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Heat-health messaging in Canada: A review and content analysis of public health authority webpages and resources

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ABSTRACT

Background: With the growing threat posed by extreme heat, heat-health messaging communicated by public health authorities is critical for raising community awareness and action. This study sought to (i) identify what heat-health content is shared online by Canadian public health authorities and (ii) analyse the material to develop an understanding of the content included within the resources.
Study design: Qualitative content analysis.
Methods: We reviewed public health authority websites in Canada (n = 99) and extracted all available heat-health content. Content analysis of each resource was performed using descriptive codes related to three categories - populations at greater risk, actions to reduce risk and awareness and knowledge.
Results: Within the public health authority websites searched, 417 webpages and online resources were identified (range: 1–43). Over half of the material came from regional health authorities (56 %), primarily located in Ontario and British Columbia (60 %). At least one population at greater risk of heat stress (e.g., older adults, children) (range: 0–24) was mentioned in 59 % of the materials, 81 % mentioned at least one action or behaviour to reduce risk (e.g., stay hydrated) (range: 0–40), and 91 % provided material related to raising awareness and knowledge (range: 0–12).
Conclusions: Although a wide array of webpages and online resources were identified, the material content and availability varied considerably across authorities and provinces and territories. These results provide important insights into the composition of heat-health webpages and online resources within Canada and can help guide relevant revisions and additions to the existing heat-health materials.

1. What this study adds

- This study is the first comprehensive review and analysis of heat-health webpages and online resources available on regional, provincial, territorial, and federal public health authority websites in Canada, shedding light on the vulnerable groups identified and heat-health risk reduction strategies recommended.
- Our findings suggest that although a wide array of resources were available, the material differed in content and scope considerably, and primarily identified vulnerability based on demographics like age but omitted many other heat susceptible groups.
- These results provide important insights into the composition of heat-health webpages and online resources within Canada and can help guide relevant revisions and additions to the existing heat-health materials.

2. Implications for policy and practice

- Given the documented benefits of using a variety of tailored strategies for communicating environmental health risks to the public, the development of a wider range of resources, using a variety of mediums, could improve the reach of heat-health messaging.
- Public health authorities and other interest holders may consider adding additional strategies for mobilizing heat-health information in their materials, such as links to official weather forecasting websites where the most up-to-date weather information can be found in real-time during an extreme heat event.

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- Given the disproportionate impact of extreme heat on certain groups, references to a broader array of vulnerable populations within heat-health materials or more tailored resources for individuals at greater risk are needed.

3. Introduction

Canada has experienced increasingly extreme heat events over the past decade. Exposure to extreme heat can negatively impact human health, with the effects disproportionately experienced by the most vulnerable (e.g., older adults and people with pre-existing medical conditions) [1]. Given that extreme heat events are expected to increase in frequency and severity as the global climate changes [2], heat warnings and public health messages will be of growing importance as Canadians will be searching for guidance to protect themselves, their families and communities. In Canada, extreme heat alert and response involves federal, provincial, territorial, and regional agencies. Federally, Environment and Climate Change Canada (ECCC) issues heat warnings and associated heat-health messages when specific regional heat warning criteria are met [3]. These heat warning criteria are mostly health evidence-based and developed in partnership with Health Canada (another federal authority) and/or provincial public health authorities. Heat warnings are publicized through ECCC's forecasting website and via various media channels to convey meteorological data such as details on the affected location, expected duration, severity, and information on how to protect oneself from adverse health effects [4].

As provincial and territorial governments are responsible for the management and delivery of health care services in Canada, the various ministries and regional public health agencies also play a role in this communication chain and coordination of efforts, as well as the dissemination of area-specific information that the public needs to respond effectively [5]. These agencies use various mediums to communicate with the public, including various health-related resources, such as website content pages and downloadable health education materials. Although Health Canada provides some guidance to support public health authorities with communicating the health risks of extreme heat [4], and other provincial and territorial ministries may provide additional guidance to their health units, the development of heat-health protection materials is primarily at the discretion of the individual health authority. As a result, the scope of content, variability in messaging, accuracy, or process for updating regularly based on new evidence is unknown.

Most investigations to date on heat-health communication have been primarily focused on messaging associated with public health interventions during heat episodes [6,7], adaptation advice included in heat wave early warning systems [8] and their ability to increase risk awareness and protective behaviour during extreme heat events [6,8]. Although these studies are critical to expanding our understanding, especially of in-event communication, they only represent one avenue for disseminating heat-health guidance to the public. Recently, Zottarelli et al. [9] conducted an initial investigation to support addressing this critical knowledge gap and examined extreme heat event preparedness and response information communicated to the public on municipal government webpages in the ten most populated cities in the United States. The authors found that information on the websites often failed to identify the breadth of populations at greater risk for adverse heat-health outcomes and omitted some recommended actions to prevent adverse heat-health events. This is an important finding, as other studies on the public's risk perception, knowledge, and behaviours related to extreme heat have frequently highlighted that people often underestimate their vulnerability [10,11] and are often unaware or unable to take the recommended actions necessary during an extreme heat event to mitigate risk [12,13]. Thus, if the information available and accessible to the public (i.e., public health authority websites) is insufficient or incorrect, this could have negative health consequences.

To help address this critical knowledge gap and better understand the limitations of the current heat-health messaging across Canada, we content analysed all identifiable federal, provincial, territorial, and regional public health authority websites in Canada to address two overarching objectives. Firstly, to identify if Canadian public health agencies currently have heat-health content available (Objective I) and secondly, to analyse the material to develop an understanding of the content included within the resources (Objective II). For Objective I, we hypothesized that few health authorities would have webpages and online resources dedicated to heat-health content. Regarding Objective II, we hypothesized that most of the content would identify a limited number of populations at risk for adverse heat-health outcomes and would present a small scope of recommended actions to prevent adverse heat-health events.

4. Methods

4.1. Search strategy

The *Structural Profile of Public Health in Canada* was referenced to determine the list of public health authorities to include within the analysis [14]. This list was supplemented with advanced Google searches performed for each province and territory in Canada. This resulted in a list of 139 potential public health authorities (federal $n = 8$; provincial/territorial $n = 41$; regional $n = 90$). The searches were then conducted between October 21st and December 23rd, 2022. A subsequent verification search was conducted between February 3rd and 8th, 2024. During this stage of data collection, it was identified that some of the identified agencies share websites. For example, some provinces have multiple ministries with health responsibilities but are linked on the same government website. Therefore, the total number of 'unique' websites searched was reduced to 99. The content pages (webpages) of each of these sites were reviewed, as well as all links were within the secondary pages.

Where available, website search functions were utilized with a preset list of Medical Subject Headings controlled vocabulary thesaurus terms and included heat stress, heat wave, warm weather, hot weather, and heat exhaustion, along with spelling variations (e.g., heatwave, heat wave). For authority sites in the province of Quebec, the same terms were searched in French (e.g., *temps chaud*, *chaleur*) when English page translations were unavailable. This process was continued until (a) the links were only linking back to previously reviewed pages, (b) the links were no longer providing additional extreme heat information, or (c) the links were to other agencies providing heat-health information [9]. The content page(s) were captured in portable document format (PDF). All relevant search information was recorded in Excel (Microsoft®, Version 16), including the search date, the search term(s), the total number of pages screened on the website, the number of PDFs saved, access links, and location of the content on the website (i.e., the navigation pathway from the website home page to the content of interest). Overall, 32,156 website content pages and resources were screened (S.J.I.J. and E.J.T.). This initially resulted in the identification of 714 web pages and resources.

A secondary screening process was conducted to ensure each resource met the inclusion criteria. Inclusion required that the resource provide information relevant to human heat-health protection (e.g., actions to reduce heat-health risks). Therefore, resources specific to heat-health and animal or environmental protection were excluded. As this analysis sought to identify material available to support the public seeking information, resources were also excluded if they were not 'publicly oriented' (e.g., guidance on worker heat stress protection, procedures for healthcare providers caring for heat stroke patients). Additionally, material deemed transitional or time-sensitive (e.g., news/press releases), were omitted, as well as content on community/municipal level websites. Lastly, the resources had to be publicly available; therefore, any webpages or online resources behind paywalls or that required purchasing to download were omitted from the analysis.

Based on secondary screening, an additional 297 webpages and online resources were excluded, resulting in 417 being included for content analysis.

4.2. Preliminary and subsequent codebook development

To develop the initial deductive (concept-driven) codes for the content analysis, we reviewed the current heat guidance available from Health Canada [4,5]. These sources were referenced to initiate the codebook because Health Canada supports provincial and territorial health partners with protecting the health of Canadians from extreme heat. We also referenced the recently developed *Extreme Heat Event Public Response Rubric* [9]. However, as codebook development is an iterative process, we allowed flexibility to enable additional concepts to be identified inductively (data-driven) during preliminary coding. This resulted in the final structure of three main categories and 14 subcategories (Table 1).

4.3. Coding agreement, coding and file classification

After the code definitions were stable, coding agreement was established before applying the codes to the entire data set. Three authors (E.J.T., S.J.I.J. and K.E.W.) reviewed and coded the same ~10 % of the total webpages and online resources ($n = 51$) using NVivo (Release 1.6.2, QSR International). Inter-rater reliability (or the degree of agreement between coders) was measured using Kappa coefficient. Kappa coefficient is a statistical measure which considers the amount of agreement that could be expected to occur through chance. The Kappa coefficient was determined to be 0.77, indicating a 'very good' agreement [15]. The remaining webpages and online resources ($n = 366$) were then divided equally between the coders (E.J.T., S.J.I.J. and K.E.W.), and all articles were fully coded. Each document was also file and case classified in NVivo (E.J.T.) by publishing health authority, location, date and resource type.

4.4. Analysis

Following coding and file classification, the analysis was conducted in three steps. Firstly, a qualitative content analysis method was employed to review the coded findings and interpret the meaning of the data. The authors met during this phase to discuss the data and achieve consensus on the broader themes and concepts. Next, a descriptive analysis of the characteristics of the included webpages and online resources and the extracted data (coded findings) (e.g., publication date, location) was conducted. The findings were then translated into tabular formatting to aid interpretation. Lastly, a relational analysis was performed using coding and matrix coding queries in NVivo to explore any additional patterns within the data (e.g., comparisons between provinces and territories, comparison by type of health authority).

Table 1
Main categories and subcategories of the content analysis codebook.

Category 1: Populations at Greater Risk	Category 2: Actions to Reduce Heat-Health Risks	Category 3: Awareness and Knowledge
•Populations at risk due to demographics and health conditions •Populations at risk due to socioeconomics and living conditions •Populations at risk due to work or recreational activities •Everyone is susceptible to heat	•Staying hydrated •Strategies for staying cool - indoors •Strategies for staying cool - outdoors •Protecting skin and eyes •Providing social support •Practicing car safety •Modifying diet	•Knowing the signs and symptoms of heat-related illnesses •Seeking updates and heat event information •Additional information

5. Results

5.1. Heat-health material characteristics

The dataset included 417 webpages and resources published by 73 Canadian public health authorities; therefore, 74 % of the websites searched ($n = 99$) had heat-health content available to the public. The content was published by federal ($n = 43$, 10 %), provincial and territorial ($n = 140$, 34 %), and regional health authorities ($n = 234$, 56 %) (Table 2). Although heat-health content was available on health authority websites from most provinces and territories, Ontario and British Columbia accounted for the majority (60 %) of the material. Most resources captured were categorized as webpage content ($n = 278$, 67 %); however, 139 downloadable materials were also identified (e.g., handouts, posters, infographics, emergency planners). The median number of resources included by each site was 3 (average: 6, range: 1–43). Nearly half of the heat-health material was published (or revised) recently between 2020 and 2023 ($n = 110$, 46 %); however, some webpages and online resources dated back to 2006 ($n = 15$, 4 %). Based on the month of publication, the most significant proportion of publications were released between May and August ($n = 144$, 35 %).

5.2. Content related to heat-vulnerable population groups

Overall, 18 % of the resources indicated that everyone is at risk in the heat. In addition to the generalized risk statement, 59 % of the resources explicitly cited at least one additional heat-vulnerable population group. Each public health authority typically identified nine heat-vulnerable groups (range: 0–24) among all resources combined (Table 3). The most cited heat-vulnerable group was populations at risk due to demographics and health conditions (56 %), such as infants and young children, older adults, and people with pre-existing physical health conditions. The second most cited heat-vulnerable group was people at risk due to socioeconomics and living conditions (32 %). Populations within this group included people who are experiencing homelessness or housing insecurity, people who are socially isolated/live alone, and people living without air conditioning or access to adequate cooling. The third most referenced population was those at risk due to work or recreational activities (27 %), such as people training or exercising outdoors, or people working inside without air conditioning.

5.3. Content related to actions to reduce heat-health risks

Regarding heat-health actions, 81 % of the resources mentioned at least one action to reduce heat-health risks (Table 4). Each health authority provided, on average, 18 statements/messages (range: 0–40), where a statement represents an individual action item. The most common action for reducing heat-health risks cited was staying hydrated (66 %), followed by strategies to stay cool indoors (64 %), including spending time in cool spaces (e.g., community-based cooling centres), taking cool baths and showers, using interior shading, using fans or windows and doors for ventilation, among others. The resources also commonly included additional guidance on staying cool outdoors (63 %), such as limiting outdoor activity or scheduling to cooler times of the day and seeking shade. It was also common for the public health authorities to provide guidance on protecting the skin and eyes during high heat (52 %).

Many public health authorities also included statements on providing social support (41 %), such as checking on people at high risk for heat-related illness. Most statements broadly stated to conduct wellness checks on loved ones or neighbours either in person or by phone; however, some provided additional guidance on when/how to provide support (e.g., check in at least twice daily, check in the evening

Table 2
Summary of heat-related resources identified on Canada's regional, provincial/territorial, and federal public health authority websites.

Province/Territory	Type of Health Authority						
	Regional		Provincial/Territorial		Federal		Total
	Webpage	Other	Webpage	Other	Webpage	Other	
Ontario	122	29	2	2	–	–	155 (37 %)
British Columbia	19	26	34	15	–	–	94 (23 %)
Quebec	21	11	5	4	–	–	41 (10 %)
Canada	–	–	–	–	30	13	43 (10 %)
Saskatchewan	–	–	21	2	–	–	23 (6 %)
Alberta	–	–	5	17	–	–	22 (5 %)
Manitoba	3	1	2	4	–	–	10 (2 %)
New Brunswick	1	1	4	4	–	–	10 (2 %)
Nova Scotia	–	–	4	3	–	–	7 (2 %)
Prince Edward Island	–	–	–	6	–	–	6 (1 %)
Newfoundland and Labrador	–	–	2	–	–	–	2 (<1 %)
Northwest Territories	–	–	1	1	–	–	2 (<1 %)
Yukon Territory	–	–	2	–	–	–	2 (<1 %)
Nunavut	–	–	–	–	–	–	0 (0 %)
Subtotal	166 (71 %)	68 (29 %)	82 (59 %)	58 (41 %)	30 (70 %)	13 (30 %)	
Total	**234 (56 %)**		**140 (34 %)**		**43 (10 %)**		**417 (100 %)**

Note: 'Other' includes handouts, infographics, brochures/tri-folds, factsheets, posters, personal decision tools, etc.

and early morning, check their thermostat or indoor thermometer, etc.). Next, 30 % of public health authorities provided guidance on practicing car safety (e.g., not leaving pets or people in a parked car and shading windows). Lastly, a few public health authorities recommended modifying diet during high-heat periods (10 %) (e.g., consuming foods with high water content).

5.4. Content related to awareness and knowledge of heat stress

The vast majority (91 %) of the resources provided material related to raising awareness and providing knowledge on heat stress and information on how to seek updates (Table 5). Each health authority provided, on average, seven statements/messages (range: 0–12) related to awareness, knowledge or methods to seek additional information. Most resources included information on knowing signs and symptoms of heat-related illnesses, as well as identifying types of heat-related illnesses, causes of heat stress and actions when heat-related illness is suspected (78 %). A few of the authorities also provided knowledge and guidance on creating an emergency plan in advance of an extreme heat event occurring.

Many of the public health authorities also included information on how to seek updates and safety information during extreme heat (66 %). This included details on calling public information phone lines or event-specific lines, contacting health professionals, and checking local news or the WeatherCAN app. Some agencies also recommended monitoring and keeping track of the temperature in your home and signing up for notifications from utility providers for extreme heat event-related power outages. Lastly, three additional topics were frequently identified on the web pages and resources. This included information on when and how heat warnings are issued, content on the risk posed by air quality issues during periods of extreme heat, and material on how to protect against COVID-19 and heat.

6. Discussion

This study is the first comprehensive review of heat-health webpages and online resources available on regional, provincial, territorial, and federal public health authority websites in Canada. Our analysis identified that nearly three quarters of the health authority websites searched had heat-health content available to the public. Within these websites we were able to capture over 400 different webpages and online resources. This contrasts our original hypothesis which anticipated that few health authorities would have heat specific content available to the public; although we did identify considerable variability by province and territory and health authority, in the breadth of heat-related resources and webpage content provided. Our results did however support our secondary hypothesis, which anticipated that many resources would omit population groups known to be heat-vulnerable (e.g., people with mental illness). We also found that 81 % of the webpages and online resources provided actions to reduce heat-health risks, but critical actions were absent from many sites (e.g., guidance on the safe use of fans) and various inconsistencies in messaging were identified. Our findings also highlighted that out-of-date heat-related materials are accessible to the public, published in some cases over a decade ago, which suggests that individuals may not be obtaining the most up-to-date evidence-based guidance. These observations are expanded on in the following subsections.

6.1. Availability of heat-health content on webpages and online resources in Canada

Our Canada-wide search showed that the availability of heat-health material on public health authority websites is highly variable between federal, provincial, territorial, and regional jurisdictions across the country. For example, the province of Ontario provided 37 % of all webpages and online resources, and British Columbia accounted for 23 %. All other provinces contributed less than 10 % each (e.g., Alberta 5 %, Nova Scotia 2 %) (Table 2). Similarly, a considerable variance was seen between individual authorities, with some authorities providing over 40 different webpages and online resources and others providing only one. The quantity of content from the different provinces and authorities may be the result of several factors, including (but not limited to) differences in public health systems between jurisdictions, perceived need for heat-health guidance, lack of capacity or expertise, and competing priorities (e.g., focusing on other weather related hazards with greater health impacts for that region) [14]. However, further research into the effect of these, and other, potential factors would be beneficial to identify the limitations and/or barriers to developing, updating, and sharing evidence-based heat-health messaging.

Most heat-health information was presented as webpage content directly on the host site. This is consistent with the literature, which indicates that online sources are a typical channel used to communicate health [16–18] and disaster or emergency preparedness information to the public [19]. Although only one study (conducted in the United States) is known to have specifically explored government-based online heat-health material to date [9], evidence from other weather events similarly promotes that the public typically seeks information from asynchronous communication channels (e.g., websites) versus

Table 3
Summary of populations indicated to be at risk.

Population Group	Number of Resources (n = , %)	Textual Examples from Public Health Authority Webpages or Resources
Populations at risk due to demographics and health conditions		
Infants and young children	178 (43 %)	*"Keep in mind that children are particularly vulnerable to heat exhaustion and dehydration."*
Older adults/65 years and older	172 (41 %)	*"Older adults are most at risk of heat-related illness."*
People with pre-existing health conditions	171 (41 %)	*"Those most at risk for heat illness include … people with certain chronic medical conditions."*
People who use specific medication	111 (27 %)	*"Various medications are known to interfere with the body's thermoregulatory mechanisms, predisposing the person to heat illness."*
People with mental impairment or illness	81 (19 %)	*"There is also evidence of higher risk of excess deaths during heat events in populations with pre-existing psychiatric diagnoses conditions."*
People with mobility restrictions	58 (14 %)	*"People with mobility challenges may also need extra help to take steps to keep cool."*
People under the influence of alcohol, unregulated substances or those engaged in non-medical drug use	55 (13 %)	*"People suffering from alcoholism may increase their chances of developing a heat-related illness."*
People who are pregnant or breastfeeding	47 (11 %)	*"Pregnant people are at higher risk of health impacts due to heat exposure, including heat-related illness."*
People who are overweight or obese	29 (7 %)	*"People who are overweight tend to retain more body heat, and as a result may be prone to heat sickness."*
Populations at risk due to socioeconomics and living conditions		
People who are experiencing homelessness or housing insecurity	78 (19 %)	*"People experiencing homelessness … are at increased risk because they often have fewer resources to stay cool."*
People who are socially isolated/living alone	71 (17 %)	*"Social isolation may also increase risk of heat-related mortality."*
People living without air conditioning or access to adequate cooling	46 (11 %)	*"High heat and humidity can be a threat to your health, especially if you live in a building that does not have adequate cooling."*
People living in low-income households	31 (7 %)	*"Low socioeconomic status may also increase vulnerability to heat-related illness."*
People living in cities	20 (5 %)	*"People who live in cities are especially vulnerable to illness during a heat wave."*
Newcomers and tourists	10 (2 %)	*"These vulnerable groups include … newcomers."*
People not regularly exposed to hot environments	5 (1 %)	*"Moreover, the health risks are higher for those who are not regularly exposed to hot environments."*
Built environment	4 (<1 %)	*"There are several instances that are related to a person's housing and lifestyle that can lead to a higher risk of heat-related illness, such as: … Living on the top floor of a building."*
Lack of transportation	2 (<1 %)	*"We can all feel the effects of heat on our health, but populations who are more at risk include: … lack of access to transportation."*
People that engage in certain cultural practices	2 (<1 %)	*"First Nations, Inuit, and Métis People frequently participate in culturally important, land-based activities and ceremonies that may put them at greater risk to extreme heat."*
People living in rural communities	2 (<1 %)	*"Some of us are more vulnerable than others to the effects including … people living in rural communities."*
Populations at risk due to work or recreational activities		
People training or exercising outdoors	84 (20 %)	*"Without proper precautions, people who are physically active or engaged in sports activities can be at higher risk of heat illness."*
People working outdoors	64 (15 %)	*"Be aware that … outdoor workers are especially vulnerable to heat."*
People working indoors	51 (12 %)	*"Those who work … indoors in places that are not temperature controlled are at increased risk."*
People that spend time outdoors	1 (<1 %)	*"People at higher risk of adverse health impacts include … those who spend large amounts of time outdoors."*

Note: Content solely related to occupational heat stress was omitted; however, any mention of workers as a heat-vulnerable group by public health agencies in combination with other members of the public was included. n, count.

synchronous (e.g., phone calls) [20]. Our results also revealed that most authorities offered a limited number of alternative online heat-related resources (e.g., brochures, trifolds, handouts) (3 or less). Given the documented benefits of using a variety of tailored strategies for communicating environmental health risks to the public [21], the development of a wider range of resources, using a variety of mediums, could improve the reach of heat-health messaging [16]; however, further investigation would be needed to assess their impact.

6.2. Heat-mitigating actions and action-oriented messaging

Based on the findings of our content analysis, it was common for the heat-health webpages and resources to include material related to actions to reduce heat-health risks (81 %). The emphasis on action-oriented content reflects the importance of both preparing the public to take protective measures during a hazardous event [9], and of providing guidance on cooling measures that reduce the risk of adverse health outcomes during heat waves [22]. Previous research has found that including action-oriented content is critical because the general public often lacks an understanding of actions to take during an extreme heat event to mitigate risks [6,12,23]. However, we also observed that less than half of the sources provided material related to seeking updates about extreme heat events, such as checking the WeatherCAN app, signing up for notifications or suggestions to call non-emergency phone lines (Table 5). Zottarelli et al. [9] similarly found that most U.S. government heat websites did not refer readers to sources like broadcast heat warnings, weather forecasts or other mobilizing actions. Previous studies have demonstrated that providing this type of 'mobilizing information' can serve as a cue to encourage the public to engage in health-protective behaviours [16,18]. Therefore, public health authorities and other interest holders may consider adding additional strategies for mobilizing heat-health information in their materials, such as links to official weather forecasting websites where the most up-to-date weather information can be found in real-time during an extreme heat event.

Table 4
Summary of the actions recommended in the public health authority heat-health material to reduce heat-health risks.

Recommended Strategies/ Statements	Number of Resources (n = , %)	Textual Examples from Public Health Authority Webpages or Resources
Staying Hydrated		
Drink plenty of fluids/ water	265 (64 %)	*"Keep hydrated. Even before you feel thirsty, drink plenty of cool liquids (especially water)."*
Avoid alcohol, caffeine, and/or sugary drinks	93 (22 %)	*"Limit drinks with caffeine, alcohol, or lots of added sugar; these can cause further dehydration."*
Hydrate in advance	87 (21 %)	*"Stay hydrated. Plan ahead. Proper hydration begins the night before."*
Modify hydration for medical conditions	22 (5 %)	*"If your health care provider limits the amount you drink or has you on water pills, ask how much you should drink while the weather is hot."*
Hydrate while breast-/ chest-feeding	7 (2 %)	*"If you are breast/chest-feeding you also need to stay well hydrated; try having a cool non-alcoholic, low sugar drink during every feed in addition to other beverages throughout the day."*
Strategies for Staying Cool - Indoors		
Spend time in air conditioning (e.g., at home, cooling centres)	234 (56 %)	*"If it reaches 31 degrees Celsius indoors, it is time to relocate to a cool, shady outdoor space, a community cooling centre, or stay with a friend or family."*
Take cool baths and showers	148 (35 %)	*"Sit in a cool or tepid bath to draw heat from the body into the water or take a cool shower."*
Use interior shading	121 (29 %)	*"Install curtains, blinds or awnings in windows to deflect the heat, and keep them closed during the day. A low cost option is covering windows with cardboard."*
Use a fan	115 (28 %)	*"If you do not have air conditioning, use fans."*
Use windows and doors for ventilation	86 (21 %)	*"Practice opening doors and windows to move cool air in at night and shutting windows during the day to prevent hot outdoor air from coming inside."*
Avoid using heat generating electronics and ovens	83 (20 %)	*"Prepare meals that don't need to be heated as using appliances will increase the indoor temperatures."*
Access pools, splash parks, and water	67 (16 %)	*"To keep cool, consider visiting other sources of water like a lake or the ocean, as rivers in your community may be affected by rapid snow melt."*
Spend time in the coolest part of your home	56 (13 %)	*"Identify cool zones in your home – basements or one room that can be kept cool. Consider using that space to sleep."*
Mist yourself with water	51 (12 %)	*"Cool showers and misting yourself and your clothing with cool water will help keep you from overheating."*
Ensure cooling devices are working	47 (11 %)	*"Make sure air-conditioners or fans are working properly."*
Acclimate slowly	28 (7 %)	*"Before you travel to a hot environment, you can improve your ability to handle heat. Start by exercising for a short time in the heat. Then for the next 2 to 3 weeks, slowly increase the time you exercise in the heat."*
Create a cool sleeping area	12 (3 %)	*"Our community is heating up. Try these home tips if you don't have A/C: … sleep in wet clothing, sleep in your coolest room."*
Use cold packs	11 (3 %)	*"Apply ice packs and cool, damp cloths to your wrists and neck."*
Modify exterior of home	8 (2 %)	*"Choose light-coloured paint for the exterior of your home … Plant a broadleaf tree to provide shade and shelter to the house."*
Avoid areas with poor ventilation	7 (2 %)	*"Never leave anyone alone in a poorly ventilated room, even for a few minutes."*
Strategies for Staying Cool - Outdoors		
Limit outdoor activity or schedule to cooler times of the day	171 (41 %)	*"Avoid being outdoors between 11 a.m. and 3 p.m., when the sun's rays are strongest … Do outdoor chores in the early morning, late afternoon or early evening."*
Seek shade	171 (41 %)	*"Bring a shade option for the afternoon, when the sun is at its strongest. A naturally shady area with lots of trees is a great place for an afternoon picnic!"*
Avoid strenuous activity	111 (27 %)	*"Schedule outdoor activities carefully: Lower your activity level and avoid strenuous activity during the heat."*
Take breaks	70 (17 %)	*"Take frequent breaks from heat, spending time indoors."*
Check play structures prior to use	6 (1 %)	*"Check pavement and playground structures. They can become very warm."*
Protecting Skin and Eyes		
Wear lightweight, light-coloured, loose-fitting clothes	195 (47 %)	*"Cover up. Ensure children are wearing loose fitting clothing and wide brimmed hats. UV- certified materials or closely-woven cotton provide natural protection from the sun."*
Wear a wide-brimmed hat	195 (34 %)	*"Protect yourself from the sun by staying in the shade, avoiding direct sun mid-day, wearing a hat and protective clothing, using sunscreen, and wearing UV-protective eyewear."*
Wear and reapply sunscreen	126 (30 %)	*"Avoid getting sunburned. It decreases the body's ability to cool."*
Wear sunglasses	76 (18 %)	*"Wear UV-protective eyewear."*
Use an umbrella	56 (13 %)	*"If possible, use a sun umbrella if you can't find a shady spot."*
Providing Social Support		
Check on people at high risk for heat-related illness	172 (41 %)	*"Individuals who are socially isolated may not be able to easily seek help, or be able to monitor their own symptoms. Be a good neighbour and check on your vulnerable community members regularly."*
Practicing Car Safety		
Do not leave people or pets in a parked car	126 (30 %)	*"On extremely hot days, the inside temperature of a car can be several degrees warmer than the air outside. It is therefore never safe to leave pets or children in a vehicle, even for a few minutes."*
Shade windows	3 (<1 %)	*"Use sunshades on windows to block the sun during car rides."*
Modifying Diet		
Eat food with high water content	24 (6 %)	*"Eat fruits and vegetables. They have a high-water content and can help keep you hydrated."*
Avoid heavy meals (eat small meals)	18 (4 %)	*"Don't skip meals, instead eat smaller amounts more often. Use Canada's New Food Guide."*

(continued on next page)

Table 4 (*continued*)

Recommended Strategies/ Statements	Number of Resources (n = , %)	Textual Examples from Public Health Authority Webpages or Resources
Avoid hot meals (eat cold food)	4 (<1 %)	*"Eat light, cool foods, and avoid heavy meals that involve using the oven or other hot appliances."*
Avoid salty foods	2 (<1 %)	*"Drink water and eat light, regular meals — avoid using salt."*
Eat salty foods	2 (<1 %)	*"Be sure to maintain salt levels in your body and avoid high-protein foods."*

6.3. Inclusion of heat-vulnerable groups on heat-health webpages and online resources

Extreme heat poses a health risk to everyone; however, certain populations are particularly vulnerable to the threat, including older adults, children and the chronically ill [24]. Therefore, it has been recommended that heat-health warnings and public health materials specifically identify these groups to draw attention to the need for protective actions [25]. However, similar to the Zottarelli et al. [9] analysis of the U.S. government heat websites, our analysis identified that nearly half of the materials did not include content on specific heat-vulnerable groups (Table 3). For example, individuals with mental illnesses were only identified on 20 % of the webpages and online resources. This is an important gap given that this group in particular has been shown to be disproportionally impacted by extreme heat. For example, the British Columbia coroner's investigation of the 2021 Heat Dome reported that 64 % of decedents were identified with chronic illnesses that impact cognitions, including mood and anxiety disorders, dementia and schizophrenia [26]. Therefore, references to a broader array of vulnerable populations within heat-health materials or more tailored resources for individuals at greater risk could be considered [9,24,27].

6.4. Limitations and future studies

There are limitations to this study and opportunities for future work. First, there is no current master list of public health authorities, or authorities with other mandates which promote public health content in Canada, beyond the simplified structure presented in the *Structural Profile of Public Health in Canada* [14]. Although we tried to ensure our list was comprehensive, reviewed by a government representative engaged in public health (M.G.), and supplemented by an Advanced Google search, there is the possibility that some sites were omitted. Nonetheless, given the methods used to identify sources, our list likely represents most of the resources that a member of the public would seek out for heat-health content. Next, as the intent of this investigation was specific to online resources, print resources were not captured. As not all members of the public seek heat-health information online, future research could investigate the availability and content of print-based materials to expand upon the insights generated by the present study. Further, it was not within the scope of this analysis to analyse or comment on the scientific accuracy and evidence-base of the heat-mitigating actions reviewed within the study. Therefore, future investigations are needed to explore the accuracy and efficacy of the recommended heat-mitigating actions.

7. Conclusion

Our study systematically collated the heat-health resources available on regional, provincial, territorial, and federal public health authority websites in Canada. We then conducted an in-depth investigation of the content of these resources, inclusive of identifying all populations indicated to be vulnerable to the heat and health authority

Table 5
Summary of the information identified in the public health authority heat-health material related to raising awareness and providing knowledge on heat stress.

Recommended Strategies/ Statements	Number of Resources (n = , %)	Textual Examples from Public Health Authority Webpages or Resources
Knowledge of Causes, Signs and Symptoms and Response		
Know the signs and symptoms of heat-related illnesses	239 (57 %)	*"The symptoms of heat stroke include high body temperature, lack of sweat, disorientation, fainting, unconsciousness."*
Actions to take when heat-related illness is suspected	182 (44 %)	*"If you start to feel overheated, stop your activity immediately. Seek shade and drink fluids. Seek medical attention immediately for anyone who is feeling faint."*
Types of heat-related illness	153 (37 %)	*"Extensive exposure to extreme heat can result in serious medical conditions such as heat cramps, heat exhaustion and heat stroke."*
Causes of heat-related illnesses	95 (23 %)	*"Too much heat can be harmful to your health and cause heat-related illnesses. Heat-related illness is the result of your body gaining heat faster than it can cool itself down."*
Create an emergency plan	58 (14 %)	*"Prepare a personal health plan/ family plan for extreme heat events, and build an emergency kit for your family and pets."*
Seeking Updates and Heat Event Information		
Check regional, provincial and federal health authority web pages	175 (42 %)	*"See more about heatstroke at MyHealth.Alberta.ca."*
Ask a health professional how medications or health conditions can affect your risk in the heat	102 (25 %)	*"If you take regular medications, drugs, or have a health condition, ask your doctor or pharmacist whether it increases your health risk in the heat and follow their recommendations."*
Check local news and other media sources	85 (20 %)	*"Pay attention to local heat and weather alerts to know when extra heat caution is needed."*
Call public information phone lines	69 (17 %)	*"Read, watch, or listen to the local news and weather channel for updates on weather and warnings. If you are concerned about heat-related illness, call BC's free health information line at 8-1-1 (not 9-1-1, unless it is an emergency)."*
Check the WeatherCAN App or weather.gc.ca	60 (14 %)	*"Download the WeatherCAN app or visit Environment Canada's Public Weather Alerts for Alberta website for current and forecasted weather conditions."*
Monitor indoor temperature	30 (7 %)	*"Know temperatures indoors and outdoors by checking local weather forecasts and the thermostat inside your home."*
Sign up for notification from your utility provider	3 (<1 %)	*"Extreme heat can lead to power and water outages. Sign-up for notifications from your utility provider so you are notified of any issues in your area."*
Additional Information		
Heat warnings and Heat Alert Response Systems	89 (21 %)	*"For extreme heat emergencies, the Province is prepared to issue alerts through the national public alerting system, Alert Ready, which is already used to issue Amber alerts and tsunami, wildfire and flood warnings. The criteria for the BC Heat Alert and Response System are as follows …"*
Air quality	63 (15 %)	*"When a heat alert occurs during an air quality advisory, prioritize cooling down. Heat is typically*

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Table 5 (*continued*)

Recommended Strategies/ Statements	Number of Resources (n = , %)	Textual Examples from Public Health Authority Webpages or Resources
COVID-19	49 (12 %)	*more dangerous than short-term exposure to poor air quality."* *"If you have air conditioning, use it to take the edge off indoor heat - but don't over-cool and remember that circulation of fresh air is important for reducing COVID-19 risk."*

recommended heat-health risk reduction strategies. Although a wide array of resources were identified, availability across agencies and provinces/territories was variable, and in many instances, the material differed in content and scope considerably. We also found that the heat-health materials primarily identified vulnerability based on demographics like age but omitted many other heat susceptible groups. Similarly, although an array of potential heat-mitigation actions were identified across the full dataset, few webpages and online resources provided comprehensive lists. These results provide important insights into the composition of heat-health webpages and online resources within Canada and can help guide relevant revisions and additions to the existing heat-health resources.

Ethics approval

This article does not contain any studies with human participants or animals performed by any authors.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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References

[1] W. Cheng, D. Li, Z. Liu, R.D. Brown, Approaches for identifying heat-vulnerable populations and locations: a systematic review, Sci. Total Environ. 799 (2021) 149417.

[2] IPCC, Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, UK, 2022, p. 3056.

[3] Environment and Climate Change Canada, Criteria for public weather alerts [Internet] [cited 2022 Oct 20]. Available from: https://www.canada.ca/en/environment-climate-change/services/types-weather-forecasts-use/public/criteria-alerts.html, 2022.

[4] Health Canada, Communicating the Health Risks of Extreme Heat Events: Toolkit for Public Health and Emergency Management Officials, Health Canada, Ottawa, 2011 [cited 2022 Oct 31]. Available from: https://www.canada.ca/content/dam/hc-sc/migration/hc-sc/ewh-semt/alt_formats/hecs-sesc/pdf/pubs/climat/heat-chaleur/heat-chaleur-eng.pdf.

[5] Health Canada, Heat Alert and Response Systems to Protect Health: Best Practices Guidebook [Internet], Health Canada, Ottawa, Canada, 2012 [cited 2024 Mar 7]. Available from: https://www.canada.ca/en/health-canada/services/environmental-workplace-health/reports-publications/climate-change-health/heat-alert-response-systems-protect-health-best-practices-guidebook.html.

[6] K. Bassil, D. Cole, Effectiveness of public health interventions in reducing morbidity and mortality during heat episodes: a structured review, Int. J. Environ. Res. Publ. Health 7 (3) (2010) 991–1001.

[7] M. Nitschke, A. Krackowizer, A. Hansen, P. Bi, G. Tucker, Heat health messages: a randomized controlled trial of a preventative messages tool in the older population of South Australia, Int. J. Environ. Res. Publ. Health 14 (9) (2017 Aug 31) 992.

[8] D. Lowe, K.L. Ebi, B. Forsberg, Heatwave early warning systems and adaptation advice to reduce human health consequences of heatwaves, Int. J. Environ. Res. Publ. Health 8 (12) (2011 Dec 12) 4623–4648.

[9] L.K. Zottarelli, S.A. Blake, M.T. Garza, Communicating heat-health information to the public: Assessing municipal government extreme heat event website content, Weather Clim. Soc. 14 (1) (2022 Jan) 311–321.

[10] F.S. Arsad, R. Hod, N. Ahmad, M. Baharom, F. Tangang, The Malay-version knowledge, risk perception, attitude and practice questionnaire on heatwaves: development and construct validation, Int. J. Environ. Res. Publ. Health 19 (4) (2022 Feb 17) 2279.

[11] F. El-Gamal, A. Ghandoura, A. Alammari, B. Alghamdi, L. Babhair, S. Alsabhani, Knowledge, attitude and practice towards heat related illnesses of the general public of Jeddah, Saudi Arabia, World Fam. Med. J. Middle East J. Fam Med. 19 (9) (2021 Sep) [cited 2022 Dec 23], http://www.mejfm.com/Sptember%202021/Heat%20related%20illness.htm.

[12] S.C. Sheridan, A survey of public perception and response to heat warnings across four North American cities: an evaluation of municipal effectiveness, Int. J. Biometeorol. 52 (1) (2007 Oct 10) 3–15.

[13] O.V. Wilhelmi, M.H. Hayden, Connecting people and place: a new framework for reducing urban vulnerability to extreme heat, Environ. Res. Lett. 5 (1) (2010 Jan) 014021.

[14] Institute National de Santé Publique Québec, Structural Profile of Public Health in Canada, Centre de Collaboration Nationale sur les Politiques et la Santé, 2018.

[15] J. Fleiss, B. Levin, M. Paik, Statistical Methods for Rates & Proportions [Internet], third ed., John Wiley & Sons Inc, New York, NY, 2003. Available from: https://onlinelibrary.wiley.com/doi/book/10.1002/0471445428.

[16] H.C. Henderson, J. Hong, D.B. Friedman, D.E. Porter, A.C. Halfacre, G.I. Scott, et al., A content analysis of Internet resources about the risks of seafood consumption, Int. J. Environ. Health Res. 26 (4) (2016 Jul 3) 433–447.

[17] B.W. Hesse, D.E. Nelson, G.L. Kreps, R.T. Croyle, N.K. Arora, B.K. Rimer, et al., Trust and sources of health information: the impact of the internet and its implications for health care providers: findings from the first health information national trends survey, Arch. Intern. Med. 165 (22) (2005 Dec 12) 2618.

[18] A. Tanner, D.B. Friedman, Health on the Web: an examination of health content and mobilising information on local television Websites, Inf. Health Soc. Care 36 (1) (2011 Jan) 50–61.

[19] D.B. Friedman, M. Tanwar, J.V.E. Richter, Evaluation of online disaster and emergency preparedness resources, Prehospital Disaster Med. 23 (5) (2008 Oct) 438–446.

[20] V.S. Diwanji, L. Arpan, M.B. Ulak, J. Hou, Jove, E.E. Ozguven, R. Arghandeh, Understanding citizens' communication channel preferences during natural disasters: a synchronicity-based, mixed-methods exploration using survey and geospatial analysis, Int. J. Disaster Risk Reduc. 47 (2020 Aug) 101646.

[21] D. Fitzpatrick-Lewis, J. Yost, D. Ciliska, S. Krishnaratne, Communication about environmental health risks: a systematic review, Environ. Health 9 (1) (2010 Nov 1) 67.

[22] A. Bouchama, Prognostic factors in heat wave–related DeathsA meta-analysis, Arch. Intern. Med. 167 (20) (2007) 2170.

[23] K.R. Weinberger, A. Zanobetti, J. Schwartz, G.A. Wellenius, Effectiveness of National Weather Service heat alerts in preventing mortality in 20 US cities, Environ. Int. 116 (2018 Jul) 30–38.

[24] H.E. Deegan, J. Green, S. El Kurdi, M. Allen, S.L. Pollock, Development and implementation of a heat alert and response system in rural British Columbia, Can. J. Public Health 113 (3) (2022 Jun) 446–454.

[25] E. MacIntyre, S. Khanna, A. Darychuk, R. Copes, B. Schwartz, Evidence synthesis - evaluating risk communication during extreme weather and climate change: a scoping review, Health Promot. Chronic Dis. Prev. Can. 39 (4) (2019 Apr) 142–156.

[26] B.C. Coroners Service, Extreme Heat and Human Mortality: A Review of Heat-Related Deaths in B.C. In Summer 2021, British Columbia Coroners Service, British Columbia, Canada, 2022 Jun p. 56. Available from: https://www2.gov.bc.ca/gov/content/life-events/death/coroners-service/news-and-updates/heat-related.

[27] C.J. Gronlund, L. Sheppard, S.D. Adar, M.S. O'Neill, A. Auchincloss, J. Madrigano, et al., Vulnerability to the cardiovascular effects of ambient heat in six US cities: results from the multi-ethnic study of atherosclerosis (MESA), Epidemiology 29 (6) (2018 Nov) 756–764.