

HEATWAVES

IMPLICATIONS FOR PUBLIC HEALTH AND POLICY

INTRODUCTION

Dr. Samantha Green often remembers an elderly patient with asthma, who lives alone without any close family members available for regular check-ins. She used to worry that, during a heat wave, this patient might die alone in his apartment because he did not have access to air conditioning, no one could check-in and drive him to a cooling facility, and the heat likely exacerbated his asthma. Dr. Green managed to get her patient an air conditioner through the Ontario Disability Support Program, ensuring he would not be at risk during future heat waves.¹ However, most people do not have any such advocates during extreme heat events.¹⁻⁴

Heat waves, also known as extreme heat events, are characterized by most jurisdictions as hot weather conditions with the potential to result in unacceptable levels of health effects, including increased rate of mortality. Consistently high temperatures are one component of heat waves, with humidity, wind speed, and sunlight intensity also contributing to health risks. Extreme heat events have the potential to aggravate underlying health conditions, including respiratory,

cardiovascular and psychological conditions, to a point of fatality, and also cause heat stroke that could result in death.¹⁻⁵ The effect of extreme heat may also be compounded by the side effects of certain medications, such as psychiatric medications that decrease the ability to self-regulate body temperature.^{1,6} Although the Canadian Disaster Database only observed five extreme heat events between 1900 and 2005, several other media and expert reports highlight current, more common occurrences of heat waves.⁵

Unfortunately, it is difficult to quantify the true impact of extreme heat events. Even though it is known that heat exacerbates existing health conditions, leading to death, there is no scientific way to understand the degree to which this occurs. As such, in many jurisdictions, deaths caused by extreme heat events are only reported as deaths caused by the underlying health condition of the deceased, such as reporting natural causes for the death of a patient with cardiovascular disease who passed away because of a heart attack triggered by heat. Still, recent estimates in Ontario have linked a 5°C increase in temperature with a 2.5% increase in the death rate.¹

Given the above, it is clear that heat waves have preventable health effects that increase public health burden. However, given that the health effects of heat waves are avoidable, there exists a straightforward path to combatting this public health burden, making it imperative that policymakers and health officials act now to prevent these unnecessary deaths and health impacts.²⁻⁵ The purpose of this policy brief is to explore the environmental, political, and socioeconomic factors contributing to heat wave-related health effects, as well as providing a critique of commonly proposed policy solutions.

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ENVIRONMENTAL CAUSES OF HEAT WAVES

Climate change has resulted in extreme weather variations, characterised by dramatic increases in the frequency and intensity of warm and cold weather extremes.⁷ As a result, heat waves now occur at least 2.8 times more frequently compared to the pre-industrial age. Analysis conducted by the World Weather Attribution (WWA), using simulations, suggested that the global average temperature increase of 1.2°C since pre-industrial times has made heat waves at least 150 times more likely to occur.⁸ Current policies focus heavily on air conditioning access and provision; however, studies have demonstrated that a greater consideration of costs, energy usage, and targeted demographics must be maintained.⁷ With rising temperatures, heat waves are increasing in prevalence. Consequently, a comprehensive understanding and reassessment of the current political counteractions to this global environmental crisis is warranted.⁷

Rising global temperatures contributed to a week of record-breaking heat in Canada and the US in 2021.⁹ This heat wave affected large cities that rarely experience extreme heat, such as Seattle, Washington and Vancouver, Canada. On June 29, the village of Lytton in British Columbia (BC) reported a peak temperature of 49.6°C, the highest temperature historically reported in Canada.⁹ Among impacts on the village's water supply, forest fires, and the elderly population, citizens were forced to evacuate to protect their health. Greater worries arise due to the village's growing familiarity with forest fires, which are beginning to spread even more rapidly and frequently due to dryer climates and heat domes, areas of high pressure that trap heat. Temperature differences between the warm western Pacific Ocean and the cold eastern Pacific Ocean create winds that blow dense, tropical western air eastward. This warm air then becomes trapped in the jet stream, creating a current that maintains heat for long periods of time.¹⁰ According to the BC coroner's report released after this heat event, human activity was a notable contributor given the severity and rarity of the events, particularly due to rising greenhouse gas emissions.¹⁰

Human influences also have ramifications in urbanized areas. The urban heat island (UHI) effect describes that cities can be between 10–15°C hotter than their surroundings due to increased albedo and minimal greenspace. Modern car-dependent cities consist of concrete and asphalt in buildings, streets, and parking lots. These dark materials have very low reflectance and absorb massive amounts of heat, which prevents nighttime cooling. The consequent accumulation of heat results in extreme heat waves.^{11–13}

CURRENT POLICIES WORSEN ENVIRONMENTAL IMPACT

Decades of policy choices about home cooling regulations have led to exceptionally heat-vulnerable cities in Canada.^{1,10,14} Although Canadian jurisdictions have a robust framework for regulating home heating in winter, a similar framework does not exist for cooling over hotter summers. For example, current Ontario building codes require heating, which are also backed up by municipal laws. Regarding cooling however, only 6% of Toronto apartments have central air, and only an additional 9% have at least one air conditioned room. The Ontario Building Code has no requirements for air conditioning (AC), and local municipal laws may not be exhaustive enough to curb the effects of extreme heat events.^{1,14} According to the coroner's report, most of those who died in the BC heat wave lived in homes without in-unit AC.¹⁰



SOCIOECONOMIC FACTORS WORSEN INEQUITIES CAUSED BY HEAT WAVES

Many social, economic, and community factors contribute to the increased vulnerability of certain individuals. These groups can be referred to as heat-vulnerable groups. It is important to understand these factors to conceptualize the full extent of the problem, and to determine policies to tackle the systemic issues creating inequities during extreme heat events.⁵

Low-income and racialized neighbourhoods are often the most affected by UHI effects, have the least access to green space, and are the most likely to live without AC; consequently, they are more likely to experience negative effects during heat waves.^{10-13,15} Further, individuals experiencing homelessness are impacted by extreme heat events due to their reliance on cooling from public spaces that are often hostile towards them, together with the complications of multiple comorbidities that are characteristic of homelessness.^{2-4,16,17} Additionally, low-income populations may experience 40% higher exposure to heat waves than their higher income counterparts.¹⁸ This discrepancy is attributable to location and unequal access to cooling options, like AC. Additionally, the global energy demand for AC may triple by 2050.¹⁹ Without cheaper, more sustainable methods of heat adaptation, low-income populations will continue to be disproportionately affected by extreme heat. By 2100, the lowest-income quarter of Canada's population may experience 23 more days of extreme heat annually when compared to the highest income quarter.¹⁷

The individuals in heat-vulnerable communities are often low-income, speak English as their second language, and are disengaged from political processes; thus, they carry a greater risk of illness and morbidity. In contrast, the majority of political decision makers are homeowners, who may be spared from the negative impact of heat waves because of access to greener neighbourhoods, tree-shaded backyards, secure homes, and air conditioned cars. Therefore, the risks of extreme heat events may be downplayed in political decision-making and in mortality reports. For example, despite undergoing heat waves around the same time, Ontario, Quebec, and BC displayed death counts that differed by orders of magnitude due to classification disparities. While BC and Quebec account for all causes of deaths during the heat wave, including tangential cases that may have been worsened or triggered by extreme heat, Ontario only considers deaths directly related to heat pathologies (e.g. heat stroke). This dramatically under reports the issue, reflecting a concerning lack of awareness in provincial urban cooling policies, which may impact availability and accessibility to city cooling centres and services.^{1,16,17,20-23}

Another particularly heat-vulnerable group is the elderly population, many of whom are at risk because of pre-existing health conditions and living conditions, whether in homes, apartments, rooming houses, or long-term care homes (LTCs). LTCs have been in a spotlight recently due to their drastically unsafe conditions during the pandemic, but negligent conditions

have prevailed, particularly concerning air conditioning.²⁴ While LTCs are mandated to have at least one air conditioned area, seniors with limited mobility in facilities with limited staffing are unable to escape the stifling heat of their personal rooms.²⁵ The BC coroners report indicates that most of the heat-related deaths in 2021 were of elderly individuals, especially those living alone who may not have been able to access help.^{1,10}

A study also showed that on average, 22 hours per worker was lost each summer due to extreme heat exhaustion, which corresponds to 1% of annual work hours and a loss of \$1,100 to each individual.²³ Multiple areas of the economy suffer from reduced worker productivity during heat waves, notably agriculture and construction. Roughly 2% of annual working hours is lost globally due to extremely hot working conditions that preclude on-site workers from maintaining their working pace. Global productivity loss from on-site heat exhaustion is valued at \$4.2 trillion dollars per year.²⁶ With the agriculture system employing 2.1 million Canadians and generating \$134.9 billion of Canada's GDP, heat waves entail devastating impacts on many Canadians' livelihood.^{27,28} Heat waves engender lost productivity for Canada's economy, smaller harvests for farmers, and higher prices for consumers.

CRITIQUE OF COMMONLY PROPOSED POLICY SOLUTIONS

Affordable residences in Toronto are often fitted with decades-old heating and cooling systems that take days to turn on or off, and they deliver inconsistent heating throughout the building. Unexpected heat waves may strike while these heating systems remain turned on. Retrofitting these apartments, along with those lacking AC, would be expensive and cost millions. A mass retrofit will only become more challenging as time goes on, as heat stress has the potential to cause mass power failures.¹¹

In contrast, a policy of refit incentives and mandates for passive cooling, a building design that promotes passive heat dissipation, and AC on new builds has been pursued. For passive cooling measures, studies have shown high effectiveness under heat wave conditions along with substantial energy savings.²⁹ However, landlords have historically been resistant to

refits, and the passing-on of costs to tenants remains an issue. Policies around new builds can only impact roughly 4% of the housing stock annually, and have minimal impact on long-tenured residents. Regardless, these measures are precarious; Toronto Green Standard, the municipal program which includes passive cooling and air conditioning mandates, is facing resistance due to the recent passing of Ontario's Bill 23, the government's recent housing bill.³⁰⁻³²

Heat mitigation policy faces an array of challenges. Electrical grids are at extreme risk of damage from heat, which has historically led to grid-wide failures. This risk is worsened by increased AC usage.¹¹ Toronto's grid is based on outdated infrastructure primed for failure, which is further exacerbated by the long term crisis of power generation caused by the current Conservative government.³⁰ More concerning is the crisis of housing affordability, which Bill 23 is ostensibly meant to address. Many Canadian cities, such as Toronto, Vancouver, and Hamilton, rank among the least affordable cities in the world. Expensive and scarce rental housing availability along with factors like restrictive zoning policies and parking requirements have provided landlords with a massive degree of leverage with tenants. These same circumstances deter developers from building new, affordable housing and allow landlords to employ climate concerns to push forward further economic costs for their tenants. Bill 23 is one example of this, pairing liberalisation of zoning measures with repeal of the Toronto Green Standards (though this is being walked back by the province).^{32,33} On a smaller scale, this dynamic played out in a recent case in Parkdale, Toronto, where tenants were faced with eviction if they refused to pay extra fees for AC.^{34,35}

CONCLUSION

As temperatures continue to rise, further political action is required to properly protect civilians from the health effects of extreme heat events. It must be recognized that the current political and socioeconomic systems prevent adequate legislative change, although there may exist well-intentioned efforts from municipalities and provinces. Certainly, more robust, accessible cooling systems are mandatory; however, a greater emphasis must be placed upon the underprivileged, such as the development of effective public health and emergency response countermeasures. More research is thus required to explore current technologies and infrastructure to fully address the repercussions of heat waves, as well as better ways of measuring and reporting the full health impact of extreme heat events.

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- Roy I. As Toronto temperatures rise, inequalities widen [Internet]. The Local. 2022 Jun 21. Available from: https://thelocal.to/toronto-heat-wave-inequality/?fbclid=IwAR1HZY-rwdW1dlUPE_VUteVnODQ-iQpuKOPNM5LJEaht1DXcrWqT4Z1uBpA [cited 2022 Nov 26].
- Aufiero P. Witness: 'Like the whole system is collapsing' [Internet]. Human Rights Watch. 2021 Oct 5. Available from: <https://www.hrw.org/news/2021/10/05/witness-whole-system-collapsing> [cited 2022 Nov 26].
- LaFortune R. One year since deadly heatwave in Canada, protections still needed [Internet]. Human Rights Watch. 2022 May 27. Available from: <https://www.hrw.org/news/2022/05/27/one-year-deadly-heatwave-canada-protections-still-needed?fbclid=IwAR0TpeUjOo1zzRNYuyyL4LUEgHu7Mgbw3Nd6-53STHOuWm-V-11BwdeLGR8> [cited 2022 Nov 26].
- Human Rights Watch. Canada: Disastrous impact of extreme heat [Internet]. Human Rights Watch. 2021 Oct 5. Available from: <https://www.hrw.org/news/2021/10/05/canada-disastrous-impact-extreme-heat?fbclid=IwAR0MvIdiojBz82hL15r11GpQhCgtgLR7m0ldFDCXpnkPod7BZxg7b7Nn4> [cited 2022 Nov 26].
- Government of Canada. Communicating the Health Risks of Extreme Heat Events [Internet]. 2020 Dec 14. Available from: <https://www.canada.ca/en/health-canada/services/environmental-workplace-health/reports-publications/climate-change-health/communicating-health-risks-extreme-heat-events-toolkit-public-health-emergency-management-officials-health-canada-2011.html#ref> [cited 2022 Nov 26].
- Westaway K, Frank O, Husband A, McClure A, Shute R, Edwards S, et al. Medicines can affect thermoregulation and accentuate the risk of dehydration and heat-related illness during hot weather. *J Clin Pharm Ther*. 2015;40(4):363-7. Available from: doi:10.1111/jcpt.12294.
- Clarke B, Otto F, Stuart-Smith R, Harrington L. Extreme weather impacts of climate change: An attribution perspective. *Environ Res*. 2022;1(1):012001. Available from: doi:10.1088/2752-5295/ac6e7d.
- WWA. Western North American extreme heat virtually impossible without human-caused climate change [Internet]. Available from: <https://www.iea.org/news/air-conditioning-use-emerges-as-one-of-the-key-drivers-of-global-electricity-demand-growth> [cited 2023 Jan 11].
- Schiermeier Q. Climate change made North America's deadly heatwave 150 times more likely [Internet]. Nature. 2021 Jul 8. Available from: <https://www.nature.com/articles/d41586-021-01869-0> [cited 2022 Nov 26].
- Egillon M. Extreme heat and human mortality: A review of heat-related deaths in B.C. in summer 2021. Victoria (BC): BC Coroners Service; 2022. 53 p.
- Doiron D, Setton EM, Shairsingh K, Brauer M, Hystad P, Ross NA, et al. Healthy built environment: Spatial patterns and relationships of multiple exposures and deprivation in Toronto, Montreal and Vancouver. *Environ Int*. 2020;143:106003. Available from: doi:10.1016/j.envint.2020.106003.
- Rinner C, Hussain M. Toronto's urban heat island—exploring the relationship between land use and surface temperature. *Remote Sens*. 2011;3(6):1251-65. Available from: doi:10.3390/rs3061251.
- Greene CS, Robinson PJ, Millward AA. Canopy of advantage: Who benefits most from city trees? *J Environ Manage*. 2018;208:24-35. Available from: doi:10.1016/j.jenvman.2017.12.015.
- Executive Director, Municipal Licensing and Standards. Mitigating the Negative Impacts of Extreme Heat in Apartment Buildings. Toronto (ON): City of Toronto; 2018. 30 p. Report No.:LS25.1.
- Pinault L, Christi's T, Olaniyan T, Crouse DL. Ethnocultural and socioeconomic disparities in exposure to residential greenness within urban Canada. Ottawa (ON): Statistics Canada; 2021. 14 p. Report No.:82-003-X.
- Pagliaro J. John Tory announces commitment to Toronto parks, critics cite encampment evictions, lack of basic facilities [Internet]. Toronto Star. 2022 Oct 9. Available from: <https://www.thestar.com/news/gta/2022/10/09/john-tory-announces-commitment-to-toronto-parks-critics-cite-encampment-evictions-lack-of-basic-facilities.html> [cited 2022 Nov 26].
- Braga M. A park for all, or a park for some? [Internet]. The Local. 2019 Jul 23. Available from: <https://thelocal.to/a-park-for-all-or-a-park-for-some/> [cited 2022 Nov 26].
- Alizadeh MR, Abatzoglou JT, Adamowski JF, Prestemon JP, Chittoori B, Asanjan AA, et al. Increasing heat-stress inequality in a warming climate. *Earth's Futur*. 2022;10(2):e2021EF002488. Available from: doi:10.1029/2021EF002488.
- AGU. POOREST PEOPLE BEAR GROWING BURDEN OF HEAT WAVES AS TEMPERATURES RISE [Internet]. Available from: <https://news.agu.org/press-release/poorest-people-bear-growing-burden-of-heat-waves-as-temperatures-rise/#:~:text=Lower%20income%20populations%20currently%20face,rest%20of%20the%20population%20combined> [cited 2023 Jan 11].
- IEA. Air conditioning use emerges as one of the key drivers of global electricity-demand growth [Internet]. <https://www.iea.org/news/air-conditioning-use-emerges-as-one-of-the-key-drivers-of-global-electricity-demand-growth> [cited 2023 Jan 11].
- The Canadian Press. A timeline of B.C.'s record-setting extreme heat event in June 2021 [Internet]. Toronto Star. 2022 Jun 24. Available from: <https://www.thestar.com/news/canada/2022/06/24/a-timeline-of-bcs-record-setting-extreme-heat-event-in-june-2021.html?fbclid=IwAR0ZjLBDas58Ar2axKl6450407MLHBdMvUDKjwblsMEzEwK3JXk2epk9Hxl> [cited 2022 Nov 26].
- Lorinc J. Why we can't go: A report on Toronto's public washrooms, pt. 1 [Internet]. Spacing Toronto. 2022 Jun 14. Available from: <http://spacing.ca/toronto/2022/06/14/why-we-cant-go-a-report-on-torontos-public-washrooms-pt-1/> [cited 2022 Nov 26].
- Skjerven K. Toronto is a city flush with parks. So why aren't there more public washrooms available? [Internet]. Toronto Star. 2022 Oct 17. Available from: <https://www.thestar.com/news/gta/2022/10/17/toronto-is-a-city-flush-with-parks-so-why-arent-there-more-public-washrooms-available.html> [cited 2022 Nov 26].
- City of Toronto. Cool spaces near you [Internet]. Available from: <https://www.toronto.ca/community-people/health-wellness-care/health-programs-advice/hot-weather/cool-spaces-near-you/#location=27.27%20Victoria%20Park%20Ave&lat=43.77793179961336&lng=-79.32272648049143> [cited 2022 Nov 26].
- Vanos J. Workplace heat exposure, health protection, and economic impacts: A case study in Canada. *Am J Ind Med*. 2019;62(12):1024-37. Available from: doi:10.1002/ajim.22966.
- International Labour Organization. Working on a WARMER planet: The impact of heat stress on labour productivity and decent work. Geneva (CH): International Labour Office; 2019. 98 p.
- CIHI. COVID-19's impact on long-term care [Internet]. Available from: <https://www.cihi.ca/en/covid-19-resources/impact-of-covid-19-on-canadas-health-care-systems/long-term-care> [cited 2023 Jan 11].
- Dangerfield K. 'It's a death trap': Families horrified by lack of air conditioning in long-term care homes [Internet]. Global News. 2020 Jul 14. Available from: <https://globalnews.ca/news/7161608/long-term-care-homes-heat-wave-air-conditioner/> [cited 2023 Jan 11].
- Government of Canada. Overview of Canada's agriculture and agri-food sector [Internet]. 2022 Jul 18. Available from: <https://agriculture.canada.ca/en/canadas-agriculture-sectors/overview-canadas-agriculture-and-agri-food-sector> [cited 2022 Nov 26].
- Hogan S. Building code changes could take decades to 'future-proof' homes for extreme heat that's here now [Internet]. CBC. 2022 Jun 15. Available from: <https://www.cbc.ca/news/canada/heat-dome-retrofit-building-codes-passive-cooling-1.6488244> [cited 2022 Nov 26].
- Lorinc J. Will Doug Ford's housing reforms kill the Toronto Green Standard? [Internet]. The Globe and Mail. 2022 Nov 18. Available from: <https://www.theglobeandmail.com/real-estate/article-will-doug-fords-housing-reforms-kill-the-toronto-green-standard/> [cited 2022 Nov 26].
- Syed F. More green construction, less gravel mining: Ford walks back some environmental changes in Ontario housing bill [Internet]. The Narwhal. 2022 Nov 25. Available from: <https://thenarwhal.ca/ontario-housing-bill-changes/> [cited 2022 Nov 26].
- Syed F. Ontario could be entering an energy supply crisis. Here's what you need to know [Internet]. The Narwhal. 2022 Jul 22. Available from: <https://thenarwhal.ca/ontario-electricity-grid/> [cited 2022 Nov 26].
- Cohen B. 'We feel violated and traumatized': Parkdale tenants outraged after dozens served eviction notices over air conditioning [Internet]. Toronto Star. 2022 Jun 29. Available from: <https://www.thestar.com/news/gta/2022/06/29/we-feel-violated-and-traumatized-parkdale-tenants-outraged-after-dozens-served-eviction-notice-over-air-conditioning.html> [cited 2022 Nov 26].
- CBC News. Facing eviction for using air conditioning, residents of a Parkdale building speak out [Internet]. CBC. 2022 Jun 28. Available from: <https://www.cbc.ca/news/canada/toronto/eviction-air-conditioning-parkdale-1.6504633> [cited 2022 Nov 26].