Protecting Vulnerable People from Health Impacts of Extreme Heat

July 2011

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Authors: Stephanie Gower, Carol Mee, and Monica Campbell

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Report at: http://www.toronto.ca/health/hphe

For Further Information:

Healthy Public Policy
Toronto Public Health
277 Victoria Street, 7th Floor
Toronto, Ontario
Canada M5B 1W2

Tel: 416-392-6788
Fax: 416-392-7418

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Background

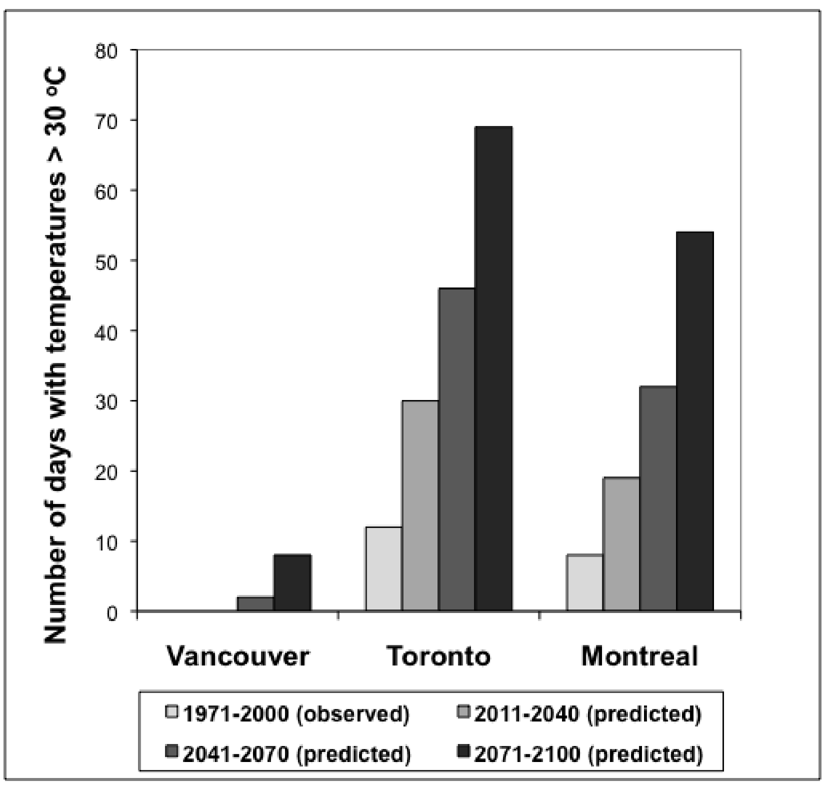
Climate Change, Extreme Heat, and Health

Evidence that climate change is occurring is now widely accepted. The International Panel for Climate Change 4th Assessment (IPCC, 2007) and the Government of Canada's National Climate Change Assessment, From Impacts to Adaptation: Canada in a Changing Climate 2007 (Natural Resources Canada, 2007) conclude that Canada will be affected by climate change in a number of ways. A key impact expected in many regions of Canada including Toronto is increasing intensity, duration and frequency of extreme heat events.

Between 1961 and 1990, Toronto experienced an average of about 15 days per year where temperatures rose above 30 degrees. Environment Canada predicts that with climate change, the number of days in Toronto with temperatures over 30 degrees will more than quadruple to about 65 days per year by 2080-2100 (Hengeveld, 2005) (see Figure 1).

Figure 1: The number of hot days in Toronto is expected to increase in the future.

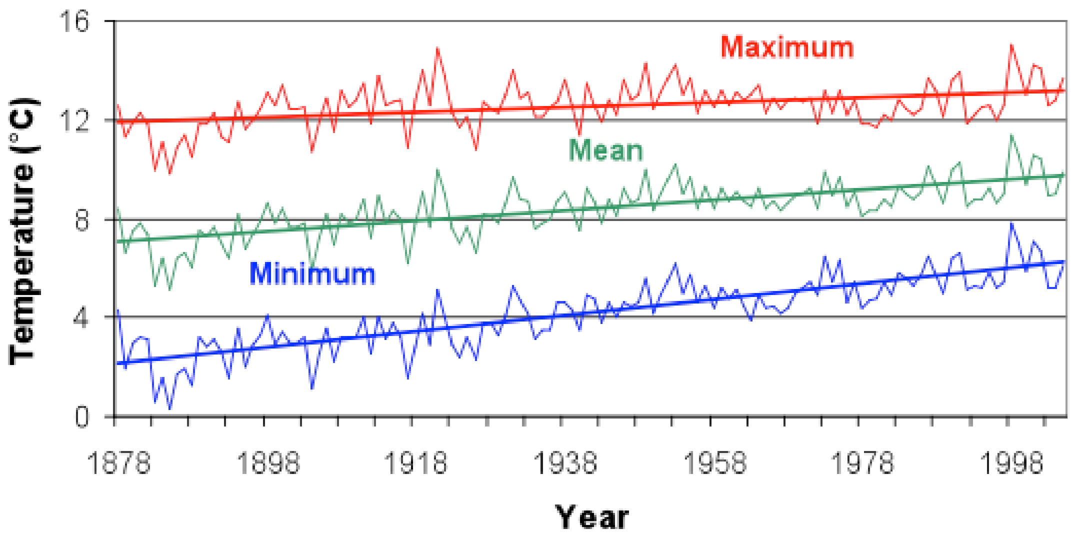
Figure constructed based on data extracted from Environment Canada's Canadian Climate Change Scenarios Network, 2010



The effect of high temperatures can be magnified in urban areas because of the urban heat island effect. That is, urban areas are warmer than surrounding rural areas as a result of a predominance of dark, heat-absorbing surfaces such as roofs, asphalt, and concrete, the displacement of trees and green spaces which provide natural cooling through shading and evapotranspiration, and heat released from common urban sources such as vehicles.

Figure 2 shows that while temperatures in Toronto fluctuate from year to year, they have been generally increasing over the past 130 years. The figure also shows that the daily minimum temperatures are increasing faster than the average or maximum temperatures. This phenomenon likely arises because heat absorbed throughout the day by dark structures and surfaces in the city is released overnight, preventing the city from cooling off.

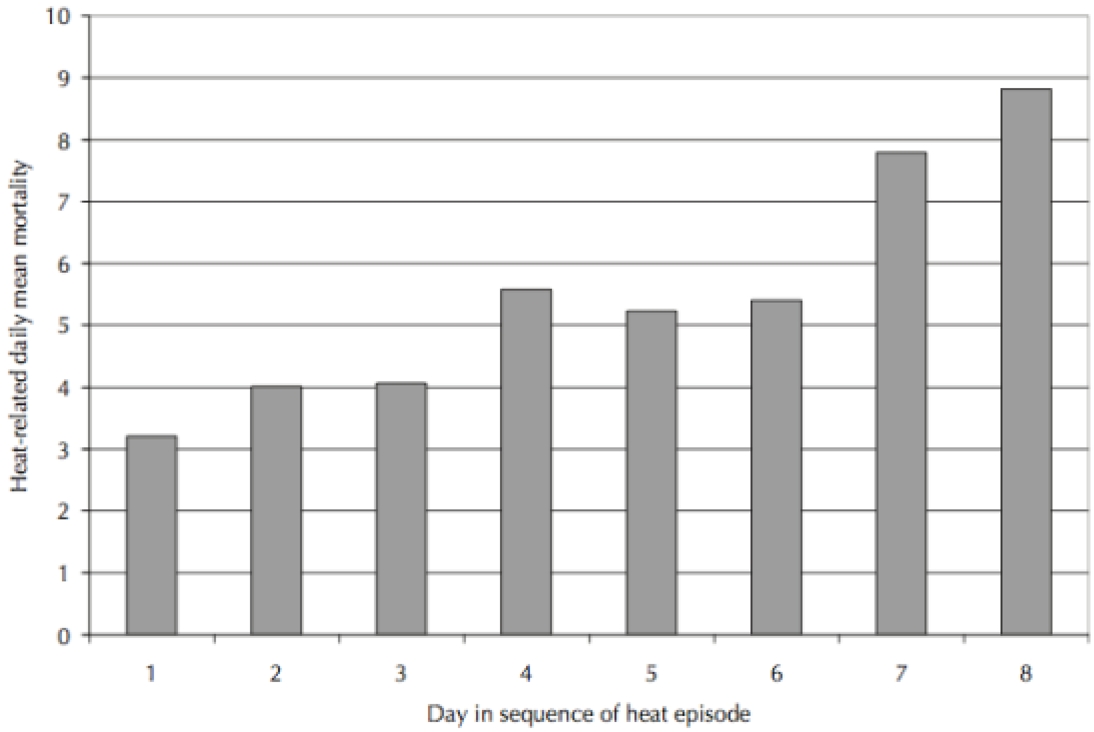
Figure 2: Toronto Annual Temperatures, 1878 – 2005. Based on data received from Environment Canada



Taken together, Figures 1 and 2 suggest that in the future, there will be little opportunity for relief from the heat. If most of the expected 60-70 hot days fall during a four-month heat season, temperatures would reach 30 degrees on at least half of all days. At the same time, the city may not cool off much at night. Having the opportunity to cool off, even for a few hours, is critical in preventing heat-related illness and death (Rogot, 1992).

In 2005, TPH and Environment Canada estimated that between 1954 and 2000, heat contributed to an average of 120 premature deaths per year in the City (Toronto Public Health, 2005). Research in Toronto also showed that the likelihood of mortality during a heat episode increased with each day of a heat episode (see Figure 3). As Toronto experiences hot days more often, days that are more intensely hot, and longer heat waves, the impact of heat on health is expected to increase.

Figure 3: Mortality related to length of heat episode in Toronto (Source: Pengelly et al., 2007)



Research using climate change scenarios for the future suggests that Toronto's annual average heat-related mortality could triple by the 2080s (Toronto Public Health, 2005). The warming climate may also compound other health concerns in the future. For example, higher temperatures are expected to promote formation of secondary air pollutants that can lead to urban smog. Toronto Public Health estimated that even if air pollution emissions remain constant, air-pollution related mortality will increase 20% by 2050 and 25% by 2080, largely because of increased ozone levels (Toronto Public Health, 2005). Other potential impacts of hot weather include increased allergies due to an extended pollen season, food spoilage and related illness as peoples' usual food handling practises may become inadequate, and increased drownings as people seek relief from the heat in pools and at the beach.

Toronto's heat-related mortality projections for the future are based on annual average values observed in the past. In reality, heat-related mortality varies greatly from year-to-year. During extended extreme heat events, the incidence of heat-related mortality and morbidity can increase over a very short timescale, and the health impacts of extreme heat can be severe. In some cases, the number of deaths associated with a single heat event can be in the hundreds or thousands. For example, from July 12 through July 16, 1995, in Chicago, the maximal and minimal temperatures reached unprecedented highs accompanied by extremes of relative humidity and led to at least 700 excess deaths (Semenza et al. 1996). Heat waves affecting large areas of Western Europe during July and August 2003 were associated with 70,000 deaths (Robine et al. 2008). In 2010, about 56,000 deaths were attributed to 28 consecutive days of temperatures over 30 °C in Western Russia (U.N., 2011).

Vulnerability to Extreme Heat

Some people are more vulnerable to heat than others. Vulnerability can increase due to both exposure and sensitivity to heat. Exposure to heat describes the likelihood that a person will encounter heat, how hot it is, and for how long. Sensitivity refers to factors that decrease a person's ability to cope with hot weather. Some people are able to cope well with hot weather, while others have little resilience to heat and could become ill quickly if they do not take adequate preventive measures.

Exposure to heat is determined by a person's home and community environments. For example, having access to air conditioning or other cooling in the home, or living in a home that is shaded reduces a person's exposure to heat. Living on the top floor of a high-rise might result in more heat exposure than living on the ground floor, since heat rises. The environment around a person's home can also affect exposure. Areas that are built-up, dominated by concrete and asphalt and without much vegetation are often hotter than those with more green space. For someone who does not have in-home cooling, the proximity of services can also affect their exposure to heat – they may be likely to leave a hot home environment to go to a library or community centre to cool down on a hot day if it is nearby – but not if it is farther away.

Sensitivity usually arises because of individual physiological, medical, behavioural, and social factors. For example, very young people, the elderly, and people with some pre-existing illnesses are at increased risk from heat, because their ability to thermoregulate and respond to physical hazards is diminished (Bernard and McGeehin 2004; Rey et al. 2007).

Sensitivity to heat also arises from people's personal circumstances such as isolation or poverty. The impacts of heat are disproportionately borne by frail, elderly, and isolated people (R. Sari Kovats and Hajat 2008). For example, a profile of 140 deaths that occurred during a 2006 heat wave in California showed that victims were mainly older adults, and 46% were known to have lived alone (Climate Change Public Health Impacts Assessment and Response Collaborative 2008).

Deprivation, particularly in downtown urban areas, increases sensitivity to heat (see Ishigami et al. 2008). Low-income households are at higher risk, likely due to poorer quality housing and limited access to air conditioning (Medina-Ramon et al. 2006, O'Neill et al. 2005). Individuals on low incomes are also more likely to suffer from chronic diseases or other medical risk factors that put them at particular risk. Lower socioeconomic groups may also face higher risk from heat because they are more likely to be exposed to heat. A study in Phoenix found that lower socio-economic status and ethnic minority groups were more likely to live in warmer neighbourhoods and less likely to have air conditioning, reflective roofs, swimming pools, and the resources to shape their environments in ways to decrease their heat stress (Harlan et al. 2006).

People who face language or literacy barriers, cognitive disorders, mobility limitations, mental health or addictions, homelessness or marginalization related to experiences of discrimination or social exclusion may also be at increased risk. They may be less likely to hear, interpret or be able to respond to public warnings and recommendations. Practical limitations such as language and literacy can be compounded by fear, lack of social networks, and reluctance to ask for help (Phillips 2007, Fothergill et al. 2007).

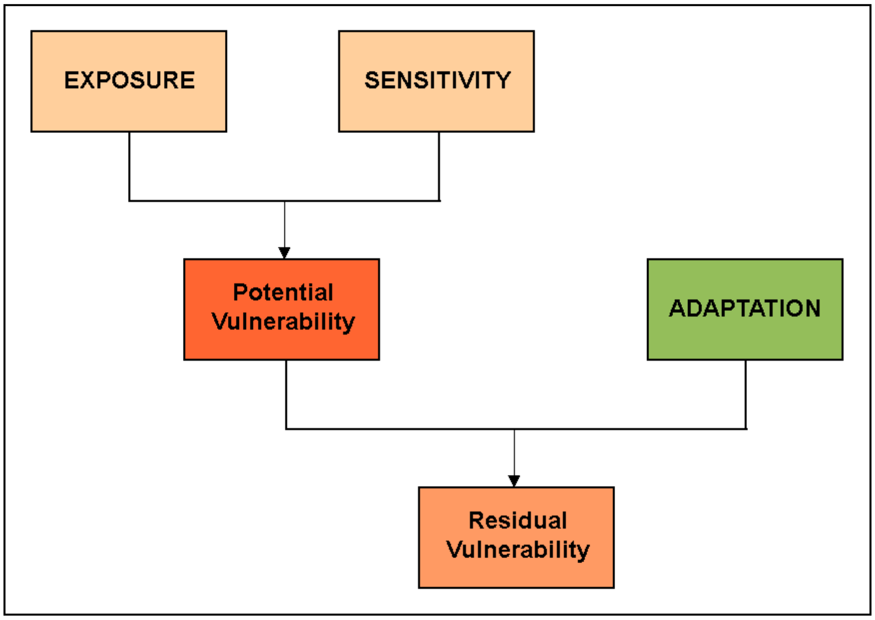
Some features of a person's social or physical environment can help reduce exposure to heat or help to cope with hot weather. This is called adapting to heat. Examples of adaptation are using air conditioning on a hot day, spending time in a cool place such as a library or community centre, drinking lots of water, or avoiding exertion outdoors. City or community agencies can also provide adaptive services such as cooling places or outreach and education. Table 1 lists some example indicators for exposure, sensitivity, and adaptation.

Table 1: Example indicators for Exposure, Sensitivity, and Adaptation (TPH, 2009)

Exposure	Sensitivity	Adaptation
Surface Temperature Distance from Green Space Tree Shading High-Rise Buildings Rented Dwellings in Older High-Rises Population density	Low-Income Persons Low-Income Among Young Children Housing Costs of Renter Households Housing Costs of Low-Income Renters English Language Knowledge Recent Immigrants No High School Certificate Among Adults Racialized Groups Disability Seniors	Public Green Areas Cooling Centres Community Recreation Centres Libraries Rapid Transit Stops Licensed Childcare Centres Schools Public Pools and Splash Pads Hospitals Shelters and Hostels Long-Term Care Homes Rooming Houses

Figure 4 shows how exposure, sensitivity, and adaptation influence vulnerability. Exposure and sensitivity combine to form potential vulnerability, which represents a person's vulnerability in the absence of any adaptation activities. Adaptation represents the positive effects of current interventions, including short-term interventions as well as long-term interventions. Where it exists, adaptation offsets potential vulnerability. What remains is residual, post-adaptation vulnerability. This is the vulnerability that is not addressed by existing services or resources.

Figure 4: Components of vulnerability to heat (TPH, 2009)



Toronto's Heat Alert and Response System

Since 1999, Toronto Public Health has co-ordinated a Heat Alert and Response Program for the City of Toronto. The system was the first in Canada and is considered a premiere example of climate change adaptation. The goal of the program is to reduce heat-related illness and death in Toronto. The program makes a special effort to reach out to people who are especially vulnerable to heat, such as isolated seniors, people with chronic and pre-existing illnesses, children, and people who are marginally housed or homeless. The program is composed of a Heat-Health Alert System, which helps the Medical Officer of Health determine when to call a Heat Alert or an Extreme Heat Alert, proactive activities, and a Hot Weather Response Plan, which is set into action when an Alert is called.

The Toronto Heat-Health Alert System is based on a spatial synoptic classification system. This system relies on analysis of historical meteorological and mortality data for Toronto, which allowed researchers to identify which meteorological conditions coincide with increased numbers of excess deaths in the City. The synoptic system classifies the air mass using forecast weather data and then the single algorithm calculates the likelihood of excess mortality based on day in sequence of offensive air mass and the afternoon apparent temperature. The Heat-Health Alert System is updated each time the Environment Canada weather forecast changes. TPH staff access the password-protected system online, and during the heat season (May 15 - September 30), they check the system throughout to determine whether an Alert should be called.

In 2010, the algorithms used to link forecast weather to the likelihood of excess mortality from heat were updated using the most recently available weather and mortality data for Toronto.

Beginning in 2011, new definitions are being used for Alerts. In general, a Heat Alert is when forecast weather conditions suggest that the likelihood of a high level of mortality is between 25 and 50 percent greater than what would be expected on a typical day. An Extreme Heat Alert is when forecast weather conditions suggest that the likelihood of a high level of mortality is at least 50 percent greater than what would be expected on a typical day.

Other improvements to the Heat-Health Alert System include an extension of the forecast period from three to seven days and mortality calculations for all air masses.

Declaration of a Heat Alert or Extreme Heat Alert by Toronto's Medical Officer of Health activates specific responses under the City of Toronto Hot Weather Response Plan to help prevent heat-related illness and death. Many of these activities are carried out in partnership with other City Divisions and community agencies. Services include providing bottled water, operating a heat information line, and promoting libraries, community centres and shopping malls as places to stay cool. As well, shelters ease their curfew rules to allow people to stay inside during the day, and TTC tokens are distributed at drop-in centres, so homeless and marginally housed clients can receive a token to get to an air-conditioned place. During an Extreme Heat Alert, the City opens designated cooling centres at various public locations, such as civic centres, and City swimming pools may extend their operating hours. During extended heat events, Toronto Public Health inspectors will visit known rooming houses, boarding homes and other residential premises of concern to determine if the recommended Hot Weather Protection Plan has been implemented at the building.

In addition to specific response activities, TPH promotes heat-health advice year-round through brochures and online fact sheets in multiple languages. Additionally, TPH conducts an annual review of the City's hot weather response. Recent changes to the plan include changing locations of some cooling centre from Civic centres to Community Centres, in response to a Board of Health request to establish ward-based cooling centres.

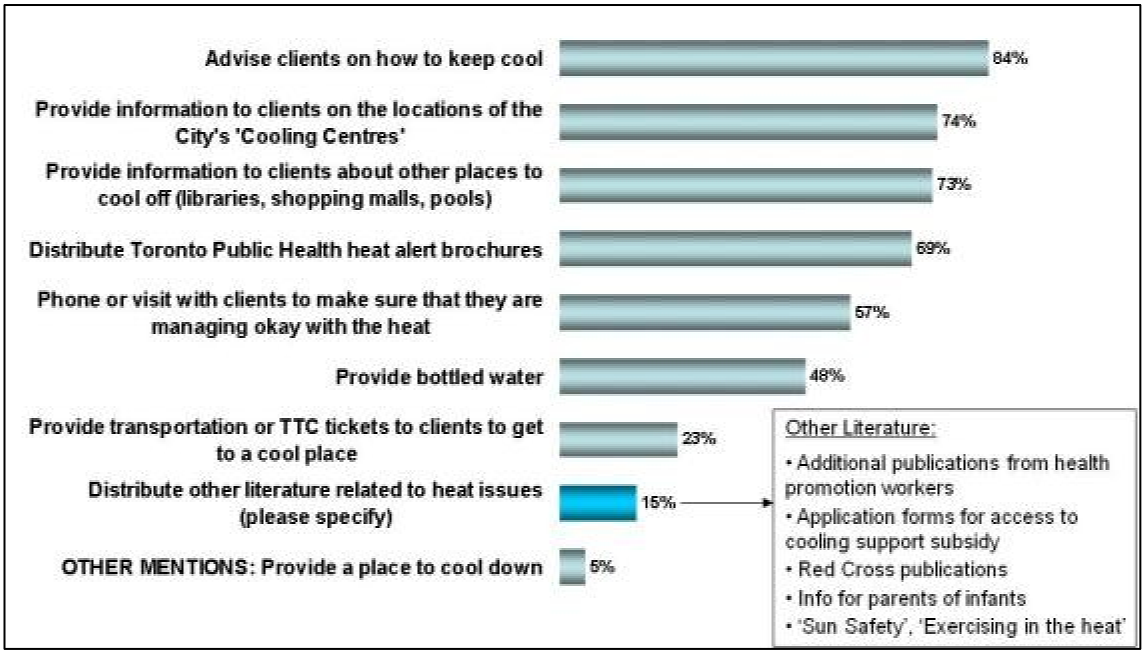
Evidence for the Success of Toronto's HARS

Research conducted about Toronto's heat alert and response system by TPH and Health Canada suggests that many aspects of the program are effective.

A review of the processes used to call Alerts in Toronto found that the synoptic system is a useful tool to understand the extreme heat health risks in the community. The updates to the system are expected to further facilitate the decision to call or terminate an Alert.

TPH appears to be effective in communicating with the community agencies who are partners in hot weather response. In 2010, interviews with 100 hot weather response partner organizations and an online survey of frontline workers at agencies across the city who receive Alert notifications found that both are aware of the risks that heat creates for the health of their vulnerable clients. They reported that they take action to help clients protect themselves, especially if they know that a Heat Alert or Extreme Heat Alert was declared. Of those surveyed, 92% of partner organizations and 95% of frontline workers indicated that they received notifications of Alerts. The survey found that a key activity for the organizations is to provide advice and information (see Figure 5), and that the advice being provided to clients is often based directly on information provided by TPH.

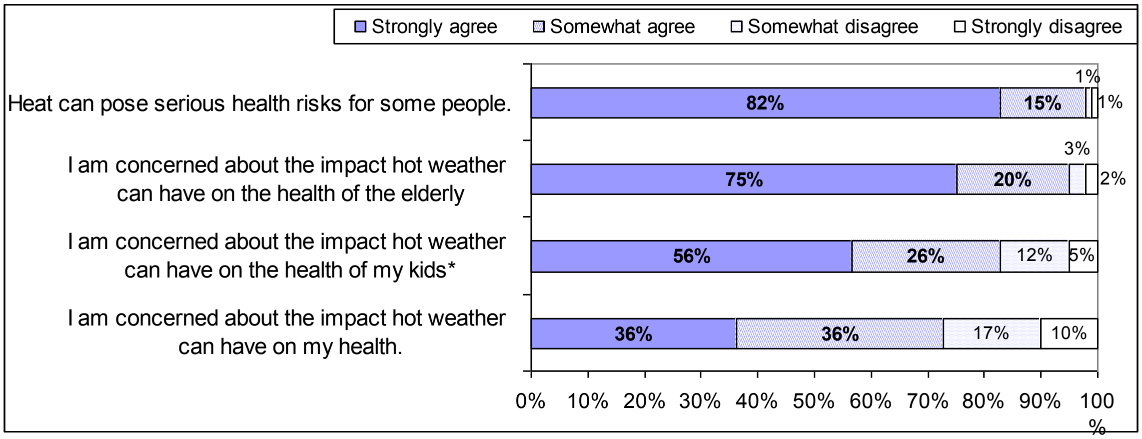
Figure 5: Actions that hot weather response partner organizations report taking to take to help protect their clients in the community against adverse effects of heat on hot days (TPH, 2010)



TPH's approach to communicating to the public also appears to be effective. A media analysis conducted by Health Canada reviewing news articles from the years 2007-2009 found that TPH's key messages are being communicated effectively through the media, especially broadcast media. Furthermore, a survey conducted by TPH in August 2010 confirmed that a high proportion of Toronto adults have some awareness of heat-related illness. When asked to name any of the symptoms associated with excessive heat exposure, 77% of Toronto residents correctly named at least one. As well, nearly all respondents were aware of times when guidance about heat has been issued, with 96% of participants saying that they had heard weather warnings or alerts about excessive heat in 2010. Most people remembered hearing about these warnings on the television (75%) or the radio (45%), although 15% said they heard about them from the internet and 10% saw them in the newspaper.

Most respondents strongly agreed that heat can pose risks for some people, especially the elderly and young children, with 95% agreeing that they are concerned about the impact of heat on the elderly, and 82% of parents agreeing that they are concerned about the impact of hot weather on their kids (See Figure 6). Seventy-two percent (72%) were at least somewhat concerned about the impact heat has on their own health.

Figure 6: Extent to which respondents agree or disagree with statements about the health risks of heat. * indicates asked only to parents (TPH, 2010)



As well, most people can identify at least some actions they can take to help protect themselves from the adverse effects of extreme heat (See Table 3, next section).

The success of Toronto's program led to a recent profile by Natural Resources Canada in a 2010 publication entitled, *Adapting to Climate Change: An Introduction for Canadian Municipalities* (Natural Resources Canada, 2010). Toronto's recent heat research and HARS will also be included as a case study in an upcoming book on Climate Change and Cities (Rozensweig, in press).

Preparing for Climate Change

Under the Ontario Public Health Standards, the goal of the Emergency Preparedness Protocol is "to enable and ensure a consistent and effective response to public health emergencies and emergencies with public health impact". The Health Hazard Prevention and Management Protocol has specific requirements for public education on climate change and extreme weather, and additionally specifies the need to develop healthy policies related to reducing exposure to health hazards including extreme weather.

While Toronto's HARS may currently be effective in reaching out to community agencies and the public to help them prevent heat related mortality and illness, the situation may change as the climate warms. The recent heat waves in Europe and Russia suggest that during such extreme heat waves, the survival of those without access to effective cooling and those who are the most vulnerable depends on effective preparedness and response during emergency situations.

If an extended heat emergency were to arise in Toronto, TPH would activate a divisional emergency plan, and potentially request that the City activate its Emergency Operations Centre to co-ordinate further activities by municipal and partnering agencies. While there is an understanding within the City and in the provincial health standards that heat-related emergencies may arise, there are currently no specific protocols for a heat emergency to be identified and declared.

There may be a need to explore whether heat-related emergency planning should be expanded at the Corporate or TPH level. This could include support for external organizations in developing plans for heat emergencies. Currently, staff at TPH and in the City's Shelter, Support and Housing Administration Division have expressed concern that many individual facilities and organizations such as those that house vulnerable people do not have their own emergency plan in place, and would depend entirely on the City should a heat emergency arise.

Access to Cooling in Toronto

Heat-related illness can be prevented if appropriate action is taken. For example, access to a cool environment such as an air conditioned location has repeatedly been identified as key to preventing heat-related illness (Kilbourne et al, 1982; Semenza et al, 1996; Curriero et al, 2002, Chestnut et al, 1998, Kalkstein L, 1997; Donaldson et al, 2003; Rogot et al, 1992; Kaiser et al, 2001, Naughton et al, 2002; Jacques & Kosatsky, 2005). There is also strong evidence to suggest that actions such as increasing hydration, monitoring people who take medications that may affect physiological response to heat, and reducing activity level all reduce the risk from hot weather (O'Connor and Kosatsky, 2008).

Despite the importance of access to cooling in preventing heat-related illness and mortality, it is difficult to know who has easy access to a cool place on hot days in Toronto. A data scan by TPH in 2010 found little data available to describe air conditioner use or ownership in Toronto. Natural Resources Canada's Survey of Household Energy Use indicates that 80% of Ontario households had air conditioning, with 72% of those being central air conditioning and the remaining 28% being window/room air conditioners, (Natural Resources Canada, 2007) but does not provide information at the municipal level. While Statistics Canada's Survey of Household Spending and Households and the Environment Surveys collect information on the presence of air conditioners by household income and type, it is only available at the Census Metropolitan level, and is not always freely available. Municipal Property Assessment Corporation data provide information about air conditioners in homes, but may be incomplete.

In order to understand how residents of a diverse urban centre such as Toronto currently access cooling during hot weather, TPH developed and conducted a survey of Toronto residents. The survey explored relationships between demographic and housing variables and in-home air conditioning, including types of air conditioners in use (e.g. central air or window air conditioners). The survey also explored access and use of cool locations outside the home including homes of friends, family and neighbours, community centres, libraries, and cooling centres. Finally, it also assessed knowledge, perceptions, and actions people take related to preventing adverse health effects of extreme heat.

Between August 16 and September 3, 2010, TPH conducted telephone interviews with a random, representative sample of 1,001 Toronto residents age 18+. The data collected from the interviews were weighted by age, gender, and region within Toronto to reflect the actual proportions of Toronto residents based on Census data. An over-sample of 100 residents who do not have air conditioning in their household was interviewed in order to boost the sample size of this group for analysis purposes. The overall data of 1,101 were weighted down to the correct proportion of in-home air conditioning based on the representative sample.

The questions asked about peoples' experiences during the summer of 2010. The summer was considered a hot one, especially in comparison with 2009. Environment Canada notes that 25 hot days (above 30°C) were recorded at Toronto's Pearson Airport, compared to a normal of 14, and that between July 1 and August 10, there were 23 days with humidex at or above 35 compared to 3 days in 2009 (Environment Canada, 2010). In 2010 Toronto Public Health declared 5 Heat Alert days and 11 Extreme Heat Alert days (compared with just 1 Heat Alert Day and 2 Extreme Heat Alert Days in 2009, and an average of 6.1 Heat Alert Days and 5.8 Extreme Heat Alert days each year since 2001).

How People in Toronto Keep Cool

Many people in Toronto keep cool at home using air conditioning. Overall, 85% of Toronto residents have air conditioning in their home. Two-thirds of those have central air, while one-third have a window unit (30%) or ductless (5%).

The distribution of air conditioning is uneven across the City: depending on the area, in-home air conditioning prevalence ranges by 20% from 77% in the Parkdale/Bloor West area up to 96% in Etobicoke North (Table 2).

Table 2: Percent of respondents with air conditioning by region within Toronto

Region of Toronto	% with A/C
Etobicoke North	96%
Don Valley (East)	92%
North York	91%
Etobicoke South	90%
Downtown	88%
Hillcrest/York	88%
Don Valley (West)	85%
Scarborough North	84%
Scarborough South	83%
Rexdale	83%
North York	79%
Danforth/Beaches	79%
Yonge Corridor	79%
Parkdale/ Bloor W	77%
TOTAL	***85%***

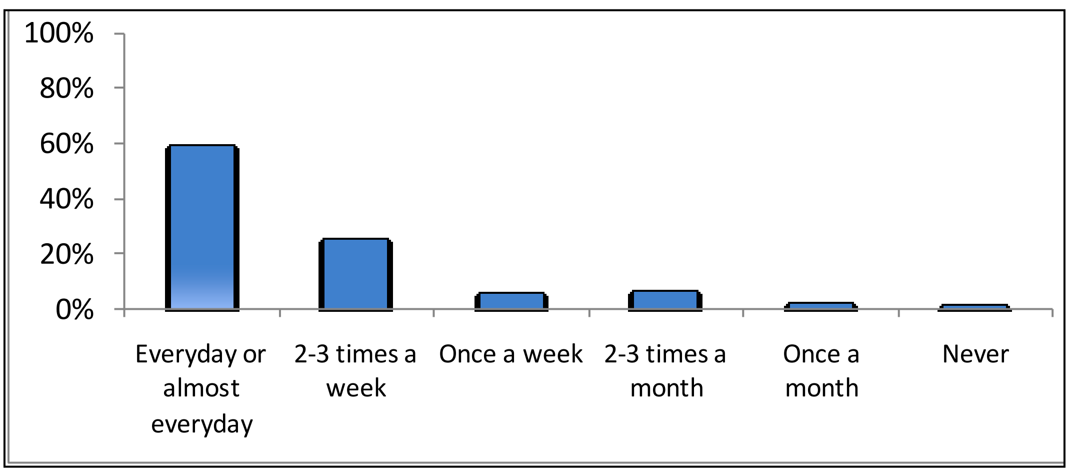
The large size of these City regions makes it is difficult to correlate these findings to neighbourhood features such as income or housing age. However, it is interesting to note that in the past, the Parkdale Activity Recreation Centre has been an active member of Toronto's Hot Weather response Committee and active in supporting vulnerable clients on hot days in recognition of the vulnerable population in the Parkdale neighbourhood.

On average, those with in-home air conditioning report that they set their household temperature at 23.2 ^{o}C. The Canadian Centre for Occupational Safety and Health recommends that comfortable temperatures inside offices should fall within the 23-28 ^{o}C range depending on humidity and type of clothing worn (CCOHS, 2011), and the U.S Department of Energy recommends that home thermostats be set to 26 ^{o}C (U.S. Department of Energy, 2010). It is not clear that either of these guidelines is health-based or adequately considers the needs of vulnerable groups – the U.S. Department of Energy recommendation appears to be driven mainly by concerns about energy efficiency, and the CCOHS indicates that its recommended ranges "have been found to meet the needs of at least 80% of individuals. Some people may feel uncomfortable even if these values are met. Additional measures may be required."

Overall, the survey results suggest that many people set their air conditioners at very low temperatures relative to these guidelines. This suggests that many people may be cooling their homes more than needed.

The survey also suggests that many people use their air conditioners all the time, while others who have air conditioners use them infrequently. Those with air conditioning either use it every day or almost every day during the summer (59%) or 2 to 3 times per week (25%). Only 14% use it once a week (5%) or less often (9%) (See Figure 7). Among those who cite usage of less than once a week, most said that they only turn on their air conditioning on very hot or humid days.

Figure 7: Frequency of air conditioner use in summer 2010 among those with air conditioning (TPH, 2010)

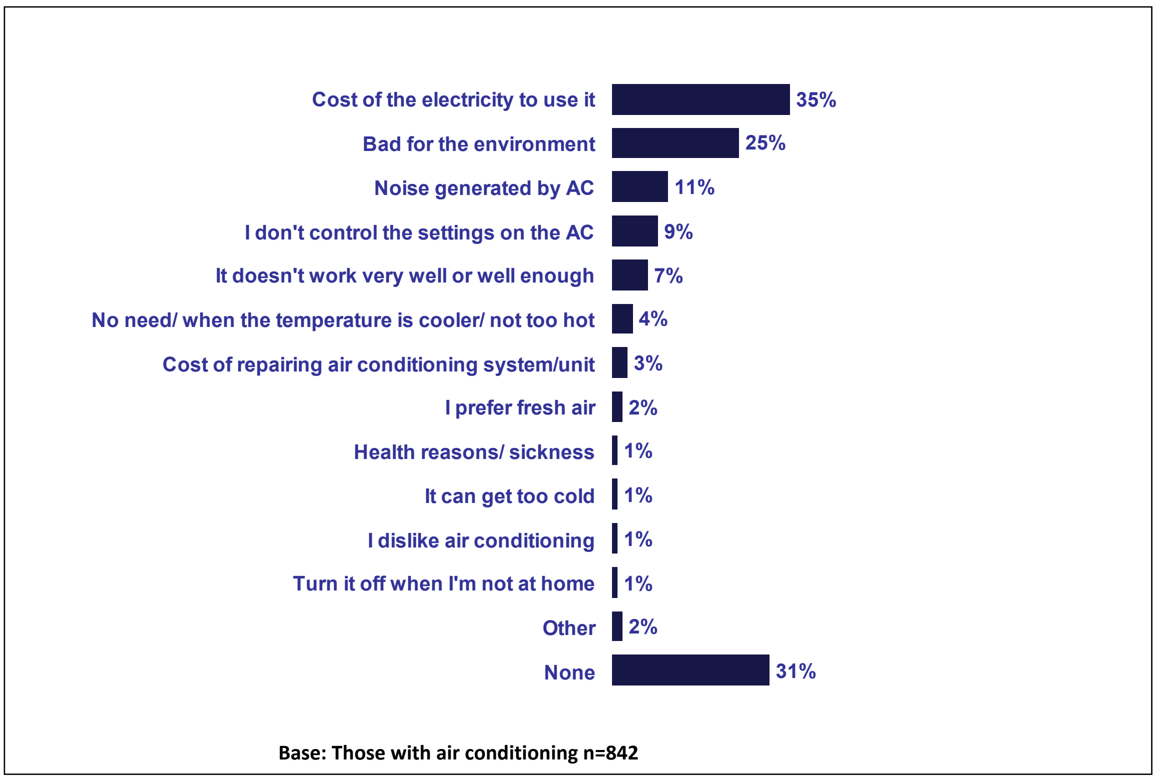


The findings reflect previous survey research conducted in the GTA, which found that of those who used their air conditioners, about 60% of them had the temperature set lower than recommended (Kalkstein, 2007). On the other hand, many people did not make proper use of air conditioners to cool themselves, with about 20% of people who owned air conditioners not turning them on during the Alert.

Reasons cited for not using air conditioning include cost (35%), followed by a concern about the environmental impact (25%). Lesser reasons include noise (11%), lack of control over settings (9%) and that it is not in good repair (7%) (See Figure 8).

The findings suggest that there is a need for more information about appropriately using air conditioning that considers common concerns such as harm to the environment and the cost of running an air conditioner. Information comparing the relative health benefits of using an air conditioner, especially on very hot days, or in homes with vulnerable people, with environmental and monetary costs may help people decide when and for how long to run an air conditioner. Health-based guidance for appropriate temperature settings for in-home air conditioning and information about placement and use of window air conditioners would also be beneficial. However, much of this information may not currently be available.

Figure 8: Reasons for not using air conditioning (TPH, 2010)

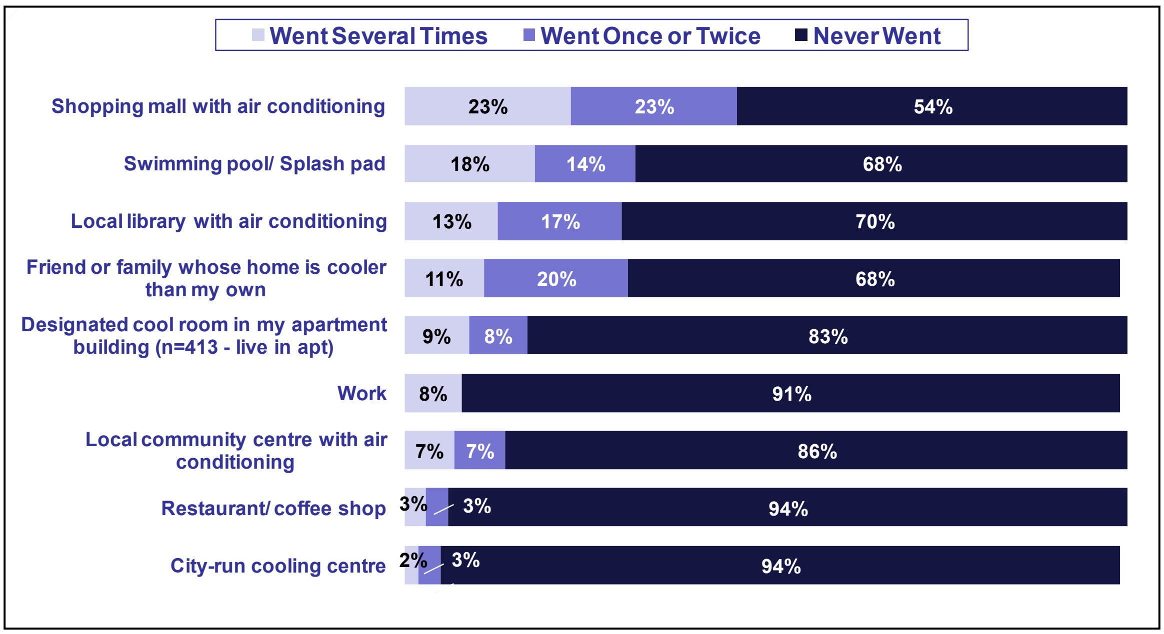


Nearly all residents without air conditioning (96%) say they have access to at least one cool place within a 5 minute walk of their home. The most common is shaded area such as a park (84%), followed by public places such as a local library with air conditioning (57%), shopping mall with air conditioning (47%) or a swimming pool (47%). Three-quarters (74%) have actually accessed at least one cool place within 5 minutes of their home (See Figure 9). Over half (55%) of those without air conditioning say they rely on a public space to find a cool place, while 41% indicate that they could go to a friend or family member's home which is cooler than their own.

Despite this, many people without air conditioning often choose to stay home. Even though most people said they had a cool place nearby, they indicated that transportation represents the greatest barrier to access to an air-conditioned environment, with respondents indicating "places are too far" (14%) or "lack of transportation" (10%). Other barriers include a lack of access during certain hours (e.g. at night, 11%) and inaccessibility for disabled persons (5%) as well as worries about personal safety (4%).

These results highlight the need to identify and communicate effective interventions and advice that people can carry out in their own homes to protect themselves and their families on hot days.

Figure 9: Frequency of going to certain places to keep cool among people without air conditioning at home (Some less frequently cited places included movies, cottage, beach, park, school, and car) (TPH, 2010)



Most of those without air conditioning say they opened windows (85%) and/or used fans (76%) to keep cool at home throughout the summer of 2010. Only one-third (38%) say this worked very well for them, while half say it worked only somewhat well (51%) and one in ten (10%) felt it didn't work very well or at all.

A large proportion of respondents with and without in-home air conditioning take a variety of actions recommended by Toronto Public Health to help stay cool on very hot days (See Table 3). Those without air conditioning are significantly more likely to take a cool bath or shower to cool down (70% vs. 55% for those with air conditioning), keep windows open (79% vs. 47%), use a fan to increase airflow (75% vs. 45%) or sleep in the basement in order to escape the heat (51% vs. 41%). These represent easy actions that people can take without leaving home.

Table 3: Percent of people who said they take specific actions to help protect themselves against the effects of heat on hot days (* indicates significant difference between A and B at the p <0.05 level)

	Total (n=1101)	With air conditioning (n=842)	Without air conditioning (n=259)
Specific Action		A	B
Keep shades or drapes drawn and blinds closed on the sunny side of your home	86%	88%	78%
Drink lots of water and/or natural fruit juices even if you don't feel very thirsty.	84%	87%	90%
If you must go outside, stay in the shade as much as possible	83%	86%	82%
Keep lights off or turned down low	78%	84%	80%
Avoid going out in the sun or heat when possible.	78%	79%	76%
If you must go outside, plan to go out early in the morning or evening when it is cooler	72%	73%	76%
Avoid intense or moderately intense physical activity.	71%	73%	71%
Take a cool bath or shower periodically or cool down with cool, wet towels	57%	55%	70%*
Keep windows slightly open	53%	47%	79%*
Turn on a fan with windows open	50%	45%	75%*
Go to air conditioned or cool places such as shopping malls, libraries, community centres or a friend's place	45%	43%	50%*
Sleep in the basement, or coolest room if there is no basement	43%	41%	51%*
Visit a local swimming pool	25%	24%	29%

Who has in-home air conditioning in Toronto

Being able to cool down is one of the most effective ways of preventing heat-related illness. The 2010 TPH survey found that 85% of Toronto residents have air conditioning in their home.

However, many of the characteristics of the 15% of respondents without in-home air conditioning align with those that increase vulnerability to heat. They are much more likely to be born in another country, to rent their place of residence, and to live in an apartment building. They are also more likely to be classified as low-income and to live in community housing. In addition, one third of people without air conditioning say they experience barriers in accessing cooling, mainly as a result of transportation difficulties.

Figure 10 shows that the incidence of having in-home air conditioning is significantly higher in households earning more than $20,000 per year than households earning less, and suggests that there may be a slight relationship between further increases in household income and having in-home air conditioning. As well, higher-earning households are more likely to have central air conditioning as compared with window air conditioners (See Figure 11).

Figure 10: Percent of respondents with and without an operational air conditioner in their home by income. *Indicates a significant difference between households earning < $20,000 and those earning > $20,000. (People who did not provide information about household income are excluded; household income was provided by 90% of respondents) (TPH, 2010)

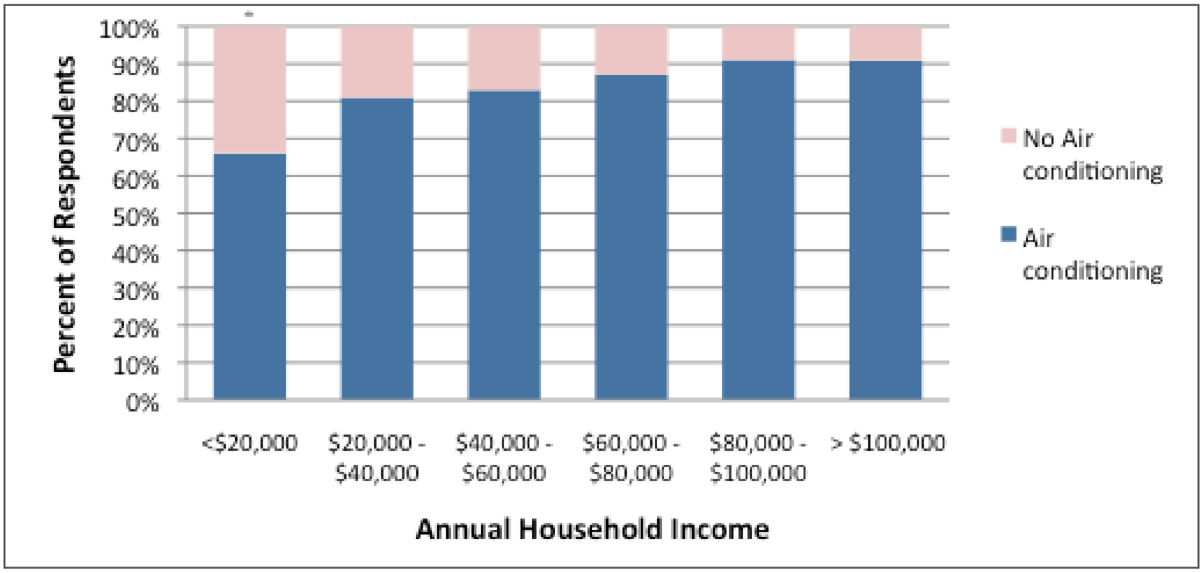
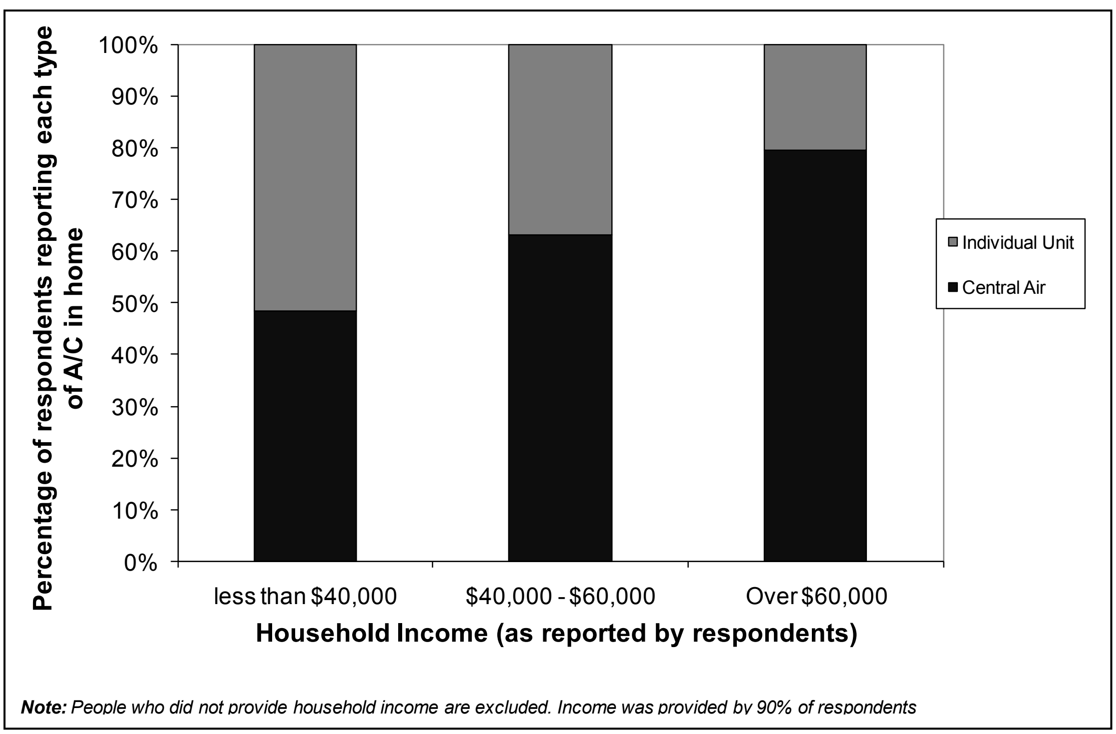
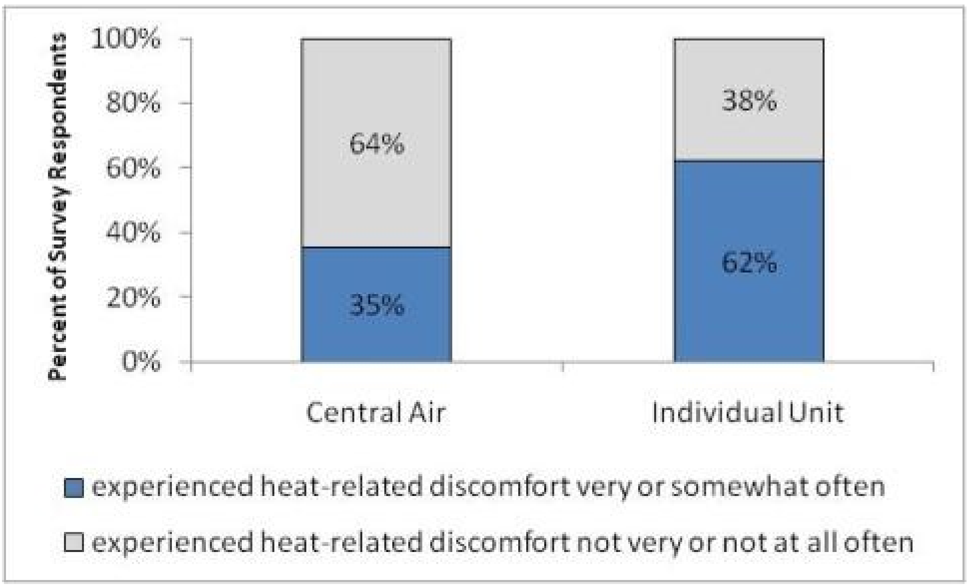


Figure 11: Of households who report having in-home air conditioning, those with a higher household income are more likely to have central air conditioning. (TPH, 2010)



There is some evidence that window air conditioners may be less effective for preventing heat-related illness (Rogot 1992). Respondents who had window air conditioners were more likely to report heat-related discomfort than those with central air conditioners (See Figure 12). This suggests the possibility that some people are uncomfortable because window air conditioners do not provide sufficient cooling for an entire home. However, the figure shows that a third of those with central air conditioning also say they experience discomfort. This could be because some people who have air conditioners choose to use them infrequently.

Figure 12: Those with window units were more likely to report heat-related discomfort than those with central air conditioning (TPH, 2010)



Other findings from the survey support the idea that there is a socioeconomic divide in who has access to air conditioning at home. Air conditioning incidence is highest in detached homes and lowest in apartments/condos (92% vs. 79%) and is higher in non-community housing households (86% vs. 75%). Also, those who own their home are significantly more likely to have air conditioning than those who rent (93% vs. 73%). The incidence of in-home air conditioning is higher in households with 2 or more people, specifically two or four, than in households where people are living alone (89% vs. 79%). The incidence of in-home air conditioning is higher among those who were born in Canada than those who immigrated (87% vs. 82%). In particular, in-home air conditioning is significantly lower among those born in India (60%). The most recent immigrants (less than 5 years living in Canada) are least likely to have an air conditioner (only 62% report having one).

Table 4 compares the percent of people with in-home air conditioning for several groups considered to be "at-risk", as compared with the overall Toronto population

Table 4: Percent of respondents in various at-risk groups with in-home air conditioning, compared with general population

Population	% With A/C
Seniors (Age 65+)	86%
People Living Alone	79%
Low Income Households (households earning < $40,000)	82%
Renter Households	73%
Household in Community Housing	75%
Apartment/Condo[1]	79%
General Population in Toronto	***85%***

[1] As opposed to detached house, semi-detached house, townhouse, or rowhouse

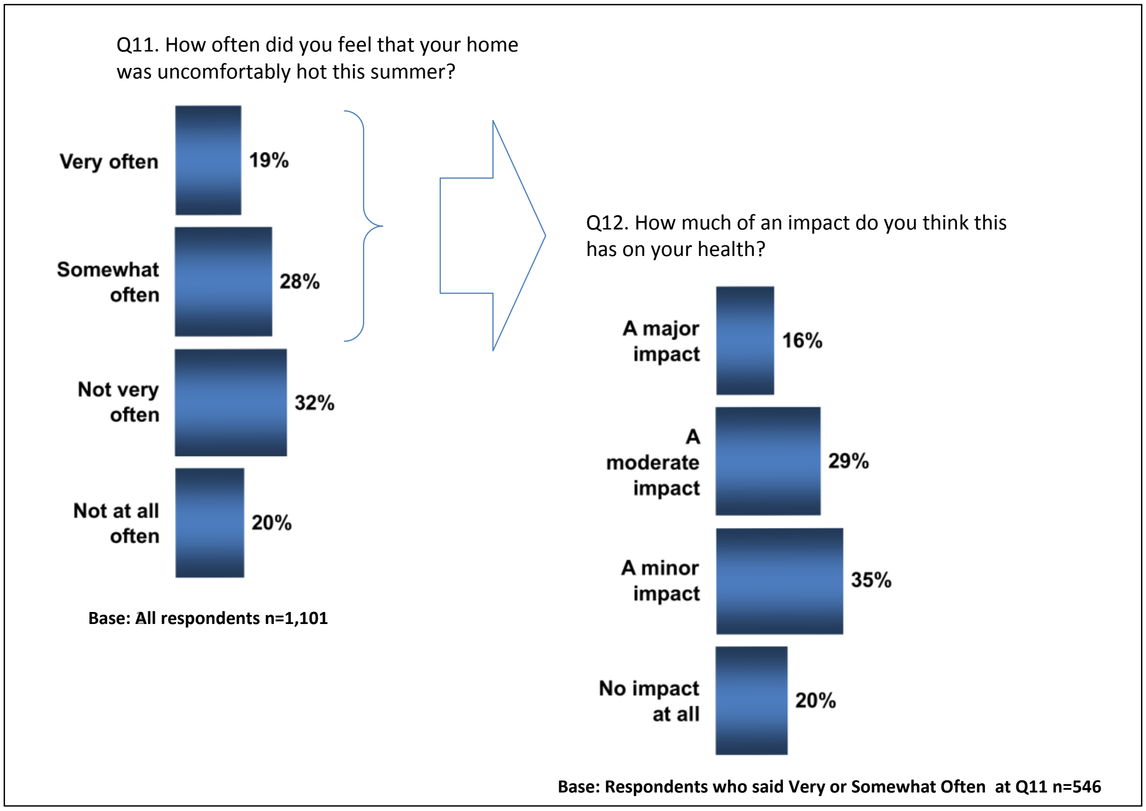
It is important to realize that these results are drawn from a telephone survey that likely missed some of the most vulnerable members of Toronto's community. A heat registry pilot project conducted at the Parkdale Activity Recreation Centre in 2008 collected some information from a group of 100 people reporting high levels of social isolation, with only 60% having access to a phone and only 37% reporting having frequent contacts with others. Results collected from 42 participants suggest that some members of this group of people may have difficulty protecting themselves from extreme heat even if they are aware of the risks it poses for their health. While almost two-thirds felt they could access services easily on a hot day, others reported difficulties due to long walking distance, mobility issues, limited access to transit, perceptions of safety and problems in the building. Of the people registered, almost all reported experiencing personal distress during hot weather, and reported difficulties coping with heat in the past.

In general terms, these findings highlight the need to address challenges faced by low socioeconomic status groups that reduce resilience to many health risks, including extreme heat.

Discomfort and Concern during Hot Weather

Despite relatively high in-home access to air conditioning, a large group of people still experience heat-related discomfort. Nearly half (47%) of Toronto residents felt their home was uncomfortably hot often during summer 2010 (See Figure 13). This increases to 68% among those without air conditioning. Of those who said their homes were too hot to be comfortable in the summer, over 90% said they experienced symptoms such as thirst, trouble sleeping, exhaustion, irritability and heavy sweating. Over half (59%) say they experienced 4 or more of these symptoms. While not all of these symptoms necessarily indicate heat-related illness (for example, sweating is not threatening if hydration is adequate), they do indicate that respondents' environments were hot enough to elicit a physical response.

Figure 13: Experience with heat-related discomfort at home and concern about related health impacts (TPH, 2010)



Among those who felt their home was uncomfortably hot very or somewhat hot often in summer 2010, 45% believe this had a moderate or major impact on their health. When asked to agree or disagree with the statement "I am concerned about the impact hot weather can have on my health", those without air conditioning in their home are significantly less concerned about the impact hot weather can have on their health than those with air conditioning in the household (65% of those without air conditioning are concerned compared to 74% of those with air conditioning).

It is not possible to determine from this survey whether people without air conditioning are generally self-selected to be a less vulnerable group, or whether they only perceive themselves to be less vulnerable than people who have air conditioners perceive themselves. However, research in Canada and elsewhere (Sheridan 2007, Abrahamson et al, 2008) suggests that many potentially vulnerable people do not identify themselves as being vulnerable to heat. This highlights the importance of disseminating outreach and education materials that improve public understanding of what heat-related risks are, and especially, who is at risk. Such materials are available from TPH and Health Canada and also encourage people to take simple actions to protect themselves (and others) before they feel uncomfortable.

This survey was unable to distinguish whether the discomfort cited by respondents reflects adverse health effects. However, the health impacts from extreme heat are often viewed as a continuum from mild to severe, with preventive actions being crucial. This suggests that some of those experiencing heat related discomfort could be at risk of heat related illness.

Air Conditioning, Air Pollution, and Energy Use

Although increasing access to air conditioning is an effective way to prevent heat-related illness, it presents environmental, economic, and infrastructural challenges. Air conditioners consume a significant amount of energy, and by extension contribute to emissions of greenhouse gases and harmful air pollutants. Advocating for increased air conditioner use is likely to result in release of harmful pollutants that contribute to climate change and adversely affect health. In particular, hot weather and poor air quality often occur together already. Promoting air conditioner use in the summer may adversely affect air quality at times when vulnerable people are already at risk from both heat and air pollution.

Additionally, air conditioners are expensive to install and to operate. Many of those people who are most vulnerable to heat have less capacity to absorb the costs associated with air conditioners.

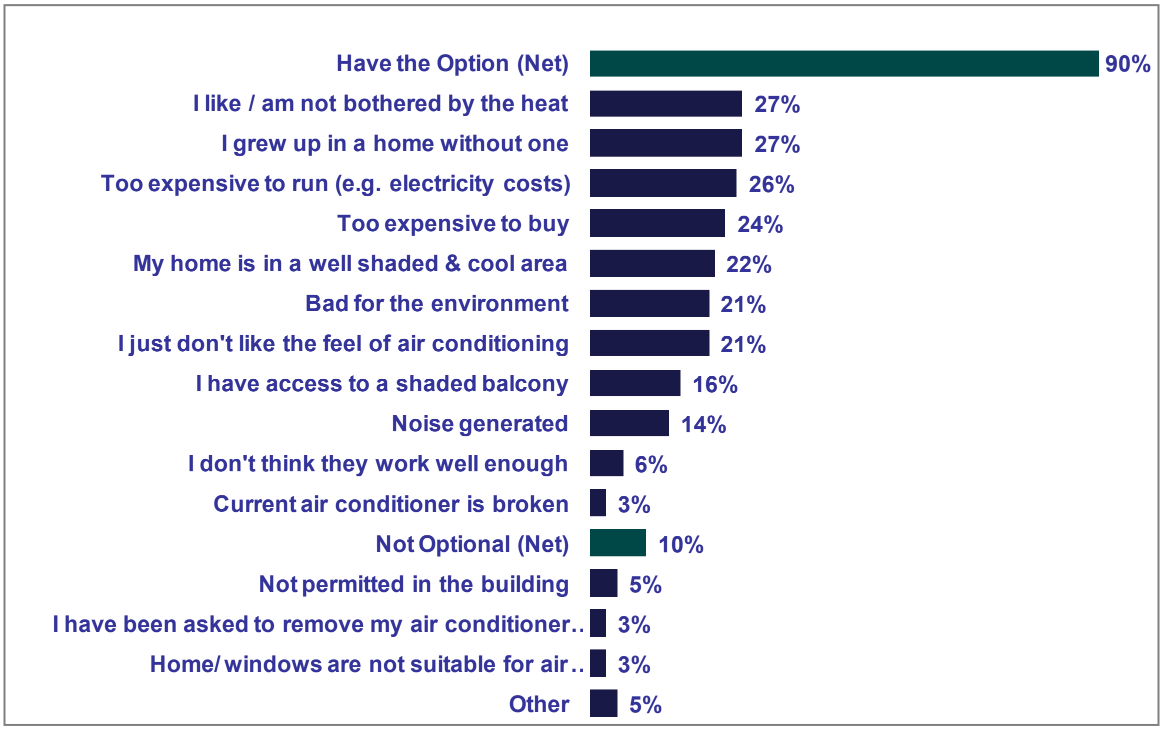
As a result, there is a need to identify and adopt effective alternatives to air conditioning for protection against heat-related health impacts. Some strategies are already available and promoted: much of the advice offered to individuals by Toronto Public Health and other agencies including Health Canada about how to prevent heat-related illnesses can be carried out without air conditioning. Air conditioning use and costs can also be minimized with strategies such as "sharing the cool" by going to a public place or gathering family and friends in one cool home.

Effective building and neighbourhood design can also promote cooling. For example, increasing shade, introducing white or green roofs, and strategically placing safe, openable windows to encourage cross-breezes can aid indoor cooling.

Neighbourhood design can also influence access to cooling outside the home. The key barriers cited by Torontonians for accessing a cool place include accessible transportation, distance, and neighbourhood safety. Connected, accessible, safe neighbourhoods with features such as high walkability, accessible transit, and shaded seating areas are more likely to encourage people to leave their home and go to a place that is cooler. Such neighbourhoods may also foster greater social interaction and connectedness, which can encourage people to either seek out neighbours if they feel unwell or need help, or check in on people in the community who may be elderly or living alone.

TPH's survey found that while half of those without air conditioning have considered buying an air conditioner (56%), one-third of respondents indicated that they would not use an air conditioner even if they had access to one (30%). A full 90% indicate that they could have an air conditioning unit in the home, but elected not to (See Figure 14). The reasons provided include a preference for the heat (27%), having grown up without air conditioning (27%), the cost to run an air conditioner (26%), the cost to buy an air conditioner (24%), living in a shaded area (22%), environmental concerns (21%) and a general dislike of conditioned air (21%). These findings suggest that at least some respondents may have found ways of keeping cool and comfortable without air conditioning.

Figure 14: For people who do not have air conditioners, reasons why. "Have the Option (NET)" describes reasons which are within the control of the respondent, "Not Optional (NET)" describes reasons which are beyond the respondents' control (TPH, 2010)



Mapping to identify Vulnerable People in Toronto

A challenge for Toronto's hot weather response program is knowing where vulnerable people are located. Understanding who and where Toronto's vulnerable people are and some of the challenges they face during hot weather can support effective prevention of heat-related illness and mortality, and emergency preparedness should a heat emergency ever arise.

One way of understanding where Toronto's most heat-vulnerable populations are located is to create maps of heat vulnerability. Heat vulnerability maps can show where "hotspots" in the city overlap with populations who may be more vulnerable to heat. Such maps may help the City and community-based hot weather partners to effectively deliver heat-related resources where they are most needed. This includes both long-term adaptation activities that offset impacts of hot weather, as well as planning and delivery of short-term response activities that are activated on Alert days.

In 2009, TPH developed an approach for mapping heat vulnerability. The approach was based on a review of the literature, a scan of heat vulnerability mapping efforts in other jurisdictions, and a review of spatial data that are available for mapping in Toronto (Toronto Public Health, 2009). With funding support from Natural Resources Canada, TPH collaborated with experts in epidemiology, spatial analysis, and health equity to implement the heat vulnerability mapping. The mapping itself was supplemented by stakeholder consultations on the value of mapping and characteristics of maps that would be most helpful.

The mapping process involved collecting relevant data to represent exposure, sensitivity, and adaptation in Toronto. Since there were several indicators for each of these, composite indices were created to represent overall exposure, sensitivity, and vulnerability. Maps of Toronto were created to show the spatial distribution of each individual indicator, and composite maps were created for each of exposure, sensitivity and potential vulnerability. Because the literature is clear that seniors are at particular risk from extreme heat, a separate composite index was created for seniors' heat vulnerability.

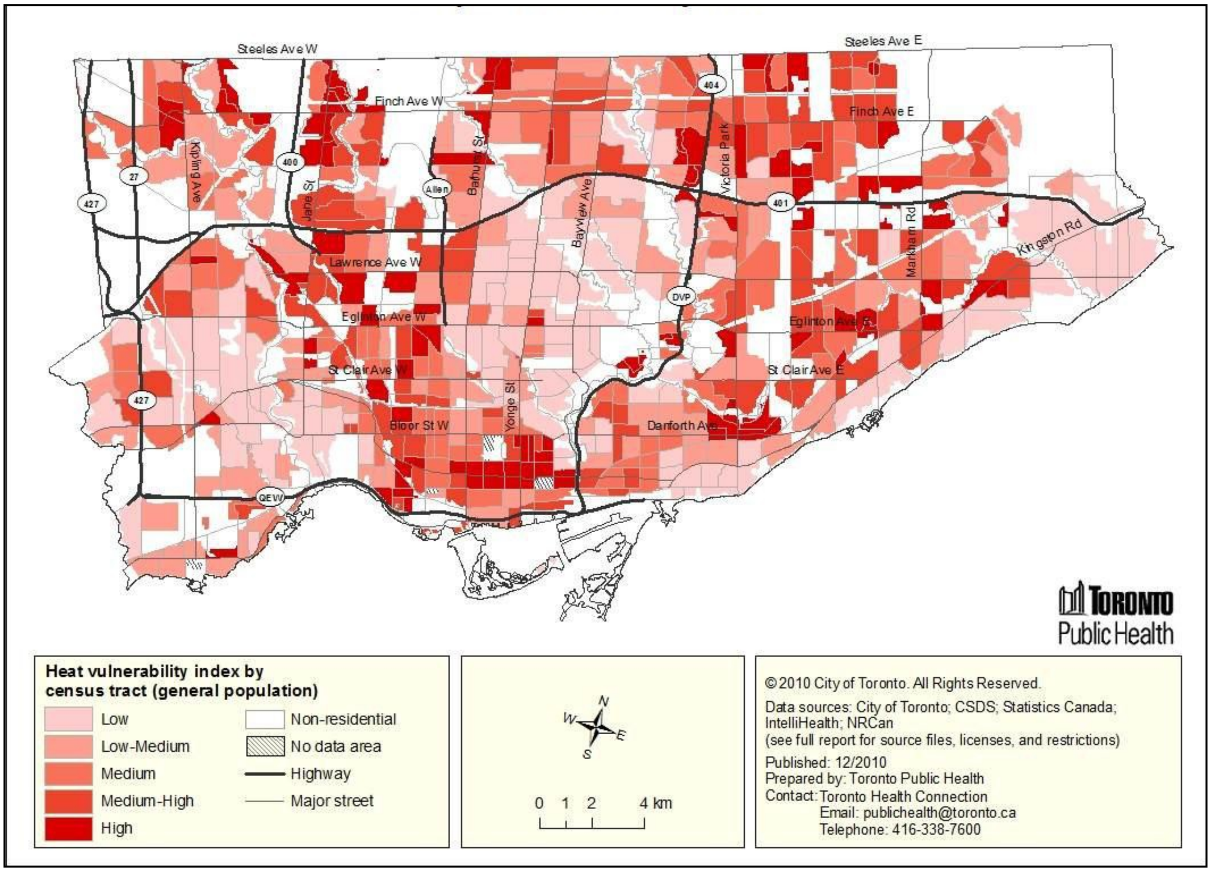
Several statistical techniques including correlation analysis, coverage analysis, and principle component analysis were used to check that the composite indices were reasonable representations of vulnerability to heat. The findings of the survey also support many of the decisions made in the heat vulnerability mapping. For example, the results support inclusion of groups such as those with low income, renters, and those with limited access to green space among those considered most vulnerable. For more details on the methodology and to see a complete map series, please refer to the full technical report Implementation of a Map-Based Heat Vulnerability Assessment and Decision Support System, at http://www.toronto.ca/health/hphe/air_quality/pdf/implementation_mapping_heat_vulnerability.pdf.

Using Maps to Support Hot Weather Response

An example of one of the key heat vulnerability maps produced for Toronto is the composite heat vulnerability map shown in Figure 15. The map incorporates information about both exposure to heat and sensitivity to heat, and applies to the general population. The map suggests that areas of higher vulnerability are located in a "donut" pattern that includes the downtown, several suburbs, and the north end of Toronto. The map shows areas known to be wealthier and more well-treed such as Forest Hill as having low vulnerability to heat, as expected.

A preliminary version of this map was shown to members of Toronto's Hot Weather response Committee in late 2009, and it was later part of a set of thirty-nine maps provided to a group of about 60 stakeholders at a workshop held at the beginning of the 2010 heat season. The purpose of meeting with the hot weather response committee and the workshop was to collect feedback on the possible uses, benefits and limitations of the maps from the perspective of their organizations' mandates and daily activities. The participants represented several City of Toronto Divisions, community organizations, and representatives of various organizations involved in health and social service delivery as well as climate change adaptation.

Figure 15: Vulnerability to Heat in Toronto



In general, stakeholders indicated that the maps of heat vulnerability would assist in targeting resources or investments geographically within the city. They indicated that the maps would be useful for both day-to-day operational use, as well as longer-term, strategic use.

Some of the operational uses identified included supporting appropriate staffing or case load allocation, assistance for ambulance service in preparing for heat alert days; supporting targeted door-to-door outreach; confirming known or assumed areas of vulnerability; identifying existing clients in at-risk areas; identifying potential new clients; supporting collaboration between agencies during peak demand; and supporting service delivery and emergency power setup during power outages.

Some of the strategic uses for the heat vulnerability maps included to append maps to Public Health Emergency Plans; devise a geographically diversified heat alert program; guide development of heat registries; identify suitable locations for stationary and mobile cooling centres; assist with selection of other cool spaces (e.g. libraries) and suitable opening hours; study the influence of land use and built form on surface temperature; contribute to Medical Officer of Health’s comments on urban development issues; adapt neighbourhood plans (secondary plans) and building code; support targeted green roof and cool roof programs; support other targeted building retrofits; guide tree planting; prioritize artificial shading in public spaces; support training of home-care workers; raise awareness of where clients live; support public education; serve as an advocacy tool; bolster grant applications; and support research by community organizations.

When TPH followed up with workshop participants after the 2010 heat season, most said they had used the maps, either by distributing them to staff in their organization for communication or information purposes, using them to validate their own work, as an example of work that could be adopted or used in the future, or to identify areas within client catchment areas that were classified as vulnerable. Some organizations had not used the maps; the reasons included that heat was considered the responsibility of others within their organization, that they believed that their established caseload already captured the vulnerable clients, or that heat was only indirectly linked to their activities but that the maps could potentially be used for future planning activities.

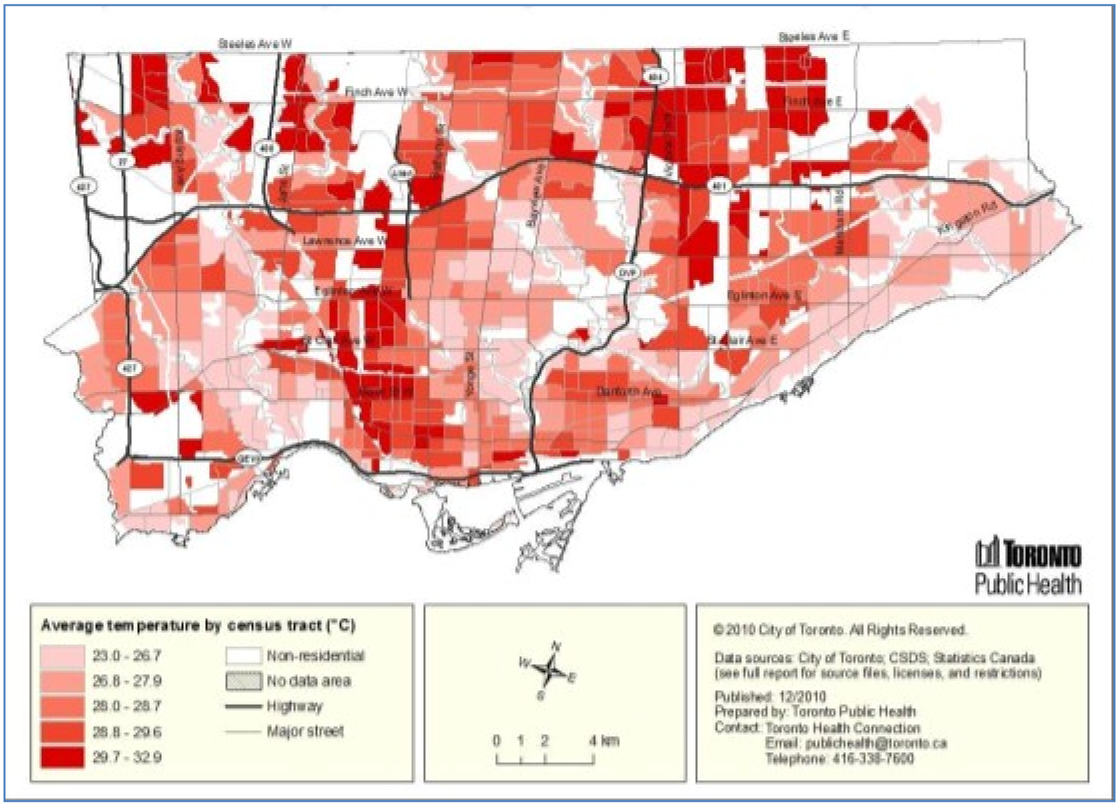
The maps were initially only available as letter-sized pdf hard copies. When asked how the maps could be more useful, respondents suggested that they should be sent out as a matter of course to those who work with vulnerable clients, that they should be available online, and that they should be available as a mappable "layer". As well, stakeholders indicated that it would be useful to be able to view heat vulnerability maps interactively. In particular, participants wished to be able to "zoom in" on specific neighbourhoods and overlay their own information onto the maps. They were also interested in being able to choose to add specific socio-demographic layers, types of facilities, and administrative information such as boundaries of priority neighbourhoods. Respondents also asked for more geographic context and better links to heat-related illness on the map. Finally, respondents requested more information about the analysis and mapping methodology and the data sources.

Understanding and Planning for Heat in Toronto

Interventions to reduce the impacts of extreme heat can address the physical environment in the home and in the community, the social environment, provision of services or resources, or knowledge and perceptions. For example, thermal imagery for the City of Toronto shows that there are areas where surface temperatures are likely to be hotter (See Figure 16). These locations typically correspond with built-up areas such as the downtown, or industrial areas with little green space.

Surface temperature is mainly reflective of outdoor conditions, so maps such as Figure 16 could be best used to help identify locations where efforts to alter the urban physical environment to create cool or shaded environments are needed. Such efforts could include tree-planting and expanding existing green space. Toronto's urban forestry unit indicated that they may consider using TPH's heat vulnerability map series in the future to inform tree-planting priorities.

Figure 16: Geographic Variation in Surface Temperature Across Toronto (Toronto Public Health, 2011)[2]

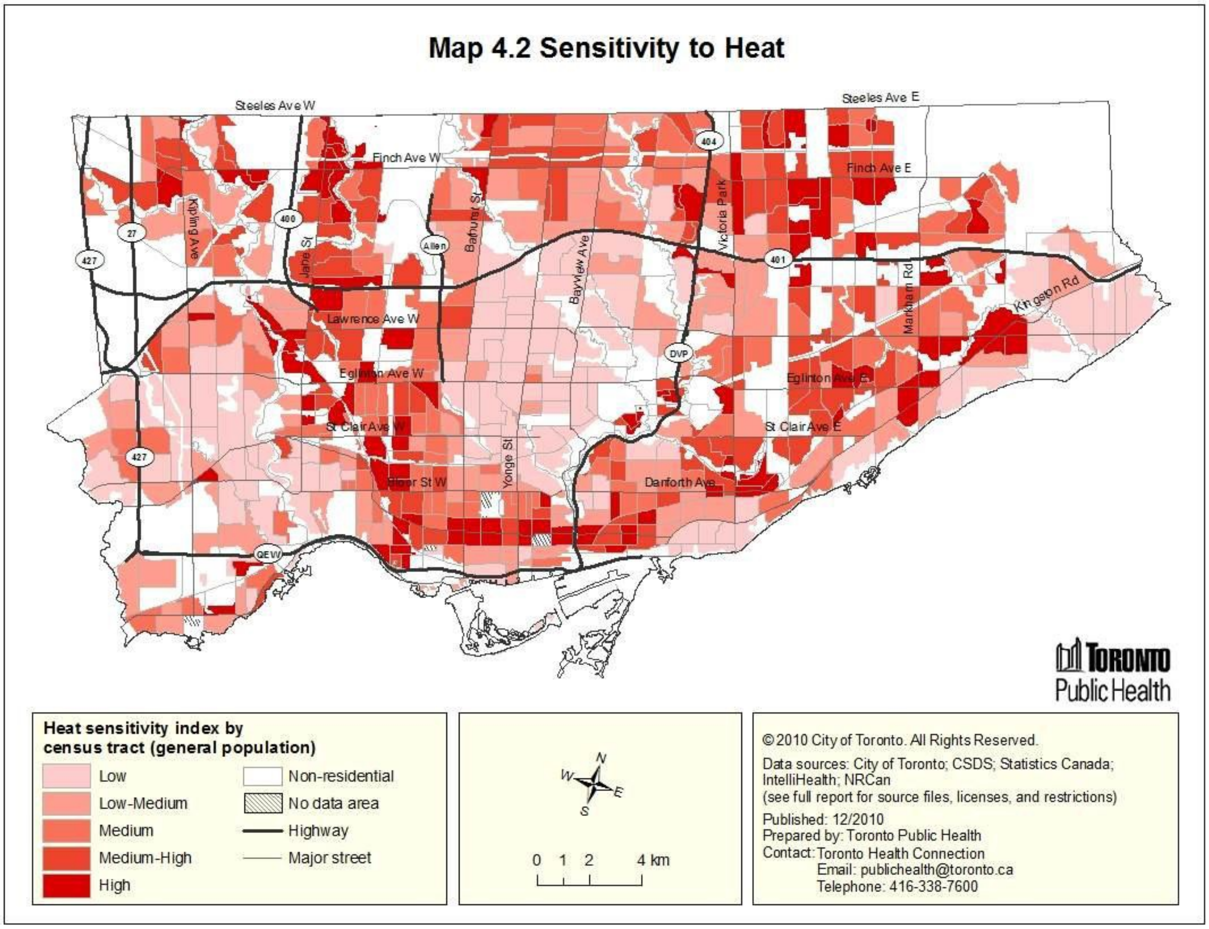


[2] Average of June 29 2007, and September 3, 2008

Figure 17 shows the spatial distribution of sensitivity to heat in Toronto. The composite index for sensitivity accounts for various factors that may reduce resilience to heat including low income, older age, and living alone. The overall pattern of the figure reflects the donut shape from Figure 16, suggesting that many of the hotter areas of the city are also home to groups of people who are especially sensitive to heat. This supports the need for programming and outreach to target especially sensitive groups in the city.

According to recent research, poverty is increasing in Toronto, and becoming more geographically concentrated in certain neighbourhoods. Hulchanski (2010) reports that between 1970 and 2005, the percent of the City's neighbourhoods classified as low-income grew from 19% to 53%, while the percent of extremely low-income neighbourhoods grew from 1% to 9%. Research by the United Way found a significant decline in the incomes of families, in real terms, over the past 25 years, and an increase in the number of families living in poverty in Toronto. The median income of all households, in adjusted 2006 dollars, declined by $3,580 from 1981 to 2006 (United Way, 2011).

Figure 17: Geographic variation in sensitivity to heat across Toronto



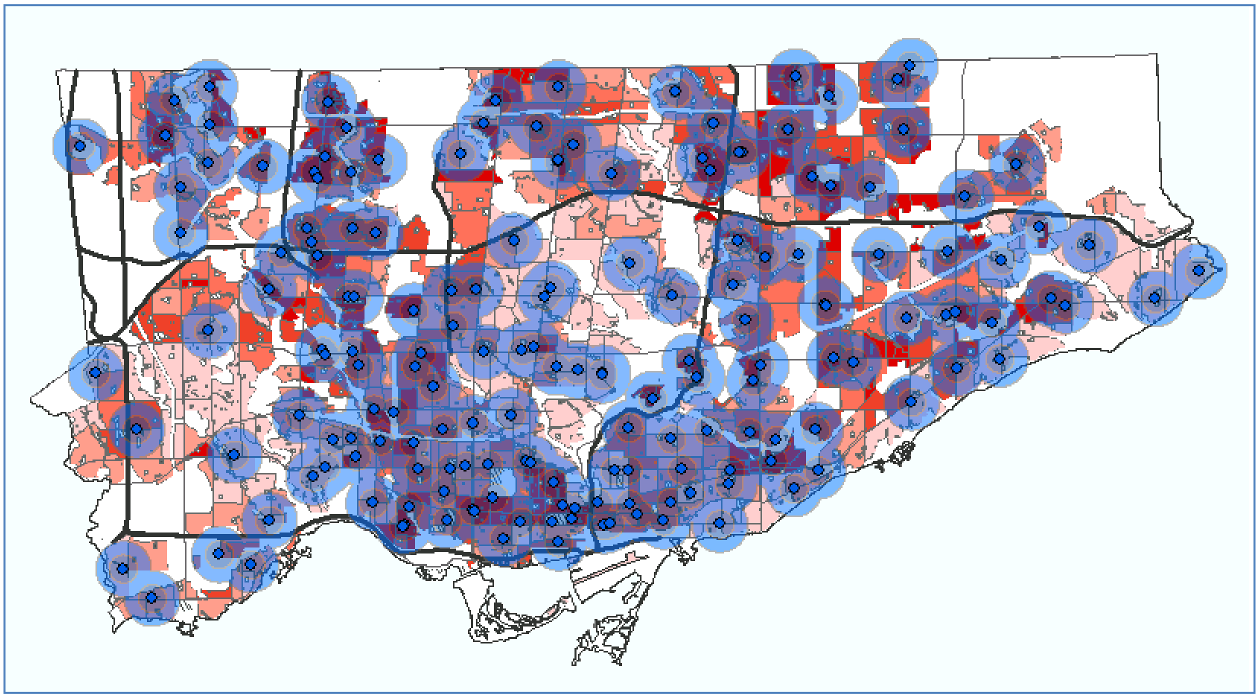
The costs of purchasing and operating air conditioners are among the reasons why Toronto residents surveyed in 2010 said they do not use air conditioning. For low-income groups who are already vulnerable, these costs may be prohibitive.

In New York City, the community housing authority has been able to provide tenants with newer air conditioners while cutting overall costs. According to the New York City Housing Authority (NYCHA), the cost of replacing existing air conditioning units owned by residents with new energy efficient models supplied by NYCHA can be recouped well within the air conditioners' lifetime, and is followed by net savings (NYCHA, 2009). The models supplied by NYCHA enable automatic power-off at preset temperature thresholds, thus offering cooling while reducing overall electricity use.

Limited support for obtaining air conditioning is available to some of the most vulnerable populations in Ontario. Currently, clients of Ontario Works (OW) and Ontario Disability Support Program (ODSP) can apply to purchase and install an air conditioner. Applications must provide evidence of a medical need from a health professional to be eligible.

Overlaying information about vulnerability with data about adaptation services can also help future planning. Figure 18 shows that there are some areas of the city such as the downtown that are well-served by publicly available cool places. However, there are also vulnerable areas of the city, which are farther than 1 km from a cool place. This type of map may suggest areas which could benefit from additional outreach or services. This could include targeted advice on how to "Beat the Heat", or identifying additional types of facilities in the area that could potentially be opened in the case of a heat emergency.

Figure 18: Vulnerability to Heat and libraries and community centres, which are promoted as "cool places". The circles show buffers of 500 metres and 1 km from each facility (TPH, 2011)



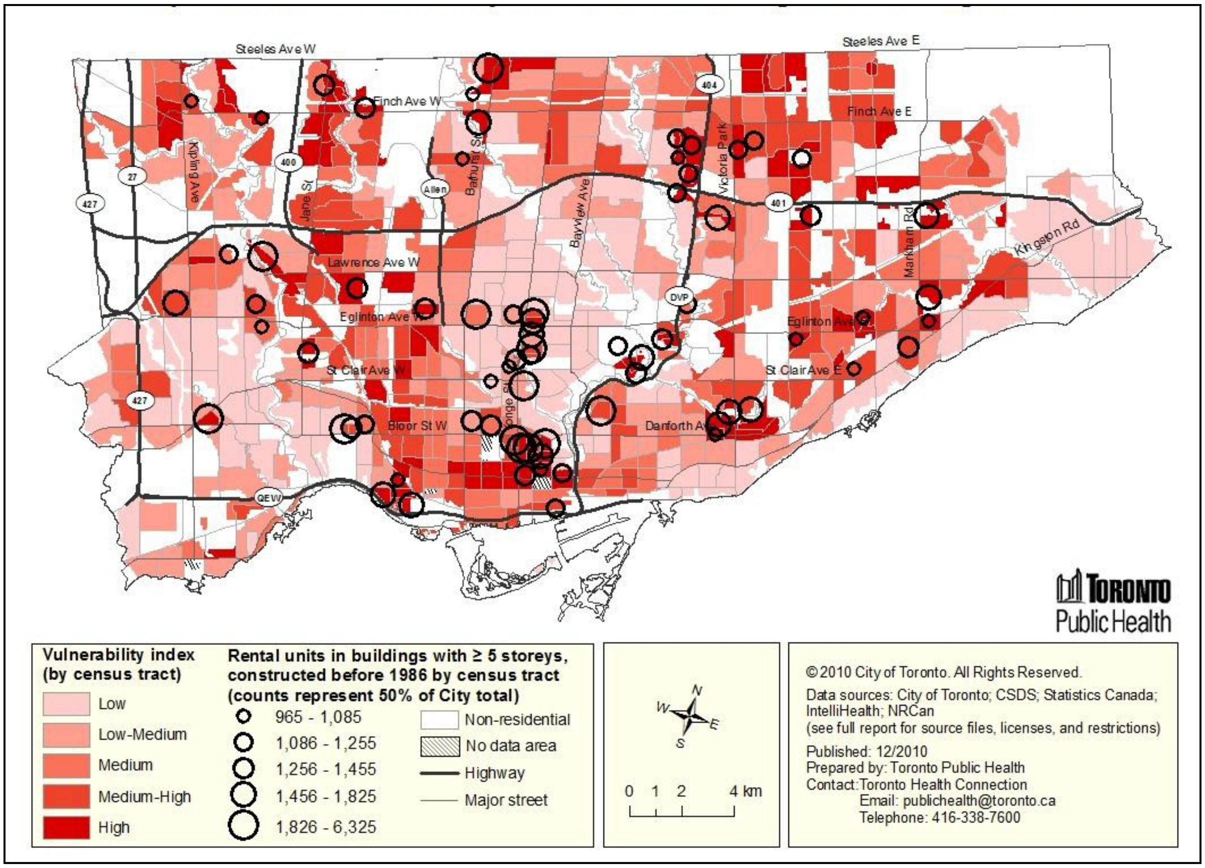
Heat and Multi-Residential Apartment Buildings in Toronto

According to the access to cooling survey, a key group who are less likely to have access to air conditioning (and in particular, to central air conditioning) are renters. In Toronto, there are over 1000 residential, rental apartment towers. Many are aging concrete buildings that were built between the 1950s and 1980s, and few have central air conditioning. Figure 19 shows where the City's older, rented high-rises are located (circles) on top of a map of heat vulnerability. Many appear to coincide with areas of higher overall vulnerability. Many residents of these buildings may be exposed to high levels of heat: Smargiassi et al. (2008) found that indoor temperatures are related to building height, and Patz et al. (2000) concluded that populations living on the top floors of buildings without air conditioning are at greater risk from heat.

People living in Toronto high-rises have reported exposure to uncomfortable levels of summertime heat. In 2010, 16.4% of survey respondents who were tenants in privately-owned

Toronto high-rise buildings said that their apartment was always too hot in the summer and a further 33.4% said it was sometimes too hot (United Way, 2011).

Figure 19: Vulnerability to heat and rented dwellings in older high-rises



People living in multi-residential high-rises may be at particular risk from heat not only as a result of their exposure to heat, but also because they may be more sensitive to heat. These buildings house some of Toronto's most vulnerable groups. Many residents of these building are lower income groups and newcomers to Canada. The United Way's 2011 *Vertical Poverty* report demonstrates that in Toronto, high-rise apartment buildings have increasingly become sites of concentrated poverty within neighbourhoods. The decline in household income among renter households between 1981 and 2006 was nearly double the median amount for all households, at $6,396. At the same time, the cost of rent increased in private-sector high-rises, with the average annual cost of a two-bedroom apartment in the City of Toronto increasing by $3,709 between 1981 and 2006, and rent for a three-bed unit going up by an average of $4,697.

In buildings where an air conditioning system exists, Toronto's Municipal Code Chapter 629, Property Standards, requires that it be kept in good repair and maintained in good working order at all times relevant to the operation of the system. These systems must be operated from June 2 to Sept 14 so as to maintain an indoor temp of not more than 26 ^{o}C.

However, most of the older buildings do not have central air conditioning. In these buildings, tenants must either find ways to cope with summer temperatures in their apartments, or purchase and install a window unit, where allowable. However, renters in these buildings face a number of challenges in keeping their units cool.

It is difficult for tenants in these buildings to achieve much natural ventilation, as the extent to which most windows open is restricted. To protect children from falling out of windows, the City of Toronto's property standards require that residential windows higher than 2 metres above the ground have mechanical safety devices that restrict windows from opening more than ten centimetres (four inches) (City of Toronto, 2010).

However, purchasing and installing a window air conditioner can present challenges, especially to lower-income tenants. As a result of concerns that improperly installed air conditioners could fall out of windows, landlords can require tenants who purchase window units to arrange for installation or inspection of installed window units by a third party professional. The installer must be able to certify that the air conditioner is safely installed, and the installation/inspection must be carried out at the cost of the tenant. If landlords are not satisfied that the unit is safely installed, they can request that it be removed. Whether this occurs at any specific property may depend on the tenancy contract.

On occasion, existing regulations that were designed to protect tenants from cold weather can result in increased exposure to heat. The City of Toronto Municipal Code Chapter 497, Heating specifies that landlords must provide heat to a minimum air temperature of 21 $^{\circ}$C between September 15 - June 1 (City of Toronto, 2010). Servicing the heating system and switching off the heat in one of these older buildings can be an intensive job requiring skilled HVAC personnel. As a result, many landlords leave the heating on until June 1, regardless of outdoor temperatures. In 2010, this led to tenants reporting that heat was on in their units during several days in late May when TPH issued Heat Alerts or Extreme Heat Alerts.

Given the increases in overall temperatures expected with climate change, it may become more common to experience hot weather before June 1. To avoid landlords having the heat on during hot weather, because of concerns over complying with the minimum temperature standards, it may be helpful to review the dates associated with the requirement to determine whether they should be revised in light of climate changes.

In the past, ideas of creating regulations that would either require landlords to permit tenants to have window air conditioners installed, or legislate a maximum heat standard for apartment dwellers without air conditioning encountered complex challenges related to legislative authority, implementation, enforcement, and practical considerations.

Staff from Municipal Licensing and Standards and City Legal reviewed the City's authority to pass by-laws respecting air-conditioning and maximum heat. While the City has broad general powers to pass by-laws under section 8 of the *City of Toronto Act*, *2006*, there are three general conditions that limit the scope of its powers. The proposed regulation in the by-law must be with respect to at least one of the listed matters in subsection 8(2). The proposed regulation must also have a municipal purpose and must not conflict with other legislation. Based on the evidence to date, these limitations would not permit City Council to enact a by-law under the *City of Toronto Act, 2006* to simply require all landlords in the City of Toronto to "permit tenants to have window air conditioners installed where central air conditioning is not available."

The relationship between landlords and tenants is governed by the *Residential Tenancies Act, 2006*. Under that Act, a municipality can only enact by-laws with respect to the supply of vital services, and air conditioning is not identified as a vital service in the *Residential Tenancies Act, 2006.* Requesting an amendment to either the *City of Toronto Act, 2006* or the *Residential Tenancies Act, 2006* to permit a by-law requiring landlords to allow tenants to have air conditioners would require that the City develop a case for why air conditioning is needed.

The idea of legislating a maximum heat standard for apartment dwellers without air conditioning has been raised in the past, and a number of challenges to implementing the standard have been identified. It may be possible for Toronto to create a new standard in Municipal Code Chapter 629, Property Standards. Under section 15.1 of the *Building Code Act,1992* municipalities may prescribe standards for the maintenance and occupancy of property within the municipality. However, property standards do not differentiate on whether the property concerned is a rental property, meaning that the standard would also have to apply to non-rental residences, which may be impractical.

Even if a regulation was passed instituting a standard or requiring some kind of cooling to be available in all rental units, further research may be required to identify an appropriate temperature threshold. As well, the aging electrical infrastructure in many of Toronto's tall towers means that if all tenants installed window air conditioners, the buildings may not be able to handle the additional electrical load. In parts of North America, the significant load placed on the electrical grid by air conditioners has increased the threat of brownouts or blackouts for whole communities. Installing and running either central air conditioning or multiple window units into an older building also places a significant financial burden on the property owner. These costs could potentially be passed on to the tenants. Finally, running air conditioning actually generates heat, adding to the heat outdoors around the building.

Another possibility is to permit a maximum heat standard to be met by a property owner (landlord) providing at minimum a cool location where building occupants (tenants) can go during hot weather. This option might minimize the energy and financial demands placed on older buildings while providing a place where tenants can obtain relief from hot weather. Toronto Public Health has conducted some initial exploration of this idea and identified some of the associated benefits and challenges.

A "Cool Room" Scoping Project in a Toronto High-rise

In the summer of 2010, TPH conducted a scoping exercise to identify the challenges and opportunities for making adequate cooling available to residents of multi-residential, high-rise buildings without central air conditioning. Staff from TPH worked in collaboration with staff from Toronto's Tower Renewal (TR) initiative at a privately owned high-rise apartment property to facilitate the implementation of a volunteer-run “cool room”. The TR initiative focuses on apartment tower neighbourhood revitalization and has undertaken activities towards improving energy efficiency in high-rise residential buildings and revitalizing the apartment tower neighbourhoods to improve quality of life at pilot sites across the city.

The apartment tower community selected for the cool room exercise is located in one of Toronto's priority areas for neighbourhood revitalization and social infrastructure investment. Most of the apartment tower community population is newcomers or immigrants to Toronto (City of Toronto 2011). The community includes two towers built in the later part of the 1970s that did not have central air conditioning or an air conditioned common space in the towers where residents could go. A small number of apartment units appeared to be equipped with window air conditioners. Outside the tower, there was little access to cooling or natural shade. The shade cast by the building was mainly in unsafe or undesirable areas such as in the parking lots and beside the waste storage area.

Preliminary measurements suggest that temperatures in the apartments reach high levels during hot periods. Between August 29 and September 2, 2010 there was one heat alert and four extreme heat alert days. During this time, the maximum indoor temperature levels in seven apartment units ranged from 29.4°C to 33.5°C, the mean temperatures ranged from 27.7°C to 30.4°C, and minimum temperatures ranged from 25.3°C to 28.1°C.

As part of the cool room scoping exercise, TPH undertook activities including education and outreach on health effects and precautions to be taken during heat events; enabling access to a common, cooled space for residents; and facilitating an on-site, volunteer-run hot weather response program. The exercise identified some successes and challenges for implementing cool rooms in multi-residential high-rise buildings.

TPH was fortunate to be able to build on a pre-existing relationship that Tower Renewal staff and a local community group called Action for Neighbourhood Change (Rexdale) had built with residents of the towers and the landlord. An initial success was that the property manager supported the idea of a volunteer-run cooling room in one of the common rooms in the building and agreed to provide essential equipment and amenities provided that norms for supervision and conduct were established and enforced. An available room was selected for running the cool room in consultation with the property manager and a resident group. The room was already equipped with table and chairs, a washroom and a kitchen, and by the end of the summer, the property manager purchased and installed two air-conditioners in the room.

Creating a self-sustaining resident group to organize and run the cool room was challenging. Many residents had limited experience planning and acting on general community matters, there were few resident volunteers, and many had limited time to take on tasks, mainly due to their responsibilities caring for their children, shift work or personal health issues. The group's capacity to use computers was limited by lack of skills, access to computers, and/or access to the internet. Ultimately, TR and TPH staff negotiated the logistics of running the cool room with the property management, suggesting that involvement of a third party may have been critical in enabling the creation of the cool room.

The need for appropriate evaluation of a room's cooling needs was demonstrated when the two air conditioners installed by the property manager did not provide adequate cooling in the room.

Challenges associated with access and use of the cool room included insufficient time and resources to notify residents of the availability of the cool room and promote its use, apparent language barriers and poor communications systems within the buildings, and limited visibility of the room, as it was not along a regular route into and out of the building. Elderly or handicapped residents may have been discouraged from attending the cool room because of limited mobility and concerns about the reliability of elevators in the building. Finally, the cool room may not have been appealing to those who would benefit most from its use because of a lack of activities or entertainment.

Comments from residents at the apartment tower community indicate that outdoor shaded areas would be a preferred alternative to a cool room unless there is programming or some entertainment in the cool room.

Ongoing and Future Activities

Providing Up-To Date Advice and Information

The importance of preparing for extremely hot weather and implementing programs such as HARS is underscored by recent activities in Canada. In 2008, Health Canada completed a comprehensive national assessment and published a report on human health vulnerability to a changing climate. The assessment recognized that extreme heat poses a health risk in Canada and led to Health Canada launching a three-year heat initiative. Entitled *Developing Heat Resilient Communities and Individuals in Canada*, it included piloting HARS in several Canadian communities and collaborating with Toronto Public Health to evaluate Toronto's HARS. In spring 2011, Health Canada began launching a series of documents to support Canadian communities prepare for extreme heat, starting with a communications toolkit for Public Health and Emergency Management Officials, and brochures that deliver heat-health messages to specific audiences. Over the coming months, several additional documents are expected to be released including vulnerability assessment guidelines, health care worker guidelines for heat events, and a best practises guidebook.

In light of this recent research, TPH is planning a review of all of its heat-related messaging. This summer, TPH will provide agencies and individuals with links to the updated Health Canada pamphlets as a supplement to the TPH resources.

TPH recently updated its heat alert website (http://www.toronto.ca/health/heatalerts/index.htm). Some of the new features of the site include a community agency page and Google map listing of all air conditioned libraries, community centres and cooling centres.

To facilitate community access to the heat vulnerability information, TPH recently selected four maps from the heat vulnerability series to be posted on the Toronto Community Health Profiles (TCHP) website this summer (see http://www.torontohealthprofiles.ca/). Maps will be posted to the website in Adobe portable document format (PDF) with a link to background information. TPH will also link to the Toronto Community Health Profiles website from the TPH hot weather response webpage. For those seeking further information and the full map series, the technical reports documenting the analysis and mapping methodology, data sources, and providing the full map series are now publicly posted on TPH's website.

TPH is also able to create customized maps for each of Toronto's neighbourhoods and wards showing heat vulnerability and some adaptation information such as locations of cooling places, hospitals, swimming pools, and boarding/rooming houses.

TPH plans to collaborate with the City's Geospatial Competency Centre (GCC) to make the heat vulnerability index available online through the City's iMAPit software tool, which enables users to interactively explore the City and its services. The GCC works on mapping projects with individual City departments and has expressed an interest and willingness to work with TPH on a customized heat vulnerability application. The current iMapIt application can be viewed at http://map.toronto.ca/imapit/iMapIt.jsp?app=TOMaps. An updated version of iMAPit with more functionality is planned for release later in 2011.

Additionally, the heat vulnerability index could be made publicly available through the open data initiative. This will enable users with advanced GIS skills to download the index and import it into their own software. The index can then be overlaid with an organization's own data (eg., client locations and profiles).

Expanding Cool Room Project in 2011

TPH will continue supporting implementation of a cool room in one of the TR pilot sites in 2011, and plans to consult with residents at the end of the summer to determine their perceptions of the benefits and feasibility of having a common cool space in their tower community.

Collaboration with City Agencies on Adaptation Planning that addresses Public Health Issues

Some policies are already in place in Toronto to mitigate the urban heat island effects and promote cooler, more accessible environments. In 2010, the Shade Policy Committee of the Toronto Cancer Prevention Coalition in collaboration with Parks, Forestry and Recreation and with the support of Toronto Public Health released Shade Guidelines for the City. The Shade Guidelines are intended to complement the 2007 Shade Policy for the City of Toronto and contain recommendations and principles for increasing shade at facilities operated by the City of Toronto.

In 2007, Toronto adopted a Climate Change, Clean Air and Sustainable Energy Action plan that committed the city to several actions that could reduce the urban heat island effect and provide cool places for Toronto residents to go on hot days. For example, the plan calls for a doubling of the urban tree canopy. Parks, Forestry and Recreation responded with a Forestry Service Plan aimed at managing existing growing stock, protecting the forest and planting more trees. The increase in tree canopy has the potential to provide more shade and help mitigate the urban heat island effect.

TPH will collaborate with Parks, Forestry and Recreation about the vulnerability assessment results. Urban Forestry has identified that they will consider this information in combination with existing tree canopy coverage mapping as they prioritize planting in the most vulnerable areas of the City. Currently Urban Forestry plants more than 100,000 trees each year. TPH will continue to support the need to protect and enhance tree canopy to provide shaded areas for people seeking relief from the heat.

The Toronto Environment Office is completing climate research that will provide more detailed information about the average climate and climate extremes expected in Toronto over the next fifty years. TPH will continue established collaboration with TEO to enable TPH to gain a better understanding of the expected changes in weather for the City of Toronto specifically, and the implications of the changes in weather for hot weather programming. In particular, the results will aid TPH to assess the risk of severe hot weather emergencies, and explore whether such emergencies deserve specific preparedness planning and attention in the Division's and the City's emergency plans.

Collaboration with Provincial Agencies

TPH will continue collaborating with provincial agencies who have responsibilities for environmental and health issues, including the Ministry of the Environment, Ministry of Municipal Affairs and Housing, and the Ontario Agency for Health Protection and Promotion (Public Health Ontario).

In April 2011, TPH provided input on proposed standards for retirement homes under the new *Retirement Homes Act*. TPH encouraged the Ontario Seniors' Secretariat to consider including specific requirements for licensees to plan for and respond to extreme hot weather in the Retirement Homes Act. TPH suggested that the requirements should specify that procedures include (i) making residents aware of heat-related risks and signs of heat illness and to provide resources, (ii) monitoring residents for heat-related illness and sufficient hydration on hot days, and (iii) ensuring that all residents have access to a cool location onsite on hot days. TPH additionally suggested that the Act provide guidelines about what constitutes extreme "hot weather" to trigger actions by licences such as ensuring availability of a cooling room.

Given the issues facing renters, especially those in high-rise communities, TPH has also initiated dialogue with the Ministry of the Environment and the Ministry of Municipal Affairs and Housing to explore the relationships between the provincial and municipal regulations that govern rental units in Ontario. Currently, the application of regulations for providing heating is inconsistent across the province, and there are no examples of regulations that would require access to some form of cooling for tenants. An initial exploration of the currently available policy tools and options, and their advantages and disadvantages may indicate next steps for how to sustainably support protection of tenants in Ontario during hot weather.

As well, Toronto Public Health will collaborate with the Ontario Agency for Health Protection and Promotion (Public Health Ontario) to explore the feasibility of developing health-based guidance to help people access cooling effectively. This could include information about how long people need to spend in a cool location for prevention of heat-related illness, whether certain people should spend more time in a cool environment, and what conditions constitute a sufficiently cool environment to offer health protection.

NASA-funded SIMMER project leading to cutting-edge model for Toronto

TPH's heat research attracted the attention of a NASA-funded U.S. research team developing an integrated model of extreme heat risk. They are currently developing a prototype model for Houston TX, and selected Toronto as a test city for transferring their model of extreme heat risk to other large cities.

The goal of the project is to combine information about climate change predictions, land use, and survey data including the access to cooling results, with demographic data and health data to better understand the linkages between the physical and social environments and health risk, now and for the future.

The research will be led by the NCAR scientists with input from City staff, and builds on work already completed for Toronto, including climate drivers work by the Toronto Environment Office, HARS evaluation research by Health Canada and TPH, and the TPH spatial heat vulnerability assessment project, which was supported by Natural Resources Canada.

The project is already fostering partnerships within the City, between City and other levels of government, and internationally. Expected in 2012, the findings will support long-term planning and short-term adaptation to hot weather in Toronto.

Conclusions

Vulnerability to heat depends on individual characteristics as well as features of a person's physical and social environment – and how they affect resilience to hot weather and ability to access cooling on a hot day (Health Canada, 2008; Toronto Public Health, 2009). For example, social networks or status can affect access to: health care or cool locations, advice about coping with heat, or support for implementing preventive actions. Features of the physical environment such as presence of vegetation, building design, building density, and presence of impervious surfaces affect the level of heat in any particular location. Individual characteristics such as social isolation, old age, presence of pre-existing illness, disabilities, or low income can affect a person's ability to cope with high temperatures. These factors may further combine to create significant barriers for some people to access a safe environment on a hot day.

While many people are aware of Heat Alerts and Extreme Heat Alerts and take actions recommended by Toronto Public Health to keep cool, there are groups of people in the city who may be vulnerable to heat both because they live in areas of the city and home environments that are hotter, and they have fewer resources to cope with the heat. Effective, sustainable provision of cooling is a complex issue. Effective collaboration among city and provincial agencies may help to identify ways to support especially vulnerable groups such as those living in multi-residential apartments, and to assess and appropriately prepare for the risk of a heat emergency.

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