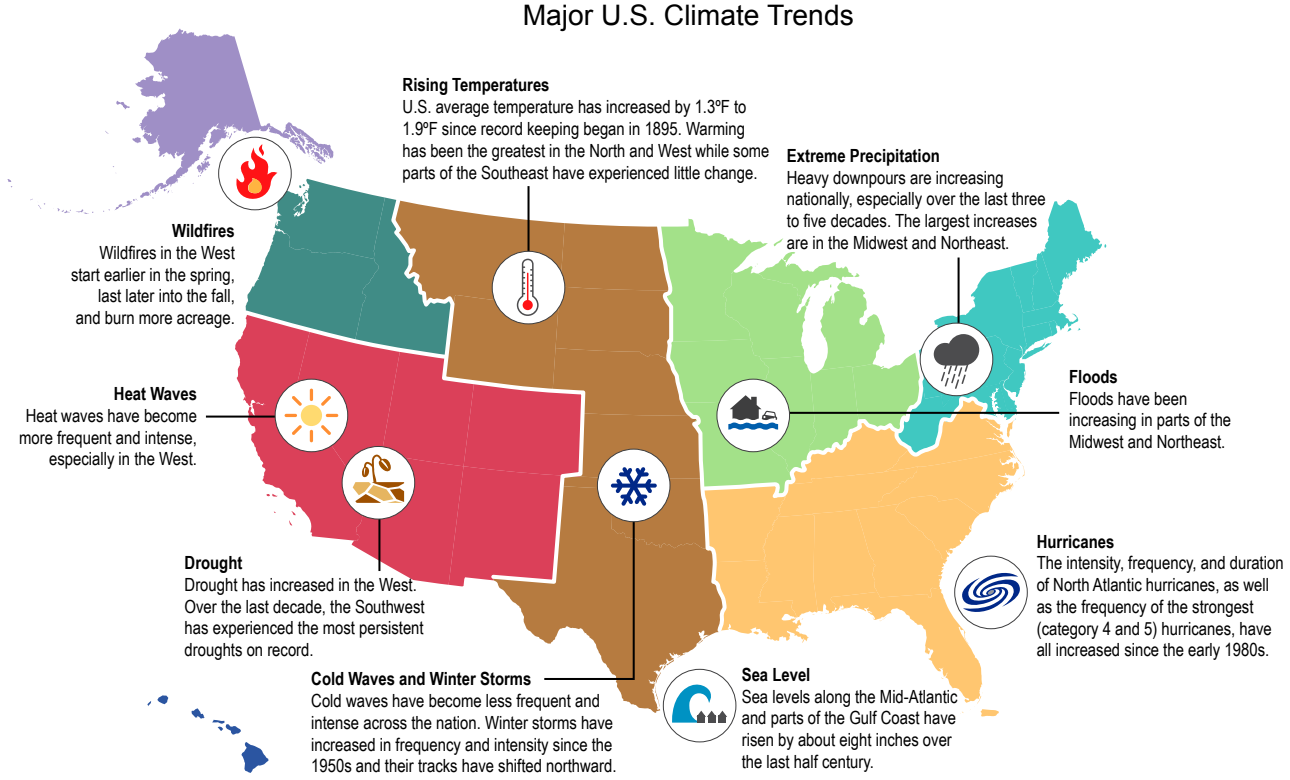
Climate Change and Human Health

Climate change is a significant threat to the health of the American people. It is the result of the buildup of greenhouse gases in the atmosphere, primarily from the burning of fossil fuels, such as oil and gasoline, for energy and other human activities. These gases, such as carbon dioxide and methane, warm and alter the global climate. Temperatures and the frequency of heavy rain and snow have been increasing in the United States (see map). The changes in temperature and precipitation, as well as other changes, such as more intense severe weather and rising sea levels, all have effects on people's environments that can in turn harm their health and well-being. Climate change is anticipated to worsen all of the major climate trends in the U.S. The NIEHS Climate Change and Human Health Program leads and coordinates the institute and NIH efforts to better understand how climate change affects people's health.

Major U.S. Climate Trends



Source: USGCRP (2016). The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment. Crimmins, A., J. Balbus, J.L. Gamble, C.B. Beard, J.E. Bell, D. Dodgen, R.J. Eisen, N. Fann, M. Hawkins, S.C. Herring, L. Jantarasami, D.M. Mills, S. Saha, M.C. Sarofim, J. Trtanj, and L. Ziska, Eds. U.S. Global Change Research Program, Washington, DC.

How Does Climate Change Affect Human Health?

While climate change is a global process, it has both local and regional impacts that profoundly affect communities. Some of these effects are relatively direct, as when heat waves or intense hurricanes cause injury and illness, and even death. Some health effects of climate change are less direct and involve changes in our environment that in turn can affect human health and diseases. For example, changes in temperatures and rainfall can have a strong effect on the lifecycles of insects and other species that transmit disease, such as Lyme disease and West Nile virus, leading to new outbreaks or shifts in places where these diseases occur. Rising sea levels can worsen the flooding from hurricanes in coastal areas, leading to human exposures to water and areas contaminated by industrial pollutants and hazardous wastes. In all cases, the effects of climate change occur in combination with other well-known health stressors, such as poverty, social disadvantage, impaired language ability, and others. Often referred to as the social determinants of health, these factors lead to certain people being more vulnerable, by making it more likely they may be exposed to climate change-related risks or less able to cope with such exposures and their health impacts. Examples of the varied ways that climate change can affect people's health are shown in the table on the following page.

Examples of Climate Change Impacts on Health

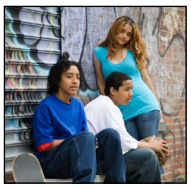
	Climate Driver	Exposure	Health Outcome	Impact
Extreme Heat	More frequent, severe, prolonged heat events	Elevated temperatures	Heat-related death and illness	Rising temperatures will lead to an increase in heat-related deaths and illnesses.
Outdoor Air Quality	Increasing temperatures and changing precipitation patterns	Worsened air quality (ozone, particulate matter, and higher pollen counts)	Premature death, acute and chronic cardiovascular and respiratory illnesses	Rising temperatures and wildfires and decreasing precipitation will lead to increases in ozone and particulate matter, elevating the risks of cardiovascular and respiratory illnesses and death.
Flooding	Rising sea level and more frequent or intense extreme precipitation, hurricanes, and storm surge events	Contaminated water, debris, and disruptions to essential infrastructure	Drowning, injuries, mental health consequences, gastrointestinal and other illness	Increased coastal and inland flooding exposes populations to a range of negative health impacts before, during, and after events.
Vector-borne Infection (Lyme disease)	Changes in temperature extremes and seasonal weather patterns	Earlier and geographically expanded tick activity	Lyme disease	Ticks will show earlier seasonal activity and a generally northward range expansion, increasing risk of human exposure to Lyme disease-causing bacteria.
Water-related Infection (Vibrio vulnificus)	Rising sea surface temperature, changes in precipitation, and runoff affecting coastal salinity	Recreational water or shellfish contaminated with Vibrio vulnificus	Vibrio vulnificus induced diarrhea and intestinal illness, wound and bloodstream infections, death	Increases in water temperatures will alter timing and location of Vibrio vulnificus growth, increasing exposure and risk of waterborne illness.
Food-related Infection (Salmonella)	Increases in temperature, humidity, and season length	Increased growth of pathogens, seasonal shifts in incidence of Salmonella exposure	Salmonella infection, gastrointestinal outbreaks	Rising temperatures increase Salmonella prevalence in food; longer seasons and warming winters increase risk of exposure and infection.
Mental Health and Well-being	Climate change impacts especially extreme weather	Level of exposure to traumatic events, like disasters	Distress, grief, behavioral health disorders, social impacts, resilience	Changes in exposure to climate- or weather-related disasters cause or exacerbate stress and mental health consequences, and with greater risk for certain populations.

Source: USGCRP (2016). The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment. Crimmins, A., J. Balbus, J.L. Gamble, C.B. Beard, J.E. Bell, D. Dodgen, R.J. Eisen, N. Fann, M. Hawkins, S.C. Herring, L. Jantarasami, D.M. Mills, S. Saha, M.C. Sarofim, J. Trtanj, and L. Ziska, Eds. U.S. Global Change Research Program, Washington, DC.

Who Is Most at Risk From Climate Change?

Although the U.S. has a well-developed public health and medical system, every American is vulnerable to the impacts of climate change at some point in their lives, no matter where they live. Globally, the effects of climate change will have even more severe consequences for human health. Certain U.S. populations are more vulnerable to climate change health threats as a result of specific physical, environmental, and sociodemographic factors, as well as age and life stage. Some of these groups and the challenges they face from climate change include the following.

Low Income Groups



People with low incomes live with many factors that increase their vulnerability to health impacts of climate change. They are more likely to live in risk-prone areas, such as urban heat islands, isolated rural areas, or coastal and other flood-prone areas, or where there is older or poorly maintained infrastructure. Low income groups often face an increased burden of air or other toxic pollution that may be increased or mobilized by climate change impacts like severe storms. They experience relatively greater incidence of chronic medical conditions, such as cardiovascular and kidney disease, diabetes, asthma, and COPD, all of which may be worsened by climate change impacts. Also, limited transportation and access to health education can impede their ability to prepare for, respond to, and cope with climate-related health risks.

Indigenous Peoples

A number of health risks are higher among indigenous populations, such as poor mental health related to historical or personal trauma, environmental exposures from pollutants or toxic substances, and diabetes. Because of existing vulnerabilities, indigenous people, especially those who are dependent on the environment for sustenance or who live in geographically isolated or impoverished communities, are likely to experience greater exposure and lower resilience to climate-related health effects. Indigenous communities already face threats to their homes, food sources, and cultural traditions from climate impacts on the environment, such as reductions in sea ice, increases in flooding and landslides, damage to wildlife habitats, loss of medicinal plants, and effects on abundance and nutrition of certain traditional foods.

Children and Pregnant Women

Children have a proportionately higher intake of air, food, and water relative to their body weight compared to adults. They also share unique behaviors and interactions with their environment, such as more time spent outdoors and placing hands in their mouth. These factors, combined with climate changes, may increase their exposure to environmental contaminants. Extreme heat threatens student athletes who practice outdoors, as well as children in homes or schools without air conditioning. Children may be vulnerable to injury during extreme weather events as they depend on adults to escape harm, and can suffer emotional trauma from displacement, loss of home or school, and exposure to the event itself. Climate-related exposures may lead to adverse pregnancy outcomes, including spontaneous abortion, low birth weight, preterm birth, and risks to newborns and infants, including increased neonatal death, dehydration, malnutrition, diarrhea, and respiratory diseases.

Older Adults

The number of older adults, age 65 and older, is growing substantially in the U.S., and they make up a population of concern for climate impacts from extreme heat and weather events, degraded air quality, vector-borne diseases, and others. Older adults may be further challenged by climate change impacts due to factors such as social isolation and living in older structures that make them vulnerable to heat and extreme events, such as hurricanes and floods; preexisting health conditions, such as respiratory conditions that may be worsened by climate changes; and mental health challenges, such as depression, dementia, and other cognitive impairments. Older adults are also more likely to be taking medications to treat chronic medical conditions that make them more vulnerable to complications from heat exposure, including antidepressant and antipsychotic drugs and diuretics.

Occupational Groups

Outdoor workers are often among the first to be exposed to the effects of climate change. Climate change is expected to affect the health of outdoor workers through increases in ambient temperature, degraded air quality, extreme weather, vector-borne diseases, industrial exposures, and changes in built environment. Workers affected by climate change include farmers, ranchers, and other agricultural workers; commercial fishermen; construction workers; paramedics, firefighters and other first responders; and transportation workers. Also, laborers exposed to hot indoor work environments, such as steel mills, dry cleaners, manufacturing facilities, warehouses, and other areas that lack air conditioning, are at risk for extreme heat exposure. Military personnel who train and conduct operations in hot field environments are at risk for heat-related illness, and may also be at increased risk for certain vector-borne diseases.

Persons With Disabilities or Chronic Medical Conditions

The term disability covers a wide variety of functional limitations related to hearing, speech, vision, cognition, and mobility. An increase in extreme weather can be expected to disproportionately affect populations with disabilities. Pre-existing medical conditions present risk factors for increased illness and death associated with climate-related stressors, especially exposure to extreme heat. The prevalence of common chronic medical conditions, including cardiovascular disease, respiratory disease, diabetes, asthma, and obesity, is anticipated to increase over the coming decades, resulting in larger populations at risk of medical complications from climate change related exposures. Communities that are both medically underserved and have a high prevalence of chronic medical conditions can be especially at risk.

What Are the Cobenefits of Mitigating and Aadapting to Climate Change?

In addition to investigating how climate change can affect human health, NIEHS is also working to understand how responses to climate change can also affect health. Some responses to climate change may lead to substantial reductions in harmful exposures to people, so-called cobenefits, or additional benefits to people's health beyond the benefits of reducing the severity of climate change itself. For example, measures to reduce emissions of carbon dioxide from burning fossil fuels can also greatly reduce toxic air pollution that causes tens of thousands of deaths in the U.S. each year. Increases in physical activity from policies that lead people to walk, bicycle, or use public transportation, rather than drive, can improve health even

as they reduce the combustion of gasoline or other fossil fuels used for transportation. Other examples of cobenefits include healthy changes in food production and consumption that reduce methane emissions from agricultural sources, and improved housing insulation that helps people use less energy while adapting to more extreme temperatures.

What Is NIEHS Doing to Help People Prepare for and Adapt to Climate Change?

Working closely with researchers, communities, and decision-makers, NIEHS is supporting research and developing strategies to help people and communities prepare for and adapt to the health impacts climate change, while also protecting health and the environment for future generations. Examples include the following.

- Developing models to define and predict high-risk days to determine when those with heart disease are most vulnerable.
- Investigating the impact of climate change on the spread of disease in food and water.
- Research on the impact of extreme weather events on pregnant women and fetuses.
- Supporting training and capacity building in developing countries on climate change and human health.
- Developing toolkits for sustainable and climate-resilient health care facilities.
- Conducting innovation challenges to spur public development of informational resources and tools.
- Partnering with other federal agencies through the U.S. Global Change Research Program, and internationally with the Intergovernmental Panel on Climate Change and the World Health Organization, to identify research gaps and develop tools for decision-making.

Where Can I Get More Information About NIEHS's Work in Climate Change?

NIEHS Climate Change and Human Health Program
www.niehs.nih.gov/about/od/programs/climatechange/index.cfm

HHS Climate Change and Health
http://www.hhs.gov/climate/index.html

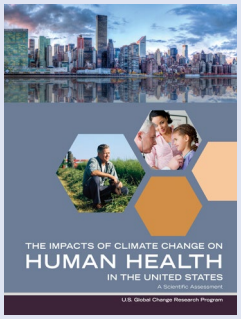
NIEHS Climate Change and Environmental Exposures Challenge
http://www.niehs.nih.gov/funding/challenges/climate_change/index.cfm

HHS Sustainable and Climate Resilient Health Care Facilities Toolkit
https://toolkit.climate.gov/tool/sustainable-and-climate-resilient-health-care-facilities-toolkit

U.S. Global Change Research Program Interagency Crosscutting Group on Climate Change and Human Health
http://www.globalchange.gov/what-we-do/link-climate-health

For more information on the National Institute of Environmental Health Sciences, go to **www.niehs.nih.gov**

Impacts of Climate Change on Human Health in the United States



Every person in the U.S. is vulnerable to the health impacts of climate change at some point in their lives, no matter where they live. This finding is part of a report by the U.S. Global Change Research Program, The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment. The report, which estimates the current and future impacts of climate change on public health, finds that climate change is exacerbating existing health threats and creating new ones. Nearly all of the health threats, from increases in heat; more frequent or severe extreme events, such as floods or hurricanes; degraded air quality; diseases transmitted through food, water, and vectors, such as ticks and mosquitoes; and stresses to mental health, are expected to worsen with climate change. Certain populations, including low income groups; some communities of color; limited English proficiency; and immigrant groups; as well as indigenous peoples, children, pregnant women, older adults, certain workers, persons with disabilities, and people with preexisting medical conditions,are more vulnerable to climate change health impacts.

www.Health2016.globalchange.gov

What Can I Do to Prevent Climate Change or Prepare for It?

CDC Climate and Health Program
http://www.cdc.gov/climateandhealth/default.htm

Climate Change: What You Can Do
http://www.epa.gov/climatechange/wycd/index.html

U.S. Climate Resilience Toolkit
https://toolkit.climate.gov

Climate Change and Children's Health Policy Roundup
http://www.hhs.gov/climate/childrenshealth/index.html

Department of Homeland Security Ready Program
http://www.ready.gov

Additional References

1. USGCRP (2016). The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment. Crimmins, A., J. Balbus, J.L. Gamble, C.B. Beard, J.E. Bell, D. Dodgen, R.J. Eisen, N. Fann, M. Hawkins, S.C. Herring, L. Jantarasami, D.M. Mills, S. Saha, M.C. Sarofim, J. Trtanj, and L. Ziska, Eds. U.S. Global Change Research Program, Washington, DC. Available: http://www.health2016.globalchange.gov
2. Melillo, Jerry M., Terese (T.C.) Richmond, and Gary W. Yohe, Eds., 2014: Climate Change Impacts in the United States: The Third National Climate Assessment. U.S. Global Change Research Program, 841 pp. doi:10.7930/J0Z31WJ2. Available: http://data.globalchange.gov/report/nca3
3. Portier CJ, Thigpen Tart K, Carter SR, Dilworth CH, Grambsch AE, Gohlke J, Hess J, Howard SN, Luber G, Lutz JT, Maslak T, Prudent N, Radtke M, Rosenthal JP, Rowles T, Sandifer PA, Scheraga J, Schramm PJ, Strickman D, Trtanj JM, Whung P-Y. 2010. A Human Health Perspective On Climate Change: A Report Outlining the Research Needs on the Human Health Effects of Climate Change. Research Triangle Park, NC:Environmental Health Perspectives/National Institute of Environmental Health Sciences. doi:10.1289/ehp.1002272 Available: www.niehs.nih.gov/climatereport