The previous article identified the potential impacts of climate change on human health, as well as the projected magnitude of these risks in Canada and abroad. However, research shows that certain populations face a greater than average risk due to increased exposures, existing sensitivities or low adaptive capacity. For example, geographic location may increase exposure to extreme weather events or high temperatures. Some individuals may be more sensitive due to pre-existing health conditions or deficits in other “health determining” areas of their lives. As well, communities may have a limited capacity to cope with and adapt to climate-related events, due to poor infrastructure, limited knowledge about the risks, lack of human and social capital, or economic disparities. Clearly, the populations most at risk are those coping with all three factors.

Research shows that certain populations are more vulnerable than others to the health risks posed by climate change. This article explains the concepts of vulnerability and adaptive capacity, and explores how they are influenced by the determinants of health. It also identifies groups most at risk, and discusses our collective responsibility for protecting these populations from the impacts of climate change.

Vulnerability and the Determinants of Health

Although the unpredictable nature of extreme weather and high temperature events can increase “feelings” of vulnerability, vulnerability is actually a function of exposure, sensitivity and adaptive capacity. So, regardless of how vulnerable people feel, their vulnerability depends upon the degree to which these three variables are in play. These variables — increased exposure, existing sensitivities and low adaptive capacity — in turn, are influenced by the determinants of health (see Figure 1).
Exposure
Although the degree of exposure to climatic variables depends on geographic location, it is also influenced by a range of occupational and behavioural factors. Socio-economic factors can play an important role as well — for example, a family with low relative income may have no other option but to live in substandard housing, thus increasing their exposure to hazards (e.g., the risk of injury during an extreme weather event).

Sensitivity
Sensitivity is the degree to which an individual is affected, either adversely or beneficially, by climate-related stimuli. It depends on many variables, such as the magnitude of the risk and the individual’s pre-existing health status. A function of the interaction among all the determinants of health, health status is also a key factor in determining a person’s susceptibility to the impacts of climatic events. For example, when an individual’s health is compromised due to a pre-existing health condition (e.g., respiratory illness), he/she will be more sensitive to the health risks of air pollution. Sensitivity also depends on the magnitude of the threat posed by the environmental change. Some individuals may not be sensitive to mild changes in the environment, but are very sensitive to severe and repetitive climatic events. For example, a child who is being treated appropriately for asthma may not be sensitive to one smog day, but may be exceptionally sensitive to a two-week long smog event compounded by higher than average temperatures.

Adaptive Capacity
Although sensitivities and exposure levels may both be high, the capacity to adapt to the impacts of climate change can reduce or eliminate vulnerability.2 For instance, people who have an existing respiratory illness and are exposed to extreme heat will be more able to adapt to the negative impacts of heat and less vulnerable if they have direct access to health services and have been provided with treatment information.

The health risks of climate change are determined by the individual and society’s collective ability to adapt, now and in the future.2 Adaptive capacity is influenced by many interrelated societal factors, such as economic resources, technology, information and skills, infrastructure, institutions, existing inequities in health status and pre-existing disease burdens.1 Countries will have greater adaptive capacity when they have higher levels of GDP or financial capital; substantial per capita investments in health care; access to technologies such as vaccines or water treatment facilities; high levels of human capital or knowledge (e.g., health research); well-developed public health infrastructures; well-established social institutions; equitable access to health care and social supports; and overall population well-being.9,10

The complex relationship between factors that influence the coping ability of societies and individuals makes it difficult to measure existing adaptive capacity. While Canada is generally considered able to cope with most climatic events, weaknesses in adaptive capacity are often not discovered until after an event or disaster has taken place. With a better understanding of which factors require further investment, adaptive capacity can be strengthened over time, thereby reducing vulnerabilities.11

Global Vulnerability
Globally, the most influential determinant of vulnerability is the level of development in the affected country or region. For example, over a billion people worldwide lack access to adequate supplies of safe water, sanitation, energy and nutrition.12,13 High poverty levels contribute to environmental degradation because current needs take precedence over long-term stewardship of resources, and environmental degradation increases poverty as resource yields decline.14 Many of
the same regions that commonly experience excessive environmental degradation, poverty and health problems also have low adaptive capacity because of political and economic instability, non-existent or deteriorating public health infrastructures and barriers to necessary resources.

It is expected that existing health and environmental problems will be exacerbated by climate change, and people living in regions without sufficient capacity to adapt will be exceptionally vulnerable to illnesses and death.\(^1\) For example, two thirds of Africa is already affected by aridity and drought, and desertification is expanding. Climate change in Africa is expected to further decrease annual precipitation in some regions, aggravating food shortages and access to clean water, thus increasing rates of illness and death. At the same time, precipitation and floods are increasing in frequency and magnitude in some parts of northern India and Bangladesh, causing loss of life, economic decline, and widespread food and water quality problems. Small island developing states, particularly those in the Pacific Islands, are experiencing rising sea levels threatening food and water sources, housing and other key infrastructure. Some parts of these islands are already submerged, and if sea levels rise an additional one metre, the Marshall Islands and Tuvalu will likely disappear altogether.\(^{15}\)

**Although Canada has considerable capacity to adapt to the health impacts of climate change, some risks (e.g., extreme weather events, infectious diseases, air pollution) pose unique challenges because they may exceed our threshold to respond. In addition, certain subpopulations are more vulnerable to all climate-related impacts because of age, health status, gender or employment.**

Through the Canadian International Development Agency (CIDA), Canada contributes to economic and social development in many of these regions. Countries around the world have learned to cope with most existing climate variability. However, as the climate becomes more extreme, climate-related events will increasingly occur outside the normal range of variability, creating new vulnerabilities as countries are not able to cope with such extremes. As Figure 2 shows, climate change impacts in some countries are expected to exceed the current coping threshold, resulting in even more deaths. Development and adaptation activities in developing regions will require approaches designed to anticipate future impacts of climate change in order to reduce vulnerability and improve the adaptation response.

As Canada enjoys good overall health and access to financial and technological resources, it is well placed to help countries around the world take measures to protect their populations from the impacts of climate change.

**Vulnerable Populations in Canada**

Although Canada has considerable capacity to adapt to the health impacts of climate change, some risks (e.g., extreme weather events, infectious diseases, air pollution) pose unique challenges because they may exceed our threshold to respond. In addition, certain

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**Figure 2: Impact of Climate Change on Vulnerability**

![Figure 2: Impact of Climate Change on Vulnerability](image-url)
subpopulations are more vulnerable to all climate-related impacts because of age, health status, gender or employment. Our present public services and personal means may not be adequate to protect these populations against illness or death. Additional investments in institutional structures, public education, as well as new adaptive measures and strategies, may be needed to ensure healthy outcomes.

**Infants and Children**

Infants and children are especially vulnerable to climate change, as they are to environmental degradation, because of their inability to protect themselves, relatively high intake of water, air and certain foods, rapid growth and development, immature physiology and metabolism, and potential for high cumulative exposures over their lifetime. For example, some researchers hypothesize that the significant increase in asthma rates since the early 1960s, particularly in young children, is due to climate change and resulting increases in pollen quantity and season length.

**Women**

Recent research indicates that pregnant women and their developing fetuses may be at special risk during extreme weather events. A 2004 study of the 1998 ice storm in Ontario, Québec and New Brunswick concluded that anxiety and stress as a result of the extreme weather can give rise to obstetric and developmental complications. Research has also shown that women may be more vulnerable to psychosocial health impacts during extreme weather events because they are more likely to bear the burden of recovering from the extreme event, and of continuing to meet multiple demands within and outside the household.

**Older Seniors**

Older seniors are especially vulnerable because of their diminished ability to acclimatize to changing temperatures, pre-existing health conditions and social isolation. A study conducted by Toronto Public Health found that when air pollution combines with extreme heat, this group is the most vulnerable to premature mortality. Research suggests that older men may be particularly vulnerable to climatic extremes because they tend not to be as well integrated into a defined social structure and therefore have less access to assistance through family members or community volunteer organizations.

**Gender in Climate Change**

In many developing countries, women are especially vulnerable to the health impacts of climate change because they are more likely to be poor and dependent on natural resources, and have less access to property rights and information. For example, following the 1991 cyclone and flood in Bangladesh, the death rate was almost five times as high for women as for men. This was attributed to social roles that resulted in warning information being transmitted among men only, and prevented women from moving to safety if not accompanied by a male relative. In contrast, when Hurricane Mitch struck Central America in 1998, more men than women died because of gender norms encouraging men to engage in risky behaviour during the disaster.

**Other Populations at Increased Risk**

People with low income and those with pre-existing health conditions, including mental health illnesses, are vulnerable because of their health status, and in some cases existing barriers to health care. Outdoor workers will be more vulnerable as they are directly exposed to extreme heat events and increased levels of ultraviolet (UV) radiation. Those who live on the land and whose livelihood is tied to natural resource-based employment will also be at greater risk.

**Geographic Variation**

Regions across Canada will experience climate change differently. While urban populations may experience warmer temperatures and more smog episodes, rural populations may have greater problems with water quality and quantity as a result of flooding and drought. In regions that are closely tied to natural resources (e.g., farming, forestry, fishing), climate change may cause economic decline, social disruption and population displacement. Coastal areas will be hard hit by a rise in sea level, which may increase the degree of damage from natural disasters.
Evidence in the North

Even now, Northerners are experiencing fundamental changes to their way of life and well-being because of a warming climate. That said, it is difficult to entirely separate climate change impacts from other drivers of change in the North, such as the presence of environmental contaminants, resource development and loss of culture. The Arctic Climate Impact Assessment (ACIA) summarizes research that has been conducted around the world on northern climate change issues and concludes that, although there may be fewer injuries and less stress as a result of warmer winters, the risks of changing sea and ice patterns on food sources, water quality, mental and social stress, and disease outbreaks far outweigh the benefits.

Recent studies of traditional knowledge demonstrate that Northerners are already observing these impacts in their communities. Hunters, elders and youth have documented changes in travel patterns, the ability to find and hunt certain country food species, and access to clean, natural sources of drinking water. As the evidence suggests, shifts to more western diets are increasing the risks of cancer, obesity, diabetes and cardiovascular diseases among Northerners.

As well, changes in animal species may introduce infectious diseases previously unknown in the area. Socioeconomic disruption occurs when there are reduced opportunities for employment and subsistence living, and communities are dislocated and disrupted because of erosion, permafrost thawing and impacts on infrastructure. People often experience mental health problems and increased stress when they face new risks such as heat stress and loss of species, and feel marginalized when their livelihoods are disrupted and their communities forced to relocate.

Northern communities are making great efforts to adapt to these changes, for example, by introducing community freezer programs to ensure food safety, and changing hunting routes to protect against injury. However, they will continue to require support from the rest of Canada to successfully manage these impacts and make the transition to a northern environment that will be vastly different in the centuries to come.

Meeting Future Needs

One of the keys to managing the risks that all Canadians face from climate change is a better understanding of existing vulnerabilities so that adaptive capacity can be enhanced in communities and population groups most at risk. Although research has identified some important factors influencing capacity, the interrelationships among these factors is less well understood. Canadians are fortunate they have well-established support systems to protect them against climate risks. But we should not take for granted that these infrastructures are fail-safe, or that Canadians will not be affected by the vulnerabilities of other countries or regions. Some populations, even in Canada, will be unable to cope with the effects of climate change. We need to develop adequate responses that increase our adaptive capacity even further and minimize the negative impact of climate change on health. At a global level, Canada needs to help protect the health of all populations and contribute to global efforts to manage the future impacts of climate change.

Click here for references.
References for Vulnerability: Who’s Most at Risk? (p. 22)


References


