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Climate Change and Public Health

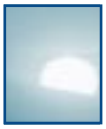
Gases in the atmosphere such as carbon dioxide and methane trap the sun's energy and warm the earth. This natural "greenhouse effect" is intensified by human activities, especially the combustion of fossil fuels. Increased energy use in cars, homes, and factories raises the concentration of carbon dioxide in the atmosphere, and this can cause a variety of impacts on the global climate. As the climate changes, natural systems will be destabilized, which could pose a number of risks to human health.

> ***"The balance of evidence suggests that there is a discernible human influence on global climate."***
>
> Intergovernmental Panel on Climate Change of the United Nations and World Meteorological Organization

Exactly how much risk is entailed by climate change is difficult to quantify in terms of projected numbers of increased deaths or illnesses. For one thing, human populations differ in vulnerability. Factors such as crowding, food scarcity, poverty, and local environmental decline make populations in some developing countries especially vulnerable. Likewise, in industrialized countries, the demographic trend toward an aging population raises the health risks.

Potential Health Impacts From Global Climate Change

Temperature increases, precipitation changes, and sea level rise

 Heat Waves	More heat-related deaths and illnesses
 Air Pollution	Aggravation of cardiovascular and respiratory diseases from worsening air quality
 Terrestrial Changes	Risk of infectious diseases because of new geographic ranges and activity of disease-carrying animals, insects, and infective parasites
 Altered Marine Ecology	Changes in incidence of cholera and food poisoning from toxic algae
 Storms	Deaths and injuries from storms and floods and intestinal illnesses from flooding of sewage treatment plants
 Droughts	Rising malnutrition in some countries
 Population Displacement	Injuries and increased risk of disease due to migration and crowding
 Saltwater Encroachment in Coastal Aquifers	Greater risk of intestinal illnesses from inadequate water supplies

Recent Heat Waves

City	Year	Approx. No. of Fatalities
Chicago	1995	465
Milwaukee	1995	85
Philadelphia	1993	118
St. Louis	1995	31
St. Louis	1980	113
St. Louis	1966	400

Heat Waves

Some health consequences may occur as a direct result of higher temperatures. More frequent or severe heat waves could boost deaths and illnesses among the elderly, infants, and people with cardiovascular and respiratory disorders. Studies of selected U.S. cities indicate that the number of heat-related deaths would increase substantially by the year 2050 under some climate change scenarios.

The increase in mortality could be partially offset by a decrease in cold-related deaths during milder winters. The data are insufficient at present to quantify this tradeoff, but preliminary results suggest that global warming would cause a net increase in deaths. Gains and losses would vary by region.

Adaptive responses such as use of air conditioning may have important modulating effects on deaths related to thermal stress. People living in inadequate housing with no air conditioning in urban areas where heat is retained by buildings and pavement are particularly vulnerable.

Acute Episodes of Air Pollution

Location	Year	No. of Fatalities or Illnesses
Glasgow, Scotland	1909	1,063 deaths
Meuse Valley, Belgium	1930	63 deaths and 6,000 people sick
Donora, Pennsylvania	1948	20 deaths and 1,190 people sick*
London	1952	4,000 to 8,000 fatalities
New York City	1953	175 to 260 fatalities

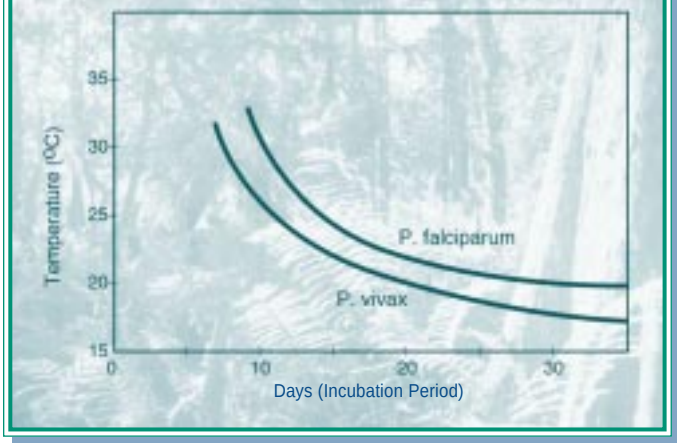
*Almost 43 percent of the area's population.

Air Pollution

In the 20th century, there have been several episodes where sudden build-ups of air pollution have caused widespread illnesses and deaths. With the introduction of air pollution control measures, these severe episodes have been avoided. However, moderate air pollution episodes continue to occur especially under adverse weather conditions.

Hotter temperatures could enhance the formation of secondary air pollutants such as ground-level ozone. Burning fossil fuels such as coal, gas, and oil produces a number of air pollutants in addition to carbon dioxide. Exposure to air pollutants has been shown to aggravate respiratory and cardiovascular diseases and cause premature deaths. The net effect on human health from simultaneous exposure to stressful weather and air pollution may be greater than the separate effects added together.

Temperature Sensitivity of Two Malaria Parasites



From Giles HM. Epidemiology of Malaria. In: Giles HM, Warrell DA, eds. Bruce-Chwatt's essential malariology. London: Edward Arnold Div. of Hodder & Stoughton; 1993.

Infectious Diseases

Some health effects of climate change may occur indirectly through impacts on natural ecosystems. Altering climatic factors such as temperature, surface water, and humidity can change the habitat of organisms such as mosquitoes and rats and the parasites they carry. Changing the abundance and geographic range of carriers and parasites could shift the seasonal occurrence of many infectious diseases and cause them to spread.

For example, simulations based on climate change scenarios for the latter half of the next century predict an increase from approximately 45 percent to 60 percent in the proportion of the world's population living within the

potential zone for malaria transmission. Climate change may intensify transmission and could result in 50-80 million additional cases annually, against an assumed global background total of 500 million.

Other infectious diseases such as encephalitis and dengue (a severe influenza-like disease) also are sensitive to climate. Recent field studies in California suggest that a 3° to 5°C increase in temperature could cause a significant northern shift in the United States in two types of encephalitis. In addition, annual epidemics of dengue have returned to Central America during the past decade. In Mexico, dengue has spread to higher elevations that were previously unaffected, and it could reach the southern United States.

"It is anticipated that most of the [health] impacts would be adverse."

Intergovernmental Panel on Climate Change of the United Nations and World Meteorological Organization

Developed countries should be able to minimize exposure to these diseases through existing methods such as spraying insecticides to control insects and other disease-bearing organisms. However, these pesticides entail health risks themselves. Further, the quicker "turnover" of parasite life cycles that occurs in warmer temperatures would increase the likelihood of their evolving greater resistance to drugs and control methods.

Water-borne Diseases

Poor sanitation, poor erosion control management, coastal sewage release, and contamination of drinking water from agricultural fertilizers and waste may all increase the likelihood of water-borne diseases. Any changes that affect the sea—water temperatures at the surface, nutrient levels, winds, currents, and precipitation patterns—also can change the marine ecosystem, leading to possible increases in diseases transmitted from fish and shellfish. Higher surface temperatures, for example, stimulate the growth of certain species of algae, in particular, toxic "red tides." When these algae are consumed by fish and shellfish, they pose a threat of food poisoning to humans.

Marine phytoplankton and zooplankton can shelter a dormant form of cholera when pH, temperature, salinity, and nutrient levels are insufficient to sustain the infectious form. When waters warm or when nutrient levels increase, cholera can become infectious again.

In addition, saltwater intrusion caused by changes in sea level is threatening drinking water supplies in many communities along the East Coast. Florida has already resorted to building a large number of desalinization plants.

Health-Related Impacts of Mississippi River Flood of 1993

Fatalities	**48**
Health-Related Impacts	
Displaced Missourians (increased exposure to risk of disease)	60,000
Injuries and illnesses in Missouri*	483
Hospital emergency room patients in Missouri*	234
Hospitalizations in Missouri*	32
Potential Health-Related Impacts	
Closures of primary-care physician offices in Iowa**	14% of population affected
Interruptions in public health services in Iowa**	24% of population affected
Loss of operating public water system in Des Moines, Iowa	250,000 people affected for 12 days
Loss of operating public sewer systems in Iowa***	35% of population affected
More reports of mosquitoes and rats in Iowa**	53% of population affected

* Emergency room flood-related data reported to CDC for July 16–September 3.

** CDC survey for July 15–16.

*** CDC survey for week of July 18–24.

Weather Disasters

Climate change could alter the frequency and severity of extreme weather events. In some cases (e.g., hurricanes), current climate models are unable to predict whether these extreme weather events will increase. There is no clear evidence for changes in extreme events worldwide in recent decades, but evidence of changes on a regional level does exist.

Such events, when they occur, endanger human health by increasing deaths, injuries, infectious diseases,

stress-related disorders, and the adverse health effects associated with social disruption and forced migration, internal or external.

Floods could lead, in addition to deaths, to the spread of infectious diseases because of crowded living conditions in shelters, exposure to fecal material because of impaired sewage treatment, exposure to toxic chemicals from heavier runoff from agricultural lands and urban stormwater systems, and hazardous exposure from ingesting contaminated water and fish.

What Needs to Be Done

Everyone has a part to play in preventing the probable negative health effects from climate change. Individuals and businesses can help by taking steps to reduce the burning of fossil fuels. Gains in energy efficiency of 10 to 30 percent above present levels are feasible at little or no cost through conservation measures, use of available technologies, development of new energy technologies, and better land management practices.

If intense rainfall and floods occur more frequently in a warmer world, the number of displaced victims and rates of injuries and infectious diseases could rise.

Federal, state, and local governments can play an important role by enacting flexible and cost-effective policies to reduce greenhouse gas emissions. Significant reductions in net greenhouse gas emissions can be achieved by employing an array of technologies and policy measures that accelerate technology development and transfer. However, it will be important to assess risks to health from proposed technological adaptations. For example, intensive use of air conditioning would protect against heat stress, but it also could boost emissions of greenhouse gases and conventional air pollutants.

Physicians and public health practitioners can help by directly reducing the impacts through improved primary health care for vulnerable populations. Measures that can be taken include improved public health monitoring, better disease surveillance and control programs, more thorough disaster preparedness vaccination, and public education.

Communities and state governments can help through better management of ecosystems, wider use of protective technologies such as sea walls and levees, and improved water purification. Assessing the risks from these adaptive strategies is also critical. For example, if new pesticides are used to control insects, the effects of these pesticides on human health, insect predators, and increased insect resistance all need to be considered.

For More Information

Call EPA's Fax-On-Demand service (202-260-2860), or access EPA's global warming Internet site at http://www.epa.gov/globalwarming.

Reference

McMichael, A.J., et al. 1996. Human population health (Chapter 18). In *Climate change 1995—Impacts, adaptations, and mitigation of climate change: Scientific-technical analyses.* Intergovernmental Panel on Climate Change (IPCC), pp. 563-584.