HEALTH FORUM



Rapid Evidence Profile #30.2

(21 June 2022)

Question

What are the biggest gaps in evidence – both overall and for equity-deserving groups – about:

- 1) the impacts of climate change on population health in Canada; and
- 2) adaptation and mitigation strategies that are applicable to Canada?

What we found

To identify gaps in evidence about the impacts of climate change on population health in Canada and on adaptation and mitigation strategies applicable to Canada, we used data from a living evidence synthesis that identified 17,105 documents as of the end of 2021, as well as from Social Systems Evidence. See Box 1 for additional details about our approach. We organized documents that mentioned Canada or one or more Canadian provinces using the components of the framework from the living evidence synthesis related to health risks and impact (for part 1 of the question above) and options and responses to address climate change (for part 2 of the question above). The framework is provided below. In this update, we have categorized the single studies by the form of evidence they address (data analytics, modelling, evaluation, behavioural/ implementation research, and/or qualitative insights) and provide more detailed findings from systematic reviews related to the first question. If there is an opportunity to further extend this work in future, we would move beyond relying on the machine-learning based assignment of documents to public-health related topics, and manually assign documents to a mutually exclusive and collectively exhaustive list of public-health functions.

Organizing framework

- Health risks and impacts
 - o All-cause mortality
 - o Chronic

Box 1: Our approach

We identified evidence related to the question from the 17,105 documents included in a living evidence synthesis that used machine learning to map the global research on climate change and health. The dataset was last updated in December 2021. We added to the dataset - drawing from Social Systems Evidence and excluding duplicates systematic reviews, rapid reviews or protocols for systematic reviews that mention Canada or a province in the title or abstract, and/or include at least one study conducted in Canada. Each of the 402 documents that mentioned Canada and/or one or more provinces and territories was assessed by one reviewer to ensure relevance to Canada, climate change, and public health. In this update, we also classified each of the included single studies according to the forms of evidence profiled in the Evidence Commission report (data analytics, modelling, evaluation, behavioural/implementation, and/or qualitative insights). The 6,433 documents that included one or more authors with a Canadian affiliation were used to derive a list of Canadian institutions and authors who had published one or more documents related to climate change and health, and the number of publications from each.

We appraised the methodological quality of full systematic reviews and rapid reviews using AMSTAR. Note that quality-appraisal scores for rapid reviews are often lower because of the methodological shortcuts that need to be taken to accommodate compressed time frames. AMSTAR rates overall quality on a scale of 0 to 11, where 11/11 represents a review of the highest quality. It is important to note that the AMSTAR tool was developed to assess reviews focused on clinical interventions, so not all criteria apply to systematic reviews pertaining to delivery, financial or governance arrangements within health systems or to broader domains like climate change.

This update to a rapid evidence profile was prepared in the equivalent of three days of a 'full-court press' by all involved staff.

- Heat stress
- Thermal stress and comfort
- Stroke
- o Food and nutrition
 - Farmers and agriculture
 - Food insecurity
- o Patients and health systems
 - Public health
 - Hospital admissions (note that this sub-element and the next two are not relevant to public health per se)
 - Patients
 - Visits to healthcare facilities
- o Infectious diseases
 - Infectious diseases general
 - Viral diseases
 - Mosquito vector dynamics
 - Malaria
 - Dengue
 - Influenza
 - Hand, foot, and mouth disease (HFMD)
 - Leptospirosis
 - Cholera
- o Maternal and child health
 - Child health
 - Birth and pregnancy
- Mental health
 - Mental health and post-traumatic stress disorder (PTSD)
 - Suicide
- o Occupational health and injury
- Respiratory
 - Air pollution
 - Respiratory viruses
 - Pollen and allergies
 - Asthma
 - Fungal spores
- o Water, sanitation and hygiene (WASH)
 - Drinking water quality
- Options and responses
 - o Developing community resilience
 - Disaster risk reduction
 - o Mitigation
 - Energy policy and co-benefits
 - Greenhouse pathways
 - o Policies and practices that support adaptation

The living evidence synthesis included 395 documents that mentioned Canada and/or one or more provinces and territories, and we identified another seven potentially relevant evidence syntheses from Social Systems Evidence. As summarized in Table 1, we included 360 documents (29 evidence syntheses and 331 single studies), of which 290 address question 1 about health risks and impacts from

climate change (25 evidence syntheses and 265 single studies), and 101 address question 2 about options and responses to climate change (18 evidence syntheses and 83 single studies). The 29 evidence syntheses include one overview of systematic reviews, 19 systematic reviews, six scoping reviews, and three non-systematic reviews. We classified the 331 single studies as providing data analytics (n=209), qualitative insights (n=50), modelling (n=40), behavioural/implementation research (n=13), evaluations (n=12), and technology assessment/cost-effectiveness (n=4). We also identified an inprogress scoping review of reviews focused on climate change that will provide additional synthesized evidence once available. No guidelines were identified.

For each question, we provide a high-level profile of the available evidence. In addition, based on the included evidence syntheses, we provide a more in-depth summary of key findings, gaps identified in the evidence, and insights about equity-deserving groups in relation to health risks and impacts from climate change (Table 2), and about adaptation and mitigation strategies that are applicable to Canada and within the sphere of control and/or influence of public-health leaders (Table 3). We then provide a profile of Canadian producers of evidence about climate change and health by institution (Table 4) and by author (Table 5). Note that the profile of producers includes Canadian institutions and authors with a Canadian affiliation in any of the 17,105 documents included in the data from the living evidence synthesis. A detailed summary of our methods is provided in Appendix 1, key findings from all of the included evidence syntheses (including those deemed of medium and low relevance) in Appendix 2, and the documents identified as addressing equity-deserving populations are provided in Appendizs 3a (for health risks and impacts) and 3b (for evidence syntheses).

Profile of Canadian studies, and key findings and gaps in available evidence syntheses about health risks and impacts from climate change

Profile of included Canadian studies

We identified 265 single studies relevant to Canada, which we defined as mentioning either Canada and/or one or more provinces or territories in Canada. As can be seen in Table 1, in relation to the health risks and impacts in the organizing framework, the three most addressed by the Canadian literature are: 1) patients and health systems (50% of the articles, with most focused on public health); 2) respiratory (25% of all articles, with most focused on the role of air pollution); and 3) all-cause mortality (16% of all articles). Fewer studies focused on infectious diseases (10.5%), maternal and child health (7.9%), mental health (7.5%), chronic diseases (4.9%), food and nutrition (4.2%), occupation health and injury (4.2%), and water, sanitation, and hygiene (3.4%).

The most common forms of evidence provided in the single studies addressing this question were data analytics (67%), qualitative insights (12%), and modelling (11%). Fewer studies included evaluations (3.7%), behavioural/implementation research (3.4%), and technology assessment/cost-effectiveness (1.1%).

Regarding the climate hazards addressed, most of the included articles had a general focus on climate change (25.6%), heat (20%), and particulate matter (17%). Emissions, extreme weather events and wildfires were each addressed in 13% of the studies included. Other hazards such as cold and extreme temperatures (4.9%), floods (4.5%), drought (2.3%), and hurricanes (0.8%) were uncommonly considered in the single studies. We also found that 25% of the Canadian studies had a national focus, and five provinces were most commonly the focus of the rest of the included studies: 27% from Quebec, 23% from Ontario, 10% from Alberta, 8.7% from British Columbia and 3% from Nunavut. Five provinces and territories (Saskatchewan, Manitoba, New Brunswick, Nova Scotia and Prince Edward Island) were only addressed in 1% or less of the studies included, while Yukon, Northwest

Territories, and Newfoundland and Labrador were not considered in any single study included. These data are not presented in Table 1, but are available upon request.

Several notable gaps are apparent from the profile of single studies, which include:

- few single studies addressing risks and impacts of climate change on infectious diseases, maternal and child health, mental health, chronic diseases, food and nutrition, occupation health and injury, and water, sanitation, and hygiene;
- limited study in Canada of climate hazards such as cold and extreme temperatures, floods, drought and hurricanes;
- limited evidence in several provinces and territories (as outlined above); and
- limited efforts to address equity considerations overall, but also specifically in relation to considering the risks and impacts of climate change on unhoused and homeless persons, persons who use substances, infants, and sex and gender considerations.

Moreover, the forms of evidence available are unbalanced with most from data analytics and modelling studies, and few providing evaluations, behavioural/implementation research, technology assessment or cost-effectiveness studies, and guidelines.

Key findings and main research gaps identified in evidence syntheses

One low-quality scoping review found that changing climate conditions are negatively affecting the health and well-being of individuals in rural and remote regions. The increased prevalence and severity of extreme weather events, changes to sea ice, vegetation, fish, wildlife, weather and environmental uncertainties have health impacts such as poor nutrition, obesity, vector-borne/waterborne/foodborne diseases, cardiovascular diseases, respiratory issues, and mental health issues, among others. In addition, two low-quality systematic reviews reported on the significant health risks and impacts of climate change on the physical and mental health of Aboriginal communities and long-term evacuees. Acute and short-term weather such as storms, flooding, temperature and seasonality were linked to a range of psychological and mental health impacts including depression, anxiety, suicide, self-harm, post-traumatic stress disorder, psychological resilience, mental illness and behavioural disorders, and strong emotional reactions such as fear and anxiety. Sub-acute and chronic weather events and environmental changes were often linked to feelings of loss, worry, anger, sadness, and ongoing emotional distress, but were not directly linked to many of the more acute presentations of mental health distress such as suicide and depression. One medium-quality scoping review found that age, gender, time, and proximity to wildfires can have psychosocial impacts in children, adolescents and their families. Another medium-quality systematic review reported the health impacts of climate change and air-pollution exposures in older adults and immigrants living in Canada, as well as factors influencing risk and resilience in these populations.

One <u>low-quality systematic review</u> identified eight health morbidity and mortality indicators used (or that could be used) in Canada to quantify the impacts of climate change. These include indicators or morbidity-mortality related to general climate change, or specifically related to air pollution, heat and infectious disease.

Regarding food and nutrition, a <u>medium-quality systematic review</u> found that the effects of climate change on subsistence harvesting and other land-based activities, and the determinants of vulnerability and adaptation to such changes are well understood. However, the effects of climate change on health are less known. No evidence syntheses were focused on chronic diseases, occupational health and injury, or water, sanitation and hygiene.

The main research gaps and/or priorities for future research identified from the evidence syntheses include:

- lack of <u>consistent available data</u> across the country to assess/model health morbidity and mortality indicators;
- need for <u>disaggregated population-level data</u> that allows for conclusions to be drawn about which populations are most vulnerable to climatic change factors;
- lack of studies that help to understand potential effects of <u>prolonged vsersus short-term</u> <u>displacement</u>, and the long-term repercussions of emergencies and disasters;
- need for more studies focusing on <u>children and adolescent</u> perspectives to expand the understanding of their psychosocial responses to wildfires and other climate hazards;
- limited population-level studies providing a longitudinal perspective on the effects of meteorological, seasonal and climactic changes on <u>Indigenous mental health</u>; and
- lack of studies that evaluate <u>the impact of air pollution</u> on health, especially on the population living in rural areas, provinces other than Ontario and Quebec, and in the elderly and immigrants.

Insights about equity-deserving groups

From the 290 studies included, we identified five systematic reviews and 42 single studies that focus on the health risks and impacts from climate change on equity-deserving populations. We adopt the acronym PROGRESS-Plus to describe characteristics across which health-equity considerations may be relevant. Findings from the documents included in this rapid evidence profile focused on the following equity-deserving populations (ordered by PROGRESS-plus characteristics): those living in the Arctic (or sub-arctic) (n=8), those living in rural and remote regions (n=6), Indigenous populations (n=17), gender/sex differences (n=4), low-socio-economic and materially deprived neighbourhoods (n=14), unhoused and homeless persons (n=2), persons who use substances (n=1), older adults (n=11), and infants (n=3). It should be noted that these groupings are not mutually exclusive as documents could have relevance to several equity-deserving groups. The greatest concentration of equity-focused literature on health risks and impacts related to public health (n=22), followed by hospital admissions (n=7) and food insecurity (n=5).

Profile of single studies, and key findings and gaps in available evidence syntheses about adaptation and mitigation strategies that are applicable to Canada and within the sphere of control and/or influence of public-health leaders

Profile of included Canadian studies

We identified 81 single studies relevant to Canada (defined as mentioning either Canada and/or one or more provinces or territories in Canada). As can be seen in Table 1, in relation to options and responses to climate change in the organizing framework, the most frequent areas of focus are policy and practice (48%), mitigation (41% of all articles, with half focused on energy policy and co-benefits, and the other half in greenhouse and pathways), developing community resilience (25%), and disaster and risk reduction (7%).

The most common forms of evidence provided in the single studies addressing this question were qualitative insights (38%), data analytics (31%), modelling (12%), and behavioural/implementation research (11%). Few studies were intended for evaluation (5%) or technology assessment/cost-effectiveness (2.5%).

Regarding the climate hazards addressed, most of the articles had a general focus on climate change (44%). Other climate hazards such as heat, emissions, extreme weather, wildfires, and floods were each addressed in approximately 10% of the studies included. Other hazards such as particulate matter and drought were only considered in one and two studies, respectively, while hurricanes were not addressed in any of the single studies included for this question. We also found that 39.5% of the Canadian studies had a national focus, and four provinces were most commonly the focus of the rest of the included studies: 21% from Quebec, 11% from Alberta, 10% from British Columbia and 7.5% from Ontario. Seven provinces and territories (Saskatchewan, Manitoba, New Brunswick, Nova Scotia, Prince Edward Island, Northwest Territories and Nunavut) were only addressed by one paper, while Yukon and Newfoundland and Labrador were not considered in any of the included studies. These data are not presented in Table 1, but are available upon request.

Several notable gaps are apparent from the profile of single studies, which include:

- a lack of single studies addressing options and responses to climate change, as most of the studies included in this rapid evidence profile were focused on health risks and impacts;
- options and responses to climate hazards such as particulate matter and drought having not been deeply studied in Canada (although particulate matter was frequently addressed in single studies assessing health risks and impacts of climate change, but was not in relation to options and responses); and
- limited evidence in several provinces and territories (as outlined above).

As with the studies addressing health risks and impacts, we found an imbalance in the forms of evidence available, with few providing evaluations of interventions for climate change adaptation or mitigation strategies, behavioural/implementation research, technology assessment or cost-effectiveness studies, and guidelines.

Key findings and main research gaps identified in evidence syntheses

We identified 18 evidence syntheses (one overview of systematic reviews, 13 systematic reviews, three scoping reviews, and one non-systematic review) addressing options and responses to climate change, which are summarized in Table 3 according to key findings, gaps in evidence identified, and insights about equity-deserving groups. Syntheses are grouped into the four areas related to options and responses from the organizing framework: developing community resilience (n=2), mitigation (n=4), and policies and practices that support adaptation (n=14) (note that some evidence syntheses addressed more than one category). We did not identify evidence syntheses addressing options for disaster-risk reduction.

Key findings from a <u>low-</u> and a <u>medium-quality</u> evidence synthesis addressing developing community resilience mentioned that changing climate conditions is negatively affecting the health and well-being of individuals in rural and remote regions. It highlights the necessity of strategies that promote community resilience. Examples of strategies highlighted include <u>using multiple knowledge systems</u> specific to socio-cultural contexts, supporting sustainable-development practices, enhancing risk communication and knowledge of climate change, and increasing community-based monitoring to address the <u>disproportionate food security and climate-change impacts experienced by Indigenous communities</u>. One review mentioned that <u>measuring resilience is challenging</u> because concepts like food-system resilience have not been well-defined for climate change, and the relationships between resilience of food systems and climate change are complex.

Regarding mitigation responses, two systematic reviews (<u>one medium</u>- and <u>one low-quality</u>) showed a potential risk of a trade-off between accountability and efficiency. When decision-makers are using

policies that target the private sector, they will <u>need to carefully balance practical and feasible policies</u> with political pressures to deliver for stakeholders. One <u>low-quality systematic review</u> also mentioned the necessity of mitigation responses to face the public-health effects of long-term evacuees in Canada. Another <u>low-quality systematic review</u> focused on understanding the direct effects of policy instruments that target environmental problems and how these policies interact. It reported that: 1) policy instruments designed to control expenditure perform better than regulatory instruments; 2) policy instruments with voluntary reporting procedures are much less likely to be positively evaluated than those with mandatory reporting procedures; and 3) as the defined time frame of policies increases, the likelihood these policies will be positively evaluated for efficiency and process also increases.

We identified a greater number of systematic reviews addressing policies and practices that support adaptation (seven low quality, two medium quality, and one high quality). One <u>medium-quality</u> <u>systematic review</u> reported the most frequent adaptation activities identified in the studies included community-based programs, ecological restoration, knowledge sharing and learning platforms, changing crop types, and planting and harvesting practices. Those activities demonstrated improvement in at least one category of <u>effectiveness</u> (that is, they reduced risk and vulnerability, developed resilient social systems, improved the environment, increased economic resources, or enhanced governance and institutions). One high-quality systematic review specifically reported that <u>multi-pronged heat action</u> plans were highly effective in reducing heat-related mortality and morbidity, especially among vulnerable populations such as the elderly and those with chronic conditions. Additional systematic reviews focused on <u>other adaptation</u> activities such as: enhancing <u>risk-management</u> activities by local public-health units; development of community <u>adaptation plans</u>; and awareness, research and networking activities implemented by civil society organizations (CSOs) that aim to build <u>adaptive</u> <u>capacity</u>, principally in water contamination and air quality.

One <u>low-quality systematic review</u> identified and characterized Canadian federal, provincial, territorial, and municipal adaptation to health risks. The review found that federal health-adaptation initiatives emphasize capacity building and gathering information to address general health, infectious disease, and heat-related risks. The review identified variations in adaptation strategies adopted by provinces and territories. For instance, Quebec is a leader in climate change adaptation, addressing almost all risks posed by climate change in the province, and having implemented various adaptation types. Meanwhile, all other Canadian provinces and territories are in the early stages of adaptation. Moreover, the review notes that in a sample of six sampled Canadian regional health authorities (Calgary, Edmonton, Montreal, Ottawa, Toronto, Vancouver), adaptation initiatives were not reported.

One <u>low-quality systematic review</u> focused on the impacts of climate change on occupational health and safety suggested some adaptation strategies such as developing training tools to prepare workers for the health effects of climate change, developing protective clothing and other equipment for extreme climates, and developing methods to heighten workplace awareness of potential risks.

A <u>low-quality systematic review</u> focused on adaptations being employed by Inuit population in the Arctic to manage the risks of current climate change found that financial resources are an important component of the means to adapt, and are identified as one of the main barriers preventing adaptation from taking place. Many adaptations are costly and exceed the financial ability of households, communities, businesses, regional governments, and regional institutions. Other adaptation barriers are social–cultural in nature, including the erosion of traditional land skills among younger generations, weakening of sharing networks, and the cultural value of hunting and consuming certain <u>traditional foods</u> at certain times of the year.

Gaps in evidence identified by included evidence syntheses

Eleven systematic reviews (six low quality and five medium quality) identified several research gaps, which can be grouped into three areas related to options and responses to address climate change. First, there is limited focus of studies that evaluate the effectiveness of mitigation and adaptation strategies. This includes a lack of detail about the context in which efforts were undertaken, which makes it difficult to generate programs and frameworks, because the approaches to measuring variables such as risk perception and a willingness to act are not cohesive or consistent. Second, the need for research focused on the rationale, design, implementation and performance measurement of private policy initiatives was identified as another key gap in the literature. Lastly, the necessity of considering vulnerable populations was noted as a gap and as a priority for future research. Specifically, there is a need for studies providing gender-disaggregated data that facilitate the understanding of how women, men, and gender-diverse people may have different experiences with community resilience options, mitigation, and adaptation responses. Additional studies are needed that contribute to a better understanding of the full spectrum of community-based monitoring practice occurring within Indigenous communities, the representation of diverse types of knowledge and expertise in designing adaptation strategies, and the health impacts of long-term evacuees in Canada.

Insights about equity-deserving groups

We identified insights about equity-deserving groups in seven of the 18 evidence syntheses included in question 2. These seven syntheses focus on people living in the Arctic (or sub-Arctic) (n=1), those living in rural and remote regions (n=2), Indigenous populations (n=3), gender/sex differences (n=1), low-socio-economic and materially deprived neighborhoods (n=1), older adults (n=2), and people with physical disabilities (n=1).

One medium-quality systematic review reported that only one-third of the reviewed articles provided gender-disaggregated data. The authors highlighted the necessity of studies establishing the relationship between <u>climate</u>, food, and gender, for planning and designing a community-based monitoring systems that reflect gender equity.

A <u>medium-quality systematic review</u> found that vulnerable communities such as low-income communities, the elderly, racial and ethnic minorities, and people with disabilities, face challenges in seeking and processing risk-communication information, including complex language, information overload and contradictory information.

One <u>high-quality scoping review</u> found that multi-pronged heat-action plans are highly effective in reducing heat-related mortality and morbidity, especially among vulnerable populations such as the elderly and those with chronic conditions.

Lastly, two low-quality systematic reviews reported several challenges faced by Inuit populations in the Arctic. For instance, key challenges identified included: the <u>substitution of traditional foods</u> for store foods when hunting areas are not accessible; altered timing, mode, and methods of subsistence activities; the erosion of traditional land skills among younger generations; weakening of sharing networks; the <u>cultural value</u> of hunting and consuming certain traditional foods at certain times of the year; and households often do not have access to the <u>capital resources</u> to purchase new hunting equipment to take advantage of new conditions or replace equipment lost or damaged in climate-related hunting accidents.

Producers of Canadian evidence about climate change and health

Table 3 provides a list of 30 Canadian institutions that have been listed at least five times in any of the 17,105 publications identified in the <u>living evidence synthesis</u> (a full list of institutions was too long to include here, but is available upon request). The list includes groups located in 18 universities with the rest being federal or provincial government agencies (n=7), other arm's-length government-funded agencies (n=3), and groups within hospital research centres (n=2). This is accompanied by a list of 195 authors who appear in at least five publications and who listed at least one Canadian affiliation (a full list of authors was too long to include here, but is available upon request).

Table 1: Canadian studies addressing health risks and impacts from climate change, and options and responses to climate change, by form of evidence addressed in the study

		All (n=	=360)	Pan-Canadian fo	ocus (n=107)*	Provincial foc	us (n=253)**	Equity fo	cus (n=52)
F	ocus	Evidence syntheses (n=29)	Single studies (n=331)	Evidence syntheses (n=18)	Single studies (n=89)	Evidence syntheses (n=12)	Single studies (n=241)	Evidence syntheses (n= 10	Single studies (n= 42)
		H	ealth risks an	d impacts from o	climate change	e (n=290)	· · · ·		
All-cause	Death	-	7	-	-	-	7	-	
mortality	Mortality	1	36	1	13	-	23	2	3
	Heat stress	-	30	-	4	-	26	-	1
Chronic	Thermal stress & comfort	-	6	-	-	-	6	-	-
	Stroke	-	9	-	1	-	8	-	-
Food &	Farmers & agriculture	-	4	-	2	-	2	-	-
nutrition	Food insecurity	1	5	1	1	-	4	2	5
	Public health	13	83	9	29	4	54	8	22
Patients &	Hospital admissions	-	24	-	4	-	20	-	7
health	Patients	-	5	-	1	-	4	-	-
systems	Visits to healthcare facilities	-	29	-	3	-	26	-	1
	Infectious diseases general	2	23	1	4	1	19	1	1
	Viral diseases	-	3	-	2	-	1	1	-
	Influenza	-	2	-	1	-	1	-	-
Infontions	HFMD	-	-	-	-	-	-	-	-
Infectious	Mosquito vector dynamics	-	-	-	-	-	-	-	-
	Malaria	_	-	_	-	-	-	-	-
	Dengue	_	-	_	-	-	-	-	-
	Cholera	_	-	-	-	_	-	-	-

	Leptospirosis	-	-	-	-	-	-	-	-
	Child health	-	13	-	6	-	8	1	1
child health	Birth &	_	8	-	2	-	8	-	-
	pregnancy								
Mental	Mental health &	1	17	1	7	-	1-	2	7
Mental health	PTSD								
incartii	Suicide	-	2	-	1	-	1	1	1
Occupational	Occupational	-	11	-	3	-	8	1	1
health &	health & injury								
injury									
	Air pollution	1	55	-	15	1	40	-	5
	Respiratory	-	3	-	-	-	2	-	-
	viruses								
Respiratory	Pollen &	-	1	-	-	-	1	-	-
	allergies		10		1		11		
	Asthma	-	12	-	1	-	11	-	-
	Fungal spores	1	-	-	-	1	-	-	-
Water,	Drinking water	1	8	1	1	-	7	-	2
sanitation	quality								
and hygiene									
(WASH)					(104)				
		Options and re	sponses to ad	dress climate ch	ange (n=101)	<u>^</u>	-		
Developing co resilience	ommunity	2	20	2	12	0	8	2	6
Disaster risk reduction		-	6	-	3	-	3	-	-
	Energy policy	1	17	1	5	0	12	-	2
Mitigation	Greenhouse	3	16	2	4	1	12	-	1
	pathways								
Policies and p	ractices that	14	39	7	16	7	23	9	16
support adapts	ation								

*Includes documents that mention Canada at the national level as at least part of the focus of the document **Includes documents that mention one or more Canadian provinces and territories as at least part of the focus of the document

Table 2: Summary of key findings and gaps identified from included evidence syntheses about health risks and impacts that are applicable to Canada

Area of focus		Key findings from included evidence	Gaps identified from included	Insights about equity-
	-	syntheses	evidence syntheses	deserving groups
Health risks and impacts with climate change	All-cause mortality (n=1)	 One low-quality systematic review identified eight health morbidity and mortality indicators used (or that could be used) in Canada to quantify the impacts of climate change: Excess daily all-cause mortality due to heat Premature deaths due to air pollution Preventable deaths from climate change Disability adjusted life years lost from climate change Daily all-cause mortality (trends associated with heat and air pollution) Daily non-accidental mortality (trends associated with heat and air pollution) West Nile disease incidence (in humans) Lyme borreliosis incidence (in humans) 	• <u>Consistent availability of data</u> across the country to assess/model indicators and expertise, and human resources to continuously evaluate and modify the analysis	• None identified
	Food and nutrition (n=1)	 No evidence syntheses identified A medium-quality systematic review found that the effects of climate change on subsistence harvesting and other land-based activities, and the determinants of vulnerability and adaptation to such changes are well understood; however, the effects of climate change on health are less known 		None identified
	Patients and health systems (n=4)	 A <u>low-quality systematic review</u> identified some determinants related to constraining adaptive capacity and increasing sensitivity to climate change on Aboriginal health, among those: Poverty, technological capacity constraints, socio-political values and inequality, institutional capacity challenges, and information deficit 	• One low-quality systematic review reported a research gap on understanding potential effects of prolonged versus short-term displacement, and the long-term repercussions of emergencies and disasters in high-income countries	 Some factors constrain adaptive capacity and increase <u>sensitivity to</u> <u>climate change on</u> <u>Aboriginal health</u>, including: Material conditions and behaviours

1		1
	• The magnitude and nature of these	associated with
	determinants are distributed unevenly within	poverty will increase
	and between Aboriginal populations	sensitivity and
	necessitating place-based and regional level	constrain adaptive
	studies to examine how these broad factors	capacity to climate
	will affect vulnerability at lower levels	change
	• A <u>low-quality scoping review</u> provided a list of	• Surveillance and early
	criteria for vector-borne disease prioritization,	warning capacity for
	and the most common categories of criteria	those living in remote
	included: public health impacts, economic or	regions is
	market impacts, animal health impacts (generally	underdeveloped for
	pertaining to market impacts, but also for	identifying emerging
	animal-welfare), public perception and public	risks and vulnerable
	health capacity to deal with a disease	populations
	• A low-quality scoping review found that	0 Comprehensive,
	changing climate conditions is negatively	reliable, and culturally
	affecting the health and well-being of	specific health-
	individuals in rural and remote regions,	assessment measures
	including: increased prevalence and severity of	from which to assess
	extreme weather events, changes to sea ice,	climate change
	vegetation, fish, wildlife, weather and	impacts are absent
	environmental uncertainties	• Access to health
	• Health impacts of these include poor	information,
	nutrition, obesity, vector-	diagnosis, and
	borne/waterborne/food-borne disease.	treatment is
	cardiovascular disease, respiratory issues, and	insufficient for timely
	mental health issues, among others	and effective
	• A low-quality systematic review which explored	intervention to
	the roles and responses of public health for	manage climate-
	long-term evacuees (LTEs) in Canada found	sensitive health
	that.	outcomes
	o In Canada most evacuations have lasted less	0 The special rights and
	than two weeks but in some instances	needs of Aboriginal
	people have been displaced for months or	peoples have often
	vears	been neglected,
	years	resulting in continued
		 and persistent

	 It is difficult to determine if there are public health effects of prolonged evacuation and to what extent Trends in the incidence of disasters and emergencies underscore the urgency of conducting more research to improve our understanding of prolonged displacement within Canada and in other high-income countries 		 inequality which exacerbates climate change health vulnerability Institutions responsible for Aboriginal health are challenged by jurisdictional conflict and resource constraints, limiting the ability to identify and prepare for future risks and address inequalities
Infectious (n=1)	 One low-quality systematic review found strong evidence for the association between climactic factors for food- and waterborne diseases, largely because of increased temperature and increased precipitation which raises the incidence of these diseases Some evidence was found for an expected increase in vector- and rodent-borne diseases as climate changes in temperature, precipitation, and changes to the length of seasons change the suitability, reproduction, distribution and abundance of vectors and rodents 	 One low-quality systematic review noted that because of the frequently aggregated, population- level data used in the included studies, it was difficult to draw conclusions regarding which populations were most vulnerable to climatic factors Additional gaps in knowledge include surveillance mechanisms to ensure risk of disease is appropriately and reliably calculated, and additional studies focused on confounding and intermediate factors, particularly for climatic effects of vector- and rodent- borne diseases 	• A <u>low-quality systematic</u> <u>review</u> examined the association between climactic factors and infectious disease in the arctic and sub-arctic regions and found strong evidence for the association between climactic factors for food- and waterborne diseases, largely as a result of increased temperature and increased precipitation which increases the incidence of these diseases
Maternal and child health (n=1)	• <u>A medium-quality scoping review</u> focused on studies assessing the psychosocial impacts of wildland fires on children, adolescents, and family functioning found that age, gender, time, and proximity to the wildfire can have an impact on both children and adolescents, while	 One <u>medium-quality scoping</u> <u>review</u> reported the following research gaps: O Insufficient discussion of research questions or findings 	None identified

	F	•	
	behaviours of family members and home and	within a larger disaster	
	property loss are important among families	framework	
		• More studies focusing on	
		children and adolescent	
		perspectives of community	
		factors would expand our	
		understanding of their	
		psychosocial responses to	
		wildfings	
		• Lucreation to use of the algorithm	
		o Investigators need to clearly	
		outline differences between	
		groups of participants and time	
		periods post-event	
		• Family units (i.e., parents or	
		surrogates with children) also	
		need to be studied to gain	
		information useful for	
		programs needed to address the	
		issues this group experiences	
		post-fire	
		• Authors highlighted the lack of	
		research that included children or	
		adolescents' perspectives of	
		domestic violence post-disaster	
Mental health	• A medium-quality scoping review focused on	• One medium-quality scoping	• Age gender time and
(n=2)	studies assessing the psychosocial impacts of	review reported the following	provimity to the wildfire
()	wildland fires on children adolescents and	research gaps:	cap have an impact both
	family functioning found that age, gender, time	• Insufficient discussion of	on children and
	and provimity to the wildfire can have an	research questions or findings	adologopta while
	impact on both shildren and adalassents while	within a langer disector	habarianna of family
	had a series of formily and a dolescents, while	for a second	benaviours of failing
	behaviours of family members and nome and	framework	members and nome and
	property loss are important among families	• More studies focusing on	property loss are
	• One <u>medium-quality systematic review</u>	children and adolescent	important among
	synthesized literature on the effects of	perspectives of community	tamilies
	meteorological, seasonal and climactic changes	factors would expand our	• There is some evidence
	on Indigenous mental health, and found that:	understanding of their	to show that females
			report higher levels of

		1 1	
	 Acute and short-term weather such as storms, flooding, temperature and seasonality were linked to a range of psychological and mental health impacts including depression, anxiety, suicide, self-harm, post-traumatic stress disorder, psychological resilience, mental illness and behavioural disorders, and strong emotional reactions such as fear and anxiety Sub-acute and chronic weather events and environmental changes were often, linked to feelings of loss, worry, anger, sadness, and ongoing emotional distress, but were not directly linked to many of the more acute presentations of mental health distress such as suicide and depression Climatic stressors did not need to be experienced directly to induce mental health impacts, but rather can be experienced through vicarious distress, whereby individuals fear or empathize with those experiencing intense weather or environmental conditions Climatic change was also found to disrupt place-attachment, which is critical for enabling Indigenous populations feelings of identity, self-worth and for strengthening interpersonal relationships and cultural practices 	 psychosocial responses to wildfires Investigators need to clearly outline differences between groups of participants and time periods post-event Family units (i.e., parents or surrogates with children) also need to be studied to gain information useful for programs needed to address the issues this group experiences post-fire <u>Authors</u> highlighted the lack of research that included children or adolescents' perspectives of domestic violence post-disaster One medium-quality systematic review focused on the effects of meteorological, seasonal and climactic changes on Indigenous mental health, and reported that very little of the included research were population-level studies or provided a longitudinal perspective 	 frustration, sadness, fear, anger, and helplessness in the face of climatic changes Climactic changes were reported to compound existing feelings of abandonment of Indigenous peoples by government and the broader global community
Occupational health and injury	No evidence syntheses identified		
Respiratory (n=1)	• One <u>medium-quality scoping review</u> explored the reported health impacts of climate change and air pollution exposures in older adults and immigrant people living in Canada, as well as factors influencing risk and resilience in these populations, and found:	 One <u>medium-quality scoping</u> <u>review</u> found the following research gaps: There are substantial gaps in terms of the location of 	• The health impacts of climate change in rural populations and the specific factors that influence this relationship in Canada

	 That older adults in Canada experience health risks due to climate and air pollution exposures Little information about the climate- and air pollution-related health impacts experienced by immigrant communities 	 populations that have been studied The impact of climatic and air pollution variables on health was studied most frequently in southern Ontario and Quebec, but less in other provinces, especially in rural areas The Proirie and Maritimer. 	are largely undetermined for older adults and immigrants
		 provinces were largely understudied, with urban populations in Alberta being studied the most frequently within this group No studies in the territories were found, despite the fact that these northern regions are facing greater impacts from climate change Most publications were also set in urban areas, though some province-wide population studies included urban and rural residence indicators The health impacts of climate change in rural populations and 	
WZ		the specific factors that influence this relationship in Canada are largely undetermined for older adults and immigrants	
Water, sanitation, and hygiene (WASH)	No evidence syntheses identified		

Table 3: Summary of key findings and gaps identified from included evidence syntheses about adaptation and mitigation strategies that are applicable to Canada and within the sphere of control and/or influence of public-health leaders

Area of focus	Key findings from included evidence syntheses	Gaps identified from included	Insights about equity-
Options and responses to address climate change Developing community resilience (n=2)	 One low-quality scoping review mentioned that changing climate conditions is negatively affecting the health and well-being of individuals in rural and remote regions, including: increased prevalence and severity of extreme weather events; changes to sea ice; vegetation; fish, wildlife; and weather and environmental uncertainties Adaptation strategies were identified as being needed to address these challenges, including: Using multiple knowledge systems, specific to socio-cultural context Addressing socio-cultural barriers Using innovative technology Improving and integrating public health and environmental surveillance Supporting sustainable-development practices Enhancing risk communication and knowledge of climate change One medium-quality systematic review reported an increasing interest in community-based monitoring (CBM), which is a strategy to address the disproportionate food security and climate change impacts often experienced by Indigenous communities globally Considering the history of unethical research conducted on and not with Indigenous communities, there is increasing demand for the recognition of Indigenous peoples' contributions and knowledge 	 evidence syntheses One medium-quality systematic review identified the following gaps: Lack of studies providing gender- disaggregated data, resulting in an incomplete understanding of how Indigenous women, men, and gender-diverse people may differentially participate in, and experience community-based monitoring The limited focus of studies on reporting evaluation findings The need of analyzing the grey literature to better understand the full spectrum of community-based monitoring practice occurring within Indigenous communities, especially of autonomous monitoring systems which may be investigated or evaluated outside of research and the published literature 	 One medium-quality systematic review reported that only one third of the reviewed articles provided gender-disaggregated data; authors highlighted the necessity of studies establishing the relationship between climate, foo, and gender, for planning and designing community-based monitoring systems that reflect gender equity
	development of local adaptation responses		

Disaster risk reduction (n=0)	 Measuring resilience is challenging because the concept of food-system resilience has not been well defined for climate change, and the links between resilience of food systems and climate change are not straight forward No evidence syntheses identified 		
Mitigation (n=3)	 One low-quality systematic review reported the difficulty in determining if and to what extent the public-health effects of prolonged evacuation and the public-health needs of long-term evacuees (LTEs) in Canada are being assessed, monitored, and addressed One medium-quality systematic review that focused on the use of alternative fuels in cement manufacturing found that energy recovery in cement manufacturing is one of the best end-of-life options, even though the performance in resource consumption and conservation, and metal and hazardous air pollutant emissions can be worse than for other end-of-life options, such as recycling One low-quality systematic review focused on understanding the direct effects of policy instruments that target environmental problems and how these policies interact, reported the following key findings: A potential risk of a trade-off between accountability and efficiency depending on a policy instrument's source of authority; this indicates that decision-makers using policies that target the private sector must carefully balance a need for practical and feasible policies against the threat of becoming captured by these interests Expenditure instruments perform better than regulatory instruments in overall and impact evaluations Policies with built-in flexibility are more likely to have positive overall, process and efficiency evaluation results 	 Trends in the incidence of disasters and emergencies underscore the urgency of conducting more research to improve our understanding of prolonged displacement within Canada and in other high-income countries Academic papers focused on the use of alternative fuels in cement manufacturing did not discuss health or social impacts, and economic impacts were investigated for few end-of-life options More research is needed to examine the leaders in the water management field to understand what works and does not work for adapting to climate change in different coastal and freshwater systems It is also important to study the emerging nexus between water and energy, for instance, countries that experienced water's significance first-hand during droughts, can bring acute electricity blackouts and energy rationing to the populous, and this risk also exists in other power generation sources, such as nuclear energy The need for primary research with business on the rationale, design, implementation and performance measurement of private policy 	• None identified

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		 Policy instruments with voluntary reporting procedures are much less likely to be positively evaluated than those with mandatory reporting procedures There is a possible trade-off between environmental effectiveness and cost-effectiveness depending on the stage of activity that a policy targets As the defined time frame of policies increases, the likelihood these policies will be positively evaluated for efficiency and process also increases 	initiatives; similarly, primary research examining a wider swath of policies would help verify that expenditure policies fare better than regulation in overall evaluations	
I F s a	Policies and practices that support adaptation (n=9)	 One high-quality scoping review reporting effective population-level heat-related interventions found that: Heat-action plans might include establishing heat monitoring systems, information campaigns, mobilization of healthcare professionals, volunteers, social workers and trained caregivers in the surveillance, and management of individuals with known vulnerabilities Other action plans addressed education and awareness campaigns Multi-pronged heat-action plans were highly effective in reducing heat-related mortality and morbidity, especially among vulnerable populations such as the elderly and those with chronic conditions One medium-quality systematic review reported which adaptation activities are most frequently represented, which include community-based programs, ecological restoration, knowledge sharing and learning platforms, and changing crop types and planting and harvesting practices While these activities demonstrated improvement in at least one category of effectiveness (that is, they reduced risk and vulnerability, developed resilient social systems, improved the environment, increased economic resources, or enhanced governance and institutions), several activities indicated <u>effectiveness across multiple categories</u> 	 It is necessary for more research addressing issues of justice, including representation of diverse types of knowledge and expertise, fair distribution of adaptation benefits, and imbalanced power relationships within the adaptation process Research and evaluation offer techniques to reveal issues in leadership, decision-making, access, and profit, and to monitor progress towards developing more equitable adaptation practices Assessments of heat-health vulnerabilities require projections of the future frequency and severity of extreme heat events, information related to the geographical variation in exposure to extreme heat, identification of vulnerable populations, and identification of actual temperature and morbidity/mortality thresholds Public-health interventions that may be implemented to reduce climate change impacts on health within relevant time scales (five to 10 years) need to be identified through assessments 	 <u>Vulnerable communities</u> such as low-income communities, the elderly, racial and ethnic minorities, and people with disabilities, face challenges in seeking and processing risk communication information, including complex language, information overload and contradictory information A low-quality systematic review reported several adaptations documented as being employed by Inuit population in the Arctic to manage the risks of current climate change, among those: The substitution of traditional foods for store foods when hunting areas are not accessible Altered timing, mode, and methods of subsistence activities The establishment of community evacuation

	• One <u>low-quality systematic review</u> found that regular	on <u>direct potable reuse</u> policies and	
	population-health risk assessments and risk-	implementation	
	management activities by local public-health units	• Specifically for the Arctic, <u>one</u>	
	can help to address risks related to climate hazards	medium-quality systematic review	
	• One <u>low-quality systematic review</u> found that	identified several gaps in different	
	adaptations being implemented by civil society	fields, which are summarized in the	
	organizations (CSOs) in Canada consist	remaining points below	
	predominantly of groundwork interventions	Infrastructure and transportation	
	including awareness, research and networking	 Limited published research exists 	
	activities that aim to build adaptive capacity	on the vulnerability of municipal	
	 Adaptations most frequently address water 	infrastructure (e.g., community	
	contamination and air quality, and occur most	drinking water, waste management,	
	often as awareness-raising and research activities	buildings), industry-related	
	 Adaptations infrequently recognize vulnerable 	infrastructure, including mine sites,	
	groups or climate change as a motivator	ice roads, and shipping access,	
	 While water contamination and air quality are 	permafrost thaw and other	
	commonly addressed, extreme heat, which is	landscape hazards, and extreme	
	widely acknowledged as a key vulnerability facing	weather (except for southern	
	Canadians in a changing climate, is reported in	Baffin)	
	fewer than 2% of initiatives	 Studies that examine sensitivity 	
	 Similarly, flooding is another key vulnerability yet 	and capacity to adapt to future	
	is addressed in fewer than 7% of actions	climate change are typically	
	• One <u>medium-quality systematic review</u> focused on	speculative in nature, and these	
	practices for risk communication, found that the	topics are not the primary focus of	
	most common practices were public-media	the research being reported on	
	campaigns, including radio and internet-based	 Health and well-being 	
	messages, and organization or expert-led	• There are significant gaps in	
	presentations or workshops to communities affected	understanding climate change	
	by natural hazards	impacts on health and well-being	
	• Within Ontario, communication activities such as	in the eastern and central Canadian	
	promotional messaging, response guidelines, and	Arctic	
	heat alerts and warning systems were typical risk	 Mental health is largely neglected 	
	communication tools used in practice	in the scholarship, despite the	
	 Self-efficacy and feelings of adequate 	disproportionate rates of suicide	
	preparedness were positively correlated with risk	and other mental health issues in	
	reduction behaviours in communities at high risk	the North and rapid acculturation	
	for wildfires	that is likely to increase sensitivity	
	• People were more aware of extreme weather risks	to such impacts	
	and more likely to initiate protective activities if	• Vector-, food- and waterborne	
	they were involved in a participatory exercise	diseases (e.g., E. coli, salmonella,	
		trichinella, brucellosis) that could	

	• One low-quality systematic review found that less	become more problematic with	
	than half of the articles included covered climate	climate change have been largely	
	shares solutions in a health context	overlooked	
	• Energy also of mitigation startering included	• Little research has examined how	
	O Examples of miligation strategies included	o Entre research has examined now	
	decreasing greenhouse gas emissions by installing	effect fotons for a distanting	
	solar panels, improving household insulation, and	affect future food-sharing	
	increasing active transport use	networks that structure who gets	
	 Suggested adaptation strategies included creating 	what and when	
	community adaptation plans, cutting back on	 Business and economy 	
	strenuous outdoor activity on hot or smoggy days,	• Only 11% of the articles reviewed	
	and building coastal protection	here focus on the business and	
	• A low-quality systematic review focused on	economy sector	
	adaptations being employed by Inuit populations in	 Few studies have examined 	
	the Arctic to manage the risks of current climate	opportunities for shipping and	
	change found that financial resources are an	how they should be managed to	
	important component of the means to adapt, and are	take advantage of its potential for	
	identified as one of the main barriers proventing	significant economic benefits	
	adaptation from taking place	• Few independent studies in the	
	a Many adaptations are postly and avoud the	peer-reviewed scholarship have	
	o Many adaptations are costly and exceed the	tried to determine the socio	
	inancial ability of nousenoids, communities,	aconomic and environmental	
	businesses, regional governments, and regional	imposts of minoral sytuation on	
	institutions		
	• Households often do not have access to the	surrounding communities. and	
	capital resources to purchase new hunting	their implications (positive or	
	equipment to take advantage of new conditions or	negative) for climate vulnerability	
	replace equipment lost or damaged in climate-	and adaptation	
	related hunting accidents	• Few studies examine how market	
	 Municipalities often struggle to afford existing 	conditions, transportation access,	
	maintenance projects and are not able to invest in	government policy, or	
	climate proofing infrastructure	international regulations will affect	
	• Other adaptation barriers are social-cultural in	vulnerability and adaptation in the	
	nature including the erosion of traditional land skills	eastern and central Canadian	
	among younger generations, weakening of sharing	Arctic	
	networks and the cultural value of hunting and	Culture and education	
	consuming certain traditional foods at certain times	• There is an absence of scholarship	
	of the year	comprehensively examining how	
	• One low quality antonetic accient for and a	the cultural dimensions of climate	
	One <u>iow-quality systematic review</u> focused on	change might evolve in the future	
	municipalities considering a shift to direct potable	considering climate projections	
	reuse (DPK), suggested that while conducting the	and socio-economic change	
	public engagement, planners, engineering and		
	policymakers should ensure information does not	 Hunting and subsistence harvesting 	

overburden citizens with technical information, but	• As with the other sectors, future	
at the same time, should not withhold information	dimensions of vulnerability have	
because experts feel the public may lack the	been less examined, despite ample	
knowledge or understanding to provide accurate	evidence for substantial disruption	
feedback	with changing ice regimes and	
• This review also suggested that <u>post-secondary</u>	animal populations	
education should do more to focus on curricula that	The wildlife-management literature	
includes alternative energy models and policy	has been the most forward looking,	
solutions	although future social-economic	
	trends have not been	
	comprehensively assessed	

Institutions	Number of affiliation mentions in articles*	Percent
McGill University	194	3.02
University of Toronto	148	2.30
University of British Columbia	128	1.99
University of Guelph	119	1.85
University of Alberta	98	1.52
Health Canada	97	1.51
Dalhousie University	86	1.34
McMaster University	80	1.24
Institut National de Santé Publique du Québec	64	0.99
British Columbia Centre for Disease Control	62	0.96
University of Laval	59	0.87
Hamilton Health Sciences, Population Health Research Institute	57	0.89
Public Health Agency Canada	56	0.87
Public Health Ontario	49	0.76
University of Ottawa	43	0.67
Western University	37	0.58
Institute of Clinical and Evaluative Sciences	49	0.76
University of Montreal	30	0.47
Simon Fraser University	29	0.45
Institute National Reserche Scientifique, Eau Terre	22	0.26
Carloton University	23	0.30
Montreal Heart Institute	19	0.34
Concordia University	15	0.28
University of Waterloo	15	0.23
University Booing	14	0.23
Environment and Climate Change Canada	13	0.22
Environment Canada, Atmospheric Science and Application Unit	12	0.20
Ontario Agency of Health Protection and Promotion	11	0.17
Rverson University	11	0.17
University of Calgary	10	0.17
Chiversity Of Calgary	10	0.10

Table 3: Canadian institutions with publications relevant to climate change and health

*Note that this column provides the total number of mentions of an institution in the articles identified, and includes articles that have two or more mentions of the same affiliation

Author	Affiliation	Number of	Percent of contribution to
		publications	all Canadian publications
Gosselin, Pierre	Ouranos & Univ Laval, Inst Natl Sante Publ Quebec, Quebec City, PQ G1V 5B3,	97	1.51
	Canada.		1.01
Henderson, Sarah B.	Univ British Columbia, Sch Populat & Publ Hith, Vancouver, BC V5Z 1M9, Canada.	65	1.01
Smargiassi, Audrey	Univ Montreal, Sch Publ Hlth, Dept Environm & Occupat Hlth, Montreal, PQ,	59	0.92
	Canada.		
Lavigne, Eric	Univ Ottawa, Interdisciplinary Sch Hlth Sci, Ottawa, ON, Canada.	54	0.84
Harper, Sherilee L.	Univ Guelph, Dept Populat Med, Guelph, ON N1G 2W1, Canada.	50	0.80
Auger, Nathalie	Univ Montreal, Dept Social & Prevent Med, Montreal, PQ H3C 3J7, Canada.	45	0.70
Ford, James D.	McGill Univ, Dept Geog, Montreal, PQ, Canada.	44	0.70
Brauer, Michael	Univ British Columbia, Sch Environm Hlth, Vancouver, BC V5Z 1M9, Canada.	42	0.65
Goldberg, Mark S.	McGill Univ, Div Clin Epidemiol, Ctr Hlth, Montreal, PQ H3A 1A1, Canada.	32	0.50
Belanger, Diane	CHUQ, Ctr Rech, Quebec City, PQ G1V 2M2, Canada.	30	0.47
Chen, Hong	Inst Clin Evaluat Sci, Toronto, ON, Canada.	30	0.47
Kosatsky, Tom	Direct Sante Publ Montreal, Inst Natl Sante Publ Quebec, Montreal, PQ H2L 1M3, Canada.	29	0.45
Berrang-Ford, Lea	McGill Univ, Dept Geog, Montreal, PQ, Canada.	28	0.50
Gilliland, Jason A.	Western Univ, Sch Hlth Studies, London, ON, Canada.	26	0.40
Fisman, David N.	Univ Toronto, Dalla Lana Sch Publ Hlth, Div Epidemiol, Toronto, ON M5T 3M7, Canada.	25	0.39
Baumgartner, Jill	McGill Univ, Inst Hlth & Social Policy, Montreal, PQ H3A 0G4, Canada.	24	0.37
Martin, Randall V.	Dalhousie Univ, Dept Phys & Atmospher Sci, Halifax, NS B3H 4R2, Canada.	24	0.30
Kwong, Jeffrey C.	Inst Clin Evaluat Sci, Toronto, ON, Canada.	21	0.33
To, Teresa	Univ Toronto, Dalla Lana Sch Publ Hlth, Toronto, ON, Canada.	21	0.33
Berry, Peter	Hlth Canada, Climate Change & Hlth Off, Ottawa, ON K1A 0K9, Canada.	20	0.31
Bilodeau-Bertrand, Marianne	Inst Natl Sante Publ Quebec, Montreal, PQ, Canada.	19	0.30
van Donkelaar, Aaron	Dalhousie Univ, Dept Phys & Atmospher Sci, Halifax, NS B3H 4R2, Canada.	19	0.30

Table 4: Canadian authors of publications relevant to climate change and health

Author	Affiliation	Number of	Percent of contribution to
		publications	all Canadian publications
Villeneuve, Paul J.	Carleton Univ, Dept Hlth Sci, Ottawa, ON K1S 5B6, Canada.	19	0.30
Cakmak, Sabit	Hlth Canada, Populat Studies Div, Ottawa, ON K1A 0L2, Canada.	18	0.28
Copes, Ray	Univ Toronto, Toronto, ON, Canada.	17	0.26
Rowe, Brian H.	Univ Alberta, Emergency Operat Clin Network, Univ Alberta Hosp, Dept Emergency Med, Alberta Hlth Serv, Edmonton, AB T6G 2B7, Canada.	17	0.26
Cunsolo, Ashlee	Mem Univ, Labrador Inst, Happy Valley Goose Bay, NF A0P 1E0, Canada.	16	0.25
Dales, Robert	Hlth Canada, Populat Studies Div, Ottawa, ON K1A 0K9, Canada.	16	0.30
Edge, Victoria L.	Univ Guelph, Dept Populat Med, Guelph, ON N1G 2W1, Canada.	16	0.30
Valois, Marie-France	McGill Univ, Royal Victoria Hosp, Dept Med, Montreal, PQ H3A 1A1, Canada.	16	0.25
Berke, Olaf	Univ Guelph, Ontario Vet Coll, Dept Populat Med, Guelph, ON N1G 2W1, Canada.	15	0.23
Burnett, Richard T.	Hlth Canada, Ottawa, ON K1A 0L2, Canada.	15	0.23
Clemens, Kristin K.	Lawson Hlth Res Inst, London, ON, Canada.	15	0.23
Ng, Victoria	Hosp Sick Children, Res Inst, Toronto, ON M4V 1X6, Canada.	15	0.23
Ogden, Nicholas H.	Publ Hlth Agcy Canada, Ctr Food Borne Environm & Zoonot Infect Dis, Zoonoses Div, 3200 Rue Sicotte, St Hyacinthe, PQ J2S 7C6, Canada.	15	0.23
Talbot, Denis	Univ Laval, Ctr Hosp Univ Quebec, Res Ctr, 1050 Chemin St Foy, Quebec City, PQ G1S 4L8, Canada.	15	0.23
Sargeant, Jan M.	Univ Guelph, Ctr Publ Hlth & Zoonoses, Guelph, ON N1G 2W1, Canada.	14	0.22
Abdous, Belkacem	CHUQ, Ctr Rech, Quebec City, PQ G1V 2M2, Canada.	13	0.20
Brook, Jeffrey R.	Univ Toronto, Dalla Lana Sch Publ Hlth, Toronto, ON, Canada.	13	0.20
Greer, Amy L.	Univ Guelph, Ctr Publ Hlth & Zoonoses, Guelph, ON, Canada.	13	0.20
Ouarda, Taha B. M. J.	Inst Natl Rech Sci, Quebec City, PQ, Canada.	13	0.20
Szyszkowicz, Mieczyslaw	Hlth Canada, Populat Studies Div, Ottawa, ON K1A 0K9, Canada.	13	0.20
Valois, Pierre	Univ Laval, Fac Sci Educ, Quebec City, PQ G1V 0A6, Canada.	13	0.20
Weichenthal, Scott	McGill Univ, Dept Epidemiol Biostat & Occupat Hlth, Purvis Hall,1020 Pine Ave West, Montreal, PQ H3A 1A2, Canada.	13	0.20
Wen, Shi Wu	Ottawa Hosp Res Inst, Clin Epidemiol Program, Ottawa, ON, Canada.	13	0.20
Agyapong, Vincent I. O.	Univ Alberta, Dept Psychiat, Edmonton, AB T6G 2B7, Canada.	12	0.19

Author	Affiliation	Number of	Percent of contribution to
Chahara Estal	Last Netl Dash Sei, Cta Eau Tean Earling an Orabas Cita DO, Canada	publications	all Canadian publications
Chebana, Faten	Inst Nati Rech Sci, Ctr Eau Terre Environm, Quebec City, PQ, Canada.	12	0.19
Galanıs, Eleni	Univ British Columbia, Sch Populat & Publ Hlth, Vancouver, BC, Canada.	12	0.19
Yao, Jiayun	British Columbia Ctr Dis Control, Environm Hlth Serv, Vancouver, BC V5Z 4R4, Canada.	12	0.19
Brown, Matthew R. G.	Univ Alberta, Dept Psychiat, Edmonton, AB T6G 2B7, Canada.	11	0.17
Buckeridge, David L.	McGill Univ, Clin & Hlth Informat Grp, Montreal, PQ H3A 1A3, Canada.	11	0.17
King, Suzanne	McGill Univ, Montreal, PQ H3A 1A1, Canada.	11	0.17
Orbinski, James	York Univ, Fac Hlth, Sch Hlth Policy & Management, Toronto, ON, Canada.	11	0.17
Willox, Ashlee Cunsolo	Cape Breton Univ, Dept Community Hlth, Sydney, NS, Canada.	11	0.17
Campagna, Celine	Inst Natl Sante Publ Quebec, Quebec City, PQ, Canada.	10	0.16
Chen, Yue	Univ Ottawa, Fac Med, Dept Epidemiol & Community Med, Ottawa, ON, Canada.	10	0.16
Kaplan, Gilaad G.	Univ Calgary, Dept Community Hlth Sci, Calgary, AB T2N 4N1, Canada.	10	0.16
Requia, Weeberb J.	McMaster Univ, Sch Geog & Earth Sci, Hamilton, ON, Canada.	10	0.16
Stieb, David M.	Hlth Canada, Populat Studies Div, Vancouver, BC V6C 1A1, Canada.	10	0.16
Wilk, Piotr	Inst Clin Evaluat Sci, London, ON, Canada.	10	0.16
Benmarhnia, Tarik	McGill Univ, Inst Hlth & Social Policy, 1130 Pine Ave West, Montreal, PQ H3A 1A3, Canada.	9	0.14
Bogoch, Isaac I.	Univ Hlth Network, Div Infect Dis, Toronto, ON, Canada.	9	0.14
Evans, Greg J.	Univ Toronto, Southern Ontario Ctr Atmospher Aerosol Res, Dept Chem Engn & Appl Chem, 200 Coll St, Toronto, ON M5S3E5, Canada.	9	0.14
Fournier, Michel	Agence Sante & Serv Sociaux Montreal, Direct Sante Publ, Montreal, PQ, Canada.	9	0.14
Khan, Kamran	St Michaels Hosp, Keenan Res Ctr, Li Ka Shing Knowledge Inst, Toronto, ON M5B 1W8, Canada.	9	0.14
Kulkarni, Manisha A.	Univ Ottawa, Sch Epidemiol & Publ Hlth, 600 Peter Morand Cresent, Room 217B, Ottawa, ON K1G5Z3, Canada.	9	0.14
Pearce, Tristan	Univ Guelph, Dept Geog, Guelph, ON N1G 2W1, Canada.	9	0.14
Sadeghieh, Tara	Publ Hlth Agcy Canada, Natl Microbiol Lab, Publ Hlth Risk Sci Div, Guelph, ON, Canada.	9	0.14
Sigal, Ronald J.	Univ Calgary, Dept Cardiac Sci, Calgary, AB, Canada.	9	0.14
Takaro, Tim K.	Simon Fraser Univ, Fac Hlth Sci, Burnaby, BC V5A 1S6, Canada.	9	0.14

Author	Affiliation	Number of	Percent of contribution to
Zavad Josaph	Univ Montreal Sch Publ Hith Dept Favironm & Occupat Hith Montreal PO	publications	all Canadian publications
Zayeu, joseph	Canada.	9	0.14
Zinszer, Kate	McGill Univ, Clin & Hlth Informat Grp, Montreal, PQ H3A 1A3, Canada.	9	0.14
Adams, Matthew D.	McMaster Univ, Sch Geog & Earth Sci, Hamilton, ON, Canada.	8	0.12
Austin, Stephanie E.	McGill Univ, Dept Geog, Montreal, PQ H3A 0B9, Canada.	8	0.12
Bouchard, Catherine	Univ Montreal, Grp Rech Epidemiol Zoonoses & Sante Publ GREZOSP, FMV, St Hyacinthe, PQ J2S 2M1, Canada.	8	0.12
Brown, Kevin A.	Publ Hlth Ontario, Toronto, ON M5G 1V2, Canada.	8	0.12
Daneman, Nick	Inst Rech Sunnybrook, Div Infectiol, Toronto, ON, Canada.	8	0.12
Genereux, Melissa	Eastern Townships Publ Hlth Dept, Sherbrooke, PQ, Canada.	8	0.12
Hakami, Amir	Carleton Univ, Dept Civil & Environm Engn, Ottawa, ON K1S 5B6, Canada.	8	0.12
Jacques, Louis	Clin Interuniv Sante Travail & Sante Environm, Inst Thorac Montreal, Montreal, PQ, Canada.	8	0.12
Kandlikar, Milind	Univ British Columbia, Inst Resources Environm & Sustainabil, Vancouver, BC V6T 1Z4, Canada.	8	0.12
Kenny, Glen P.	Univ Ottawa, Sch Human Kinet, Human Envirornm Physiol Res Unit, Fac Hlth Sci, Ottawa, ON K1N 6N5, Canada.	8	0.12
Michel, Pascal	Publ Hlth Agcy Canada, Natl Microbiol Lab St Hyacinthe, St Hyacinthe, PQ, Canada.	8	0.12
Stall, Nathan M.	Univ Toronto, Dept Med, Toronto, ON, Canada.	8	0.12
Wheeler, Amanda J.	Hlth Canada, Air Hlth Sci Div, Ottawa, ON K1A 0L2, Canada.	8	0.12
Yagouti, Abderrahmane	Hlth Canada, Climate Change & Hlth Off, Ottawa, ON K1A 0K9, Canada.	8	0.12
Bai, Li	Inst Clin Evaluat Sci, Toronto, ON, Canada.	7	0.11
Bernatsky, Sasha	McGill Univ, Canada Div Clin Epidemiol, Res Inst, Hlth Ctr, Royal Victoria Hosp, Montreal, PQ H3A 1A1, Canada.	7	0.11
Bishop-Williams, Katherine E.	Univ Guelph, Ontario Vet Coll, Dept Populat Med, Guelph, ON N1G 2W1, Canada.	7	0.11
Booth, Gillian L.	Univ Toronto, Dept Med, Toronto, ON, Canada.	7	0.11
Gachon, Philippe	Environm Canada, Canadian Ctr Climate Modelling & Anal CCCma, Montreal, PQ H5A 1L9, Canada.	7	0.11
Greenshaw, Andrew J.	Univ Alberta, Dept Psychiat, Edmonton, AB T6G 2B7, Canada.	7	0.11

Author	Affiliation	Number of	Percent of contribution to
Hatuanoulou Marianna	Univ Toyonto Dont Civil Enon Toyonto ON Canada		all Canadian publications
Hatzopoulou, Marianne	Univ Toronto, Dept Civil Engn, Toronto, ON, Canada.	/	0.11
Jha, Prabhat	Univ Toronto, Dalla Lana Sch Publ Hlth, St Michaels Hosp, Ctr Global Hlth Res, Toronto, ON, Canada.	./	0.11
Juni, Peter	St Michaels Hosp, Appl Hlth Res Ctr, Li Ka Shing Knowledge Inst, Toronto, ON, Canada.	7	0.11
Kaufman, Jay S.	McGill Univ, Dept Epidemiol Biostat & Occupat Hlth, Montreal, PQ, Canada.	7	0.11
Labreche, France	Univ Montreal, Sch Publ Hlth, Dept Environm & Occupat Hlth, Montreal, PQ, Canada.	7	0.11
Liu, Ling	Hlth Canada, Populat Studies Div, Hlth Environm & Consumer Safety Branch, Ottawa, ON K1A 0K9, Canada.	7	0.11
Luginaah, Isaac	Univ Western Ontario, Dept Geog, London, ON N6A 5C2, Canada.	7	0.11
McGee, Tara K.	Univ Alberta, Dept Earth & Atmospher Sci, 1-26 Earth Sci Bldg, Edmonton, AB T6G 2E3, Canada.	7	0.11
McLean, Kathleen E.	British Columbia Ctr Dis Control, Environm Hlth Serv, Vancouver, BC V5Z 4R4, Canada.	7	0.11
Middleton, Jacqueline	Univ Guelph, Dept Populat Med, 50 Stone Rd E, Guelph, ON N1G 2W1, Canada.	7	0.11
Moineddin, Rahim	Univ Toronto, Dalla Lana Sch Publ Hlth, Toronto, ON, Canada.	7	0.11
Ravel, Andre	Univ Montreal, Fac Med Vet, Dept Pathol & Microbiol, St Hyacinthe, PQ, Canada.	7	0.11
Sander, Beate	Univ Toronto, Inst Hlth Policy Management & Evaluat, Toronto, ON, Canada.	7	0.11
Schuster-Wallace, Corinne J.	United Nations Univ Inst Water Environm & Hlth, Hamilton, ON, Canada.	7	0.11
Schwartz, Brian	Sunnybrook Osler Ctr Prehosp Care, Toronto, ON, Canada.	7	0.11
Silverstone, Peter H.	Univ Alberta, Dept Psychiat, Edmonton, AB T6G 2B7, Canada.	7	0.11
Wu, Jianhong	York Univ, Dept Math & Stat, Lab Ind & Appl Math, Toronto, ON M3J 1P3, Canada.	7	0.11
Zhu, Huaiping	York Univ, LAMPS CDM, Dept Math & Stat, Toronto, ON M3J 1P3, Canada.	7	0.11
Arain, Altaf	McMaster Univ, Sch Geog & Earth Sci, Hamilton, ON, Canada.	6	0.09
Brand, Allan	INSPQ, Quebec City, PQ, Canada.	6	0.09
Brett-MacLean, Pamela	Univ Alberta, Dept Psychiat, Edmonton, AB T6G 2B7, Canada.	6	0.09
Brophy, James M.	McGill Univ, Ctr Hlth, Div Clin Epidemiol, Dept Med,Res Inst, Montreal, PQ H3A 1A1, Canada.	6	0.09

Author	Affiliation	Number of	Percent of contribution to
		publications	all Canadian publications
Brunet, Alain	McGill Univ, Montreal, PQ H3A 1A1, Canada.	6	0.09
Button, Brenton L. G.	Western Univ, Human Environm Anal Lab, London, ON, Canada.	6	0.09
Charland, Katia	McGill Univ, Clin & Hlth Informat Grp, Montreal, PQ H3A 1A3, Canada.	6	0.09
Chue, Pierre	Univ Alberta, Fac Med & Dent, Dept Psychiat, Edmonton, AB, Canada.	6	0.09
Clark, Andrew F.	Childrens Hlth Res Inst, London, ON, Canada.	6	0.09
Coates, Frances	Aerobiol Res Labs, Ottawa, ON, Canada.	6	0.09
Cole, Donald C.	Univ Toronto, Dalla Lana Sch Publ Hlth, Toronto, ON, Canada.	6	0.09
Dickin, Sarah K.	United Nations Univ Inst Water Environm & Hlth, Hamilton, ON, Canada.	6	0.09
Drolet, Julie	Univ Calgary, Fac Social Work, Edmonton, AB, Canada.	6	0.09
Fazil, Aamir	Publ Hlth Agcy Canada, Lab Foodborne Zoonoses, Publ Hlth Risk Sci Div, Guelph, ON N1G 5B2, Canada.	6	0.09
Fleury, Manon D.	Publ Hlth Agcy Canada, Environm Issues Div, Guelph, ON N1H 8J1, Canada.	6	0.09
Fraser, William D.	Univ Montreal, Hosp Res Ctr, Montreal, PQ, Canada.	6	0.09
Furgal, Chris	Trent Univ, Peterborough, ON K9J 7B8, Canada.	6	0.09
Gough, William A.	Univ Toronto, Dept Phys & Environm Sci, Scarborough, ON M1C 1A4, Canada.	6	0.09
Hayes, Katie	Univ Toronto, Dalla Lana Sch Publ Hlth, Toronto, ON, Canada.	6	0.09
Hipel, Keith W.	Conflict Anal Grp, Waterloo, ON, Canada.	6	0.09
Jones-Bitton, Andria	Univ Guelph, Dept Populat Med, 50 Stone Rd E, Guelph, ON N1G 2W1, Canada.	6	0.09
Kinlin, Laura M.	Univ Toronto, Dalla Lana Sch Publ Hlth, Toronto, ON M4T 3M7, Canada.	6	0.09
Knudby, Anders	Univ Ottawa, Dept Geog, Ottawa, ON K1N 6N5, Canada.	6	0.09
Li, Ye	Publ Hlth Ontario, 480 Univ Ave, Off 922, Toronto, ON MSG 1V2, Canada.	6	0.09
Mascarenhas, Mariola	Publ Hlth Agcy Canada, Natl Microbiol Lab, St Hyacinthe, PQ, Canada.	6	0.09
Mauro, Ian	Univ Winnipeg, Dept Geog, Winnipeg, MB R3B 2E9, Canada.	6	0.09
McGeer, Allison	Univ Toronto, Dalla Lana Sch Publ Hlth, Toronto, ON, Canada.	6	0.09
Morency, Patrick	CRCHUM, Montreal, PQ, Canada.	6	0.09
Otterstatter, Michael	Univ British Columbia, Sch Populat & Publ Hlth, Vancouver, BC, Canada.	6	0.09
Perron, Stephane	Agence Sante & Serv Sociaux Montreal, Direct Sante Publ, Montreal, PQ H2L 1M3, Canada.	6	0.09

Author	Affiliation	Number of	Percent of contribution to
		publications	all Canadian publications
Plante, Celine	Agence Sante & Serv Sociaux Montreal, Direct Sante Publ, Quebec City, PQ, Canada.	6	0.09
Renaud, Jean-Sebastien	Univ Laval, Fac Med, Quebec City, PQ, Canada.	6	0.09
Richard, Lucie	Univ Montreal, IRSPUM, Stn Ctr Ville, PQ H3C 3J7, Canada.	6	0.09
Shin, Hwashin Hyun	Hlth Canada, Environm Hlth Sci & Res Bur, Ottawa, ON, Canada.	6	0.09
Shiwak, Inez	Rigolet Inuit Community Govt, My Word Storytelling & Digital Media Lab, Labrador City, ON A0P 1P0, Canada.	6	0.09
Soucy, Jean-Paul R.	McGill Univ, Dept Epidemiol Biostat & Occupat Hlth, Montreal, PQ, Canada.	6	0.09
Su, Yushan	Ontario Minist Environm Conservat & Pk, Environm Monitoring & Reporting Branch, Toronto, ON, Canada.	6	0.09
Wang, Jonathan M.	Ontario Minist Environm, Environm Monitoring & Reporting Branch, Conservat & Pk, Etobicoke, ON M9P3V6, Canada.	6	0.09
Wood, Michele	Nunatsiavut Govt, Dept Hlth & Social Dev, Happy Valley Goose Bay, NF A0P 1CO, Canada.	6	0.09
Akinjise, Idowu	Univ Alberta, Fac Med & Dent, Dept Family Med, Edmonton, AB, Canada.	5	0.08
Beltrami, Hugo	St Francis Xavier Univ, Dept Earth Sci, Antigonish, NS B2G 1C0, Canada.	5	0.08
Chapman, Colin A.	McGill Univ, Dept Anthropol, 855 Sherbrook St West, Montreal, PQ H3A 2T7, Canada.	5	0.08
Chatwood, Susan	Inst Circumpolar Hlth Res, Yellowknife, NT, Canada.	5	0.08
Corbett, Sandra E.	Northern Lights Reg Hlth Ctr, Dept Psychiat, Ft Mcmurray, AB, Canada.	5	0.08
Dhar-Chowdhury, Parnali	Publ Hlth Agcy Canada, Natl Microbiol Lab, Winnipeg, MB, Canada.	5	0.08
Dodd, Warren	Univ Waterloo, Sch Publ Hlth & Hlth Syst, Waterloo, ON, Canada.	5	0.08
Drews, Steven J.	Mt Sinai Hosp, Toronto, ON M5G 1X5, Canada.	5	0.08
El-Gabalawy, Renee	Univ Manitoba, Dept Anesthesiol Perioperat & Pain Med, AE209, Harry Medovy House, 671 William Ave, Winnipeg, MB R3E 0Z2, Canada.	5	0.08
Ge, Erjia	Univ Toronto, Dana Lana Sch Publ Hlth, Toronto, ON, Canada.	5	0.08
Goudreau, Sophie	Agence Sante & Serv Sociaux Montreal, Direct Sante Publ, Montreal, PQ, Canada.	5	0.08
Gower, Stephanie	Toronto Publ Hlth, Toronto, ON M5B 1W2, Canada.	5	0.08
Haque, C. Emdad	Univ Manitoba, Nat Resources Inst, Winnipeg, MB, Canada.	5	0.08
Hawkes, Michael T.	Univ Alberta, Women & Childrens Res Inst, Edmonton, AB, Canada.	5	0.08

Author	Affiliation	Number of	Percent of contribution to
		publications	all Canadian publications
He, Siyi	Inst Natl Sante Publ Quebec, 190 Cremazie Blvd E, Montreal, PQ H2P 1E2, Canada.	5	0.08
Ho, Hung Chak	Okanagan Coll, Dept Geog Earth & Environm Sci, Kelowna, BC V1Y 4X8, Canada.	5	0.08
Hongoh, Valerie	Univ Montreal, Fac Med Vet, Grp Rech Epidemiol Zoonoses & Sante Publ, St Hyacinthe, PQ, Canada.	5	0.08
Hrabok, Marianne	Univ Alberta, Fac Med & Dent, Dept Psychiat, 8440 112 St NW, Edmonton, AB T6G 2B7, Canada.	5	0.08
Khan, Yasmin	Univ Toronto, Div Emergency Med, Dept Med, Toronto, ON, Canada.	5	0.08
Kong, Jude Dzevela	York Univ, Ctr Dis Modelling, Toronto, ON, Canada.	5	0.08
Li, Xin-Min	Univ Alberta, Fac Med & Dent, Dept Psychiat, Edmonton, AB, Canada.	5	0.08
Lo, Ernest	Inst Natl Sante Publ Quebec, Montreal, PQ H2P 1E2, Canada.	5	0.08
Majeed, Haris	Univ Toronto, Inst Med Sci, Toronto, ON, Canada.	5	0.08
Mak, Sunny	British Columbia Ctr Dis Control, Vancouver, BC, Canada.	5	0.08
Martin, Gina	Childrens Hlth Res Inst, London, ON N6A 5A5, Canada.	5	0.08
Masselot, Pierre	Canada Res Chair Stat Hydroclimatol INRS ETE, Quebec City, PQ, Canada.	5	0.08
McDonald-Harker, Caroline	Mt Royal Univ, Dept Sociol & Anthropol, Calgary, AB, Canada.	5	0.08
Mills, Brian	Univ Waterloo, Meteorol Res Div, Environm Canada, Fac Environm, Waterloo, ON N2L 3G1, Canada.	5	0.08
Montesanti, Stephanie	Univ Calgary, Dept Community Hlth Sci, Calgary, AB, Canada.	5	0.08
Moore, G. W. K.	Univ Toronto, Dept Phys, Toronto, ON, Canada.	5	0.08
Nwaka, Bernard	Univ Alberta, Fac Med & Dent, Dept Family Med, Edmonton, AB, Canada.	5	0.08
Pearl, David L.	Univ Guelph, Ontario Vet Coll, Dept Populat Med, Guelph, ON N1G 2W1, Canada.	5	0.08
Pollock, Nathaniel	Labrador Grenfell Reg Hlth Author, Goose Bay, NF, Canada.	5	0.08
Rockwood, Kenneth	Dalhousie Univ, Dept Med, Halifax, NS, Canada.	5	0.08
Saari, Rebecca K.	Univ Waterloo, Dept Civil & Environm Engn, Waterloo, ON, Canada.	5	0.08
Saposnik, Gustavo	Inst Clin Evaluat Sci, Toronto, ON, Canada.	5	0.08
Sawatzky, Alexandra	Univ Guelph, Dept Populat Med, 50 Stone Rd E, Guelph, ON N1G 2W1, Canada.	5	0.08

Author	Affiliation	Number of	Percent of contribution to
		publications	all Canadian publications
Shutt, Robin	Hlth Canada, Healthy Environm & Consumer Safety Branch, Environm Hlth Sci &	5	0.08
	Res Bur, Ottawa, ON K1A 0L2, Canada.		
Smit, Barry	Univ Guelph, Dept Geog, Guelph, ON N1G 2W1, Canada.	5	0.08
Somayaji, Ranjani	Univ Calgary, Dept Infect Dis, Calgary, AB, Canada.	5	0.08
Thompson, Wendy	Publ Hlth Agcy Canada, Ottawa, ON, Canada.	5	0.08
Wells, Samantha	Western Univ, Schulich Sch Med & Dent, Dept Epidemiol & Biostat, London, ON	5	0.08
	N6A 5C1, Canada.		
White, Alexander N. J.	Univ Toronto, Fac Med, Toronto, ON M5S 1A8, Canada.	5	0.08
Young, Ian	Publ Hlth Agcy Canada, Lab Foodborne Zoonoses, Publ Hlth Risk Sci Div,	5	0.08
	Guelph, ON N1G 5B2, Canada.		
Zhang, Leiming	Environm & Climate Change Canada, Sci & Technol Branch, Air Qual Res Div,	5	0.08
	Toronto, ON, Canada.		
Zhu, Jingqin	Inst Clin Evaluat Sci, Toronto, ON, Canada.	5	0.08

Vélez CM, Waddell K, Berrang-Ford L, Callaghan M, Minx J, Harper S, Lavis JN, Wilson MG. Rapid evidence profile #30.2: What are the biggest gaps in evidence about the impacts of climate change on population health in Canada, and adaptation and mitigation strategies that are applicable to Canada? Hamilton: McMaster Health Forum, 21 June 2022.

To help health- and social-system leaders as they respond to pressing challenges related, the McMaster Health Forum prepares rapid evidence profiles like this one. This rapid evidence profile was commissioned by the Office of the Chief Science Officer, Public Health Agency of Canada. The opinions, results, and conclusions are those of the McMaster Health Forum and are independent of the funder. No endorsement by the Public Health Agency of Canada is intended or should be inferred.





>> Contact us 1280 Main St. West, MML-417 Hamilton, ON, Canada LBS 4L6 +1.905.525.9140 x 22121 forum@mcmaster.ca

Appendices for COVID-19 Rapid Evidence Profile #30.2

(21 June 2022)

Appendix 1: Methodological details

Identifying research evidence

To identify gaps in evidence about the impacts of climate change on population health in Canada and on adaptation and mitigation strategies applicable to Canada, we used data from a <u>living</u> evidence synthesis that identified 17,105 documents as of the end of 2021. Of these documents, 402 mentioned Canada and/or one or more province in the title or abstract, and/or included at least one study conducted in Canada. Each of the 402 documents were assessed by a single reviewer to ensure relevance to Canada, climate change, and public health. In addition, each of the included single studies were categorized by one reviewer according to the forms of evidence profiled in the <u>Evidence Commission report</u> (data analytics, modelling, evaluation, behavioural/implementation, and/or qualitative insights).

We supplemented this dataset by drawing on Social Systems Evidence and excluding duplicates that had already been included from the living evidence synthesis. In Social Systems Evidence, we used filters under programs and services for "climate action," "environmental conservation," "food safety and security," and "natural resources." We combined these with key words searches for "climate change" AND (health OR public health) and required that the documents mentioned Canada and/or one or more studies was conducted in Canada. A single reviewer assessed these documents for inclusion to ensure they related to climate change and public health.

Searching and triaging process to identify and include equity-relevant evidence

We draw on WHO's definition of equity and health equity, defining equity as the absence of avoidable, unfair, or remediable differences among groups of people, whether those groups are defined socially, economically, demographically or geographically, or by other means of stratification. Health equity implies that everyone should have a fair opportunity to attain their full health potential and that no one should be disadvantaged from achieving this potential.

To identify documents that include an equity focus, we compiled key words across 10 equity-related search strings or filters identified in the literature or through recognized library and information science organizations. In addition to terms describing PROGRESS-Plus (acronym used to describe the many dimensions across which health equity may exist), we also included an ethics-specific filter, developed by the Health Technology Assessment division of the Institut national de l'excellence en santé et services sociaux (INESSS). Our final list included 243 unique keywords addressing various equity-related terms.

We individually searched for each keyword in the titles and abstracts of all included documents. Documents were screened by a single reviewer.

Assessing relevance and quality of evidence

We assess the relevance of each included evidence document as being of high, moderate or low relevance to the question. We then use a colour gradient to reflect high (darkest blue) to low (lightest blue) relevance.

Two reviewers independently appraised the methodological quality of systematic reviews and rapid reviews that are deemed to be highly relevant. Disagreements are resolved by consensus with a third reviewer if needed. AMSTAR rates overall methodological quality on a scale of 0 to 11, where 11/11 represents a review of the highest quality. High-quality reviews are those with scores of eight or higher out of a possible 11, medium-quality reviews are those with scores between four and seven, and low-quality reviews are those with scores less than four. It is important to note that the AMSTAR tool was developed to assess reviews focused on clinical interventions, so not all criteria apply to systematic reviews pertaining to health-system arrangements or to economic and social responses to COVID-19. Where the denominator is not 11, an aspect of the tool was considered not relevant by the raters. In comparing ratings, it is therefore important to keep both parts of the score (i.e., the numerator and denominator) in mind. For example, a review that scores 8/8 is generally of comparable quality to a review scoring 11/11; both ratings are considered 'high scores.' A high score signals that readers of the review can have a high level of confidence in its findings. A low score, on the other hand, does not mean that the review should be discarded, merely that less confidence can be placed in its findings and that the review needs to be examined closely to identify its limitations. (Lewin S, Oxman AD, Lavis JN, Fretheim A. SUPPORT Tools for evidence-informed health Policymaking (STP): 8. Deciding how much confidence to place in a systematic review. Health Research Policy and Systems 2009; 7 (Suppl1):S8.

Preparing the profile

Each included document is hyperlinked to its original source to facilitate easy retrieval. For all included guidelines, systematic reviews, rapid reviews and single studies (when included), we prepare declarative headings that provide a brief summary of the key findings and act as the text in the hyperlink. Protocols and titles/questions have their titles hyperlinked given that findings are not yet available. We then draft a brief summary that highlights the total number of different types of highly relevant documents identified (organized by document), as well as their key findings, date of last search (or date last updated or published), and methodological quality.

Appendix 2: Key findings from evidence syntheses that address the question, organized by document type and sorted by relevance to the question

Type of document	Relevance to question	Key findings	Recency or status
Scoping review	 Climate risks Heat Health risks and impacts All-cause mortality Options and responses Policy and practice Adaptation Equity-deserving groups Elderly 	 This review focused on the negative consequences of extreme temperatures on the environment, ecosystem, and human health, especially heat-related illnesses The review synthesized effective population-level heat-related interventions from 17 studies Heat action plans included but were not limited to establishing a heat monitoring system, informative campaigns, the mobilization of healthcare professionals, volunteers, social workers and trained caregivers in the surveillance, and management of individuals with known vulnerabilities Other action plans addressed education and awareness campaigns Multi-pronged heat action plans were highly effective in reducing heat-related mortality and morbidity, especially among vulnerable populations such as the elderly and those with chronic conditions 	Literature last searched 2020
Systematic review	 Climate risks General climate change Health risks and impacts Food and nutrition Food insecurity Options and responses Developing community resilience Equity-deserving groups Indigenous Women and gender-diverse people 	 This review synthesized 86 articles focused on the global trends and future actions for community-based monitoring of Indigenous food security Authors reported an increasing interest in community-based monitoring (CBM) and explained this increase in interest as part of a broader trend around the need to address the disproportionate food security and climate change impacts often experienced by Indigenous communities globally One third of the reviewed articles provided gender-disaggregated data; authors recommend a better understanding of the gendered nature of CBM, as well as the relationship between climate, food and gender, for planning and designing a CBM system that reflects gender equity Considering the history of unethical research conducted on and not with Indigenous communities, there is increasing demand for the recognition of Indigenous peoples' 	Literature last searched 2018

		 contributions and knowledge in the context of research, including climate change research Successful CBM generally occurs when Indigenous communities monitor things they personally connect with and care about, rather than for externally driven needs Community engagement is also important for generating local ownership and understandings of environmental change, and to facilitate the development of local climate change adaptation responses It is likely that monitoring is carried out without documentation in the published literature, as many Indigenous communities often monitor environmental changes and the health of their land In studies where the food-security pillar was specified, CBM typically focused on food availability and access Measuring resilience is challenging because the concept of food-system resilience has not been well defined for climate change, and the links between resilience of food systems and climate change are not straight forward; moreover, limited conceptual tools and frameworks are available to guide such assessments Research gaps Lack of studies providing gender-disaggregated data, resulting in an incomplete understanding of how Indigenous women, men, and gender-diverse people may differentially participate in, and experience CBM The limited focus on reporting evaluation findings Analyzing the grey literature is recommended for future research to better understand the full spectrum of CBM practice occurring within Indigenous communities, especially of autonomous monitoring systems which may be investigated or evaluated outside of research and the published literature 	
Systematic review	 Climate risks General climate change Options and responses Mitigation co-benefits Energy policy and co-benefits 	• This systematic review synthesized 204 studies to understand how and whether characteristics of environmental problems influence the effectiveness of policy instruments, as well as to understand the possible trade-offs between cost-effectiveness, solving the environmental problems and government	Literature last searched 2011
		accountability	

• Authors found that there is the potential risk of a trade-off
between accountability and efficiency depending on a policy
instrument's source of authority; this indicates that decision-
makers using policies that target the private sector must
carefully balance a need for practical and feasible policies
against the threat of becoming captured by these interests
• Expenditure instruments perform better than regulatory
instruments in overall and impact evaluations
• Policies with built-in flexibility are more likely to have positive
overall, process and efficiency evaluation results
• Policy instruments with voluntary reporting procedures are
much less likely to be positively evaluated than those with
mandatory reporting procedures
• There is a possible trade-off between environmental
effectiveness and cost-effectiveness depending on the stage of
activity that a policy targets
• As the defined time frame of policies increases, the likelihood
these policies will be positively evaluated for efficiency and
process also increases
Research gaps
• More research is needed to examine the leaders in the water-
management field to understand what works and does not
work for adapting to climate change in different coastal and
fresh-water systems
• It is also important to study the emerging nexus between
water and energy, for instance, countries that experienced
water's significance first-hand during droughts, can bring
acute electricity blackouts and energy rationing to the
populous, and this risk also exists in other power
generation sources, such as nuclear energy
 Thermal power production across Canada in 2005
consumed 64 percent of national gross water use,
underscoring its high reliance on water and the close
connection of water and energy
• The need for primary research with business on the rationale,
design, implementation and performance measurement of
private policy initiatives; similarly, primary research examining
a wider swath of policies would help verify that expenditure
policies fare better than regulation in overall evaluations
• <u>Source</u> (AMSTAR rating 2/9)

Systematic review	 Climate risks General climate change Health risks and impacts Patients and health systems Public health 	 This systematic review, which synthesized 117 articles, focused on the current knowledge about human dimensions of climate change in the Canadian Arctic Authors found that the effects of climate change on subsistence harvesting and other land-based activities, and the 	Published September 2012
	 Options and responses Policy and practice Adaptation 	determinants of vulnerability and adaptation to such changes are well understood; however, the effects of climate change on health are less known	
	 Equity-deserving groups Arctic inhabitants Indigenous 	• Studies on food security and personal safety dominate, and little peer-reviewed scholarship focuses on the business and economic sector	
		 Published research shows a strong bias toward case studies in smaller communities, especially communities in Nunavut, with studies focused primarily on negative impacts of climate change, present-day vulnerabilities, and adaptive capacity Studies proposing opportunities for adaptation intervention are beginning to emerge Authors highlighted the adaptability of northern populations and the effects of economic-political stresses on vulnerability to changing climate There is a lack of studies that examine how Northerners can benefit from new opportunities that may arise from climate change, or assess how the interaction of future climatic and socio-economic changes (specifically, resource development and enhanced shipping) will affect their experience of and response to climate change, or discuss the broader 	
		determinants of vulnerability and adaptation	
		 Infrastructure and Transportation Broader vulnerabilities in the infrastructure and transportation sector have been neglected Only limited published research exists on the vulnerability of municipal infrastructure (e.g., community drinking water, waste management, buildings), industry-related infrastructure, including mine sites, ice roads, and shipping access, permafrost thaw and other landscape hazards, and extreme weather (except for southern Baffin) Studies that examine sensitivity and capacity to adapt to 	



Scoping review	 Climate risks 	 Culture and education It is necessary for more research about the potential mental health ramifications of cultural impacts of climate change in the Arctic There is an absence of scholarship comprehensively examining how the cultural dimensions of climate change might evolve in the future considering climate projections and socio-economic change Many questions remain unanswered: will larger regional communities with their strong and growing wage-based economies be as vulnerable as smaller communities to the cultural implications of climate change?; are non-Inuit residents susceptible to similar cultural effects?; would reduced reliance on subsistence hunting reduce sensitivity to potential cultural impacts?; and as northern self-determination proceeds, will communities feel better prepared to address the cultural effects of climate change? Hunting and subsistence harvesting As with the other sectors, future dimensions of vulnerability have been less examined, despite ample evidence for substantial disruption with changing ice regimes and animal populations The wildlife-management literature has been the most forward looking, although future social-economic trends have not been comprehensively assessed Resource development could have significant implications for wildlife management, through its effects on populations, by altering socio-economic characteristics of communities, and in other ways that have not been examined Source (AMSTAR rating 4/9) The objective of this review was to explore the reported health 	Literature last
	 Particulate matter Health risks and impacts Respiratory Air pollution Options and responses Developing community resilience 	 impacts of climate change and air pollution exposures in older adults and immigrant people living in Canada, as well as factors influencing risk and resilience in these populations Authors identified 52 eligible studies, most of them focused on Ontario and Quebec 	searched June 2020

		 Older people in Canada experience health risks due to climate and air-pollution exposures Authors found little information about the climate- and air pollution-related health impacts experienced by immigrant communities Research gaps There are substantial gaps in terms of the location of populations that have been studied The impact of climatic and air-pollution variables on health was studied most frequently in southern Ontario and Quebec, but less in other provinces, especially in rural areas The Prairie and Maritimes provinces were largely understudied, with urban populations in Alberta being studied the most frequently within this group No studies in the territories were found, despite the fact that these northern regions are facing greater impacts from climate change Generally, urban areas in southern Ontario, Alberta, and British Columbia experience higher levels of PM2.5, O3, and NO2 relative to other regions Variations in climate adaptation and mitigation policy between regions may also reflect research priorities and provide some explanation for geographical gaps Most publications were also set in urban areas, though some province-wide population studies included urban and rural residence indicators The health impacts of climate change in rural populations and the specific factors that influence this relationship in Canada are largely undetermined for older adults and immigrants 	
Systematic review		Source (AMSTAR rating 6/9)	Litoutture last
Systematic review	 Climate risks General climate change Options and responses Policy and practice Adaptation 	 This review focused on identifying climate change adaptation initiatives that have been implemented and show some degree of effectiveness, with most relevant findings from the synthesis of 110 case studies being: Adaptation activities most frequently represented in this review were community-based programs, ecological restoration, knowledge sharing and learning platforms, and changing crop types and planting and harvesting practices 	searched 2018

		 While these activities demonstrated improvement in at least one category of effectiveness (that is, they reduced risk and vulnerability, developed resilient social systems, improved the environment, increased economic resources, or enhanced governance and institutions), several activities indicated effectiveness across multiple categories The development of local cooperative associations improved individual and community access to resources, improved livelihoods through offering financial assistance and increasing income levels, and facilitated learning and knowledge sharing within and across communities Community-based and institutionalized techniques for sharing physical, financial and informational resources, and techniques that aim to improve human well-being, institutional relations, and environmental security Research gaps It is necessary for more research addressing issues of justice, including representation of diverse types of knowledge and expertise, fair distribution of adaptation benefits, and imbalanced power relationships within the adaptation process Research and evaluation offer techniques to reveal issues in leadership, decision-making, access, and profit, and to monitor progress towards developing more equitable adaptation practices; however, these techniques are not often implemented in practice 	
Scoping review	 Climate risks Extreme weather events Health risks and impacts Patients and health systems Public health Options and responses Policy and practice Adaptation Equity-deserving groups Low-income communities The elderly Racial and ethnic minorities People with disabilities 	 Source (AMSTAR rating 4/9) This scoping review was led by Public Health Ontario, and highlighted three main themes: First, the most common practices for risk communication were public-media campaigns, including radio and internet-based messages, and organization- or expert-led presentations or workshops to communicate affected by natural hazards Within Ontario, communication activities such as promotional messaging, response guidelines, and heat alerts and warning systems were typical risk-communication tools used in practice Self-efficacy and feelings of adequate preparedness were positively correlated with risk reduction behaviours in communities at high risk for wildfires 	Literature last searched 2014

Systematic review	 Climate risks Extreme weather events Options and responses Policy and practice Adaptation 	 Authors highlighted three major research gaps surrounding EWCC (extreme weather climate change) risk communications First, a shortage of empirical studies and a limited amount of applied theory in study design and execution; the reviewed literature is context specific and difficult to use to generate programs and frameworks because the approaches to measuring variables such as risk perception and a willingness to act are not cohesive or consistent Second, a lack of evaluation of current risk-communications strategies, especially poor integration of community-led initiatives in future planning, often because such initiatives were not properly evaluated Third, the research base relates to a focus on individuals, at the expense of the household and extended family networks, so future research might therefore include families and various intimate social groupings as a starting point in theoretical frameworks, and allow analysis of household dynamics as they pertain to preparedness activity for EWCC risks Source (AMSTAR rating 4/9) Several adaptations are documented as being employed by Inuit populations in the Arctic today to manage the risks of current climate change: The substitution of traditional foods with store foods when hunting areas are not accessible 	Literature last searched 2009
		 Second, vulnerable communities, such as low-income communities, the elderly, racial and ethnic minorities, and people with disabilities, face challenges in seeking and processing risk communication information, including complex language, information overload and contradictory information Third, the importance of leveraging social networks and creating strategies housed [or based] in communities; for instance, people were more aware of extreme weather risks and more likely to initiate protective activities if they were involved in a participatory exercise Broader involvement of civil society organizations such as the Red Cross and YMCA play important social roles in health adaptation and community engagement 	

o Indigenous	 Altered timing mode and methods of subsistance
0 mugenous	activities
	• The establishment of community evacuation and
	preparedness plans in case of extreme events
	• The development of new ice-based transportation routes
	to avoid dangerous areas
	• The strengthening of municipal infrastructure to cope with
	altered climatic extremes
	• The development of youth–elder mentoring programs to
	transmit traditional knowledge on environmental risks
	o Increasing use of community freezers to store and make
	• Financial resources are an important component of the means
	preventing adaptation from taking place
	• Many adaptations are costly and exceed the financial ability
	of households, communities, businesses, regional
	governments, and regional institutions
	• Households often do not have access to the capital
	resources to purchase new hunting equipment to take
	advantage of new conditions or replace equipment lost or
	damaged in climate-related hunting accidents
	• Municipalities often struggle to afford existing maintenance
	projects and are not able to invest in climate-proofing
	• Other destation having an inlanding strend in setting
	• Other adaptation barriers are social-cultural in nature,
	generations, weakening of sharing networks, and the cultural
	value of hunting and consuming certain traditional foods at
	certain times of the year
	• Some adaptations have the potential to reduce future exposure
	sensitivities and increase adaptive capacity, including integrated
	regional planning to anticipate future conflicts and stresses,
	enhanced harvester support assistance, improved skills
	training, improved search and rescue capacity, better weather
	and ice hazard forecasting, protection of cultural sites,
	infrastructure strengthening, and support for new technology
	Research gaps
	• There is a need to identify a suite of potential adaptations and
	examine their effectiveness in reducing climate change

		 vulnerability, specify their costs and benefits, and assess broader non-climatic benefits Studies lack detailed policy analysis and often present adaption responses as part of 'wish lists' No published studies have undertaken cost benefit analysis of adaptation options, examined how adaptations would be developed and implemented, assessed support for various options among stakeholders and community members, or examined the performance of adaptation options under different climate change scenarios Few publications report on adaptations in health, cultural and education, or economy and business sectors Source (AMSTAR rating 3/9) 	
Systematic review	 Climate risks General climate change Health risks and impacts All-cause mortality Patients and health systems Public health 	 The review aims to identify health morbidity and mortality indicators used (or that could be used) in Canada to quantify the impacts of climate change The review identified 77 health indicators of which eight were identified based on an indicator rating scale for best use: Excess daily all-cause mortality due to heat Premature deaths due to air pollution Preventable deaths from climate change Disability adjusted life years lost from climate change Daily all-cause mortality (trends associated with heat and air pollution) Daily non-accidental mortality (trends associated with heat and air pollution) West Nile disease incidence (in humans) Lyme borreliosis incidence (in humans) The first four indicators are modelled (i.e., require statistical calculations based on collected data) while the second four are non-modelled The modelled indicators may be difficult for public-health adaptation applications as they are not currently available for many communities in Canada, while the non-modelled indicators may be more readily available for immediate use by Canadian public-health authorities Research gaps The authors of the review also identified two existing gaps: The need for indicators, such as those above, to evaluate the health effects of climate change 	Literature last searched December 2012

	assess/model indicators and expertise and human resources to continuously evaluate and modify the analysis Source (AMSTAR rating 2/9)	
Systematic review Climate risks General climate change Health risks and impacts Mental health Mental health and post-traumatic stress disorder Suicide Equity-deserving groups Indigenous 	 Review (interfect tading <i>e</i>/<i>s</i>/<i>s</i> Review aims to synthesize literature on the effects of meteorological, seasonal and climactic changes on Indigenous mental health The review found that climactic stressors were not exclusive to any one pathway, people or region, and were often overlapping Acute and short-term weather events such as storms, flooding, temperature and seasonality were linked to a range of psychological and mental health impacts, including depression, anxiety, suicide, self-harm, post-traumatic stress disorder, psychological resilience, mental illness and behavioural disorders, and strong emotional reactions such as fear and anxiety Sub-acute and chronic weather events and environmental changes were often linked to feelings of loss, worry, anger, sadness, and ongoing emotional distress, but were not directly linked to many of the more acute presentations of mental health distress such as suicide and depression Climatic stressors did not need to be experienced directly to induce mental health impacts, but rather can be experienced through vicarious distress, whereby individuals fear or empathize with those experiencing intense weather or environmental conditions Climatic change was also found to disrupt place-attachment which is critical for enabling Indigenous populations feelings of identity, self-worth, and for strengthening interpersonal relationships and cultural practices There is some evidence to show that females report higher levels of frustration, sadness, fear, anger and helplessness in the face of climatic changes Climatic changes were reported to compound existing feelings of abandonment of Indigenous peoples by government and the broader global community No estimates were provided regarding the prevalence or incidence of these impacts 	Literature last searched 2018

		• The review notes that very little of the included research were population-level studies or provided a longitudinal perspective Source (AMSTAR rating 5/9)	
Systematic review	 Climate risks General climate change Health risks and impacts Patients and health systems Public health Equity-deserving groups Indigenous 	 This review focused on effects of climate change on Aboriginal health, with synthesized literature on Aboriginal health outcomes, determinants, and trends in Canada using a vulnerability framework to identify the broad-level factors constraining adaptive capacity and increasing sensitivity to climate change Authors identified some determinants related to constraining adaptive capacity and increasing sensitivity to climate change on Aboriginal health, including: Poverty, technological capacity constraints, socio-political values and inequality, institutional capacity challenges, and information deficit The magnitude and nature of these determinants are distributed unevenly within and between Aboriginal populations, necessitating place-based and regional level studies to examine how these broad factors will affect vulnerability at lower levels Authors concluded that is necessary for collaboration across all sectors and levels of government, open and meaningful dialogue between policymakers, scientists, health professionals and Aboriginal communities, and capacity building at a local level, to plan for climate change 	Literature last searched July 2009
Systematic review	 Climate risks General climate change Health risks and impacts Patients and health systems Public health Options and responses Policy and practice Adaptation 	 This study aimed to identify and characterize Canadian federal, provincial, territorial, and municipal adaptation to health risks Federal health adaptation initiatives emphasize capacity building and gathering information to address general health, infectious disease and heat-related risks Provincial and territorial adaptation is varied, for instance, Quebec is a leader in climate change adaptation, addressing almost all risks posed by climate change in the province, and having implemented various adaptation types; meanwhile, all other Canadian provinces and territories are in the early stages of health adaptation The six sampled Canadian regional health authorities, or equivalent (Calgary, Edmonton, Montreal, Ottawa, Toronto, Vancouver) are not reporting any adaptation initiatives 	Published January 2015

		Source (AMSTAR rating 2/9)	
Scoping review	 Climate risks General climate change Health risks and impacts Patients and health systems Public health Options and responses Developing community resilience Policy and practice Adaptation Mediating pathways Geographic exposure Rural households Equity-deserving groups Rural and remote regions 	 Changing climate conditions is negatively affecting the health and well-being of individuals in rural and remote regions, including increased prevalence and severity of extreme weather events, changes to sea ice, vegetation, fish, wildlife and weather, and environmental uncertainties Health impacts of these include poor nutrition, obesity, vector-borne/waterborne/food-borne disease, cardiovascular disease, respiratory issues, and mental health issues, among others Adaptation strategies are needed to address these challenges, including: Using multiple knowledge systems, specific to sociocultural context Address socio-cultural barriers Use innovative technology Improve and integrate public health and environmental surveillance Support sustainable development practices Enhance risk communication and knowledge of climate change Additional details for the implementation or evaluation of these adaption strategies were not provided 	Literature last searched 2019
Systematic review	 Climate risks General climate change Options and responses Policy and practice Adaptation 	 Health impacts of climate change on populations include greater morbidity and mortality from poor air quality, food shortages, water- and food-borne contamination, extreme weather events, and changing patterns of disease spread by animals Literature review examines the similarities and difference between the climate change adaptation frameworks that have been developed and the Ontario Public Health Standards The review found that regular population-health risk assessments and risk-management activities by local public-health units can help to address risks related to climate hazards The comparison between frameworks and Ontario Public Health Standards shows many similarities in the steps to address health impacts – steps featured in both include: 	Literature last searched 2008

		• Engagement of stakeholders	
		• Identification and burden of climate-related illness and	
		injury	
		• Assessment of the effectiveness of programs and estimities	
		o Assessment of the effectiveness of programs and activities	
		o Identification and prioritization of policy and program	
		ontions to meet health needs	
		Research gaps	
		• Assessments of heat health values abilities require projections	
		• Assessments of heat-health vulnerabilities require projections	
		information related to the geographical variation in exposure	
		to extreme heat identification of suberable populations and	
		identification of actual temperature and morbidity/mortality	
		thresholds	
		• Public-health interventions that may be implemented to reduce	
		climate change impacts on health within relevant time scales	
		(five to 10 years) need to be identified through assessments	
		• It is necessary for case studies and community examples that	
		aid public-health officials in their efforts to obtain, analyze and	
		integrate findings from climate scenarios and models to gauge	
		future impacts on health	
		• Additional efforts should be made to understand the most	
		effective and efficient ways to provide this information to	
		authorities charged with protecting the public from climate-	
		related health risks	
		Source (AMSTAR rating 2/9)	
Systematic review	Climate risks	• This review aimed to identify and examine what adaptations	Literature last
	 General climate change 	are being developed by civil society organizations (CSOs) to	searched 2013
	Health risks and impacts	adapt to the health effects of climate change, based on a	
	 Patients and health systems 	systematic review of the activities of 190 organizations	
	 Public health 	Adaptations being implemented by CSOs in Canada consist	
	o WASH	predominantly of groundwork interventions including	
	 Drinking-water quality 	awareness, research and networking activities that aim to build	
	Options and responses	adaptive capacity	
	• Policy and practice	• Adaptations most frequently address water contamination and	
	 Adaptation 	air quality, and occur most often as awareness raising and	
		research acuvities	
		• Adaptations intrequently recognize vulnerable groups or	
		climate change as a motivator	

		 There is a deficit in terms of what needs to be done to address adaptation and what is being done, which is part of a broader problem identified in Canada and beyond and that is reflected in limited CSO action on key vulnerabilities, for instance: While water contamination and air quality are commonly addressed, extreme heat, which is widely acknowledged as a key vulnerability facing Canadians in a changing climate, is reported in fewer than 2% of initiatives Similarly, flooding is another key vulnerability yet is addressed in fewer than 7% of actions Such impacts will affect the activities of multiple CSOs that deal with the elderly, low-income households, marginalized communities and the homeless The diversity of organizations engaged in adaptation indicates potential for collaboration between public health bodies and CSOs Research gaps It is necessary for more research on adaptations to flooding and extreme heat Consideration of vulnerable groups is limited 	
Systematic review	 Climate risks Drought Health risks and impacts WASH Drinking-water quality Options and responses Policy and practice Adaptation 	 This review provided an analysis of the existing literature about direct potable reuse of water in developed countries, mainly the United States, Australia and Canada When municipalities are considering a shift to direct potable reuse (DPR), while conducting public engagement, planners, engineering and policymakers should ensure information does not overburden citizens with technical information, but at the same time, should not withhold information because experts feel the public may lack the knowledge or understanding to provide accurate feedback In the United States, Australia and Canada, citizens would report negative feedback when asked about drinking recycled wastewater Post-secondary education should do more to focus on curricula that includes alternative energy models and policy solutions Research points to decentralized direct potable reuse (DPR) either being already competitive, or shortly becoming 	Published May 2017

		competitive against traditional waster water treatment plants	
		(W/W/T'De)	
		• Some of the major reasons that DDP has not been	
		• Some of the major reasons that DFK has not been	
		• A lack of understanding on public opinion around drinking	
		and using recycled wastewater for potable reuse	
		 Policies and regulations are varied across provinces 	
		territories and municipalities	
		• Canada has not had to experience as many extreme	
		weather events as a result of global warming	
		• A lack of research and interest by industry, academia and	
		the federal government	
		• Due to the diversity of climate, urbanization and landscape	
		across Canada, it can be difficult to standardize a triple bottom	
		line (TBL) that could serve as the backbone for many	
		municipalities	
		Research gaps	
		• There needs to be more research to understand the policy	
		implications of either allowing municipalities, the provinces	
		and territories, or the federal government to take the lead on	
		DPR policies and implementation	
		Source (AMSTAR rating 2/9)	T 1 .
Systematic review	Climate risks	• Less than half of the articles included in this review covered	Literature last
	• General climate change	climate change solutions in a health context	searched 2010
	• Health risks and impacts	• Examples of mitigation strategies included decreasing	
	• Patients and health systems	greenhouse gas emissions by installing solar panels, improving	
	Public health	nousehold insulation, and increasing active transport use	
	Options and responses	• Suggested adaptation strategies included creating community	
	• Policy and practice	and plation plans, cutting back on strenuous outdoor activity	
	 Adaptation 	on not of smoggy days, and building coastal protection	
		• Adaptation was discussed more frequently than mitigation in	
		was also more frequently mentioned than mitigation between	
		2007 and 2008 compared to other years	
		The limited coverage on climate change solutions may	
		contribute to the feelings of honelessness commonly	
		associated with climate change thereby undermining the	
		public's feelings of self-efficacy and impetus to engage in	
		climate-mitigating or adaptive actions	
1		Source (AMSTAR rating $2/0$)	

Systematic review	 Climate risks Hurricanes Health risks and impacts Patients and health systems Public health Options and responses Mitigation co-benefits Greenhouse pathways Equity-deserving groups Long-term evacuees 	 This review explored literature specific to Canada and then expanding to include literature on other high-income countries focused on the roles and responses of public health for long-term evacuees (LTEs) in Canada Authors found that in Canada, most evacuations have lasted less than two weeks, but in some instances, people have been displaced for months or years It is difficult to determine if there are public-health effects of prolonged evacuation and to what extent There is a lack of evidence regarding whether the public-health needs of long-term evacuees (LTEs) in Canada are being assessed, monitored and addressed Trends in the incidence of disasters and emergencies underscore the urgency of conducting more research to improve our understanding of prolonged displacement within Canada and in other high-income countries Research gaps Some studies broadly consider the long-term repercussions of emergencies and disasters in high-income countries, but they pay little or no attention to the effects of evacuation, and potential effects of prolonged versus short-term displacement 	Literature last searched 2018
Systematic review	 Health risks and impacts Infectious diseases Infectious diseases general Viral diseases Leptospirosis Equity-deserving groups Indigenous Arctic inhabitants 	 Source (AMSTAR rating 2/9) The review examined the association between climactic factors and infectious disease in the Arctic and sub-Arctic regions Strong evidence was found for the association between climactic factors for food- and waterborne diseases, largely as a result of increased temperature and increased precipitation which increases the incidence of these diseases Some evidence was found for an expected increase in vector-and rodent-borne diseases as climate changes in temperature, precipitation, and changes to the length of seasons change the suitability, reproduction, distribution and abundance of vectors and rodents Three studies from Canada also point to the potential increase in bacterial and airborne diseases given the increase in air temperature and humidity Research gaps The review noted that because of the frequently aggregated, population-level data used in the included studies, it was 	Literature last searched May 2013

		 difficult to draw conclusions regarding which population were most vulnerable to climatic factors Additional gaps in knowledge include surveillance mechanisms to ensure risk of disease is appropriately and reliably calculated, and additional studies focused on confounding and intermediate factors, particularly for climatic effects of vector-and rodent-borne diseases Source (AMSTAR rating 2/9) 	
Systematic review	 Health risks and impacts Water, sanitation and hygiene Drinking-water quality 	 The review focuses on different approaches that can be used to inform waterborne disease burden and source attribution estimates on a national level Links between extreme precipitation and other climate events and increases in waterborne disease, show it is critical to understand how to reliably assess the risk of waterborne disease and source attributions The review suggests relatively few methods are available to quantify the burden of acute gastrointestinal illness, however those that do exist include simple point estimates, quantitative microbial risk assessment, and monte carlo simulations that rely on epidemiological data from robust studies The review included 11 studies that quantified the burden of waterborne disease, and two of these were Canadian studies which reported burden estimates of between \$40.3 million (1997) and \$2.7 billion (2012) as a result of costs associated with acute gastrointestinal illness and respiratory infections The authors of the review identified knowledge and data gaps that limit the ability to accurately calculate disease burdens and make source attributions, including: Epidemiological studies that quantify the risk of: Illness due to consumption of water from small and private water systems Illness due to the consumption of groundwater supplies Pathogen occurrence water-quality data, particularly for groundwater supplies Centralized data on populations served by different types of water supplies such as small systems and private systems 	Literature last searched 2013

		 Data on the state and condition of drinking-water infrastructure including treatment systems, distribution means, and private wells Water consumption-related health effects on vulnerable sub-populations such as children, the elderly and immunocompromised Research that quantifies the risk of acute gastrointestinal illness associated with the effects of changing climate (increased precipitation) on drinking supplies Source (AMSTAR rating 6/9) 	
Scoping review	 Climate risks Wildfires Health risks and impacts Mental health Mental health and PTSD Maternal and child health Child health Equity-deserving groups Children and adolescents 	 This scoping review found 19 studies that assessed the psychosocial impacts of wildland fires on children, adolescents, and family functioning Age, gender, time, and proximity to the wildfire can have an impact on both children and adolescents, while behaviours of family members and home and property loss are important among families Authors reported contradictory findings, for instance, the reported association between parent and child PTSD symptom agreement Research gaps Insufficient discussion of research questions or findings within a larger disaster framework More studies focusing on children and adolescent perspectives of community factors would expand our understanding of their psychosocial responses to wildfires Investigators need to clearly outline differences between groups of participants and time periods postevent Family units (i.e., parents or surrogates with children) also need to be studied to gain information useful for programs needed to address the issues this group experiences post-fire Authors highlighted the lack of research that included children or adolescents' perspectives of domestic violence post-disaster 	Literature last searched October 2017
Scoping review	 Climate risks General climate change Health risks and impacts Patients and health systems Public health Infectious 	 This study, which included a systematic review of literature focused on criteria for vector-borne disease prioritization, summarized findings from 26 studies A preliminary list of criteria was identified, with the most common categories of criteria being public-health impacts, economic or market impacts, animal-health impacts (generally 	Literature last searched Spring 2014

	 Infectious diseases in general 	 pertaining to market impacts but also for animal welfare), public perception, and public-health capacity to deal with a disease Authors also included the "Risk and Epidemiology" category aimed at capturing epidemic potential, recent disease trends and proportion of susceptible population <u>Source</u> (AMSTAR rating 2/8) 	
Overview	 Climate risks Extreme weather events Health risks and impacts Occupational health and injury Options and responses Policy and practice Adaptation 	 The review identifies five categories of climate hazards that are likely to affect occupational health and safety in Canada, including heat waves/increased temperatures, air pollutants, UV radiation, extreme weather events, and vectorborne/zoonotic diseases The review notes that they will have a significant effect on occupations related to natural resources such as agriculture and fishing, as well as changing the built environment and emerging green industries which in turn will change the occupational-hazard landscape In addition to acquiring new knowledge on hazards and ongoing surveillance, the review suggests the following adaptation strategies: Identify and evaluate adaptation methods Develop training tools to prepare workers for the health effects of climate change Explore adaptation methods using organization of work and work-schedule management Develop methods to heighten workplace awareness of potential risks 	Literature last searched December 2010
Systematic review	 Climate risks Emissions Options and responses Mitigation co-benefits Greenhouse pathways 	 This review focused on the use of alternative fuels in cement manufacturing Overall, energy recovery in cement manufacturing is one of the best end-of-life options, even though the performance in resource consumption and conservation, and metal and hazardous air-pollutant emissions, can be worse than for other end-of-life options, such as recycling Landfilling should be avoided, and incineration discouraged in for output of batter end of life options. 	Literature last searched 2010

		 An environmentally sound end-of life solution is the use of sludge as fertilizer, although the practice is illegal in some countries if the sludge is not treated Landfilling or reusing tires in asphalt road pavement appeared to be the worst options Research gaps The social impact of the use of alternative energy sources in cement manufacturing were not identified Academic papers did not address comparisons between the use of animal and bone meal, industrial, commercial and institutional residues, and waste wood in cement kilns with other end-of-life options Academic papers did not discuss health or social impacts, and economic impacts were investigated for few end-of-life options Source (AMSTAR rating 4/9) 	
Systematic review	 Climate risks General climate change Health risks and impacts All-cause mortality Equity-deserving groups Low-income and materially deprived neighbourhoods 	 The review aims to identify climate change-related risk factors at the local community level and create actionable health vulnerability index scores to map community risks to previously identified priority climate-related exposures in British Columbia The review presents priority risk factors for each of four climate hazards: The percentage of days per year over 25 degrees Celsius Inland flooding and predicted sea-level rise Extreme wildfire smoke Ground level ozone Category-specific indices were also created to identify populations that may be more or less adaptive to the four hazards Source (AMSTAR rating 3/9) 	Published March 2021
Systematic review	 Climate risks General climate change Food and nutrition Food insecurity 	 The review develops a framework for the climate change and food security nexus that details the ways in which climate change will alter the production, processing, distribution, preparation and consumption of food in Canada In relation to food production heavy rainfall and temperature have an effect on water yields and have additional effects on fresh-water, biodiversity, soil degradation and fisheries 	Literature last searched April 2019

 For food distribution, climate change can disrupt food distribution through acute weather events, limiting the ability for distribution channels to be used For food safety and nutrition, climate change will have a significant effect on altering the availability of traditional foods which provide an important putritional value and contribute to a significant effect. 	
healthy diets, particularly for Indigenous populations	
Limited research has been conducted on the effects of climate	
change on Indigenous, rural and remote communities in	
regions south of 60 degrees latitude	
Source (AMSTAR rating 2/9)	

Appendix 3a: Identified documents on health risks and impacts of climate change that include an equity focus, organized by **PROGRESS-Plus**

Progress-Plus	Progress-plus	Identified documents
characteristics	characteristics	
	identified in included	
	documents	
Place of residence	Arctic (or sub-Arctic)	• Identifying and achieving consensus on health-related indicators of climate change in
		Nunavut
		<u>Food insecurity among Inuit women exacerbated by socioeconomic stresses and climate</u> shapes
		<u>change</u>
		• <u>"From this place and of this place:" climate change, sense of place, and health in Nunatsiavut,</u> Canada
		• Climate change influences on environment as a determinant of Indigenous health:
		Relationships to place, sea ice, and health in an Inuit community
		• What we know, do not know, and need to know about climate change vulnerability in the
		western Canadian Arctic
		<u>SOS! Summer of smoke: A retrospective cohort study examining the cardiorespiratory</u>
		impacts of a severe and prolonged wildfire season in Canada's high sub-Arctic
		• "We're people of the snow" Weather, climate change, and Inuit mental wellness
		• Inuit vulnerability and adaptive capacity to climate change in Ulukhaktok, Northwest
		<u>Territories, Canada</u>
		<u>Protective factors for mental health and well-being in a changing climate: Perspectives from</u>
		<u>Indit youth in Nunatsiavut Labrador</u>
		<u>Community vumerability to cinnate change in the context of other exposure sensitivities in</u> Kughktuk. Nupavut
		 Using qualitative scenarios to understand regional environmental change in the Canadian
		North
	Rural and remote	• The association between farming activities, precipitation, and the risk of acute gastrointestinal
		illness in rural municipalities of Quebec, Canada: A cross-sectional study
		• Household access to capital and its effects on drought adaptation and migration: A case study
		of rural Alberta in the 1930s
		• Use of traditional environmental knowledge to assess the impact of climate change on
		subsistence fishing in the James Bay Region of Northern Ontario, Canada
		• <u>Climate change impacts on health and well-being in rural and remote regions across Canada</u>

		• Exploration of the spatial patterns and determinants of asthma prevalence and health services
		use in Ontario using a Dayesian approach
		• Energy poverty in Canada: Prevalence, social and spatial distribution, and implications for
		research and policy
		• Waterborne outbreaks: A public health concern for rural municipalities with unchlorinated
		drinking-water distribution systems
	Urban	• Air quality in Canadian port cities after regulation of low-sulphur marine fuel in the North
		American Emissions Control Area
		• Nature-based equity: An assessment of the public health impacts of green infrastructure in
		Ontario Canada
		• A multilevel analysis to explain self-reported adverse health effects and adaptation to urban
		heat: A cross-sectional survey in the deprived areas of 9 Canadian cities
		• Neighbourhood and dwelling characteristics associated with the self-reported adverse health
		effects of heat in most deprived urban areas: A cross-sectional study in 9 cities
		Healthy neighbourhoods: Walkability and air pollution
		• Reduction of disparities in access to green spaces: Their geographic insertion and recreational
		functions matter
		• The impact of climate change on the food systems in Toronto
Race/ethnicity/	Indigenous populations	Identifying and achieving consensus on health-related indicators of climate change in
culture/language	~	Nunavut
		• Food insecurity among Inuit women exacerbated by socioeconomic stresses and climate
		change
		• Health effects of flooding in Canada: A 2015 review and description of gaps in research
		• "From this place and of this place:" climate change, sense of place, and health in Nunatsiavut.
		Canada
		• Vulnerability of Aboriginal health systems in Canada to climate change
		• What we know do not know and need to know about climate change vulnerability in the
		western Canadian Arctic
		• Preparing for the health impacts of climate change in Indigenous communities: The role of
		community-based adaptation
		• Use of traditional environmental knowledge to assess the impact of climate change on
		subsistence fishing in the James Bay Region of Northern Ontario, Canada
		• Erequent flooding and perceived adaptive capacity of sub-Arctic Kashechewan First Nation
		• I requent moding and perceived adaptive capacity of sub-metic reasincene wait rist readon,

		<u>Spring flooding and recurring evacuations of Kashechewan First Nation, northern Ontario,</u> <u>Canada</u>
		• Climate change impacts on health and well-being in rural and remote regions across Canada
		• Community-based monitoring of Indigenous food security in a changing climate: Global
		trends and future directions
		• Evacuating First Nations during wildfires in Canada
		• "We're people of the snow" Weather, climate change, and Inuit mental wellness
		Indigenous mental health in a changing climate
		• Inuit vulnerability and adaptive capacity to climate change in Ulukhaktok, Northwest
		Territories, Canada
		• Protective factors for mental health and well-being in a changing climate: Perspectives from
		Inuit youth in Nunatsiavut Labrador
		• Community vulnerability to climate change in the context of other exposure sensitivities in
		<u>Kugluktuk, Nunavut</u>
		• Using qualitative scenarios to understand regional environmental change in the Canadian
		North
		• Like the plains people losing the buffalo: Perceptions of climate change impacts, fisheries
		management, and adaptation actions by Indigenous peoples in coastal British Columbia,
	T · . 1.:	<u>Canada</u>
	Immigrant populations	• <u>Risk and resilience: How is the health of older adults and immigrant people living in Canada</u>
		impacted by climate- and air pollution-related exposures?
Occupation	-	
Gender/sex	Gender/sex	<u>Risk of hospitalization for fire-related burns during extreme cold weather</u>
		• Spatial variability of climate effects on ischemic heart disease hospitalization rates for the
		<u>period 1989-2006 in Quebec, Canada</u>
		• <u>Food insecurity among Inuit women exacerbated by socioeconomic stresses and climate</u>
		<u>change</u>
		• <u>A difference-in-difference approach to assess the effect of a heat action plan on heat-related</u>
		mortality, and differences in effectiveness according to sex, age, and socioeconomic status
		(Montreal, Quebec)
Deligion		• Inteats to mental health and well-being associated with climate change
Education	- Education levels	
Education	Education levels	• A difference-in-difference approach to assess the effect of a heat action plan on heat-related
		(Montreal Quades)
		(Monteal, Quebec)

		<u>Threats to mental health and well-being associated with climate change</u>
Socio-economic	Low socio-economic	• Nature-based equity: An assessment of the public health impacts of green infrastructure in
status and social	status or experiencing	Ontario Canada
capital	material deprivation	• Spatial variability of climate effects on ischemic heart disease hospitalization rates for the
		period 1989-2006 in Quebec, Canada
		• A multilevel analysis to explain self-reported adverse health effects and adaptation to urban
		heat: A cross-sectional survey in the deprived areas of 9 Canadian cities
		• Neighbourhood and dwelling characteristics associated with the self-reported adverse health
		effects of heat in most deprived urban areas: A cross-sectional study in 9 cities
		• <u>A difference-in-difference approach to assess the effect of a heat action plan on heat-related</u>
		mortality, and differences in effectiveness according to sex, age, and socioeconomic status
		(Montreal, Quebec)
		• Quantifying vulnerability to extreme heat in time series analyses: A novel approach applied to
		neighbourhood social disparities under climate change
		<u>Factors influencing the mental health consequences of climate change in Canada</u>
		<u>Threats to mental health and well-being associated with climate change</u>
		<u>Risk and protective factors for heat-related events among older adults of Southern Quebec</u>
		<u>(Canada): The NuAge study</u>
		• <u>Reduction of disparities in access to green spaces: Their geographic insertion and recreational</u>
		functions matter
		• The role of maps in neighbourhood-level heat vulnerability assessment for the City of
		Toronto
Personal	Infants and children	• The association between climate, geography and respiratory syncitial virus hospitalizations
characteristics		among children in Ontario, Canada
associated with discrimination and/or exclusion		<u>Extreme heat and pediatric emergency department visits in Southwestern Ontario</u>
	Older adults	<u>Risk of hospitalization for fire-related burns during extreme cold weather</u>
		• <u>A difference-in-difference approach to assess the effect of a heat action plan on heat-related</u>
		mortality, and differences in effectiveness according to sex, age, and socioeconomic status
		(Montreal, Quebec)
		Incidence of hot tap water scalds after the introduction of regulations in Ontario
		• <u>Reducing the risks of extreme heat for seniors: Communicating risks and building resilience</u>
		<u>Risk and protective factors for heat-related events among older adults of Southern Quebec</u>
		<u>(Canada): The NuAge study</u>
		• <u>Canadian forest fires and the effects of long-range transboundary air pollution on</u>
		hospitalizations among the elderly

		 How do non-catastrophic natural disasters impact middle-aged-to-older persons? Risk and resilience: How is the health of older adults and immigrant people living in Canada impacted by climate- and air pollution-related exposures?
		• Effects of climate and fine particulate matter on hospitalizations and deaths for heart failure in elderly
		 <u>Effects of diurnal variations in temperature on non-accidental mortality among the elderly</u> population of Montreal, Quebec, 1984-2007
	Unhoused or homeless	• Health effects of flooding in Canada: A 2015 review and description of gaps in research
		• <u>Cold weather conditions and risk of hypothermia among people experiencing homelessness:</u> <u>Implications for prevention strategies</u>
	People who use	<u>Ambient air pollution exposure and emergency department visits for substance abuse</u>
	substances	
Time dependent relationships	-	

Appendix 3b: Identified systematic reviews about adaptation and mitigation strategies that include an equity focus, organized by PROGRESS-Plus

Progress-Plus	Progress-plus	Identified documents
characteristics	characteristics	
	identified in included	
	documents	
Place of residence	Arctic (or sub-Arctic)	What we know, do not know, and need to know about climate change vulnerability in the western
		Canadian Arctic
		Association of climatic factors with infectious diseases in the Arctic and sub-Arctic region - a
		<u>systematic review</u>
		Research on the Human Dimensions of Climate Change in Nunavut, Nunavik, and Nunatsiavut:
		<u>A Literature Review and Gap Analysis</u>
	Rural and remote	Climate change impacts on health and well-being in rural and remote regions across Canada: a
	regions	synthesis of the literature
Race/ethnicity/	Indigenous populations	Community-based monitoring of Indigenous food security in a changing climate: Global trends
culture/language		and future directions
		What we know, do not know, and need to know about climate change vulnerability in the western
		Canadian Arctic
		Civil society organizations and adaptation to the health effects of climate change in Canada
		Indigenous mental health in a changing climate: a systematic scoping review of the global
		literature
		Association of climatic factors with infectious diseases in the Arctic and sub-Arctic region - a
		systematic review
		Research on the Human Dimensions of Climate Change in Nunavut, Nunavik, and Nunatsiavut:
		A Literature Review and Gap Analysis
		Vulnerability of Aboriginal health systems in Canada to climate change
		Climate change impacts on health and well-being in rural and remote regions across Canada: a
		synthesis of the literature
Occupation	-	
Gender/sex	Gender/sex	Community-based monitoring of Indigenous food security in a changing climate: Global trends
		and future directions
Religion	-	
Education	-	
Socio-economic	Low-income and	Evaluating risk communication during extreme weather and climate change: A scoping review
status and social	materially deprived	Geospatial indicators of exposure, sensitivity, and adaptive capacity to assess neighbourhood
capital	neighbourhoods	variation in vulnerability to climate change-related health hazards

Personal	Children and	The psychosocial impacts of wildland fires on children, adolescents and family functioning: A
characteristics	adolescents	scoping review
associated with	Older adults	Evaluating risk communication during extreme weather and climate change: A scoping review
discrimination and/or		Effective Community-Based Interventions for the Prevention and Management of Heat-Related
exclusion		Illnesses: A Scoping Review
	People with physical	Evaluating risk communication during extreme weather and climate change: A scoping review
	disabilities	
Time dependent	-	
relationships		