

Health Promotion and Chronic Disease Prevention in Canada

Research, Policy and Practice

Volume 44 • Number 3 • March 2024

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ISSN 2368-738X

Pub. 230541

HPCDP.journal-revue.PSPMC@phac-aspc.gc.ca

Également disponible en français sous le titre : *Promotion de la santé et prévention des maladies chroniques au Canada : Recherche, politiques et pratiques*

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Editorial

Using death investigation data to better understand the overdose crisis

Amanda VanSteeelandt, PhD; Jenny Rotondo, MHSc

Part of our “Accidental overdose mortality” theme series.

In response to the overdose (or acute drug toxicity) crisis, the Government of Canada committed to a public health response supported by a strong evidence base.¹ Information regarding the people affected, their exposure to risk factors, opportunities to connect them to supports, the circumstances of their death and the substances involved is critical to effectively support policy decisions and identify and prioritize potential interventions to reduce drug toxicity events.

The collection of articles in this theme series of the journal presents results from a national chart review study of the death investigation files of people who died of acute toxicity in Canada between 2016 and 2017. This study endeavoured to better understand the characteristics of the people who died, the circumstances of their deaths and the substances involved. While information about the study and some of its findings have previously been published,^{2,3} we would like to share more about how the study came to be, the people involved and the value of collaborative efforts between coroners, medical examiners and public health practitioners.

Work on the national chart review study began in 2018 to complement the national surveillance system of apparent opioid- and stimulant-related acute toxicity deaths.⁴ Both activities aimed to address the lack of comparable national data on acute toxicity mortality using death investigation data, and neither could have proceeded without the collaboration of chief coroners, chief medical examiners and their offices across provinces and territories. The mandate of coroners and medical examiners is to establish the cause and manner of non-natural deaths. During the

course of their investigations, they collect a variety of information, including interviews with family members, witnesses and medical practitioners; descriptions of the scene of the death; medical and law enforcement records; and autopsy and toxicology reports. The chart review study brought these sources of information together in one dataset, which is being analyzed by multiple research teams to answer key questions about the overdose crisis. As the articles in this series demonstrate, these data can be a rich source of public health information not available elsewhere from which we can learn more about the groups of people most affected and discover ways to tailor policies and programs to better meet their needs.

Though the study was funded and coordinated by staff at the Public Health Agency of Canada (PHAC), the co-investigator team leading the vision and design of the study was made up of multidisciplinary members from many organizations. The team was assembled to represent voices from across Canada with a variety of expertise, including lived experience of substance use, death investigations, harm reduction programs, addictions counselling, toxicology, health equity, Indigenous health research, geomatics, health care and public health. Decisions about how to analyze the dataset were informed by the co-investigator team in combination with priorities identified by stakeholder groups that included people with lived and living experience of substance use and government policy leads.

The collection of articles in this theme series focusses on specific subpopulations of people who died accidentally of acute toxicity from 2016 to 2017, including

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youth⁵ and older adults.⁶ A future issue will include articles on additional populations. The articles share common threads examining the prevalence of characteristics related to social and medical history, circumstances of death and substances involved for each of these groups. The overdose crisis has affected people of all walks of life, and these articles demonstrate the diversity of the circumstances surrounding deaths and the importance of taking an intersectional approach when assessing how factors affect risk across populations.⁷

An important challenge to applying an intersectional approach to analyses is identifying subpopulations within the dataset. As the mandate of coroners and medical examiners is to establish the cause and manner of non-natural deaths, we found that most files were missing information relevant for public health purposes, particularly regarding socioeconomic and social identity characteristics. Therefore, the results of the national chart review study represent the *minimum* prevalence of characteristics among the people who died.

The process of identifying what information was available in death investigation files and comparing this across provinces and territories has supported collaborative efforts between coroners, medical examiners and public health practitioners to improve the data available and the knowledge base on acute toxicity deaths. Some of these discussions are centred around how to better identify additional subpopulations

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and evaluate their risk of acute toxicity, including subpopulations based on self-identity (e.g. race, ethnicity, distinctions-based Indigenous status, gender and sexual orientation) and life experiences (e.g. involvement with correctional systems, foster care, occupational groups and potentially traumatic experiences), which were often unavailable in death investigation files.

The national chart review study provides a snapshot of the overdose crisis in its early years. While it serves as a national baseline for future research, some of the patterns observed in the theme series articles may have changed, as the drug supply has become increasingly toxic, harm reduction and treatment options have expanded and the social circumstances of Canadians have changed since 2016 and 2017.^{8,9} Even with the support of the coroner and medical examiner offices, planning and data collection for the national chart review study took over four years. Though this was partly due to the COVID-19 pandemic, data abstraction from physical files is time-intensive, and many of the relationships, processes and agreements necessary to proceed with this project did not exist at the outset.

Hopefully, the groundwork laid by this study will support similar activities across provinces and territories, improvements to Statistics Canada's Canadian Coroner and Medical Examiner Database,¹⁰ and the work of the Chief Coroner, Chief Medical Examiners and Public Health Collaborative. The latter group comprises members from PHAC, all 13 Canadian chief coroner and chief medical examiner offices and Statistics Canada, with a mandate to support the development of common approaches to death investigations and data infrastructure requirements.

Timely and comparable data are essential to the development of a robust evidence base that public health professionals can use to address the evolving national overdose crisis and its drivers. Key to developing this evidence base is fostering collaborative relationships between multidisciplinary teams, including the public health sector and the coroner and medical examiner community.

Acknowledgements

We would like to acknowledge our collaborators at the offices of chief coroners and

chief medical examiners across Canada for providing access to their death investigation files. We are deeply thankful to our co-investigators on the National Chart Review Study of Substance-Related Acute Toxicity Deaths for their continued guidance and participation in the project over the last five years: Brandi Abele, Songul Bozat-Emre, Matthew Bowes, Jessica Halverson, Dirk Huyer, Beth Jackson, Graham Jones, Jennifer Leason, Regan Murray, Erin Rees and Emily Schleihauf. We are grateful for the contributions of people with lived and living experience of substance use who have supported the chart review study at multiple stages.

Statement

The content and views expressed in this article are those of the authors and do not necessarily reflect those of the Government of Canada.

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Original quantitative research

Accidental substance-related acute toxicity deaths among youth in Canada: a descriptive analysis of a national chart review study of coroner and medical examiner data

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This article has been peer reviewed.

Part of our “Accidental overdose mortality” theme series.

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Abstract

Introduction: Substance-related acute toxicity deaths (ATDs) are a public health crisis in Canada. Youth are often at higher risk for substance use due to social, environmental and structural factors. The objectives of this study were to understand the characteristics of youth (aged 12–24 years) dying of accidental acute toxicity in Canada and examine the substances contributing to and circumstances surrounding youth ATDs.

Methods: Data from a national chart review study of coroner and medical examiner data on ATDs that occurred in Canada between 2016 and 2017 were used to conduct descriptive analyses with proportions, mortality rates and proportionate mortality rates. Where possible, youth in the chart review study were compared with youth in the general population and youth who died of all causes, using census data.

Results: Of the 732 youth who died of accidental acute toxicity in 2016–2017, most (94%) were aged 18 to 24 years. Youth aged 20 to 24 who were unemployed, unhoused or living in collective housing were overrepresented among accidental ATDs. Many of the youth aged 12 to 24 who died of accidental acute toxicity had a documented history of substance use. Fentanyl, cocaine and methamphetamine were the most common substances contributing to death, and 38% of the deaths were witnessed or potentially witnessed.

Conclusion: The findings of this study point to the need for early prevention and harm reduction strategies and programs that address mental health, exposure to trauma, unemployment and housing instability to reduce the harms of substance use on Canadian youth.

Keywords: *substance use, drug overdose, opioid overdose, acute toxicity deaths, children, youth, young adults, Canada*

Introduction

Substance-related acute toxicity deaths (ATDs) are a public health crisis in Canada that have had a serious impact on youth. Between 2013 and 2017, there was a 53% increase in rates of opioid poisoning-related hospitalizations of youth aged 15 to 24.¹ In March 2022, pediatricians reported

seeing a concerning number of children and youth with severe or life-threatening cases of opioid, stimulant or sedative use in the previous 24 months.² Youth face unique social, environmental and structural factors that contribute to substance use and can lead to poor overall health, mental health conditions and death.^{3,4}

Highlights

- In 2016 and 2017, nearly half (46%) of all accidental deaths among youth 18 to 24 years of age were due to acute toxicity.
- Youth aged 20 to 24 who were unemployed, living in collective housing or unhoused were overrepresented among those who died of accidental acute toxicity.
- Almost one-third (30%) of youth 12 to 24 years of age who died of accidental acute toxicity had at least one documented potentially traumatic event during their life.
- Opioids (fentanyl, morphine, diacetylmorphine [heroin], carfentanil) and stimulants (cocaine, methamphetamine, amphetamine) of non-pharmaceutical origin were the most common contributors to accidental acute toxicity deaths among youth aged 12 to 24 years.
- Thirty-eight percent of the accidental acute toxicity deaths in youth were witnessed or potentially witnessed.

As the risk of ATD is often higher for youth with a history of substance use or substance use disorders, it is critical to explore the risk factors of substance use

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and substance use disorders in order to understand the risk of ATD.^{5,6} Adolescents' risk factors for substance use and substance use disorders are unique to this age group due to the many changes that come with this transitional period of life.⁵ Some risk factors include adverse childhood experiences (such as abuse, traumatic events, neglect and mental health conditions in family members),^{3,4} mental health conditions,^{7,9} history of correctional involvement¹⁰ and family history of substance use.^{3,4}

Analyses of death investigation data from Ontario and British Columbia and linkage of census and vital statistics data have revealed factors specifically associated with ATDs among Canadian youth.^{6,11-12} These factors include neighbourhood-level income inequality,¹¹ living arrangements and housing instability, the absence of a bystander who could intervene, a mental health diagnosis^{6,12} and receipt of current or previous child, youth or family services.¹²

Previous research has highlighted challenges in opioid-related services for youth, including gaps in the continuum of care, inaccessibility of services, stigma, lack of respect for youth autonomy and a lack of family supports.¹³⁻¹⁶ Opioid agonist therapy prescription rates and residential treatment rates have been declining among Ontario youth since 2014, despite increasing opioid-related youth ATDs.⁶ About half of the youth who died from opioid-related acute toxicity in Ontario had an opioid use disorder. Difficulties youth face in accessing treatment or harm reduction services that suit their needs and preferences limit their protection from an increasingly toxic and unpredictable illegal drug supply. Nonpharmaceutical fentanyl has been the primary contributor to youth ATDs in Ontario and British Columbia in recent years.^{6,12} Youth who use substances intermittently may be at particular risk of opioid toxicity because they have less experience and lower opioid tolerance.¹⁷

Previous research has explored ATDs within provinces or cities or with a focus on sub-populations of youth, but only a few studies have examined ATDs among youth at a national level in Canada.^{6,11-12,18-21} The purpose of this study was to address these knowledge gaps by examining ATDs among youth based on Canadian death investigation data from 2016 and 2017, and to set a

baseline in the early years of the overdose crisis for comparison with future research. The objectives of this study were

(1) to report the minimum prevalence of risk factors for substance use and substance use disorders identified by previous research among youth who died of accidental acute toxicity in Canada in 2016 and 2017;

(2) to examine the most common substances contributing to ATDs among youth; and

(3) to describe the circumstances of ATDs among youth.

Methods

Ethics approval

This study was reviewed and approved by the Public Health Agency of Canada Research Ethics Board (REB 2018-027P), the University of Manitoba Health Research Ethics Board (HS22710) and Newfoundland and Labrador Health Research Ethics Board (20200153).

Data sources

This analysis uses data on 732 accidental ATDs of youth taken from a retrospective chart review study of coroner and medical examiner death investigations of ATDs in all Canadian provinces and territories that occurred between 1 January 2016 and 31 December 2017.²² An ATD is defined as a death after an acute toxicity due to the direct effects of one or more drugs or alcohol.²³ Further details on the study protocol and the variables collected have been published elsewhere.²² Using census data from 2016²⁴⁻²⁷ and Canadian Vital Statistics - Death data from 2016 and 2017²⁸ permitted comparisons to the general population and the calculation of mortality rates.

Youth definition

In this study, youth are defined as individuals 12 to 24 years of age. To capture the differences among youth within this age range, this study stratifies youth into two categories: those between 12 and 17 years of age and those between 18 and 24 years of age. Each group has unique characteristics, and some variables are more age-dependent than others. Youth between 12 and 17 years of age are most

likely students who live with parents or guardians, whereas youth aged 18 years and older may be legally permitted to use some substances and may no longer live with a parent or guardian and may have increased independence.

While youth aged 12 years and older are more likely to be actively using substances, children younger than 12 are more likely to experience accidental exposure to substances. Given the difference in the type of exposure (unintentional use is a different phenomenon from intentional use of substances) and the small number of ATDs in this age group, children under 12 were excluded from this study. Most of the analysis in this study includes youth aged between 12 and 24. However, to compare with the 2016 Census data, results for those aged 20 to 24 years are presented separately.

Variables of interest

The primary outcome variable in this analysis was ATDs. The chart review study dataset provided data on previously identified risk factors for substance use, substance use disorders and ATDs among youth. These include sociodemographic factors (i.e. age, sex, employment status, living arrangement) and social or medical history (i.e. history of incarceration, contact with health services in the preceding year, history of mental health conditions or symptoms, history of substance use, history of substance use disorder and potentially traumatic life events).

Contact with health services includes inpatient admission (hospital or other) and outpatient treatment (e.g. emergency medical services, emergency department, general practitioner or nurse practitioner).

Potentially traumatic events are used as the best comparable measure to adverse childhood events from the death investigation files. Potentially traumatic events include one-off events, series of events or circumstances that are physically or emotionally harmful or life threatening and could have lasting adverse effects on the person's mental, physical, social, emotional or spiritual well-being.²⁹ They might include a health problem of a family member or relative, intimate partner problems, other relationship problems (e.g. a family argument), job or school problems, financial problems, the recent death of a friend or family member, criminal or other

legal problems (e.g. custody dispute, civil suit), perpetrating or being a victim of interpersonal violence or a victim of child abuse, foster care experiences, experiencing sexual abuse, or experiencing physical abuse or assault.

These variables were collected from any available source in the death investigation file, which might include statements from family, friends or a primary health care provider, medical records, autopsy reports or police reports, for example. Therefore, some of the medical conditions reported may not necessarily have been medically diagnosed. Where available, residential postal codes were linked to Statistics Canada's Postal Code Conversion File Plus to obtain area-based neighbourhood income quintile after tax (QAATIPPE).³⁰

In this paper, the substances contributing to death are reported by their origin (pharmaceutical or nonpharmaceutical) and whether the substance contributed to death alone or in combination with other substances.

Variables that indicate the circumstances of the acute toxicity events and death include the most likely mode of substance use, the presence of a witness, the actions taken by the witness during the first and subsequent encounters, the administration of naloxone for youth with symptoms of opioid toxicity, the place of the acute

toxicity event and the place of death. We also examined whether the place of the acute toxicity event was indoors or outdoors, whether the person was found in or near a bed or in a vehicle and, in the case of youth who experienced the acute toxicity event inside their personal residence, whether they lived alone or with someone else.

Statistical methods

To calculate accidental acute toxicity mortality rates and proportionate mortality due to acute toxicity, we used population data from the 2016 Census and all-cause accidental death counts from the Canadian Vital Statistics - Deaths Database as denominators.^{24,28} As a person's entire life history is not documented in coroner and medical examiner files and there is variation in what is collected across jurisdictions, there is likely additional history and information that was not captured. The results of this study should therefore be considered the minimum proportions of youth that had a given characteristic. Census data were used to compare proportions and calculate mortality rates for youth aged 20 to 24 by employment status and living arrangement.²⁵⁻²⁷ For the remainder of the analyses, the minimum proportions of youth aged 12 to 24 who had a given characteristic were calculated. An UpSet plot was constructed using the ComplexUpSet package to identify the most common

substances and substance combinations contributing to death, and their origin.³¹

All statistical analyses were performed using R statistical software version 4.1.1.³² To protect privacy, cell sizes less than 10 were either suppressed or grouped into larger categories, all counts were randomly rounded to base 3 and proportions and mortality rates were based on rounded counts.²²

Results

Burden of acute toxicity deaths among youth

Overall, there were 732 people aged 12 to 24 years who died of accidental acute toxicity, and most of these youth were between 18 and 24 years of age (94%; Table 1). Death due to accidental acute toxicity accounted for nearly half (46%) of all-cause accidental mortality among youth aged 18 to 24. Among youth aged 12 to 17 years, the contribution of acute toxicity to all-cause accidental deaths was higher among females (23%) than males (11%).

Characteristics of youth who died of accidental acute toxicity

A subset of 567 youth between 20 and 24 years of age who died of accidental acute toxicity in 2016 or 2017 were compared

TABLE 1
Number of deaths, mortality rates and proportionate mortality rates for youth aged 12 to 24 years in Canada who died from accidental substance-related acute toxicity in 2016 and 2017

Measure	Youth aged 12–24 years	Youth aged 12–17 years	Female youth aged 12–17 years	Male youth aged 12–17 years	Youth aged 18–24 years	Female youth aged 18–24 years	Male youth aged 18–24 years
Number of acute toxicity deaths	732	42	24	18	690	183	507
Total population in 2016	5 418 470	2 339 370	1 139 935	1 199 430	3 079 100	1 505 960	1 573 145
Mortality rate due to accidental acute toxicity per 100 000 population	6.8	0.9	1.1	0.8	11.2	6.1	16.1
Total accidental deaths in 2016 and 2017	1 770	270	105	165	1 500	390	1 110
Proportionate accidental acute toxicity mortality rate in relation to all-cause accidental deaths ^a	41%	16%	23%	11%	46%	47%	46%

Data sources: National Chart Review Study of Substance-Related Acute Toxicity Deaths.²² The denominator for each group's mortality rates is from the 2016 Census.²⁴ The all-cause mortality counts by demographic group used to calculate proportionate mortality rates were provided by Statistics Canada from the Canadian Vital Statistics - Death database.²⁸ All accidental deaths include *International Classification of Diseases 10th Revision* (ICD-10) codes: V01–V99, W00–W99, X00–X59, Y85 and Y86.

Notes: Counts from the National Chart Review Study of Substance-Related Acute Toxicity Deaths were randomly rounded to base 3, and proportions and rates are based on rounded counts. Deaths due solely to prescribed substances or alcohol were not available from British Columbia; therefore, acute toxicity deaths in this table may be underestimates.

^a All-cause accidental death estimates are rounded using Statistics Canada's controlled rounding process for confidentiality purposes. The counts exclude the deaths of nonresidents of Canada. The cause of death is tabulated as the underlying cause of death. This is defined as (a) the disease or injury that initiated the train of events leading directly to death, or (b) the circumstances of the accident or violence that produced the fatal injury. This underlying cause is selected from a number of conditions listed on the death registration form.

to youth of the same age using 2016 Census data (Table 2). The employment status of youth who died of acute toxicity was most often unknown (49%), and the other employment status categories in Table 2 represent the minimum proportions of youth in that category. At least 23% of individuals who died were employed and at least 18% were unemployed. Given the number of unknowns, the employment rate among those who died of acute toxicity may be lower, equivalent or higher than the rate in the general population. However, unemployment was more prevalent among youth who died (at least

18% but perhaps higher) than among youth in the general population (11%). The mortality rate due to acute toxicity for youth who were unemployed was 20.4 per 100 000.

While most youth aged 20 to 24 lived in a private dwelling (70%), 4% lived in a collective dwelling and 9% were unhoused at the time of their death. Youth who were living in collective dwellings or unhoused were overrepresented among those who died of acute toxicity when compared to the general population. We did not calculate mortality rates for these two groups

due to differences in the definitions used by the two data sources.

Table 3 presents the characteristics of the 732 youth aged 12 to 24 years who died of accidental acute toxicity in 2016 and 2017. Commonly documented mental health conditions or symptoms in this group included depressive disorder or depressive symptoms (22%), substance use disorder (excluding alcohol; 20%), anxiety disorder (16%) and suicidal ideation or suicide attempt (12%). Eighty-three percent of youth had a documented history of substance use, and more than

TABLE 2
Comparison of employment status and living arrangements for youth aged 20 to 24 years who died of accidental acute toxicity (2016 to 2017) and in the Canadian general population (2016)

Characteristic	Proportion of youth who died of accidental acute toxicity in 2016 or 2017, % (n)	Proportion of youth in the general Canadian population in 2016, % (n)	Rate of accidental deaths due to acute toxicity per 100 000 population, (95% CI)
Total youth aged 20 to 24 years	567	2 242 690	12.6 (11.6–13.7)
Employment status^a			
Employed ^b	23 (132)	65 (1 466 900)	4.5 (3.7–5.3)
Unemployed ^c	18 (99)	11 (243 215)	20.4 (16.3–24.4)
Student (full-/part-time)	7 (39)	—	—
Social assistance program ^d	3 (18)	—	—
Illegal sources of income	3 (18)	—	—
Other income source	4 (21)	—	—
Unknown	49 (276)	<1 (21 015) ^e	—
Not in the labour force	—	23 (511 560) ^f	—
Living arrangement			
Private dwelling	70 (399)	99 (2 221 685)	9.0 (8.1–9.9)
Collective dwelling ^g	4 (24)	<1 (20 940)	Not calculated
Unhoused	9 (51) ^h	<1 (1 855) ⁱ	Not calculated
Other dwelling type	Suppressed	—	—
Unknown	15 (84)	—	—

Abbreviation: CI, confidence interval.

Data sources: National Chart Review Study of Substance-Related Acute Toxicity Deaths²²; Statistics Canada, 2016 Census of Population, Statistics Canada Catalogue Nos. 98-316-X2016001,²⁴ 98-400-X2016198,²⁵ 98-400-X2016021²⁶ and 98-400-X2016018.²⁷

Notes: This age range (20–24 y) was used in the table to align with the age range used in census data. “—” indicates that a comparable statistic was not available in census data or chart review study data. “Not calculated” indicates that a similar statistic was available in census data, but the variable definitions were too different to calculate a mortality rate. Counts from the National Chart Review Study of Substance-Related Acute Toxicity Deaths are randomly rounded to base 3, and percentages and rates are based on rounded counts.

^a More than one selection may have been made for youth who died of acute toxicity, as the options were not mutually exclusive. Only one selection could be made in census data.

^b Includes those who are employed full-time and part-time, and seasonal workers.

^c The definition for unemployed used by the census may not be equivalent to the definitions used by the coroner and medical examiner offices.

^d Includes disability support.

^e Individuals aged 20 to 24 from the 2016 Census (98-316-X2016001) who are not accounted for in the labour force status statistics (98-400-X2016198).

^f People who are not in the labour force include students, retired persons, unpaid family workers and others not looking for work.

^g Includes supportive or transitional housing and health or correctional facility (mental health facility, substance use/addictions treatment facility, harm reduction residence, correctional facility or police custody). The chart review study did not include people living in shelters in this category, but they are included in the census count. The mortality rate for people who lived in collective dwellings was not calculated given the difference in definitions for the study and the census.

^h Acute toxicity deaths data include people who are unsheltered, emergency sheltered, provisionally accommodated, at immediate risk of homelessness or hidden homelessness.

ⁱ 2016 Census data only include people in shelters. The mortality rate for people who were unhoused was not calculated given the difference in definitions for the study and the census.

TABLE 3
Characteristics of youth aged 12 to 24 years who died of accidental acute toxicity in Canada, 2016 or 2017

Characteristic	Proportion of youth who died of accidental acute toxicity (N = 732), % (n)
Documented mental health conditions or symptoms^a	
Depressive disorder or depressive symptoms	22 (162)
Substance use disorder (excluding alcohol)	20 (147)
Anxiety disorder	16 (117)
Suicidal ideation/suicide attempt	12 (84)
Alcohol use disorder	5 (39)
Unknown	29 (210)
History of substance use (drugs and/or alcohol)	
Yes	83 (606)
Contact with health services in the year preceding death	
Yes	59 (432)
Potentially traumatic life events^b	
Any potentially traumatic events in their lifetime	30 (219)
Criminal legal problem (e.g. arrest, jail, court)	14 (102)
Relationship problem not concerning intimate partner (e.g. family argument)	6 (45)
Any potentially traumatic events within 2 weeks of death	5 (36)
History of incarceration^c	
Yes	6 (45)
Neighbourhood-level income quintile	
Q1 (lowest)	26 (192)
Q2 (medium-low)	16 (114)
Q3 (middle)	12 (90)
Q4 (medium-high)	12 (90)
Q5 (highest)	10 (72)
Unknown	24 (174)

Data source: National Chart Review Study of Substance-Related Acute Toxicity Deaths.²²

Abbreviation: Q, quartile.

Notes: Counts from the National Chart Review Study of Substance-Related Acute Toxicity Deaths are randomly rounded to base 3, and percentages are based on rounded counts.

^a More than one selection may have been made as the options were not mutually exclusive. Any mention of a mental health condition or symptom was abstracted but these may not all have been medically diagnosed.

^b More than one type of potentially traumatic event could be documented for each person. Only the types of potentially traumatic events that occurred for more than 5% of youth that died are shown in this table.

^c Information protected by the *Youth Criminal Justice Act*;³³ may be less available in coroner and medical examiner files.

half (59%) had contact with health care services in the year preceding their death. At least 30% of the youth had experienced a potentially traumatic event in their lifetime, the most common of these being a criminal legal problem (e.g. arrest, jail time, court hearing; 14%). About one in 20 (5%) experienced a potentially traumatic event in the two weeks before their death. Youth from the lowest neighbourhood income quintile were overrepresented among those who died. It is likely

that many of the youths with unknown residential postal codes also belonged to lower income quintiles, because at least one-quarter of those with unknown postal codes were unhoused at the time of their death (data not shown).

Substances contributing to accidental ATDs

Fentanyl (56%), cocaine (30%), methamphetamine (18%) and ethanol (alcohol;

16%) were the most common substances identified as contributing to death among youth who died by accident (Table 4). Seven of the substances contributing to at least 5% of deaths were opioids (fentanyl, morphine, diacetylmorphine [heroin], carfentanil, methadone, oxycodone and hydro-morphone); four were stimulants (cocaine, methamphetamine, amphetamine and MDMA); and the other two were alcohol and a benzodiazepine (alprazolam). The substances contributing to accidental deaths for youth were most often of non-pharmaceutical origin. Carfentanil, methadone, fentanyl, cocaine and ethanol (alcohol) contributed to deaths on their own (without the contribution of other substances) more often than other substances.

The substances and substance combinations that were the most common contributors to accidental deaths among youth 12 to 24 years of age were fentanyl alone (111 deaths, 15% of youth) and fentanyl and cocaine in combination (36 deaths, 5% of youth; Figure 1). Most of the top substances and combinations involved opioids and/or stimulants, and most were drugs of nonpharmaceutical origin.

Circumstances of accidental acute toxicity event and death

During the acute toxicity event that led to death, the mode of substance use by youth aged 12 to 24 was most often unknown; however, similar proportions of youth were likely using substances orally (15%), through nasal insufflation (snorting; 14%), smoking (13%) or injection (11%; Table 5).

For 38% (279) of youth, the acute toxicity event was witnessed or potentially witnessed (the person was still alive when found, or it was unclear) (Table 5). In these situations, witnesses called 911 58% of the time and attempted resuscitation 32% of the time. No action was taken by potential witnesses for one in four acute toxicity events (25%). When no action was taken at the first encounter, the potential witnesses believed the individual was sleeping 61% of the time. Other reasons the potential witness might not have taken action at the first encounter included not recognizing a medical emergency or lack of access to a phone, for example.

During subsequent encounters, potential witnesses called 911 in 91% of cases and attempted resuscitation in 35% of cases.

TABLE 4
Origin of the most common substances contributing to accidental acute toxicity deaths among youth 12 to 24 years of age in Canada, 2016 to 2017

Most common substances contributing to death	Deaths where substance contributed (N = 732), n (%)	When substance contributed to death, the origin of the substance, ^a n (%)			When substance contributed to death, the contribution of other substances, n (%)	
		Nonpharmaceutical	Pharmaceutical	Unknown	None	Multiple substances contributed
Fentanyl	408 (56)	213 (52)	Suppressed	189 (46) ^b	111 (27)	297 (73)
Cocaine	216 (30)	208 (100)	NA	NA	24 (11)	189 (88)
Methamphetamine	132 (18)	125 (100)	NA	NA	Suppressed	126 (96)
Ethanol (alcohol)	117 (16)	NA	NA	NA	12 (10)	102 (87)
Morphine	96 (13)	21 (22)	0 (0)	78 (81)	Suppressed	90 (94)
Amphetamine	84 (12)	15 (18)	Suppressed	68 (81)	Suppressed	81 (96)
Diacetylmorphine (heroin)	75 (10)	75 (100)	NA	NA	Suppressed	72 (96)
Alprazolam	72 (10)	NA	72 (100)	NA	Suppressed	69 (96)
Carfentanil	63 (9)	51 (100)	NA	NA	24 (38)	39 (62)
Methadone	48 (7)	NA	45 (100)	NA	15 (31)	33 (69)
Oxycodone	39 (5)	NA	39 (100)	NA	0 (0)	39 (100)
Hydromorphone	36 (5)	NA	36 (100)	NA	Suppressed	30 (83)
MDMA	36 (5)	36 (100)	NA	NA	Suppressed	27 (75)
For all deaths	732 (100)	534 (73)	213 (29)	84 (12)	480 (66)	237 (32)

Data source: National Chart Review Study of Substance-Related Acute Toxicity Deaths.²²

Abbreviation: NA, not applicable.

Notes: More than one substance can be identified as a contributor to death in a single ATD. Some of the substances in this table are active metabolites of other substances. For example, morphine is a metabolite of heroin and amphetamine is a metabolite of methamphetamine. Their presence in toxicology might indicate that they were consumed, or a parent substance was consumed. Counts from the National Chart Review Study of Substance-Related Acute Toxicity Deaths are randomly rounded to base 3, and percentages are based on rounded counts.

^a A substance can have more than one origin. Some substances have only one origin and the other is not applicable (NA).

^b In most cases where fentanyl is listed as being of unknown origin, it is due to data being unavailable from British Columbia. As pharmaceutical fentanyl is not widely available, nearly all fentanyl of unknown origin is likely to have been nonpharmaceutical.

When individuals showed symptoms of opioid toxicity (such as snoring or gurgling, difficulty breathing, pinpoint pupils, being unconscious or unresponsive, or blue lips, fingernails or face), naloxone was given at least 34% of the time.

The most common place of acute toxicity event was in a personal residence setting (60%) followed by the home of another person (15%). A minority of acute toxicity events occurred outside (6%) or inside a vehicle (4%). Almost one-third of those who died were found in or near a bed (31%). Most youth died where the acute toxicity event occurred (70%), while 23% died in a hospital.

Discussion

The findings of this study highlight the minimum prevalence of factors among accidental youth ATDs that previous researchers have identified as important for youth substance use, substance use disorders, and ATDs. Most youth who

died of acute toxicity had a history of substance use (83%), and 20% had a documented history of a substance use disorder. Mental health conditions or symptoms such as depressive disorder or depressive symptoms, anxiety disorder and suicidal ideation or suicide attempts were commonly documented among youth who died of acute toxicity.

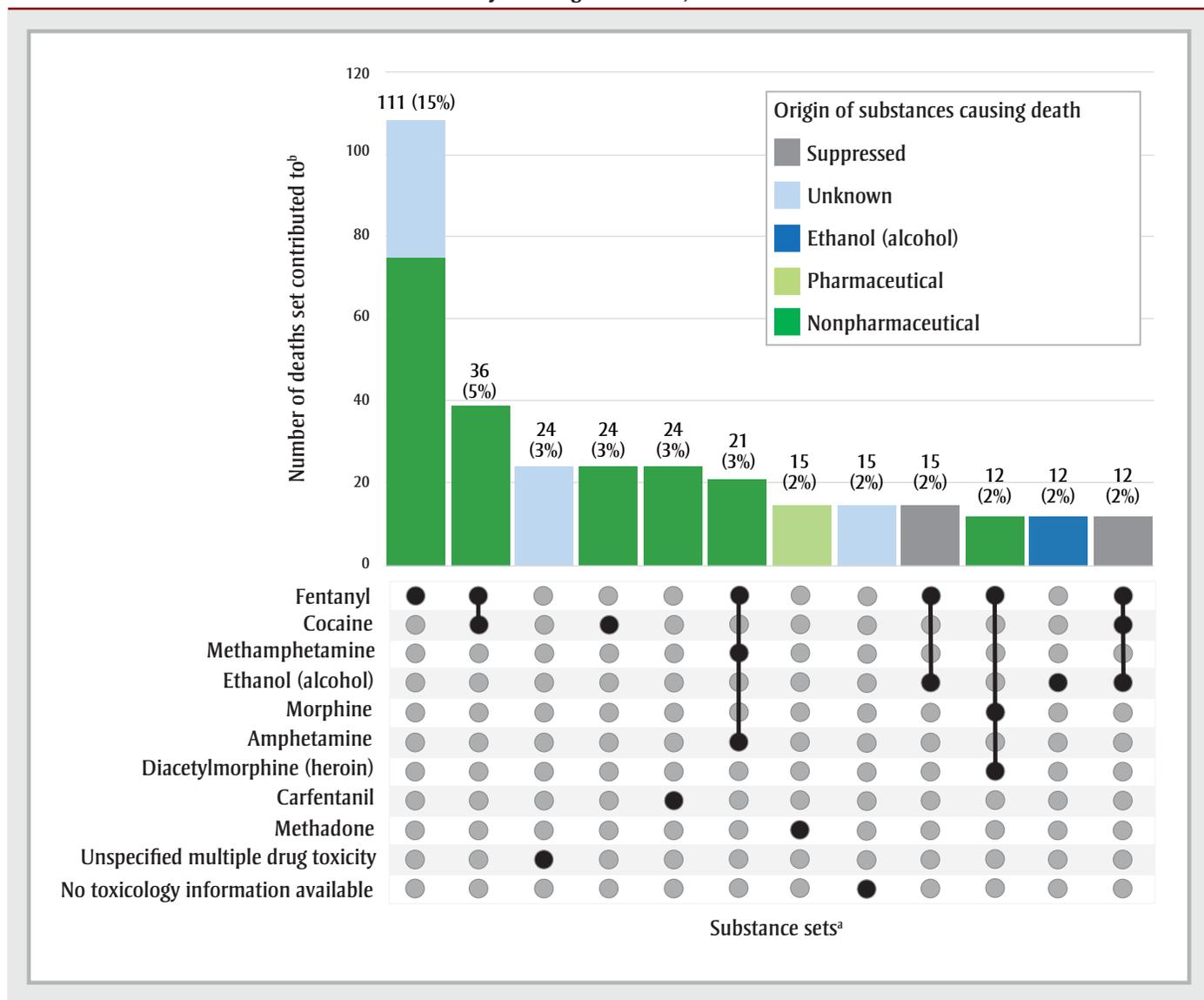
Previous research has pointed to the relationship between mental illness, history of substance use and substance use disorders;^{5-6,12} this study's findings further illuminate the need for early prevention, treatment and harm reduction for substance use and accessible mental health care and supports for youth to prevent ATDs. More than half of youth had contact with health services in the year preceding their death, suggesting a potential opportunity for intervention. Ensuring that substance use services for youth are appropriately tailored to the unique needs of this population is important. Improved and targeted supports for youth, including

during transitions to early adulthood, could reduce harms in this population.

Additionally, about one-third of youth who died of accidental acute toxicity experienced at least one potentially traumatic event in their lifetime. This finding aligns with existing literature on the role that trauma plays in substance use disorders.³⁴ However, different types of traumatic events may impact individuals differently, and may or may not always be related to substance use. Death investigations do not deliberately set out to collect potentially traumatic events that occurred earlier in life; therefore, the number of youth who had been exposed to traumatic events is likely higher than was documented in this study. In British Columbia, 73% of youth aged 18 and younger who died of an unregulated drug-related acute toxicity were in receipt of child, youth or family services.¹²

The results of this study also suggest potential opportunities for targeted upstream

FIGURE 1
UpSet plot of the most frequent substances and substance combinations contributing to accidental deaths for youth 12 to 24 years of age in Canada, 2016 to 2017



Data source: National Chart Review Study of Substance-Related Acute Toxicity Deaths.²²

Notes:

(a) The grid of substance sets displays specific substances and combinations of substances contributing to death in columns. Substances are represented by black dots and combinations are joined by a black line. “Unspecified multiple drug toxicity” refers to cases in which multiple substances contributed to death but the specific substances were not identified. “No toxicology information” means that nothing is known about specific substances contributing to death or their number.

(b) The vertical bar chart shows the number of deaths for which a specific substance or substance combination described in the grid below contributed to death. The percentage of deaths due to the set is also shown above the bars. The bars are coloured to show the origin of the substances. As pharmaceutical fentanyl is not widely available, nearly all fentanyl of unknown origin is likely to be nonpharmaceutical.

Morphine and amphetamine are active metabolites of diacetylmorphine (heroin) and methamphetamine, respectively, and might be present in toxicology results because the parent substance was consumed (diacetylmorphine [heroin] or methamphetamine). Counts are randomly rounded to base 3. Sets contributing to fewer than 10 deaths were excluded from the plot. The substances in the UpSet plot differ from the substances most commonly contributing to death (Table 2) because exclusive combinations are prioritized over total number of deaths. For example, although alprazolam contributed to 10% of deaths, it does not appear in the UpSet plot because it was involved in a variety of combinations contributing to fewer than 10 deaths each.

interventions. Male youth aged 18 to 24 accounted for the highest proportion of youth ATDs. Unemployed youth had a very high mortality rate due to acute toxicity, though it is unknown if all people described as unemployed in their coroner or medical examiner file met the Statistics Canada definition. Youth who lived in

collective housing or were unhoused were overrepresented among those who died of acute toxicity. The Statistics Canada definition of collective housing includes more institution types than that used by the chart review study, yet the minimum proportion of youth who died of accidental acute toxicity and lived in collective

housing was higher than that of the general population of youth (4% and <1%, respectively). The Statistics Canada definition of being unhoused counted only those who were staying in a shelter, while the chart review study definition also included youth unsheltered on the street or temporarily staying with family or

TABLE 5
Circumstances of death for accidental acute toxicity events and deaths among youth 12 to 24 years of age in Canada, 2016 to 2017

Circumstances of death	Proportion, % (n)
Mode of substance use,^a N = 732	
Likely oral	15 (108)
Likely nasal insufflation or intranasal (snorting)	14 (102)
Likely smoking	13 (96)
Likely injection	11 (78)
Other or unknown ^b	57 (420)
Witnesses, N = 732	
No, individual deceased when found and no evidence event was witnessed	22 (162)
Unclear, unconscious or unresponsive when found	21 (150)
Yes, individual alive when found and showing symptoms of acute toxicity	12 (90)
Unclear, individual thought to be asleep	6 (42)
Unknown	39 (288)
Action taken when potential witness was at scene,^c N = 279	
Called 911	58 (162)
Attempted resuscitation ^d	32 (90)
No action taken	25 (69)
Other	23 (63)
When potential witness did not take action at first encounter, N = 69	
Witness thought they were sleeping	61 (42)
On subsequent encounter, called 911	91 (63)
On subsequent encounter, attempted resuscitation ^d	35 (24)
On subsequent encounter, took some other action ^e	17 (12)
Naloxone given to individuals showing symptoms of opioid toxicity,^f N = 255	
Yes	34 (87)
No	25 (63)
Unknown	41 (105)
Location of acute toxicity event, N = 732	
Indoor setting	
Personal residence	93 (684)
Home of another person	60 (441)
Hotel or motel	15 (108)
Public building	3 (21)
Substance use/addictions treatment facility	2 (15)
Other (all other indoor settings)	2 (12)
Other (all other indoor settings)	5 (36)
Outdoor setting	
Outdoor public place	6 (45)
Outdoor public place	5 (33)
Other (all other outdoor settings)	2 (12)
Unknown setting	
Unknown setting	8 (57)
Living situation of those who had the acute toxicity event inside their personal residence, N = 441	
Living with parents	20 (90)
Living with friends or roommates	9 (39)
Living alone	7 (30)
Living with partner (not common law or unknown if common law)	3 (12)

Continued on the following page

friends. Nevertheless, it is very concerning that nearly 1 in 10 youth who died of accidental acute toxicity were documented as unhoused—a situation that should be rare.

Developing prevention and harm reduction programs specifically for youth who are unemployed, living in collective housing or unhoused would reach a large proportion of youth at risk for ATD. These findings also highlight a need for improved service integration for this population, so that other social supports such as housing and employment that are often interrelated are easily accessible alongside mental health and substance use services.

The substances most commonly contributing to youth ATDs were opioids and stimulants of nonpharmaceutical origin. In Canada, illegal fentanyl was first recognized in 2011, and by 2016, opioids were among the top 10 controlled substances most detected by Canada's Drug Analysis Service (DAS).³⁵ Additionally, over half of the heroin samples tested by DAS between 2012 and 2017 contained fentanyl.³⁵ As youth may not have been aware of these changes in the drug supply, increasing awareness of the presence of fentanyl in other substances could potentially reduce accidental ATDs.^{4,36} People who have been using opioids for a long time develop a tolerance, requiring greater amounts over time to achieve the same effects.¹⁷ Those who have just started using substances or who have had a break in substance use—situations in which many youth may find themselves—cannot tolerate greater amounts, and highly toxic opioids such as fentanyl present a greater risk.

Evidence-based prevention and treatment for opioid toxicity such as naloxone access, opioid agonist treatment and supervised consumption sites are key.³⁷ Drug-checking services that are accessible to youth may allow them to test that the substances they purchase on the street are not contaminated with dangerous drugs.³⁷ Additionally, services that offer prescribed medications as an alternative to illegal drugs may give youth access to a safer supply while connecting them with health and social services.³⁸

Another important method to reduce the risk of an ATD is to not use substances alone.¹⁷ Only 38% of accidental acute toxicity events leading to death among youth

TABLE 5 (continued)
Circumstances of death for accidental acute toxicity events and deaths among youth 12 to 24 years of age in Canada, 2016 to 2017

Circumstances of death	Proportion, % (n)
Living with family (spouse, common law partner or children)	3 (12)
Other	4 (18)
Unknown	53 (234)
Specific setting of acute toxicity event, N = 732	
In or near bed	31 (228)
Vehicle	4 (27)
Location of death, N = 732	
Same as place of acute toxicity event	70 (513)
Hospital	23 (168)
Other	7 (51)

Data source: National Chart Review Study of Substance-Related Acute Toxicity Deaths.²²

Notes: Counts from the National Chart Review Study of Substance-Related Acute Toxicity Deaths are randomly rounded to base 3, and percentages are based on rounded counts.

^a More than one mode of use may have been selected, so the combined count does not equal the total number of ATDs in youth. There can be uncertainty about the mode of drug use; therefore, these are described as the mode of use most likely based on evidence available in the death investigation file.

^b Includes unknown or other modes of use (e.g. transdermal patches); these categories have been collapsed because of small cell sizes.

^c The denominator for “action taken” proportion calculations is the number of ATDs in which the person was still alive (or if it was unclear if they were still alive) when found. More than one action may have been taken by each potential witness; these actions are not mutually exclusive.

^d Includes CPR, rescue breathing, stimulation, giving epinephrine, giving oxygen and other resuscitative activities.

^e Includes calling someone else, other, and no action taken.

^f The denominator for “Naloxone given to individuals showing symptoms of opioid toxicity” proportion calculations is the number of ATDs for which opioid toxicity symptoms (such as snoring, difficulty breathing, loss of balance, confusion, or if the individual was asleep) were observed.

were witnessed or potentially witnessed by someone who could call for help or give aid. Among the youth whose fatal acute toxicity event occurred in their personal residence, 20% lived with their parents, 9% lived with friends or roommates and only 7% were living alone. For many of those who died, someone might have been nearby while they used substances, but stigma may have prevented the youth from telling others about their substance use and having someone who could support them in the event of an emergency.³⁹

The ability of the bystander to recognize and respond to an acute toxicity event is also important. About one in three youth were found in or near a bed, and when bystander actions were delayed, it was most often due to a belief that the person was asleep or sleeping off substance use. These findings suggest a need for increasing awareness of the signs of acute toxicity and how it may be confused with sleep so that bystanders can better recognize the medical emergency.

Other reasons bystanders might not act immediately could be the absence of a phone to call 911 or not having naloxone on hand, for example. Improving access to naloxone and the means of calling emergency health services would increase bystanders’ ability to act more rapidly.

Targeted public education and awareness efforts on the toxicity of the drug supply and recognizing and responding to an overdose, as well as to reduce stigma around substance use in this population remain important. It is also relevant to note that the study period reflects the early stages of the overdose crisis before communications and messaging efforts were widely increased.

Some of the youth in this study were above the legal threshold for majority, and some were below; there are big differences in how laws, policies and practices are applied to these two groups.³⁶ While minors are often grouped together in these analyses due to small counts, interventions for youth under the age of 18 must

consider the roles of parents and guardians and children’s rights.

Strengths and limitations

This study provides an important baseline to examine ATDs among Canadian youth on the national level near the beginning of the overdose crisis. Coroner and medical examiner data provide details on the circumstances of death, such as the location of death and the presence of witnesses, and are often more comprehensive than other mortality data sources.

However, it is important to note that death investigations are not methodologically designed to collect all variables of interest to our study, and some variables may be more likely to have missing data than others. Information protected by the *Youth Criminal Justice Act*,³³ such as history of incarceration, may have been less available in the death investigation files for youth. Based on the numbers reported by British Columbia,¹² death investigation files provide limited documentation of child, youth or family services received by youth who died. Therefore, as information is missing for many of our variables of interest, the findings in this analysis only represent the minimum proportions of youth characteristics, and the mortality rates and proportions presented are likely underestimated.

Both the drug supply and environmental stressors have changed since the study period in 2016 and 2017, particularly during the years of the COVID-19 pandemic. Some of the findings may no longer be as relevant to youth today, as the substances contributing to death and the harm reduction practices adopted by youth may have changed since 2017. There has been conflicting evidence on whether substance use among youth decreased or increased during the COVID-19 pandemic; changes in the patterns of substance use may be due to other factors.⁴⁰⁻⁴³

Based on an Ontario comparison of youth aged 15 to 24 who died of opioid-related acute toxicity during the pre-pandemic period versus the pandemic period, we might expect to see an increase in the proportion of deaths to which nonpharmaceutical fentanyl or benzodiazepines contributed, fewer deaths outdoors and an increase in substance use via inhalation or smoking in recent years across Canada after our study period.⁶ However, as the

pace of change and context of the overdose crisis varies across provinces and territories, it is difficult to extrapolate from one province to the national level.

Nevertheless, despite the older study period, this study identified concerning upstream factors that were highly prevalent among youth who died of acute toxicity and can serve as a baseline for future studies.

Conclusion

This study provides an important baseline near the beginning of the overdose crisis for examining ATDs among Canadian youth on the national level, and will support future work investigating how the crisis has evolved over time. Understanding the characteristics of youth who died of accidental acute toxicity, the substances contributing to their deaths and the circumstances of death can inform harm reduction and social programs and policies to better meet the needs of youth and prevent further acute toxicity deaths. Additionally, these findings highlight the need to implement early prevention interventions that address mental health, exposure to trauma, unemployment and homelessness to reduce the harms of substance use on Canadian youth.

Acknowledgements

We would like to acknowledge our collaborators at the offices of chief coroners and chief medical examiners across Canada for providing access to their death investigation files, and Jenny Rotondo, Brandi Abele, Songul Bozat-Emre, Matthew Bowes, Jessica Halverson, Dirk Huyer, Beth Jackson, Graham Jones, Jennifer Leason, Regan Murray, Erin Rees and Emily Schleihauf for their contributions to developing the National Chart Review Study of Substance-Related Acute Toxicity Deaths.

Conflicts of interest

None.

Authors' contributions and statement

YSC, AV, KM, FK: Conceptualization.

YSC, AV: Analysis.

YSC: Writing—original draft.

YSC, AV, KM, FK: Writing—review & editing.

YSC, AV: Project administration.

AV: Supervision.

The content and views expressed in this article are those of the authors and do not necessarily reflect those of the Government of Canada. This report is based on data and information compiled and provided by the offices of chief coroners and chief medical examiners across Canada. However, the analyses, conclusions, opinions and statements expressed herein are those of the authors, and not necessarily those of the data providers.

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Original quantitative research

Accidental substance-related acute toxicity deaths in older adults in 2016 and 2017: a national chart review study

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This article has been peer reviewed.

Part of our “Accidental overdose mortality” theme series.

Research article by Ha JH et al.
in the HPCDP Journal.
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Abstract

Introduction: Limited research exists on substance-related acute toxicity deaths (ATDs) in older adults (≥ 60 years) in Canada. This study aims to examine and describe the sociodemographic characteristics, health histories and circumstances of death for accidental ATDs among older adults.

Methods: Following a retrospective descriptive analysis of all coroner and medical examiner files on accidental substance-related ATDs in older adults in Canada from 2016 to 2017, proportions and mortality rates for coroner and medical examiner data were compared with general population data on older adults from the 2016 Census. Chi-square tests were conducted for categorical variables where possible.

Results: From 2016 to 2017, there were 705 documented accidental ATDs in older adults. Multiple substances contributed to 61% of these deaths. Fentanyl, cocaine and ethanol (alcohol) were the most common substances contributing to death. Heart disease (33%), chronic pain (27%) and depression (26%) were commonly documented. Approximately 84% of older adults had contact with health care services in the year preceding their death. Only 14% were confirmed as having their deaths witnessed.

Conclusions: Findings provide insight into the demographic, contextual and medical history factors that may influence substance-related ATDs in older adults and suggest key areas for prevention.

Keywords: *drug overdose, opioid overdose, mortality, older adults, substance use, Canada, acute toxicity*

Highlights

- Males 60 years or older had a higher mortality rate due to accidental acute toxicity than females.
- When a pharmaceutical substance contributed to accidental acute toxicity death, 61% of older adults had a prescription for the substance. At least one nonpharmaceutical substance contributed to 43% of accidental older adult acute toxicity deaths.
- Multiple substances contributed to most of the accidental deaths (61%), with fentanyl, cocaine and ethanol (alcohol) most often contributing to death.
- Almost three-quarters of the older adults who died of acute toxicity had accessed health care in the year preceding death.

Introduction

Substance-related acute toxicity deaths (ATDs) are an ongoing public health issue in Canada. At the national level, data on substance-related ATDs in specific sub-populations, for example, individuals aged 60 years and older, are limited. What is known is that people in this age group made up 9% to 11% of apparent opioid toxicity deaths from 2016 to 2022 and 8% to 10% of apparent stimulant toxicity deaths from 2018 to 2022.¹ This study aims to better understand the characteristics of people aged 60 years and older

who died of acute toxicity as well as the substances involved and circumstances of their deaths.

Several biomedical factors put older adults at high risk for acute toxicity: pharmacokinetic changes with age include increased body fat that prolongs the half-life of fat-soluble drugs (e.g. diazepam); decreased body water, which increases concentrations of water-soluble drugs (e.g. ethanol); reduced metabolism, which can lead to higher steady-state concentrations of some drugs (e.g. alprazolam); and reduced

excretion of drugs (e.g. morphine) due to decreased cardiac output and kidney function.² Very few clinical studies have been conducted to examine changes in pharmacokinetics and pharmacodynamics as people age, although adverse drug reactions are known to include increased mortality.²

For opioids in particular, the expected efficacy and side effects may change as regular biological functions change with age.³ Changes in drug distribution and impairment of metabolism and elimination of

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drugs can increase the potency, duration of action, and side effects of opioids.³ Disparities in drug distribution between older and younger adults may be due to decreases in digestion time and increases in gastric pH caused by medications commonly used by older people, as well as increases in adipose tissue combined with decreases in overall body mass and water volume.³

Older adults are more likely to have multiple prescriptions for multiple conditions, including for opioids for pain management,^{4,5} which increases the likelihood of incorrect ingestion of dosages as well as of errors in prescribing.⁶⁻⁸ A population-based cohort study from Ontario, Canada, found that adults older than 45 years and women were more likely to have an active opioid prescription at the time of death than adults younger than 25 years and men.⁹

Some older adults also use substances for relief of unmet medical or psychological needs or non-medical reasons. For example, among people aged 65 and older who consumed cannabis for medical and non-medical reasons, 72% did so for pain-related reasons, 29% to help with problems sleeping and 12% to manage anxiety or depression.¹⁰ About 6.1% of people aged 60 to 75 years reported using illicit substances in the past year and 7.6% reported high-risk alcohol use (one or more occasions of drinking 5 or more drinks or of drinking more than 10 (females) or 15 (males) drinks in the last week).¹¹ Using other substances while taking prescription medications could increase the risk of acute toxicity events. Substance use can also lead to or escalate medical conditions common in older age, such as diabetes, cardiovascular disease or lung conditions,¹²⁻¹⁴ and these medical conditions could make older adults more susceptible to acute toxicity and at higher risk of death after an acute toxicity event.¹⁵⁻¹⁷

Because social isolation and stigma can also affect substance use among older adults, opportunities to modify risk of use may arise through social and structural interventions.^{18,19} For example, as a result of increasing medical concerns and prescriptions with age, older adults have a higher usage of health care services.²⁰ Points of contact with health care services could be used as opportunities for substance use and mental health interventions,

particularly for older adults with less social support.

Taken together, the medical histories and sociodemographic characteristics of older adults may increase the risk of accidental acute toxicity. This study examined accidental ATDs and sought, at the national level, to (1) describe the characteristics of older adults who died from acute toxicity and compare them with those of older adults in the general Canadian population; (2) characterize the substances contributing to ATDs in older adults as well as their origins (pharmaceutical vs. nonpharmaceutical) and sources (e.g. prescribed vs. diverted prescriptions); (3) explore the prevalence of physical and mental health conditions; and (4) describe social and environmental circumstances of ATDs among older adults.

Methods

Ethics statement

This study was reviewed and approved by the Public Health Agency of Canada Research Ethics Board (REB 2018-027P), the University of Manitoba Health Research Ethics Board (HS22710) and Newfoundland and Labrador Health Research Ethics Board (20200153).

Study design

We used a retrospective, population-based, cross-sectional chart review design to explore the relationship between accidental ATDs and older adult sociodemographic risk factors, prescription and medical history, circumstances of death and toxicological findings. All coroner and medical examiner files involving substance-related ATDs that occurred in Canada between 1 January 2016 and 31 December 2017 were reviewed and abstracted into a common database. Data abstractors were trained to abstract information according to a comprehensive study protocol that provided guidelines on case definition, data classification and how to describe certain data. Electronic databases were mapped to the study's database variables. The study's co-investigator team, who developed the study protocol and reviewed all analysis projects using the dataset, includes people with expertise in death investigations, toxicology, public health, harm reduction and Indigenous health research and with lived experience of substance use. A detailed explanation of the

study design and abstraction process²¹ and a general summary of the dataset²² have been reported elsewhere.

Study population

Our study included all people in Canada who died at age 60 years and older as a result of an accidental substance-related ATD. A substance-related ATD refers to any death that is a direct result of the administration of one or more exogenous substances that is a drug or alcohol.

A cut-off of age 60 years and older was used in accordance with literature on older adulthood;²³⁻²⁵ this was also supported by the natural breaks in the data we observed during exploratory data analysis. Depending on minimum cell sizes, stratification varied by 10-year age categories or no stratification (all older adults). For the 10-year age categories, individuals 80 years and older were combined into one age group due to smaller counts with increasing age.

Analysis

A descriptive summary of older adult characteristics was generated from chart review data. Dichotomous and categorical variables were reported as percentages. As death investigation files are not a complete record of a person's life and information available in the files varies, it is important to note that these percentages are the minimum proportions of older adults that had a given characteristic. Further analyses investigated proportions and mortality rates for older adults who died of accidental acute toxicity and older adults in the general Canadian population. Data sources for the general Canadian population included the 2016–2017 Labour Force Survey²⁶ and the 2016 Census profile.²⁷ Chi-square tests for independence were conducted between age cohorts where minimum cell sizes permitted. In addition to examining older adults as a specific age group, we applied a sex-based approach to the analysis, minimum cell size permitting.²⁸ All statistical analyses were carried out using statistical computing software R version 4.2.2 (R Foundation for Statistical Computing, Vienna, AT).²⁹

Our analysis had four aims. The first aim was to compare older adults who died of accidental acute toxicity with older adults in the general Canadian population by

demographic characteristics including age, sex, income and living arrangements. The second aim was to describe the most common substances and combinations of substances that contributed to death for older adults and explore the origin (pharmaceutical vs. nonpharmaceutical) and source (e.g. prescribed vs. diverted prescriptions) of these substances with an UpSet plot constructed using the ComplexUpSet package.³⁰

The third aim was to examine and report on documented health conditions or symptoms, health service utilization, prescribed medications and history of substance use. Documented history of mental and physical health conditions or symptoms is based on any information available in the death investigation file, including medical records or witness statements (family or friends). Therefore, these conditions or symptoms are not necessarily clinical diagnoses, were not necessarily experienced at the time of death, and may not capture a person's entire medical history. Prescription types refers to a medication class that was prescribed up to 6 months before death. Prescriptions associated with chronic pain were based on a framework for the most commonly prescribed medications for treatment of chronic pain and includes unspecified opioid prescriptions.³¹

The fourth aim of the analysis was to explore and describe the circumstances of ATDs: the location of death, the possibility of medical error, how often deaths were witnessed, how often naloxone was administered, and the most common modes of substance use.

To protect privacy, any cell that contained a count of less than 10 was suppressed and all counts were randomly rounded to base 3 (i.e. values had different chances of being rounded to nearest multiples of 3).²¹ Since table totals were independently rounded to base 3, the sum of values do not always equal the total. Any calculated percentages and crude rates were based on the rounded counts. Test statistics and exact *p* values are not provided to protect random rounding.

Results

Accidental acute toxicity deaths

We identified 705 older adults who died of accidental substance-related acute toxicity between 1 January 2016 and 31 December

2017. The accidental ATD mortality rate was 4.3 per 100 000 population for all older adults (Table 1). The accidental ATD mortality rate was highest for adults aged 60 to 69 years (7.1 deaths per 100 000 population) and lowest for those aged 80+ years (0.6 per 100 000 population). The mortality rate for males was approximately double that for females (6.0 vs. 2.8 deaths per 100 000 population).

At 35%, the proportion of female older adults who died from acute toxicity was smaller than the proportion of female older adults in the overall population (54%) (Table 1). Conversely, a higher proportion of male older adults died from acute toxicity (66%) than the proportion of male older adults in the overall population (46%). A higher proportion of adults aged 60 to 69 years died of acute toxicity (86%) than the proportion in the overall population (52%). The proportion of adults aged 70 to 79 years (11%) and 80 years and older (3%) was lower among those who died of acute toxicity than in the overall population (30% and 18%, respectively).

Of the older adults who died of accidental substance-related acute toxicity, a higher proportion was unemployed than the proportion of unemployed older adults in the overall population (13% vs. 2%) (Table 1). The accidental mortality rate for older adults was much higher for those who were unemployed than for those who were employed (37.6 vs. 2.0 deaths per 100 000 population). No comparison statistic for those who were retired was available. Older adults living in a private dwelling had a lower accidental mortality rate than those in collective dwellings (3.6 vs. 8.7 deaths per 100 000 population).

Substances contributing to accidental death

The most common substances that contributed to death in older adults were fentanyl (27%; 189/705), cocaine (27%; 189/705), ethanol (alcohol; 23%; 165/705) and morphine (15%; 105/705) (Table 2). At least one nonpharmaceutical substance (unregulated drugs and substances not intended for human use, such as industrial or household chemicals or veterinary medications, and not including ethanol [alcohol]) contributed to the death of 43% (300/705) of older adults who died of accidental acute toxicity, and at least one pharmaceutical substance contributed to the death of 49% (342/705). Substances of

both nonpharmaceutical and pharmaceutical origin contributed to 10% of deaths (data not shown). When a pharmaceutical substance contributed to a person's death, at least 60% (204/342) of the time that substance had been prescribed to that person.

Multiple drug toxicity due to unspecified substances (8% of deaths; 57/705) and fentanyl and cocaine (4%; 27/705) were the most common substance combinations contributing to death (Figure 1). Multiple substances contributed to 61% (432/705) of older adult deaths, but only the two substance combinations mentioned occurred in more than 10 deaths. The top three substances that contributed to deaths on their own (without a contribution from other substances) were cocaine (8% of deaths; 57/705), ethanol (6%; 42/705) and fentanyl (5%; 36/705).

Most of the substance sets had a single origin, except for fentanyl, fentanyl and cocaine combined, and morphine (Figure 1). Fentanyl that contributed to deaths alone was pharmaceutical (30% of deaths) and nonpharmaceutical (42% of deaths) in origin. When fentanyl and cocaine were combined, they were mainly both nonpharmaceutical in origin, with fewer than 10 deaths due to combined pharmaceutical and nonpharmaceutical origin (not shown due to small counts). Morphine had a mix of pharmaceutical and unknown origins (origins not shown due to small counts).

Health history

Several health conditions or symptoms were documented for 10% or more of the older adults who died of accidental acute toxicity (Table 3). Around one-quarter (26%; 186/705) had current or past depression. Prevalence of current or past anxiety disorder, alcohol use disorder and substance use disorder other than alcohol was about the same, at 14% (96–102/705). At least 17% (123/705) had two or more of these mental health conditions or symptoms.

About one-third (33%; 234/705) of older adults who died had a history of heart disease, 27% (189/705) had a history of chronic pain and 21% (147/705) had a past surgery. Comorbidity was common; 39% (276/705) had two or more of these documented health conditions. The majority (84%; 594/705) had contact with health services in the year preceding their death. Of those who had contact with

TABLE 1
Distribution of characteristics among adults who died of accidental acute toxicity and among the general population, ≥60 years, and accidental mortality rates, Canada, 2016–2017

Characteristic	Number and proportion of older adults who died of accidental substance-related acute toxicity, n (%)	Number and proportion of older adults in the general population, n (%)	Accidental acute toxicity death rate per 100 000 population, n (95% CI)
Total	N = 705	N = 8 226 155	4.3 (4.0–4.6)
Age, years			
60–69	606 (86)	4 262 995 (52)	7.1 (6.6–7.7)
70–79	81 (11)	2 442 720 (30)	1.7 (1.3–2.1)
≥80	18 (3)	1 520 440 (18)	0.6 (0.4–0.9)
All ages (≥60)	705 (100)	8 226 155 (100)	4.3 (4.0–4.6)
Sex			
Female	246 (35)	4 416 115 (54)	2.8 (2.4–3.1)
Male	462 (66)	3 810 040 (46)	6.1 (5.5–6.6)
Employment or income source			
Social assistance program ^a	102 (14)	–	–
Unemployed ^b	93 (13)	123 600 (2)	37.6 (30.4–46.1)
Employed ^c	75 (11)	1 856 200 (23)	2.0 (1.6–2.5)
Retired	75 (11)	–	–
Unknown	339 (48)	–	–
Living arrangement			
Private dwelling	552 (78)	7 742 250 (94)	3.6 (3.3–3.9)
Private residence	534 (76)	–	–
Retirement home	18 (3)	–	–
Collective dwelling	84 (12)	483 710 (6)	8.7 (6.9–10.8)
Supportive or transitional housing ^d	60 (9)	–	–
Other ^e	24 (3)	–	–
Unknown	27 (4)	–	–
Unhoused ^f	18 (3)	2515 (≤1)	n/c

Sources: National Chart Review Study of Substance-Related Acute Toxicity Deaths, 2016–2017; the 2016 Census profile²⁷; and the 2016–2017 Labour Force Survey.²⁶

Abbreviations: CI, confidence interval; n/c, not calculated.

Notes: Counts from the National Chart Review Study of Substance-Related Acute Toxicity Deaths are randomly rounded to base 3. Percentages and rates are based on rounded counts. Comparisons to census data were made where possible; in some instances, there was no census equivalent.

^a Includes disability supports.

^b Coroner and medical examiner offices may have used definitions of unemployment different to that used by Statistics Canada.

^c Includes individuals employed full-time and part-time and seasonal workers. Census data were not adjusted for seasonality.

^d Supportive housing includes long-term accommodation that provides a range of supportive services. Transitional housing is considered an intermediate step between emergency shelter and supportive housing.

^e Includes hotels, motels, long-term care facilities, nursing homes, correctional facilities and mental health facilities.

^f Older adults who died of acute toxicity and were unhoused at the time of their death included people who were unsheltered, emergency sheltered, provisionally accommodated and at immediate risk of being unhoused, whereas 2016 Census estimates only included people in shelters. Since national level counts of people who are unhoused underestimate the true proportion, the accidental mortality rate was not estimated.

health services, 27% (162/594) had sought assistance for pain-related reasons.

Many older adults who died of accidental acute toxicity had prescriptions for opioids (33%; 231/705), antidepressants (26%; 186/705) and benzodiazepines (24%; 171/705). Almost half (45%; 318/705) had multiple prescription types and 45% (315/705) had at least one prescription associated with chronic pain treatment.

Circumstances of death

Of all accidental older adult ATDs, fewer than 10 had evidence of a medication error, that is, that a prescription medication was mistakenly consumed (e.g. not realizing what it was, or forgetting that a dose had been taken already and consuming more), incorrectly dispensed drugs at a pharmacy or incorrectly administered drugs in a hospital.

Only 14% (96/705) of lethal acute toxicity events were definitely witnessed, and 17% (120/705) of deaths were potentially witnessed by someone who might have been able to respond (it was unclear if the person was still alive or deceased when found) (Table 4). In 39% (273/705) of cases, the person had already died when they were found, and there was no evidence that the acute toxicity event had been witnessed. Adults aged 80 years and

TABLE 2
Specific substances most commonly contributing to accidental acute toxicity deaths of adults, ≥60 years, their origin and the contributions of other substances, Canada, 2016–2017 (N = 705)

Most common substances contributing to death ^a	Contribution to deaths, n (%)	Origin of substance contributing to death, n (%)			Contribution of other substances, n (%)	
		Nonpharmaceutical ^b	Pharmaceutical ^c	Unknown ^d	Other substances	None
Fentanyl	189 (27)	63 (33)	18 (10)	108 (57)	156 (83)	36 (19)
Cocaine	189 (27)	189 (100)	n/a	n/a	132 (70)	57 (30)
Ethanol (alcohol) ^e	165 (23)	n/a	n/a	n/a	123 (75)	42 (25)
Morphine ^f	105 (15)	Suppressed	30 (29)	66 (63)	93 (89)	12 (11)
Multidrug toxicity, no substances specified	66 (9)	n/a	n/a	n/a	66 (100)	0 (0)
Methamphetamine	63 (9)	63 (100)	n/a	n/a	48 (76)	12 (19)
Hydromorphone	60 (9)	n/a	60 (100)	n/a	45 (75)	15 (25)
Oxycodone	60 (9)	n/a	60 (100)	n/a	48 (80)	12 (20)
Codeine	54 (8)	Suppressed	33 (61)	18 (33)	51 (94)	Suppressed
Methadone	51 (7)	n/a	51 (100)	n/a	39 (76)	12 (24)
Diacetylmorphine (heroin)	39 (6)	39 (100)	n/a	n/a	36 (92)	Suppressed
Amphetamine ^f	36 (5)	Suppressed	Suppressed	33 (92)	36 (100)	Suppressed
All deaths	705 (100)	300 (43)	342 (49)	84 (12)	432 (61)	261 (37)

Abbreviation: n/a, not applicable.

Notes: Counts are randomly rounded to base 3 and counts <10 are suppressed. Percentages were based on rounded counts and therefore may not sum to 100. Some substances contributing to a single death can have multiple origins.

^a Substances that contributed to at least 5% of accidental deaths among older adults.

^b Evidence indicates that the substance was of nonpharmaceutical origin. This includes unregulated drugs and substances not intended for human use, such as industrial or household chemicals or veterinary medications.

^c Evidence indicates that a substance was of pharmaceutical origin. This includes record of prescription information or scene evidence of substances prescribed to the person who died. Substances of pharmaceutical origin may or may not have been prescribed to the person who died and include substances prescribed to other people or prescription drugs acquired from the street supply.

^d Insufficient evidence to determine if the substance was of pharmaceutical or nonpharmaceutical origin.

^e Ethanol (alcohol) originates in the alcoholic beverage industry or home-distilled alcohol and does not belong in the other origin categories.

^f Amphetamine and morphine are active metabolites of other substances, i.e. methamphetamine and diacetylmorphine (heroin), respectively. In some cases, these substances might be present in toxicology results because the parent substance (methamphetamine or heroin) was consumed.

older had their acute toxicity event witnessed significantly more often than those aged 60 to 69 years (chi-square test, $p < 0.05$; data not shown).

The mode of substance use was unknown for 41% (288/705) of older adults. The most commonly reported mode of substance use was oral (20%; 144/705), smoking (12%; 84/705) and injection (11%; 81/705). Of older adults who died and were observed to have signs of opioid toxicity (i.e. snoring/gurgling, difficulty breathing, pinpoint pupils, unconscious or unresponsive, or blue lips or fingernails), only 7% (12/162) were administered naloxone.

Discussion

This study examined accidental ATDs among adults aged 60 years and older that occurred between 1 January 2016 and 31 December 2017 in Canada. ATDs occurred more often

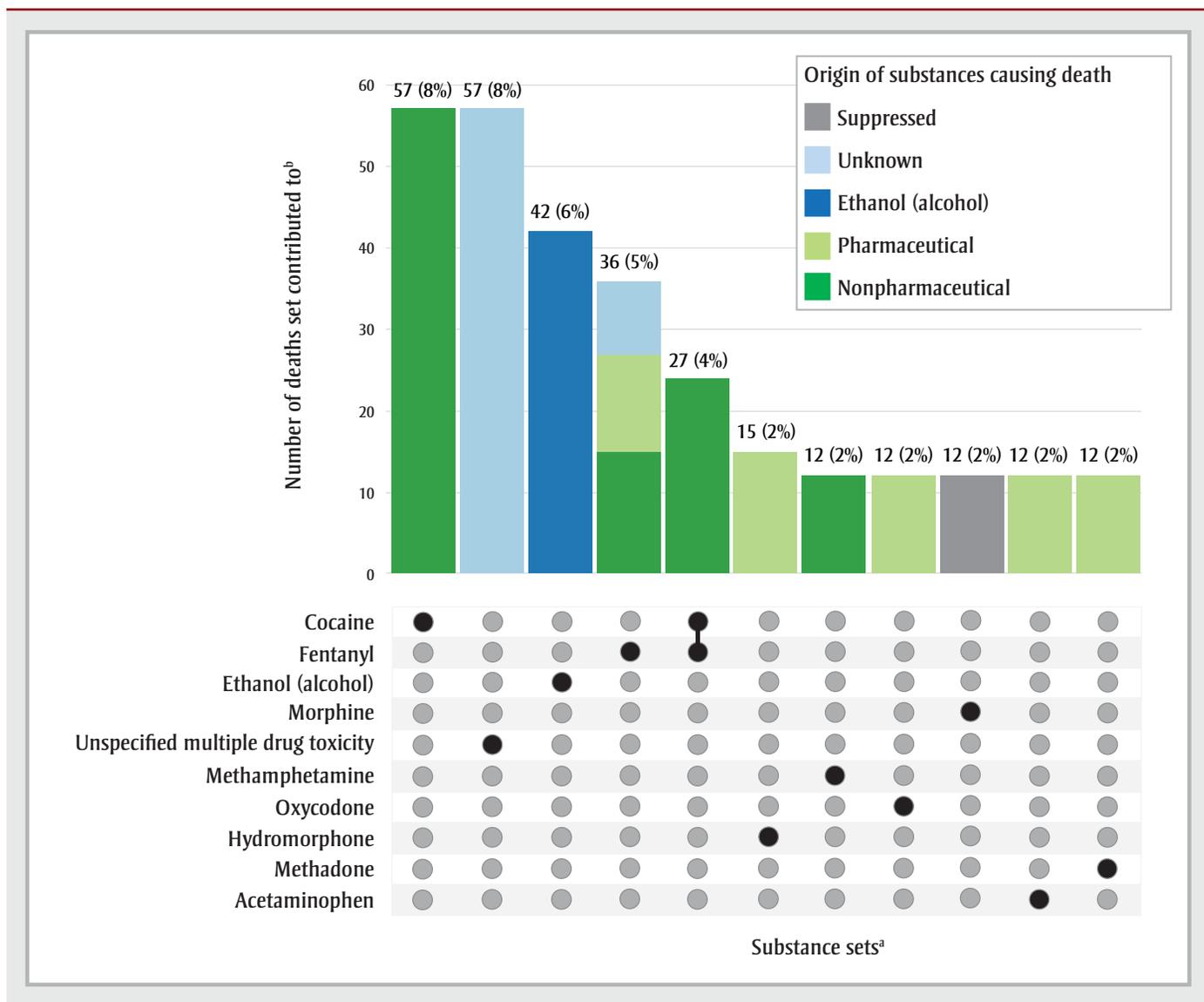
in those aged 60 to 69 years, males and those who were unemployed. These findings align with previous research that suggests that the sex distribution of opioid deaths in Canada is disproportionately represented in males.^{32,33} Unemployment has also previously been identified as a risk factor for higher-risk use of opioids and death.^{34,35} Coroner and medical examiner offices may use different definitions for unemployment than Statistics Canada; therefore, this finding should be interpreted with caution.

Fentanyl and cocaine contributed to most of the accidental ATDs among older adults. The origin of the fentanyl was a mixture of nonpharmaceutical (illegal) and pharmaceutical fentanyl. Fentanyl was the sixth and fourth most prevalent illegal substance seized by law enforcement organizations across Canada and tested by Health Canada's Drug Analysis Service (DAS) in 2016 and 2017, respectively.^{36,37}

However, at least one-third of the fentanyl contributing to the ATDs of older adults was of pharmaceutical origin. Most of the time, fentanyl was one of multiple substances contributing to death. Nonpharmaceutical fentanyl is commonly used to contaminate other substances and is deliberately combined with other substances.³⁸ The high proportion of ATDs associated with fentanyl in combination with other substances could also be related to the higher likelihood of older adults having multiple prescriptions.^{6,39}

Of the substances most commonly contributing to death in older adults—fentanyl, cocaine, ethanol and morphine—only cocaine has entirely nonpharmaceutical origins. In 2016 and 2017, cocaine was the most prevalent controlled substance, after cannabis, to be seized by law enforcement in Canada.^{36,37} Cocaine use by older adults is often under-screened and unrecognized, although it is a growing

FIGURE 1
UpSet plot of the top substances and substance combinations contributing to accidental acute toxicity deaths of adults, ≥60 years, by origin, Canada, 2016–2017 (N = 705)



Notes:

^a The grid of substance sets displays specific substances and combinations of substances contributing to death in columns. Substances are represented by black dots and combinations are joined by a black line. “Unspecified multiple drug toxicity” refers to cases where multiple substances contributed to death but the specific substances were not identified. When no toxicology information was available nothing is known about specific substances contributing to death or their number.

^b The vertical bar chart shows the number of deaths where a specific substance or substance combination described in the grid (a) contributed to death. The bars are coloured to show the origin of the substances. Unspecified multiple drug toxicity, fentanyl and cocaine, and morphine had other substance origins that are not shown because they contributed to less than 10 deaths.

Morphine is an active metabolite of diacetylmorphine (heroin) and might be present in toxicology results because the parent substance was consumed (diacetylmorphine [heroin]). Counts are randomly rounded to base 3. Sets contributing to less than 10 deaths were excluded from the plot. The substances in the UpSet plot differ from the substances most commonly contributing to death (Table 2) because exclusive combinations are prioritized over total number of deaths. For example, although codeine contributed to 8% of deaths, it does not appear in the UpSet plot because it was involved in a variety of combinations contributing to less than 10 deaths each.

concern.^{40,41} Cocaine use can contribute to the development of heart disease and cause death through its acute effects on the cardiovascular system⁴²; it is noteworthy that 33% of older adults who died of acute toxicity had a documented history of heart disease.

Multiple substances contributed to the majority of accidental older adult deaths;

however, only one combination, fentanyl and cocaine, occurred in more than 10 deaths. This suggests that a wide variety of substance combinations contribute to the death of older adults. Substances of nonpharmaceutical and pharmaceutical origin both commonly contributed to accidental deaths among older adults, and substances of both origins contributed to

at least 11% of the deaths. Programs and policies that reduce the harms of the illegal drug supply and pharmaceuticals would both be beneficial for this population.

Where substances of pharmaceutical origin contributed to the accidental ATD, the majority had been prescribed to the person who had died (61%). This finding

TABLE 3
Documented health histories of adults, ≥60 years, who died of accidental acute toxicity, Canada, 2016–2017 (N = 705)

	Number and proportion of older adults who died of accidental acute toxicity, n (%)
Health history^a	N = 705
Documented mental health conditions or symptoms	–
Depressive disorder or depressive symptoms	186 (26)
Anxiety disorder	102 (14)
Substance use disorder (not including alcohol)	102 (14)
Alcohol use disorder	96 (14)
≥2 of the mental health conditions or symptoms listed above	123 (17)
Documented medical conditions	–
Heart disease	234 (33)
Chronic pain ^b	189 (27)
Hypertension	177 (25)
Past surgery	147 (21)
Chronic obstructive pulmonary disease (COPD)	117 (17)
Diabetes	99 (14)
≥2 of the medical conditions listed above	276 (39)
Contact with health services in the year preceding death	594 (84)
Contact with health services in the year preceding death	N = 594
Sought assistance for pain	162 (27)
Sought assistance for substance use and/or addiction	57 (10)
Sought assistance for mental health	45 (8)
Sought assistance for acute toxicity event	36 (6)
Sought assistance for surgery	30 (5)
Sought assistance for acute injury	24 (4)
Sought assistance for other reasons	138 (24)
Sought assistance for unknown reasons	252 (42)
Types of prescriptions in the 6 months preceding death^c	N = 705
Opioids	231 (33)
Antidepressants	186 (26)
Benzodiazepines	171 (24)
Antipsychotic drugs	93 (13)
Gabapentinoids	96 (14)
Muscle relaxants	27 (4)
Opioid-agonist therapies	15 (2)
Cannabinoids	Suppressed
Stimulants	Suppressed
Other	338 (48)
≥2 prescription types (in the categories listed above)	318 (45)
Prescription associated with treatment for chronic pain ^d	315 (45)
Prescription history unknown	297 (42)
Of those who had a prescription for an opioid or opioid-agonist therapy...	N = 243
Had an opioid prescription reduced or denied in the 6 months prior to death	18 (7)

Notes: Counts are randomly rounded to base 3 and percentages are based on rounded counts. Counts <10 are suppressed.

^a Physical and mental health conditions or symptoms were reported only when a specific condition or symptom was documented for at least 10% of older adults. Documented health histories were based on medical records as well as witness accounts; therefore, conditions may not have been clinically diagnosed.

^b Includes documented chronic pain, chronic back pain, long-term (>90 days) treatment with opioids, fibromyalgia, arthritis or other pain disorders.

^c These percentages do not add up to 100 because a person can have multiple prescriptions.

^d Prescriptions associated with treatment for chronic pain include those listed in the RxFiles academic detailing program's *Pain Management & Opioids: Addressing Important Challenges and Introducing a Chronic Pain & Opioids Mini-Book*²⁰ and unspecified opioid prescriptions.

TABLE 4
Circumstances of death of adults, ≥60 years, who died of accidental acute toxicity, Canada, 2016–2017 (N = 705)

	Number and proportion of older adults who died of acute toxicity, n (%)
Death witnessed	N = 705
Person was alive and showing symptoms of acute toxicity when found	96 (14)
Person had already died when found and there was no evidence that the acute toxicity event was witnessed	273 (39)
Unclear if the person was still alive or had already died when found ^a	120 (17)
Unknown if the person was still alive or had already died when found	219 (31)
Mode of substance use ^b	N = 705
Likely oral ^c	144 (20)
Likely smoking	84 (12)
Likely injection	81 (11)
Likely nasal insufflation or intranasal (snorting)	36 (5)
Likely transdermal (patches)	15 (2)
Other	Suppressed
Unknown	288 (41)
For people who had symptoms of opioid toxicity ^d	N = 162
Naloxone was administered	12 (7)

Notes: Counts are randomly rounded to base 3 and percentages are based on rounded counts. Counts <10 are suppressed.

^a This includes people who were unconscious or unresponsive when found or thought to be asleep.

^b Because more than one mode of substance use can be involved in an acute toxicity death, these percentages do not sum to 100.

^c Includes the consumption of ethanol (alcohol).

^d Signs of opioid toxicity include snoring/gurgling, difficulty breathing, pinpoint pupils, unconscious or unresponsive, or blue lips or fingernails.

suggests a need to improve assessment identifying inappropriate prescribing or potentially harmful use of or dependence on prescribed substances. In this study, we found that 45% of older adults who died were known to have had two or more known prescription types in their medical history. True rates are likely higher given potential under-ascertainment of data on prescribed substances throughout the data abstraction process. For comparison, some degree of polypharmacy has previously been found in 65% of older adults.⁴ In this study and the general population, many older adults have multiple prescriptions to manage their medical conditions; improving our understanding of the risks of polypharmacy and managing and communicating these risks is also important. A 2016 systematic review of opioid and benzodiazepine misuse in older adults suggests that this is a growing concern in an aging population.⁴³ The authors suggest there is an increasing need for education of primary care providers on risk-reducing prescription practices and for policy maker and stakeholder engagement in prescription monitoring programs.⁴³ Where pharmaceutical substances and polypharmacy are concerned, ATDs due to medication errors were rare, although this may have been

underestimated because of a lack of documentation in coroner and medical examiner files or the absence of witnesses able to notice errors in dosage.

Depressive disorders or symptoms of depressive disorders were documented for one in four older adults who had died due to accidental acute toxicity, and anxiety disorder was documented for more than one in ten. Older adults with severe depression symptoms are more likely to be taking high-potency opioid medications.⁴⁴ Social isolation, depression and anxiety increased during the COVID-19 pandemic,⁴⁵ and these have been linked with higher-risk substance use among older adults.^{18,46} These factors, combined with decreased access to harm reduction and other health services during the pandemic, may have put older adults at greater risk of ATDs since our study period.

To reduce the risk of opioid overdose, people using substances should not use alone and should have a naloxone kit available.⁴⁶ A substantial portion (at least 38%) of accidental overdoses occurred when the older adults were alone, and only 7% of the older adults who showed

signs of opioid toxicity received naloxone.⁴⁷ Literature on the relationship between social isolation indicators, including living alone, and substance use is divided, with some studies suggesting that social isolation is not associated with overdose death and others suggesting it is.⁴⁸⁻⁵¹ According to the British Columbia Centre for Disease Control *Take Home Naloxone Program Report*, 3.7% of clients who received naloxone kits in 2017 were aged 60 years and older,⁵² while people in that age group made up 7% of illicit drug toxicity deaths in British Columbia in 2016 and 2017.⁵³ Improved access to harm reduction services and social supports for older adults who use substances could prevent ATDs.

Contact with health services presents an opportunity to screen older adults for social supports, inquire about high-risk substance use behaviours and provide naloxone kits.^{51,54} As 72% of the older adults who died had accessed health care in the year preceding their death, health care visits may present opportunities to identify potential issues in prescribing and substance use and address them. About one in five of these consultations with health care services were pain-related and could involve assessments of and

discussions about pain management, including prescribed medications and relief sought from other substances, as well as alternative approaches to alleviate pain.

While deaths due to accidental acute toxicity are less common among older adults than among younger adults and most deaths in this age group are due to chronic diseases such as heart disease, cancer and stroke,⁵⁵ given the preventable nature of ATDs, the risk factors identified in this study have practical implications for interventions that may reduce the burden of acute toxicity mortality in older adults in Canada.

Strengths and limitations

Data for this study were collected from coroner and medical examiner files across all the provinces and territories by trained data abstractors. Prior to and during the collection period, data abstractors completed intra-rater and inter-rater reliability testing to ensure reliable data collection. However, the information available differed across individual files and coroner and medical examiner offices in terms of investigation processes, forms and toxicological testing. The files are administrative in nature and exist to document investigations into cause and manner of death; they are not a complete record of a person's life. This may have resulted in underreporting of certain factors where data were unavailable, and therefore the proportions in this study represent the minimum number of older adults who died of acute toxicity and had a given characteristic.

Additional factors aside from those reported in this study may have contributed to the risk of accidental ATDs among older adults. For example, First Nations people have been disproportionately impacted by the overdose crisis.³² Although data about people with diverse gender identities are sparse, a number of interrelated factors are known to put them at high risk of substance use-related harms.⁵⁶ Also, this study examines deaths at the national level, but there may be differences in local contexts, including access to services and to illegal drug markets, that affect risk of death. Some of these factors and their intersectionality will be explored in future work.

In addition, limited comparisons could be drawn between ATD data in this study

and other data sources because of the differences in definitions of variables. In particular, it is unclear if coroner and medical examiner offices defined unemployment in the same way as was done by Statistics Canada in the Labour Force Survey. Despite these limitations, this study provides an in-depth descriptive nationwide review of Canadian coroner and medical examiner files for ATDs in older adults.

Conclusion

This is the first nationwide Canadian study to use coroner and medical examiner files to examine the characteristics of older adults who died from acute toxicity as well as the substances involved and circumstances of their deaths. As such, it provides a baseline for comparison as the overdose crisis changes with time. The drivers of acute toxicity in older adults are multifaceted and unique to this population. Heart disease, depression, chronic pain and polypharmacy were highly prevalent among older adults who died of accidental acute toxicity; however, high levels of contact with health services provides opportunities for intervention to better understand motivations for substance use and reduce the risk of potential harms.

Acknowledgements

We would like to thank our collaborators at the offices of chief coroners and chief medical examiners across Canada for providing access to their death investigation files. We would also like to acknowledge Brandi Abele, Matthew Bowes, Songul Bozat-Emre, Jessica Halverson, Dirk Huyer, Beth Jackson, Graham Jones, Fiona Kouyoumdjian, Jennifer Leason, Regan Murray, Erin Rees, Jenny Rotondo and Emily Schleihauf for their contributions in developing the national chart review study on substance-related ATDs. We are grateful for the contributions of people with lived and living experience of substance use who have supported the chart review study at multiple stages.

Funding

This study was funded by the Public Health Agency of Canada.

Conflicts of interest

The authors report no conflicts of interest.

Authors' contributions and statement

JB – Conceptualization, writing – original draft, writing – review & editing.

SR – Conceptualization, writing – original draft, writing – review & editing.

AV – Conceptualization, data curation, supervision, writing – original draft, writing – review & editing.

JH – Conceptualization, data curation, project administration, writing – original draft, writing – review & editing.

Opinions and conclusions in this report are the authors' own and not endorsed or approved by data providers or funders. The content and views expressed in this article are those of the authors and do not necessarily reflect those of the Government of Canada.

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Original quantitative research

A prospective study of financial worry, mental health changes and the moderating effect of social support among Canadian adolescents during the COVID-19 pandemic

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This article has been peer reviewed.

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Abstract

Introduction: The COVID-19 pandemic intensified the impact of risk factors for adolescent mental health, including financial worry. Social support has shown to protect from negative mental health during times of stress. We examined the effect of financial worry on changes in anxiety and depression symptoms among Canadian adolescents prior to and during the pandemic, and assessed whether social support from family and friends moderated any changes.

Methods: We analyzed 2-year linked data from the 2018/19 (pre-pandemic) and 2020/21 (during-pandemic) waves of the COMPASS study, with reports from 12 995 Canadian secondary school students. A series of multilevel linear regressions were conducted to examine the main hypotheses under study.

Results: Students scored an average (SD) of 7.2 (5.8) on the anxiety (GAD-7) and 10.0 (6.5) on the depression (CESD-10) scales; 16.1% reported they experienced financial worry during the pandemic. Financial worry was a strong and significant predictor of increased anxiety scores (+ 1.7 score between those reporting “true/mostly true” versus “false/mostly false”) during the pandemic, but not for depression scores. Low family and friend support were associated with anxiety, and low family support was associated with depression. No significant interactions were detected between social support and financial worry.

Conclusion: Pandemic-related financial worry was significantly associated with anxiety in our large sample of Canadian adolescents. Clinical and public health initiatives should be aware of adolescents’ financial worry and its associations with anxiety during times of crisis.

Keywords: financial worry, adolescents, COVID-19 pandemic, Canada, anxiety, depression, social support

Introduction

Adolescent mental health continued to be a global priority during the COVID-19 pandemic.¹ The pandemic impacted the lives of adolescents across the world, with school closures and shifts to online education,

physical distancing and social isolation, and the closure of social and recreational facilities.² These pandemic-related measures are believed to have contributed to worsening mental health among adolescents² and widened inequities in access to support.³ For instance, a large cross-sectional

Highlights

- The COVID-19 pandemic intensified risk factors to adolescent mental health.
- Pandemic-related financial worry was significantly associated with changes in anxiety scores, but not depression scores.
- Low family and friend support were associated with anxiety, and low family support was associated with depression; however, no significant interactions were identified with financial worry.
- Public health policy-makers, clinicians and parents should be aware that financial worry is associated with anxiety among adolescents and may be exacerbated by economic crises.
- Family support programs that focus on promoting adolescent mental health, given the association between parental financial worry and their children’s mental health, may be a suggested next step.

study found that up to 70% of Canadian youth experienced a deterioration in mental health, despite that more than one-third had no prior indication of mental

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health concerns.⁴ Prior to the pandemic, approximately 1 in 4 Canadian youth experienced a mental disorder.⁵ Given that the first onset of adult mental disorders usually occurs during childhood and adolescence, it is important to address risk factors early in the life course.⁶

A potential risk factor for mental disorders in adolescents that, for some, intensified during the pandemic is financial stress.⁷ Financial stress (or financial worry) is defined as the uncertainty, concern and fear of income instability, unemployment and debt.^{8,9} The mechanism by which financial worry and adolescent mental health are linked is complex and driven through indirect and direct pathways.^{10,11} According to the family stress model, stress experienced by parents because of financial hardships may result in disrupted parenting (e.g. inconsistent and harsh parenting, reduced family time and withdrawing support), which increases the risk of their children experiencing poor mental health.¹² Effects of parental financial stress on the child vary depending on the child's developmental age, with adolescents particularly at risk for adverse mental health outcomes because of their greater awareness and understanding of financial issues and potential pressures to contribute to family finances.^{13,14}

Over the past 20 years, Canadian household saving rates have declined, with many families lacking financial assets to fulfill basic needs in the event of an emergency.¹⁵ The onset of the pandemic in March 2020, and the subsequent economic downturn, led to the emergence and exacerbation of financial uncertainties for many families. During the early pandemic phases, 17% of Canadian adults expressed major concern about their ability to uphold financial commitments and meet their basic needs.¹⁶ Racialized people and those with low socioeconomic status were disproportionately affected (e.g. higher rates of disease leading to loss of workdays, lower-paying jobs eliminated because of unsafe conditions/inability to work remotely).^{17,18} In response to these pandemic-related economic ramifications, the Canadian government introduced relief programs (e.g. tax rebates, income replacement) that financially supplemented 68.4% of Canadians.¹⁹

An important protective factor to adverse mental health outcomes among adolescents

is social support. Social support, defined as interactions with individuals (e.g. family, friends) who provide physical and emotional support, has been linked with increased resilience, self-esteem, well-being and life satisfaction among adolescents.^{20,21} Social support has been shown to protect against depression and anxiety.²¹ The importance of social relationships, particularly during periods of stress and crises (e.g. economic downturns), is well documented.²² A recent systematic review included survey studies conducted during the pandemic that affirmed this association; having social and familial support was associated with having better mental health outcomes.²³ A recent study has shown social support to be a coping mechanism protecting against adverse mental health stemming from financial stress.²⁴

There are few published studies on the relationship between financial worry and adolescent mental health in the context of the pandemic. While one US study identified financial stress as a predictor of depression among adolescents,²⁵ most research has focussed on adults.^{26,27} Evidence exists for the positive effects of social support on adolescent mental health during the pandemic,²³ and one US study identified a moderating effect of parental support on adolescents' financial stress and mental health.²⁸ However, to our knowledge, no studies have examined financial worry and mental health, and the moderating role of social support, among Canadian adolescents.

To address these gaps, we developed a prospective study design using pre- and during-pandemic data from a large sample of Canadian adolescents. We examined the relationship between financial worry and changes in anxiety and depression from before to during the pandemic and assessed the potential moderating role of family and friend support. The findings may inform the prevention of mental disorders by (1) identifying an underrecognized risk factor at a critical developmental stage, and (2) exploring social support as a protective factor and target for interventions.

Methods

Design and participants

We used two-year linked student-level data from two waves of the Cannabis, Obesity, Mental health, Physical activity, Alcohol,

Smoking, and Sedentary behaviour (COMPASS) Study spanning the 2018/19 (pre-pandemic) and 2020/21 (during-pandemic) waves. COMPASS is an ongoing prospective study that collects annual survey data from a rolling cohort of students in Grades 9 to 12 (Secondary I–V in Quebec) across secondary schools in four Canadian provinces (British Columbia, Alberta, Ontario and Quebec).²⁹

Students are recruited using an active-information passive-consent protocol. Student-level data were collected using the COMPASS student questionnaire.²⁹ The 2018/19 questionnaire was completed during class time via paper-and-pencil surveys; the 2020/21 questionnaire was completed during class time in person or, because of pandemic-related school closures, at home through an emailed link to an online survey.³⁰ Data from 2019/20 were not used because data collection interruptions occurred halfway through the year with school closures due to the first COVID-19 lockdown.

This study used linked-longitudinal data from 12 995 participants from 111 secondary schools. In the 2018/19 and 2020/21 survey years, average response rates across schools were 84.2% and 58.0%, respectively. Primary reasons for non-linkage and nonparticipation included students graduating out of the cohort, missing data on linkage items, and collection methods (e.g. student absences, scheduling data collection outside of class time).

Additional details about COMPASS study methods can be found online (<https://uwaterloo.ca/compass-system/>) or in print.²⁹ COMPASS study data are available upon request by completing a COMPASS Data Usage Application at <https://uwaterloo.ca/compass-system/information-researchers/data-usage-application>. The datasets used in the current study are available from the corresponding author on reasonable request.

Ethics approval

All procedures received ethics approval from the University of Waterloo (ORE#30118), Brock University (REB#18-099), Centre intégré universitaire de santé et des services sociaux du Centre-Ouest-de-l'île-de-Montréal (CIUSSS) de la Capitale-Nationale–Université Laval (#MP-13-2017-1264) and participating school boards, including the use of active-information passive-consent parental permission protocols.

Consent to participate

To be considered eligible using the active-information passive-consent protocol, schools informed parents/guardians about the study, and after a reasonable time had passed (e.g. 2 weeks) parents/guardians had to have informed the COMPASS school representative that they did not want their child to participate in the study. In addition, students had to assent to participate and were able to withdraw their assent to participate at any time.

Mental health measures

Depression

Symptoms of depression were measured using the 10-item Center for Epidemiologic Studies Depression Scale (CESD-10), which comprises questions related to sadness, loneliness and loss of interest during the past 7 days.³¹ CESD-10 scores are calculated by summing individual item response scores. Scores range from 0 to 30, and those greater than or equal to 10 indicate clinically relevant depression symptomatology.

This tool has been validated for use in adolescent populations against the original CESD-20.³² In the present study, the internal consistency was .82 (good) and .84 (good) for the 2018/19 and 2020/21 survey years, respectively.

Anxiety

Symptoms of anxiety were measured using the Generalized Anxiety Disorder 7-item Scale (GAD-7).³³ This tool uses self-reported questions related to nervousness, excessive or uncontrollable worrying, irritability, and restlessness over a 2-week period.³³ GAD-7 scores are calculated by summing individual item response scores. Scores range from 0 to 21, and those greater than or equal to 10 indicate clinically relevant anxiety symptomatology.

This scale has been validated to determine anxiety symptoms and clinical anxiety in adolescent populations.³⁴ In this study, the internal consistency was .89 (good) and .91 (excellent) for the 2018/19 and 2020/21 survey years, respectively.

Financial worry

Financial worry was measured through the single item “I am worried about my family being able to pay bills and expenses” that was included in the 2020/21 survey

COVID-19 module (i.e. “How true are the following statements about COVID-19 for you right now?”). Response options used a 5-point Likert scale. Responses were condensed to three categories because of small cell sizes: true/mostly true; neutral/don’t know; and mostly false/false. This measure was adapted from the COVID-19 Adolescent Symptom and Psychological Experience Questionnaire³⁵ and pretested by the COMPASS study team.

Social support

We selected, a priori, the following theory-driven variables as potential effect modifiers: family support (“I can talk about my problems with my family”) and friend support (“I can talk about my problems with my friends”). Both items were in the 2018/19 and 2020/21 COMPASS surveys and both were derived from the Multidimensional Scale of Perceived Social Support (MSPSS).³⁶ Response options on a 5-point Likert scale were condensed into the following three categories because of small cell sizes: strongly agree/agree; neither agree nor disagree; and disagree/strongly disagree.

Covariates

The following covariates described in the 2020/21 survey were included in analyses: age (years); gender (male, female, I describe my gender in a different way/prefer not to say [responses collapsed because of small cell sizes]); race/ethnicity (White, Black, Asian, Latin American/Hispanic, Other/Mixed); province (Ontario, Alberta, British Columbia, Quebec), as experiences may have varied between locations; and school learning mode (in person, online or hybrid [alternating online and in-person school days]), as there may have been differences in pandemic-related experiences, depending on the school setting.

Statistical analysis

We conducted univariate analysis to collect participants’ basic characteristics. To account for missing data, multiple imputation was conducted for all variables using the *mice* (multivariate imputation by chained equation) and *miceadds* packages in RStudio version 4.2.0 (PBC, Boston, MA, US).³⁷ Individual-level missing values were imputed using predictive means matching. Items from the CESD-10 and GAD-7 were imputed prior to scoring to reduce bias.³⁸ Missing data on the CESD-10

and GAD-7 were 8.5% and 7.9%, respectively, and as a result, 10 imputations were sufficient according to guidelines established by Graham et al.;³⁹ 50 iterations were deemed appropriate after visually examining convergence via trace plots.

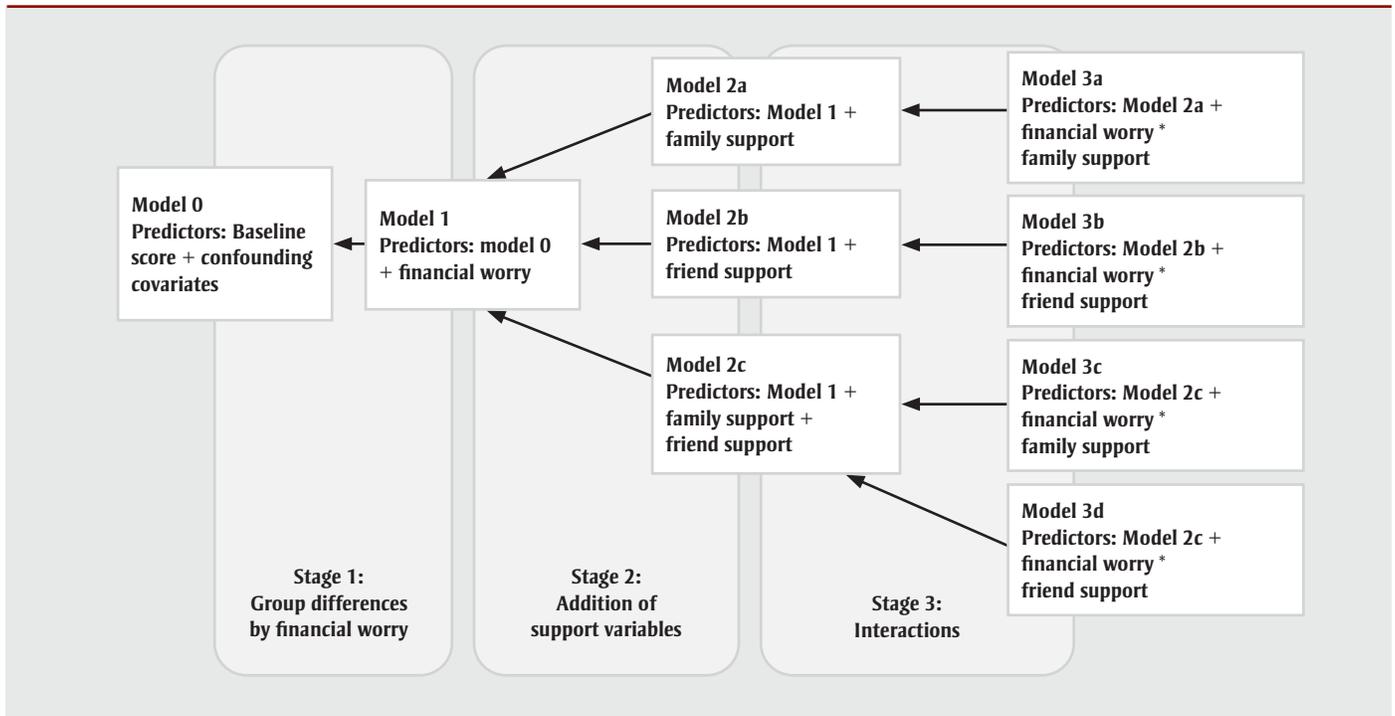
To assess school clustering, intraclass correlation coefficients (ICC) were calculated via addition of a random intercept (school-level) to an unadjusted regression model for both anxiety and depression. The ICC values for both models were within the acceptable range of less than 3% (0.5% for both depression and anxiety); as a result, school clustering did not account for enough variation in outcomes to require its inclusion in subsequent models.⁴⁰

We conducted a series of multilevel linear regressions to examine the association between financial worry and changes in mental health scores, and whether this association was moderated by family or friend support. To assess change, time-point 2 for depression and anxiety were regressed on their respective baseline (time 1) score, in addition to adjusting for covariates. Models from the multiple imputed datasets were pooled using Rubin’s rules. Hypothesis testing was conducted by comparing a series of iterative nested models based on the Akaike information criterion (AIC) and analysis of variance (ANOVA) using the D2 pooled likelihood ratio tests to determine if adding predictor variables of interest improved upon the nested reduced model.

For both depression and anxiety score changes, the models were compared in three iterative stages: (1) whether adding financial worry improved upon a reduced model of confounding covariates alone; (2) whether the addition of family and/or friend support improved on the full model from Stage 1; and (3) whether interactions between family and/or friend support and financial worry improved upon the full models identified in Stage 2 (illustrated in Figure 1). Pairwise post-hoc tests were conducted to evaluate group comparisons on statistically significant models; *p* values were adjusted using the Bonferroni method.

We also conducted tests of interaction effects between financial worry and gender in models 2a, 2b and 2c (not reported); however, these results showed no significant

FIGURE 1
A diagram of nested models and comparisons



Notes: Arrows represent model comparisons, with the arrowhead pointing towards the restricted nested model for each stage of hypothesis testing. Asterisks represent interactions between variables.

gender interactions and nonsignificant model improvement compared to the reduced models and so were not included in further analyses.

Results

Participant characteristics

The mean (SD) age of the 12 995 participants at time 2 (during the COVID-19 pandemic in 2020/21) was 15.9 (1.1) years, with the majority identifying as female (55.3%), White (80.2%), attending a secondary school in Quebec (62.8%) and reporting a hybrid school learning mode during the pandemic (53.4%).

A total of 16.1% of participants reported experiencing financial worry during the pandemic. The mean (SD) GAD-7 score was 7.2 (5.8) and the mean (SD) CESD-10 score was 10.0 (6.5). The proportions of participants reporting clinically relevant GAD-7 and CESD-10 scores were 30.2% and 46.0%, respectively. More than half of the sample agreed that they were able to talk to about their problems with their family (56.6%), and nearly three-quarters agreed that they could talk about their problems to their friends (73.9%) (Table 1).

Model comparison statistics and likelihood ratio tests for mental health changes

For anxiety, the addition of financial worry (Model 1) was a significant improvement on the null model (Model 0), exhibiting a lower AIC (mean [SD], AIC = 77 325.8 [50.0]). Using Model 1 as the new reduced model, the inclusion of family and friend support, both individually (Models 2a and 2b) and collectively (Model 2c), showed a significant improvement. Model 2c emerged as the best fitting model with lowest AIC (76 518.2 [46.9]) relative to Model 1 (Table 2).

For depression, the inclusion of financial worry (Model 1) did not significantly improve upon Model 0. When evaluating the inclusion of support relative to Model 1, family support alone (Model 2a), and coupled with friend support (Model 2c), showed significant model improvement. Model 2a (including family support) was identified as having best model fit with lowest AIC (85 062.9 [9.9]).

Post-hoc comparisons using the Bonferroni method for financial worry

Differences in average anxiety scores followed a positive trend; after adjusting for covariates, those who reported having

financial worry had the highest estimated marginal mean anxiety score at timepoint 2 (9.0), followed by those reporting “neutral/don’t know” (8.0) and then “false/ mostly false” (7.3). In turn, the largest differences in anxiety change scores were exhibited between those who reported financial worry, relative to those without (+ 1.7); differences in anxiety scores between each category were significant ($p < 0.01$).

For depression, no significant differences between groups were identified (Table 3).

Post-hoc comparisons for social support

For anxiety, significant differences were shown between family support responses. Those without family support had the highest estimated marginal mean anxiety score at time 2 relative to those with family support (9.7 versus 7.2). Friend support showed a similar difference in marginal mean anxiety scores (8.9 versus 7.9).

For depression, significant differences were found in the estimated marginal mean depression score among those without family support compared to those with such support (10.7 versus 10.2) (Table 4).

TABLE 1
Characteristics of 2020/21 sample (n = 12 995)

Characteristics	n (%)
Demographics	
Age (years), mean (SD)	15.9 (1.1)
Gender, n (%)	
Male	5 519 (42.7)
Female	7 153 (55.3)
Describe in a different way or prefer not to say	256 (2.0)
Race/ethnicity, n (%)	
White	10 358 (80.2)
Black	289 (2.2)
Asian	706 (5.5)
Latin American/Hispanic	212 (1.6)
Other/Mixed	1 353 (10.5)
Province where school is located, n (%)	
Ontario	3 675 (28.3)
Quebec	8 157 (62.8)
Alberta	347 (2.7)
British Columbia	816 (6.3)
Learning mode, n (%)	
In person	2 790 (21.6)
Fully online	3 225 (25.0)
Hybrid (online and in person)	6 891 (53.4)
Exposure	
Financial worry, n (%)	
True/mostly true	1 898 (16.1)
Neutral/don't know	1 817 (15.4)
False/mostly false	8 101 (68.6)
Outcomes	
Depression (CESD-10),^a mean (SD)	
CESD-10 score <10, n (%)	6 421 (54.0)
CESD-10 score ≥10, n (%)	5 469 (46.0)
CESD-10 change score, ^b mean (SD)	2.6 (8.3)
Anxiety (GAD-7),^c mean (SD)	
GAD-7 score <10, n (%)	8 347 (69.8)
GAD-7 score ≥10, n (%)	3 619 (30.2)
GAD-7 change score, ^d mean (SD)	2.1 (5.4)
Effect modifiers	
Family support, n (%)	
Strongly agree/agree	6 825 (56.6)
Neither agree nor disagree	2 569 (21.3)
Strongly disagree/disagree	2 685 (22.2)
Friend support, n (%)	
Strongly agree/agree	8 936 (73.9)
Neither agree nor disagree	1 998 (15.4)
Strongly disagree/disagree	1 154 (9.5)

Abbreviations: CESD-10, 10-item Center for Epidemiologic Studies Depression Scale – Revised; GAD-7, Generalized Anxiety Disorder 7-item Scale; SD, standard deviation.

^a Scores range from 0 to 30, with higher scores (≥10) representing clinically relevant depression symptoms.

^b Depression change scores = timepoint 2 depression score – timepoint 1 depression score.

^c Scores range from 0 to 21, with higher scores (≥10) representing clinically relevant anxiety symptoms.

^d Anxiety change scores = timepoint 2 anxiety score – timepoint 1 anxiety score.

Interaction between financial worry and social support

No meaningful or statistically significant interactions were detected for both anxiety and depression (Table 5). Models that further adjusted for the reciprocal support measure (that was not included in the interaction term) similarly showed nonsignificant results.

Discussion

We examined the effect of financial worry on changes in anxiety and depression from prior to and during the pandemic among Canadian adolescents and whether social support moderated this relationship. Our most important findings were: (1) financial worry was significantly associated with changes in anxiety from pre- to during-pandemic timepoints, but not with changes in depression; (2) having low family and friend support was associated with changes in anxiety scores, but only low family support (and friend support when coupled with family support) was associated with changes in depression; and (3) there were no significant interactions between financial worry and family and friend support with regard to changes in adolescent anxiety and depression.

On average, participants experienced an increase in both anxiety and depression scores during the pandemic relative to their pre-pandemic scores. This finding aligns with contemporary evidence. One systematic review of 21 studies (longitudinal and repeated cross-sectional designs) assessing mental health changes pre- and during the pandemic among youth (aged 0 to 24 years) identified increased depression and anxiety reported across most of studies included in their review.¹ A global meta-analysis found the pooled prevalence of elevated depression and anxiety disorders was 25.2% and 20.5%, respectively.⁴¹ The authors compared these prevalence estimates to pre-pandemic estimates and noted that adolescents struggling with a mental disorder approximately doubled during the pandemic.⁴¹

It is important to consider the context and clinical relevance of these mental health changes. From a developmental perspective, we expect to see an increase in anxiety and depression symptoms as adolescents age.⁴² Therefore, we cannot distinguish between developmental and pandemic-related effects on mental health in our

TABLE 2
Main effect model comparison fit indices and likelihood ratio test summary for depression and anxiety change

	Model number	Reduced model	Full model		Likelihood ratio comparison			
		Mean AIC (SD)	Model number and added predictors	AIC, mean (SD)	X ²	df	p	riv
Anxiety	0	77 440.4 (51.2)	1: Financial worry	77 235.8 (50.0)	92.1	2	<0.01	0.131
			2a: Family support	76 575.7 (46.0)	261.0	2	<0.01	0.271
	1	77 235.8 (50.0)	2b: Friend support	77 032.3 (51.8)	94.7	2	<0.01	0.095
			2c: Family + friend support	76 518.2 (46.9)	154.7	4	<0.01	0.712
Depression	0	85 072.8 (11.0)	1: Financial worry	85 073.5 (10.6)	1.4	2	0.24	0.092
			2a: Family support	85 062.9 (9.9)	6.8	2	0.01	0.071
	1	85 073.5 (10.6)	2b: Friend support	85 072.4 (11.2)	2.4	2	0.09	0.069
			2c: Family + friend support	85 065.0 (10.3)	3.8	4	<0.01	0.074

Abbreviations: AIC, Akaike information criterion; riv, robust instrumental variables estimator; SD, standard deviation.

Note: Reduced Model 1 includes financial worry variable and covariates.

study. To determine clinical relevance, 4-point and 6-point change scores on the GAD-7 have been suggested according to the minimal clinically important difference⁴³ and Reliable Change Index,⁴⁴ respectively. However, these changes apply to clinical samples with existing psychopathology and were developed to evaluate treatments to decrease patient scores to under the 10-point threshold.

The mean change scores in our study may not be clinically significant, but nevertheless may be relevant at a population level; a small increase may be sufficient for many individuals to reach or surpass the

clinical threshold of 10. The only such guideline for the CESD-10 is the threshold score of 10 to determine clinically relevant symptomatology.³¹ Notably, our sample had a mean score of 10 on the CESD-10 during the pandemic, with nearly half of participants scoring above this threshold.

Financial worry was associated with heightened anxiety during the pandemic, but not with depression in our sample. Although anxiety and depression are highly co-morbid and share many similarities, these results are not necessarily surprising as anxiety is characterized by “worry” (e.g. nervousness, fear of the future) while

amotivation and anhedonia are primary characteristics of depression.⁴⁵ Some evidence suggests that anxiety disorders generally precede the presentation of depression.⁴⁶ Thus, future research with longer follow-up is warranted.

In contrast to our findings, two US studies found relationships between youths’ stress about their family’s finances and depression²⁵ and negative affect (e.g. sad, anxious, depressed)²⁸ among adolescents.

The protective effects of social support on adolescent mental health are well established. Social support has been shown to

TABLE 3
Post-hoc test summary of group comparisons for anxiety and depression

		Financial worry	Emmean	95% LCL	95% UCL	
Anxiety	True/mostly true		9.0	8.55	9.36	
	Neutral/don’t know		8.0	7.59	8.41	
	False/mostly false		7.3	6.86	7.63	
		Group comparison	Estimate	SE	t(12 902)	p
		True/mostly true vs. false/mostly false	1.7	0.16	13.53	<0.01
		True/mostly true vs. neutral/don’t know	1.0	0.13	6.04	<0.01
		Neutral/don’t know vs. false/mostly false	0.8	0.13	5.88	<0.01
Depression		Financial worry	Emmean	95% LCL	95% UCL	
	True/mostly true		10.6	10.09	11.10	
	Neutral/don’t know		10.2	9.71	10.70	
	False/mostly false		10.4	9.94	10.80	
		Group comparison	Estimate	SE	t(12 902)	p
		True/mostly true vs. false/mostly false	0.2	0.17	1.21	0.68
		True/mostly true vs. neutral/don’t know	0.4	0.22	1.65	0.30
	Neutral/don’t know vs. false/mostly false	-0.2	0.17	-0.89	1.00	

Abbreviations: emmean, estimated marginal mean; LCL, lower confidence limit; SE, standard error; UCL, upper confidence limit.

Notes: Emmean reported after adjusting for other covariates in the model. Models adjusted for respective time 1 mental health scores, age, gender, race/ethnicity, province and school learning mode.

TABLE 4
Post-hoc test summary of group comparisons for anxiety and depression for best fitting models from Stage 2

Model	Family support	Emmean	95% LCL	95% UCL	
Anxiety (Model 2c)	Strongly agree/agree	7.2	6.83	7.58	
	Neither agree nor disagree	8.3	7.91	8.72	
	Strongly disagree/disagree	9.7	9.32	10.10	
	Group comparison	Estimate	SE	t(12 898)	p
	Strongly agree/agree – False/mostly false	-2.5	0.11	-9.70	<0.01
	Strongly agree/agree – neither agree nor disagree	-1.1	0.12	-21.27	<0.01
	Neither agree nor disagree – false/mostly false	-1.4	0.14	-10.10	<0.01
	Friend support	Emmean	95% LCL	95% UCL	
	Strongly agree/agree	7.9	7.50	8.26	
	Neither agree nor disagree	8.5	8.09	8.88	
	Strongly disagree /disagree	8.9	8.42	9.30	
	Group comparison	Estimate	SE	t(12 898)	p
	Strongly agree/agree – false/mostly false	-0.98	0.15	-6.47	<0.01
	Strongly agree/agree – neither agree nor disagree	-0.61	0.12	-5.02	<0.01
Neither agree nor disagree – false/mostly false	-0.38	0.17	-2.20	0.08	
Depression (Model 2a)	Family support	Emmean	95% LCL	95% UCL	
	Strongly agree/agree	10.2	9.73	10.60	
	Neither agree nor disagree	10.3	9.82	10.80	
	Strongly disagree/disagree	10.7	10.27	11.20	
	Group comparison	Estimate	SE	t(12 900)	p
	Strongly agree/agree vs. false/mostly false	-0.56	0.16	-3.64	<0.01
	Strongly agree/agree vs. neither agree nor disagree	-0.11	0.15	-0.76	1.00
Neither agree nor disagree vs. false/mostly false	-0.50	0.18	-2.49	0.04	

Abbreviations: emmean, estimated marginal mean; LCL, lower confidence limit; SE, standard error; UCL, upper confidence limit.

Notes: Emmean reported after adjusting for other covariates in the model. Models adjusted for respective time 1 mental health scores, age, gender, race/ethnicity, province and school learning mode.

mitigate adverse mental health outcomes and promote coping during periods of heightened stress and uncertainty, including during the COVID-19 pandemic.^{23,28} Our study reaffirmed these findings, identifying significant associations between both family and friend support with anxiety

change scores, and family support, both individually and when paired with friend support, was associated with changes in depression. Our finding that family and friend support remained an important asset to the mental health of Canadian adolescents was encouraging. Many adolescents

may have faced barriers in accessing support during the pandemic (e.g. restrictions to in-person socializing, school and facility closures).

No significant interactions resulted when examining the family and friend support

TABLE 5
Model comparisons at Stage 3: Testing family and friend support interactions

	Reduced model		Full model		Likelihood ratio comparison		
	Model number	AIC, mean (SD)	Model and interaction with financial worry	AIC, mean (SD)	χ^2	p	riv
Anxiety	2a	77 032.27 (51.81)	3a: Friend Support	77 029.98 (50.82)	2.22	0.064	0.116
	2b	76 575.67 (45.65)	3b: Family Support	76 575.62 (45.33)	1.64	0.163	0.154
	2c	76 518.23 (46.90)	3c: Friend Support	76 516.77 (45.94)	2.05	0.084	0.108
			3d: Family Support	76 518.07 (46.44)	2.05	0.156	0.151
Depression	2a	85 072.38 (11.16)	3a: Friend Support	85 075.69 (11.47)	1.01	0.400	0.089
	2b	85 062.87 (9.88)	3b: Family Support	85 063.72 (11.30)	1.53	0.191	0.110
	2c	85 064.99 (10.29)	3c: Friend Support	85 068.33 (10.54)	1.00	0.404	0.088
			3d: Family Support	85 065.73 (11.69)	1.55	0.185	0.111

Abbreviations: AIC, Akaike information criterion; riv, robust instrumental variables estimator; SD, standard deviation.

as moderators of the relationships between pandemic-related financial worry and anxiety and depression. In contrast, a daily diary study conducted in the USA during the early pandemic identified a moderating effect of parental support on the relationship between financial uncertainty and negative affect among adolescents.²⁸ Conflicting results may reflect differences across studies in timing, contexts or designs; a micro-longitudinal design was employed that did not account for participants' pre-pandemic mental health. Research conducted prior to the pandemic is also inconsistent and has largely focussed on adult samples. For instance, Åslund et al⁴⁷ identified social support as having a "buffering" role in adverse mental well-being attributable to financial stress among Swedish adults, whereas Viseu et al²⁴ failed to identify a moderating effect of support on financial threat and stress, anxiety and depression among Portuguese adults during an economic crisis. Further research is warranted to confirm the tested moderating effects among Canadian adolescents.

While financial protections were implemented by the Canadian government, 16.1% of adolescents were worried about their family's ability to pay bills as a result of the COVID-19 pandemic; this worry was associated with an increase in anxiety from their pre-pandemic levels. Public health policy-makers, clinicians and parents should be aware that financial worry is associated with anxiety among adolescents, which may be exacerbated by economic downturns, and that ensuring equitable access to mental health support is crucial to the early intervention of mental disorders.

Our study identified that social support remained relevant in the context of the pandemic and should continue to be a focus of mental health initiatives. However, our results suggest social support is not sufficient to significantly moderate the association between financial worry and mental health outcomes. In accordance with the family stress model,¹² targeted family support programs may be effective in promoting mental health among adolescents,⁴⁸ given the downstream effects of financial stress from parent to child.

Strengths and limitations

Important strengths of this study include the use of prospective data from a large

sample of Canadian adolescents; robust statistical analyses that accounted for pre-pandemic mental health scores; and well-validated mental health scales.^{32,34} Our focus on adolescents was novel, given the limited evidence on mental health relative to financial stress in this demographic, particularly during the pandemic.

Limitations of the study also warrant comment. Selection bias may have been introduced, with the lower response rate (58%) during the pandemic. However, the survey was administered to students across the four largest Canadian provinces, including areas that differed in urbanicity and income, and private and public schools. While self-reported questionnaires are subject to potential recall error and social desirability bias, the passive-consent and confidentiality protocols may promote generalizability and honest reporting.⁴⁹

The measures of financial worry and social support are single-item variables derived from scales that have been previously used and validated in adolescent populations.^{35,36} While single-item measures typically correlate with multi-item measures, they can have limitations when capturing more complex constructs.

The student questionnaire was designed to be brief for data quality and feasibility in a large school-based population-level study covering multiple domains. No measures of absolute financial status of adolescents' families were available, given the difficulties that adolescents may have measuring household income. We were also unable to test for potential interaction effects by race/ethnicity, given the small cell sizes in some groups. The change from paper-and-pencil to online questionnaires during the pandemic may have impacted responses. Finally, baseline financial worry responses were not available as this measure was introduced in the pandemic questionnaire.

Conclusion

Pandemic-related financial worry was significantly associated with anxiety in Canadian adolescents. While family and friend support are important protective factors for anxiety symptoms, and family support on depression symptoms, during the COVID-19 pandemic, they did not moderate the relationship between financial worry and mental health changes.

Future research should continue to monitor the association between financial worry and adolescent mental health and explore and test other potential protective factors that may mitigate adverse effects.

Acknowledgements

The authors would like to thank the schools, school boards and students that have participated in the COMPASS study and all COMPASS team members, staff, partners and youth engagement committee members. It takes a large team, many collaborators and particularly, students and schools themselves, to make this study possible.

Funding

The COMPASS study has been supported by a bridge grant from the Canadian Institutes of Health Research (CIHR) Institute of Nutrition, Metabolism and Diabetes (INMD) through the "Obesity – Interventions to Prevent or Treat" priority funding awards (OOP-110788) awarded to STL; an operating grant from the CIHR Institute of Population and Public Health (IPPH) (MOP-114875) awarded to STL; a CIHR project grant (PJT-148562) awarded to STL; a CIHR bridge grant (PJT-149092) awarded to KAP/STL; a CIHR project grant (PJT-159693) awarded to KAP; a research funding arrangement with Health Canada (#1617-HQ-000012) awarded to STL; a CIHR-Canadian Centre on Substance Abuse (CCSA) team grant (OF7 B1-PCPEGT 410-10-9633) awarded to SL; and a project grant from the CIHR Institute of Population and Public Health (IPPH) (PJT-180262) awarded to STL and KAP.

A SickKids Foundation New Investigator Grant, in partnership with CIHR Institute of Human Development, Child and Youth Health (IHDCYH) (Grant No. NI21-1193), awarded to KAP, funds a mixed methods study examining the impact of the COVID-19 pandemic on youth mental health, leveraging COMPASS study data. A CIHR operating grant funds analysis of COVID-19 impacts on health behaviours in COMPASS (UIP 178846 CIHR; awarded to KAP). The COMPASS-Québec project also benefits from funding from the Ministère de la santé et des services sociaux of the province of Quebec and the Direction régionale de santé publique du CIUSSS de la Capitale-Nationale. KAP is the Canada Research Chair in Child Health Equity and Inclusion.

The funding sources had no role in the study design; in the collection, analysis and interpretation of data; in the writing of the manuscript; or in the decision to submit the article for publication.

Conflicts of interest

Scott Leatherdale is one of this journal's associate scientific editors, but has recused himself from the review process for this article.

The authors have no other conflicts of interest to declare.

Authors' contributions and statement

JAG: Conceptualization, formal analysis, writing – original draft, writing – review & editing.

VFP: Conceptualization, formal analysis, writing – original draft, writing – review & editing.

MS: Conceptualization, writing – review & editing.

KAP: Conceptualization, funding acquisition, supervision, writing – review & editing.

WP: Conceptualization, supervision, writing – review & editing.

STL: Conceptualization, funding acquisition, methodology, supervision, writing – review & editing.

MJD: Formal analysis, writing – review & editing.

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The content and views expressed in this article are those of the authors and do not necessarily reflect those of the Government of Canada.

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Evidence synthesis

COVID-19 among Black people in Canada: a scoping review

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This article has been peer reviewed.

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Abstract

Introduction: The COVID-19 pandemic exacerbated health inequities worldwide. Research conducted in Canada shows that Black populations were disproportionately exposed to COVID-19 and more likely than other ethnoracial groups to be infected and hospitalized. This scoping review sought to map out the nature and extent of current research on COVID-19 among Black people in Canada.

Methods: Following a five-stage methodological framework for conducting scoping reviews, studies exploring the effects of the COVID-19 pandemic on Black people in Canada, published up to May 2023, were retrieved through a systematic search of seven databases. Of 457 identified records, 124 duplicates and 279 additional records were excluded after title and abstract screening. Of the remaining 54 articles, 39 were excluded after full-text screening; 2 articles were manually picked from the reference lists of the included articles. In total, 17 articles were included in this review.

Results: Our review found higher rates of COVID-19 infections and lower rates of COVID-19 screening and vaccine uptake among Black Canadians due to pre-COVID-19 experiences of institutional and structural racism, health inequities and a mistrust of health care professionals that further impeded access to health care. Misinformation about COVID-19 exacerbated mental health issues among Black Canadians.

Conclusion: Our findings suggest the need to address social inequities experienced by Black Canadians, particularly those related to unequal access to employment and health care. Collecting race-based data on COVID-19 could inform policy formulation to address racial discrimination in access to health care, quality housing and employment, resolve inequities and improve the health and well-being of Black people in Canada.

Keywords: racialized populations, inequity, vaccine hesitancy, racial discrimination

Introduction

The World Health Organization declared COVID-19 a global pandemic in March 2020, triggering the adoption of numerous public health measures, including lockdowns, social distancing and the use of

facemasks in public places. However, the health risks of COVID-19 infection and public health measures to reduce infection did not affect everyone equally;¹⁻⁵ the burden was disproportionately greater for racialized people and those living in low-income communities.⁶

Black people in Canada, the United Kingdom (UK) and the United States (USA) experienced a disproportionately higher prevalence of COVID-19 infections and a greater risk of COVID-19-related hospitalizations and mortality compared to their White counterparts.⁷⁻¹³ For every 100 000 Americans, about 26 Black people died from COVID-19 infection, a mortality rate more than twice that of Latino, Asian or White people.¹³ In the UK, the mortality rate among

Highlights

- Black Canadians are overrepresented in frontline jobs, which increases their risk of contracting COVID-19.
- Low uptake of COVID-19 screening and vaccine hesitancy may be attributed to mistrust of the health care system in Canada.
- Existing structural racism within the Canadian health care system has created inequities in accessing COVID-19-related health care services among Black Canadians.
- There is a need to collect race-based data with a focus on resolving inequities and improving the health and well-being of Black people in Canada.



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Black people was likely four times that of their White counterparts.¹⁴⁻¹⁷ Despite representing only 9.28% of the population of Toronto, Ontario, Canada's largest city, Black people accounted for nearly one-quarter of COVID-19 cases in 2020, while White people, who constituted 49.64% of the city's population, represented only 21.7% of cases.¹⁸

Canada is a common destination for international migrants, with a growing population of Black people from sub-Saharan African and Caribbean nations.¹⁹ Black people are the third-largest racialized group in Canada, at 4.3% of the country's total population, after South Asian (7.1%) and Chinese (4.7%) people.²⁰

Most of the reasons why the Black population was highly susceptible to and affected by COVID-19 infection are rooted in social determinants of health, such as socioeconomic status, crowded living environments, cultural barriers, racial discrimination, poor access to health care and anti-Black racism.²¹ In Canada and the USA, systemic racism cuts across all sectors—health care, education and the labour force—a problem that continues to be overlooked in policies.^{21,22} Because of the extensive emphasis on individual behaviours, rather than tackling the challenges that confront systemically marginalized Black people,²¹ the health care system failed to account for numerous inequities, including in education and employment, that tended to expose Black people to high rates of COVID-19 infection and mortality, to the point that racism has been described as “a risk factor for dying from COVID-19.”²³

For instance, racialized and immigrant populations experienced unequal access to vaccination and high rates of infection and death from COVID-19.^{24,25} A significant proportion of Black people are precariously employed and overrepresented in risky but essential frontline jobs across Canada, as well as in the UK and the USA,^{17,26} where the risks of COVID-19 infection were high.²⁷⁻³⁰ Racial inequalities to do with health and environmental factors affect racialized people in a way that left them “more exposed [to] and less protected” from the COVID-19 virus.^{8,23,30}

Data from the USA demonstrate racial disparities in rates of COVID-19 infection and mortality, with Black people among the

most disadvantaged.^{8,23} However, few studies have focussed on COVID-19 among Black Canadians. Given the disproportionate burden of COVID-19 and the distinct risks that Black Canadians face, the purpose of this scoping review was to map out the scope of research on COVID-19 among Black people in Canada.

Methodology

We utilized a scoping review methodology to explore the “extent, range and nature of research activity,”³¹ explicate what is currently known about COVID-19 among Black Canadians and pinpoint knowledge gaps for future research. We applied Arksey and O'Malley's³¹ five-stage methodological framework for conducting scoping reviews: identifying the research question; identifying relevant studies; selecting studies; charting the data; and collating, summarizing and reporting the results. We used the Tricco et al.³² Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) approach.

Identifying the research question

This review was guided by the following question: “What is the scope and nature of the literature on COVID-19 among Black people in Canada?”

Identifying relevant studies

We identified relevant studies through a systematic search in seven electronic databases: Ovid MEDLINE (Table 1), Elsevier Embase, APA PsycINFO, CABI Global Health, EBSCO CINAHL, Elsevier Scopus and the Wiley Cochrane Library. Our search strategy was derived based on two main concepts: (1) COVID-19 (all variants), and (2) Black people in Canada.

Selecting studies

Our initial search was conducted in January 2022 with no time restrictions. We subsequently updated the search to include all records published to 31 May 2023. A total of 457 records underwent initial screening of titles and abstracts (by AO and JK), and 124 duplicates were excluded. Two authors (AO and JK), working independently, reviewed the abstracts of the remaining 333 articles. Any conflicts during the process of selecting articles were resolved by a third author (DA).

An additional 279 articles were excluded as they did not meet the inclusion criteria (studies focussing on Black people living in Canada and on COVID-19). Of the remaining 54 articles, 39 were excluded after the full-text screening. In total, 17 articles were included in this review.

The selection process is depicted in Figure 1.

Charting the data

Two research team members (AO and JK) conducted the data extraction, which involved charting and sorting the findings of the included studies into key issues and analytical categories related to the impact of COVID-19 on Black people in Canada. The following information was extracted from each of the included articles and recorded on an Excel spreadsheet (version 2007; Microsoft Corp., Redmond, WA, US) designed by the research team: author name(s), year of publication, study purpose/research question, study population, methods, results/findings and comments/implications (Table 2). A research team member (DA) performed a quality check to ensure completeness and accuracy.

Collating, summarizing and reporting the results

We analyzed quantitative data from numerical summary and qualitative studies using thematic analysis. Drawing on Braun and Clarke,³⁴ two research team members (AO and JK) read the included articles several times, familiarized themselves with the data, and synthesized and categorized the interpretations of recurring findings into themes. They then open coded the extracted data by going through the fragments of texts, line by line, and assigning labels that best described these fragments. The codes were then compiled into potential themes, all the data relevant to each potential theme were grouped together, and the data were compared across the coded excerpts and the entire dataset. Two other research team members (DA and BS) reviewed the assigned codes and themes.

Ethics approval

This scoping review does not contain any studies with human participants or animals that may have required ethics approval.

TABLE 1
Search strategy

Ovid Medline	
Concept	Query
1	((exp Coronavirus/ or exp Coronavirus Infections/ or (coronavirus* or corona virus* or OC43 or NL63 or 229E or HKU1 or HCoV* or nCoV* or covid* or sars-cov* or sarscov* or Sars-coronavirus* or Severe Acute Respiratory Syndrome Coronavirus*).mp.) and 20190601:20301231.(ep.) not (SARS or SARS-CoV or MERS or MERS-CoV or Middle East respiratory syndrome or camel* or dromedar* or equine or coronary or coronal or covidence* or covidien or influenza virus or HIV or bovine or calves or TGEV or feline or porcine or BCoV or PED or PEDV or PDCoV or FIPV or FCoV or SADS-CoV or canine or CCov or zoonotic or avian influenza or H1N1 or H5N1 or H5N6 or IBV or murine corona*).mp.) or Covid-19/ or (covid or covid19 or 2019-ncov or nCoV19 or nCoV-19 or 2019-novel CoV or sars-cov2 or sars-cov-2 or sarscov2 or sarscov-2 or Sars-coronavirus2 or Sars-coronavirus-2 or SARS-like coronavirus* or coronavirus-19 or ((novel or new or nouveau) adj2 (CoV or nCoV or covid or coronavirus* or corona virus or Pandemi*2)) or (variant* adj2 (India* or "South Africa*" or UK or English or Brazil* or alpha or beta or delta or gamma or kappa or lambda or "P.1" or "C.37")) or ("B.1.1.7" or "B.1.351" or "B.1.617.1" or "B.1.617.2")).mp
2	exp African Continental Ancestry Group/
3	(black* or african* or caribbean or afro* or "person of colo?r" or "people of colo?r" or colo?red or "dark-skin*" or BIPOC or ((racial or ethnic) adj2 minorit*)).mp
4	2 or 3
5	exp Canada/ or (Canad* OR "British Columbia" OR "Colombie Britannique" OR Alberta* OR Saskatchewan OR Manitoba* OR Ontario OR Quebec OR "Nouveau Brunswick" OR "New Brunswick" OR "Nova Scotia" OR "Nouvelle Ecosse" OR "Prince Edward Island" OR Newfoundland OR Labrador OR Nunavut OR NWT OR "Northwest Territories" OR Yukon OR Nunavik OR Inuvialuit)
6	1 and 4 and 5

Results

A total of 17 empirical studies met our inclusion criteria. Twelve articles used quantitative methodologies (mostly cross-sectional study designs), four used qualitative methodologies (mostly explorative) and one used mixed methods. All included articles described the impacts on Black Canadians of, for example, poor accessibility to COVID-19–related health care services, health inequities caused by COVID-19 and the role of systemic discrimination and racism in the creation of these inequities.

Our findings are presented in five themes: low uptake of COVID-19 screening; high rates of COVID-19 infection; low uptake of COVID-19 vaccines; systemic racism and discrimination; and mental health impacts.

Low uptake of COVID-19 screening

Two studies reported on disparities in COVID-19 screening.^{35,36} In a cross-sectional study, Pongou et al.³⁶ found that the prevalence of being tested for COVID-19 across reported COVID-19 symptoms was far lower among Black Canadians (8.46%) than among those who were White (17.30%), mixed race/ethnicity (28.41%) or from another ethnoracial group (27.37%), although the differences were not statistically significant.

In a 2021 qualitative study, local community health centre leaders who serve

communities with large populations of racialized people within the Greater Toronto Area expressed concerns that individuals' reluctance to get tested for COVID-19 were due to misconceptions that the test is painful and that people can get infected with COVID-19 from screening.³⁵ The study also noted discrepancies in resource allocation within the health care system. For instance, mobile testing was made available in nonracialized neighbourhoods sooner than in poorer and racialized areas with worse access to health care.³⁵

High rates of COVID-19 infection among Black Canadians

Four studies examined high rates of COVID-19 infection among Black Canadians.³⁶⁻³⁹ A quantitative study indicated that higher numbers of COVID-19 cases are associated with socioeconomic factors such as race and housing. For instance, of all marginalized groups in Montréal, Quebec, the strongest relationship with positive COVID-19 cases occurred among those living in overcrowded housing and in boroughs with high proportions of Black people.³⁷

Two qualitative studies reported on the greater risks for Black people of contracting COVID-19 as a result of overrepresentation in frontline work and low-income communities.^{37,38} Using COVID-19 counts and tabular census data, Choi et al.³⁹ showed that there were relatively higher numbers of infections in communities

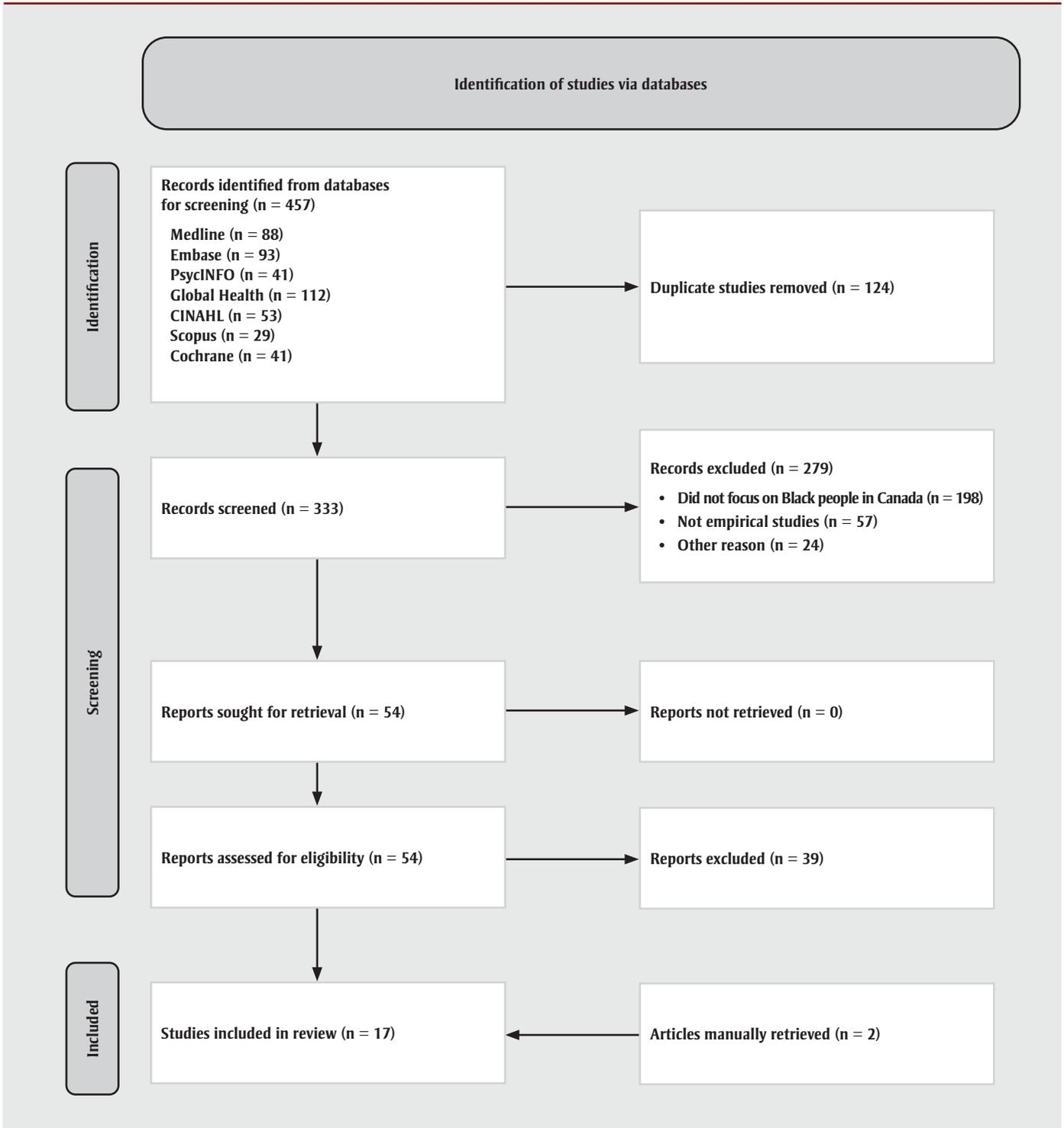
with larger proportions of Black and low-income residents across Canada. These vulnerabilities were created by poverty, overcrowded living environments, predominance of frontline work and existing health care inequities.^{36,37}

Low uptake of COVID-19 vaccines

Seven studies explored low uptake of COVID-19 vaccines among Black Canadians.^{38,40-45} A quantitative study exploring COVID-19 vaccine coverage among people experiencing homelessness in Toronto found that about 80.4% of participants received at least one dose of a COVID-19 vaccine and 63% had received two or more doses; however, Black participants were consistently found to have greater vaccine hesitancy, likely because of distrust in health care providers, perceived commercial gains for vaccine manufacturers, perception of vaccine risks, and lack of paid sick or vaccination leave.⁴¹

Two qualitative studies reported that the spread of disinformation and misinformation about COVID-19 within Black communities in Canada during the early part of the pandemic affected people's understanding of the risk of the consequences of COVID-19 infection, which propagated vaccine hesitancy.^{38,40} Gerretsen et al.⁴² conducted a quantitative web-based survey in Canada and the USA to assess variations in vaccine hesitancy; the authors reported that despite perceiving COVID-19

FIGURE 1
PRISMA 2020 flow diagram depicting identification of studies via databases on COVID-19 among Black people in Canada



Adapted from: Page et al.,³³ Tricco et al.³²

TABLE 2
Data extraction sheet

Author(s)	Study purpose / research question	Study population	Methods	Results/findings	Comments/implications
Ahmed et al. (2021) ³⁵	To examine the needs and concerns of Black communities in the Greater Toronto Area (GTA) and to show the importance of collecting race-based COVID-19 data	Local community health centre leaders	Qualitative interviews (n = 6)	The community leaders indicated that Black Canadians were unwilling to screen for COVID-19 due to misconceptions (e.g. the test is painful, getting infected with COVID-19 from screening). Mobile testing was provided for nonracialized GTA neighbourhoods before areas with worse living conditions and worse access to health care. The community leaders highlighted discrepancies in resource allocation among specific populations that indicates systemic discrimination and neglect. The community leaders recommended early measures to prevent COVID-19 cases among Black people and other people of colour.	The findings suggest that greater numbers of Black Canadians and racialized people are affected by COVID-19 because of inequity among frontline workers and people living in low-income communities, indicating the necessity of collecting race-based COVID-19 data.
Cénat et al. (2023) ⁴⁴	To examine the sociodemographic characteristics and factors associated with COVID-19 vaccine mistrust in the Black population in Canada	Black individuals in Canada	Quantitative (n = 2002)	Participants with previous COVID-19 infection had greater COVID-19 vaccine mistrust scores (M = 11.92, SD = 3.88) than those with no previous COVID-19 infection (M = 11.25, SD = 3.83), $t(1999) = -3.85$, $p < 0.001$. Participants who experienced major racial discrimination in health care settings were more likely to report COVID-19 vaccine mistrust (M = 11.92, SD = 4.03) than those who had not (M = 11.36, SD = 3.77), $t(1999) = -3.05$, $p = 0.002$. The mediated moderation model revealed that conspiracy theories totally mediated the association between racial discrimination and vaccine mistrust (B = 1.71, $p < 0.001$).	It is essential to create health educative programs that can emphasize health literacy among the Black population in Canada.
Choi et al. (2021) ³⁹	To identify the key demographic factors for COVID-19 infections across Canada's health regions	People living in Canada	Quantitative (secondary data)	COVID-19 infections are more prevalent in health regions with greater numbers of Black and low-income residents. Population density and urban centres are significantly correlated with COVID-19 infections. The number of Black residents in a neighbourhood determines the number of COVID-19 infections.	Collection of race-based data and better policies that target racial discrimination, unequal access to health care and crowded and inadequate housing are needed.
Etowa et al. (2023) ⁴⁵	To examine factors associated with COVID-19 vaccine willingness using logistic regression analysis	African, Caribbean and Black (ACB) people	Quantitative (n = 375)	ACB persons who opined that the ACB group is at a higher risk for COVID-19 were more likely to be willing to get vaccinated than those who did not (OR = 1.79, $p < 0.05$). ACB individuals who had received a minimum of 1 dose of the COVID-19 vaccine were more likely to be enthusiastic to receive it in the future (OR = 2.75, $p < 0.05$). In addition, ACB persons with a postgraduate degree (OR = 2.21, $p < 0.05$) were more likely to report vaccine willingness compared to those without a bachelor's degree.	It is necessary to address limited COVID-19 risk perception and knowledge among ACB, non-existence of prior COVID-19 vaccine experience, and mistrust of government COVID-19 information. To resolve these issues, it may be useful to incorporate culturally and linguistically sensitive messaging and outreach about COVID-19 and vaccines.
Etowa et al. (2021) ⁴⁸	To assess current knowledge gaps in COVID-19 care for African, Caribbean and Black (ACB) communities	ACB community	Qualitative	There is a lack of information on how socioeconomic vulnerability, comorbidity and discrimination influenced health care access and outcomes in ACB communities. There is insufficient information on the type of training frontline health workers and administrators require with respect to services for ACB communities. No concrete evidence is available to enhance strategies to ensure health equity and mitigate the impact of COVID-19 in ACB communities.	Research participation among the stakeholders (community leader, health providers) should be promoted to generate approaches to tackle COVID-19-related health outcomes.

Continued on the following page

TABLE 2 (continued)
Data extraction sheet

Author(s)	Study purpose / research question	Study population	Methods	Results/findings	Comments/implications
Gerretsen et al. (2021) ⁴²	To assess variations in vaccine hesitancy, complacency and confidence among extremely affected ethnic groups in Canada and the USA	Indigenous (Native American, American Indian, First Nations, Inuit and Métis), Black, Latinx (Hispanic), East Asian (Chinese, Japanese or Korean) and White racial/ethnic groups	Quantitative: web-based survey	Compared to White participants, Black and Indigenous survey participants in Canada and the USA have greater vaccine hesitancy and mistrust in vaccine efficacy with concerns about potential future side effects, commercial gain and favouring Whites despite that these populations perceive COVID-19 with the same level of seriousness. Racial minorities with less education and employment, lower incomes and higher levels of conservatism or religiousness than White participants were also more likely to be affected by COVID-19.	Local and national governments can achieve herd immunity against COVID-19 across racialized communities by ensuring vaccine accessibility and targeted cultural and community-sensitive efforts to raise vaccine confidence.
Innovative Research Group (2021) ⁴³	To identify factors that influence COVID-19 vaccine hesitancy and the communities that are more hesitant	Black Canadians	Quantitative online survey	Black Canadians reported lower vaccination rates due to their low confidence in vaccines. Some likely contributing factors to low vaccine confidence and high vaccine hesitancy within the Black community include distrust of health care providers and vaccine manufacturers and concerns related to vaccine risks. A vital aspect related to low vaccine uptake was lack of paid sick leave or paid vaccination leave.	The study urges Canadian federal and provincial governments to provide strategies geared towards partnerships with Black-led and Black-focussed community groups to appropriately manage COVID-19 vaccine knowledge gaps and factors related to distrust and blockades through culturally sensitive and safe implementation of government-supported education that takes into account language and education differences as well as socioeconomic disparities.
Kemei et al. (2023) ³⁸	To describe the impacts of the COVID-19 pandemic on Black Canadians	Black stakeholders in Canada	Qualitative	In the early part of COVID-19 pandemic, the propagation of COVID-19 disinformation in Black communities exacerbated Black Canadians' vulnerability to COVID-19 as a result of increased vaccine hesitancy.	The participants recommended tackling systemic inequities in health care; promoting cultural competency among service providers; increasing diversity in health care, in particular by employing larger numbers of Black health care personnel; and promoting Afrocentric approaches to health care.
Kemei et al. (2023) ⁴⁰	To explain the nature of online COVID-19 disinformation among Black people in Canada and identify the factors contributing to this phenomenon	Black stakeholders in Canada	Qualitative	Underlying systemic racism and related inequities in Canada has built mistrust in public health personnel and resulted in Black Canadians' readiness to replace truths about COVID-19 with disinformation.	There is a need to build trust and accept collaborative strategies in resolving community worries such as employment discrimination, medical racism and anti-racist workplace practices and policies, and provide funds to existing Black community organizations to create culturally congruent health education material.

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TABLE 2 (continued)
Data extraction sheet

Author(s)	Study purpose / research question	Study population	Methods	Results/findings	Comments/implications
Lei & Guo (2022) ⁴⁶	To understand social issues of inequality with focus on exposing unequal power relations and hegemonic knowledge	Asian, Black and Indigenous ethnic groups in Canada	Quantitative	The increase of anti-Black racism since the onset of the COVID-19 pandemic indicates that multiculturalism has, in effect, sustained a racist and unequal population in Canada, with racism embedded in its history and built into every aspect of its social structure and socioeconomic and health care services, resulting in inequities. Multiculturalism allows cultural variance but does not dispute an unjust society premised on white sovereignty. The significant link between police cruelty towards Black people in Canada, increased rates of Covid-19 in the Black population and the correlation of their low socioeconomic status, low level of education, and lower-paying employment with great risk of exposure to Covid-19, serve as a symbol of historical racism against Black people.	A pandemic anti-racism education model is sourced from critical race theory and seeks to address and eradicate all pandemic-related racism, xenophobia and racial oppression beyond COVID-19 within Canada.
Miconi et al. (2020) ⁴⁷	To examine the association of exposure to the COVID-19 virus to discrimination and stigma associated with mental health among culturally diverse adults in Quebec	White, Asian (East, South and South-East), Black, Arab, Other (first, second, third or more immigrant generations)	Quantitative	Exposure to COVID-19 predominately affected Black, Arab and South Asian participants. Asian and Black participants disclosed greater COVID-19-related discrimination and stigma. Increase in negative mental health outcomes was associated with exposure and or COVID-19-related discrimination. Among minority groups, Black respondents described the worst mental distress due to pandemic risk factors.	Policies and discourse should focus on promoting societal partnerships, decreasing discrimination against racialized communities and ensuring security of vulnerable groups. Community-based antidiscrimination programs should be established. Accessible and culturally sensitive mental health services are required for racial minorities during and beyond the pandemic.
Noble et al., (2022) ⁴⁹	To describe the impacts of the pandemic on youth experiencing homelessness in Toronto, Ontario	Youth experiencing homelessness	Mixed method	Systemic racism (exemplified by the successive public displays of police cruelty against unarmed Black citizens) and the COVID-19 pandemic exacerbated distress among the Black youth experiencing homelessness. They found it very difficult to secure employment and were discriminated against by landlords, which make it difficult for them to get accommodation.	There is a need to stabilize health and continuous access to in-person services that centre on provision of housing and equitable supports for subcategories of youth.
Pang et al. (2021) ⁵⁰	To determine mental health risk factors during the COVID-19 pandemic among eye care professionals	Eye care professionals (doctors, staff and students) in the USA and Canada	Quantitative	Female, younger, and Black or Asian eye care professionals and students were more prone to mental distress on all assessed factors. Racial inequity and racism seemingly contribute to these results, especially considering that Black people experience higher rates of COVID-19 exposure and severity of illness, which might add to greater mental health challenges for Black eye care professionals.	The findings suggest the need to develop strategies that target young and female students and racial minorities to improve their mental health.
Pongou et al. (2022) ³⁶	To examine the association between reported COVID-19 symptoms and testing for COVID-19 in Canada	N = 2790 White: n = 2402 Black: n = 85 Mixed race/ethnicity: n = 126 Other ethnoracial groups: n = 177	Quantitative	Prevalence of testing for COVID-19 differed by ethnicity (White: 17.30%; Black: 8.46%; mixed race/ethnicity: 28.41%; other ethnic groups: 27.37%).	There is a need to accelerate COVID-19 testing in Canada, and for the provinces of British Columbia and Quebec in particular to accommodate the need for COVID-19 tests and expand accessibility and availability of testing.

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TABLE 2 (continued)
Data extraction sheet

Author(s)	Study purpose / research question	Study population	Methods	Results/findings	Comments/implications
Pongou et al. (2022) ⁵¹	To examine the predictors of psychological distress during the COVID-19 pandemic in Canada and how they differ by gender.	N = 2756 White: n = 2364 Black: n = 83 Mixed race/ethnicity: n = 177 Other race/ethnicity: n = 132	Quantitative	Descriptive analysis indicates that nearly half of the participants (49%) experienced mild, moderate or severe psychological distress. Mild: White: 26.15, Black: 34.97, mixed race/ethnicity: 32.25, other ethnic group: 25.33. Severe: White: 7.70, Black: 3.06, mixed race/ethnicity: 4.25, other ethnic group: 16.96 $p < 0.069$ The odds of psychological distress were significantly higher for participants who declared COVID-19 symptoms compared to those who did not declare COVID-19 symptoms.	There is a significant need to make mental health support services available to vulnerable groups. Also, interventions and policies targeted at tackling psychological distress throughout pandemics such as COVID-19 should be gender specific.
Richard et al. (2022) ⁴¹	To describe COVID-19 vaccine coverage in the homeless population in Toronto and explore factors related to the receipt of at least 1 dose.	N = 728 Indigenous: n = 27 White: n = 353 Black: n = 159 Other/multiracial: n = 156	Quantitative	Slightly more than 80.4% of participants received at least 1 COVID-19 vaccine; 63.6% received ≥ 2 doses. Black participants were consistently found to have lower vaccination acceptance or greater hesitancy. Black (18.3% vaccinated vs. 32.9% unvaccinated) [Arr0.89 [95% CI: 0.80–0.99]]	More public health approaches are required to understand and resolve how interconnecting experiences of marginalization and oppression encountered by various of the subgroups recognized in this study influence the choices and opportunities to uptake vaccination.
Rocha et al. (2020) ³⁷	To highlight the dire need to collect race-based data on increased morbidity, mortality and exposure to COVID-19 in subpopulations in Montréal, Quebec, by socioeconomic factor with a particular focus on Black populations.	Montréal's demographic groups, including the Black population, neighbourhoods, income, education, essential workers and crowded housing.	Quantitative	There is an association between COVID-19 cases and socioeconomic factors such as race and housing: of all marginalized groups, the strongest association with positive COVID-19 cases occurred in Montréal boroughs with high proportions of Black residents: Montréal-Nord, with a high proportion of Haitian people, and Rivière des Prairies, Pointe aux Trembles, LaSalle, Villeray and Parc-Extension. Strong correlations also existed between COVID-19 cases and health care workers, low-income earners and those living in inadequate and crowded housing. Another key correlation for COVID-19 exposure also occurred among under-educated persons in Montréal.	The Canadian government needs to collect race-based data as these are critical for highlighting and understanding key socioeconomic influences and the shared experiences of Black people, especially in relation to the effect of COVID-19 on Black populations in Montréal.

with the same level of seriousness, Black and Indigenous people possess a greater degree of vaccine hesitancy and mistrust in efficacy than do White people due to concerns about potential future side effects and commercial gains and because they favoured natural immunity to a greater degree.

Two quantitative study findings reported lower vaccination rates and higher vaccine mistrust scores among Black individuals as a result of their experiences of major racial discrimination in the health

care system.^{43,44} In addition, a quantitative study of vaccine willingness found that African, Caribbean and Black individuals at greater risk of infection with COVID-19 were more willing to get vaccinated, and those who had received their first dose of the COVID-19 vaccine were more willing to receive upcoming doses.⁴⁵

Systemic racism and discrimination

The five studies that explored the difficulties Black Canadians faced during the pandemic as a result of systemic racism and discrimination determined that the

difficulties study participants experienced accessing COVID-19-related health care might have been exacerbated by existing stress stemming from racism, systematic bias and barriers, and socioeconomic vulnerabilities.^{40,46-49} The significant link between police cruelty towards Black people in Canada, increased rates of COVID-19 in the Black population and the correlation of lower socioeconomic status, lower level of education and lower-paying employment with great risk of exposure to COVID-19, serves as a symbol of the continuing and historical racism experienced by Black people.⁴⁶

The underlying systemic racism and related inequities resulted in mistrust of health care providers.⁴⁰ Miconi et al.⁴⁷ conducted a mixed study on risk of exposure to COVID-19 and the relation to discrimination and stigma associated with mental health findings. The authors reported that Black, Arab and South Asian participants had higher prevalence of infection, while Black and Asian participants disclosing greater COVID-19-related discrimination and stigma as a result of their employment, for example, as frontline workers.⁴⁷

The quantitative study conducted by Noble et al.⁴⁹ revealed that systemic racism and the COVID-19 pandemic exacerbated mental distress among Black youth experiencing homelessness in Toronto, with barriers to securing employment and landlords' racial discrimination making it difficult to obtain accommodation.

A qualitative study revealed that there was insufficient information on the type of training frontline health workers and administrators require when providing services to African, Caribbean and Black communities.⁴⁸ No concrete evidence is available to enhance strategies to ensure health equity and mitigate the impact of COVID-19 in African, Caribbean and Black communities.

Mental health impacts

Four studies reported on mental health impacts of the COVID-19 pandemic on Black people in Canada.^{38,47,50,51} A qualitative study found that online misinformation about COVID-19 aggravated mental health issues among Black Canadians and resulted in fear of and anger about mandatory vaccine orders.³⁸ Some Black community members were afraid of being stigmatized whether they received or declined the COVID-19 vaccine, which amplified their anxiety about COVID-19 and prevented them from getting vaccinated or promoting vaccination.³⁸

In their quantitative study on eye care professionals' mental health risk factors during the COVID-19 pandemic, Pang et al.⁵⁰ reported poor emotional health among Black and Asian optometrists, noting that they were more prone to mental distress and elevated symptoms of depression and anxiety than other ethnoracial groups. Miconi et al.⁴⁷ reported an increase in negative mental health outcomes associated with exposure to the COVID-19

virus and/or COVID-19-related discrimination, with Black survey respondents describing the worst mental distress due to the pandemic. Further, research on predictors of psychological distress during the COVID-19 pandemic in Canada show that nearly half of the participants (49%) experienced mild, moderate or severe psychological distress, with Black Canadians (mild: 34.97%; severe: 3.06%) reporting a higher percentage of mild and severe psychological distress compared to White (mild: 26.15%; severe: 7.70%) and mixed race/ethnicity (mild: 32.25%; severe: 4.25%) Canadians.⁵¹

Discussion

This scoping review identified five themes addressing the impact of COVID-19 on Black Canadians. Key among our findings is evidence of the inequalities in access to COVID-19-related health care, which may be attributed to existing structural racism within the Canadian health care system. Given the highly infectious nature of the disease, inequalities in access to care in the context of COVID-19 affects the entire population. For instance, anyone who does not adopt COVID-19 preventive measures, prompt diagnosis and treatment, may contract the virus and spread it in their community.

The COVID-19 pandemic accentuated health inequities based on anti-Black racism. Two studies in this scoping review showed that early measures to control the spread of COVID-19 (e.g. screening) were not effectively implemented in the areas where most Black people resided, which increased residents' risk of infection.^{35,36} The COVID-19 mortality rate among Black people living in low-income areas was 3.5 times higher than in nonracialized and non-Indigenous populations living in low-income areas.⁵² Further, Black people have been at greater risk of hospitalization for and dying from COVID-19 due to inadequate access to health care providers and services.^{53,54} Other factors that contribute to the high rates of COVID-19 infection among Black people include poverty, poor and overcrowded living conditions, and employment in precarious frontline work.^{55,56} Communities in Canada with larger proportions of Black and racialized populations had higher rates of COVID-19 infection and death.^{55,56} For instance, Ontario is home to more than 50% of Canada's Black population, and overrepresentation of COVID-19 cases were

reported in Black neighbourhoods.^{18,55-57} Other studies conducted in Edmonton, Alberta,⁵⁸ and Montréal, Quebec,⁵⁹ also revealed that Black Canadians were more likely to experience negative socioeconomic effects of the COVID-19 pandemic.^{58,59} These results speak to the need for fair distribution of COVID-19 preventive and treatment services.

Several studies^{38,40-42,44,45} in our scoping review described the low uptake of COVID-19 vaccines among Black Canadians. Vaccine hesitancy, recognized as a serious threat to public health, is significant among Black people. Some of the factors leading to vaccine hesitancy among Black Canadians are anti-Black racism in health care, distrust of the health care system and the failure to prioritize Black communities during vaccine rollouts.^{40,42} This is consistent with the findings of a systematic review from Canada⁶⁰ and a meta-analysis from the USA.⁶¹ Statistics Canada reported that a much lower proportion of the Black population (56.4%) were very or somewhat willing to be vaccinated compared to White (77.7%) and South Asian (82.5%) populations.⁶² The distrust of COVID-19 vaccines is partly rooted in historical events of medical cruelty and unethical health research carried out on Black people, the perceived precipitous development of the vaccines, and community members' lack of access to adequate information about the safety of the vaccines.⁶³⁻⁶⁵

A systematic review found that, given that many factors influence vaccine hesitancy, multicomponent interventions that incorporate intensified communication, culturally inclusive informational materials, community outreach and greater accessibility are the most reliable strategies to address this issue.⁶⁶ Black people's trust in the COVID-19 vaccine and its acceptance can be achieved by involving trusted community and faith leaders,⁶⁷ providing culturally congruent materials and making vaccine information more accessible.^{68,69} In addition, a change in health policies and programs to garner trust and direct more attention to anti-Black racism will increase vaccine uptake in the Black Canadian community. Employing culturally representative health care personnel to inform Black people in the community can also influence acceptance of COVID-19 vaccine.⁷⁰

The findings from this scoping review suggest that many Black Canadians had difficulties accessing COVID-19-related health care as a result of racism, systemic bias and socioeconomic vulnerabilities. Black Canadians largely perceive the health care system as racially and culturally alienating, and feel that the medical language and cultural barriers had a negative impact on their health care access;⁶² and this was exacerbated at the peak of the COVID-19 pandemic. The pandemic revealed the discrimination and racism that have long resulted in poor emotional, mental and physical health outcomes for African-Americans in the USA,⁷⁰ with minority groups tending to receive lower standard of care than White people do, predisposing African-Americans to worse COVID-19 outcomes.⁷¹

Black Canadians' relationships with health care personnel have been negatively affected by cultural differences, lack of cultural competence, dependence on the biomedical model and discrimination that has resulted in mistrust.⁷²⁻⁷⁴ Culturally sensitive interventions can enhance health care and patient outcomes,^{75,76} so it is critical to provide Black Canadians with a range of treatment options that incorporate culturally specific supports. Cultural awareness training for health care workers and employment of more Black health care workers would meaningfully contribute to overcoming cultural barriers to health care for Black people in Canada.

Our scoping review also found that Black Canadians and other minority groups encountered mental health distress during the pandemic.^{38,47,50,51} Existing discrepancies in mental health among Black people in Canada and African-Americans in the USA were exacerbated during the COVID-19 pandemic.^{77,78} Numerous factors, such as socioeconomic factors and access to mental health services, are responsible for the discrepancy.⁷⁸ Resolving misinformation among Black Canadians through reliable sources and adapting tailored, multimodal and culturally intelligent messaging is important.

Strengths and limitations

To the best of our knowledge, this is the first scoping review that focusses on empirical research on the effects of the COVID-19 pandemic on Black people living in Canada. The small number of studies included (n = 17) demonstrates the lack of research on COVID-19 among

Black people in Canada, suggesting the need for more studies.

Conclusion

Our review revealed structural barriers, high rates of COVID-19 infections and low uptake of COVID-19 vaccines among Black Canadians, confirming research findings that the COVID-19 pandemic amplified health inequities, generated new barriers to health care, increased mistrust and reduced a sense of belonging among Black people.^{8,17,79} More research needs to be conducted to inform policies and programs to address the root causes of inequities.

Some of the studies in this scoping review highlight the need to prioritize the equitable allocation of COVID-19 preventive measures and treatment. COVID-19 prevention strategies that are culturally appropriate and specific should also be made available and accessible. More generally, such initiatives should address the existing barriers associated with structural racism, medical distrust, educational inequities and health inequities. Canadian federal and provincial governments should implement strategies geared towards partnerships with Black-led and Black-focussed community groups to appropriately manage COVID-19 vaccine knowledge gaps and associated distrust factors and barriers, as sensitive and safe education implementation will increase vaccine confidence and herd immunity among Black communities to the benefit of society. Finally, collecting race-based data with the aim of resolving inequities and improving the health and well-being of Black people in Canada is essential to inform policies and address racial discrimination and access to health care services, as well as quality housing and employment.

Acknowledgments

The authors thank Mary Olukotun, PhD Student, Faculty of Nursing, University of Alberta, for her invaluable contributions in searching the databases for the reviewed articles.

Funding

This work was funded by the Government of Canada, Department of Heritage Digital Citizenship Program (<https://www.canada.ca/en/canadian-heritage/services/online-disinformation/digital-citizen-contribution-program.html>).

Conflicts of interest

The authors declare no competing interests.

Authors' contributions and statement

BS: Conceptualization, funding acquisition, supervision, writing – review & editing.

AO: Data curation, formal analysis, writing – original draft.

JK: Data curation, writing – review & editing.

DA: Data analysis, writing – review & editing.

MT: Review & editing.

AR: Review & editing.

AS: Review & editing.

DVM: Review & editing.

KO: Review & editing.

All authors read and agreed on the manuscript.

The content and views expressed in this article are those of the authors and do not necessarily reflect those of the Government of Canada.

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Call for papers: Generating stronger evidence to inform policy and practice: natural experiments on built environments, health behaviours and chronic diseases

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Guest editors: Dr. Stephanie Prince Ware (Public Health Agency of Canada), Dr. Gavin McCormack (University of Calgary)

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Where we work, learn, play, eat and live has important implications for health. The built environment has been associated with the development of chronic disease, and with health behaviours often seen as critical pathways for this relationship.^{1,2} Built environments refer to components of the physical environment that are human-made or human-modified and include structures and buildings, recreation facilities, green spaces and parks, transportation systems and community design.

Natural experiments are interventions that occur without a researcher's ability to manipulate the intervention or exposure to the intervention.^{3,4} Natural experiments offer the opportunity to evaluate the effects of "naturally occurring" interventions such as changes to the built environment (e.g. creation of a new bike path, park improvements, infrastructure changes to schools or workplaces, construction of a new recreation facility or grocery store) on health behaviours and chronic disease risk. Natural experiments are often more practical for investigating the health impacts of environmental interventions when compared to traditional experimental studies (e.g. randomized controlled trials). Compared to cross-sectional studies, natural experiments provide a means to generate rigorous evidence to better establish causality, as well as to understand the implementation of interventions in "real-world" scenarios.

This special issue answers the 2017 Canadian Public Health Officer annual report's call to further evaluate the health impacts of community design features in Canada.⁵ This special issue resonates with the expanding scholarly and policy-oriented interest in the utility of natural experiments as a critical tool in advancing the body of evidence and for informing interventions to improve public and population health.^{6,7} Specifically, the objective of this special issue on natural experiments is to provide timely evidence to further understand the effectiveness of built environment interventions on health behaviours and chronic disease prevention in a Canadian context.

Health Promotion and Chronic Disease Prevention in Canada: Research, Policy and Practice is seeking relevant topical research articles that present new findings or synthesize/review existing evidence on natural experiments of the built environment (or related policies) that influence health behaviours with implications for chronic disease prevention in Canada.

Relevant topic areas include, but are not limited to:

- Built environments, including community or neighbourhoods, workplaces, schools, transportation infrastructure, home environments, recreation environments, parks, playgrounds, green spaces, public open spaces, natural environments and seniors' residences.
- All health-related behaviours, including physical activity, sedentary behaviour, sleep, food consumption, smoking and substance use.
- Chronic diseases and health-related outcomes, including body mass index, fitness, blood pressure, blood lipids, blood sugar, injuries, falls, mental health, stress, depression, anxiety, Alzheimer's disease, dementia, obesity, metabolic syndrome, cardiovascular disease, cancer, diabetes and lung disease.

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Other PHAC publications

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Researchers from the Public Health Agency of Canada also contribute to work published in other journals and books. Look for the following articles published in 2023:

Gabet S, Thierry B, **Wasfi R**, et al. How is the COVID-19 pandemic impacting our life, mental health, and well-being? Design and preliminary findings of the pan-Canadian longitudinal COHESION study. *BMC Public Health*. 2023;23(1):2401. <https://doi.org/10.1186/s12889-023-17297-w>

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King EC, Zagrodny KAP, **Rabeenthira P**, et al. Why did home care personal support service volumes drop during the COVID-19 pandemic? The contributions of client choice and personal support worker availability. *Health Services Insights*. 2023;16:11786329231210692. <https://doi.org/10.1177/11786329231210692>

O'Sullivan B, Zhong A, Yin LL, et al. The future of global health: restructuring governance through inclusive youth leadership. *BMJ Global Health*. 2023;8(11):e013653. <https://doi.org/10.1136/bmjgh-2023-013653>

Prince SA, **Lang JJ**, **de Groh M**, [...] **Butler GP**, [...] **Geneau R**. Prioritizing a research agenda on built environments and physical activity: a twin panel Delphi consensus process with researchers and knowledge users. *Int J Behav Nutr Phys Act*. 2023;20(1):144. <https://doi.org/10.1186/s12966-023-01533-y>

Saragosa M, Zagrodny KAP, **Rabeenthira P**, et al. How might we have known? Using administrative data to predict 30-day hospital readmission in clients receiving home care services from 2018 to 2021. *Health Services Insights*. 2023;16:11786329231211774. <https://doi.org/10.1177/11786329231211774>

Souleymanov R, Akinyele-Akanbi B, Njeze C, [...] **Kim J**, et al. Migration and health study: a socio-ecological analysis of sexual health among migrants in Manitoba, Canada. *BMC Public Health*. 2023;23(1):2438. <https://doi.org/10.1186/s12889-023-17379-9>

Ziam S, Lanoue S, McSween-Cadieux E, [...] **Jean E**, et al. Validation of a framework for evaluating knowledge mobilization strategies: a Delphi method approach. *Proceedings of the European Conference on Knowledge Management, ECKM*. 2023;24(2):1510-5. <https://doi.org/10.34190/eckm.24.2.1642>

