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Original quantitative research

Sentinel surveillance of injuries and poisonings associated with cocaine and other substance use: results from the Canadian Hospitals Injury Reporting and Prevention Program (CHIRPP)

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Abstract

Introduction: Consumption of cocaine can lead to numerous injuries and poisoning. However, only a limited number of studies have explored cocaine-related injuries. This study examined a wide range of injuries and poisonings related to cocaine only and in combination with other substances in Canada using sentinel surveillance data captured by the electronic Canadian Hospitals Injury Reporting and Prevention Program (eCHIRPP).

Methods: Injuries and poisonings related to the use of cocaine only or in combination with other substances were identified in the eCHIRPP database between January 2012 and December 2019 for all ages. Descriptive analyses were performed to investigate the distribution of demographic and injury characteristics in poisoning and injury records related to the use of cocaine only and in combination with other substances. Statistical analyses were conducted to find the proportion of cocaine-related injuries per 100 000 eCHIRPP records. Cocaine-related injury trends were assessed using annual percent change (APC).

Results: Cocaine-related injuries and poisonings were observed in 123 records per 100 000 eCHIRPP records. Of the 1482 patients who presented to emergency departments of CHIRPP sites with this type of injury or poisoning, the majority involved cocaine use in combination with one or more substances (80.0%; n = 1186), whereas cocaine-only use was the minority (20.0%; n = 296). Among all cocaine-related records, poisoning was the leading diagnosis (62.7%; n = 930) and most injuries and poisonings were unintentional (73.5%; n = 1090). Overall, the trend of cocaine-related eCHIRPP records for all age groups increased over the study period from 2012 to 2019 (APC [total] = 47.8%, *p* < 0.05).

Conclusion: Our findings of a higher proportion of cocaine-related injuries and poisonings among adolescents and young adults, as well as the co-consumption of cocaine with other substances, demonstrate the importance of extensive surveillance of cocaine-related injuries and poisonings and the implementation of evidence-based public health interventions.

Keywords: *cocaine, cocaine-related injuries and poisonings, co-consumption, emergency department, Canadian Hospitals Injury Reporting and Prevention Program*

Highlights

- There were 123 records of cocaine-related injuries and poisonings per 100 000 eCHIRPP records identified in the eCHIRPP database between January 2012 and December 2019 for all age groups.
- The majority of injuries and poisonings occurred when cocaine was used in combination with one or more substances (80.0%; n = 1186).
- The proportion of cocaine-related injuries and poisonings was generally higher among males across most age groups compared to females, except for females under 19 years of age, who represented a slightly higher proportion than males in the same age group.
- The overall trend of cocaine-related records for all age groups showed an increase over the study period from 2012 to 2019 (APC [total] = 47.8%, *p* < 0.05).
- Among all cocaine-related records, poisoning was the leading diagnosis (62.7%; n = 930).

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Introduction

In Canada, as in many parts of the world, substance use and addiction are significant public health problems. The Canadian Substance Use Costs and Harms 2015–2017 report indicated that in 2017, substance use cost Canadians approximately CAD 46 billion, both directly and indirectly, and led to 275 000 hospitalizations and nearly 75 000 deaths.[1] According to the Government of Canada, psychoactive substances, such as alcohol, tobacco, prescription medications and cannabis, are most commonly used by Canadians, while other psychoactive substances that are illicit, such as cocaine, heroin, ecstasy and methamphetamine, are used by a smaller number of Canadians at some point in their lifetime.[2]

Cocaine is regulated under Canada's *Controlled Drugs and Substances Act*.[3] The criminal penalty for possession of cocaine can be as many as seven years of imprisonment, while production and trafficking can lead to lifetime imprisonment. Despite these regulatory measures, Canada ranks second in the world for the median number of days of cocaine use among those who reported using cocaine in the previous 12 months, according to the Global Drug Survey 2019.[4] Furthermore, the 2017 Canadian Tobacco, Alcohol and Drugs Survey (CTADS) found that around 2% of the Canadian population were using cocaine, compared to 1% in 2015.[5,6] This survey further revealed that cocaine was the third most prevalent substance consumed after alcohol and cannabis (besides tobacco) among those 19 years of age and older.[5-7] In addition, according to the Canadian Student Tobacco, Alcohol and Drugs Survey (CSTADS), an estimated 2.2% of students in Grades 7 to 12 reported cocaine use in 2018-2019; among these students, those in Grades 10 to 12 reported the highest cocaine use (3.4%).[8]

Cocaine, a powerful nerve stimulant and an addictive substance, is derived from coca leaves. It is a popular street drug also known as "coke," "blow," "crack," "snow" and "Charlie," among others.[9] Cocaine users may consume it by snorting it directly into the nose, rubbing it on their gums, dissolving it in water and injecting it, or smoking it. The consumption of cocaine increases energy and alertness, lowers appetite and sleep and generates intense feelings of euphoria.[10] Evidence indicates that cocaine use is associated with short- and long-term health risks to multiple organs, such as the brain, heart, lungs, liver and kidneys.[11] Another major concern about using cocaine, a sympathomimetic and psychoactive substance, is that it can impact the drug user's cognitive ability and judgment, which could lead to fatal or nonfatal injuries.[12,13] Furthermore, consuming cocaine alongside other drugs is a common practice among street drug users.[14] Polysubstance use, such as illicit drugs with alcohol or other substances, can lead to physical, behavioural and health complications.[15]

So far, cocaine research has focussed on drug overdose deaths, trauma and fatal injuries involving cocaine. Nevertheless, injuries and poisonings associated with cocaine use among the Canadian population have not been studied well. Considering the rapid increase in harms associated with cocaine use in Canada[1] and the small number of studies that have explored cocaine-related injuries, the objective of our study was to examine the various injuries and poisonings related to cocaine and other substance use among Canadians using sentinel surveillance data captured from January 2012 to December 2019 by the electronic Canadian Hospitals Injury Reporting and Prevention Program (eCHIRPP).

Methods

Data source

The eCHIRPP is an injury and poisoning sentinel surveillance system that collects and analyzes data on injuries and poisonings of patients who visit the emergency departments (EDs) of 11 pediatric hospitals and 9 general hospitals across Canada.[16] During their visit to the ED of a participating CHIRPP hospital, the injured person or the accompanying caregiver is asked to complete a questionnaire about the injury circumstances.[17] The attending physician or other hospital staff later adds clinical details of the injury. These data are entered into the secure, web-based eCHIRPP database by the CHIRPP site coordinators. Narratives of injury information given by the patients or caregivers are extracted by data coders from the Public Health Agency of Canada (PHAC). Data from the eCHIRPP database were initially queried for injuries and poisonings related to the use of cocaine occurring between April 2011 and July 2020 for all ages.

Cocaine-related records were identified using search terms such as "cocaine", "crack cocaine", "coke", "blow", "free base", "crack", "snow", and "Charlie" in the substance ID and the narrative description of the injury/poisoning event in the eCHIRPP database, and were confirmed manually. A total of 1629 cocaine-related injuries and poisonings were reported in the eCHIRPP database between April 2011 and July 2020. We excluded records from the years 2011 and 2020, as these were incomplete. This reduced the cocaine-related records to 1482, representing 123.1 records per 100 000 eCHIRPP records.

Injuries associated with cocaine use were characterized into two distinct categories based on substance ID, diagnosis and manual review of the narrative description: cocaine-only and cocaine with one or more substances.[18] To identify potential drug combinations used with cocaine, cocaine with one or more substances was further stratified into subcategories such as cocaine and alcohol, cocaine and cannabis, cocaine and other illicit drugs, cocaine and medications (over the counter or prescription-based), and cocaine and mixed substances (i.e. more than one specified category was used with cocaine).

To explore the characteristics of the location variable, cocaine-related records were categorized based on two classifications: rural or urban and indoor or outdoor. Though substance use was often perceived to occur at parties, recreational places or outdoors, surveys found it occurred mostly at a person's own home or another's home. Therefore, to investigate these findings (i.e. the specific locations of injury event), indoor and outdoor settings were further characterized into subcategories.

Statistical analyses

Descriptive analyses were performed to investigate the distribution of demographic and injury characteristics (such as sex, age, location—rural/urban, location—indoor/outdoor, nature of injury, intent and disposition) of associated cocaine and other substance-related poisoning and injury records. Frequency distributions such as counts and percentages were generated, and data were presented overall and stratified by cocaine-only and cocaine-related substance use. Cocaine-related proportions were calculated relative to

100 000 eCHIRPP records by identifying cocaine-related records relative to all records (excluding cocaine-related records) found in the eCHIRPP database. Statistical analyses were conducted using Microsoft Excel 2010 and Joinpoint Regression Program version 4.8.0.1.[19] Time trend analyses were performed for the study period of January 2012 to December 2019 by sex and age group (15–19 years, 20–29 years, 30 years and older, and all ages) for all cocaine-related and cocaine-only injuries using Joinpoint software. The age group under 15 years was excluded from the time trend analyses due to the small counts. The annual percentage change (APC) and p-values were computed to describe trends over time. APC segments are significantly different from zero at the $\alpha = 0.05$ level.

Results

Demographic and injury characteristics of cocaine-related records between 2012 and 2019 are presented in Table 1. Of the 1482 cocaine-related records, the majority involved cocaine use in combination with one or more other substances (80.0%; n = 1186), whereas cocaine-only use occurred in 20.0% of records (n = 296). For both cocaine-only use and cocaine use in combination with one or more substances, males (67.5% and 62.5%, respectively) represented the larger proportion. The number of injury and poisoning records related to cocaine-only use was highest among those aged 30 to 39 years (24.7%, n = 73), whereas the number of records related to the use of cocaine with one or more other substances was highest among those aged 20 to 29 years (32.6%, n = 386). When cocaine-related records were stratified by sex and age to calculate the number of records per 100 000 eCHIRPP records, males accounted for a higher proportion of all cocaine-related records across most age groups, except for those aged less than 15 years and 15 to 19 years; in those groups, females (11.3 and 267.1 records/100 000 eCHIRPP records, respectively) represented a larger proportion compared to males (5.6 and 158.7 records/100 000 eCHIRPP records, respectively; Figure 1).

Cocaine-only incidents and incidents involving cocaine with one or more substances had similar distributions in rural (9.5% vs. 10.8%) and urban (85.8% vs. 85.7%) settings. There were 483 incidents related to cocaine use at indoor locations,

TABLE 1
Distribution of cocaine-related injury characteristics, using eCHIRPP records, January 2012 to December 2019

Characteristics	All n (%)	Cocaine only n (%)	Cocaine with one or more substances[a] n (%)
Total	1482 (100.0)	296 (20.0)	1186 (80.0)
Sex			
Male	941 (63.5)	200 (67.5)	741 (62.5)
Female	541 (36.5)	96 (32.5)	445 (37.5)
Age group (years)			
< 10	15 (1.0)	5 (1.7)	10 (0.8)
10–14	51 (3.4)	6 (2.1)	45 (3.8)
15–19	294 (19.8)	37 (12.5)	257 (21.7)
20–29	457 (30.8)	71 (24.0)	386 (32.6)
30–39	334 (22.5)	73 (24.7)	261 (22.0)
40–49	179 (12.1)	60 (20.3)	119 (10.0)
≥ 50	152 (10.3)	44 (14.9)	108 (9.1)
Location—urban/rural[b]			
Urban	1271 (85.8)	254 (85.8)	1017 (85.7)
Rural	156 (10.5)	28 (9.5)	128 (10.8)
Location—indoor/outdoor			
Indoor locations[c]	483 (32.6)	93 (31.4)	390 (32.9)
Own home	188 (12.7)	35 (11.8)	153 (13.0)
Other people's home	118 (8.0)	23 (7.8)	95 (8.0)
Other	68 (4.6)	11 (3.7)	57 (4.8)
Outdoor locations[d]	389 (26.3)	67 (22.6)	322 (27.3)
Street, highway or public road	147 (9.9)	23 (7.8)	124 (10.5)
Public transportation or vehicle	105 (7.1)	27 (9.1)	78 (6.6)
Public park	20 (1.4)	1 (0.3)	19 (1.6)
Residential	37 (2.6)	4 (1.4)	33 (2.8)
Nature of injuries[e]			
Poisoning	930 (62.7)	149 (50.3)	781 (65.8)
External wound	129 (8.7)	23 (7.8)	106 (8.9)
Fracture, sprain or strain	104 (7.0)	26 (8.8)	78 (6.6)
Traumatic brain injury	61 (4.1)	12 (4.1)	49 (4.1)
Other injuries[f]	35 (2.4)	5 (1.7)	30 (2.5)
Intent of injuries			
Unintentional	1090 (73.5)	233 (78.7)	857 (72.3)
Self-harm	274 (18.5)	42 (14.2)	232 (19.6)
Physical assault	79 (5.3)	14 (4.7)	65 (5.5)
Sexual assault	17 (1.2)	1 (0.3)	16 (1.4)
Maltreatment	17 (1.2)	2 (0.7)	15 (1.3)
ERP involvement	5 (0.3)	4 (1.4)	1 (0.1)

TABLE 1 (continued)
Distribution of cocaine-related injury characteristics, using eCHIRPP records, January 2012 to December 2019

Characteristics	All n (%)	Cocaine only n (%)	Cocaine with one or more substances[a] n (%)
Disposition			
Left without being seen by physician	47 (3.2)	20 (6.8)	27 (2.3)
Advice only, diagnostic testing, referred to GP (no treatment in ED)	111 (7.5)	27 (9.1)	84 (7.1)
Treated in ED with follow-up PRN	239 (16.1)	63 (21.3)	176 (14.8)
Observation in ED, follow-up PRN	638 (43.1)	102 (34.5)	536 (45.2)
Observation in ED, follow-up required	88 (5.9)	20 (6.8)	68 (5.7)
Treated in ED, follow-up required, referred for injury treatment	107 (7.2)	12 (4.1)	95 (8.0)
Admitted to hospital for injury treatment	199 (13.4)	38 (12.8)	161 (13.6)
Admitted for other than injury treatment	45 (3.0)	11 (3.7)	34 (2.9)

Abbreviations: eCHIRPP, electronic Canadian Hospitals Injury Reporting and Prevention Program; ED, emergency department; ERP, emergency response personnel; GP, general practitioner; PRN, as needed.

Note: For injuries/poisonings occurring among those less than one year of age, cocaine was suspected to pass through the nursing or pregnant mother to the baby.

[a] Substances include alcohol, cannabis, other illicit drugs and medications.

[b] Location includes missing and unknown data; totals do not add up to 100%.

[c] Unspecified indoor location subcategories were not presented; totals do not add up to 100%.

[d] Other outdoor location subcategories were not presented due to small injury counts; totals do not add up to 100%.

[e] Also includes "not specified" and "no injury detected" categories; totals do not add up to 100%.

[f] Injuries that a clinician would consider as internal.

the highest proportion of which occurred at the patient's own home (n = 188). Conversely, cocaine-related injuries that occurred outdoors (n = 389) frequently took place on streets, highways or public roads (n = 147; Table 1).

Poisoning (62.7%) was the leading nature of injury among all cocaine-related records, followed by external wound (8.7%), fracture, sprain or strain (7.0%), brain injury (4.1%), and other injuries (2.4%; Table 1). With regard to the intent

of injuries, unintentional injuries were the most frequent (73.5%), while self-harm (18.5%) was found to be the second most common. Most patients were observed in the ED with follow-up as needed (43.1%, n = 638; Table 1), while 199 (13.4%) patients were admitted to hospital for injury treatment, the majority of which were males (n = 139), and patients aged 20 to 29 years (n = 65). There were 45 (3.0%) patients admitted for reasons other than injury treatment.

As shown in Figure 2, the majority of patients consumed cocaine with mixed substances (i.e. more than one substance, including alcohol, cannabis, illicit drugs or medication; n = 457) followed by cocaine and alcohol (n = 417). There were more male patients than female across all substance categories (Figure 2).

The time trend for cocaine-related injuries and poisonings, by sex, for the period between January 2012 and December 2019, is shown in Figure 3. For males, there was a slight decrease from 2012 to 2013 and 2014 to 2015, followed by an increasing trend from 2015 to 2019. The Joinpoint analysis software did not identify significant inflection points, and the overall trend for males was represented by an increasing APC of 49.1% ($p < 0.05$). For females, the Joinpoint analysis software identified a decreasing trend from 2012 to 2014 (APC = -20.3%, $p > 0.05$) and an increasing trend from 2014 to 2019 (APC = 64.3%, $p < 0.05$). A significant inflection point occurred in 2014 for females (Figure 3).

Figure 4 shows the trends in all cocaine-related injuries and poisonings by age group for 2012 to 2019. The overall trend of cocaine-related records for all age groups in eCHIRPP increased between the years 2012 and 2019 (APC = 47.8%, $p < 0.05$). Among those aged 15 to 19 years, the proportion of cocaine-related incidents increased slightly for 2012 through 2016 (APC = 6.8%, $p > 0.05$), then considerably increased from 2016 to 2019 (APC = 44.5%, $p < 0.05$). A steady growth was observed for those aged 20 to 29 and 30 years and older between 2012 and 2019 (APC = 39.6%, $p < 0.05$ and APC = 41.7%, $p < 0.05$, respectively).

Figure 5 displays the trend of the cocaine-only injury and poisoning proportion by age group over the 2012 to 2019 period.

FIGURE 1
Normalized distribution of all cocaine-related injuries and poisonings, by sex and age group, eCHIRPP, January 2012 to December 2019
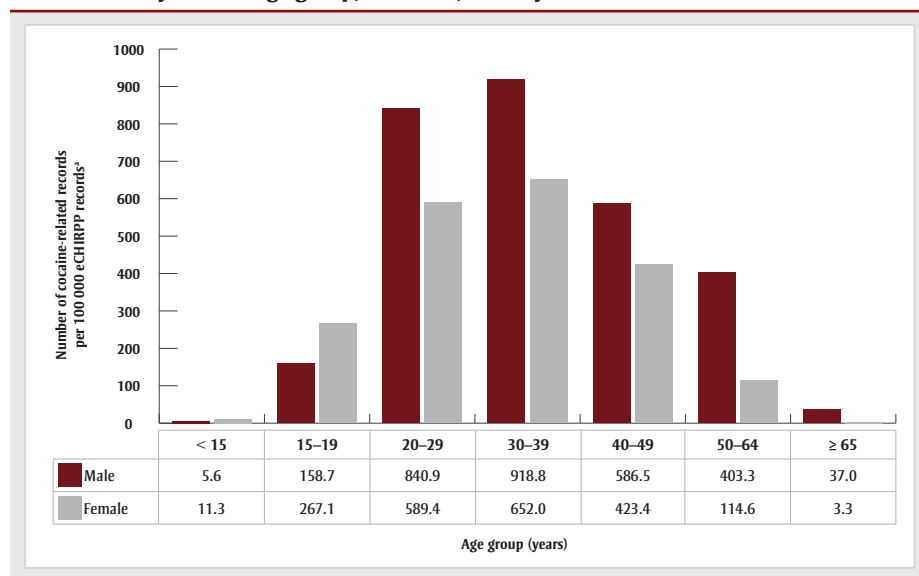
Age group (years)	< 15	15–19	20–29	30–39	40–49	50–64	≥ 65
Male	5.6	158.7	840.9	918.8	586.5	403.3	37.0
Female	11.3	267.1	589.4	652.0	423.4	114.6	3.3

Abbreviation: eCHIRPP, electronic Canadian Hospitals Injury Reporting and Prevention Program.

[a] Expressed as a proportion of eCHIRPP records for each age group (× 100 000).

FIGURE 2
Distribution of injuries and poisonings related to the use of cocaine only and cocaine plus one or more substances, by sex, eCHIRPP, January 2012 to December 2019

	Cocaine only	Cocaine and alcohol	Cocaine and cannabis	Cocaine and other illicit drugs	Cocaine and medications	Cocaine and mixed substances
Male	200	256	43	136	20	286
Female	96	161	15	81	17	171

Abbreviation: eCHIRPP, electronic Canadian Hospitals Injury Reporting and Prevention Program.

Note: "Mixed substances" refers to more than one specified substance category use with cocaine.

The trend has no significant inflection point for the 15 to 19 years, 30 years and older, and all-age groups, and demonstrated an increasing trend (15–19: APC = 16.7%, $p > 0.05$; 30 years and older: APC = 37.7%, $p < 0.05$; all ages: APC = 46.2%, $p < 0.05$) during the study period. The APC for the 20 to 29 age group could not be estimated due to the insufficient number of cocaine injuries and poisonings in certain years.

When investigating the nature of cocaine-related injuries and poisonings, we found that the nature of injury varied by the age group. Intoxication was found to be the leading nature of injury among all age groups (Figure 6A). External wound was the second highest among those aged 15 to 19 (9%) and 20 to 29 years (15%), and third among those aged 30 years and over (9%). Fracture, sprain or strain ranked third among those aged 15 to 19 (4%) and 20 to 29 (10%), and second among those aged 30 and over (10%; Figure 6A). Similarly, the intent of injuries among cocaine-related incidents also varied by age groups. Unintentional injury ranked first, followed by self-harm and physical assault for all age groups, except that in the 15 to 19 age group, sexual assault ranked third (Figure 6B).

Discussion

Our study revealed a substantial number of cocaine-related injuries and poisonings and increasing trends in cocaine-related injury and poisoning patients presenting to EDs participating in eCHIRPP between January 2012 and December 2019. Adolescent years can be a time of experimentation with substance use for many young people.[20] Research has shown that early (12–14 years of age) to late (15–17 years of age) adolescence is a critical period for the initiation of substance use, with substance use typically being highest in early adulthood.[20] Consistent with the existing research,[20] we observed similar patterns of cocaine-related injuries in which younger adults (20–29 years) comprised a higher proportion of cocaine-related injuries and

FIGURE 3
Time trend of cocaine-related injuries and poisonings, by sex, eCHIRPP, January 2012 to December 2019

Abbreviations: APC, annual percent change; eCHIRPP, electronic Canadian Hospitals Injury Reporting and Prevention Program.

[a] Joinpoint graphs are shown to highlight the inflection point in 2014 for females.

[b] Expressed as a proportion of eCHIRPP records for a given year (× 100 000).

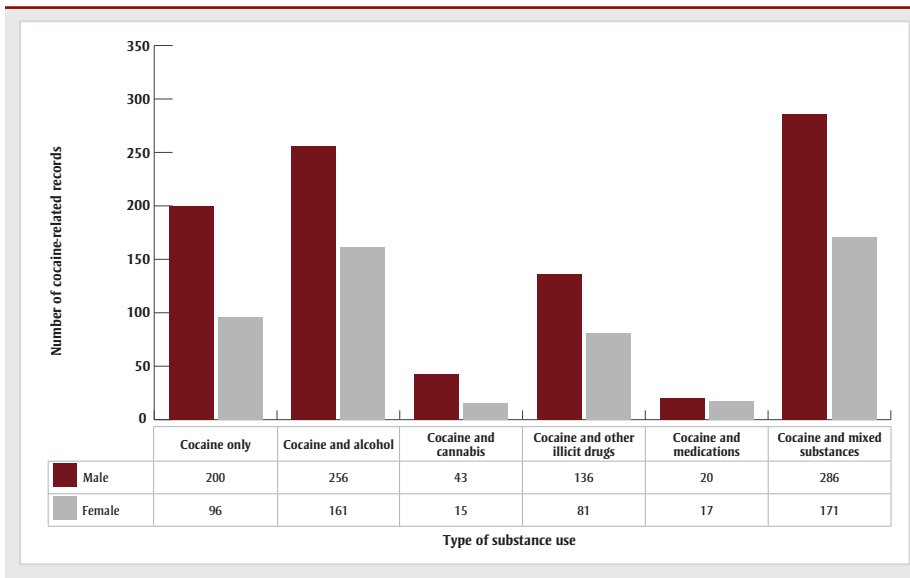* Indicates that APC is significantly different from zero at the α = 0.05 level.

FIGURE 4

FIGURE 4
Time trend of all cocaine-related injuries and poisonings, by age group, eCHIRPP, January 2012 to December 2019
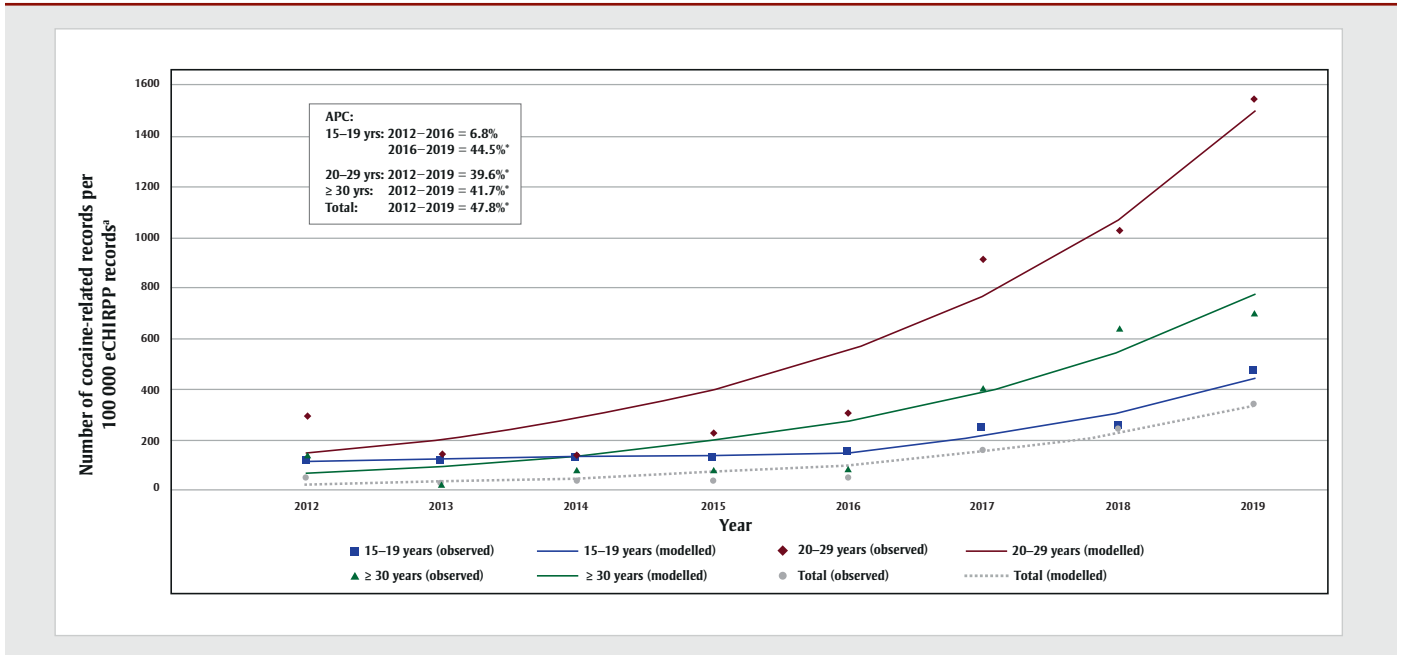
Abbreviations: APC, annual percent change; eCHIRPP, electronic Canadian Hospitals Injury Reporting and Prevention Program.

[a] Expressed as a proportion of eCHIRPP records for a given year (× 100 000).

[*] Indicates that APC is significantly different from zero at the α = 0.05 level.

FIGURE 5
Time trend of cocaine-only injuries and poisonings, by age group, eCHIRPP, January 2012 to December 2019
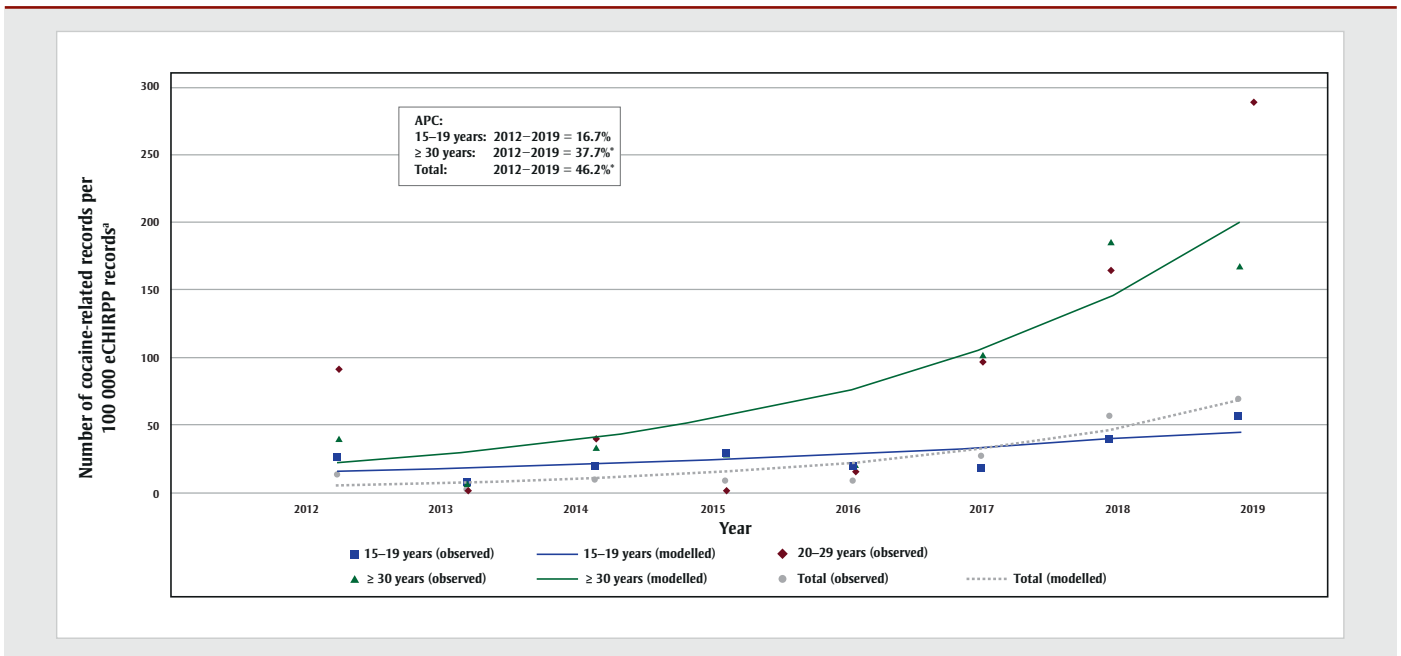
Abbreviations: APC, annual percent change; eCHIRPP, electronic Canadian Hospitals Injury Reporting and Prevention Program.

Note: APC for the 20–29 age group could not be estimated due to the insufficient number of cocaine-only injuries and poisonings in certain years.
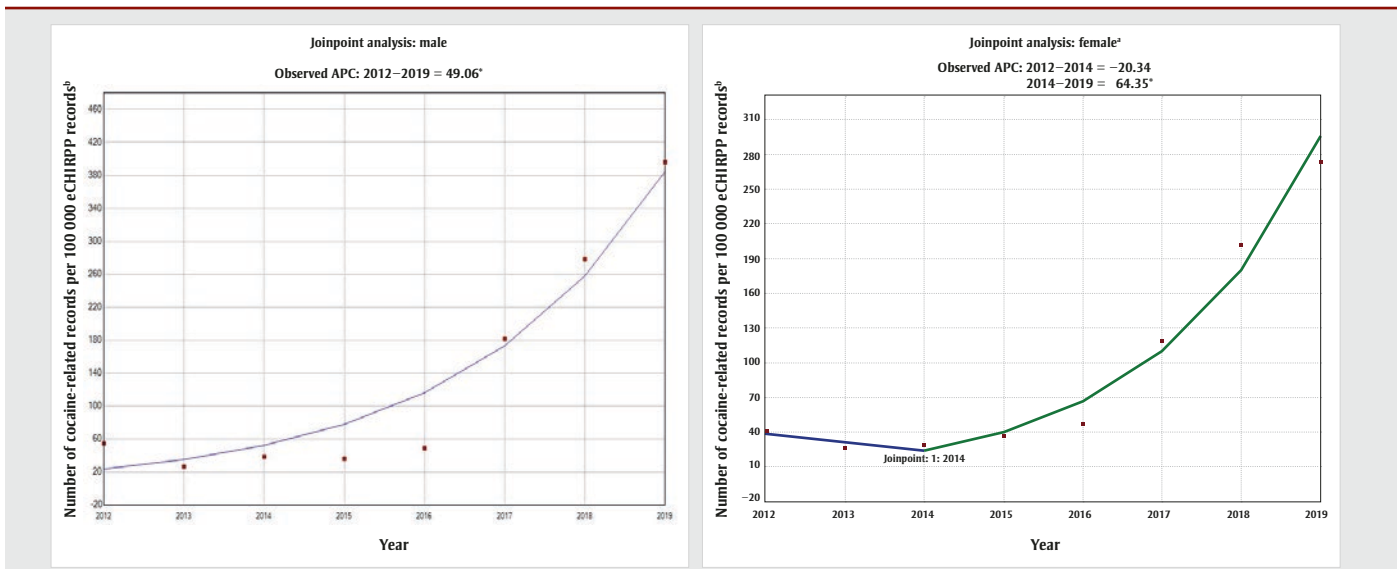
[a] Expressed as a proportion of eCHIRPP records for a given year (× 100 000).

[*] Indicates that APC is significantly different from zero at the α = 0.05 level.

FIGURE 6

**Distribution of (A) nature of injury and (B) intent of injury among all cocaine-related records by age group,
eCHIRPP, January 2012 to December 2019**
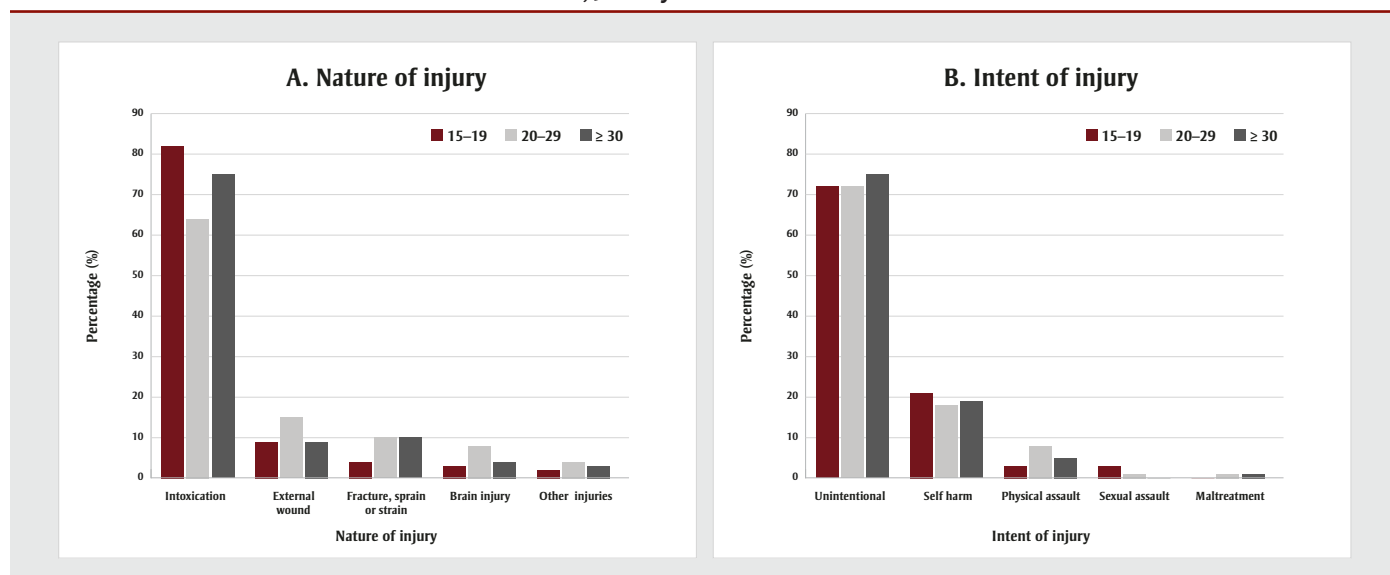
Abbreviation: eCHIRPP, electronic Canadian Hospitals Injury Reporting and Prevention Program.

poisonings relative to older adults. This is of particular concern, given the evidence that substances with psychoactive effects have a greater impact on developing brains.[21] Adolescents may face difficulties as they pass through the different phases of development into young adulthood, and they may turn to substance use to cope with the demands of difficult situations.[22] Our findings illustrate the importance of continued surveillance of substance-related harms, especially among youth and young adults.

This study found that cocaine-related injuries and poisonings were generally higher among males compared to females, which is in accordance with the Canadian Tobacco, Alcohol and Drugs Survey (CTADS) findings that cocaine use was more prevalent among males than females in 2017.[6] However, our study found the proportion of cocaine-related injuries and poisonings among females under 19 years of age was slightly higher compared to males. Another key finding from our study is the most common injury location. When exploring the distribution of injuries occurring at indoor settings, we found that the highest proportion of cocaine-related injuries and poisonings occurred at the patient's own home, followed by another person's home. This is consistent with data from the 2001 Australia National Drug Strategy Household Survey, in which participants reported that they usually

used cocaine at their own home or at a friend's home.[23]

Cocaine users frequently use cocaine with other substances, particularly alcohol or other psychoactive substances that modify the psychological effects of cocaine or blunt its unpleasant side effects.[24] However, cocaine taken in combination with other substances, presents more severe health risks than cocaine taken by itself, as it increases the toxicity of cocaine and risk of fatal overdose.[15] A study from Switzerland on acute cocaine-related health problems in patients presenting to an urban ED found that cocaine alone was used by a smaller proportion of patients (16%), whereas most patients (84%) consumed cocaine with at least one other substance such as alcohol, illicit drugs or cannabis.[25] Similarly, a technical report on the emergency health consequences of cocaine use in Europe revealed that alcohol is the substance most frequently co-ingested with cocaine, followed by psychoactive medicines.[26]

In line with these studies, we observed that among all cocaine-related eCHIRPP records, 20% were related to cocaine-only use, while 80% were related to cocaine use combined with one or more other substances. Furthermore, the substances associated with the most injuries and poisonings identified in our study were cocaine in combination with mixed substances (i.e. cocaine plus more than one

other substance), followed by cocaine combined with alcohol.

As cocaine is a psychoactive substance with known neurobehavioural effects such as irritability, anger and aggression, studies found that people who use cocaine might be more likely to be involved in injuries related to violence and assault.[27,28] Our study found approximately 25% of patients presenting to the ED with cocaine-related injuries or poisonings were there due to self-harm (18.5%), physical assault (5.3%) or sexual assault (1.2%). Though the majority of injuries in this study were due to intoxication and were unintentional, the acute use of alcohol and cocaine is known to be associated with suicide attempts and fatal injuries.[29,30] Our study demonstrates the importance of continued surveillance of substance-related harms including those involving cocaine use to help prevent the increasing incidence of substance-related emergencies.

Strengths and limitations

The major strength of this study is the utilization of the eCHIRPP database as the data source. The eCHIRPP is a well-established and reliable sentinel surveillance system that collects detailed clinical data from the EDs of 20 hospitals across Canada and captures a wide range of injuries and poisonings associated with the use of cocaine and other substances.

However, this study also has some limitations. It is possible that substance use may have been underreported due to stigma associated with the nature of the topic. Also, the majority of the participating eCHIRPP hospitals are pediatric hospitals; therefore, certain groups may be underrepresented in the data, such as older teens and adults.[17] In addition, as the eCHIRPP sentinel surveillance program operates only at selected Canadian hospital EDs, the true burden of cocaine-related injuries may have been underestimated. Another limitation is that the eCHIRPP data do not capture most of the fatal incidents or mild ones treated at other locations such as clinics, supervised injection sites or nonparticipating CHIRPP hospitals. Despite having data spanning an eight-year period (2012–2019), trend analysis (APC) for some strata were constrained by small sample sizes, which are subject to random variations. Future studies with larger sample sizes are needed to improve the precision of the trend estimates. Regardless of these limitations, the eCHIRPP database is a robust source of data related to injuries and poisonings associated with cocaine use among Canadians.

Conclusion

This study provides a descriptive overview of cocaine-related injury and poisoning characteristics, including intent and nature of injury. The higher frequency of cocaine-related injuries and poisonings in the adolescent and young adult age groups identified in this study suggests the need for ongoing surveillance efforts. In addition, the majority of injury and poisoning incidents captured in this study were related to the co-consumption of other substances with cocaine. Therefore, future research should aim to better understand the risk of injuries and poisonings associated with co-consumption of substances with cocaine. Finally, considering that 2020 and 2021 data were not included in our study, further study of any potential impacts of the COVID-19 pandemic on substance use would be beneficial.

Conflicts of interest

The authors have no conflicts to declare.

Authors' contributions and statement

II, MTD, SZ, SD, ZW, LG, SRM, AC and JC were involved in the project design and conceptualization. II conducted the literature review search and data analyses and drafted the manuscript. SRM, AC and JC extracted the eCHIRPP data. All authors contributed to revising the article.

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 mixed methods research

Experiences, impacts and service needs of injured and ill workers in the WSIB process: evidence from Thunder Bay and District (Ontario, Canada)

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Abstract

Introduction: Individuals experience negative physical, social and psychological ramifications when they are hurt or become ill at work. Ontario's Workplace Safety and Insurance Board (WSIB) is intended to mitigate these effects, yet the WSIB process can be difficult. Supports for injured workers can be fragmented and scarce, especially in underserved areas. We describe the experiences and mental health needs of injured and ill Northwestern Ontario workers in the WSIB process, in order to promote system improvements.

Methods: Community-recruited injured and ill workers (n = 40) from Thunder Bay and District completed an online survey about their mental health, social service and legal system needs while involved with WSIB. Additional Northwestern Ontario injured and ill workers (n = 16) and community service providers experienced with WSIB processes (n = 8) completed interviews addressing similar themes.

Results: Northwestern Ontario workers described the impacts of workplace injury and illness on their professional, family, financial and social functioning, and on their physical and mental health. Many also reported incremental negative impacts of the WSIB processes themselves, including regional issues such as "small town" privacy concerns and the cost burden of travel required by the WSIB, especially during COVID-19. Workers and service providers suggested streamlining and explicating WSIB processes, increasing WSIB continuity of care, and region-specific actions such as improving access to regional support services through arm's-length navigators.

Conclusion: Northwestern Ontario workers experienced negative effects from workplace injuries and illness and the WSIB process itself. Stakeholders can use these findings to improve processes and outcomes for injured and ill workers, with special considerations for the North.

Keywords: occupational injuries, occupational stress, mental health, rural health services, workers' compensation, WSIB

Highlights

- Individuals in Northwestern Ontario who were hurt or became ill at work experienced negative effects on their physical, financial, social and psychological well-being, including some related to or worsened by the WSIB process. This is consistent with research conducted elsewhere in the province.

- Injured and ill workers in Northwestern Ontario may face additional regional barriers to proper care and recovery, including limited employment opportunities, "small town" privacy concerns and the costs and burden of care-related travel, especially during public health crises such as the COVID-19 pandemic.

- Suggestions to improve the WSIB process provided by Northwestern Ontario injured workers and service providers included general system improvements (e.g. streamlining and explicating WSIB processes, increasing WSIB continuity of care, designating an arm's-length system navigator), and several suggestions particular to the northern context.

Introduction

When individuals get hurt or become ill at work (henceforth "injured workers"), they encounter a cascade of negative effects on their physical, financial, social and psychological well-being.[1-3] Ontario's Workplace Safety and Insurance Board (WSIB), formerly known as the Workers' Compensation Board, is intended to help. First introduced in 1914, the Worker's Compensation Board provided compensation to injured workers in the form of wage replacement and health care benefits, regardless of fault, in

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order to reduce adversarial relations between workers and employers when workplace injury or illness occurred.[4] The current WSIB, having undergone several substantial changes over time, is now an independent trust agency responsible for balancing interests of employers and injured workers.[5] The WSIB describes its function as collecting appropriate premiums from employers in order to provide timely and fair compensation to individuals who are hurt or become ill at work, while supporting their recovery and return to work.[5]

Although most WSIB claims are adjudicated quickly and smoothly, and most injured workers return to work with minimal disruptions to life and career,[6] evidence suggests that approximately 20% of claims are prolonged, complicated and litigious, accounting for approximately 80% of total compensation claim costs.[3] Furthermore, when the WSIB denies a worker's claim and the worker files an appeal, they may be without income and necessary health and social supports for years while the appeal is resolved. Such situations inevitably lead to catastrophic consequences to workers and their families.[1,7] Examples of such situations are frequently profiled in the media,[8,9] illustrating the vulnerability of injured workers and the power that the WSIB system has to support or deny workers in need.

Recourse pathways and resources for people wanting to appeal WSIB decisions are fragmented and scarce. In Ontario, specialized, Toronto-based, community legal clinics assist injured workers across the province. Smaller, satellite community legal clinics also exist in other locations, but many of those clinics, including the ones in Northwestern Ontario, are not fully staffed; frequently they do not employ a lawyer at all, and often do not have the resources to provide assistance in workers' compensation matters. Moreover, while the Ministry of Labour's Office of the Worker Adviser provides no-cost representation to non-unionized injured workers, their waiting list is years long, leaving people without the financial means to pay for legal assistance, and without recourse. Altogether, individuals who become engaged in the WSIB claims and appeals processes frequently experience a toll on their finances, families and mental health.[7]

The risk of developing or exacerbating psychological illness during the WSIB claims and appeals process is high. Recent data suggest that up to half of individuals who get hurt or become ill at work develop depressive symptoms within a year of injury.[10,11] Such emergent mental health conditions further impede workers' long-term recovery and potential to return to work.[12,13] Many workers also lose the ability to access mental health services and supports once they become injured or ill because they lose access to employer insurance and the income needed to pay for mental health services. In Ontario, waitlists for free, public mental health services are often six months or more.[14]

In northern, rural or remote areas of Ontario, at least two additional challenges may further impede recovery and return to work. These include a general lengthening of the WSIB process, as workers frequently must travel to access specialists for assessments to justify receipt of WSIB benefits, and difficulties in accessing appropriate care once benefits are in place. For example, with just 11 WSIB-registered psychologists in Thunder Bay City and District[15] (a region geographically larger than countries such as Germany and Spain), workers with benefits may have to wait months to begin receiving services and then travel several hours by car or plane to receive care when in-person services are required.

In order to improve the services and outcomes for injured workers in Northwestern Ontario, WSIB, policymakers and community stakeholders need research that describes workers' needs throughout the WSIB claims and appeals processes, predictors of worker WSIB experiences and the available supports in the region. The WSIB, policymakers and community stakeholders particularly need research that describes the mental health and social service needs of injured workers engaged in the WSIB process in northern, rural and remote areas such as Thunder Bay City and District, in order to identify service gaps and quality issues, and to inform future system improvements in this high-needs, underserved region. Thus, our study describes Northwestern Ontario injured workers' experiences with the WSIB process and its impacts, plus system factors affecting WSIB experience, and suggestions to improve it.

Methods

Study design and participants

This study included a convergent, parallel, mixed methods design,[16] including a quantitative online survey (n = 40 injured workers) and semistructured qualitative interviews with n = 16 injured workers and n = 8 service providers experienced with WSIB processes in Thunder Bay City and District (Ontario). Lakehead University's Research Ethics Board approved the study procedures (reference no. 1467879).

Eligibility criteria

Eligible injured workers (1) were at least 18 years of age; (2) were able to read and write in English; (3) were residents of Thunder Bay City or District; (4) were previously injured at work or ill from work; and (5) had filed a WSIB claim or were involved with the WSIB compensation process (including appeals) within the past five years. Injured workers elected to participate in either the online survey or semistructured interview.

Eligible service providers (1) were at least 18 years of age; (2) had the ability to read and write in English; and (3) had provided services to at least eight injured and ill workers in Thunder Bay City and District in the past two years.

Recruitment

Our team recruited injured workers through social (e.g. Facebook, Kijiji, Reddit) and print (e.g. local newspapers, hardcopy flyers) media. We recruited service providers through (1) emails to listservs and service organizations; (2) professional networks; and (3) snowball sampling, with the intention of interviewing service providers from diverse service (legal, social and psychological) backgrounds.

Instruments

We designed and used three separate data collection tools for the study, including separate tools for workers and service providers. Our worker survey instrument was primarily designed to collect quantitative information, and both interview guides were designed to collect exclusively qualitative information.

Online survey and worker interview guide
We developed online survey and worker interview guides that included questions about (1) demographics; (2) workers'

injuries or illnesses; (3) workers' experiences engaging in the WSIB claims (and separately) appeals processes; (4) workers' use of any community or supplementary services during the claims and appeals processes (e.g. food bank, or legal or community mental health services); and (5) workers' suggestions for improving the WSIB claims and appeals processes. Workers also reported their perceived impacts of the WSIB claims (and separately) appeals processes. In the online survey, workers responded to the question, "How stressful was the claims (or appeals) process?" on a 5-point Likert scale from "not at all" to "extremely" stressful.

Service provider interview guide

Service providers were asked about similar topics, but from their point of view. Service providers reported (1) personal demographics and professional experience with injured workers; (2) perceived impacts of WSIB claims and appeals process on workers; (3) experience supporting workers engaged in the appeals process; (4) workers' use of supplementary services while in the WSIB claims or appeals processes; (5) challenges supporting workers in the WSIB claims and appeals processes; and (6) suggestions for improving the WSIB claims and appeals processes.

All data collection tools are available by request.

Data collection

We collected data between November 2020 and March 2021. We collected data from both sources (survey and interview) concurrently.

Online survey

Upon confirmation of eligibility and written informed consent, research assistants sent participants an email with a link to the online survey, hosted on the SurveyMonkey platform. The survey included 70 questions and took participants approximately 14 minutes to complete.

Qualitative interviews

Clinical psychology graduate students (JH, JL, CN), trained and under the supervision of a registered clinical psychologist (DS), interviewed injured and ill workers and service providers experienced with WSIB processes via Zoom or telephone (respondent's choice). Because we collected data during the COVID-19 pandemic,

we did not offer participants the option of in-person interviews. During each interview, interviewers reiterated the purpose of the study, collected verbal informed consent and posed questions to guide discussion. Interviewers encouraged participants to elaborate, specify and discuss their experiences. Interviews were audio recorded and transcribed.

Data analysis

We analyzed qualitative and quantitative data separately, using different but complementary approaches.

Quantitative analysis

Our team used descriptive statistics to characterize the sample, including workers' injuries, needs, experiences and associated health and social service use. We also ran very preliminary, exploratory, univariate general linear models to suggest factors that might be associated with workers' self-reported stress (on a 5-point Likert scale) separately during the claims and appeals processes. Due to our small sample size, we limited these analyses to a short list of demographic and injury-related factors derived from the literature and authors' clinical experiences. These factors included participants' age, sex, employment industry when injured (agriculture, manufacturing, transportation and warehousing; construction and mining; education, health care and social assistance; emergency services; hospitality, retail, arts, entertainment and recreation; and other industries), and permanence of disability (permanent, not sure, no permanent disability). All analyses were performed using SAS version 9.4 (SAS Institute Inc., Cary, NC, USA).

Qualitative analysis

We (DS, CN, JH, JL) conducted a thematic content analysis,[17,18] first by reviewing transcripts and extracting relevant themes related to workers' experiences and needs, and then by identifying convergent and divergent issues using a mixed analysis grid.[18] More specifically, we developed an initial coding framework for deductive analyses based on the preliminary themes used to organize the interview guide (experiences with and impacts of the WSIB process, system factors affecting WSIB experience, and suggestions to improve it). As there is a dearth of research related to injured worker experiences with workers' compensation in rural, remote and northern communities

in Ontario and in Canada overall, we kept themes in the initial coding framework minimal and broad, allowing for maximal generation of new themes and categories reflecting injured workers' experiences.[19] Accordingly, we also conducted an inductive analysis to identify emergent themes and categories, which resulted in many new emergent themes (i.e. WSIB-specific risk factors vs. broader system risk factors affecting WSIB experience, varying suggestions to improve the process) and categories (e.g. various WSIB claim impacts) that we included in the final categorization.

To do this, we first familiarized ourselves with the data collected through the online surveys and qualitative interviews. Second, we summarized data into smaller fragments of information that were first descriptive (paraphrases), then interpretative (words representative of underlying concepts, called "codes," selected by coders). We then grouped codes that reflected similar meaning under categories, and we grouped categories into themes within the coding framework.[18] We analyzed data continuously until saturation was reached (i.e. no new themes emerged). We finalized the coding framework, scheme and final categorization using co-coding and discussion, and we resolved disagreements through consensus.

Results

Participants

Injured worker characteristics are shown in Table 1. Injured workers were largely between 35 and 54 years of age, male, not legally married (i.e. single or common-law) and with no dependents. Participants largely identified as White. Nearly all participants were born in Canada, lived in Thunder Bay, Ontario, and spoke English as their first language. Gender and ethnicity were representative of the worker demographics of the region, but, in comparison, our sample was slightly older than other workers in the region.[20]

Service providers (n = 8) were mostly female, with an average of M = 12.9 (SD = 14.25) years' experience providing services to injured workers. Providers practised in the areas of mental health, legal and physical rehabilitation services and described their geographic practice areas as including Kenora, Thunder Bay, all of Northwestern Ontario, or all of Ontario including the North.

	Survey (n = 40)	Interview (n = 16)
	n (%)	n (%)
Age (years)		
18–34	11 (27.5)	*
35–54	20 (50.0)	7 (43.8)
55+	9 (22.5)	5 (31.2)
Sex		
Female	17 (42.5)	7 (43.8)
Male	23 (57.5)	9 (56.2)
Marital status		
Legally married	15 (37.5)	8 (50.0)
Not legally married	25 (62.5)	8 (50.0)
Ethnicity		
White	34 (85.0)	12 (75.0)
Other	6 (15.0)	*
Number of dependents		
0	19 (47.5)	8 (50.0)
1	7 (17.5)	5 (31.3)
2	9 (22.5)	*
3+	5 (12.5)	*
City of origin		
Thunder Bay	38 (95.0)	15 (93.8)
Other	*	*

* Redacted due to small cell size.

Workplace injuries, disability and need for accommodation

Injured workers described their workplace injuries, the presence of disabilities and their needs for accommodation through the online survey and semistructured interviews.

Survey

The majority (n = 28; 70%) of survey respondents' injuries occurred in the past five years. Respondents' injuries were largely physical (n = 32; 80%) as opposed to psychological or occupational disease. Respondents made claims while working in the following sectors: education, health care and social assistance (n = 8; 20%); agriculture, manufacturing, transportation and warehousing (n = 10; 25%); hospitality, retail, arts, entertainment and recreation (n = 8; 20%); construction and mining (n = 6; 15%); emergency services (n = 5; 12.5%) and "other" (redacted due to small cell size).

Half (n = 20; 50%) of survey respondents stated that they were working either full time (n = 15; 75%) or part time (n = 5; 25%) since filing a WSIB claim. Among respondents who stated that they were currently working (n = 20), 40% (n = 8) stated that they had accommodations in place including modified tasks, a modified workspace, reduced hours, delayed return to work and changes in their role. The majority (n = 25; 62.5%) of respondents stated that the workplace injury changed their life "a lot" or "completely." Nearly half (n = 19; 47.5%) of all respondents reported sustaining a permanent disability from their workplace injury.

Interviews

The majority (n = 12; 75%) of interviewees' injuries also occurred in the past five years. This means that a quarter of interviewees' injuries occurred more than five years ago, yet they were still engaged in the WSIB process at the time of their interview. Their injuries were mostly physical (n = 12; 75%), with many fewer psychological and occupational diseases (n = 4; 25%). Injured worker interviewees also largely made claims while working in the education, health care and social assistance industries (n = 8; 50%). Other (n = 8; 50%) interviewees made claims while working in construction and mining, agriculture, manufacturing, transportation and warehousing and emergency services (% redacted due to small cell sizes). Fewer than half of all worker interviewees reported that they were working full time at the time of the interview (n = 7; 43.8%).

Experience and impacts of the WSIB claims and appeals processes

Injured workers and service providers described the experiences and impacts of the WSIB claims and appeals processes on injured workers through the online survey and semistructured interviews.

Survey

Although most (n = 32; 80.0%) respondents reported that their original claim was accepted, the majority of these still rated the claims process as "extremely" (n = 13; 32.5%) or "very" (n = 9; 22.5%) stressful. Similarly, among the nearly half of all respondents (n = 18; 45.0%) who reported appealing a WSIB claim, less than half of those appeals (n = 8; 44.4%) were accepted, and nearly one-quarter (n = 4; 22.2%) were still in progress. Nearly all respondents described the appeals process as "extremely" (n = 10; 55.6%) or "very" (n = 4; 22.2%) stressful. Respondents who filed claims only, or both claims and appeals, described the processes as having negative impacts on their psychological health, physical health, relationship with their family, relationship with their friends, hobbies, community involvement, financial security and career (Figure 1).

With full recognition of our small sample size (n = 40 survey respondents), we conducted very preliminary univariate linear regression analyses designed to identify worker and injury characteristics potentially associated with elevated levels of claim- and appeal-related stress, largely as potential suggestions for future research. Our univariate predictors included age, gender, injury type, industry and disability permanence, and our outcome was self-reported claim-related stress, measured on a 5-point Likert scale. Workers' mean self-reported claim-related stress was 3.4 (SD = 1.5), and their mean self-reported appeal-related stress was 4.1 (SD = 1.3). Only presence of a permanent disability

FIGURE 1

Impact of WSIB claims and appeals processes on respondents to injured workers survey, across multiple domains, Thunder Bay City and District (Ontario, Canada), November 2020 to March 2021
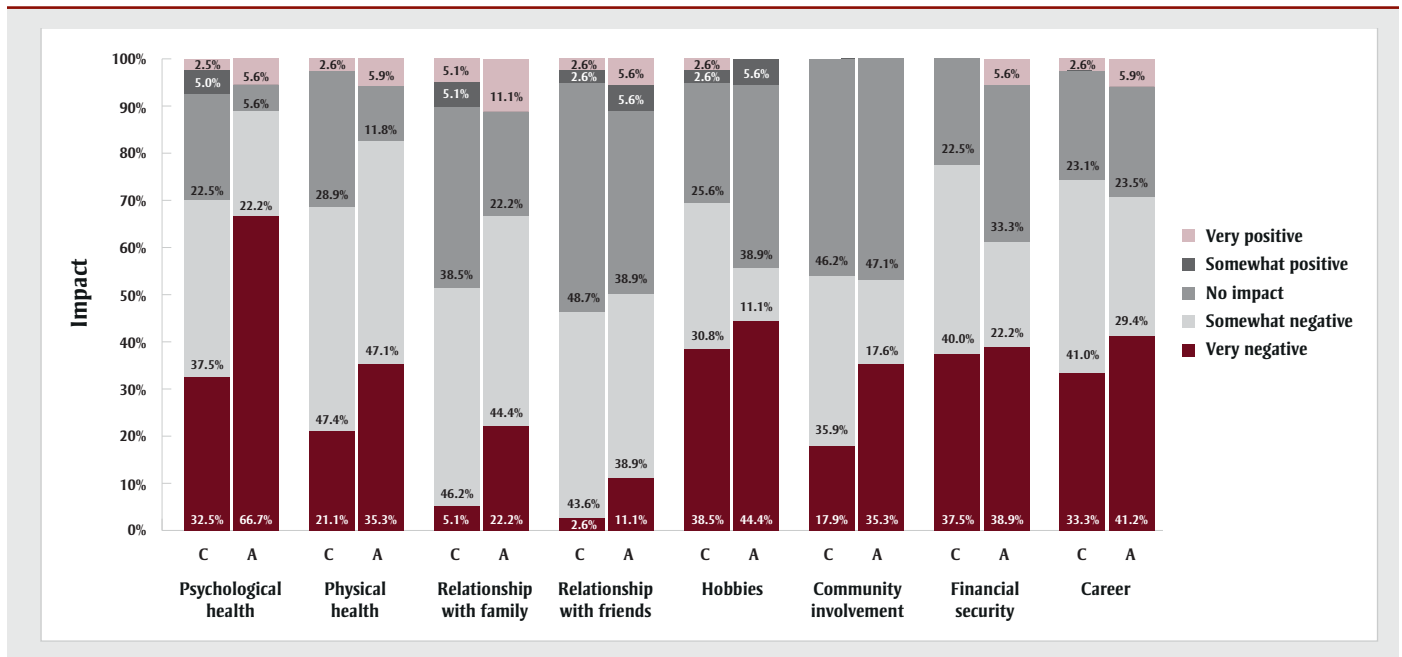
Abbreviations: A, frequencies related to the appeals process; C, frequencies related to the claims process.

Note: Percentages (%) represent the frequency of responses for n = 40 injured workers who reported on their experiences filing a claim, and a subset of n = 18 injured workers who appealed the decision of a claim.

was found to be associated with claim stress (R^2 = 0.17, $F_{2,47}$ = 3.78, p = 0.03). Specifically, workers reporting a permanent disability (B = 1.49, p = 0.01) experienced significantly more claim-related stress than workers with no permanent disability (reference group). None of the variables that we examined were significantly associated with appeal-related stress.

Interviews

We used Northwestern Ontario injured worker and service provider interviews to describe the ways in which the WSIB claims and appeals processes affected workers' mental health. Worker and service provider responses fit within nine common themes: (1) family role instability and conflict (e.g. partners and children transitioning to wage-earning roles; loss of respect or authority of injured worker with reduced ability to provide for others); (2) financial anxiety and insecurity (e.g. worries about the onset, duration and extent of WSIB wage replacement); (3) frustration and anger (e.g. about WSIB paperwork requirements, difficulty accessing case representatives and having the validity of their claims constantly questioned); (4) helplessness and hopelessness (e.g. processes were slow, requests

for support to promote return to work were delayed or denied); (5) job insecurity (e.g. unavailability of pre-injury job after recovery or appropriate accommodated or alternate work); (6) loss of professional or occupational identity (e.g. disappointment about inability to work in the field that they were trained for and where they had careers); (7) retraumatization (e.g. needing to recount traumatic details of the workplace injury to multiple WSIB workers and reassert the validity of the claim); (8) guilt and shame (e.g. about not being able to work and support families); and (9) social isolation (e.g. separation from coworkers, self-isolation from friends and loved ones associated with workplace injury–related depression). Illustrative quotations may be found in Table 2.

System factors impacting workers' WSIB experiences

Injured workers and service providers also described system factors impacting workers' experiences with the WSIB through the online survey and semistructured interviews.

Survey

Respondents selected (from a list) aspects of the WSIB process that went smoothly

and those that were challenging, separately, during the claims (n = 40) and appeals (n = 18) processes (Figure 2).

Injured workers identified some aspects of the claims and appeals processes that went smoothly (n = 34; 85.0%), including medical expert assessment and consultation (n = 15 [37.5%] for claims and n = 5 [27.8%] for appeals, respectively), interactions with coworkers (claims: n = 10 [25.0%]; appeals data redacted due to small cell size) and scheduling meetings and appointments (n = 11 [27.5%] and n = 6 [33.3%], respectively).

All participating workers chose to identify challenges during the claims process. These included communication with WSIB (n = 29; 72.5%), paperwork (n = 22; 55.0%), finances while off of work (n = 22; 55.0%), medical expert assessment/consultation (n = 19; 47.5%) and going through the application process while still injured/ill (n = 18; 45.0%). Findings were similar for the appeals process. Respondents reported encountering challenges related to communication with WSIB (n = 14; 77.8%), paperwork (n = 9; 50.0%), medical expert assessment and consultation (n = 7; 38.9%) and going through the application process while still

TABLE 2
Nine common themes emerging from worker and service provider descriptions of the mental health impacts of the WSIB claims and appeals processes, Thunder Bay City and District (Ontario, Canada), November 2020 to March 2021

Theme	Sample quotation
Family role instability and conflict	"WSIB has caused a lot of issues, like, I'm upset more, so it's affecting my relationship with my wife." – IW 9
	"I've seen marriages end because of what's happened to the individual that's been injured. Their life just spirals out of control and so you can see how that impacts relationships, how it impacts marriages, like I said, people have lost their homes. I don't have to spend a lot of time with the injured workers group to see the significant changes that have happened, even to the ones that don't have a brain injury. I have [seen] other kinds of injuries, and how [workers have] been impacted by those work-related injuries, and how it impacts their lives for the rest of their lives." – SP 5
Financial anxiety/ insecurity	"I'm a single mom, my kids live with me full time, I'm 100% responsible for them, and I'm getting calls about my vehicle being repossessed. And then I can't make my mortgage payments. And, you know, all these things that add to already, like you're already mentally not coping well." – IW 4
	"I try not to think about my own case too much because it just gets me pissed off. It hasn't been good by any means, because [I] pretty much lost everything. I'm going from making 100 and something thousand dollars a year to I don't even know now. It's not a lot. I had to sell my house. Sell my camp. Like, I'm not poor, but I am definitely not well off, and I was." – IW 3
	"Often pride comes in, and they don't want to access the social assistance benefits, which often they have to, they're forced into, because otherwise they have no income. We see people selling off their assets, which are very important in our area. So boats, snow machines, trailers, all those things. Part of it as qualifiers for social assistance, is that they're forced into selling these things. And part of it is that they're, they're accessing money so that they can live." – SP 2
Frustration/anger	"Every time you call WSIB, it ignites like, an anger inside of me." – IW 13
	"Having somebody call you and call you and call you, and then send you letters and call you some more and then ask for updates and then want to talk to your doctors, want to take notes, and it's different people every time, is infuriating." – IW 10
Helplessness/ hopelessness	"You get into the process and if you don't have any help, you are overwhelmed, it is just set up … to make people give up." – IW 3
	"If it's an appeals process, then it's sort of got an adversarial component to it, which I think increases that sense of feeling under threat, right, and then so that's just exacerbating any feelings of hopelessness or helplessness." – SP 1
Job insecurity	"From the mental health side of it, [following my physical injury] even though I had a really hard time keeping up with their production, I was still required to do it, or [face] the threat of job loss. So that became a real issue, mentally … and that's how the two are intertwined. From a physical to mental health." – IW 11
Loss of professional or occupational identity	"[My workplace] just sang the praises, like whenever they needed somebody, I worked with all the very difficult cases. I gave them 110% all the time. And then when I became an injured worker when I was injured there, well then I became a nothing." – IW 5
	"They're not able to work towards their career goals. It is just human nature, right, to want to aspire to something and to further. And I actually feel like it's a shame because that's an effect of the trauma that's actually unnecessary. Once they're well enough, psychologically, they should be supported, to be able to have gainful, meaningful work without any kind of financial costs, if we're really true to the spirit of WSIB." – SP 4
Retraumatization	"And then going through the process and retelling your story to everyone you meet with, which is also, like, very retriggering going over things and over things. And you get to the point where you're telling them and trying to get your point across and make them not only understand, but believe you, because you've said it so many times and obviously, when you're repeating it for the 10th time, you're just, like, okay, so obviously the last couple people didn't believe me." – IW 4
Shame/guilt	"All those feelings of shame that go with it—I'm, you know, I'm normally this strong, confident woman and I can't do the things I normally would do. And it has such a compounding effect on your whole life." – IW 4
	"You feel guilty that you're incapable of doing the one thing that you wanted to do." – IW 10
Social isolation	"It took a huge toll on my mental health. It took a long time for me to admit that. I'm a very strong, stubborn person. And so it was my husband first that realized that I wasn't going out anymore. I'm very, very active person, you know, hiking, canoeing, hunting everything outside, I was staying in a lot more." – IW 1
	"And so of course, that affects them socially. Because then they don't have these things to go and do. And they lose their friends and connections that were associated with it. They also have no money to go out and hang out with people. So they become isolated." – SP 2
	"They start to become socially isolated from their own friends and family because they physically can't do things, you know, they can't pick up a coffee mug. When you're in chronic pain you're just very down and just give up. Right?" – SP 4

Abbreviations: IW, injured/ill worker; SP, service provider; WSIB, Workplace Safety and Insurance Board.

FIGURE 2
Injured and ill workers' reports of the smooth and challenging components of the WSIB process, Thunder Bay City and District (Ontario, Canada), November 2020 to March 2021
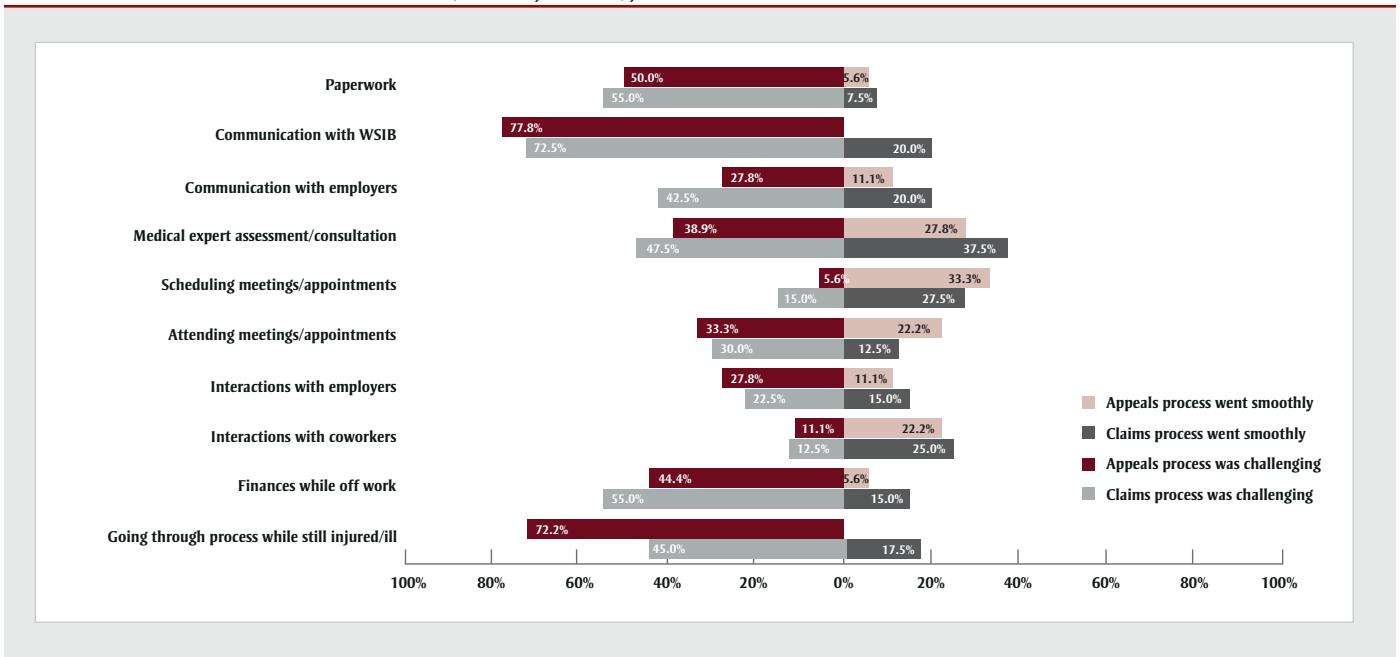
Abbreviation: WSIB, Workplace Safety and Insurance Board.

Note: Percentages (%) represent the frequency of responses for n = 40 injured workers who reported on their experiences filing a claim, and a subset of n = 18 injured workers who appealed the decision of a claim.

injured/ill (n = 13; 72.2%) during the appeals process. More information about the nature of these challenges came from worker interviews (see next section).

Workers were also asked if they had accessed non-WSIB community supports during the WSIB claims and appeals processes. Some (n = 16; 40.0%) workers reported accessing support services in the process of making claims or appeals, including psychological and legal services, chronic pain programs, employment services, injured worker groups, employee assistance programs, foodbanks, crisis lines, transportation services, income supplement services and the Office of the Worker Adviser (n's and percentages redacted due to small cell sizes). Among workers (n = 16) who accessed support services, the majority (n = 14; 87.5%) described them as "very" or "extremely" helpful.

Interviews

Northwestern Ontario workers and service providers described system factors that positively and negatively impacted their WSIB claims and appeals experiences, including both WSIB-specific and broader system factors. Corresponding sample quotations for themes and categories are shown in Table 3.

Protective (i.e. positive or experience-enhancing) factors identified by workers were: (1) access to adequate services (e.g. psychological); (2) the recent introduction of a WSIB online portal to coordinate and file claims and appeals; and (3) WSIB transparency (i.e. instances in which workers knew exactly what to expect from WSIB and what procedures to follow).

Risk factors (i.e. negative or factors that detract from the experience) specific to WSIB identified by workers included: (1) care coordination and treatment planning issues (e.g. accessing and aligning services between providers); (2) communication challenges (e.g. difficulty getting in touch with WSIB representatives); (3) paperwork (total amount, complex nature); (4) staff turnover and continuity of care (e.g. having to repeat basic injury/illness information to multiple new workers); and (5) transparency (e.g. uncertainty about process steps and requirements). Worker-identified broader system risk factors included: (6) location and ability to access medical experts for assessments, consultation or services; (7) employer and union relations (e.g. pressure from employers to return to work, or work in ways negatively impacting recovery, or tensions between unions and employers); and (8) having to go through the WSIB

process while injured or ill (because it is complex, it requires multiple actions, taking up time that could have been spent in rest and recovery).

Suggestions for improvements

Workers and service providers made a number of suggestions for improving the WSIB system and how it functions overall and in the context of Northwestern Ontario.

Survey

Survey respondents' suggestions for how they would improve the WSIB process included increasing access to supplementary services (n = 15; 35.0%) such as counselling or psychological services (n = 7; 17.5%). Individuals also listed legal aid, pain or rehabilitation specialists and disability compensation (n's < 5) as ways to improve services for Northwestern Ontario injured workers.

Survey and interview

As survey respondents also proposed suggestions to improve the WSIB process in an open-ended fashion, we analyzed interview transcripts and answers to open-ended survey questions jointly. Injured worker and service provider suggestions for how to improve the WSIB processes

Theme	Category	Sample quotation
Protective factors	Access to adequate services (e.g. psychological)	"I was lucky that my psychologist still continued to do just pro bono check-ins with me. I would say the [most helpful] thing has been, like, my nurse practitioner and my psychologist." – **IW 4**
		"I will give credit for the fact that they did have funding in place for the psychology component. I will be, I can't, I can't thank them enough for that." – **IW 12**
	Introduction of online portal	"I really enjoyed that when I utilized their online service to submit a question. It allows you to input what time is the best time to call you at. I think that's great, because I work three jobs. So sometimes it's nice for me to be able to put in, don't call me until after five, like, I'm at work, like, I can't answer the phone. [Also], I think that having things like that in writing is also really beneficial. Because, like, coming from a union perspective … being able to submit that and have a copy of that, and then a copy of a response that if anything was to ever happen." – **IW 10**
		"Well, definitely the electronic portion of their, their claims submission now, as has been changed, you know, before, like I say, you could only mail your stuff, or fax it to them. So now, now they've established, you know, electronic reporting. And also, you know, now they have a secure email format. They never have, they never had that before. And even one of the first times I talked to that colleague, I said, you know, rather than me phoning you, or you phoning me, because we did sort of play phone tag there for a little bit. And back in May, I says, you know, would be nice if, you know, I could just send you an email and wouldn't be this …. And so she says, oh, yeah, well, we're working on that. And she says, we need to make, make it secure. And probably back in April, I asked her that. And then eventually, they did, you know, develop that system. So that was very, very good." – **IW 16**
	WSIB transparency	"I did find the return-to-work specialist from WSIB. I mean, she was, I found her great. She was very helpful. Um, like, insightful, gave you information and things like that." – **IW 4**
WSIB system-specific risk factors	Care coordination and treatment planning	"A lot of [service providers] don't understand WSIB and a lot of them you don't want to deal with WSIB because WSIB for the doctors in some cases [have] big broad goals." – **IW 7**
		"I had one worker tell me when I wasn't ready to go back to work yet, because I haven't even gone to see my specialist, he said that you're going to be cut off if you just don't get back to work right now. So I felt very bullied to go back to work when I wasn't ready to, which made the situation worse." – **IW 1**
		"I haven't talked to [a neurologist or my family doctor yet], but [the WSIB] already set a plan up. And so I'm like wait a sec. How can you be making all these decisions without talking to the medical field?" – **IW 9**
	Communication	"It's always the same process. You call there, you wait in the queue, you talk to customer service, they transfer you to your case manager, she doesn't answer, you leave a voicemail, she never calls back, then you have to call again the next day, the next day, the day after, and go through the whole process again. And then ask to speak with the manager and find out why your case manager is not calling you back in what in the timeframe they tell you that they're supposed to." – **IW 13**
		"I would say most of it's communication. I think most workers, even those with allowed claims really, really struggle to get a person on the phone, to be honest, um and I don't want to denigrate or speak ill of the case managers because they're union members too, they're part of CUPE and they're so overworked." – **SP 4**
	Paperwork	"I don't know how people can keep up with some of the stuff like the paper[work] comes, the mail. And a lot of time, it's like having a third job and you'll watch your binders get thicker and thicker over the year. And you [have] to keep up with it because if you don't keep up with it, at the end of the day, you're going to pay for it. You have to be proactive yourself to actually make the system work. If you don't do your job, at the end of the day, you're gonna get screwed." – **IW 7**
		"It's up to you to prove to them that you need these services, and that you need these things to happen. And there was months where, like, I felt like it honestly, to a certain degree, it's been like a full time job, sort of staying on top of this, making the phone calls, following up with things, making notes, like, I have, like, this notebook, and it's, like, all tabs. And this is my, like my Bible." – **IW 4**
		"[If] the person has a brain injury, cognitive impairments, information processing difficulties, memory problems, they'll get this piece of mail, or they may not understand what [the WSIB is] asking, and then the [injured worker doesn't] think to get help to fill out this form, or it ends up in the junk drawer or falls behind the fridge and the Board [will] come after them for noncompliance because they didn't [complete] some form, and they don't stop to think about how hard it is for this injured worker, if they have issues with fatigue, or if they've got cognitive fugue or had a seizure, and now their memory is that much more compromised, and it takes them a couple of weeks to get back up to speed again, and something shows up during that period of time. And [if] they're not complying then they get cut off [WSIB benefits]." – **SP 5**

TABLE 3 (continued)
**Injured and ill workers' and service providers' descriptions of challenges and protective factors of WSIB processes,
Thunder Bay City and District (Ontario, Canada), November 2020 to March 2021**

Theme	Category	Sample quotation
	Staff turnover and continuity of care	"I'm gonna be honest with you, it was never the same person that I spoke to. In that particular one, it every time somebody called me it was somebody else, it was almost like they were overwhelmed, which I can understand. And they, I just, my case was passed off, I would say I talked to about six different people. And nobody actually knew, like, what my injury was. So every time somebody would call me, I'd have to redo the whole story with them, and then go about whatever they called me about in the first place. Which is frustrating because you, it puts you in a position where not necessarily that someone doesn't care, because it's not really necessarily their job to care, but they don't know who I am. It's their job to make sure that I get the supports that I need." – **IW 10**
		"The other thing is, is that what the WSIB will do is they will switch their case managers or their nurse consultants quite frequently. So if somebody's been on their roster for, you know, a long time, and they want to move them, they start changing their either case manager and nurse consultant, every, say, I don't, don't quote me on this, but, like, every three months, or something, or every six, six months, and so to be somebody with a fresh pair of eyes, but also somebody who doesn't have the context of having read through their whole file." – **SP 1**
	Transparency	"The biggest thing was just knowing partially, like, what your rates are, but also what's out there for WSIB to offer you. Because they're not really forthcoming and saying, we can do this, this and this for you, they're only going to give you that if you go to say a doctor, a specialist, who knows what they can offer who, you know, writes that note, and then pushes you into that program. But yeah, it's hard to know how to navigate and what WSIB should and shouldn't be doing. Because you're just following kind of what that what WSIB is telling you." – **IW 13**
		"You're going in blind, potentially, like you don't know, all of a sudden you got hurt and you can't work and you don't know what that looks like, you know what I mean? So that adds to the stress of everything else. And then now you have WSIB calling you every day. And you don't understand what their purpose is. There is no information on that." – **IW 10**
		"The WSIB doesn't educate its clinicians on their processes, which would help us to educate our clients because the clients are kind of in the dark … which feeds into the sense of uncertainty and lack of safety, which again, inhibits their psychological progress, right?" – **SP 1**
Broader system: risk factors	Access/location issues	"It was incredibly frustrating, because there's only so much that I can do when you live in a northern city that only has so many health care providers. So, if you have to go to the fracture clinic, if you have to go to a chiropractor, if you have to go to physical therapy, like, those things take time. They're not just you called me yesterday, and now you're calling today. Nothing has changed, like, in an 18-hour timespan." – **IW 10**
		"There's a lot of times for these services that I've been receiving anyways, you need a referral. And so if you can't get in to see your own doctor to request that referral, while you're on your own, you know, I've been trying to read a lot and try to educate myself and try to, you know, learn about myself as to what I'm dealing with. And it's been an experience in that sense all by itself." – **IW 16**
		"[When] I had to go and explain my pre-existing condition, and that my specialist was in Toronto, that's when it became very complicated. Realizing that there would be a lot of travel expenses back and forth from Toronto, hotel stays, lots of time off work, and things like that. They, they became very rude, very quick." – **IW 1**
		"Yeah, like, it was very aggressive, like, very aggressive. And they made me go back to the emergency room four times to get more paperwork from the same doctor, because my family doctor wasn't good enough." – **IW 10**
		"The big thing that I find that I didn't hit enough is that how different it is in the North, and, meaning, like me, disconnected, Kenora north, not very north, from sort of the urban Toronto-centric access to services, that, you know, it's always important to explain the difference and how, you know, services are different, the people are different, accessing. So WSIB is always different like that." – **SP 2**
	Access to medical experts for assessment/ consultation/ service	"It would be nice if the government had [medical experts], especially in Northern Ontario, you don't really have much open over there. In Toronto and Ottawa, places like that, I'm sure you could find someone just walking outside your building, like, some, somebody that knows the rules. But Northern Ontario, a lot of people are on their own. It's an older generation and younger generation. You know [service providers], don't really want to deal with WSIB, I'm sure you have a couple labour lawyers that are involved in that stuff." – **IW 7**
		"Something happens, they'll deny your claim because there's no, the big word is continuity, with WSIB. They want to see the MRIs, they want to see the doctors appointments. They want to hear the transcripts from the doctors and most people won't do that because they don't have the time, especially if they have a family." – **IW 7**

Theme	Category	Sample quotation
	Employer and union relations	"I ended up getting let go [from] my job, like, within two weeks of [calling the labour board to notify them about my unsafe workplace], or I suspect it was reprisal because I called the labour board and all this kind of stuff. So I more or less was like, on top of being injured … Just kind of didn't help anything." – **IW 6**
		"Unfortunately, I wasn't able to access anything legal, because my agency is unionized, so I did have a union rep helping me out at first but was told via private emails that the agency basically bullied her off my case, because they said that if she continues supporting me that she would be fired and so I didn't, I don't really have any help with them, either. Because they, they don't have anyone representing me." – **IW 1**
		"What was worse was having my workplace come in to Workers' Comp and say that I must have been faking it, or that I wasn't worthy of a meaningful re-education, that they didn't want to be liable for it. Having my workplace not back me up, that was bad." – **IW 8**
	Going through the process while still injured/ill	"Every day when I do talk to someone, I have to make notes because I also, my memory is not what it used to be, so I don't retain information the same and so I have to do that. And there was huge periods of time where mentally I wasn't able to advocate for myself. And luckily, I have great family and friends supports that sort of helped pull me through and, like, my children of course. But I sort of, I look at it like if I hadn't had those, you know, where would where would I be right now?" – **IW 4**
		"I don't have the mental capacity anymore to try and remember when things have to be in, how things get organized, this group I'm working with, [I've] got all kinds of people helping me out with organizing and stuff like that and my wife just doesn't have the time because she's driving me to doctors' appointments." – **IW 3**

Abbreviations: IW, injured/ill worker; SP, service provider; WSIB, Workplace Safety and Insurance Board.

were tightly aligned and included the following themes: (1) the addition of a systems or arm's-length navigator to help workers understand and move effectively through WSIB processes; (2) greater compassion from WSIB workers; (3) continuity of care (e.g. more opportunities to speak with WSIB representatives familiar with workers' cases); (4) increased access to and knowledge about support services, within and outside of WSIB-funded care; (5) more responsive communication from WSIB; (6) special considerations and succession planning for Northern providers; and (7) transparency (e.g. information about worker pathways and options, including available services). Corresponding sample quotations for these themes may be found in Table 4.

Discussion

Although workers' compensation systems such as the WSIB are devised to reduce financial harms and promote recovery and return to work,[5] research has demonstrated that injured workers generally have poor physical health, mental health and occupational outcomes.[21-26] In our study, injured workers and service providers in Northwestern Ontario described the range of impacts from their workplace injuries, incremental impacts on injury, illness and recovery from the worker compensation system, and suggestions for improving the system intended to support them.

Consistent with previous research on workers elsewhere in the province, the Northwestern Ontario injured workers in this study described a wide range of negative impacts from their injuries and illness, including impacts on their psychological, physical, social,[21-29] recreational,[30] financial[30] and occupational[31] well-being. In particular, this study identified a high rate of psychological distress among injured workers, with most survey respondents stating that their workplace injury changed their life "a lot" or "completely."

A key finding from this work is that Northwestern Ontario injured workers clearly described incremental negative impacts from being involved in the workers' compensation claims and appeals processes. More than half of the participants in this study rated the claims and appeals processes as extremely or very stressful. These findings are consistent with research conducted elsewhere in the province showing that injured workers involved in workers' compensation systems report considerable levels of stress and are at greater risk of developing persistent mental health problems than those who were not injured at work, and the general population.[32,33] The injured workers and service providers highlighted several aspects of the process that could contribute to a negative claim or appeal experience, outlined below.

The injured workers in this study described specific mental health impacts of the WSIB process, including feelings of helplessness, hopelessness, shame, guilt, frustration and anger, as well as retraumatization, financial and job anxiety and insecurity, the loss of professional or occupational identity, social isolation and family role instability or conflict. These results substantiate previous research highlighting power differentials between claimants and the workers' compensation system, and build upon previous injured workers' accounts of de-legitimization, coercion and stigmatization perpetrated by compensation system actors[4,34,35] occurring elsewhere in Canada. Moreover, the mental health impacts of the WSIB process described by participants lend support to previous injured worker studies describing feelings of frustration, helplessness and hopelessness resulting from "adversarial" and unjust workers' compensation experiences,[3,34-38] and the consequent negative ramifications of these processes and experiences on career plans, hobbies and community involvement, finances and mental health of claimants.[30,31,36,38-40]

We also found some very preliminary evidence that stress related to claims and appeals was different across groups.

TABLE 4
Sample suggestions by Thunder Bay City and District (Ontario, Canada) injured and ill workers and service providers for improving the WSIB experience, by theme, November 2020 to March 2021

Theme	Sample quotations
Addition of systems/arm's-length navigator	"I think that there needs to be someone who is, and I don't know how it would work, but someone who talked you through any process, like a staff services manager, knowledgeable on all aspects of [the WSIB claims and appeals process]. And you could [get help/guidance] with filling out forms, letting you know what forms you needed, walking you through those things and just check[ing] in on you. Um, it [would] make a huge difference." – **IW 4** "I would love some sort of like, I'm, I'm new, I don't even know what it would be called, but almost like a place where they could go to, to discuss, like, consult with someone regarding navigating this system, right? So, somebody who would be syncing them up with the resources that you're talking about who would be giving them realistic expectations around what, around what they could expect from the WSIB, what their rights are, like, educating them about that. Just somebody just sort of, like, give them, like, a roadmap of what this chapter is going to look like, of their life, like, almost." – **SP 1**
Compassion	"I just wish WSIB was a little bit more compassionate towards people. It's a very stressful situation going through what people go through. I know every case is different, some are minor, some are not, some are life-threatening, some are not. Fortunately, mine wasn't life-threatening, but did lead to lifelong problems and to be called a number instead of by my name, to me, it just feels like they push you aside, like it's not that big of a deal." – **IW 1** "Also treating you with, you know, basic human respect and dignity." – **IW 16** "I think that like anything that's going to help people to have to feel more seen and more heard and acknowledged, is going to be supportive for their mental health." – **SP 1**
Continuity of care	"Yeah, the continuity with the same person I'd say, with this, if you were seeking help, then you'd be talking to the same person all the time, I think those things same things is a good thing to have." – **IW 11** "If you have a case manager that you started with the very beginning, I'd like to see you remain with the case manager, because they pass you on to this case manager, and then the next one, the next one. But over time, they change it, it's a, I don't know why they do that. I don't think they want you to have rapport with your case manager. I just think they want to keep it as business but when you're comfortable talking with a case manager that you're dealing with, it's a lot easier to be open with them, and you're not hiding things or you're not afraid to say what you're supposed to say or a lot more clear and more willing to give the information that they asked for. There's no hidden agenda." – **IW 7**
Improved access to/knowledge about support services	"It just kills you. Some of these people really, really need help dealing with depression and they need to know how to find it." – **IW 3** "I feel like I probably could have done well with some sort of a stress management or anxiety management program." – **IW 10** "After their initial communication, they provided no information to me in regards to psychological or physiological services. I do believe that my organization extended that if I needed to use my Employee and Family Assistance Program, EFAP, that it was available to me, but I don't believe, and in my notes I have no indication, that WSIB provided any type of supplementary care options." – **IW 12**
Increased/improved/responsive communication	"They definitely need to work on their communication skills. I understand 100% that they have big case loads, and that mine may not always be a priority. I'm very, very aware of that. But missing opportunities for medical appointments and to hopefully be in less pain, because they just haven't called me back in three months is 100% unacceptable." – **IW 1** "Better communication." – **IW 13, 16** "I think they could streamline [the WSIB process] a little bit." – **IW 7** "Better communication between the case manager and the treating psychologist I think would be helpful." – **SP 1**
Special considerations and succession planning for Northern providers	"People will practise in WSIB until they die just because there's not very many people and they become such an expert in it. And, and the detriment of losing that one person and all their knowledge, like, the entire province feels it." – **SP 1** "I've had referrals from outside of Thunder Bay for sure, yep, but I kind of stopped taking them for a little while just because they were a lot of work." – **SP 2**

Theme	Sample quotations
Transparency	"I think right off the bat, they need to make it very clear that they are not working for me, they're working for the agency. I didn't know that, once again, because I've never had to deal with WSIB before. I thought they were insurance for me and to cover me and they were on my side, and then very, very quickly found out that it was not that way." – **IW 1**
	"WSIB likely would do themselves a massive service, if they made their initial point of contact with the consumer, aka the person who's injured. If they explained to people upfront that this is a process that could take months and months of their time and their lives in a very difficult situation. For some reason, there's this predisposition it seems on their part to assume that people have a clue of what happens in this bureaucratic internal thing that really presents itself as this kind of iron curtain. You have no idea what's going on there. And they don't explain anything to you. So, I think that likely, in the perfect world, my suggestion would be that they do some basic customer service and talk people through the initial stages." – **IW 12**
	"As an injured worker you don't, you don't know what's required." – **IW 16**
	"I think clarity, clarity of process, consistency of process. Um, at least, what's sort of the typical, there always then at least, you know when you're deviating, right, and you can provide good rationale as to why you're deviating because there's at least a consistent process. Um, and I think clarity of role as well. So, when you're asked of your opinion, from your little corner of expertise, that there's some clarity of role that you're, in fact, being a major influencer in the decision that happens and some kind of feedback loop, where if that doesn't happen, that's communicated and preferably not through the client, I, I kind of wonder if what you're trying to do is empower the client and have the client be in charge." – **SP 3**

Abbreviations: IW, injured/ill worker; SP, service provider; WSIB, Workplace Safety and Insurance Board.

Specifically, we found that sustaining a permanent disability following workplace injury was a significant predictor of claim-related stress. This finding helps to substantiate previous research demonstrating that injured workers with permanent impairments have poorer outcomes than injured workers who fully recover and return to work, and the general population.[10] More research with larger samples is needed to confirm and identify other potential subgroups of individuals (e.g. lower preinjury income, English language learners) at risk for negative mental health impacts from the claims and appeals processes, in Northwestern Ontario and beyond. If replicated, special considerations (e.g. enhanced supports for managing stress, and different expectations for income replacement among workers unable to return to their workplaces in the same capacity) might benefit workers in the WSIB system.

Although our sample was restricted to workers and service providers in Northwestern Ontario, claimants and service providers described many challenging aspects of the claims process consistent with previous research conducted elsewhere in the province. These included care coordination and treatment planning issues,[38,41-44] communication challenges,[38,45] paperwork,[34,40] staff turnover and lack of continuity of care[35,38,46] and lack of transparency.[34,38,47] As expected,

being involved in the appeals process negatively contributed to injured workers' experience with the WSIB, and interviewees and survey respondents reported that, due to the adversarial nature of their appeals, already challenging aspects of the WSIB process were even more unsatisfactory during the appeals process. While these themes for workers in the WSIB system are not new, ours is the first study that we are aware of that shows that these issues persist in small, northern and rural communities throughout Northwestern Ontario.

Critical to the importance of our work overall, we also identified risk factors (i.e. negative, or those detracting from the experience) specific to WSIB claimants in Northwestern Ontario. For instance, we easily traced several region-specific issues to anticipated problems accessing services, including legal, social and health care services. In particular, well-known health services issues endemic in the North, such as insufficient numbers of providers to meet the population need, clearly affected the injured workers in our study. Importantly, problems related to low or no access to primary care services had cascading effects on workers, because primary care providers must assess the need for and initiate referrals to specialists, as well as plan and coordinate assessments and care. Limited access to specialist providers was also problematic,

including long waitlists for local providers or the cost, logistics and time needed to travel for assessments or care while workers were ill and had family responsibilities. The COVID-19 pandemic also restricted travel for several of the workers in this study, further delaying access to assessments and care. Communication infrastructure issues were also common within this sample, including low or no access to reliable Internet or telephone service, which are likely less common in more populous parts of the province. These regional issues are consistent with research documenting disproportionate negative impacts of workplace injuries on injured workers in remote and rural communities and associated lack of access to care.[44,48-51]

We also documented regional cultural impacts of workplace injury, including loss of equipment for local recreational pastimes. For example, workers described losing boats and snow machines (snowmobiles), which serve as transportation and connection to community, when their income was not adequately replaced. Policies that require individuals to sell all of their belongings in order to qualify for benefits are likely to have unintended, negative impacts on the overall recovery of people who become hurt or ill at work.

Finally, service providers in the North were very concerned about succession

planning, noting that in small communities of practitioners, the whole service system suffers (and in some cases, can cease to function) when individuals, often serving as the sole providers to populations or regions, retire, move away or die. Attracting and training local providers to offer community and culturally informed services must be a priority for the WSIB to ensure adequate system function in the North.

Factors associated with the presence of psychological distress related to claims and appeals are modifiable,[52] as workplace response to injury and insurance claims and appeals processes can be altered.[53,54] Some aspects of the WSIB process that were described as protective can be maintained and enhanced for potentially underserved groups, such as access to adequate support services (mostly psychological or legal). Several workers also touted the recent introduction of a WSIB online portal to coordinate file claims and appeals; in consultation with workers and providers, WSIB may be able to further leverage technology to simplify and enhance small, rural, remote or northern community workers' experiences.

Workers and service providers also suggested system improvements, such as

- creating arm's-length navigators to help workers understand and move effectively through WSIB processes;

- enhancing WSIB employee compassion;

- increasing continuity of care (e.g. greater opportunity to speak with WSIB representatives familiar with one's case);

- improving access to and knowledge about support services within and outside of WSIB-funded services;

- ensuring more responsive communication from WSIB;

- engaging in workforce development or succession planning, making special provisions for northern providers and special populations (e.g. enhanced provider training); and

- increasing transparency about WSIB's role and the claims and appeals processes overall.

The main goal of all of these suggestions is to improve the well-being of injured workers.

Strengths and limitations

Although ours is the first study we are aware of describing the experiences, impacts and social service needs in small, northern and rural communities throughout Northwestern Ontario, our results should be considered within the limitations of the research design.

This study was cross-sectional, meaning that participants provided risk factor data specific to injury impact and to WSIB processes at the same time. Thus, some of our findings may have been subject to reverse causality effects, with workers experiencing negative impacts from their injuries inadvertently attributing some of their injury-related experiences to the WSIB system itself. Our design also did not give us access to information about workers' preinjury (baseline) mental illness, which could have had an effect on workers' descriptions of their injury impacts and risk factors while involved in the WSIB process.

We are also aware that our sample size is very small, although in line with other published, well-cited studies of the WSIB. Therefore, our findings may not represent the experience of all Northwestern Ontario workers and service providers, even though the total population of providers in the region is very small.[15] We are also aware that our assessment of risk factors is underpowered; future research with a larger sample (e.g. existing WSIB data) is needed to replicate and extend our analyses of workers' claims- and appeals-related distress.

Our sample, besides its small size, was also limited to English speakers who were able to communicate with researchers over the telephone or computer. The experiences of new immigrants with limited English skills, very remote workers and completely indigent individuals were not fully captured in this research.

Finally, the quantitative survey measure used to assess injured workers' experiences with the WSIB was developed for the study, and is not a validated measure of workers' experiences. Future research is needed to validate our findings and assess their generalizability to larger samples of workers and service providers in Northwestern Ontario.

Conclusion

This mixed-methods study adds to the existing research on the plight of injured workers in Northwestern Ontario—a large and unique geographical region whose outcomes following workplace injury and illness are poorer than elsewhere in the province. It provides novel information about the experience of Northwestern Ontario injured workers, how they are multiplicatively impacted by their injuries and how the system intended to support them imparts negative impacts of its own. These workers and service providers familiar with the Ontario workers' compensation system suggested improvements from their unique perspectives. The WSIB, policymakers, researchers and other stakeholders can use the findings in this research to improve supports for Northwestern Ontario injured workers to promote equity in their timely recovery, improved well-being and return to sustainable work.

Conflicts of interest

Declaration of interest: through her part-time private practice, Dr. Scharf provides psychological services to injured and ill workers whose care is paid for by the WSIB.

Authors' contributions and statement

CN led the manuscript writing, contributed to data analysis and interpretation, figure preparation, and document preparation. APK designed the study, contributed to manuscript writing, data collection, analysis and interpretation. JH and JL contributed to the study design and data collection and interpretation. JK contributed to the study design, data interpretation and manuscript writing. DS led the study design and contributed to manuscript writing and data analysis and interpretation. All authors contributed to and have approved the final 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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Original mixed methods research

"I see beauty, I see art, I see design, I see love." Findings from a resident-driven, co-designed gardening program in a long-term care facility

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Abstract

Background: Engagement with the natural environment is a meaningful activity for many people. People living in long-term care facilities can face barriers to going outdoors and engaging in nature-based activities. In response to needs expressed by our long-term care facility resident partners, we examined the feasibility and benefits of a co-designed hydroponic and raised-bed gardening program.

Methods: Our team of long-term care facility residents, staff and researchers co-designed and piloted a four-month hydroponic and raised-bed gardening program along with an activity and educational program, in 2019. Feedback was gathered from long-term care facility residents and staff through surveys (N = 23 at baseline; N = 23 at follow-up), through five focus groups (N = 19: n = 10 staff; n = 9 residents) and through photovoice (N = 5). A qualitative descriptive approach was applied to focus group transcripts to capture a rich account of participant experiences within the naturalistic context, and descriptive statistics were calculated.

Results: While most residents preferred to go outside (91%), few reported going outside every day (30%). Program participants expressed their joy about interacting with nature and watching plants grow. Analyses of focus group data generated the following themes: finding meaning; building connections with others through lifelong learning; impacts on mental health and well-being; opportunities to reminisce; reflection of self in gardening activities; benefits for staff; and enthusiasm for the program to continue.

Conclusion: Active and passive engagement in gardening activities benefitted residents with diverse abilities. This fostered opportunity for discussions, connections and increased interactions with others, which can help reduce social isolation. Gardening programs should be considered a feasible and important option that can support socialization, health and well-being.

Keywords: social isolation, loneliness, older adults, aging, photovoice, qualitative, co-creation, engagement, gardening

Highlights

- Integrating nature-based interventions, including hydroponic and raised-bed gardening, into the long-term care facility setting is feasible and can result in active and inclusive engagement of residents, along with meaningful conversation among residents and between residents and facility staff.
- Participation in gardening activities increased opportunities for social engagement and relationship building as well as for mitigating social isolation.
- Locating flower beds and/or hydroponic gardens in a high traffic area with nearby seating and access for wheelchairs and mobility devices supported inclusivity so that all residents could engage in gardening activities.
- Implementation and sustainability of the gardening program and activities require collaboration among multiple stakeholders.

Introduction

Social isolation and loneliness in long-term care facilities in Canada are reaching epidemic proportions.[1] Individuals who are socially isolated (socially disconnected with small, infrequent interactions with others) and lonely (subjective perception of lack of social relationships) are one of the most vulnerable social groups in Canadian society.[2-4] An estimated 12% of Canadians aged 65 years and older report social isolation, while 24% reported low participation in social activities including recreational, sports, volunteering and friendship activities.[5] Although social isolation and loneliness are separate constructs, it is important to examine them

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together when trying to understand the social context of older adults[3] as the people experiencing both social isolation and loneliness are more likely to experience psychological distress and gaps in social supports networks.[4]

With improvements in health care services and increases in life expectancy, the number of Canadians living longer with multimorbidities continues to grow.[6,7] While most individuals, including those with complex care needs, prefer to live independently in the community, entry into a long-term care facility can be a necessary option when the need for support requires a level of care that can no longer be met by personal and community supports.[8] Long-term care facilities are increasingly becoming places where people with substantial physical and cognitive impairments receive care until death.[8]

During relocation to a long-term care facility, people may become disconnected from friends, family and their community, which can substantially affect their ability to create new friendships and engage in activities within an unfamiliar setting. Risk factors for social isolation in long-term care facilities are experienced at the individual level (e.g. communication barriers, cognitive impairment), systems level (e.g. location of the long-term care facility, availability of staff, types of service provision) and structural level (e.g. social and physical characteristics of the long-term care facility; built design; shared vs. private space).[9] In this context, social isolation and loneliness can negatively affect the health and well-being of older adults,[2,4,10,11] with a lack of social networks associated with decline in cognition and increased risk of depression, anxiety and mortality[2,12,13]. Although residents in long-term care facilities may be surrounded by other people every day and have regular contact with staff and others at mealtimes, they may still experience loneliness and/or isolation.

Long-term care facilities face increasing expectations to balance finite resources and necessary provision of personal and health care supports, while also providing person-centred care and facilitating activities that promote meaningful engagement and quality of life (QOL) among diverse resident populations. Meeting person-specific needs of residents who range in needs and abilities, from independent/

minimal care to severe impairments/high dependency, poses unique challenges. A one-size-fits-all approach to planned physical, social and recreational activities in the long-term care facility setting[14] is not ideal as residents may differ widely in what they perceive to be meaningful activities. Matching activities to residents' individualized preferences can promote a sense of control, empowerment and autonomy and improve QOL.[15] A person-centred approach can support people to engage in activities they find meaningful and purposeful, and result in improved health and well-being of the person and their support network.[16]

In 2018, one long-term care facility resident shared, with a researcher on our team, their need to connect to nature and their strong desire to participate in gardening activities. This individual felt connection to nature, having lived all their life on a rural property, gardening and growing their own food. They described feeling disconnected from nature since transitioning into the long-term care facility, and how this had negatively affected their mental health and well-being. Gardening programs did not exist within their long-term care facility at that time; opportunities to spend time outdoors were also limited, especially during long, harsh winters.

Contemporary qualitative research has reported on older adults' pleasure and enjoyment when they are in a natural environment.[17] Studies have demonstrated that an increase in exposure to a natural environment is associated with a decrease in psychological issues in older adults.[18] Gardening has been shown to promote overall health and QOL, including physical fitness and strength, fall prevention, cognitive ability, socialization, pain and stress reduction, and improved life satisfaction and self-esteem.[19-23] Yet, current understandings of older adults' sensory engagement with the natural environment remain under-researched.[17]

In response to the great and immediate need to address the mental wellness and psychosocial needs identified by the long-term care facility resident, our team of long-term care facility residents, dietitians, researchers and staff co-designed a gardening pilot program as a means to provide opportunities for meaningful engagement

and to potentially reduce social isolation and loneliness.

Methods

Study location

This study took place at a medium-sized (100+ beds) assisted living and long-term care facility in a northern, geographically isolated, medium-sized city (population <100 000 people) in a province in western Canada, in 2019. The facility has various outdoor courtyards and protected garden areas, but before this program started, these spaces were not widely used.

Project design and research

This project was co-created in partnership with seven long-term care facility residents, four of whom had created a small gardening club, along with researchers, allied health care providers, nursing management and trainees.

With the support of a research assistant, gardening club members gathered information from online resources, academic literature and other care facilities to learn if and how long-term care facilities can offer horticulture/gardening programs. They found limited horticulture/gardening programming in Canadian long-term care facilities, with only a handful offering gardening programs year-round and few reporting that they had employees with any training in horticulture therapy. Long-term care facilities more commonly offered access to passive nature and gardening activities, such as nature walks, visits to outdoor gardens and greenhouses, and enjoying indoor plants located in shared spaces and residents' rooms.

Planning and design

During the planning stages, residents identified challenges related to declining health and changes in function that affected their abilities to engage in gardening. These challenges included physical limitations (inability to lift or grasp garden tools) and vision and mobility impairments that prevented them from being able to get outdoors to enjoy the natural environment. In particular, poor physical health contributing to walking and mobility challenges acted as a barrier to enjoying nature.[24] Access to adaptable tools was identified by residents as necessary to

support residents' involvement in gardening activities.

Based on the early planning, four wooden raised-bed vegetable gardens were placed in an outdoor courtyard space at the long-term care facility (Figure 1A–1D) and an indoor hydroponic tower garden was situated in the entrance to the building (Figure 1E).

To complement the opportunities for hands-on gardening, a four-month activity and educational program was offered (see Table 1 for the schedule and list of activities). These activities were chosen by the gardening club members.

At the initial garden planting party, residents, research assistants and staff planted a variety of vegetables (e.g. kale, cucumbers, snow peas), herbs (e.g. dill, oregano, cilantro) and flowers (e.g. pansies, violas).

These plants were identified and chosen by the gardening club members.

The smoothie making and tea party activities, led by long-term care facility dietitian (EB) in partnership with recreation staff, were designed to safely include individuals with swallowing difficulties (e.g. dysphagia) or dental concerns.

In addition to these formal events, the residents, research assistants, volunteers and staff spent many hours in the garden.

Ethical considerations

The study underwent harmonized research ethics review (#H19-01250-A002). While all residents and long-term care facility staff were invited to make use of the garden spaces and to attend gardening activity programming, those who chose to participate in surveys and focus groups were required to provide informed written

or verbal consent. Recreation staff identified which residents were able to give consent. As a result, the number of residents who attended and participated in activities exceeded the number who provided feedback.

Data collection and analysis

A multimethod participatory research design, including the use of descriptive surveys, focus groups and photovoice, was adopted for this pilot study. Through this approach, a combination of quantitative and participatory qualitative methods was employed to glean insights on a complex health issue. Each method provided a unique exploration of engagement in nature-based gardening activities. In concert with the multimethod approach, findings were integrated later in the analytic process.[25] In addition, team members were regularly available onsite for residents to share their insights and provide feedback

FIGURE 1A–1E
Outdoor raised garden bed and hydroponic gardens at the long-term care facility

Figure 1A

Figure 1B

Figure 1C

Figure 1D

Figure 1E

Photo summaries

Figure 1A-E: Photos of outdoor raised bed and hydroponic gardens.

1A: Empty raised beds in courtyard prior to planting.

1B: Close-up of raised beds at time of planting in courtyard showing different heights of raised beds for those who may be standing (left) and seated in a wheelchair (right).

1C: Raised bed garden planting party.

1D: Close-up of planted raised bed.

1E: Close-up of hydroponic tower garden.

TABLE 1
Description of gardening activity and educational program

Season	Week no.	Activity	Description
Spring	1	Initial planting	Seeds started for hydroponic tower garden
			Set up of hydroponic tower
	2	Opening event – Garden planting party	Residents, staff and research team members joined together to plant outdoor raised beds
			Attendees planted seeds in small pots to care for in their rooms
			Attendees enjoyed ice cream treats
	3	Hydroponic tower care presentation	Master gardeners from local botanical society gave an educational presentation on hydroponic gardening and maintenance of the tower
			Residents and research team planted seedlings in the hydroponic tower
Summer	7	Salad creations	Harvested greens and edible flowers from hydroponic tower
			Harvested vegetables and sprouts from outdoor raised beds
			Gardening club members prepared, shared and ate salads
	8	Drying teas	Residents harvested plants and prepared to dry them ahead of fall tea party
	9	House plant care presentation	Master gardeners from local botanical society gave an educational presentation on caring for houseplants
	10	Fairy garden workshop	Community gardeners led an interactive activity where residents created small fairy gardens for their rooms
	11	Smoothie making	Attendees made and consumed smoothies from vegetables and fruits harvested from hydroponic tower and outdoor raised beds
			Activity led by dietitian and recreation staff
	12	Garden summer picnic	Gardening club members prepared and enjoyed eating salads from vegetables from the hydroponic tower and outdoor raised beds
	13	Growing microgreens	Master gardeners from local botanical society gave an educational presentation on growing microgreens
	14	Putting the gardens to bed	Attendees and research team members harvested the remaining plants and flowers
			Raised beds prepared for winter storage
Fall	17	End-of-season tea party	Garden club participants showcased their photovoice activities
			Attendees sampled a variety of teas made from dried leaves, flowers and plants grown in the hydroponic tower and outdoor raised beds

into the research process and outcomes, which was documented in field notes.

Descriptive surveys

At the start and end points of the study, respondents completed, anonymously, a descriptive survey of background information (age, sex, length of time residing in the facility) as well as experiences and interests in gardening. The Geriatric Depression Scale (GDS-5) screener was used to determine possible depression;[26] a score of two or higher on the five-item scale indicated potential depression.

Survey data were considered valuable to understanding the characteristics and perspectives of the participants with respect to depression and loneliness. The small sample size limited our abilities to measure individual change in scores over time, so only descriptive statistics of aggregate scores are provided. As some participants did not provide responses to all the questions, the respective percentages have been calculated based on those who did respond to that question. Descriptive statistics (sample percentages) were calculated using Microsoft Excel 2016 (Microsoft Corp., Redmond, WA, US).

Focus groups

A total of 19 people—including long-term care facility staff (n = 10) and residents (n = 9)—participated in three staff focus groups and two resident focus groups. The focus groups varied in size from 4 to 7 participants. They were run as "town hall" meetings to determine insights and experiences related to the gardening intervention.

A qualitative description approach, guided by Sandelowski,[27,28] was applied to analyze focus group transcripts. This is a flexible and pragmatic approach that supports in-depth investigation of participant experiences within the naturalistic context. The qualitative descriptive approach seeks to understand phenomena from the perspectives of participants and seeks to generate straight descriptions of phenomena by staying as close as possible to the participants' words.

Researchers took an inductive thematic approach by cleaning transcripts (editing lightly to ease readability), reviewing for accuracy and then reading closely to become familiar with the data before coding and organizing words and phrases into a codebook of themes. Coding was conducted manually, and segments of text were highlighting and coded using Microsoft Word 2016 (Microsoft Corp., Redmond, WA, US). As analysis progressed, codes

were grouped to form themes and illustrative quotes organized using a codebook. Throughout the analysis process, the team met to discuss the emerging codes and themes, working to clarify and refine these over time. This strategy captured a rich account of participant experiences while also remaining close to the participants' words.[27,29]

Photovoice

Photovoice was used, in addition to the focus groups, to engage more deeply with gardening club members, co-create research and centre members' voices and perspectives throughout the research process.[30] Photos are valuable for promoting discussions about important topics within a community and to reach policy makers.[31] As a social process, the generation of grassroots participation through photovoice has been shown to empower individuals.[30] The use of pictures as self-expression can be enlightening and empowering, especially for people experiencing cognitive loss.

Five residents were recruited to participate in the photovoice activities. Participants used their own devices, or were provided with a camera, to take photos to document their experiences in the gardening project. While most were able to take photos independently, to remain inclusive and respectful of the varying degrees of physical abilities, residents could also opt to direct a research team member to take photos for them.

Participants shared between three and four photos at each of the focus groups, engaging in discussions using the "SHOWED" mnemonic.[32] SHOWED follows a series of six questions: S ("What do you SEE here?"); H ("What is really HAPPENING here?"); O ("How does this relate to OUR lives?"); W ("WHY does this problem exist?"); E ("How can we be EMPOWERED by this?"); and D ("What can we DO about it?"). Insights were generated collectively and detailed field notes were recorded and analyzed descriptively.

Results

Descriptive survey results

At the initial raised-bed planting event, 23 residents (n = 19 women; mean age 83.2 years, range 59–99 years) completed the baseline survey. Respondents reported living in the facility for between less than 1 year and 14 years, with the average length of time 3 years and 3 months.

Nearly three-quarters of respondents (n = 17/23) felt happy and content most of the time and satisfied with life; about one-third (n = 8/23) reported feeling confident and independent most of the time. An equal proportion (n = 8/23) reported feeling lonely sometimes (see Figure 2).

More than half of respondents (n = 11/21) exhibited signs of depression (GDS score > 2) (Figure 2). Most respondents (n = 21/23) preferred to go outside; however, less than one-third (n = 7/22) reported going outside daily (Figure 3). Four-fifths (n = 17/21) reported that they enjoyed gardening. When asked what aspects of gardening they enjoyed the most, respondents said that they liked watching the plants grow from small seeds and being harvested, noted joy in being able to eat what they grew and described the advantages of the gardening environment, including being outside in fresh air and being able to "get their hands dirty in the soil." Respondents expressed interest in actively participating in the planned gardening activities, hoping to work the soil, weed, sit in the gardening environment, watch the plants grow and harvest the vegetables.

At the end-of-season tea party, 23 residents (n = 21 women; mean age 83.2 years,

FIGURE 2
Percentage of resident self-reported mood and Geriatric Depression Scale indicators at baseline (N = 21) and follow-up (N = 19)

FIGURE 3
Percentage of self-reported frequency of times residents were able to go outside the facility (n = 22)

- Every day — 32%
- 2–3 times a week — 36%
- Once a week — 18%
- Once a month — 9%
- Only if weather is nice — 5%

range 58–99 years) completed the follow-up survey. Three-quarters of respondents (n = 15/20) felt happy and content most of the time and satisfied with life; half (n = 10/20) reported feeling confident and independent most of the time; one-quarter (n = 5/20) reported feeling lonely sometimes. More than half (n = 10/19) exhibited signs of depression (GDS score > 2); nearly half reported feeling helpless (n = 9/20); over one-third reported feeling worthless the way they are now (n = 7/19) (Figure 2).

Respondents found meaning and joy in getting their "hands in the dirt," watching plants grow, getting outside, socializing and connecting with others, and reminiscing about past outdoor activities such as gardening when they were younger. About half reported discussing the gardening program activities with other residents (n = 11/20) and with their family and friends (n = 10/20). Almost all (n = 15/17) hoped to see the program continue.

Photovoice showcase

At the end-of-season tea party, photovoice participants presented photo displays that included phrases and words the residents associated with the photos. Examples of the photos and the meanings described by photovoice participants are shown in Table 2.

Focus group analyses

Analyses of data from the five focus groups—three with long-term care facility staff (n = 10) and two with residents (n = 9)—generated seven themes: finding meaning; building connections with others through lifelong learning; impacts on mental health and well-being; opportunity to reminisce; reflection of self in gardening activities; benefits for staff; and enthusiasm for the program to continue.

Finding meaning

Residents described the profound impact that engaging in the gardening project had on their daily lives, giving them a reason to wake up, providing opportunity for meaningful contribution to the other residents and community within the facility, and in the joy of fostering and caring for something that grew and developed over time. Residents described how active engagement in gardening activities made them feel valued. One resident noted, "It makes me feel useful, like I'm doing something, helping someone … got me going and doing something instead of procrastinating … I went out every day and checked on the cucumber and that got me out and got me going." [P1, male resident]

Residents shared how the physical connection to nature through gardening led to feelings of satisfaction from getting their hands dirty in the soil and warmth in watching what they planted as seeds grow into vegetables and flowers.

They're so pretty and they smell so nice. They really do. Everybody commented on my morning glories, so

that's nice. Makes other people happy too. Earth is so… it feels good in your hands. It just makes you feel good to put your hand in the earth and feel it. [P4, female resident]

The long-term care facility staff echoed this quote, observing decreased boredom, increased engagement and increased sense of connection, joy, pride and ownership among residents who participated in the gardening activities. The staff also noted the residents experiencing the joy of meaningful engagement with the gardens by watching the plants grow. For some, the presence and awareness of the gardens fostered the opportunity to get outside.

I find this program meaningful to the residents, yeah. I think it's a good opportunity for them to be outdoors, doing stuff. … imagine like how months in a year and they'll just be indoors or doing stuff. I find that a lot of us, you know, if they get out and do something in their yard or in the garden, I think that's a break from the monotony. [P5, male staff member]

Gardening at the long-term care facility also fostered a sense of interpersonal connection and community cohesion. The respondents saw the value in the meaningful engagement between residents, between residents and staff, and between residents and visiting family and friends as a result of the gardens. Many described how taking part in the program enabled them to build new connections and strengthen existing bonds.

It was very positive, just to even see them out there with their hats on and checking the herbs. … I'm in the main office and I could see families just kind of peek through the doors, and when it was nice and sunny, they would grab their loved ones, and just even to walk or push them in their wheelchair around the gardens was, to me, like you say [it] was satisfying and it was something different that they were doing. Because they had something to look for, they had something, not that they just had a flower, they were looking at, "oh, has the lettuce grown? Oh, look at that" … like just even the talk amongst them was very positive, that I witnessed. [P6, female staff member]

P8, Female, Resident

P8 said that this photo reminded them of growth, representing the process from seed to vegetable, and attainment of a desired result. Seeing "mother nature at work," even for a short time, led to the participant feeling grateful for the opportunity: "We weren't just fooling around, we were actually trying to grow something edible!"

P8 took this photo two days after planting alfalfa microgreens. They saw the change from morning to afternoon in the same day, sharing their joy in the process of capturing a photo of something they were working on: "I was watching it day by day and knew how quickly it grew."

P8 shared how this photo shows new growth and old growth together. Being able to grow outdoor plants indoors brought P8 happiness and pride. P8 noted that hydroponic tower gardening was clean, was something that anyone could do and that it allowed growing things all winter long.

P8 took this photo when a butterfly landed on their plate during an outdoor gardening activity. When reflecting on the photo's beauty, they noted the comparison between the vegetables and the butterfly: "We don't normally invite butterflies to our food, but in that case, it was very nice." P8 emoted how looking at and showing the photo elicited strong feelings of gratitude and amazement: "We need to eat more food outside! Picnic more often!"

P1, Male, Resident

P1 noted that the cucumber in the photo represented a sense of accomplishment and life. The tissue box was placed beside it to show its size. P1 reflected on the meaningfulness of watching a seed grow into a plant that eventually produced a big, edible cucumber: "It made me feel good about myself," and was a reason to get out of their room. P1 said that the cucumber was a good conversation starter, noting that it "kept me busy. Everyone was asking me how my cucumber was growing."

P1 described how watching plants grow amazed them, especially what can be grown in water. P1 described how looking at the hydroponic tower garden relaxed them and gave them a purpose for leaving their room. P1 also described purpose in going to look at the tower, seeing the changes overnight: "It means a lot to me." The tower also served as a valuable topic of conversation.

P1 described how gardening made them feel "useful and engaged with life." They found that watching something grow elicited feelings of meaningfulness, sharing that this made them feel like they were doing something. P1 shared that the meaningful activity of "going out there brightens my day up."

When reflecting on this photo, P1 described the power in observing the plants' life cycles and growth. They felt accomplished in their role leading the watering of the garden and pride seeing the success of the raised beds. P1 shared how this photo represented the value of gardening and how it "got them going and doing something instead of procrastinating."

P4, Female, Resident

P4 focussed on the meaningfulness of "getting their hands dirty." The participant described how the earth and nutrients represented the starting point for the whole garden as the foundation of life and growth. They described their experiences and feelings of pleasure, joy, happiness and fulfillment. P4 described the beauty and satisfaction they found in pushing one's limits, both through gardening and by taking pictures.

Describing this photo, P4 reflected on the devastation that plants can experience, noting, "the plant is still living and happy." They were interested in the shapes the bugs make, connecting that to disappointments and anxieties that are a part of life. Although the plant had "been through a lot," P4 emphasized that the plant is still "growing and winning … it's still smiling too." They felt this reflected the reality of life coming to an end and feelings of thankfulness for that life.

P4 vividly described the beauty and loveliness watching how "the dew makes the leaves shimmer." Further, they described how the leaves were "happy" as the dew stays for such a long time. They described feeling fascinated and excitement, noting "I'm drawn to it."
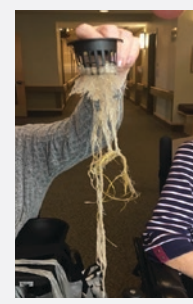
P4 found it interesting to see what a big root system the plants have inside the hydroponic tower. To them the roots symbolized death but not sadness. "We're on the same path as the plant, our life is coming to an end." They described the complexity long-term care facility residents experience in their lives, comparing that to the long roots and incredible bodies, each with their own interesting pattern and design.

The gardens led to conversations that may not otherwise have occurred, connecting residents with a common interest.

> I know it's opened a lot of conversation already. Different people ask me about what's going on. 'Cause I know different people see me going to the garden all the time. … Then they ask questions and call me "Mr. Gardener." I mean that's why I feel I accomplished something. I feel right at home. [P1, male resident]

The long-term care facility staff described how important it was for residents to feel part of a group with a shared focus and engagement in group conversation and activity: "There's a sense of belongingness and commitment. 'Cause they feel part of a community. They feel valuable because there's something they can contribute even if it's in their own little ways." [P5, male staff member]

> I think they feel that "I belong to something," because I mean let's face it, in the long-term facility, there's not much going on, you know. Other than some recreation programs. And a lot of these folks don't have families to take them out, so I think for them to be part of something like this, it makes them realize they are worth more than what they think they are. Because they are belonging to something. [P6, female staff member]

The residents actively involved in the gardening club put stickers on their doors to let others know that they were leading gardening activities. These stickers sparked further conversation: "The stickers on their door, like it's a little bit like a pride, 'I'm a garden member!' When I asked one of the residents out there what does that mean, she was very proud to tell me." [P7, female staff member]

Residents also found the photos they took as part of the photovoice activities useful for showing to other residents, family and friends as proof of their accomplishments in the gardening activities. Taking photos and participating in photovoice activities was new and challenging.

> … a lot of plusses for this [photovoice discussion group]. And taking pictures. I didn't think we'd be doing this. We're just learning and here we

are taking pictures. [Resident Name] takes beautiful pictures you know. We're pushing our limits and that's good for us, at our age pushing ourselves into you know, being active and enjoying what we have. What we can still do. To me, anyway. [P4, female resident]

Building connections with others through lifelong learning

All respondents self-identified as lifelong learners. During the co-design process, gardening club members had a strong desire to continue to learn about gardening, even though many had been gardeners their whole life. They were very enthusiastic about connecting with master gardeners from outside of the facility and learning more about the nuances of gardening in the specific region as some residents had grown up in other geographical regions and relocated to the city to live in the facility. This allowed for meaningful conversation about a shared topic of interest with new connections.

> I think it's fantastic! It brings the whole… the city, the botanical society together… talking to the mayor, and we're connected with all the gardeners in [City Name], like the big group gardeners, they come in and give us talks on different things. Isn't that nice? [P4, female resident]

Residents, including those actively engaged in the gardening activities, embraced the opportunity to learn and experiment with new things. One described great pride in their accomplishments: "Made us all feel a little better about ourselves." [P8, female resident]

> I'm very proud of what the display is. I'm very proud of what we did for the year. I think we accomplished a great deal and I'm very proud of it. … Expands it, enriches us, and it's good for your heart that we can still contribute. [P4, female resident]

One resident also described how having the photos supported him in overcoming his shyness and engaging more with others, which led to greater confidence when opening up and participating in discussions.

> [The photos] show what we're doing, accomplishing. And sharing, and I tell people what I'm doing. And I find

it easier if I have a picture. I can talk. I can explain what I'm doing. It's easier for me … Yeah, I got to meet new people 'cause they were always asking me questions. Everybody knew I was the gardener. Sit at coffee time and talk, usually one or two will ask me how my garden is doing. It's a great project. [P1, male resident]

Increased conversation and engagement with others led to a sense of accomplishment, confidence and personal growth: "It gives you a feeling of being able to do something. It feels good. It really … it's not very easy to grow cucumbers. And it just made me feel good. Wow." [P1, male resident]

Engaging in gardening activities, from co-design of the program, through deciding what to plant where in the gardening beds, searching together online and talking to experts about solutions for overcoming bugs, residents were invigorated and encouraged to learn and do more. As residents were able to find answers to their questions, and see the plants continue to grow, they reflected on the impacts that had on their confidence: "[It gives us] a lot of confidence in ourself that we had an idea and we brought it to fulfillment and we're just seeing that it really, it's really working." [P4, female resident]

Impacts on mental health and well-being

Residents used a variety of words to describe the effects of the gardening program and how it made them feel.

> Isn't that just charming? … It was just magical, really … I see beauty, I see art, I see design, I see excitement, interest. I see love, caring. … It gives me a calm, good feeling—warm feeling to go in the garden and relax. I think about the garden club, me going out there, forget about everything else that was going on and I was calm. Just go out there and look at some …, just relax. [P4, female resident]

The top 75 descriptive words are represented as a word cloud in Figure 4. The residents perceived the garden to be a happy place and an escape from daily routines. The long-term care facility staff also reported this, describing the effects they saw on residents: "I think this is a positive program for them, for sure. It's meaningful

FIGURE 4
Word cloud of top 75 words used by long-term care residents to describe the gardening project

Note: The size of the word corresponds to the frequency with which the word was used: the larger the print size in the cloud, the more times the word was used.

and it's something for them to, as she said, look forward to every day." [P5, male staff member]

Residents involved in the gardening club perceived the gardening program to be a "mature" activity that engaged them intellectually, physically and socially. The educational components and connection with community gardening leaders differentiated their role from participation as an activity/program attendee to being actively engaged in the co-design, prioritization and selection of educational and activity program components. Residents involved in the gardening project felt great pride in being able to contribute their experiences and to talk about, on an equal level, their engagement in the program. This shifted the dynamic of power as the residents took ownership of this project. The long-term care facility staff recognized this when interacting with residents, for example:

> [Resident Name], up on the [Floor Number], she really enjoyed it. She thought it was really cool that there was something, like a program that was mature in the way that it wasn't like patronizing them, it was something that was like necessary, and yeah, just more mature activity. [P7, female staff member]

Opportunity to reminisce
Conversations about the current gardening activities sparked conversations about past experiences. Residents shared positive memories of gardening when they were younger and of family and friends. One participant shared fond memories of their mother and how they used to garden together, while another participant shared vivid descriptions of their past home and gardens:

> Brings back, flood[s] memories back, of before. Reminds me of the first house we had, we had neighbours and there were buildings too. It was an old house, an old farmstead we bought, I had them gut it, and rebuilt it and it's just beautiful … Yeah, memories. I think that'[s the case] for the other people too. [P4, female resident]

Facility staff also observed that the gardens prompted reminiscences, bringing back memories for many residents who grew up in rural areas, of being outside and growing things.

> I think, for me, is people got out of their rooms more because they had a purpose. They had another purpose, and even listening to them sometimes—you know when we're having breaks—it took them back … to especially people that were raised on farms, and we have a lot of those folks and it took them back to those days, you know. And I think my wish

was to have that area garden, vegetable garden, all of it. [P6, female staff member]

Reflection of self in gardening activities
Discussions of photos showing the root system of a plant and showing how a bug had eaten through the leaves sparked thought-provoking conversations about the realities of life, the cycle of life and how the residents could see themselves in the plants they were growing. The residents recognized the beauty in watching "Mother Nature" at work and the reality that the plant is on a journey of life towards death.

> It's reality and that's just the way life is, right? As long as you can … the plant has obviously been through a lot, but it's still growing and it's winning. It's winning. So, there's a lot of meaning in that if you read it. And it still looks reasonably happy [laughs]. It's still smiling too. Well, it's not really what we want to see, but if you don't keep your eye on it, that's what happens. Reality. Reality is always there. Just the way life is. Life does come to an end. [P4, female resident]

The following conversation illustrates the residents' shared connections of how they identified with the plants they had worked to grow and saw the beauty in their own mortality.

> P8, female resident: For that plant it's the end of life and yet the roots are healthy.
>
> P4, female resident: And we're on the same path as the plant. Our life is coming to an end too so we can relate that way too. Just the way it's supposed to be.
>
> Interviewer: Cycle of life.
>
> P4, female resident: Kind of sad, but it's positive, it's the way it is. Life … Very complex, our lives, I mean everybody's life is really complex.

Benefits for staff
Long-term care facility staff reported experiencing benefits from engaging in gardening activities with residents, including helping care for plants, taking residents for a walk and chatting about the plants, and enjoying participating in gardening activities. They noted that encouraging

residents to get outside helped provide a more home-like environment. Sharing in activities led to conversation starters and were noted to spark meaningful discussions "[We] enjoyed mint leaves from it, [it was a] conversation starter with residents and other staff. [P11, female staff member]

The required maintenance of the garden was not possible without help from research team members, who obtained and safely stored the chemicals (e.g. fertilizers) necessary to keep the garden healthy. While it was recognized that these tasks could be adopted by the recreation staff, it was noted that recreation staff need to have the capacity and commitment to take on this responsibility and that time demands can be taxing on staff and a barrier to older adults' use of green spaces.

Enthusiasm for the program to continue

Residents and facility staff alike expressed an interest in continuing the program following completion of this pilot study: "I'd like to see the group kind of get together and talk about what we plan to do for next year. That's my goal." [P1, male resident]

To sustain the activities, participants recognized and noted the need to engage more people and were excited to take on this role.

> We need more people involved with the garden club and we need to kind of build up the garden club … I think we want to get more people involved, there's not too many people. Most people I know like gardening. I think it can draw people to come. That's what we're hoping for. [P4, female resident]

The facility staff were keen to encourage greater engagement with family, friends and volunteers:

> I think once the word gets out, you know, there's a lot of families, or a lot of residents … that their families don't come and visit them too often, and I think once the word gets out and says hey, we have this at [Facility Name], I think it will bring in more families. 'Cause I know the difference when the garden was there, when we initiated the garden and we had a few

new residents come in, especially for the first floor, and we mentioned, hey this is, they're like what? You have that? Can my mom participate? You can tell the excitement. Really, they can go outside and weed. [P6, female staff member]

The interest in continuing to support residents' engagement in the gardening activities was rooted in the positive value and meaning that participation brought to the residents' QOL and to the atmosphere in the facility environment. None of the facility staff reported that presence of the hydroponic tower or the raised-bed gardens increased their workload.

Discussion

It can be challenging to create a home-like atmosphere for each individual in the long-term care facility setting, especially when residents previously lived in rural or remote geographical areas. Over time, depression remains a pervasive issue in the long-term care facility setting, which warrants focussed attention. Enhancing opportunities for engagement with the natural environment through indoor and outdoor gardening, as well as nature-based activities, can benefit many residents.

Participation in gardening activities presented new opportunities to reduce both social isolation and loneliness, especially for those looking to "get their hands dirty" and garden through the group gardening club activities. Respondents described how these activities led to interactions and purposeful discussions with other residents and staff. Further, passive engagement with the hydroponic tower and raised-bed gardens may have reduced loneliness, as residents noted their connection to the beauty and atmosphere by simply looking at and being close to nature. This confirms findings from a recent literature review that concluded that older adults derive pleasure and enjoyment from being in and viewing nature, which in turn, positively affects their well-being and QOL.[17]

Long-term care facilities in both rural and urban communities may lack surrounding green space areas, resulting in an increased prevalence of social isolation and loneliness. Residents described longing for nature, especially those who relocated from the countryside where they

were close to the natural environment.[33] Residents may also have limited or no access to gardening and the nature-based activities they found meaningful when living in the community. Thus, nature-based activities may provide a meaningful and impactful way to promote the health and well-being of adults in long-term care facilities.

In northern communities where winters are often harsh and growing seasons short, outdoor gardening may be challenging for beginner and novice gardeners. The built environment may also prevent many from going outside (e.g. doors may be locked or are too heavy for residents to push open and navigate on their own, outdoor spaces may be inaccessible in the winter due to heavy snowfall or ice). Hydroponic technology can be a feasible and innovative way to support connection to nature and reduce isolation year-round, regardless of climate and infrastructure.

The hydroponic tower enhanced opportunities for residents to connect with others. Introduction of this technology offered opportunities for shared learning and encouraged positive interaction between individuals, often acting as a source of discussion for visiting friends and family. Some residents felt more valued through their participation in the planting, growing and maintenance of the tower. This is consistent with existing literature demonstrating that the availability of green spaces generating opportunities for social interaction, elevating the everyday lives of older adults.[34] Engaging in activities with nature was important for maintaining social connections and self-confidence.[35]

Overall, there existed a sense of accomplishment and pride, as the tower provided year-round access to fresh produce and flowers. Sharing of the plants and flowers also gave residents opportunities for social engagement. The placement of the hydroponic tower in a high traffic area in the hallway of the facility, with seating nearby, further enhanced opportunities for passive enjoyment of the plants. The rapid growth of the plants provided an ongoing topic for conversation for those actively and passively engaged in the gardening activities.

This pilot project demonstrated that a nature-based gardening intervention, including outdoor raised-bed and indoor hydroponic

gardens, is feasible and beneficial in the long-term care facility setting. While gardening was embraced by residents, their families and the facility staff, sustainability and safe operation of the gardening sites, including the hydroponic tower, relied heavily upon staff and facility management. Although both residents and staff experienced diverse benefits, it was noted that recreation or other long-term care facility staff must have the capacity and commitment to take on the responsibility. The time demands and complexities involved in maintaining gardens can be taxing on staff and a barrier to older adults' use of green spaces.[36] Staff commitment and support is essential for successful engagement of older adults with nature and green activities, and a lack of support can be a barrier for ongoing engagement.[17]

Strengths and limitations

This research focussed on the inclusion of diverse long-term care facility residents in planned and adapted nature-based activities. Adaptations are key when working with an aging population to ensure meaningful participation, including residents' involvement in co-creation activities. The co-creation process identified many meaningful activities and resulted in several revelations for the research team. Further, adopting photovoice as an approach for gardening club members to engage more deeply was a powerful way to mitigate social isolation as it enabled individuals to reflect on strengths of the gardening activities and promoted discussions.

However, despite initial enthusiasm, two participants withdrew due to declining health, and a few felt some frustration with using digital camera technology. While cellphones with cameras are common, only one participant in this study owned one.

Further research iterations of the raised-bed and hydroponic gardening project were also disrupted by the COVID-19 pandemic. This resulted in an early pause in the hydroponic tower activities and associated programming; gardening club members were able to continue their raised-bed gardening activities in a more limited capacity.

Finally, our small sample size and inability to link survey responses at the baseline and follow-up periods are limitations.

Future research may benefit from the engagement of a larger cohort of long-term care facility residents as well as more systematic screening for depression and QOL. Future research should also seek to gather quantitative data from a larger number of participants to investigate the potential impact of participation in gardening activities.

Implications for long-term care facility settings

Integrating nature-based interventions, including hydroponic and raised-bed gardening, into the long-term care facility setting is feasible and can result in the active and inclusive engagement of residents, along with meaningful conversations among residents and with facility staff. Key learnings include:

- Residents' participation in gardening activities increases opportunities for social engagement and relationship building between residents and staff, providing opportunities to mitigate social isolation.

- Positioning flower beds and/or hydroponic gardens in a high traffic area with seating nearby and access for wheelchairs and mobility devices supports inclusivity for all residents who wish to engage in gardening activities.

- Implementation and sustainability of the gardening program and activities requires collaboration among multiple stakeholders—residents, care staff, recreation staff and dietitians—to co-create a gardening program that is tailored to the long-term care facility context.

- Access to outdoor raised-bed gardens may require support from facility staff/families.

Conclusion

Participation in gardening activities was a valued and meaningful activity for long-term care facility residents and can help provide opportunities for meaningful engagement with others. Active and passive engagement with hydroponic indoor gardening and outdoor raised-bed gardening fostered opportunities for discussion, connection and increased interaction with others, helping to reduce social isolation. In this study, gardening activities helped participants feel connected to nature and the land, helping to reduce feelings of disconnection and isolation in the long-term care facility setting. Of note, connections and interactions between residents and with staff improved, demonstrating the importance of these activities in initiating and sustaining robust connections. When developing and prioritizing activity programming for long-term care facilities, gardening programs are an important option that can support the socialization, health and well-being of residents.

Conflicts of interest

Kelly Skinner is an Associate Scientific Editor with the HPCDP Journal, but has recused herself from the review process for this paper. The authors have no other conflicts of interest to declare.

Authors' contributions and statement

All authors actively contributed to this project.

SF, DB and KS were involved in all aspects of the project, from project design and conceptualization through to analysis, drafting and revising of this paper.

EB was involved in project design and data acquisition.

ML was involved in acquisition of the data and drafting the paper.

GB was involved in acquisition and cleaning of the data.

TW was involved in analysis, drafting and revising this paper.

The content and views expressed in this article are those of the authors and do not

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At-a-glance

Update on cancer incidence trends in Canada, 1984 to 2017

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Abstract

This paper highlights findings on cancer trends from the *Canadian Cancer Statistics 2021* report. Trends were measured using annual percent change (APC) of age-standardized incidence rates. Overall, cancer incidence rates are declining (-1.1%) but the findings are specific to the type of cancer and patient sex. For example, in males, the largest decreases per year were for prostate (-4.4%), colorectal (-4.3%), lung (-3.8%), leukemia (-2.6%) and thyroid (-2.4%) cancers. In females, the largest decreases were for thyroid (-5.4%), colorectal (-3.4%) and ovarian (-3.1%) cancers.

Keywords: neoplasms, data analysis, trend, cancer surveillance

Highlights

- Overall, cancer incidence is declining at a rate of -1.1% per year. In males, the two largest decreases were for prostate (-4.4% per year) and colorectal (-4.3% per year) cancer. In females, they were for thyroid (-5.4% per year) and colorectal (-3.4% per year) cancer.
- Melanoma (males: 2.2% per year; females: 2.0% per year) and multiple myeloma (males: 2.5% per year; females: 1.6% per year) rates are increasing.
- Cancer trends in Canada are dynamic and type-specific. The decreases for prostate and thyroid cancer underscore the importance of updating testing practices based on best evidence.

Introduction

This paper highlights findings on cancer trends from the *Canadian Cancer Statistics 2021* (CCS 2021) report,[1] which was developed by the Canadian Cancer Statistics Advisory Committee in collaboration with the Canadian Cancer Society, Statistics Canada and the Public Health Agency of Canada with data provided by the provincial and territorial cancer registries.

The number and rate of new cases of cancer diagnosed each year and over time are important measures of the cancer burden on the Canadian population and health care system. This information is essential for stakeholders planning for screening, diagnosis, treatment and support services. Although they have been fairly stable between 1984 and 2012, overall cancer incidence rates have declined at a pace of -1.1% per year since 2012.[1] This decline is likely due to success in screening for cervical and colorectal cancer, but also to the change in testing practices for prostate and thyroid cancer and decline in smoking prevalence. Monitoring incidence of individual cancers over time can help identify emerging trends, highlight progress and suggest where to prioritize research and resources. The purpose of this report is to feature findings from the CCS 2021 report relating to time trends in the incidence of cancers in Canada. We report on 22 cancer types but highlight those that have shown the most significant changes in recent years.

Methods

Results are drawn from the incidence chapter of the 2021 CCS report,[1] covering the period from 1984 to 2017. Quebec was not included because data were only available up to 2010. The source of cancer incidence data from 1992 to 2017 was the Canadian Cancer Registry (CCR),[2] and for data prior to 1992, the National Cancer Incidence Reporting System (NCIRS).

Age-standardized incidence rates (ASIR, "the rates") were determined using direct standardization and the 2011 Canadian standard population.[3] Joinpoint[4] analysis software (version 4.7.0.0) was used to calculate the rates' annual percent change (APC) for each cancer type from 1984 to 2017, and to determine any inflection years in the APCs. The minimum time span to report a trend was set at five years, with 2013 to 2017 as the most recent trend period possible. Otherwise, default Joinpoint parameters were used. We investigated 22 types of cancer,

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categorized according to their most recent trend. Specifically, we looked at those whose trend changed significantly (*p*-value < 0.05 or *p*-value < 0.001) and those for which no significant change was detected (*p*-value ≥ 0.05). For more detail, see Appendix II, "Data Sources and Methods," of the 2021 CCS report.[1]

Results and discussion

Table 1 shows trends identified by Joinpoint analyses between 1984 and 2017 for 22 cancer types. Figure 1 displays the most recent trend categorized in three groups according to the significance of the change in trend. The following highlights the most significant results.

Decreasing trends

Thyroid cancer rates have declined in males and females since 2013 (APC males: −2.4%, not significant; APC females: −5.4%). The rate increase that happened before 2013 was likely due to overdiagnosis.[5] A recent Canadian study found evidence to support the overdiagnosis hypothesis, including the confirmation of the central role played by papillary thyroid cancer in past trends.[6] **Prostate cancer** rates declined steeply from 2007 to 2017 (APC: −4.4%). The incidence rate peaked in 1993 and 2001, which mirrored intensified use of prostate-specific antigen (PSA) testing in Canada.[7] The Canadian Task Force advised against PSA screening in 2014.[8] A similar decline due to guidelines update has been documented in the USA.[9] **Colorectal cancer** rates have declined steeply in both sexes since 2013 (APC males: −4.3%; APC females: −3.4%). The recent decline is likely due in part to increased screening, which can identify treatable precancerous polyps and reduce cancer incidence. Between 2007 and 2017, most provinces and territories have implemented organized colorectal cancer screening programs; they are in planning stage in Quebec and the Northwest Territories.[10] **Lung cancer** rates have decreased since the 1990s in males (APC: −1.0% to −3.8%) and since 2013 in females (APC: −2.0%). The differences in trends reflect past cigarette smoking habits. In males, a decrease in the prevalence of daily smokers began in the mid-1960s in Canada, while in females, the drop did not happen until the mid-1980s.[11] The incidence rate of **ovarian cancer** has

TABLE 1
Annual percentage change (APC) in age-standardized incidence rates by cancer site and sex, Canada (excluding Quebec), 1984 to 2017

Cancer type	Males			Females		
	Year range	APC	*p*-value	Year range	APC	*p*-value
Head and neck	1984–2004	−2.4	< 0.001	1984–2004	−1.1	< 0.001
	2004–2017	0.6	0.003	2004–2017	0.3	0.099
Esophagus	1984–2005	0.3	0.034	1984–2017	−0.4	< 0.001
	2005–2011	2.8	0.008			
	2011–2017	−1.8	0.009			
Stomach	1984–2002	−2.6	< 0.001	1984–2001	−2.8	< 0.001
	2002–2017	−1.0	< 0.001	2001–2017	−0.5	0.009
Colorectal	1984–2013	−0.3	< 0.001	1984–1994	−1.7	< 0.001
	2013–2017	−4.3	< 0.001	1994–2000	0.4	0.41
				2000–2013	−0.5	< 0.001
				2013–2017	−3.4	< 0.001
Liver	1984–2013	3.8	< 0.001	1984–2005	1.9	< 0.001
	2013–2017	−0.3	0.86	2005–2013	5.8	< 0.001
				2013–2017	−3.2	0.16
Pancreas	1984–2002	−1.4	< 0.001	1984–2006	−0.3	0.023
	2002–2017	1.4	< 0.001	2006–2013	2.2	0.004
				2013–2017	−2.2	0.074
Lung and bronchus	1984–1990	−0.7	0.077	1984–1993	2.9	< 0.001
	1990–2003	−2.2	< 0.001	1993–2013	0.9	< 0.001
	2003–2013	−1.0	< 0.001	2013–2017	−2.0	< 0.001
	2013–2017	−3.8	< 0.001			
Melanoma	1984–2017	2.2	< 0.001	1984–1994	0.2	0.74
				1994–2017	2.0	< 0.001
Breast	1984–2017	0.5	0.019	1984–1991	2.0	< 0.001
				1991–2017	−0.2	0.008
Cervix	N/A			1984–2005	−2.0	< 0.001
				2005–2017	−0.6	0.019
Uterus	N/A			1984–1990	−1.5	0.08
				1990–2005	0.4	0.055
				2005–2011	3.1	< 0.001
				2011–2017	1.0	0.054
Ovary	N/A			1984–1997	−1.5	< 0.001
				1997–2013	−0.1	0.42
				2013–2017	−3.1	0.01
Prostate	1984–1993	5.6	< 0.001	N/A		
	1993–2007	0.2	0.61			
	2007–2017	−4.4	< 0.001			
Testis	1984–2017	1.3	< 0.001	N/A		
Bladder	1984–2007	−1.2	< 0.001	1984–2008	−0.9	< 0.001
	2007–2011	7.8	0.005	2008–2012	7.2	0.053
	2011–2017	−0.5	0.49	2012–2017	−1.2	0.38

Continued on the following page

TABLE 1 (continued)
Annual percentage change (APC) in age-standardized incidence rates by cancer site and sex, Canada (excluding Quebec), 1984 to 2017

Cancer type	Males			Females		
	Year range	APC	p-value	Year range	APC	p-value
Kidney and renal pelvis	1984–1989	4.0	0.005	1984–2017	1.1	< 0.001
	1989–2003	0.1	0.61			
	2003–2012	2.7	< 0.001			
	2012–2017	0.4	0.63			
Brain and CNS	1984–2017	−0.4	< 0.001	1984–2017	−0.5	< 0.001
Thyroid	1984–1998	2.8	< 0.001	1984–1998	4.0	< 0.001
	1998–2013	7.0	< 0.001	1998–2004	10.4	< 0.001
	2013–2017	−2.4	0.17	2004–2013	5.5	< 0.001
				2013–2017	−5.4	< 0.001
Hodgkin lymphoma	1984–2017	−0.4	< 0.001	1984–2017	0.1	0.54
Non-Hodgkin lymphoma	1984–2017	1.3	< 0.001	1984–1993	2.1	< 0.001
				1993–2017	0.9	< 0.001
Multiple myeloma	1984–2007	0.3	0.064	1984–2005	0.2	0.26
	2007–2017	2.5	< 0.001	2005–2017	1.6	< 0.001
Leukemia	1984–1994	−1.1	0.022	1984–2001	−0.3	0.15
	1994–2013	0.9	< 0.001	2001–2010	1.9	< 0.001
	2013–2017	−2.6	0.038	2010–2017	−1.6	0.004

Data source: Canadian Cancer Statistics Advisory Committee in collaboration with the Canadian Cancer Society, Statistics Canada and the Public Health Agency of Canada. Canadian cancer statistics 2021. Toronto (ON): Canadian Cancer Society; 2021.

Abbreviation: CNS, central nervous system.

declined rapidly (APC: −3.1%) since 2013. Several factors could be contributing to the favourable trend, including increased use of oral contraceptives, changes in reproductive and protective risk factors (e.g. older age at childbirth), decreased prevalence of smoking and changes in disease classifications; since 2000, ovarian neoplasms with borderline or low malignant potential are no longer considered malignant tumours.[12-14] **Leukemia** rates have declined rapidly since 2013 in males (APC: −2.6%) and since 2010 in females (APC: −1.6%). Similar trends have been reported globally between 1990 and 2017, though the rate of decline varies between countries and leukemia subtypes.[15,16] Factors driving these trends are not well understood, though some suggest that changes in environmental exposures (e.g. benzene), lifestyle (e.g. smoking) and parental behaviours (e.g. increased intake of folate during the preconception period and pregnancy) may be at play.[15,17] **Esophageal cancer** incidence rates are decreasing more rapidly in males (APC: −1.8%; 2011 to 2017) than females (APC: −0.4%; 1984 to 2017).

Risk factors for this cancer include obesity, alcohol consumption and tobacco consumption.[18] Whereas obesity[19] and sales of alcoholic drinks[20] have been increasing in Canada, past decreases in tobacco consumption[11] may account for the observed decrease. Since 2013, female **liver cancer** rates have declined, but not statistically significantly (APC: −3.2%). The most common type of liver cancer, hepatocellular carcinoma, is generally driven by chronic hepatitis B and C infection, as well as excessive alcohol consumption and diabetes.[21] It is not clear why this recent shift exists for females, but it may relate to changes in risk factor prevalence and early detection. **Cervical cancer** rates are decreasing (APC: −0.6%) largely due to routine screening with Pap tests. Every province in Canada (except Quebec) has an organized cervical cancer screening program. Current guidelines recommend screening every two to three years starting at age 21 or 25 until age 65 or 70.[22] In the coming years, human papillomavirus (HPV) vaccination and the adoption of primary HPV testing as part of

screening are expected to result in further reductions in cervical cancer incidence.[23]

Increasing trends

The incidence of **multiple myeloma** increased 2.5% per year in males from 2007 to 2017 and 1.6% in females since 2005. Improved detection and case ascertainment has been reported to contribute to some of the increase in multiple myeloma cases in other countries.[24] The increased prevalence of obesity, a known risk factor for multiple myeloma, could be contributing to the recent upward trend in the incidence rate.[19,25] Elevated risk of multiple myeloma has also been linked with pesticide use and proximity to contaminated bodies of water and rivers.[26,27] The incidence rate for **skin melanoma** increased an average of 2.2% per year between 1984 and 2017 in males and 2.0% per year between 1994 and 2017 in females. Exposure to ultraviolet (UV) radiation[28] through sunlight, tanning beds and sun lamps is a well-established risk factor for melanoma.[29]

Conclusion

Results show that cancer incidence trends in Canada are dynamic and site-specific. The most recent trends show rapidly increasing rates of melanoma and myeloma. Conversely, rates of other cancers have recently decreased, most notably thyroid, prostate, lung and colorectal. The decreases for prostate and thyroid cancer underscore the importance of updating testing practices based on best evidence.

Conflicts of interest
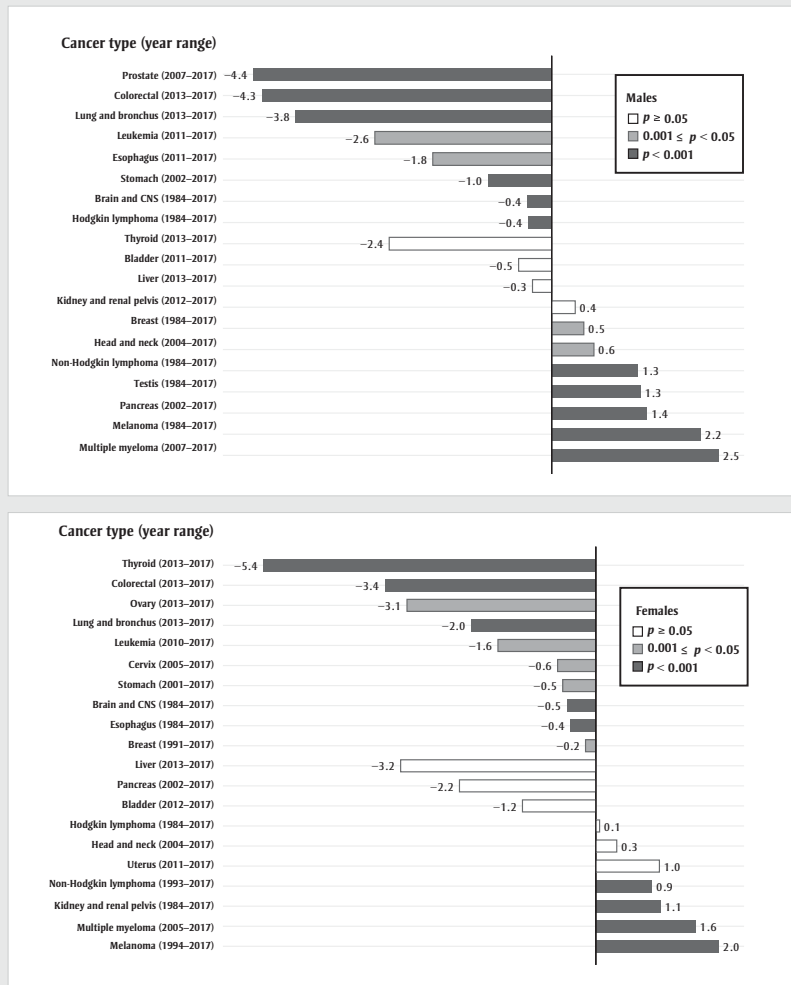
The authors have no conflicts of interest to declare.

Authors' contributions and statement

All authors contributed to the design, conceptualization, data interpretation and revision. The Public Health Agency of Canada performed the data analysis.

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

FIGURE 1
Most recent[a] annual percent change (APC) in age-standardized incidence rates, by cancer site and sex, Canada (excluding Quebec)

Cancer type (year range) — Males

Prostate (2007–2017) −4.4
Colorectal (2013–2017) −4.3
Lung and bronchus (2013–2017) −3.8
Leukemia (2011–2017) −2.6
Esophagus (2011–2017) −1.8
Stomach (2002–2017) −1.0
Brain and CNS (1984–2017) −0.4
Hodgkin lymphoma (1984–2017) −0.4
Thyroid (2013–2017) −2.4
Bladder (2011–2017) −0.5
Liver (2013–2017) −0.3
Kidney and renal pelvis (2012–2017) 0.4
Breast (1984–2017) 0.5
Head and neck (2004–2017) 0.6
Non-Hodgkin lymphoma (1984–2017) 1.3
Testis (1984–2017) 1.3
Pancreas (2002–2017) 1.4
Melanoma (1984–2017) 2.2
Multiple myeloma (2007–2017) 2.5

Males
☐ $p \geq 0.05$
▨ $0.001 \leq p < 0.05$
■ $p < 0.001$

Cancer type (year range) — Females

Thyroid (2013–2017) −5.4
Colorectal (2013–2017) −3.4
Ovary (2013–2017) −3.1
Lung and bronchus (2013–2017) −2.0
Leukemia (2010–2017) −1.6
Cervix (2005–2017) −0.6
Stomach (2001–2017) −0.5
Brain and CNS (1984–2017) −0.5
Esophagus (1984–2017) −0.4
Breast (1991–2017) −0.2
Liver (2013–2017) −3.2
Pancreas (2002–2017) −2.2
Bladder (2012–2017) −1.2
Hodgkin lymphoma (1984–2017) 0.1
Head and neck (2004–2017) 0.3
Uterus (2011–2017) 1.0
Non-Hodgkin lymphoma (1993–2017) 0.9
Kidney and renal pelvis (1984–2017) 1.1
Multiple myeloma (2005–2017) 1.6
Melanoma (1994–2017) 2.0

Females
☐ $p \geq 0.05$
▨ $0.001 \leq p < 0.05$
■ $p < 0.001$

Data source: Canadian Cancer Statistics Advisory Committee in collaboration with the Canadian Cancer Society, Statistics Canada and the Public Health Agency of Canada. Canadian cancer statistics 2021. Toronto (ON): Canadian Cancer Society; 2021.

Abbreviation: CNS, central nervous system.

[a] The APCs were calculated from 1984 to 2017. If one or more significant changes were detected in the trends, the most recent APC was used. If no significant change was detected, the APC reflects the trend over the entire period.

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