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Evidence synthesis

What is known about the prevalence of household food insecurity in Canada during the COVID-19 pandemic: a systematic review

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Abstract

Introduction: Household food insecurity (HFI) is a persistent public health issue in Canada that may have disproportionately affected certain subgroups of the population during the COVID-19 pandemic. The purpose of this systematic review is to report on the prevalence of HFI in the Canadian general population and in subpopulations after the declaration of the COVID-19 pandemic in March 2020.

Methods: Sixteen databases were searched from 1 March 2020 to 5 May 2021. Abstract and full-text screening was conducted by one reviewer and the inclusions verified by a second reviewer. Only studies that reported on the prevalence of HFI in Canadian households were included. Data extraction, risk of bias and certainty of the evidence assessments were conducted by two reviewers.

Results: Of 8986 studies identified in the search, four studies, three of which collected data in April and May 2020, were included. The evidence concerning the prevalence of HFI during the COVID-19 pandemic is very uncertain. The prevalence of HFI (marginal to severe) ranged from 14% to 17% in the general population. Working-age populations aged 18 to 44 years had higher HFI (range: 18%–23%) than adults aged 60+ years (5%–11%). Some of the highest HFI prevalence was observed among households with children (range: 19%–22%), those who had lost their jobs or stopped working due to COVID-19 (24%–39%) and those with job insecurity (26%).

Conclusion: The evidence suggests that the COVID-19 pandemic may have slightly increased total household food insecurity in Canada during the pandemic, especially in populations that were already vulnerable to HFI. There is a need to continue to monitor HFI in Canada.

Keywords: *food insecurity, COVID-19, systematic review, underserved populations, Canada*

Highlights

- This review examined household food insecurity (HFI) during the COVID-19 pandemic in Canada, with data collected between April 2020 and April 2021.
- The reported HFI prevalence among the general population ranged from 14% to 17%. Subpopulations most vulnerable to HFI included households whose working-age members lost their employment (range: 24%–39%) or were job-insecure (26%) and households with children (range: 19%–22%). The certainty of evidence for most findings was low to very low, which means the interpretation could change as new research findings emerge.
- The evidence suggests that the COVID-19 pandemic may have slightly increased total household food insecurity in Canada during the pandemic, especially in populations that were already vulnerable to HFI.
- New research on the impacts of COVID-19 on household food insecurity in the territories, in remote communities and among Indigenous and racialized populations is needed.

Highlights continued on the following page

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Highlights (continued)

- Policies and interventions are needed to reduce HFI in Canada within the context of the pandemic, the pandemic recovery period and beyond.

Introduction

Household food insecurity (HFI) is a persistent public health issue in Canada and can be understood as a harmful lack in the basic human right to food.[1,2] It is a marker of both deprivation and impoverishment and is a potent social determinant of health.[3] Prior to the COVID-19 pandemic, 1 in 8 households (12.7%) in Canada were food-insecure,[1] representing 4.4 million Canadians, including 1.2 million children.[1]

The measurement and monitoring of household food insecurity in Canada adopts a narrow focus, defining food insecurity as the inadequate or insecure access to food due to financial constraints. In Canada nationally, and in this paper, household food insecurity is operationalized using responses to the Household Food Security Survey Module.[4] Research has consistently demonstrated that those living in food-insecure households have poorer mental, physical and oral health, report greater stress and are more likely to suffer from chronic conditions such as diabetes, hypertension and mood and anxiety disorders.[5-9] HFI is also associated with more frequent hospitalizations and early death.[10] Health care costs among severely food-insecure adults are more than double that of food-secure adults, even after adjusting for well-established social determinants of health, such as education and income levels.[11]

Monitoring of HFI in Canada for almost two decades has shown that some segments of society are more affected than others. For example, one-third (33.1%) of female-led, lone-parent households are food-insecure.[1] HFI also differs markedly by Indigenous status and cultural group. Some of the highest rates of food insecurity have been found among households in which the respondent identified as Indigenous (28.2%) or Black (28.9%).[1] While being unemployed can contribute to HFI, data collected prior to the COVID-19 pandemic show that most food-insecure households had members who were in the workforce.[1,12] In 2017–2018, two out of three (65.0%) food-insecure households reported their main source of income as wages or salaries from employment rather than social assistance, employment insurance or seniors' pensions.[1] Another study found that most food-insecure working households had members that worked in low-wage, temporary or part-time jobs.[12] The COVID-19 pandemic has had a disproportionate impact on some of these same subpopulations in terms of both COVID-19 cases and hospitalizations, as well as indirect effects such as unemployment.[13]

To inform HFI policy and action in Canada, we undertook a systematic review of the prevalence of HFI in Canada during the COVID-19 pandemic. The purpose of this review was to report on the prevalence of HFI in the general population, and to identify subpopulations that may be more affected by HFI. This is important, as there is speculation that the COVID-19 pandemic has negatively affected household food insecurity among vulnerable subgroups.[13]

Methods

Review scope and team

This systematic review built upon the studies identified by a rapid review of the evidence on the prevalence of HFI in North America during the COVID-19 pandemic conducted by the National Collaborating Centre for Methods and Tools (NCCMT).[14] The methods used in that rapid review differed from a traditional systematic review in terms of the screening process. In this case, only one reviewer screened the titles and abstracts, as opposed to the usual two people independently screening the abstracts and full text for inclusion. All inclusions were later verified by an independent second reviewer. The list of included studies was also confirmed with two subject matter experts to ensure that no studies were missing.

Using the studies with Canadian data identified by the NCCMT rapid review, our multidisciplinary team, with expertise in knowledge synthesis, epidemiology, chronic and infectious diseases and public health, undertook independent data extraction, risk of bias assessment and quality of evidence evaluation. The review methods were established prior to the conduct of the review and carried out with no significant deviations. The outcome domain to be assessed was HFI.

Search strategy, inclusion criteria and selection process

As part of the original NCCMT rapid review, 16 databases were searched from 1 March 2020 up to and including 5 May 2021, using key terms related to food insecurity. A full copy of the search strategy is available online.[15] Searches were limited to English- and French-language studies, and there were no restrictions based on publication status: peer-reviewed, preprint and non–peer reviewed sources were included. All identified references were exported into DistillerSR systematic review software (Evidence Partners, Inc., Ottawa, ON, Canada) and duplicates were removed. A single reviewer screened all titles and abstracts for potential eligibility. Another reviewer screened full-text articles of all potentially eligible studies for final inclusion. These inclusions were verified by a second reviewer at the data extraction stage. Conflicts were resolved by a third reviewer. More detailed information about the rapid review can be found elsewhere.[14]

In the current systematic review, we included studies from the NCCMT rapid review that reported on the prevalence of HFI in Canadian households. Studies that included households outside of Canada were only included if they reported on Canadian HFI separately. We included data collected after the declaration of the COVID-19 pandemic (11 March 2020). Studies that reported a comparison to prepandemic values were included if they provided data on HFI prevalence during the pandemic.

Data extraction

A form was developed to extract data on key study characteristics (e.g. study design, date of study, tool used to measure HFI), participant characteristics (e.g. demographic and socioeconomic variables) and HFI prevalence outcomes (data extraction form available upon request). The form was pre-tested by all three reviewers to ensure clarity and consistency and that all the necessary information to address the research topic was extracted. For each HFI outcome, the prevalence, numerator and denominator were extracted along with the confidence interval, range and/or standard deviation.

Prevalence estimates were extracted for the general population as well as for subgroups of interest, which were identified in consultation with subject matter experts as well as policy makers at the Public Health Agency of Canada. These subgroups were: low-income households, single-parent households, Indigenous households, households with children, home ownership status (owner, renter), main source of income of household head, employment status of household head, sex or gender of the household head, race or racial identity of household head, and sexual orientation of the household head. Subpopulation analysis was not limited to these populations, and other affected groups were included in the analysis as necessary. One reviewer extracted the study characteristics and outcomes, and a second reviewer verified the extracted information. Any discrepancies found by the verifier were discussed and resolved by consensus. In the event of missing or unclear data, the original authors of the studies were contacted.

Risk of bias and certainty of evidence appraisal

We first assessed the risk of bias of individual studies using a validated critical appraisal tool for prevalence studies designed by the Joanna Briggs Institute (JBI).[16] The checklist includes nine questions focussed on assessing selection and information bias. We then assessed the certainty of evidence of each HFI outcome (total HFI, to include marginal, moderate and severe HFI vs. moderate and severe HFI) by applying the Grading of Recommendations Assessment, Development and Evaluation (GRADE) methodology.[17]

Two modifications were made to the JBI critical appraisal tool when applying risk of bias within the GRADE assessment. Question 3, pertaining to sample size, was removed, as this question was assessed during the GRADE assessment and we did not want to double penalize any study. Question 4, pertaining to the detailed description of subjects and setting, was considered not applicable, as this item relates to an issue of reporting rather than the study's risk of bias. Therefore, seven questions in total were included in the risk of bias assessment as it was utilized in the GRADE assessment. Two reviewers independently assessed risk of bias for each study. Reviewers resolved conflicts through consensus or consultation with a third reviewer. In the event of missing or unclear data, the original authors of the included studies were contacted.

In the absence of a formal framework for prevalence in GRADE, we used the GRADE framework for assessment of incidence estimates in the context of prognostic studies.[17] We then made specific adaptions, similar to what others have done[18] (details available upon request). One reviewer assessed the quality of the body of evidence for each outcome and another verified the assessment, with disagreements resolved through discussion or consultation with a third reviewer. Details of the GRADE decision framework are outlined in Table 1. Following guidelines,[17] we initially assigned the certainty of evidence from studies of all designs as "high" for all outcomes, with final level of certainty rating scored as high (0 point loss), moderate (−0.5 to −1.5 points), low (−2 to −3 points) or very low (−3.5 points or more).

Synthesis methods

We conducted a narrative synthesis of the evidence for the research question according to overall findings that emerged from the literature. Individual studies were compared based on the characteristics of the populations, the outcome measures and the reference time period. Meta-analyses were planned if more than two studies were available that adequately reported similar data suitable for pooling.

Results

Study selection

Figure 1 presents the study selection process using the PRISMA flow diagram.[19] Reasons for exclusion were not reported due to the rapid time frame of the NCCMT rapid review. A total of 8986 studies were identified in the search (8973 from databases and registers and 13 from other sources), of which 144 were deemed potentially relevant. Six publications, representing four unique datasets, were deemed eligible for inclusion in this review.[13,20-24] Three studies[13,20,21] reported findings from the same dataset collected in May 2020 as part of the Canadian Perspectives Survey Series (CPSS-2) from Statistics Canada. All three CPSS-2 studies reported prevalence values within 1% of each other, with small differences due to criteria for inclusion of data in the final analysis. Among these studies,[13,20,21] we excluded two studies and included only the study by Men and Tarasuk[13] in our review, as this study reported on HFI in the most detail for the subpopulations of interest and was the only peer-reviewed study utilizing the data. Four studies were therefore ultimately included in the current review.[13,22-24]

Study characteristics

The study characteristics are included in Table 2. All four studies utilized web surveys to collect data. Two studies were large, population-based, cross-sectional surveys[13,24] and two studies were cross-sectional surveys conducted within the context of an ongoing longitudinal cohort study.[22,23] Three studies were peer-reviewed[13,22,23] and one was a non–peer reviewed government report.[24] Sample sizes varied from 254 to 6691 participants. Each study used a different instrument to measure HFI and different criteria to define HFI. For example, one study[22] defined HFI as moderate or severe experiences of HFI, whereas the other studies included marginal, moderate and severe experiences of HFI.[13,23,24] Three studies measured HFI over the previous 30 days,[13,23,24] while one study[22] used a reference period of 7 days. Three studies collected data in the first wave of the pandemic, between April and May 2020,[13,22,23] and one in the third wave, in April 2021.[24]

Risk of bias in studies

A summary of the risk of bias assessments is provided in Table 3, with detailed assessments available upon request. Serious concerns about risk of bias were found for three of the four included studies,[22-24] while the remaining study was assessed at low risk of bias.[13]

Prevalence of HFI

The prevalence of total HFI for the general population (including marginal, moderate and severe HFI) ranged from 14% to 17% across included studies (low certainty; Table 4). Thus, the evidence suggests that the COVID-19 pandemic may have slightly increased total household food insecurity. The prevalence of moderate and severe HFI over the last 30 days was 10% (very

TABLE 1
GRADE decision rules framework as applied in the systematic review on household food insecurity, Canada, March 2020 to May 2021

Factors that can affect the quality of evidence	Rating of evidence	Number of points	Decision rules
Risk of bias	No serious risk of bias	0	• All studies that were considered had no serious ROB
	Serious risk of bias	−0.5 point	• At least one study was considered to be at serious risk of bias
		−1 point	**If data synthesized narratively:** • ≥ 1 study had very serious ROB, but a study at very serious ROB **was not** outside the expected prevalence range as judged by SMEs **If data synthesized by random effects MA:** • ≥ 1 study (but < 50% of total studies) had very serious ROB
	Very serious risk of bias	−1.5 points	**If data synthesized narratively:** • ≥ 1 study had very serious ROB, and a study with very serious ROB **was** outside the expected prevalence range as judged by SMEs **If data synthesized by random effects MA:** • 50% or more of studies contributing to an outcome had very serious ROB
Inconsistency[a]	No serious inconsistency	0	• In the judgment of SMEs, heterogeneity was considered expected or acceptable • Heterogeneity could be explained by a priori–determined subgroup analyses
	Serious inconsistency	−0.5 point	• Heterogeneity could be partially (but not completely) explained by a priori–determined subgroup analyses
		−1 point	• Only one study contributed to an outcome • Heterogeneity could not be explained by a priori–determined subgroup analyses
Indirectness	No serious indirectness	0	• The study populations corresponded to the general Canadian population • The outcome measured was HFI over a 12-month reference period
	Serious indirectness	−0.5 point	• The study/studies contributing to an outcome did not include people living in the territories, but was/were otherwise representative of the general population
		−0.5 point	• The outcomes were measured over a period of less than 12 months
	Very serious indirectness	−1 point	• The study/studies contributing to an outcome did not include people living in the territories, and was/were also not representative of the general population
Imprecision	No serious imprecision	0	• If the OIS was met • If it was not clear whether the OIS was met (i.e. due to missing information), but the subgroup sample was drawn from large population surveys (more than 2000 respondents), then there is not risk of serious imprecision, unless there is suspicion that the subgroup represents a rare event
	Serious imprecision	−0.5 point	• If the OIS was not met and the sample included fewer than 2000 respondents • If it is not clear whether the OIS was met (i.e. due to missing information) AND there is suspicion that the subgroup represented a rare event, even if the sample was drawn from a large population survey (> 2000 respondents)
Publication bias	No serious risk of publication bias	0	• Due to the fact that pre-prints as well as unpublished grey literature and reports were included in this review, we do not expect that important results were missed. In addition, any other surveys conducted were likely small online surveys and are not likely to have a great impact on the results

Abbreviations: GRADE, Grading of Recommendations Assessment, Development and Evaluation[17]; HFI, household food insecurity; MA, meta-analysis; OIS, optimal information size; ROB, risk of bias; SME, subject matter expert.

Notes: The quality of the prevalence evidence from studies of all designs was initially assigned as "high" for all outcomes.[17] We did not consider upgrading the quality of the evidence given that upgrading is only appropriate when there is no cause to downgrade, and the quality of evidence was initially assigned as "high." Final scoring for the overall certainty of evidence was as follows: 0.5 to 1.5 points = "moderate"; −2 to −3 points = "low"; –3.5 points or more = "very low."

[a] I^2 values were not considered because high I^2 values are expected in a MA of prevalence studies that include heterogeneous populations.

low certainty; Table 5). The prevalence of moderate and severe HFI over the last 7 days was 1% (very low certainty; Table 5). The COVID-19 pandemic may have increased the prevalence of moderate and severe HFI, but the evidence is very uncertain and new evidence may change the interpretation of this data.

Data by subgroup for all levels of HFI are summarized below. GRADE was applied to all subgroup analyses, as detailed in Tables 4 and 5.

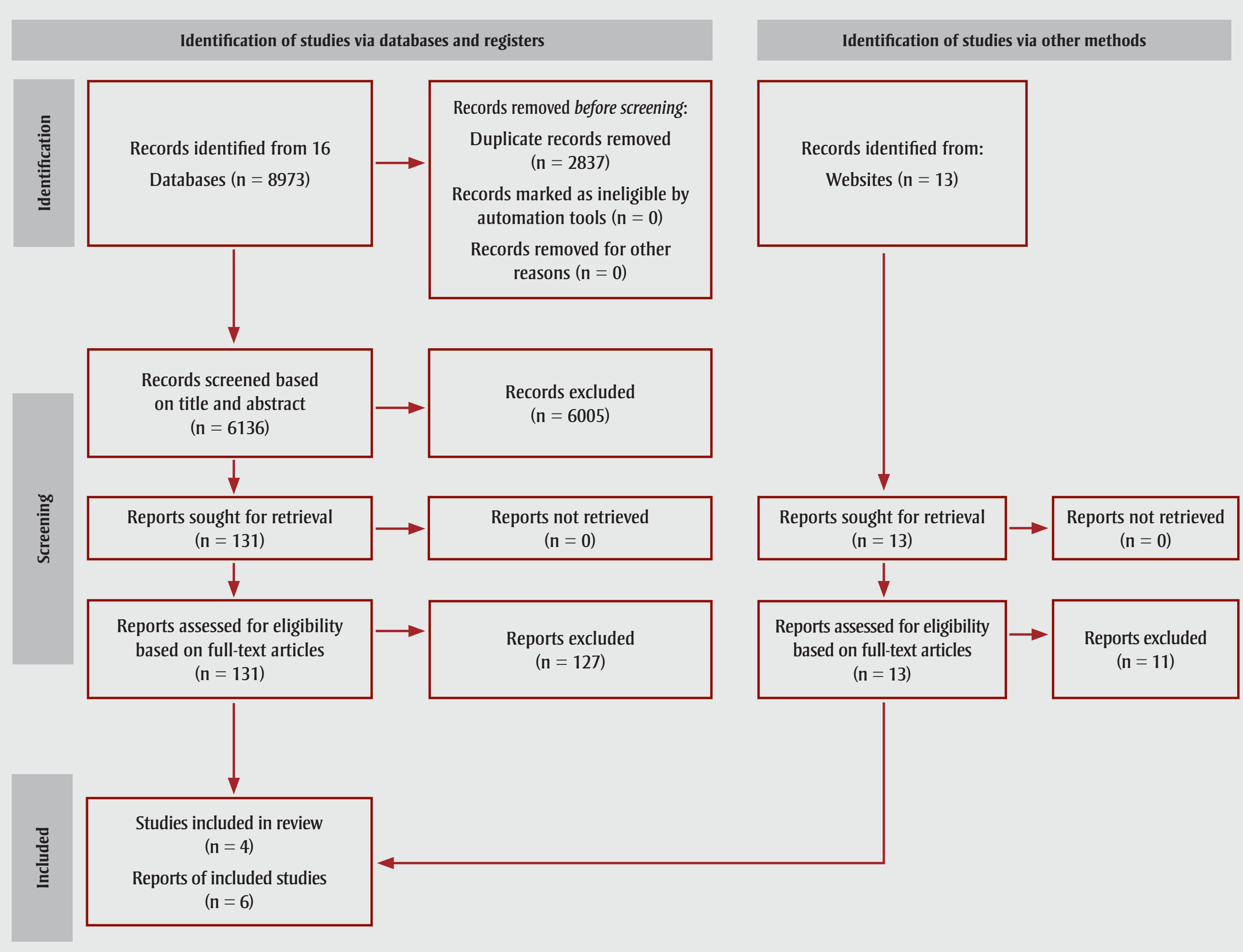
Households with children

Two studies reported higher HFI prevalence in households with versus without children (22% vs. 16% and 19% vs. 12%, respectively); however, no formal statistical tests were conducted for between-group differences, as confidence intervals were not reported in the original studies.[13,24]

Age

Two studies reported on HFI prevalence and age of the primary respondent.[13,24] One study found that the highest prevalence of

FIGURE 1
PRISMA flow diagram of study selection for HFI systematic review, Canada, March 2020 to May 2021



Abbreviation: HFI, household food insecurity.

HFI was in those aged 18 to 44 (range: 21%–22%) and the lowest prevalence in those aged 60 and older (range: 9%–11%).[24] A second study found that respondents aged 25 to 34 years had the highest HFI prevalence (range: 18%–23%) among all age groups, whereas those aged 65 and older had the lowest prevalence (range: 5%–7%).[13] No statistical testing was reported for between-group differences.

Gender

Two studies found similar HFI prevalence by respondent's gender, with 17% in both men and women in one study[24] and 15% in men and 14% in women in another study.[13] A third study found similar prevalence of HFI among middle- and high-income parents in Ontario, ranging from 9% for mothers to 5% for fathers.[23]

Living conditions

One study found that HFI among those living in apartments, flats, or double, row or terrace housing was 19%, and 12% in those living in single, detached houses.[13] The same study reported HFI in rural (17%) and urban (14%) residents.[13] A second study found similar HFI prevalence among urban (10% in metropolitan region residents) and rural residents (11%).[24]

Immigrant status

One study found that HFI was 22% among immigrants and 16% among non-immigrants,[24] while a second found similar HFI prevalence between immigrant status (15% immigrants vs. 14% Canadian-born).[13]

Education

Two studies found HFI prevalence to be between 15% and 20% among those with a high school diploma and 11% to 12% among those with a university degree.[13,24]

Marital status

One study described HFI prevalence by marital status, reporting 21% HFI among single or never married populations versus 10% among married couples.[13]

Employment circumstances

Two studies found different HFI prevalence by employment circumstances.[13,24] One found that among those who were absent from work in the last week because of a business closure or layoff due to COVID-19, the prevalence of HFI was 32% (compared to 11% for those at work without absence). The study also reported that 26% of job-insecure individuals experienced HFI compared with 8% of their

TABLE 2
Selected study characteristics, systematic review of household food insecurity in Canada, March 2020 to May 2021

First author, year	Location	Study design	Dates of data collection	Sample size and recruitment	Response rate	Income	Age in years (SD)	HFI measure	Reported outcome
Carroll, 2020	City of Guelph, Ontario	Cross-sectional online survey	April–May 2020	N = 254 families with children under 11, recruited from the Guelph Family Health Study	83%	56.7% HH income more than CAD 100 000 per year	Mean age of mothers: 37.5 (4.8) fathers: 39.4 (5.5)	**Definition**: presence of HFI **Tool**: single question (not enough money to buy food) (not validated)[a] **Reference period**: last 30 days	Prevalence of HFI, unadjusted
INSPQ, 2021	Quebec province	Cross-sectional online survey	April 2021	N = 6691 adults recruited through an online web panel	10%	NR	18–44: 42% 45–59: 26% 60+: 33%	**Definition**: marginal to severe HFI **Tool**: 4 items derived from the 18-item HFSSM[b] (not validated) **Reference period**: last 30 days	Prevalence of HFI, weighted to approximate the sociodemographic distribution of the Quebec adult population
Lamarche, 2021	Quebec province	Cross-sectional online survey	April–May 2020	N = 922 adults, recruited from the NutriQuébec study	37%	39.5% HH income more than CAD 100 000 per year	18–49: 50% 50–69: 34% 70+: 16%	**Definition**: moderate to severe HFI **Tool**: 15 items derived from the 18-item HFSSM (not validated)[c] **Reference period**: last 7 days	Prevalence of HFI, weighted to approximate the sociodemographic distribution of the Quebec adult population and probability of nonresponse
Men and Tarasuk, 2021	All 10 Canadian provinces	Cross-sectional online survey	May 2020	N = 4410. The CPSS-2 draws a probability sample from respondents to the Labour Force Survey 2019. Canadians aged 15+ years living in 10 provinces	64%	NR	15–44: 48% 45–64: 32% 65+: 20%	**Definition**: marginal to severe HFI **Tool**: validated 6-item questionnaire derived from the 18-item HFSSM[d] **Reference period**: last 30 days	Prevalence of HFI, weighted to approximate the sociodemographic distribution of the Canadian population

Abbreviations: CPSS-2, Canadian Perspectives Survey Series-2; HFI, household food insecurity; HFSSM, Household Food Security Survey Module (gold standard for measurement of HFI); HH, household; INSPQ, Institut national de santé publique du Québec; NR, not reported; SD, standard deviation.

Note: Totals may not equal 100 due to rounding.

[a] HFSSM items: a single question related to HFI was asked ("During the past month, was there a time when you were worried you would not have enough money to buy food for you and your family?"). The question related to whether parents were worried about running out of food over the next 6 months was excluded, as this is a prediction and not a measure of experienced HFI.

[b] HFSSM items: worried that food would run out; cannot afford balanced meals; food did not last; ate less than they should.

[c] HFSSM items: the three questions relating to frequency were not asked.

[d] HFSSM items: food did not last; cannot afford balanced meals; frequency of cutting meal size; frequency of skipping meal; eat less than they should; go hungry.

TABLE 3
Risk of bias assessments for systematic review of HFI, Canada, March 2020 to May 2021

Question	Carroll et al. (2020)	INSPQ (2021)	Lamarche et al. (2021)	Men and Tarasuk (2021)
1. Was the sample frame appropriate to address the target population?	No	No	No	Yes
2. Were study participants sampled in an appropriate way?	No	No	No	Yes
3. Was the sample size adequate?[a]	No	Yes	Yes	Yes
4. Were the study subjects and setting described in detail?[a]	Yes	Yes (upon request)	Yes	Yes
5. Was data analysis conducted with sufficient coverage of the identified sample?	No	No	No	No
6. Were valid methods used to identify HFI?	No	No	No	Yes
7. Was HFI measured in a standard, reliable way for all participants?	Yes	Yes	Yes	Yes
8. Was there appropriate statistical analysis?	No	No	No	Yes
9. Was the response rate adequate, and if not, was the low response rate managed appropriately?	Yes	Yes	Yes	Yes
Score	6 of 9	5 of 9	5 of 9	1 of 9
Overall risk of bias[b]	**Serious ROB**	**Serious ROB**	**Serious ROB**	**Low ROB**
Risk of bias as applied in GRADE[c]	5 of 7	5 of 7	5 of 7	1 of 7

Abbreviations: GRADE, Grading of Recommendations Assessment, Development and Evaluation; HFI, household food insecurity; INSPQ, Institut national de santé publique du Québec; ROB, risk of bias.

[a] These items were not included in the risk of bias, as it was applied during the GRADE assessment.

[b] Studies that included 0–2 negative responses were considered to be not at serious risk of bias, 3–6 negative responses at serious risk of bias, and 7–9 negative responses at very serious risk of bias for the GRADE assessment.

[c] Studies that included 0–1 negative responses were considered to be not at serious risk of bias, 2–4 negative responses at serious risk of bias, and 5–7 negative responses at very serious risk of bias for the GRADE assessment.

job-secure counterparts.[13] Similarly, a second study found that HFI was high for people experiencing job loss or work leave (39%).[24] The same study also found that food insecurity was at least twice as prevalent among applicants for Canada Emergency Response Benefit (CERB) (28%) and employment insurance (EI) (23%) as among non-applicants (11%).[24]

Overall, the evidence suggests that the COVID-19 pandemic may have resulted in an increase in prevalence of HFI among the known vulnerable subgroups identified above. Due to the lack of data, we were not able to assess levels of HFI among those with vulnerabilities related to household income or housing status, nor among households with Indigenous members or racialized communities. Their omission should not preclude concern for their continued or increased HFI during the COVID-19 pandemic.

Discussion

The purpose of this systematic review was to determine the prevalence of HFI in Canada during the COVID-19 pandemic in the general population and in subpopulations. We found four studies that assessed HFI, three in the early pandemic during the first wave (April–May 2020) and one during the third wave (April 2021). These studies reported a prevalence of 14% to 17% for the general population. Results further indicated that households with children, households with members who had lost their jobs or stopped working due to the pandemic and households where members faced job insecurity (might lose job) had the highest prevalence of HFI. In addition, working-age populations (aged 18–44) were most affected; however, these differences should be interpreted cautiously; no statistical testing was conducted to determine whether differences were statistically significant, as confidence intervals were not reported in these studies. Consistent with prepandemic studies, there were low rates of HFI among seniors, in line with previous evidence demonstrating the protectiveness of the guaranteed annual income pension program.[25]

The certainty of evidence for most findings was low to very low, which means the interpretations could change as new research findings emerge. We believe that the true prevalence of HFI may be greater than reported in these studies, particularly among vulnerable subgroups such as those living in remote regions of Canada, low-income individuals and those in tenuous living situations—not all of whom were captured by the studies included in this review. The reasons for this are explicated below.

First, HFI in territories, remote or isolated communities and Indigenous populations was not specifically assessed in any of the studies, due to a lack of data. The prevalence of HFI has traditionally been higher in these populations, and while they represent a small population, their exclusion could contribute to an overall underestimation of HFI prevalence in Canada. Two of the four studies were conducted in Quebec, which had the lowest HFI prevalence rate of all the provinces and territories before the pandemic, in 2017–2018 (11.1% vs. 12.7% across Canada).[1]

Second, all data came from web-based surveys, which may have favoured the participation of more affluent populations with more time and resources, and under-represented disadvantaged populations who are at higher risk of HFI. For instance, two studies included a large proportion of older people, who are traditionally more food secure than the general population of Canada,[22,24] and two studies included a large proportion of people with a higher average income (> CAD 100 000) than the general population.[22,23] Such populations tend to have lower rates of HFI. Thus, the

TABLE 4
Prevalence of total household food insecurity (marginal, moderate and severe) among selected subpopulations from a systematic review of HFI, Canada, March 2020 to May 2021

Subpopulations	Prevalence of food insecurity (%)		GRADE certainty rating
	INSPQ (2021)	Men and Tarasuk (2021)	
General population	17	14	Low[c]
Age (years)			
18–44	Range 18–22	Range 18–23[a]	Low[c]
60+	Range 9–11	Range 5–7[b]	Low[c]
Gender			
Men	17	15	Low[c]
Women	17	14	Low[c]
Household status			
Households with children	22	19	Low[c]
Households with no children	16	12	Low[c]
Place of residence			
Urban	10	14	Low[c]
Rural	11	17	Low[c]
Education			
High school or less	20	15	Low[c]
University degree	12	11	Low[c]
Housing type			
Apartment, flat or double, row, or terrace housing	NR	19	Low[d]
Single detached houses	NR	12	Low[d]
Immigration status			
Immigrant	22	15	Low[c]
Non-immigrant	16	14	Low[c]
Marital status			
Single or never married	NR	21	Low[d]
Married	NR	10	Low[d]
Work-related indicators			
Job loss or work leave	39	NR	Very low[e]
Worked full-time continuously	17	NR	Very low[e]
Absence			
Absent from work	NR	24	Low[d]
Worked without absence	NR	11	Low[d]
Job security			
Job secure	NR	8	Low[d]
Job insecure	NR	26	Low[d]
Government programs			
Applied for CERB	28	NR	Very low[e]
Applied for EI	23	NR	Very low[e]
Did not apply for CERB or EI	11	NR	Very low[e]

Abbreviations: CERB, Canada Emergency Response Benefit; EI, employment insurance; GRADE, Grading of Recommendations Assessment, Development and Evaluation; HFI, household food insecurity; INSPQ, Institut national de santé publique du Québec; NR, not reported.

[a] The lower age bracket in this study was 15 years old.

[b] The age bracket was 65 and older.

[c] One study has a serious risk of bias; however, the prevalence estimate was not outside the expected range; outcomes were measured over less than 12 months; data do not include the territories.

[d] A single study contributed to this outcome; data are not representative of Canadian population (do not include the territories).

[e] A very serious risk of bias; only a single study contributed to this outcome; data are not representative of Canadian population (do not include the territories).

TABLE 5
Prevalence of moderate and severe household food insecurity among selected populations from a systematic review of HFI, Canada, March 2020 to May 2021

Subpopulations	Prevalence of food insecurity (%)		GRADE certainty rating
	INSPQ (2021)	Lamarche et al. (2021)	
General population	10	1	Very low[a]
Age (years)			
18–44	Range 14–15	NR	Very low[b]
60+	Range 3–4	NR	Very low[b]
Household status			
Households with children	13	NR	Very low[b]
Households with no children	9	NR	Very low[b]
Work-related indicators			
Job loss or work leave	31	NR	Very low[b]

Abbreviations: GRADE, Grading of Recommendations Assessment, Development and Evaluation; HFI, household food insecurity; INSPQ, Institut national de santé publique du Québec; NR, not reported.

Note: The recall periods for the INSPQ and Lamarche studies were 30 and 7 days, respectively.

[a] Both studies have a serious risk of bias, and Lamarche et al.[22] was outside the expected range; outcomes were measured over less than 12 months; data do not include the territories.

[b] A very serious risk of bias; only a single study contributed to this outcome; data are not representative of Canadian population (do not include the territories).

use of a web survey may have underestimated the prevalence of HFI.

Third, as data were mostly collected in the early pandemic (April–May 2020), some households may not yet have fully experienced the impact of employment and income loss on their HFI.

Fourth, a 7-day or 30-day reference period is not as sensitive as a 12-month period to capture HFI, and thus we would expect HFI over the year to be higher. Given that three of the four studies were conducted at the start of the COVID-19 pandemic,[13,22,23] it was not possible for researchers to use a 12-month period to calculate HFI during the pandemic. However, as the pandemic has now been ongoing for nearly two years at the time of writing, future studies should use an expanded time period to collect these data.

To determine whether the COVID-19 pandemic–associated public health measures influenced HFI prevalence, a comparison to prepandemic data is needed. While a direct comparison of these data to prepandemic levels of HFI is not possible due to differences in methodology, we are nonetheless able to make indirect comparisons using Statistics Canada data. A recent report, utilizing the CPSS-2 data, found that one in seven households in the 10 provinces were affected by HFI in April 2020.[20] After adjusting for differences in the questionnaire and reference time period, the authors found that food insecurity was significantly higher during the early COVID-19 pandemic in comparison to Statistics Canada 2017–2018 data:[21] 14.6% versus 10.5%, respectively. Unfortunately, this was a 30-day measure collected in April 2020 and we do not have data describing what happened after this date. Data from the Institut national de santé publique du Québec (INSPQ) at various time points between August 2020 and April 2021 demonstrate that HFI remained relatively stable in Quebec over time (range: 17%–19%)*; however, these findings may not be directly generalizable to other Canadian provinces and territories.

This review shows that people in working-age households, households with children and those who either lost their jobs or were job insecure may have suffered the highest levels of HFI. While the COVID-19 pandemic did not create HFI in Canada, many of the subpopulations with high HFI are also some of the most impacted by employment and income loss as a result of the pandemic. HFI is tightly linked to income and reflects the broader material circumstances of households, such as income, assets like property, and other resources that a household could draw upon.[1] It seems that HFI was particularly prevalent among workers who were not able to work due to the pandemic business closures.[13,24] Between February and April 2020, half of job losses occurred in the bottom earnings quartile, disproportionately affecting the younger, hourly paid, and non-unionized workers.[26] Between March and May 2020, nearly half of the residents in the 10 provinces indicated that the COVID-19 pandemic had impacted their ability to meet financial obligations or essential needs.[27]

Taken together, findings point to the role that financial resources and income play in HFI. Benefit programs, such as the CERB and the Canada Recovery Benefit (CRB), may have offset some of the impact on certain Canadian households. CERB was launched on 6 April 2020 and ran through September 2020, when it was replaced by the CRB for unemployed workers ineligible for EI. The aim of these programs was to provide temporary income to Canadians who faced unemployment due to the COVID-19 pandemic. As most of the data in this review were collected in the early pandemic (April–May 2020), some of the benefits from CERB and other programs may have been missed.

Food banks are another intervention commonly used to address food insecurity in the short term, but data both prior to and during the pandemic show that very few food-insecure households use food banks on a regular basis.[13] Two studies[13,20] utilizing the CPSS-2 dataset assessed food bank usage during the early pandemic in May 2020. Polsky et al.[20] found that only 9.3% of food-insecure households had used a community organization to access free food within the last month. Men and Tarasuk[13] reported that only 4.3% of households used food charity more than once in the last month. Given the low usage of food banks, other solutions that target issues of chronic poverty are required, particularly within the context of the pandemic and pandemic recovery periods.

Strengths and limitations

Findings from this review should be interpreted with caution, given a number of limitations. First, there is very limited

* Data collected by the INSPQ prior to August 2020 are not comparable because HFI was measured using a different reference period (past 15 days vs. past 30 days).

evidence, as only three peer-reviewed and one non–peer reviewed study were identified. Second, with the exception of the CPSS-2 data, the data were limited to a single province or city, and no study included data from the territories. Third, most studies used convenience samples that favoured populations with higher socioeconomic status. While three studies used weighting methods to approximate the target population, this may provide only part generalizability, as the weighted data were still skewed in some instances. Fourth, most of the evidence is from the early pandemic (April–May 2020), with the exception of the INSPQ data (April 2021), thus we are unable to assess trends over time. Fifth, there is very serious risk of bias related to three of the four studies included. Therefore, the results should be interpreted with caution, as newly emerging evidence may change the interpretation of the results of this review. Sixth, the measures used to assess HFI differed across the four studies and we were therefore unable to pool data. Seventh, the expedited screening process may have introduced some risk of bias, due to not using two independent reviewers for screening.

Moving forward, we recommend further research on trends in HFI over time from high-quality representative surveys to compare early in the pandemic to later time points. Standardization of HFI measures is also needed to allow comparisons across populations and time. In addition, it will be important to capture other subgroups such as racialized populations, Indigenous people, LGBTQ+ communities, single parents, isolated or remote communities and people living in the territories, all of which have had traditionally higher rates of HFI. Finally, the impact of policy interventions, such as the CERB, is still unknown. Focussed research is required to determine the effect that these types of programs may have had on mitigating HFI.

Conclusion

This research draws attention to the important issue of food insecurity in Canada, especially as it affects vulnerable groups, and it adds to the limited information available that is specific to COVID-19. This review identifies knowledge gaps and can inform actions for HFI, specifically within the Canadian pandemic context. HFI is not a new issue related to the pandemic but a longstanding and prevalent problem that may have been exacerbated by the pandemic. The COVID-19 pandemic disrupted financial resources for many households, especially low-income households, those with young children, and those in tenuous work environments. Loss or reduction in employment due to the pandemic shutdown likely contributed to HFI. Populations most vulnerable to HFI appear to be households with working-age members who lost their employment or were job insecure, and households with children. This is not a departure from prepandemic vulnerable populations; the pandemic has only shone a spotlight on the already affected populations.

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Conflicts of interest

The authors have no conflicts of interest.

Authors’ contributions and statement

LI, GG and AJG contributed to the conceptualization of the work; LI, GG and TC conducted the data extraction, risk of bias and GRADE assessment; LI and GG jointly drafted the manuscript; VT, LM, SNS, MD, SS, TC and AJG contributed to the interpretation of the data and revised the manuscript critically for important intellectual content; all co-authors reviewed, edited and approved the final manuscript.

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

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Evidence synthesis

A comparative systematic scan of COVID-19 health literacy information sources for Canadian university students

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Abstract

Introduction: With the rapid spread of online coronavirus-related health information, it is important to ensure that this information is reliable and effectively communicated. This study observes the dissemination of COVID-19 health literacy information by Canadian postsecondary institutions aimed at university students as compared to provincial and federal government COVID-19 guidelines.

Methods: We conducted a systematic scan of web pages from Canadian provincial and federal governments and from selected Canadian universities to identify how health information is presented to university students. We used our previously implemented health literacy survey with Canadian postsecondary students as a sampling frame to determine which academic institutions to include. We then used specific search terms to identify relevant web pages using Google and integrated search functions on government websites, and compared the information available on pandemic measures categorized by university response strategies, sources of expertise and branding approaches.

Results: Our scan of Canadian government and university web pages found that universities similarly created one main page for COVID-19 updates and information and linked to public sector agencies as a main resource, and mainly differed in their provincial and local sources for obtaining information. They also differed in their strategies for communicating and displaying this information to their respective students.

Conclusion: The universities in our sample outlined similar policies for their students, aligning with Canadian government public health recommendations and their respective provincial or regional health authorities. Maintaining the accuracy of these information sources is important to ensure student health literacy and counter misinformation about COVID-19.

***Keywords:** COVID-19, health literacy, public health, online information, Canada, postsecondary students, university*

Highlights

- This paper identifies measures taken by postsecondary institutions to enhance student COVID-19 health literacy in Canada.
- Advice from Canadian universities is compared to Canadian provincial and federal government public health guidelines.

Introduction

COVID-19 was declared a global pandemic on 11 March 2020 by the World Health Organization.[1] The first known case occurred in Wuhan, China, in December 2019, and the first case in Canada was detected on 25 January 2020.[1] The pandemic also gave rise to a COVID-19 "infodemic," or "information epidemic," which is an overwhelming amount of information spread rapidly through communication technologies.[2] This surplus of information includes both credible information and misinformation.[2] In relation to COVID-19, this ranges from information on viral distribution and preventive measures published by reliable public health authorities, to unsubstantiated "remedies," to claims by unauthorized sources of the virus being a hoax.[3]

Previous research has revealed that conspiracy allegations can directly impact preventive behaviours; this has arisen not only in the context of COVID-19, but for past major disease outbreaks including HIV and the Zika virus.[3] The distribution of, access to and uptake of credible information thus play important roles in mitigating pandemic spread and contributing to the success of public health measures. Credible health resources may aid individuals in developing the skills to identify pandemic-related misinformation and are key to ensuring health literacy.

Health literacy is the "degree to which people are able to access, understand, appraise and communicate information to engage with the demands of different

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health contexts to promote and maintain health across the life-course."[4,p.ii] In addition to accessing information, health literacy is also necessary for applying the acquired information to making health-related decisions.[4] Conversely, low levels of health literacy may signify difficulty in understanding health conditions and related information, thereby affecting an individual's health-related decision-making processes.[4] With the ongoing pandemic, it is necessary to enhance literacy to promote better understanding of the public health information available, and to thereby encourage compliance with public health protocols.

From 1 July to 30 September 2020, we conducted a cross-sectional survey of COVID-19-related health literacy in Canadian postsecondary students, which served as context for the present study.[5] The survey was conducted by researchers at the University of Toronto and Simon Fraser University, in partnership with the international COVID-19 Health Literacy Consortium (a global network for research on health literacy and digital health literacy), and obtained data on the health literacy of young adults in over 50 countries.[6] The survey revealed that Canadian young adults frequently accessed sources of health information about the coronavirus through websites of public sector bodies such as the Public Health Agency of Canada (PHAC), as well as other health portals. The use of these reputable sources was reported to be beneficial by students, since it might enhance their health literacy through reliable and accurate information distribution.[5]

Ideally, curtailing coronavirus misinformation in students should also be a priority for academic institutions. In pursuing mitigation strategies for COVID-19, postsecondary institutions in Canada shifted early in the pandemic to remote learning methods, with the cessation of many in-person activities, in accordance with physical distancing measures and national and provincial pandemic restrictions.[7] This sudden transition into remote learning created new challenges for students in adapting to the online learning environment, particularly due to the lack of previous online learning opportunities.[7,8] Because of this new online learning environment, postsecondary students who require constant access to the Internet may also experience increased exposure to both reliable and unreliable online claims, which in turn may affect their understanding of current health information. Academic institutions can collectively help to reverse the confusion and misinformation stemming from these unauthorized sources and improve student health literacy by mirroring official government public health information, thereby also providing consistency in the information presented by each institution. As postsecondary students may communicate health information to others, it is important to ensure that this population group is also able to effectively access, comprehend and evaluate the credibility of online information sources.[5]

There is limited research regarding the health literacy of postsecondary students, particularly those in Canada, and few studies focus on the sources from which students are receiving health information.[5] This study aims to address this knowledge gap within the context of the COVID-19 pandemic in Canada. In this paper, we report on a systematic scan of publicly available sources of health information from both federal and provincial government websites and postsecondary institutions. Our scans aimed to examine (1) what information on pandemic measures was disseminated to universities and students by the federal and provincial governments and by Canadian universities; (2) how these sources compare with each other; and (3) whether this access to health information had an impact on the health literacy levels self-reported by postsecondary students.

Methods

To identify the health information available to university students, we conducted systematic scans of publicly available information drawn from government and university web platforms. We defined this systematic scanning process as the identification of and data extraction from relevant web pages guided by the application of specific search and inclusion/exclusion criteria listed in the sections that follow. The time frame for scanning government platforms was July to October 2020, and the time frame for scanning university platforms was November 2020 to January 2021.

Scans of publicly available information drawn from government platforms

In deciding which government agencies and types of information to use in our scan, we created criteria for inclusion and exclusion as follows. Included were official Canadian federal government and Ontario and British Columbia provincial government web pages, publicly available (i.e. not in private domains, and accessible to the general public) online information about COVID-19, and information that would affect postsecondary students and institutions (i.e. through closures of facilities and travel restrictions). Excluded were municipal government web pages and private databases.

We chose not to include municipal and city-level data, because, due to the pandemic, we could not assume that students were physically based in the city where their institution was located. We relied only on publicly available information for accessibility reasons, as these sources are likely more readily available to all students compared to private web pages blocked to individuals not part of a specific organization, or requiring subscription. Finally, because the international survey that we referenced as a sampling frame was focussed on postsecondary institutions, we limited the information sources we observed to those relevant to the postsecondary setting.

After determining these inclusion/exclusion criteria, we selected three relevant public sector agencies to search, based on the study location: the official sites of the governments of Canada, Ontario and British Columbia. We then performed a search using the websites' integrated search functions with the search terms "COVID-19" plus one of the following: "policy", "measures", "public health" or "postsecondary". This resulted in the inclusion of eight government web pages, including the Government of Canada's federal legislations[9-11] and guidance for postsecondary institutions,[12] PHAC's individual and community-based measures to mitigate the spread of COVID-19 in Canda,[13] the province of Ontario's pandemic restrictions and framework for reopening the province[14,15] and the province of British Columbia's pandemic restrictions and BC restart plan.[16]

The time frame for scanning government web pages was from July to October 2020; therefore, the results are limited to the most recent available at that time. We scanned the web pages by extracting and summarizing information about the pandemic public health measures (which we defined as a range of regulations, policies and guidance) put in effect by federal and provincial governments that would affect academic institutions and students, as well as guidelines for how to enact and follow these measures.

Scans of publicly available information drawn from university platforms

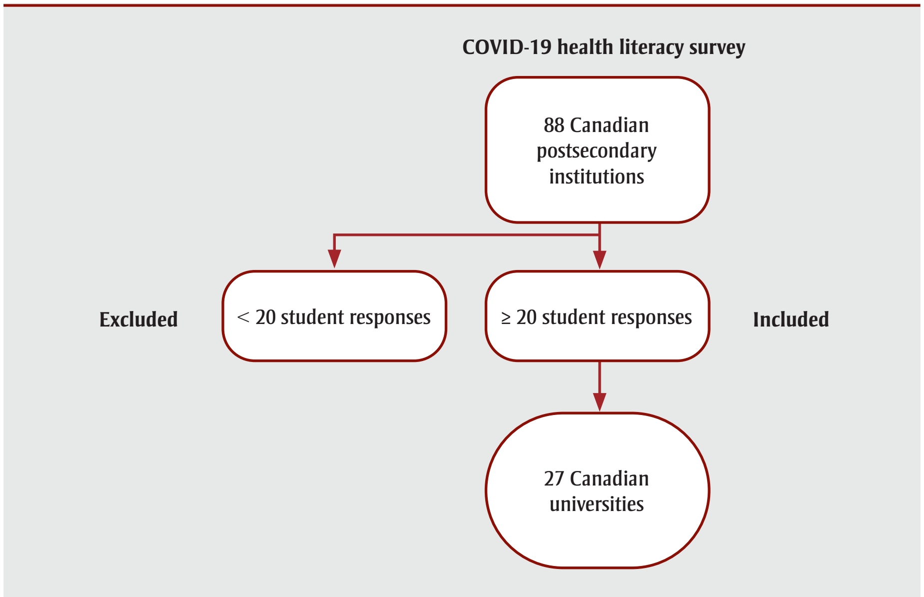
To compare postsecondary institution information sources to those from government public health authorities, we created a framework for deciding which institutions' web pages to scan. We used the results of our earlier COVID-19 health literacy cross-sectional study as a sampling frame from which to choose a subset of academic institutions to include in our scan. In total, the survey received 2679 responses from students enrolled across 88 Canadian postsecondary institutions (Figure 1).[5] We specifically limited the institutions searched to those from which at least 20 students enrolled at the academic institution had responded (while institutions themselves were not recruited to participate in the survey, students from different institutions were able to voluntarily respond). This cut-off value narrowed our scans to observing the pandemic-related information published by 27 Canadian universities aimed at their students, and consequently resulted in the exclusion of any Canadian colleges due to a lower response rate from college students.

Next, we determined keywords to identify relevant web pages from this subset of universities. The search terms were: [institution name], "COVID-19" and "student", which were input into the Google search engine. The time frame for scanning universities was between November 2020 and January 2021. We then developed a guideline for the kinds of common information to extract and observe from each university, namely the institution's response strategies, frequently asked questions (FAQ), sources of expertise, and branding approaches (Table 1). These selected items were also used to provide a side-by-side comparison of the universities' responses to the pandemic directives by federal and provincial governments, through the listing of provincial and local sources of expertise and any additional public sector agencies or public health bodies on their web pages.

To better understand how the mirroring of official resources by academic institutions may have a role in enhancing student health literacy, we also presented students' average estimated health literacy from the top four and bottom two universities in our 27-university subsample. The health literacy data was obtained from our earlier COVID-19 health literacy survey study; these estimates were generated in that study by reviewing the responses to health literacy-related questions (Table 2).[5]

We further grouped the 27 universities included in the scan by region: three universities in the West Coast (British Columbia), eight universities from the Prairie Provinces (Alberta, Saskatchewan and Manitoba), 14 universities in Central Canada (Ontario and Quebec), and two universities from the Atlantic Provinces (Nova Scotia) (Table 1).

FIGURE 1
Inclusion and exclusion of postsecondary institutions in systematic scan of postsecondary student health literacy[a] during the COVID-19 pandemic, Canada, 2020 to 2021



[a] The COVID-19 health literacy survey was administered to students in Canadian postsecondary institutions from July to September 2020.[5]

Results

First, we present our review of four web pages from the federal government and three web pages from the provincial governments of Ontario and British Columbia for information available to the postsecondary student population. Next, we highlight the results from our scan of 27 Canadian universities for the types of web pages used to provide health information about COVID-19 to students.

Federal government: guidance for postsecondary institutions and students

Web pages presented by the Canadian federal government included those on pandemic measures that would affect the general population and thereby students, as well as postsecondary institution–specific information on how to enforce these measures for students on campus. In response to the COVID-19 pandemic, the federal government enacted measures to prevent people with COVID-19 coming in from outside of Canada, including border closures and limiting of nonessential travel, along with mandatory 14-day isolation periods upon entry into the country.[9-11]

These mandates were followed by guidance for academic institutions during the pandemic, developed by PHAC and Canadian public health experts, directed at postsecondary institution administrators. This guidance outlined a risk-based approach for campus planning and operations to administrators and course providers, taking into consideration factors such as the amount of on-campus COVID-19 transmission and domestic and international travel requirements. It also addressed collaboration with local public health authorities in the event of an outbreak, and included recommendations for the timing of school closures and openings.[12]

TABLE 1
Scans of 27 Canadian universities' health information provided to students during the COVID-19 pandemic, November 2020 to January 2021

Item	Description	Universities that used these items on their web pages
Response strategies		
Campus closures and restrictions	Institution-initiated, campus-related changes in response to the pandemic, including the implementation of physical distancing practices, closures or restrictions on campus facilities and services, and shifts to remote learning	Simon Fraser University,[17,20,21] University of British Columbia,[18] University of Victoria,[19] Brandon University,[22] University of Calgary,[23] University of Alberta,[24] University of Lethbridge,[25] Mount Royal University,[26] University of Winnipeg,[27] University of Saskatchewan,[28] University of Manitoba,[29] University of Waterloo,[30] University of Toronto,[31,32] University of Ottawa,[33] York University,[34] Lakehead University,[35] Western University,[36] McMaster University,[37] Queen's University,[38] University of Guelph,[39] Brock University,[40] Laurentian University,[41] Ryerson University,[42] Concordia University,[43] McGill University,[44] Acadia University,[45] Dalhousie University[46]
COVID-19 updates and information pages	Web pages published by individual universities citing COVID-19-related information and providing students with updates to the new academic term and remote learning strategies, public health measures in place on campus and additional health tips and resources	
COVID-19 FAQ	Community-specific FAQ organized based on inquiries from students as well as faculty and staff	
COVID-19 roadmaps	Detailed plans and steps for returning to campus, in line with government and public health authorities' advice	Simon Fraser University,[17,20,21] University of Lethbridge,[25] University of Toronto,[31,32] University of Ottawa,[33] York University,[34] Acadia University[45]
Campus case trackers	Information on locations and buildings on campus at which there was a confirmed positive case	University of Calgary,[23] University of Manitoba,[29] Queen's University,[38] University of Guelph,[39] McGill University,[44] Acadia University[45]
Screening tools and self-assessment forms	Tools initiated for assessing oneself regarding signs or symptoms that may require self-isolation	Simon Fraser University,[17,20,21] University of Lethbridge,[25] University of Toronto,[31,32] University of Guelph,[39] Brock University,[40] Laurentian University,[41] Ryerson University,[42] McGill University[44]
Instructional videos	Videos entailing detailed instructions for safety protocols enacted on campus and how to effectively follow them	University of Saskatchewan,[28] University of Toronto,[31,32] Western University,[36]
Training courses	E-courses on adhering to safety protocols following public health guidance	University of Alberta,[24] University of Guelph,[39] McGill University[44]
Chat features	Live chat functions were available for queries about the pandemic	Laurentian University[41]
Sources of expertise: federal public health authorities		
Government of Canada, PHAC		Simon Fraser University,[17,20,21] University of British Columbia,[18] University of Victoria,[19] Brandon University,[22] University of Calgary,[23] University of Alberta,[24] University of Lethbridge,[25] Mount Royal University,[26] University of Winnipeg,[27] University of Saskatchewan,[28] University of Manitoba,[29] University of Waterloo,[30] University of Toronto,[31,32] University of Ottawa,[33] York University,[34] Lakehead University,[35] Western University,[36] McMaster University,[37] Queen's University,[38] University of Guelph,[39] Brock University,[40] Laurentian University,[41] Ryerson University,[42] Concordia University,[43] McGill University,[44] Acadia University,[45] Dalhousie University[46]
Provincial public health authorities		
Government of British Columbia, British Columbia Centre for Disease Control		Simon Fraser University,[17,20,21] University of British Columbia,[18] University of Victoria[19]
Government of Alberta		University of Calgary,[23] University of Alberta,[24] University of Lethbridge,[25] Mount Royal University[26]
Government of Saskatchewan		University of Saskatchewan[28]
Government of Manitoba		Brandon University,[22] University of Winnipeg,[27] University of Manitoba[29]

Continued on the following page

TABLE 1 (continued)
Scans of 27 Canadian universities' health information provided to students during the COVID-19 pandemic, November 2020 to January 2021

Item	Description	Universities that used these items on their web pages
Government of Ontario, Public Health Ontario		University of British Columbia,[18] University of Victoria,[19] University of Waterloo,[30] University of Toronto,[31,32] University of Ottawa,[33] York University,[34] Western University,[36] McMaster University,[37] Brock University,[40] Laurentian University,[41] Ryerson University[42]
Quebec Public Health		Queen's University,[38] Concordia University[43]
Government of Nova Scotia		Acadia University,[45] Dalhousie University[46]
Local public health authorities		
Toronto Public Health		University of Toronto,[31,32] York University,[34] Ryerson University[42]
Region of Waterloo Public Health		University of Waterloo[30]
Thunder Bay District Health Unit		Lakehead University[35]
Simcoe Muskoka District Health Unit		Lakehead University[35]
Middlesex-London Health Unit		Western University[36]
KFL&A Public Health		Queen's University[38]
Wellington-Dufferin-Guelph Public Health		University of Guelph[39]
Niagara Region Public Health		Brock University[40]
Prairie Mountain Health		Brandon University[22]
Branding approaches		
Hashtags	Branding approaches included the use of hashtags for individual universities with the goal of fostering connection while still physically apart, and staying informed (included #UTogether, #YU Better Together, #TakeCareWesternU Toolkit)	University of Toronto,[31,32] York University,[34] Western University[36]

Abbreviations: FAQ, frequently asked questions; KFL&A, Kingston, Frontenac, Lennox and Addington; PHAC, Public Health Agency of Canada.

Note: While the web pages in Table 1 remained relatively constant during the scanning time frame, the links in the References list may lead to pages that have changed or been updated since this study was conducted.

Federal advice also referred postsecondary institutions to previously issued general guidance for personal preventive measures and community-based measures in mitigating COVID-19 spread in Canada detailing the risk of transmission, which is particularly high in indoor environments with a high density of people, thereby reinforcing the need for campus closures.[13] Federal guidance further stated that relevant information should be shared by academic institutions with their students.[12]

Provincial government: measures in effect in Ontario and British Columbia

Provincial government web pages also presented safety measures, including those being implemented in classroom settings. We limited the scope of our

TABLE 2
Digital health literacy and satisfaction with COVID-19 information from survey of postsecondary students, by university, Canada, 2020

School	DHLI-COVID (N = 1749) Range of possible scores: 15–60 Mean, median (IQR)		Satisfaction with COVID information (N = 1889) Range: 1–5 (1 = very dissatisfied; 5 = very satisfied) Mean, median (IQR)	
	Mean	Median	Mean	Median
Simon Fraser University	47.1	47.0 (43.0–51.0)	3.6	4.0 (3–4)
University of Waterloo	46.5	47.0 (43.0–50.0)	3.7	4.0 (3–4)
University of British Columbia	48.1	48.0 (44.0–52.0)	3.6	4.0 (3–4)
University of Toronto	47.6	48.0 (43.0–52.0)	3.6	4.0 (3–4)
Ryerson University	45.6	44.5 (41.0–49.5)	3.6	4.0 (3–4)
University of Manitoba	46.4	46.0 (42.0–49.0)	3.8	4.0 (3–4)

Abbreviations: DHLI, digital health literacy instrument; IQR, interquartile range.

Note: Data are from the top four and bottom two institutions in a 27-university subsample, ranked by health literacy determined in an earlier health literacy study among postsecondary students.[5]

review of provincial measures to Ontario and British Columbia, mainly due to the geographic location of the institutions of the research team.[5]

Ontario was first declared to be in a state of emergency in March of 2020, when schools and other public establishments were shut down.[14] The provincial government provided guidance as to when these establishments would be permitted to resume operations, and at what capacity, with restrictions listed in Ontario's Roadmap to Reopen.[14,15]

Similarly, the province of British Columbia enacted measures that followed the province's restart plan: this was founded on principles for moving forward during COVID-19 by staying informed and prepared, and by following public health advice.[16] During the first phase of this restart plan, a public health state of emergency was declared for the province, limiting operations to essential services; this also resulted in reduced in-classroom learning.[16]

Additional public health messaging issued in both provinces reiterated and encouraged the practice of good hygiene and safety measures through mask-wearing and physical distancing.[15,16]

Scans of universities from the West Coast

The three universities from the Canadian West Coast region—Simon Fraser University, the University of British Columbia and the University of Victoria—referenced recommendations and policies from the BC Centre for Disease Control, the provincial government of British Columbia and PHAC for planning their university operations and pandemic measures for students, staff and faculty members.[17-19] Each institution had published similar web pages in terms of the content and resources dedicated to COVID-19 information, and each had included pages for students' FAQ. They also provided links to additional resources, including British Columbia government COVID-19 self-assessment tools and mandatory isolation policies, as well as links for student health and well-being that allowed students to both give and receive support during COVID-19 outbreaks.[17-21]

Scans of universities from the Prairie Provinces

The eight universities in the Prairie Provinces region were Brandon University, the University of Calgary, the University of Alberta, the University of Lethbridge, Mount Royal University, the University of Winnipeg, the University of Saskatchewan and the University of Manitoba.[22-29] These institutions cited similar recommendations made by PHAC, as well as recommendations set by their respective regional health authorities and provincial bodies (e.g. ministries of health).[22-29] The COVID-19 web pages published by these institutions included information on campus operations and updates, FAQ and self-assessment and prevention tools. As with the other universities, students are required to complete health declaration forms prior to accessing campus facilities.[22-29]

Scans of universities from Central Canada

The 14 universities from Central Canada were the University of Waterloo, the University of Toronto, the University of Ottawa, York University, Lakehead University, Western University, McMaster University, Queen's University, the University of Guelph, Brock University, Laurentian University, Ryerson University, Concordia University and McGill University.[30-44] These institutions also referenced guidelines provided by PHAC, and additionally adhered to the recommendations from their respective regional health authorities or public health units (in the case of Ontario-based academic institutions) for campus operations, international travel policies and COVID-19 measures.[30-44] These institutions created web pages for FAQ regarding COVID-19, newly implemented campus protocols and self-assessment tools. Additional resources provided by these institutions were mental health portals designed to help students adapt to the challenges introduced by the pandemic.[30-44]

Scans of universities from the Atlantic Provinces

The two universities from the Atlantic Provinces were Acadia University and Dalhousie University.[45,46] These two institutions followed and referenced notices from the Government of Nova Scotia, and created pages for campus updates on the pandemic and future university reopening plans, as well as student health and safety resources and FAQ.[45,46]

Survey results

Using the data from the earlier COVID-19 health literacy survey for the top four (Simon Fraser University, the University of Waterloo, the University of British Columbia and the University of Toronto) and bottom two (Ryerson University and the University of Manitoba) institutions of our 27-university sample, we determined the average response for six questions (Table 2). Five questions (numbered 14 to 18 on the survey) related to digital health literacy, and one (question 23) gauged satisfaction with online COVID-19 information (Table 3).[5] The averages of the responses to each of the six questions were compared across the given institutions, and no significant difference was observed for either digital health literacy or for satisfaction with COVID-19. Findings from the scans of institutions' web pages showed that they similarly followed government guidelines and had similar coronavirus-related resources available for their students.

Discussion

The COVID-19 pandemic has been a primary focus of research due to its widespread impacts; however, a relatively small portion of this research has focussed on pandemic-related health literacy, specifically among postsecondary students. Due to the shift to remote, online learning across many Canadian academic institutions, postsecondary students would be expected to have increased exposure to both credible and less reliable online claims about COVID-19.

It is crucial for reliable sources such as public health bodies and postsecondary institutions to continue to distribute accurate health information to counter misinformation. There is a correlation between professional encouragement and preventive behaviour in university students. One Canadian study found students were 76 times more likely to willingly receive COVID-19 vaccines once available if they had been encouraged by medical professionals as opposed to other students that had not received advice from their doctor or pharmacist, or if they had unaddressed concerns about the safety and efficacy of the COVID-19 vaccines.[47] This study further substantiated the importance of regularly communicating accurate COVID-19 health information, as health communication can correlate with the uptake of coronavirus vaccines among the university student population.[47]

TABLE 3
COVID-19 health literacy survey[a] questions 14 to 18 and 23

Q14. When you search the Internet for information on the coronavirus or related topics, how easy or difficult is it for you to… (on a scale from very easy, easy, difficult, very difficult):
... make a choice with all the information you find?
... use the proper words or search query to find the information you are looking for?
… find the exact information you are looking for?
Q15. When typing a message (e.g. on a forum, or on social media such as Facebook or Twitter) about the coronavirus or related topics, how easy or difficult is it for you to... (on a scale from very easy, easy, difficult, very difficult):
... clearly formulate your question or health-related worry?
... express your opinion, thoughts or feelings in writing?
... write your message as such, for people to understand exactly what you mean?
Q16. When you search the Internet for information on the coronavirus or related topics, how easy or difficult is it for you to... (on a scale from very easy, easy, difficult, very difficult):
... decide whether the information is reliable or not?
... decide whether the information is written with commercial interests (e.g. by people trying to sell a product)?
... check different websites to see whether they provide the same information?
Q17. When you search the Internet for information on the coronavirus or related topics, how easy or difficult is it for you to... (on a scale from very easy, easy, difficult, very difficult):
... decide if the information you found is applicable to you?
... apply the information you found in your daily life?
... use the information you found to make decisions about your health (e.g. on protective measures, hygiene regulations, transmission routes, risks and their prevention)?
Q18. When you post a message about the coronavirus or related topics on a public forum or social media, how often... (on a scale from never, once, several times, often):
... do you find it difficult to judge who can read along?
... do you (intentionally or unintentionally) share your own private information (e.g. name or address)?
... do you (intentionally or unintentionally) share someone else's private information?
Q23. How satisfied are you with the information you find on the Internet about coronavirus (on a scale from very dissatisfied, dissatisfied, partly satisfied, satisfied, very satisfied)?

[a] The COVID-19 health literacy survey was administered to students in Canadian postsecondary institutions from July to September 2020.[5]

For this reason, we examined the kinds of resources made available to postsecondary students searching for coronavirus-related information. This included publicly available information from government bodies and web pages of postsecondary institutions, since students may rely on them as a resource for disease-related information and campus restrictions and protocols.

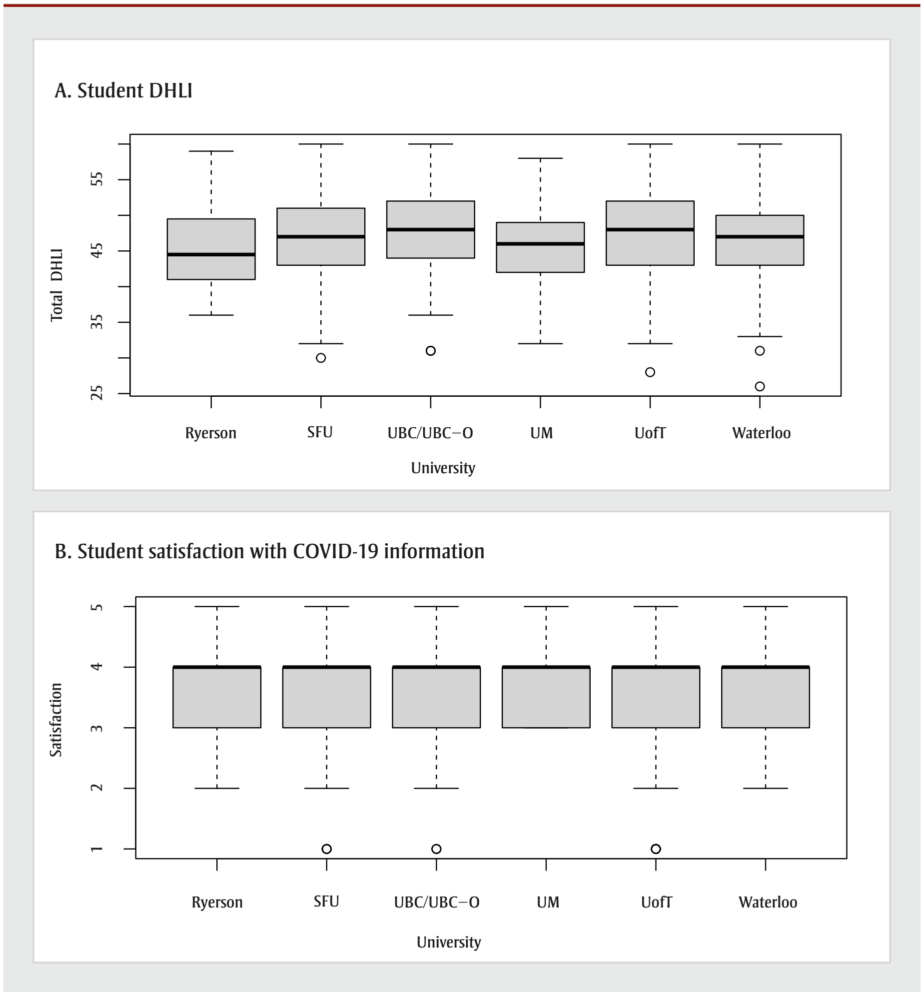
In scanning the information published by federal and provincial governments in Canada, we noted that both had taken measures to ensure the health and safety of the general population in terms of reducing viral transmissions. The changes that would directly affect postsecondary students and institutions were the closures of academic institutions. The provinces of Ontario and British Columbia both created frameworks for reopening each province after a reduction in case counts, which listed already implemented restrictions and plans for the future, and drew attention to the importance of communicating up-to-date information.[15,16]

The federal government created a web page for guidance and recommendations directed specifically toward postsecondary institutions regarding changes across campus that should be made in response to the pandemic and recommended to these institutions that they share relevant information with their students, but did not have information specifically addressing students.[12] This may be because education is a provincial jurisdictional responsibility. While this web page provided recommendations for campus-related changes, further guidance should be provided by government to institutions on how to monitor and enforce the changes.

A majority of the students who participated in the COVID-19 health literacy survey reported high levels of health literacy, with 52.6% finding it "easy" and 30.4% finding it "very easy" to use online health information to make health-related decisions (Table 3, Figure 2).[5] This level of ease could be attributed to the accessibility and availability of health information from public bodies. These sources are also relayed by postsecondary institutions; the survey showed that a high proportion of students use official government sources to obtain health information about the pandemic. In scanning information published by postsecondary institutions, we found these scans showed alignment with the frequently used sources by students in accessing COVID-19 information, as they mirrored the information and directives available on the websites of government bodies, including safety and distancing protocols, recommended closures of buildings on campus and links directing users to additional resources published by these official bodies.

In particular, we found that all of these institutions similarly sourced the Government of Canada and related public health authorities such as PHAC for COVID-19 information. The major contrasts that we noticed regarding sources of expertise across these web pages mainly consisted of the institutions' references to provincial and municipal bodies, which is to be expected since many of the institutions are located in different regions across Canada.

FIGURE 2
Postsecondary student digital health literacy and satisfaction with institution's COVID-19 information, COVID-19 health literacy survey, by university, July to September 2020



Abbreviations: DHLI, digital health literacy instrument; SFU, St. Francis Xavier University; UBC/UBC-O, University of British Columbia/University of British Columbia-Okanagan; UM, University of Manitoba; UofT, University of Toronto.

Notes: Data are from a cross-sectional survey of Canadian university students' COVID-19 health literacy.[5] Only the top four and bottom two schools of a 27-school subsample (ranking for digital health literacy) are shown here. Error bars indicate confidence intervals.

In terms of the universities' response strategies and branding approaches, we noted that universities mainly differed in the methods used for providing information, but maintained the same goal of educating their students on the pandemic and ensuring safety. All of the observed universities had created main pages for COVID-19 information with links navigating to additional resources, including updates, the universities' responses and FAQ. The universities' strategies for providing information began branching when it came to other resources available to students. For example, some universities provided self-screening tools to determine whether one might be at risk or health-compromised and should self-isolate, while other universities instead opted for online campus case trackers to alert their students to locations where there were confirmed cases of COVID-19 and suggesting students isolate if they had been at these locations during the time of exposure.

Other differences included the universities' use of instructional videos versus training courses to inform their students of current public health guidelines and how to effectively follow these protocols on campus, and the use of different social media hashtags to tailor information to their own students and maintain a sense of connection while apart during the pandemic.

Strengths and limitations

This study provides insight into the kinds of publicly accessible sources of COVID-19 health information made available to postsecondary students by government and academic institutions. As the scans were conducted between September 2020 and January 2021, it provides contextual information on the Canadian public health policy environment during the COVID-19 pandemic. Furthermore, by comparing our findings with our earlier health literacy survey results, we found evidence of some congruence between the behaviours of postsecondary institutions and those of the students, in that they both referred back to government policies for university responses and COVID-19 information.

However, some limitations should be noted. These include the lack of consistently available information during the pandemic, as responses from federal and provincial governments and regional health authorities were still unstable due to the rapid release of new COVID-19-related information. The provincial web page scans are further limited, as we only observed information from the provinces of Ontario and British Columbia.

In addition, our scans of postsecondary institutions and the measurements of health literacy may have been subject to sampling bias, as a majority of the respondents to the health literacy survey were students in the health field, which may have resulted in an overestimation of health literacy levels among postsecondary students. Similarly, a sampling bias may have also stemmed from the exclusion of colleges within our scanning frame, as there were not enough responses from colleges to meet our sampling threshold. The use of Google (a commercial database) as the sole search engine for our study may have led to selection bias through the indexing of web pages. The visual presentation of information, such as the positioning and/or use of infographics by different university web pages, was not explored in this study, although how information is presented and the ease of navigation through a web page can also impact health literacy.

Despite these limitations, this study provides novel insights into the online health resources available to university students, and into students' health literacy levels.

Conclusion

Overall, we examined 27 universities in this study and found that these institutions followed the same guidelines from the federal government, including from agencies such as PHAC, as well as their respective provincial government and local health authorities, for campus operations, COVID-19 measures and enhancement of health literacy among their students. Greater health literacy levels in this student population would encourage adherence to the current pandemic public health measures such as physical distancing, mask-wearing and vaccination, which directly relate to minimizing the spread of COVID-19. The Canadian government and Canadian postsecondary institutions should continue to provide easily accessible and verified up-to-date information to their students to assist in curbing the spread of COVID-19 and reducing health care burdens.

This study helped to identify the online information-seeking behaviours of university students, and how information published by the government and by universities promotes access to credible online health resources. Future research is needed to address the limitations mentioned above, and to include local public health information.

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Conflicts of interest

The authors declare that they have no conflicts of interest.

Authors' contributions and statement

EDR and PA completed the study conceptualization. SM, JF, HE and SP performed the data collection and analysis, and EDR and PA reviewed the interpretation of results. SM, JF, EDR and PA wrote the manuscript draft. EDR and PA reviewed and edited the manuscript. All authors approved the final version of the manuscript before submission.

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Original quantitative research

Self-reported injuries among Canadian adolescents: rates and key correlates

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Abstract

Introduction: Injuries sustained by adolescents in Canada represent a costly public health issue. Much of the limited research in this area uses administrative data, which underestimate injury prevalence by ignoring injuries that are not treated by the health care system. Self-reported data provide population-based estimates and include contextual information that can be used to identify injury correlates and possible targets for public health interventions aimed at decreased injury burden.

Methods: The 2017 wave of the Canadian Community Health Survey was used to calculate the prevalence of self-reported total, intentional and unintentional injuries. We compared injury prevalence according to age, sex, employment status, presence of a mood disorder, presence of an anxiety disorder, smoking and binge drinking. Analyses were performed using logistic regression to identify significantly different injury prevalence estimates across key correlates.

Results: Overall past-12-month injury prevalence among adolescents living in Canada was 31.4% (95% CI: 29.4%–33.5%). Most injuries were unintentional. All provinces had estimates within a few percentage points, except Saskatchewan, which had substantially higher prevalence for both overall and unintentional injury. Smoking and binge drinking were significantly associated with higher injury prevalence in most jurisdictions. Remaining correlates exhibited nonsignificant or inconsistent associations with injury prevalence.

Conclusion: The data suggest that injury prevention interventions aimed at reducing alcohol consumption, particularly binge drinking, may be effective in reducing adolescent injury across Canada. Future research is needed to determine how provincial context (such as mental health support for adolescents or programs and policies aimed at reducing substance use) impacts injury rates.

Keywords: *wounds, injuries, adolescent, Canada, cross-sectional studies, binge drinking, smoking*

Highlights

- Self-reported data from a population-based dataset offer insight into the "hidden figure" of adolescent injury in Canada.
- Approximately 31% of adolescents aged 12 to 19 years in southern Canada reported having sustained an injury serious enough to limit their normal activities or to require medical care in the previous year.
- Most injuries were unintentional.
- Public health interventions that target adolescent alcohol consumption will likely reduce injury burden.
- Saskatchewan had a substantially greater prevalence of self-reported injury than other provinces.

Introduction

Injuries sustained by Canadians aged 10 to 19 years cost more than CAD 2.3 billion in 2010[1] and killed more members of this age group than all diseases combined.[2] Across all age groups, 60 000 Canadians are disabled and 3.5 million emergency department visits are required due to injuries each year.[1] Despite the considerable burden that injuries pose on public health, there has been little systematic research on injury prevalence and correlates among Canadian adolescents, likely because injuries are oftentimes labeled as "unlucky accidents," "random," or "unavoidable."[3-5] This mischaracterization implies that injury rates cannot be ameliorated and ignores that injury risk is unequally distributed among adolescent populations,[6] thus contributing to health inequality. Previous studies have shown that injury risk in adolescents is positively associated with lower income, being male,[5,7-9] poor mental health[10] and substance use.[7,10,11]

Much of the limited research on adolescent injury rates draws on administrative data sources such as the Canadian Hospitals Injury Reporting and Prevention Program (CHIRPP),[12] the National Ambulatory Care Reporting System (NACRS)[13] and the Discharge Abstract Database (DAD).[14] Unfortunately, these data are not population-based and, as such, injury rates based on these surveillance programs do not reflect the injury

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burden sustained outside of hospitals. These data suffer from two major limitations. First, administrative data underestimate the prevalence of injury; most injuries are unreported because they are simply ignored, not serious enough to merit medical attention, or hidden because they are the result of neglect or other forms of abuse.[5,15,16] Second, administrative datasets typically do not include demographic or contextual information, which would allow researchers to examine differences in injury rates between population groups. In contrast, self-reported data—such as those used in the current study—typically capture a wider array of injuries, details about the context in which injuries occurred, and more comprehensive sociodemographic information.

Injury research typically delineates intentional and unintentional injuries because they have different determinants. Intentional injuries are those that are inflicted upon oneself or another person deliberately, such as interpersonal violence and self-harm. Unintentional injuries are those without the deliberate intent to harm, such as injuries resulting from inclement weather, falls, sports-related injuries and unintentionally being hit by an object.[3,4,17] Although unintentional injuries are technically "accidental," it is important to remember that they often cluster in certain populations,[5-11] and the adverse health implications associated with these events are numerous and can last a long time.[18]

Determining the prevalence and correlates of self-reported injuries among Canadian adolescents is essential to identify groups that may benefit most from injury prevention–based interventions and to ultimately reduce the overall injury burden. This study used self-reported data to determine the self-reported prevalence of overall, unintentional and intentional past-12-month injuries among adolescents aged 12 to 19 years in southern Canada (provinces only), compare rates between provinces and identify key correlates.

Methods

Data

Data were drawn from the 2017 Canadian Community Health Survey (CCHS)—Annual Component.[19] This survey was administered by Statistics Canada, using both in-person and telephone surveying, and designed to be representative at the health district level. This survey collected information from Canadians aged 12 years and older about their health status, health determinants and use of health care services, among other topics.

The target population excluded individuals living on Indian Reserves and some other Indigenous settlements, Crown Lands, in parts of northern Quebec (Nunavik, Terres-Cries-de-la-Baie-James) and in institutions. Also excluded were full-time members of the Canadian Forces and people aged 12 to 17 years living in foster care. Data were not collected from these groups. Despite these exclusions, the CCHS target population covers about 98% of Canadians aged 12 years and older. Most adolescent respondents (aged 12–17) were sampled using a list frame created from the Canada Child Benefit, while all adult respondents were sampled using an area frame from the Canadian Labour Force Survey.[19]

Due to the challenges of surveying in the territories, only half of the communities are surveyed each year, meaning data are representative of the territories after two years. Consequently, all territorial respondents have been removed from the analytical sample and the estimates presented here only represent the 10 provinces.

The confidential microdata version of the CCHS was accessed through the Atlantic Research Data Centre located at Dalhousie University. Ethical approval for this study was granted by the Dalhousie Research Ethics Board.

Population

The full dataset included 58 135 respondents aged 12 years and older. However, our analytical sample included only the 5366 respondents aged 12 to 19 years, inclusive, who resided in one of the 10 Canadian provinces: British Columbia (B.C.), Alberta (Alta.), Saskatchewan (Sask.), Manitoba (Man.), Ontario (Ont.), Quebec (Que.), New Brunswick (N.B.), Nova Scotia (N.S.), Prince Edward Island (P.E.I.) and Newfoundland and Labrador (N.L.). The sample was representative of the 3 236 864 adolescents who lived in the Canadian provinces at the time.[20] Minors required active consent from a parent or guardian to participate. The national response rate for participants aged 12 to 18* years was 56.0%, ranging from 51.1% in P.E.I to 68.1% in Que.[19]

Study variables

Outcome

"Overall injury" was operationalized as any injury sustained in the previous year that was either severe enough to limit normal activities or not severe enough to limit normal activities but was investigated or treated by a health professional. Specifically, we derived our injury measures from survey questions about repetitive strain injuries in the previous 12 months that were serious enough to limit normal activities (i.e. carpal tunnel syndrome, tennis elbow, tendonitis), injuries serious enough to limit daily activities for at least 24 hours after the injury occurred (i.e. a broken bone, a bad cut, a burn or a sprain) and injuries in the past 12 months that were treated by a health professional but did not limit normal activities. We determined intentionality based on whether the injury was the result of a fall and the type of activity that caused the injury.

"Intentional injury and motor vehicle collisions (MVCs)" resulted from one of the following known causes: being a driver or passenger in an on- or off-road motor vehicle, physical assault or intentionally self-inflicted injury. While interpersonal violence and self-inflicted injury are widely considered to be intentional, there is ongoing debate as to whether motor vehicle collisions should be considered intentional or unintentional. We have chosen to combine MVC with intentional injuries in recognition that these incidents are largely preventable and that someone is almost always at fault. Some examples of "unintentional injuries" captured in the dataset are falls, overexertion or strenuous movement, unintentional contact with a sharp object or hot substance, injuries resulting from extreme weather or natural disasters, those sustained during leisure sports or physical activity, and repetitive strain injuries. We could not categorize some injuries as either intentional or unintentional, in which case they were counted as neither, but were included in the overall injury category.

* The user guide for the 2017 CCHS lists the response rates for children (aged 12–18) and adults (aged 19 and older) in Canada and each province but does not provide a response rate for our study population (aged 12–19).

Correlates

Key injury correlates that were examined were age (12–13, 14–16, 17–19 years), sex (male, female), income (low, middle, high), employment status (yes, no), presence of mood disorder(s) (yes, no), presence of anxiety disorder(s) (yes, no), cigarette consumption (yes, no) and binge drinking (yes, no).

Income was measured as total household income before taxes and deductions in the previous year, divided into terciles (low [≤ CAD 72 736]; medium [CAD 72 737–CAD 132 226]; high [≥ CAD 132 227]). A member of the household was asked to provide income information for underage respondents (aged 12–17 years) in recognition that young people may not know this information. The person who provided income information was asked for consent to link their data with tax records as a means of validation.

Employment status was classified into employed (employed in a business, self-employed or working in a family business, irrespective of pay) or not employed. All respondents aged 12 to 14 years were listed as "unemployed" because this age group is not legally able to work.

Mood disorders (such as depression, bipolar disorder, mania and dysthymia) and anxiety disorders (such as phobias, obsessive-compulsive disorders and panic disorders) were limited to those that had been diagnosed by a health care professional and had lasted or were expected to last six months or longer.

Smoking was defined as having smoked any cigarettes in the past 30 days. Binge drinking was defined as the consumption of five or more (males) or four or more (females) alcoholic drinks on one occasion during the previous year.

Data analysis

Prevalence estimates of overall injury (including those without cause information), intentional injury and MVCs and unintentional injury were calculated for the provinces combined ("pooled analysis") and individually. Cross-tabulation was used to determine injury prevalence across key correlates. Sample weights were used in all analyses. Accordingly, prevalence estimates are reported with a 95% confidence interval (CI). Logistic regression was used to assess whether differences in injury prevalence across correlates were statistically significant ($p < 0.05$). We created categories for all missing data to avoid losing any data from the analytical sample; however, these estimates have been suppressed in the tables presented here. As a condition of accessing confidential microdata through the Atlantic Research Data Centre, all cells with fewer than 15 cases in unweighted analyses were suppressed to avoid divulging potentially identifiable information. Analyses were conducted using Stata 15.[21]

Results

Injury prevalence by location

The prevalence of self-reported injuries in the previous year varied widely by type and location. The pooled (all provinces) point estimate for overall injury was 31%, and most provinces ranged from 28% (N.S.) to 33% (N.L.). However, Sask. was an outlier, where an estimated 41% of youth reported sustaining an injury in the previous year. Most injuries were unintentional, with a pooled prevalence of 27%, and most provinces ranged from 24% (Que.) to 28% (Alta.). Again, Sask. was an outlier at 36%. An estimated 1% of adolescents experienced an intentional injury/MVC in southern Canada. We only provide estimates for pooled analyses because most provincial estimates could not be published due to low cell counts.

Key correlates of injury prevalence

The number of significant correlations between correlates and prevalence rates varied widely by location, ranging from zero in N.L. to 11 in Ont., and 18 for all pooled analyses. Generally, there were fewer significant correlations in provinces with smaller (n < 300) sample sizes; in these cases, calculations may have been underpowered. Prevalence estimates were only reported for significant correlations for the pooled analyses for the sake of brevity. Full results can be found in Tables 1 to 3.

Overall injury prevalence across correlates

Table 1 shows the overall injury prevalence. Females had significantly lower injury rates in pooled analyses (females: 27.4%, 95% CI: 24.9%–30.2%; males: 35.0%, 32.1%–38.0%), and in B.C., Alta. and Que. Income exhibited a significant gradient association in pooled analyses and in Ont., and high-income household adolescents had significantly higher injury rates in N.S. and P.E.I., but middle-income household adolescents did not differ significantly. Adolescents from high-income households (34.4%, 30.7%–38.2%) and middle-income households (32.4%, 29.1%–35.7%) had a significantly higher overall injury rate relative to their low-income peers (27.6%, 24.4%–31.1%) in pooled analyses. Being employed was significantly correlated with a lower injury rate in Alta. Adolescents with mood disorders in Ont. had significantly higher overall injury prevalence. Likewise, adolescents with anxiety disorders had a significantly higher injury prevalence in Ont. and N.B. Cigarette use was significantly correlated with higher injury prevalence in pooled analyses (consumers: 45.2%, 36.3%–54.4%; abstainers: 30.7%, 28.7%–32.8%) and in Ont., while binge drinking was significantly correlated in pooled analyses (consumers: 39.6%, 35.2%–44.0%; abstainers: 28.6% (26.3%–31.0%), and in B.C. and Ont. There was no significant correlation between overall injury prevalence and age.

Unintentional injury prevalence across correlates

Unintentional injury rates are presented in Table 2. Saskatchewanians aged 17 to 19 years had significantly greater unintentional injury prevalence than those aged 12 to 13 years. Females had significantly lower unintentional injury rates in pooled analyses, in B.C. and in Que. Pooled analyses (highest tercile: 28.0%, 24.8%–31.5%; lowest tercile: 24.1%, 21.0%–27.6%) and N.S. exhibited significantly higher unintentional injury rates among the highest tercile of income, compared to the lowest (middle tercile was not significantly different). Being employed in Alta. and having an anxiety disorder in N.B. were significantly associated with greater unintentional injury risk. Smoking cigarettes was significantly correlated with unintentional injury risk in pooled analyses (consumption: 39.9%, 31.0%–49.5%; abstinence: 25.7%, 23.9%–27.7%), and in Ont. and Que. Binge drinking was significantly associated with increased unintentional injury in pooled analyses (consumption: 34.1%, 29.9%–38.4%); abstinence: 23.7%, 21.6%–25.9%), and in B.C., Man., Ont., Que. and N.B. There was no significant correlation between unintentional injury prevalence and mood disorders.

TABLE 1
Overall injury prevalence (%) among Canadians aged 12 to 19[a] years, weighted (prevalence and 95% CI), CCHS 2017

	Canada (n = 5366)	British Columbia (n = 620[a])	Alberta (n = 540[a])	Saskatchewan (n = 195[a])	Manitoba (n = 237[a])	Ontario (n = 1310[a])	Quebec (n = 907[a])	New Brunswick (n = 162[a])	Nova Scotia (n = 172[a])	Prince Edward Island (n = 92[a])	Newfoundland and Labrador (n = 160[a])
Overall	31.4 (29.4–33.5)	30.7 (25.9–36.0)	32.0 (27.5–36.8)	41.4 (32.8–50.5)	28.8 (21.8–37.0)	32.0 (28.4–36.0)	29.7 (26.1–33.5)	29.3 (21.1–39.1)	28.2 (21.2–36.4)	29.6 (21.5–39.3)	32.6 (23.2–43.7)
Age (years)											
12–13	31.1 (27.6–34.9)	26.5 (18.8–35.8)	33.6 (25.4–43.0)	27.1 (16.9–40.4)	24.2 (13.4–39.6)	34.1 (27.4–41.5)	28.5 (22.5–35.4)	29.1 (17.7–43.9)	37.4 (25.0–51.7)	35.6 (20.2–54.6)	24.8 (13.4–41.3)
14–16	32.4 (29.4–35.6)	33.1 (25.8–41.3)	38.1 (30.8–46.0)	43.1 (30.2–57.1)	27.6 (17.9–40.1)	30.4 (24.9–36.4)	32.6 (26.8–39.0)	27.1 (17.3–39.9)	29.0 (19.5–40.8)	25.4 (15.3–39.1)	39.1 (27.3–52.4)
17–19	30.7 (27.2–34.4)	31.4 (23.0–41.3)	25.3 (18.6–33.5)	49.3 (32.4–66.4)	32.8 (20.3–48.5)	32.2 (25.9–39.3)	27.5 (21.6–34.3)	31.8 (15.9–53.4)	20.9 (10.5–37.1)	31.4 (15.7–52.9)	28.7 (10.5–58.2)
Sex											
Male	35.0 (32.1–38.0)	36.9 (29.9–69.5)	35.3 (28.7–42.6)	44.3 (31.9–57.5)	35.5 (25.1–47.4)	35.5 (30.1–41.2)	33.4 (28.3–38.9)	27.2 (17.9–39.2)	27.1 (17.8–39.0)	33.7 (21.8–48.1)	29.8 (19.5–42.7)
Female	27.4 (24.9–30.2)*	24.7 (18.7–31.7)*	28.6 (23.0–35.0)*	38.3 (27.1–50.9)	21.2 (13.5–31.8)	28.1 (23.4–33.5)	25.4 (20.8–30.3)*	31.6 (19.0–47.6)	29.5 (20.0–41.0)	25.3 (15.4–38.5)	35.3 (20.9–53.0)
Income											
Low	27.6 (24.4–31.1)	33.0 (24.8–42.3)	28.6 (20.6–38.2)	33.6 (20.4–50.0)	26.4 (16.3–39.8)	25.4 (19.9–31.8)	29.6 (23.7–36.4)	23.0 (12.9–37.5)	21.0 (12.2–33.5)	14.3 (6.5–28.6)	23.3 (13.3–37.5)
Middle	32.4 (29.1–35.7)*	34.9 (26.9–43.7)	32.3 (24.0–41.9)	46.0 (31.1–61.7)	18.4 (10.5–30.1)	35.3 (29.2–42.0)*	26.8 (21.6–32.6)	34.5 (19.8–52.8)	30.4 (20.3–42.7)	31.2 (18.4–47.9)	29.0 (16.7– 45.3)
High	34.4 (30.7–38.2)*	24.0 (16.8–33.0)	33.7 (27.4–40.5)	43.4 (29.7–58.2)	44.1 (29.5–59.8)	36.1 (29.4–43.4)*	32.7 (26.2–40.0)	29.4 (17.8– 44.6)	41.5 (25.7–59.3)*	50.4 (31.3–69.5)*	42.3 (25.6– 61.4)
Employment											
No	30.6 (28.3–32.9)	30.3 (25.1–36.0)	35.1 (29.6–41.0)	43.9 (34.4–53.9)	27.4 (19.5–37.1)	30.2 (26.1–34.7)	27.6 (23.6–32.0)	30.8 (22.6–40.4)	26.2 (19.2–24.7)	32.4 (22.8–43.7)	29.9 (21.6–39.8)
Yes	33.7 (29.8–37.9)	31.9 (22.0–43.8)	23.4 (17.1–31.2)*	31.8 (17.1–51.3)	31.5 (19.0–47.5)	38.2 (30.8–46.1)	34.8 (27.7–42.7)	25.4 (8.7–55.9)	32.1 (16.8–52.3)	22.6 (10.7–43.0)	42.2 (17.1–72.1)
Mood disorder											
No	31.1 (29.1–33.2)	29.9 (25.0–35.3)	32.4 (27.7–37.5)	42.2 (33.3–51.6)	28.7 (21.4–37.3)	31.5 (27.7–35.6)	29.6 (26.0–33.5)	—	—	—	—
Yes	37.0 (29.6–45.1)	38.6 (19.7–61.7)	26.6 (15.7–41.4)	22.6 (8.0–49.4)	31.3 (14.2–55.7)	46.0 (32.3–60.4)*	33.0 (15.4–57.3)	—	—	—	—
Anxiety disorder											
No	31.0 (29.0–33.2)	31.0 (26.0–36.4)	31.7 (27.0–36.9)	42.6 (33.4–52.4)	28.7 (21.4–37.4)	31.5 (27.6 –35.6)	29.4 (25.8–33.4)	23.6 (16.8 –32.0)	27.5 (20.2–36.3)	—	—
Yes	35.9 (29.1–43.2)	27.4 (13.5–47.7)	32.8 (21.0–47.4)	34.4 (14.3–62.2)	31.3 (14.2–55.7)	40.7 (28.1–54.7)*	33.1 (20.6–48.6)	61.5 (34.5– 82.9)*	31.5 (14.9–54.7)	—	—

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TABLE 1 (continued)
Overall injury prevalence (%) among Canadians aged 12 to 19[a] years, weighted (prevalence and 95% CI), CCHS 2017

	Canada (n = 5366)	British Columbia (n = 620[a])	Alberta (n = 540[a])	Saskatchewan (n = 195[a])	Manitoba (n = 237[a])	Ontario (n = 1310[a])	Quebec (n = 907[a])	New Brunswick (n = 162[a])	Nova Scotia (n = 172[a])	Prince Edward Island (n = 92[a])	Newfoundland and Labrador (n = 160[a])
Cigarette use											
No	30.7 (28.7–32.8)	30.4 (25.4–35.8)	31.2 (26.7–36.2)	40.7 (31.9–49.7)	29.2 (21.9–37.7)	31.1 (27.4–35.1)	28.6 (25.0–32.6)	—	—	—	—
Yes	45.2 (36.3–54.4)*	39.6 (20.3–62.9)	45.5 (26.5–66.0)	51.4 (18.1–83.5)	21.0 (7.3–47.1)	53.3 (36.0–69.9)*	42.0 (28.6–56.8)	—	—	—	—
Binge drinking											
No	28.6 (26.3–31.0)	25.3 (20.3–31.1)	32.1 (26.8–39.9)	38.6 (29.5–48.6)	23.2 (16.3–32.0)	29.3 (25.1–33.8)	26.4 (22.0–31.3)	26.2 (18.7–35.3)	29.8 (22.2–38.7)	27.7 (18.9–38.7)	31.7 (23.0–41.9)
Yes	39.6 (35.2–44.0)*	52.6 (40.3–64.6)*	32.2 (23.8–41.8)	54.5 (32.1–75.2)	46.9 (29.5–65.1)	40.9 (32.2–50.2)*	34.3 (27.9–41.3)	48.8 (25.0–73.2)	20.4 (8.3–41.9)	30.1 (14.5–52.2)	41.0 (14.6–73.9)

Abbreviation: CCHS, Canadian Community Health Survey.

Note: "—" denotes that estimates have been suppressed due to small cell count.

[a] Canada data include respondents aged 12 to 19, but provincial-level CCHS data include only ages 12 to 18, since data for age 19 was suppressed due to small cell counts. We provide the number of respondents aged 12 to 18 years in each province, which is publicly available.

* Statistically significantly different odds of injury ($p < 0.05$).

TABLE 2
Unintentional injury prevalence (%) among Canadians aged 12 to 19[a] years, weighted (prevalence and 95% CI), CCHS 2017

	Canada (n = 5366)	British Columbia (n = 620[a])	Alberta (n = 540[a])	Saskatchewan (n = 195[a])	Manitoba (n = 237[a])	Ontario (n = 1310[a])	Quebec (n = 907[a])	New Brunswick (n = 162[a])	Nova Scotia (n = 172[a])	Prince Edward Island (n = 92[a])	Newfoundland and Labrador (n = 160[a])
Overall	26.5 (24.6–28.4)	25.7 (24.6–28.4)	28.0 (23.8–32.7)	36.4 (28.1–45.5)	25.2 (18.3–33.5)	27.1 (23.7–30.8)	23.8 (20.6–27.3)	24.8 (17.0–34.7)	24.3 (17.9–32.2)	25.9 (18.3–35.4)	27.5 (18.4–38.9)
Age (years)											
12–13	26.2 (22.8–29.8)	23.3 (16.1–32.5)	30.5 (22.6–39.8)	22.1 (12.9–35.4)	21.5 (11.1–37.5)	29.1 (22.7–36.4)	21.4 (16.4–27.3)	20.0 (11.1–33.4)	33.0 (21.3–47.3)	31.7 (17.3–50.8)	20.6 (10.7–36.2)
14–16	28.0 (25.0–31.1)	26.0 (19.7–33.6)	32.4 (25.5–40.2)	39.2 (26.6–53.4)	23.9 (14.7–36.5)	27.8 (22.4–33.9)	26.6 (21.1–33.0)	22.6 (13.5–35.3)	26.1 (17.0–38.0)	23.7 (13.9–37.3)	31.3 (20.4–44.7)
17–19	25.3 (22.2–28.7)	27.0 (19.1–36.7)	22.4 (16.0–30.6)	43.3 (27.5–60.5)*	28.7 (16.6–44.8)	25.4 (20.0–31.6)	22.5 (17.5–28.5)	30.4 (14.8–52.4)	16.4 (7.7–31.6)	24.2 (10.8–45.7)	26.7 (8.9–57.6)
Sex											
Male	29.9 (27.2–32.7)	33.0 (26.1–40.6)	31.5 (25.2–38.7)	39.4 (27.5–52.8)	31.9 (21.7–44.2)	29.8 (24.9–35.2)	27.1 (22.6–32.0)	23.9 (15.1–35.6)	23.7 (15.2–35.0)	28.1 (17.2–42.4)	24.4 (15.2–36.6)
Female	22.7 (20.3–25.3)*	18.6 (13.8–24.7)*	24.6 (19.3–30.7)	33.1 (22.6–45.6)	17.5 (10.3–28.1)	24.0 (19.5–29.2)	19.9 (15.6–25.1)*	25.8 (13.8–42.9)	25.1 (16.3–36.5)	23.6 (14.1–36.7)	30.5 (16.4–49.6)

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TABLE 2 (continued)
Unintentional injury prevalence (%) among Canadians aged 12 to 19[a] years, weighted (prevalence and 95% CI), CCHS 2017

	Canada (n = 5366)	British Columbia (n = 620[a])	Alberta (n = 540[a])	Saskatchewan (n = 195[a])	Manitoba (n = 237[a])	Ontario (n = 1310[a])	Quebec (n = 907[a])	New Brunswick (n = 162[a])	Nova Scotia (n = 172[a])	Prince Edward Island (n = 92[a])	Newfoundland and Labrador (n = 160[a])
Income											
Low	24.1 (21.0–27.6)	27.8 (19.9–37.4)	25.4 (17.7–35.0)	31.4 (18.5–47.9)	20.7 (11.6–34.3)	23.7 (18.3–30.1)	24.0 (18.5–30.5)	18.5 (9.6– 32.8)	14.8 (8.0–25.6)	—	—
Middle	27.4 (24.3–30.6)	29.9 (22.4–38.7)	27.4 (19.5–37.0)	39.7 (25.1–56.4)	16.3 (8.8–28.1)	28.7 (23.0–35.1)	23.4 (18.6–29.0)	31.4 (17.1– 50.5)	30.4 (20.3–42.7)	—	—
High	28.0 (24.8– 31.5)*	19.2 (13.5–26.6)	30.0 (24.1–36.8)	37.5 (24.8–52.2)	40.8 (26.3–57.1)	29.2 (23.4–35.9)	23.8 (18.6–29.9)	22.6 (12.8– 36.8)	35.9 (20.7–54.6)*	—	—
Employment											
No	26.0 (23.9–28.3)	25.2 (20.4–30.6)	30.5 (25.2–36.3)	37.5 (28.2–47.8)	24.3 (16.6–34.1)	26.0 (22.0–30.4)	22.7 (19.1–26.8)	25.6 (18.0–35.0)	23.7 (17.0–32.1)	27.4 (18.8–38.5)	24.4 (16.9–33.9)
Yes	27.6 (24.2–31.4)	27.2 (18.1–38.8)	21.1 (15.1–28.8)*	30.9 (16.5–50.2)	27.0 (15.0–43.5)	30.8 (24.5–37.8)	26.2 (20.2–33.2)	23.0 (7.0–54.2)	25.9 (13.0–45.0)	22.6 (10.2–43.0)	38.4 (13.8–70.8)
Mood disorder											
No	26.3 (24.4–28.3)	24.9 (20.4–30.1)	28.9 (24.4–33.9)	—	27.9 (19.9–37.7)	26.8 (23.3–30.6)	23.5 (20.3–27.1)	—	—	—	—
Yes	30.0 (23.3–37.6)	32.8 (15.6–56.4)	18.0 (9.2–32.1)	—	17.3 (8.6–31.9)	35.7 (24.1–49.2)	31.9 (14.6–56.2)	—	—	—	—
Anxiety disorder											
No	26.2 (24.2–28.2)	25.8 (21.2–31.1)	27.8 (23.3–32.8)	37.3 (28.4–47.0)	25.0 (17.9–33.7)	26.8 (23.5–30.7)	23.6 (20.4–27.3)	18.4 (12.4–26.4)	23.3 (16.7–31.5)	—	—
Yes	30.0 (23.9–36.9)	23.7 (11.3–42.9)	28.9 (17.6–43.6)	31.5 (12.1–60.7)	30.0 (13.2–54.6)	32.2 (21.3–45.5)	25.6 (14.7–40.75)	60.9 (33.8– 82.5)*	29.9 (13.6– 53.5)	—	—
Cigarette use											
No	25.7 (23.9–27.7)	25.7 (21.1–30.9)	27.5 (23.1–32.3)	—	25.4 (18.3–34.0)	26.2 (22.8–29.9)	22.4 (19.3–26.0)	—	—	—	—
Yes	39.9 (31.0–49.5)*	26.5 (10.6–52.3)	38.5 (21.1–59.4)	—	21.0 (7.3–47.1)	47.8 (30.3–65.9)*	39.2 (26.0–54.1)*	—	—	—	—
Binge drinking											
No	23.7 (21.6–25.9)	20.6 (16.1–25.9)	28.0 (22.8–33.7)	33.4 (24.6–43.5)	19.6 (13.1–28.3)	24.5 (20.7–28.7)	20.2 (16.3–24.7)	20.0 (13.4–28.8)	25.5 (18.5–34.1)	25.2 (16.8–36.0)	25.1 (17.3–34.9)
Yes	34.1 (29.9–38.4)*	46.3 (34.1–58.9)*	28.2 (20.4–37.7)	49.7 (28.7–70.7)	43.5 (26.1–62.7)*	34.9 (26.7–44.2)*	27.8 (22.3–34.2)*	48.0 (24.3–72.7)*	19.4 (7.7–40.9)	26.3 (11.9–48.6)	39.8 (13.6–73.6)

Abbreviation: CCHS, Canadian Community Health Survey.

Note: "—" denotes that estimates have been suppressed due to small cell count.

[a] Canada data include respondents aged 12 to 19, but provincial-level CCHS data include only ages 12 to 18, since data for age 19 was suppressed due to small cell counts. We provide the number of respondents aged 12 to 18 years in each province, which is publicly available.

* Statistically significantly different odds of injury ($p < 0.05$).

TABLE 3
Intentional injury/MVC prevalence (%) among Canadians aged 12 to 19[a] years, weighted (prevalence and 95% CI), CCHS 2017

	Canada (n = 5366)
Overall	0.7 (0.5–1.0)
Age (years)	
12–13	0.19 (0.1–0.5)
14–16	0.5 (0.3–0.9)
17–19	1.3 (0.8–1.9)*
Sex	
Male	0.8 (0.5–1.3)
Female	0.6 (0.4–1.0)
Income	
Low	—
Middle	—
High	—
Employment	
No	0.4 (0.3–0.6)
Yes	1.5 (0.94–2.5)*
Mood disorder	
No	0.6 (0.4–0.9)
Yes	3.0 (1.5–5.8)*
Anxiety disorder	
No	0.6 (0.4–0.9)
Yes	1.6 (0.9–2.9)*
Cigarette use	
No	0.6 (0.4–0.8)
Yes	3.2 (1.4–7.3)*
Binge drinking	
No	0.5 (0.4–0.8)
Yes	1.3 (0.7–2.3)*

Abbreviations: CCHS, Canadian Community Health Survey; MVC, motor vehicle collision.

Note: "—" denotes that estimates have been suppressed due to small cell count.

[a] Canada data include respondents aged 12 to 19, but provincial-level CCHS data include only ages 12 to 18, since data for age 19 was suppressed due to small cell counts. We provide the number of respondents aged 12 to 18 years in each province, which is publicly available.

* Statistically significantly different odds of injury ($p < 0.05$).

Intentional injury/MVC prevalence across correlates

Table 3 provides prevalence estimates for intentional injury/MVC among Canadians 12 to 19 years. We were unable to publish intentional injury/MVC estimates for most locations or for income, due to low cell counts. Therefore, we only provide pooled estimates and have suppressed provincial analyses. Adolescents aged 17 to 19 years (1.3%, 0.8%–1.9%) had a significantly higher rate compared to those aged 12 to 13 years (0.19%, 0.1%–0.5%). Adolescents who were employed had significantly higher prevalence (employed: 1.5%, 0.9%–2.5%; not employed: 0.4%, 0.3%–0.6%), as did those with a mood disorder (disorder: 3.0%, 1.5%–5.8%; no disorder: 0.6%, 0.4%–0.9%), or an anxiety disorder (disorder: 1.6%, 0.9%–2.9%; no disorder: 0.6%, 0.4%–0.9%). Adolescents who smoked cigarettes (consumers: 3.2%, 1.4%–7.3%; abstainers: 0.6% (0.4%–0.8%) or partook in binge drinking (consumers: 1.3%, 0.7%–2.3%; abstainers: 0.5%, 0.4%–0.8%) had significantly higher rates. There was no significant correlation between intentional injury/MVC prevalence and sex.

Discussion

We calculated self-reported overall, unintentional and intentional/MVC injury prevalence in the past year among southern Canadians aged 12 to 19 years according to socioeconomic, mental health and substance use indicators. In pooled analyses, an estimated 31.4% (29.4%–33.5%) of adolescents reported sustaining an injury in the previous year, most of which were unintentional (26.5%, 24.6%–28.4%). Overall injury prevalence varied by location, with Alta., Sask., Ont. and N.L. reporting greater prevalence than pooled analyses and the other provinces reporting lower rates. Sask. far exceeded other provinces' overall and unintentional injury rates. Around 1% of adolescents sustained an intentional injury/MVC in the previous year. These rates are substantially greater than prevalence rates obtained from hospitalization data (DAD, indexed with ICD-10 codes).[22] This discrepancy was expected because our rates include injuries that did not meet the threshold for medical attention (or did not receive treatment for other reasons, such as neglect or lack of access).

Previous research also found that adolescents in Sask. face a substantially greater injury burden than in other provinces; Sask. has the highest rate of child and adolescent hospitalization for injuries.[23,24] This province requires targeted interventions. Unfortunately, our study found few significant associations between injury rates and key correlates among adolescents in Sask., due to low sample size, meaning that future investigation is needed to identify subpopulations that may benefit from targeted interventions.

Echoing previous research on Canadian adolescents,[7,9] this study found that substance use is associated with injury prevalence. Of particular note, our research updates and corroborates previous research by Mo and colleagues,[7] based on the 2000/01 CCHS, that found similar significant correlations between household income, smoking status, binge drinking and sex with injury prevalence.

Other findings include that employment status was rarely significantly associated with injury prevalence, which is surprising considering previous research found that most Canadian adolescents are injured either at work or during sports and leisure activities.[7] Intentional injury/MVC was more prevalent among employed adolescents (pooled analysis). However, in Alta., there was a significantly *lower* prevalence of overall and unintentional injury among employed adolescents.

The scarcity of significant associations is surprising, given that previous research found key differences in injury by sex, age, socioeconomic status,[8,9] employment status[25] and mental health status.[10] However, many previous studies have drawn on administrative health records rather than self-report, which may indicate that sex, age and socioeconomic status are more strongly linked to injuries severe enough to warrant hospital care rather than to the overall injury rate. Overall, the results of this study suggest that injury prevention interventions aimed at binge drinking are likely to be effective in reducing adolescent injury burden. [11]

The general inconsistency in associations between covariates and injury prevalence across provinces—except for binge drinking—demonstrates that context matters. Our findings suggest that any attempts to reduce injury prevalence should be customized to the province in which they will be implemented, because there are few common correlates among provinces.

Future research should investigate how provincial (or more granular) contexts impact injury rates. An important first step would be to create a comparative evaluation of provincial programs and policies aimed at limiting the harms associated with adolescent binge drinking.

Injury prevention programs have been shown to reduce injury rates in Canada,[26,27] but the patchwork of injury prevention schemes contributes to the variation in injury rates.[28] The long-term morbidity and quality of life impact of adolescent injuries is another promising direction for future research, as it may affirm the need to invest in injury prevention.[18] Some injury prevention interventions have been proven to both ease injury burden and provide net savings (i.e. by preventing hospitalizations or lost productivity); however, more information is needed to support the economic basis for injury prevention.[5,29,30]

Strengths and limitations

Our study boasts a rich, representative dataset. By drawing on self-reported data that were representative of the adolescent population (aged 12–19 years) in southern Canada, we shed light on the "hidden figure" of adolescent injury, which is not captured by administrative datasets. The dataset also allowed us to examine injury prevalence by 10 socioeconomic, mental health and substance use variables, which are also mainly missing from administrative datasets.

However, this dataset also presented some limitations. Most notably, the small sample sizes in some provinces prohibited us from examining some known correlates of injury prevalence—such as indigeneity[31,32]—and may have caused some associations to be underpowered. Just as small sample sizes in provinces prohibited confident estimates, the large sample sizes in Ont. and Que. may have resulted in statistically significant correlations that have little practical significance.

The CCHS survey also prohibited causal conclusions due to its cross-sectional nature. Although the exclusion of territorial residents from our analyses is unfortunate, previous research using self-reported data found no significant difference between overall injury rates between Canadian provinces and the territories, although the prevalence of some specific injury types differed.[33] The CCHS target population covers about 98% of Canadians aged 12 years and older,[19] but the exclusion of on-reserve Indigenous populations and those in the military is unfortunate because previous research shows that these populations have higher risk of injury than the general population.[31,34,35]

Furthermore, this study does not consider fatal injuries. As fatalities are beyond the scope of our research question, we consider this as an omission rather than a limitation. However, it is important to recognize that many Canadians who die young do so because of injury. Unintentional injuries are the leading cause of death for Canadians aged 10 to 19 years. Intentional injuries are also responsible for a high proportion of deaths: suicide is the third and second most common cause of death, and homicide is the tenth and the fifth most common cause of death, among those aged 10 to 14 years and 15 to 19 years, respectively.[36]

Conclusion

This study complements an existing body of research on injury burden among Canadian adolescents, which often relies on hospitalization and fatality data. By using self-reported data from a representative dataset, this study sheds light on the "hidden figure" of adolescent injury. Just under a third of Canadians aged 12 to 19 years living in the 10 provinces experienced an injury that was serious enough to limit their normal activities or require medical care in the previous year; most of those injuries were unintentional. Policies and programs aimed at reducing binge drinking among Canadian adolescents are likely to lower injury rates.

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Conflicts of interest

None to declare.

Authors' contributions and statement

MA conceptualized and designed the study, with help from GE. Data analysis was conducted by NS with assistance from MA, AR and GI. The first draft of the manuscript was written by KM and all authors commented on previous versions of the manuscript.

The content and views expressed in this article are those of the authors and do not necessarily reflect those of the Government of Canada. Although the research and analysis are based on data from Statistics Canada, the opinions expressed do not necessarily represent the views of Statistics Canada.

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Original quantitative research

An evaluation of the amount, type and use of shade at public playgrounds in Guelph, Ontario, Canada

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This article has been peer reviewed.

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Abstract

Introduction: The provision of shade at outdoor recreation sites such as playgrounds confers a variety of public health benefits. It can prevent overexposure to solar ultraviolet radiation, and, in turn, protect against skin cancer. Further, shade mitigates heat and may promote physical activity. In this study, we evaluate and describe the amount, type and use of shade at public playgrounds.

Methods: Using a modified shade audit tool, shade audits were conducted to visually evaluate shade coverage at 85 city-operated playgrounds in Guelph, Ontario, Canada, in summer 2019.

Results: The main play area of most playgrounds (68%) had no shade available. Although the areas surrounding playgrounds had more shade coverage than the main play areas, we also found minimal shade coverage (> 0% to 30%) in this area for many playgrounds (48%). All shade over main play areas was provided by trees (i.e. natural shade). Permanent, built shade structures were observed in the surrounding area of 13% of playgrounds. Shade coverage in the areas surrounding playgrounds was positively correlated with the number of individuals (r_s = 0.259; p = 0.017), children (r_s = 0.270; p = 0.012), and active individuals (r_s = 0.253; p = 0.020) using the surrounding area. This suggests that individuals seek shade at playgrounds and may be more active in shaded areas.

Conclusion: Children have limited protective shade available to them at playgrounds. Future research is needed to determine how to best increase shade provision and to further explore the impact it has on playground usage, activity levels, temperature and UVR exposure.

Keywords: *public health, environmental health, child health, prevention and control, play and playthings, health equity*

Highlights

- Most playgrounds in our study offered little to no shade; when present, shade was provided mainly by trees.
- More individuals were observed using the main play areas of playgrounds relative to surrounding areas, even though these areas had significantly less shade.
- Shade coverage in the surrounding areas of playgrounds was positively correlated with the number of individuals using these areas.
- Poorer neighbourhoods had fewer playgrounds, but no association between shade coverage and neighbourhood socioeconomic status of playgrounds was observed.

Introduction

Shade at outdoor spaces imparts a variety of public health benefits. In particular, shaded environments expose people to less ultraviolet radiation (UVR) than sunny ones.[1] This is important, considering UVR from the sun is recognized as one of the major causes of skin cancer.[2] Skin cancer represents a significant public health concern in Canada; it is the most common form of cancer among Canadians, and incidence rates for melanoma, the deadliest form of skin cancer, have increased significantly over the past several years.[3] Children are especially vulnerable to the damaging effects of UVR.[4,5] Sun safety messages recommend that individuals seek shade as a way to protect themselves.[6] To encourage shade-seeking behaviours, modifications can be made to physical environments; thus, the provision of shade is an important environmental cancer prevention strategy.[7] Modifying environments to include more shade makes sun safe behaviours more accessible to all community members and contributes to the creation of more socially sustainable environments.[8]

Shade also plays a role in promoting physical activity. Researchers in Australia have observed a positive association between adolescent girls' moderate to vigorous physical activity levels and the presence of trees providing shade.[9] Relatedly, research from the United States and Australia indicates that as the provision of shade at public parks increases, so does the likelihood of people using those shaded areas.[10] This is noteworthy, considering parks can be an essential area for

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people to engage in outdoor play.[11] Trees, which provide natural shade, also play a role in ameliorating heat in urban areas,[12] improving thermal comfort and the safety of outdoor activities. As an added benefit, exposure to trees and greenery can positively impact mental health by lowering the odds of psychological distress.[13]

Public playgrounds are a key area for shade provision due to the potential in these places for adults and children to spend significant amounts of time in the sun. The desirability of shade as refuge from the sun at playgrounds has been made evident in previous research. For example, parents have expressed a desire for shade at playgrounds and report avoiding playgrounds with their children at certain times of the day if shade is unavailable.[14] Further, Canadian research shows that both adults and children seek and use shade when spending time in the sun.[15,16]

Despite the desirability and benefits of shade, research evaluating shade available at public playgrounds is limited. The available studies in this area have noted that shade coverage at these playgrounds is typically low.[17-21] For example, in one study from New Zealand, mean shade coverage of playground areas was 11%;[18] in another from Australia, mean shade coverage was 37%.[17] Thus, in both studies, the majority of playground areas were unshaded. A study conducted in Germany found that on average, 41% of the total playground area was in the shade, yet shade was only available in 22% of the main play areas.[21] This suggests that children are exposed to more sun while using play equipment than their parents or caregivers, who may be spectating on the side.[21] Some studies also suggest that playgrounds in areas of lower socioeconomic status (SES) are less likely to have shade,[17,20] highlighting shade as an important health equity concern.

There are currently no published studies evaluating shade coverage at public playgrounds in Canada. Given the protective health benefits of shade, including those for children, it is important to address this research gap. Our study objectives were: (1) to estimate and describe the extent and type of shade available at publicly accessible, city-operated playgrounds in Guelph, Ontario, Canada, via shade audits; (2) to determine whether shade coverage is significantly different across playground activity areas (i.e. main play area vs. surrounding area); and (3) to investigate potential correlates of shade coverage, including neighbourhood SES of playgrounds and the number and activity level of playground users. It is important to evaluate the provision of shade at outdoor spaces in order to determine if more is needed and to help inform future shade planning and design for outdoor public spaces.

Methods

Selection of playground sites

Guelph is a city of approximately 135 000 people located in the southwest portion of Ontario, situated about 100 km west of Toronto. There are approximately 3 million trees in Guelph, constituting an urban canopy coverage of 23.3%.[22] The City of Guelph website maintains a list of playgrounds (n = 87) located within city limits. After removing duplicates from this list (n = 2), we identified 85 playground sites to be included in the shade audit study. Playgrounds were defined as areas within a park space containing play equipment. All playgrounds were publicly available and free to use.

Shade audit procedure

The primary researcher (AC) visited all 85 City of Guelph playgrounds in July 2019. These visits took place on mostly sunny days, between the hours of 11 a.m. and 3 p.m., when UVR is highest.[23] AC used a previously described shade audit tool,[24] modified to fit the objectives of this study, to visually observe the amount and type of shade available at each playground. Shade audit tools are designed to assess the amount of existing shade at outdoor spaces.[24,25] Conducting visual shade audits for this purpose is well-established in the literature.[17,18,26,27]

Playgrounds were divided into two areas for assessment: the main play area, where the play equipment was found, and the surrounding area, which was defined as 10 m from the edge of the play area. AC visually estimated the percentage of each area that was covered by shade. Estimates were in 10% intervals and ranged from 0% to 100%. Shade coverage for each playground area (i.e. main play area and surrounding area) was also categorized as none (0%), minimal (> 0% to 30%), some (> 30% to 50%), most (> 50% to < 100%), or complete (100%). For the main play area, AC also noted which playground areas were covered by shade, including open space, main play equipment and stand-alone equipment pieces.

To validate AC's shade coverage estimates and subsequent categorization of shade (i.e. none, minimal, some, most or complete), a research assistant accompanied AC to 10 playgrounds, where each estimated shade coverage independently. These 10 playgrounds were selected because they offered significant shade, and thus presented an opportunity to assess validity. Playgrounds with no shade coverage were not eligible because full agreement was expected.

When estimating the amount of shade coverage in 10% intervals, researchers were in agreement for 60% of playground areas (n = 12 of 20). Interrater reliability of these estimates was assessed by calculating Cohen's kappa (κ), revealing a moderate agreement between the two researchers (κ = 0.552; 95% confidence interval [CI]: 0.313–0.791; p < 0.001). When categorizing shade coverage, researchers were in agreement for 85% of playground areas (n = 17 of 20), with Cohen's kappa revealing substantial agreement between the researchers (κ = 0.792; 95% CI: 0.574–1.010; p < 0.001). For all discrepancies, estimates were within 10% (for 10% interval estimates) or one category (for shade categorization). After discussing these discrepancies, researchers reached 100% agreement for all shade coverage estimates and categorizations.

Shade type was classified as natural (i.e. shade provided by trees or vegetation), built (i.e. shade provided by roofed structures or shade sails or shadows from nearby buildings), or portable (i.e. shade provided by personal umbrellas). For natural shade, the density of the tree foliage was classified as heavy or medium based on a canopy density guide by Greenwood et al.[25] Based on this guide, trees classified as having light canopy were excluded because these trees do not adequately block UVR and, as such, are not recommended as a means of sun protection.[25]

Using height as a guide, trees were further classified as being new or mature. The composition of built shade structures was classified as wood, metal, fabric, plastic, glass or other. Consistent with prior research,[18] natural shade that was less than 2 m wide or further than 10 m from the edge of the play area was excluded. Built shade structures that exceeded the 10 m boundary but offered a clear view of the playground were included because it is possible they would be used by those visiting the playground. Natural and built shade features considered unusable (i.e. playground not readily visible while in use) were excluded.

To assess UV reflectance, AC recorded the ground surface material (e.g. woodchips, pea gravel, grass) of the main play area and surrounding area, excluding the surface of pathways in the surrounding that did not enclose the entire play area. Playground use was evaluated by AC upon arrival to each playground (for total number of users) and before auditing each playground area (for the number of users stratified by playground area). AC counted the total number of people (adults and children combined), adults, and children present, along with their activity level (i.e. active or sedentary). We consider the number of playground users an estimate because individuals were moving and may have entered or left while AC counted. Active individuals were those who were standing, walking, playing or climbing in the playground areas, while sedentary individuals were those in seated positions. Ethics approval was not required because the research took place in a public setting, we only collected generic count information and no staged interaction between AC and playground users occurred.

Additional variables collected were start and finish times of shade audits, temperature, weather, UV index and the SES classification of the playground's surrounding neighbourhood. Temperature and UV index values were obtained from The Weather Channel website and recorded at the beginning of each shade audit. SES information was extracted from previous research that calculated SES classification levels (low, low-medium, medium, medium-high, high) for Guelph census tracts (CTs) using principal component analysis on 11 variables representing income, family structure, unemployment rate, education, home value, monthly rent and occupation, obtained from 2011 Census Profile, 2011 National Household Survey Profile, and 2011 tax filer datasets.[28] We plotted playgrounds to their CT and recorded their SES classification level according to the SES level of the CT in which they were located.[28]

Statistical analysis

Data were initially recorded on paper forms onsite, then entered into Excel version 16.28 (Microsoft Corp., Redmond, WA, USA) offsite. All analyses were conducted using SPSS Statistics version 26 (IBM Corp., Armonk, NY, USA). Basic descriptive analyses were performed to describe the extent and type of shade available at playgrounds, along with the number of people using the playgrounds. The Wilcoxon signed-rank test was used to determine if shade coverage was significantly different across playground areas (i.e. main play area vs. surrounding area). The Wilcoxon signed-rank test, which accounts for paired data, was necessary because two shade coverage estimates were recorded at each playground. To test for variables correlated with shade coverage, Spearman rank correlation coefficients were calculated, as the data were not normally distributed. Variables of interest included playground and activity areas, SES classification levels and the estimated number and activity level of playground users.

Results

Shade audits took an average of 16 minutes to complete per park. Average

TABLE 1
Estimated number of playground users and their recorded activity level at distinct areas[a] of publicly accessible playgrounds in Guelph, Ontario, Canada, 2019

Playground users present	Total playground area[b] (N = 370 people)[c]			
	Median	Mean	SD	Min, Max
Total individuals	1	4.35	9.98	0, 65
Adults	0	1.32	3.09	0, 25
Children	0	3.05	7.39	0, 48

Playground users present	Main play area (N = 260)[c]				Surrounding area (N = 135)[c]			
	Median	Mean	SD	Min, Max	Median	Mean	SD	Min, Max
Total individuals	0	3.06	7.90	0, 50	0	1.59	4.28	0, 35
Adults	0	0.61	1.48	0, 10	0	0.73	1.84	0, 15
Children	0	2.45	6.61	0, 40	0	0.86	2.60	0, 20
Activity level of playground users	% (n/N)				% (n/N)[d]			
Active	96 (249/260)				16 (16/100)			
Sedentary	4 (11/260)				84 (84/100)			

Abbreviations: Max, maximum number of playground users at any one playground; Min, minimum number of playground users at any one playground; SD, standard deviation.

[a] Playgrounds were divided into two distinct areas: the main play area, where the play equipment was found, and the surrounding area, defined as 10 m from the edge of the play area.

[b] Total playground area consists of both the main play area and surrounding area.

[c] N is the estimated number of individuals at playground areas. For total playground area, estimates were taken upon arrival at playgrounds. For main play area and surrounding area, estimates were taken when auditing of each section began. Due to people arriving, leaving, or moving between areas after estimates were taken, the totals do not add up.

[d] Data missing for 35 people using surrounding area due to data recording error at one playground.

temperature during shade audits was 24.9°C and median temperature was 24.0°C. Average "feels like" temperature (i.e. taking into account air temperature, relative humidity and wind speed) during shade audits was 25.3°C and median "feels like" temperature was 24.0°C. Just over half of shade audits were conducted on clear, sunny days (n = 44/85, 52%), some were conducted on days that were considered mostly sunny (n = 20/85, 24%) and others were conducted on days with a mix of sun and clouds (n = 21/85, 25%). No audits were conducted on overcast or rainy days. The mean UV index value during shade audits was 7.56 and the median UV index value was 8, though values ranged from 5 to 9.

Guelph neighbourhood SES classification was as follows: seven low SES areas, four low-medium SES areas, five medium SES areas, eight medium-high SES areas and three high SES areas.[28] Neighbourhoods located in medium-high SES areas had the greatest number of playgrounds (n = 21/85, 25%), followed by medium SES areas with 20/85 playgrounds (24%), high SES areas with 17/85 playgrounds (20%), low-medium SES areas with 14/85 playgrounds (16%), and low SES areas with 13/85 playgrounds (15%).

Park use

Data in Table 1 describe how playgrounds were being used at the time of the audit. In total, 370 individuals were counted using playgrounds; 42 playgrounds had no one present. The main play areas had an average of 2.45 children and 0.61 adults present per playground, with

TABLE 2
Extent of shade coverage, shade type and ground surface at distinct areas[a] of publicly accessible playgrounds in Guelph, Ontario, Canada, 2019

	Main play area	Surrounding area
	% (n/N)[b]	% (n/N)[b]
Extent of shade coverage		
None (0%)	68 (58/85)	1 (1/85)
Minimal (> 0% to 30%)	25 (21/85)	48 (41/85)
Some (> 30% to 50%)	6 (5/85)	31 (26/85)
Most (> 50% to < 100%)	1 (1/85)	20 (17/85)
All (100%)	0 (0/85)	0 (0/85)
Type of shade observed		
Natural shade	32 (27/85)	96 (82/85)
Heavy density	80 (63/79)[c]	82 (530/648)[c]
Medium density	20 (16/79)[c]	18 (118/648)[c]
New trees	0 (0/81)[c]	14 (92/649)[c]
Mature trees	100 (81/81)[c]	86 (557/649)[c]
Permanent built shade	0 (0)	13 (11/85)
Metal	0 (0)	73 (8/11)
Other[d]	0 (0)	27 (3/11)
Portable shade	0 (0)	0 (0)
Ground surface		
Woodchips	71 (60/85)	0 (0/85)
Sand	20 (17/85)	0 (0/85)
Pea gravel	6 (5/85)	0 (0/85)
Rubber	2 (2/85)	0 (0/85)
Woodchips and rubber	1 (1/85)	0 (0/85)
Grass	0 (0/85)	44 (37/85)
Grass and cement	0 (0/85)	29 (25/85)
Grass and gravel	0 (0/85)	2 (2/85)
Grass and asphalt	0 (0/85)	6 (5/85)
Grass, cement and gravel	0 (0/85)	1 (1/85)
Grass, cement and asphalt	0 (0/85)	18 (15/85)

[a] Playgrounds were divided into two distinct areas: the main play area, where the play equipment was found, and the surrounding area, defined as 10 m from the edge of the play area.

[b] n is the number of playgrounds.

[c] n is the number of trees.

[d] "Other" included roofing shingles and a shadow from an adjacent house.

most of these individuals being active (n = 249/260, 96%). The area surrounding the play area had an average of 0.86 children and 0.73 adults per playground, with most of these individuals being sedentary (n = 84/100, 84%).

Shade coverage

The main play area of most playgrounds (n = 58/85, 68%) had no shade coverage, rendering them completely exposed to the sun (Table 2). Nearly one-quarter of playgrounds (n = 21/85, 25%) had minimal shade coverage (> 0% to 30%) over the main play area, a few (n = 5/85, 6%) had some shade coverage (> 30% to 50%) and only one play area (n = 1/85, 1%) was mostly covered by shade (> 50% to < 100%). No playground areas had complete shade coverage.

In contrast, shade coverage was more prevalent in the area surrounding the main play area: 48% (n = 41/85) of playgrounds had minimal shade coverage (> 0% to 30%) over this area, 31% (n = 26/85) had some shade coverage (> 30% to 50%), 20% (n = 17/85) were mostly covered by shade (> 50% to < 100%), and only 1% (n = 1/85) had no shade. A well shaded playground is shown in Figure 1; a poorly shaded playground is shown in Figure 2. The Wilcoxon signed-rank test indicated that the shade coverage of areas surrounding playgrounds was statistically significantly greater than the shade coverage of main play areas ($z = -7.806$, $p < 0.001$; Figure 3).

Shade type

Shade over the main play area of playgrounds was provided solely by natural shade (Table 2). This shade covered the open space at 24% (n = 20/82) of play areas, stand-alone equipment pieces at 13% (n = 11/82) of play areas, the main play equipment at 11% (n = 9/82) of play areas, swings at 6% (n = 5/82) of play areas, and the sandbox at 1% (n = 1/82) of play areas. There were no permanent built shade structures (e.g. shade sails) providing shade over the main play area of playgrounds, though 49% (n = 42/85) of playgrounds had small roof-like structures on play equipment. In areas surrounding playgrounds, natural shade was also very common, with 96% (n = 82/85) of playgrounds having this type of shade. Permanent built structures were observed in the surrounding area at 13% of playgrounds (n = 11/85). No playground users were observed using portable shade.

Correlation analyses

Shade coverage over the main play areas and shade coverage over the surrounding areas were positively correlated ($r_s = 0.681$, $p < 0.001$; Table 3). Coverage over the surrounding area of playgrounds was positively correlated with the number of people using the surrounding area ($r_s = 0.259$, $p = 0.017$), the number of children using the surrounding areas ($r_s = 0.270$, $p = 0.012$) and the number of active people in the surrounding areas ($r_s = 0.253$, $p = 0.020$). No significant

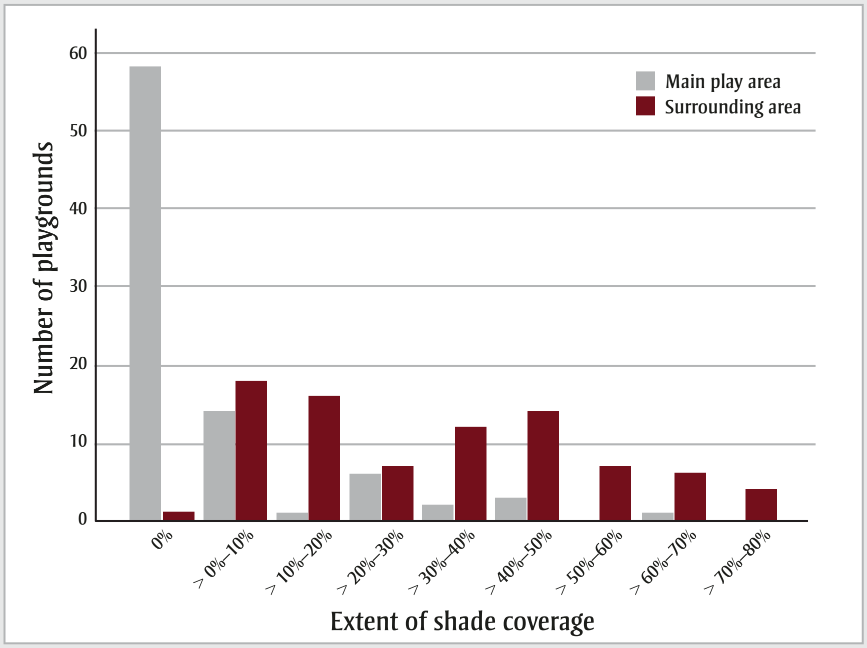
FIGURE 1
Example of a well shaded playground: Royal City Park, Guelph, Ontario, Canada, 2019

Photo credit: Andrea Cimino

FIGURE 2
Example of a poorly shaded playground: Earl Brimblecombe Park, Guelph, Ontario, Canada, 2019

Photo credit: Andrea Cimino

FIGURE 3
Shade coverage over distinct areas[a] of publicly accessible playgrounds in Guelph, Ontario, Canada, 2019 (n = 85)



[a] Playgrounds were divided into two distinct areas: the main play area, where the play equipment was found, and the surrounding area, defined as 10 m from the edge of the play area.

correlations were observed between shade coverage of playground areas and neighbourhood SES.

Discussion

Our findings indicate there is limited shade available at most playgrounds in Guelph. Consistent with previous research,[17-21,27] we found that most playground areas had limited to no shade, meaning individuals using these areas were exposed to high levels of direct sunlight and therefore solar UVR. To take advantage of the numerous community-wide health benefits of shade, environments must be designed with adequate amounts of shade. Future research into why shade coverage at playgrounds is low is needed to develop an evidence base upon which effective solutions can be built.

Our finding that the main play areas of playgrounds, where children are more likely to play, had significantly less shade than the areas surrounding playgrounds, where one might spectate, sit or eat, is consistent with previous research.[17,18,20,21] For example, the areas surrounding the main play areas of German playgrounds had about twice as much shade as playground equipment areas.[21] Furthermore, we found that the ground surface of the main play areas was most commonly woodchips or sand, which reflect more UVR than grass,[29] thereby increasing UVR exposure in already unshaded areas. Children's skin is particularly vulnerable to solar UVR,[4] so these findings are especially concerning. Ensuring adequate shade and minimizing reflected UVR in areas where children are most expected to play are important elements in the design and redesign of parks.

Though shade was lacking over the main play areas of playgrounds, children observed during our shade audits continued to use these areas. We also found a significant positive correlation between shade coverage in the surrounding areas of playgrounds and the number of children observed using those areas. Together, this suggests that though children readily play in unshaded areas exposed to direct sunlight, they may seek refuge from the sun by migrating to areas with more shade. In studies where the provision of shade was increased via built shade structures, adults and adolescents tended to use rather than avoid newly shaded areas.[10,30] Indeed, shade at playgrounds is an attractive feature to many parents.[14] Thus, increasing the provision of shade at playgrounds may encourage more people to use them.

Playgrounds are important for physical activity. We found a significant positive association between shade coverage in the surrounding areas of playgrounds and the number of active people, suggesting shade supports physical activity. Results from previous research have been mixed. In one study, the presence of trees providing shade to public open spaces was positively associated with girls' moderate to vigorous physical activity levels.[9] However, another study found more sedentary people in park areas with more shade.[31] These studies are not entirely comparable, and neither investigated the effect of shade location or type. Regardless, children view trees and vegetation surrounding playgrounds as an extension of the play equipment.[32] Trees can help to facilitate physical activity at playgrounds, and as they grow yield increased natural shade. Future research should further explore the relationship between shade at playgrounds and physical activity, taking into account shade type and location.[31]

To increase shade coverage at playgrounds, two types of shade can be used: built shade structures and natural shade. In our study, natural shade was more prevalent than built shade structures, and this has been seen previously in the literature.[19-21] We observed shade over main play areas to be provided exclusively by natural shade, with only a small percentage of playgrounds having built shade structures in the surrounding areas. While both natural shade and built shade are useful for UVR protection, natural shade also plays a role in reducing temperatures in urban areas.[12] This can make playing outdoors on playgrounds a more comfortable experience, allowing people to use playgrounds and remain active for longer periods of time. It is important to consider the time it takes for trees to grow and mature enough to provide substantial natural shade. Policy actions targeting shade can help ensure the provision of shade at outdoor spaces is adequate not only in terms of quantity, but also quality.[33]

We found no association between shade coverage and SES of playground neighbourhoods, which is consistent with

TABLE 3
Spearman rank correlation coefficients between shade coverage estimates and playground areas, neighbourhood socioeconomic status classification level and number and activity level of playground users, Guelph, Ontario, Canada, 2019

	Shade covering main play area[a]		Shade covering surrounding area[a]	
	r_s	*p*-value	r_s	*p*-value
Playground area				
Shade covering main play area	1.000	N/A	0.681**	< 0.001
Shade covering surrounding area	0.681**	< 0.001	1.000	N/A
Shade covering equipment in main play area	0.824**	< 0.001	0.552**	< 0.001
Shade covering open space in main play area	0.860**	< 0.001	0.618**	< 0.001
Neighbourhood characteristics				
Socioeconomic status classification level	−0.201	0.065	−0.197	0.071
Playground users present				
Users in main play area				
Number of individuals	−0.178	0.104	−0.026	0.816
Number of adults	−0.074	0.502	0.020	0.857
Number of children	−0.172	0.114	−0.018	0.870
Users in surrounding area				
Number of individuals	0.151	0.167	0.259*	0.017
Number of adults	0.184	0.092	0.210	0.054
Number of children	0.162	0.138	0.270*	0.012
Activity levels of playground users				
Activity of users in main play area				
Number of active individuals	−0.173	0.114	−0.014	0.899
Number of sedentary individuals	−0.032	0.771	0.010	0.928
Activity of users in surrounding area				
Number of active individuals	0.191	0.082	0.253*	0.020
Number of sedentary individuals	0.103	0.350	0.199	0.069

[a] Playgrounds were divided into two distinct areas: the main play area, where the play equipment was found, and the surrounding area, defined as 10 m from the edge of the play area.

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

research by Schneider et al.[21] Conversely, two studies have found playgrounds in lower SES areas have less shade relative to playgrounds in higher SES areas[17,20] and lower SES neighbourhoods are less likely to have trees that provide shade and other features that promote physical activity amongst children.[34] Understanding the association between shade coverage at playgrounds and the SES of neighbourhoods is important for health equity. Further research should continue examining this relationship to understand why there are mixed findings.

Strengths and limitations

This research is the first to provide evidence of the availability of shade at public playgrounds in Canada, using an Ontario city as an example. Our results shed light on the need for significant improvements to shade provision at public playgrounds. Shade coverage estimates were somewhat subject to the judgment of the researchers, though shade audit guidelines were followed and estimates were verified by a second researcher. Future shade audit research may benefit from the use of technology (i.e. drones) to obtain a more objective measurement of shade coverage. Each playground was only visited once, making shade coverage estimates and the estimated number of playground users valid for those specific timepoints. People may have visited parks outside the time we conducted shade audits. Shade audits were not conducted on days that were perfectly comparable in terms of weather (i.e. some days were cloudier or hotter than others), though this was minimized by collecting all data within one summer month and on days that had at least some sun. We examined physical activity overall, but not for adults versus children; this should be explored in future research. Lastly, data were analyzed using correlation analyses; thus, only the degree of association between variables could be measured.

Conclusion

Most playgrounds in Guelph had little to no shade over the main play area and minimal shade over the surrounding area of playgrounds. Our findings can inform the design of both playgrounds and shade policy. Municipalities and local governments should prioritize shade to reduce UVR exposure for skin cancer prevention, promote park use for physical activity and mitigate heat for thermal comfort and safety. Focussed efforts on improving shade provision will contribute to more sustainable environments as the health benefits of shade become more accessible. More research is needed, and policy approaches should be explored, to help ensure playgrounds and other outdoor recreation sites have sufficient shade to promote health and prevent disease.

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Conflicts of interest

The authors have no conflicts of interest to disclose.

Authors' contributions and statement

All authors contributed to the study conception and design. AC performed the data acquisition and analysis, as well as wrote the initial draft of the manuscript with support from JM and AP. All authors commented on and revised previous versions of the manuscript. All authors read and approved the final manuscript.

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At-a-glance

Self-rated mental health, community belonging, life satisfaction and perceived change in mental health among adults during the second and third waves of the COVID-19 pandemic in Canada

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Abstract

Findings from the 2020 Survey on COVID-19 and Mental Health (SCMH) suggested that the positive mental health of adults in Canada was lower during the second wave of the pandemic (fall 2020) than in 2019. With 2021 SCMH data from winter/spring 2021, we find in the current study that average life satisfaction and the prevalence of high self-rated mental health, high community belonging and perceptions of stable/improved mental health were even lower during the third wave of the pandemic as compared to the second wave in the overall adult population and in most sociodemographic groups.

Keywords: *COVID-19, coronavirus, mental health, life satisfaction, community belonging, Canadian adults, public health*

Highlights

- Fewer adults in Canada reported high self-rated mental health in winter/spring 2021 (51.5%) compared to fall 2020 (59.9%).
- Fewer adults reported high community belonging in winter/spring 2021 (57.3%) compared to fall 2020 (63.7%).
- Rated from 0 (very dissatisfied) to 10 (very satisfied), average life satisfaction was lower in winter/spring 2021 (6.9) compared to fall 2020 (7.2).
- Fewer adults in winter/spring 2021 (58.1%) compared to fall 2020 (66.5%) reported that their mental health was better or about the same compared to before the COVID-19 pandemic.

Introduction

Beyond the direct impact of COVID-19 on Canadians' physical health,[1,2] there have been wider effects of the pandemic on mental health. For instance, the percentage of Canadian adults who screened positive for major depressive disorder was two times higher during the second wave of the pandemic in fall 2020 compared to before the pandemic.[3] The positive mental health (PMH) of Canadians also appears to have been negatively affected, with lower average life satisfaction and fewer adults in Canada reporting high self-rated mental health (SRMH) and high community belonging during fall 2020 compared to pre-pandemic levels.[4,5]

Ongoing measurement of population mental health is necessary to understand changes in Canadians' well-being during different periods of the pandemic and provide information about the recovery of the population. There is already some evidence of mental health in Canada worsening as the pandemic progressed from fall 2020 to winter/spring 2021. For instance, a higher percentage of adults screened positive for major depressive disorder and generalized anxiety disorder during the third (vs. second) wave of the pandemic.[6] Similarly, high self-rated levels of anxiety and depression were more prevalent among adults in February and April of 2021 compared to 2020.[7,8] In the current analysis, we investigated whether PMH outcomes and perceived change in mental health also differed in winter/spring 2021 from fall 2020 in the overall population and in various sociodemographic groups.

Methods

Mental health during the COVID-19 pandemic's second wave was estimated using data from the 2020 Survey on COVID-19 and Mental Health (SCMH), which was collected from 11 September to 4 December 2020.[9] Mental health during the third wave was estimated using data from the 2021 SCMH, which was collected from 1 February to 7 May 2021.[10] Adults (18 years and older) living in the 10 provinces and the three capital cities of the territories voluntarily completed the 2020 and 2021 SCMH by computer-assisted telephone interview or electronic questionnaire. A simple random sample of dwellings was selected within each province and territorial city using the Dwelling Universe File as the sampling frame, with an adult then sampled within each dwelling. The response rate for the 2020 SCMH was 53.3%, with 14 689 respondents in total. The response rate for the 2021 SCMH was 49.3%, with 8032 respondents in

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total. We analyzed data only from the 12 344 and 6592 respondents of the 2020 and 2021 SCMH, respectively, who agreed to share their data with the Public Health Agency of Canada.

SRMH was assessed by asking, “In general, how is your mental health?” with “Excellent”, “Very good”, “Good”, “Fair” and “Poor” as response options. High SRMH included those who answered “Excellent” or “Very good”.[11] Community belonging was assessed by asking, “How would you describe your sense of belonging to your local community?” with “Very strong”, “Somewhat strong”, “Somewhat weak” and “Very weak” as response options. High community belonging included those who answered “Very strong” or “Somewhat strong”.[11] Life satisfaction was assessed by asking, “Using a scale of 0 to 10 where 0 means ‘Very dissatisfied’ and 10 means ‘Very satisfied’, how do you feel about your life as a whole right now?” We examined life satisfaction as a numerical variable.[11] Perceived change in mental health was assessed by asking, “Compared to before the COVID-19 pandemic, how would you say your mental health is now?” with “Much better now”, “Somewhat better now”, “About the same”, “Somewhat worse now” and “Much worse now” as response options. Stable/improved mental health included those who answered “About the same”, “Somewhat better now” or “Much better now”.[4]

We conducted analyses using SAS Enterprise Guide version 7.1 (SAS Institute Inc., Cary, NC, USA). We used sampling weights from Statistics Canada to obtain nationally representative estimates that take into account the complex survey design. We estimated coefficients of variation and 95% confidence intervals (CIs) using bootstrap weights. We compared estimates of average life satisfaction and the prevalence of high SRMH, high community belonging and perceptions of stable/improved mental health in winter/spring 2021 to fall 2020 for the overall population and for specific sociodemographic groups using the SURVEYMEANS procedure in SAS Enterprise Guide.

We included the same sociodemographic variables as in our previous study,[4] although we examined broader categories for household income (tertiles instead of quintiles) and geographical location (combining prairie provinces together, Atlantic provinces together and territorial capitals together),[5] as the sample size was smaller in the 2021 SCMH. We also investigated changes in mental health outcomes by work status (frontline worker, essential non-frontline worker, absent from work due to a business closure/layoff/personal circumstances related to COVID-19, other), as previous research has found some differences in suicide ideation and perceived change in mental health during the pandemic between these groups.[4,12] Lastly, whether an individual lives alone (yes, no) was examined, as living alone has been associated with lower SRMH and life satisfaction pre-pandemic;[13] those living alone may be even more likely to be socially isolated and vulnerable to declines in mental health during the pandemic.[14]

Significant differences over time were identified when the 95% CI of a difference score excluded 0 and by p-values < 0.05. When reporting results, we also highlighted when differences were significant at even stricter alpha levels (p-values < 0.01 and < 0.001).

Results

High SRMH, high community belonging and average life satisfaction results are reported in Table 1.

Overall, 51.5% of adults in Canada reported high SRMH in winter/spring 2021, which is significantly lower than the 59.9% who reported high SRMH in fall 2020. High SRMH was significantly less common in winter/spring 2021 than in fall 2020 in every sociodemographic group we examined, except for those absent from work due to the pandemic and those living in the territorial capitals.

The prevalence of high community belonging was 57.3% in winter/spring 2021, which is significantly lower than the 63.7% who reported high community belonging in fall 2020. High community belonging was significantly less common in winter/spring 2021 than in fall 2020 in most of the sociodemographic groups we examined. The exceptions for which high community belonging was not significantly different in fall 2020 and winter/spring 2021 included among racialized individuals, those from low-income households, those living in rural areas, frontline workers, those absent from work due to the pandemic and those living in Quebec, the Atlantic provinces and the territorial capitals.

Average life satisfaction was 6.9 in winter/spring 2021, which is significantly lower than the average life satisfaction of 7.2 in fall 2020. Average life satisfaction was significantly lower in winter/spring 2021 than in fall 2020 in every sociodemographic group we examined, except for those aged 50 to 64 years old, frontline workers, essential non-frontline workers, those absent from work due to the pandemic and those living in the territorial capitals.

Lastly, perceived change in mental health results are reported in Table 2. Overall, 58.1% of adults in Canada reported in winter/spring 2021 that their mental health is stable/improved compared to before the pandemic, which is significantly lower than the 66.5% who reported stable/improved mental health in fall 2020. A significantly lower prevalence in winter/spring 2021 was found in all sociodemographic groups, except those absent from work due to the pandemic, and those living in British Columbia or the territorial capitals.

Discussion

This study provides further evidence for worsening population mental health from the second to the third wave of the pandemic in Canada,[6-8,15] with adults feeling less satisfied with their life on average and fewer individuals reporting high SRMH, high community belonging and stable/improved mental health. The lower mental health levels observed during the third wave may be attributable to the cumulative effect of stressors after a year in a pandemic,[16] more Canadians being affected by a COVID-19 infection personally or within their social network as additional waves of the pandemic occur,[1] the unintended consequences of public health measures to limit the spread of COVID-19 in various jurisdictions during the third wave[17] and/or other factors.

Decreases in mental health were found in many sociodemographic groups, but young adults aged 18 to 34 years appeared to be struggling the most in the third wave, with just one-third reporting high SRMH and fewer than half reporting high community belonging or stable/improved mental health. Declines in some mental health outcomes

TABLE 1
Prevalence of high self-rated mental health and high community belonging, and average life satisfaction in fall 2020 and winter/spring 2021

Characteristics	High self-rated mental health			High community belonging			Average life satisfaction		
	2020 SCMH % (95% CI)	2021 SCMH % (95% CI)	Difference 2020–2021 (95% CI)	2020 SCMH % (95% CI)	2021 SCMH % (95% CI)	Difference 2020–2021 (95% CI)	2020 SCMH Mean (95% CI)	2021 SCMH Mean (95% CI)	Difference 2020–2021 (95% CI)
Overall	59.9 (58.7, 61.2)	51.5 (49.7, 53.3)	8.5*** (6.3, 10.6)	63.7 (62.4, 64.9)	57.3 (55.6, 59.1)	6.3*** (4.2, 8.4)	7.2 (7.1, 7.3)	6.9 (6.8, 7.0)	0.3*** (0.2, 0.4)
Gender									
Female	55.7 (53.9, 57.5)	49.3 (46.9, 51.6)	6.4*** (3.4, 9.4)	63.6 (61.9, 65.3)	56.7 (54.3, 59.1)	6.9*** (4.0, 9.8)	7.1 (7.0, 7.2)	6.8 (6.7, 6.9)	0.3*** (0.2, 0.5)
Male	64.5 (62.6, 66.4)	54.0 (51.2, 56.7)	10.5*** (7.2, 13.9)	63.8 (61.9, 65.7)	58.2 (55.4, 60.9)	5.6*** (2.3, 8.9)	7.3 (7.2, 7.4)	7.0 (6.9, 7.1)	0.3*** (0.1, 0.4)
Age (years)									
18–34	50.6 (47.6, 53.7)	33.4 (29.4, 37.5)	17.2*** (12.2, 22.2)	51.4 (48.3, 54.6)	43.7 (39.3, 48.1)	7.7** (2.3, 13.1)	6.8 (6.6, 6.9)	6.3 (6.1, 6.5)	0.5*** (0.2, 0.7)
35–49	57.2 (54.6, 59.7)	48.6 (44.9, 52.3)	8.6*** (4.1, 13.0)	62.8 (60.2, 65.3)	54.4 (50.9, 58.0)	8.3*** (4.1, 12.6)	7.1 (7.0, 7.2)	6.9 (6.7, 7.0)	0.3** (0.1, 0.5)
50–64	62.0 (59.7, 64.3)	57.6 (54.2, 60.9)	4.4* (0.4, 8.5)	65.9 (63.6, 68.2)	61.3 (58.2, 64.4)	4.6* (0.7, 8.5)	7.2 (7.1, 7.3)	7.0 (6.9, 7.2)	0.2 (−0.01, 0.3)
65+	72.5 (70.4, 74.6)	68.0 (64.9, 71.1)	4.5* (0.8, 8.3)	77.7 (75.8, 79.6)	71.5 (68.6, 74.4)	6.2*** (2.8, 9.6)	7.8 (7.7, 7.9)	7.5 (7.3, 7.6)	0.3*** (0.2, 0.5)
Racialized group member									
Yes	60.8 (57.8, 63.8)	50.1 (45.9, 54.4)	10.6*** (5.5, 15.8)	59.9 (56.8, 63.0)	57.1 (52.8, 61.4)	2.8 (−2.3, 8.0)	6.9 (6.8, 7.1)	6.7 (6.5, 6.9)	0.2* (0.02, 0.5)
No	59.7 (58.3, 61.1)	52.1 (50.2, 54.0)	7.6*** (5.2, 10.0)	65.0 (63.6, 66.5)	57.7 (55.8, 59.6)	7.4*** (5.0, 9.7)	7.3 (7.2, 7.4)	7.0 (6.9, 7.1)	0.3*** (0.2, 0.4)
Immigrant status									
Yes	64.0 (61.2, 66.8)	55.5 (51.4, 59.5)	8.6*** (3.6, 13.5)	63.7 (60.9, 66.5)	58.5 (54.7, 62.4)	5.2* (0.5, 9.9)	7.1 (7.0, 7.2)	6.9 (6.7, 7.0)	0.2* (0.03, 0.5)
No	58.4 (56.9, 59.8)	49.9 (47.9, 51.9)	8.5*** (6.0, 11.0)	63.7 (62.2, 65.2)	56.8 (54.8, 58.8)	6.9*** (4.4, 9.3)	7.2 (7.2, 7.3)	6.9 (6.8, 7.0)	0.3*** (0.2, 0.4)
Household income									
Low	58.9 (56.7, 61.1)	51.2 (48.3, 54.2)	7.7*** (4.0, 11.3)	62.0 (59.8, 64.2)	58.9 (56.0, 61.8)	3.1 (−0.5, 6.7)	7.1 (7.0, 7.2)	6.8 (6.6, 6.9)	0.3*** (0.2, 0.5)
Middle	59.3 (56.8, 61.7)	51.4 (48.0, 54.8)	7.9*** (3.7, 12.1)	63.4 (60.9, 65.8)	57.1 (53.6, 60.6)	6.3** (1.9, 10.6)	7.1 (7.0, 7.2)	6.9 (6.8, 7.1)	0.2* (0.02, 0.4)
High	61.5 (59.1, 63.9)	53.6 (50.0, 57.3)	7.9*** (3.5, 12.3)	63.5 (61.1, 66.0)	54.3 (50.7, 57.8)	9.3*** (4.9, 13.6)	7.3 (7.2, 7.4)	7.1 (6.9, 7.2)	0.3** (0.1, 0.4)

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TABLE 1 (continued)
Prevalence of high self-rated mental health and high community belonging, and average life satisfaction in fall 2020 and winter/spring 2021

Characteristics	High self-rated mental health			High community belonging			Average life satisfaction		
	2020 SCMH	2021 SCMH	Difference 2020–2021 (95% CI)	2020 SCMH	2021 SCMH	Difference 2020–2021 (95% CI)	2020 SCMH	2021 SCMH	Difference 2020–2021 (95% CI)
	% (95% CI)	% (95% CI)		% (95% CI)	% (95% CI)		Mean (95% CI)	Mean (95% CI)	
Place of residence									
Population centre	58.5 (57.1, 60.0)	50.5 (48.5, 52.6)	8.0*** (5.5, 10.5)	62.3 (60.8, 63.8)	55.6 (53.6, 57.6)	6.7*** (4.3, 9.2)	7.1 (7.0, 7.2)	6.8 (6.7, 6.9)	0.3*** (0.2, 0.4)
Rural area	66.1 (63.4, 68.7)	56.3 (52.3, 60.3)	9.8*** (5.1, 14.5)	69.9 (67.3, 72.6)	65.6 (61.7, 69.5)	4.4 (−0.5, 9.2)	7.6 (7.5, 7.7)	7.3 (7.2, 7.5)	0.3** (0.1, 0.5)
Educational attainment									
High school or lower	58.1 (55.6, 60.6)	48.3 (44.9, 51.7)	9.8*** (5.7, 13.9)	65.7 (63.2, 68.1)	59.0 (55.5, 62.5)	6.7** (2.4, 10.9)	7.2 (7.1, 7.3)	6.9 (6.7, 7.1)	0.3** (0.1, 0.5)
Post-secondary	60.7 (59.2, 62.2)	52.9 (50.7, 55.1)	7.8*** (5.2, 10.5)	62.7 (61.2, 64.3)	56.6 (54.5, 58.7)	6.1*** (3.6, 8.6)	7.2 (7.1, 7.3)	6.9 (6.8, 7.0)	0.3*** (0.2, 0.4)
Parent/guardian of child < 18 years									
Yes	59.2 (56.8, 61.6)	49.2 (45.6, 52.8)	10.0*** (5.7, 14.3)	64.9 (62.4, 67.3)	56.8 (53.3, 60.3)	8.1*** (3.9, 12.2)	7.2 (7.1, 7.3)	6.9 (6.8, 7.1)	0.3** (0.1, 0.4)
No	60.3 (58.7, 61.9)	52.3 (50.2, 54.4)	8.0*** (5.4, 10.6)	63.2 (61.7, 64.7)	57.6 (55.5, 59.6)	5.7*** (3.2, 8.2)	7.2 (7.1, 7.3)	6.9 (6.8, 7.0)	0.3*** (0.2, 0.4)
Work status									
Frontline worker	57.2 (52.1, 62.3)	46.4 (39.6, 53.2)	10.8* (2.5, 19.1)	64.5 (59.4, 69.5)	59.0 (52.1, 65.9)	5.4 (−3.0, 13.9)	7.2 (6.9, 7.4)	6.9 (6.6, 7.2)	0.2 (−0.1, 0.6)
Essential non-frontline worker	62.5 (59.5, 65.5)	52.7 (48.5, 56.9)	9.8*** (4.6, 15.0)	64.5 (61.6, 67.4)	58.6 (54.7, 62.6)	5.9* (0.9, 10.9)	7.3 (7.1, 7.4)	7.1 (7.0, 7.3)	0.2 (−0.1, 0.4)
Not working due to COVID-19	38.4 (27.3, 49.5)	49.9^{E} (33.2, 66.6)	−11.5^{E} (−31.8, 8.9)	58.6 (47.5, 69.7)	60.9^{E} (44.4, 77.4)	−2.3^{E} (−22.6, 18.0)	6.3 (5.7, 6.8)	6.5^{E} (6.0, 7.0)	−0.2^{E} (−1.0, 0.5)
Other	59.9 (58.4, 61.4)	51.6 (49.4, 53.7)	8.3*** (5.7, 10.9)	63.5 (61.9, 65.0)	56.6 (54.5, 58.6)	6.9*** (4.4, 9.4)	7.2 (7.1, 7.3)	6.8 (6.7, 6.9)	0.4*** (0.3, 0.5)
Living alone									
Yes	59.0 (56.8, 61.3)	51.6 (48.3, 54.8)	7.5*** (3.4, 11.6)	62.2 (59.9, 64.5)	58.1 (54.9, 61.2)	4.2* (0.2, 8.1)	7.1 (7.0, 7.2)	6.8 (6.7, 7.0)	0.3** (0.1, 0.5)
No	60.0 (58.6, 61.5)	51.5 (49.4, 53.6)	8.6*** (6.0, 11.1)	63.9 (62.4, 65.4)	57.1 (55.2, 59.1)	6.7*** (4.3, 9.2)	7.2 (7.2, 7.3)	6.9 (6.8, 7.0)	0.3*** (0.2, 0.4)

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TABLE 1 (continued)
Prevalence of high self-rated mental health and high community belonging, and average life satisfaction in fall 2020 and winter/spring 2021

Characteristics	High self-rated mental health			High community belonging			Average life satisfaction		
	2020 SCMH % (95% CI)	2021 SCMH % (95% CI)	Difference 2020–2021 (95% CI)	2020 SCMH % (95% CI)	2021 SCMH % (95% CI)	Difference 2020–2021 (95% CI)	2020 SCMH Mean (95% CI)	2021 SCMH Mean (95% CI)	Difference 2020–2021 (95% CI)
Geographical location									
British Columbia	55.6 (52.1, 59.1)	48.2 (43.5, 52.8)	7.4* (1.5, 13.3)	61.9 (58.5, 65.2)	53.5 (48.9, 58.2)	8.3** (2.6, 14.1)	6.9 (6.8, 7.1)	6.7 (6.5, 6.9)	0.3* (0.01, 0.5)
Prairie provinces	53.6 (51.2, 56.0)	46.9 (43.4, 50.4)	6.7** (2.3, 11.1)	61.7 (59.4, 64.0)	57.3 (54.0, 60.7)	4.3* (0.2, 8.5)	6.9 (6.8, 7.0)	6.6 (6.5, 6.8)	0.3** (0.1, 0.5)
Ontario	58.9 (56.4, 61.4)	47.8 (44.3, 51.4)	11.1*** (6.9, 15.3)	63.3 (60.8, 65.8)	54.9 (51.4, 58.4)	8.4*** (4.2, 12.6)	7.1 (7.0, 7.2)	6.7 (6.6, 6.9)	0.3*** (0.2, 0.5)
Quebec	70.1 (67.6, 72.5)	63.6 (60.0, 67.1)	6.5** (2.1, 10.9)	65.0 (62.3, 67.6)	61.1 (57.7, 64.4)	3.9 (−0.3, 8.1)	7.8 (7.7, 7.9)	7.5 (7.4, 7.7)	0.2** (0.1, 0.4)
Atlantic provinces	57.1 (55.0, 59.2)	50.8 (47.7, 53.9)	6.3*** (2.5, 10.0)	70.4 (68.3, 72.4)	66.9 (64.0, 69.9)	3.5 (−0.2, 7.1)	7.4 (7.3, 7.5)	7.1 (7.0, 7.3)	0.2** (0.1, 0.4)
Territorial capitals	51.4 (47.6, 55.2)	47.5 (43.5, 51.4)	3.9 (−1.5, 9.3)	73.8 (70.6, 77.1)	71.7 (67.8, 75.5)	2.2 (−3.0, 7.4)	7.2 (7.1, 7.3)	7.0 (6.8, 7.2)	0.2 (−0.02, 0.4)

Abbreviations: CI, confidence interval; SCMH, Survey on COVID-19 and Mental Health.

Notes: Life satisfaction was rated on a scale from 0 (very dissatisfied) to 10 (very satisfied). Prairie provinces include Alberta, Manitoba and Saskatchewan. Atlantic provinces include New Brunswick, Newfoundland and Labrador, Nova Scotia and Prince Edward Island. Territorial capitals include Iqaluit, Whitehorse and Yellowknife. Positive values in the difference columns mean that the percentage/average was higher in fall 2020 than in winter/spring 2021; negative values in the difference columns mean that the percentage/average was lower in fall 2020 than in winter/spring 2021. Due to rounding, the difference scores do not always equal the difference between estimates from fall 2020 and winter/spring 2021. Some positive mental health estimates from the 2020 SCMH reported in this table differ slightly from the positive mental health estimates in Capaldi et al.[4] because the latter excluded territorial data to be more comparable with the 2019 Canadian Community Health Survey.

[E] Estimates should be interpreted with caution, as the unweighted total sample size is between 75 and 150. Please look at the confidence intervals when interpreting these estimates.
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

TABLE 2
Prevalence of perceived stability/improvement in mental health compared to before the COVID-19 pandemic in fall 2020 and winter/spring 2021

Characteristics	2020 SCMH % (95% CI)	2021 SCMH % (95% CI)	Difference 2020–2021 (95% CI)
Overall	66.5 (65.2, 67.8)	58.1 (56.3, 59.9)	8.5*** (6.2, 10.7)
Gender			
Female	62.3 (60.6, 64.0)	55.3 (53.0, 57.7)	7.0*** (4.0, 9.9)
Male	71.0 (69.0, 72.9)	61.1 (58.2, 63.9)	9.9*** (6.4, 13.4)
Age (years)			
18–34	58.7 (55.5, 61.8)	44.2 (39.9, 48.6)	14.4*** (9.0, 19.8)
35–49	62.4 (59.8, 65.0)	51.9 (48.3, 55.6)	10.5*** (6.1, 14.8)
50–64	67.8 (65.6, 70.1)	63.5 (60.2, 66.7)	4.4* (0.4, 8.4)
65+	79.6 (77.7, 81.5)	74.7 (71.8, 77.6)	4.9** (1.5, 8.3)
Racialized group member			
Yes	68.2 (65.1, 71.2)	60.1 (55.8, 64.4)	8.1** (2.8, 13.3)
No	65.8 (64.3, 67.3)	57.6 (55.6, 59.6)	8.2*** (5.8, 10.7)
Immigrant status			
Yes	71.0 (68.3, 73.7)	61.9 (57.9, 65.9)	9.1*** (4.3, 13.9)
No	64.7 (63.2, 66.2)	56.4 (54.4, 58.5)	8.3*** (5.8, 10.8)
Household income			
Low	69.1 (66.9, 71.2)	60.6 (57.7, 63.5)	8.5*** (4.8, 12.1)
Middle	64.5 (62.0, 66.9)	59.9 (56.6, 63.2)	4.6* (0.5, 8.7)
High	63.5 (60.9, 66.2)	53.9 (50.3, 57.5)	9.7*** (5.3, 14.1)
Place of residence			
Population centre	65.4 (63.8, 66.9)	56.4 (54.3, 58.4)	9.0*** (6.4, 11.5)
Rural area	71.9 (69.4, 74.4)	66.0 (62.3, 69.6)	5.9** (1.5, 10.3)
Educational attainment			
High school or lower	71.1 (68.6, 73.6)	62.7 (59.1, 66.2)	8.4*** (4.1, 12.7)
Post-secondary	64.3 (62.8, 65.9)	56.2 (54.0, 58.4)	8.1*** (5.5, 10.8)
Parent/guardian of child < 18 years			
Yes	62.4 (59.9, 64.8)	52.6 (49.1, 56.2)	9.7*** (5.5, 14.0)
No	68.0 (66.5, 69.6)	60.1 (58.0, 62.2)	7.9*** (5.3, 10.6)

Continued on the following page

TABLE 2 (continued)
Prevalence of perceived stability/improvement in mental health compared to before the COVID-19 pandemic in fall 2020 and winter/spring 2021

Characteristics	2020 SCMH % (95% CI)	2021 SCMH % (95% CI)	Difference 2020–2021 (95% CI)
Work status			
Frontline worker	61.9 (57.0, 66.7)	47.6 (40.5, 54.7)	14.3*** (6.0, 22.6)
Essential non-frontline worker	66.1 (63.0, 69.1)	59.2 (55.3, 63.2)	6.9** (1.9, 11.8)
Not working due to COVID-19	49.8 (38.1, 61.4)	45.9^E (30.2, 61.7)	3.9^E (−15.6, 23.3)
Other	67.4 (65.9, 69.0)	58.6 (56.5, 60.8)	8.8*** (6.2, 11.5)
Living alone			
Yes	69.5 (67.4, 71.7)	61.2 (57.9, 64.5)	8.3*** (4.4, 12.3)
No	66.1 (64.6, 67.6)	57.5 (55.5, 59.6)	8.6*** (6.1, 11.1)
Geographical location			
British Columbia	62.7 (59.3, 66.1)	57.1 (52.5, 61.8)	5.6 (−0.2, 11.3)
Prairie provinces	63.1 (60.8, 65.3)	54.2 (50.8, 57.5)	8.9*** (4.8, 13.0)
Ontario	66.5 (64.1, 68.9)	56.3 (52.8, 59.8)	10.2*** (5.9, 14.4)
Quebec	70.2 (67.7, 72.7)	62.3 (58.8, 65.7)	8.0*** (3.7, 12.3)
Atlantic provinces	70.8 (68.9, 72.8)	66.0 (63.2, 68.8)	4.8** (1.5, 8.2)
Territorial capitals	65.1 (61.4, 68.9)	63.3 (59.2, 67.4)	1.9 (−3.8, 7.5)

Abbreviations: CI, confidence interval; SCMH, Survey on COVID-19 and Mental Health.

Notes: Prairie provinces include Alberta, Manitoba and Saskatchewan. Atlantic provinces include New Brunswick, Newfoundland and Labrador, Nova Scotia and Prince Edward Island. Territorial capitals include Iqaluit, Whitehorse and Yellowknife. Positive values in the difference column mean that the percentage was higher in fall 2020 than in winter/spring 2021; negative values in the difference column mean that the percentage was lower in fall 2020 than in winter/spring 2021. Due to rounding, the difference scores do not always equal the difference between estimates from fall 2020 and winter/spring 2021.

^E Estimates should be interpreted with caution, as the unweighted total sample size is between 75 and 150. Please look at the confidence intervals when interpreting these estimates.

* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

from fall 2020 were also found among frontline workers, with fewer than half reporting high SRMH or stable/improved mental health in winter/spring 2021. Although speculative, it is possible that the sense of purpose and social contribution to the protection of the health and well-being of Canadians during the pandemic may have partially buffered similar declines in community belonging and life satisfaction among some frontline workers. Future research could examine risk and protective factors among this population and other vulnerable groups. Contrary to expectation, the PMH of those living alone and those living with others was quite similar at both time points. Distinguishing between *living* alone and *feeling* alone is likely important.[18]

While some of the limitations of previous research (e.g. differing sampling frames and data collection methods)[4] are not present, the current study still has some limitations. For instance, nonresponse bias may be an issue given the response rates,[19] findings may not generalize to populations excluded from the SCMH (e.g. those living on reserves)[9,10] and seasonal effects may be (partially) driving the observed differences in mental health.[20,21]

In conclusion, ongoing surveillance of mental health is essential for understanding the wider impacts of the COVID-19 pandemic, and is especially needed for sociodemographic groups not captured in the current study, including children, youth, LGBTQ2+ communities and those in institutions.

Conflicts of interest

The authors have no conflicts of interest.

Authors' contributions and statement

CC drafted the article and all authors contributed to its revisions. LL conducted the statistical analyses and all authors interpreted the results.

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

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Alam M, Getchius TS, Schünemann H, […] **Ogunremi T**, et al. A memorandum of understanding has facilitated guideline development involving collaborating groups. J Clin Epidemiol. 2022;144:8-15. https://doi.org/10.1016/j.jclinepi.2021.12.022

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