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HEALTH EFFECTS REVIEW

Health Effects and Climate Change Along the Canadian-US Border Region

Introduction

Mark Twain once said that everybody talks about the weather but no one does anything about it. While it is true we cannot stop the sun from shining, we can certainly influence how hot the weather gets. Our actions as an industrialized society have altered our sensitive climate system in ways not yet fully understood.

As global temperatures continue to rise, there are growing concerns that climate change may produce serious adverse health effects. In the United States, average temperatures have risen by about 0.5°C (1°F) over the past 100 years or so, and precipitation, especially heavy storm events, has also increased. From 1889 to 1990, our global average temperature rose by 0.4-0.8°C (0.7-1.4°F) (1). We now know that even such small changes in temperature may have significant effects on population health.

Our climate system involves complicated interactions between the atmosphere and the oceans. Warmer temperatures influence the circulation of nutrients, carbon dioxide, and oxygen in the oceans. With warmer temperatures comes an increase in frequency and intensity of storm events in certain parts of the world and extreme droughts in other parts. Climate scenarios from two General Circulation Models, the Canadian Climate Center Model (CGCM1) and the United Kingdom Hadley Center Model (HadCM2), project that our climate will be 2-4ºC (3.6-7.2ºF) warmer with approximately 25% more precipitation by the end of this century (2).

Possible health effects of a warmer global climate include heat-related illnesses, spread of infectious disease, coastal flooding from snowcap melting, respiratory disorders, diminished agricultural productivity due to droughts, and more frequent extreme weather events.

A quarterly review and summary of the scientific literature on human health effects and environmental pollutants, with an emphasis on pollutants of the Great Lakes ecosystem. Prepared under the direction of the Health Professionals Task Force of the International Joint Commission. This does not represent the official position of the International Joint Commission.

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Temperature-Related Illnesses

Studies of heat waves in urban areas have shown an association between increased mortality and increases in heat (3). As populations in cities along the Canadian – US border region grow, the population at risk for heat-related illness and death may also increase. Heat effects also vary among individuals. Although conditions such as heat stroke are the most obvious outcome, morbidity and mortality from respiratory conditions and heart problems can also be associated with increased temperatures.

However, while the summers may grow hotter, likewise, the winters may grow milder. Death rates are higher in the winter and may be reduced with a warmer climate. The association between mortality and morbidity and temperature is poorly understood because of the unknown influence of factors such as influenza transmission.

Indirect Health Effects

Climate change can influence our health in more subtle ways. Increased temperatures also increase photochemical oxidant formation (smog) in urban areas. A simple analysis of the GCM output from the CGCM1 and HadCM2 models suggests that the number of days with high ozone levels will increase by the end of this century (2). Increase in pollen and mold spores may further aggravate respiratory disorders such as asthma, emphysema, and chronic bronchitis.

The transmission of infectious diseases may also rise as temperatures grow warmer and insects migrate northward to the Canadian-US border. Malaria, dengue, and yellow fever are long-term concerns, but the West Nile Virus and Lyme disease may dramatically affect the Canadian-US border region during the next decade (4).

Furthermore, as climate grows warmer, our ozone layer becomes thinner, possibly leading to increased skin cancer. While some indirect health impacts are more likely than others, they are all of serious concern.

Extreme Weather Events

Halfway between the equator and the North Pole, in the middle of a continent near the largest lakes in the world, the Great Lakes region of Canada and the United States possesses a very sensitive climate. Due to the unique location, global climate change may have a greater effect in this region. The most obvious impact could be felt through extreme weather events. Although climate scientists cannot prove conclusively the links between global warming and extreme events at this time, nevertheless, the increased frequency of such events are consistent with the outputs of climate models.

During the first week of January 1998, Canada's worst ice storm hit central and eastern portions of the country. Six days of freezing rain, as much as 100mm in some parts, coated trees and brought down power lines. At least 25 lives were lost and 3 million people were left without electricity and heat, some for almost five weeks. The ice storm was the most expensive natural disaster in Canada history. The Insurance Bureau of Canada estimated that storm related claims

would exceed $500 million. In all, including Quebec, New Brunswick, and Ontario, losses to the community totaled over $2 billion (5).

Res. 2000, 19(1)313-319.Climate change may also affect heavy lake-effect snowstorms near the Great Lakes. These storms contribute up to 50% of the annual snowfall totals in areas surrounding the lake and can have paralyzing effects on hard-hit areas. For example, just recently, in November (2000), Buffalo, NY was overwhelmed by a lake-effect snowstorm that left buses stranded on streets and children taking shelter in nearby buildings until the storm eased. As the climate continues to change, the occurrence of these extreme weather events may become more frequent. With each storm comes the threat of economic and personal loss.

In addition to the obvious injury and death that directly result, storms can have health effects that are felt long after the snow and rain have stopped. Hurricanes and heavy rainstorms result in flooding and contaminated drinking water. Waterborne diseases are often a result of heavy rainfall. For example, in the Great Lakes region, a Cryptosporidium outbreak occurred in 1993. Cryptosporidium is a gastrointestinal disease that lasts for one to two weeks in healthy individuals, but may be fatal among the immuno-compromised population. Contamination of the water supply in Milwaukee, Wisconsin was partly due to heavy rainfall and runoff that affected the quality of the water arriving at the drinking water plants. Over 400,000 cases were reported, including 54 deaths (1).

The quality of recreational water can also be affected by precipitation events. Local coastal waters show higher counts of fecal bacteria and infectious viruses after heavy rains and runoff (6). Especially in cities that employ combined sewer and storm water sewerage systems and are located in border areas projected to experience increases in precipitation, the risk of waterborne illnesses will likely increase as a result of climate change.

Marine Algal Toxins

Along the Canadian-US border region, an important health effect of climate change is increased harmful algal blooms (HABs), such as red tides due to the pigment of the phytoplankton. Over the past three decades, the frequency and expansion of these blooms have increased. The cause of this increase has been linked to climate change.

Two algal groups, diatoms and dinoflagellates, produce the toxins responsible for human illnesses. The dangerous marine algal blooms are ingested by herbivorous fish and concentrated by filter-feeding shellfish, which are then consumed by people.

The occurrence of harmful algal blooms throughout parts of the world has coincided with El Niño events, suggesting that future warming trends may stimulate the growth of red tides (7). El Niño events usually occur once or twice a decade, but their frequency and duration have intensified since the mid-1970s. During two major El Niño events (1982-1983 and 1997-1998), sea surface temperatures and harmful algal outbreaks increased significantly. Future implications of this association between temperature and blooms will likely impact regions of the world currently still unaffected. As northern climates grow warmer, the range of the outbreaks will shift with the temperature change to include regions such as the Canadian-US border.

Warm temperatures are not sufficient for harmful algal blooms to occur. The problem is complex, and climate, while nevertheless significant, is only one of many factors. Studies show that certain conditions are necessary in addition to temperature (7,8). Often, weak winds are needed to stratify the water columns, making water stagnant. A shallow nutricline must also be present. These conditions are general requirements. For each algal species associated with human illness, there exists specific environmental conditions that cannot be generalized.

Furthermore, human activities other than those which contribute to climate change, like coastal eutrophication, can influence harmful algal blooms. The rise in human illnesses due to marine toxins may also be due to better diagnosis and heightened exposure from population increases in certain regions, and may not be temperature related.

Specific to the Canadian-US border, experiments have been conducted that examine the level of phytotoxin from algal blooms. In Puget Sound this past summer, geoduck clams had toxin levels that exceeded the regulatory level of 80 µg saxitoxin equivalents per 100g shellfish tissue (7). Clams from shallow water were observed to be more toxic than those from deep water. These results are a definite concern for public health.

Conclusion

Climate changes include temperature change on global, regional, and local scales, and changes in the average and frequency of rainfall, winds, and ocean currents. Health effects of climate change range from direct impacts like heat stroke to more complicated associations with water- and food-borne diseases.

The consequences of climate change on health effects vary over time. An increase in mortality due to heatwaves, hurricanes, and vector-borne diseases would be observed early. Impacts of sea level rise and reduced agricultural productivity would not become apparent for decades. More importantly, by the time the most probable scenarios among the many suggested come to pass, it will be too late to rectify matters. Precautionary policies in the face of some significant uncertainties become the only prudent public health response. As a result, global climate change is emerging as arguably the most important public policy, environmental and public health issue of the coming century.

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