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Original mixed methods research

Development of the Whole Day Matters Toolkit for Primary Care: a consensus-building study to mobilize national public health guidelines in practice

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This article has been peer reviewed.

Abstract

Introduction: Strategic knowledge mobilization efforts are needed to enhance uptake and use of the Canadian 24-Hour Movement Guidelines (24HMG), which describe optimal amounts of physical activity, sedentary behaviour and sleep each day for overall health. *The Whole Day Matters Toolkit for Primary Care* is an evidence-informed resource to help primary care providers (PCPs) disseminate the 24HMGs. The purpose of this study was to describe gaining consensus on toolkit components through iterative revisions to improve its utility in preparation for the September 2022 launch, and to summarize early dissemination efforts.

Methods: A multidisciplinary expert working group planned three modified Delphi surveys to assess PCPs' level of agreement with toolkit components on 7-point Likert scales with follow-up prompts for ratings of 4 or less. Consensus was defined a priori as a mean of 6 or higher out of 7 and 60% or more of PCPs selecting at least "somewhat agree." Items on which consensus was reached were removed from subsequent surveys unless they were revised.

Results: Twenty PCPs completed surveys 1 and 2; 15 completed survey 3. Consensus was reached on 5% (4/83), 17% (14/83) and 55% (38/69) of the items in surveys 1, 2 and 3, respectively. The number of qualitative comments decreased from 26 to 19 to 12, further indicating increasing consensus.

Conclusion: Items on which consensus was not gained may reflect differences in provider characteristics or settings. A coproduced dissemination strategy was enacted. Toolkit reach was evaluated at launch and 4 months later.

Keywords: *health promotion, preventive health services, research methodology, physical activity, sedentary behaviour, sleep, movement behaviours, Delphi*

Highlights

- We used a modified Delphi method in a rigorous, mixed methods approach to coproduce a toolkit for the 24-Hour Movement Guidelines.
- The toolkit suggests opportunities for primary care physicians in Canada to initiate discussions about adults' current levels of physical activity, sedentary behaviour and sleep and ways to optimize these three behaviours through interventions.
- Most toolkit components were considered to be useful, understandable and relevant.
- Because a range of perspectives were considered, this toolkit can be used by diverse primary care professionals to promote the 24-Hour Movement Guidelines and therefore national public health.
- This modified Delphi approach can guide the dissemination and implementation of other public health guidelines.

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Introduction

Increasing chronic disease rates among adults are a prevailing global public health concern.[1] Physical inactivity, excessive sedentary behaviour and poor sleep are risk factors for chronic disease and contribute to high health care costs.[2] However, even small changes in a person's physical activity, sedentary behaviour and sleep, or "movement behaviours," can attenuate chronic disease risk.[3] The Canadian 24-Hour Movement Guidelines (24HMGs) are national public health guidelines that promote sufficient good quality sleep, maximized physical activity and minimized sedentary behaviour each day.[4] The 24HMGs guide innovative approaches to optimizing population-level movement behaviours and overall health in a 24-hour timeframe.[4] Given that the 24HMGs are relatively new, they must be paired with effective knowledge mobilization efforts to enhance their uptake in practice and influence public health. Primary care providers (PCPs) are key to promoting the 24HMGs. However, barriers such as lack of time, confidence or belief in the efficacy of movement behaviour promotion may prevent PCPs from promoting movement behaviours among clients. These barriers must be strategically addressed to enable the successful promotion of the 24HMGs.[5]

As physical activity, sedentary behaviour and sleep are interdependent behaviours, changes to one offset time spent doing one or both of the other two, and discussing them together, rather than separately, may enhance the efficacy of movement behaviour promotion.[6,7] For instance, engaging in physical activity may improve sleep while decreasing sedentary behaviour, so discussing with clients how to change multiple movement behaviours may not be a significant burden for PCPs in practice and could create additional avenues to improving population health outcomes.[7]

Until now, no known tool has existed for integrating discussions about the 24HMGs into PCP practice. We conducted a scoping review, which guided the development of "The Whole Day Matters Tool" mock-up (phase 1[8]), and a usability study, which informed its adaptation into a toolkit (phase 2[9]). The toolkit is informed by theory, following a modified 5 *A*s (ask, assess, advise, agree and assist) counselling framework.[8] Gaining the broad approval of the PCPs who would be using the toolkit in their practice prior to its implementation would help strengthen its mobilization. Therefore, the aim of this study was to gain consensus on the utility, acceptability and understandability (i.e. clarity) of the Whole Day Matters Toolkit for Primary Care among PCPs (phase 3) and summarize early toolkit dissemination. This article is based on a longer, previously published report.[10]

Table 1 describes the toolkit.

Methods

Ethics approval

Institutional research ethics board approval was obtained, prior to study commencement, from the Queen's University General Research Ethics Board (reference number: TRAQ#: 6034390).

Guiding process

Phases 1 to 3 of the development of the toolkit were guided by the Knowledge to

TABLE 1
Description of The Whole Day Matters Toolkit

Page/section		Description
Preamble		One-page-long preface describing the purpose of the toolkit overall and of the Tool, the User Guide and the Handout. The Preamble includes a link to the supplement describing the evidence informing the development of the 24HMGs.
Tool[a]		One page that includes 6 sections with instructions and optional prompts to help providers discuss one or more movement behaviours.
	Ask	Instructions for PCPs on starting the conversation on how the 24HMGs relate to the client's context and history and asking their permission to discuss movement behaviours.
	Assess	Three open-ended questions for PCPs to gauge the client's current levels of physical activity, sedentary behaviour and sleep. The 24HMGs that target benchmarks for each behaviour are provided under each question. Fillable text forms and checkboxes can be used to record current behaviours.
	Advise	Instructions for PCPs on how to decide what to work on based on the current movement behaviour levels determined in the "Assess" section. Fillable checkboxes can be used to note the chosen behaviour.
	Plan	Instructions for PCPs on how to discuss what is already going well with the movement behaviour chosen in the "Advise" section and what realistic changes could be made. Reference to set a SMART goal in the Handout (see Handout page 2 in this table).
	Counsel	Instructions for PCPs on how to use motivational interviewing principles to confirm that the chosen goal is feasible for the client. Includes tips on how to increase motivation for each movement behaviour.
	Arrange	Instructions for PCPs on how to agree upon a follow-up date with the client or how to refer them to another provider where necessary or appropriate.
User guide[a]		One page offering additional guidance on how to use each of the 6 sections of the Tool, shown in the same order. These sections can be read alongside the Tool as another resource while learning to use it, or they can be referred to as a refresher.
Handout		Two-page resource for clients that provides information on the 24HMGs and the interactive sections of the toolkit.
	Page 1	Explains the benefits of engaging in healthy movement behaviours, provides definitions and gives examples of activities for all intensities of physical activity, strength and balance training, sedentary activities and sleep.
	Page 2	Describes the fillable areas where a person can • record what a typical day looks like • track what healthy movement behaviours they are already achieving • select which movement behaviour they could improve upon • set a SMART goal, with an area for the client and/or the PCP to date and sign as a behavioural contract. Suggests visiting the CSEP website and/or downloading the ParticipACTION app for more examples of setting a SMART goal.

Abbreviations: CSEP, Canadian Society for Exercise Physiology; 24HMGs, 24-Hour Movement Guidelines; PCP, primary care provider; SMART, Specific, Measurable, Attainable, Realistic, Timely.

Note: The toolkit is intended for use with adults aged ≥18 years. It includes additional suggestions for adults aged ≥65 years.

[a] The content of the Tool and User Guide were informed through the use of a modified 5 *A*s (ask, assess, advise, agree and assist) counselling framework and motivational interviewing principles.

Action Framework[11] in a coproduction approach that engaged a working group of experts in public health, medicine, health promotion, kinesiology and communications throughout all the research stages.[8,9,11,12] In the present study (phase 3), the working group collaborated from December 2021 to September 2022 on the ethics, study design, recruitment of participants, data interpretation and dissemination of findings.[12] Further, critical realism supported the need for a range of ideas and processes to understand the PCPs' evolving approval of the toolkit.[13] We also followed the Guidance on Conducting and Reporting Delphi Studies (CREDES).[14]

Participant recruitment and study procedure

Feedback on the toolkit was sought from PCPs using a modified Delphi method.[15] We modified the original Delphi method as the questions in the first survey were not entirely open-ended and we did not conduct follow-up interviews.[16] Modified Delphi methods have commonly been used to gain consensus among health professionals, which make them the best consensus-building approach to use among geographically dispersed PCPs.[17]

This was a concurrent nested mixed methods study as we simultaneously collected quantitative and qualitative data. However, we prioritized qualitative data to achieve our study aims of gathering data to inform toolkit revisions and to guide dissemination plans.[18] To show the diversity of perspectives across various PCP roles and in line with published recommendations,[19] we sought to recruit five PCPs from six "categories" of eligible professions—physicians/residents, nurses/nurse practitioners, dietitians, pharmacists, psychosocial professionals (psychologists, social workers and registered psychotherapists working in a family health team), and occupational therapists working in a family health team—for a target sample of 30 PCPs. A graphic and the accompanying text were posted on Twitter (now X) and Facebook inviting PCPs working in Canada to click on a link to a preliminary survey and potentially participate. Posts were also shared by the coauthors of this article to further promote the study. Twitter and Facebook were used for this convenience sampling as the coauthors' collective professional networks spanned medical and research fields and national and local health organizations, and research shows that these two platforms are frequently used by PCPs as means of professional communication[20] as they are quick, low-cost, broad-reaching communication tools that use existing rather than new networks across geographic and professional settings.[21]

The preliminary survey included questions to help characterize our sample, on demographics (i.e. field of work, years practising, community/ies in which the respondents work [e.g. urban, rural] and population/s they serve [e.g. adults aged 18–64 or ≥65 years, adults with chronic conditions]); self-identification (i.e. gender identity and racial or ethnic identity); knowledge and awareness of the 24HMGs (i.e. familiarity, recall of recommendations); and own 24HMG behaviours (i.e. self-reported levels of physical activity, sedentary behaviour and sleep). Eligible PCPs who provided their email address were emailed the link to the first survey (survey 1). Each survey had to be completed for the respondent to be eligible for subsequent surveys. Ongoing informed consent was sought at the start of each survey.

Figure 1 shows the study flow procedure.

Surveys were hosted on the Qualtrics survey-making tool (Seattle, WA, US). PCPs' agreements with survey items were recorded on a 7-point Likert scale, with 1 meaning "strongly disagree," 4 "neither agree nor disagree" and 7 "strongly agree." Each survey page contained questions relevant to one toolkit component (e.g. the Preamble). A text box on each page prompted participants to explain their reason for rating any items at 4 (i.e. "neither agree nor disagree") on the Likert scale or lower and their suggested improvements, if any. Before starting surveys 2 and 3, participants were asked to review a document summarizing the results from the previous survey and the revisions made to address their comments (available from authors upon request). Up to three surveys were planned, with data collection terminated once consensus was reached on all survey items or all three surveys were completed, whichever occurred first.

Participants were compensated with a CAD 20 e-gift card for completing surveys 1 and 2 and a CAD 35 e-gift card for completing survey 3.

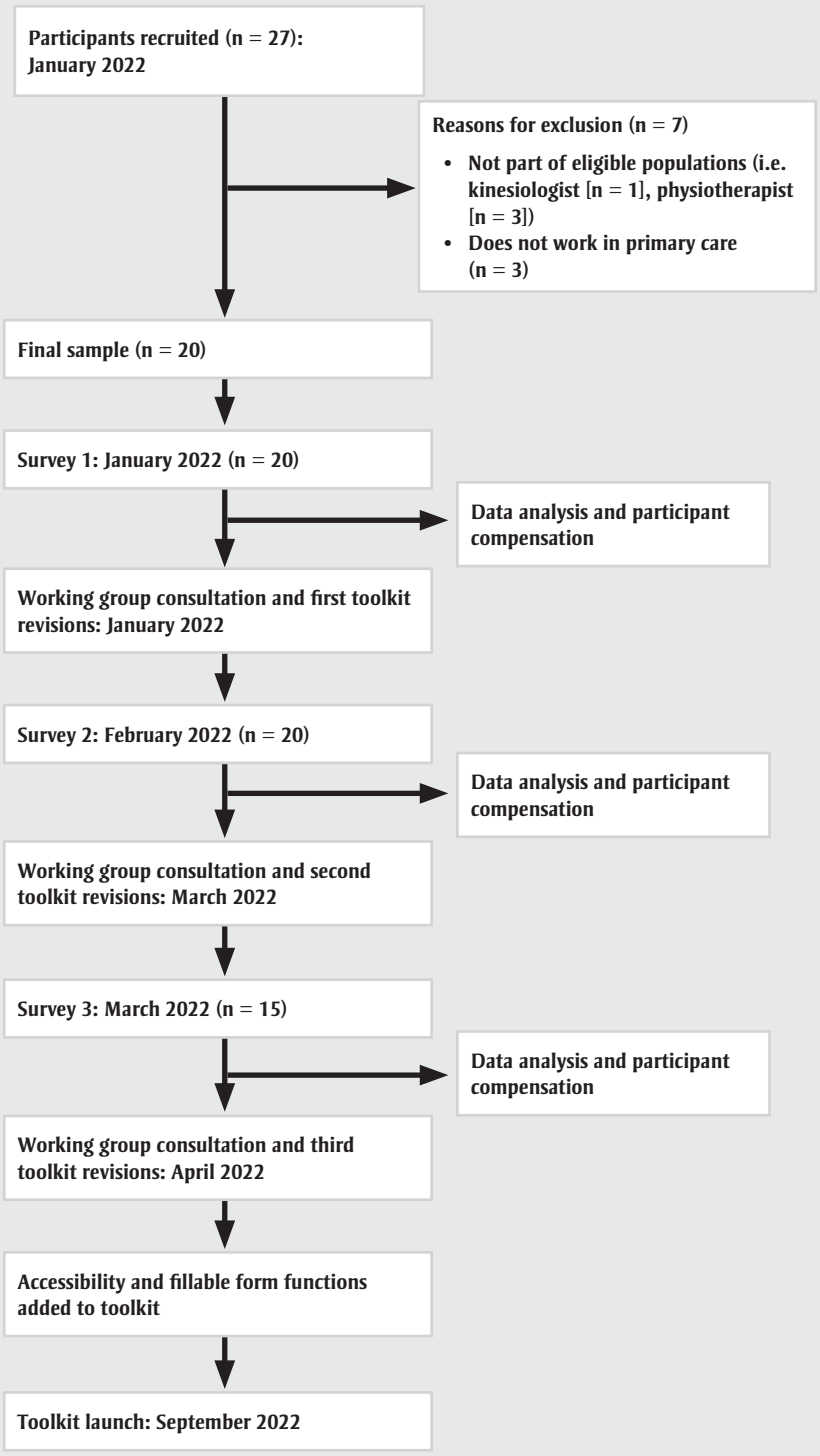
Statistical analysis

Data from Qualtrics were exported into Microsoft Excel for Windows 10 (Microsoft Corp., Redmond, WA, US) and SPSS version 28.0 for Windows 10 (IBM, Chicago, IL, US) to calculate percentage agreement scores, mean scores, standard deviations, medians, interquartile ranges and levels of concordance. Consensus was defined a priori as a mean of 6 or greater on the 7-point Likert scale and 60% or more of participants selecting "somewhat agree" or higher per survey item (i.e. ≥5 on the 7-point Likert scale).[22] Items for which participants did not suggest any modifications were removed from the subsequent survey and kept as-is in the toolkit. Those items that were revised based on participants' suggestions were included in the subsequent survey to solicit further agreement on the changes.

Dissent was defined as a lack of consensus, with more than 10% of participants presenting conflicting comments or suggesting changes to a survey item. Further, the notion of stability of ratings was applied[23] by defining "subthreshold consensus" as items on which a mean score between "somewhat agree" and "agree" (i.e. between 5 and 6 on the 7-point Likert scale) was reached and on which either favourable comments, suggested changes from less than 10% of participants, or no suggested changes were provided. Differentiating dissent from subthreshold consensus allowed us to distinguish between those items for which there was no consensus, those for which there was qualitatively suggested disagreement (i.e. relatively lower utility, acceptability and understandability) and those for which there was agreement (i.e. relatively greater utility, acceptability and understandability). Qualitative data were used to interpret quantitative ratings and were the primary drivers of toolkit revisions. To make the revisions, participants' suggested changes were noted following each survey analysis and discussed among the working group during 90-minute virtual meetings and via email correspondence to collaboratively decide how to best address these comments. These discussions either resulted in the toolkit item being revised (e.g. by changing the wording, design or order) or removed (i.e. if participants found it to be redundant, unhelpful or not visually appealing).

Levels of association between participants' ratings were analyzed for each survey using the Kendall coefficient of concordance (*W*) as the data were non-parametric and all surveys had more than two raters

FIGURE 1
Flowchart showing the procedure for the modified Delphi surveys to revise the Whole Day Matters Toolkit for Primary Care prior to launch



(i.e. participants).[24] Chi-square (χ^2) analyses were run to assess for statistical significance of *W* using 95% confidence intervals.

Validation

To externally validate the toolkit, we contacted the researchers who led the systematic reviews that informed the physical activity, sedentary behaviour and sleep recommendations of the 24HMG, who are experts in their fields in Canada, and asked for their feedback on content accuracy.

Dissemination

We codeveloped and coenacted a dissemination strategy, which included creating and hosting a short video on the Canadian Society for Exercise Physiology (CSEP) 24HMGs website; posting about the toolkit on the Canadian Medical Association's Physician Wellness Hub; e-blasting the professional networks of CSEP, the Canadian Frailty Network, the 24HMGs Knowledge Translation Advisory Committee and Guideline Development Consensus Panel, and the Health Promotion team at Queen's University; and posting on Twitter (10 posts), Instagram (8 posts, 5 stories), Facebook (7 posts, 1 story), LinkedIn (2 posts) and YouTube (2 videos). This dissemination strategy was put into practice on the day the toolkit was launched, and metrics were collected at one week and four months post launch to evaluate toolkit reach.

Results

Twenty-seven individuals completed the intent to participate form, but seven were ineligible because they worked outside of primary care (n = 3) or were not in an eligible population (n = 4). Twenty PCPs working in British Columbia, Alberta and Ontario were eligible to participate, consented to do so and completed surveys 1 and 2. Despite email reminders, five PCPs did not complete survey 3. This sample size of 20 was lower than intended, and we were unable to extend our recruitment period; however, many Delphi studies have used 15 to 20 participants.[25]

Table 2 displays participant characteristics.

Percentage agreement scores, means, standard deviations, medians and interquartile ranges from surveys 1 to 3 are shown in

TABLE 2
The Whole Day Matters Toolkit for Primary Care Providers consensus-building study participant demographic and occupational characteristics

	Surveys 1 and 2 n = 20	Survey 3 n = 15
Gender identity, n (%)		
Female	16 (80.0)	11 (73.3)
Male	3 (15.0)	3 (20.0)
Undeclared	1 (5.0)	1 (6.7)
Racial or ethnic identity, n (%)		
White	13 (65.0)	8 (53.3)
Chinese	2 (10.0)	2 (13.3)
Other[a]	3 (15.0)	3 (20.0)
Prefer not to answer	2 (10.0)	2 (13.3)
Profession, n (%)		
Resident	2 (10.0)	2 (13.3)
Physician	5 (25.0)	4 (26.7)
Nurse	3 (15.0)	3 (20.0)
Dietitian	2 (10.0)	2 (13.3)
Social worker	2 (10.0)	1 (6.7)
Psychologist	1 (5.0)	1 (6.7)
Psychotherapist	1 (5.0)	0 (0.0)
Nurse practitioner	2 (10.0)	1 (6.7)
Pharmacist	2 (10.0)	1 (6.7)
Average time in practice, years (SD)	**9.95 (5.7)**	**8.29 (5.9)**
Minimum time in practice, years	1	1
Maximum time in practice, years	18	16
Community served, n (%)		
Urban	14 (70.0)	11(73.3)
Suburban	4 (20.0)	2 (13.3)
Rural	1 (5.0)	1 (6.7)
Not answered	1 (5.0)	1 (6.7)
Population of adults served,[b] n (%)		
Aged 18–64 years	18 (90.0)	13 (86.7)
Aged ≥ 65 years	8 (40.0)	8 (53.3)
With diabetes	7 (35.0)	7 (46.7)
Who are pregnant	5 (25.0)	5 (33.3)
With osteoporosis	4 (20.0)	4 (26.7)
With cancer	5 (25.0)	5 (33.3)
With Alzheimer disease	5 (25.0)	5 (33.3)
With Parkinson disease	6 (30.0)	6 (40.0)
With multiple sclerosis	5 (25.0)	5 (33.3)
With spinal cord injury	5 (25.0)	5 (33.3)
Familiarity with the 24-Hour Movement Guidelines, n (%)		
Not familiar at all	2 (10.0)	2 (13.3)
Familiar	17 (85.0)	12 (80.0)
Just heard the name	4 (20.0)	4 (26.7)
Somewhat familiar	12 (60.0)	7(46.7)
Very familiar	1 (5.0)	1(6.7)

Continued on the following page

TABLE 2 (continued)
The Whole Day Matters Toolkit for Primary Care Providers consensus-building study participant demographic and occupational characteristics

	Surveys 1 and 2 n = 20	Survey 3 n = 15
Knowledge of the 24-Hour Movement Guidelines (open text), n (%)		
Correctly identified the 3 main components (i.e. physical activity, sedentary behaviour and sleep)	4 (20.0)	3 (20.0)
Correctly identified 2 of the 3 main components	1 (5.0)	1 (6.7)
Correctly identified 1 of the 3 main components	11 (55.0)	7 (46.7)
Did not know/incorrect response/no response	4 (20.0)	4 (26.7)
Knowledge of the 24-Hour Movement Guidelines (multi-select), n (%)		
At least 150 minutes of moderate-to-vigorous physical activity a week, including at least 2 days of muscle-strengthening activities per week	15 (75.0)	10 (66.7)
Several hours of light physical activity, including standing	3 (15.0)	3 (20.0)
Limit sedentary time to 8 hours or less per day	0 (0)	0 (0)
7–9 hours of good quality sleep on a regular basis, with consistent bedtimes and wake-up times (for adults aged 18–64 years)	7 (35.0)	5 (33.3)
7–8 hours of good quality sleep on a regular basis, with consistent bedtimes and wake-up times (for adults ≥65 years)	2 (10.0)	2 (13.3)
Perform physical activities that challenge balance	1 (5.0)	1 (6.7)
Replacing sedentary behaviour with additional physical activity and trading light physical activity for more moderate-to-vigorous physical activity, while preserving sufficient sleep, can provide greater health benefits	8 (40.0)	5 (33.3)
Did not know/unsure	0 (0)	0 (0)
Incorrect response	9 (45.0)	8 (53.3)
Participant movement behaviours, n (%)		
Meets the recommendation of 7–9 hours of sleep	16 (80.0)	12 (80.0)
Self-reports sleep to be of good quality	9 (45.0)	8 (53.3)
Meets the recommendation of at least 150 minutes of moderate-to-vigorous physical activity a week	15 (75.0)	10 (66.7)
including at least 2 days of muscle-strengthening activities per week	3 (15.0)	3 (20.0)
Meets the daily recommendation of several hours of light physical activity, including standing	4 (20.0)	3 (20.0)
Meets the recommendation of limiting sedentary time to 8 hours or less per day	3 (15.0)	3 (20.0)
Meets all 4 recommendations	0 (0.0)	0 (0.0)
Meets 3 of the 4 recommendations	7 (35.0)	6 (40.0)
Meets 2 of the 4 recommendations	2 (10.0)	2 (13.3)
Meets 1 of the 4 recommendations	9 (45.0)	5 (33.3)
Meets none of the recommendations/did not answer	2 (10.0)	2 (13.3)

Abbreviation: SD, standard deviation.

[a] Included people who identified as First Nations, South Asian and mixed descent.

[b] Total is greater than combined sample size because participants could select multiple responses.

Table 3. Across all surveys, the percentage agreement criterion was met 100% of the time, while the mean score criterion was met in increasing proportions with each survey. In survey 1, participants reached consensus on 5% (4/83) of the toolkit items and made 26 qualitative comments. The item "I think [adults accessing care] would use the Handout" received the lowest mean score of 5.4 out of 7. The participants reached consensus on the following items: that they would want to use the "Advise" and "Arrange" sections and the User Guide in their practice; and that adult clients would understand the Handout. Qualitative comments were about how the Preamble, Tool, User Guide and Handout were too busy and text-heavy (e.g. "It is a lot of text but I understand the need to provide this information for accurate use of this Tool." [P01]).

The toolkit was revised in response to each comment, or to multiple comments in cases where participants made similar statements. Specifically, we tried to improve the visual appeal (i.e. via bullet points, checkboxes and streamlined colours, graphics and fonts) and usability (i.e. by deleting redundant or unnecessary text, restructuring the "Counsel" section in the Tool and the User Guide, and clarifying wording, including by renaming the section "Agree" to "Plan").

In survey 2, participants reached consensus on 17% (14/83) of the items and made 19 qualitative comments. How easy the title was to understand received the

TABLE 3
Results from surveys 1 to 3 of the Whole Day Matters Toolkit for Primary Care Providers consensus-building study

Toolkit section/survey item	Value	Survey 1	Survey 2	Survey 3
Preamble				
The Preamble is visually appealing.	*M* (SD)	5.5 (1.43)	5.5 (0.95)	5.4 (0.99)
	Median	6.0	6.0	6.0
	IQR	1	1	1
	% agreement	80	95	87
The Preamble is easy to understand.	*M* (SD)	5.35 (0.75)	5.2 (0.95)	5.67 (0.72)
	Median	5.5	5.5	6.0
	IQR	1	1.25	1
	% agreement	85	75	93
The Preamble will make it easier to use the toolkit.	*M* (SD)	5.5 (0.89)	5.65 (0.67)	6.27 (0.88)[b]
	Median	6.0	6.0	6
	IQR	1	1	1
	% agreement	90	100	93
The Preamble contains a sufficient amount of information.	*M* (SD)	5.75 (0.91)	5.65 (0.75)	6.2 (0.68)[b]
	Median	6.0	6.0	6.0
	IQR	1	1	1
	% agreement	90	90	100
The Preamble is important to include for myself or other providers.	*M* (SD)	5.7 (0.92)	5.55 (0.69)	5.8 (0.86)
	Median	6.0	6.0	6.0
	IQR	1	1	1
	% agreement	90	95	93
Tool				
The title is visually appealing.	*M* (SD)	5.7 (0.80)	5.9 (0.64)	6.0 (0.65)[b]
	Median	6.0	6.0	6.0
	IQR	1	0.75	0
	% agreement	90	100	100
The title is easy to understand.	*M* (SD)	5.45 (0.76)	5.15 (0.99)	5.53 (0.74)
	Median	5.5	5.0	5.0
	IQR	1	1	1
	% agreement	90	80	100
I would use the title in my practice.	*M* (SD)	5.7 (1.1)	5.6 (1.05)	5.87 (0.52)
	Median	6.0	6.0	6.0
	IQR	1.25	1	0
	% agreement	90	90	100
The title will make it easier to discuss movement behaviours.	*M* (SD)	5.65 (0.67)	5.65 (0.99)	6.13 (0.83)[b]
	Median	6.0	6.0	6.0
	IQR	1	1	1
	% agreement	95	90	93
I feel that I have the knowledge to use the title in my current practice.	*M* (SD)	5.8 (0.83)	5.75 (0.79)	6.2 (0.77)[b]
	Median	6.0	6.0	6.0
	IQR	1.25	1	1
	% agreement	100	95	93
I would feel confident using the title in my current practice.	*M* (SD)	5.65 (0.75)	5.55 (0.94)	5.87 (0.64)
	Median	6.0	6.0	6.0
	IQR	1	1	0.5
	% agreement	90	90	100

Continued on the following page

TABLE 3 (continued)
Results from surveys 1 to 3 of the Whole Day Matters Toolkit for Primary Care Providers consensus-building study

Toolkit section/survey item	Value	Survey 1	Survey 2	Survey 3
The title contains a sufficient amount of information.	*M* (SD)	5.55 (0.89)	5.3 (0.86)	5.93 (0.59)
	Median	6.0	5.0	6.0
	IQR	1	1	0
	% agreement	85	90	100
The title is important to include for myself or other providers.	*M* (SD)	5.45 (1.0)	5.55 (0.69)	5.87 (0.64)
	Median	5.5	6.0	6.0
	IQR	1	1	0.5
	% agreement	80	95	100
The "Ask" section is visually appealing.	*M* (SD)	5.7 (0.80)	5.6 (0.68)	6.07 (0.46)[b]
	Median	6.0	6.0	6.0
	IQR	1	1	0
	% agreement	90	95	100
The "Ask" section is easy to understand.	*M* (SD)	5.45 (0.76)	5.65 (0.99)	5.6 (0.74)
	Median	5.5	6.0	5.0
	IQR	1	1	1
	% agreement	90	85	100
I would use the "Ask" section in my practice.	*M* (SD)	5.8 (0.70)	5.85 (0.81)	5.87 (0.74)
	Median	6.0	6.0	6.0
	IQR	1	1	0
	% agreement	100	95	93
The "Ask" section will make it easier to discuss movement behaviours.	*M* (SD)	5.85 (0.75)	5.65 (0.87)	6.2 (0.77)[b]
	Median	6.0	6.0	6.0
	IQR	0.25	1	1
	% agreement	95	90	93
I feel that I have the knowledge to use the "Ask" section in my current practice.	*M* (SD)	5.95 (0.83)	5.65 (0.93)	6.13 (0.64)[b]
	Median	6.0	6.0	6.0
	IQR	2	1	0.5
	% agreement	100	85	100
I would feel confident using the "Ask" section in my current practice.	*M* (SD)	5.55 (0.89)	5.45 (0.94)	5.73 (0.70)
	Median	5.5	6.0	6.0
	IQR	1	1	0.5
	% agreement	90	80	93
The "Ask" section contains a sufficient amount of information.	*M* (SD)	5.75 (0.55)	5.85 (0.81)	5.93 (0.59)
	Median	6.0	6.0	6.0
	IQR	1	0	0
	% agreement	100	90	100
The "Ask" section is important to include for myself or other providers.	*M* (SD)	5.75 (0.55)	5.6 (0.68)	5.73 (0.80)
	Median	6.0	5.0	6.0
	IQR	0	1	1
	% agreement	95	95	93
The "Assess" section is visually appealing.	*M* (SD)	5.95 (0.60)	6.15 (0.75)[b]	–
	Median	6.0	6.0	–
	IQR	0	1	–
	% agreement	100	100	–

Continued on the following page

TABLE 3 (continued)
Results from surveys 1 to 3 of the Whole Day Matters Toolkit for Primary Care Providers consensus-building study

Toolkit section/survey item	Value	Survey 1	Survey 2	Survey 3
The "Assess" section is easy to understand.	*M* (SD)	5.45 (1.0)	5.5 (1.05)	6.27 (0.59)[b]
	Median	5.0	5.5	6.0
	IQR	1	1	1
	% agreement	90	80	100
I would use the "Assess" section in my practice.	*M* (SD)	5.9 (0.85)	6.1 (0.79)[b]	–
	Median	6.0	6.0	–
	IQR	0	1.25	–
	% agreement	90	100	–
The "Assess" section will make it easier to discuss movement behaviours.	*M* (SD)	5.85 (0.75)	5.6 (0.94)	5.8 (0.86)
	Median	6.0	6.0	6.0
	IQR	0.25	1	1.5
	% agreement	95	85	100
I feel that I have the knowledge to use the "Assess" section in my current practice.	*M* (SD)	5.55 (0.76)	5.9 (0.72)	6.2 (0.68)[b]
	Median	5.5	6.0	6.0
	IQR	1	1	1
	% agreement	95	100	100
I would feel confident using the "Assess" section in my current practice.	*M* (SD)	5.65 (0.75)	5.8 (0.89)	6.53 (0.52)[b]
	Median	6.0	6.0	7.0
	IQR	1	1.25	1
	% agreement	95	95	100
The "Assess" section contains a sufficient amount of information.	*M* (SD)	5.86 (0.75)	5.9 (0.72)	6.13 (0.64)[b]
	Median	6.0	6.0	6.0
	IQR	0.25	1	0.5
	% agreement	95	100	100
The "Assess" section is important to include for myself or other providers.	*M* (SD)	5.75 (0.72)	5.7 (0.86)	5.87 (0.74)
	Median	6.0	6.0	6.0
	IQR	1	1	1
	% agreement	95	95	100
The "Advise" section is visually appealing.	*M* (SD)	5.75 (0.72)	6.05 (0.60)[b]	–
	Median	6.0	6.0	–
	IQR	1	0	–
	% agreement	95	100	–
The "Advise" section is easy to understand.	*M* (SD)	5.55 (0.89)	5.85 (0.88)	6.27 (0.46)[b]
	Median	5.5	6.0	6.0
	IQR	1	1.25	0.5
	% agreement	90	95	100
I would use the "Advise" section in my practice.	*M* (SD)	6.05 (0.89)	5.9 (0.91)	5.73 (0.88)
	Median	6.0	6.0	5.0
	IQR	1.25	2	1.5
	% agreement	95	95	100
The "Advise" section will make it easier to discuss movement behaviours.	*M* (SD)	5.8 (0.70)	5.95 (0.83)	6.2 (0.56)[b]
	Median	6.0	6.0	6.0
	IQR	1	0.5	0.5
	% agreement	100	95	100

Continued on the following page

TABLE 3 (continued)
Results from surveys 1 to 3 of the Whole Day Matters Toolkit for Primary Care Providers consensus-building study

Toolkit section/survey item	Value	Survey 1	Survey 2	Survey 3
I feel that I have the knowledge to use the "Advise" section in my current practice.	*M* (SD)	5.65 (0.49)	5.65 (0.88)	6.4 (0.74)[b]
	Median	6.0	6.0	7.0
	IQR	1	1	1
	% agreement	100	90	100
I would feel confident using the "Advise" section in my current practice.	*M* (SD)	5.8 (0.83)	5.65 (0.75)	6.07 (0.59)[b]
	Median	6.0	6.0	6.0
	IQR	0.25	1	0
	% agreement	90	95	100
The "Advise" section contains a sufficient amount of information.	*M* (SD)	5.85 (0.75)	5.7 (0.86)	6.13 (0.92)[b]
	Median	6.0	6.0	6.0
	IQR	1	1	2
	% agreement	100	90	100
The "Advise" section is important to include for myself or other providers.	*M* (SD)	5.7 (0.98)	5.5 (0.69)	6.13 (0.64)[b]
	Median	6.0	6.0	6.0
	IQR	1	1	0.5
	% agreement	90	90	100
The "Plan"[a] section is visually appealing.	*M* (SD)	5.7 (0.66)	5.95 (0.69)	6.13 (0.64)[b]
	Median	6.0	6.0	6.0
	IQR	1	0.25	0.5
	% agreement	95	100	100
The "Plan" section is easy to understand.	*M* (SD)	5.75 (0.85)	5.85 (0.67)	5.87 (0.83)
	Median	6.0	6.0	6.0
	IQR	1	1	1.5
	% agreement	95	100	100
I would use the "Plan" section in my practice.	*M* (SD)	5.95 (0.83)	5.9 (1.07)	6.2 (0.68)[b]
	Median	6.0	6.0	6.0
	IQR	0.5	2	1
	% agreement	95	85	100
The "Plan" section will make it easier to discuss movement behaviours.	*M* (SD)	5.8 (0.70)	5.84 (0.83)	6.6 (0.51)[b]
	Median	6.0	6.0	7.0
	IQR	1	1	1
	% agreement	100	90	100
I feel that I have the knowledge to use the "Plan" section in my current practice.	*M* (SD)	5.7 (0.73)	5.6 (0.99)	6.0 (0.65)[b]
	Median	6.0	6.0	6.0
	IQR	1	1	0
	% agreement	95	85	100
I would feel confident using the "Plan" section in my current practice.	*M* (SD)	5.45 (0.83)	5.9 (0.64)	5.73 (0.96)
	Median	6.0	6.0	6.0
	IQR	1	0.25	1.5
	% agreement	85	100	93
The "Plan" section contains a sufficient amount of information.	*M* (SD)	5.6 (0.75)	5.4 (0.88)	6.27 (0.46)[b]
	Median	6.0	6.0	6.0
	IQR	1	1	0.5
	% agreement	90	80	100

Continued on the following page

TABLE 3 (continued)
Results from surveys 1 to 3 of the Whole Day Matters Toolkit for Primary Care Providers consensus-building study

Toolkit section/survey item	Value	Survey 1	Survey 2	Survey 3
The "Plan" section is important to include for myself or other providers.	*M* (SD)	5.5 (0.76)	5.65 (0.75)	5.93 (0.88)
	Median	6.0	6.0	6.0
	IQR	1	1	2
	% agreement	90	95	100
The "Counsel" section is visually appealing.	*M* (SD)	5.9 (0.96)	6.0 (0.73)[b]	–
	Median	6.0	6.0	–
	IQR	0.5	0.5	–
	% agreement	95	100	–
The "Counsel" section is easy to understand.	*M* (SD)	5.65 (0.81)	5.25 (1.07)	5.93 (0.70)
	Median	6.0	5.0	6.0
	IQR	1	1.25	0.5
	% agreement	90	75	100
I would use the "Counsel" section in my practice.	*M* (SD)	5.7 (0.86)	6.4 (0.60)[b]	–
	Median	6.0	6.0	–
	IQR	1	1	–
	% agreement	95	100	–
The "Counsel" section will make it easier to discuss movement behaviours.	*M* (SD)	5.65 (0.81)	5.8 (0.89)	5.67 (1.05)
	Median	6.0	6.0	6.0
	IQR	1	1.25	1.5
	% agreement	95	95	87
I feel that I have the knowledge to use the "Counsel" section in my current practice.	*M* (SD)	5.75 (0.55)	5.7 (0.73)	6.2 (0.86)[b]
	Median	6.0	6.0	6.0
	IQR	1	1	1
	% agreement	100	95	93
I would feel confident using the "Counsel" section in my current practice.	*M* (SD)	5.7 (1.0)	5.55 (0.76)	6.33 (0.72)[b]
	Median	6.0	6.0	6.0
	IQR	1	1	1
	% agreement	90	90	100
The "Counsel" section contains a sufficient amount of information.	*M* (SD)	5.6 (0.68)	5.9 (0.79)	5.87 (0.83)
	Median	6.0	6.0	6.0
	IQR	1	1.25	1.5
	% agreement	95	100	100
The "Counsel" section is important to include for myself or other providers.	*M* (SD)	5.55 (0.76)	5.85 (0.75)	6.13 (0.74)[b]
	Median	6.0	6.0	6.0
	IQR	1	0.25	1
	% agreement	90	95	100
The "Arrange" section is visually appealing.	*M* (SD)	5.9 (0.79)	6.1 (0.72)[b]	–
	Median	6.0	6.0	–
	IQR	0.25	1	–
	% agreement	95	100	–
The "Arrange" section is easy to understand.	*M* (SD)	5.7 (0.92)	5.85 (0.81)	6.27 (0.46)[b]
	Median	6.0	6.0	6.0
	IQR	1	1	0.5
	% agreement	90	95	100

Continued on the following page

TABLE 3 (continued)
Results from surveys 1 to 3 of the Whole Day Matters Toolkit for Primary Care Providers consensus-building study

Toolkit section/survey item	Value	Survey 1	Survey 2	Survey 3
I would use the "Arrange" section in my practice.	*M* (SD)	6.2 (0.83)	6.1 (0.91)[b]	–
	Median	6.0	6.0	–
	IQR	1.25	1.25	–
	% agreement	100	95	–
The "Arrange" section will make it easier to discuss movement behaviours.	*M* (SD)	5.85 (0.99)	5.8 (0.83)	5.6 (0.83)
	Median	6.0	6.0	5.0
	IQR	1.25	1	1
	% agreement	95	95	100
I feel that I have the knowledge to use the "Arrange" section in my current practice.	*M* (SD)	5.8 (0.77)	5.55 (1.00)	5.93 (0.70)
	Median	6.0	5.5	6.0
	IQR	1	1	0.5
	% agreement	100	85	100
I would feel confident using the "Arrange" section in my current practice.	*M* (SD)	5.85 (0.81)	5.85 (0.75)	6.4 (0.51)[b]
	Median	6.0	6.0	6.0
	IQR	0	1	1
	% agreement	90	100	100
The "Arrange" section contains a sufficient amount of information.	*M* (SD)	5.5 (0.76)	6.0 (0.79)[b]	–
	Median	6.0	6.0	–
	IQR	1	2	–
	% agreement	90	100	–
The "Arrange" section is important to include for myself or other providers.	*M* (SD)	5.6 (0.68)	5.75 (0.97)	5.67 (0.82)
	Median	6.0	6.0	5.0
	IQR	1	1.25	1
	% agreement	95	90	100
User Guide				
The User Guide is visually appealing.	*M* (SD)	5.8 (1.1)	6.15 (0.67)[b]	–
	Median	6.0	6.0	–
	IQR	0.25	1	–
	% agreement	95	100	–
The User Guide is easy to understand.	*M* (SD)	5.8 (0.70)	6.1 (0.91)[b]	–
	Median	6.0	6.0	–
	IQR	1	1.25	–
	% agreement	100	95	–
I would use the User Guide in my practice.	*M* (SD)	6.15 (0.88)	5.95 (0.76)	5.87 (1.25)
	Median	6.0	6.0	6.0
	IQR	1	1.25	0.5
	% agreement	95	100	93
The User Guide will make it easier to use the Whole Day Matters Tool.	*M* (SD)	5.65 (0.81)	5.65 (0.99)	5.33 (1.11)
	Median	6.0	5.5	5.0
	IQR	1	1.25	1
	% agreement	95	90	87
I feel that I have the knowledge to use the User Guide in my current practice.	*M* (SD)	5.65 (0.81)	6.0 (0.65)[b]	–
	Median	6.0	6.0	–
	IQR	0.25	0	–
	% agreement	85	90	–

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TABLE 3 (continued)
Results from surveys 1 to 3 of the Whole Day Matters Toolkit for Primary Care Providers consensus-building study

Toolkit section/survey item	Value	Survey 1	Survey 2	Survey 3
I would feel confident using the User Guide in my current practice.	*M* (SD)	5.75 (0.79)	5.65 (1.09)	6.13 (0.74)[b]
	Median	6.0	5.5	6.0
	IQR	1	2	1
	% agreement	95	85	100
The User Guide contains a sufficient amount of information.	*M* (SD)	5.7 (0.57)	5.9 (0.85)	6.53 (0.64)[b]
	Median	6.0	6.0	7.0
	IQR	1	1.25	1
	% agreement	100	95	100
The User Guide is important to include for myself or other providers.	*M* (SD)	5.8 (0.83)	5.75 (0.91)	5.8 (0.94)
	Median	6.0	6.0	6.0
	IQR	0.25	1.25	1.5
	% agreement	90	95	93
Handout				
The Handout is visually appealing.	*M* (SD)	5.85 (1.1)	6.35 (0.59)[b]	–
	Median	6.0	6.0	–
	IQR	0.5	1	–
	% agreement	95	100	–
The Handout is easy to understand.	*M* (SD)	5.6 (0.82)	5.75 (0.72)	6.13 (0.64)[b]
	Median	5.0	6.0	6.0
	IQR	1	1	0.5
	% agreement	95	100	100
My clients would easily understand the Handout.	*M* (SD)	6.1 (0.91)	5.9 (0.97)	5.73 (0.80)
	Median	6.0	6.0	6.0
	IQR	1.25	2	1
	% agreement	95	95	100
I would use the Handout in my practice.	*M* (SD)	5.7 (0.86)	5.55 (0.83)	6.2 (0.68)[b]
	Median	6.0	6.0	6.0
	IQR	1	1	1
	% agreement	95	90	100
I think my clients would use the Handout.	*M* (SD)	5.4 (0.82)	5.7 (0.92)	6.2 (0.77)[b]
	Median	5.0	6.0	6.0
	IQR	1	1	1
	% agreement	90	90	100
The Handout will make it easier to use the Whole Day Matters Tool.	*M* (SD)	5.7 (0.86)	5.9 (1.11)	6.27 (0.59)[b]
	Median	6.0	6.0	6.0
	IQR	1	1.25	1
	% agreement	95	80	100
I feel that I have the knowledge to use the Handout in my current practice.	*M* (SD)	5.95 (1.0)	5.8 (0.83)	6.13 (0.74)[b]
	Median	6.0	6.0	6.0
	IQR	2	1	1
	% agreement	90	95	100
I would feel confident using the Handout in my current practice.	*M* (SD)	5.65 (1.0)	5.7 (0.80)	6.07 (0.80)[b]
	Median	6.0	6.0	6.0
	IQR	1	1	1.5
	% agreement	80	95	100

Continued on the following page

TABLE 3 (continued)
Results from surveys 1 to 3 of the Whole Day Matters Toolkit for Primary Care Providers consensus-building study

Toolkit section/survey item	Value	Survey 1	Survey 2	Survey 3
The Handout contains a sufficient amount of information.	*M* (SD)	5.55 (1.0)	5.75 (0.91)	6.0 (0.65)[b]
	Median	6.0	6.0	6.0
	IQR	1	1.25	0
	% agreement	90	95	100
The Handout is important to include for myself or other providers to give to clients.	*M* (SD)	5.8 (0.77)	6.0 (0.73)[b]	–
	Median	6.0	6.0	–
	IQR	1	0	–
	% agreement	95	95	–
Overall toolkit				
The toolkit caught my attention.	*M* (SD)	5.85 (0.93)	6.15 (0.59)[b]	–
	Median	6.0	6.0	–
	IQR	0.25	0.25	–
	% agreement	95	100	–
I would easily pick up the toolkit and use it.	*M* (SD)	5.75 (1.1)	5.25 (0.91)	6.07 (0.46)[b]
	Median	6.0	5.0	6.0
	IQR	1.25	1	0
	% agreement	85	80	100
The toolkit will fit well with the way I like to work.	*M* (SD)	5.65 (0.67)	5.85 (0.75)	5.6 (0.74)
	Median	6.0	6.0	5.0
	IQR	1	0.25	1
	% agreement	100	95	100
All pages in the toolkit have a logical flow.	*M* (SD)	5.8 (0.70)	5.85 (0.67)	5.87 (0.83)
	Median	6.0	6.0	6.0
	IQR	0.25	1	0.5
	% agreement	95	100	93

Abbreviations: IQR, interquartile range; *M*, mean score; SD, standard deviation.

[a] The "Plan" section was called "Agree" in survey 1 but was changed to "Plan" during revisions before survey 2.

[b] Rounds (surveys 1, 2 or 3) in which consensus was reached on an item.

lowest mean score, 5.15 out of 7. Consensus was reached on the following 14 items: the visual appeal of the "Assess," "Advise," "Counsel" and "Arrange" sections, the User Guide and the Handout; the usability of the "Assess," "Counsel" and "Arrange" sections; the "Arrange" section contained enough information; the User Guide was easy to understand; participants had sufficient knowledge to use the User Guide; it was important to include the Handout; and the overall toolkit caught PCPs' attention. As a result, these 14 items were removed from survey 3.

The participants' qualitative comments indicated that the Preamble was not easy to understand and suggested rewording the Tool subtitle, tidying up the "Counsel" section, improving the visual appeal of the Tool and Handout, and providing more instructions in the "Plan" and "Counsel" sections (e.g. "May be helpful to specify that 1 is low confidence and 10 is high confidence" [P20]). Thus, the amount of text was further reduced, the graphics were simplified and enlarged, and the Tool subtitle and instructions for choosing a target behaviour, setting a goal and using the "Arrange" section were modified.

Consensus was reached on 55% (38/69) of the items in survey 3; however, the lowest mean score among the remaining items was 5.33 out of 7 ("The User Guide will make it easier to use the Whole Day Matters Tool"). No item received comments from more than one participant (i.e. < 10% of participants), so subthreshold consensus was considered as having been reached for the remaining 45% of the items. Consensus was reached on the following 38 items: the Preamble contained enough information and improved the ability to use the toolkit; the visual appeal of the title and the "Ask" and "Plan" sections; the usability of the "Plan" section (for PCPs) and the Handout (for PCPs and adult clients); the title, "Ask," "Advise" and "Plan" sections and the Handout made it easier to discuss movement behaviours; the "Assess," "Advise" and "Arrange" sections and the Handout were easy to understand; PCPs would have sufficient knowledge to use the title, the "Ask," "Assess," "Advise," "Plan" and "Counsel" sections and the Handout; PCPs would feel confident in their use of the "Assess," "Advise" and "Arrange" sections, the User Guide and the Handout; the "Assess," "Advise," "Plan" and "Counsel" sections, the User Guide and the Handout contained enough information; it was important to include the "Advise" and "Counsel" sections; and the overall toolkit was easy to pick up and use.

Qualitative comments recommended rewording the toolkit title; restructuring the Preamble; emphasizing that the User Guide was for optional or temporary use; and making the Handout more accessible (based on comments such as the following: "For lower education patients or non-English speaking/English as a second-language patients, the Handout might be overwhelming or confusing" [P19]). The PCPs provided 12 qualitative comments, which were addressed by refining the wording in the "Arrange" section and restructuring the Preamble and Handout to improve readability.

Table 4 shows results of the concordance analyses. Results of the concordance analyses indicated a lack of concordance in survey 1 (W = 0.055, χ^2 (82, 20) = 90.64, p = 0.241) and significant but poor levels of concordance in survey 2 (W = 0.099, χ^2 (82, 20) = 162.50, p < 0.001) and survey 3 (W = 0.177, χ^2 (68, 15) = 180.60, p < 0.001). Poor levels of concordance may not necessarily indicate poor agreement or lack of consensus; rather, they indicate a larger range in participants' responses. This increasing yet persistently poor concordance suggests that participants' individual ratings still varied despite their increasing agreement at each survey.

Prior to launch, the toolkit was translated into French and minor adjustments were made to improve accessibility, including increasing font size, adding alt text to images, ensuring logical reading order for screen reader use, and performing accessibility checks using Adobe Pro (Adobe Inc., San Jose, CA, US). On 21 September 2022, the toolkit was publicly launched on the CSEP website as a fillable PDF form available for free download (https://www.csepguidelines.ca/; see Figure 2 for a sample page).

Dissemination

One week post launch, the toolkit had been downloaded 493 times and the CSEP website had received 1291 unique page views (average time on page = 4:39 minutes, 2 minutes longer than other pages). Links to the toolkit across all dissemination channels were clicked 875 times. There were 8373 recipients of e-blasts and 13 498 impressions (the number of times the 24HMG content was displayed across a user's feed, which includes multiple views from the same user), 405 Instagram and Facebook story views, 399 likes, 245 video views, 72 shares, 40 retweets and 15 comments across all social media platforms. At the 4-month follow-up (in January 2023), the toolkit had been downloaded 1072 times and there had been 2900 unique page views on the CSEP website (average time on page = 3:50 minutes). Over the 4 months since its release, the toolkit was the sixth most visited webpage on the CSEP guidelines website, surpassed only by the number of visits to the landing pages of the guidelines for the early years, children and youth, adults aged 18 to 64 years and adults aged 65 years and older.

TABLE 4
Associations between the Whole Day Matters Toolkit for Primary Care Providers consensus-building study participant ratings

	W[a]	χ^2	*df*	*p* value
Survey 1[b]	0.055	90.64	82, 20	0.241
Survey 2[b]	0.099	162.50	82, 20	< 0.001**
Survey 3[b]	0.177	180.60	68, 15	< 0.001**

Abbreviations: *df*, degrees of freedom; *W*, Kendall coefficient of concordance; χ^2, chi square statistic.

[a] Values for *W* range between 0 and 1, with 0 denoting perfect disagreement and 1 denoting perfect agreement.[20] Scores between 0 and 0.39 indicate poor agreement, scores between 0.40 and 0.74 indicate fair to good agreement and scores between 0.75 and 1 indicate excellent agreement beyond chance.

[b] Results indicate a nonstatistically significant lack of concordance in survey 1 and significant but poor levels of concordance in surveys 2 and 3.

** Statistically significant at an alpha level of 0.01.

Discussion

The aim of this study was to gain consensus on the utility, acceptability and understandability (i.e. clarity) of the Whole Day Matters Toolkit for Primary Care, a resource aimed at mobilizing Canada's 24HMGs in primary care practice, by adjusting parts of the toolkit as suggested by PCPs participating in this consensus-building study. Our findings support an increasing level of consensus among PCPs after three modified Delphi e-surveys. The percentage agreement criterion was met all of the time, whereas the mean score criterion was met 5%, 17% and 55% of the time in surveys 1, 2 and 3, respectively, signifying that this was the criterion that drove consensus. Consensus evolution was further supported by a decrease in qualitative comments, from 26 comments in survey 1, to 19 in survey 2 and 12 in survey 3. The qualitative comments in each survey guided toolkit revisions and helped ensure the working group was accurately interpreting participants' quantitative ratings. We found subthreshold consensus on the remaining 45% of items in survey 3, indicating that the majority of toolkit components were deemed acceptable among intended users. Indeed, the concordance analyses revealed poor concordance, demonstrating that participants' opinions continued to differ despite increasingly supporting consensus. Collectively, these findings informed our toolkit dissemination efforts, where we highlighted how the toolkit could be applied differently based on PCPs' unique roles and needs or the time available to them.

Research has highlighted the value of striving to understand dissent and using mixed methods in consensus-building approaches. In a recent paper, Shrier[26] argued that interpreting both consensus and dissent can provide a more inclusive recognition of all participants' opinions, as Delphi studies tend to inadvertently conceal dissenting opinions. In the present study, we strove to understand dissent and found it indicative of the various preferences of the participants, who came from nine different fields. Dissent may also represent a variety of well-documented barriers to movement behaviour promotion in primary care such as lack of time, competing priorities or limited training in movement behaviour promotion.[5,27] For instance, participants in this study may not have reached consensus on the item "The 'Counsel' section will make it easier to discuss movement behaviours" because lack of time during clinical visits prevents movement behaviour counselling regardless of whether the "Counsel" section is usable.[5] Moreover, Monforte et al.[28] reported that Delphi methods may not capture sufficient depth of opinion from participants, and qualitative methods are required to provide a nuanced understanding. We attempted to add nuance by interpreting participants' qualitative comments in parallel

FIGURE 2
Sample page of the Whole Day Matters Toolkit for Primary Care Providers showing the one-page Tool

THE WHOLE DAY MATTERS

Tool for Discussing Physical Activity, Sedentary Time, and Sleep

ASK The 24-Hour Movement Guidelines for Adults recommend to "Move More, Reduce Sedentary Time, and Sleep Well" each day. Explain how they relate to the individual's history:

- *"Is it okay if we discuss what your typical day looks like? It could help your _____"*

(Not ready? **End here**)

ASSESS

PHYSICAL ACTIVITY	SEDENTARY TIME	SLEEP
"How active are you each day?"	*"When are you not active?"*	*"How is your sleep?"*

The Guidelines recommend that a healthy 24 hours includes:

- ≥ 150 mins/week of moderate to vigorous aerobic physical activity
- AND
- ≥ 2 times/week muscle strengthening
- AND
- Several hours of light physical activities per day

- ≤ 8 hours/day of sedentary time

INCLUDING:

- ≤ 3 hours/day of recreational screen time
- Breaking up long periods of sitting as often as possible

- 7 to 9 hours/day of good-quality sleep on a regular basis

INCLUDING:

- Consistent bed and wake up times

For adults 65+ years: Add balance activities and aim for 7 to 8 hrs/day of good-quality sleep on a regular basis

Moderate-to-vigorous _____ (mins/week)	Sedentary time _____ (hours/day)	Sleep _____ (hours/day)
Strength training _____ (times/week)	Recreational screen time__ (hours/day)	Consistent bed and wake
Light activity _____ (hours/day)	Breaking up sitting? Yes ☐ No ☐	times? Yes ☐ No ☐

ADVISE Recommend what behaviour(s) they could work on to improve health:

- *"You're doing a great job with _____. To improve your [health/chronic condition], I suggest _____"*
- **Ask what behaviour(s) they want to work on, if any.**

Start with one: Physical Activity ☐ Sedentary Time ☐ Sleep ☐

PLAN Agree on what the individual is already doing well for the behaviour(s) chosen in ADVISE. Set a **SMART goal(s)** as outlined in the HANDOUT.

- *"What could you keep doing? What changes could you work toward?"*

COUNSEL Ensure each goal is feasible by assessing confidence on a scale of 1 (low) to 10 (high).

- Elicit change talk: *"Why aren't you a lower number?"*
- Assess barriers: *"What would make you a higher number?"*

Use tips to modify goal if confidence is low:

PHYSICAL ACTIVITY TIPS	REDUCE SEDENTARY TIME TIPS	SLEEP HYGIENE TIPS
• Do what you enjoy, when you have the most energy • All intensities and minutes count	• Stand/stretch while talking on the phone • Timer for standing breaks while working (e.g., once/hour) • Pair screen time with activity	• Avoid/reduce caffeine after 2PM • Relaxing, dark bedroom setting • No screens 30-60 min before bed • Same sleep and wake times daily

ARRANGE Follow up in a mutually convenient timeframe or refer to support behaviour change.

with their quantitative ratings, which guided toolkit revisions and helped convey why full consensus may not have been possible.

Tools have been previously created and used to help PCPs promote other public health guidelines. An example is the exercise prescription and referral tool available through the College of Family Physicians of Canada to promote Canada's 2011 physical activity guidelines.[29] However, consensus-building approaches have seldom been used prior to the implementation of public health promotion tools, limiting their utility and applicability in practice. Indeed, primary care discussions about health-promoting movement behaviours occur infrequently.[30,31] In addition, most existing physical activity tools either omit sedentary behaviour or conflate it with physical inactivity. Overall, the integrated promotion of movement behaviours by health professionals continues to be a missed opportunity to broadly improve public health. Use of The Whole Day Matters toolkit could fill this gap by providing a flexible, usable, evidence-informed resource to support the dissemination and implementation of Canada's 24HMGs in a wide range of health settings.

This study has several important practical and methodological implications. Practically, the toolkit is a resource that PCPs can use to more effectively promote the new Canadian public health guidelines and align their health promotion and preventive practices with a novel 24-hour approach.[7]

The present study advances tool development and consensus-building methodology, which can guide future tool development. Over 60% of participants at least "somewhat agreed" with all survey items, meaning this criterion did not impact consensus. Had we used a higher threshold (e.g. 70%), consensus would not have changed. The lowest percentage agreement score was 75%, which had a subthreshold mean score of 5.25 out of 7. Thus, this item would not have reached consensus anyway based on the mean score. Combining a higher percentage agreement threshold with a higher mean (e.g. 6 on a 7-point scale) would ensure that both a larger portion of participants "agree" and that participants who "disagree" are shifting toward "neither agree nor disagree" (i.e. "strongly disagree" less). Thus, in line with other researchers, we recommend using a 70% cut-point in future studies.[32]

Strengths and limitations

A primary strength of this study was our coproduction approach, which allowed us to consider multiple decision-maker perspectives and ensure that we were incorporating the varying preferences of PCPs.[12] Another strength was the use of the modified 5 *A*s counselling framework to inform the development of the toolkit;[8] this approach is often used by PCPs and further strengthens the toolkit's utility in practice.[33]

This study also has limitations. Some professions who could work in primary care (e.g. kinesiologists, physiotherapists) were excluded. In Canada, there is no established mandate for the consistent, widespread integration of exercise professionals (e.g. kinesiologists, clinical exercise physiologists) or physiotherapists in family practices. Nevertheless, chronic disease prevention and management are central to the exercise physiology and physiotherapy professions in both public health and health care settings.[34,35] For this reason, in the "Arrange" section of the Tool we identified exercise professionals to whom clients can be referred for follow-up movement behaviour support. We have also adapted the toolkit for physiotherapists in Canada since the present study (https://csepguidelines.ca/the-whole-day-matters-toolkit-for-physiotherapists/). Furthermore, while we attempted to recruit a national sample of PCPs, only PCPs working in British Columbia, Alberta and Ontario responded to the invitation to participate and were deemed eligible for the study. The sample also largely comprised PCPs who served urban communities and met the 24HMG recommendations of 150 minutes or more per week of moderate-to-vigorous physical activity. Indeed, challenges to social media recruitment strategies have been noted, including difficulties obtaining engagement and the need for existing social networks to be diverse and functional.[21] Thus, the small sample size may have been a result of our use of social media to recruit PCPs and short recruitment window. Limitations of the low sample size include potential bias of results and reduced generalizability. Accordingly, the findings of this study may not capture the concerns of PCPs who engage in less physical activity and/or work in rural communities, other provinces or the territories in Canada; these PCPs may take different approaches to discussing the 24HMGs.

Notably, it was not possible to include all relevant information on movement behaviour promotion in the toolkit as the limited space prevented showing the extent of revisions (e.g. the "Arrange" section of the User Guide had to be restricted to four lines to keep the guide down to one page in length). Further, balancing varying views was challenging; some PCPs proposed removing content while others wanted more information on the same content. Finally, we did not evaluate toolkit implementation or its efficacy in increasing knowledge, skill, confidence and frequency of discussions about the 24HMGs in primary care.

Future research could explore what characteristics influence toolkit implementation by mapping PCPs' barriers to using the toolkit and intervention strategies onto established behaviour change theories, models and frameworks (e.g. Capability, Opportunity, Motivation—Behaviour (COM-B) model, Behaviour Change Wheel).[36] Chart reviews, questionnaires, recorded encounters and/or accelerometry could be conducted to assess how effective the toolkit is at enhancing PCPs' knowledge, attitudes, confidence, skill and frequency of discussions about the 24HMGs and bringing about positive behaviour changes among adults in their care. The acceptability of the toolkit should continue to be assessed to identify what adaptations may be needed to ensure its continued utility among diverse PCPs.

Conclusion

The 24HMGs are new public health guidelines in Canada that outline how adults can optimize their physical activity, sedentary behaviour and sleep to make their "whole day matter." Strategic knowledge mobilization efforts ensure the 24HMGs implementation in PCPs' practice, and future feasibility and effectiveness studies are needed to evaluate their public health impact. *The Whole Day Matters Toolkit for Primary Care* provides a suite of resources that a sample of PCPs in Canada have agreed can be used to enhance the health of the population. The toolkit is informed by evidence and behaviour change principles to support movement behaviour promotion. The whole toolkit or component pages can be used to help PCPs strengthen

their health promotion services and improve public health.

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Conflicts of interest

Taylor McFadden works for the Canadian Medical Association. However, the opinions and conclusions expressed are the writers' own and not those of the Canadian Medical Association.

There are no other conflicts of interest to declare.

Authors' contributions and statement

TLM: Conceptualization, methodology, validation, formal analysis, investigation, data curation, writing – original draft, writing – review and editing, visualization, project administration

MSF: Conceptualization, visualization, supervision, methodology, writing –review and editing

RJ: Conceptualization, visualization, methodology, writing – review and editing

KNL: Conceptualization, visualization, writing – review and editing

KM: Conceptualization, visualization, writing – review and editing

TM: Conceptualization, visualization, writing – review and editing, resources

JP: Conceptualization, visualization, methodology, writing – review and editing

JR: Visualization, writing – review and editing

ZJW: Visualization, writing – review and editing, resources

JRT: Conceptualization, visualization, supervision, methodology, writing – review and editing, funding acquisition

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Original quantitative research

Prevalence of posttraumatic stress disorder (PTSD) in Canada during the COVID-19 pandemic: results from the Survey on COVID-19 and Mental Health

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This article has been peer reviewed.

Abstract

Introduction: This study provides a descriptive overview of the prevalence of posttraumatic stress disorder (PTSD) in Canada, across sociodemographic characteristics, mental health–related variables and negative impacts of the COVID-19 pandemic.

Methods: Data were obtained from cycles 1 and 2 of the Survey on COVID-19 and Mental Health (SCMH), collected in fall 2020 (N = 14 689) and spring 2021 (N = 8032). The prevalence of PTSD was measured using the PTSD Checklist for *DSM-5* (PCL-5) Cross-sectional associations were quantified using logistic regression, while controlling for sociodemographic characteristics.

Results: The overall prevalence of PTSD was 6.9%. Factors associated with higher PTSD prevalence were female gender; younger age; lower income (females only); living in an urban area; frontline worker status or not being at work in the past week (males only); fair or poor mental health; a weak sense of community belonging; symptoms of generalized anxiety disorder and major depressive disorder; suicidal ideation; heavy alcohol use; daily cannabis use; increased alcohol and cannabis use since the start of the pandemic; decreased alcohol consumption since the start of the pandemic (males only); concerns about violence in the home; and negative impacts of the pandemic.

Conclusion: PTSD prevalence in Canada varies significantly across sociodemographic groups and is more common among those with indicators of lower mental health and well-being, as well as those more adversely affected by the COVID-19 pandemic. Ongoing and enhanced surveillance of PTSD in Canada is important to better understand and address the burden and impacts of this condition.

Keywords: *posttraumatic stress disorder, symptoms, PCL-5, mental health, SCMH, survey*

Highlights

- According to pooled cross-sectional data from fall 2020 and spring 2021, the overall prevalence of PTSD in Canada was 6.9%.
- PTSD prevalence was higher among younger individuals, females, frontline workers, those with lower income (females only) and those living in urban areas.
- PTSD prevalence was higher among individuals with poor or fair mental health or mental health that worsened relative to before the pandemic, a weaker sense of local community belonging, symptoms of anxiety and depression, suicidal thoughts, and heavy or increased use of alcohol and cannabis.
- Individuals who expressed concerns about family violence, particularly females who considered themselves the target of violence, had a higher prevalence of PTSD.
- Prevalence of PTSD increased with the number of reported negative COVID-19 pandemic impacts.

Introduction

Posttraumatic stress disorder (PTSD) can occur after exposure to a potentially psychologically traumatic event (PPTE), for example, actual or threatened death, natural disasters or sexual assault. Many people in Canada have experienced a PPTE,[1] but most will not develop PTSD.[2] PTSD is characterized by post-exposure symptoms that include persistent re-experiencing of the event, frequent avoidance of event reminders, as well as negative thoughts, emotions and behaviours.[3] A PTSD diagnosis requires post-exposure symptoms that, according to the *Diagnostic and Statistical Manual of Mental Disorders, fifth edition* (*DSM-5*), cause "clinically significant distress or impairment in social, occupational, or other important areas of functioning."[3]

PTSD is associated with substantial burdens, including lower quality of life;[4] higher functional impairment;[5] and higher prevalence of comorbid mental disorder

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diagnoses[6] and alcohol and substance use disorders.[1] The economic burden of PTSD is unknown, but mental disorders in Canada are associated with billions of dollars per year in lost productivity and health care costs.[7]

PTSD risk factors can be categorized into pre-exposure (e.g. history of mental disorders), peri-exposure (e.g. peri-traumatic dissociation) and post-exposure (e.g. low social support).[8,9] In terms of demographic differences, PTSD is about twice as common among women than men,[1] is less common in older age groups[10] and is more common among military personnel[5] and Veterans,[11] first responders and other public safety personnel (e.g. correctional workers, firefighters, paramedics, police officers)[12] and nurses,[13] among others.

PTSD prevalence in Canada

Ongoing surveillance of PTSD prevalence is important for understanding the overall burden and to monitor for trends. Estimates from large nationally representative samples are optimal for addressing these questions. A 2018 systematic review found Canadian PTSD prevalence estimates to be largely dated, based on insufficient data (e.g. nonrepresentative or small samples) and varying greatly in terms of study population (e.g. clinical or general population), PTSD assessment method (clinical assessment, screening tool or self-reported diagnosis) and time frame (e.g. lifetime, past year or past month).[14] Recent national survey data suggest that the prevalence of a self-reported PTSD diagnosis by a health care professional was 3.4% in 2022 (Public Health Agency of Canada internal analysis using data from the 2022 Mental Health and Access to Care Survey). However, this only includes the treated population who were willing to disclose their diagnosis.

In 2020, the Survey on COVID-19 and Mental Health (SCMH)[15] was implemented to examine Canadians' mental health and well-being in the context of the pandemic. Early findings based on a screening tool (which can identify both diagnosed and undiagnosed individuals) indicated that the prevalence of moderate to severe symptoms of PTSD was 6.3% in 2020 and 7.5% in 2021.[16]

PTSD surveillance is also important for assessing potential impacts of the COVID-19 pandemic. Research conducted in China reported a high prevalence of PTSD during the first month of the pandemic, especially among those who were most impacted,[17] with one study reporting that more than a quarter of COVID-19 patients screened positive for PTSD within one year of the time that they were affected.[18] Another study identified risk factors (e.g. economic instability) and protective factors (e.g. timely government action) for PTSD symptoms during the pandemic.[19] A large population survey in the USA found that 26.3% of adults had symptoms of a trauma- and stressor-related disorder (including PTSD) related to the pandemic.[20]

The current study was designed to use data from cycles 1 and 2 of the SCMH (fall 2020 and spring 2021) to provide a more detailed description of the prevalence of PTSD in Canada, stratifying PTSD prevalence by gender, by several sociodemographic and mental health–related characteristics and by several negative impacts of the COVID-19 pandemic. The current study was also designed to quantify the relationships between these stratification variables and PTSD, while controlling for potential sociodemographic confounders.

Methods

Data sources

Data were collected in fall 2020 (11 September 2020 to 4 December 2020) and in spring 2021 (1 February 2021 to 7 May 2021).[15] The survey covers non-institutionalized persons aged 18 years and older living in Canada's 10 provinces and the three territorial capitals, who were not living on reserves or in collective, unmailable, inactive or vacant dwellings. The SCMH used a two-stage sampling design, with the dwelling as the first stage unit and the person within the dwelling as the second stage unit. The SCMH was stratified by province with random sampling of dwellings within each province and within the three territorial capitals. Survey responses were voluntarily completed by electronic questionnaire or through computer-assisted telephone interviews and respondents were informed that their answers would be strictly confidential. The survey response rate was 53.3% (n = 14 689) for fall 2020 and 49.3% (n = 8032) for spring 2021. The total sample for both collection periods (n = 18093) includes those respondents who agreed to share their responses with the Public Health Agency of Canada.

Measures

Sociodemographic variables

Sociodemographic variables included gender, age group, total household income tertile, highest level of education, area of residence (urban or rural), immigrant status, racialized background and occupation (i.e. frontline work, essential work, other work).

Immigrants included landed immigrants and nonpermanent residents, and nonimmigrants included people born in Canada. Racialized people were those who did not identify as White or as Indigenous (First Nations, Métis or Inuit).

Occupation groups included anyone aged 75 years or younger who worked "at a job or business" in the past week. Frontline workers were defined as people with "the potential to come in direct contact with COVID-19 by assisting those who have been diagnosed with the virus."[15] Examples provided were "police officers, firefighters, paramedics, nurses or doctors."[15] Essential workers were defined as people working "in a service, facility or in an activity that is necessary to preserving life, health, public safety and basic societal functions of Canadians."[15] Examples provided were "employees working in transportation (e.g. public transit, gas stations), financial institutions, health care or as first responders (e.g. police, firefighters, paramedics), pharmacies, childcare, food supply (e.g. grocery stores, truck drivers)."[15] Frontline workers represented a subset of essential workers; accordingly, the current study excluded frontline workers from the essential worker category to enable comparisons.

PTSD

Positive screens for PTSD were assessed using the 20-item PTSD Checklist for *DSM-5*, the PCL-5.[21] Instead of using the full Life Events Checklist for *DSM-5* (LEC-5),[22] respondents were asked, "Have you ever experienced a highly stressful or traumatic event during your life?" Respondents were then asked, "Keeping your worst event in mind, over the past month, how often have you been bothered by the following problems?" Respondents rated their symptoms for each PCL-5 item on a 5-point scale (0 = not at all; 1 = a little bit; 2 = moderately; 3 = quite a bit; 4 = extremely). The PCL-5 total score is the sum of the individual item scores. A positive screen for PTSD was based on total scores greater than 32 out of 80.[21]

A more nuanced screen was also applied, wherein the total score threshold was combined with another recommended method where each *DSM-5* criterion is met based on PCL-5 subscale scores.[21] This more nuanced screening algorithm produced lower overall estimates but a very similar pattern of results (available at https://osf.io/); accordingly, PCL-5 total scores greater than 32 were included. Although aligned with *DSM-5* diagnostic criteria, the PCL-5 does not replace the more comprehensive clinical assessment required for diagnosis. For the sake of simplicity, we use "PTSD prevalence" in this study, despite reference to PCL-5 positive screens.

Mental health–related variables

Respondents were asked the following questions about their mental health: (1) "In general, how is your mental health?" with responses dichotomized as "poor/fair" versus "good/very good/excellent";[23] and (2) "Compared to before the COVID-19 pandemic, how would you say your mental health is now?" with responses ("much better now," "somewhat better now," "about the same," "somewhat worse now" or "much worse now") dichotomized as "same or better" versus "worse."[24]

Respondents were also asked, "How would you describe your sense of belonging to your local community?" Responses were dichotomized as "very strong/somewhat strong" versus "somewhat weak/very weak."[25]

Symptoms of generalized anxiety disorder (GAD) and major depressive disorder (MDD) were measured using the Generalized Anxiety Disorder Scale (GAD-7)[26] and the Patient Health Questionnaire (PHQ-9),[27] respectively, with scores greater than 9 indicating a positive screen on either measure. Respondents were also asked the following two questions: "Have you ever seriously contemplated suicide?" and "Have you seriously contemplated suicide since the COVID-19 pandemic began?" Responses to these facilitated a three-level variable of "lifetime history of suicidal ideation, but not during the COVID-19 pandemic," "suicidal ideation during the COVID-19 pandemic" and "no history of suicidal ideation."

Heavy drinking was assessed by asking how often in the past month females had consumed more than 4 drinks in one sitting and males more than 5 drinks in one sitting.[28] Respondents were also asked how often they consumed cannabis in the past month. Respondents were then asked how their use of alcohol and cannabis had changed over the course of the COVID-19 pandemic when compared to before the pandemic, with potential responses being "increased," "decreased" and "no change."

Respondents were asked, "How concerned are you about violence in your home?" Those who reported some level of concern ("somewhat," "very" or "extremely" vs. "not at all") were asked who in their household they were concerned was the target of violence. Nonmutually exclusive responses ("self," "another adult/adults" and "child/children") were categorized into three groups: "self as target," "other household member as target" and "no concerns.")

COVID-19 impacts

Respondents were asked, "Have you experienced any of the following impacts due to the COVID-19 pandemic?" Potential answers were "loss of job/income," "difficulty meeting financial obligations/essential needs," "death of family/friend/colleague" (i.e. someone close), "feelings of loneliness/isolation," "emotional distress," "physical health problems," "challenges in personal relationships" and "other." We categorized the total number of reported impacts as "2 or fewer," "3 or 4" and "5 or more."

Statistical analyses

PTSD prevalence estimates were calculated for the overall sample and stratified by gender, for all study variables. Logistic regression analyses estimated associations between the odds of PTSD and these variables. Respondents who entered a gender other than "male" or "female" (i.e. gender-diverse) were not included in gender-stratified analyses because of small counts. Due to the nearly identical methodologies and relative proximity in time, data from the two collection periods were pooled to maximize the sample size for analyses.[29] However, separate analyses were also conducted for each collection period to enable comparisons.

Logistic regressions were adjusted for the sociodemographic variables listed in the "Measures" section and the collection period (fall 2020 or spring 2021). Proportions and adjusted odds ratios (aORs) were weighted using sampling weights provided by Statistics Canada to ensure the findings were representative of the population in Canada, and adjusted for nonresponse. To account for the effects of the complex survey design of the SCMH, we estimated 95% confidence intervals (CIs) using bootstrap weights for proportions and aORs. Statistically significant aORs were those where unrounded 95% CIs did not include 1. Survey and bootstrap weights were divided in half for pooled analyses.[29] All analyses used SAS Enterprise Guide version 9.4 (SAS Institute Inc., Cary, NC, US).

Results

Compared to fall 2020, the spring 2021 sample had a lower proportion of people aged 25 to 34 years, a higher proportion of people aged 35 to 49 years, a higher proportion of essential workers and a lower proportion of other workers (Table 1). A higher proportion of respondents in spring 2021 reported fair/poor mental health, worse mental health since the pandemic began, somewhat or very weak local community belonging, moderate to severe symptoms of MDD, suicidal ideation during the pandemic, and decreased alcohol consumption and cannabis use since the start of the pandemic, whereas a lower proportion reported less than daily heavy drinking. Also, a higher proportion of respondents in spring 2021 reported being affected by the pandemic in terms of the death of someone close, feelings of loneliness/isolation, emotional distress, physical health problems and challenges in personal relationships.

PTSD prevalence in the overall sample was 6.9% (Table 2). Prevalence appeared to be higher (but not statistically significantly) in spring 2021 (7.5%) than in fall 2020 (6.3%). Prevalence was higher among females than males (aOR = 1.8) and among those aged 18 to 64 years than those aged 65 years and older (aOR range: 3.5–6.2). Among females only, prevalence was particularly high among those aged 18 to 24 years (19.9%).

Prevalence was higher among those from the lowest tertile than the highest tertile of household income (aOR = 1.9) and among those living in urban areas (aOR = 1.3). Among males, compared with other workers, prevalence was higher among frontline workers (aOR = 3.9) and those not at work in the past week who were aged 75 years or younger (aOR = 2.6).

TABLE 1
Sample characteristics for the pooled sample and by data collection period

Study variable	Pooled sample		Fall 2020		Spring 2021	
	%	(95% CI)	%	(95% CI)	%	(95% CI)
Sociodemographic variables						
Gender						
Male	49.3	(49.1–49.6)	49.3	(49.0–49.6)	49.4	(49.0–49.7)
Female	50.7	(50.4–50.9)	50.7	(50.4–51.0)	50.6	(50.3–51.0)
Age group, years						
18–24	9.4	(8.5–10.2)	9.7	(8.7–10.6)	9.1	(7.7–10.4)
25–34	17.3	(16.5–18.2)	18.8	(17.8–19.7)	15.9	(14.6–17.3)
35–49	25.9	(25.1–26.8)	24.4	(23.9–24.9)	27.5	(25.8–29.1)
50–64	25.5	(25.0–26.0)	25.2	(24.7–25.8)	25.8	(25.0–26.6)
≥65	21.9	(21.7–22.0)	22.0	(21.8–22.2)	21.8	(21.5–22.1)
Household income						
Lowest third	31.4	(30.4–32.4)	31.0	(29.8–32.1)	31.8	(30.2–33.4)
Middle third	27.9	(26.8–28.9)	28.5	(27.3–29.7)	27.2	(25.5–28.9)
Highest third	30.1	(29.0–31.2)	29.7	(28.4–30.9)	30.5	(28.9–32.2)
Did not report income	10.7	(9.9–11.5)	10.8	(9.9–11.8)	10.5	(9.2–11.8)
Highest level of education						
High school diploma or less	30.1	(29.0–31.2)	31.2	(30.0–32.5)	29.0	(27.3–30.7)
More than high school but less than university	33.6	(32.5–34.7)	32.8	(31.6–34.1)	34.3	(32.5–36.2)
Bachelor degree or higher	36.3	(35.2–37.4)	35.9	(34.6–37.2)	36.7	(34.9–38.4)
Area of residence						
Urban[a]	82.3	(81.6–83.0)	82.3	(81.5–83.1)	82.2	(81.0–83.5)
Rural	17.7	(17.0–18.4)	17.7	(16.9–18.5)	17.8	(16.5–19.0)
Immigration status						
Immigrant	27.3	(26.3–28.4)	27.2	(26.0–28.4)	27.4	(25.7–29.1)
Nonimmigrant	72.7	(71.6–73.7)	72.8	(71.6–74.0)	72.6	(70.9–74.3)
Racialized background						
Racialized[b]	23.9	(22.9–24.9)	24.4	(23.3–25.6)	23.4	(21.8–25.0)
Nonracialized	76.1	(75.1–77.1)	75.6	(74.4–76.7)	76.6	(75.0–78.2)
Occupation group						
Frontline work[c]	6.1	(5.6–6.6)	6.4	(5.8–7.1)	5.8	(5.0–6.6)
Essential work[d]	23.2	(22.1–24.2)	20.9	(19.8–22.1)	25.4	(23.7–27.1)
Other work	29.5	(28.4–30.5)	31.2	(30.0–32.4)	27.7	(26.0–29.4)
Not at work in the past week	34.2	(33.0–35.3)	34.5	(33.3–35.8)	33.8	(32.0–35.5)
Aged ≥76 years[e]	7.1	(6.7–7.5)	6.9	(6.4–7.4)	7.3	(6.6–8.0)
Mental health–related variables						
General mental health						
Fair or poor	15.3	(14.5–16.2)	13.0	(12.1–13.9)	17.7	(16.2–19.1)
Good, very good or excellent	84.7	(83.8–85.5)	87.0	(86.1–87.9)	82.3	(80.9–83.8)
Mental health relative to before the COVID-19 pandemic						
Worse	37.4	(36.2–38.5)	33.1	(31.7–34.5)	41.7	(39.8–43.5)
Same or better	62.6	(61.5–63.8)	66.9	(65.5–68.3)	58.3	(56.5–60.2)
Sense of local community belonging						
Somewhat weak or very weak	39.3	(38.1–40.4)	36.2	(34.9–37.5)	42.4	(40.6–44.2)
Somewhat strong or very strong	60.7	(59.6–61.9)	63.8	(62.5–65.1)	57.6	(55.8–59.4)

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TABLE 1 (continued)
Sample characteristics for the pooled sample and by data collection period

Study variable	Pooled sample		Fall 2020		Spring 2021	
	%	(95% CI)	%	(95% CI)	%	(95% CI)
Positive screen for generalized anxiety disorder[f]						
Yes	13.9	(13.0–14.7)	12.9	(11.9–13.8)	14.9	(13.5–16.3)
No	86.1	(85.3–87.0)	87.1	(86.2–88.1)	85.1	(83.7–86.5)
Positive screen for major depressive disorder[g]						
Yes	16.7	(15.8–17.6)	14.9	(13.8–15.9)	18.5	(17.0–20.1)
No	83.3	(82.4–84.2)	85.1	(84.1–86.2)	81.5	(79.9–83.0)
Suicidal ideation						
Suicidal ideation during the COVID-19 pandemic	3.3	(2.8–3.7)	2.4	(2.0–2.8)	4.2	(3.4–5.0)
Lifetime history of suicidal ideation, but not during the COVID-19 pandemic	9.4	(8.8–10.1)	9.6	(8.8–10.4)	9.3	(8.2–10.3)
No history of suicidal ideation	87.3	(86.5–88.1)	88.0	(87.1–88.9)	86.6	(85.3–87.9)
Past month heavy drinking[h]						
Yes, daily or almost daily	1.9	(1.6–2.2)	1.6	(1.3–1.9)	2.1	(1.6–2.7)
Yes, less than daily	25.5	(24.5–26.5)	27.1	(25.9–28.3)	23.9	(22.3–25.5)
No	72.6	(71.6–73.7)	71.3	(70.1–72.6)	74.0	(72.3–75.6)
Change in alcohol consumption since the start of the COVID-19 pandemic						
Increase	16.0	(15.2–16.8)	15.6	(14.7–16.6)	16.4	(15.1–17.8)
Decrease	12.1	(11.2–12.9)	10.0	(9.1–10.8)	14.2	(12.7–15.6)
No change	71.9	(70.9–73.0)	74.4	(73.2–75.6)	69.4	(67.7–71.2)
Past month cannabis use						
Yes, daily	5.1	(4.6–5.7)	4.8	(4.2–5.3)	5.5	(4.6–6.4)
Yes, less than daily	10.8	(10.0–11.6)	10.9	(10.0–11.8)	10.7	(9.5–11.9)
No	84.1	(83.2–85.0)	84.4	(83.4–85.3)	83.8	(82.3–85.3)
Change in cannabis use since the start of the COVID-19 pandemic						
Increase	6.0	(5.4–6.5)	5.4	(4.7–6.1)	6.5	(5.5–7.5)
Decrease	2.6	(2.2–3.0)	1.8	(1.4–2.1)	3.4	(2.6–4.2)
No change	91.4	(90.7–92.2)	92.8	(92.1–93.6)	90.1	(88.8–91.3)
Concerns about violence in the home[i]						
Self as target	2.1	(1.7–2.5)	1.7	(1.3–2.1)	2.5	(1.8–3.1)
Other household member as target	2.1	(1.7–2.5)	2.1	(1.7–2.6)	2.1	(1.5–2.7)
Not concerned	95.8	(95.3–96.3)	96.2	(95.6–96.8)	95.4	(94.6–96.3)
COVID-19 impacts						
Loss of job/income						
Yes	25.1	(24.0–26.1)	25.3	(24.1–26.6)	24.8	(23.1–26.4)
No	74.9	(73.9–76.0)	74.7	(73.4–75.9)	75.2	(73.6–76.9)
Difficulty meeting financial obligations/essential needs						
Yes	15.5	(14.7–16.4)	15.5	(14.5–16.5)	15.6	(14.2–17.0)
No	84.5	(83.6–85.3)	84.5	(83.5–85.5)	84.4	(83.0–85.8)
Death of family/friend/colleague						
Yes	8.5	(7.8–9.2)	6.1	(5.5–6.8)	10.8	(9.7–12.0)
No	91.5	(90.8–92.2)	93.9	(93.2–94.5)	89.2	(88.0–90.3)
Feelings of loneliness/isolation						
Yes	42.9	(41.8–44.1)	38.7	(37.4–40.0)	47.1	(45.3–49.0)
No	57.1	(55.9–58.2)	61.3	(60.0–62.6)	52.9	(51.0–54.8)

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TABLE 1 (continued)
Sample characteristics for the pooled sample and by data collection period

Study variable	Pooled sample		Fall 2020		Spring 2021	
	%	(95% CI)	%	(95% CI)	%	(95% CI)
Emotional distress						
Yes	40.1	(39.0–41.2)	38.2	(36.9–39.5)	42.0	(40.2–43.8)
No	59.9	(58.8–61.0)	61.8	(60.5–63.1)	58.0	(56.2–59.8)
Physical health problems						
Yes	27.6	(26.5–28.6)	24.1	(22.9–25.3)	31.0	(29.3–32.8)
No	72.4	(71.4–73.5)	75.9	(74.7–77.1)	69.0	(67.2–70.7)
Challenges in personal relationships						
Yes	20.4	(19.5–21.4)	18.0	(16.9–19.0)	22.9	(21.3–24.5)
No	79.6	(78.6–80.5)	82.0	(81.0–83.1)	77.1	(75.5–78.7)
Other impacts						
Yes	4.7	(4.2–5.2)	4.3	(3.8–4.9)	5.1	(4.2–6.0)
No	95.3	(94.8–95.8)	95.7	(95.1–96.2)	94.9	(94.0–95.8)
Number of COVID-19 impacts						
≤2	67.9	(66.9–69.0)	71.5	(70.2–72.8)	64.4	(62.6–66.2)
3 or 4	23.3	(22.3–24.3)	21.4	(20.2–22.5)	25.2	(23.5–26.9)
≥5	8.8	(8.0–9.5)	7.1	(6.4–7.9)	10.4	(9.2–11.6)

Data source: Survey on COVID-19 and Mental Health, Fall (September to December) 2020 and Spring (February to May) 2021.

Abbreviation: CI, confidence interval.

[a] Urban areas were defined as continuously built-up areas with populations of ≥1000 and densities of ≥400 per km^2. This information came from postal codes.

[b] Included people who identified as South Asian (e.g. East Indian, Pakistani, Sri Lankan), Chinese, Black, Filipino, Arab, Latin American, Southeast Asian (e.g. Vietnamese, Cambodian, Laotian, Thai), West Asian (e.g. Iranian, Afghan), Korean, Japanese or "other," and did not identify as Indigenous (First Nations, Métis or Inuit) or White.

[c] Frontline workers included police officers, firefighters, paramedics, nurses and doctors.

[d] Essential workers included people employed in transportation, financial institutions, pharmacies, childcare and food supply, and did not include frontline workers.

[e] Respondents aged ≥76 years were not asked about current work status or occupation as it was assumed that most would have retired.

[f] Measured using the Generalized Anxiety Disorder Scale (GAD-7).[26]

[g] Measured using the Patient Health Questionnaire (PHQ-9).[27]

[h] Assessed by asking how often in the past month females had consumed >4 drinks in one sitting and males >5 drinks in one sitting.[28]

[i] Respondents who reported some level of concern ("somewhat," "very" or "extremely" vs. "not at all") about violence in their home were asked who in their household they were concerned was the target of violence.

PTSD prevalence was higher among people who had fair or poor mental health (aOR = 9.6), had worse mental health compared to before the pandemic (aOR = 6.5), had a weaker sense of community belonging (aOR = 3.6), screened positive for GAD (aOR = 18.9) or MDD (aOR = 22.4), had suicidal ideation before (aOR = 4.1) and during (aOR = 12.1) the pandemic; engaged in heavy drinking daily or almost daily (aOR = 3.5) and less than daily (aOR = 1.6), used cannabis daily (aOR = 3.1) and less than daily (aOR = 2.4), increased their alcohol consumption (aOR = 2.4) or decreased their alcohol consumption (aOR = 1.5) since the pandemic began, increased their cannabis use (aOR = 3.6) or decreased their cannabis use (aOR = 2.8) since the pandemic began; and reported being concerned about violence in the home where they identified themselves (aOR = 5.3) or another household member (aOR = 2.5) as the target. Identifying oneself as the target of violence was associated with a particularly high PTSD prevalence (aOR = 7.4) among females.

PTSD prevalence was higher among those who had experienced COVID-19 pandemic impacts (aOR range: 2.1 [loss of job/income] to 8.7 [emotional distress]). Prevalence was also higher among those who reported three or four impacts (aOR = 7.1) or five or more impacts (aOR = 21.3) than among those who reported two or fewer impacts.

Tables 3 and 4 show PTSD prevalence for the two collection periods. Among those who experienced job or income loss due to the pandemic, PTSD prevalence was higher in spring 2021 (15.2%) than in fall 2020 (9.3%). In terms of associations between study variables and PTSD, there were no differences in aORs between collection periods.

Discussion

The current study was designed to provide estimates of the prevalence of PTSD in the general population in Canada, across sociodemographic characteristics, mental health–related factors and COVID-19 pandemic impacts in fall 2020 and spring 2021. Contextualizing these results against international data is challenging because of variations in PTSD assessments. A 2017 study in 24 countries (but not including Canada) reported a lifetime PTSD prevalence of 5% in high-income countries, with substantial variation across

TABLE 2
PTSD prevalence and adjusted odds ratios, pooled data from fall 2020 and spring 2021, by gender, sociodemographic characteristics, mental health–related variables and impacts of the COVID-19 pandemic

Study variable	Overall				Males				Females			
	%	(95% CI)	aOR	(95% CI)	%	(95% CI)	aOR	(95% CI)	%	(95% CI)	aOR	(95% CI)
Total sample	6.9	(6.3–7.5)	—	—	5.0	(4.2–5.8)	Ref	—	8.6	(7.6–9.5)	1.8*	(1.4–2.2)
Collection period												
Fall 2020	6.3	(5.6–7.0)	Ref	—	4.4	(3.6–5.3)	Ref	—	7.9	(6.9–8.9)	Ref	—
Spring 2021	7.5	(6.4–8.5)	1.2	(1.0–1.5)	5.6	(4.2–6.9)	1.3	(0.9–1.8)	9.2	(7.6–10.8)	1.2	(0.9–1.5)
Sociodemographic variables												
Age group, years												
18–24	11.9	(8.8–15.0)	6.2*	(3.9–9.9)	4.9	(2.2–7.5)	2.8*	(1.2–6.3)	19.9	(13.9–25.9)	10.0*	(5.6–17.6)
25–34	8.5	(6.8–10.3)	4.8*	(3.1–7.4)	6.1	(3.7–8.4)	4.2*	(1.9–9.2)	10.4	(7.8–13.0)	5.3*	(3.2–8.7)
35–49	7.6	(6.3–8.8)	4.5*	(3.0–6.9)	6.0	(4.2–7.7)	4.4*	(2.1–9.0)	9.1	(7.3–10.9)	4.9*	(3.0–7.8)
50–64	7.0	(5.9–8.1)	3.5*	(2.5–5.0)	5.6	(4.2–7.0)	3.3*	(1.8–6.2)	8.3	(6.6–10.0)	3.7*	(2.4–5.7)
≥65	2.5	(1.9–3.0)	Ref	—	2.3	(1.3–3.2)	Ref	—	2.6	(1.9–3.4)	Ref	—
Household income												
Lowest third	9.0	(7.9–10.2)	1.9*	(1.4–2.6)	7.4	(5.8–8.9)	1.7	(1.0–2.8)	10.4	(8.6–12.2)	2.1*	(1.5–3.1)
Middle third	5.8	(4.8–6.9)	1.0	(0.8–1.4)	4.0	(2.7–5.4)	0.8	(0.5–1.4)	7.5	(5.9–9.0)	1.2	(0.8–1.7)
Highest third	5.7	(4.6–6.9)	Ref	—	4.5	(3.0–6.0)	Ref	—	7.0	(5.2–8.7)	Ref	—
Did not report income	6.5	(4.3–8.6)	1.1	(0.7–1.8)	2.2	(0.5–3.9)	0.5	(0.2–1.3)	9.7	(6.3–13.2)	1.7	(1.0–3.0)
Highest level of education												
High school diploma or less	7.1	(6.0–8.3)	1.1	(0.8–1.5)	5.1	(3.6–6.6)	1.2	(0.7–2.0)	8.9	(7.1–10.7)	1.0	(0.7–1.4)
More than high school but less than university	7.6	(6.4–8.7)	1.2	(0.9–1.6)	6.1	(4.5–7.7)	1.4	(0.9–2.2)	8.8	(7.3–10.4)	1.1	(0.8–1.6)
Bachelor degree or higher	6.0	(5.1–7.0)	Ref	—	4.0	(3.0–5.0)	Ref	—	8.0	(6.4–9.6)	Ref	—
Area of residence												
Urban[a]	7.2	(6.4–7.9)	1.3*	(1.0–1.7)	5.1	(4.2–6.0)	1.2	(0.8–1.8)	9.0	(7.9–10.2)	1.3	(1.0–1.8)
Rural	5.4	(4.3–6.4)	Ref	—	4.1	(2.7–5.5)	Ref	—	6.5	(5.0–8.0)	Ref	—
Immigration status												
Immigrant	6.4	(5.0–7.7)	0.9	(0.6–1.3)	5.1	(3.4–6.8)	1.0	(0.6–1.5)	7.9	(5.7–10.0)	0.9	(0.5–1.4)
Nonimmigrant	7.1	(6.4–7.8)	Ref	—	5.0	(4.1–5.9)	Ref	—	8.8	(7.7–9.8)	Ref	—
Racialized background												
Racialized[b]	7.1	(5.6–8.6)	0.9	(0.6–1.3)	5.2	(3.3–7.1)	0.9	(0.6–1.6)	9.3	(6.8–11.7)	0.9	(0.5–1.4)
Nonracialized	6.7	(6.1–7.4)	Ref	—	4.8	(4.0–5.7)	Ref	—	8.3	(7.3–9.3)	Ref	—
Occupation group												
Frontline work[c]	10.5	(7.5–13.4)	1.7*	(1.1–2.5)	13.1	(6.9–19.4)	3.9*	(2.0–7.8)	8.8	(5.8–11.8)	1.1	(0.7–1.7)
Essential work[d]	6.8	(5.4–8.1)	1.2	(0.9–1.6)	4.0	(2.6–5.5)	1.2	(0.7–1.9)	10.3	(7.8–12.8)	1.3	(0.9–1.9)
Other work	5.9	(4.8–7.0)	Ref	—	3.4	(2.4–4.4)	Ref	—	8.3	(6.3–10.3)	Ref	—
Not at work in the past week	8.3	(7.2–9.4)	1.6*	(1.2–2.2)	7.0	(5.3–8.8)	2.6*	(1.6–4.4)	9.2	(7.7–10.7)	1.3	(0.9–1.8)
Aged ≥76 years[e]	1.6	(0.8–2.4)	0.9	(0.4–1.7)	1.6	(0.3–2.9)	1.4	(0.5–4.3)	1.6	(0.6–2.6)	0.7	(0.3–1.5)

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TABLE 2 (continued)
PTSD prevalence and adjusted odds ratios, pooled data from fall 2020 and spring 2021, by gender, sociodemographic characteristics, mental health–related variables and impacts of the COVID-19 pandemic

Study variable	Overall				Males				Females			
	%	(95% CI)	aOR	(95% CI)	%	(95% CI)	aOR	(95% CI)	%	(95% CI)	aOR	(95% CI)
Mental health–related variables												
General mental health												
Fair or poor	26.5	(23.7–29.4)	9.6*	(7.6–12.1)	22.2	(18.1–26.3)	11.6*	(7.8–17.2)	29.5	(25.7–33.4)	8.4*	(6.2–11.3)
Good, very good or excellent	3.3	(2.8–3.8)	Ref	—	2.4	(1.8–3.0)	Ref	—	4.2	(3.4–5.0)	Ref	—
Mental health relative to before the COVID-19 pandemic												
Worse	14.6	(13.1–16.0)	6.5*	(5.3–8.1)	11.5	(9.5–13.6)	6.8*	(4.8–9.7)	16.8	(14.7–18.9)	6.3*	(4.8–8.3)
Same or better	2.3	(1.9–2.7)	Ref	—	1.7	(1.3–2.2)	Ref	—	2.8	(2.2–3.4)	Ref	—
Sense of local community belonging												
Somewhat weak or very weak	12.4	(11.1–13.8)	3.6*	(2.9–4.6)	9.4	(7.7–11.2)	4.3*	(2.9–6.2)	15.1	(13.1–17.1)	3.4*	(2.5–4.5)
Somewhat strong or very strong	3.3	(2.7–3.9)	Ref	—	2.2	(1.6–2.9)	Ref	—	4.3	(3.4–5.2)	Ref	—
Positive screen for generalized anxiety disorder[f]												
Yes	35.0	(31.8–38.3)	18.9*	(15.0–23.9)	31.0	(25.6–36.5)	19.6*	(13.4–28.6)	37.2	(33.1–41.2)	18.2*	(13.4–24.8)
No	2.4	(2.0–2.8)	Ref	—	2.0	(1.5–2.5)	Ref	—	2.7	(2.1–3.3)	Ref	—
Positive screen for major depressive disorder[g]												
Yes	31.7	(28.8–34.7)	22.4*	(17.0–29.4)	28.2	(23.6–32.8)	27.3*	(17.6–42.4)	34.0	(30.1–37.9)	19.7*	(13.8–27.9)
No	1.9	(1.5–2.2)	Ref	—	1.4	(0.9–1.8)	Ref	—	2.3	(1.7–2.9)	Ref	—
Suicidal ideation												
Suicidal ideation during the COVID-19 pandemic	42.3	(35.1–49.4)	12.1*	(8.3–17.8)	35.9	(24.9–46.9)	11.8*	(6.5–21.4)	46.5	(37.0–56.0)	11.5*	(6.9–19.1)
Lifetime history of suicidal ideation, but not during the COVID-19 pandemic	17.5	(14.7–20.3)	4.1*	(3.2–5.3)	10.8	(7.4–14.2)	3.2*	(2.0–4.9)	22.5	(18.3–26.7)	4.8*	(3.5–6.6)
No history of suicidal ideation	4.4	(3.8–4.9)	Ref	—	3.4	(2.7–4.1)	Ref	—	5.4	(4.5–6.2)	Ref	—
Past month heavy drinking[h]												
Yes, daily or almost daily	14.7	(9.7–19.7)	3.5*	(2.2–5.6)	13.7	(6.7–20.7)	3.3*	(1.6–6.8)	16.2	(8.8–23.7)	2.9*	(1.6–5.5)
Yes, less than daily	8.8	(7.3–10.3)	1.6*	(1.2–2.0)	6.2	(4.3–8.0)	1.5*	(1.0–2.3)	11.8	(9.4–14.1)	1.5*	(1.2–2.0)
No	6.0	(5.4–6.7)	Ref	—	4.3	(3.4–5.1)	Ref	—	7.4	(6.4–8.5)	Ref	—
Change in alcohol consumption since the start of the COVID-19 pandemic												
Increase	11.9	(9.9–13.8)	2.4*	(1.9–3.1)	8.6	(6.3–10.8)	2.5*	(1.7–3.8)	14.7	(11.6–17.8)	2.3*	(1.7–3.1)
Decrease	7.7	(5.6–9.7)	1.5*	(1.0–2.1)	6.9	(4.1–9.8)	2.0*	(1.2–3.4)	8.6	(5.8–11.5)	1.1	(0.7–1.7)
No change	5.6	(5.0–6.3)	Ref	—	3.8	(3.0–4.7)	Ref	—	7.2	(6.1–8.2)	Ref	—

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TABLE 2 (continued)
PTSD prevalence and adjusted odds ratios, pooled data from fall 2020 and spring 2021, by gender, sociodemographic characteristics, mental health–related variables and impacts of the COVID-19 pandemic

Study variable	Overall				Males				Females			
	%	(95% CI)	aOR	(95% CI)	%	(95% CI)	aOR	(95% CI)	%	(95% CI)	aOR	(95% CI)
Past month cannabis use												
Yes, daily	16.9	(13.2–20.7)	3.1*	(2.3–4.3)	9.8	(6.2–13.4)	2.4*	(1.5–3.9)	26.3	(19.0–33.5)	3.8*	(2.5–5.7)
Yes, less than daily	13.1	(10.5–15.7)	2.4*	(1.8–3.1)	9.3	(6.2–12.5)	2.3*	(1.5–3.5)	17.6	(13.2–22.0)	2.4*	(1.7–3.4)
No	5.5	(4.9–6.1)	Ref	—	4.0	(3.2–4.8)	Ref	—	6.8	(5.8–7.7)	Ref	—
Change in cannabis use since the start of the COVID-19 pandemic												
Increase	20.8	(16.6–25.0)	3.6*	(2.7–4.9)	12.7	(8.3–17.1)	3.1*	(1.9–5.0)	28.0	(21.1–35.0)	4.0*	(2.7–5.9)
Decrease	16.9	(10.1–23.7)	2.8*	(1.7–4.7)	13.3	(4.3–22.3)	3.0*	(1.3–7.2)	21.2	(10.6–31.7)	2.5*	(1.3–4.7)
No change	5.7	(5.1–6.3)	Ref	—	4.2	(3.4–5.0)	Ref	—	7.1	(6.2–8.0)	Ref	—
Concerns about violence in the home[i]												
Self as target	27.0	(18.4–35.5)	5.3*	(3.4–8.2)	12.9	(4.1–21.7)	2.6*	(1.1–6.5)	38.5	(26.1–50.9)	7.4*	(4.2–13.1)
Other household member as target	15.1	(9.1–21.0)	2.5*	(1.5–4.1)	12.2	(4.7–19.6)	2.3*	(1.0–5.1)	18.1	(8.5–27.6)	2.6*	(1.3–5.0)
Not concerned	6.2	(5.6–6.8)	Ref	—	4.6	(3.8–5.4)	Ref	—	7.7	(6.7–8.6)	Ref	—
COVID-19 impacts												
Loss of job/income												
Yes	12.2	(10.4–14.1)	2.1*	(1.7–2.7)	8.6	(6.3–10.8)	1.8*	(1.3–2.7)	16.3	(13.3–19.3)	2.1*	(1.6–2.8)
No	5.2	(4.6–5.7)	Ref	—	3.8	(3.1–4.4)	Ref	—	6.3	(5.4–7.1)	Ref	—
Difficulty meeting financial obligations/essential needs												
Yes	19.1	(16.4–21.7)	4.0*	(3.2–5.0)	13.2	(10.1–16.3)	3.3*	(2.2–4.9)	25.2	(21.0–29.3)	4.4*	(3.3–5.8)
No	4.7	(4.2–5.2)	Ref	—	3.5	(2.8–4.2)	Ref	—	5.7	(4.9–6.5)	Ref	—
Death of family/friend/colleague												
Yes	16.0	(12.8–19.1)	2.7*	(2.0–3.6)	12.5	(8.1–16.8)	3.0*	(1.9–5.0)	18.6	(14.1–23.0)	6.2*	(4.3–9.1)
No	6.1	(5.5–6.7)	Ref	—	4.4	(3.7–5.2)	Ref	—	7.6	(6.6–8.5)	Ref	—
Feelings of loneliness/isolation												
Yes	13.2	(11.9–14.5)	6.0*	(4.7–7.8)	10.6	(8.8–12.5)	6.2*	(4.3–9.1)	15.0	(13.2–16.8)	6.0*	(4.3–8.4)
No	2.2	(1.7–2.6)	Ref	—	1.7	(1.2–2.3)	Ref	—	2.7	(2.0–3.4)	Ref	—
Emotional distress												
Yes	14.7	(13.3–16.2)	8.7*	(6.7–11.2)	12.4	(10.3–14.5)	9.3*	(6.1–14.1)	16.1	(14.2–18.0)	8.1*	(5.8–11.3)
No	1.7	(1.4–2.1)	Ref	—	1.3	(0.9–1.8)	Ref	—	2.1	(1.5–2.7)	Ref	—
Physical health problems												
Yes	17.3	(15.5–19.1)	6.1*	(4.9–7.6)	12.6	(10.2–15.1)	4.8*	(3.3–7.1)	20.3	(17.8–22.7)	7.2*	(5.5–9.4)
No	3.0	(2.5–3.5)	Ref	—	2.8	(2.1–3.5)	Ref	—	3.1	(2.5–3.8)	Ref	—
Challenges in personal relationships												
Yes	18.0	(15.8–20.2)	4.6*	(3.8–5.7)	12.9	(10.1–15.7)	4.2*	(2.9–6.0)	21.8	(18.6–24.9)	5.0*	(3.8–6.4)
No	4.1	(3.6–4.6)	Ref	—	3.3	(2.5–4.0)	Ref	—	4.8	(4.1–5.6)	Ref	—
Other impacts												
Yes	15.1	(11.5–18.8)	2.1*	(1.5–2.9)	11.1	(6.7–15.5)	2.1*	(1.2–3.7)	17.2	(12.0–22.5)	2.1*	(1.4–3.2)
No	6.5	(5.9–7.1)	Ref	—	4.8	(4.0–5.6)	Ref	—	8.2	(7.2–9.1)	Ref	—

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TABLE 2 (continued)
PTSD prevalence and adjusted odds ratios, pooled data from fall 2020 and spring 2021, by gender, sociodemographic characteristics, mental health–related variables and impacts of the COVID-19 pandemic

Study variable	Overall				Males				Females			
	%	(95% CI)	aOR	(95% CI)	%	(95% CI)	aOR	(95% CI)	%	(95% CI)	aOR	(95% CI)
Number of COVID-19 impacts												
≤2	1.8	(1.5–2.1)	Ref	—	1.4	(1.0–1.8)	Ref	—	2.2	(1.7–2.8)	Ref	—
3 or 4	12.5	(10.9–14.1)	7.1*	(5.6–9.0)	11.2	(8.7–13.8)	8.2*	(5.5–12.3)	13.3	(11.3–15.4)	6.5*	(4.7–8.8)
≥5	31.7	(27.5–36.0)	21.3*	(15.9–28.5)	23.1	(17.2–29.0)	19.7*	(12.3–31.5)	37.4	(31.5–43.3)	21.6*	(14.8–31.6)

Data source: Survey on COVID-19 and Mental Health, pooled data from Fall (September to December) 2020 and Spring (February to May) 2021.

Abbreviations: aOR, adjusted odds ratio; CI, confidence interval; PTSD, posttraumatic stress disorder; ref, reference.

[a] Urban areas were defined as continuously built-up areas with populations of ≥1000 and densities of ≥400 per km^2. This information came from postal codes.

[b] Included people who identified as South Asian (e.g. East Indian, Pakistani, Sri Lankan), Chinese, Black, Filipino, Arab, Latin American, Southeast Asian (e.g. Vietnamese, Cambodian, Laotian, Thai), West Asian (e.g. Iranian, Afghan), Korean, Japanese or "other," and did not identify as Indigenous (First Nations, Métis or Inuit) or White.

[c] Frontline workers included police officers, firefighters, paramedics, nurses and doctors.

[d] Essential workers included people employed in transportation, financial institutions, pharmacies, childcare and food supply, and did not include frontline workers.

[e] Respondents aged ≥76 years were not asked about current work status or occupation as it was assumed that most would have retired.

[f] Measured using the Generalized Anxiety Disorder Scale (GAD-7).[26]

[g] Measured using the Patient Health Questionnaire (PHQ-9).[27]

[h] Assessed by asking how often in the past month females had consumed >4 drinks in one sitting and males >5 drinks in one sitting.[28]

[i] Respondents who reported some level of concern ("somewhat," "very" or "extremely" vs. "not at all") about violence in their home were asked who in their household they were concerned was the target of violence.

* Statistically significant odds ratio, adjusted for sociodemographic characteristics.

the countries.[2] We found the overall prevalence of PTSD to be 6.9%, similar to rates in the USA (6.9%) and Australia (7.3%) in 2017;[2] however, the Koenen et al. study[2] took place before the pandemic and used a different assessment method.

Recent national survey data indicate a notable increase in the prevalence of people self-reporting having received a PTSD diagnosis from a health care professional. In 2021, this prevalence was reported as 5%,[30] significantly higher than the rates evidenced in 2012 (1.7%) and 2002 (1%).[31] The results highlight a concerning upward trend in the prevalence of PTSD in Canada and a potential increase in associated burden. This increase in reported PTSD diagnoses could reflect a true increase in PTSD prevalence, increased awareness of PTSD and access to care, greater societal acceptance of and reduced stigma towards PTSD, as well as differences in survey methods.

The current results align with previous research that show that PTSD is more prevalent among adults who are female,[2,3] younger,[2,3,32] living on lower income[2] and residing in an urban area.[32] Specifically, the increased risk among younger individuals fits with the broader pattern observed during the pandemic when individuals aged 18 to 34 years disproportionately reported decreased mental health.[33] Also, sexual assault has a strong association with PTSD,[3,34] but victims of sexual assault are less likely than victims of other crimes to receive support and acknowledgement from others.[35] Accordingly, the elevated PTSD prevalence among females aged 18 to 24 years is, unfortunately, consistent with expectations.

Frontline workers, including health care workers and public safety personnel, had higher prevalence of PTSD than other occupational groups, which aligns with pre-pandemic research results.[12] In addition, emerging evidence has highlighted that health care workers experienced higher levels of PTSD during the pandemic.[36,37] Our study results show increased PTSD risk only among male frontline workers, which contradicts previous research findings.[12,37] Further investigation is necessary to gain a deeper understanding of occupational impacts from a gendered perspective.

The results of the current study align with previous research regarding associations between PTSD and neighbourhood social cohesion,[4] social support[38,39] and symptoms of GAD and MDD.[40] The results also highlight the substantial level of psychiatric comorbidity among people with PTSD, while further implicating social support as a protective factor.

Evidence of an increased association between PTSD and suicidal ideation relative to before the pandemic is potentially important but may be an artifact of the timing of the PTSD assessment. The current results should be considered in the context of complex interrelationships between PTSD, MDD and suicidal ideation.[41] Also, PTSD is a risk factor for death by suicide,[42] but a suicide attempt is also a PPTE that can cause PTSD symptoms.[43]

Higher PTSD prevalence was associated with more frequent heavy drinking, more frequent cannabis use and an increase in alcohol and cannabis use since the pandemic began. The association between PTSD and substance use is complex. Individuals with PTSD often resort to alcohol and cannabis use for symptom management, but misuse of these and other substances can also increase risks for PPTE exposures[44] and exacerbate PTSD symptoms.[45] Among females, daily cannabis use was associated with a particularly high PTSD prevalence as compared to less than daily use. The reasons for this gender difference are not clear, but regular cannabis use has been linked to experiences of sexual trauma among females.[46] While our evidence regarding decreased alcohol consumption and cannabis use may seem counterintuitive, decreased consumption among people who report heavy use, for whom PTSD was more prevalent, may reflect a growing awareness of the problematic nature of their previous consumption.

TABLE 3
PTSD prevalence and adjusted odds ratios, fall 2020 collection period, by gender, sociodemographic characteristics, mental health–related variables and impacts of the COVID-19 pandemic

Study variable	Overall				Males				Females			
	%	(95% CI)	aOR	(95% CI)	%	(95% CI)	aOR	(95% CI)	%	(95% CI)	aOR	(95% CI)
Total sample	6.3	(5.6–7.0)	—	—	4.4	(3.6–5.3)	Ref	—	7.9	(6.9–8.9)	1.8*	(1.4–2.4)
Sociodemographic variables												
Age group, years												
18–24	10.8	(7.5–14.2)	5.4*	(3.0–10.0)	5.9	(2.3–9.6)	4.8*	(1.5–15.6)	16.6	(10.4–22.8)	6.7*	(3.4–13.3)
25–34	7.0	(5.3–8.7)	3.6*	(2.1–6.4)	3.8	(1.8–5.7)	2.8	(0.9–9.4)	9.4	(6.8–12.1)	4.3*	(2.4–8.0)
35–49	6.7	(5.4–8.1)	3.8*	(2.2–6.7)	5.3	(3.5–7.0)	4.3*	(1.5–12.2)	8.2	(6.0–10.3)	3.7*	(2.0–6.9)
50–64	6.7	(5.5–7.9)	3.1*	(1.9–5.1)	5.4	(3.9–6.9)	3.7*	(1.5–9.4)	8.0	(6.1–9.9)	2.9*	(1.7–5.0)
≥65	2.7	(1.9–3.5)	Ref	—	2.1	(0.9–3.2)	Ref	—	3.2	(2.1–4.3)	Ref	—
Household income												
Lowest third	7.8	(6.7–9.0)	1.8	(1.3–2.5)*	6.1	(4.5–7.6)	1.8*	(1.0–3.1)	9.4	(7.7–11.0)	1.8*	(1.2–2.7)
Middle third	5.6	(4.4–6.9)	1.1	(0.7–1.5)	4.2	(2.5–5.8)	1.2	(0.7–2.1)	6.6	(4.9–8.4)	1.0	(0.6–1.5)
Highest third	5.1	(3.9–6.3)	Ref	—	3.5	(2.2–4.7)	Ref	—	6.8	(4.8–8.8)	Ref	—
Did not report income	7.0	(4.5–9.5)	1.4	(0.8–2.3)	3.2	(0.3–6.2)	0.8	(0.2–2.7)	9.7	(5.9–13.6)	1.7	(1.0–3.0)
Highest level of education												
High school diploma or less	6.7	(5.4–8.0)	1.1	(0.7–1.6)	4.1	(2.7–5.5)	0.8	(0.4–1.6)	8.8	(6.7–10.9)	1.3	(0.8–2.0)
More than high school but less than university	7.4	(6.2–8.6)	1.4*	(1.0–1.8)	5.4	(3.9–6.9)	1.2	(0.7–2.1)	9.2	(7.3–11.0)	1.5*	(1.0–2.1)
Bachelor degree or higher	4.9	(4.0–5.9)	Ref	—	3.8	(2.5–5.2)	Ref	—	6.0	(4.6–7.5)	Ref	—
Area of residence												
Urban[a]	6.5	(5.7–7.3)	1.2	(0.9–1.8)	4.5	(3.6–5.5)	1.0	(0.6–1.8)	8.2	(7.0–9.4)	1.2	(0.9–1.8)
Rural	5.4	(4.1–6.6)	Ref	—	4.0	(2.3–5.7)	Ref	—	6.6	(4.7–8.4)	Ref	—
Immigration status												
Immigrant	5.6	(4.2–7.0)	1.1	(0.8–1.5)	4.7	(2.8–6.6)	1.2	(0.7–2.0)	6.6	(4.5–8.7)	1.0	(0.6–1.7)
Nonimmigrant	6.5	(5.8–7.3)	Ref	—	4.4	(3.4–5.3)	Ref	—	8.3	(7.1–9.5)	Ref	—
Racialized background												
Racialized[b]	5.7	(4.2–7.2)	0.7	(0.5–1.1)	4.7	(2.6–6.7)	0.8	(0.4–1.4)	6.8	(4.7–9.0)	0.7	(0.4–1.1)
Nonracialized	6.4	(5.6–7.2)	Ref	—	4.3	(3.5–5.2)	Ref	—	8.1	(6.9–9.2)	Ref	—
Occupation group												
Frontline work[c]	9.7	(6.1–13.2)	1.9*	(1.2–3.1)	8.4	(2.6–14.2)	2.5*	(1.0–6.4)	10.6	(6.2–15.0)	1.7	(1.0–3.1)
Essential work[d]	6.6	(4.9–8.3)	1.4	(1.0–2.0)	3.5	(1.8–5.1)	1.0	(0.5–1.9)	10.5	(7.5–13.4)	1.7*	(1.1–2.6)
Other work	4.8	(3.8–5.9)	Ref	—	3.2	(2.1–4.3)	Ref	—	6.4	(4.5–8.2)	Ref	—
Not at work in the past week	7.7	(6.5–8.9)	1.8*	(1.3–2.5)	6.3	(4.5–8.0)	2.4*	(1.3–4.3)	8.6	(7.1–10.1)	1.6*	(1.1–2.3)
Aged ≥76 years[e]	1.7	(0.8–2.7)	0.9	(0.4–2.0)	1.8	(0.3–3.3)	1.7	(0.4–6.7)	1.7	(0.4–3.0)	0.6	(0.2–1.8)
Mental health–related variables												
General mental health												
Fair or poor	26.1	(22.8–29.5)	9.2*	(7.0–11.9)	23.4	(18.1–28.7)	13.0*	(8.2–20.6)	27.5	(23.2–31.7)	7.5*	(5.3–10.4)
Good, very good or excellent	3.3	(2.8–3.9)	Ref	—	2.2	(1.5–2.8)	Ref	—	4.4	(3.5–5.3)	Ref	—
Mental health relative to before COVID-19												
Worse	13.8	(12.1–15.5)	5.7*	(4.3–7.4)	10.8	(8.3–13.2)	5.8*	(3.7–9.0)	15.8	(13.5–18.1)	5.6*	(4.0–7.9)
Same or better	2.6	(2.1–3.1)	Ref	—	1.9	(1.3–2.5)	Ref	—	3.2	(2.4–4.0)	Ref	—

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TABLE 3 (continued)
PTSD prevalence and adjusted odds ratios, fall 2020 collection period, by gender, sociodemographic characteristics, mental health–related variables and impacts of the COVID-19 pandemic

Study variable	Overall				Males				Females			
	%	(95% CI)	aOR	(95% CI)	%	(95% CI)	aOR	(95% CI)	%	(95% CI)	aOR	(95% CI)
Sense of local community belonging												
Somewhat weak or very weak	12.5	(11.0–14.1)	4.6*	(3.5–6.0)	9.6	(7.5–11.6)	6.4*	(4.0–10.4)	15.2	(12.8–17.5)	4.0*	(2.8–5.6)
Somewhat strong or very strong	2.8	(2.2–3.3)	Ref	—	1.5	(1.0–2.1)	Ref	—	3.8	(2.9–4.8)	Ref	—
Positive screen for generalized anxiety disorder[f]												
Yes	33.2	(29.3–37.1)	18.0*	(13.7–23.6)	26.1	(20.3–31.8)	15.2*	(9.4–24.7)	37.1	(32.3–42.0)	20.2*	(14.3–28.6)
No	2.4	(1.9–2.8)	Ref	—	2.1	(1.5–2.7)	Ref	—	2.5	(1.9–3.1)	Ref	—
Positive screen for major depressive disorder[g]												
Yes	31.5	(28.0–35.0)	23.9*	(17.7–32.2)	26.0	(20.9–31.1)	25.8*	(14.9–44.7)	35.1	(30.4–39.8)	23.2*	(16.2–33.1)
No	1.8	(1.4–2.2)	Ref	—	1.4	(0.8–1.9)	Ref	—	2.1	(1.6–2.6)	Ref	—
Suicidal ideation												
Suicidal ideation during the COVID-19 pandemic	50.2	(41.3–59.2)	20.3*	(12.9–32.0)	39.3	(25.2–53.4)	18.3*	(8.7–38.8)	56.2	(45.9–66.5)	22.4*	(13.1–38.1)
Lifetime history of suicidal ideation, but not during the COVID-19 pandemic	18.5	(15.1–21.8)	5.2*	(3.9–6.9)	12.0	(8.0–16.0)	4.4*	(2.7–7.5)	23.2	(18.3–28.0)	5.9*	(4.2–8.4)
No history of suicidal ideation	3.8	(3.2–4.3)	Ref	—	2.9	(2.1–3.6)	Ref	—	4.6	(3.8–5.5)	Ref	—
Past month heavy drinking[h]												
Yes, daily or almost daily	14.4	(7.6–21.1)	3.6*	(1.9–6.7)	14.5[E]	(4.9–24.2)	3.9*[E]	(1.6–9.5)	14.1[E]	(5.2–23.0)	2.7*[E]	(1.2–6.4)
Yes, less than daily	7.8	(6.3–9.3)	1.5*	(1.1–2.0)	4.4	(2.9–5.9)	1.1	(0.7–1.7)	11.5	(8.9–14.1)	1.7*	(1.2–2.4)
No	5.6	(4.8–6.3)	Ref	—	4.2	(3.2–5.2)	Ref	—	6.6	(5.5–7.6)	Ref	—
Change in alcohol consumption since the start of the COVID-19 pandemic												
Increase	10.4	(8.3–12.4)	2.3*	(1.7–3.0)	7.4	(4.9–9.9)	2.3*	(1.5–3.8)	13.0	(9.9–16.0)	2.2*	(1.6–3.2)
Decrease	7.3	(4.8–9.8)	1.5	(1.0–2.2)	5.7[E]	(3.1–8.4)	1.6[E]	(0.9–2.9)	9.4[E]	(4.8–14.1)	1.3[E]	(0.7–2.4)
No change	5.3	(4.6–6.0)	Ref	—	3.6	(2.7–4.5)	Ref	—	6.7	(5.6–7.7)	Ref	—
Past month cannabis use												
Yes, daily	18.9	(14.3–23.5)	4.0*	(2.7–5.8)	13.1	(8.0–18.1)	3.9*	(2.3–6.8)	25.6	(17.6–33.5)	4.2*	(2.5–7.1)
Yes, less than daily	10.6	(8.1–13.2)	2.1*	(1.5–3.0)	6.1	(3.6–8.7)	1.9*	(1.1–3.2)	15.9	(11.5–20.3)	2.3*	(1.5–3.5)
No	5.0	(4.3–5.7)	Ref	—	3.6	(2.7–4.5)	Ref	—	6.2	(5.2–7.3)	Ref	—
Change in cannabis use since the start of the COVID-19 pandemic												
Increase	19.9	(15.2–24.7)	3.7*	(2.6–5.4)	12.3	(7.1–17.6)	3.7*	(2.0–6.8)	26.3	(18.9–33.8)	4.0*	(2.5–6.4)
Decrease	15.4	(8.0–22.9)	3.0*	(1.7–5.5)	10.2	(3.0–17.5)	2.8*	(1.1–7.1)	22.2	(8.4–36.0)	2.9*	(1.2–6.9)
No change	5.3	(4.7–6.0)	Ref	—	3.8	(3.0–4.6)	Ref	—	6.7	(5.7–7.7)	Ref	—
Concerns about violence in the home[i]												
Self as target	17.0	(10.1–23.8)	3.3*	(1.9–5.6)	[F]	—	[F]	—	23.7[E]	(13.4–34.0)	4.1*[E]	(2.1–7.9)
Other household member as target	16.0	(8.8–23.2)	3.1*	(1.7–5.8)	10.7[E]	(1.8–19.6)	2.7[E]	(0.9–8.1)	22.0[E]	(10.2–33.8)	3.6*[E]	(1.5–8.6)
Not concerned	5.8	(5.2–6.5)	Ref	—	4.0	(3.3–4.8)	Ref	—	7.3	(6.3–8.4)	Ref	—

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TABLE 3 (continued)
PTSD prevalence and adjusted odds ratios, fall 2020 collection period, by gender, sociodemographic characteristics, mental health–related variables and impacts of the COVID-19 pandemic

Study variable	Overall				Males				Females			
	%	(95% CI)	aOR	(95% CI)	%	(95% CI)	aOR	(95% CI)	%	(95% CI)	aOR	(95% CI)
COVID-19 impacts												
Loss of job/income												
Yes	9.3	(7.5–11.1)	1.6*	(1.2–2.1)	5.9	(3.8–8.0)	1.2	(0.8–2.0)	12.9	(10.0–15.7)	1.7*	(1.2–2.5)
No	5.4	(4.7–6.0)	Ref	—	4.0	(3.1–4.8)	Ref	—	6.5	(5.4–7.5)	Ref	—
Difficulty meeting financial obligations/essential needs												
Yes	16.8	(14.1–19.5)	3.9*	(3.0–5.1)	11.0	(7.6–14.4)	3.0*	(1.9–4.9)	22.7	(18.4–26.9)	4.5*	(3.2–6.3)
No	4.4	(3.8–5.0)	Ref	—	3.3	(2.5–4.0)	Ref	—	5.4	(4.5–6.3)	Ref	—
Death of family/friend/colleague												
Yes	16.8	(12.3–21.3)	3.0*	(2.1–4.3)	10.5	(4.4–16.6)	2.6*	(1.3–5.4)	20.8	(14.6–26.9)	7.5*	(4.7–12.0)
No	5.7	(5.0–6.3)	Ref	—	4.2	(3.4–5.0)	Ref	—	7.0	(5.9–8.0)	Ref	—
Feelings of loneliness/isolation												
Yes	13.2	(11.6–14.7)	6.8*	(5.1–8.9)	10.5	(8.4–12.6)	7.5*	(4.7–12.0)	14.8	(12.7–16.8)	6.5*	(4.6–9.3)
No	2.1	(1.6–2.5)	Ref	—	1.5	(0.9–2.1)	Ref	—	2.7	(1.9–3.5)	Ref	—
Emotional distress												
Yes	13.9	(12.3–15.5)	9.0*	(6.6–12.2)	11.9	(9.5–14.2)	12.6*	(7.0–22.7)	15.0	(12.9–17.1)	7.3*	(5.1–10.6)
No	1.7	(1.3–2.1)	Ref	—	1.0	(0.6–1.5)	Ref	—	2.4	(1.7–3.2)	Ref	—
Physical health problems												
Yes	17.1	(14.9–19.2)	6.3*	(4.8–8.1)	14.4	(11.0–17.9)	7.9*	(5.1–12.3)	18.3	(15.6–21.0)	5.6*	(4.0–7.8)
No	3.0	(2.4–3.5)	Ref	—	2.1	(1.5–2.7)	Ref	—	3.9	(2.9–4.8)	Ref	—
Challenges in personal relationships												
Yes	17.1	(14.5–19.6)	4.5*	(3.5–5.8)	14.2	(10.6–17.7)	6.2*	(4.1–9.3)	18.8	(15.3–22.3)	3.7*	(2.7–5.1)
No	4.0	(3.4–4.6)	Ref	—	2.6	(2.0–3.3)	Ref	—	5.3	(4.4–6.2)	Ref	—
Other impacts												
Yes	14.5	(10.3–18.7)	2.2*	(1.5–3.4)	15.1	(7.9–22.3)	4.0*	(2.0–7.7)	12.6	(7.5–17.6)	1.6	(0.9–2.6)
No	6.0	(5.3–6.7)	Ref	—	4.0	(3.2–4.9)	Ref	—	7.8	(6.7–8.8)	Ref	—
Number of COVID-19 impacts												
≤2	2.1	(1.7–2.5)	Ref	—	1.5	(1.0–2.1)	Ref	—	2.7	(2.0–3.4)	Ref	—
3 or 4	11.9	(10.1–13.8)	6.0*	(4.4–8.0)	9.7	(7.2–12.1)	6.9*	(4.2–11.6)	13.2	(10.7–15.8)	5.5*	(3.8–8.0)
≥5	32.4	(27.3–37.5)	20.4*	(14.3–29.0)	27.2	(19.1–35.4)	22.6*	(12.4–41.2)	35.4	(28.7–42.0)	18.3*	(11.6–28.9)

Data source: Survey on COVID-19 and Mental Health, Fall (September to December) 2020.

Abbreviations: aOR, adjusted odds ratio; CI, confidence interval; PTSD, posttraumatic stress disorder; ref, reference.

[a] Urban areas were defined as continuously built-up areas with populations of ≥1000 and densities of ≥400 per km^2. This information came from postal codes.

[b] Included people who identified as South Asian (e.g. East Indian, Pakistani, Sri Lankan), Chinese, Black, Filipino, Arab, Latin American, Southeast Asian (e.g. Vietnamese, Cambodian, Laotian, Thai), West Asian (e.g. Iranian, Afghan), Korean, Japanese or "other," and did not identify as Indigenous (First Nations, Métis or Inuit) or White.

[c] Frontline workers included police officers, firefighters, paramedics, nurses and doctors.

[d] Essential workers included people employed in transportation, financial institutions, pharmacies, childcare and food supply, and did not include frontline workers.

[e] Respondents aged ≥76 years were not asked about current work status or occupation as it was assumed that most would have retired.

[f] Measured using the Generalized Anxiety Disorder Scale (GAD-7).[26]

[g] Measured using the Patient Health Questionnaire (PHQ-9).[27]

[h] Assessed by asking how often in the past month females had consumed >4 drinks in one sitting and males >5 drinks in one sitting.[28]

[i] Respondents who reported some level of concern ("somewhat," "very" or "extremely" vs. "not at all") about violence in their home were asked who in their household they were concerned was the target of violence.

* Statistically significant odds ratio, adjusted for sociodemographic characteristics.

[E] Use with caution. Quality should be assessed using the confidence interval.

[F] Too unreliable to be published.

TABLE 4
PTSD prevalence and adjusted odds ratios, spring 2021 collection period, by gender, sociodemographic characteristics, mental health–related variables and impacts of the COVID-19 pandemic

Study variable	Overall				Males				Females			
	%	(95% CI)	aOR	(95% CI)	%	(95% CI)	aOR	(95% CI)	%	(95% CI)	aOR	(95% CI)
Total sample	7.5	(6.4–8.5)	—	—	5.6	(4.2–6.9)	Ref	—	9.2	(7.6–10.8)	1.7*	(1.2–2.4)
Sociodemographic variables												
Age group, years												
18–24	13.1	(7.5–18.6)	7.3*	(3.5–15.1)	3.5[E]	(0.0–7.5)	1.2[E]	(0.1–11.2)	22.9	(12.9–32.8)	14.5*	(5.8–36.5)
25–34	10.3	(7.1–13.5)	6.2*	(3.2–12.1)	8.7	(4.2–13.3)	5.3*	(1.8–15.7)	11.6	(6.8–16.4)	7.0*	(3.0–16.2)
35–49	8.3	(6.3–10.3)	5.3*	(2.9–9.9)	6.6	(3.7–9.4)	4.4*	(1.6–12.4)	9.9	(7.1–12.7)	6.5*	(3.0–14.1)
50–64	7.3	(5.4–9.1)	4.0*	(2.3–7.0)	5.9	(3.4–8.3)	2.9*	(1.2–7.3)	8.6	(5.8–11.4)	4.9*	(2.3–10.4)
≥65	2.2	(1.4–3.1)	Ref	—	2.4	(1.0–3.9)	Ref	—	2.1	(1.0–3.1)	Ref	—
Household income												
Lowest third	10.2	(8.2–12.3)	2.1*	(1.3–3.4)	8.8	(6.1–11.5)	1.6	(0.7–3.7)	11.3	(8.2–14.4)	2.4*	(1.3–4.5)
Middle third	6.0	(4.3–7.7)	1.0	(0.6–1.6)	3.8	(1.7–6.0)	0.6	(0.3–1.5)	8.4	(5.7–11.0)	1.4	(0.8–2.6)
Highest third	6.4	(4.5–8.3)	Ref	—	5.6	(2.9–8.3)	Ref	—	7.1	(4.2–10.1)	Ref	—
Did not report income	5.9	(2.4–9.4)	0.9	(0.4–2.1)	x	—	x	—	9.7	(3.9–15.5)	1.6	(0.6–4.2)
Highest level of education												
High school diploma or less	7.6	(5.6–9.6)	1.1	(0.7–1.7)	6.2	(3.5–8.9)	1.5	(0.7–3.2)	9.0	(6.1–11.9)	0.9	(0.5–1.6)
More than high school but less than university	7.7	(5.8–9.6)	1.1	(0.7–1.8)	6.7	(3.9–9.5)	1.6	(0.7–3.4)	8.6	(6.0–11.1)	1.0	(0.6–1.6)
Bachelor degree or higher	7.1	(5.5–8.7)	Ref	—	4.1	(2.6–5.6)	Ref	—	10.0	(7.1–12.8)	Ref	—
Area of residence												
Urban[a]	7.9	(6.6–9.1)	1.4	(0.9–2.1)	5.7	(4.2–7.2)	1.3	(0.6–2.7)	9.9	(8.0–11.8)	1.4	(0.8–2.3)
Rural	5.4	(3.7–7.1)	Ref	—	4.2	(1.9–6.5)	Ref	—	6.4	(4.0–8.8)	Ref	—
Immigration status												
Immigrant	7.1	(4.9–9.4)	0.7	(0.4–1.3)	5.5	(2.7–8.2)	0.8	(0.4–1.8)	9.2	(5.5–13.0)	0.7	(0.3–1.6)
Nonimmigrant	7.6	(6.4–8.8)	Ref	—	5.6	(4.1–7.1)	Ref	—	9.2	(7.5–11.0)	Ref	—
Racialized background												
Racialized[b]	8.6	(5.8–11.3)	1.1	(0.6–2.1)	5.8	(2.6–9.0)	1.0	(0.4–2.5)	11.9	(7.4–16.4)	1.1	(0.5–2.5)
Nonracialized	7.0	(6.0–8.1)	Ref	—	5.3	(3.9–6.7)	Ref	—	8.5	(6.8–10.1)	Ref	—
Occupation group												
Frontline work[c]	11.3	(6.5–16.1)	1.4	(0.7–2.8)	19.9[E]	(7.8–32.1)	5.4*[E]	(1.7–16.7)	7.0	(3.1–11.0)	0.7	(0.3–1.6)
Essential work[d]	6.9	(4.9–8.9)	1.1	(0.7–1.7)	4.5	(2.3–6.7)	1.3	(0.6–2.9)	10.2	(6.4–14.0)	1.0	(0.5–1.8)
Other work	7.0	(4.9–9.1)	Ref	—	3.6	(1.8–5.3)	Ref	—	10.5	(6.7–14.3)	Ref	—
Not at work in the past week	8.9	(7.0–10.8)	1.5	(0.9–2.4)	7.8	(4.9–10.8)	2.8*	(1.3–6.3)	9.8	(7.3–12.3)	1.1	(0.6–1.9)
Aged ≥76 years[e]	1.5	(0.2–2.8)	0.8	(0.2–2.9)	x	—	x	—	1.6	(0.0–3.2)	0.7	(0.1–3.9)
Mental health–related variables												
General mental health												
Fair or poor	26.8	(22.5–31.2)	10.3*	(7.1–22.4)	21.4	(15.6–27.2)	11.6*	(6.0–22.4)	31.2	(25.3–37.1)	9.7*	(5.9–16.0)
Good, very good or excellent	3.3	(2.5–4.1)	Ref	—	2.6	(1.6–3.6)	Ref	—	4.0	(2.8–5.2)	Ref	—
Mental health relative to before the COVID-19 pandemic												
Worse	15.2	(12.9–17.5)	7.8*	(5.5–11.2)	12.1	(9.0–15.2)	8.3*	(4.6–15.2)	17.6	(14.3–20.9)	7.4*	(4.7–11.7)
Same or better	2.0	(1.4–2.5)	Ref	—	1.5	(0.8–2.2)	Ref	—	2.4	(1.6–3.3)	Ref	—

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TABLE 4 (continued)
PTSD prevalence and adjusted odds ratios, spring 2021 collection period, by gender, sociodemographic characteristics, mental health–related variables and impacts of the COVID-19 pandemic

Study variable	Overall				Males				Females			
	%	(95% CI)	aOR	(95% CI)	%	(95% CI)	aOR	(95% CI)	%	(95% CI)	aOR	(95% CI)
Sense of local community belonging												
Somewhat weak or very weak	12.4	(10.3–14.4)	3.0*	(2.1–5.4)	9.3	(6.6–12.0)	3.0*	(1.6–5.4)	15.0	(12.0–18.1)	3.1*	(2.0–4.9)
Somewhat strong or very strong	3.9	(2.9–4.9)	Ref	—	2.9	(1.7–4.2)	Ref	—	4.8	(3.2–6.4)	Ref	—
Positive screen for generalized anxiety disorder[f]												
Yes	36.6	(31.6–41.7)	21.1*	(14.1–55.2)	35.3	(26.6–44.1)	29.5*	(15.7–55.2)	37.2	(31.1–43.3)	18.1*	(10.6–30.9)
No	2.4	(1.8–3.1)	Ref	—	1.9	(1.2–2.6)	Ref	—	3.0	(1.9–4.1)	Ref	—
Positive screen for major depressive disorder[g]												
Yes	31.9	(27.4–36.4)	21.9*	(14.0–65.5)	30.2	(23.0–37.3)	30.3*	(14.0–65.5)	33.2	(27.4–38.9)	18.5*	(10.3–33.3)
No	1.9	(1.3–2.6)	Ref	—	1.4	(0.7–2.1)	Ref	—	2.4	(1.4–3.5)	Ref	—
Suicidal ideation												
Suicidal ideation during the COVID-19 pandemic	37.8	(28.1–47.4)	9.0*	(5.1–15.9)	34.1[E]	(19.3–48.8)	9.4*[E]	(3.6–24.8)	40.6[E]	(27.5–53.7)	7.7*[E]	(3.6–16.7)
Lifetime history of suicidal ideation, but not during the COVID-19 pandemic	16.5	(12.0–21.0)	3.4*	(2.2–5.2)	9.6	(4.1–15.1)	2.3*	(1.0–5.3)	21.8	(15.1–28.5)	4.2*	(2.5–7.2)
No history of suicidal ideation	5.0	(4.1–6.0)	Ref	—	3.9	(2.7–5.1)	Ref	—	6.1	(4.6–7.6)	Ref	—
Past month heavy drinking[h]												
Yes, daily or almost daily	14.9	(7.4–22.4)	3.4*	(1.6–7.0)	13.2[E]	(3.5–22.9)	3.0[E]	(1.0–9.5)	18.1[E]	(5.7–30.5)	3.2*[E]	(1.2–8.8)
Yes, less than daily	9.9	(7.3–12.5)	1.7*	(1.1–2.5)	8.1	(4.6–11.5)	2.0*	(1.1–3.7)	12.1	(8.0–16.2)	1.4	(0.9–2.2)
No	6.5	(5.3–7.6)	Ref	—	4.4	(3.0–5.7)	Ref	—	8.2	(6.5–10.0)	Ref	—
Change in alcohol consumption since the start of the COVID-19 pandemic												
Increase	13.3	(10.0–16.6)	1.5	(0.9–5.1)	9.7	(5.8–13.5)	2.7*	(1.5–5.1)	16.3	(11.0–21.7)	2.3*	(1.4–3.8)
Decrease	8.0	(5.0–10.9)	2.6*	(1.7–3.8)	7.8	(3.3–12.3)	2.3*	(1.0–5.1)	8.1	(4.6–11.5)	1.0	(0.5–1.8)
No change	6.0	(4.8–7.1)	Ref	—	4.1	(2.7–5.5)	Ref	—	7.7	(5.9–9.5)	Ref	—
Past month cannabis use												
Yes, daily	15.2	(9.3–21.2)	2.5*	(1.5–4.1)	7.0	(2.1–12.0)	1.6	(0.7–3.7)	26.9	(15.1–38.6)	3.5*	(1.8–6.6)
Yes, less than daily	15.6	(10.9–20.3)	2.6*	(1.7–4.0)	12.4	(6.8–18.1)	2.4*	(1.2–4.8)	19.4	(11.6–27.3)	2.3*	(1.3–4.2)
No	5.9	(4.9–6.9)	Ref	—	4.4	(3.1–5.7)	Ref	—	7.3	(5.8–8.8)	Ref	—
Change in cannabis use since the start of the COVID-19 pandemic												
Increase	21.5	(15.0–28.1)	2.7*	(1.3–17.6)	13.0	(6.1–19.9)	2.7*	(1.2–6.0)	29.4	(18.6–40.1)	3.8*	(2.1–6.9)
Decrease	17.6	(7.9–27.4)	3.5*	(2.2–5.5)	15.0[E]	(1.3–28.6)	3.1[E]	(0.5–17.6)	20.7[E]	(6.6–34.8)	2.2[E]	(0.8–6.0)
No change	6.0	(5.1–7.0)	Ref	—	4.6	(3.4–5.9)	Ref	—	7.4	(5.9–8.9)	Ref	—
Concerns about violence in the home[i]												
Self as target	33.8[E]	(20.7–46.9)	1.9	(0.8–4.5)	—[F]	—	[F]	—	48.7[E]	(30.8–66.7)	10.5*[E]	(4.4–24.8)
Other household member as target	14.1[E]	(4.6–23.7)	6.9*	(3.7–13.1)	—[F]	—	[F]	—	—[F]	—	—[F]	—
Not concerned	6.7	(5.6–7.7)	Ref	—	5.2	(3.8–6.5)	Ref	—	8.0	(6.5–9.5)	Ref	—

Continued on the following page

TABLE 4 (continued)
PTSD prevalence and adjusted odds ratios, spring 2021 collection period, by gender, sociodemographic characteristics, mental health–related variables and impacts of the COVID-19 pandemic

Study variable	Overall				Males				Females			
	%	(95% CI)	aOR	(95% CI)	%	(95% CI)	aOR	(95% CI)	%	(95% CI)	aOR	(95% CI)
COVID-19 impacts												
Loss of job/income												
Yes	15.2	(11.9–18.5)	2.8*	(2.0–3.9)	11.2	(7.3–15.0)	2.6*	(1.4–4.8)	19.8	(14.5–25.2)	2.5*	(1.6–3.8)
No	5.0	(4.1–5.8)	Ref	—	3.6	(2.5–4.6)	Ref	—	6.1	(4.8–7.4)	Ref	—
Difficulty meeting financial obligations/essential needs												
Yes	21.3	(16.8–25.8)	4.1*	(2.8–5.8)	15.3	(10.1–20.5)	3.6*	(1.9–6.9)	27.7	(20.6–34.8)	4.3*	(2.7–6.9)
No	4.9	(4.1–5.8)	Ref	—	3.7	(2.6–4.9)	Ref	—	6.0	(4.7–7.3)	Ref	—
Death of family/friend/colleague												
Yes	15.5	(11.3–19.7)	2.5*	(1.7–3.8)	13.4	(7.8–19.0)	3.3*	(1.7–6.4)	17.1	(10.8–23.5)	5.3*	(2.8–9.9)
No	6.5	(5.5–7.6)	Ref	—	4.7	(3.4–6.0)	Ref	—	8.2	(6.6–9.8)	Ref	—
Feelings of loneliness/isolation												
Yes	13.3	(11.3–15.3)	5.5*	(3.6–8.3)	10.7	(7.8–13.6)	5.3*	(2.8–9.9)	15.2	(12.4–18.0)	5.5*	(3.1–10.0)
No	2.3	(1.6–3.1)	Ref	—	2.0	(1.1–2.8)	Ref	—	2.7	(1.5–4.0)	Ref	—
Emotional distress												
Yes	15.5	(13.1–17.8)	8.4*	(5.6–12.8)	12.9	(9.5–16.3)	7.3*	(3.9–13.9)	17.1	(14.0–20.2)	9.1*	(4.9–16.6)
No	1.7	(1.1–2.3)	Ref	—	1.6	(0.9–2.4)	Ref	—	1.8	(0.9–2.7)	Ref	—
Physical health problems												
Yes	17.5	(14.7–20.2)	6.1*	(4.3–8.7)	11.3	(7.9–14.7)	3.1*	(1.7–5.7)	21.9	(18.0–25.8)	10.2*	(6.3–16.4)
No	3.0	(2.2–3.8)	Ref	—	3.5	(2.2–4.9)	Ref	—	2.3	(1.5–3.2)	Ref	—
Challenges in personal relationships												
Yes	18.7	(15.3–22.1)	4.8*	(3.4–6.7)	11.9	(7.9–16.0)	3.2*	(1.8–5.9)	24.2	(19.2–29.1)	6.4*	(4.2–9.7)
No	4.2	(3.3–5.0)	Ref	—	3.9	(2.6–5.2)	Ref	—	4.4	(3.3–5.5)	Ref	—
Other impacts												
Yes	15.7	(10.1–21.3)	1.9*	(1.1–3.1)	7.7[E]	(2.3–13.1)	1.0[E]	(0.3–3.0)	21.1	(12.3–29.9)	2.6*	(1.4–4.8)
No	7.0	(6.0–8.1)	Ref	—	5.5	(4.1–6.9)	Ref	—	8.5	(6.9–10.2)	Ref	—
Number of COVID-19 impacts												
≤2	1.5	(1.0–2.0)	Ref	—	1.3	(0.7–1.9)	Ref	—	1.7	(1.0–2.5)	Ref	—
3 or 4	13.0	(10.5–15.6)	8.7*	(5.7–13.2)	12.5	(8.4–16.7)	9.8*	(5.0–19.2)	13.4	(10.4–16.4)	8.0*	(4.6–13.9)
≥5	31.3	(24.9–37.6)	23.7*	(14.4–38.9)	20.6	(12.4–28.7)	17.9*	(8.0–40.3)	38.9	(30.0–47.8)	26.5*	(13.6–51.7)

Data source: Survey on COVID-19 and Mental Health, Spring (February to May) 2021.

Abbreviations: aOR, adjusted odds ratio; CI, confidence interval; ref, reference.

[a] Urban areas were defined as continuously built-up areas with populations of ≥1000 and densities of ≥400 per km^2. This information came from postal codes.

[b] Included people who identified as South Asian (e.g. East Indian, Pakistani, Sri Lankan), Chinese, Black, Filipino, Arab, Latin American, Southeast Asian (e.g. Vietnamese, Cambodian, Laotian, Thai), West Asian (e.g. Iranian, Afghan), Korean, Japanese or "other," and did not identify as Indigenous (First Nations, Métis or Inuit) or White.

[c] Frontline workers included police officers, firefighters, paramedics, nurses and doctors.

[d] Essential workers included people employed in transportation, financial institutions, pharmacies, childcare and food supply, and did not include frontline workers.

[e] Respondents aged ≥76 years were not asked about current work status or occupation as it was assumed that most would have retired.

[f] Measured using the Generalized Anxiety Disorder Scale (GAD-7).[26]

[g] Measured using the Patient Health Questionnaire (PHQ-9).[27]

[h] Assessed by asking how often in the past month females had consumed >4 drinks in one sitting and males >5 drinks in one sitting.[28]

[i] Respondents who reported some level of concern ("somewhat," "very" or "extremely" vs. "not at all") about violence in their home were asked who in their household they were concerned was the target of violence.

[*] Statistically significant odds ratio, adjusted for sociodemographic characteristics.

[E] Use with caution. Quality should be assessed using the confidence interval.

[F] Too unreliable to be published.

[X] Suppressed to meet the confidentiality requirements of the *Statistics Act*.

Our results regarding concerns about violence in the home and PTSD prevalence highlight an important gender difference. PTSD prevalence was similar among males regardless of the target of violence (self versus others). In contrast, among females, PTSD prevalence was noticeably higher when they reported being the target compared to when the target was another household member. This likely reflects the fact that, in Canada, women are significantly more likely than men to be victims of intimate partner violence[47] and specifically sexual violence,[48] which in turn is a key predictor of PTSD among abused women.[49]

The degree to which the COVID-19 pandemic has affected PTSD prevalence is unclear. We observed a higher prevalence of PTSD among participants whose mental health had worsened during the pandemic and identified several potential pandemic-related risk factors for PTSD. Across collection periods, we found a general worsening of mental health, a noticeable (though not statistically significant) increase in PTSD prevalence overall and a higher PTSD prevalence associated with job or income loss due to the pandemic. These findings highlight the dynamic nature of the COVID-19 pandemic, including changes over time in terms of its social and economic impacts on society, as well as its potential effects on the prevalence of PTSD. However, the associations are likely bidirectional since pre-existing PTSD symptoms could increase the risk of experiencing these pandemic-related impacts. For instance, the sudden unexpected death of a loved one may account for about one-third of lifetime PTSD cases.[1]

Regardless of causal relationships between pandemic impacts and PTSD, our results show that individuals with PTSD were often substantially affected by the pandemic. Future work will employ more recent Canadian survey data to examine the nature of the PPTEs experienced to provide additional context to prevalence based on screening tools.

Strengths and limitations

The main strengths of the current study include the use of a large, nationally representative sample of Canadians, which enhances the generalizability of the findings to the population, as well as the quantification of PTSD risk while controlling for potential confounders.

There are important limitations to consider when interpreting the results. First, the survey was cross-sectional and self-reported, limiting directional statements about effects between variables and facilitating biases such as social desirability or recall bias. Second, certain subpopulations were excluded from the SCMH, limiting generalizability to the entire Canadian population. Third, there are other important intersections of the population that could be explored in terms of PTSD. Our study only identified intersections of study variables with gender and thus could not identify more specific demographic subgroups that could be identified as at-risk. Fourth, the use of a single question to establish the experience of a PPTE, rather than using the LEC-5,[22] may have affected the PTSD prevalence estimates. Finally, although we used a recommended cut-point for scoring the PCL-5, this method may incorrectly identify PTSD cases (i.e. false positives) due to a lack of focus on clinical criteria. Indeed, sensitivity analyses showed that our alternative scoring method resulted in a significantly lower overall prevalence estimate (5.6%). We have provided these results are available as supplementary materials at https://osf.io/gvbn6/?view_only=c031ae386f364de4a1064d7bb6d9c8ea to provide context and promote discussion regarding best practices for the use of the PCL-5 to measure PTSD prevalence.

Conclusion

The current study provides an overview of PTSD prevalence in Canada across many different characteristics, identifies groups at increased risk and highlights the interplay of the negative impacts of the COVID-19 pandemic and PTSD symptoms. The current results may have important implications for policy makers, because they shed light on the burden of PTSD in Canada and they can help guide the development of targeted interventions and support systems for high-risk groups, including in the context of a public health event.

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Conflicts of interest

The authors have no conflicts of interest to disclose.

Authors' contributions and statement

MW: Conceptualization, formal analysis, data curation, writing – original draft, writing – review & editing.

DM: Investigation, writing – original draft, writing – review and editing.

AMR: Writing – review and editing.

RNC: Writing – review and editing.

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Original quantitative research

Implementing a smoke-free generation policy for Canada: estimates of the long-term impacts

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This article has been peer reviewed.

Abstract

Introduction: The aim of this study was to assess the potential impacts of the introduction of a smoke-free generation (SFG) policy in Canada with a perpetual ban on cigarette sales to anyone born after 2009 instigated on 1 January 2025.

Methods: An existing Canadian model relating to smoking cessation was adapted and augmented to assess the impact of an SFG policy on quality-adjusted life years (QALYs), life expectancy, health care costs, smoking-related taxes, and Canadian tobacco industry gross domestic product (GDP). The cumulative impact of the policy for the entire Canadian population was assessed for time horizons up to 90 years with an annual discount rate of 1.5%.

Results: After 50 years, this SFG policy would lead to 476 814 more QALYs, $2.3 billion less in health care costs, $7.4 billion less in smoking-related taxes and a $3.1 billion reduction in tobacco industry GDP. The combined value of health benefits gained and health care costs averted would exceed the sum of tax revenues foregone and reduced GDP, if the value of a QALY was at least $17 147. Use of higher discount rates and inclusion of unrelated health care costs had little impact on the interpretation of the results.

Conclusion: The implementation of an SFG policy will bring substantive health benefits to the population in Canada. Although health care cost savings are lower than the combination of lost tax revenues and the decline in the GDP from the Canadian tobacco industry, the value of the health benefits realized outweigh the negative offsets.

Keywords: *tobacco smoking, health policy, smokefree generation*

Highlights

- A smoke-free generation (SFG) policy involves prohibiting the sale of tobacco products to people born after a specific date for their lifetime.
- The impact of an SFG policy on quality-adjusted life years, life expectancy, health care costs, smoking-related taxes and Canadian tobacco industry gross domestic product was assessed for up to 90 years.
- Implementing an SFG policy leads to substantive health gains and significant health care cost savings.

Introduction

Although the prevalence of smoking has decreased consistently over the last 50 years, the proportion of Canadians who are current daily smokers showed a small increase, from 8.4% to 9.1%, in 2022.[1] Despite the decreasing trend in prevalence, smoking remains a major cause of preventable disease and mortality in Canada.[2]

The current target of federal government policy is to reduce tobacco use to less than 5% by 2035.[3] The strategy focuses on helping Canadians who are current smokers to quit and on protecting those who do not smoke, particularly youth, from developing a tobacco addiction. However, provinces vary with respect to smoking cessation initiatives such as the age when it becomes legal to purchase tobacco (between 18 and 21 years).

Despite the restrictions on the sale of tobacco products, responses to the Canadian Student Tobacco, Alcohol and Drugs Survey show that 3% of students in Grades 7 to 12 in 2018 to 2019 (aged 11–18 years) were currently smoking cigarettes.[4] In addition, 58% of the students responded that it would be "fairly easy" or "very easy" to get a cigarette if they wanted one.[4] By the time they were aged 18 years, 7.5% of males and 4.6% of females reported that they were current daily smokers.[4]

Various jurisdictions across the world have contemplated introducing a smoke-free generation policy (SFG) to limit tobacco consumption.[5,6] An SFG policy involves prohibiting the sale of tobacco products to people born after a specific date for their lifetime. Concerns with current legislation are that smoking initiation continues among individuals who are prohibited from purchasing tobacco and that those individuals for whom the protective measures apply will reach an age where the restriction of

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tobacco sales is no longer valid. An SFG policy can address both of these concerns.

To determine the impacts of an SFG policy, an existing Markov model for assessing the impact of smoking cessation in Canada was adapted to determine the impacts on life expectancy, quality-adjusted life years (QALYs), smoking-related health care costs, taxes raised through tobacco sales and the Canadian gross domestic product (GDP).

Methods

Analytical approach

An approach was adopted that was similar to a previous analysis that examined the impact of vaping by teenagers on the uptake of smoking tobacco and the subsequent impacts on QALYs and costs.[7] The revised model adopts the same approach to modelling smoking commencement, cessation and relapse and focuses on health states related to smoking status.[7] The model simulates a Canadian population aged 15 years and older and the transition of individuals between the following states: current smokers, former smokers, never smokers and dead. The model predicts the proportion of the cohort in each of these states every 6 months. The numbers of males and females turning age 15 years in 2025 were based on the most recent census figures adjusted for both mortality and immigration.[8-10]

All data used in the analysis are presented in Table 1.

Comparators

Two scenarios were compared: (1) the status quo, where no SFG policy is implemented and the uptake and retention of smoking behaviour over the course of the model is informed by current age–gender specific start and quit rates; and (2) the existence of an SFG policy whereby a perpetual ban is instigated, on 1 January 2025, on cigarette sales to anyone born after 2009, with the aim of no uptake of smoking by Canadians born after 2009.

Despite current age restrictions on the purchase of tobacco, consumption appears to begin during the early teenage years. To allow for potential access to tobacco for those in their early teens during the initial years of the SFG policy, two scenario analyses were conducted: assuming a 5-year

TABLE 1
Comprehensive data for Markov model stratified by gender—transition probabilities, disease prevalence, relative risks, costs and utility values

Age, years	Males	Females
6-month probability of starting smoking		
15–17	0.0067	0.00272
18–19	0.00735	0.00695
20–24	0.00785	0.00336
25–29	0.00275	0.00105
30–34	0.000001	0.000001
35–39	0.000001	0.000001
40–44	0.000001	0.00096
45–49	0.000001	0.000001
50–54	0.000001	0.000001
55–59	0.000001	0.000001
60–64	0.000001	0.000001
65–69	0.000001	0.000001
70–74	0.000001	0.000001
75–79	0.000001	0.000001
≥ 80	0.000001	0.000001
6-month probability of quitting smoking		
15–17	0.3	0.176
18–19	0.143	0.164
20–24	0.1113	0.0979
25–29	0.1513	0.0788
30–34	0.0682	0.0825
35–39	0.0883	0.0648
40–44	0.093	0.0749
45–49	0.0636	0.0592
50–54	0.0638	0.0345
55–59	0.0447	0.049
60–64	0.0796	0.0562
65–69	0.087	0.0665
70–74	0.012	0.0404
75–79	0.046	0.00009
≥ 80	0.0958	0.038
6-month probability of smoking relapse	0.011	0.011
Lung cancer prevalence		
< 45	0.00004	0.00004
45–54	0.00086	0.00106
55–64	0.00394	0.00388
65–74	0.01036	0.00913
75–84	0.01715	0.01273
≥ 85	0.01736	0.00917

Age, years	Males	Females
Stroke prevalence		
20–34	0.00118	0.00143
35–49	0.00572	0.00648
50–64	0.02441	0.02048
65–79	0.07701	0.05942
≥ 80	0.18326	0.16371
CHD prevalence		
20–34	0.00256	0.00207
35–49	0.02051	0.01231
50–64	0.10480	0.05616
65–79	0.28235	0.16995
≥ 80	0.46176	0.34595
COPD prevalence		
35–39	0.009	0.009
40–44	0.025	0.025
45–49	0.044	0.048
50–54	0.069	0.074
55–59	0.093	0.094
60–64	0.119	0.115
65–69	0.154	0.144
70–74	0.197	0.175
75–79	0.242	0.2
80–84	0.284	0.222
≥ 85	0.315	0.236
Relative risks		
Lung cancer – current smokers	8.05	7.32
Lung cancer – former smokers	3.08	2.92
COPD – current smokers	4.11	3.28
COPD – former smokers	2.87	2.02
Stroke – current smokers	1.67	1.83
Stroke – former smokers	1.08	1.17
CHD – current smokers	1.6	1.7
CHD – former smokers	1.1	1.4
Death – former smokers	2.24	2.29
Death – current smokers	1.3	1.35

Continued on the following page

TABLE 1
Comprehensive data for Markov model stratified by gender—transition probabilities, disease prevalence, relative risks, costs and utility values

Age, years	Males	Females
6-month disease costs, $		
Lung cancer	10 052	10 164
COPD	3251	3521
Stroke	8220	8220
CHD	2235	2235
Utility values		
Non-smoker		
16–24	0.95	0.93
25–34	0.95	0.91
35–44	0.92	0.9
45–54	0.88	0.86
55–64	0.82	0.8
65–74	0.79	0.79
> 75	0.74	0.71
Former smoker		
16–24	0.93	0.91
25–34	0.93	0.9
35–44	0.91	0.89
45–54	0.86	0.85
55–64	0.8	0.78
65–74	0.78	0.77
> 75	0.74	0.7
Current smoker		
16–24	0.92	0.89
25–34	0.91	0.88
35–44	0.89	0.87
45–54	0.84	0.83
55–64	0.78	0.76
65–74	0.76	0.75
> 75	0.71	0.68
Annual probability of death		
15	0.00024	0.00017
16	0.00033	0.00022
17	0.00042	0.00026
18	0.0005	0.00028
19	0.00057	0.00028
20	0.00064	0.00029
21	0.00071	0.0003
22	0.00076	0.00031
23	0.00081	0.00032
24	0.00084	0.00034
25	0.00087	0.00036
26	0.00089	0.00038
27	0.00092	0.0004
28	0.00095	0.00042
29	0.00098	0.00045
30	0.00101	0.00047
31	0.00104	0.0005
32	0.00107	0.00052
33	0.0011	0.00054
34	0.00113	0.00057
35	0.00115	0.00059
36	0.00119	0.00061
37	0.00123	0.00065
38	0.00128	0.00069
39	0.00134	0.00074
40	0.00141	0.0008
41	0.0015	0.00087
42	0.00159	0.00094
43	0.0017	0.00103
44	0.00181	0.00111
45	0.00194	0.00121
46	0.00209	0.00132
47	0.00225	0.00143
48	0.00243	0.00155
49	0.00263	0.00168
50	0.00286	0.00182
51	0.00311	0.00198
52	0.00339	0.00215
53	0.00369	0.00234
54	0.00403	0.00254
55	0.00439	0.00277
56	0.0048	0.00302
57	0.00524	0.0033
58	0.00573	0.0036
59	0.00627	0.00394
60	0.00686	0.00432
61	0.00751	0.00473
62	0.00823	0.00519
63	0.00903	0.00571
64	0.00991	0.00627
65	0.01088	0.00691
66	0.01196	0.00761
67	0.01315	0.0084
68	0.01447	0.00928
69	0.01593	0.01025
70	0.01755	0.01135
71	0.01934	0.01257
72	0.02134	0.01394
73	0.02355	0.01548
74	0.02602	0.0172
75	0.02875	0.01914
76	0.0318	0.02131
77	0.03519	0.02376
78	0.03897	0.02652
79	0.04319	0.02963
80	0.04789	0.03313
81	0.05314	0.03709
82	0.059	0.04157
83	0.06555	0.04664
84	0.07287	0.05238
85	0.08106	0.05889
86	0.09024	0.06627
87	0.10051	0.07466
88	0.11203	0.0842
89	0.12495	0.09506
90	0.13946	0.10743
91	0.15535	0.12121
92	0.1723	0.13613
93	0.19026	0.1522
94	0.20917	0.16939
95	0.2303	0.18813
96	0.2506	0.20746
97	0.27158	0.22783
98	0.29308	0.24911
99	0.31492	0.27115
100	0.33693	0.29378
101	0.3589	0.31677
102	0.38065	0.33993
103	0.40199	0.36302
104	0.42277	0.38583

Sources: Statistics Canada[8,11]; Krall et al.[12]; Lariscy et al.[13]; Public Health Agency of Canada Canadian Chronic Disease Surveillance System (CCDSS)[14]; Canadian Cancer Statistics Advisory Committee[15]; O'Keeffe et al.[16]; Forey et al.[17]; Shields et al.[18]; Peters et al.[19]; Chen et al.[20]; de Oliveira et al.[21]; Tam-Tham et al.[22]; Coyle et al.[23]; Vogl et al.[24]

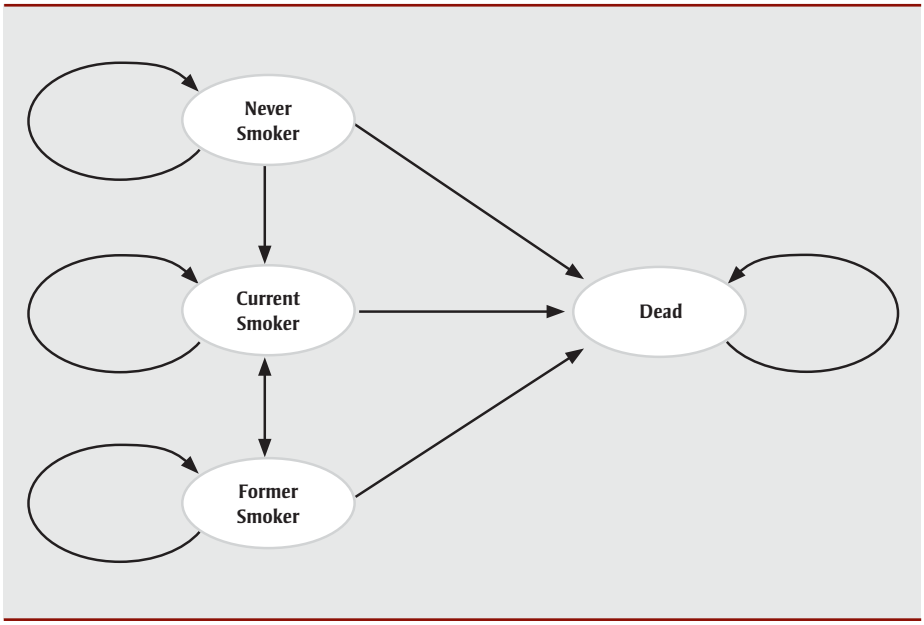
Abbreviations: CHD, coronary heart disease; COPD, chronic obstructive pulmonary disease.

lag such that those born between 2009 and 2013 could obtain tobacco illegally despite the restrictions of an SFG policy from 1 January 2025; and assuming an SFG policy that reduces the uptake of smoking in the relevant age cohorts by 90% rather than 100%.

Model design

Markov models for both males and females were developed to model the transition of a population cohort between states of being a current smoker, former smoker, never smoker or dead from age 15 years to death (Figure 1). Stratification by gender was necessary due to differential input parameters relating to onset of smoking, smoking cessation, utility values and underlying mortality data. The model facilitates estimating the cumulative impacts on life expectancy, QALYs, health care costs, tax revenue and GDP over time horizons of up to 90 years.

FIGURE 1
Schematic showing the Markov model for transition of a population cohort between states of being a current smoker, former smoker, never smoker or dead from age 15 years to death



Transitions

For the no SFG policy scenario, age–gender specific probabilities were required for the transition from never smoker to current smoker ("start"), current smoker to former smoker ("quit") and former smoker to current smoker ("relapse"). Probabilities of starting and quitting were derived from data from the 2017 Canadian Tobacco, Alcohol and Drugs Survey (CTADS),[11] while the long-term probability of relapse after cessation was based on Krall et al.[12] For the SFG policy scenario, in the base (primary) analysis, after policy initiation all individuals were assumed to remain in the never smoker category until death.

The six-month probabilities of dying for each age–gender cohort by smoking status were derived through a calibration process using Statistics Canada mortality data, current smoking status from CTADS data and the relative risk of mortality by smoking status.[13]

Costs of smoking-related diseases

The base analysis focuses on the health care costs associated with the four smoking-related diseases that comprise 75% of smoking-related mortality in developed countries: chronic obstructive pulmonary disease (COPD), coronary heart disease (CHD), stroke and lung cancer.[25] The six-month probabilities of having each of these diseases for each age–gender cohort by smoking status was derived through a calibration process using prevalence data, current smoking status data and the relative risk of disease by smoking status. Age–gender specific prevalence rates were obtained from Canadian population-based data for COPD, CHD and stroke.[14] Due to the lack of prevalence data, lung cancer prevalence was estimated by dividing available incidence data by estimates of average life expectancy.[15] Relative risks of disease by smoking status were obtained from published literature.[16-19]

Average six-month Canadian costs for each of the diseases were derived from the available literature.[20-23] Costs were estimated in 2023 Canadian dollars, with adjustments where necessary using the Bank of Canada Inflation Calculator.[26]

Additional health care costs

Delaying mortality and avoiding smoking-related diseases may lead to an increase in health care expenditures for other conditions. Thus, a scenario analysis was conducted to include health care costs that are not related to the smoking-related diseases. Values for six-month additional health care costs were derived for individuals with differential values applied depending on whether the individuals died or survived the cycle.[27,28] These values were obtained by adjusting available estimates of annual health care costs by age group and gender, and health care costs in the last year of life by the prevalence of smoking-related diseases and their costs and by the age–gender specific mortality rates.

Utility values

Utility values represent individuals' preferences for different health states on a scale of 0 to 1 where 0 represents death and 1 represents perfect health. Age–gender specific utility values by smoking status were obtained from Vogl et al.[24] Values incorporated the impact of smoking-related diseases on health-related quality of life. Thus, further disutilities associated with the four smoking-related illnesses were excluded as this would lead to double counting of the impact of smoking.

Tobacco industry GDP

Tobacco industry GDP is a measure of the total output created through the production of tobacco-related goods and services. The current magnitude of the GDP for the Canadian tobacco industry was divided by the estimated number of smokers in Canada to obtain an average annual contribution to the GDP per smoker of $711.25.[29]

Tobacco-related taxes

The average tobacco-related tax contributed by a smoker in Canada was estimated at $1685 a year.[30]

Analysis

The model calculated the impact of enacting an SFG policy for each year of the analysis across all affected birth year cohorts. For Year 1 (2025), outcomes were assessed for those born in 2010 (i.e. for the year they turned 15). For Year 2 (2026), outcomes were assessed for both those born in 2010 (i.e. for the year they turned 16) and those born in 2011 (i.e. for the year they turned 15). Calculations for further years followed the same logical approach.

Results

The cumulative impact each year up to 90 years, and specifically for time horizons of 10, 25, 50 and 90 years are shown in Figures 2a, b and c and Tables 2, 3a, 3b, 3c and 3d. Analysis determined the threshold value of a QALY whereby the value of health benefits (QALYs weighted by the threshold value) plus health care costs avoided exceeded the sum of tax revenues foregone and the decline in GDP.

Analysis adhered to guidelines for economic evaluations in Canada.[31] To account for uncertainty in inputs, outcomes were assessed by probabilistic analysis through a Monte Carlo simulation of 5000 replications to ensure stability of the data. Probability distributions were used to account for uncertainty around the parameters of interest, and the choice of distribution was based on common practice.[31] To allow for society's preferences with regards to the timing of events, an annual discount rate of 1.5% was applied to all costs and utilities.[31]

Scenario analyses

The following scenario analyses were presented as cumulative impacts at 50 years:

- A 90% reduction in smoking initiation to allow for potential illicit market adoption.
- An SFG policy only impacting initiation of smoking after 5 years based on the assumption that individuals may be able to access cigarettes despite the restrictions.
- Different discount rates (0%, 3% and 5%) to assess the impact of discounting.

FIGURE 2A
Cumulative outcomes up to 90 years—QALYs and life years gained

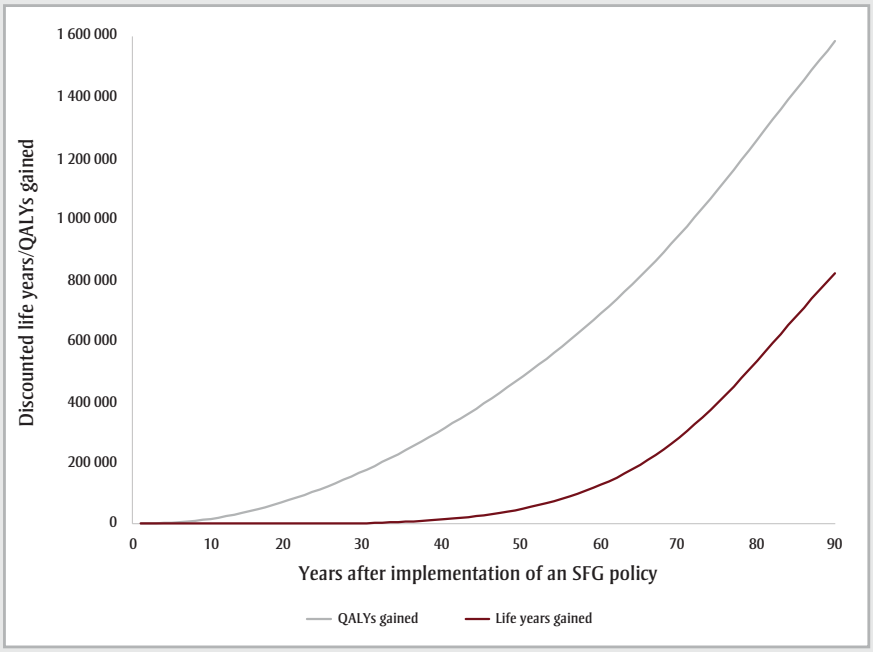
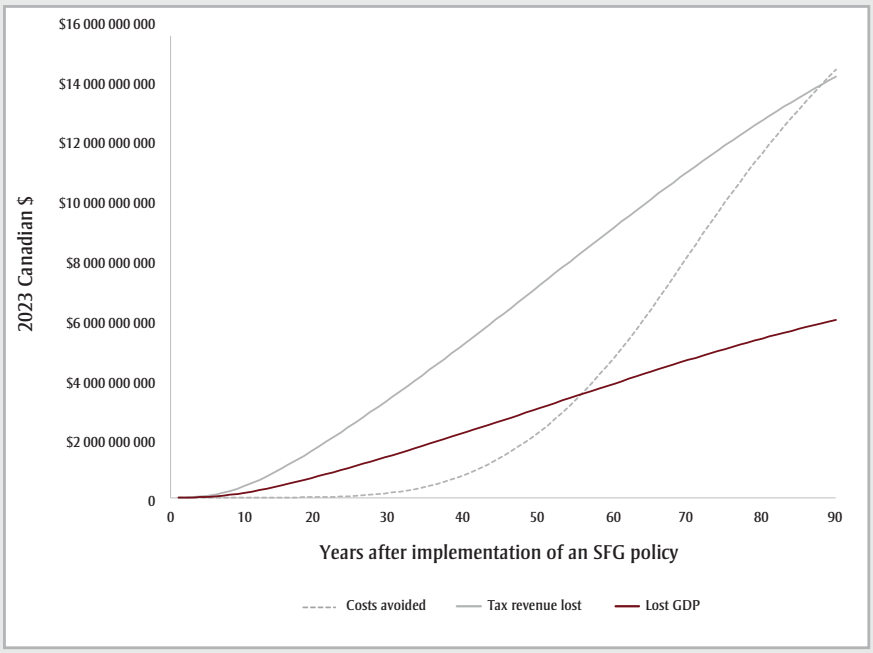


FIGURE 2B
Cumulative outcomes up to 90 years—financial gains and losses



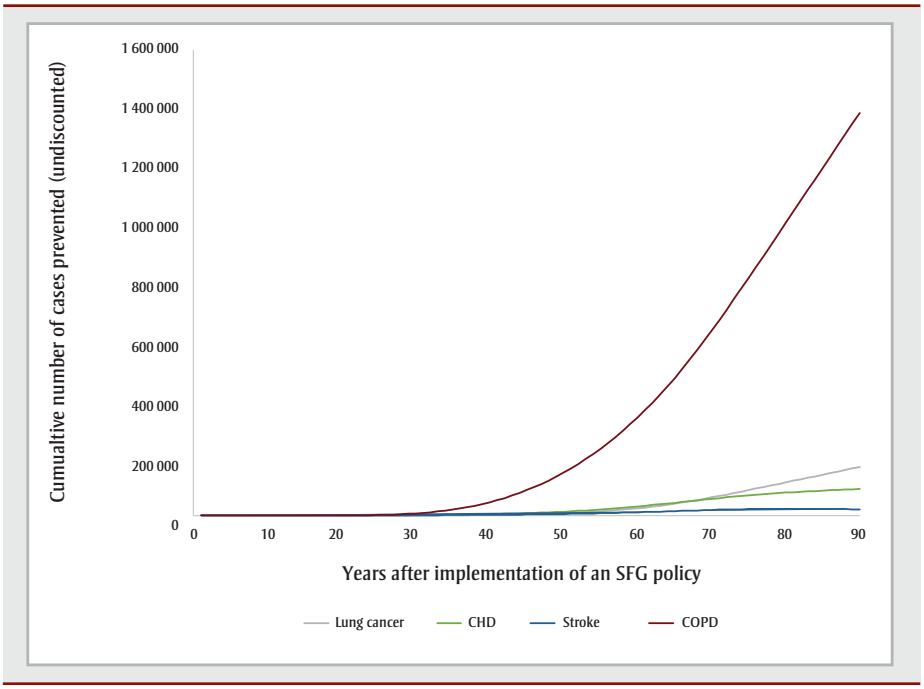
- Inclusion of additional costs of health care not related to the specific smoking-related diseases.

Base analysis

Table 2 summarizes the impact of an SFG policy after 10, 25, 50 and 90 years. The annual impacts tend to increase over time, although the annual number of disease cases prevented declines in later years, leading to a reduction in the annual health care costs avoided (Figures 2a, 2b and 2c). This results in a non-linear increase in cumulative impacts (Figures 3a, 3b and 3c).

After 10 years, the policy would not impact life years but would lead to substantive

FIGURE 2C
Cumulative outcomes up to 90 years—number of cases prevented



Abbreviations: CHD, coronary heart disease; COPD, chronic obstructive pulmonary disease; GDP, gross domestic product; QALY, quality-adjusted life year; SFG, smoke-free generation.

gains in QALYs (15 700) and a modest decrease in health care costs for smoking-related diseases ($3.0 million). The benefits increase over time with life years gained increasing to 214 after 25 years, 39 475 after 50 years and 769 042 after 90 years, QALYs gained increasing to 122 766 after 25 years, 476 814 after 50 years and 1 545 288 after 90 years and health care costs averted increasing to $66.7 million after 25 years, $2.3 billion after 50 years and $15.3 billion after 90 years. Similarly, the negative impacts of a policy on tobacco tax revenue and Canadian GDP from the tobacco industry increase over time: tax revenues foregone will be $403.5 million after 10 years, $2.6 billion after 25 years, $7.4 billion after 50 years and $14.7 billion after 90 years; decline in GDP would be $170.3 million after 10 years, $1.1 billion after 25 years, $3.1 billion after 50 years and $6.2 billion after 90 years (Table 2).

At 50 years, the proportion of outcomes that occur in females is 28% for life years, 35% for both QALYs and health care costs avoided, and 39% for both tax revenues foregone and decline in GDP (data not shown). Up until Year 9, the largest number of cumulative disease cases prevented is for lung cancer; from Year 10 until Year 21, the largest number of cumulative cases prevented is for CHD and thereafter the largest number of cumulative cases prevented is for COPD (Figure 3c).

For all years the cumulative health care costs averted are less than the sum of tax revenues foregone and decline in GDP, though after 58 years, the annual health care costs averted exceed the sum of tax revenues foregone and decline in GDP (Figures 2b and 3b). After 50 years, if a

TABLE 2
Base results of the impact of introduction an SFG policy over time—life years, QALYs, health care costs, tax revenue from smoking, GDP and incident cases of smoking-related diseases

		Net impact of a smoke-free generation policy			
		After 10 years	After 25 years	After 50 years	After 90 years
Discounted	Life years gained, n (95% CI)	0 (0, 0)	214 (182, 248)	39 475 (33 848, 45 220)	769 042 (668 060, 869 939)
	QALYs gained, n (95% CI)	15 700 (1031, 30 175)	122 766 (69 351, 175 793)	476 814 (356 366, 596 756)	1 545 288 (1 313 033, 1 786 258)
	Health care costs of smoking-related diseases averted, $ (95% CI)	3 026 244 (1 982 557, 4 440 914)	66 717 071 (47 722 982, 89 691 232)	2 347 379 210 (1 555 158 031, 3 374 988 738)	15 323 097 839 (10 080 762 862, 22 120 111 561)
	Decline in tax revenue from smoking, $ (95% CI)	403 529 109 (402 420 408, 404 743 294)	2 614 073 547 (2 585 016 743, 2 645 492 764)	7 399 915 299 (7 202 870 009, 7 610 491 722)	14 692 321 355 (14 110 794 329, 15 311 629 335)
	Decline in GDP from Canadian tobacco industry, $ (95% CI)	170 332 391 (169 864 401, 170 844 907)	1 103 418 285 (1 091 153 210, 1 116 680 551)	3 123 554 752 (3 040 380 590, 3 212 440 497)	6 201 729 118 (5 956 262 592, 6 463 143 243)
Undiscounted	Cases of lung cancer prevented, n (95% CI)	24 (21, 27)	215 (194, 234)	7239 (6579, 7860)	170 971 (152 642, 188 052)
	Cases of CHD prevented, n (95% CI)	1 (1, 2)	494 (158, 842)	13 403 (2295, 24 824)	98 012 (−45 697, 240 391)
	Cases of stroke prevented, n (95% CI)	27 (22, 31)	398 (334, 463)	5057 (4149, 5963)	23 474 (9877, 37 022)
	Cases of COPD prevented, n (95% CI)	0 (0, 0)	1335 (1145, 1525)	149 095 (128 616, 170 048)	1 420 646 (1 226 684, 1 612 460)

Abbreviations: CI, confidence interval; CHD, coronary heart disease; COPD, chronic obstructive pulmonary disease; GDP, gross domestic product; QALY, quality-adjusted life year; SFG, smoke-free generation.
Note: Amounts are in 2023 Canadian dollars.

TABLE 3A
Disaggregated results for life years, QALYs, health care costs, tax revenue from smoking, GDP and incident cases of smoking-related diseases in the absence and presence of an SFG policy and net impact after 10 years

	No smoke-free generation policy			Smoke-free generation policy			Net impact of policy		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Discounted									
Life years gained, n (95% CI)	6 289 113 (6 288 151, 6 290 013)	5 969 755 (5 969 002, 5 970 475)	12 258 868 (12 257 662, 12 260 031)	6 289 113 (6 288 151, 6 290 013)	5 969 755 (5 969 002, 5 970 475)	12 258 868 (12 257 662, 12 260 031)	0 (0, 0)	0 (0, 0)	0 (0, 0)
QALYs gained, n (95% CI)	5 978 358 (5 939 437, 6 017 829)	5 520 463 (5 483 037, 5 558 178)	11 498 821 (11 444 768, 11 554 338)	5 988 227 (5 944 238, 6 032 445)	5 526 294 (5 483 930, 5 567 853)	11 514 521 (11 453 218, 11 576 460)	9869 (−734, 20 826)	5831 (−3882, 15 855)	15 700 (1031, 30 175)
Health care costs of smoking-related diseases averted, $ (95% CI)	58 878 268 (40 782 393, 80 444 989)	60 066 018 (40 900 215, 83 268 876)	118 944 285 (81 709 064, 163 298 593)	57 306 239 (39 757 437, 78 139 228)	58 611 802 (39 919 047, 81 331 301)	115 918 041 (79 628 414, 159 391 265)	1 572 029 (992 507, 2 321 612)	1 454 216 (904 217, 2 193 476)	3 026 244 (1 982 557, 4 440 914)
Net health benefit (QALY = $50 000), $ (95% CI)	298 917 889 091 (296 971 865 193, 300 891 448 755)	276 023 160 904 (274 151 838 195, 277 908 921 343)	574 941 049 995 (572 238 386 412, 577 716 887 479)	299 411 326 311 (297 211 895 581, 301 622 239 415)	276 314 708 720 (274 196 479 930, 278 392 672 093)	575 726 035 030 (572 660 893 203, 578 823 009 444)	493 437 220 (−36 689 829, 1 041 309 221)	291 547 816 (−194 097 359, 792 752 767)	784 985 036 (51 571 870, 1 508 728 083)
Number of years as current smoker, n (95% CI)	150 783 (150 319, 151 290)	88 701 (88 506, 88 913)	239 483 (238 825, 240 204)	0 (0, 0)	0 (0, 0)	0 (0, 0)	−150 783 (−150 319, −151 290)	−88 701 (−88 506, −88 913)	−239 483 (−238 825, −240 204)
Tax revenue from smoking, $ (95% CI)	254 068 541 (253 287 884, 254 923 614)	149 460 568 (149 131 881, 149 818 317)	403 529 109 (402 420 408, 404 743 294)	0 (0, 0)	0 (0, 0)	0 (0, 0)	−254 068 541 (−253 287 884, −254 923 614)	−149 460 568 (−149 131 881, −149 818 317)	−403 529 109 (−402 420 408, −404 743 294)
GDP from Canadian tobacco industry, $ (95% CI)	107 244 065 (106 914 544, 107 604 997)	63 088 326 (62 949 585, 63 239 334)	170 332 391 (169 864 401, 170 844 907)	0 (0, 0)	0 (0, 0)	0 (0, 0)	−107 244 065 (−106 914 544, −107 604 997)	−63 088 326 (−62 949 585, −63 239 334)	−170 332 391 (−169 864 401, −170 844 907)
Undiscounted									
Number of cases of lung cancer prevented, n (95% CI)	109 (106, 112)	130 (127, 133)	239 (234, 243)	95 (90, 101)	119 (114, 124)	215 (207, 222)	14 (11, 16)	11 (9, 13)	24 (21, 27)
Number of cases of CHD prevented, n (95% CI)	706 (705, 707)	542 (541,542)	1248 (1247, 1249)	705 (704, 707)	541 (541, 542)	1247 (1245, 1248)	1 (0, 1)	1 (0, 1)	1 (1, 2)
Number of cases of stroke prevented, n (95% CI)	410 (405, 415)	474 (469, 479)	885 (878, 891)	397 (389, 405)	461 (452, 469)	858 (846, 870)	13 (10, 17)	13 (10, 17)	27 (22, 31)
Number of cases of COPD prevented, n (95% CI)	0 (0, 0)	0 (0, 0)	0 (0, 0)	0 (0, 0)	0 (0, 0)	0 (0, 0)	0 (0, 0)	0 (0, 0)	0 (0, 0)

TABLE 3B
Disaggregated results for life years, QALYs, health care costs, tax revenue from smoking, GDP and incident cases of smoking-related diseases in the absence and presence of an SFG policy and net impact after 25 years

	No smoke-free generation policy			Smoke-free generation policy			Net impact of policy		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Discounted									
Life years gained, n (95% CI)	30 488 796 (30 481 955, 30 495 578)	28 997 998 (28 992 903, 29 002 947)	59 486 794 (59 478 302, 59 495 129)	30 488 960 (30 482 135, 30 495 756)	28 998 048 (28 992 955, 29 002 997)	59 487 008 (59 478 502, 59 495 344)	164 (134, 196)	50 (42, 59)	214 (182, 248)
QALYs gained, n (95% CI)	28 879 242 (28 753 933, 29 008 817)	26 670 799 (26 546 917, 26 794 001)	55 550 041 (55 373 149, 55 734 650)	28 958 539 (28 814 893, 29 107 278)	26 714 268 (26 574 728, 26 853 500)	55 672 807 (55 468 836, 55 884 786)	79 298 (39 542, 120 136)	43 469 (8890, 78 194)	122 766 (69 351, 175 793)
Health care costs of smoking-related diseases averted, $ (95% CI)	847 564 426 (598 859 239, 1 144 156 758)	800 104 443 (553 286 022, 1 104 312 757)	1 647 668 869 (1 150 794 631, 2 234 142 455)	808 484 259 (564 542 610, 1 095 470 224)	772 467 539 (532 862 274, 1 067 635 865)	1 580 951 798 (1 099 481 539, 2 148 079 667)	39 080 167 (26 314 329, 54 521 281)	27 636 904 (19 542 762, 37 721 224)	66 717 071 (47 722 982, 89 691 232)
Net health benefit (QALY = $50 000), $ (95% CI)	1 443 962 081 828 (1 437 696 663 635, 1 450 440 835 930)	1 333 539 970 215 (1 327 345 831 442, 1 339 700 051 781)	2 777 502 052 044 (2 768 657 430 995, 2 786 732 512 214)	1 447 926 967 221 (1 440 744 647 303, 1 455 363 890 591)	1 335 713 405 304 (1 328 736 382 167, 1 342 675 007 639)	2 783 640 372 525 (2 773 441 796 527, 2 794 239 279 783)	3 964 885 393 (1 977 120 415, 6 006 791 680)	2 173 435 088 (444 523 273, 3 909 710 469)	6 138 320 481 (3 467 545 898, 8 789 649 726)
Years as current smoker, n (95% CI)	960 075 (948 771, 972 272)	591 304 (585 364, 597 758)	1 551 379 (1 534 135, 1 570 025)	0 (0, 0)	0 (0, 0)	0 (0, 0)	−960 075 (−948 771, −972 272)	−591 304 (−585 364, −597 758)	−1 551 379 (−1 534 135, −1 570 025)
Tax revenue from smoking, $ (95% CI)	1 617 726 185 (1 598 678 344, 1 638 278 737)	996 347 362 (986 339 119, 1 007 222 344)	2 614 073 547 (2 585 016 743, 2 645 492 764)	0 (0, 0)	0 (0, 0)	0 (0, 0)	−1 617 726 185 (−1 598 678 344, −1 638 278 737)	−996 347 362 (−986 339 119, −1 007 222 344)	−2 614 073 547 (−2 585 016 743, −2 645 492 764)
GDP from Canadian tobacco industry, $ (95% CI)	682 853 263 (674 813 040, 691 528 636)	420 565 022 (416 340 474, 425 155 426)	1 103 418 285 (1 091 153 210, 1 116 680 551)	0 (0, 0)	0 (0, 0)	0 (0, 0)	−682 853 263 (−674 813 040, −691 528 636)	−420 565 022 (−416 340 474, −425 155 426)	−1 103 418 285 (−1 091 153 210, −1 116 680 551)
Undiscounted									
Number of cases of lung cancer prevented, n (95% CI)	555 (527, 584)	654 (625, 683)	1209 (1168, 1250)	432 (392, 475)	563 (522, 603)	995 (938, 1053)	123 (107, 138)	92 (79, 104)	215 (194, 234)
Number of cases of CHD prevented, n (95% CI)	12 724 (12 154, 13 251)	8555 (8239, 8854)	21 279 (20 634, 21 890)	12 450 (11 633, 13 230)	8336 (7935, 8724)	20 785 (19 890, 21 684)	274 (−42, 611)	220 (122, 320)	494 (158, 842)
Number of cases of stroke prevented, n (95% CI)	6390 (6276, 6500)	7128 (6967, 7276)	13 518 (13 328, 13 708)	6189 (6030, 6343)	6931 (6724, 7120)	13 120 (12 868, 13 370)	201 (153, 251)	197 (155, 242)	398 (334, 463)
Number of cases of COPD prevented, n (95% CI)	3879 (3636, 4122)	3861 (3458, 4262)	7740 (7271, 8209)	2913 (2607, 3244)	3492 (3023, 3970)	6405 (5832, 6981)	966 (808, 1126)	369 (264, 478)	1335 (1145, 1525)

TABLE 3C
Disaggregated results for life years, QALYs, health care costs, tax revenue from smoking, GDP and incident cases of smoking-related diseases in the absence and presence of an SFG policy and net impact after 50 years

	No smoke-free generation policy			Smoke-free generation policy			Net impact of policy		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Discounted									
Life years gained, n (95% CI)	91 976 913 (91 946 884, 92 006 798)	87 834 418 (87 812 521, 87 855 727)	179 811 331 (179 772 950, 179 848 254)	92 005 198 (91 974 125, 92 036 689)	87 845 607 (87 823 736, 87 867 190)	179 850 806 (179 811 393, 179 888 656)	28 286 (23 032, 33 665)	11 190 (9569, 12 875)	39 475 (33 848, 45 220)
QALYs gained, n (95% CI)	85 568 194 (85 301 369, 85 831 402)	79 545 776 (79 284 306, 79 800 930)	165 113 970 (164 743 330, 165 503 487)	85 878 657 (85 566 416, 86 184 007)	79 712 128 (79 413 427, 80 002 740)	165 590 784 (165 164 872, 166 037 423)	310 462 (216 976, 405 535)	166 352 (88 836, 244 376)	476 814 (356 366, 596 756)
Health care costs of smoking-related diseases averted, $ (95% CI)	15 910 895 359 (11 777 285 676, 20 749 681 443)	13 450 743 721 (9 889 792 985, 17 606 524 271)	29 361 639 080 (21 803 430 445, 38 191 016 475)	14 395 952 578 (10 557 852 116, 18 892 106 774)	12 618 307 291 (9 247 080 757, 16 554 797 229)	27 014 259 869 (19 950 650 961, 35 223 714 920)	1 514 942 781 (958 187 999, 2 238 337 990)	832 436 429 (550 018 994, 1 205 731 984)	2 347 379 210 (1 555 158 031, 3 374 988 738)
Net health benefit (QALY = $50,000), $ (95% CI)	4 278 409 716 667 (4 265 068 426 626, 4 291 570 076 847)	3 977 288 794 754 (3 964 215 304 702, 3 990 046 500 116)	8 255 698 511 420 (8 237 166 484 257, 8 275 174 333 474)	4 293 932 833 048 (4 278 320 780 257, 4 309 200 372 204)	3 985 606 388 981 (3 970 671 337 491, 4 000 137 010 818)	8 279 539 222 029 (8 258 243 617 598, 8 301 871 137 059)	15 523 116 381 (10 848 777 289, 20 276 757 543)	8 317 594 227 (4 441 794 956, 12 218 787 877)	23 840 710 609 (17 818 295 378, 29 837 775 244)
Years as current smoker, n (95% CI)	2 662 548 (2 587 442, 2 743 057)	1 729 093 (1 687 374, 1 773 608)	4 391 641 (4 274 700, 4 516 612)	0 (0, 0)	0 (0, 0)	0 (0, 0)	−2 662 548 (−2 587 442, −2 743 057)	−1 729 093 (−1 687 374, −1 773 608)	−4 391 641 (−4 274 700, −4 516 612)
Tax revenue from smoking, $ (95% CI)	4 486 393 321 (4 359 840 381, 4 622 050 666)	2 913 521 978 (2 843 225 373, 2 988 529 238)	7 399 915 299 (7 202 870 009, 7 610 491 722)	0 (0, 0)	0 (0, 0)	0 (0, 0)	−4 486 393 321 (−4 359 840 381, −4 622 050 666)	−2 913 521 978 (−2 843 225 373, −2 988 529 238)	−7 399 915 299 (−7 202 870 009, −7 610 491 722)
GDP from Canadian tobacco industry, $ (95% CI)	1 893 737 240 (1 840 318 380, 1 950 999 131)	1 229 817 511 (1 200 144 835, 1 261 478 588)	3 123 554 752 (3 040 380 590, 3 212 440 497)	0 (0, 0)	0 (0, 0)	0 (0, 0)	−1 893 737 240 (−1 840 318 380, −1 950 999 131)	−1 229 817 511 (−1 200 144 835, −1 261 478 588)	−3 123 554 752 (−3 040 380 590, −3 212 440 497)
Undiscounted									
Number of cases of lung cancer prevented, n (95% CI)	11 815 (10 456, 13 275)	12 871 (11 536, 14 332)	24 687 (22 719, 26 779)	7635 (5997, 9512)	9813 (8224, 11 567)	17 448 (15 129, 19 961)	4180 (3636, 4692)	3059 (2732, 3358)	7239 (6579, 7860)
Number of cases of CHD prevented, n (95% CI)	301 623 (281 821, 320 785)	159 344 (150 134, 168 521)	460 966 (439 210, 482 999)	294 219 (264 920, 323 346)	153 344 (141 602, 165 210)	447 563 (416 301, 479 517)	7404 (−3132, 18 569)	5999 (3149, 8926)	13 403 (2295, 24 824)
Number of cases of stroke prevented, n (95% CI)	104 462 (102 207, 106 636)	96 745 (94 064, 99 244)	201 207 (197 823, 204 591)	101 889 (99 007, 104 665)	94 260 (91 103, 97 236)	196 149 (192 032, 200 253)	2573 (1822, 3337)	2484 (1994, 2977)	5057 (4149, 5963)
Number of cases of COPD prevented, n (95% CI)	417 631 (393 573, 442 403)	455 660 (413 323, 498 229)	873 291 (824 507, 922 540)	315 381 (281 557, 351 963)	408 815 (355 616, 463 137)	724 196 (660 192, 789 233)	102 250 (86 133, 118 267)	46 845 (33 895, 59 938)	149 095 (128 616, 170 048)

TABLE 3D
Disaggregated results for life years, QALYs, health care costs, tax revenue from smoking, GDP and incident cases of smoking-related diseases in the absence and presence of an SFG policy and net impact after 90 years

	No smoke-free generation policy			Smoke-free generation policy			Net impact of policy		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Discounted									
Life years gained, n (95% CI)	192 915 709 (192 693 114, 193 134 803)	187 012 518 (186 869 949, 187 156 504)	379 928 227 (379 660 107, 380 193 875)	193 421 910 (193 117 349, 193 722 988)	187 275 359 (187 100 769, 187 453 443)	380 697 269 (380 338 043, 381 055 107)	506 201 (417 054, 595 379)	262 841 (226 234, 300 422)	769 042 (668 060, 869 939)
QALYs gained, n (95% CI)	173 848 749 (173 373 157, 174 329 696)	163 965 575 (163 496 187, 164 414 343)	337 814 324 (337 156 863, 338 493 163)	174 847 855 (174 256 442, 175 429 440)	164 511 757 (163 973 199, 165 034 534)	339 359 612 (338 583 746, 340 183 119)	999 106 (817 314, 1 183 333)	546 182 (403 412, 691 922)	1 545 288 (1 313 033, 1 786 258)
Health care costs of smoking-related diseases averted, $ (95% CI)	131 938 140 902 (97 817 123 657, 171 816 474 092)	111 909 799 243 (83 264 333 301, 145 469 720 163)	243 847 940 144 (181 447 284 445, 316 435 856 745)	122 298 985 620 (89 672 787 208, 161 242 850 360)	106 225 856 685 (78 432 404 217, 138 724 681 598)	228 524 842 306 (169 153 393 774, 299 108 804 401)	9 639 155 281 (5 831 184 944, 14 455 892 953)	5 683 942 557 (3 797 918 731, 8 170 599 406)	15 323 097 839 (10 080 762 862, 22 120 111 561)
Net health benefit (QALY = $50 000), $ (95% CI)	8 692 437 440 717 (8 668 657 833 082, 8 716 484 824 609)	8 198 278 766 050 (8 174 809 354 000, 8 220 717 134 964)	16 890 716 206 767 (16 857 843 135 812, 16 924 658 141 232)	8 742 392 754 849 (8 712 822 122 780, 8 771 472 015 818)	8 225 587 843 059 (8 198 659 928 943, 8 251 726 723 861)	16 967 980 597 907 (16 929 187 282 075, 17 009 155 957 215)	49 955 314 131 (40 865 724 922, 59 166 666 211)	27 309 077 009 (20 170 602 989, 34 596 097 788)	77 264 391 140 (65 651 649 620, 89 312 881 425)
Years as current smoker, n (95% CI)	5 203 169 (4 988 795, 5 432 735)	3 516 310 (3 386 173, 3 654 644)	8 719 479 (8 374 359, 9 087 020)	0 (0, 0)	0 (0, 0)	0 (0, 0)	−5 203 169 (−4 988 795, −5 432 735)	−3 516 310 (−3 386 173, −3 654 644)	−8 719 479 (−8 374 359, −9 087 020)
Tax revenue from smoking, $ (95% CI)	8 767 338 970 (8 406 119 782, 9 154 158 767)	5 924 982 384 (5 705 701 087, 6 158 074 954)	14 692 321 355 (14 110 794 329, 15 311 629 335)	0 (0, 0)	0 (0, 0)	0 (0, 0)	−8 767 338 970 (−8 406 119 782, −9 154 158 767)	−5 924 982 384 (−5 705 701 087, −6 158 074 954)	−14 692 321 355 (−14 110 794 329, −15 311 629 335)
GDP from Canadian tobacco industry, $ (95% CI)	3 700 753 616 (3 548 280 531, 3 864 032 892)	2 500 975 502 (2 408 415 370, 2 599 365 466)	6 201 729 118 (5 956 262 592, 6 463 143 243)	0 (0, 0)	0 (0, 0)	0 (0, 0)	−3 700 753 616 (−3 548 280 531, −3 864 032 892)	−2 500 975 502 (−2 408 415 370, −2 599 365 466)	−6 201 729 118 (−5 956 262 592, −6 463 143 243)
Undiscounted									
Number of cases of lung cancer, n (95% CI) prevented	306 025 (274 686, 341 714)	276 420 (250 681, 304 563)	582 444 (540 219, 628 176)	198 473 (154 043, 248 974)	213 000 (180 289, 248 966)	411 473 (355 068, 473 635)	107 551 (92 110, 121 938)	63 420 (55 323, 71 148)	170 971 (152 642, 188 052)
Number of cases of CHD prevented, n (95% CI)	3 852 811 (3 523 108, 4 189 395)	2 382 767 (2 234 011, 2 532 652)	6 235 578 (5 879 444, 6 608 787)	3 819 676 (3 353 667, 4 290 419)	2 317 890 (2 125 288, 2 510 913)	6 137 566 (5 641 229, 6 653 979)	33 135 (−100 553, 170 771)	64 876 (21 738, 108 089)	98 012 (−45 697, 240 391)
Number of cases of stroke prevented, n (95% CI)	1 486 974 (1 456 183, 1 516 655)	1 330 371 (1 304 597, 1 355 247)	2 817 345 (2 778 458, 2 856 348)	1 481 096 (1 438 583, 1 522 112)	1 312 775 (1 280 187, 1 344 536)	2 793 871 (2 741 924, 2 845 769)	5878 (−5595, 17 873)	17 597 (10 753, 24 557)	23 474 (9877, 37 022)
Number of cases of COPD prevented, n (95% CI)	4 395 740 (4 111 603, 4 710 568)	4 889 478 (4 442 902, 5 342 165)	9 285 217 (8 742 023, 9 832 232)	3 421 595 (3 014 181, 3 874 428)	4 442 976 (3 870 131, 5 026 020)	7 864 571 (7 137 476, 8 596 963)	974 145 (829 220, 1 107 103)	446 501 (314 440, 575 948)	1 420 646 (1 226 684, 1 612 460)

Abbreviations: CHD, coronary heart disease; COPD, chronic obstructive pulmonary disease; GDP, gross domestic product; QALY, quality-adjusted life year; SFG, smoke-free generation.
Note: Amounts are in 2023 Canadian dollars.

FIGURE 3A
Annual undiscounted outcomes up to 90 Years—QALYs and life years gained

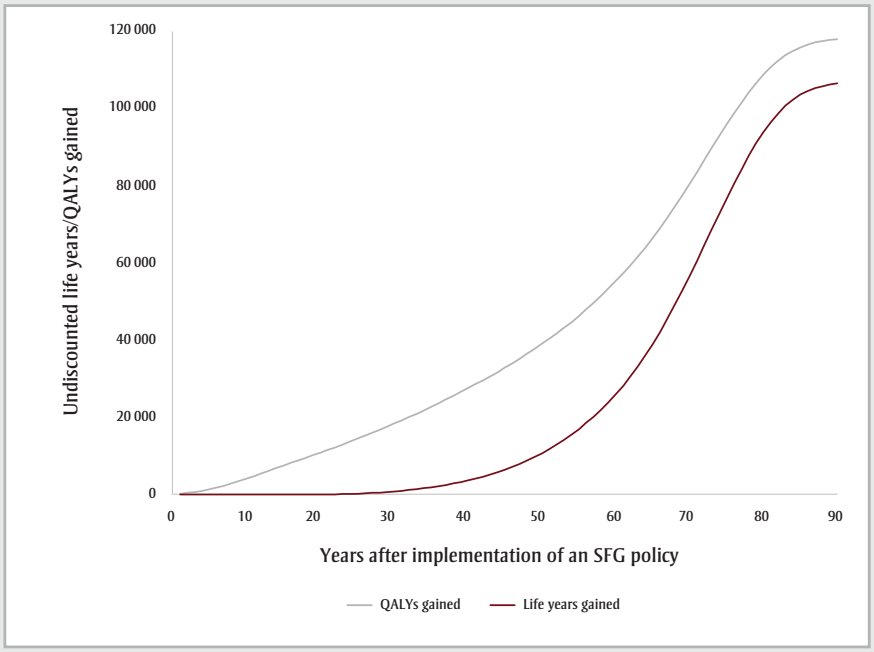
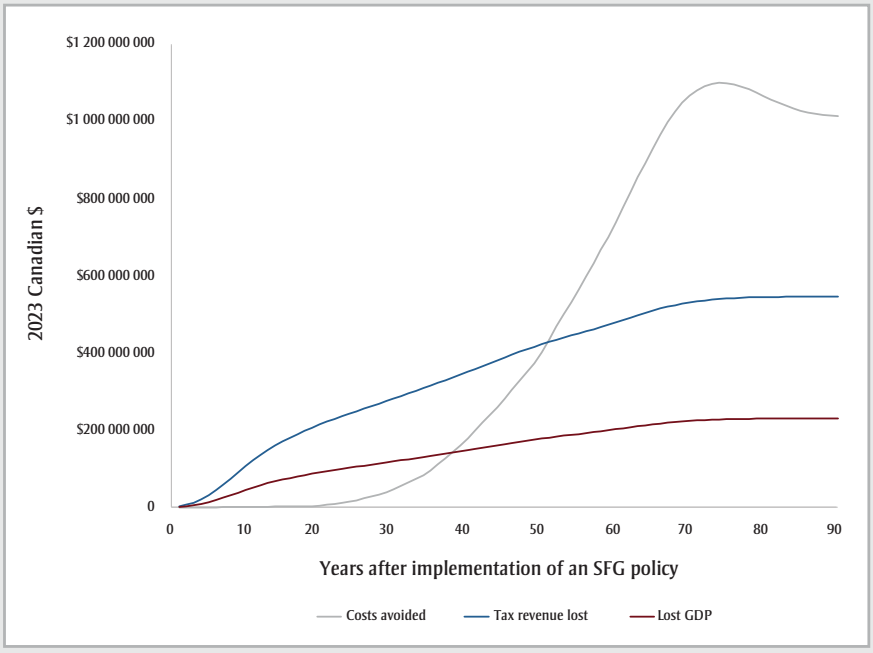


FIGURE 3B
Annual undiscounted outcomes up to 90 years—financial gains and losses



QALY was valued at at least $17 147, the combined value of the QALYs gained and the health care costs averted would exceed the sum of lost tax revenues and reduction in GDP by $36 423 after 10 years, $29 738 after 25 years and $3605 after 90 years (data not shown).

Scenario analyses

Scenario analyses for cumulative outcomes up to 50 years show that results are consistent across all scenarios explored (Table 4). Although the magnitude of impacts varies across scenarios, the relative values across each component remains consistent.

Within the scenario analyses, the necessary threshold value for a QALY required for the SFG policy to be optimal, which was $17 147 in the base case, varies between $14 091 and $20 909, highlighting the consistency in the results.

Discussion

The results show that, based on the study assumptions, imposing an SFG policy will lead to substantive health benefits and reduced health care expenses that are only partially offset by reduced tax revenues from smoking and a decline in GDP.

The general conclusions hold across multiple scenario analyses—including adding non–smoking-related disease health care costs, as scenario analysis found that when including all health care costs allowing for the increased life expectancy from the SFG policy, the SFG policy was still associated with reduced health care costs (a reduction of $2 002 394 607 rather than $2 347 379 210).

Analysis predicts that the government's target for smoking prevalence of less than 5% would be achieved in 2035, should the SFG policy be introduced. Without the SFG policy, and based on current trends, the model predicts that a prevalence of less than 5% would be reached in 2040. The SFG policy would achieve further prevalence targets much more quickly. Of note, a smoking prevalence of less than 2.5% would be achieved in 2050 if the SFG policy were introduced but, without an SFG policy, this rate would not be reached until 2075.

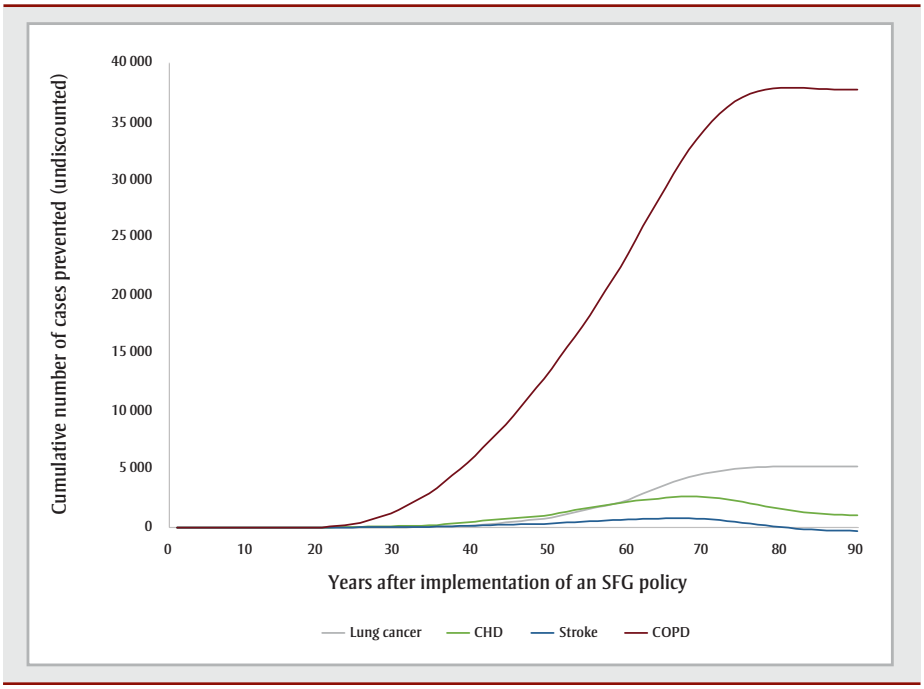
Programs that reduce tobacco smoking also aim to reduce premature deaths, defined by Statistics Canada as deaths prior to age 75 years.[32] The model predicts that for a cohort of 15-year-olds, premature deaths would be reduced from 20.2% without the SFG policy to 19.3% with the SFG policy, a relative reduction of 4.6%.

Strengths and limitations

A major strength of this study is that it uses data pertinent to the Canadian population. However, a number of caveats and limitations should be considered when reviewing the results.

Analysis included the impact of the imposition of an SFG policy on both the amount of tax revenues raised through

FIGURE 3C
Annual undiscounted outcomes up to 90 years—cases prevented



Abbreviations: CHD, coronary heart disease; COPD, chronic obstructive pulmonary disease; GDP, gross domestic product; QALY, quality-adjusted life year; SFG, smoke-free generation.

tobacco sales and the reduction in GDP from the tobacco industry. A concern to do with the introduction of smoking cessation policies is the impact on tax revenue and government expenditure. The percentage reduction in overall tax revenue from an SFG policy is minimal when considered alongside total taxes and government expenditure: equivalent to only 0.2% of total income tax raised and 0.06% of total government expenditure. It is also worth noting that the current analysis does not consider the additional income tax raised by extensions to life expectancy through the SFG policy.

Further, decline in tax revenues is not a loss from a societal perspective as taxation is merely a transfer of funds from individuals to government. The impact of decreasing taxes will be uncertain as the changes in the level of taxation can be associated with either an increase or decrease in economic growth. Reducing the consumption of tobacco will lead to more disposable income available to consume other resources. Thus, by including both lost taxation and a decline in GDP as a negative offset, the estimated threshold values of a QALY required for an SFG policy to be beneficial are likely overestimated.

The analysis does not consider alternative policy options such as raising the legal age for the purchase of tobacco, access to vaping products, reducing nicotine standards for smoked tobacco products, increasing taxation on tobacco products or further restrictions on smoking in public.[33] Such policies are not necessarily mutually exclusive when considering an SFG policy as many of these target current rather than potential smokers. Of note, an SFG policy is akin to raising the legal age for smoking by one year each year. Thus, it avoids the concern that by raising the legal age for smoking to a fixed age there is the high likelihood that those below the legal age will access tobacco products as the disparity between the legal age and the age at which smoking commences remains minimal.

Another limitation with the analysis is that it relies on data for some input parameters (e.g. smoking-related mortality, relapse) that are not recent. Analysis is based on the most contemporaneous data available, but if input parameters have changed noticeably, results may vary.

TABLE 4
Results of scenario analyses for cumulative outcomes up to 50 years

	Net impact of a smoke-free generation policy after 50 years					
	Life years gained	QALYs gained	Health care costs averted, $	Decline in tax revenue, $	Reduction in GDP, $	Threshold value of a QALY, $
Base case	39 475	476 814	2 347 379 210	7 399 915 299	3 123 554 752	17 147
Males	28 286	310 462	1 514 942 781	4 486 393 321	1 893 737 240	15 671
Females	11 190	166 352	832 436 429	2 913 521 978	1 229 817 511	19 903
0% discount rate	108 341	918 711	5 835 615 560	13 206 427 893	5 574 523 346	14 091
3% discount rate	20 981	295 559	1 278 456 727	4 789 828 352	2 021 819 238	18 721
5% discount rate	9271	165 492	587 057 331	2 846 037 620	1 201 331 904	20 909
5-year lag in impact	20 133	362 395	1 363 694 271	5 930 627 350	2 503 358 280	19 510
90% reduction in smoking uptake	35 528	429 133	2 112 641 289	6 659 923 769	2 811 199 276	17 147
Include non-smoking-related disease health care costs	39 475	476 814	2 002 394 607	7 399 915 299	3 123 554 752	17 871

Abbreviations: GDP, gross domestic product; QALY, quality-adjusted life year.

Note: Amounts are in 2023 Canadian dollars.

In addition, although input parameters for the uptake of smoking and quit rates for smoking are based on the most contemporaneous data, they may change over time. This analysis is based on the assumption that such rates will be stable over the time horizon of the model. If uptake rates were to decline without an SFG policy, then the benefits of the SFG policy would decline proportionally. However, the general conclusion is that the benefits are higher than the negative consequences would hold.

Another limitation with the analysis is that it does not consider all the potential benefits and costs of implementing an SFG policy. As noted, the analysis does not include any additional income tax raised by the increased life expectancy through the SFG policy. The analysis also does not consider the impact of an SFG policy on existing illegal markets for tobacco purchase or the costs of enforcing tobacco-related legislation (estimated at $37.6 million per year in 2012).[34] Enforcement costs may grow in the initial years of implementation of an SFG policy but could subsequently decline as the prevalence of smoking declines across the population.

The arguments against tobacco control policies such as an SFG policy from advocates for the tobacco industry tend to focus on three areas: the denial of freedom of behaviour; the unworkability of such a policy; and the contribution of the tobacco industry to society through both GDP and tax generation.[6] It could be argued that the first argument is the least addressed by the analysis in this study. However, it is important to note that tobacco addiction is often initiated during childhood or at least before the age of 21 years, the minimum age for selling tobacco in many provinces. Further, the analysis does not incorporate any additional health and health care benefits from the decline in passive smoking as a result of an SFG policy. Analysis does demonstrate the substantive benefits of an SFG policy even if there is a lag in its effects or a less than perfect cessation of smoking uptake. Thus, concerns relating to unworkability are irrelevant. Analysis directly addresses the final argument by not focusing solely on the impacts on health and health care consumption.

Conclusion

This study highlights the impacts of imposing an SFG policy across Canada, and demonstrates that the health benefits and reduction in health care costs outweigh any positive contribution of tobacco smoking to the Canadian population.

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Author's contributions and statement

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At-a-glance

Use of nicotine vaping products during an attempt to quit smoking by Canadian adults who smoke or recently quit: findings from the 2022 Canada International Tobacco Control Four Country Smoking and Vaping Survey

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Abstract

An analysis of 1771 Canadian adults who smoke or used to smoke cigarettes was conducted using data from the 2022 International Tobacco Control Four Country Smoking and Vaping Survey. Using weighted data, we estimated the prevalence of Canadian adults who tried to quit smoking between 2020 and 2022, and the use of a nicotine vaping product (NVP) and the flavours and devices used most often at their most recent quit attempt. Overall, 36.5% made a quit attempt; of those, 19.4% used an NVP. Those who were younger and quit smoking were more likely to have used an NVP. Prefilled cartridges or pods (36.3%) and fruit flavours (39.5%) were used most frequently.

Keywords: *nicotine vaping, cigarette smoking, quit attempt, vaping flavours, vaping devices, policy*

Highlights

- In 2021, Health Canada proposed imposing federal restrictions on all nicotine vaping product (NVP) flavours except for tobacco, menthol and mint, although some provinces have already implemented flavour bans.
- One in five Canadian adults who tried to quit smoking used an NVP during their most recent attempt; fruit flavours and prefilled cartridges or pods were most commonly used.
- 68% of Canadian adults who attempted to quit smoking used flavours that would be prohibited under Health Canada's flavour restrictions proposal.
- There were no differences in flavours or devices used most between those who reported quitting smoking and those who did not quit.

Introduction

Cigarette smoking causes about 48 000 deaths in Canada each year,[1] and 3.8 million Canadians smoked cigarettes in 2022.[2] Canadian clinical practice guidelines state that the most effective smoking cessation method is a combination of pharmacotherapy and face-to-face behavioural support from a health care professional.[3] However, few people use prescription medication and support services.[4,5] Although nicotine vaping products (NVPs, also known as e-cigarettes) are not approved as a smoking cessation aid in Canada, they have been found to be effective in helping people to quit smoking,[6] particularly when vaping is more frequent (e.g. daily).[7-9] The Canadian government has stated that "switching completely to vaping means stopping smoking all cigarettes, which will reduce the risks of harms to your health."[10]

The increase in vaping among youth and non-smoking young adults in Canada[11] is a significant public health concern.[12-16] The availability of a variety of flavours, coupled with novel, innovative and inexpensive devices likely appeals to tech-savvy youth and young adults. As a result, some provinces have adopted or are considering

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regulations intended to deter NVP use by minors.[15,16] In June 2021, Health Canada published a draft regulatory proposal with the intention of protecting youth from inducements to use vaping products, in order to help reduce youth vaping by (1) restricting the promotion of flavours in vaping products to tobacco, mint, menthol and a combination of mint and menthol; (2) prohibiting all sugars and sweeteners as well as most flavouring ingredients, with limited exceptions, to impart tobacco, mint, menthol, or a combination of mint and menthol flavours; and (3) prescribe sensory attributes standards to prevent a sensory perception other than one that is typical of tobacco or mint/menthol.[17]

Little is known about Canadian adults who used an NVP when they were most recently attempting to quit smoking except that they appear to prefer fruity and other sweet NVP flavours.[18-21] Studies also suggest that adults who vape are less likely than youth to use disposable devices.[22-24]

Using data from a nationally representative survey of Canadian adults who smoke cigarettes or quit smoking, we estimated (1) the prevalence of adults who attempted to quit smoking between 2020 and 2022; (2) the use of NVPs by those who attempted to quit smoking; and (3) the NVP flavour and device used most when they were attempting to quit.

Methods

The current study used data from Wave 4 (August–December 2022) of the Canadian arm of the International Tobacco Control (ITC) Four Country Smoking and Vaping (4CV) Survey and included Canadian adults (≥18 years) who reported that they smoked cigarettes daily (n = 1217), weekly (n = 262) or monthly, but had previously smoked daily (n = 65) or quit smoking in the last 2 years (and had previously smoked daily or smoked at least weekly in the last 24 months; n = 227).

Respondents were recruited from Leger Opinion's (Montréal, QC) online probability-based panel across 10 provinces. All eligible respondents provided consent.

Ethics approval

The survey protocols and all materials, including the survey questionnaires, were approved by the University of Waterloo Research Ethics Board (REB#20803/30570). Details about the 2022 ITC 4CV Survey are presented in the *ITC Four Country Smoking and Vaping Survey, Wave 4 (4CV4, 2022) Technical Report*.[25]

Measures

The 2022 Canadian ITC 4CV Survey questionnaire is available from the ITC Project website: https://itcproject.org/surveys/canada/4cv4-ca/.

Respondents were asked, "In the last 24 months, have you tried to stop smoking?" If they answered "yes," they were then instructed to "select all that apply: Which of the following forms of help did you use as part of your last quit attempt?" The response options considered for this study were a vaping product (e-cigarette); nicotine replacement therapy (NRT); prescription medications (combined: varenicline or bupropion); and/or support services (combined: telephone quitline service or smokers' helpline, apps or automated services on a mobile phone or tablet, and/or clinic, individual or group counselling, stop-smoking course or behaviour therapy); or quitting on their own without using any medication, nicotine (such as e-cigarettes, heated tobacco or smokeless tobacco products, nicotine pouches), support services or other methods of assistance (i.e. no assistance). Respondents could select more than one form of assistance, if applicable. If respondents reported using a vaping product (e-cigarette) at the time of their most recent quit attempt, they were asked: (1) "What type of vaping device did you use on your last quit attempt"; and (2) "Which e-liquid flavour category did you use most for your last quit attempt"?

Statistical analyses

Weighted descriptive statistics were used to estimate the proportion of Canadian adults who attempted to quit smoking between 2020 and 2022. Cross-sectional weights were computed to make the sample as representative as possible of the Canadian adult population who vape, smoke or formerly smoked, with respect to sex, age group, education and geographic region. The 2022 Canadian Tobacco and Nicotine Survey was used as the benchmark for the construction of the weights.

We identified the population characteristics of those who were more likely to use an NVP at their most recent quit attempt. We used multinomial regression to assess the flavour and device used most often by those who used an NVP at the time of their quit attempt, adjusting for age, sex and smoking status. Thereafter, we used a logistic regression model to compare whether there were differences by smoking status in the use of flavours that would be prohibited versus those that would not under the Health Canada flavour restrictions proposal. The model adjusted for sex and age.

Data availability statement

In each country participating in the ITC Policy Evaluation Project, the data are jointly owned by the lead researcher(s) in that country and the ITC Project at the University of Waterloo. Data from the ITC Project are available to approved researchers 2 years after the date of issuance of cleaned data sets by the ITC Data Management Centre. Researchers interested in using ITC data are required to apply for approval by submitting an International Tobacco Control Data Repository (ITCDR) request application and subsequently to sign an ITCDR Data Usage Agreement. The criteria for data usage approval and the contents of the Data Usage Agreement are described online (http://www.itcproject.org).

Results

Of the 1771 adults who were eligible for inclusion for further analyses, 36.5% (weighted; n = 739) reported that they attempted to quit smoking at least once in the last 2 years; 37.4% did not use any assistance, 31.2% used NRT, 19.4% used an NVP, 12.2% used prescription medication (varenicline or bupropion) and 8.8% used support services.

Those who used an NVP when they most recently tried to quit were more likely to be younger (18–39 years; $p < 0.001$) and to report having quit smoking (31.5%; $p < 0.001$) and used support services (34.9%; $p = 0.03$) (see Table 1). Of those respondents who used an NVP (n = 169), 45.5% also used NRT (n = 61), 13.5% used a prescription medication (n = 22) and 20.7% used support services (n = 21).

The most commonly used device types were prefilled cartridge or pod devices (36.3%) and the most commonly used flavours were fruit flavours (39.5%) (see Table 2).

TABLE 1
Characteristics of adults (≥18 years) who used an NVP versus those who did not use an NVP during their most recent smoking quit attempt between 2020 and 2022,[a] Canada (n = 739)

Characteristics[b]	Used an NVP at last QA (n = 169), %[c]	*p* value[d]	OR (95% CI)
Sex at birth			
Female	20.5	0.64	0.13 (0.68–1.90)
Male	18.6		Reference
Age group, years			
18–24	28.2	<0.001	4.47 (2.05–9.77)
25–39	31.6		5.26 (2.54–10.91)
40–54	12.2		1.59 (0.79–3.21)
≥ 55	8.1		Reference
Highest level of education			
High school or less	24.0	0.35	1.67 (0.86–3.24)
Trade school/college/some university	16.4		1.04 (0.55–1.95)
University degree or higher	15.9		Reference
Annual household income, CAD			
<30 000	13.4	0.10	0.55 (0.26–1.14)
30 000–59 999	22.6		1.04 (0.57–1.89)
≥60 000	9.8		Reference
Smoking status			
Any smoking[e]	12.7	<0.001	Reference
Current daily smoking	11.9	—	—
Current weekly smoking	15.8	—	—
Current monthly smoking	17.1	—	—
Quit smoking	31.5	<0.001	3.16 (1.89–5.26)
Used NRT			
Yes	21.5	0.50	1.21 (0.70–2.10)
No	18.5		Reference
Used Rx Med[f]			
Yes	16.3	0.51	0.79 (0.39–1.59)
No	19.9		Reference
Used support services[g]			
Yes	34.9	0.03	2.45 (1.11–5.40)
No	17.9		Reference

Abbreviations: CAD, Canadian dollar; CI, confidence interval; NRT, nicotine replacement therapy; NVP, nicotine vaping product; OR, odds ratio; QA, quit attempt; Rx Med, prescription medication.

[a] Data were retrospectively reported at the time of the 2022 Canadian International Tobacco Control Four Country Smoking and Vaping Survey. Respondents self-reported making a quit attempt in the last 2 years (2020–2022) (n = 739); using an NVP at last quit attempt (n = 169); and not using a vaping product at last quit attempt (n = 570). Data are presented for those who used an NVP at their most recent quit attempt (n = 169). The comparison group were those who did not use an NVP (n = 570).

[b] Characteristics in 2022.

[c] Data are weighted and unadjusted.

[d] *P* value is from the omnibus test (main effect).

[e] Canadian adults (≥18 years) in this 2022 study included those who (1) smoked cigarettes daily; (2) smoked cigarettes weekly; (3) smoked cigarettes monthly, but previously smoked daily; (4) quit smoking in the last 2 years (and previously smoked daily or smoked at least weekly in the last 24 months). "Any smoking" combines groups 1–3.

[f] Prescription medication includes varenicline or bupropion.

[g] Support services: quitline service, apps or automated services on a mobile phone or tablet and/or clinic, individual or group counselling, stop-smoking course or behavioural therapy.

TABLE 2
Device types and flavours used most by adults (≥18 years) who used an NVP during their most recent smoking quit attempt between 2020 and 2022, Canada (n = 169)

Outcome variables	Currently smoking (n = 119), % (SE)[a]	Quit smoking (n = 50), % (SE)[a]	*p* value[b]	Overall (n = 169), % (SE)
Device type used (most)				
Tank (refillable) (n = 40)	27.3 (7.8)	25.5 (8.3)	0.74	26.3 (5.6)
Prefilled pod/cartridge (n = 64)	38.4 (7.6)	34.8 (8.4)		36.3 (5.7)
Refillable pod/cartridge (n = 37)	17.3 (5.3)	27.3 (8.3)		23.1 (5.3)
Disposable (reference) (n = 26)	16.3 (5.6)	10.4 (5.6)		12.9 (3.8)
Don't know (n = 2)	0.6 (0.6)	2.1 (2.1)		1.4 (1.2)
Flavour used most[c]				
Tobacco flavour only (n = 23)	20.5 (7.9)	13.9 (8.0)	0.36	16.6 (5.5)
Mix of tobacco and menthol flavours (n = 16)	9.5 (4.0)	2.8 (2.4)		5.6 (2.1)
Menthol only (n = 8)	2.7 (1.7)	6.8 (4.8)		5.1 (2.7)
Mint only (n = 8)	4.3 (2.1)	1.5 (1.6)		2.7 (1.2)
Mix of mint with another flavour (e.g. blueberry mint)[d] (n = 10)	4.4 (2.2)	5.1 (3.8)		4.8 (2.3)
Mix of ice / cool flavour with another flavour (e.g. melon ice)[d] (n = 19)	8.9 (3.2)	10.1 (4.6)		9.6 (2.8)
Fruit only (e.g. mango, strawberry, blueberry)[d] (n = 65)	41.9 (8.3)	37.8 (8.5)		39.5 (5.7)
Candy, desserts, sweets, chocolate[d] (n = 15)	7.6 (3.6)	18.1 (7.3)		13.7 (4.4)
Unflavoured e-liquid (reference) (n = 3)	0.3 (0.3)	3.8 (2.9)		2.3 (1.6)

Abbreviations: NVP, nicotine vaping product; SE, standard error.

[a] Weighted.

[b] *P* value is from the model omnibus test (main effect).

[c] Flavour used most: n = 167 (2 respondents had missing data). All responses are based on self-report.

[d] Flavours that would be prohibited under the Health Canada flavour restrictions proposal.

There were no significant differences between those who smoked or quit smoking by device type (p = 0.74) or flavour (p = 0.36). The regression analysis found that a majority of adults (both those with a failed and successful quit attempt) used flavours that would be prohibited (67.6%) under the proposed Health Canada flavour restrictions.

A higher percentage of those who quit smoking used e-liquid flavours that would be prohibited (70.9%) than those who were smoking in 2022 (66.3%), but the difference was not statistically significant (*p* = 0.70) (see Table 3).

Discussion

We found that about two in five Canadian adults who smoked cigarettes tried to quit between 2020 and 2022. Nearly 40% of those who tried to quit did not use any form of assistance. Of those who tried to quit with assistance, NRT was the most common form of assistance reported, followed by NVPs. Close to half of the adults who used an NVP also used NRT when they most recently tried to quit. Those who were more likely to use an NVP were younger and reported having quit smoking. There were no significant differences between adults who failed and succeeded quitting when using an NVP in terms of device types or flavours. However, the majority of all adults used flavours that would be prohibited under Health Canada's flavour restrictions proposal. This raises

TABLE 3
Comparison of current and former smokers (≥18 years) who used an NVP with flavours that would be prohibited versus those that would not be prohibited[a] during their most recent smoking quit attempt between 2020 and 2022, Canada (n = 169)

Smoking status	Used prohibited flavour, % (SE)[b]	Odds ratio	95% CI
Currently smoking in 2022	66.3 (7.1)	Reference	
Quit smoking between 2020 and 2022	70.9 (10.2)	1.24	0.42–3.70

Abbreviations: CI, confidence interval; NVP, nicotine vaping product; SE, standard error.

[a] Flavours that would be prohibited under the proposed Health Canada flavour restrictions (i.e. all flavoured e-liquids except for tobacco, menthol and mint and unflavoured e-liquids). All responses are based on self-report.

[b] Conditional marginal estimates are presented from the model. Some estimates have high sampling variability due to small sample sizes (i.e. the relative SE is greater than 30%). Interpret with caution.

the possibility of unintended consequences of policies that would make NVPs less appealing and satisfying as substitutes for cigarettes, which might diminish initiation and maintenance of NVP use by adults who smoke and are considering switching to an NVP.

Because of the dangers of cigarette smoking, health care providers should encourage individuals who smoke to use whatever method is necessary to stop smoking. For those attempting to quit without assistance (i.e. "cold turkey"), the failure rate for a given quit attempt is typically greater than 90%.[5] Notably, while NVPs may offer an effective way for people who smoke to transition away from cigarettes,[6-9,26] even among those who do not initially plan to quit,[27] NVP preferences when trying to quit smoking vary.[4] For example, some adults (particularly those who are older) may not consider using an NVP as a cessation aid, but may prefer to use other forms of assistance. Using pharmacological treatment in any capacity can significantly increase the chances that tobacco-dependent adults will successfully quit smoking.[5] Complete substitution with NVPs may also help individuals remain abstinent, but this requires more investigation.

Evidence suggests that e-liquid flavours are an important factor in the initiation, maintenance, acceptability, appeal and satisfaction related to e-cigarette use.[19,28-30] The "taste" of flavours is a subjective sensory experience that varies from individual to individual as a result of different threshold sensitivities.[31] While some people prefer harsh, bitter or sour flavours, others favour sweet, savoury or cool flavours. The aim of our study was not to test differences in NVP flavours used on smoking cessation outcomes, but rather to describe preferences of NVP flavours used most by Canadian adults who have attempted to quit smoking. Our study found that adults specifically seeking to quit smoking showed a strong preference for flavoured products that would be restricted under the current Health Canada policy proposal. A smaller, but nonnegligible, proportion of adults most often used tobacco flavour, although this was more common among older adults.

Making lower-risk products less appealing should be carefully considered in policy development, including any impact in diminishing the interest in, and successful use of, NVPs by Canadian adults when trying to achieve smoking cessation. Given the likely importance of flavoured NVPs for adults, and to also prevent youth use or uptake, alternatives to an outright flavour ban should be considered, such as requiring that NVPs be sold by licensed adult retailers under regulations requiring plain packaging, strict regulations on advertising and promotions, and strict age verification at the time of purchase. To encourage transitions from combusted to non-combusted products, risk-proportionate regulation and taxation should be deployed.

Strengths and limitations

This study has some limitations. First, being cross-sectional, this study cannot be used to infer causality (e.g. we cannot determine whether certain flavours or devices were causally related to cessation outcomes). Second, the retrospective measurements in this study may have resulted in recall bias. Finally, some estimates should be interpreted with caution due to small sample sizes in some subgroups.

Conclusion

Overall, we found that most of the adults who attempted to quit smoking and used an NVP were using a variety of flavours that would be restricted under the Health Canada vaping flavour ban policy. Careful consideration should be given to the effects of policies that would ban appealing flavoured NVP products from the market. Prospective research studies are needed to examine the role of flavours specially for smoking cessation purposes.

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Conflicts of interest

KMC has served and continues to serve as a paid expert witness in litigation against cigarette manufacturers. GTF has served as an expert witness or consultant for governments defending their country's tobacco policies or regulations in litigation and was a member of the Health Canada Vaping Products Scientific Advisory Group (2017–2020; unpaid). All other authors have no conflicts of interest to declare.

Authors' contributions and statement

SG: Conceptualization, formal analysis, writing – original draft.

DS: Conceptualization, writing – review & editing.

PD: Data validation, writing – review & editing.

DTL: Writing – review & editing.

GTF: Funding acquisition, writing – review & editing.

ACKQ: Writing – review & editing.

LVC: Writing – review & editing.

JC: Writing – review & editing.

SCK: Writing – review & editing.

KMC: Funding acquisition, writing – review & editing.

All authors approved the final manuscript prior to submission.

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