

# BMJ Open Burden of opioid toxicity death in the fentanyl-dominant era for people who experience incarceration in Ontario, Canada, 2015–2020: a whole population retrospective cohort study

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## ABSTRACT

**Objectives** To describe mortality due to opioid toxicity among people who experienced incarceration in Ontario between 2015 and 2020, during the fentanyl-dominant era.

**Design** In this retrospective cohort study, we linked Ontario coronial data on opioid toxicity deaths between 2015 and 2020 with correctional data for adults incarcerated in Ontario provincial correctional facilities.

**Setting** Ontario, Canada.

**Participants** Whole population data.

**Main outcomes and measures** The primary outcome was opioid toxicity death and the exposure was any incarceration in a provincial correctional facility between 2015 and 2020. We calculated crude death rates and age-standardised mortality ratios (SMR).

**Results** Between 2015 and 2020, 8460 people died from opioid toxicity in Ontario. Of those, 2207 (26.1%) were exposed to incarceration during the study period. Among those exposed to incarceration during the study period (n=1 29 152), 1.7% died from opioid toxicity during this period. Crude opioid toxicity death rates per 10 000 persons years were 43.6 (95% CI=41.8 to 45.5) for those exposed to incarceration and 0.95 (95% CI=0.93 to 0.97) for those not exposed. Compared with those not exposed, the SMR for people exposed to incarceration was 31.2 (95% CI=29.8 to 32.6), and differed by sex, at 28.1 (95% CI=26.7 to 29.5) for males and 77.7 (95% CI=69.6 to 85.9) for females. For those exposed to incarceration who died from opioid toxicity, 10.6% died within 14 days of release and the risk was highest between days 4 and 7 postrelease, at 288.1 per 10 000 person years (95% CI=227.8 to 348.1).

**Conclusions** The risk of opioid toxicity death is many times higher for people who experience incarceration compared with others in Ontario. Risk is markedly elevated in the week after release, and women who experience incarceration have a substantially higher SMR than men who experience incarceration. Initiatives to prevent deaths should consider programmes and policies in correctional facilities to address high risk on release.

## STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ Our study uses whole population data, minimising the risk of sample selection bias.
- ⇒ Given the mandated reporting of deaths to coroners in Ontario, we expect that the study has a high level of outcome ascertainment, that is, death by opioid toxicity.
- ⇒ We defined our exposure group based on incarceration over a 5 year timeframe (2015–2020), and we may have misclassified exposure to incarceration for those incarcerated only prior to 2015.
- ⇒ We had limited sociodemographic and clinical data, so we were not able to explore risk factors for death in detail.

## BACKGROUND

Canada and the USA have experienced alarming rates of opioid toxicity deaths in recent years. Between January 2016 and March 2022, 30 843 people died of opioid toxicity in Canada, driven largely by synthetic opioids, such as fentanyl.<sup>1 2</sup> Unintentional poisonings, which include drug overdose, now surpass motor vehicle collisions as a leading cause of death in Canada.<sup>3</sup> In the USA in 2021, 107 622 people died from a drug overdose, a 15% increase from the previous year, and synthetic opioids were involved in at least two-thirds of those deaths.<sup>4</sup>

People who use drugs often belong to intersecting marginalised groups, and therefore face barriers to accessing care, which may compromise their health.<sup>5</sup> Studies have found that experiencing an opioid overdose is associated with a lack of social support, a history of mental illness, stigma, polysubstance use, lack of coordinated healthcare,

homelessness and housing instability.<sup>6–8</sup> With population-level over-representation of each of these factors, people who experience incarceration are at particularly high risk of experiencing drug-related harms including fatal and non-fatal overdose,<sup>9–12</sup> illness or injury requiring hospitalisation<sup>12</sup> and frequent emergency department use.<sup>13</sup> Prior North American studies have shown that the risk of drug toxicity death (ie, death from drug overdose) is increased for people who experience incarceration compared with others in the general population, especially in the days and weeks following prison release,<sup>10 14–16</sup> however, we lack evidence on the absolute and relative burden of opioid mortality in the fentanyl-dominant era.

In the context of structural barriers to health and opportunities to improve health for people who experience incarceration, there is a need for timely data on mortality for this population in order to prioritise and inform prevention and treatment in custody and post-release. In this study, we aim to calculate the number of people who experienced incarceration who died from opioid toxicity and describe their characteristics, and to estimate and compare the rates of death for people who experienced incarceration and others in the general population.

## METHODS

The Ministry of the Solicitor General operates all correctional institutions in Ontario for adults who are on remand awaiting trial or sentencing, or who have been sentenced to less than 2 years in custody, and they oversee and deliver healthcare in provincial correctional facilities. Persons sentenced to 2 years or more in custody will be transferred to federal penitentiaries. Every person who is sentenced to a federal penitentiary in Ontario will first be in custody in a provincial facility (because the provincial correctional authority is responsible for remand). So, while our data only include provincial corrections, they reflect all people admitted to a provincial or federal facility during our study period. Access to opioid agonist therapy (OAT)—that is, evidence-based treatment for opioid use disorder which reduces withdrawal symptoms and opioid use and overdose mortality—was available to all Ontario correctional facilities during the study period. However, timely access and access to the breadth of OAT options differs across prisons in Ontario and this has been documented at both the provincial and federal levels.<sup>17 18</sup>

We accessed corrections data from the Ministry of the Solicitor General for all persons aged 18 and older who were detained or incarcerated in an Ontario provincial correctional facility for adults between 1 January 2015 and 31 December 2020, including name, date of birth, sex, Indigenous identity, marital status, race, periods of admission to and release from custody and reasons for release. In this paper, we use the term ‘incarcerated’ to describe persons who were detained or incarcerated in provincial correctional facilities.

We also accessed coronial data from the Office of the Chief Coroner for all deaths from opioid toxicity between 1 January 2015 and 31 December 2020, including name, date of birth, sex and date of death. In Ontario, there is a legal obligation to report any death from opioid toxicity to a coroner. Opioid toxicity deaths include all sudden and unexpected deaths where an opioid was identified in postmortem toxicology and was determined to have directly contributed to cause of death, either alone or in combination with other substances. Data from the investigations of these deaths are maintained by the Office of the Chief Coroner.

We linked coronial data for people who died from opioid toxicity between 2015 and 2020 to correctional data for people who experienced incarceration between 2015 and 2020. We linked data using name, date of birth and sex, using Link Plus V.2.0.<sup>19</sup> Link Plus produces all possible matches and assigns a score, with higher scores indicating a more likely match. The scores are based on how well each of the elements (first, middle and last name, date of birth and sex) match, and the study team reviewed specific matches and came to consensus regarding whether to consider them an accurate match. After we completed data linkage, we used deidentified data for all subsequent analyses.

Our *exposed* group was adults who were incarcerated in an Ontario provincial correctional facility at any time between 2015 and 2020, and our *unexposed* group was all other people in the general population in Ontario. Persons entered the exposed group from the date of their first admission to custody during the study period and contributed person time to the exposed group up to the end of the study or death, whether they remained in custody or were released to the community. We use the term ‘people exposed to incarceration’ to describe the exposed group. Our *unexposed* group was everyone in the general population who had not been exposed to provincial incarceration, and persons who experienced incarceration contributed person-time to the unexposed group prior to their first admission to custody.

Our primary outcome was death from opioid toxicity. For the exposed and unexposed groups and by sex, we calculated the number of deaths, the percentage of people who died, and rates of death using person time as the total days of follow-up. We calculated age-standardised mortality ratios (SMRs) for those exposed to incarceration compared with those not exposed to incarceration, as a ratio of observed over expected deaths. We calculated the expected number of opioid toxicity deaths using all opioid toxicity deaths for persons aged 18 and over and the mean age-specific and sex-specific Ontario population over the study period, based on Statistics Canada Census data for age and sex,<sup>20</sup> which were interpolated to estimate the populations from 2015 to 2020. We assumed that persons in the unexposed group contributed one person year (PY) per calendar year. We applied the rate of opioid toxicity death for the general population to the total PYs in each age-sex group of people who experienced

incarceration to obtain the expected number of deaths for each age-sex group, and then summed the expected deaths across age groups to get a total expected number. We divided the actual number of deaths (ie, observed deaths) by the expected number of deaths for each age-sex group to get the SMR. We calculated 95% CI for the crude death rates and SMRs.

Given our study focus on persons who experience incarceration, we also calculated descriptive statistics for those exposed to incarceration using available demographic and correctional data, including age, sex, marital status and cumulative time in custody, length of most recent incarceration and number of incarcerations during the period under study (2015–2020). Using the same variables, we calculated bivariate statistics (standardised differences) comparing people who died from opioid toxicity and those who did not. For persons exposed to incarceration who died from opioid toxicity, we described the number and rate of deaths by period in custody and postrelease, and the number of deaths per calendar year in total and within 1 week, 1 month, 3 months and 1 year of incarceration. Analyses were performed in SAS V.10.0.<sup>21</sup>

### Patient and public involvement

We also formally engaged a group of 14 experts with lived experience of incarceration and illicit substance use in a knowledge exchange initiative (ie, not research) to help us contextualise and interpret the study findings, as well as discuss next steps for knowledge dissemination and action. They had either experienced incarceration themselves or had family experience of incarceration. They participated in three 1 hour structured discussion sessions, facilitated by a company that specialises in community engagement. The experts were compensated \$30 per workshop and an additional \$30 for preparation time (\$120 in total). We present select content from these sessions in the Discussion, and a full summary report is available online.<sup>22</sup>

## RESULTS

A total of 8460 people died from opioid toxicity in Ontario between 2015 and 2020. Of those, 2207 (26.1%) were exposed to incarceration between 2015 and 2020 and 6253 (73.9%) were not. Among those exposed to incarceration, the majority of the population were male (85.7%). The median age at first incarceration during this period was 33 years (IQR=25–43). People who died from opioid toxicity tended to have more incarceration events and a higher number of cumulative days spent in custody compared with those who did not die from opioid toxicity. More than half of those who died (53.1%) were aged 25–39 (see [table 1](#)).

Among the 129 152 persons exposed to incarceration between 2015 and 2020, 1.7% (n=2207) died from opioid toxicity. Of these 2207, 2.2% (n=48) died in provincial custody, 2064 (93.4%) died in community and for 85 (3.9%), we could not confirm if they died in community

or an institution because their release information was censored in the correctional data, or they were transferred to a federal prison. Ten per cent (n=234) died within 14 days of release, and the rate of death was highest between 4 and 7 days after release (288.0 per 10 000 PYs, 95% CI=277.8 to 348.1) (see [figure 1](#)).

The total numbers of deaths within certain periods postrelease for the exposed group as a proportion of the total deaths in Ontario are shown in [figure 2](#). We found that 15.6% of all opioid toxicity deaths in Ontario occurred among people who had been incarcerated in the past year.

The crude rates of opioid toxicity death were 43.6 per 10 000 PYs (95% CI=41.8 to 45.5) for persons exposed to incarceration and 0.95 per 10 000 PYs (95% CI=0.93 to 0.97) for those unexposed (see [table 2](#)). Sex-specific crude rates of opioid toxicity death for persons exposed to incarceration were 50.7 per 10 000 PYs (95% CI=45.4 to 56.0) for females and 42.5 per 10 000 PYs (95% CI=40.6 to 44.4) for males. In contrast, for persons not exposed to incarceration, the rates were 0.60 per 10 000 PYs (95% CI=0.58 to 0.63) for females and 1.3 per 10 000 PYs (95% CI=1.3 to 1.4) for males ([table 2](#)).

Compared with those not exposed to incarceration, the SMR for persons exposed to incarceration was 31.2 (95% CI=29.8 to 32.6). The SMR was 28.1 (95% CI=26.7 to 29.5) for males and 77.7 (95% CI=69.6 to 85.9) for females (see [table 3](#)).

## DISCUSSION

We found a high crude rate of opioid toxicity death for people who experience incarceration, and substantial inequity in the burden of mortality for this population compared with others in the Ontario population. Over one-quarter of all opioid toxicity deaths in Ontario between 2015 and 2020 were among people who experienced incarceration during that period. Rates of death were particularly high for females who experienced incarceration and in the 2 weeks after release from prison.

Our study reveals that the high absolute and relative opioid toxicity mortality burden in persons who experience incarceration<sup>10 15 16 23</sup> continues during the fentanyl-dominant era. A study of all drug toxicity deaths in Ontario between 2006 and 2013,<sup>16</sup> a period before fentanyl dominated the illicit drug supply, identified that 10.1% of *all drug* toxicity deaths occurred in persons released from any correctional facility in the past year, and we found that between 2015 and 2020, 15.6% of all *opioid* toxicity deaths occurred in persons released from a provincial correctional facility in the past year. That study also found that SMR for drug toxicity deaths in the year postrelease was 11.6 compared with others in the general population,<sup>21</sup> which is much smaller than the SMR in our study—31.2—though not directly comparable. Ranapurwala *et al*<sup>24</sup> similarly identified a substantial increase in opioid overdose death rates and SMRs for formerly incarcerated persons in North Carolina between 2017 and

**Table 1** Characteristics of persons who experienced incarceration in a provincial correctional facility in Ontario between 2015 and 2020, stratified by death by opioid toxicity 2015 to 2020

Characteristic	Total, n=129 152 (%)	Did not die from opioid toxicity, n=126 945 (%)	Died from opioid toxicity, n=2207 (%)	Standardised difference*
<b>Age</b>				
18–24	21.8	21.9	15.8	0.158
25–39	45.4	45.2	53.1	0.159
40–49	18.3	18.2	20.6	0.060
50+	14.6	14.6	10.5	0.126
Missing	0.0	0.0	0.0	0.007
<b>Sex</b>				
Male	85.7	85.7	84.0	0.047†
Female	14.1	14.0	15.6	0.003†
<b>Marital status</b>				
Married, common law	23.4	23.6	15.6	0.202
Single, separated, divorced, widow(er)	71.8	71.6	82.6	0.266
Missing	4.8	4.9	1.8	0.174
<b>Cumulative days in provincial custody 2015–2020</b>				
Mean (SD)	148.7 (258.1)	148.2 (258.2)	180.8 (252.2)	0.128
Median (IQR)	41.9 (5.3–166.6)	41.1 (5.2–165.0)	87.6 (15.8–238.7)	0.296
<b>Length of most recent incarceration (days)</b>				
Mean (SD)	74.7 (157.5)	74.8 (157.9)	70.7 (130.4)	0.028
Median (IQR)	18.0 (3.2–78.6)	18.0 (3.1–78.6)	20.7 (4.9–81.7)	0.090
<b>Number of incarceration episodes 2015–2020</b>				
Mean (SD)	2.5 (2.7)	2.5 (2.7)	3.5 (3.4)	0.327
Median (IQR)	1 (1–3)	1 (1–3)	2 (1–4)	0.447
*Standardised difference comparing those who died due to opioid toxicity to those who did not. Standardised differences smaller than 0.10 (10%) indicate negligible correlation between those who did not die from opioid toxicity and those who died from opioid toxicity.				
†The standardised difference for sex compares the per cent female (or, equivalently, the per cent male) for those who died and those who did not die. For the sex variables only, trans and unknown sex are not included.				

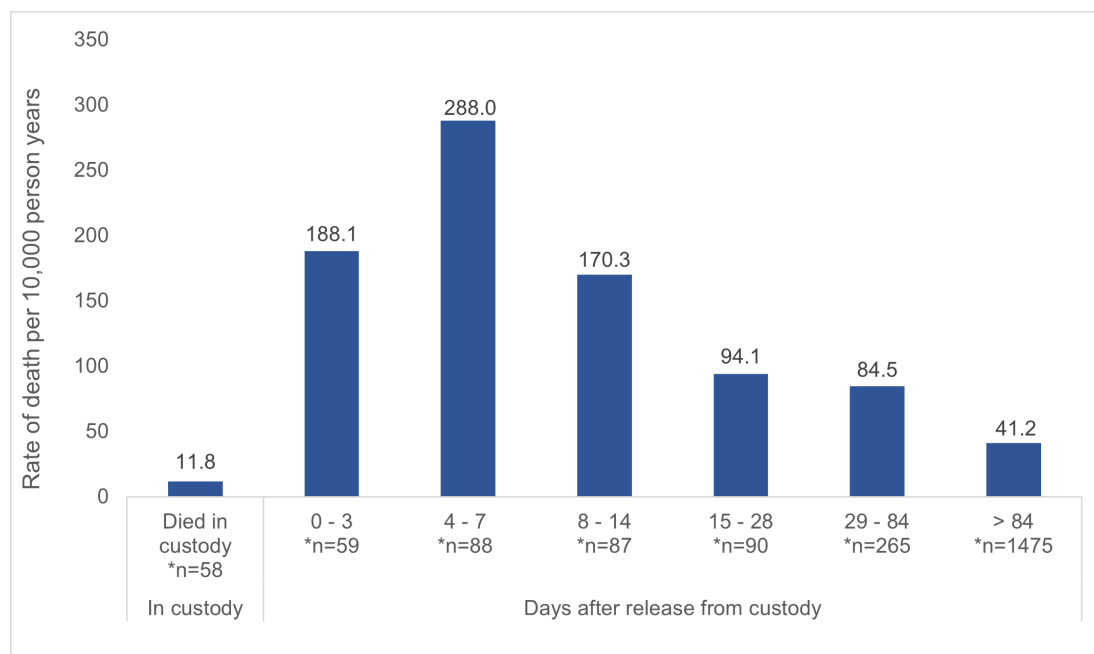
2018, largely attributable to the rise in synthetic opioids over this period.

Also consistent with previous studies,<sup>9 15 25</sup> we observed that the immediate postrelease period is the highest risk period for opioid toxicity death, which is likely due, at least in part, to decreased drug tolerance during incarceration,<sup>26 27</sup> and potentially also to housing, social and medical challenges on release.<sup>28 29</sup> Experts with lived experience attributed the higher risk of death on release to the lack of appropriate services and continuity of care on release, the changing and unpredictable drug supply, and stigma associated with drug use, and explained that many people lack access to safe drugs when they return to community because the drug supply is increasingly contaminated, and they may have lost access to their trusted drug supplier. They stressed that the timing of supports is critical, because many people want to maintain

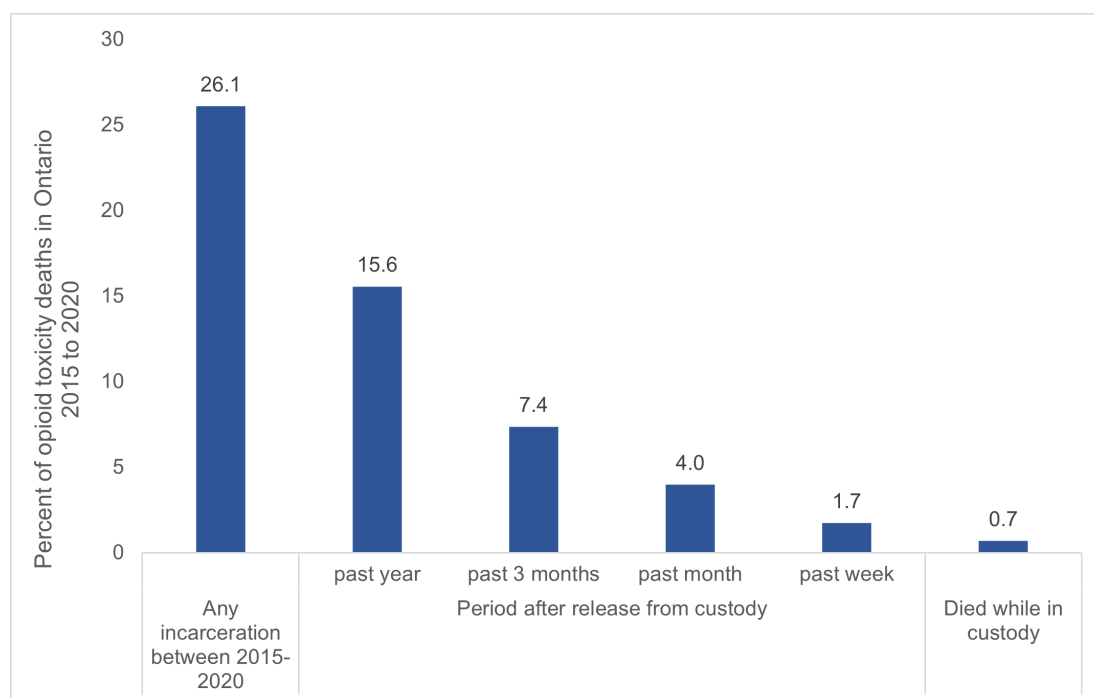
sobriety on release, but do not have necessary resources and people are especially vulnerable on release, as they often lack social and family supports. Of note, the majority of opioid toxicity deaths occurred more than a month postrelease in our study, suggesting that enhanced prevention efforts and supports are required beyond the immediate postrelease period. Enhanced prevention may include ongoing access to harm reduction services/supplies, substance use treatment options, primary care, as well as efforts to address structural and social determinants of health such as housing, income, social support and food security.

Our findings are also consistent with studies that have found that while most drug-related deaths among people who experience incarceration occur in men, reflecting disproportionately higher rates of incarceration for males than females, the highest rates of death occur among





**Figure 1** Opioid toxicity death rates per 10 000 person years and number of opioid toxicity deaths for persons incarcerated in provincial correctional facilities in Ontario 2015 to 2020, by period in custody or postrelease. \*n=number of people who died in that period.



**Figure 2** Per cent of opioid toxicity deaths in Ontario (N=8460) 2015–2020 in people exposed to incarceration 2015 to 2020, in total, within a certain period of incarceration, and in provincial custody. For 2015, the per cent who died after release in the past quarter is calculated for those whose most recent release was between 1 April and 31 December, the per cent who died after release in the past month is calculated for those whose most recent release was between 31 January and 31 December; the per cent who died after release in the last week is calculated for those whose most recent release was between 8 January and 31 December. The per cent who died after release in the past year is calculated for people whose most recent release was on or after 1 January 2016, so that they would have a full one-year lookback period, and the denominator includes all opioid toxicity deaths in Ontario between 2016 and 2020 (n=7699).

**Table 2** Crude death rate from opioid toxicity among persons who experienced incarceration in a provincial correctional facility in Ontario between 2015 and 2020 and others in the Ontario population 2015 to 2020

		Deaths	Total person years	Deaths/10 000 person years (95% CI)
Persons not exposed to incarceration	Females	2044	34 026 804	0.60 (0.58 to 0.63)
	Males	4149	31 354 655	1.3 (1.3 to 1.4)
	Total	6193	65 381 384	0.95 (0.93 to 0.97)
Persons exposed to incarceration	Females	347	68 438	50.7 (45.4 to 56.0)
	Males	1860	437 611	42.5 (40.6 to 44.4)
	Total	2207	506 049	43.6 (41.8 to 45.5)

women.<sup>15 16 23</sup> Research shows that incarcerated women are more likely than incarcerated men to have co-occurring mental and substance use disorders, self-harm and suicide attempts, histories of trauma and abuse and severe substance use needs.<sup>30–34</sup> As women have historically constituted a much smaller proportion of the prison population than men, models of care in custody and post-release have typically been developed around the needs of men.<sup>35</sup> Our findings of high rates of opioid toxicity deaths in females underscore the importance of gender-responsive care in custody and in the community, as well as prevention efforts that consider gendered needs and different pathways into prison. Experts with lived experience confirmed that women face different and considerable barriers including a lack of specific services and spaces for women who use drugs and are criminalised. They also reflected on the structural and systemic pressures faced by women, including being more likely to act as care providers for their partners and children,

and being more likely to experience intimate partner violence. Women are also at higher risk because of power dynamics with drug suppliers and partners, for example, male partners may control their connection to drugs, and their dosage, increasing their risk of drug related harms.

Our study has several strengths and limitations. We used whole population data, and given legally mandated reporting of deaths to coroners, we expect that the study has a high level of outcome ascertainment. We defined our exposure based on incarceration in provincial correctional facilities between the specific period 2015 and 2020, and with available data, we are unable to identify incarceration experience prior to 2015; for example, a person who was released from provincial custody in December 2014 and died from opioid toxicity in January 2015 would have been categorised as unexposed (no incarceration) based on our exposure definition, despite recent incarceration history. This would have led to a conservative bias between groups, that is, would have resulted in more

**Table 3** Expected and observed deaths for persons who died from opioid toxicity who experienced incarceration in a provincial correctional facility in Ontario between 2015 and 2020\*

Sex	Age group	General population death rate for opioid toxicity (deaths/10 000 PYs)	Person-time for people who experience incarceration (10 000 PYs)	Expected deaths	Observed deaths	Mortality ratio (observed/expected)	SMR (95% CI)
Female	18–24	0.443	1.596	0.707	31	43.8	77.7 (69.6 to 85.9)
	25–39	0.747	3.315	2.476	199	80.4	
	40–49	0.742	1.253	0.930	77	82.8	
	50+	0.516	0.680	0.351	40	114.0	
Male	18–24	0.896	9.478	8.497	144	16.9	28.1 (26.7 to 29.5)
	25–39	1.918	19.678	37.741	958	25.4	
	40–49	1.672	8.088	13.524	445	32.9	
	50+	1.000	6.517	6.519	313	48.0	
Total	18–24	0.674	11.074	7.462	175	23.5	31.2 (29.8 to 32.6)
	25–39	1.316	22.933	30.264	1157	38.2	
	40–49	1.187	9.341	11.085	522	47.1	
	50+	0.744	7.197	5.351	353	66.0	

\*Standardised to Ontario population.

PYs, person years; SMR, standardised mortality ratios.

similar crude mortality rates and a smaller SMR. We had limited sociodemographic and other data, and so we were not able to explore risk factors for death in detail in the current study. Specifically, we did not describe available data on race and Indigenous identity or conduct stratified analyses, as we did not have necessary partnerships and engagement in place. We plan to conduct additional analyses on these topics in the future. Given that our data on periods in custody included only periods in provincial correctional facilities, we were unable to estimate the risk of death within or after release from federal penitentiaries.

This study suggests the need for population-level interventions to prevent opioid toxicity deaths during incarceration and postrelease, including evidence-based strategies and consideration of other strategies in consultation with community and other experts and with rigorous evaluation. Primary prevention strategies include access to opioid agonist treatment (OAT), for which there are barriers and unmet needs in custody.<sup>36–41</sup> Evidence shows that for persons who experience incarceration, OAT increases treatment initiation and retention, and reduces substance use, recidivism and overdose,<sup>42–50</sup> including postincarceration opioid toxicity deaths.<sup>46</sup> Experts with lived experience agreed that treatment and harm reduction in custody, including access to OAT and naloxone and naloxone training, could reduce harms for people who use drugs. They described that in Ontario, access to OAT in custody is variable and wait times can be long. Other primary prevention strategies include decriminalisation and diversion from incarceration, both of which could prevent disruption in care (including OAT), risky substance use in custody and loss of opioid tolerance in custody, as well as providing pharmaceutical alternatives to the illicit drug market ('safer supply'<sup>51</sup>), which could prevent exposure to the toxic drug supply. Secondary prevention initiatives include screening for substance use and substance use disorders on admission to correctional facilities and in healthcare settings in the community. Tertiary prevention may include training in overdose recognition and naloxone administration, providing access to naloxone in custody and postrelease, and providing drug checking services and supplies such as fentanyl test strips.<sup>52</sup> Further upstream, primordial prevention strategies that could impact opioid toxicity risk include addressing the social and structural determinants of health and crime.

Recognising the heterogeneous interests and situations of people who experience incarceration and who may be at risk of opioid overdose, interventions should engage people with lived and living experience of incarceration and illicit drug use to support acceptability and effectiveness and programmes with multiple components may be more appropriate and effective at addressing population health needs and mitigating risk.<sup>53</sup> Given the considerable barriers to health faced by people who experience incarceration, and the very high risk of overdose postrelease, we need to urgently develop targeted interventions and policy solutions to

support health and reduce opioid toxicity death for people who experience incarceration.

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**Contributors** All authors were involved in conceptualising the project and planning the manuscript. FK completed the data access requests. Methods and analytic design plans were codeveloped by FK, AB and RC and were reviewed and approved by all coauthors at several project intervals. AB, FK and CB co-led the planning of three workshops with experts with lived experience, and AB and HA incorporated content into the manuscript. RC conducted the data linkage and statistical analyses. AB conducted the literature review and wrote the first full draft of the manuscript with support from FK. All authors (AB, RC, CB, HA, AMB, SJB, KEM, TG, TK, LAK, AMO, DG, AO-B, LR and FK) critically revised the manuscript, contributed to subsequent iterations and approved the final draft. AB is responsible for the overall content as the guarantor.

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**Competing interests** All authors have completed the ICMJE uniform disclosure form at [www.icmje.org/coi\\_disclosure.pdf](http://www.icmje.org/coi_disclosure.pdf) and declare: the study is supported by funding provided the Canadian Institutes of Health Research through the Canadian Research Initiative in Substance Misuse; no financial relationships with any organisations that might have an interest in the submitted work; no other relationships or activities that could appear to have influenced the submitted work.

**Patient and public involvement** Patients and/or the public were involved in the design, or conduct, or reporting or dissemination plans of this research. Refer to the Methods section for further details.

**Patient consent for publication** Not required.

**Ethics approval** This study involves human participants. We obtained approval for this study from the Hamilton Integrated Research Ethics Board (#5878), as well as from the Ministry of the Solicitor General and the Office of the Chief Coroner. While we accessed nominal data for the purposes of data linkage, we did not obtain informed consent from participants, since the study met criteria for a waiver of consent as articulated in the Canadian Tri-Council Policy Statement on Ethical Conduct for Research Involving Humans, and the waiver of consent was approved by the Research Ethics Board.

**Provenance and peer review** Not commissioned; externally peer reviewed.

**Data availability statement** Data may be obtained from a third party and are not publicly available.

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## REFERENCES

- Public Health Agency of Canada. Opioid- and stimulant-related harms in Canada. Ottawa, ON: Public Health Agency of Canada; 2022. Available: <https://health-infobase.canada.ca/substance-related-harms/opioids-stimulants>
- Government of Canada. Opioid- and stimulant-related harms in Canada (September 2022). Ottawa, ON: Author; 2022. Available: <https://health-infobase.canada.ca/substance-related-harms/opioids-stimulants>
- Jiang A, Belton K, Fuselli P. *Evidence Summary on the Prevention of Poisoning in Canada*. Toronto, ON: Parachute and Injury Prevention Centre, University of Alberta, 2020.
- Centers for Disease Control and. U.S. overdose deaths in 2021 increased half as much as in 2020 – but are still up 15 %: CDC/ national center for health statistics. 2022. Available: [https://www.cdc.gov/nchs/pressroom/nchs\\_press\\_releases/2022/202205.htm](https://www.cdc.gov/nchs/pressroom/nchs_press_releases/2022/202205.htm)
- Sheehan L, Corrigan P. Stigma of disease and its impact on health. *The Wiley Encyclopedia of Health Psychology* 2020;57–65.
- Public Health Agency of Canada. *Special Advisory Committee on the Epidemic of Opioid Overdoses. Highlights from phase one of the national study on opioid and other drug-related overdose deaths: insights from coroners and medical examiners*. 2019.
- Thumath M, Humphreys D, Barlow J, et al. Overdose among mothers: the association between child removal and unintentional drug overdose in a longitudinal cohort of marginalised women in Canada. *Int J Drug Policy* 2021;91:S0955-3959(20)30315-7:102977..
- Fine DR, Dickens KA, Adams LD, et al. Drug overdose mortality among people experiencing homelessness, 2003 to 2018. *JAMA Netw Open* 2022;5:e2142676.
- Binswanger IA, Stern MF, Deyo RA, et al. Release from prison -- a high risk of death for former inmates. *N Engl J Med* 2007;356:157–65.
- Binswanger IA. Mortality after prison release: opioid overdose and other causes of death, risk factors, and time trends from 1999 to 2009. *Ann Intern Med* 2013;159:592.
- Gan WQ, Kinner SA, Nicholls TL, et al. Risk of overdose-related death for people with a history of incarceration. *Addiction* 2021;116:1460–71.
- Young JT, Heffernan E, Borschmann R, et al. Dual diagnosis of mental illness and substance use disorder and injury in adults recently released from prison: a prospective cohort study. *Lancet Public Health* 2018;3:S2468-2667(18)30052-5:e237–48..
- Butler A, Love AD, Young JT, et al. Frequent attendance to the emergency department after release from prison: a prospective data linkage study. *J Behav Health Serv Res* 2020;47:544–59.
- Kinner SA, Gan W, Slaunwhite A. Fatal overdoses after release from prison in British Columbia: a retrospective data linkage study. *CMAJ Open* 2021;9:E907–14.
- Kouyoumdjian FG, Kiefer L, Wobeser W, et al. Mortality over 12 years of follow-up in people admitted to provincial custody in Ontario: a retrospective cohort study. *CMAJ Open* 2016;4:E153–61.
- Groot E, Kouyoumdjian FG, Kiefer L, et al. Drug toxicity deaths after release from incarceration in Ontario, 2006-2013: review of coroner's cases. *PLOS ONE* 2016;11:e0157512.
- Russell C, Nafeh F, Pang M, et al. Opioid agonist treatment (oat) experiences and release plans among federally incarcerated individuals with opioid use disorder (OUD) in Ontario, Canada: a mixed-methods study. *BMC Public Health* 2022;22:436.
- Bodkin C, Bondy S, Regenstreif L, et al. Rates of opioid agonist treatment prescribing in provincial prisons in Ontario, Canada, 2015-2018: a repeated cross-sectional analysis. *BMJ Open* 2021;11:e048944e048944.
- Centers for Disease Control and Prevention. Link plus: author. 2022. Available: <https://www.cdc.gov/cancer/npcr/tools/registryplus/lp.htm>
- Statistics Canada. Age (in single years), average age and median age and gender: Canada, provinces and territories, census metropolitan areas and census agglomerations with parts Ottawa. 2022. Available: <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=9810002001>
- SAS Institute Inc. Sas version 10.0 North Carolina, us. n.d. Available: [https://www.sas.com/en\\_ca/home.html](https://www.sas.com/en_ca/home.html)
- Amplify Engagement. Reimagining the story of incarceration and opioid use. 2022. Available: <https://fammed.mcmaster.ca/wp-content/uploads/2022/12/Summary-document-for-sharing.pdf>
- Zlodre J, Fazel S. All-Cause and external mortality in released prisoners: systematic review and meta-analysis. *Am J Public Health* 2012;102:e67–75.
- Ranapurwala SI, Figgatt MC, Remch M, et al. Opioid overdose deaths among formerly incarcerated persons and the general population: North Carolina, 2000–2018. *Am J Public Health* 2022;112:300–3.
- Bukten A, Stavseth MR, Skurtveit S, et al. High risk of overdose death following release from prison: variations in mortality during a 15-year observation period. *Addiction* 2017;112:1432–9.
- Farrell M, Marsden J. Acute risk of drug-related death among newly released prisoners in England and Wales. *Addiction* 2008;103:251–5.
- Brehm Christensen P, Hammerby E, Smith E, et al. Mortality among Danish drug users released from prison. *Int J Prison Health* 2006;2:13–9.
- Hartwell S. Triple stigma: persons with mental illness and substance abuse problems in the criminal justice system. *Criminal Justice Policy Review* 2004;15:84–99.
- Mallik-Kane K, Visser CA. Health and prisoner reentry: how physical, mental, and substance abuse conditions shape the process of reintegration. 2008.
- Baldry E, Cunneen C. Imprisoned Indigenous women and the shadow of colonial patriarchy. *Australian & New Zealand Journal of Criminology* 2014;47:276–98.
- Day A, Gerace A, Oster C, et al. The views of women in prison about help-seeking for intimate partner violence: at the intersection of survivor and offender. *Victims & Offenders* 2018;13:974–94.
- Abbott P, Magin P, Davison J, et al. Medical homelessness and candidacy: women transiting between prison and community health care. *Int J Equity Health* 2017;16:130.
- Breuer E, Remond M, Lighton S, et al. The needs and experiences of mothers while in prison and post-release: a rapid review and thematic synthesis. *Health Justice* 2021;9.
- Hawton KP, Linsell LM, Adeniji TM, et al. Self-Harm in prisons in England and Wales: an epidemiological study of prevalence, risk factors, clustering, and subsequent suicide. *Lancet* 2014;383:1147–54.
- Bartels L, Eastaugh P, Westgate R. Understanding women's imprisonment in Australia. *Women & Criminal Justice* 2020;30:204–19.
- Correctional Service Canada. Opioid agonist treatment (oat) in CSC July 2019, author. 2020. Available: <https://www.csc-scc.gc.ca/health/002006-3001-en.shtml>
- Correctional service Canada. Opioid agonist treatment June 2022: author. 2022. Available: <https://www.csc-scc.gc.ca/health/002006-3010-en.shtml>
- Owens MD, Chen JA, Simpson TL, et al. Barriers to addiction treatment among formerly incarcerated adults with substance use disorders. *Addict Sci Clin Pract* 2018;13:19.
- Velasquez M, Flannery M, Badolato R, et al. Perceptions of extended-release naltrexone, methadone, and buprenorphine treatments following release from jail. *Addict Sci Clin Pract* 2019;14:37.
- Jamin D, Vanderplasschen W, Sys O, et al. "my first 48 hours out": drug us'rs' perspectives on challenges and strategies upon release from prison. *Harm Reduct J* 2021;18:32.
- Finlay AK, Harris AHS, Rosenthal J, et al. Receipt of pharmacotherapy for opioid use disorder by justice-involved U.S. Veterans Health Administration Patients *Drug Alcohol Depend* 2016;160:222–6.
- Perry AE, Neilson M, Martyn-St James M, et al. Pharmacological interventions for drug-using offenders. *Cochrane Database Syst Rev* 2015;6:CD010862.
- Malta M, Varatharajan T, Russell C, et al. Opioid-related treatment, interventions, and outcomes among incarcerated persons: a systematic review. *PLoS Med* 2019;16:e1003002e1003002.
- Sharma A, O'Grady KE, Kelly SM, et al. Pharmacotherapy for opioid dependence in jails and prisons: research review update and future directions. *Subst Abuse Rehabil* 2016;7:27–40.
- Moore KE, Roberts W, Reid HH, et al. Effectiveness of medication assisted treatment for opioid use in prison and jail settings: a meta-analysis and systematic review. *J Subst Abuse Treat* 2019;99:S0740-5472(18)30449-5:32–43..
- Green TC, Clarke J, Brinkley-Rubinstein L, et al. Postincarceration fatal overdoses after implementing medications for addiction treatment in a statewide correctional system. *JAMA Psychiatry* 2018;75:405–7.
- Bozinoff N, DeBeck K, Milloy M-J, et al. Utilization of opioid agonist therapy among incarcerated persons with opioid use disorder in Vancouver, Canada. *Drug Alcohol Depend* 2018;193:S0376-8716(18)30690-2:42–7..



- 48 Farrell-MacDonald S, MacSwain M-A, Cheverie M, *et al.* Impact of methadone maintenance treatment on women offenders' post-release recidivism. *Eur Addict Res* 2014;20:192–9.
- 49 Gisev N, Bharat C, Larney S, *et al.* The effect of entry and retention in opioid agonist treatment on contact with the criminal justice system among opioid-dependent people: a retrospective cohort study. *Lancet Public Health* 2019;4:S2468-2667(19)30060-X:e334–42..
- 50 Russolillo A, Moniruzzaman A, McCandless LC, *et al.* Associations between methadone maintenance treatment and crime: a 17-year longitudinal cohort study of Canadian provincial offenders. *Addiction* 2018;113:656–67.
- 51 Tyndall M. A safer drug supply: a pragmatic and ethical response to the overdose crisis. *CMAJ* 2020;192:E986–7.
- 52 Klaire S, Janssen RM, Olson K, *et al.* Take-Home drug checking as a novel harm reduction strategy in British Columbia, Canada. *Int J Drug Policy* 2022;106:S0955-3959(22)00160-8:103741..
- 53 Waddell EN, Baker R, Hartung DM, *et al.* Reducing overdose after release from incarceration (ROAR): study protocol for an intervention to reduce risk of fatal and non-fatal opioid overdose among women after release from prison. *Health Justice* 2020;8:18.