chronology of the COVID-19 case definition and testing strategy is described by Bustos Sierra et al. in the supplementary material [8]. Daily COVID-19 mortality was extracted on 17 June 2021. Results of COVID-19 deaths are presented by region of residence, with region of death used as a proxy when region of residence is unknown (region of residence is unknown for 33% of COVID-19 deaths in the first wave).

3. Historical all-cause mortality

To assess historical mortality, yearly mortality rates per 100,000 inhabitants were calculated from 1841 to 2020, using mortality counts and the mid-year population of each year (and the population as of 1 January of 2020 for 2020).

Historical mortality data (per year from 1841 and per month from 1876) and the population sizes are provided by Statistics Belgium (Statbel) (extracted in March 2021). The unavailability of age at death for people who died before 1989 did not allow us to standardize mortality rates by age.

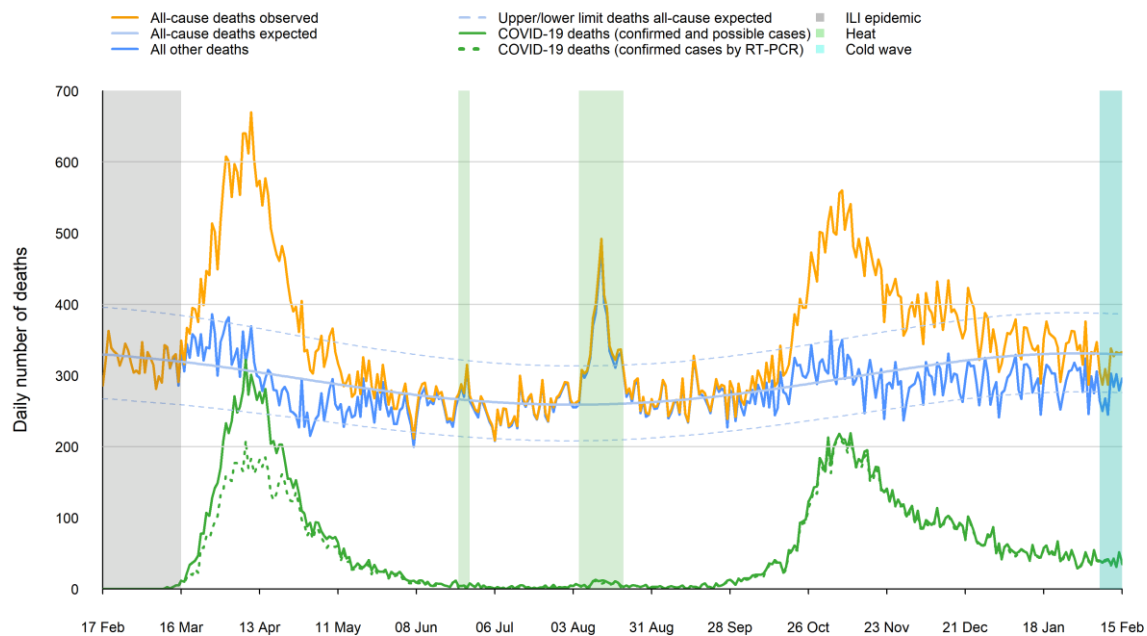
RESULTS

1. What was the link between COVID-19 and all-cause mortality?

Key messages

- COVID-19 mortality was strongly correlated with excess all-cause mortality in the first two waves of the epidemic.
- All-cause mortality validates that the reporting of COVID-19 mortality, as part of the epidemiological surveillance, was correctly performed during the epidemic.
- Non-COVID-19 deaths tended to increase slightly during the first weeks of excess mortality and then remained below the expected number of deaths from all causes. This was observed across age groups.
- Excess mortality due to flu can be excluded during both waves because the seasonal flu epidemic ended on 15 March 2020 and was non-existent thereafter.

COVID-19 mortality was strongly correlated with excess all-cause mortality in the first two waves of the epidemic. The inclusion of deaths occurring in nursing homes and deaths of “possible” COVID-19 cases (mainly among nursing homes residents) provided the best correlation between all-cause and COVID-19 mortality during March and April 2020 (Figure 1).



How to read this graph ? When the number of all-cause deaths per day (orange line) exceeds the upper or lower limits of deaths predicted by the modelling (blue dashed lines), there is a statistically significant excess or under-mortality. The dark blue line corresponds to daily number of deaths for other causes captured by subtracting the number of COVID-19 deaths from the number of all-cause deaths.

Figure 1. All-cause mortality, COVID-19 and other causes of death, February 2020 to February 2021, Belgium

Given that the circulation of **influenza** virus in Belgium ended on 15 March 2020, an excess mortality due to influenza can be excluded in both excess mortality periods (<https://epistat.wiv-isp.be/influenza/>). Excess mortality during the first wave of 2020 was more than twice that observed during intense and severe influenza epidemics (Figure 2).

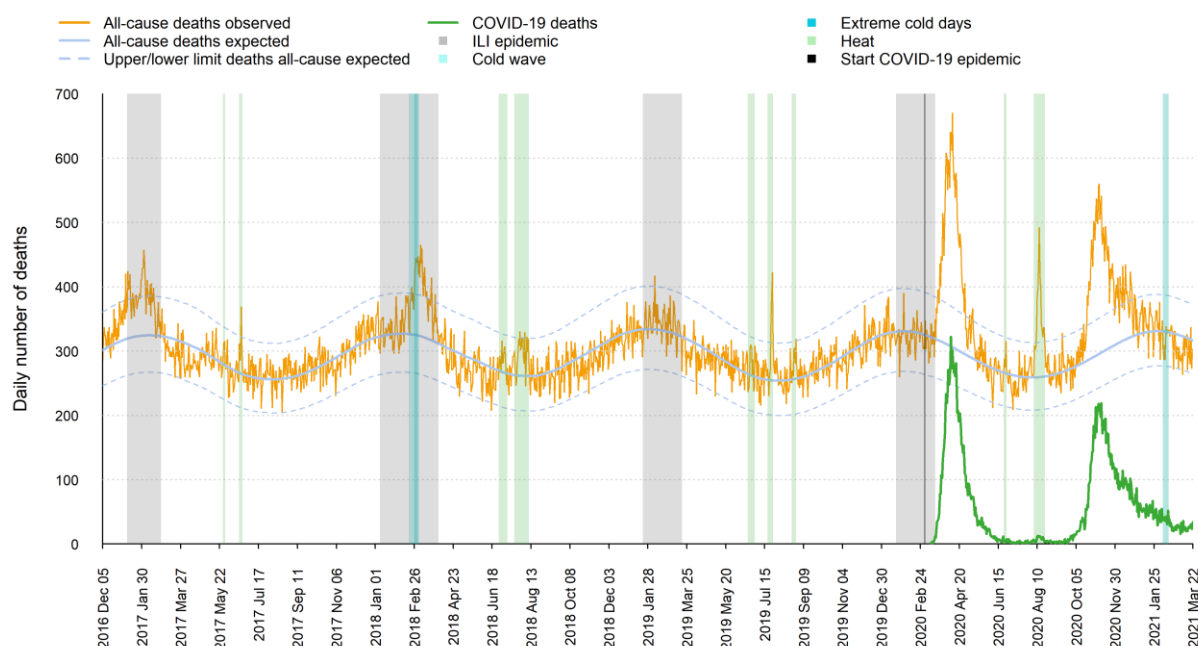


Figure 2. All-cause mortality, COVID-19, December 2016 to February 2021, Belgium

The number of **deaths from causes other than COVID-19** (dark blue line, Figure 1) tends to increase slightly during the first few weeks of excess mortality and then remains at a lower level than the number of all-cause deaths predicted by the modelling, mainly in the downhill phase of each wave. This is observed across age groups (Figure 3).

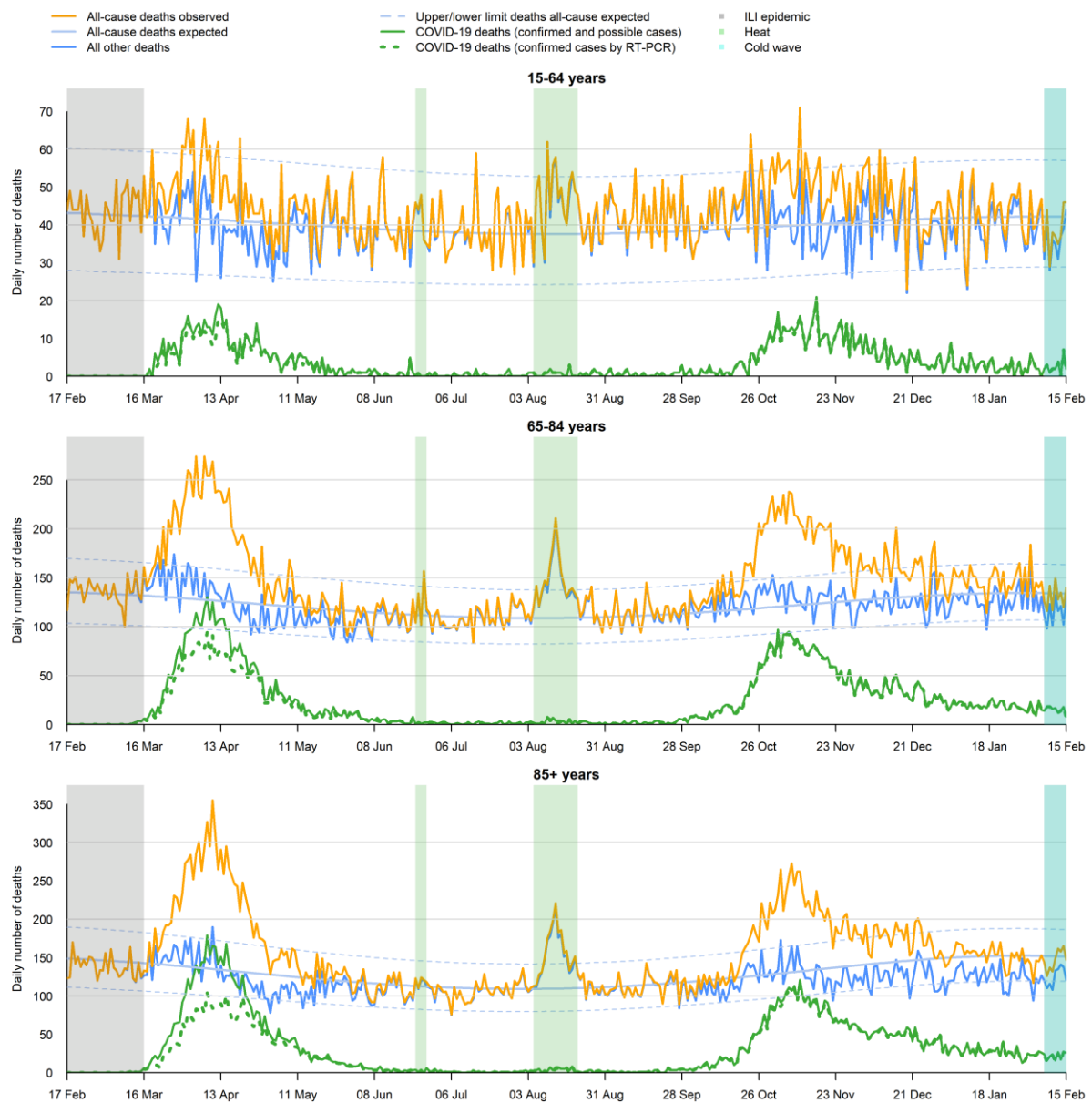


Figure 3. All-cause mortality, COVID-19 and other causes of death, February 2020 to February 2021, by age group, Belgium

2. What was the weekly proportion of COVID-19 deaths to all-cause mortality?

Key messages

- 46% of weekly deaths were caused by COVID-19 during the first wave peak (week 15), and 39% during the second wave peak (weeks 45 and 46).
- Considering the many other possible causes of death among people over 65 years of age, COVID-19 stands out as a major cause of death during each wave.
- The proportion increased according to age group.

COVID-19 was the cause of death for 46% of deaths during week 15, the peak of mortality in the first wave (Figure 4). This proportion was slightly lower in the 2nd wave peak (39% in weeks 45 and 46). This weekly proportion reached 52% and 43% during the first and second wave peaks among 85+ years old, 45% and 40% among 65-84 year old, and 24% among 15-64 years old in both waves.

As of January 2021, COVID-19 still accounted for about 10% of weekly deaths in the population.

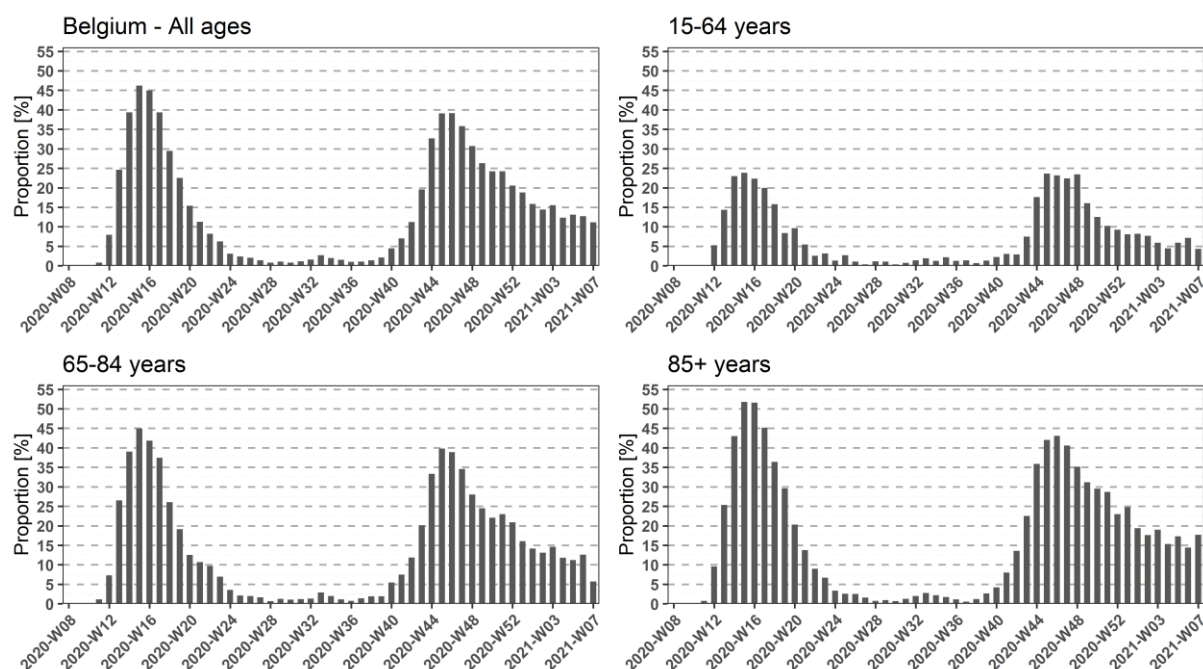


Figure 4. Weekly proportion of COVID-19 deaths in relation to all-cause mortality, by age group, Belgium

3. What was the excess mortality in the first wave?

Key messages

- During the period of statistically significant excess mortality (20 March – 28 April 2020), 7,893 deaths in excess were observed, 64.3% of excess mortality. 7,578 persons died of COVID-19 during that period.
- During the week of the peak, excess mortality reached 100%.
- Week 15 corresponds to the peak of excess mortality (670 deaths on 10 April) and COVID-19 mortality (322 deaths on 8 April).
- In the first four weeks of the rising excess mortality curve (weeks 12 to 15), 747 additional deaths cannot be attributed to COVID-19 or were missed by the surveillance.

Between Friday 20 March and Tuesday 28 April 2020 inclusive, there were 7,893 additional deaths out of the 20,168 deaths observed, i.e. an excess mortality of 64.3% (Table 1). The excess mortality particularly concerned persons aged over 65 years, but it also affected younger age groups. Over the same period, the number of deaths due to COVID-19 amounted to 7,578 deaths.

The excess mortality during the whole first wave (between 10 March and 21 June 2020) represented 8,502 additional deaths and 27.8% excess mortality. 9,595 persons died of COVID-19 during that period.

Tabel 1 | Number of deaths from all causes from 20 March to 28 April 2020, Belgium

Group	Number of deaths observed	Number of deaths expected (Be-MOMO)	Number of death in excess*	Excess mortality (%)	Crude mortality rate (100,000 inhabitants)	Average number of deaths per day (standard deviation)
Total	20 168	12 275	7 893	64.3	175.5	504 (86)
85+ years	9 640	5 423	4 217	77.8	2 876.4	241 (49)
65-84 years	8 444	5 085	3 359	66.1	451.7	211 (36)
0-64 years	2 084	1 725	359	20.8	22.4	52 (9)
15-64 years	2 039	1 659	380	22.9	27.7	51 (8)
Male	9 657	5 991	3 666	61.2	170.6	241 (43)
85+ years	3 551	2 013	1 538	76.4	3 183.7	89 (20)
65-84 years	4 789	2 896	1 893	65.4	555.5	120 (23)
0-64 years	1 317	1 061	256	24.2	28.1	33 (6)
15-64 years	1 293	1 022	271	26.5	35.0	32 (6)
Female	10 511	6 268	4 243	67.7	180.2	263 (48)
85+ years	6 089	3 404	2 685	78.9	2 723.2	152 (33)
65-84 years	3 655	2 186	1,469	67.2	362.9	91 (16)
0-64 years	767	650	117	17.9	16.7	19 (4)
15-64 years	746	624	122	19.6	20.4	19 (4)

* As the number of additional deaths is calculated separately by age group, it is normal to see a small difference between the total figures for Belgium and the sum of these figures by age group.

The number of deaths from all causes began to increase from week 12, with 20 March being the first day with an excess mortality alert (Table 2). Week 15 corresponded to the peak of excess mortality (670 deaths observed on 10 April) and COVID-19 mortality (322 deaths on 8 April). The excess mortality for weeks 14, 15 and 16 reached 85%, 100% and 75% respectively. At the time of the peak, 93% of the excess mortality can be explained by COVID-19.

In the first four weeks of the rising excess mortality curve (weeks 12 to 15), 747 deaths in excess cannot be attributed to COVID-19 or were missed by the surveillance (boxed, Table 2).

Tabel 2 | All-cause and COVID-19 mortality, weekly and cumulative, Belgium, wave 1

Week	Monday's date	Number of deaths observed (cumulative)	Number of deaths in excess (Be-MOMO) (cumulative)	Number of days with significant excess mortality	% excess mortality	Number of COVID-19 deaths (cumulative)	Difference (death in excess – COVID-19 deaths) (cumulative)	% (COVID-19 deaths / death in excess) (cumulative)
2020-W11	09/03/2020	2 231	-17	0	-1%	18	-35	-106%
2020-W12	16/03/2020	2 554	327	2	15%	203	124	62%
		(4 785)	(310)			(221)	(89)	(71%)
2020-W13	23/03/2020	3 188	985	7	45%	785	200	80%
		(7 973)	(1 295)			(1 006)	(289)	(78%)
2020-W14	30/03/2020	4 027	1 851	7	85%	1 585	266	86%
		(12 000)	(3 146)			(2 591)	(555)	(82%)
2020-W15	06/04/2020	4 285	2 137	7	100%	1 980	157	93%
		(16 285)	(5 283)			(4 571)	(712)	(87%)
2020-W16	13/04/2020	3 709	1 591	7	75%	1 668	-77	105%
		(19 994)	(6 874)			(6 239)	(635)	(91%)
2020-W17	20/04/2020	3 030	941	7	45%	1 192	-251	127%
		(23 024)	(7 815)			(7 431)	(384)	(95%)
2020-W18	27/04/2020	2 380	321	2	16%	701	-380	218%
		(25 404)	(8 136)			(8 132)	(4)	(100%)
2020-W19	04/05/2020	2 387	357	3	18%	537	-180	150%
		(27 791)	(8 493)			(8 669)	(-176)	(102%)
2020-W20	11/05/2020	2 044	42	0	2%	315	-273	750%
		(29 835)	(8 535)			(8 984)	(-449)	(105%)
2020-W21	18/05/2020	2 073	99	0	5%	234	-135	236%
		(31 908)	(8 634)			(9 218)	(-584)	(107%)
2020-W22	25/05/2020	1 972	24	0	1%	162	-138	675%
		(33 880)	(8 658)			(9 380)	(-722)	(108%)
2020-W23	01/06/2020	1 803	-120	-1*	-6%	113	-233	-94%
		(35 683)	(8 538)			(9 493)	(-955)	(111%)
2020-W24	08/06/2020	1 903	3	0	0%	59	-56	1967%
		(37 586)	(8 541)			(9 552)	(-1 011)	(112%)
2020-W25	15/06/2020	1 808	-72	0	-4%	43	-115	-60%
		(39 394)	(8 469)			(9 595)	(-1 126)	(113%)

* -1: One day with an alert of under-mortality

In week 19, the **cumulative number of COVID-19 deaths exceeded the cumulative number of all-cause deaths in excess**. This may be due to a combination of several

factors: fewer new COVID-19 deaths, fewer deaths from other causes, and a harvesting effect¹.

A few days of statistically significant excess mortality were still observed in weeks 18 and 19, particularly for people over 65 years of age.

The last day of excess mortality alert was 28 April (week 18). Thereafter, three additional excess mortality days were observed on 5, 8 and 9 May (week 19) (Figure 5). **High ozone concentrations** were recorded on 8 and 9 May by IRCELINE with 137 and 131 $\mu\text{g}/\text{m}^3$ (threshold set at 120 $\mu\text{g}/\text{m}^3$ for the daily maximum of the 8 hour mean). Be-MOMO cannot determine the cause of the excess mortality, but it is possible that these ozone peaks generated this significant short-term excess mortality, as is common during the summer (Be-MOMO report, summer 2018).

From 11 May (week 20), there was no further excess mortality, and the observed number of deaths remained within the expected range until the August heat wave. From 1 June (week 23), the cumulative number of additional deaths decreased from the previous week, with the observed number of deaths passing below the baseline of the last five years.

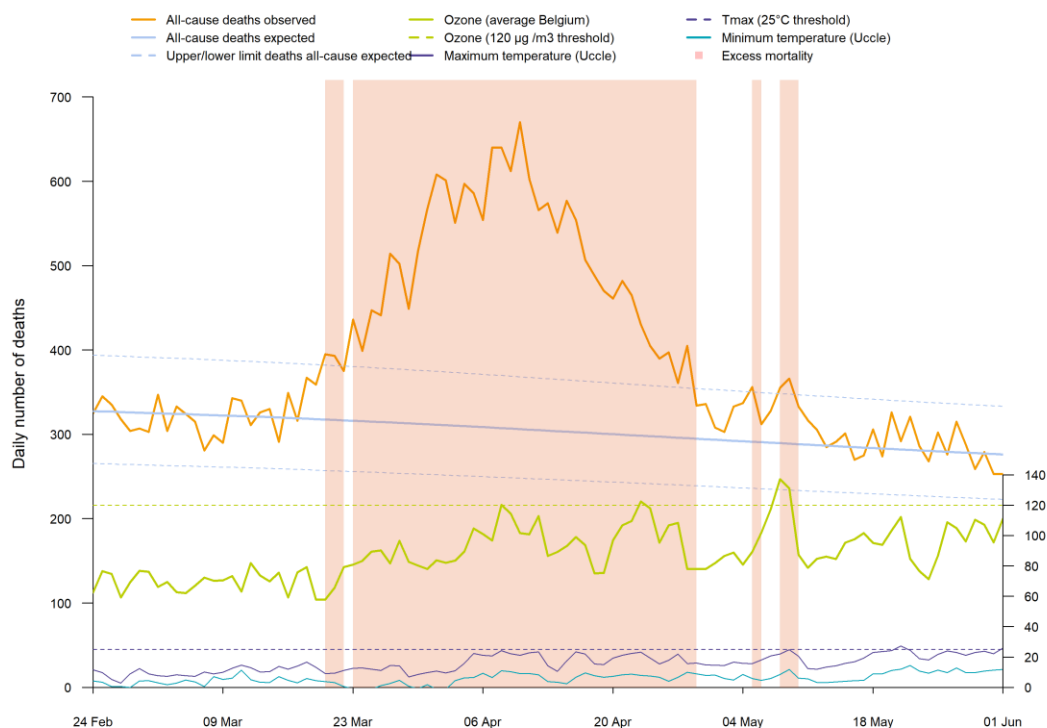


Figure 5. Excess mortality and ozone concentrations during the first wave of COVID-19, Belgium

¹ The harvesting effect is a phenomenon of mortality displacement, with the most vulnerable people dying earlier as a result of a particular event.

4. What was the excess mortality in the second wave?

Key messages

- During the period of statistically significant excess mortality (20 October – 24 December 2020), 8,350 deaths in excess were observed, 41.6% of excess mortality. 8,686 persons died of COVID-19 during that period.
- During the week of the peak, the excess mortality reached 78%.
- Week 45 corresponds to the peak of excess mortality (560 deaths on 7 November) and week 46 to COVID-19 mortality peak (219 deaths on 10 November).
- In the first three weeks of the rising excess mortality curve (weeks 43 to 45), 446 additional deaths cannot be attributed to COVID-19 or were missed by the surveillance.

Between 20 October and 24 December 2020, there were 8,350 additional deaths out of the 28,432 deaths observed, i.e. 41.6% excess mortality (Table 3). The excess mortality again concerned in particular persons aged over 65 years, but it also affected younger age groups. Over the same period, the number of COVID-19 deaths amounted to 8,686 deaths.

The excess mortality during the whole second wave (between 31 August 2020 and 14 February 2021) represented 9,298 additional deaths and 18.3% excess mortality. 11,954 persons died of COVID-19 during that period.

Tabel 3 | Number of deaths from all causes from 20 October to 24 December 2020, Belgium

Group	Number of deaths observed	Number of deaths expected (Be-MOMO)	Number of death in excess*	Excess mortality (%)	Crude mortality rate (100,000 inhabitants)	Average number of deaths per day (standard deviation)
Total	28 432	20 082	8 350	41.6	247.4	431 (56)
85+ years	13 032	8 994	4 038	44.9	3 888.5	197 (29)
65-84 years	12 046	8 226	3 820	46.4	644.4	183 (27)
0-64 years	3 354	2 770	584	21.1	36.1	51 (9)
15-64 years	3 265	2 664	601	22.6	44.4	49 (8)
Male	14 164	9 759	4 405	45.1	250.2	215 (31)
85+ years	5 041	3 361	1 680	50.0	4 519.5	76 (13)
65-84 years	6 963	4 687	2 276	48.6	807.7	106 (18)
0-64 years	2 160	1 685	475	28.2	46.1	33 (6)
15-64 years	2 113	1 625	488	30.0	57.2	32 (6)
Female	14 268	10 237	4 031	39.4	244.6	216 (29)
85+ years	7 991	5 607	2 384	42.5	3 573.8	121 (20)
65-84 years	5 083	3 520	1 563	44.4	504.6	77 (12)
0-64 years	1 194	1 054	140	13.3	25.9	18 (5)
15-64 years	1 152	1 005	147	14.6	31.5	17 (5)

* As the number of additional deaths is calculated separately by age group, it is normal to see a small difference between the total figures for Belgium and the sum of these figures by age group.

The number of deaths from all causes increased considerably from week 43, with 20 October being the first day of excess mortality (Table 4). Week 45 corresponds to the peak of excess mortality (560 deaths on 7 November) and week 46 corresponds to the COVID-19 mortality peak (219 deaths on 10 November). The excess mortality for weeks 44, 45 and 46 reached 61%, 78% and 63% respectively. At week 45, 89% of the excess mortality can be explained by COVID-19. In the first three weeks of the rising excess mortality curve (weeks 43 to 45), 446 deaths in excess cannot be attributed to COVID-19 or were missed by the surveillance (boxed, Table 4).

From week 48, the **cumulative number of COVID-19 deaths exceeded the cumulative number of all-cause deaths in excess**. From week 49, a plateau set in with a few more days of statistically significant excess mortality through week 52, particularly for persons over 65 years of age. The last day of excess mortality of this long period was 24 December. There was one isolated day of excess mortality on 28 December (week 53).

Tabel 4 | All-cause and COVID-19 mortality, weekly and cumulative, Belgium, wave 2

Week	Monday's date	Number of deaths observed (cumulative)	Number of deaths in excess (Be-MOMO) (cumulative)	Number of days with significant excess mortality	% excess mortality	Number of COVID-19 deaths (cumulative)	Difference (death in excess – COVID-19 deaths) (cumulative)	% (COVID-19 deaths / death in excess) (cumulative)
2020-W36	31/08/2020	1 873	29	0	2%	19	10	66%
2020-W37	7/9/2020	1 809	-51	0	-3%	19	-70	-37%
		(3 682)	(-22)			(38)	(-60)	(-173%)
2020-W38	14/09/2020	1 994	117	1	6%	28	89	24%
		(5 676)	(95)			(66)	(29)	(69%)
2020-W39	21/09/2020	1 907	10	0	1%	40	-30	400%
		(7 583)	(105)			(106)	(-1)	(101%)
2020-W40	28/09/2020	1 909	-11	0	-1%	85	-96	-773%
		(9 492)	(94)			(191)	(-97)	(203%)
2020-W41	5/10/2020	2 055	109	0	6%	144	-35	132%
		(11 547)	(203)			(335)	(-132)	(165%)
2020-W42	12/10/2020	2 142	170	1	9%	240	-70	141%
		(13 689)	(373)			(575)	(-202)	(154%)
2020-W43	19/10/2020	2 614	613	6	31%	512	101	84%
		(16 303)	(986)			(1 087)	(-101)	(110%)
2020-W44	26/10/2020	3 263	1 232	7	61%	1 066	166	87%
		(19 566)	(2 218)			(2 153)	(65)	(97%)
2020-W45	2/11/2020	3 674	1 614	7	78%	1 435	179	89%
		(23 240)	(3 832)			(3 588)	(244)	(94%)
2020-W46	9/11/2020	3 418	1 327	7	63%	1 337	-10	101%
		(26 658)	(5 159)			(4 925)	(234)	(95%)
2020-W47	16/11/2020	3 159	1 037	7	49%	1 132	-95	109%
		(29 817)	(6 196)			(6 057)	(139)	(98%)
2020-W48	23/11/2020	2 877	726	6	34%	883	-157	122%
		(32 694)	(6 922)			(6 940)	(-18)	(100%)
2020-W49	30/11/2020	2 680	500	5	23%	705	-205	141%
		(35 374)	(7 422)			(7 645)	(-223)	(103%)
2020-W50	7/12/2020	2 759	551	5	25%	668	-117	121%
		(38 133)	(7 973)			(8 313)	(-340)	(104%)
2020-W51	14/12/2020	2 715	480	5	21%	657	-177	137%
		(40 848)	(8 453)			(8 970)	(-517)	(106%)
2020-W52	21/12/2020	2 615	359	3	16%	538	-179	150%
		(43 463)	(8 812)			(9 508)	(-696)	(108%)
2020-W53	28/12/2020	2 430	153	1	7%	457	-304	299%
		(45 893)	(8 965)			(9 965)	(-1 000)	(111%)
2021-W01	4/1/2021	2 456	163	0	7%	389	-226	239%

Week	Monday's date	Number of deaths observed (cumulative)	Number of deaths in excess (Be-MOMO) (cumulative)	Number of days with significant excess mortality	% excess mortality	Number of COVID-19 deaths (cumulative)	Difference (death in excess – COVID-19 deaths) (cumulative)	% (COVID-19 deaths / death in excess) (cumulative)
		(48 349)	(9 128)			(10 354)	(-1 226)	(113%)
2021-W02	11/1/2021	2 389	84	0	4%	345	-261	411%
		(50 738)	(9 212)			(10 699)	(-1 487)	(116%)
2021-W03	18/01/2021	2 427	114	0	5%	376	-262	330%
		(53 165)	(9 326)			(11 075)	(-1 749)	(119%)
2021-W04	25/01/2021	2 413	96	0	4%	297	-201	309%
		(55 578)	(9 422)			(11 372)	(-1 950)	(121%)
2021-W05	1/2/2021	2 292	-25	0	-1%	301	-326	-1 204%
		(57 870)	(9 397)			(11 673)	(-2 276)	(124%)
2021-W06	8/2/2021	2 212	-99	0	-4%	281	-380	-284%
		(60 082)	(9 298)			(11 954)	(-2 656)	(129%)

5. Which wave had the highest excess mortality?

Key messages

- Compared with the second wave, the first wave showed:
 - higher excess mortality (69.9% versus 39.6%),
 - higher number of deaths in excess per week (1,501 versus 844),
 - higher number of COVID-19 death per week (1,442 versus 893) (between weeks 13-17 and weeks 43-52).
- Persons 85 years and older were heavily affected during both waves.
- The pattern of COVID-19 deaths influenced the periods of excess mortality.

Based on prediction of the weeks with statistically significant excess mortality in Belgium (weeks 13-17 and weeks 43-52), the first wave showed more excess mortality than the second (Table 5).

The waves of COVID-19 deaths had different characteristics that influenced the periods of excess mortality. In period 1, excess mortality was very rapid, high, and concentrated over five weeks, whereas in period 2, excess mortality was rapid too but more moderate and spread over ten weeks.

During period 1, an average of 1,501 additional deaths per week were observed, compared with 844 in period 2, across all ages. There was an average of 1,442 COVID-19 deaths per week in period 1, compared with 893 in period 2. In period 1 and 2, persons over 84 years of age were the most affected.

Tabel 5 | Comparison of excess mortality and COVID-19 deaths by age group between the 2 waves, Belgium

Period of excess mortality during the 2 waves	Number of weeks of excess mortality (period)	Number of additional deaths (per week)	Excess mortality	Number of COVID-19 deaths (per week)	Number of weeks of excess mortality (period)	Number of additional deaths (per week)	Excess mortality	Number of COVID-19 deaths (per week)
All ages								
15-64 years								
Period 1	5 (weeks 13-17)	7 507 (1 501/week)	69.9%	7 210 (1 442/week)	2 (weeks 14-15)	355 (177/week)	24.5%	190 (95/week)
Period 2	10 (weeks 43-52)	8 438 (844/week)	39.6%	8 933 (893/week)	4 (weeks 43-46)	597 (149/week)	21.1%	264 (66/week)
65-84 years								
85+ years								
Period 1	5 (weeks 13-17)	3 169 (634/week)	71.3%	2 922 (584/week)	6 (weeks 13-18)	4 039 (673/week)	85.2%	4 294 (716/week)
Period 2	10 (weeks 43-52)	3 836 (384/week)	43.9%	3 703 (370/week)	10 (weeks 43-52)	4 122 (412/week)	43.1%	4 639 (464/week)

6. What was the excess mortality in 2020?

Key messages

- During 2020, 18,765 deaths in excess were observed, 17.5% excess mortality.
- Analysis by age group shows: 8,833 deaths in excess among 85+ years (18.7% excess mortality), 8,856 deaths in excess among 65-84 years (19.9% excess mortality), 1,638 deaths among those aged 15-64 (11.1% excess mortality).
- Analysis by sex shows that women aged 85 and over and men aged 65-84 were the most affected in terms of number of deaths in excess.

The 2020 death toll was severe, with more than 126,000 deaths observed over the entire year (Table 6). Be-MOMO estimates that there were 18,765 additional deaths (17.5% excess mortality) compared with the model's prediction of 107,492 expected deaths for 2020. There were 19,720 COVID-19 deaths in 2020.

The percentage of excess mortality was similar for those aged 85 years and over (18.7% excess mortality) and 65-84 years (19.9% excess mortality). Men aged 15-64 years had an excess mortality of 15.2% compared with 7.5% for women in the same age group.

There were more COVID-19 deaths than additional deaths. This does not imply an overestimation of COVID-19 deaths because each COVID-19 death was not necessarily an additional death for the following reasons: (1) a proportion of the victims would have died anyway in the same year because they were at the end of life, (2) most probably, the lockdown prevented some deaths (e.g. accidents), reducing deaths for causes other than COVID-19, (3) the calculation of excess mortality includes both days with additional deaths (that add up) and days with mortality deficits (that subtract from additional deaths). This may explain why the number of additional deaths calculated over a large period including periods of under-mortality is less than the cumulative total of COVID-19 deaths, which only adds up.

Tabel 6 | Number of deaths from all causes in 2020, Belgium

Group	Number of deaths observed	Number of deaths expected (Be-MOMO)	Number of deaths in excess*	Excess mortality (%)	Crude mortality rate (100 000 inhabitants)	Average number of deaths per day (standard deviation)
Total	126 257	107 492	18 765	17.5	1 098.6	345 (90)
85+ years	56 030	47 197	8 833	18.7	16 718.4	153 (49)
65-84 years	53 347	44 491	8 856	19.9	2 853.8	146 (39)
0-64 years	16 880	15 304	1 576	10.3	181.7	46 (8)
15-64 years	16 348	14 710	1 638	11.1	222.3	45 (8)
Male	61 769	52 421	9 348	17.8	1 091.3	169 (45)
85+ years	20 780	17 502	3 278	18.7	18 630.4	57 (20)
65-84 years	30 330	25 346	4 984	19.7	3 518.4	83 (24)
0-64 years	10 659	9 356	1 304	13.9	227.4	29 (6)
15-64 years	10 384	9 017	1 367	15.2	280.9	28 (6)
Female	64 488	54 714	9 774	17.9	1 105.7	176 (48)
85+ years	35 250	29 554	5 696	19.3	15 764.7	96 (31)
65-84 years	23 017	19 065	3 952	20.7	2 285.0	63 (17)
0-64 years	6 221	5 799	422	7.3	135.2	17 (4)
15-64 years	5 964	5 548	416	7.5	163.1	16 (4)

* As the number of additional deaths is calculated separately by age group, it is normal to see a small difference between the total figures for Belgium and the sum of these figures by age group.

7. Did the year 2020 diverge from the historical evolution of mortality in Belgium?

Key messages

- The year 2020 was an outlier, with an excess mortality eight times higher than the average of the last five years.
- The COVID-19 epidemic reminds us that it is not unusual for epidemics of respiratory infectious diseases to be major lethal events, of rapid onset in a susceptible and vulnerable population.
- Analysis encompassing entire winter seasons is more accurate for flu, which often spreads over several winter months, spread over two calendar years. It provides very different results than a typical annual analysis from January to December.

7.1. YEARLY COMPARISON FROM 2002 TO 2020

In the years 2015 to 2019 we also experienced excess mortality from heat waves and influenza, but with an average excess mortality percentage of 2% per year (Table 7). The excess mortality in 2020 was therefore eight times greater than the average for the past five years. The year 2020 was particularly lethal and can be explained by the number of deaths associated with COVID-19 (19,720 deaths in 2020) and the excess mortality during the August heat wave (1,545 additional deaths, 39.7% excess mortality between 6 and 20 August 2020, including 126 COVID-19 deaths).

Tabel 7 | Excess death, number of deaths in excess by year, 2002-2020, Belgium

Year	Number of deaths observed	Number of deaths expected	Number of death in excess	% Excess death	Crude mortality rate (100 000 inhabitants)
2002	105 214	103 015	2 199	2.1	1 020.5
2003	106 830	103 125	3 705	3.6	1 031.6
2004	102 120	104 336	-2 216	-2.1	982.3
2005	103 489	102 874	615	0.6	990.7
2006	101 687	101 358	329	0.3	967.4
2007	101 901	99 229	2 672	2.7	962.7
2008	104 390	100 418	3 972	4.0	978.6
2009	104 442	102 339	2 103	2.1	971.3
2010	104 946	103 507	1 439	1.4	968.1
2011	104 016	103 953	63	0.1	949.8
2012	108 796	104 541	4 255	4.1	985.8
2013	108 994	107 308	1 686	1.6	982.0
2014	104 388	107 103	-2 715	-2.5	936.2
2015	110 070	106 645	3 425	3.2	982.0
2016	107 541	105 635	1 906	1.8	954.4
2017	109 012	106 176	2 836	2.7	962.8
2018	109 934	107 992	1 942	1.8	966.4
2019	107 839	107 013	826	0.8	943.4
2020	126 257	107 492	18 765	17.5	1 098.6

7.2. HISTORICAL MORTALITY FROM 1841 TO 2020

Since 1841, the most lethal and acute events in Belgium have been infectious disease epidemics and major societal events such as wars or economic crises (February 1929). While the population has continued to increase (dotted orange line, Figure 6), the mortality rate has tended to decrease over time (green line, Figure 6). The year 2020 has a mortality rate of 1,106 per 100,000 inhabitants, and 127,134 deaths (based on Statbel figures). The last time the mortality rate observed in 2020 was exceeded was in 1986. The last time the annual number of deaths observed in 2020 was exceeded was in 1918.

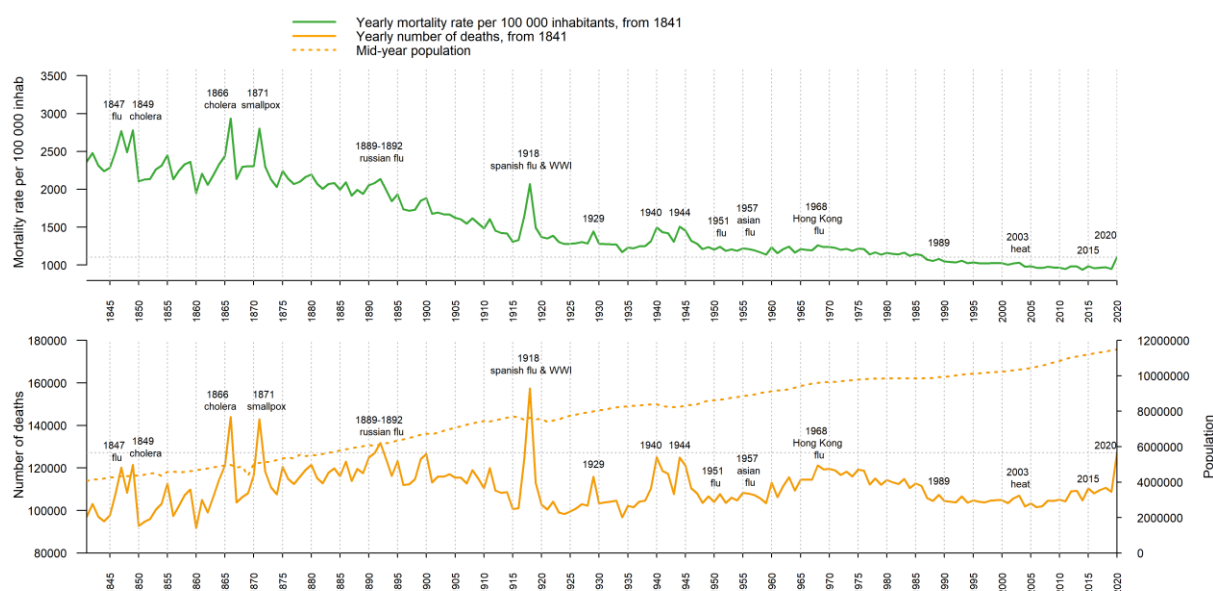


Figure 6. Historical evolution of mortality in Belgium, yearly numbers and rates, 1841-2020

The decrease in the number of deaths in 1915 and 1916 could be explained by a decrease in infant mortality following the fall in the birth rate from 1914, the increase in emigration and an underestimation of deaths among soldiers [9].

7.3. HISTORICAL MORTALITY BY SHIFTED YEAR FROM 1876 TO 2020

Analysis of annual mortality from January to December may hide the occurrence of lethal events such as influenza concentrated over several winter months, spread over two calendar years.

If we do the same analysis on the basis of a period starting in winter (from October) of year X and ending in summer (September) of year X+1 (shifted year), the end 2019-begin 2020 period showed 8.7% excess mortality (including the first wave of the COVID-19 epidemic and the heat wave) (Table 8).

Based on Statbel figures, the shifted 2019 period, had a mortality rate of 1,027 per 100,000 inhabitants, and 118,007 deaths (Figure 7). The last time this mortality rate was exceeded was in 1999. The last time the annual number of deaths of shifted 2019 was exceeded was in 1975 (119,198 deaths), and during the Hong Kong influenza pandemic (A H3N2) in 1967-1970

This approach reveals several lethal events with more deaths than the 2019-20 period (including the first wave of COVID-19) that did not appear in a January to December analysis (e.g., 1879, 1882-86, 1887-95, 1898-99, 1902-04, 1907-09, 1910-11, World War II, 1967-70, 1971-73, 1974-76).

Historical analysis of all-cause mortality based on a shifted year demonstrates that it not unusual for epidemics of respiratory infectious diseases to be major lethal events of rapid onset in a susceptible and vulnerable population.

Tabel 8 | Yearly mortality from winter (week 41) to summer (to week 40), Belgium, 2002-2020

Year	Number of deaths observed	Number of deaths expected	Number of death in excess	% Excess death	Crude mortality rate (100 000 inhabitants)
2002-2003	105 343	102 580	2 763	2.7	1 018.3
2003-2004	103 077	103 760	-683	-0.7	992.5
2004-2005	105 365	104 722	643	0.6	1 009.8
2005-2006	102 435	101 441	994	1.0	975.9
2006-2007	99 485	99 608	-123	-0.1	941.4
2007-2008	104 183	99 112	5 071	5.1	978.5
2008-2009	104 385	101 794	2 591	2.5	972.7
2009-2010	106 237	104 773	1 464	1.4	982.0
2010-2011	103 183	103 636	-453	-0.4	944.5
2011-2012	108 344	103 612	4 732	4.6	983.5
2012-2013	109 607	106 211	3 396	3.2	988.8
2013-2014	103 505	107 745	-4 240	-3.9	929.3
2014-2015	110 289	105 998	4 291	4.0	985.1
2015-2016	107 490	107 880	-390	-0.4	955.1
2016-2017	109 374	105 416	3 958	3.8	967.1
2017-2018	110 025	106 928	3 097	2.9	968.2
2018-2019	107 379	107 258	122	0.1	940.4
2019-2020	116 402	107 111	9 291	8.7	1 014.0

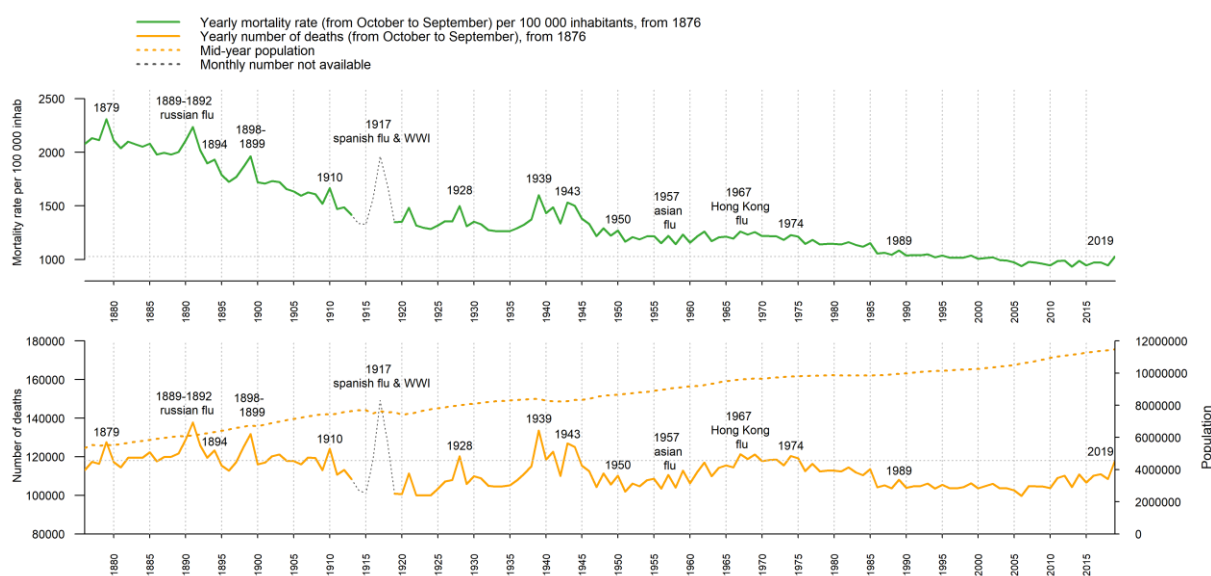


Figure 7. Historical evolution of mortality in Belgium, yearly numbers and rates from winter (October) to summer (September), 1876-2020..

CONCLUSION

COVID-19 mortality was highly correlated with excess all-cause mortality during the first two waves of the epidemic. Epidemiologic surveillance of COVID-19 deaths was accurately conducted during the epidemic and it is even likely that COVID-19 deaths were under-reported during the ascending phases of excess mortality by 1,193 deaths. The first wave of the epidemic has a larger excess mortality than the second wave. People aged 85 and over were the most affected during the two periods of excess mortality.

The year 2020 has a 17.5% excess mortality with 18,765 additional deaths, eight times the average excess mortality of the past five years. In the absence of the implementation of restrictive measures (e.g., social distancing, etc.) and non-pharmaceutical interventions (e.g., hand hygiene, personal protective equipment, etc.), it is possible that the excess mortality during this period would have been greater.

Mortality analysis encompassing entire winter seasons is more accurate for flu, which often spreads over several winter months, spread over two calendar years. It provides very different results than a typical annual analysis from January to December.

Even in the 21st century, epidemics of respiratory infectious diseases can be major lethal events of rapid onset in a susceptible and vulnerable population.

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ANNEXES

1. All-cause mortality, COVID-19 and other causes of death, by region

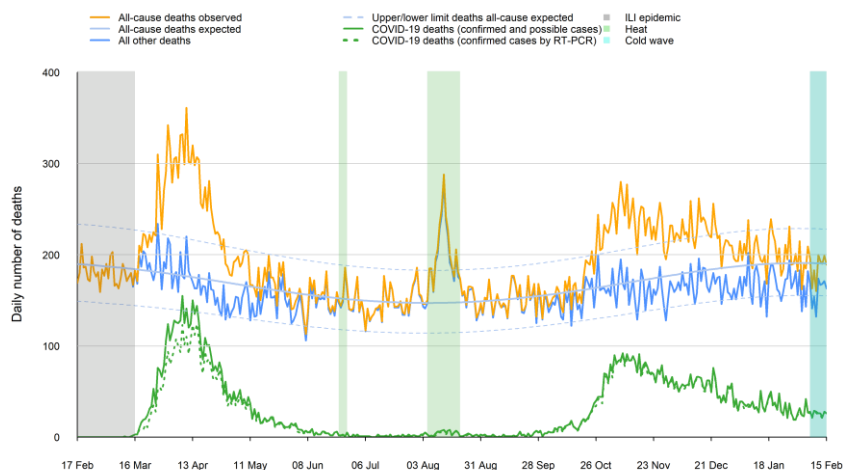


Figure 8. All-cause mortality, COVID-19 and other causes of death, February 2020 to February 2021, Flanders

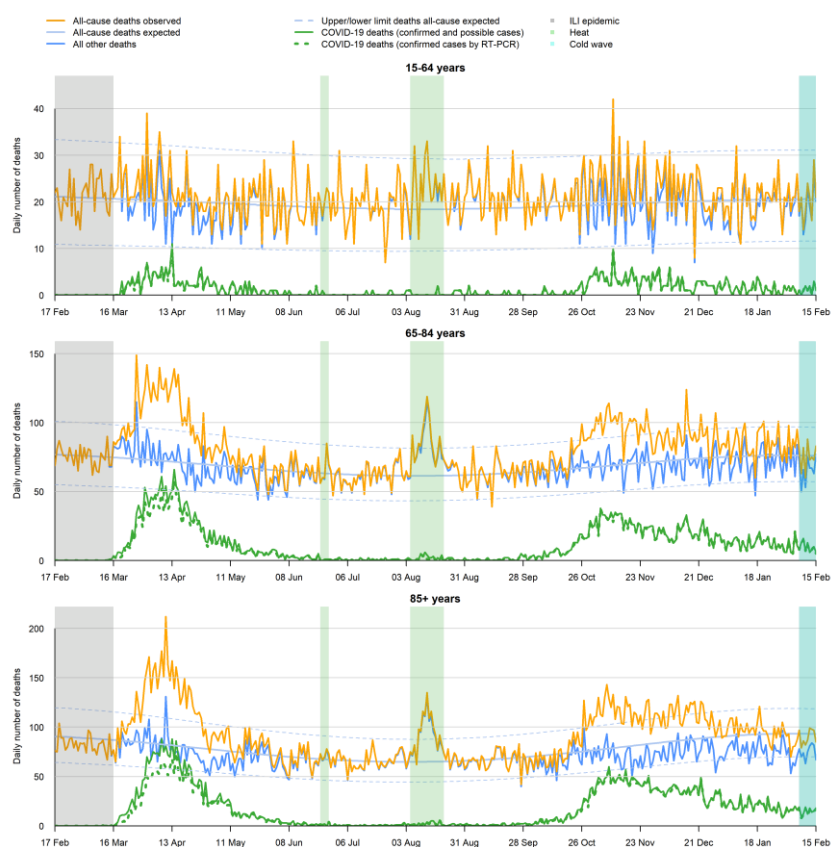


Figure 9. [Click or tap here to enter text.](#) All-cause mortality, COVID-19 and other causes of death, February 2020 to February 2021, by age group, Flanders

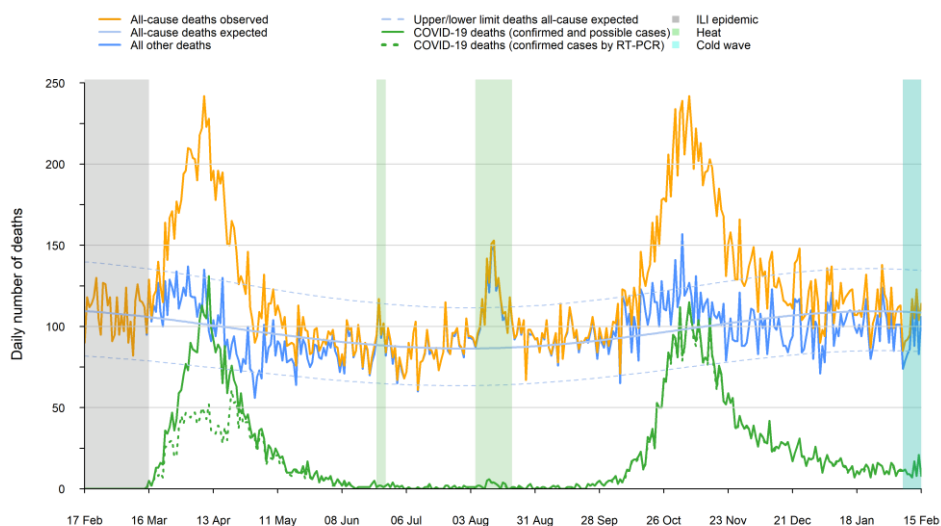


Figure 10. All-cause mortality, COVID-19 and other causes of death, February 2020 to February 2021, Wallonia

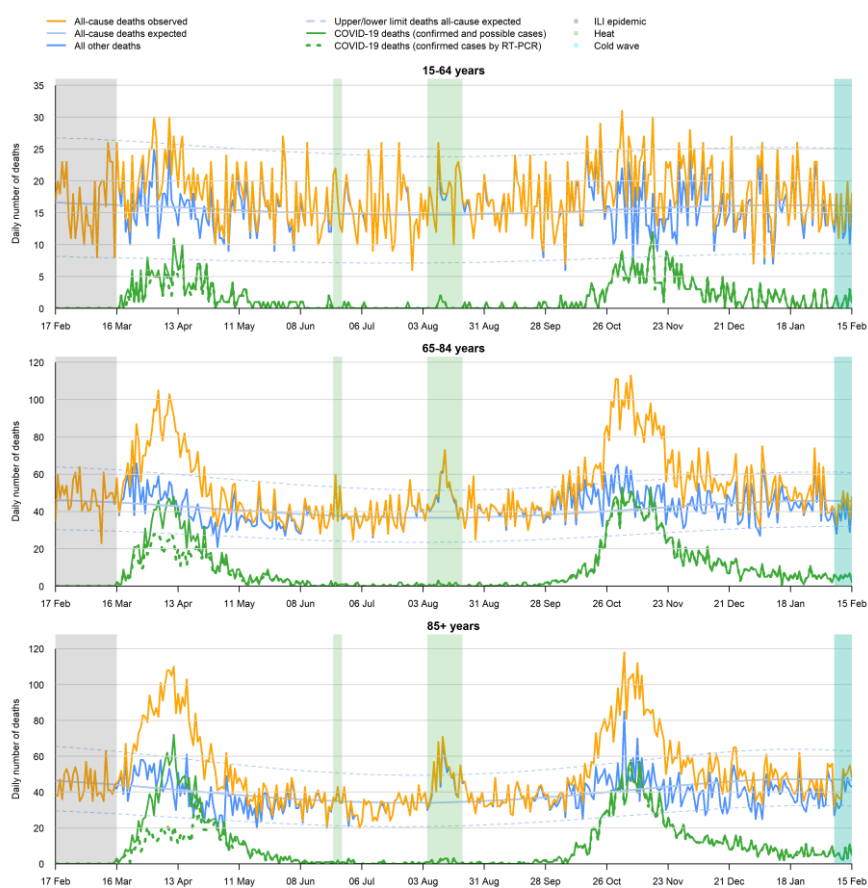


Figure 11. All-cause mortality, COVID-19 and other causes of death, February 2020 to February 2021, by age group, Wallonia

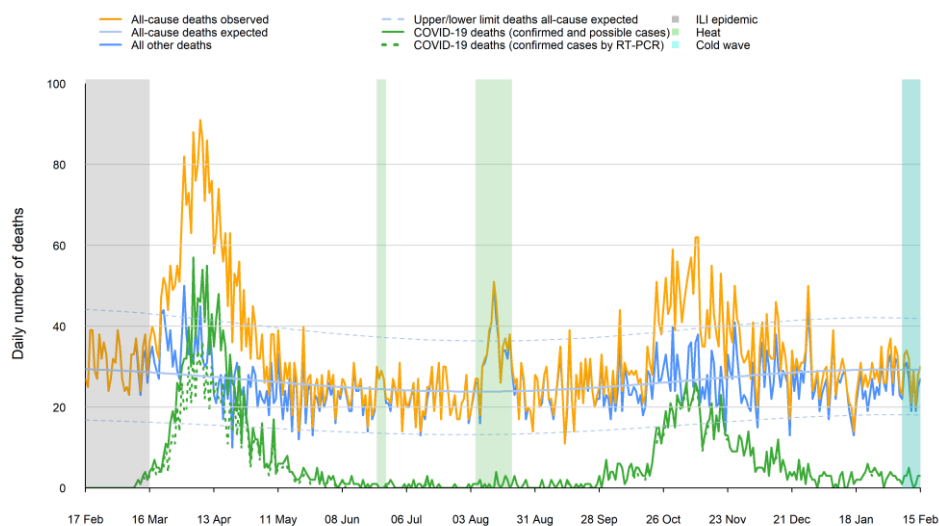


Figure 12. All-cause mortality, COVID-19 and other causes of death, February 2020 to February 2021, Brussels

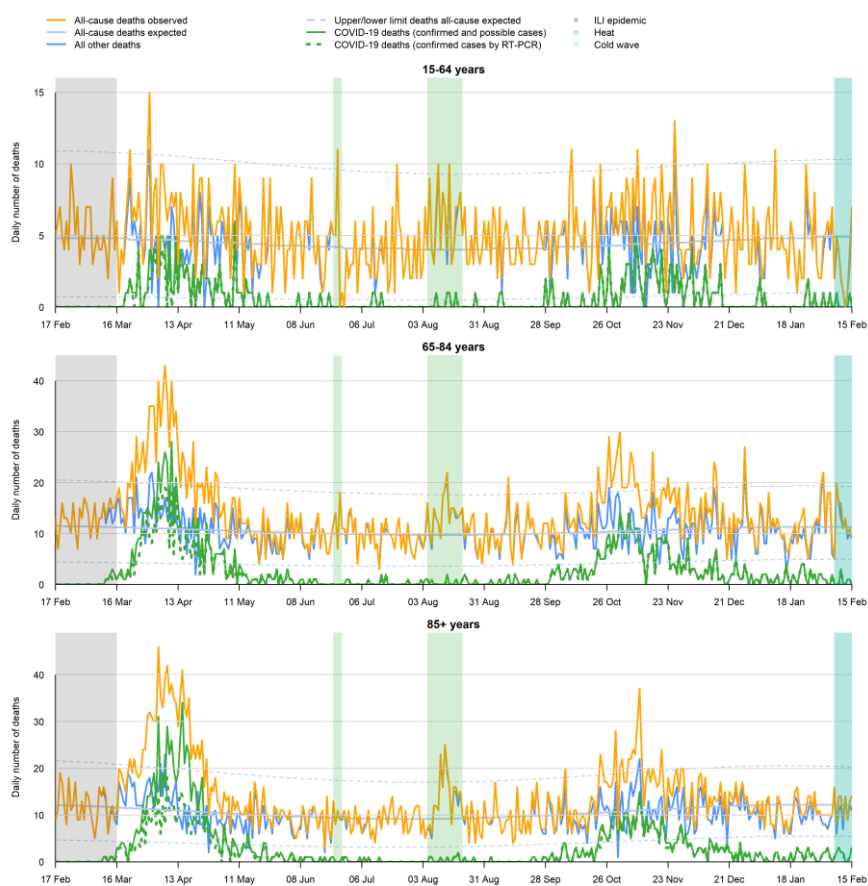


Figure 13. All-cause mortality, COVID-19 and other causes of death, February 2020 to February 2021, by age group, Brussels

2. Weekly proportion of COVID-19 deaths to all-cause mortality, by region

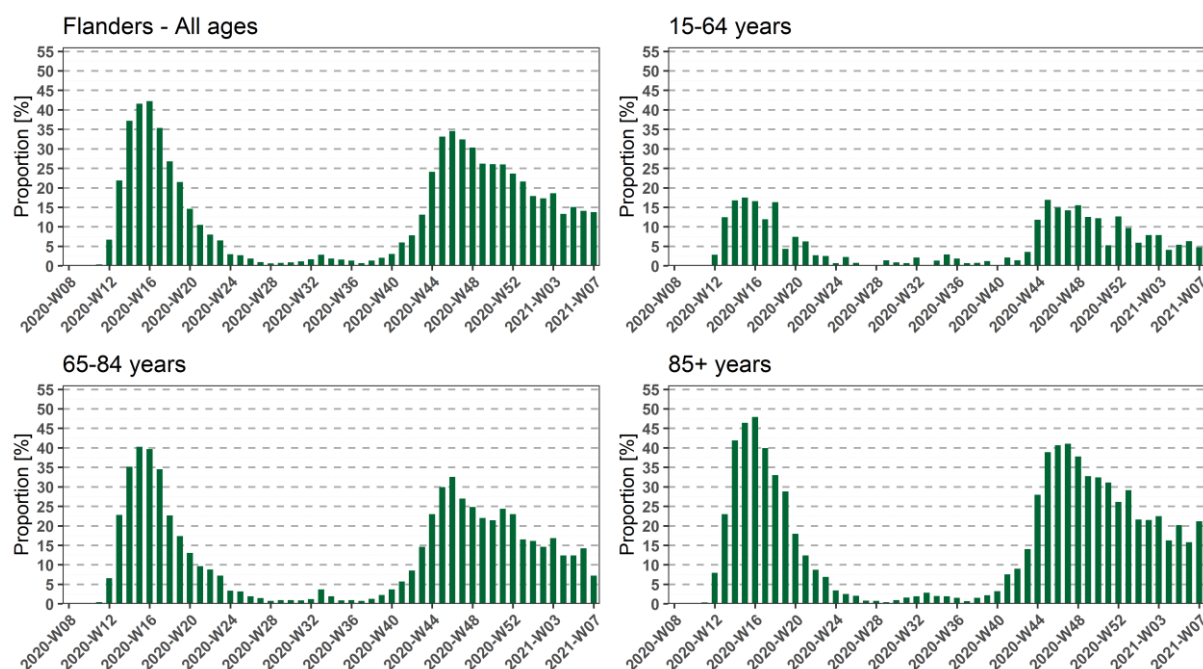


Figure 14. Weekly proportion of COVID-19 deaths in relation to all-cause mortality, by age group, Flanders

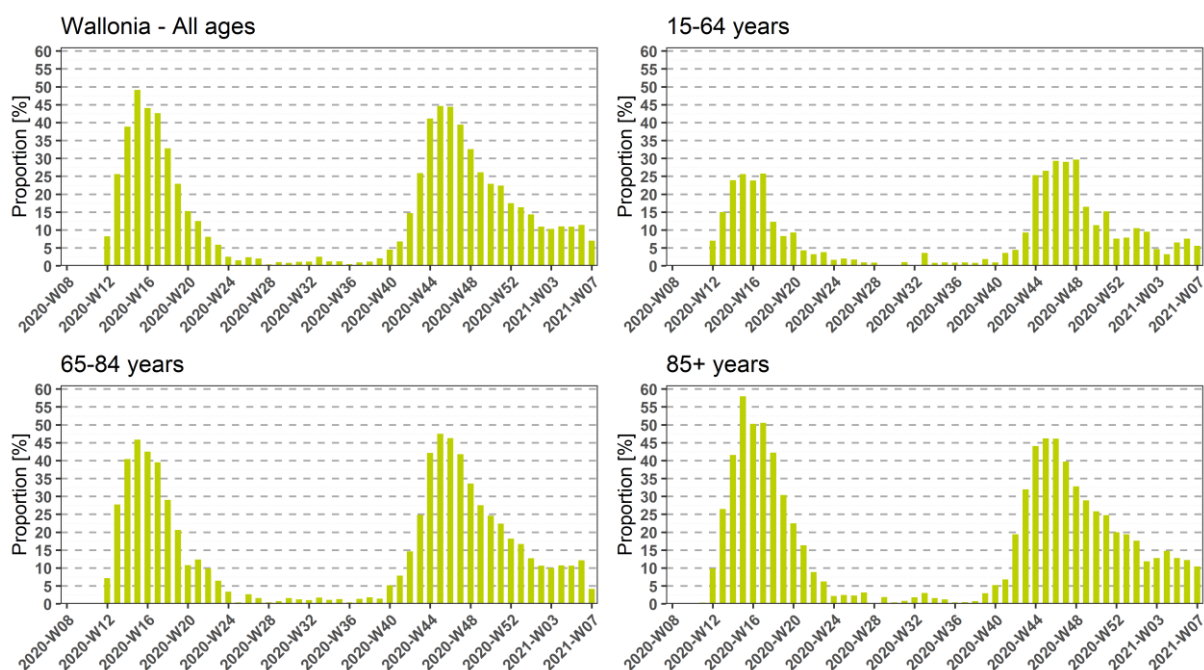


Figure 15. Weekly proportion of COVID-19 deaths in relation to all-cause mortality, by age group, Wallonia

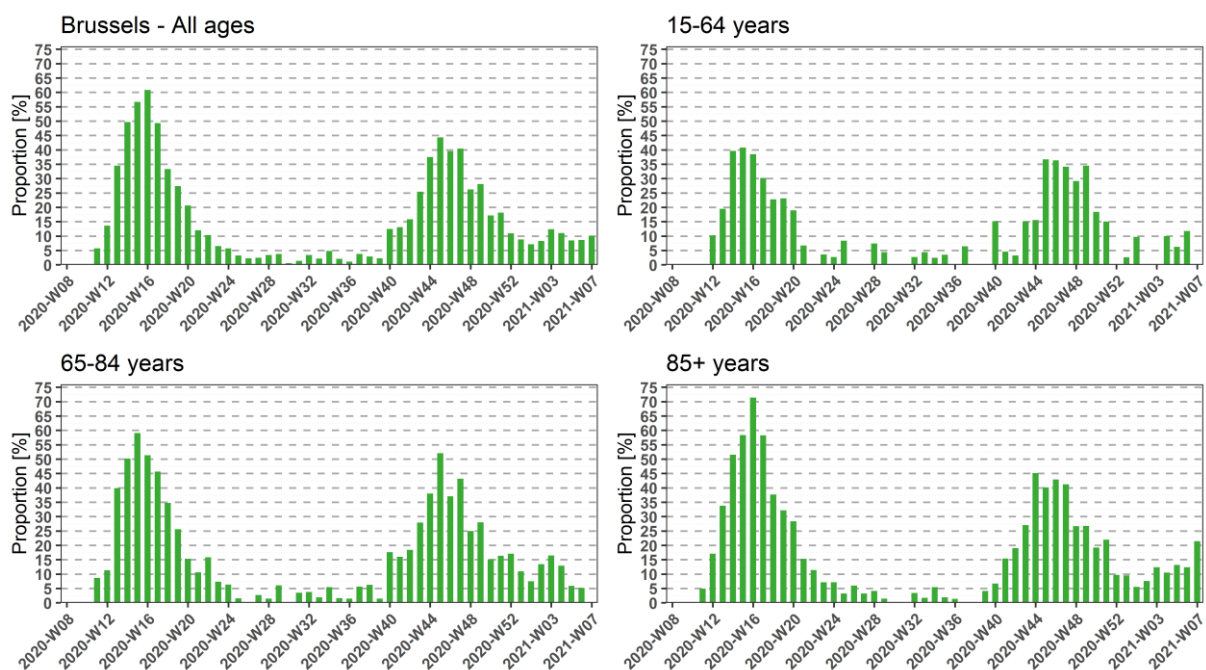


Figure 16. Weekly proportion of COVID-19 deaths in relation to all-cause mortality, by age group, Brussels

3. Excess mortality in the first wave, by region

3.1. IN FLANDERS

- During the period of statistically significant excess mortality (25 March – 28 April 2020), 3,531 deaths in excess were observed in Flanders, 57.3% of excess mortality and 3,575 persons died of COVID-19 during that period.
- During the week of the peak, excess mortality reached 78%.
- Week 15 corresponds to the peak of excess mortality in Flanders (361 deaths on 10 April) and COVID-19 mortality (155 deaths on 8 April).
- In the first four weeks of the rising excess mortality curve (weeks 12 to 15), 219 additional deaths cannot be attributed to COVID-19 or were missed by the surveillance.

Tabel 9 | Number of deaths from all causes from 25 March to 28 April 2020, Flanders

Group	Number of deaths observed	Number of deaths expected (Be-MOMO)	Number of death in excess*	Excess mortality (%)	Crude mortality rate (100 000 inhabitants)	Average number of deaths per day (standard deviation)
Total	9 692	6 161	3 531	57.3	146.2	277 (41)
85+ years	4 856	2 871	1 985	69.1	2 323.3	139 (25)
65-84 years	4 000	2 518	1 482	58.9	348.3	114 (18)
0-64 years	836	738	98	13.2	15.9	24 (6)
15-64 years	815	708	107	15.1	19.4	23 (5)
Male	4 665	3 022	1 644	54.4	142.2	133 (24)
85+ years	1 865	1 121	744	66.4	2 562.5	53 (12)
65-84 years	2 298	1 441	857	59.5	425.2	66 (13)
0-64 years	502	444	58	12.9	18.8	14 (4)
15-64 years	493	428	66	15.3	23.3	14 (4)
Female	5 027	3 131	1 896	60.6	150.1	144 (22)
85+ years	2 991	1 746	1 244	71.3	2 195.6	85 (17)
65-84 years	1 702	1 076	626	58.1	279.9	49 (9)
0-64 years	334	288	46	16.1	12.8	10 (3)
15-64 years	322	276	46	16.8	15.5	9 (3)

* As the number of additional deaths is calculated separately by age group and by region, it is normal to see a small difference between the total figures for Flanders and the sum of these figures by age group.

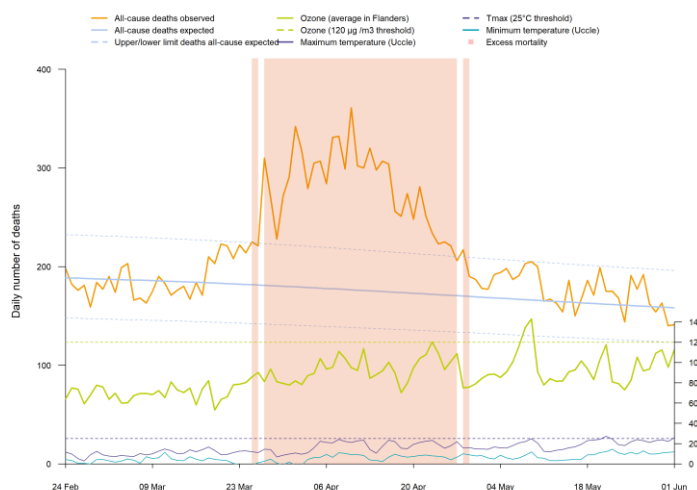


Figure 17. Excess mortality and ozone concentrations during wave 1, Flanders

3.2. IN WALLONIA

- During the period of statistically significant excess mortality (20 March – 28 April 2020), 2,921 deaths in excess were observed in Wallonia, 71.9% of excess mortality and 2,703 persons died of COVID-19 during that period.
- During the week of the peak, excess mortality reached 113%.
- Week 15 corresponds to the peak of excess mortality in Wallonia (242 deaths on 9 April) and COVID-19 mortality (131 deaths on 11 April).
- In the first four weeks of the rising excess mortality curve (weeks 12 to 15), 363 additional deaths cannot be attributed to COVID-19 or were missed by the surveillance.

Tabel 10 | Number of deaths from all causes from 20 March to 28 April 2020, Wallonia

Group	Number of deaths observed	Number of deaths expected (Be-MOMO)	Number of death in excess*	Excess mortality (%)	Crude mortality rate (100 000 inhabitants)	Average number of deaths per day (standard deviation)
Total	6 981	4 060	2 921	71.9	191.5	175 (33)
85+ years	3 178	1 670	1 508	90.3	3 193.5	79 (17)
65-84 years	2 958	1 728	1 230	71.1	503.2	74 (15)
0-64 years	845	651	194	29.8	28.6	21 (5)
15-64 years	834	636	198	31.0	35.7	21 (4)
Male	3 272	1 957	1 315	67.2	183.6	82 (17)
85+ years	1 090	558	532	95.3	3 546.3	27 (8)
65-84 years	1 628	970	658	67.9	615.6	41 (8)
0-64 years	554	410	144	35.0	37.3	14 (3)
15-64 years	546	402	144	35.7	46.7	14 (3)
Female	3 709	2 092	1 616	77.3	199.0	93 (19)
85+ years	2 088	1 093	995	91.0	3 035.8	52 (12)
65-84 years	1 330	751	579	77.2	411.3	33 (8)
0-64 years	291	231	60	25.8	19.8	7 (3)
15-64 years	288	225	63	28.1	24.7	7 (3)

* As the number of additional deaths is calculated separately by age group and by region, it is normal to see a small difference between the total figures for Wallonia and the sum of these figures by age group.

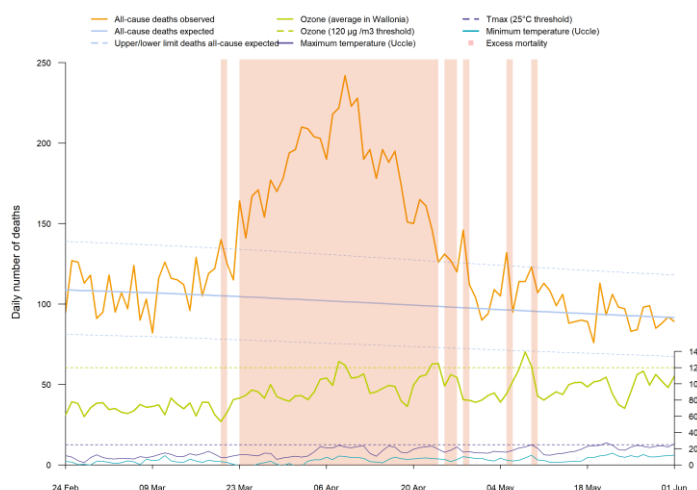


Figure 18. Excess mortality and ozone concentrations during wave 1, Wallonia

3.3. IN BRUSSELS

- During the period of statistically significant excess mortality (21 March – 30 April 2020), 1,322 deaths in excess were observed in Brussels, 116.9% of excess mortality and 1,189 persons died of COVID-19 during that period.
- During the week of the peak, excess mortality reached 190%.
- Week 15 corresponds to the peak of excess mortality in Brussels (91 deaths on 7 April) and week 14 to the peak of COVID-19 mortality (57 deaths on 4 April).
- In the first four weeks of the rising excess mortality curve (weeks 12 to 15), 194 additional deaths cannot be attributed to COVID-19 or were missed by the surveillance.

Tabel 11 | Number of deaths from all causes from 21 March to 30 April 2020, Brussels

Group	Number of deaths observed	Number of deaths expected (Be-MOMO)	Number of death in excess*	Excess mortality (%)	Crude mortality rate (100 000 inhabitants)	Average number of deaths per day (standard deviation)
Total	2 452	1 130	1 322	116.9	201.3	60 (16)
85+ years	1 122	452	670	148.1	4 215.8	27 (8)
65-84 years	1 040	448	592	132.1	782.1	25 (8)
0-64 years	290	207	83	40.0	27.4	7 (3)
15-64 years	279	190	89	46.5	34.0	7 (3)
Male	1 180	535	645	120.4	197.4	29 (9)
85+ years	392	158	234	147.6	4 887.2	10 (4)
65-84 years	602	240	362	151.3	1 052.2	15 (6)
0-64 years	186	123	63	50.7	34.9	5 (2)
15-64 years	181	113	68	60.6	44.0	4 (2)
Female	1 272	573	699	122.1	205.0	31 (9)
85+ years	730	285	445	156.5	3 926.2	18 (6)
65-84 years	438	196	242	123.2	578.1	11 (3)
0-64 years	104	81	23	28.9	19.8	3 (1)
15-64 years	98	74	24	32.8	23.9	2 (1)

* As the number of additional deaths is calculated separately by age group and by region, it is normal to see a small difference between the total figures for Brussels and the sum of these figures by age group.

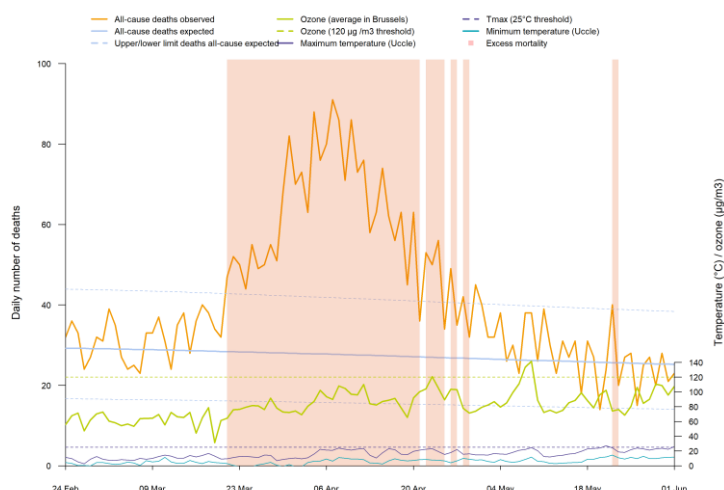


Figure 19. Excess mortality and ozone concentrations during wave 1, Brussels

4. Excess mortality in the second wave, by region

4.1. IN FLANDERS

- During the period of statistically significant excess mortality (24 October – 23 December 2020), 3,494 deaths in excess were observed in Flanders, 32.9% of excess mortality and 4,061 persons died of COVID-19 during that period.
- During the week of the peak, excess mortality reached 50.6%.
- Week 45 corresponds to the peak of excess mortality in Flanders (280 deaths on 7 November) and COVID-19 mortality (92 deaths on 8 November).
- In the first four weeks of the rising excess mortality curve (weeks 43 to 45), 5 additional deaths cannot be attributed to COVID-19 or were missed by the surveillance.

Tabel 12 | Number of deaths from all causes from 24 October to 23 December 2020, Flanders

Group	Number of deaths observed	Number of deaths expected (Be-MOMO)	Number of death in excess*	Excess mortality (%)	Crude mortality rate (100 000 inhabitants)	Average number of deaths per day (standard deviation)
Total	14 111	10 617	3 494	32.9	212.9	231 (20)
85+ years	6 903	5 000	1 903	38.1	3 302.7	113 (13)
65-84 years	5 742	4 309	1 433	33.3	499.9	94 (10)
0-64 years	1 466	1 250	216	17.3	27.8	24 (6)
15-64 years	1 427	1 201	226	18.8	34.0	23 (6)
Male	7 040	5 184	1 856	35.8	214.6	115 (11)
85+ years	2 784	1 951	833	42.7	3 825.2	46 (6)
65-84 years	3 321	2 476	845	34.1	614.6	54 (7)
0-64 years	935	738	197	26.8	35.1	15 (4)
15-64 years	914	708	206	29.1	43.2	15 (4)
Female	7 071	5 386	1 685	31.3	211.2	116 (14)
85+ years	4 119	3 039	1 080	35.5	3 023.6	68 (11)
65-84 years	2 421	1 819	602	33.1	398.1	40 (7)
0-64 years	531	489	42	8.5	20.4	9 (4)
15-64 years	513	469	44	9.4	24.7	8 (4)

* As the number of additional deaths is calculated separately by age group and by region, it is normal to see a small difference between the total figures for Flanders and the sum of these figures by age group.

4.2. IN WALLONIA

- During the period of statistically significant excess mortality (8 October – 12 December 2020), 4,136 deaths in excess were observed in Wallonia, 63.1% of excess mortality and 3,564 persons died of COVID-19 during that period.
- During the week of the peak, excess mortality reached 126.8%.
- Week 45 corresponds to the peak of excess mortality in Wallonia (242 deaths on 6 November) and COVID-19 mortality (115 deaths on 6 November).
- In the first four weeks of the rising excess mortality curve (weeks 43 to 45), 431 additional deaths cannot be attributed to COVID-19 or were missed by the surveillance.

Tabel 13 | Number of deaths from all causes from 8 October to 12 December 2020, Wallonia

Group	Number of deaths observed	Number of deaths expected (Be-MOMO)	Number of death in excess*	Excess mortality (%)	Crude mortality rate (100 000 inhabitants)	Average number of deaths per day (standard deviation)
Total	10 692	6 556	4 136	63.1	293.3	162 (38)
85+ years	4 512	2 745	1 767	64.4	4 533.9	68 (20)
65-84 years	4 790	2 726	2 064	75.7	814.9	73 (19)
0-64 years	1 390	1 056	334	31.6	47.0	21 (5)
15-64 years	1 367	1 032	336	32.5	58.5	21 (4)
Male	5 330	3 161	2 169	68.6	299.1	81 (21)
85+ years	1 679	946	733	77.5	5 462.6	25 (9)
65-84 years	2 761	1 528	1 233	80.7	1 044.1	42 (13)
0-64 years	890	660	230	34.9	59.9	13 (3)
15-64 years	878	647	231	35.6	75.1	13 (3)
Female	5 362	3 370	1 992	59.1	287.8	81 (20)
85+ years	2 833	1 766	1 067	60.4	4 118.9	43 (13)
65-84 years	2 029	1 186	844	71.2	627.4	31 (8)
0-64 years	500	377	123	32.7	34.0	8 (3)
15-64 years	489	366	123	33.6	41.9	7 (3)

* As the number of additional deaths is calculated separately by age group and by region, it is normal to see a small difference between the total figures for Flanders and the sum of these figures by age group.

4.3. IN BRUSSELS

- During the period of statistically significant excess mortality (22 October – 27 November 2020), 684 deaths in excess were observed in Brussels, 69.2% of excess mortality and 624 persons died of COVID-19 during that period.
- During the week of the peak, excess mortality reached 159.3%.
- Week 45 corresponds to the peak of excess mortality in Brussels (62 deaths on 9 and 10 November) and COVID-19 mortality (26 deaths on 5 November).
- In the first four weeks of the rising excess mortality curve (weeks 43 to 45), 52 additional deaths cannot be attributed to COVID-19 or were missed by the surveillance.

Tabel 14 | Number of deaths from all causes from 22 October to 27 November 2020, Brussels

Group	Number of deaths observed	Number of deaths expected (Be-MOMO)	Number of death in excess*	Excess mortality (%)	Crude mortality rate (100 000 inhabitants)	Average number of deaths per day (standard deviation)
Total	1 673	988	684	69.2	137.3	45 (8)
85+ years	704	406	298	73.6	2 645.2	19 (5)
65-84 years	711	390	321	82.2	534.7	19 (4)
0-64 years	258	177	81	45.4	24.4	7 (3)
15-64 years	244	162	82	50.4	29.7	7 (3)
Male	856	468	388	83.1	143.2	23 (4)
85+ years	269	139	130	93.4	3 353.7	7 (3)
65-84 years	412	210	202	95.9	720.1	11 (3)
0-64 years	175	109	66	60.8	32.9	5 (2)
15-64 years	169	99	70	70.2	41.1	5 (2)
Female	817	505	312	61.8	131.7	22 (6)
85+ years	435	259	176	68.2	2 339.6	12 (4)
65-84 years	299	169	130	77.0	394.6	8 (4)
0-64 years	83	67	16	24.6	15.8	2 (1)
15-64 years	75	59	16	27.8	18.3	2 (1)

* As the number of additional deaths is calculated separately by age group and by region, it is normal to see a small difference between the total figures for Flanders and the sum of these figures by age group.

5. Excess mortality by wave, by region

Tabel 15 | Comparison of excess mortality and COVID-19 deaths by age group between the 2 waves, Flanders

Period of excess mortality during the 2 waves	Number of weeks of excess mortality (period)	Number of additional deaths (per week)	Excess mortality	Number of COVID-19 deaths (per week)	Number of weeks of excess mortality (period)	Number of additional deaths (per week)	Excess mortality	Number of COVID-19 deaths (per week)
All ages				15-64 years				
Period 1	5 (weeks 13-17)	3 520 (704/week)	56.9%	3 517 (703/week)	2 (weeks 14-15)	108 (54/week)	15.2%	63 (31/week)
Period 2	8 (weeks 44-51)	3 282 (410/week)	33.7%	3 803 (475/week)	1 (week 46)	216 (216/week)	19.6%	27 (27/week)
65-84 years				85+ years				
Period 1	5 (weeks 13-17)	1 481 (296/week)	58.6%	1 394 (279/week)	4 (weeks 14-17)	1 976 (494/week)	68.5%	1 805 (451/week)
Period 2	5 (weeks 44-48)	1 338 (268/week)	33.9%	937 (187/week)	9 (weeks 44-52)	1 789 (199/week)	39.0%	2 463 (274/week)

Tabel 16 | Comparison of excess mortality and COVID-19 deaths by age group between the 2 waves, Wallonia

Period of excess mortality during the 2 waves	Number of weeks of excess mortality (period)	Number of additional deaths (per week)	Excess mortality	Number of COVID-19 deaths (per week)	Number of weeks of excess mortality (period)	Number of additional deaths (per week)	Excess mortality	Number of COVID-19 deaths (per week)
All ages				15-64 years				
Period 1	5 (weeks 13-17)	2 785 (557/week)	78.5%	2 570 (514/week)	2 (weeks 14-15)	197 (98/week)	35.5%	82 (41/week)
Period 2	10 (weeks 41-50)	4 164 (416/week)	60.0%	3 606 (361/week)	1 (week 46)	337 (337/week)	30.8%	43 (43/week)
65-84 years				85+ years				
Period 1	5 (weeks 13-17)	1 166 (233/week)	77.1%	1 060 (212/week)	5 (weeks 13-17)	1 436 (287/week)	98.4%	1 337 (267/week)
Period 2	10 (weeks 41-50)	2 093 (209/week)	72.5%	1 686 (169/week)	6 (weeks 43-48)	1 767 (294/week)	60.9%	1 366 (228/week)

Tabel 17 | Comparison of excess mortality and COVID-19 deaths by age group between the 2 waves, Brussels

Period of excess mortality during the 2 waves	Number of weeks of excess mortality (period)	Number of additional deaths (per week)	Excess mortality	Number of COVID-19 deaths (per week)	Number of weeks of excess mortality (period)	Number of additional deaths (per week)	Excess mortality	Number of COVID-19 deaths (per week)
Period 1	All ages			15-64 years				
	5 (weeks 13-17)	1 232 (246/week)	127.5%	1 123 (225/week)	1 (week 14)	72 (72/week)	44.3%	23 (23/week)
Period 2	6 (weeks 43-48)	719 (120/week)	64.1%	664 (111/week)	3 (weeks 46-48)	86 (29/week)	46.9%	45 (15/week)
Period 1	65-84 years			85+ years				
	6 (weeks 13-18)	548 (91/week)	143.1%	509 (85/week)	5 (weeks 13-17)	635 (127/week)	164.1%	574 (115/week)
Period 2	2 (weeks 44-45)	334 (67/week)	75.5%	141 (28/week)	2 (weeks 45-46)	315 (157/week)	68.5%	126 (63/week)

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We thank our families and friends for their support throughout this crisis and for allowing us to carry out our professional tasks.

We would also like to reflect on the fact that behind these epidemiological figures there are human beings. All scientists of the COVID-19 surveillance express their deepest sympathy to all families bereaved by the loss of a loved one due to this epidemic.

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