

Questions & Answers - Heat Vulnerability Maps for Toronto

What is the purpose of the heat vulnerability maps?

Toronto Public Health developed a suite of heat vulnerability maps to characterize the geographic patterns of vulnerability to heat in the City. These maps are intended to support community agencies and organizations in pre-season planning for heat, hot weather response activities and long-term climate change adaptation planning.

These maps are best used in combination with the knowledge of your service areas and the outreach experience already present in your organization.

How is heat vulnerability defined?

Vulnerability to heat is defined as a combination of *exposure* to heat and *sensitivity* to heat.

Exposure to heat describes the likelihood that a person will encounter heat, how hot it is, and for how long. Exposure may be affected by factors related to a person’s home and community environment such as access to air conditioning in the home, type of residence (eg., unit on an upper floor of a multi-residential building vs. detached house), presence of shade near the home, and presence of green space in the neighbourhood.

Sensitivity refers to decreased ability to cope with hot weather, and 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. Sensitivity to heat also arises from people’s personal circumstances such as isolation or poverty.

The indicators selected for mapping heat exposure and sensitivity were based on a review of the scientific and grey literature up to the summer of 2010, an investigation of Toronto-specific datasets available and suitable for mapping, a statistical analysis of the numeric relationships between potential indicators, and two stakeholder workshops held in fall 2009 and spring 2010.

Table 1 lists indicators used in Toronto's heat vulnerability project for exposure and sensitivity.

Table 1: Indicators used by Toronto Public Health for Exposure and Sensitivity to heat

Exposure	Sensitivity
Surface Temperature	Low-Income Persons
Distance from Green Space	Low-Income Among Young Children
Tree Canopy Shading	Housing Costs of Renter Households
Dwellings in High-Rise Buildings	Housing Costs of Low-Income Renters
Rented Dwellings in Older High-Rises	English Language Knowledge
Population density	Recent Immigrants
	No High School Certificate Among Adults
	Racialized Groups
	Disability
	Emergency visits for cardiovascular and Respiratory disease
	A seniors-specific sensitivity index

Composite indices of heat vulnerability were created following guidelines for multi-criteria decision analysis, which support the weighted combination of indicators. Details on the vulnerability assessment methodology can be found in the project report at <http://www.toronto.ca/health/>.

Why are there separate maps for the general population and for seniors?

There is a separate heat vulnerability map for seniors because they are identified in the literature as being especially at risk from heat. This risk may arise from physiological limitations, disability, taking certain medications, limited mobility, and living alone. As a result, seniors may be targets for specific outreach and education activities. Also, some organizations whose clients are mainly senior citizens may find senior-specific maps to be helpful.

How could I use this map?

The maps of heat vulnerability could enable geographic targeting of resources or investments to for both day-to-day operational use, and longer-term, strategic use. Some ideas from hot weather response stakeholders are listed here – but there may be other ways the maps could be used.

Some of the *operational uses* may include supporting appropriate staffing or case load allocation, planning service delivery 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 could be to guide development of heat registries, identify suitable locations for stationary and mobile cooling centres, assist with selection of additional cool spaces and suitable opening hours, study the influence of land use and built form on surface temperature, enable targeted greening programs, enable targeted building retrofits, prioritize natural or 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.

What type of data were used for the indicators in these maps?

Exposure was mapped based on selected thermal images obtained from Natural Resources Canada and land use information from the City of Toronto.

Most of the datasets used to represent the sensitivity indicators originate from 2006 Canadian Census profiles or cross-tabulations obtained through the Canadian Social Data Strategy. If your clients include people who are homeless or people living in long term care homes or collective dwellings, they may be under-represented in the Census variables and as a consequence, in the heat vulnerability assessment.

Most Census tracts include between 1,500 and 8,000 residents. These units provide sufficient geographic detail for general outreach planning and City-wide comparisons, without compromising individual privacy. All raw-count data were standardized (e.g. number of seniors re-calculated as percent of seniors among total population) to enable numeric combination of

indicators. In addition, the health data representing pre-existing illness were age-standardized to account for variation in the demographics of Census tracts.

Why do the maps look the way they do - how were they designed?

All maps were created for the extent of the City of Toronto at the Census tract level. The choropleth (area-shaded) maps created for most indicators and indices use a quintile classification method (all five classes contain the same number of Census tracts). A pink-to-red colour scheme was used for the thematic symbols on all maps to indicate increasing exposure, sensitivity, or vulnerability by increasingly dark shades of red.

Selected reference layers such as major roads provide orientation and support the exploration of spatial patterns of heat vulnerability across the City.

Where can I get more maps and more information about data and methods?

More information about the specific indicators and data sources is appended to this document in a section called "About the Data". Please see pages 4-6.

The full project report and map series, which describes the methods and data in detail, and includes over 40 maps, is available at <http://www.toronto.ca/health/>

About the Data:

Details on Data Sources in Composite Heat Vulnerability Indices

Variables Included in Exposure Index	Source	Date(s)
Surface Temperature	Natural Resources Canada, Earth Sciences Sector, preprocessed Landsat thermal images	29 June 2007 and 03 September 2008
Access to Green Space	City of Toronto, Parks, Forestry and Recreation, boundaries of public green areas Available at www.toronto.ca/open	2010
% Tree Canopy Coverage by CT	City of Toronto, Urban Forestry division, land cover Available at www.toronto.ca/open	2009
% of Dwelling Units that are in High Rises (Five or more storeys)	Statistics Canada, Profile of CTs 94-581-XCB2006005	2006
% of all Dwelling Units that are Renter High Rise Dwellings Constructed Before 1986	Statistics Canada, 2006 Census Community Social Data Strategy 97-554-XCB2006021_CT Period of Construction (11), Structural Type of Dwelling (10), Housing Tenure (4) and Condition of Dwelling (4) for Occupied Private Dwellings of Census Metropolitan Areas, Tracted Census Agglomerations and Census Tracts.	2006
Population Density in persons/km ² over Net Area (Pop/Net_Area)	Statistics Canada, 2006 Census Profiles of CTs over CT area minus Non-residential Residential Cutouts NonResAreas_region.shp from Toronto Public Health	2006

Population Variables in Sensitivity Index	Source	Date(s)
Income variables		
Total Persons in Low Income Households with income below Statistics Canada After –Tax Low Income Cut-off (LICO)	Statistics Canada, 2006 Census Profile of CTs 94-581-XCB2006005	2006 2005 Income
Children under 6 years of age in Low Income Households with income below Statistics Canada After-Tax Low Income Cut-off (LICO)	Statistics Canada, 2006 Census Profile of CTs 94-581-XCB2006005	2006 2005 Income
Renters paying 50% of more of their income on rent.	Statistics Canada, 2006 Census Community Social Data Strategy 977-554-XCB2006051_CT Gross Rent as a Percentage of household income by household type by age of primary household maintainer	2006 2005 Income
Low Income Renter Households Paying 50% or more of Income on Housing: Combined Low Income Renter Economic Family Households paying 50% or more of household income on housing costs PLUS Low Income Renters that are Unattached (not in economic families) paying 50% or more of income on housing	Statistics Canada, 2006 Census Community Social Data Strategy UPP06_Table-09EF_Part_A_CT Elderly/Non-Elderly Spouse or Economic Family Reference Person (3), Income Status Before Tax of Economic Family Households (3), Selected Cultural and Activity Limitation Characteristics (11), Presence of Children (5) and Selected Dwelling, Household and Income Characteristics (27) for the Economic Family Households in Non-farm, Non-reserve Private Dwellings of Census Metropolitan Areas, Tracted Census Agglomerations and Census Tracts. UPP06_Table-09UI_Part_A_CT Same as above for Unattached Individuals	2006 2005 Income
Access Variables		
Persons not speaking English (people unable to conduct a conversation in English); this includes people who speak French only, French and other or other languages with no English.	Statistics Canada, 2006 Census Profile of CTs 94-581-XCB2006005	2006
Recent Immigrants: % who became permanent residents with in the past 5 years (2001-2006) since the census was conducted in May 2006.	Statistics Canada, 2006 Census Profile of CTs 94-581-XCB2006005	2006
Age 25 and over without High School education	Statistics Canada, 2006 Census Profile of CTs 94-581-XCB2006005	2006
Racialized Groups	Statistics Canada, 2006 Census Profile of CTs 94-581-XCB2006005	2006
Health Variables		
Disability among age 25-64	Statistics Canada, 2006 Census Community Social Data Strategy UPP06_Table-01_CT Age Groups (34), Sex (3), Income Status Before Tax (3) and Selected Cultural, Activity Limitation and Demographic Characteristics (36) for the Population in Private Households	2006
Emergency Visits for Respiratory Diseases, and Circulatory Diseases	IntelliHEALTH Ontario data base, Ministry of Health and Long Term Care, National Ambulatory Care Reporting System (NACRS) data. Age standardized rates for 2004-2008) were provided by Toronto Public Health (standardized to the 1991 population of Canada).	2004- 2008

Population Variables in Seniors' Sensitivity Index	Source	Date(s)
Demographic & Income		
Frail Seniors: % of total population that are age 75+ with a disability	Statistics Canada, 2006 Census Community Social Data Strategy UPP06_Table-01_CT Age Groups (34), Sex (3), Income Status Before Tax (3) and Selected Cultural, Activity Limitation and Demographic Characteristics (36) for the Population in Private Households	2006
Living alone and being low income: % of all age 65 and over that are Low income and living alone	Statistics Canada, 2006 Census Community Social Data Strategy 97-563-XCB2006028_CT Income Status Before Tax and Income Status After Tax (8), Economic Family Structure and Presence of Children for the Economic Families; Sex, Household Living Arrangements and Age Groups for the Persons 15 Years and Over not in Economic Families; and Sex and Age Groups for the Persons in Private Households (88) of Census Metropolitan Areas, etc.	2006 2005 Income
% Low Income Seniors	Statistics Canada, 2006 Census Profile of CTs 94-581-XCB2006005	2006
% Low income among age 65 and over living alone	Statistics Canada, 2006 Census Community Social Data Strategy 97-563-XCB2006028_CT	2006 2005 Income
Elderly Economic Family Households paying at least 30% of household income on housing	Statistics Canada, 2006 Census Community Social Data Strategy UPP06_Table-09EF_Part_A_CT Elderly-led economic families	2006 2005 Income
Elderly Non-Family Households paying more than 30% of income on housing	Statistics Canada, 2006 Census Community Social Data Strategy UPP06_Table-09UI_Part_A_CT Same as Above except for unattached seniors – not in economic families.	2006
Access Variables		
Age 65 and over Not Speaking English	Statistics Canada, 2006 Census Community Social Data Strategy EO1213_TGP_7A_CMA_CT Target Group Profile of the Population 65 Years and Over of Selected Census Metropolitan Areas, Census Agglomerations and Census Tracts, 2006 Census	2006
Age 65 and over who are Recent immigrants (within 10 years)	Statistics Canada, 2006 Census Community Social Data Strategy UPP06_Table-01_CT Age Groups (34), Sex (3), Income Status Before Tax (3) and Selected Cultural, Activity Limitation and Demographic Characteristics (36) for the Population in Private Households	2006
Age 65 and over without high school certificate.	Statistics Canada, 2006 Census Profile of CTs 94-581-XCB2006005	2006
Age 65 and over in racialized groups	Statistics Canada, 2006 Census Community Social Data Strategy UPP06_Table-01_CT (See above)	2006
Health Variables		
Age 65 and over living alone with disabilities/activity limitations	Statistics Canada, 2006 Census Community Social Data Strategy UPP06_Table-09UI_Part_A_CT A Age Groups (3), Sex (3), Income Status Before Tax (3), Selected Cultural and Activity Limitation Characteristics (11) and Selected Dwelling, Income and Household Characteristics (27) for the Persons 15 Years and Over not in Economic Families in Private Households	2006
Age 65-74 with disability/activity limitations	Statistics Canada, 2006 Census Community Social Data Strategy UPP06_Table-01_CT Age Groups (34), Sex (3), Income Status Before Tax (3) and Selected Cultural, Activity Limitation and Demographic Characteristics (36) for the Population in Private Households	2006
Emergency Visits (all causes) age 65-74	Emergency Department Visits, Ministry of Health and Long Term Care, National Ambulatory Care Reporting System (NACRS) data. Provided by Toronto Central LHIN.	Fiscal Year 2004-2005