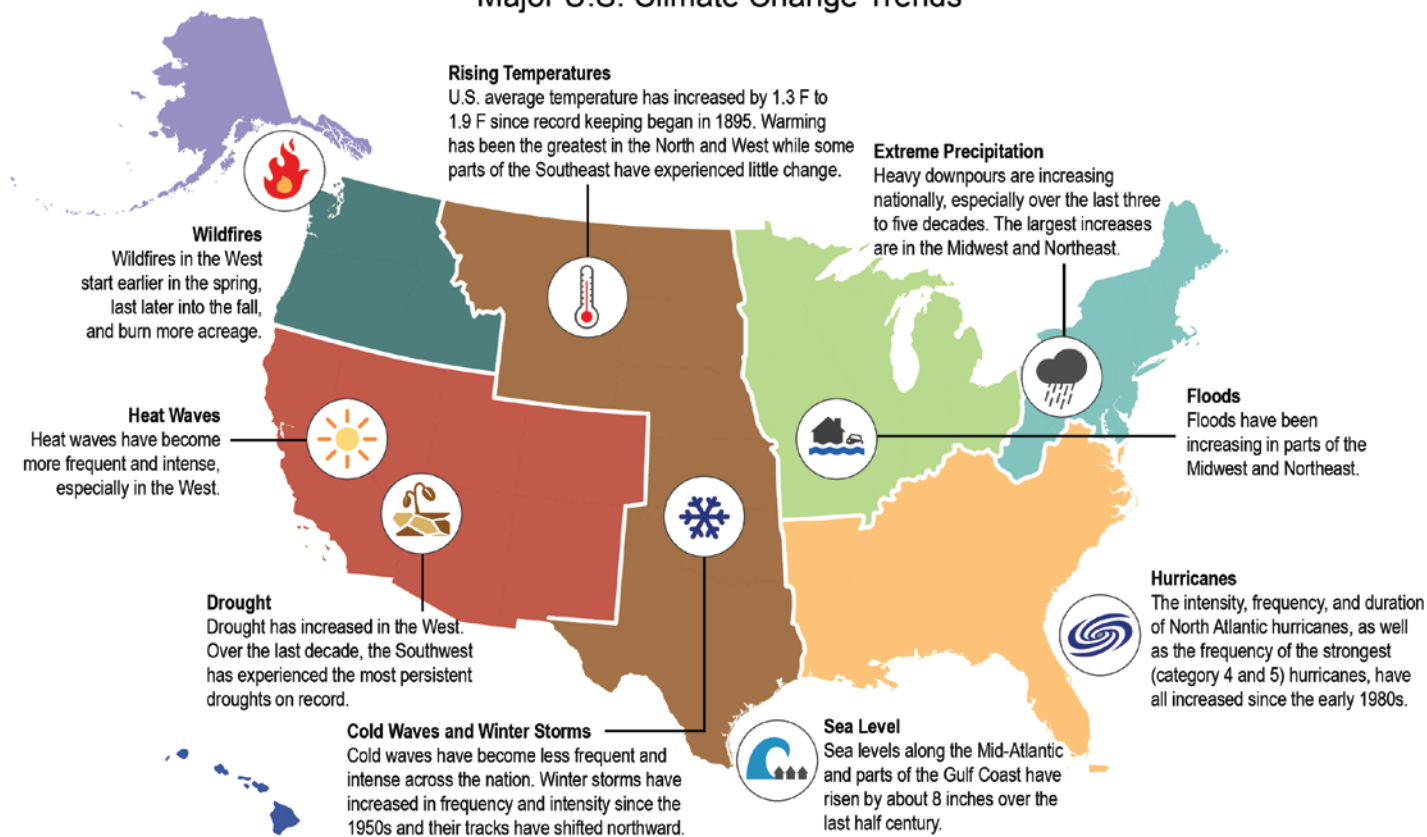


Climate Change and Human Health

Fluctuating temperatures and other changes, such as more severe weather events and rising sea levels, may affect people's environments in ways that, in turn, harm their health and well-being. At the National Institute of Environmental Health Sciences (NIEHS), research seeks to better understand how climate change-related environmental factors may affect people's health. NIEHS has funded grants exploring the health effects of climate change for more than a decade.

NIEHS is also leading a new **Climate Change and Health Initiative** to coordinate solutions-focused research throughout the National Institutes of Health (NIH) with an aim to reduce health consequences associated with evolving climate conditions and extreme weather events.

Major U.S. Climate Change 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, its impacts may affect communities in different and unequal ways. Some of these effects are relatively direct, as when heat waves or hurricanes cause injury and illness, and even death. Some effects of climate change are less direct and involve shifts in our environment that, in turn, can affect human health. For example, changes in temperatures and rainfall can affect the lifecycles of insects that transmit Lyme disease and West Nile virus, leading to new or varied outbreaks. Rising sea levels can worsen the flooding from hurricanes in coastal areas, leading to more people exposed to contaminated water, pollutants, and hazardous wastes. Climate fluctuations often occur with other health stressors, such as poverty, social disadvantage, and impaired language ability, to increase vulnerability. Under-resourced and marginalized populations are most at risk. Examples of the ways that climate change may affect people's health are shown in the table on the next 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 may 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 may 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 may 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 may 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 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 may cause or exacerbate stress and mental health consequences.

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 may be vulnerable to the impacts of climate change at some point in their lives, no matter where they live. Certain U.S. populations are more vulnerable to climate-related health threats as a result of specific physical, environmental, and sociodemographic factors, as well as age and life stage.

Low-Income Groups



People with low incomes live with many factors that increase their vulnerability to the health effects of climate. 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 added burden of air or water pollution that may be worsened by climate events like severe storms. They experience relatively more chronic medical conditions, such as diabetes and cardiovascular, respiratory, and kidney diseases, all of which may be amplified by climate change. Also, limited transportation and access to health care and education can impede their ability to prepare for, respond to, and cope with climate-related health risks.

Indigenous Peoples



Konstantin Baidin / Shutterstock.com

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 face threats to their homes, food sources, and cultural traditions from environmental impacts, such as reductions in sea ice, increases in flooding and landslides, damage to wildlife habitats, loss of medicinal plants, and effects on the abundance and nutrition of certain traditional foods.

Children and Pregnant Women



Many factors, such as economic status, nutrition and diet, living conditions, geographic location, and stage of development, will affect children's exposure to health threats due to climate change in the U.S. and internationally. These factors, combined with climate fluctuations, 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 percentage of people age 65 and older is increasing rapidly in the U.S. Older adults are a population of concern for climate change impacts from extreme heat and weather events, degraded air quality, vector-borne diseases, and other factors. Older adults may be further challenged by social factors such as isolation or 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 extreme climate; and mental health challenges, such as depression, dementia, and other cognitive impairments. Older adults are also more likely to take medications to treat chronic medical conditions, including antidepressant and antipsychotic drugs and diuretics, which make them more vulnerable to complications from heat exposure.

Occupational Groups



Outdoor workers are often among the first to be exposed to the effects of climate. Severe climate change may affect the health of outdoor workers through increases in ambient temperature, degraded air quality, extreme weather, vector-borne diseases, industrial exposures, and altered built environment. Agricultural

and construction workers are particularly vulnerable to rising temperatures. These workers may also experience socioeconomic disadvantages, including limited access to health care and limited control over work environments. Also, laborers exposed to hot indoor work environments that lack air conditioning may be at risk for extreme heat exposure. Military personnel who train and conduct operations in hot field environments may be 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 variety of functional limitations related to hearing, speech, vision, cognition, and mobility. An increase in climate change can be expected to disproportionately affect populations with disabilities. Preexisting medical conditions present risk factors for increased illness and death associated with climate-

related stressors, especially exposure to extreme heat. Chronic medical conditions, including cardiovascular disease, respiratory disease, diabetes, asthma, and obesity, are likely to increase over the coming decades, resulting in larger populations at risk of medical complications from climate-related exposures. Communities that are both medically underserved and have a high prevalence of chronic medical conditions can be especially at risk.

What Is NIEHS Doing to Help People Prepare?

Working closely with researchers, communities, and decision-makers, NIEHS is supporting research and developing strategies to help people and communities prepare for potential health impacts of 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 on the spread of disease in food and water.
- Researching the effects of extreme weather events on pregnant women and fetuses.
- Developing toolkits for sustainable and climate-resilient health care facilities.
- Assisting with 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.
- Developing climate change and health learning materials for a wide range of student audiences.

NIEHS Climate Change and Human Health Lesson Plans
<https://niehs.nih.gov/health/scied/teachers/cchh>

The NIEHS Climate Change and Human Health Literature Portal

This comprehensive knowledge-management tool offers access to curated scientific literature on the health implications of climate change. Search the database: <https://tools.niehs.nih.gov/cchhl>

Additional References

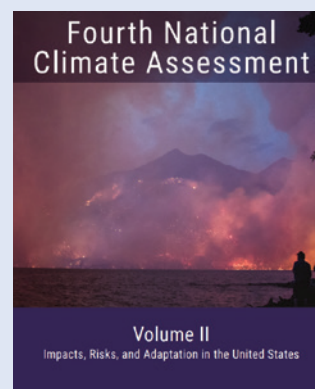
1. IPCC. 2022. Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. (Pörtner HO, Roberts DC, Tignor M, Poloczanska ES, Mintenbeck K, Alegría A, Craig M, Langsdorf S, Löschke S, Möller V, Okem A, Rama B, eds.). Cambridge University Press.
2. Hiatt RA, Beyeler N. 2020. Cancer and climate change. *Lancet Oncol.* 21(11):e519-e527. doi: 10.1016/S1470-2045(20)30448-4.
3. Reidmiller DR, Avery CW, Easterling DR, Kunkel KE, Lewis KLM, Maycock TK, Stewart BC, eds. 2018. Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II. U.S. Global Change Research Program, doi: 10.7930/NCA4.2018.
4. USGCRP (U.S. Global Change Research Program). 2016. The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment. (Crimmins A, Balbus J, et al., eds.). Washington, DC.

Climate Change Affects the Health of All Americans

Building on previous reports, the Fourth National Climate Assessment draws a direct connection between the warming atmosphere and resulting changes that affect our physical, social, and economic well-being. It concludes the evidence of climate change is overwhelming and climate-related threats to Americans' health will increase without additional action.

Mitigation and adaptation strategies are needed for coping with climate change. Reducing greenhouse gases will save many lives and avoid billions of dollars in economic costs. Helping health systems become more resilient will make it easier to manage climate-related health risks. Improving weather forecasting, developing and advancing more sustainable urban design and infrastructure, increasing education at all levels, and developing improved disaster-response plans will also reduce health risks.

Mandated by the Global Change Research Act of 1990, the U.S. Global Change Research Program delivers a National Assessment Report to Congress and the president every four years. The reports provide scientific updates on climate change-related impacts, risks, and adaptation. They inform decision-making, but do not recommend specific policies. Read more at <https://www.globalchange.gov>.



Where Can I Get More Information?

NIEHS Climate Change and Human Health Research
<https://niehs.nih.gov/research/supported/centers/climate>

NIH Climate Change and Health Initiative
<https://www.nih.gov/climateandhealth>

U.S. Department of Health and Human Services
 • **Office of Climate Change and Health Equity**
<https://hhs.gov/ash/ocche>

National Oceanic and Atmospheric Administration (NOAA)
 Climate – <https://cpo.noaa.gov>

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

U.S. Centers for Disease Control and Prevention
<https://cdc.gov/climateandhealth>

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

U.S. Department of Homeland Security
 Ready Program – <https://ready.gov>

For more information on the National Institute of Environmental Health Sciences, go to <https://niehs.nih.gov>