

Opioid-related deaths between 2019 and 2021 across 9 Canadian provinces and territories

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Abstract

Background: The drug toxicity crisis continues to accelerate across Canada, with rapid increases in opioid-related harms following the onset of the COVID-19 pandemic. We sought to describe trends in the burden of opioid-related deaths across Canada throughout the pandemic, comparing these trends by province or territory, age, and sex.

Methods: We conducted a repeated cross-sectional analysis of accidental opioid-related deaths between Jan. 1, 2019, and Dec. 31, 2021, across 9 Canadian provinces and territories using aggregated national data. Our primary measure was the burden of premature

opioid-related death, measured by potential years of life lost. Our secondary measure was the proportion of all deaths attributable to opioids; we used the Cochrane–Armitage test for trend to compare proportions.

Results: Between 2019 and 2021, the annual number of opioid-related deaths increased from 3007 to 6222 and years of life lost increased from 126 115 to 256 336 (from 3.5 to 7.0 yr of life lost per 1000 population). In 2021, the highest number of years of life lost was among males (181 525 yr) and people aged 30–39 years (87 045 yr). In 2019, we found that 1.7% of all deaths among

those younger than 85 years were related to opioids, rising to 3.2% in 2021. Significant increases in the proportion of deaths related to opioids were observed across all age groups ($p < 0.001$), representing 29.3% and 29.0% of deaths among people aged 20–29 and 30–39 years in 2021, respectively.

Interpretation: Across Canada, the burden of premature opioid-related deaths doubled between 2019 and 2021, representing more than one-quarter of deaths among younger adults. The disproportionate loss of life in this demographic group highlights the critical need for targeted prevention efforts.

In Canada, the COVID-19 pandemic occurred in the midst of a growing drug toxicity crisis. Before the emergence of COVID-19, the number of accidental opioid-related deaths across Canada rose from 2470 in 2016 to 3447 in 2019.¹ This was accompanied by rising opioid-related hospital admissions¹ and growing infectious complications associated with substance use.² Although both prescription and unregulated opioids contribute to toxicity deaths,³ the relative contribution of these substances has changed considerably over time, with fentanyl from the unregulated drug supply involved in more than 80% of opioid-related deaths in recent years (2020 to early 2023).¹ In 2021, almost 37 million people lived in Canada across 13 provinces and territories, with almost 40% residing in the province of Ontario,⁴ where the first 6 months of the pandemic saw an estimated 17 843 additional years of life lost (YLL) from opioid-related premature death.⁵

The observed acceleration in opioid-related harm across Canada has been attributed in part to public health measures implemented to curb the spread of SARS-CoV-2, including reduced access to harm reduction programs and border restrictions that may have

increased the toxicity of the drug supply.^{6–8} In addition, for many, the pandemic exacerbated feelings of anxiety, uncertainty, and loneliness, contributing to increased substance use globally.^{9–12} The intersection of the COVID-19 pandemic with the drug toxicity crisis in Canada has created an urgent need to better understand the patterns of opioid-related deaths across the country to inform targeted public health responses. Therefore, we sought to describe trends in premature opioid-related deaths between 2019 and 2021 across 9 Canadian provinces and territories.

Methods

Study design and setting

We conducted a repeated cross-sectional analysis of all opioid-related deaths in 9 Canadian provinces and territories, with data collected at annual intervals between Jan. 1, 2019, and Dec. 31, 2021.¹³ We reported this study using the Reporting of Studies Conducted using Observational Routinely-Collected Data (RECORD) checklist.¹⁴

Data sources

We used publicly available, aggregate data from the Public Health Agency of Canada summarizing the annual counts of all accidental opioid-related deaths for each province and territory in Canada.¹ These data capture all opioid-related deaths with completed and ongoing investigations (in all regions except for Saskatchewan, which includes only completed investigations) in which the coroner or medical examiner determined that an opioid directly contributed to an unintentional death. We included all provinces and territories for which age- and sex-stratified data were available at the time of the study; these were British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick, Nova Scotia, and the Northwest Territories, representing 98.0% of Canada's population.¹⁵ Additional information on the reporting of available data by province and territory can be found in Appendix 1, eTable 1, available at www.cmaj.ca/lookup/doi/10.1503/cmaj.231339/tab-related-content. Stratified data from Prince Edward Island, Nunavut, Newfoundland and Labrador, and the Yukon in all years were unavailable because of institutional privacy requirements requiring data suppression for cell sizes less than 5. We identified the annual population size of each province and territory and the national number of all-cause deaths by age and sex using deidentified, aggregated, publicly available data from Statistics Canada.^{15,16} We used the 2019–2021 Statistics Canada single-year life table estimates for males and females to calculate the average life expectancy within each age group for each year of the study period.¹⁷

Statistical analysis

Our primary study measures were annual counts and crude rates of opioid-related deaths and the burden of premature accidental opioid-related deaths, quantified by calculating the YLL using methods adapted from the Global Burden of Disease Study¹⁸ and stratified by sex and prespecified age groups (0–19 yr, 20–29 yr, 30–39 yr, 40–49 yr, 50–59 yr, 60–84 yr). We calculated the YLL separately within each stratum of sex by age group by multiplying the number of opioid-related deaths by the average remaining life expectancy at the midpoint of each age group. Given the aggregated nature of the data, we were unable to calculate the average age at death or adjust for comorbidities. We also applied an upper age limit of 84 years, as previous research showed that the absolute number and proportion of opioid-related deaths among people aged 85 years and older is small.^{19,20} We did not apply age-related weighting or discounting to the life expectancy estimates in our calculations, as recommended by the World Health Organization.¹⁸ We used the population of each province and territory to calculate crude rates of opioid-related deaths per million population and the YLL per 1000 population, and reported all metrics overall and stratified by each region.

Our secondary measure was the proportion of all-cause deaths in each age group attributable to opioids, using national and provincial age-stratified counts of opioid-related deaths with all-cause deaths as the denominator. Within each age group, we used the Cochrane–Armitage test for trend with Monte-Carlo estimates to assess whether the proportion of deaths attributable to opioids increased significantly between 2019 and 2021.

In a post hoc analysis, we conducted a time-series analysis using an interventional autoregressive integrated moving average (ARIMA) model to examine the impact of the declaration of the COVID-19 state of emergency in the first quarter of 2020 on rates of overall opioid-related deaths (per 100 000 population) between Jan. 1, 2016, and Dec. 31, 2022. We extended our study period to allow for sufficient data points to conduct the analysis. We modelled the onset of the COVID-19 pandemic using a ramp transfer function, given its anticipated gradual impact on rates of opioid-related deaths, after differencing the series to achieve stationarity, as confirmed with the Dickey–Fuller test. We explored seasonality and used model diagnostics to select the final, optimal model using the Ljung–Box χ^2 test for white noise to ensure no significant autocorrelation in model residuals was present.

We conducted all analyses using Microsoft Excel (2022) and SAS version 9.4 (SAS institute).

Sensitivity analyses

We conducted 2 sensitivity analyses to assess the robustness of our results. First, because the average age at death was not available within each age group, we repeated our overall YLL calculations using the average age at death for all accidental opioid-related deaths in each age group in the United States (Appendix 1, eTable 2). These data are reported publicly from the US Centers for Disease Control and Prevention WONDER Multiple Cause of Death Database, which includes national data on all-cause deaths from information captured on completed death certificates.²¹ Second, at the time of our analysis, a large number of deaths in BC ($n = 2346$) were under investigation by the coroner and as such were not included in the age-stratified counts of opioid-related deaths, following BC reporting requirements. To investigate whether these missing deaths influenced our overall results, we reassessed the primary and secondary measures excluding all data from BC.

Ethics approval

Given the aggregated nature of the data used, this study received a research ethics board exemption from the Unity Health Toronto Research Ethics Board.

Results

Between Jan. 1, 2019, and Dec. 31, 2021, the number of accidental opioid-related deaths increased 107%, from 3007 to 6222 deaths per year, across the 9 Canadian provinces and territories included in our analysis (Table 1). Overall, the annual YLL from opioid-related deaths doubled over the study period, rising from 126 115 (3.5 YLL per 1000) in 2019 to 256 336 (7.0 YLL per 1000) in 2021 (Figure 1). In 2021, the highest burden of deaths was observed among males (181 525 YLL, 9.9 YLL per 1000) and young adults aged 20–29 years (64 127 YLL, 12.8 YLL per 1000) and 30–39 years (87 045 YLL, 16.5 YLL per 1000). Each year, more than 70% of all opioid-related deaths occurred among males (73.9% in 2021) and around 25% of deaths occurred among people between the ages of 30 and 39 years (29.5% in 2021). The YLL in each province and territory, stratified by age, sex, and year, can be found in Appendix 1, eTable 3. The annual increases by age and

Table 1: Years of life lost (YLLs) from accidental opioid-related deaths across 9 Canadian provinces and territories between 2019 and 2021

Group	2019				2020				2021			
	Opioid-related deaths	Deaths per million	YLLs	YLLs per 1000	Opioid-related deaths	Deaths per million	YLLs	YLLs per 1000	Opioid-related deaths	Deaths per million	YLLs	YLLs per 1000
Overall*	3007	83.6	126 115	3.5	5522	151.7	226 106	6.2	6222	170.0	256 336	7.0
Age group, yr												
0–19	53	6.7	3861	0.5	94	11.8	6752	0.8	96	12.1	6896	0.9
20–29	600	119.9	34 520	6.9	1020	202.7	58 045	11.5	1123	224.9	64 127	12.8
30–39	859	168.8	41 250	8.1	1535	295.2	72 747	14.0	1834	348.3	87 045	16.5
40–49	624	132.3	24 028	5.1	1278	268.7	48 670	10.2	1431	298.5	54 420	11.4
50–59	630	122.7	18 669	3.6	1130	222.4	32 706	6.4	1252	249.7	36 323	7.2
60–84	241	29.8	3786	0.5	465	55.7	7185	0.9	486	56.4	7525	0.9
Sex												
Female	830	46.1	36 696	2.0	1310	72.0	58 140	3.2	1626	88.8	74 811	4.1
Male	2177	121.1	89 419	5.0	4212	231.5	167 966	9.2	4596	251.2	181 525	9.9
Province or territory												
British Columbia†	568	114.1	23 699	4.8	1217	241.8	48 049	9.5	863	169.9	33 335	6.6
Alberta	619	144.2	26 980	6.3	1167	268.6	48 662	11.2	1618	370.2	68 336	15.6
Saskatchewan	109	95.2	4497	3.9	254	220.7	10 721	9.3	322	279.0	13 453	11.7
Manitoba	54	40.3	2434	1.8	248	183.7	10 634	7.9	263	193.0	11 543	8.5
Ontario	1432	100.7	60 001	4.2	2327	161.7	95 835	6.7	2716	187.8	111 633	7.7
Quebec	161	19.4	5938	0.7	229	27.4	8953	1.1	369	44.0	15 078	1.8
New Brunswick	27	35.6	985	1.3	38	49.7	1385	1.8	39	50.6	1541	2.0
Nova Scotia	37	39.0	1581	1.7	39	40.7	1718	1.8	30	31.0	1324	1.4
Northwest Territories	0	0	0	0	3	66.5	149	3.3	2	44.1	93	2.0

*Based on 9 Canadian provinces or territories with available data stratified by age and sex.

†Includes only opioid-related deaths with completed investigations by the coroner; trends should be interpreted with caution as a substantial number of opioid-related deaths from 2019 to 2021 in British Columbia were still under investigation at the time of analysis.

sex in each province and territory were generally consistent with our overall analysis. However, the observed changes in YLL over time varied geographically, ranging from a 4.7-fold increase in Manitoba (2434 YLL in 2019 to 11 543 YLL in 2021) to a 0.8-fold decrease in Nova Scotia (1581 YLL in 2019 to 1324 YLL in 2021). In 2021, the rate of YLL ranged from a low of 1.4 per 1000 in Nova Scotia to a high of 15.6 per 1000 in Alberta; the absolute number of YLL ranged from 93 in the Northwest Territories to 111 633 in Ontario.

Proportion of all-cause deaths attributable to opioids

Between 2019 and 2021, the average percentage of all deaths attributed to opioids increased across all age groups (Figure 2). In 2019, 3007 (1.7%) of 173 720 deaths among people younger than 85 years were related to opioids, increasing to 6222 (3.2%) of 195 156 deaths

in 2021 ($p < 0.001$). The largest relative increase between 2019 and 2021 was among people aged 30–39 years (50.3% increase, from 19.3% to 29.0% of deaths), followed by those aged 20–29 years (48.0% increase, from 19.8% to 29.3%). Results from the Cochrane–Armitage test for trend showed that this increase was significant overall and across all age groups in Canada ($p < 0.001$). Although the percentage of deaths attributable to opioids varied geographically, in general, this proportion was highest among people aged 20–39 years in each province and territory (Figure 3 and Appendix 1, eTable 4).

Time-series analysis

Between the first quarter of 2016 and the last quarter of 2022, the quarterly rate of opioid-related deaths increased 187.5%, from 1.6 to 4.6 per 100 000 population (Figure 4). After the declaration

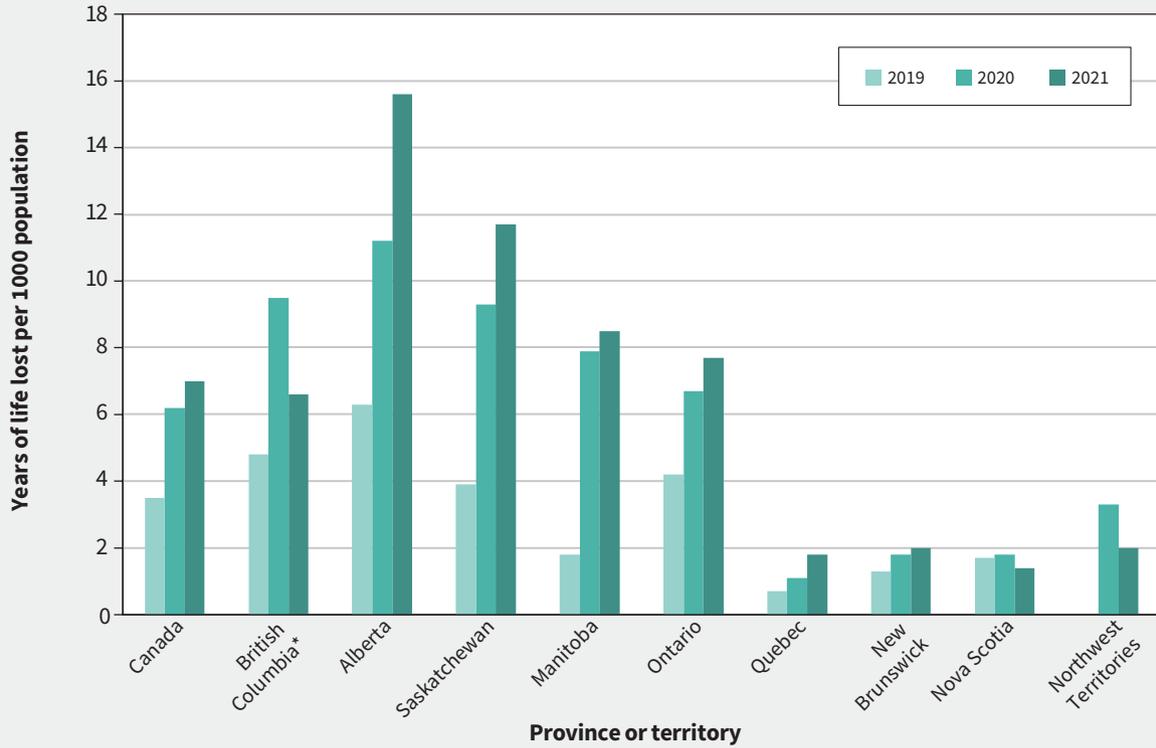


Figure 1: Years of life lost per 1000 population across 9 Canadian provinces and territories from 2019 to 2021. *Includes only opioid-related deaths with completed investigations by the coroner; trends should be interpreted with caution as a substantial number of opioid-related deaths in British Columbia were still under investigation at the time of analysis.

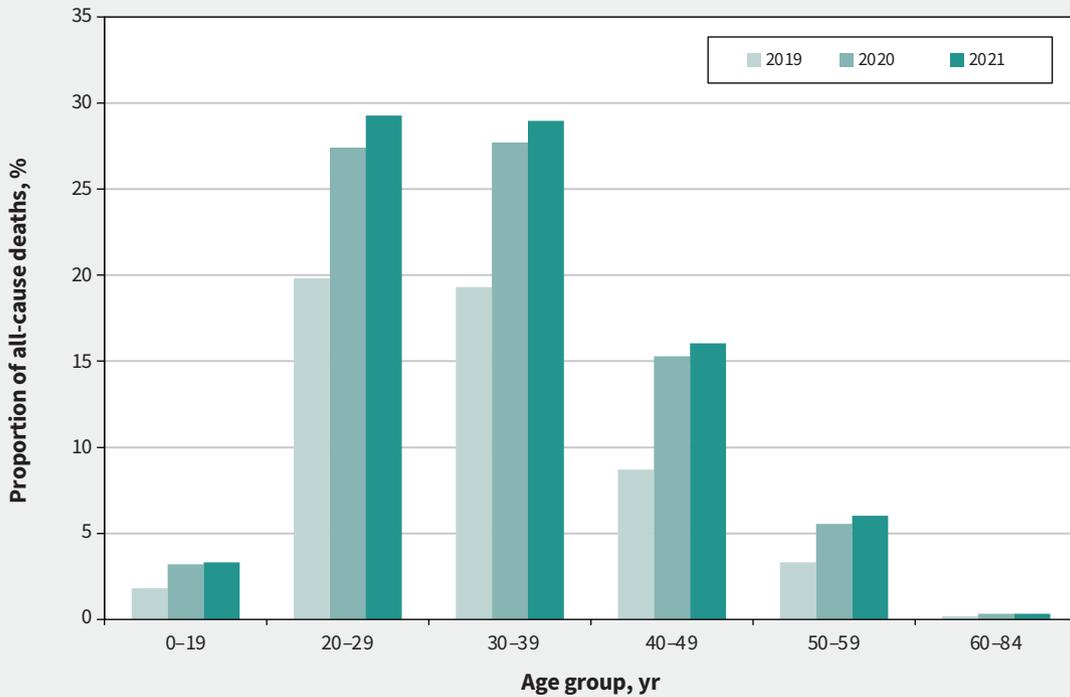


Figure 2: Proportion of all-cause deaths attributable to opioids across 9 Canadian provinces and territories, by year and age group, from 2019 to 2021.

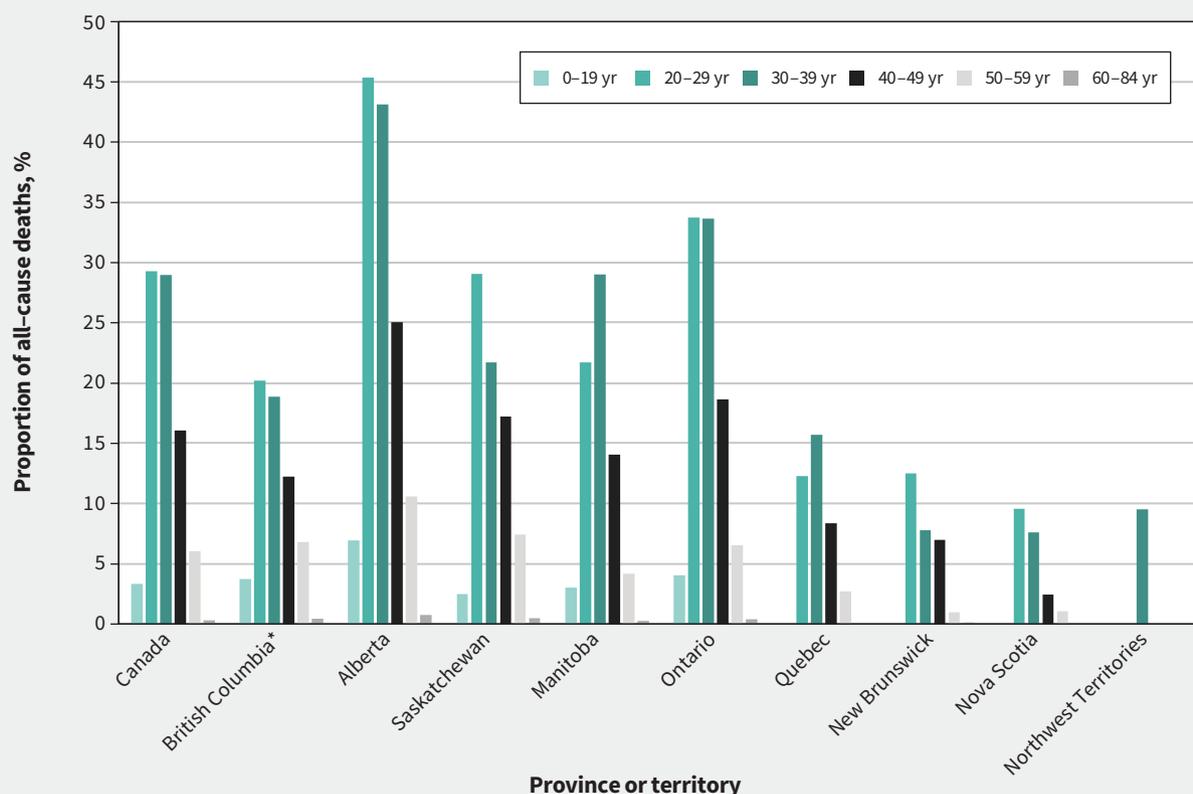


Figure 3: Proportion of all-cause deaths attributable to opioids in 2021, by age and province or territory.*Includes only opioid-related deaths with completed investigations by the coroner; trends should be interpreted with caution as a substantial number of opioid-related deaths in 2021 in British Columbia ($n = 1398$) were still under investigation at the time of analysis.

of a pandemic-related state of emergency in the first quarter of 2020, we observed a significant ramp increase of 0.27 (95% confidence interval 0.05–0.48) per 100 000 population quarterly in the overall rate of opioid-related deaths ($p = 0.02$).

Sensitivity analyses

In our first sensitivity analysis, using the US average age at time of opioid-related death, results were consistent with our primary analysis (< 1.0% change in YLL each year) (Appendix 1, eTable 5). This provides reassurance that using the midpoint for each age group to adjust for age at death did not meaningfully affect our results. In our second sensitivity analysis, excluding all data from BC, the overall YLL observed in 2021 decreased by 13.5%; however, the YLL rate per 1000 population remained the same as in our primary analysis (7.0 per 1000 population across Canada in 2021) (Appendix 1, eTable 6). Further, the percentage of deaths attributed to opioids across age groups remained fairly consistent with those in our primary analysis (Appendix 1, eTable 7).

Interpretation

We found significant increases in the burden of opioid-related deaths between Jan. 1, 2019, and Dec. 31, 2021, with more than

250 000 years of life lost in 2021 alone, representing 1 in every 31 deaths among people younger than 85 years. Furthermore, the COVID-19 pandemic-related state of emergency was associated with a significant increase in the rate of opioid-related deaths. The increases in opioid-related deaths observed between 2019 and 2020 varied considerably by province and territory, rising 359.3% and 133.0% in Manitoba and Saskatchewan, respectively. This may reflect a more recent shift to fentanyl-related deaths in these provinces, as COVID-19 may have resulted in a more volatile unregulated drug supply.^{6,8} This aligns with data from Saskatchewan, where the number of drug toxicity deaths involving fentanyl increased 281.4% between 2019 and 2020.²² Similarly, in Manitoba, 70% of opioid toxicity deaths in 2019 had fentanyl or fentanyl analogues detected, increasing to 86% in 2020.¹ In BC, 86% of all deaths in BC related to unregulated drugs had fentanyl detected in 2018.²³ In contrast, a study conducted in Australia observed a 24% decrease in fentanyl-related deaths each year between 2015 and 2020.²⁴ The increased detection of fentanyl in opioid-related deaths in Canada highlights the need for expansion of harm-reduction programs, including improved access to drug-checking services, supervised consumption sites, and treatment for substance use disorders. Given the rapidly evolving nature of the drug toxicity crisis, a public safety response is urgently required and may include continued funding of

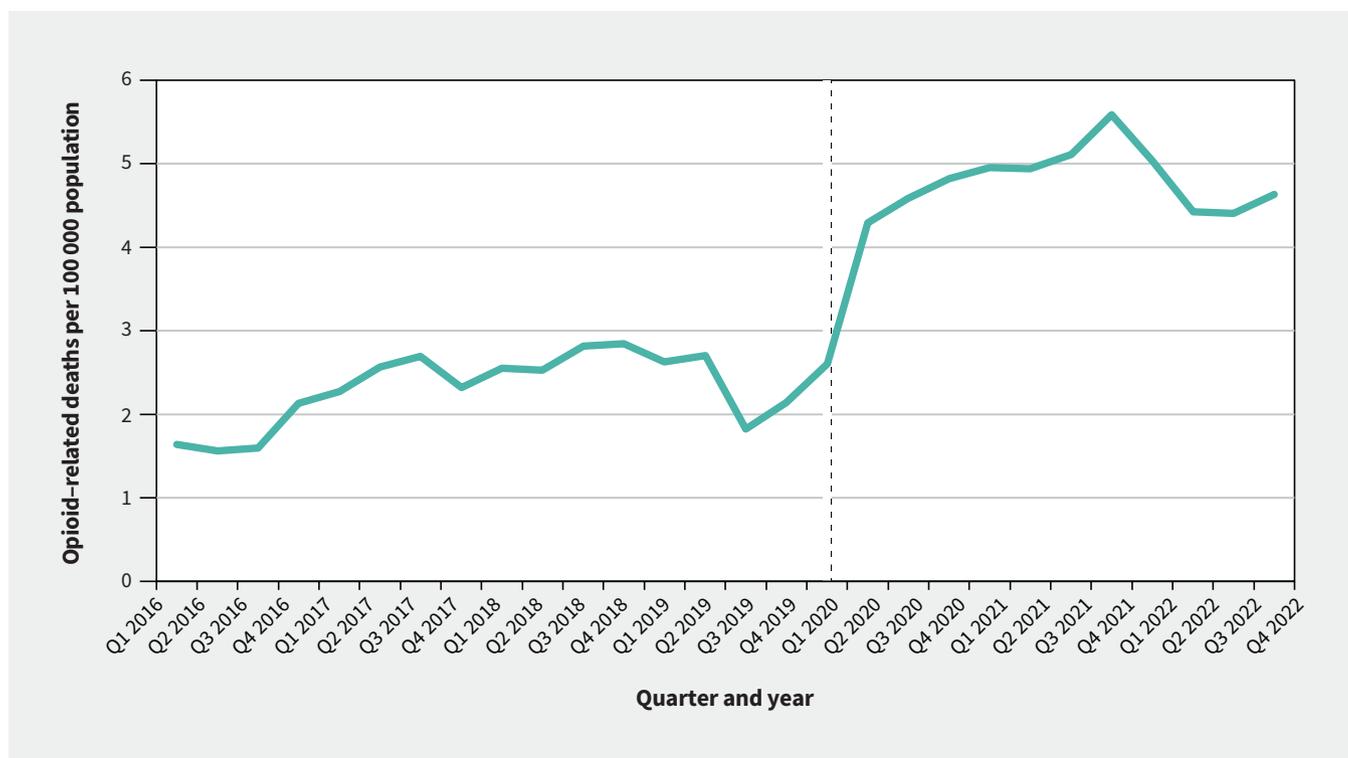


Figure 4: Quarterly rate of opioid-related deaths in 9 Canadian provinces and territories, 2016–2022.*Vertical bar represents the declaration of a pandemic-related state of emergency for COVID-19. Note: Includes opioid-related deaths with both completed and ongoing investigations by the coroner in all provinces or territories except for Saskatchewan.

safer opioid supply programs that were expanded beginning in March 2020,²⁵ improved flexibility in take-home doses of opioid agonist treatment,²⁶ and enhanced training for health care workers, harm reduction workers, and people who use drugs on appropriate responses to opioid toxicities involving polysubstance use.^{27,28}

Our findings add to those that characterized trends in the burden of opioid-related deaths before the pandemic. In Canada, the YLL from opioid-related deaths increased by 142% over the 24-year period from 1990 to 2014,²⁹ compared with a 50% increase observed over just 3 years in our study. In comparison, after the first COVID-19 lockdown in England, overall opioid-related deaths decreased from an average of 125 to 117 deaths per month between 2019 and 2021.³⁰ Although we observed significant increases in opioid-related deaths overall, this was especially pronounced among males and younger adults aged 30–39 years, representing 181 525 YLL (9.9 YLL per 1000) and 87 045 YLL (16.5 YLL per 1000), respectively, in 2021. The disproportionate burden of premature deaths among males and younger adults is consistent with previous findings from Ontario and the US.^{31–33} In 2015, the highest burden of opioid-related deaths in Ontario was among people aged 25–34 years in terms of proportion of deaths, YLL rate and total YLL (8375 YLL);³¹ people aged 24–35 years and males accounted for 20% and 68%, respectively, of all opioid-related deaths in the US in 2016.³² During the first 6 months of the pandemic in Ontario, a 320% increase in opioid-related deaths was observed among people younger than 35 years, with males accounting for three-quarters of all deaths.⁵ The sustained high rates of opioid-related harm

observed among these demographic groups highlight the urgent need for low-barrier access to harm-reduction programs tailored to unique gender- and age-related needs.

In addition to experiencing substantial reductions in access to social supports and health care services during the pandemic, people who use drugs reported changes in patterns of drug use, including more frequently using drugs alone and a shift toward increased inhalation of drugs, which are both risk factors for opioid toxicities.^{34–37} The toll of premature opioid-related deaths observed in our study can also be contextualized in comparison with other leading causes of death. In 2019, we observed 126 115 YLL from opioid-related deaths overall, exceeding estimates from the Global Burden of Disease Study for unintentional injuries excluding accidental drug toxicities (118 836 YLL), cirrhosis and other chronic liver diseases (121 884 YLL), and diabetes mellitus (102 342 YLL) for people younger than 85 years in Canada.³⁸

Limitations

We were unable to study 4 provinces and territories, for which the numbers of opioid-related deaths were suppressed because of small counts (< 5). We did have access to data on all opioid-related deaths with ongoing investigations by the coroner in BC ($n = 2346$) from the stratified data used in our analyses, with the exception of the time-series analysis. Our sensitivity analyses suggest that the demographic distribution of these deaths follow a pattern similar to our overall results, and their exclusion is therefore unlikely to bias our analyses. Nonetheless, the results from BC should be interpreted with caution, particularly in 2021, given

the high number of ongoing investigations ($n = 1398$), which may help to explain the decrease in deaths observed from 2020 to 2021. Thus, we expect that our overall findings are an underestimate of the total burden of opioid-related death. Information on age at death was unavailable, leading us to apply an upper age limit of 84 years in our calculations. However, previous research showed that opioid-related deaths among those aged 85 years and older are uncommon, and the consistency of our sensitivity analysis is reassuring. We were unable to adjust for comorbidities in our YLL calculations. Given that some people may use opioids to treat pain associated with chronic diseases resulting in lower life expectancies, our YLL estimates may be overestimated. Finally, with the exception of Saskatchewan, all data on deaths include ongoing investigations and are therefore considered preliminary and subject to change. We anticipate that the number of opioid-related deaths under investigation in Saskatchewan is low²² and is unlikely to have substantially influenced our findings.

Conclusion

Between 2019 and 2021, the burden of premature death from accidental opioid toxicities in Canada dramatically increased, especially in Alberta, Saskatchewan, and Manitoba. In 2021, more than 70% of opioid-related deaths occurred among males and about 30% occurred among people aged 30–39 years, representing 1 in every 4 deaths in this age group. The disproportionate rates of opioid-related deaths observed in these demographic groups highlight the critical need for the expansion of targeted harm reduction-based policies and programs across Canada.

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