



## SCIENCE BRIEFS

# Excess Mortality in Ontario During the COVID-19 Pandemic

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## Key Message

Based on Ontario cremation data, there has been a 12.8% increase in the number of deaths during the [COVID-19 pandemic](#), compared to the expected numbers of deaths informed by previous years' cremation data. The causes of these excess deaths include infection with [SARS-CoV-2](#), as well as causes likely related to the pandemic but not due to COVID-19 itself.

## Background

Timely estimates of [excess mortality](#) are crucial for understanding the full impact of the COVID-19 pandemic on mortality. Increases in all-cause mortality have been reported by several countries during the COVID-19 period.<sup>1-6</sup> Excess all-cause mortality will include deaths that are the result of infection with SARS-CoV-2 (recognized and unrecognized), as well as deaths that have been indirectly influenced by the pandemic, including those caused by delayed or deferred access to medical care and by worsening mental health and substance use. The impact of COVID-19 on all-cause mortality in Ontario is not well understood, and this is partially due to a delay of several months in the reporting of mortality data for Ontario by Statistics Canada because of routine data verification processes needed for official Vital Statistics records.<sup>7</sup>

Most cremations occur within three weeks of death; therefore, cremation data is a robust method of reporting mortality data that anticipates Statistics Canada mortality data by approximately five months.

In other countries, cremation data has been used to quantify mortality trends during the COVID-19 pandemic.<sup>8</sup> In Ontario, a coroner is required to certify the cremation record before cremation can occur.<sup>9</sup> Since 2017, this process has been digital, resulting in an electronic cremation record database. 70% of Ontarians are cremated, and 99% of those cremations occur within 3-weeks of their date of death. As such, cremation records provide a timely and robust source of provincial all-cause mortality data in the interim period before official Vital Statistics records are available.<sup>10</sup> This analysis uses Ontario's cremation data to estimate excess provincial mortality and to determine how much of the excess mortality is due to infection with SARS-CoV-2.

## Questions

Has there been excess mortality in Ontario during the COVID-19 pandemic period, from March 2020 to April 2021, as compared to pre-COVID-19 years?

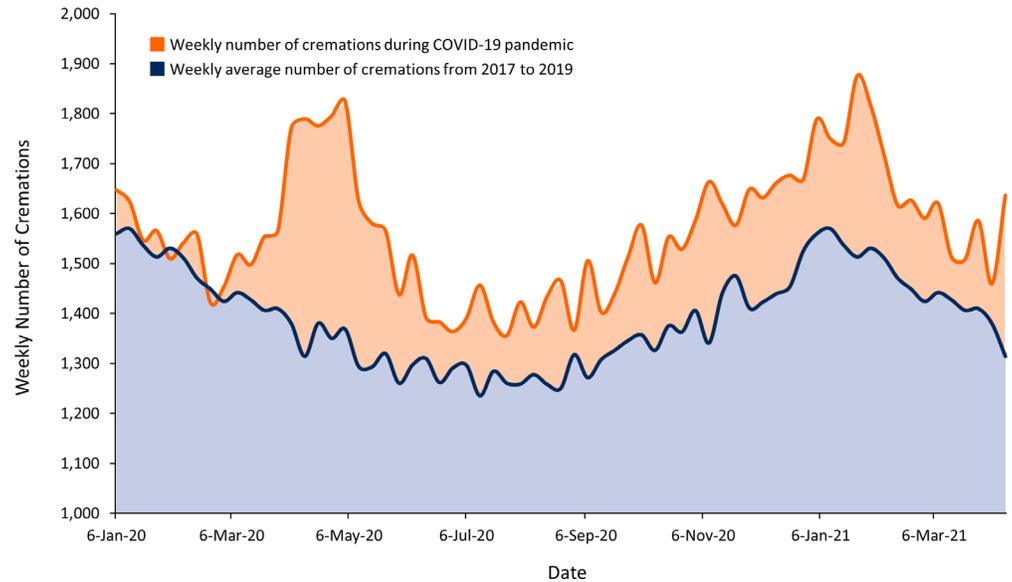
Is excess mortality observed in all age groups across Ontario?

How proportion of the excess mortality observed in Ontario during the COVID-19 pandemic is due to confirmed cases of COVID-19?

# Findings

## Excess Mortality During the COVID-19 Pandemic Period is Evident in Ontario Cremation Records

Ontario cremation records demonstrate that there was an increase in mortality in 2020, with an overall 12.8% increase in the number of cremations per week compared to baseline data (the average annual cremations seen in 2017, 2018, 2019 cremation data). The greatest increases in excess mortality were seen in April 2020 (+32.2%), May 2020 (+19.9%), and January 2021 (+17.0%). These months correspond to the peaks of the first and second waves of COVID-19 in Ontario (Figure 1).



**Figure 1. Weekly Number of Cremations in Ontario**  
 The number of weekly cremations from January 1, 2019 to April 13, 2021 as compared with the average number of weekly cremations from years 2017 to 2019. All trends were smoothed using the Statsmodel Holt’s package; the default additive model was changed to an exponential model with a fixed smoothing slope ( $\beta = 0.2$ ) and smoothing level ( $\alpha = 0.6$ ). Data sourced from Ontario’s electronic cremation certificates.

## Cremation Records Show Excess Mortality in All Age Groups

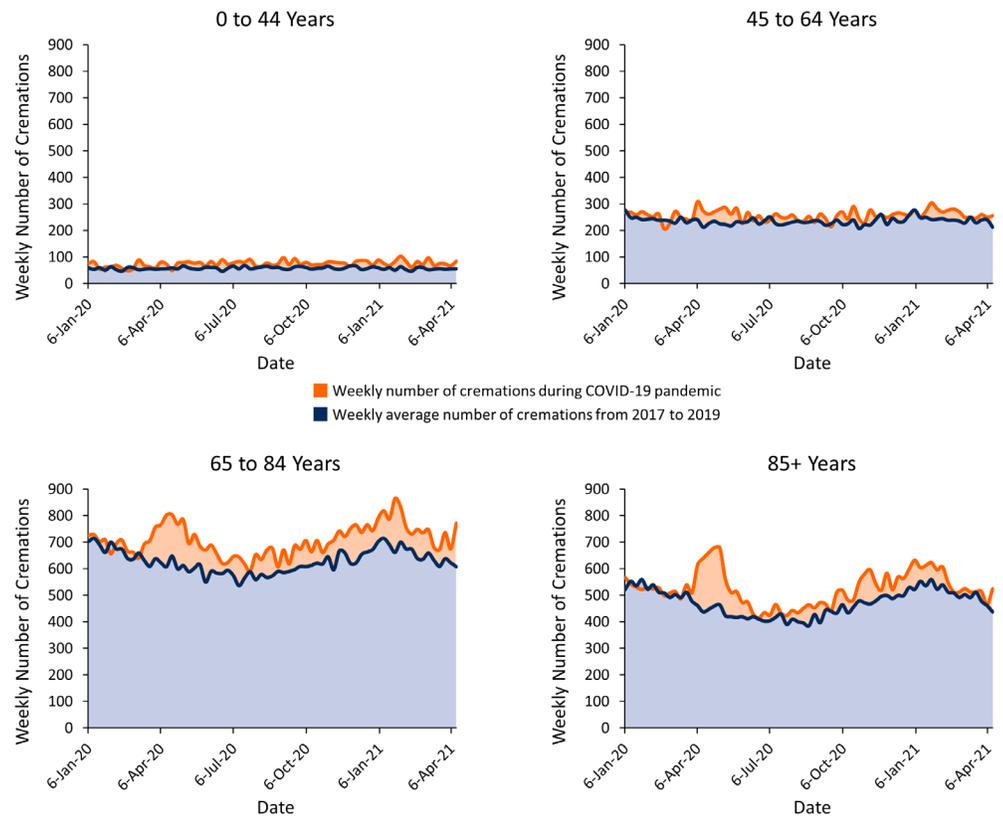
In 2020, excess mortality was observed among all age groups (Table 1, Figure 2). The majority of these excess deaths (78.2%) were among those aged 65 years and older. The largest increase in the number of cremations in 2020 compared to the average number of cremations in 2017-2019 was observed among the youngest age group, with an additional 848 cremations, representing a 27.8% increase.

Age group of decedent	2020 Cremations				2021 Cremations (January-March)			
	Expected number of cremations (average observed 2017-2019)	Total cremations	Excess mortality	Percent increase (%)	Expected number of cremations (average observed Jan-Mar 2017-2019)	Total cremations	Excess mortality	Percent increase (%)
0-44 years	3,056	3,904	848	27.8	713	1,028	315	44.2
45-64 years	12,230	13,365	1,135	9.3	3,130	3,440	310	9.9
65-84 years	32,309	36,393	4,084	12.6	8,527	9,763	1,236	14.5
85+ years	24,030	27,067	3,037	12.6	6,672	7,148	476	7.1

**Table 1. Observed Number of Cremations, by Age Group, in 2020 and from January to March 2021, Compared to Pre-Pandemic Averages in 2017-2019**

For the months spanning January to March 2021, excess mortality was again observed in all age groups (Table 1, Figure 2). The majority of the excess mortality (52.8%) was observed among those aged 65-84 years old. The largest relative increase in

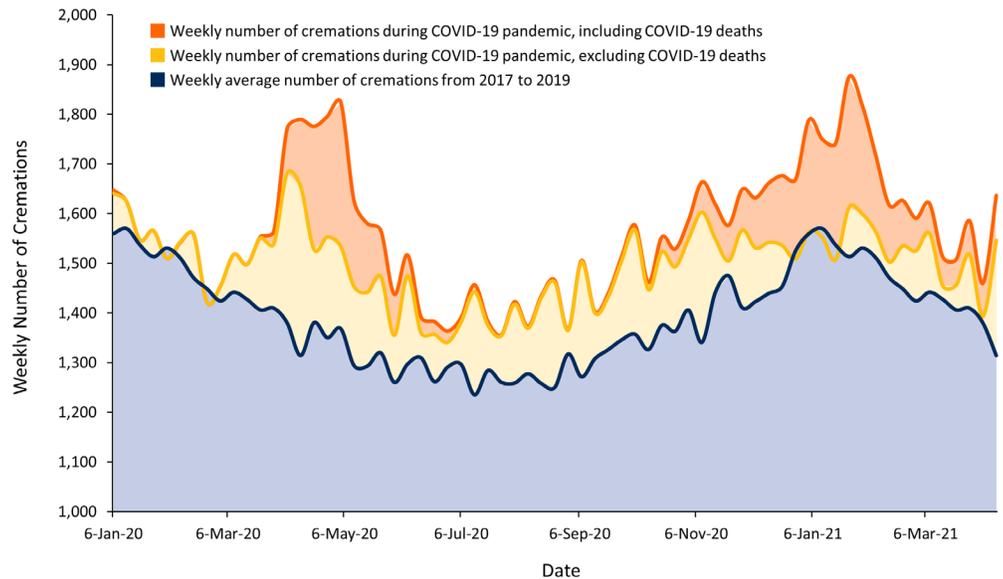
the number of cremations was again observed in the youngest age group, with a 44.2% increase in the number of cremations observed from January to March, 2021, compared to the same period in 2017-2019.



**Figure 2. Weekly Number of Cremations in Ontario by Age Group Prior to and During the COVID-19 Pandemic**  
*The number of weekly cremations from January 1, 2020 to April 13, 2021, as compared to the average number of weekly cremations from the years 2017 to 2019 in Ontario, by age group. All trends were smoothed using the Statsmodel Holt's package; the default additive model was changed to an exponential model with a fixed smoothing slope ( $\beta = 0.2$ ) and smoothing level ( $\alpha = 0.6$ ). Data sourced from Ontario's electronic cremation certificates.*

### Confirmed Deaths Due to COVID-19 Cannot Explain All of the Excess Mortality

Deaths due to infection with SARS-CoV-2, as reported in cremation records, did not account for all of the observed excess mortality (Figure 3). During the first wave, from March to May 2020, confirmed COVID-19 deaths accounted for 43.5% of the 3,505 excess deaths in the cremation records. Some of the non-COVID-19 excess deaths in the first wave may be due to underreporting of confirmed COVID-19 cases, as testing was not readily available, and cases of COVID-19 may have been missed. However, during the early part of the second wave, from August to December 2020, when testing was more readily available, confirmed COVID-19 deaths accounted for 29% of the 3,812 excess deaths in the cremation records. Most recently, from January to March 2021, confirmed COVID-19 deaths accounted for 73.1% of the 2,337 excess deaths in the cremation records, with 26.9% of excess deaths attributable to other causes.



**Figure 3. Weekly Number of Cremations in Ontario, With and Without Confirmed COVID-19 Deaths**

Weekly number of cremations from January 1, 2020 to April 13, 2021, including and excluding COVID-19 deaths, as compared with the average number of weekly cremations from 2017 to 2019. All trends were smoothed using an exponential model with a fixed smoothing slope ( $\beta = 0.2$ ) and smoothing level ( $\alpha = 0.6$ ). Data sourced from Ontario's electronic cremation certificates.

## Interpretation

Ontario cremation records demonstrate that there has been excess mortality in Ontario during the COVID-19 pandemic and that the excess mortality is due to COVID-19 as well as non-COVID-19 causes. The large initial increase in mortality due to non-COVID-19 causes during the first wave of the pandemic, from March to May 2020, suggests that COVID-19 was underdiagnosed as a cause of death early in the pandemic in Ontario (Figure 3). The subsequent increase in mortality due to non-COVID-19 causes could reflect the impact of delays in care for conditions other than COVID-19, including cancer and cardiovascular care, in addition to other indirect effects of the pandemic, such as the increase in opioid-related deaths.<sup>11,12</sup> Preliminary findings suggest that the largest absolute increase in opioid-related mortality has occurred among those aged 25 to 44 years.<sup>11</sup>

These findings are in line with the excess mortality observed in other jurisdictions during the COVID-19 pandemic period.<sup>2-6</sup> Some potential causes of excess mortality that are not directly related to infection with SARS-CoV-2 include hesitancy to seek healthcare services, delays in access to healthcare, and mental health issues secondary to social isolation.<sup>5,6,13,14</sup> Several studies have shown a significant decline in the number of patients seeking emergency care for cardiac events during the pandemic, citing hesitancy or fear as the main cause.<sup>15-17</sup> This trend is supported by data showing that Canadian emergency department volumes dropped by 50% during March and April, 2020.<sup>18</sup> Some of the excess mortality may also be a result of delayed or deferred surgical procedures.<sup>19,20</sup> Further, deaths due to acute drug toxicity, suicides, and violence secondary to the economic and social disruption of the pandemic have also been suggested as contributors to the increase in non-COVID-19 deaths.<sup>21</sup>

## Methods Used for This Science Brief

Cremation records from 2020 and 2021 were compared to historical records from 2017 to 2019, grouped according to month and age. Excess mortality was defined and calculated as the number of cremations in 2020 and 2021 for a given month and age group that were greater than the expected number of cremations based on the

observed average mortality for this month and age group between 2017 and 2019.

Deaths due to COVID-19 were isolated from the cremation records by the presence of the terms “COVID” or “novel coronavirus” in the cause of death, antecedent cause, or other cause of death categories. These were the only terms found to describe COVID-19 deaths in the cremation records. Records that matched the above criteria, but also contained the phrases “test-results pending,” “possible,” “not,” “non,” or “negative,” were excluded from the classification of death due to COVID-19.

Cremation data from 2020 was compared to 2020 mortality data from Statistics Canada (released April 2021) to determine whether the percent of Ontarians who were cremated changed during the COVID-19 pandemic. This comparison showed that, throughout the pandemic, there had been no change, in the percent of Ontarians who were cremated among all age groups.

All analyses were done using Python version 3.8.

## Author Contributions

RM and LR conceived the Science Brief. GP conducted all analyses and wrote the first draft of the Science Brief. All authors revised the Science Brief critically for important intellectual content and approved the final version.

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