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# Original quantitative research

# The relationship between COVID-19 and opioid-related emergency department visits in Alberta, Canada: an interrupted time series analysis

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## Abstract

**Introduction:** Emergency departments (EDs) are important health care access points for people who use drugs (PWUD), but little is known about whether the onset of the COVID-19 pandemic was associated with changes in opioid-related emergency presentations. We investigated whether (1) the onset of the COVID-19 pandemic was associated with any change in average rates of opioid-related ED visits in Alberta; and (2) this varied across regions with different COVID-19 case rates.

**Methods:** We conducted maximum-likelihood interrupted time series analyses to compare opioid-related ED visits during the "prepandemic period" (3 March 2019–1 March 2020) and the "pandemic period" (2 March 2020–14 March 2021).

**Results:** There were 8883 and 11 657 opioid-related ED visits during the prepandemic and pandemic periods, respectively. The onset of the COVID-19 pandemic was associated with an increase in opioid-related ED visits (Edmonton: IRR = 1.37, 95% CI: 1.30–1.44, $p < 0.05$; Calgary: IRR = 1.14, 95% CI: 1.07–1.20, $p < 0.05$; Other health zones: IRR = 1.14, 95% CI: 1.07–1.21, $p < 0.05$). Changing COVID-19 case counts did not correspond with changing rates of opioid-related ED visits across regions.

**Conclusion:** The increase in opioid-related ED visits associated with the onset of the COVID-19 pandemic was unrelated to COVID-19 case prevalence in Alberta.

***Keywords:*** *COVID-19, opioid use, emergency medicine, public health, people who use drugs, substance use, drug overdose*

### *Highlights*

- The COVID-19 pandemic exacerbated harms among people who use drugs, including through capacity reductions in health and social services.
- We compared opioid-related emergency department visits in the year before the pandemic (3 March 2019 to 1 March 2020) with those in the first year of the pandemic (2 March 2020 to 14 March 2021).
- The onset of the COVID-19 pandemic was associated with an increase in opioid-related emergency department visits, which was unrelated to the prevalence of COVID-19 cases.
- Research is needed to determine how to best support people who use drugs during pandemics and other emergencies in the future.

## Introduction

The COVID-19 pandemic coincided with Canada's ongoing drug poisoning crisis to exacerbate risks for people who use drugs (PWUD).[1,2] This was particularly apparent in Alberta, where these dual public health crises resulted in significant mortality.[3-5] Border closures and disrupted supply chains led to increased contamination, toxicity

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and costs of illegal drugs.[6-9] Social isolation and financial and psychological strain may have resulted in people using substances as a coping mechanism.[6,8-10] Non-urgent health and social services for PWUD reduced their capacity to accommodate enhanced infection prevention and control measures,[11] which limited access to supervised consumption services,[3] primary care,[12] withdrawal management and treatment facilities,[13] sterile drug supplies, naloxone kits and drug-checking services.[14,15] As a result, more people may have been using drugs alone or in other unsafe conditions for longer periods of time, increasing their risk of drug poisoning and infections[16] and their likelihood of requiring emergency care.[17]

The COVID-19 pandemic and the associated infection prevention and control measures resulted in changes in the numbers of people seeking emergency department (ED) care and in how ED care was delivered. The overall number of people seeking ED care decreased soon after the onset of the pandemic,[18] likely because of concerns about in-hospital transmission of COVID-19, fewer injuries as a result of stay-at-home orders and reductions in non-COVID-19–related in-hospital procedures.[19] ED personnel also altered how they triaged and engaged with PWUD and decreased prescribing of opioid agonist treatment (OAT),[20] shifted appointments with ancillary support staff (e.g. counsellors) from in-person to remote, which hindered rapport-building, and reduced referrals to community-based services following discharge.[14] This is particularly salient as EDs are key health care access points for PWUD, and health care providers in the ED can mitigate future opioid-related harm by initiating OAT,[21-23] distributing naloxone and providing referrals to community-based services.[24]

It is unclear how the COVID-19 pandemic and its associated impacts on EDs affected opioid-related emergency presentations. We conducted this study to determine (1) whether the onset of the COVID-19 pandemic was associated with a change in the average rates of opioid-related ED visits in Alberta; and (2) whether changes in average rates of opioid-related ED visits varied across regions with different COVID-19 case rates. We hypothesized (1) that the onset of the COVID-19 pandemic led to an increased incidence rate of opioid-related ED visits; and (2) that there is an association between the trends in COVID-19 case counts and the rate of opioid-related ED visits across regions.

## Methods

### Ethics approval

The University of Alberta Research Ethics Board 3: Health Research Ethics Board – Health Panel provided ethics approval (Pro00103203) and a waiver of consent; informed consent from participants was not required as we extracted anonymized administrative health data.

### Study design

We conducted an interrupted time series analysis to test whether the incidence of opioid-related ED visits in Alberta changed during the first year of the COVID-19 pandemic (referred to as the "pandemic period," 2 March 2020 to 14 March 2021) compared to before the pandemic (referred to as the "prepandemic period," 3 March 2019 to 1 March 2020) using counts of opioid-related ED visits over 2-week periods. Interrupted time series analyses are commonly used in observational public health studies to make pre–post comparisons by adjusting for pre-existing time trends, seasonality and other time-varying confounders.[25] The pandemic period was designated according to the implementation of Alberta's acute care COVID-19 response protocols (at the beginning of March 2020), and we created equal-length prepandemic and pandemic periods (27 data points of 2-week periods each) for pre–post analysis.

Alberta is covered by a single provincial health authority (Alberta Health Services)[26] that is made up of five defined health zones: North, Edmonton, Central, Calgary and South.[27] Each health zone varies in population and geographic size; the Edmonton and Calgary health zones, which cover metropolitan areas, have higher populations and smaller geographic areas than the North, Central and South health zones, which are more rural. There were 105 EDs (including community ambulatory sites) across the province with data available for the study period (34 in North health zone, 13 in Edmonton health zone, 29 in Central health zone, 18 in Calgary health zone and 11 in South health zone). While there are other EDs in the province, not all had data available for the study period. We merged the North, South and Central health zones to create the "Other health zones" variable because of the limited number of data points available in each of these less-populated health zones.

### Data source

We extracted opioid-related ED data (i.e. raw counts of patients) for the period 3 March 2019 to 14 March 2021 from the National Ambulatory Care Reporting System (NACRS). The NACRS collects health records on all ED visits in Alberta.[28] We included all ICD-10–coded diagnoses of poisoning related to opium (T40.0), other opioids (T40.2) and other/unspecified narcotics (T40.6) and of mental and behavioural disorders due to the use of opioids (F11.0–F11.9). We retrieved demographic data (sex, health zone) for all ED visits with these diagnoses.

### Data analysis

We evaluated trends in ED visits for opioid-related illnesses using 2-week time periods over 2 years using maximum-likelihood interrupted time series analysis for counts. We tested for correlations between variables before analysis. Negative binomial regression models (as a result of the non-normal distribution of the data and overdispersion) were then fitted to test the two study hypotheses. We modelled rates directly with a log-linear statistical model by including counts as the dependent variable and controlled for underlying trends, such as seasonality, by including 2-week time periods in the model as a dummy variable. All hypothesis tests used a significance level (alpha) of 0.05. We performed regression diagnostics postestimation, including quasi-likelihood information criteria to assess goodness of fit. Statistical analyses were performed using Stata version 17 (StataCorp LLC, College Station, TX, US) using the "nbreg" and "margins" commands.

## Results

There were 20 540 opioid-related ED visits across Alberta during the study period: 8883 (43.2%) visits during the prepandemic period and 11 657 (56.9%) visits during the pandemic period. During the entire study period, 7934 (38.6%) of the opioid-related ED visits occurred in the Edmonton health zone, 7120 (34.7%) in the Calgary health zone and 5486 (26.7%) in the Other health zones. Based on Alberta Health Services' definition of sex (the sex documented on the government-issued

identification presented at the time of registration), 12338 (60.1%) of the patients were male and 8202 (39.9%) were female.

In the Edmonton health zone, the pandemic period was associated with an increased incidence rate of opioid-related ED visits compared to the prepandemic period (incidence rate ratio [IRR] = 1.37; 95% confidence interval [CI]: 1.30–1.44; $p < 0.05$) (Figure 1).

The pandemic period was also associated with increased incidence rates of opioid-related visits in the Calgary health zone (IRR = 1.14; 95% CI: 1.07–1.20; $p < 0.05$) and the Other health zones (IRR = 1.14; 95% CI: 1.07–1.21; $p < 0.05$), albeit to lesser extents than in the Edmonton health zone (Figures 2 and 3).

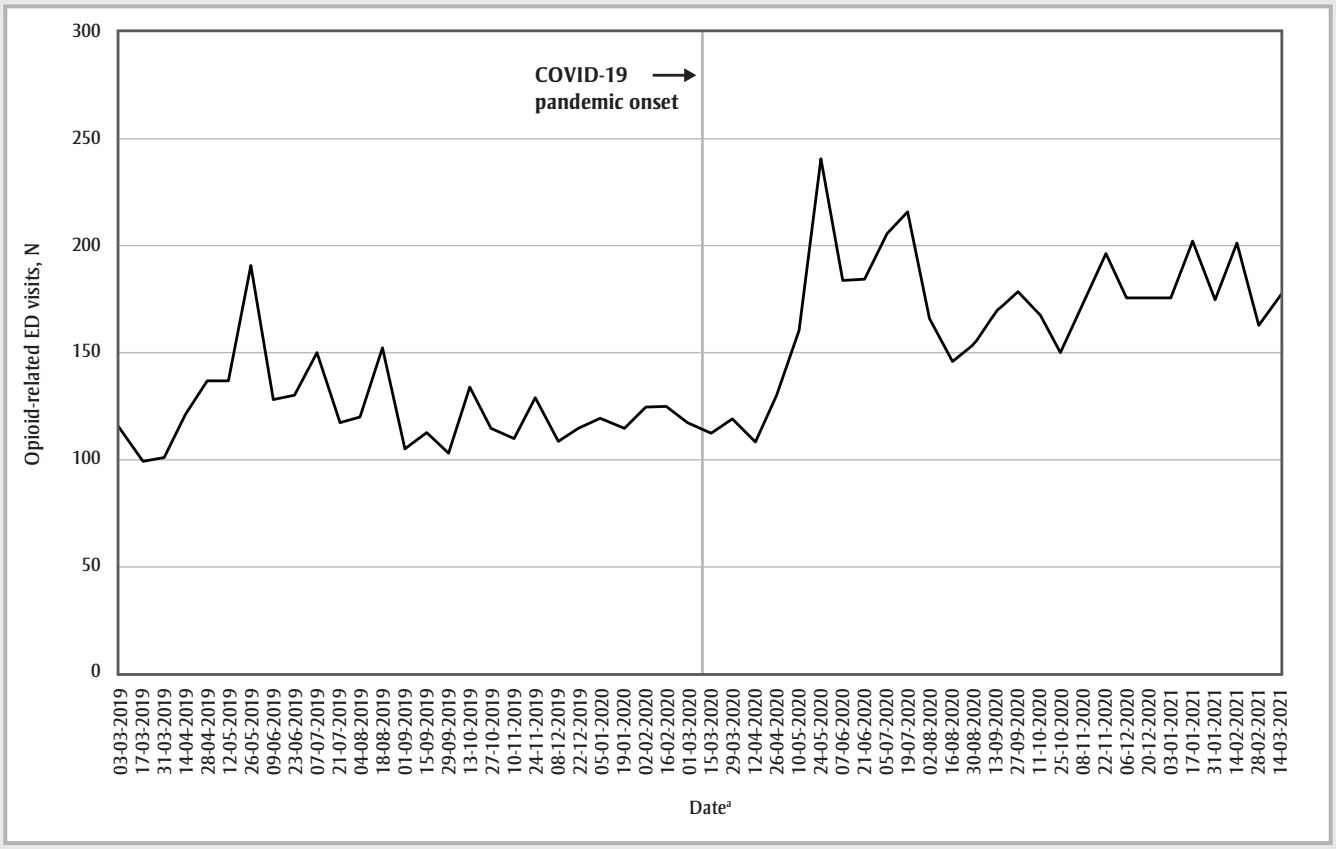
The trends in COVID-19 case counts between March 2020 and March 2021 were not associated with the rates of opioid-related ED visits in the Edmonton health zone (IRR = 1.00; 95% CI: 0.99–1.00; $p = 0.23$) or the Calgary health zone (IRR = 1.00; 95% CI: 1.00–1.00; $p < 0.05$) (Figures 4 and 5). Because of the variability in the number of COVID-19 cases in the Other health zones, we were unable to model this relationship for these rural zones.

## Discussion

The onset of the COVID-19 pandemic was associated with an increase in the rate of opioid-related ED visits across the Edmonton, Calgary and Other health zones, despite overall reductions in ED visits in Alberta for all conditions from 2019 to 2020.[29] The Edmonton health zone had the highest incidence rate of opioid-related visits during the COVID-19 pandemic. The regression model also revealed an increase in the mean absolute counts of ED visits for opioid-related concerns during the COVID-19 pandemic period in Alberta. However, COVID-19 case counts were not associated with rates of opioid-related ED visits in either the Edmonton or Calgary health zones.

Our findings align with those from studies conducted in the United States,[30] and provide much-needed Canadian context into the complex intersection between the COVID-19 pandemic and the drug poisoning crisis. Given the distinct dynamics driving infectious disease transmission and drug poisoning harms, direct comparisons between the public health responses to each crisis are problematic. Nonetheless, governments can mobilize resources and expertise quickly in response to a public health crisis. Efforts to mitigate the impacts of COVID-19—including public health orders (e.g. mask and isolation mandates),[31] a coordinated vaccination strategy[32] and the implementation of surge capacity in intensive care units[33]—were instituted early and maintained for 2 years. The response to the ongoing drug poisoning crisis has differed in scope and pace,

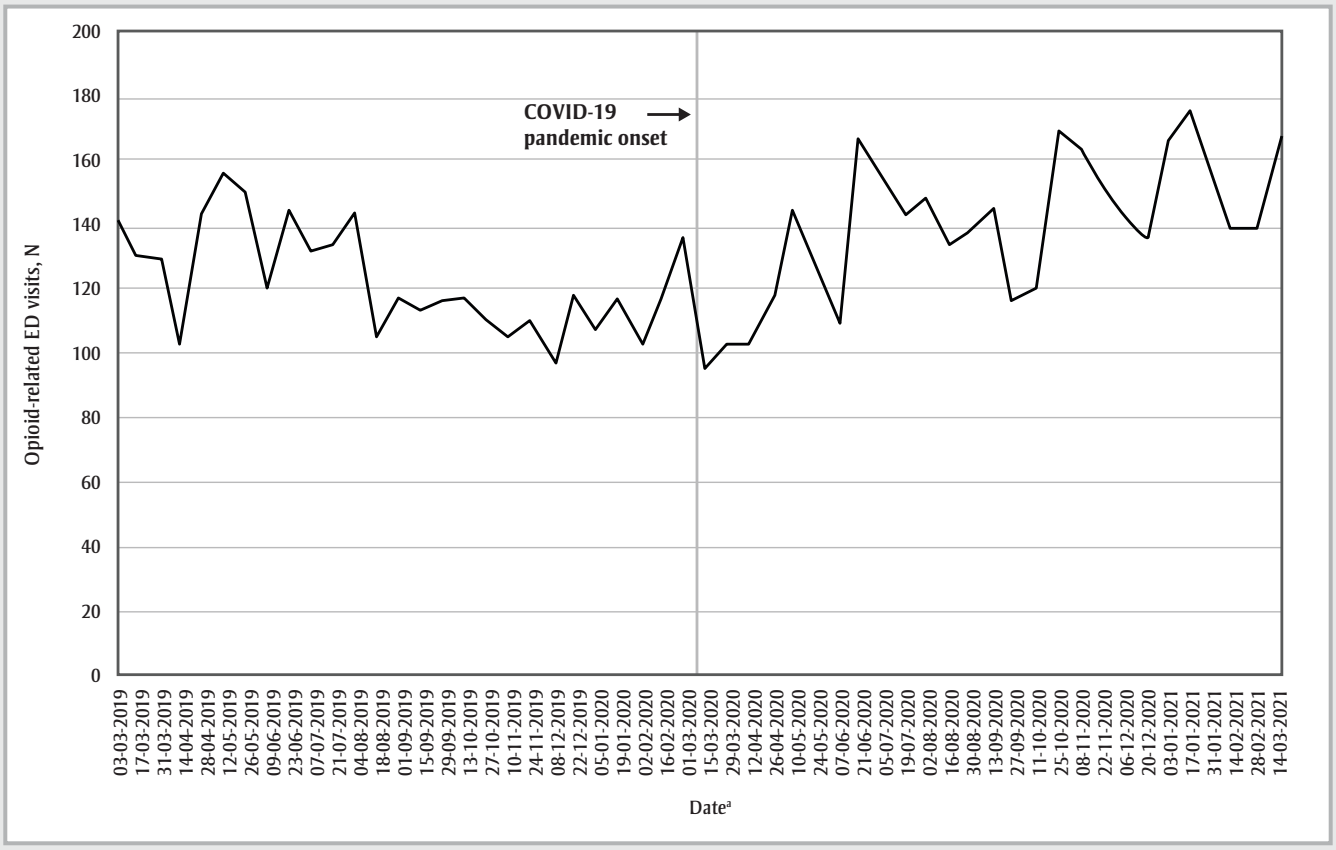
**FIGURE 1**
**Number of opioid-related ED visits in each 2-week period from 3 March 2019 to 1 March 2020 (the "prepandemic period") and from 2 March 2020 to 14 March 2021 (the "pandemic period"), Edmonton health zone, Alberta, Canada**




**Abbreviation:** ED, emergency department.

[a] Start date of each 2-week data-gathering period.

**FIGURE 2**
**Number of opioid-related ED visits in each 2-week period from 3 March 2019 to 1 March 2020 (the "prepandemic period") and from 2 March 2020 to 14 March 2021 (the "pandemic period"), Calgary health zone, Alberta, Canada**




**Abbreviation:** ED, emergency department.

[a] Start date of each 2-week data-gathering period.

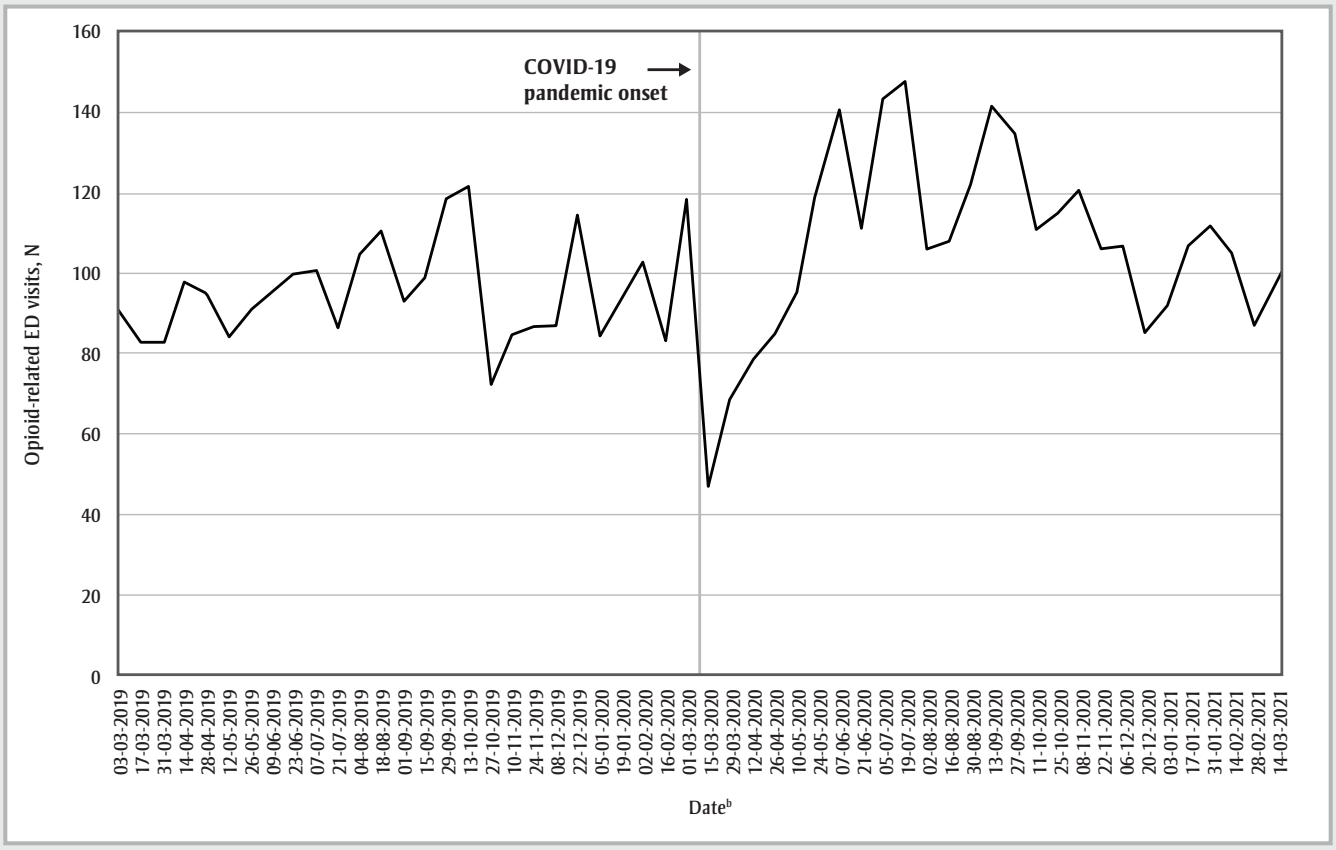
despite the 8282 opioid poisoning deaths that occurred in Alberta between January 2016 and August 2023.[3] Comparable efforts to mitigate the impacts of the drug poisoning crisis could include governments promoting widespread access to evidence-based services and treatment options (e.g. supervised consumption services, OAT) through pharmacies and temporary or mobile clinics, for example.

In addition, the response to these two intertwined public health emergencies has been largely independent of each other, despite the potential for exacerbated harms for PWUD during emergencies and periods of substantial social change such as the COVID-19 pandemic.[6] Indeed, the swift and significant increase in opioid-related harms following the onset of the COVID-19 pandemic serves as an important lesson for future public health emergencies, highlighting the importance of paying particular attention to the needs of PWUD when planning for future public health crises in the context of the ongoing drug poisoning crisis. Ensuring the best health outcomes for PWUD requires that governments swiftly implement cohesive evidence-based responses that consider the interdependence of both public health crises.

Several factors may have played a role in the larger increase in opioid-related ED visits in the Edmonton health zone compared to the Calgary and Other health zones; here, we discuss two possible factors. First, geographic differences in the illegal drug supply may have led to different rates of acute opioid toxicity in each of the health zones: provincial toxicology data show the presence of carfentanil in 20% and 54% of acute drug toxicity deaths related to any opioid in Edmonton in 2020 and 2021, respectively, and in only 1% to 5% of these deaths in Calgary during the same periods.[3] Carfentanil, a synthetic opioid that is particularly potent compared to other opioids (e.g. heroin, fentanyl),[34] has been associated with increased rates of acute drug toxicity and deaths in the United States.[35]

Second, the number of people experiencing homelessness in Edmonton increased from 1971 in 2018[36] to more than 3000 in 2022,[37] while this population remained relatively stable in Calgary (2911 in 2018[38] to 2782 in 2022[39]). Experiencing homelessness has been associated with increased opioid-related ED visits and hospitalizations before[40,41] and during[42] the COVID-19 pandemic. Moreover, opioid poisoning deaths in public spaces in Alberta increased during the pandemic,[3] which may suggest greater risk of severe opioid outcomes requiring immediate ED care among individuals experiencing homelessness. It is possible that the difference in rates of homelessness in Edmonton and Calgary could further contribute to the variance in

**FIGURE 3**
**Number of opioid-related ED visits in each 2-week period from 3 March 2019 to 1 March 2020 (the "prepandemic period") and from 2 March 2020 to 14 March 2021 (the "pandemic period"), Other health zones,[a] Alberta, Canada**




**Abbreviation:** ED, emergency department.

[a] Alberta Health Services North, South and Central health zones were combined into the "Other health zones" variable because of the limited number of data points available in each of these less-populated health zones.

[b] Start date of each 2-week data-gathering period.

rates of opioid-related ED visits found in this study.

Future research should explore whether changes in acute care settings (e.g. new personal protective equipment requirements[43]), clinician and health care worker burnout[44] or other consequences of the COVID-19 pandemic influenced the provision of patient-centred and evidence-based interventions for ED patients with opioid-related concerns.

## *Strengths and limitations*

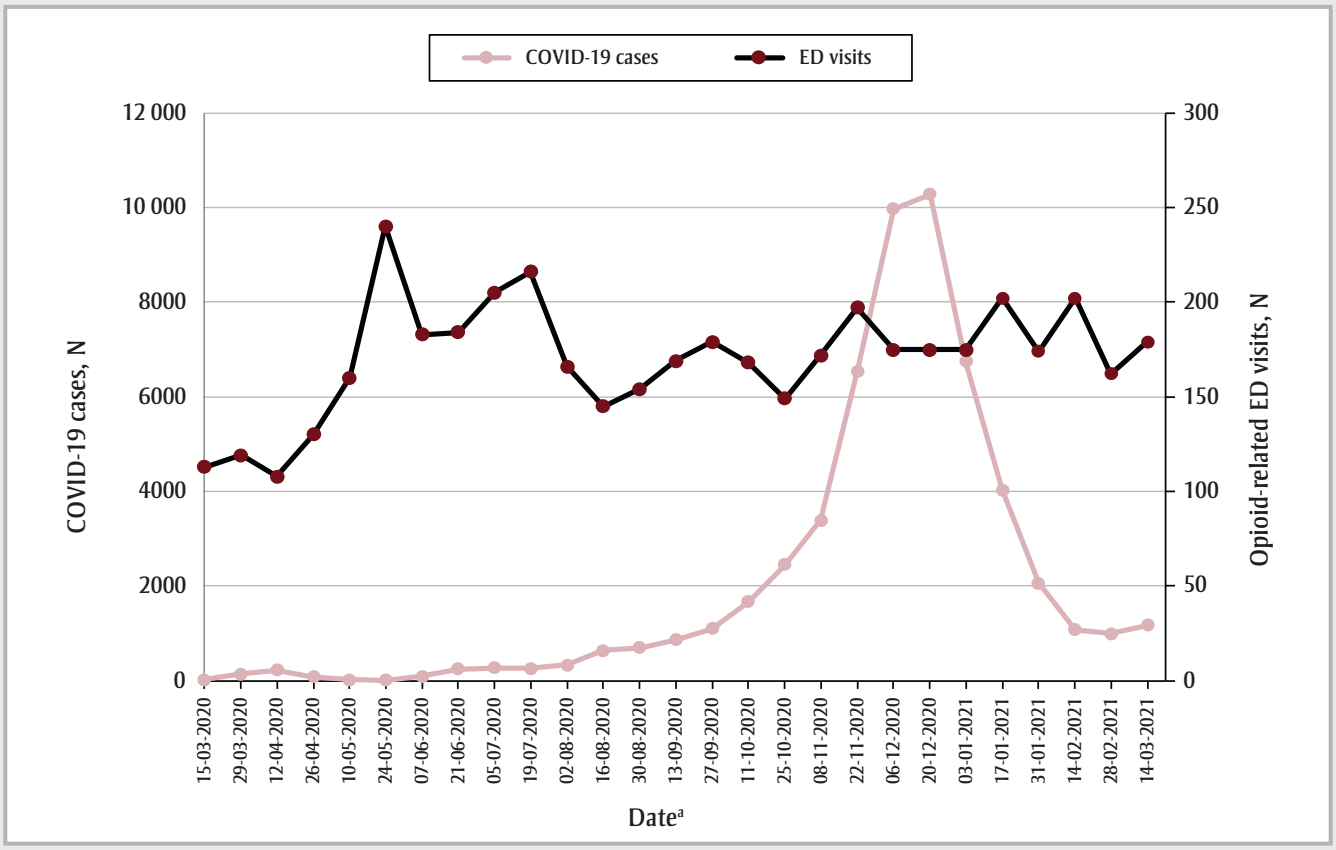
The present findings document an increase in opioid-related ED visits during the pandemic period, but our study has limitations that may affect the interpretation of these findings. First, the limited number of data points in the North, South and Central health zones precluded a more nuanced analysis of the relationship between the COVID-19 pandemic and opioid-related ED visits in geographic areas outside of the two major cities in the province.

Second, this analysis is based on ICD-10 codes as recorded in the administrative data. These codes may be applied inconsistently (e.g. because of misclassification bias, misdiagnosis, unclear or misinterpreted clinical notes, and changes in diagnostic or record-keeping practices within EDs[45]) and may not reflect the true number of ED visits related to opioid use.

Third, we were unable to account for the volatility in the drug supply across the different health zones during our study period due to a dearth of reliable publicly available information on the drug supply.

Finally, Alberta surveillance data from 2016 to 2022 show that emergency medical services responses to opioid-related emergencies were highest among people aged 20 to 39 years, while hospitalizations were highest among people aged 60 years or older (except in 2021, when people aged 30 to 39 years had the highest percentage of hospitalizations).[46] However, because we could only collect the mean age of all the visitors during each 2-week period, as opposed to the individual age of each visitor, we do not discuss age at the time of ED visits and are unable to confirm whether the data included in our study are consistent with these trends. Future research that collects individual-level age data could show important age-specific trends in opioid-related ED visits and the demographics most affected by opioid-related emergencies.

**FIGURE 4**
**Number of COVID-19 cases and opioid-related ED visits in each 2-week period from 15 March 2020 to 14 March 2021, Edmonton health zone, Alberta, Canada**




**Abbreviation:** ED, emergency department.

[a] Start date of each 2-week data-gathering period.

## Conclusion

Canada has had to contend with two concurrent public health crises since 2020. The COVID-19 pandemic and drug toxicity crisis have strained the health care system and resulted in unprecedented numbers of deaths. During the first year of the COVID-19 pandemic, harms for PWUD were exacerbated and opioid-related ED visits increased across all health zones in Alberta. The rate of opioid-related ED visits was more strongly associated with the onset of the pandemic in the Edmonton health zone than in the Calgary or Other health zones. Further research is needed to determine whether the COVID-19 pandemic influenced the quality of ED care received by care-seeking PWUD and how to best support PWUD receiving the best possible care in EDs during future pandemics and other emergencies.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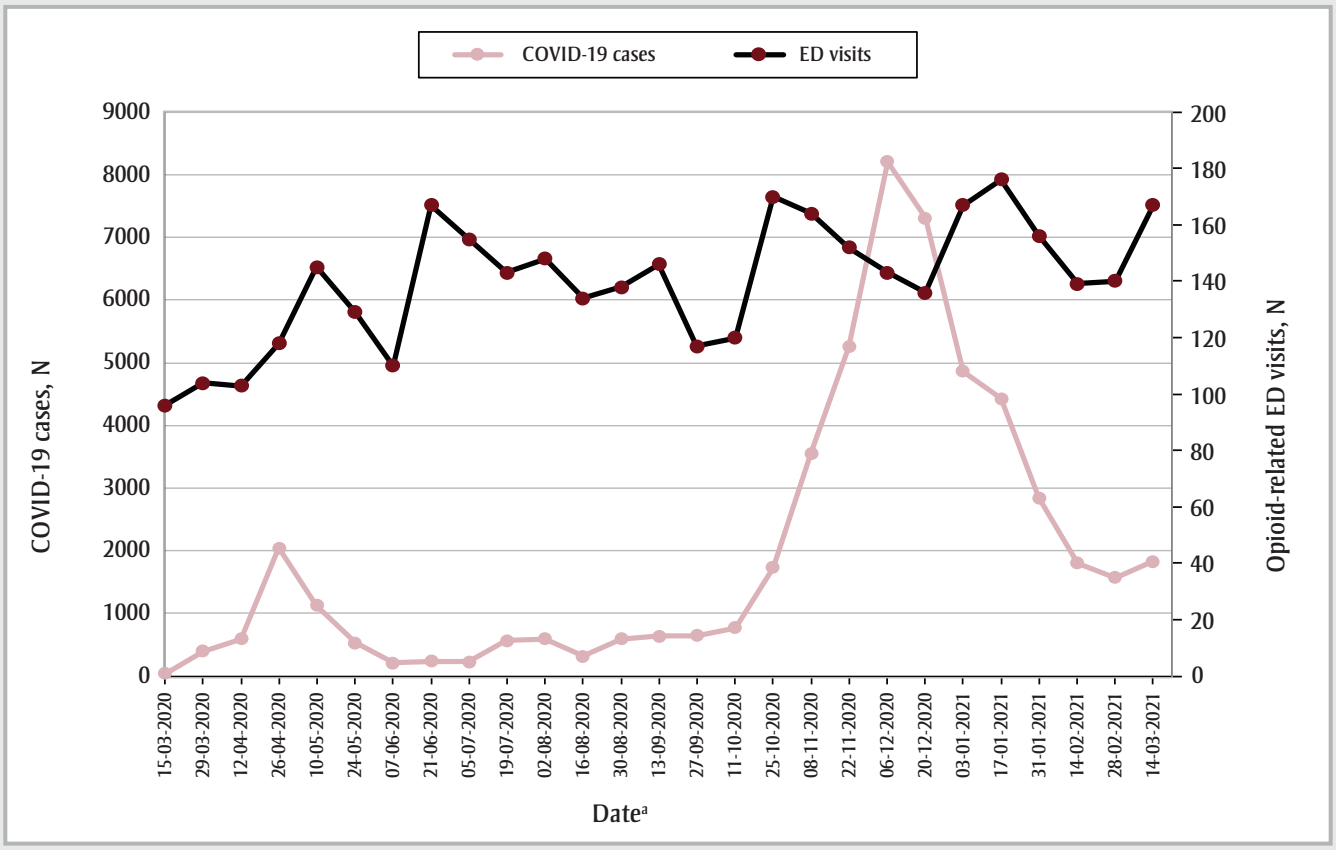
## Conflicts of interest

EH and GS have received grant funding from the Royal Alexandra Hospital Foundation and the CIHR. EH has also received grant funding from the Canadian Public Health Association, Health Canada and Alberta Health Services. She has also received a contributor fee from Alberta Views Magazine, payment of travel-related expenses from AMERSA, the National Safer Supply Community of Practice and the CIHR, and has participated on advisory boards for Health Canada, the Royal Society of Canada, Alberta Health Services and the City of Edmonton.

KDong has received grant funding from the Canadian Research Initiative in Substance Misuse, committee honoraria from the Edmonton Zone Medical Staff Association, payment for conference- and travel-related expenses from the Canadian Association of Emergency Physicians and the Royal College of Physicians and Surgeons of Canada and a medical leadership salary from Alberta Health Services while this work was being conducted.

PML has received grant funding from the CIHR, Alberta Health Services and the

**FIGURE 5**
**Number of COVID-19 cases and opioid-related ED visits in each 2-week period from 15 March 2020 to 14 March 2021, Calgary health zone, Alberta, Canada**




**Abbreviation:** ED, emergency department.

[a] Start date of each 2-week data-gathering period.

Otipemisiwak Métis Government. He has also received lecture honoraria from the Canadian Association of Emergency Physicians.

These authors declare that they have no other competing interests. All other authors declare that they have no competing interests.

## Authors' contributions and statement

KAS: Writing—original draft, writing—review and editing.

HB: Data curation, formal analysis, writing—review and editing.

NDG: Writing—original draft, writing—review and editing.

MA: Data curation, formal analysis, writing—review and editing.

KDong: Conceptualization, funding acquisition, writing—reviewing and editing.

PL: Funding acquisition, writing—review and editing.

ST: Funding acquisition, writing—review and editing.

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PML: Funding acquisition, writing—review and editing.

GS: Conceptualization, funding acquisition, writing—review and editing.

TCW: Funding acquisition, writing—reviewing and editing.

KDm: Funding acquisition, writing—review and editing.

JH: Funding acquisition, data curation, formal analysis, writing—review and editing.

EH: Conceptualization, funding acquisition, supervision, writing—review and editing.

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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An update to this article is included at the end.

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# Evidence synthesis

# Supervised consumption sites and population-level overdose mortality: a systematic review of recent evidence, 2016–2024

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## Abstract

**Introduction:** The overdose crisis is one of the most serious public health challenges in North America. Supervised consumption sites (SCSs) effectively prevent onsite overdose deaths and connect people to health services, but their association with population-level overdose mortality remains unclear.

**Methods:** We searched Embase, Global Health and MEDLINE databases for studies examining associations between SCSs and population-level overdose mortality during the post-2016 overdose crisis (January 2016 to November 2024). Two reviewers, working independently, screened studies, extracted data and assessed study quality using standardized tools (PROSPERO CRD42023406080).

**Results:** Six studies, all from Canada, met the inclusion criteria. In the four quasi-experimental studies, two large-scale analyses of local health areas or public health units found no significant associations between SCS measures and overdose mortality within provinces. Some analyses of smaller urban areas showed protective associations, although this finding was not consistent across studies. Two observational studies suggested associations between SCS and lower mortality rates, though with methodological limitations.

**Conclusion:** Province-wide analyses generally did not detect significant associations between areas with and without SCSs and population-level overdose mortality. Analyses suggest that SCSs in some smaller urban contexts were associated with less overdose mortality, though findings were inconsistent. Further research is needed to understand how geographic scale, implementation context and limited service coverage may influence the detection and magnitude of potential effects of SCSs on overdose mortality.

***Keywords:*** *supervised consumption site, harm reduction, overdose mortality, overdose epidemic, opioids, people who use drugs, PWUD*

### *Highlights*

- In this systematic review we examined evidence from six studies and found mixed associations between supervised consumption sites and population-level overdose mortality.
- Large-scale provincial-level analyses generally found no significant associations between supervised consumption sites and overdose deaths.
- Some studies of smaller geographic areas reported that supervised consumption sites were associated with fewer overdose deaths in certain urban areas, though this finding was not consistent.
- Study design, geographic scale and local implementation context may influence the observed outcomes.

## Introduction

The overdose crisis is one of the most serious public health crises globally and in North America's recent history. Its escalation in 2016 prompted public health emergency declarations in British Columbia, Virginia, and other regions in North America.[1,2] Between January 2016 and March 2024, Canada recorded 47162 apparent opioid toxicity deaths, with an annual rate of 21.5 per 100 000 population in 2023.[3] In the United States, 107 941 opioid overdose deaths were reported in 2022 alone, with an annual rate of 32.4 per 100 000 population.[4] The COVID-19 pandemic appears to have exacerbated the crisis, as daily apparent opioid toxicity deaths in Canada doubled from 10 in 2019 to 20 in 2022.[3]

Supervised consumption sites (SCSs) represent one of the key public health responses to this crisis.[5,6] SCSs provide safe, accessible and clean spaces for drug consumption. These facilities are staffed with trained personnel who provide harm reduction services and resources, such as safe injecting practices and drug-checking services, and who can intervene during overdose events.[7] They also connect individuals to health and social services such as substance use treatment and housing supports.[7] Sites can differ in the

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consumption modes they supervise (e.g. injection, inhalation, intranasal, oral) and some specialize in particular forms, such as supervised injection facilities. As of 2022, 16 countries had operational SCSs.[5]

Research examining individual-level outcomes indicate multiple benefits among people who use SCS services. Between 2017 and 2024, federally exempted SCSs in Canada responded to more than 60 000 overdose events, with no reported onsite fatalities.[8] Research has also documented social benefits, including improved access to housing and legal and health care services and enhanced community belonging and safety among people who use drugs (PWUD).[8-13] Studies have also observed lower rates of emergency service utilization, fewer nonfatal overdose events, lower all-cause mortality and decreased injection-related complications such as infections and abscesses.[12-16]

Despite the documented individual-level benefits of SCSs, the relationship with population-level overdose mortality is less clear. Evaluations from the 2000s show mixed results. After opening in 2003, Vancouver's Insite, North America's first sanctioned SCS, was associated with significant reductions in local overdose mortality.[17] Analysis of Sydney's Medically Supervised Injecting Centre, Australia's first such site, found no change in local overdose mortality after its opening in 2001.[18] Note that both these studies were conducted in a markedly different public health context, before the dramatic rise in overdose deaths that began in 2016.

Subsequent literature reviews have not specifically focused on population-level overdose mortality, and most syntheses drew primarily on the two early studies from Vancouver and Sydney.[12-14,19-22] The most recent systematic review, covering literature up to 2019, examined injection drug use exclusively.[13] Since then, the overdose crisis has evolved considerably, shaped by the COVID-19 pandemic, increased amounts of fentanyl and its analogues in the drug supply, and other factors.[23]

Given these evolving conditions and new research examining potential SCS associations with mortality outcomes, an updated systematic review was needed. This study aims to synthesize empirical evidence from 2016 to 2024 to help inform public health responses to the ongoing overdose crisis in the current context.

## Methods

### *Systematic review registration*

Our review adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines[24] and was registered in PROSPERO (CRD42023406080).

### *Information sources and search strategy*

We developed a comprehensive search strategy to identify articles in Embase, Global Health and MEDLINE databases published between January 2016 and November 2024. The search terms focused on two main concepts: overdose mortality and SCSs. We restricted our search to English and French publications from 2016 onward to capture literature published during the surge in opioid-related overdose deaths in North America and the changing characteristics of the drug supply.[25,26] Searches were conducted on 20 November 2024. The full search strategies were developed with a librarian. These search strategies are detailed in the supplementary materials (Additional File 1; available from the authors upon request).

### *Eligibility criteria*

We included empirical quantitative studies (i.e. observational, quasi-experimental or experimental study designs), published between 1 January 2016 and 11 November 2024, that reported on the association of SCSs with overdose mortality at the population level. Specifically, we included studies that investigated the presence or availability of SCSs, defined as designated spaces that provide onsite monitoring of substance use and rapid response to an overdose event. We included temporary sites, such as overdose prevention sites and urgent public health need sites, which have the same harm reduction function as SCSs but are established on a temporary basis in response to urgent needs in a particular region or community. We also included sites that are limited to a single mode of consumption. We excluded descriptive studies, mathematical modelling studies and those reporting on SCS implementation alone.

We included studies that examined either opioid-related deaths or unspecified overdose deaths, as data from 2023 indicate that most overdose deaths involving other substances also involved opioids.[27] For example, 81% of accidental apparent stimulant toxicity deaths in Canada also involved opioids.[27] Because SCSs do not necessarily document the substances used, focusing solely on opioids would have also limited the evidence from SCSs. In Canada, 69% of drugs consumed at SCSs between March 2020 and August 2024 were opioids.[8]

Finally, studies that focused on specific subpopulations (e.g. people experiencing homelessness) were excluded, as our aim was to explore the potential impact of SCSs on the broader population of PWUD. Qualitative research, reviews, editorials, opinion pieces, protocols, case reports, case studies, commentaries and books were also excluded.

### *Study selection and data extraction*

After importing references into Covidence (Veritas Health Innovation, Melbourne, AU) and removing duplicates, two reviewers (GG, RKP or RP) independently screened articles against eligibility criteria, first by examining the titles and abstracts and then conducting full-text searches. Discrepancies were resolved through discussion. The same pair of reviewers independently extracted data from included studies, that is, study design, setting, study period, mortality outcome measure, SCS measure, geographical unit of analysis and measures of association (e.g. deaths averted, correlation, regression coefficient). Data extraction discrepancies were resolved through discussion.

### *Quality assessment*

We assessed study quality using the JBI critical appraisal tools (JBI, Adelaide, AU)[28] according to study designs. JBI tools assess risk of bias for observational, quasi-experimental and experimental studies.[28] Two reviewers (GG, RKP or RP) worked independently to assess the risk of bias, with discrepancies resolved through discussion. Quality assessment forms are provided in Additional File 2 (available from the authors upon request).

### *Synthesis methods*

We sorted descriptive and study results into summary tables and summarized findings in a narrative synthesis by study design. We further considered studies

with data collected during the COVID-19 pandemic to explore its potential effects on overdose mortality outcomes. Because study design, exposure and outcome measures varied significantly, we did not conduct meta-analyses or meta-regressions.

## Results

### *Study selection and characteristics*

We included six empirical studies from 478 identified unique references. Of the 44 studies retrieved for full-text review, 38 were excluded: 15 did not include the outcome of interest; 19 had the wrong study designs; three did not include the intervention of interest; and one had been retracted (Figure 1).

### *Overall characteristics*

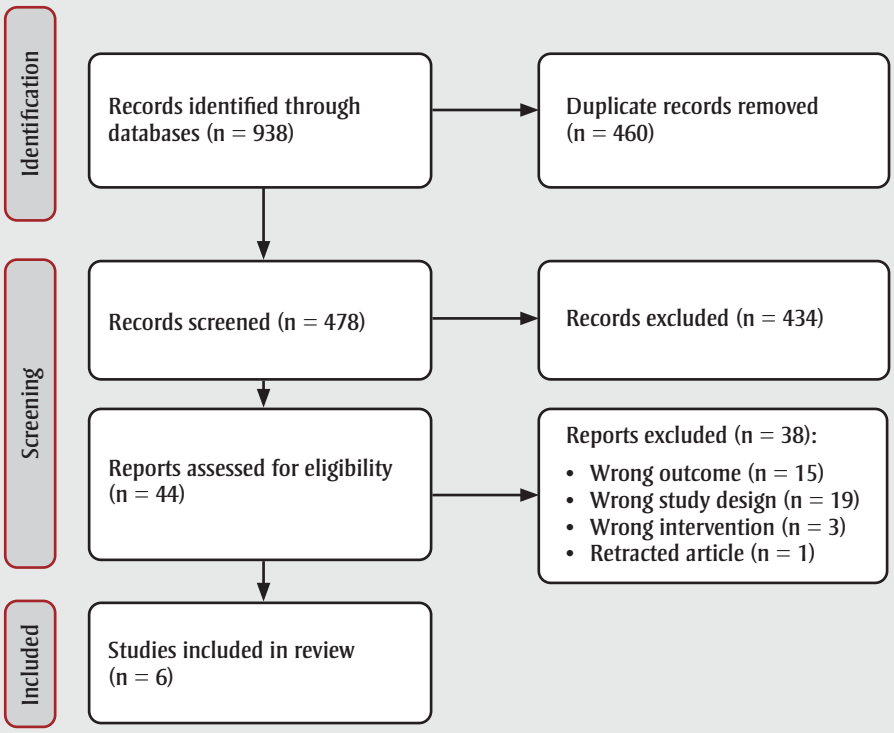
Of the six included studies, four were quasi-experimental[29-32] and two were observational.[33,34] All the studies were conducted in Canada. Four focused specifically on opioid overdose deaths,[29-32] one on fentanyl-related overdose deaths[33] and one on overdose deaths from any substance.[34] SCSs were operationalized as the implementation of SCSs in four studies,[29,31,32,34] total visits across SCS locations in one study[33] and booth-hours per 100 000 population in another study.[30] Three studies included data collected during the COVID-19 pandemic (post March 2020).[30,32,33]

### *Evidence from quasi-experimental studies*

The four quasi-experimental studies used interrupted-time series analysis.[29-32] Two used controlled designs with matched comparisons[29] or synthetic controls[30] to distinguish SCS effects from broader changes in overdose mortality, and two examined changes post SCS implementation with no control groups.[31,32] With opioid-related deaths rising across Canada during study periods, uncontrolled analyses would likely underestimate any protective associations with SCSs, as they did not account for increasing mortality trends. The studies revealed varying patterns across jurisdictions, with controlled analyses at provincial levels generally finding no significant associations, while region-specific analyses showed lower overdose mortality rates in certain urban areas (Table 1).

Two studies conducted in Ontario used different approaches to analyze data from public health units (PHUs) between 2014 and 2021.[30,32] An analysis that used synthetic controls found no significant association between SCS booth-hours and opioid-related mortality ($\beta = 0.000$; 95% confidence interval [CI]: 0.000 to 0.000), though protective effects were observed locally in the PHUs in London ($\beta = -0.004$; 95% CI: −0.006 to −0.002) and Thunder Bay ($\beta = -0.004$; 95% CI: −0.007 to −0.0002).[30] A separate study that used an uncontrolled approach found that the PHUs that implemented at least one SCS maintained stable opioid-related mortality rates (+0.02 deaths/100000/month; $p = 0.27$), while PHUs without SCSs showed increasing rates (+0.38 deaths/100000/month; $p < 0.001$), although this difference in trajectories was not directly tested statistically.[32]

**FIGURE 1**
**PRISMA 2020[24] flow chart of the review process**




**Abbreviation:** PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

**TABLE 1**
**Characteristics of studies included in the systematic review (n = 6)**

| Authors, year | Setting | Time period | Mortality outcome | SCS measure | Control group | Geographical unit of analysis | Quantitative measure of association with mortality |
|---|---|---|---|---|---|---|---|
| **Quasi-experimental studies** | | | | | | | |
| Panagiotoglou, 2022[29] | BC, Canada | 3 years; 2015–2017 | Opioid-related deaths | Local health areas with at least 1 SCS/OPS | Local health areas without an SCS | Local health area | Change in trends of deaths/100 000/month: −0.08; 95% CI: −0.23 to 0.09; $p = 0.36$ |
| Panagiotoglou and Lim, 2022[30] | ON, Canada | 7 years; 2014–2021 | Opioid-related deaths | SCS/OPS booth-hours per 100 000 population | Synthetic controls that did not have an SCS | PHU | β = 0.000; 95% CI: 0.000 to 0.000; $p = 0.25$ |
| Yeung et al., 2023[31] | Calgary, Edmonton, Red Deer, Lethbridge, AB, Canada | 5.5 years; 2013–2019 | Opioid-related deaths | Implementation of SCSs/OPSs | None | SCS-service defined local area | Calgary: −1.7 deaths/month; 95% CI: −4.5 to 0.9; $p = 0.09$<br>Edmonton: −5.9 deaths/month; 95% CI: −8.9 to −2.9; $p < 0.001$<br>Lethbridge: 0.0 deaths/month; 95% CI: −0.4 to 0.7; $p = 0.60$<br>Red Deer: −0.1 deaths/month; 95% CI: −0.5 to 0.3; $p = 0.09$ |
| Robinson et al., 2024[32] | ON, Canada | 8 years; 2014–2021 | Opioid-related deaths | Implementation of SCSs | None | PHU | PHUs with SCSs: +0.02 deaths/100 000/month; $p = 0.27$<br>PHUs without SCSs: +0.38 deaths/100 000/month; $p < 0.001$ |
| **Observational studies** | | | | | | | |
| Marshall et al., 2021[33] | AB, Canada | 4 years; 2017–2020 | Fentanyl-related deaths | Total number of visits at all 7 provincial SCS/OPS locations | None | Province | $r = −0.64$; $p = 0.03$ |
| Rammohan et al., 2024[34] | Toronto, ON, Canada | 2 years; 2017 (1 May–31 July) vs. 2019 (1 May–31 July) | Overdose deaths | Implementation of SCSs/OPSs | None | Neighbourhoods within and beyond 500 m of an SCS | Neighbourhoods within 500 m of an SCS: 67% fewer deaths/100 000; $p = 0.04$<br>Neighbourhoods beyond 500 m of an SCS: 24% fewer deaths/100 000; $p = 0.38$ |

**Abbreviations:** AB, Alberta; BC, British Columbia; CI, confidence interval; ON, Ontario; OPS, overdose prevention site; PHU, public health unit; SCS, supervised consumption site.

An uncontrolled analysis in Alberta examined changes in opioid-related deaths between 2013 and 2019 across four municipalities after the implementation of SCSs.[31] Edmonton saw the largest change with six fewer deaths per month (−5.9; 95% CI: −8.9 to −2.9), followed by Calgary with two fewer deaths per month (−1.7; 95% CI: −4.5 to 0.9), though the confidence interval indicated uncertainty.[31] Results from Red Deer (−0.1 deaths/month; 95% CI: −0.5 to 0.3) and Lethbridge (0.0 deaths/month; 95% CI: −0.4 to 0.7) showed no changes.[31] These declining or stable rates in regions with an SCS occurred during a period when opioid-related deaths across Alberta were increasing.[31]

In British Columbia, a controlled analysis of local health areas that opened SCSs between 2015 and 2017 found no differences in monthly opioid-related mortality rates compared to propensity score-matched controls at the provincial aggregate level (β = −0.08; 95% CI: −0.23 to 0.09).[29] The study excluded the Downtown Eastside of Vancouver, where Insite is located and where overdose deaths were highest, because an appropriate matched control could not be identified.[29]

Quality assessment indicated low risk of bias for the two studies with control groups[29,30] and higher risk of bias for the two studies without.[31,32] (Additional File 2; available from the authors upon request.)

### *Evidence from observational studies*

The two observational studies used ecological study designs to examine associations between SCSs and overdose mortality, one at the province level[33] and the other at the neighbourhood level[34] (Table 1). In Alberta, a province-wide analysis found that higher SCS visits across the seven provincial SCSs correlated with fewer fentanyl-related overdose deaths between 2017 and 2020 ($r = -0.64$; $p = 0.03$).[33] A study in Toronto, Ontario, compared overdose mortality rates in 2017 and 2019, that is, before and after SCSs were implemented, at different distances from the sites.[34] Neighbourhoods within 500 m of an SCS had 67% fewer overdose deaths per 100 000 people ($p = 0.04$) after the SCSs had been implemented. Areas beyond 500 m of an SCS had 24% fewer deaths, but this difference was not statistically significant ($p = 0.38$).[34] Quality assessment found that both ecological studies had high risk of bias, primarily because of a lack of control for confounding factors (Additional File 3; available from the authors upon request).

### *Evidence from the COVID-19 pandemic*

Three studies included data from before the pandemic, but provided limited insight into pandemic-specific effects.[30,32,33] A quasi-experimental analysis of Ontario SCS booth-hours conducted sensitivity analyses excluding pandemic data and found similar nonsignificant impacts on opioid-related mortality.[30] An ecological study conducted in Alberta reported a 64% decrease in the number of SCS visits and a 118% increase in fentanyl-related overdose deaths during the early months of the pandemic, but did not statistically analyze these patterns.[33] The other quasi-experimental study from Ontario acknowledged that pandemic-related service changes occurred, but did not assess their impact.[32] Overall, the influence of the pandemic on SCS operations and population-level overdose mortality remains largely unexplored.

## Discussion

This systematic review synthesized evidence from six empirical studies examining associations between SCSs and population-level overdose mortality between 2016 and 2024. All studies were from Canada. Of the four quasi-experimental studies, two province-wide analyses of SCSs in local health areas or PHUs found no significant associations. Region-specific analyses yielded mixed results, with lower mortality rates associated with SCSs in some local areas, but not others. Two additional observational studies reported protective associations but had methodological limitations. These studies reveal important nuances in understanding the associations between SCSs and overdose mortality across different contexts, with methodological factors influencing their interpretation.

Geographical scale emerged as a key methodological consideration. The studies that examined smaller geographic units (e.g. neighbourhoods[31,34]) were more likely to detect mortality-related associations than the analyses of larger administrative regions. This pattern may reflect both the localized nature of SCS services and implementation factors. Two Ontario studies,[30,32] for example, examined SCSs within PHUs from 630 km² to 266 291 km² in size.[35] Examining such a large area could potentially mask localized SCS effects. This aligns with the reports from Toronto[34] and Vancouver[17] that SCSs were associated with lower overdose mortality rates within 500 m of the sites but not beyond.

Study design and appropriate controls played a crucial role for interpreting findings. Controlled quasi-experimental analyses provided the strongest evidence by accounting for broader temporal trends in overdose mortality. In this review, the two controlled analyses did not find significant associations at the provincial level between SCSs in local health areas or PHUs and overdose mortality. The interpretation of uncontrolled analyses requires careful consideration of context. During a period when overdose deaths were rising across Canada, stable and even increasing rates in areas with SCSs might suggest potential benefits, as rates could have potentially risen even more rapidly without these services. However, controlled analyses comparing appropriate counterfactuals are needed to test this hypothesis.

Implementation contexts might have also influenced outcomes. The examined sites included established urban SCS programs with strong community support and newer sites in areas with different patterns of substance use and levels of auxiliary services. Facility location and accessibility seem to be key factors. For instance, Edmonton's centrally located SCS, which is near public transit, had significant reductions in numbers of deaths, while the less central site in Calgary had weaker associations with less precise estimates.[31] These location-based differences align with qualitative findings from feasibility studies where stakeholders consistently recommend locating SCSs in areas with high levels of drug use, easy access to public transportation and proximity to health facilities.[36]

The potential population-level impacts on mortality may also be limited by the small proportion of total drug consumption that occurs within SCSs. Recent data from Ontario suggest that SCS interventions cover less than 1% of at-risk consumption episodes in the province.[32] In Vancouver's Downtown Eastside, where SCS integration is the most extensive in Canada, only 5% of community drug injections occurred under SCS supervision in the early 2000s.[37] This limited reach is significant given that most overdose fatalities occur in residential settings during solitary use, where SCS services cannot intervene.[38,39]

Operational constraints may further restrict potential population-level impacts. These include limited hours of operation, facility capacity restrictions and a lack of specialized services such as supervised inhalation.[38,40,41] The scarcity of supervised inhalation services presents a particular challenge, as smoking has become the predominant consumption mode in Canada and, increasingly, the primary method involved in overdose deaths.[42,43] Access barriers such as geographic distance, transportation challenges and stigma may further reduce utilization among PWUD.[11,44-48]

These findings must be considered within the larger and evolving public health context. The increasing prevalence of fentanyl and its analogues in opioid toxicity deaths,[27] alongside the growing use of benzodiazepines[49] and xylazine,[50] has changed both the risk environment for PWUD and the operational demands on SCS facilities. Available interventions have concurrently expanded to include emerging approaches such as overdose response hotlines and applications, potentially offering broader reach and accessibility to complement facility-based services.[51,52] The COVID-19 pandemic added further complexity through its impact on SCS operations.[53] The potential association of the pandemic with population-level overdose

mortality remains largely unexplored in the current evidence base.

### *Limitations of the included studies*

The reviewed studies had some limitations. Most were unable to fully account for concurrent public health interventions, such as naloxone distribution programs, changes in drug supply or changes in service access.[29,33,54-56] The lack of control groups and group comparisons in some analyses limited the ability to separate SCS-associated changes from underlying overdose mortality trends. While total study periods ranged from 2 to 8 years, the post-SCS implementation periods were much shorter, limiting both the statistical power and ability to evaluate operational programs beyond their initial implementation phases. Studies conducted during the COVID-19 pandemic were challenged by service disruptions.

### *Limitations of this review*

Despite SCSs operating in at least 16 countries,[5] all included studies were from Canada, limiting generalizability. The Canadian context has specific features that may not apply to other jurisdictions, including the federal exemption process for SCSs, universal health care coverage and harm reduction policies.[38,53,57] In addition, Canada's overdose death rates are among the highest globally, comparable only to the United States, reflecting a particularly severe crisis that may not mirror conditions elsewhere.[4,5,27]

Most of the studied SCSs were in urban settings with high concentrations of overdose deaths, and their associations with mortality outcomes may differ in lower-density areas or regions with fewer overdose deaths.[51,58]

This review included only peer-reviewed literature, potentially missing SCS program evaluations and government reports from the grey literature. By focusing on population-level overdose mortality, the review does not address other important benefits of SCSs that can inform policy decisions.

### *Future directions*

Several key research priorities should be considered. First, methodological improvements are needed to address current evidence gaps. Future studies should prioritize quasi-experimental designs with appropriate controls to better distinguish SCS-associated changes in population-level mortality from concurrent interventions, changes in drug markets and changes in mortality trends. Research at smaller geographic units of analysis, while accounting for potential spillover effects between regions, could provide clearer insights for local outcomes.

Research on optimizing service delivery represents another critical direction. Studies should examine how different SCS models relate to mortality outcomes across urban, suburban and rural contexts. Research examining specific operational characteristics could further inform service approaches, including permitted consumption modes, responses to polysubstance use, integration with other services (e.g. shelters) and emerging strategies such as mobile and virtual services that could potentially extend service reach.[38,52,59] Understanding access barriers remains important, as safety concerns, stigma, the presence of police, inconvenient access and other factors can deter service utilization and impact population-level outcomes.[11,44-48]

Broader evaluative research could help to guide evidence-based policy decisions. Comprehensive cost-effectiveness analyses that consider both direct and indirect benefits can help capture the full scope of outcomes associated with SCSs.[54-56,60] Simulation models incorporating diverse real-world conditions and policy parameters can help explore how site placement, service capacity or complementary interventions might impact population-level mortality.[54-56,60-62] Research beyond Canada is also essential for understanding how different health care systems and policy contexts relate to overdose mortality outcomes.

## Conclusions

This systematic review revealed mixed evidence for associations between SCSs and population-level overdose deaths. At the provincial level, rigorous quasi-experimental studies found no differences in overdose mortality between local health areas or PHUs with and without SCSs. However, when analyzing specific urban areas and smaller geographic scales, some studies—including those using high-quality methods—found lower mortality rates in regions or neighbourhoods after SCSs were implemented. Although SCSs have well-documented individual-level benefits, their impact on overall population-level mortality is context dependent and less clear.

SCSs represent one component within comprehensive public health approaches to substance-related harm reduction.[57] Their effectiveness may be enhanced by integrating them with other evidence-based interventions, such as the availability of take-home naloxone kits, opioid agonist therapies and drug-checking services.[63] This review highlights the need for continued, rigorous research to understand the potential role of SCSs in addressing the overdose crisis.

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## Conflicts of interest

None.

## Authors' contributions and statement

GG: Conceptualization, data curation, formal analysis, investigation, methodology, project administration, supervision, writing—original draft, writing—review and editing.

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# Evidence synthesis

# Food-based interventions to mitigate household food insecurity in Canada: a systematic review

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## Abstract

**Introduction:** Household food insecurity (HFI) is a persistent and important public health and policy concern within Canada that continues to be widespread in the face of economic uncertainties and inflation. The objective of this systematic review was to synthesize the evidence on food-based interventions that could reduce HFI in Canada.

**Methods:** Studies that assessed a food-based intervention that might reduce food insecurity and measured HFI were included, regardless of whether that was the primary purpose of the study. Four databases were searched up to 19 February 2025. Screening of abstracts and full texts, data extraction, assessments of risks of bias and certainty of the evidence were conducted independently by two reviewers. PROSPERO CRD42021254450.

**Results:** Exposure to food voucher programs may reduce HFI, but exposure to food box, community gardening, school food, hunting and fishing, and food charity programs may have little to no effect on HFI. The rate of utilization of food banks by food-insecure households may be low and depends upon food insecurity level and population group.

**Conclusion:** Food charities may be a last resort for those in need of short-term access to emergency food (i.e. populations experiencing homelessness). However, given the pervasive nature of HFI as a marker of deprivation, it is unlikely that food-based responses will have a major impact on overall HFI, which is primarily an economic problem. A more comprehensive public policy approach to mitigate HFI is likely required.

***Keywords:*** *household food insecurity, food bank, food charity, food-based intervention, systematic review*

### *Highlights*

- Participating in food box, community gardening, school food, hunting and fishing and food charity programs may have little to no effect on household food insecurity (HFI) (low certainty).
- Participating in food voucher programs may reduce HFI (low to moderate certainty).
- Food-insecure households' utilization of food banks is likely low and depends on the severity of food insecurity and the population group (low to moderate certainty).
- The rate and frequency of food bank utilization is likely high among people experiencing homelessness and particularly youth (moderate to high certainty), but these interventions are unlikely to reduce HFI in the long term.
- A comprehensive public policy approach that addresses economic deprivation is likely more effective at reducing HFI (moderate certainty) than food-based interventions.

## Introduction

In 2022, 2.7 million Canadian households experienced food insecurity in the past 12 months, including 1.8 million children aged less than 18 years.[1] This is the highest number recorded in the 17 years since Canada started monitoring household food insecurity (HFI).[1] These statistics refer specifically to households' inability to acquire or consume an adequate quantity of food or the uncertainty that they will be able to do so because of financial constraints.[1]

HFI is strongly associated with multiple adverse health outcomes for children and adults in Canada, including heightened

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nutritional vulnerability;[2-7] increased risk of type 2 diabetes;[8] poorer mental health;[9-15] higher rates of infectious[16] and noncommunicable[10] diseases, injuries[17] and chronic pain;[18] poorer disease management;[16,19-22] higher rates of health care utilization;[23-28] and premature mortality.[29,30] These relationships are graded, with more severe food insecurity associated with both a higher number of and worse health outcomes[23-25,27] even after controlling for income and other sociodemographic characteristics.

It is worth noting that HFI, as it is defined in this manuscript and by public policy in Canada, is not the absence of food security. According to the Food and Agriculture Organization, "food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life."[31,p.1] Chronic HFI is a narrower concept and a strong, validated indicator for social policy and population health.[1] This construct is distinct from broader definitions related to community food security that include constructs of physical, social and economic access to sufficient, safe and nutritious food that meet peoples' dietary needs and preferences.[32]

Both public policy and food-based interventions have been proposed to reduce HFI. Public policy interventions address the upstream economic determinants of HFI and include indirect supports such as cash transfers, housing assistance and market subsidies. Food-based interventions address shortages of food at the household level. Food-based interventions include food charities that distribute food directly to people, for example, via food banks and soup kitchens, community food programs such as cooking classes, debt counselling for better food budget management, community kitchens and community gardening programs. These programs intend to improve access to food (e.g. by providing free or reduced-cost food), thus reducing the need to expend household resources on food purchases, or they aim to increase program participants' abilities to manage scarce resources (e.g. by increasing cooking and shopping skills or addressing debt).

There has been little research on the effectiveness of these interventions in reducing HFI in Canada.[33] A synthesis of the available evidence is particularly important given the surge in federal and provincial government funding of these programs throughout the COVID-19 pandemic[34] and a parallel increase in the cost of living since 2022.[35] This policy response is not new, with some food-based interventions such as food banks dating back to the 1980s.[36]

The objective of this systematic review is to synthesize the evidence on the effectiveness of food-based strategies to reduce HFI in Canada.

## Methods

### Systematic review registration

This systematic review was guided by the *Cochrane Handbook for Systematic Reviews of Interventions*[37] and followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Guideline.[38] The initial overarching research question was, "What interventions are effective in reducing HFI in Canada?"

The systematic review protocol was created a priori and registered in PROSPERO (CRD42021254450).

During the systematic review process and after discussions with HFI experts [VT, LM], it became clear that it would be best to group the interventions into two categories based on the level at which they work, that is, public policy interventions versus food-based interventions. Given that these are distinct intervention categories, this separation facilitated analysis and reporting. Public policy interventions address the underlying determinants of food insecurity and target the economic vulnerability of households. Food-based interventions address food shortages at the household level. The analyses and reporting were conducted separately for the two types of interventions. The systematic review on public policy interventions has been published elsewhere.[39]

This current systematic review summarizes the evidence on food-based interventions to reduce HFI and answers two key questions. The first of these key questions, KQ1, asked, "What is the impact of exposure to a food-based intervention on HFI in Canada?"

Given the low number of studies reporting on the effectiveness of food charity interventions and evidence that food bank utilization rates are low, we included studies of the utilization of food charity interventions by food-insecure households. The second key question, KQ2, reflects the inclusion of these studies: "What is the rate and frequency of utilization of food charity interventions in Canada among food-insecure households?"

### Eligibility criteria

The population, interventions, comparators and outcomes (PICO) model was used to facilitate search strategy development.

- Population: Households (KQ1) or food-insecure households (KQ2) in Canada.
- Intervention or utilization: Studies that sampled households that were exposed to (KQ1) or that utilized (KQ2) an intervention with the aim of reducing HFI, regardless of whether that was the primary aim of the study.
- Control: Studies with a comparator group (contemporaneous, historical or where participants act as their own control) (KQ1) or no comparator group (KQ2).
- Outcome: Any outcome that aimed to assess HFI or a construct aligned with hunger (KQ1) or the use of food charity interventions (KQ2).

Other eligibility criteria include the following:

- Dates: All studies published from 2000 onwards.
- Languages: English and French.
- Study design: Primary research studies, including controlled trials and observational studies.

For a full list of inclusion and exclusion criteria, refer to Supplementary Material A.

### Search strategy

The search strategy was developed by a Health Canada research librarian in collaboration with the authors (see Supplementary Material B for details of the search strategy). The search strategy underwent a Peer Review of Electronic Search Strategies,[40] and was independently reviewed for quality by a second librarian.

We conducted searches in the following four electronic bibliographic databases:

EconLit, Embase, Ovid MEDLINE and Scopus. The search was conducted in April 2021 and updated in November 2022, October 2023 and February 2024 and, finally, on 19 February 2025. We conducted a grey literature search using Google Scholar and a targeted website search for key terms in June 2021. In addition, the reference lists of 17 related reviews were hand searched, and experts were consulted to ensure that the database searches did not miss any studies.

### *Study selection*

Search results were imported into the web-based literature review software DistillerSR version 2.37 (DistillerSR Inc., Ottawa, ON, Canada), and duplicates were removed. Two reviewers [LI, TC, AC, EV, SK or CL], working independently, screened all titles and abstracts for potential eligibility using a standardized form developed a priori and piloted by all these reviewers. The reviewers then conducted full-text screenings of the retrieved articles that had passed this first stage of screening. (For a list of excluded studies and the reasons for exclusion at either stage of screening, see Supplementary Material C.)

Disagreements between reviewers were resolved through discussion, with a third reviewer if necessary.

The process was similar for decisions regarding data extraction, risk of bias and Grading of Recommendations, Assessment, Development and Evaluation (GRADE).

### *Data extraction*

A data extraction form for recording relevant information from each included study was developed and piloted by reviewers prior to starting data extraction. For all included studies, the following information was extracted: citation information (authors, title, journal or source, year of publication, language of publication); study information (objectives, study design, time period, description of intervention and the method or tool used to measure HFI); participant characteristics (including any subgroups of interest); and outcomes of interest (HFI severity and utilization rates of food charities).

### *Data analysis*

The final dataset was exported to Microsoft Excel 365 (Microsoft Corp., Redmond, WA, US) for analysis. Narrative synthesis was performed on the dataset. Where three or more studies measured the same outcome, a random-effects meta-analysis using the DerSimonian and Laird method[37] weighting procedure was conducted in the metaprop package in Stata version 18 (StataCorp LLC, College Station, TX, US). Logit transformation was used and the data were then subgrouped by population and level of HFI. Heterogeneity was only calculated when there were four or more observations. Subanalyses by sociodemographic factors were included where possible.

### *Risk of bias*

We used the Risk of Bias in Non-randomised Studies – of Intervention (ROBINS-I)[41] and Risk of Bias in Non-randomized Studies – of Exposures (ROBINS-E)[42] tools and the Cochrane Collaboration's tool for assessing risk of bias in randomized trials version 2 (RoB 2)[43] to assess risk of bias in the included studies that examined the effectiveness of food-based interventions (KQ1). The JBI critical appraisal tool for cross-sectional studies was used to assess risk of bias in studies of food charity utilization (KQ2) as cross-sectional data were extracted from all of the included studies.[44,45]

### *Certainty of the evidence*

The GRADE framework was used to rate the certainty and strength of the body of evidence.[46] The purpose of GRADE is to rate the quality of the evidence in relation to research questions in a systematic and transparent manner (see Supplementary Material D for the GRADE decision rules applied in this systematic review). The evidence in the studies that addressed KQ1 was first assumed as being of high certainty, and this was rated down as per recent guidance on non-randomized studies.[47] The studies that addressed KQ2 were also initially assumed to have high-certainty evidence as an adapted GRADE approach was used to assess them.[48] In assessments of rates and frequency of utilization, observational studies can provide robust estimates when they use appropriate measures and enrol representative populations.

The certainty was downgraded for each outcome to "moderate," "low" or "very low" if there were serious or very serious concerns that reduced certainty in the outcome estimates across the following five domains: risk of bias, inconsistency, indirectness, imprecision or publication bias.[47] The wording of the summary statements regarding the certainty of the evidence is based on published guidance.[49]

## Results

A total of 8542 references were screened for eligibility for both key questions. Of these, 21 articles reported on exposure to or utilization of food-based interventions intended to reduce HFI in Canada (Figure 1).

### *Descriptive summary of included studies*

The included studies (n = 21) were published between 2000 and 2023, with more than half (n = 13) published since 2014 (see Table 1 for a summary of the study characteristics). Ten studies reported on the impact of exposure to food-based interventions on HFI (KQ1), and 13 on the rates and frequency of utilization of food-based interventions by food-insecure households (KQ2); 2 of these studies reported on both the impact and utilization rate of food-based interventions. The characteristics of the studies are summarized in Table 1. Detailed risk of bias results for all studies are in Supplementary Material E.

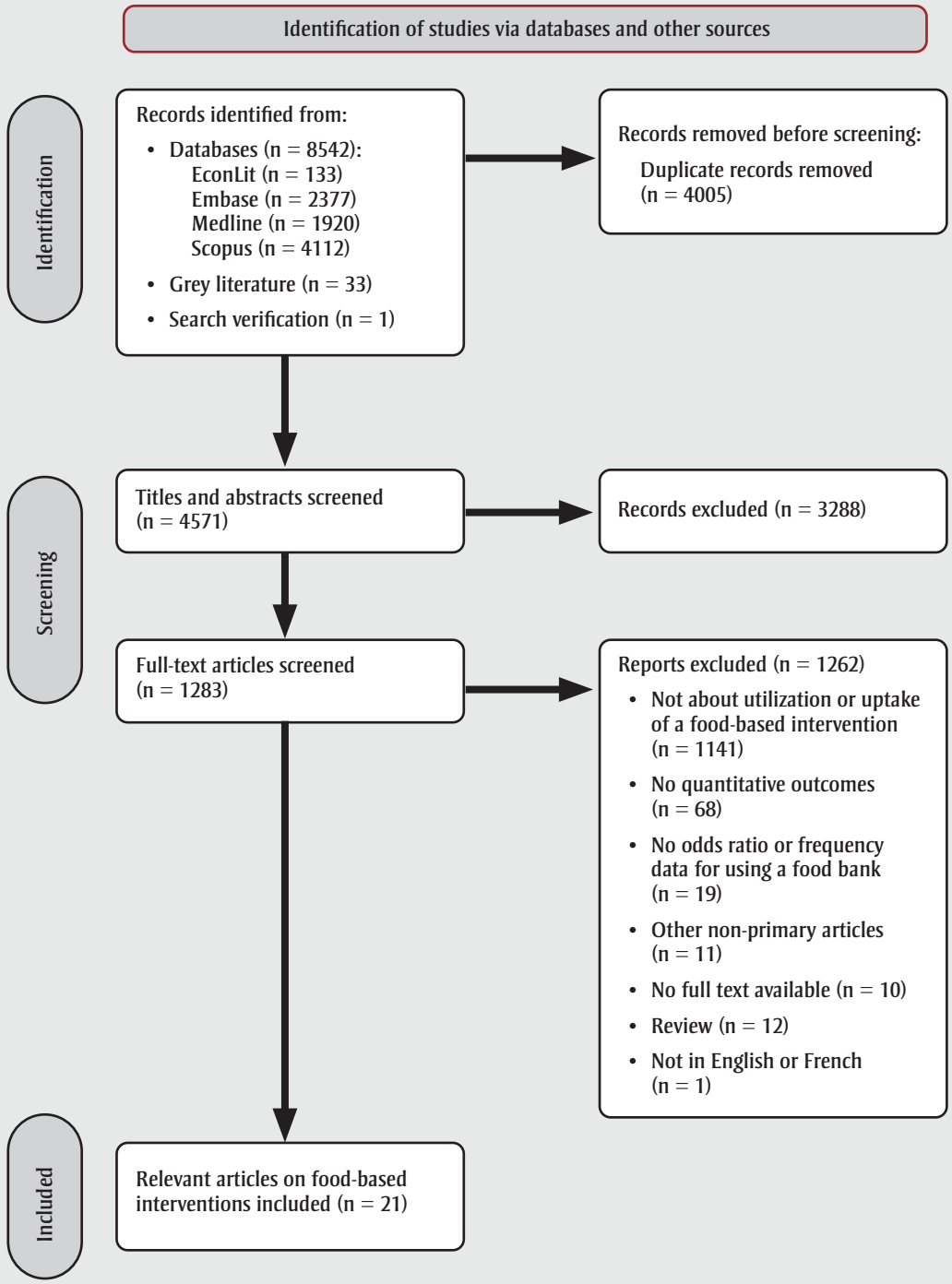
### *The impact of exposure to food-based interventions on HFI in Canada (KQ1)*

Food-based interventions included food charity programs (n = 3),[57-59] food voucher programs (n = 2),[50,51] hunting and fishing programs specific to Indigenous communities (n = 2),[55,56] food box programs (n = 1),[52] gardening programs (n = 1)[53] and school food programs (n = 1).[54] Overall, low-certainty evidence suggests that participation in food box, gardening, hunting and fishing, school food and food charity programs may have little to no effect on HFI. Low- to moderate-certainty evidence suggests that food voucher programs may reduce food insecurity. The findings are summarized in Table 2 and described in detail in the following subsections.

#### Food voucher programs

In a randomized controlled trial, adults in households with low incomes received coupons valued at CAD21 each week for 10 to 15 weeks to purchase healthy foods from local farmers' markets in British Columbia.[50] Aktary et al. reported that the odds of experiencing short-term HFI were

**FIGURE 1**
**PRISMA[38] flow diagram of searches of databases and other sources**




**Abbreviation:** PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

**TABLE 1**
**Characteristics of all included studies, by program type (n = 21)**

| First author, publication year<br>Study design<br>Dataset | Location<br>Period of data collection<br>Intervention | Population | Comparator | Food insecurity collection method<br>Reference time period | Total sample size, n | Risk of bias |
|---|---|---|---|---|---|---|
| **Food voucher programs** | | | | | | |
| Aktary, 2024[50]<br>Randomized controlled trial<br>Data collected by the authors for the purpose of this study | British Columbia<br>2019<br>Farmers' Market Nutrition Coupon Program | Adults living with low income who have never participated in the Farmers' Market Nutrition Coupon Program | Adults living with low income who do not receive the Farmers' Market Nutrition Coupon Program coupons | HFSSM<br>Past 30 days | 285 | Low |
| Heasley, 2021[51]<br>Single-arm pre–post design<br>Data collected by the authors for the purpose of this study | Guelph, Ontario<br>2019–2020<br>Food prescription voucher program | Patients with at least 1 diagnosed cardiometabolic condition or micronutrient deficiency (or both) and experiencing food insecurity | Participants pre-intervention | HFSSM<br>Past 4 months | 60 | High |
| **Food box programs** | | | | | | |
| Miewald, 2012[52]<br>Cohort (2-arm pre–post design)<br>Data collected by the authors for this study | British Columbia<br>Baseline: 2008; followup: 8 months after baseline<br>Food subscription box | Households with low incomes that received a weekly food box | Households with low incomes that accessed the same social services but did not receive a weekly food box | HFSSM<br>Not specified[a] | 192 | High |
| **Gardening programs** | | | | | | |
| Sandha, 2021[53]<br>Analytic cross-sectional<br>Data collected by the authors for the purpose of this study | Prince Edward Island<br>2013<br>At-home gardening | Mothers of children aged 0–6 years who accessed the Family Resource Centre's gardening program | Mothers of children aged 0–6 years who did not access the Family Resource Centre's gardening program | HFSSM<br>Reference time period not specified[a] | 282 | Some concerns |
| **School food programs** | | | | | | |
| Roustit, 2010[54]<br>Analytic cross-sectional<br>Health and Social Survey of Québec Children and Youth | Quebec<br>1999<br>School food programs (free or reduced-price snacks or meals) | Children and adolescents attending a primary or secondary school with a food supplementation program | Children and adolescents attending a primary or secondary school without a food supplementation program | Three statements from the Radimer/Cornell questionnaire<br>Reference time period not specified | 2346 | High |
| **Hunting and fishing interventions specific to Indigenous communities** | | | | | | |
| Blanchet, 2021[55]<br>Analytic cross-sectional<br>Data collected by the authors for the purpose of this study | Syilx People of the Okanagan Nation, British Columbia<br>2018<br>Salmon consumption | Adults who self-identified as or were in a kin relationship with a person who self-identified as Syilx of the Okanagan Nation and who eat locally caught salmon | Adults who self-identified as or were in a kin relationship with a person who self-identified as Syilx of the Okanagan Nation and who eat non-locally caught salmon or no salmon | HFSSM adapted to Indigenous populations in Canada<br>Not specified[a] | 265 | High |
| Thompson, 2012[56]<br>Analytic cross-sectional<br>Data collected by the authors for the purpose of this study | Manitoba<br>2008–2012<br>Country Food Programs | Adults in 14 remote communities in northern Manitoba | NA | HFSSM and 3 supplemental questions on gardening, hunting and fishing<br>Not specified[a] | 533 | High |

Continued on the following page

**TABLE 1 (continued)**
**Characteristics of all included studies, by program type (n = 21)**

| First author, publication year<br>Study design<br>Dataset | Location<br>Period of data collection<br>Intervention | Population | Comparator | Food insecurity collection method<br>Reference time period | Total sample size, n | Risk of bias |
|---|---|---|---|---|---|---|
| **Food charity interventions** | | | | | | |
| Loopstra, 2012[57,b]<br>Longitudinal cohort (single arm)<br>Data collected by the authors for the purpose of this study | Toronto, Ontario<br>Baseline: 2005–2007; followup: 2006–2008<br>Local food banks | Adults in families with low incomes, based on census tracts, who used a food bank in the last 12 months | Adults in families with low incomes, based on census tracts, who did not use a food bank in the last 12 months | HFSSM<br>Past 12 months | 371 | High |
| Rizvi, 2021[58,b]<br>Longitudinal cohort (single arm)<br>Data collected by the authors for the purpose of this study | Ottawa, Ontario<br>2017–2019<br>Local food banks | People who accessed community food banks, after 6, 12 and 18 months | People who accessed community food banks, at baseline | HFSSM<br>Past 12 months | 401 | High |
| Roncarolo, 2016[59]<br>Longitudinal cohort (2 arms)<br>Data collected by the authors for the purpose of this study | Montréal, Quebec<br>Baseline: 2011–2012; followup: 9 months after baseline<br>Local food banks | Individuals accessing traditional food banks or participating in alternative community interventions (community kitchens, community gardens and buying groups) | Population prior to food bank interventions | HFSSM<br>Past 12 months | 824 | High |
| **Food charity utilization** | | | | | | |
| Daly, 2023[60]<br>Cross-sectional<br>Assessing the Impacts of COVID-19 on Mental Health survey | National<br>2020–2021<br>Local food charities | Adults in food-insecure households stressed or worried about having enough food to meet the household's basic needs as a result of the COVID-19 pandemic in the past 2 weeks | NA | One question on food worry and one question from the HFSSM<br>Past 12 months | 477 | Low |
| Holmes, 2019[61]<br>Cross-sectional<br>Data collected by the authors for the purpose of this study | Vancouver, British Columbia<br>2015<br>Local food banks | Food-insecure households that accessed a local food bank | NA | HFSSM<br>Not specified[a] | 77 | High |
| Kirkpatrick, 2009[62]<br>Cross-sectional<br>Data collected by the authors for the purpose of this study | Toronto, Ontario<br>2005–2007<br>Local food banks | Food-insecure households | NA | HFSSM<br>Past 12 months | 484 | High |
| Loopstra, 2012[57,b]<br>Cross-sectional data taken from a cohort study<br>Data collected by the authors for the purpose of this study | Toronto, Ontario<br>Baseline: 2005–2007; followup: 2006–2008<br>Local food banks | Adults in families with low incomes, based on census tracts, who used a food bank at least once in the last 12 months | Adults in families with low incomes, based on census tracts, who did not use a food bank in the last 12 months | HFSSM<br>Past 12 months | 371 | Low |
| MacBain, 2023[63]<br>Cross-sectional<br>Data collected by the authors for the purpose of this study | Hamilton, Ontario<br>2021<br>Local food charities | Food-insecure households | NA | Hunger Vital Sign tool<br>Past 12 months | 173 | Low |

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**TABLE 1 (continued)**
**Characteristics of all included studies, by program type (n = 21)**

| First author, publication year<br>Study design<br>Dataset | Location<br>Period of data collection<br>Intervention | Population | Comparator | Food insecurity collection method<br>Reference time period | Total sample size, n | Risk of bias |
|---|---|---|---|---|---|---|
| McIntyre, 2000[64]<br>Cross-sectional<br>NLSCY Cycle 1 | National (excluding the territories)<br>1994<br>Local food banks | Households with children aged less than 18 years | NA | Single question on child hunger<br>Any experience ("ever experienced being hungry") | 16 639 | Some concerns |
| McIntyre, 2012[65]<br>Repeated cross-sectional<br>NLSCY Cycles 2 and 7 | National (excluding the territories)<br>1996–1997; 2006–2007<br>Local food banks | Households with children aged 2 to 9 years | NA | Single question on child hunger<br>Any experience ("ever experienced being hungry") | Cycle 2: 8165<br>Cycle 7: 15 691 | Some concerns |
| Men, 2021[66]<br>Cross-sectional<br>Canadian Perspectives Survey Series (CPSS) | National (excluding the territories)<br>2020<br>Any charitable food intervention | Canadians living in the 10 provinces | NA | Six-item questionnaire adapted from the HFSSM<br>Past 30 days | 4410 | Low |
| Parpouchi, 2016[67]<br>Cross-sectional<br>Data collected by the authors for the purpose of this study | Vancouver, British Columbia<br>2009–2011<br>Any charitable food intervention | Adults with a mental illness who were experiencing homeless-ness | NA | HFSSM adapted to populations experiencing homelessness<br>Past 30 days | 497 | Low |
| Rizvi, 2021[58,b]<br>Longitudinal design (cohort)<br>Data collected by the authors for the purpose of this study | Ottawa, Ontario<br>2017–2019<br>Local food banks | People who accessed community food banks, after 6, 12 and 18 months | People who accessed community food banks, at baseline | HFSSM<br>Past 12 months | 401 | Low |
| Tarasuk, 2009[68]<br>Cross-sectional<br>Data collected by the authors for the purpose of this study | Toronto, Ontario<br>2003<br>Any charitable food intervention | Youth aged 16–24 years without stable or secure housing | NA | Modified version of the HFSSM<br>Past 30 days | 261 | Low |
| Tarasuk, 2020[69]<br>Cross-sectional<br>Canadian Household Panel Survey (CHPS) pilot | Saskatchewan, Ontario, Quebec and New Brunswick<br>2008<br>Local food banks | Households (except those on reserves, in religious and other communal colonies or in institutions, and members of the Canadian Forces) | NA | One question from the HFSSM<br>Past 12 months | 1593 | Low |
| Vahabi, 2011[70]<br>Cross-sectional<br>Data collected by the authors for the purpose of this study | Toronto, Ontario<br>2008<br>Local food banks | Spanish- or Portuguese-speaking adults aged 20 years or older who had immigrated to Canada in the past 5 years from Central or South America | NA | One question from the HFSSM (translated into Spanish and Portuguese) that asked if participants ever had to eat less because they did not have enough money to buy food<br>Past 12 months | 70 | Low |

**Abbreviations:** HFSSM, Household Food Security Survey Module; NLSCY, National Longitudinal Survey of Children and Youth; NA, not applicable.

[a] Although not specified, it was assumed that the HFSSM time period was 12 months because no adaption of the module was reported.

[b] Included in both the food charity intervention and food charity utilization sections of this table as reported data are relevant to both.

**TABLE 2**
**Summary of findings of studies examining the impact of exposure to food-based interventions on HFI in Canada, by program type (KQ1)**

| First author, publication year<br>Study design (number of studies) | Population<br>Period of data collection | Outcome (food insecurity level) | Number of participants, n | | Effect | | Certainty of evidence |
|---|---|---|---|---|---|---|---|
| | | | Exposed to intervention | Not exposed to intervention | Effect size | Direction of effect | |
| **Food voucher programs** | | | | | | | |
| Aktary, 2024[50]<br>Randomized controlled trial | Adult population living with low income in British Columbia<br>2019 | Total HFI (marginal, moderate and severe) | 143 | 142 | Post intervention: OR = 0.21 (0.06–0.70);<br>16-week followup: OR = 0.29 (0.09–0.96) | Favours intervention (participation in Farmers' Market Nutrition Coupon Program) | Moderate[a,b] |
| Heasley, 2021[51]<br>Single-arm pre–post design | Food-insecure households in Guelph, Ontario<br>2019–2020 | Total HFI (marginal, moderate and severe) | 60 | NA | OR = 0.18 (0.07–0.50) | Favours intervention (participation in food prescription voucher program) | Low[a,b,c] |
| **Food box programs** | | | | | | | |
| Miewald, 2012[52]<br>Cohort (2-arm pre–post design) | Households with low incomes in British Columbia<br>2008 | Moderate and severe | 46 | 44 | No effect | NA | Low[a,b,c] |
| **Gardening programs** | | | | | | | |
| Sandha, 2021[53]<br>Analytic cross-sectional | General population in Prince Edward Island<br>2013 | Total HFI (marginal, moderate and severe) | 104 | 175 | No effect | NA | Low[a,b,c] |
| **School food programs** | | | | | | | |
| Roustit, 2010[54]<br>Analytic cross-sectional | Primary or secondary school-aged children and adolescents in the general population in Quebec<br>1999 | Moderate and severe | 678 | 1524 | No effect | NA | Low[a,c] |
| **Hunting and fishing interventions specific to Indigenous communities[d]** | | | | | | | |
| Blanchet, 2021[55]<br>Analytic cross-sectional | Syilx of the Okanagan Nation adults<br>2018 | Total HFI (marginal, moderate and severe) | 612 | 88 | No effect | NA | Low[a,c,e] |
| Thompson, 2012[56]<br>Analytic cross-sectional | Adults in remote communities in northern Manitoba<br>2008–2012 | Moderate and severe | | | | | |

Continued on the following page

**TABLE 2 (continued)**
**Summary of findings of studies examining the impact of exposure to food-based interventions on HFI in Canada, by program type (KQ1)**

| First author, publication year<br>Study design (number of studies) | Population<br>Period of data collection | Outcome (food insecurity level) | Number of participants, n | | Effect | | Certainty of evidence |
|---|---|---|---|---|---|---|---|
| | | | Exposed to intervention | Not exposed to intervention | Effect size | Direction of effect | |
| **Food charity interventions**[f] | | | | | | | |
| Loopstra, 2012[57]<br>Cohort (2-arm pre–post design)<br>2005–2007; 2006–2008 | Families living with low income in Toronto, Ontario | Moderate and severe | 85 | 286 | No effect | NA | Low[a,c,e] |
| Roncarolo, 2016[59]<br>Longitudinal cohort (2 arms)<br>2011–2012 | People who accessed food banks in Montréal, Quebec | Moderate and severe | 372 (traditional food banks) | 78 (alternative interventions, i.e. community kitchens, community gardens, buying groups) | OR = 0.44 (0.29–0.67) (for traditional food banks)<br>No effect (for alternative food programs) | Favours intervention (traditional food bank) | |
| Rizvi, 2021[58,g]<br>Longitudinal cohort (single arm)<br>2017–2019 | People who accessed community food banks in Ottawa, Ontario | Moderate and severe | 401 | NA | No effect | NA | |

**Abbreviations:** GRADE, Grading of Recommendations, Assessment, Development and Evaluation; HFI, household food insecurity; NA, not applicable; OR, odds ratio.

[a] Indirectness: Study population not indicative of general population.

[b] Imprecision: Optimal information size not met.

[c] Risk of bias: Study had either high risk of bias or some concerns related to risk of bias.

[d] The population, intervention, outcomes, and study design in these studies were deemed similar enough that they could be combined.

[e] Inconsistency: Inconsistent effect estimates and direction of effect.

[f] The certainty of evidence of these studies was assessed as a single group as the populations and interventions are similar enough for the GRADE ratings. The data were not combined due to the difference in study designs.

[g] Rizvi et al.[58] conducted a longitudinal study but also assessed aggregated data from all time points.

79% lower at the end of intervention ($p$ = 0.01) and 71% lower at 16 weeks postintervention ($p$ = 0.04) in the group receiving the coupon compared to the control group.[50]

In a pre- and postintervention single-arm study conducted in Guelph, Ontario, community health centre patients with a diagnosed cardiometabolic condition, a micronutrient deficiency or both and who were experiencing food insecurity were prescribed 12 weekly vouchers to use at community food markets.[51] Heasley et al. reported that the mean adult and child food insecurity scores decreased significantly from baseline to followup ($p$ < 0.001 for adults; $p$ = 0.01 for children).[51]

### Food box programs

In a cohort study conducted in Vancouver, British Columbia, Miewald et al. assessed the effects of monthly distributions of food boxes of fruits and vegetables over an 8-month period to people in households with low incomes or in areas with poor food access or to older adults assessed.[52] There was no statistically significant change in HFI among those who enrolled in the food box program versus those who did not.[52]

### Hunting and fishing interventions specific to Indigenous communities

Two analytic cross-sectional studies assessed interventions specific to Indigenous communities. Blanchet et al. found no association between the type of salmon eaten (locally caught salmon versus imported or no salmon) and HFI among Syilx of the Okanagan Nation adults in British Columbia.[55]

Thompson et al. assessed households' access to hunted and fished foods in 14 remote Indigenous communities in northern Manitoba and found no association between access to these foods and HFI.[56]

In the same study, the presence of a country food program (OR = 20.6; 95% CI: 2.4–176.1), road access to urban areas (OR = 7.6; 95% CI: 1.2–51.5) and access to a public transit system (OR = 3.9; 95% CI: 1.5–9.9) were all associated with lower rates of HFI, whereas living in a geographically compact community was not associated with lower rates of HFI.[56]

### Gardening programs

In an analytic cross-sectional study conducted in Prince Edward Island, Sandha et al. compared the levels of HFI of mothers with children aged 0 to 6 years who accessed Family Resource Centre gardening programs with those of mothers with children the same age who did not access these programs. The authors reported that there was no relationship between HFI and access to the gardening progam.[53]

### School food programs

In a cross-sectional study, Roustit et al. assessed elementary and secondary school

food supplementation programs in Quebec and found no relationship between exposure to these programs and HFI.[54] Students in schools without (10.4%) and with (12.7%) these supplementation programs were food insecure ($p = 0.22$).[54]

### Food charity interventions

Three studies assessing four food charity interventions were included.[57-59] The interventions included both traditional food bank models (where food bank clients receive a hamper of food regularly, usually once per month) and alternative community-based food charities (where participants can, for example, "shop" for groceries at a food bank or take part in community kitchen programs).

In a study that evaluated changes to HFI over a 9-month period, Roncarolo et al. found that severe HFI significantly decreased among participants in Montréal, Quebec, who accessed a traditional food bank (from 89.6% to 61.1%; OR = 0.27; 95% CI = 0.14–0.54 for severely food-insecure households), but did not significantly decrease among those who participated in alternative interventions (community kitchens, community gardens and buying groups).[59]

In a longitudinal study, Rizvi et al. found that most of the people accessing food banks in Ottawa, Ontario, were food insecure at baseline and remained food insecure at the 18-month followup, although there was a small downward trend in the proportion of people who were severely food insecure (from 38.5% to 24.6%; no measure of significance reported).[58]

In a study of families with low incomes accessing food banks in Toronto, Ontario, Loopstra and Tarasuk reported that 13.0% were no longer severely food insecure, 40.7% remained severely food insecure and 9.3% had become severely food insecure at followup 1 year post-baseline, for a net change of 3.7%.[57]

### *Rates of food charity utilization among food-insecure households (KQ2)*

Eleven studies reported on rate (n = 11)[57,60,62-70] of utilization of food charity interventions among food-insecure households.

The rate of food-insecure households that used a food charity varied by severity of HFI and population group (Table 3; Figure 2). Those with severe HFI generally accessed food charities more often than those with moderate levels of HFI (Figure 2). The rate of food charity utilization was highest among those who were precariously housed or experiencing homelessness (Table 3; Supplementary Material F).

### *Frequency of food charity utilization by food-insecure households (KQ2)*

Six studies[57,58,60,62,66,68] assessed the frequency of utilization of food charity interventions by food-insecure individuals. Although there was no consistent measurement of the frequency of utilization of food charities or food banks, it was clear that the frequency of food bank use among food-insecure households was low (Table 4). Youth aged 16 to 24 years experiencing homelessness appear to use charitable meal programs (soup kitchens, outreach vans, drop-in centres, shelters) more frequently than households that are food insecure.

## Discussion

The objective of this systematic review was to synthesize the evidence on food-based interventions to mitigate HFI, recognizing the importance of this indicator for social policy and population health. This systematic review found limited evidence (of low certainty) for interventions assessing the effectiveness of food-based strategies on HFI, except for food voucher programs, for which there was some moderate-certainty evidence favouring intervention. Of note, no evidence was found for some strategies, for example, breakfast clubs or Meals on Wheels programs. Each category of intervention is discussed separately in the following subsections.

### *Food charity interventions*

Low-certainty evidence suggests that food charity interventions may result in little to no difference in HFI. One possible explanation is that HFI is not a measure of access to food, but of absolute economic deprivation. A household that cannot afford to buy food likely cannot afford to buy necessary medications, pay the rent or pay for electricity, water and other essentials. Given that food is a basic human need, HFI is a clear marker of a household's economic resources. Thus, HFI is not about an inability to access food, but rather a measure of economic insecurity. Receiving food charity may have a minimal effect on these economic resources or circumstances. This highlights the need for a more comprehensive economic response to the issue of HFI.

Another possible explanation for this lack of change in HFI is that food charities are limited in the amount of assistance they can provide to any one household. Food charities are neither a consistent nor a reliable coping strategy over the long term and are unlikely to change levels of HFI because households require food every day. Sustaining this level of access to food banks is likely not an economically viable option[71] as food charities lack the resources to meet clients' food needs indefinitely.

This systematic review revealed that less than 40% of severely food-insecure households use food banks, and that most of the households that use them access them very infrequently. The low utilization rate may reflect food-insecure households' recognition that food charities can only provide them with limited assistance. This may be due to inconvenient opening hours or because of a lack of the quantity, quality or type of food they need or prefer, among other reasons. This systematic review also found that increased severity of HFI was associated with higher utilization of food banks. This is in line with previous research that showed that the lack of utilization of these programs likely results from intrahousehold dynamics (such as household economics or coping strategies such as borrowing food and money from friends and family) that cause people to only access food charities when they reach the end of their capabilities.[57,65]

Recognition of the stigma associated with using food banks, among other reasons, has resulted in the development of alternative food-charity interventions,[59] but evidence that these programs reduce HFI is lacking. The findings of this systematic review also bring into question the role of food banks specifically and food charities more broadly in addressing food insecurity. While beyond the scope of this review, the persistence of food charities as a dominant response to HFI would ideally be researched by experts in the field of social science.

We found the proportion of people utilizing food charity programs to be much

**TABLE 3**
**Summary of findings of the rate of food charity utilization by food-insecure households according to HFI level, Canada (KQ2) (n = 11)**

| First author, publication year<br>Study design | Period of data collection | Sample size, n[a] | | Meta-analysis subtotal, %[a] | Interpretation of effect | GRADE |
|---|---|---|---|---|---|---|
| | | Used a food charity | Did not use a food charity | | | |
| **Marginal, moderate and severely food insecurity** | | | | | | |
| Tarasuk, 2020[69]<br>Cross-sectional | 2008 | 276 | 1342 | 21 | A small proportion of households that were food insecure used a food charity | Moderate[b,c] |
| Loopstra, 2012[57]<br>Cross-sectional | 2005–2007, 2006–2008 | | | | | |
| Men, 2021[66]<br>Cross-sectional | 2020 | | | | | |
| Daly, 2023[60]<br>Cross-sectional | 2020–2021 | | | | | |
| MacBain, 2023[63]<br>Cross-sectional | 2021 | | | | | |
| **Moderately food-insecure households** | | | | | | |
| Loopstra, 2012[57]<br>Cross-sectional | 2005–2007, 2006–2008 | 63 | 237 | 21 | A small proportion of households that were food insecure used a food charity | Low[c,d,e] |
| Kirkpatrick, 2009[62]<br>Cross-sectional | 2005–2007 | | | | | |
| **Severely food-insecure households and child hunger** | | | | | | |
| McIntyre, 2012[65]<br>Repeated cross-sectional | 1996–1997, 2006–2007 | 230 | 427 | 35 | A small proportion of households that were food insecure used a food charity | Moderate[c,d] |
| Loopstra, 2012[57]<br>Cross-sectional | 2005–2007, 2006–2008 | | | | | |
| Kirkpatrick, 2009[62]<br>Cross-sectional | 2005–2007 | | | | | |
| McIntyre, 2000[64]<br>Cross-sectional | 1994 | | | | | |
| **Moderately and severely food-insecure household within immigrant populations** | | | | | | |
| Vahabi, 2011[70]<br>Cross-sectional | 2008 | 34 | 5 | 90 | A high proportion of this immigrant population used a food charity | Low[b,c,e] |
| **Marginally, moderately and severely food-insecure populations experiencing homelessness** | | | | | | |
| Parpouchi, 2016[67]<br>Cross-sectional | 2009–2011 | 431 | 101 | 83 | A very high proportion of people experiencing homelessness used a food charity | High[c] |
| Tarasuk, 2009[68]<br>Cross-sectional | 2003 | | | | | |

**Abbreviations:** GRADE, Grading of Recommendations, Assessment, Development and Evaluation; HFI, household food insecurity.

[a] Represents the combined data of the meta-analysis (see Figure 2).

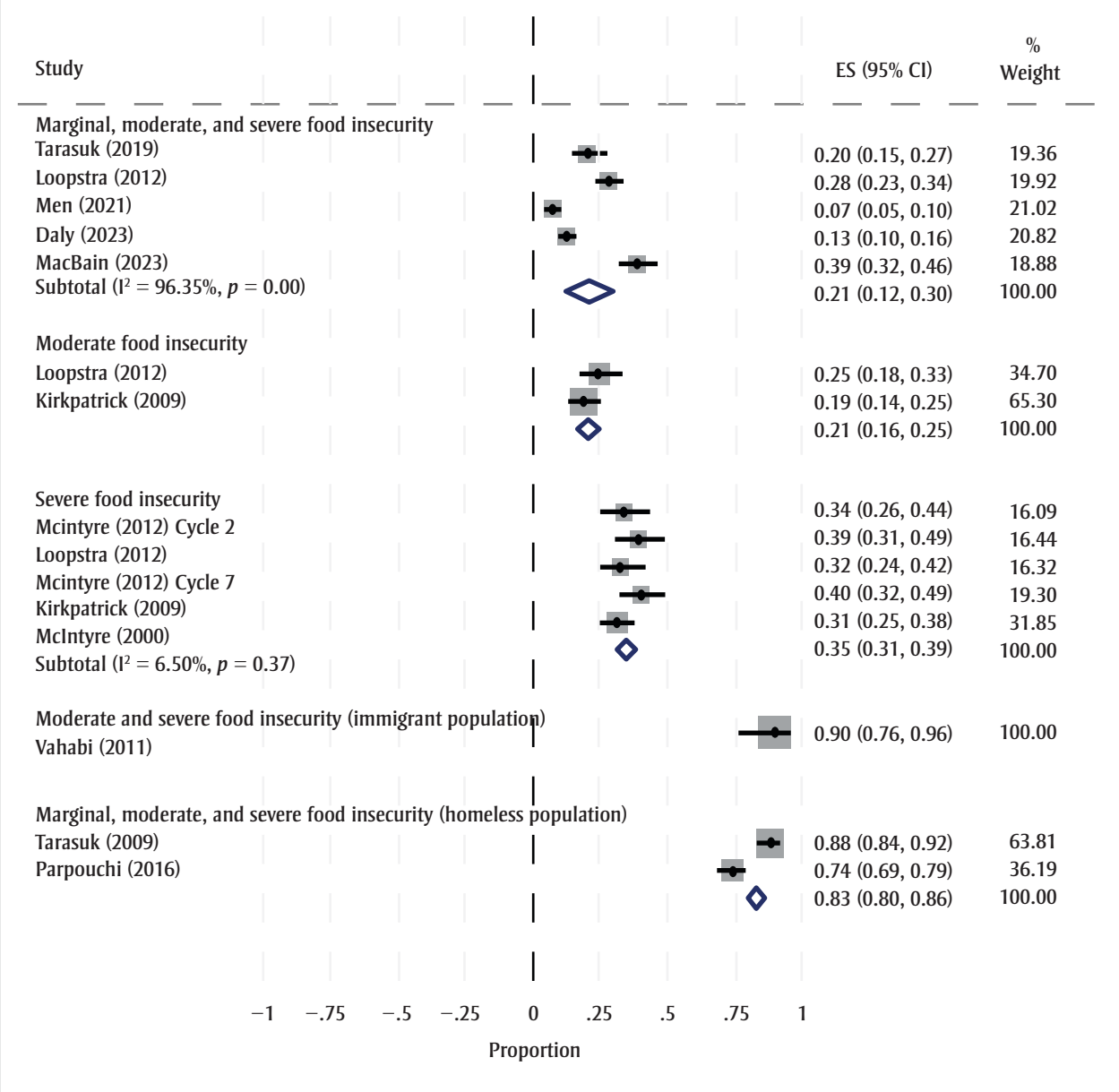
[b] Inconsistency: Inconsistent effect estimates and direction of effect.

[c] Indirectness: Study population not indicative of general population.

[d] Risk of bias: Study had either high or moderate/some concerns risk of bias.

[e] Imprecision: Optimal information size not met.

**FIGURE 2**
**Forest plot for rates of food charity utilization by HFI level, Canada (KQ2)**




**Abbreviations:** CI, confidence interval; ES, effect size; HFI, household food insecurity; $I^2$, measure of heterogeneity.

higher in populations experiencing homelessness, which may highlight the lack of other coping strategies available to them. It is important to note that even with high rates of utilization of food charities, this population continues to face severe and chronic food insecurity. An HFI-reduction strategy that is more comprehensive than solely focusing on provision of food is required.[67] This notion is corroborated by a recent systematic review that outlined the experience of HFI among people experiencing homelessness in high-income countries.[72] Easton et al. found that people experiencing homelessness are in a system that maintains food insecurity through oppression (i.e. structural inequities and institutionalism in finding adequate housing), an inability to fulfill basic needs, a lack of facilities for meal preparation and barriers to food assistance such as not having an address or means of identification.[72] Looking beyond food-based interventions is important to resolve the larger issue of the extreme deprivation of populations experiencing homelessness.

The main reasons for the low certainty of the evidence of the effect of food charities on HFI are the limitations in the study designs (inability to control for concurrent interventions outside the parameters of the study), the small study sample sizes

**TABLE 4**
**Summary of findings of frequency of food charity utilization, Canada (KQ2) (n = 6)**

| First author, publication year<br>Study design<br>Population | Food insecurity levels | Size of food-insecure population, n | Percentage of the food-insecure population, % | Frequency | GRADE |
|---|---|---|---|---|---|
| Holmes, 2019[61]<br>Cross-sectional<br>Food-insecure households | Severe | 43 | 70 | Low (< 1 visits/month) | Low[b,c,d] |
| | | | 68 | Medium (1–2 visits/month) | |
| | | | 64 | High (> 2 visits/month) | |
| Kirkpatrick, 2009[62]<br>Cross-sectional<br>Food-insecure households | Moderate | 182 | 18.7 | Used a food bank at least once in the previous 12 months | |
| | Severe | 134 | 40.3 | | |
| | Moderate | 182 | 5 | Used a food bank at least once in 10 or more of the previous 12 months | |
| | Severe | 134 | 6.7 | | |
| Loopstra, 2012[57]<br>Cross-sectional<br>Food-insecure households | Marginal | 47 | 10 | Used a food bank at least once in the previous 12 months | |
| | Moderate | 118 | 27 | | |
| | Severe | 112 | 39 | | |
| Men, 2021[66]<br>Cross-sectional<br>Food-insecure households | Total HFI (marginal + moderate + severe) | 540 | 7.4 | Received charitable food assistance at least once in the past 30 days | |
| | | | 4.3 | Received charitable food assistance more than once in the past 30 days | |
| Rizvi, 2021[58]<br>Cross-sectional[a]<br>Food-insecure households | Marginal | 226 | 24.3 | Used a food bank once in the last 3 months | |
| | Moderate | 444 | 22.6 | | |
| | Severe | 408 | 22.0 | | |
| | Marginal | 226 | 22.6 | Used a food bank twice in the last 3 months | |
| | Moderate | 444 | 17.7 | | |
| | Severe | 408 | 50.4 | | |
| | Marginal | 226 | 45.6 | Used a food bank 3 or more times in the last 3 months | |
| | Moderate | 444 | 50.4 | | |
| | Severe | 408 | 47.2 | | |
| Tarasuk, 2009[68]<br>Cross-sectional<br>Female youth experiencing homelessness | Moderate and severe | 112 | 27 | Used a charitable meal program 1–2 days in the last 7 days | Moderate[e] |
| | | | 38 | Used a charitable meal program 3–5 days in the last 7 days | |
| | | | 21 | Used a charitable meal program 6–7 days in the last 7 days | |
| Tarasuk, 2009[68]<br>Cross-sectional<br>Male youth experiencing homelessness | | 149 | 22 | Used a charitable meal program 1–2 days in the last 7 days | |
| | | | 57 | Used a charitable meal program 3–5 days in the last 7 days | |
| | | | 11 | Used a charitable meal program 6–7 days in the last 7 days | |

**Abbreviations:** GRADE, Grading of Recommendations, Assessment, Development and Evaluation; HFI, household food insecurity.

[a] Rizvi et al.[58] conducted a longitudinal study but also assessed aggregated data from all time points.

[b] Risk of bias: Study had either high or moderate/some concerns risk of bias.

[c] Inconsistency: Inconsistent effect estimates and direction of effect.

[d] Indirectness: Study population not indicative of general population.

[e] Imprecision: Optimal information size not met.

and the significant dropout rates. Large longitudinal prospective cohort studies, such as the Pathways study in Quebec,[73] will help identify the long-term effects of food charity programs on food insecurity. Without a stronger evidence base for these types of interventions, their effect on HFI in Canada remains unconfirmed. The Office of the Auditor General (OAG) of Canada reached a similar conclusion in their 2021 review of Canada's pandemic-related expenditures of the food assistance programs intended to mitigate HFI.[74] The review concluded that lack of data and performance measurement meant that the departments and agencies the OAG audited did not know whether the initiatives had achieved all their outcomes for reducing HFI.[74] While a lack of evidence does not indicate program ineffectiveness, a growing body of evidence shows that implementing more holistic public policy interventions that address income supports and root economics is effective in reducing HFI.[39] The evidence thus points towards a more holistic public policy approach that tackles the root economics of the problem in Canada.

### *Food box programs*

The evidence in this systematic review suggests that food box programs that regularly supply fresh foods may result in no effect on HFI. The long-term impacts of such programs on HFI may be limited to the lifetime of the interventions, which require sustained and considerable economic input to regularly supply program participants with sufficient fresh food.[71] This is likely because these interventions, as with all the food-based interventions assessed in this systematic review, do not address the underlying causes of HFI as a marker of economic deprivation.

### *Food voucher programs*

This systematic review found that food voucher programs may decrease food insecurity in households with low incomes for the duration of the intervention. This result aligns with those of two other systematic reviews that assessed interventions intended to reduce HFI in Canada and the United States.[75,76] These systematic reviews found that food vouchers were associated with a statistically significant decrease in HFI in both general and clinical populations.[75,76] Supplying households with vouchers may be a way to provide households with the economic resources to purchase culturally appropriate foods and thus increase their purchasing power.

Given the low number of studies that have assessed food voucher programs, more studies are needed to assess their effectiveness as well as the dose–response relationship between duration, frequency of exposure, long-term sustainability and dollar values of these interventions and food insecurity status.

### *Interventions specific to Indigenous communities*

This systematic review found low-certainty evidence for the effect of hunting and fishing programs on HFI in Indigenous communities. Food insecurity in Indigenous populations ranges from 48% among on-reserve First Nations communities to 57% among Inuit in Nunavut.[77] Given these disproportionately high rates of HFI, it is critical to find culturally sensitive and workable solutions that valorize Indigenous ways of knowing. Previous reviews have explored programs and policy interventions related to Indigenous populations,[39,78] while Drysdale et al. synthesized the interventions intended to reduce HFI in remote regions in Canada as well as Australia and the United States.[79]

### *Gardening programs*

Although many studies have assessed the potential benefits of gardening interventions, very few measured the effect of these programs on HFI using a validated scale. In a 2022 systematic review that assessed the impacts of community gardens on health in Canada, Japan, the Netherlands, South Africa, the United Kingdom and the United States, Hume et al. concluded that although HFI was not a directly measured outcome, community gardens likely do not affect HFI.[80] Future studies in this area should include a validated measure of HFI to assess the dimension of community garden and urban agriculture utilization.

### *School food programs*

Although school food programs are often touted as an important mechanism for reducing hunger and HFI among youth,[81] the evidence for their effect on HFI is sparse as most studies on school food programs retrieved for this systematic review were screened out because they did not report on HFI. Two recent reviews by the Alberta Health Services and by Nova Scotia Health independently found that school food programs do not alleviate HFI.[82,83] The Nova Scotia public health authority concluded that school food programs "are not an appropriate or sustainable solution to HFI as they do not address its root causes—primarily, inadequate income."[83,p.5] These programs may, however, be useful in achieving other outcomes such as improved dietary behaviour and critical food literacy skills (learning, culture and social norms).[84]

### *Limitations of the included studies and recommended future research*

#### Limited data

Very few studies of the studies screened used a validated scale to assess the impact of a food-based intervention on HFI or related constructs of hunger, even though the stated purpose was to reduce HFI. Future studies as well as government programming that aims to increase the effectiveness of food-based interventions should include a measure of HFI in their evaluations.

#### Intervention variation

The design and administration of interventions varied considerably, making it difficult to measure their impact on HFI. Studies that assess the effectiveness of different implementations of similar interventions would be beneficial. Authors who report on food charity studies should carefully detail the intervention, the implementation of the interventions and any possible variations. The limited number of studies precluded examination of interjurisdictional variation. However, as there are increasingly large interprovincial differences in food-insecurity prevalence and severity,[1] it might be important for future studies to take into account the policy context of these food-based interventions.

#### Type of included studies

A major limitation of this systematic review was the high risk of bias of these largely observational studies and the difficulty in implementing an experimental trial to assess the efficacy of food-based interventions on HFI. The high risk of bias was due to the presence of confounding factors (5 of 9 studies) and to the high levels of missing data because of high dropout rates and loss to followup (4 of 9 studies). Assessing the effectiveness of these interventions (assessed through

actual utilization rates) also remains a challenge.

### Potential missing studies

This systematic review only synthesized the evidence that is publicly available and may have missed evidence on other types of food-based interventions that have not been published (e.g. breakfast clubs). In addition, it is also important to report null or negative studies in the literature, to give a fuller picture of the situation.

## Conclusion

Food-based interventions date back more than 40 years,[85] yet we only retrieved 10 studies that assessed the effectiveness of these interventions on HFI or a hunger-related construct. When categorizing food-based interventions (i.e. school food programs, food charities), we found very few or in some cases no studies of program models that are particularly prominent in Canada, such as children's breakfast clubs or Meals on Wheels.

The certainty in the evidence that food-based interventions have an effect on HFI is low, indicating that these interventions may not in fact affect HFI. Given the pervasiveness of HFI, and the fact that it is a marker of economic deprivation, it is unlikely that a food-based response will have much of an impact on overall HFI, which is primarily an economic problem. Emerging evidence suggests that more comprehensive public policy approaches are required to mitigate HFI.[39]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## Conflicts of interest

The authors have no conflicts of interest to declare.

## Authors' contributions and statement

LI: Conceptualization, investigation, formal analysis, methodology, project administration, supervision, validation, writing—original draft, writing—review and editing.

CL: Formal analysis, investigation, data extraction, project administration, software, writing—original draft, writing—review and editing.

TC: Formal analysis, investigation, writing—original draft, writing—review and editing.

EV: Investigation, writing—original draft, writing—review and editing.

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# Commentary

# The evidence is in: accountability needs to be injected into the policy-making process for household food insecurity reduction

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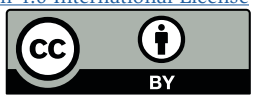

## Abstract

As the problem of household food insecurity perseveres, effective evidence-informed responses are badly needed. The systematic reviews of evidence compiled by the Public Health Agency of Canada provide an important foundation for such action, but they also indicate the need for accountability, so that precious public funds do not continue to be spent on initiatives with no evidence of impact. We need targets for food insecurity reduction and some accountability for policy interventions that come with significant public investments. Household food insecurity rates and the related adverse consequences are only going to get worse unless we address the inadequate, insecure incomes that are the primary driver of this population health problem.

***Keywords:*** *food insecurity, Canada, public policy, food assistance*

### *Highlights*

- Household food insecurity is growing in Canada and effective evidence-informed responses to this problem are badly needed.
- Accountability in policy making is essential to ensure that scarce public funds are not allocated to initiatives that lack evidence of impact.
- Many policy interventions that increase the incomes of low-income households have been shown to reduce household food insecurity; there is no such evidence base for food-based interventions.
- To increase accountability and incentivize effective, evidence-informed income interventions that address food insecurity, we propose that the federal government commit to reducing food insecurity by 50% and eliminating severe food insecurity by 2030.

## Introduction

Household food insecurity affected 25.5% of people in the Canadian provinces and 37.4% of people in the territories in 2024.[1] The recent rise may reflect inflationary pressures, but even during the low inflation period before the COVID-19 pandemic, food insecurity was widespread (Figure 1).[2] Briefly defined as the lack of access to adequate food because of financial constraint, food insecurity is most prevalent among households with low incomes, renters, social assistance recipients, lone-parent female-led families and those who identify as Black or Indigenous.[3]

Food insecurity is a serious population health problem in Canada, associated with poorer mental health, increased risk of infectious and noncommunicable diseases and injuries, poorer disease management, higher health care use and premature mortality.[4] The persistently high and now escalating prevalence of household food insecurity suggests an urgent need for effective, evidence-informed policy interventions.

Against this backdrop, staff at the Public Health Agency of Canada (PHAC) Centre for Surveillance and Applied Research led an exhaustive review of evidence to identify effective intervention strategies to reduce household food insecurity in Canada. The authors of this commentary participated on a voluntary basis as subject matter experts, an experience that was positive and informative as we observed unfailing sophistication in the review methods deployed. Yet, as is appropriate for a government science-led process, these reviews end without critical interpretation or recommendations. In this commentary, we discuss what we see as the most important policy and research implications stemming from PHAC's findings. We do so in the belief that PHAC's evidence review of interventions should not be ignored and that household food insecurity is not an intractable problem; it persists because its reduction is not an explicit policy goal of governments.

PHAC's evidence reviews comprise five peer-reviewed manuscripts,[5-9] ranging from the impact of COVID-19 on food insecurity[6] to a comprehensive review of

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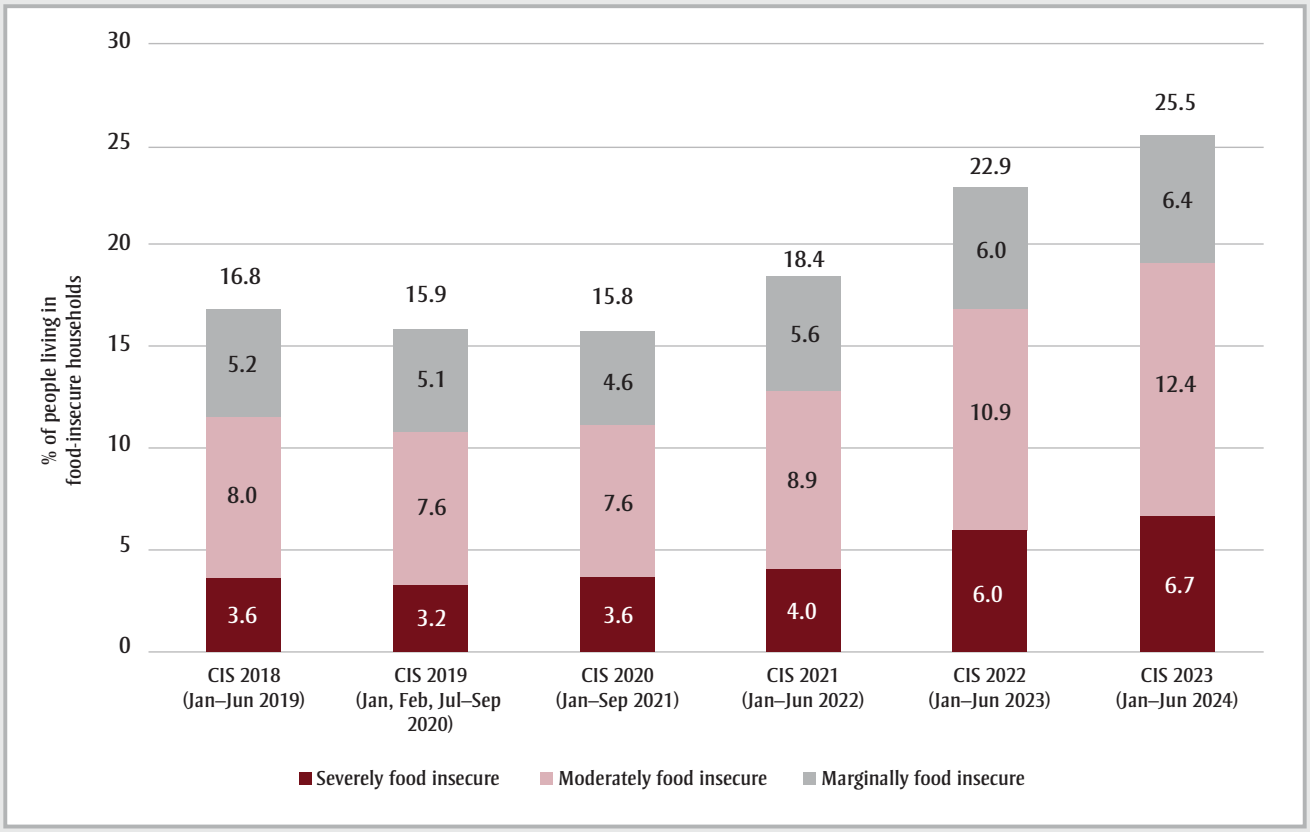
**FIGURE 1**
**Percentage of people living in food-insecure households in Canada, excluding the territories, 2019–2024**




**Data source:** Statistics Canada, Table 13-10-0834-01: Food insecurity by economic family type.[7]

**Abbreviation:** CIS, Canadian Income Survey.

**Note:** The CIS year refers to the 12-month period prior to when the CIS interview took place. The survey collection periods are shown in parentheses.

Nutrition North Canada, a federal retail subsidy program intended to support food affordability in northern Canada.[7] Taken together, these reviews offer clear direction on what works and what does not work to reduce food insecurity in Canada. But they also raise some troubling questions about current government responses.

Here we comment on the findings from the reviews of public policy interventions in the general population[1] and food-based interventions[9] because we see these evidence reviews as most germane to population health outcomes. We synthesize the main findings, identify priorities for policy intervention and suggest directions for future research.

## Main findings

### *The effectiveness of income supplementation*

The most important finding to emerge from this extensive review of the evidence is the effectiveness of federal and provincial policy interventions that modestly increase the incomes of Canadians living at low income, for example, Old Age Security pensions, the Canada Child Benefit (CCB) and social assistance. Idzerda et al. concluded with moderate to high certainty that income supplementation reduces food insecurity, but they found no evidence that the assessed housing assistance programs and food retail subsidy programs had any impact.[5] Their findings suggest that inadequate and insecure incomes are the primary driver of household food insecurity and that income support policies are key to reducing this population health problem.[5]

As indicated by the moderate to high certainty rating, the quality of the research on income supplementation is robust.[5] Researchers have been able to estimate changes in the probability of food insecurity among population subgroups exposed to specific income interventions, often employing complex econometric methods to account for other well-established influences on households' food insecurity status (e.g. housing tenure, household composition, education, province or territory of residence). The strength of the evidence garnered from these studies highlights the fallacy in discounting the importance of income as a solution to Canada's food insecurity problem simply based on recent reports that most food-insecure households have incomes above the official poverty line.[10,11]

In their systematic review, Idzerda et al. found that housing assistance (primarily rent subsidies) had no effect on food insecurity.[5] Since 2020, when the last of the studies reported findings, a variety of housing interventions have been proposed by multiple levels of government in response to the housing affordability crisis. The impact of new affordable housing interventions should be ready to be evaluated

for their effects on household food insecurity.

### *Food-based interventions fail to reduce food insecurity*

Food banks have dominated Canada's response to food insecurity for more than 40 years and received unprecedented federal and provincial funding throughout the COVID-19 pandemic.[12] Several jurisdictions, for example, British Columbia, Alberta, Quebec and New Brunswick, continue to allocate significant funds to these programs. Yet there has been almost no evaluation of the effectiveness of charitable food assistance programs in reducing food insecurity. The few studies that do exist are of low quality and provide no systematic review evidence of effectiveness.[9] A parallel body of literature has charted the very low rates of utilization of food charity programs by domiciled, food-insecure households. This is unsurprising given that charitable food assistance does not alter the underlying drivers of households' food insecurity. The conclusions of Idzerda et al.'s systematic review[9] are consistent with what many leaders in this sector have been saying for years—that the solutions to the desperation that drives people to seek food bank assistance lie in public policy reforms that address the underlying income issues.[13-15]

Similar to the literature on food charities, the existing evaluations of alternative food programs including food box, gardening and school food programs and hunting and fishing interventions specific to Indigenous populations, while limited in number, yielded no evidence of effectiveness.[9] The two available evaluations of food voucher programs provided low-to-moderate evidence that these programs may reduce food insecurity, but this could be explained by the fact that the vouchers increase the purchasing power of participating households, albeit on a small, and often time-limited, scale. Political claims that the recent one-billion-dollar investment in a National School Food Program will reduce the number of "hungry children" will need to be assessed over the next few years against food insecurity rates in households with children.[16] The lack of evidence that food programs are effective in reducing food insecurity should also be a cautionary tale for groups seeking food sovereignty for their communities. These groups perhaps should not expect different results.

We have 40 years of food-based initiatives for people experiencing food insecurity, but fewer evaluative studies than we have provinces and territories in Canada. While government science itself shows that these policy directions are not evidence-based, we will inevitably see further investments in food-based interventions as media and political eyes focus on rising rates of household food insecurity. As social scientists continue to unpack why these ideas keep on drawing resources, inhibiting more effective solutions,[15,17-19] we need to ask why no evidence is needed and what are the intended outcomes of food-based initiatives if not a reduction in household food insecurity? Indeed, Agriculture and Agri-Food Canada's 2024 evaluation of their Local Food Infrastructure Fund suggests that the outcome of resource support for the food insecure–serving sector may not be the reduction of food insecurity but rather alleviation of organizational stress brought on by increased client demand for their services.[17]

## Implications for future policy responses

This is a time for reckoning. There is little to no evidence of food-based interventions having an impact on household food insecurity.[9] Yet the fund-raising communications of charitable and alternative food providers explicitly claim that they are addressing or preventing food insecurity (see, for example[18-20]). Scholars have also commented on underlying corporatization as justifying food-based interventions.[21,22] Interdisciplinary research could reveal more about these dynamics, but surely the first step is to call out the incongruity of food-based interventions as a strategy for food insecurity reduction now that the absence of evidence has been revealed. We believe that the related lack of accountability for the impact of recent investments in food charity (e.g. pandemic-related federal programs[23] and the ongoing Local Food Infrastructure Fund[17]) is part of the explanation for the persistently high prevalence of food insecurity in Canada. No government has seriously tried to reduce food insecurity.

The positive effects of income-based interventions on household food insecurity documented by Idzerda et al.[5] derive from assessments of federal and provincial programs that were not explicitly designed to prevent or reduce food insecurity. The effects found were incidental to other policy goals. The results of the systematic review consequently do not tell us what the optimal design of an income intervention that minimizes household food insecurity might be nor the extent to which income supplementation alone could reduce food insecurity prevalence. And, as with any public policy intervention, additional equity considerations need to be evaluated—who benefits, who is missed, whether disparities increase or decrease, and whether targeted approaches need to augment universalist implementation?[24]

It is time for the reduction of the prevalence and severity of household food insecurity to become a deliberate policy goal in Canada. We propose that the federal government commit to the elimination of severe food insecurity in Canada and a 50% reduction in the 2024 prevalence of household food insecurity by 2030. The elimination of severe food insecurity is effectively Sustainable Development Goal 2: Zero Hunger, to which Canada has committed.[25] This Sustainable Development Goal matters because (1) severe food insecurity is extremely damaging to health (e.g. adults in Canada who experience severe food insecurity die on average 9 years earlier than those who are food secure[26]); (2) the prevalence of severe food insecurity is rising; and (3) making the elimination of food insecurity a discrete policy goal is essential to ensure that the implemented interventions actually reach and help those affected.[27] The elimination of severe food insecurity is a realistic goal given its high sensitivity to income interventions.[28,29]

Accountability needs to be injected into the policy-making process. With the insertion of food insecurity measurement into the Canadian Income Survey and its inclusion on the Poverty Dashboard of Indicators, the necessary tracking indicators are already in place to evaluate income intervention policy against food insecurity prevalence and severity outcomes. Through an iterative process of intervention and evaluation, using longitudinal studies with repeat measures, the crucial policy levers to minimize household food insecurity in Canada can be honed. The federal department best placed to lead this work is Employment and Social Development Canada.

Reducing food insecurity and eliminating severe food insecurity require both federal

and provincial or territorial policy reforms because both levels of government are responsible for income transfers that, depending on their design, can support or compromise household food security. Old Age Security pensions and the Guaranteed Income Supplement provide vital protection against food insecurity for older adults who rely on these programs.[27] But with food insecurity rates beginning to creep up among older adults,[1] it is imperative to maintain the protective effect of public pensions. In addition, the principles of income adequacy and security that define the Old Age Security/Guaranteed Income Supplement need to be applied to federal and provincial or territorial income support programs for working-age adults and their children. This means ensuring that the CCB enables families living at lower income to afford the food they need. With 32.9% of children aged younger than 18 years now living in families experiencing food insecurity,[1] the CCB urgently needs review. Reviews of Employment Insurance and the Canada Workers Benefit are also required to ensure that these benefits are sufficient to enable recipients to maintain household food security despite involuntary unemployment or underemployment. Provincial and territorial policies relevant to food insecurity include minimum wage, taxation, child and family benefits, and social assistance.[28,30,31] A Basic Income Guarantee[32] could replace many of these federal and provincial and territorial programs and should certainly be evaluated against food insecurity outcomes.

## Conclusion

As the problem of household food insecurity continues to grow, effective evidence-informed responses are badly needed. The systematic reviews of evidence compiled by PHAC provide an important foundation for such action. But the results of these evidence reviews also lay bare the need for accountability, so that no more public funds are wasted on initiatives with no evidence of impact under the guise of addressing food insecurity. We need targets for food insecurity reduction and some accountability for policy interventions that come with significant public investments. Household food insecurity rates and the related adverse consequences are only going to get worse unless we address the inadequate and insecure incomes that are the primary driver of this population health problem.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## Conflicts of interest

The authors declare no conflicts of interest.

## Authors' contributions and statement

VT: Conceptualization, writing—original draft, writing—review and editing.

LM: Conceptualization, writing—original draft, writing—review and editing.

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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# Release notice

# *The Health of Young People in Canada: Focus on Mental Health*

***Wendy Craig, PhD (1); Valerie F. Pagnotta, MSc (2); Stephanie Wadge, MA (2); Matthew King, BA (1); William Pickett, PhD (2,3)***

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The Public Health Agency of Canada has released *The Health of Young People in Canada: Focus on Mental Health*, a report based on the 2022–2023 Health Behaviour in School-aged Children (HBSC) survey. The study collected data from 26 360 students in Grades 6 through 10 across 317 schools and offers insight into youth health and well-being in Canada.

## *Highlights*

Findings show that mental health is a pressing concern, particularly among cisgender girls and transgender and gender-diverse (TGD) youth. Two-thirds (68%) of TGD youth in Grades 9 and 10 reported feeling sad or hopeless almost daily for two weeks or more, compared to 50% of cisgender girls and 23% of cisgender boys. Only 47% of TGD youth in Grades 9 and 10 reported having a happy home life, compared to 66% of cisgender girls and 80% of cisgender boys. Strong relationships with family, friends and teachers were consistently linked to better mental health outcomes.

Problematic social media use was reported by 21% of TGD youth in Grades 6 to 8, compared to 7% of cisgender boys and 12% of cisgender girls. Vaping is also a concern, with 29% of cisgender girls and 26% of TGD youth in Grades 9 and 10 reporting lifetime use of vaping products.

The HBSC Youth Advisory Panel emphasizes the need for improved mental health supports, safe and inclusive schools and greater recognition for the experiences of TGD youth. These youth advisors, aged 11–15 years, provide valuable input to the HBSC reports.

To access or download the national reports, visit the HBSC web page.

**Author references:**

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# Acknowledging our long-serving Associate Scientific Editors

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In 2025, *Health Promotion and Chronic Disease Prevention in Canada* (the HPCDP Journal) renewed its roster of Associate Scientific Editors. In that process we were lucky to gain new and talented Associate Scientific Editors, but unfortunately, a few long-serving editors have moved on.

## *Margaret de Groh*

Margaret de Groh retired from the public service in 2024. During her long and exceptional career with Health Canada and the Public Health Agency of Canada (PHAC), Margaret was part of the inaugural group that forged a path for PHAC in 2004. Throughout her 20-year career at PHAC, Margaret played central roles in the advancement of scientific work on diabetes prevention (notably, the CANRISK project), nutrition and food security projects, and alcohol control policies and PHAC's collaboration with the COMPASS and CLSA research platforms.

Margaret was pivotal at the HPCDP Journal, with unwavering service and leadership from 2015 until her retirement. Throughout her tenure she held numerous roles, including Editor-in-Chief from 2017 to 2019, Associate Scientific Editor (ASE), subject matter expert—including on sex- and gender-based analysis—and Associate Editor-in-Chief. Regardless of her role, she consistently embodied kindness and prioritized individuals. Despite her busy schedule, Margaret was exceptionally generous with her time, always willing to listen, offer assistance and provide support. For many members of the HPCDP Journal team, Margaret was a mentor and an inspiration.

Margaret's dedication and contributions have left an enduring mark on the HPCDP Journal. We extend our sincere gratitude for her years of service and wish her all the best in her retirement.

### *Scott Leatherdale*

The HPCDP Journal acknowledges the significant contributions of Scott Leatherdale, who served as an ASE from 2017 to 2024. Before joining the Journal, Scott was a recipient of a CIHR-PHAC Applied Public Health Chair and had already established himself as a vocal and dedicated advocate for the Journal's mission and its inherent value in the broader public health landscape in Canada.

Scott is known by the Journal team as a steadfast and grounded individual, someone who always upholds his values and beliefs. He consistently demonstrated his keen eye for detail during his numerous thorough manuscript assessments.

The HPCDP Journal team extends its sincere appreciation to Scott for his years of dedicated service and wishes him well in his future endeavours.

### *Paul Villeneuve*

Paul Villeneuve served as an ASE from 2015 to 2025. During his decade of service, Paul was an invaluable member of the Journal team. He was routinely consulted for his tremendous expertise in biostatistics and his insights into the scientific landscape.

Paul consistently demonstrated exceptional reliability in his timely manuscript assessments and communications. A dependable and efficient contributor to the editorial process, Paul was always willing to take on the most difficult editorial tasks, ensuring his standing as an integral team member.

The HPCDP Journal team expresses its sincere gratitude to Paul for his decade of dedicated service. We wish him all the best in his future endeavours.

# Other PHAC publications

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**Researchers from the Public Health Agency of Canada also contribute to work published in other journals and books. Look for the following articles published in 2025:**

Gagnon I, Turner M, Lacasse-Courchesne A, McKee M, Tang ML, Sajjadi M, **Friedman D**, et al. Feasibility of direct-access physical therapy for concussion management in the pediatric emergency department: a pilot implementation study. Phys Ther. 2025; 105(5):pzaf051. https://doi.org/10.1093/ptj/pzaf051

Langevin P, Plotnick LH, Turner M, **Friedman D**, Agnihotram R, Greenstone I, et al. Direct-access physiotherapy to improve access to quality care for children and adolescents presenting to the pediatric emergency department with musculoskeletal problems: the PEDPT-MSK pilot randomized control trial. J Orthop Sports Phys Ther. 2025;55(6):386-450. https://doi.org/10.2519/jospt.2025.13321

Marcellus L, Jack SM, MacKinnon K, Hill ME, Gonzalez A, Campbell K, […] **Tonmyr L**, et al. Strategies to engage and retain pregnant individuals and young mothers in the nurse-family partnership program (Canada): an interpretive descriptive study. Child Abuse Negl. 2025;167:107537. https://doi.org/10.1016/j.chiabu.2025.107537

Nevill AM, **Lang JJ**, Niemz M, Tomkinson GR. How should youth handgrip strength be normalized? New insights using 3-D allometry with "generalizable" norm-referenced values, data from NHANES. Sports Med. 2025:101012. https://doi.org/10.1007/s40279-025-02235-0

**Prince SA**, **Thomas T**, Apparicio P, Rodrigue L, Jobson C, Walker KL, **Butler GP**, **Wasfi R**. Cycling infrastructure as a determinant of cycling for recreation and transportation in Montréal, Canada: a natural experiment using the longitudinal national population health survey. Int J Behav Nutr Phys Act. 2025;22(1):71. https://doi.org/10.1186/s12966-025-01767-y

Raza SZ, Whitten C, **Randell S**, Sparkes B, Denic N. Polysubstance toxicity deaths in Newfoundland and Labrador: a retrospective study. J Public Health (Oxf.). 2025;47(2):114-22. https://doi.org/10.1093/pubmed/fdaf001

**Tanaka M**, **Pollock NJ**, **Shields M**, **Richter S**, **Blair D-L**, Cormier F, […] **Tonmyr L**. Referrals to child and family services during the COVID-19 pandemic: an analysis of administrative data from British Columbia and Northwest Territories, Canada. Child Abuse Negl. 2025;167:107517. https://doi.org/10.1016/j.chiabu.2025.107517

Zuniga YM, Zumla A, Zuhlke LJ, Zoladl M, Ziaeian B, Zhong C, […] **Lang JJ**, […] **Badawi A**, et al. Characterising acute and chronic care needs: insights from the Global Burden of Disease Study 2019. Nat Commun. 2025;16(1):4235. https://doi.org/10.1038/s41467-025-56910-x

https://doi.org/10.24095/hpcdp.46.2.04

# Corrigendum

# Supervised consumption sites and population-level overdose mortality: a systematic review of recent evidence, 2016–2024

*Geneviève Gariépy, PhD (1,2); Rebecca K. M. Prowse, MPH (1); Rebecca Plouffe, MPH (1); Eva Graham, PhD (1,3)*

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This corrigendum is being published to add a clarification on page 361 of the following article:

Gariépy G, Prowse RKM, Plouffe R, Graham E. Supervised consumption sites and population-level overdose mortality: a systematic review of recent evidence, 2016–2024. Health Promot Chronic Dis Prev Can. 2025;45(9):357-66. https://doi.org/10.24095/hpcdp.45.9.02

Text has been added to highlight an important precision about the Rammohan et al. study[1]. Bold has been used to identify the added text.

The authors thank Dr. Daniel Werb for raising this concern.

## Before correction

The two observational studies used ecological study designs to examine associations between SCSs and overdose mortality, one at the province level[33] and the other at the neighbourhood level.[34] In Alberta, a province-wide analysis found that higher SCS visits across the seven provincial SCSs correlated with fewer fentanyl-related overdose deaths between 2017 and 2020 ($r = -0.64$; $p = 0.03$).[33] A study in Toronto, Ontario, compared overdose mortality rates in 2017 and 2019, that is, before and after SCSs were implemented, at different distances from the sites.[34] Neighbourhoods within 500 m of an SCS had 67% fewer overdose deaths per 100 000 people ($p = 0.04$) after the SCSs had been implemented. Areas beyond 500 m of an SCS had 24% fewer deaths, but this difference was not statistically significant ($p = 0.38$).[34] Quality assessment found that both ecological studies had high risk of bias, primarily because of a lack of control for confounding factors (Additional File 3; available from the authors upon request).

## After correction

The two observational studies used ecological study designs to examine associations between SCSs and overdose mortality, one at the province level[33] and the other at the neighbourhood level.[34] In Alberta, a province-wide analysis found that higher SCS visits across the seven provincial SCSs correlated with fewer fentanyl-related overdose deaths between 2017 and 2020 ($r = -0.64$; $p = 0.03$).[33] A study in Toronto, Ontario, compared overdose mortality rates in 2017 and 2019, that is, before and after SCSs were implemented, at different distances from the sites.[34] Neighbourhoods within 500 m of an SCS had 67% fewer overdose deaths per 100 000 people ($p = 0.04$) after the SCSs had been implemented. Areas beyond 500 m of an SCS had 24% fewer deaths, but this difference was not statistically significant ($p = 0.38$).[34] **The study also conducted geographically weighted regression analyses of post-implementation spatial patterns, finding inverse associations between SCS proximity and overdose mortality that strengthened from 2018 to 2019. These analyses adjusted for neighbourhood-level sociodemographic factors and substance-use-related health services.** Quality assessment found that both ecological studies had high risk of bias, primarily because of a lack of control for confounding factors (Additional File 3; available from the authors upon request).

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