

Cities, Climate Change, & Health Equity

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Think Piece

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Today, the meeting place of Toronto is still the home to many Indigenous people from across Turtle Island and we are grateful to have the opportunity to work in the community, on this territory.

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Climate change is recognized as one of the most significant public health threats of this century.^{1,2,3} Toronto will feel its effects. Climate projections offer a picture of the city's new normal: the coming decades will bring higher temperatures, stronger storms, and new patterns of air pollution.⁴ These changes will have a significant impact on peoples' health and well-being. Research suggests that a changing climate could result in an increase in heat-related illness; more injuries and accidents from severe storms; and more respiratory illness from worsening air quality.^{1,2,3} Policy-makers in Toronto have developed a public health response in the 2015 *Climate & Health Strategy for Toronto*,⁵ which outlines proposals to strengthen the city's capacity to protect health and well-being.

Some people will feel the health impacts of a changing climate more than others. Housing, income, neighbourhood, and other social determinants of health change the way that people interact with the environment, exacerbating existing health inequities and introducing new ones.^{6,7} Understanding the social determinants of health and how they interact with climate change will be a central issue for responding to the coming challenges.

This paper will first describe the health implications of climate change in Toronto, focusing on the key threats of heat, severe storms, and air quality and will then provide an overview of dimensions of climate vulnerability and resilience. Drawing from examples in the United States and Canada, the discussion will explore how the social determinants of health including housing, income, and social support influence the way that communities experience climate change. By highlighting the intersections between social and environmental determinants of health, this discussion will raise considerations for future policy action.

Toronto's New Normal

Climate change is likely to harm public health worldwide, and Toronto is no exception. Toronto is likely to experience higher temperatures, more severe storms, and worsening air quality as a result of climate change. Policy-makers in Toronto have explored the health implications of several climate threats and, in some cases, investigated policy options to minimize the impacts on health and well-being.⁵

Prolonged exposure to high temperatures can directly cause a range of illnesses including heat stroke and heat exhaustion, and can exacerbate chronic health conditions such as cardiovascular disease or respiratory disease.^{2,3} As a result of these direct and indirect impacts, heat waves can be fatal, especially for older adults and children.² Current models predict that by 2049, Toronto will have more than 60 days per year where the temperature exceeds 30 degrees, compared to only 20 days currently.⁴ According to Toronto Public Health [TPH], these changes could result in up to 240 deaths per year, double the current rate.⁸

Protecting peoples' health during heat waves has become a major priority in Toronto, as noted in the *Climate & Health Strategy*. For example, TPH recently received additional funds to offer cooling centres in air-conditioned public buildings, while the Board of Health is exploring regulatory options to manage temperatures in high-rise apartment buildings.⁸

Storms and flooding can have immediate health impacts such as injuries and accidents, and can lead to long-term challenges like displacement from homes, interrupted medical care, and limited availability of food and other essentials.³ People may experience physical health issues from the event itself, such as injuries from a damaged home. They may also experience psychological stress or trauma from the loss of homes, loss of possessions, or displacement that can often occur during floods and storms; this can lead to longer-term mental health challenges such as anxiety or depression.³ Current models project that Toronto will have less frequent storms by 2040, but they will be much more severe with daily precipitation reaching extremes of 166mm.⁴ In comparison, a storm in July of 2013 with 126mm of rain led to recovery costs of \$70 million for the City of Toronto.⁹ So far, the city's response has largely focused on identifying vulnerabilities in infrastructure and services to minimize disruptions and economic losses.⁹ Toronto's *Climate and Health Strategy* identifies a need to better model and investigate the health impacts of extreme weather events such as storms and floods.⁵

Poor air quality has been associated with respiratory illness including asthma, bronchitis, and chronic obstructive pulmonary disease [COPD], as well as cardiac events like heart attacks.² There is also some emerging evidence that exposure to air pollution may increase risk of neurological decline and dementia.¹⁰ Air quality has been a long-standing public health challenge in Toronto, but unlike heat and severe storms, this hazard is largely produced and managed at the local level. There have been significant improvements in the past two decades due to new environmental regulations and a general decline in industry throughout Ontario and surrounding regions.¹¹ However, a changing climate may slow this progress. Most models indicate that hotter temperatures and more frequent heat waves will exacerbate some forms of harmful pollution in urban areas.¹² Higher temperatures are likely to lead to worsening smog, and are likely to extend the growing season for airborne allergens like pollen and mould. These are all common triggers for asthma attacks and other respiratory issues. Currently, TPH estimates that 3550 hospitalizations and 1300 deaths per year can be attributed to air pollution,¹¹ but it is unclear how these rates may change under new climate conditions. TPH is continuing to monitor the burden of disease from air pollution and is focusing on understanding implications for asthma.⁵

The health risks posed by a changing climate are complex and interrelated, and the evidence base is still growing. Toronto's policy-makers and public health practitioners are responding to the health impacts of climate change through expanded programs, regulatory changes, and more in-depth research and monitoring. There has also been recognition that these health

impacts will not affect everyone in the same way, and that the policy response will need to “address and mitigate the health equity impacts of climate change”.⁵ As the city continues to build its capacity to respond to new climate hazards, it will be critical to understand which individuals and communities are most vulnerable.

Understanding Climate Vulnerability & Resilience

The health risks from climate change are mediated by a range of factors: from individual characteristics like age and health status, to broader challenges like housing quality and physical geography. To understand how different circumstances affect vulnerability, the International Panel on Climate Change [IPCC] developed a framework of *exposure*, *sensitivity*, and *adaptive capacity*.¹³ Though the framework was initially designed for an international context, it has since been used to assess local vulnerability in cities around the world. It provides a useful way to conceptualize how and why some residents are more vulnerable to climate hazards than others.

- *Exposure* refers to the likelihood of experiencing a climate-related hazard. Exposure is usually due to location or geography. For example, a person living in near an industrial site is more likely to be exposed to air pollution.
- *Sensitivity* refers to the likelihood that a climate hazard will cause a negative health outcome. A person might be more sensitive because of their health status or because of social or economic conditions. For example, people with asthma or other respiratory conditions will be more sensitive to the effects of air pollution than others.
- *Adaptive capacity* refers to the ability to cope with a changing climate through new behaviours or practices. Adaptive capacity allows individuals and communities to either limit their exposure or decrease their sensitivity. For example, a person with asthma could use an inhaler or limit spending time outdoors to avoid air pollution.

These three dimensions help us understand how and why different people will experience climate change differently, a critical step in creating a policy response that supports health equity. Taken together, they indicate an individual’s or community’s degree of vulnerability. Importantly, these dimensions are often driven by the social determinants of health like housing, neighbourhood, and access to medical care.

Conversely, these dimensions also indicate opportunities to build climate *resilience*, the ability to withstand and recover from climate impacts. Policies and programs can build resilience by minimizing exposure and sensitivity and strengthening adaptive capacity. For example, stronger environmental regulations can minimize peoples’ exposure to industrial pollution; and improving access to medications for asthma can decrease sensitivity and strengthen adaptive capacity.

Drawing on examples from cities across North America, the sections below illustrate some of the ways that the social determinants of health create disparities in vulnerability and

resilience. These examples illustrate how a range of social determinants of health including housing, income, and social support can drive health inequities in a changing climate.

Chicago Heat Wave

Toronto is already feeling the effects of climate change as it relates to heat: the summer of 2016 was one of the hottest seasons on record.¹⁴ Of all the climate hazards that Toronto faces, extreme heat is one of the most well-understood. Toronto Public Health has already conducted a heat risk assessment which found that heat-related mortality may double by 2050 due to more frequent heat waves and higher daily temperatures.⁸ The home and community environment are important factors in heat vulnerability.¹⁵ Few examples demonstrate the links between heat and social determinants of health more clearly than the 1995 Chicago heat wave, when record-breaking temperatures led to an estimated 700 deaths, heavily concentrated in certain neighbourhoods.

The ability to regulate body temperature tends to decline with age, so it is not surprising that older adults were more sensitive to the heat wave than younger adults.¹⁶ However, there were also sharp differences along racial lines: African American older adults were 50% more likely to die than White older adults.¹⁶ Other heat waves across the United States have shown similar patterns.¹⁷ Subsequent analysis of the Chicago heat wave has highlighted how the social and economic marginalization of African American communities limited their ability to cope with the heat wave.

Housing conditions and low-income status, and specifically household energy insecurity, made it difficult for many households to keep cool. Air conditioning is one of the most reliable ways to cope with heat, but central air conditioning is less prevalent in the homes of African American families compared to other groups.¹⁷ Racialized groups are also more likely to rely on household energy subsidies than their non-racialized counterparts.¹⁸ In the years preceding the heat wave, these subsidies had been cut dramatically, pushing many households in Chicago to forgo using air conditioners even if they owned them.¹⁹ Without adequate access to air conditioning, low-income households, who are disproportionately racialized, were not able to keep their homes to a safe temperature.

However, the fact that mortality was largely concentrated in certain neighbourhoods suggests that beyond the individual household, the neighbourhood environment may play a role in heat-related risk for older adults. One pervasive theory argues that older adults in some neighbourhoods may be less able to rely on their neighbours for support during an emergency because of a lack of social capital and trust within their communities.²⁰ However, empirical analysis does not find an association between measures of social capital and heat wave mortality.^{19,21} On the other hand, the local commercial landscape may play a role: neighbourhoods with more active and diverse businesses fared significantly better during the heat wave than those with many closed-down businesses.¹⁹ The mechanisms behind this link

are not clear, but it is plausible that local business like grocery stores and coffee shops can draw older adults out of their homes, combating social isolation by providing an opportunity to escape a hot apartment and a chance to check in with neighbours about health concerns.

The example of Chicago's heat wave highlights how adaptive capacity is constrained by resources. These heat-related deaths could have been prevented if people were simply able to go somewhere cooler, whether an air-conditioned space in their own home, a local business, or a community facility. However, without financial and social resources, people were not able to escape the heat. In the years after the heat wave, Chicago strengthened their heat response programs by offering free transportation to local cooling centres and creating a home visiting program for older adults living alone, targeting low-income communities for additional services.¹⁵ These changes strengthened the adaptive capacity of Chicago's most vulnerable communities, giving them more resources to cope with future heat waves.

Hurricane Katrina

Toronto's geography does not leave it vulnerable to coastal flooding, but severe storms and subsequent flooding remain a major concern. A major thunderstorm in July 2013 disrupted local and regional transit systems, left hundreds of thousands of households across Ontario without power, and led to over 4700 flooded homes within Toronto.⁹ These storm events are likely to become more frequent and may overwhelm municipal infrastructure and damage residential properties. As one of the most severe natural disasters in US history, the example of Hurricane Katrina holds important lessons about how the social determinants of health influences peoples' experiences of, and recovery from, a major storm.

Like in the Chicago heat wave, Katrina's impact reflected racial and economic divisions in New Orleans. African American adults were between 1.7 to 4 times more likely to die in the hurricane than White adults.²² Racial health inequities persisted well after the storm had passed. African American individuals and those with lower incomes were more likely to experience symptoms of psychological distress, such as feeling extremely hopeless or depressed, even five years after the hurricane.²³

Echoing the findings from Chicago's heat wave, social support was an important factor in peoples' sensitivity to the hurricane, especially with regards to mental health impacts. Those who felt they had a strong sense of social support before the storm, such as by having friends whom they could trust, fared better in the aftermath.²⁴ They were less likely to face major stressors such as not having enough food, not having sufficient medical care, or not knowing the whereabouts of their loved ones.²³ These findings make intuitive sense: neighbours and friends can share material resources like food, share information and messages, and offer much-needed emotional support to cope with uncertainty and fear. Perhaps because they were able to avoid these potentially traumatic experiences, those with strong social support were less likely to report psychological distress in later years.²²

Housing tenure also played a critical role in people's sensitivity to Katrina, particularly during the storm's aftermath. As in other disasters, renters were far less likely to return to their previous homes than homeowners.²⁵ There are overlapping market and policy reasons for the slower recovery of rental housing. Local governments were slow to deliver assistance for rental units: small-scale private landlords did not receive payments until nearly two years after the hurricane hit.²⁶ The local housing authority also chose to tear down several large public housing buildings after the storm, moving tenants towards voucher programs instead.²⁷ These factors resulted in a constrained rental housing market with higher rents, making it extremely difficult for renters to find units in their old neighbourhoods. Instead, many left New Orleans altogether, settling in other cities or states. The widespread displacement of renters has serious health equity implications. Displaced residents reported higher rates of mental health concerns, more fragmented social support networks, and interruptions in medical care.²⁸

Hurricane Katrina highlights that individuals can have different degrees of sensitivity, despite experiencing the same event in the same community. For those who had limited social support or precarious housing situations, the hurricane was more traumatic and ultimately more harmful for health. These sensitivities may not be visible or obvious, but they nonetheless shape an individual's health outcomes. Moreover, sensitivity is dynamic and context-specific. For example, housing tenure emerged as an important element of sensitivity many months after the storm hit New Orleans. A policy response to climate events like storms and flooding must consider the health consequences of the event itself and of the recovery process.

Air Quality in Hamilton

Toronto has seen substantial improvement in air quality over the past few decades, thanks to a decline in heavy industry and more stringent pollution regulations throughout the province.¹¹ Despite these improvements, air quality remains a major public health concern in Toronto: TPH estimates that 3550 hospitalizations and 1300 deaths per year can be attributed to air pollution. It is likely that a changing climate may slow the city's progress towards cleaner air. Hotter and more humid summer conditions lead to an increase in certain types of pollution and can exacerbate urban smog.²⁹ For example, an extended heat wave in September of 2017 led to a special smog advisory for Toronto.³⁰

There are significant inequities in exposure to air pollution by neighbourhood. Evidence has consistently shown that low-income and racialized communities are more likely to be exposed to unhealthy air because they tend to live closer to sources of pollution, like industrial sites and dense traffic corridors.³¹ While this pattern has been mostly documented in the United States, similar dynamics are at play in Canadian cities as well, including

Toronto.³² The city of Hamilton is a close-to-home example of the connections between pollution and socio-economic status, and may highlight important considerations about inequities in exposure to climate-related hazards.

Hamilton has historically experienced high levels of air pollution, partly originating from local steel production and partly from nearby industrial operations in the USA.³³ While air quality has improved substantially over the past two decades, Hamilton remains one of the most polluted cities in Ontario with levels of some pollutants exceeding World Health Organization guidelines.³⁴ Some neighbourhoods face disproportionate risk. Spatial analysis has shown that neighbourhoods in Hamilton with lower incomes and higher rates of unemployment are disproportionately exposed to harmful air pollution because of their proximity to major pollution sources.³⁵ Moreover, there is a racial element to this disparity: neighbourhoods with a high proportion of Latin-American residents face higher exposure, independent of income level.³⁶

This pattern has severe health consequences. In Hamilton, those from lowest-income and most polluted neighbourhoods were two to three times more likely to die from cardiopulmonary causes than those from higher-income, less polluted neighbourhoods.³⁷ Like Toronto, Hamilton had significant progress in improving air quality throughout the 1980s and 1990s. These improvements lessened the socio-economic disparities in exposure, but did not eliminate them entirely, suggesting that improvements were not distributed equitably.³⁸ These health inequities may continue as Ontario's weather becomes hotter and air quality deteriorates further. Hamilton's experience suggests that broad city-wide strategies may not be sufficient for protecting health in the most vulnerable neighbourhoods.

While pollution exposure is an important driver behind respiratory health issues like asthma, it is also important to consider the role of sensitivity. There is substantial evidence that lower-income individuals are more sensitive to air pollution, independent of their exposure levels. This is likely because their health status is often compromised to begin with.³⁹ For example, they may experience poor nutrition and limited opportunities for exercise, contributing to higher rates of respiratory and cardiopulmonary conditions. These underlying health issues can amplify the negative health consequences of air pollution.³⁸

The challenges of air pollution in Hamilton demonstrate how different dimensions of vulnerability intersect. A higher level of exposure to a climate-related hazard, coupled with higher overall sensitivity, leads to more severe health consequences. Social and economic marginalization and environmental vulnerability are inextricably linked. People are not exposed to air pollution in isolation from their other working and living conditions; instead, pollution is one of many health-related challenges that vulnerable communities face. In responding to the health impacts of climate change, it will be critical to address all three dimensions of vulnerability, recognizing the complex interactions between them.

Recognizing & responding to vulnerability

Evidence-based projections are clear that Toronto will experience hotter weather, stronger storms, and worsening air quality in the coming decades. These new climate conditions will become a normal part of day-to-day life. They will pose a threat to health and well-being across the city, but different communities will be vulnerable in different ways. The experience of climate change in Chicago, New Orleans and Hamilton offers an indication of the types of vulnerabilities that Toronto could face and the health equity challenges that could arise.

The most important lesson from each of these cities is that climate change does not produce health inequity on its own. The health risks that individuals and communities face because of income, housing, social isolation, or other social determinants are simply compounded by new climate challenges. African American communities in Chicago faced household energy insecurity long before the heat wave. The response to Hurricane Katrina reflected a prevailing attitude across New Orleans that privileged the needs of homeowners over renters. Hamilton's patterns of pollution are representative of a highly segregated housing market. In all three cities, the most climate-vulnerable communities were those that already faced systemic barriers to good health. Economic marginalization, institutional racism and classism, and uneven power structures have an impact on peoples' health and well-being under the best circumstances. It is no surprise that under new and potentially harmful climate conditions, these factors continue to drive health inequity.

In recognizing that climate change magnifies existing health inequities, it also becomes clear that policy initiatives designed to support marginalized communities are also opportunities to address climate vulnerability. Broad policy actions like the National Housing Strategy, city-level strategies like City of Toronto Poverty Reduction Strategy, and local programs such as Neighbourhood Improvement Areas can be leveraged to create more climate-resilient communities. For example, efforts to improve housing quality and safety can ensure that neighbourhoods are better able to cope with floods. Initiatives to support community connectedness are useful in preparing for heat waves and other climate hazards. There is no doubt that improving housing, reducing social isolation, and increasing financial security are important policy aims in their own right. However, acknowledging their relationship to climate change can drive these policy opportunities further forward and promote solutions that address overlapping health equity issues.

Finally, although climate change is a global challenge, the health implications can be highly localized. The examples demonstrate that even across a fairly small geographic area like a city, a 'one-size-fits-all' approach can create health inequities. Individuals and neighbourhoods will have different levels and types of vulnerability. As a growing city, Toronto is experiencing rising income inequality and significant pressure on infrastructure and housing; as a global city, Toronto must deliver appropriate services to an extremely culturally diverse population. Just as been the case in other cities, Toronto's distinct social, economic, and demographic

landscape will pose unique challenges and opportunities. The response to the health impacts of climate change will need to reflect these distinct needs. This will require targeted, localized approaches, supported by an understanding of the distinct vulnerabilities that different groups face and the resources that can be used to build resilience at a local level.

It can be tempting to consider climate change as a far-off threat, but we are already feeling its effects. The experiences of other North American cities paint a clear picture: a changing climate is harmful to peoples' health, and some communities will be more vulnerable than others. What can cities do to build resilience and protect health across social and economic divides? An upcoming project from the Wellesley Institute, in collaboration with the Boston University School of Public Health, will explore how cities can build health equity into climate change strategies. Case studies from cities around the world will highlight promising approaches, practices, and tools that local governments are using to recognize and respond to health equity issues emerging from climate change. By investigating and sharing examples of innovative actions, our hope is that cities, including Toronto, can better ready themselves for the health and equity challenges of a changing climate.

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