



8 MENTAL HEALTH AND WELL-BEING

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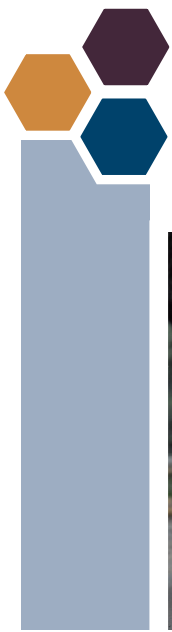
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8 MENTAL HEALTH AND WELL-BEING



Key Findings

Exposure to Disasters Results in Mental Health Consequences

Key Finding 1: Many people exposed to climate-related or weather-related disasters experience stress and serious mental health consequences. Depending on the type of the disaster, these consequences include post-traumatic stress disorder (PTSD), depression, and general anxiety, which often occur at the same time *[Very High Confidence]*. The majority of affected people recover over time, although a significant proportion of exposed individuals develop chronic psychological dysfunction *[High Confidence]*.

Specific Groups of People Are at Higher Risk

Key Finding 2: Specific groups of people are at higher risk for distress and other adverse mental health consequences from exposure to climate-related or weather-related disasters. These groups include children, the elderly, women (especially pregnant and post-partum women), people with preexisting mental illness, the economically disadvantaged, the homeless, and first responders *[High Confidence]*. Communities that rely on the natural environment for sustenance and livelihood, as well as populations living in areas most susceptible to specific climate change events, are at increased risk for adverse mental health outcomes *[High Confidence]*.

Climate Change Threats Result in Mental Health Consequences and Social Impacts

Key Finding 3: Many people will experience adverse mental health outcomes and social impacts from the threat of climate change, the perceived direct experience of climate change, and changes to one's local environment *[High Confidence]*. Media and popular culture representations of climate change influence stress responses and mental health and well-being *[Medium Confidence]*.

Extreme Heat Increases Risks for People with Mental Illness

Key Finding 4: People with mental illness are at higher risk for poor physical and mental health due to extreme heat *[High Confidence]*. Increases in extreme heat will increase the risk of disease and death for people with mental illness, including elderly populations and those taking prescription medications that impair the body's ability to regulate temperature *[High Confidence]*.

Introduction

The effects of global climate change on mental health and well-being are integral parts of the overall climate-related human health impacts. Mental health consequences of climate change range from minimal stress and distress symptoms to clinical disorders, such as anxiety, depression, post-traumatic stress, and suicidal thoughts.^{1, 2, 3, 4, 5} Other consequences include effects on the everyday life, perceptions, and experiences of individuals and communities attempting to understand and respond appropriately to climate change and its implications.^{3, 6, 7}

The social and mental health consequences of extreme weather events have been the focus of research for more than three decades.^{3, 4, 5, 8, 9, 10} The mental health and well-being consequences of extreme events, particularly natural disasters, are common and form a significant part of the overall effects on health. These consequences of climate change related impacts rarely occur in isolation, but often interact with other social and environmental stressors.

Climate Change and Mental Health and Wellness

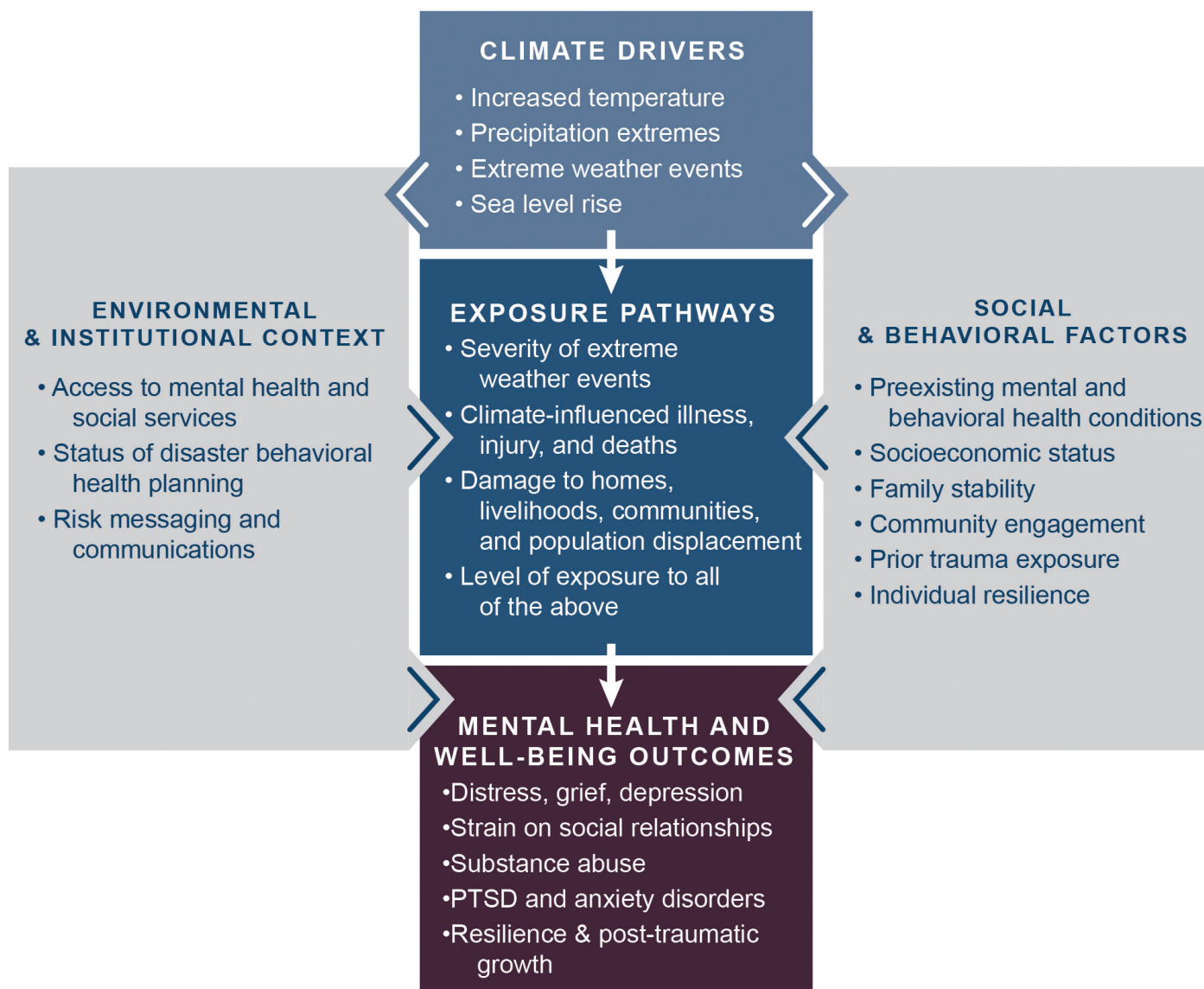


Figure 1: This conceptual diagram illustrates the key pathways by which humans are exposed to health threats from climate drivers, and potential resulting mental health and well-being outcomes (center boxes). These exposure pathways exist within the context of other factors that positively or negatively influence health outcomes (gray side boxes). Key factors that influence health outcomes and vulnerability for individuals are shown in the right box, and include social determinants of health and behavioral choices. Key factors that influence health outcomes and vulnerability at larger community or societal scales, such as natural and built environments, governance and management, and institutions, are shown in the left box. All of these influencing factors may also be affected by climate change. See Chapter 1: Introduction for more information.

The threat of climate change is a key psychological and emotional stressor. Individuals and communities are affected both by direct experience of local events attributed to climate change and by exposure to information regarding climate change and its effects.^{10, 11, 12, 13, 14, 15} For example, public communication and media messages about climate change and its projected consequences can affect perceptions of physical and societal risks and consequently affect mental health and well-being. The interactive and cumulative nature of climate change effects on health, mental health, and well-being are critical factors in understanding the overall consequences of climate change on human health.¹⁶

People have inherent capabilities to adjust to new information and experiences and adopt new behaviors to cope with change. There is also an array of interventions and treatments that mental health practitioners use to address mental health conditions and stress reactions. These interventions occur within the context of health systems that have finite resources to deliver these services. These considerations are not discussed in detail, as this chapter focuses on the state of the science regarding the effects of climate change on mental health and well-being, rather than potential actions that could be taken in response to the impacts and risks associated with climate change.

8.1 Effects of Climate Change on Mental Health and Well-being

The cumulative and interactive effects of climate change, as well as the threat and perception of climate change, adversely impact individual and societal health, mental health, and well-being. Figure 2 illustrates how climate change impacts create cascading and inter-related mental, physical, and community health effects. These impacts include exposures to higher temperatures and extreme weather events as well as vector-borne disease transmission, degraded air and water quality, and diminished food safety and security.

Extreme Weather Events

In the United States, the mental health impacts of extreme weather mainly have been studied in response to hurricanes and floods^{17, 18, 19, 20, 21, 22, 23, 24} and, to a lesser extent, wildfires.^{25, 26, 27, 28} Though many studies discuss the mental health impacts of specific historical events, they are demonstrative of the types of mental health issues that could arise as climate change leads to further increases in the frequency, severity, or duration of some types of extreme weather (see Ch. 1: Introduction and Ch. 4: Extreme Events). The mental health impacts of these events, such as hurricanes, floods, and drought, can be expected to increase as more people experience the stress—and often trauma—of these disasters.



Residents and volunteers in Queens, New York City, filter through clothes and food supplies from donors following Superstorm Sandy on November 3, 2012. A majority of individuals psychologically affected by a traumatic event recover over time, and some experience a set of positive changes that known as post-traumatic growth as a result of coping with or experiencing a traumatic event.

Many people exposed to climate- or weather-related natural disasters experience stress reactions and serious mental health consequences, including symptoms of post-traumatic stress disorder (PTSD), depression, and general anxiety, which often occur simultaneously.^{29, 30, 31, 32, 33, 34} Mental health effects include grief/bereavement, increased substance use or misuse, and suicidal thoughts.^{19, 35, 36, 37, 38} All of these reactions have the potential to interfere with the individual's functioning and well-being, and are especially problematic for certain groups (see "8.2 Populations of Concern" on page 223).

The mental health impacts of hurricanes, floods, and drought can be expected to increase as more people experience the stress—and often trauma—of these disasters.

Exposure to life threatening events, like highly destructive hurricanes such as Hurricane Katrina in 2005, have been associated with acute stress, PTSD, and higher rates of depression and suicide in affected communities.^{18, 20, 23, 30, 39, 40, 41, 42, 43, 44, 45, 46,}

⁴⁷ These mental health consequences are of particular concern for people facing recurring disasters, posing a cumulative psychological toll. Following exposure to Hurricane Katrina, veterans with preexisting mental illness had a 6.8 times greater risk for developing any additional mental illness, compared to those veterans without a preexisting mental illness.⁴⁸ Following hurricanes, increased levels of PTSD have been experienced by individuals who perceive members of their community as being less supportive or helpful to one another.⁴⁹

Depression and general anxiety are also common consequences of extreme events (such as hurricanes and floods) that involve a loss of life, resources, or social support and social networks or events that involve extensive relocation and life disruption.^{20, 21, 23, 29, 30, 31, 33, 37, 41, 46, 50, 51, 52, 53, 54} For example, long-term anxiety

and depression, PTSD, and increased aggression (in children) have been found to be associated with floods.⁵⁵ First responders following a disaster also experience increased rates of anxiety and depression.³⁷

Increases from pre-disaster rates have been observed in interpersonal and domestic violence, including intimate partner violence,^{5, 56} particularly toward women, in the wake of climate- or weather-related disasters.^{37, 57, 58} High-risk coping behaviors, such as alcohol abuse, can also increase following extreme weather events.^{37, 38, 59, 60, 61, 62} Individuals who use alcohol to cope with stress and those with preexisting alcohol use disorders are most vulnerable to increased alcohol use following extreme weather events.⁶²

Persons directly affected by a climate- or weather-related disaster are at increased incidence of suicidal thoughts and behaviors. Increases in both suicidal thoughts (from 2.8% to 6.4%) and actual suicidal plans (from 1.0% to 2.5%) were observed in residents 18 months after Hurricane Katrina.¹⁹ Following Hurricanes Katrina and Rita, a study of internally displaced women living in temporary housing found reported rates of suicide attempt and completion to be 78.6 times and 14.7 times the regional average, respectively.⁶³ In the six months following 1992's Hurricane Andrew, the rate of homicide-suicides doubled to two per month in Miami-Dade County, where the hurricane hit, compared to an average of

one per month during the prior five-year period that did not include hurricane activity of the same scale.⁶⁴

Climate- or weather-related disasters can strain the resources available to provide adequate mental (or even immediate physical) health care, due to the increased number of individuals who experience severe stress and mental health reactions. Communities adversely affected by these events also have diminished interpersonal and social networks available to support mental health needs and recovery due to the destruction and disruption caused by the event.⁶⁵

Drought

Many regions in the United States have experienced drought (see Ch 1: Introduction and Ch. 4: Extreme Events).⁶⁶ Long-term drought, unlike sudden extreme weather events, has a slow onset and long duration.^{66, 67} Long-term drought interacts over time with multiple environmental and social stressors to disrupt lives and livelihoods and the functioning of individuals, households, and communities.^{68, 69, 70} Prolonged drought can have visible and long-term impacts on landscapes, on rural agricultural industries and communities, and on individual and community resilience.^{71, 72, 73}

Cascading and interacting economic, social, and daily life circumstances have accompanied prolonged drought in rural regions. Drought-related worry and psychological distress

Impact of Climate Change on Physical, Mental, and Community Health

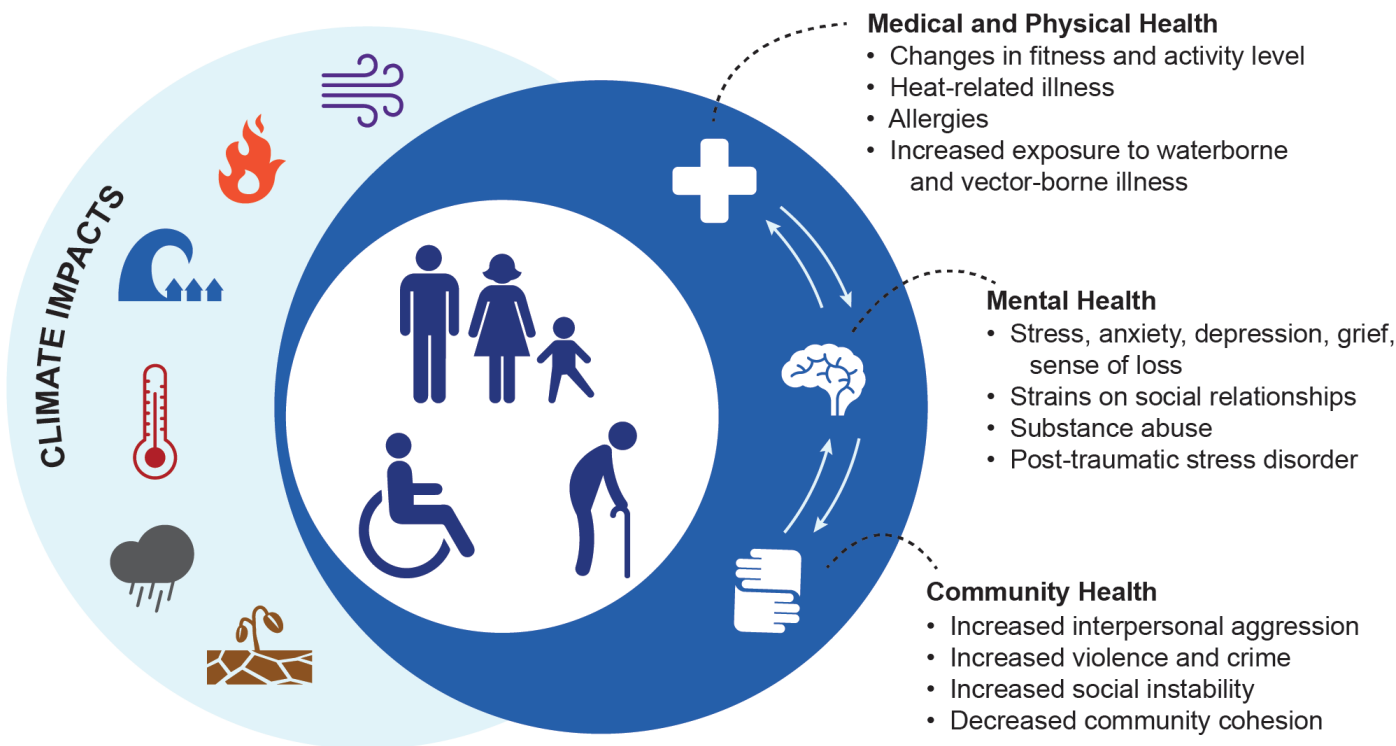


Figure 2: At the center of the diagram are human figures representing adults, children, older adults, and people with disabilities. The left circle depicts climate impacts including air quality, wildfire, sea level rise and storm surge, heat, storms, and drought. The right circle shows the three interconnected health domains that will be affected by climate impacts—Medical and Physical Health, Mental Health, and Community Health. (Figure source: adapted from Clayton et al. 2014).⁵



An elderly couple walk to the Superdome days after Hurricane Katrina made landfall. New Orleans, Louisiana, September 1, 2005.

increased in drought-declared Australian regions, particularly for those experiencing loss of livelihood and industry.^{2, 72, 74, 75, 76} Long-term drought has been linked to increased incidence of suicide among male farmers in Australia.^{2, 77}

Extreme Heat

The majority (80.7%) of the U.S. population lives in cities and urban areas⁷⁸ and urbanization is expected to increase in the future.⁷⁹ People in cities may experience greater exposure to heat-related health effects during heat waves (see Ch. 2: Temperature-Related Death and Illness). The impact of extreme heat on mental health is associated with increased incidence of disease and death, aggressive behavior, violence, and suicide and increases in hospital and emergency room admissions for those with mental health or psychiatric conditions.^{80, 81, 82, 83, 84, 85, 86, 87}

Individuals with mental illness are especially vulnerable to extreme heat or heat waves. In six case-control studies involving 1,065 heat wave-related deaths, preexisting mental illness was found to triple the risk of death due to heat wave exposure.⁸⁸ The risk of death also increases during hot weather for patients with psychosis, dementia, and substance misuse.⁸⁴ Hospital admissions have been shown to increase for those with mental illness as a result of extreme heat, increasing ambient temperatures, and humidity.^{81, 86, 87} An increased death rate has also been observed in those with mental illness among cases admitted to the emergency department with a diagnosis of heat-related pathology.⁸²

People who are isolated and have difficulty caring for themselves—often characteristics of the elderly or those with a mental illness—are also at higher risk for heat-related incidence of disease and death.^{86, 88} Fewer opportunities for social interaction and increased isolation^{89, 90, 91} put people at elevated risk for not only heat-related illness and death but also decline in mental health and, in some cases, increases in aggression and violence.⁵ Hotter temperatures and poorer

air quality limit people's outdoor activities. For many, reductions in outdoor exercise and stress-reducing activities lead to diminished physical health, increased stress, and poor mental health.⁵

There may be a link between extreme heat (climate change related or otherwise) and increasing violence, aggressive motives, and/or aggressive behavior.^{80, 92, 93, 94} The frequency of interpersonal violence and intergroup conflict may increase with more extreme precipitation and hotter temperatures.⁸³ These impacts can include heightened aggression, which may result in increased interpersonal violence and violent crime, negatively impacting individual and societal mental health and well-being.⁸⁵ Given projections of increasing temperatures (see Ch. 2: Temperature-Related Death and Illness), there is potential for increases in human conflict, but the causal linkages between climate change and conflict are complex and the evidence is still emerging.^{83, 95, 96}

Threat of Climate Change as a Stressor

Many people are routinely exposed to images, headlines, and risk messages about the threat of current and projected climate change. Forty percent of Americans report hearing about climate change in the media at least once a month.⁹⁷

Noteworthy environmental changes associated with climate change constitute a powerful environmental stressor—an ongoing and stress-inducing condition or aspect of an individual's everyday environment.^{69, 98, 99} Equally concerning are adverse impacts relating to people's connections to place and identity, and consequent sense of loss and disconnection.¹¹

About half of Americans reported being worried about climate change in a 2015 survey. However, these people tended to see climate change as a relatively distant threat: 36% said global warming would harm them personally, while more expected harm to come to people in other countries and to future generations.⁹⁷ Public risk perceptions of the phenomenon and

threat of climate change is associated with stigma, dread risk (such as a heightened fear of low-probability, high-consequence events), and uncertainty about the future.^{3, 7, 10, 70, 100, 101, 102, 103, 104, 105, 106, 107}

Many individuals experience a range of adverse psychological responses to the hybrid risk of climate change impacts. A hybrid risk is an ongoing threat or event, which is perceived or understood as reflecting both natural and human causes and processes. These responses include heightened risk perceptions, preoccupation, general anxiety, pessimism, helplessness, eroded sense of self and collective control, stress, distress, sadness, loss, and guilt.^{1, 4, 5, 16, 56, 108, 109, 110, 111, 112}

Media representations of serious environmental risks, such as climate change, are thought to elicit strong emotional responses,^{7, 113} in part dependent on how climate change information is presented.¹¹⁴ People experience the threat of climate change through frequent media coverage describing events and future risks attributed to climate change. They also are directly exposed to increasingly visible changes in local environments and seasonal patterns, and in the frequency, magnitude, and intensity of extreme weather events.^{6, 115} Furthermore, between 2012 and 2013, roughly a third of U.S. survey respondents report that they have personally experienced the effects of global warming.^{12, 13} Exposure to climate change through the media could cause undue stress if the media coverage is scientifically inaccurate or discouraging. However, effective risk communication promotes adaptive and preventive individual or collective action.^{4, 5, 116, 117, 118, 119}

Resilience and Recovery

A majority of individuals psychologically affected by a traumatic event (such as a climate-related disaster) will recover over time.¹²⁰ A set of positive changes that can occur in a person as a result of coping with or experiencing a traumatic event is called post-traumatic growth.^{121, 122, 123, 124} An array of intervention approaches used by mental health practitioners also may reduce the adverse consequence of traumatic events. While most people who are exposed to a traumatic event can be expected to recover over time, a significant proportion (up to 20%) of individuals directly exposed develop chronic levels of psychological dysfunction, which may not get better or be resolved.^{21, 35, 47, 53, 125, 126, 127, 128} Multiple risk factors contribute to these adverse psychological effects, including disaster-related factors such as physical injury, death, or loss of a loved one;^{18, 23, 51, 129} loss of resources such as possessions or property;^{20, 30, 44, 46, 47} and displacement.^{32, 130, 131, 132, 133, 134} Life events and stressors secondary to extreme events also affect mental health, including loss of jobs and social connections, financial worries, loss of social support, and family distress or dysfunction.^{18, 20, 46, 47, 129, 135}



People experience the threat of climate change through frequent media coverage.

Disaster-related stress reactions and accompanying psychological impacts occur in many individuals directly exposed to the event and can continue over extended time periods (up to a year or more). For example, three months after Hurricane Andrew, 38% of children (age 8 to 12 years) living in affected areas of south Florida reported symptom levels consistent with a “probable diagnosis” of PTSD. At 10 months post-disaster, this proportion declined to about 18%,^{21, 44} representing a substantial decrease but still indicating a significant number of individuals with serious mental health issues resulting from the disaster event.

Emerging evidence shows that individuals who are actively involved in climate change adaptation or mitigation actions experience appreciable health and well-being benefit from such engagement.^{110, 136} These multiple psychological and environmental benefits do not necessarily minimize distress. However, when people do have distress related to relevant media exposure or to thinking about or discussing climate change, taking action to address the issue can buffer against distress.^{110, 136} Such engagement both addresses the threat and helps manage the emotional responses as people come to terms with—and adjust their understandings and lives in the context of—climate change.

8.2 Populations of Concern

Populations of concern will be at higher risk for poor mental health outcomes as the negative effects of climate change progress.^{10, 137} In addition to the populations described below, farmers, those with limited mobility, immigrants, those living in coastal areas, those from Indigenous communities or tribes,^{138, 139} and veterans are also expected to experience higher risk of poor mental health outcomes (see also Ch. 9: Populations of Concern).^{1, 10, 140, 141, 142, 143, 144, 145}



Children are at particular risk for distress, anxiety, and other adverse mental health effects in the aftermath of an extreme event.

Children

Children are at particular risk for distress, anxiety, and other adverse mental health effects in the aftermath of an extreme event. As children are constantly developing, their reactions will vary by age and developmental level. Children have been shown to possess an innate resilience to adverse events,^{146, 147, 148, 149} but despite this resilience, children can and do exhibit various stress symptoms when exposed to a traumatic event. These symptoms will depend on the developmental stage of the child, the level and type of exposure, the amount of destruction seen, and that particular child's risk factors and protective factors.¹⁵⁰

Children are dependent on others for care and a significant predictor of mental health and well-being in a child is the mental health status of the primary caregiver.^{5, 151} If the primary caregiver's mental health needs are being addressed, then a child will fare better after experiencing a disaster or other trauma.^{5, 150, 151, 152, 153}

The potential exists for an array of difficult emotional and behavioral responses in children shortly after a disaster, such as depression, clinginess, aggressiveness, and social withdrawal, some of which are normal and expected and will resolve over time with proper support. However, children may be at a higher risk than adults of having symptoms persist in the long-term. Significantly more children than adults have shown continued PTSD symptoms more than two years post-disaster, and, in general, children are more likely to be impaired by a disaster.¹⁴¹ Chronic stress from the acute and ongoing impacts of climate change may alter biological stress response systems and make growing children more at risk for developing mental health conditions later in life, such as anxiety, depression, and other clinically diagnosable disorders.¹⁵¹

Women, Pregnant Women, and Post-partum Mothers

Post-disaster stress symptoms are often reported more frequently by women than men.^{154, 155} Women have higher prevalence of PTSD and other mental health disorders after disasters than do men,¹⁵⁶ and are prone to greater worry and feelings of vulnerability,¹⁵⁷ anxiety disorders, and other adverse mental health outcomes.^{141, 158} Increases in domestic violence towards women are also common after a disaster.^{5, 56}

Pregnant and postpartum women can be quite resilient, but their resilience diminishes when social supports are reduced, when they have experienced injury, illness, or danger due to the disaster, and when they have lived through multiple disaster experiences.^{39, 57, 159} Estimates indicated that there were 56,100 pregnant women and 74,900 infants directly affected by Hurricane Katrina¹⁶⁰ and that pregnant women with high hurricane exposure and severe hurricane experiences were at a significantly increased risk for PTSD and depression.¹⁵⁶ The increases in PTSD and depression found in pregnant women exposed to Hurricane Katrina were likely due to the severity of the event and the intensity of the disaster experience rather than a general exposure to the event.^{42, 156}

The many consequences of natural disasters, such as destruction of homes, and of gradual climate change impacts, such as rising temperatures, incidence of vector-borne illness, water-borne illness, and even compromised food,¹⁶⁰ can all contribute to the emotional stress that women have while pregnant, nursing, or responsible for young children. Nutrition is essential to women's health and well-being, especially if pregnant or nursing. Access to clean water and food is critical, and the lack of either may affect women's ability to cope with the impacts of climate change. Poor nutrition can lead to difficult pregnancies, delivery problems, low birth weight, and even death of a newborn, all of which can be immensely stressful to the mother.¹⁶¹

Elderly

In the United States, the number of individuals 65 years of age and older is expected to climb from 47.8 million by the end of 2015 to 98 million in 2060, an increase from 14.9% of the population to 23.6%.¹⁶² The aging population may have difficulty responding to the challenges of climate change, as they tend to have higher rates of untreated depression and physical ailments that contribute to their overall vulnerability, such as increased susceptibility to heat and accompanying physical and mental health and well-being impacts.

Physical health problems are associated with the development of mental health problems,^{163, 164} particularly among older adults.^{137, 165} Long-term exposure to air pollution is linked with poorer cognitive function and an increased rate of cognitive decline among the elderly.^{166, 167, 168, 169, 170} Greater flood exposure, lack of social support, higher stoicism, and the use of maladaptive coping are all associated with greater deterioration in mental health after floods for seniors.¹⁷ The mental health consequences experienced by the elderly in response to a disaster may ultimately be due to challenges they face with physical health, mobility, and difficulty managing trauma in response to the disaster.¹⁴²

Economically Disadvantaged

People living in poverty and with fewer socioeconomic resources have less capacity to adapt to the challenges brought by climate change. They are less able to evacuate should there be a natural disaster, and are more exposed to harmful conditions created by heat waves and poor air quality. Low-income people disproportionately experience the most negative impacts and weather-related mental distress due to more fragile overall health, reduced mobility, reduced access to health care, and economic limitations that reduce the ability to buy goods and services that could provide basic comfort and mitigate the effects of disasters.^{140, 143}



A home owner reacts after firefighters arrive to take over the protection of his home and two of his neighbors' homes in Rim Forest, California, October 3, 2003.

Many low-income people in the United States are employed in climate-dependent sectors, such as agriculture and fishing, or live in weather- and temperature-vulnerable areas, such as cities, flood zones, and drought-prone areas (see Ch. 9: Populations of Concern). As observed internationally, such individuals also have higher levels of distress and are more vulnerable to experiencing poor mental health due to extreme weather events or other climate change impacts.^{137, 171} Farming or rural communities may be particularly vulnerable to the negative mental health outcomes associated with drought. For example, older farmers in Australia reported experiencing an overwhelming sense of loss as a result of chronic drought and its economic consequences.¹⁷²

Emergency Workers and First Responders

Emergency workers and first responders, including healthcare workers and public safety workers, are exposed to deaths, injuries, diseases, and mental stress caused by climate and weather-related disasters. As some extreme weather events increase in frequency and severity (see Ch. 4: Extreme Events), there will be an increased need for emergency response workers involved in rescue and cleanup.¹⁷³ Firefighters, emergency medical service providers, healthcare workers, those recovering human remains, and non-traditional first responders who may be involved with supporting the community after a natural disaster are all at increased risk for mental health consequences, including substance use, both in the short term and long term.^{174, 175}

The very nature of the work, which involves being exposed to a traumatic event and helping others in crisis, frequently working long hours in difficult environments and away from loved ones, increases the susceptibility of first responders and emergency workers to experiencing negative mental health consequences. The level of stress and distress in responders increases when the injured are children or people they know.¹⁷⁶ Vicarious trauma or identifying with the victim's suffering, and being overwhelmed by the number and scope of injuries, can also adversely impact the general mental health and well-being of all responders.^{176, 177}

Rates of PTSD among first responders have ranged from 13% to 18% up to four years following large-scale response events.¹⁷⁴ Among Australian firefighters with PTSD, a large proportion (77%) also presented with simultaneously occurring mental health conditions, such as depression, panic disorder, or phobic disorders.¹⁷⁴ In a study of Coast Guard responders to Hurricanes Katrina and Rita, local responders were three times more likely to report depression than those who were not local.¹⁷⁸

Extreme weather events and natural disasters can cause damage to infrastructure (such as power grids, roads, and transportation) and buildings and put response workers at increased risk of traumatic injury and death (see Ch. 4: Extreme

Events).¹⁷⁹ The impacts of more frequent and intense weather events result in increased stress for responders and threaten their overall mental health and well-being.^{37, 177, 180}

People Who Are Homeless

About 30% of people who are chronically homeless suffer from some form of mental illness.¹⁸¹ The majority of homeless populations live in urban and suburban areas, where they are more vulnerable to health risks from exposure to heat waves due to the urban heat island effect.¹⁸² The combination of risk factors, including high rates of mental illness and the geographical location of the homeless, make the homeless very vulnerable to the effects of extreme heat.

Some extreme weather events are projected to become more frequent and severe, and those who become homeless due to these disasters are at increased risk for post-traumatic stress symptoms. People experiencing homelessness are also vulnerable to acquiring a vector-borne illness. Increases in human–mosquito exposure have been observed after hurricanes, such as after Hurricane Katrina.¹⁸³ For the homeless population, Lyme disease and West Nile virus have the potential to compound already high rates of mental illness with additional cognitive, neurological, and mental health complications that can result from these vector-borne illnesses.^{184, 185}

Individuals with Prior or Preexisting Mental Illness

As of 2013, there were an estimated 43.8 million adults aged 18 or older in the United States who had any mental illness in the past year, representing 18.5% of all adults in the United States.¹⁸⁶ An estimated 2.6 million youth age 12–17 had a major depressive episode during the past year.¹⁸⁶ People with mental illness and those using medications to treat a variety of mental health disorders such as depression, anxiety, and other mood disorders are particularly vulnerable to extreme weather events and extreme heat.¹³⁷ Between 2005 and 2010, approximately 6% of the U.S. adolescents aged 12–19 reported using medications to treat a mental illness.¹⁸⁷ As the U.S. population and average age increases, the total number of U.S. adults with depressive disorders is projected to increase from 33.9 million to 45.8 million from 2005 to 2050—a 35% increase, with those over 65 years old having the largest increase (117%) in depressive disorders.¹⁸⁸ As the number of people with mental health disorders increases, so will the number taking medications for these disorders, giving rise to a larger population vulnerable to the effects of extreme heat and extreme weather events.

Extreme weather events carry threats of psychological trauma and disruption to behavioral health services systems. Individuals with mental health and stress-related disorders, such as PTSD, depression, anxiety, sleep difficulties, and sometimes those who abuse drugs or alcohol, can experience an exacerbation of symptoms following a traumatic event. When infrastructure is damaged and communication lines are weakened, mental health services and personal support networks are also disrupt-



Many medications used to treat a variety of mental health disorders interfere with temperature regulation and heat elimination and may directly induce hyperthermia.

ed, leaving those with a mental illness vulnerable to experiencing additional negative mental health consequences (see Ch. 4: Extreme Events).

Many medications used to treat a variety of mental health disorders interfere with temperature regulation and heat elimination and may directly induce hyperthermia. Being dehydrated can also influence the way some medications such as lithium (used to stabilize mood)^{82, 189} or anti-epileptics work in the body.¹⁹⁰ One of the major underlying risks for death due to extreme heat is the use of medications that affect the body's ability to regulate heat or that have neurological effects, increasing susceptibility to the effect of heat.¹⁹¹

After the 2012 heat wave in Wisconsin, nearly 52% of the heat-related deaths studied occurred among people with at least one mental illness, and half of those were taking a medication that treats mental illness and sensitizes people to heat.¹⁹² Certain drugs prescribed for depression, sleep disorders, psychosis, and anxiety-related disorders were found to be independent risk factors for heat-related hospitalization cases at an emergency department studied after the 2003 heat wave in France.⁸² Many studies have found increased susceptibility to heat for people taking certain classes of medication typically used to treat mental health disorders and other conditions, as well as for alcohol- and drug-dependent people.^{81, 89, 189, 193, 194, 195, 196, 197}

Several other factors, besides the effects or side effects of medication use, might explain why people with mental illness are vulnerable to heat-related death.^{196, 198} Isolation and deficits in care, common to those with severe mental illness, are critical characteristics of those with the highest rates of heat-related illness and death, as these factors lower the likelihood of utilizing preventive strategies such as showers and cooling shelters during times of extreme heat.¹⁹² Those with mental illness often experience poorer overall health and have fewer social

supports. Persons with a combination of mental and physical disorders and who are taking more than one kind of medication are also at greater risk of heat-related death.

8.3 Emerging Issues

Multiple issues warrant further attention regarding the impact of climate change on individuals' and communities' mental health and well-being. Broadly, these include: 1) the impacts of mass evacuation and relocation before, during, and after extreme weather events; 2) the influence of individuals' understandings and attitudes toward climate change and associated risk perceptions on their disaster-related psychological reactions; and 3) the cumulative effects of media presentations of extreme events on mental health and well-being.

A more specific emerging issue is the effect of extreme temperatures on mental health, in particular suicide. Some studies report a connection between higher temperature and suicide,¹⁹⁹ with some indicating increased risk of suicide.^{200, 201, 202} The association between hotter temperatures and suicide appears to be stronger for violent suicide methods than for non-violent suicide methods,²⁰³ and there is emergent evidence that deaths by suicide may increase above certain temperatures, suggesting hot weather may trigger impulsive and aggressive behaviors.^{201, 204} More studies are needed to better understand the relationship, as negative correlations have been found,^{205, 206} as well as no correlation at all.^{207, 208, 209}

Children who use methylphenidate (for example, to treat attention deficit disorder) and are engaging in physical activity in hot and humid environments may also be at heightened risk for heat-related illness.²¹⁰ More studies are needed to assess what the impact will be on children who use behavior modification medications during extreme heat. In addition, more frequent and prolonged heat waves may increase the amount of time spent indoors, which could have an effect on mental health, particularly for children and those who use the outdoors for exercise and stress management.

As more is learned about the relationship between climate change and vector-borne illnesses, it will be important to further understand the scope of mental health consequences for those who become infected. Chapter 5 (Vector-Borne Diseases) addresses the complex relationship between climate change and vector-borne illnesses, focusing primarily on West Nile Virus (WNV) and Lyme disease. Individuals infected with either WNV or Lyme disease may experience a range of mental health consequences following infection that can include reduced cognitive function as well depression associated with other symptoms, such as fatigue, pain, and muscle and joint aches.^{184, 185} These mental health symptoms can last for months but usually resolve over time.

Clinical depression has been observed in patients who are infected with WNV.^{211, 212} In a long-term observational study, 35% of participants were found to have new-onset depression. Those with the more severe neuroinvasive forms of WNV are at greater risk for depression between 13 to 18 months post-infection.²¹² People who are left with limited mobility as a result of WNV infection can experience long-term mental health impacts.²¹² Patient experiences, such as undergoing an extended treatment process or experiencing stress in family or work life due to a lingering illness, can result in mental health consequences.

Poor air quality may have an effect on depression and suicide.^{213, 214, 215} While the current literature is not robust enough to imply causation, studies have found significant associations between short-term exposure to air pollution (sulfur dioxide [SO₂], particulate matter smaller than 2.5 microns [PM_{2.5}], nitrogen dioxide [NO₂], and carbon monoxide [CO]) and emergency department admissions for depressive episodes in Canada.^{213, 214} Recent studies conducted outside of the United States also found associations between air pollution, including aeroallergens, and risk of suicide and emergency department admissions for suicide attempts.^{215, 216, 217} These emerging issues may prove to be a significant impact if air quality conditions worsen in the United States.

The severity of risks to mental health and well-being for Indigenous populations that have a close connection to the environment, and in some cases lower economic resources, is also a concern.^{144, 145, 218, 219} All of these areas will require further study.

With regard to the impact of climate change related food safety risks, increased CO₂ levels could decrease the nutritional value of some foods (see Ch. 7: Food Safety). Malnutrition (specifically, iron deficiencies) can cause fatigue and depression in children and adolescents.²²⁰ More needs to be learned regarding the mental health and well-being impacts that will result from changes to food composition, quality, and safety due to climate change.

Climate change and rising CO₂ levels may increase the incidence of food allergies.²²¹ Such an increase in food allergies would have an impact on mental health status, where those with food allergies have higher rates of stress and anxiety.²²² Food allergy in children and adolescents has been connected to psychological distress, including anxiety and depression. Parents of children with food allergies have been found to have higher rates of stress and anxiety than parents of children without food allergies.²²³ Those with food allergies have higher rates of major depression, bipolar disorder, panic disorder, and social phobia than those with no food allergy.²²⁴

8.4 Research Needs

In addition to the emerging issues identified above, the authors highlight the following potential areas for additional scientific and research activity on mental health and well-being, based on their review of the literature. Studies of the broad range of health effects of climate change should incorporate mental health effects and consequences, since many mental health impacts are secondary to other health problems. In addition, the U.S. does not currently have sustained psychological and social impact assessments or monitoring programs and measures necessary to identify important changes in mental health and well-being associated with climate change. National psychosocial impact assessment and monitoring programs could enhance the development of standardized methodologies and measures of psychological and social pathways needed to better predict mental health and well-being outcomes.

Future assessments can benefit from research activities that:

- better understand how other health risks from gradual climate change affect mental health, including exposures to extreme heat, poor air quality, diminished food safety and security, and increased vector-borne risks;
- explore the associations between extreme temperatures and violent behavior, including violent suicide;
- develop efficient questionnaires and other methods of collecting data on mental health, psychological, and social impacts for use in epidemiological studies of other health impacts of climate change;
- identify predictors or risk factors for adverse psychological outcomes following weather-related or climate-related disasters;
- further improve evidence-based practices to facilitate recovery and post-traumatic growth following extreme events;
- identify the best practices for adaptation and prevention strategies to reduce the impacts of extreme heat on people with mental illness, including patients taking medications that increase their vulnerability to heat stress;
- improve understanding of the effects of secondary exposure, including cumulative media representations of climate change, as well as how an individual's understanding of the threat of climate change affects their psychological well-being and resilience; and
- enhance understanding of the mental health and psychosocial impacts of long-term displacement, relocation, or loss of culturally significant geographic features, particularly for Indigenous populations.

Supporting Evidence

PROCESS FOR DEVELOPING CHAPTER

The chapter was developed through technical discussions of relevant evidence and expert deliberation by the report authors at several workshops, teleconferences, and email exchanges. The authors considered inputs and comments submitted by the public, the National Academies of Sciences, and Federal agencies. For additional information on the overall report process, see Appendices 2 and 3.

Areas of focus for the Mental Health and Well-Being chapter were determined based on the most relevant available scientific literature relating to mental health, wellness, and climate change, as well as the mental health impacts of events associated with climate change. Much of the evidence on these impacts has been compiled in countries outside the United States; however, the scenarios are similar and the evidence directly relevant to the situation in the United States, and thus this literature has been considered in the chapter. The evidence-base on mental health and wellness following extreme weather disasters is both well-established and relevant to climate change. The existence of highly relevant scientific literature on specific concerns directly influenced by climate change—such as the effects of extreme heat, stress associated with the threat and perception of climate change, and special population risks—resulted in the inclusion of these more targeted topics. Although significant scientific literature for resilience exists, in-depth discussions of adaptation, coping, and treatment approaches are outside the scope of this chapter, but are discussed in brief in the Resilience and Recovery section.

KEY FINDING TRACEABLE ACCOUNTS

Exposure to Weather-Related Disasters Results in Mental Health Consequences

Key Finding 1: Many people exposed to climate-related or weather-related disasters experience stress and serious mental health consequences. Depending on the type of the disaster, these consequences include post-traumatic stress disorder (PTSD), depression, and general anxiety, which often occur at the same time [*Very High Confidence*]. The majority of affected people recover over time, although a significant proportion of exposed individuals develop chronic psychological dysfunction [*High Confidence*].

Description of evidence base

Very strong evidence from multiple studies shows a consensus that many people exposed to climate- or weather-related natural disasters experience stress reactions and serious psychological harm, which often occur simultaneously.^{30, 31, 32, 33, 34} Though many of these studies describe the mental health impacts of specific historical events, they demonstrate the

types of mental health issues that will continue to arise as climate change leads to increases in the frequency, severity, and duration of extreme climate- and weather-related events such as floods, hurricanes, droughts, and wildfires.^{17, 18, 19, 20, 21, 22, 23, 24, 25, 29, 41, 50, 51, 68, 70} Strong support is found in a number of recent studies for the potential for climate change-related psychological effects, including grief/bereavement, increased substance use or misuse, and thoughts of suicide.^{19, 35, 36, 37, 38, 60}

Research on individual resilience and recovery shows that a majority of individuals psychologically affected by a traumatic event will recover over time. However, a convincing body of recent research shows that a significant proportion (typically up to 20%) of individuals directly exposed to the event will develop chronic levels of psychological dysfunction, which may not get better or be resolved.^{21, 35, 47, 53, 125, 126, 127, 128}

Major uncertainties

There remains some uncertainty about the degree to which future extreme weather and climate events will impact mental health and wellness. An increase in the scope, frequency, or severity of these events will increase the number of people impacted and the degree to which they are affected. However, efforts that effectively increase preparation for both the physical and psychological consequences of extreme weather- and climate-related events could decrease the impact on mental health and well-being.

Assessment of confidence and likelihood based on evidence

Numerous and recent studies have examined the mental health and wellness impacts of climate- and weather-related events among a variety of populations. Taken as a whole, the strength of this scientific evidence provides **very high confidence** regarding the adverse impacts of environmental changes and events associated with global climate change on individual and societal mental health and well-being, and **high confidence** that these impacts will be long-lasting for a significant portion of the impacted population.

Specific Groups of People Are at Higher Risk

Key Finding 2: Specific groups of people are at higher risk for distress and other adverse mental health consequences from exposure to climate-related or weather-related disasters. These groups include children, the elderly, women (especially pregnant and post-partum women), people with preexisting mental illness, the economically disadvantaged, the homeless, and first-responders [*High Confidence*]. Communities that rely on the natural environment for sustenance and livelihood, as well as populations living in areas most susceptible to specific climate change events, are at increased risk for adverse mental health outcomes [*High Confidence*].

Description of evidence base

Multiple studies have identified specific populations within the United States that are particularly vulnerable to the mental health impacts of climate change events.^{1, 10, 137, 140, 142, 143} Some evidence suggests that children are at particular risk for distress, anxiety, and PTSD.^{141, 150, 151} Highly cited studies of the elderly show that high rates of physical and mental health disorders leave them more vulnerable to the impacts of climate change.^{17, 142, 163, 164} A large body of post-disaster studies shows that women often have a higher prevalence of PTSD¹⁵⁶ and other adverse psychological outcomes.^{5, 39, 56, 57, 141, 157, 158, 159, 160} Research strongly suggests that people who currently suffer from psychological disorders will face additional challenges from climate change impacts.^{81, 82, 84, 86, 87} Strong evidence suggests that people living in poverty disproportionately experience the most negative impacts,^{140, 143} in part because they have less capacity to evacuate to avoid natural disasters, and because they are more frequently exposed to harmful environmental conditions such as heat waves and poor air quality.¹⁶² Similarly, the majority (91%) of homeless populations live in urban and suburban areas, where they are more vulnerable to certain weather- and climate-related health risks.¹⁸²

A number of studies of disaster responders point to an increased risk of mental and physical health problems following climate-related disasters.^{174, 175, 178, 179} More frequent and intense weather events will increase the likelihood of this threat.^{37, 177, 180}

Several studies show that those living in drought-prone areas are vulnerable to high levels of distress.^{137, 171, 172} In addition, evidence suggests those living in Arctic or other coastal areas, such as Indigenous communities or tribes, tend to be more reliant on natural resources that could be diminished by climate change, which can lead to an increased risk of poor mental health outcomes.^{138, 139, 144, 145, 218, 219}

Major uncertainties

While there is uncertainty around the magnitude of effect, there is general agreement that climate-related disasters cause emotional and behavioral responses that will increase the likelihood of a mental illness or effect. Understanding how

exposure, sensitivity, and adaptive capacity change over time and location for specific populations of concern is challenging. Uncertainties remain with respect to the underlying social determinants of health, public health interventions or outreach, adaptation options, and climate impacts at fine local scales.

Assessment of confidence and likelihood based on evidence

The combined breadth and strength of the scientific literature supports **high confidence** that certain vulnerable populations will face psychological tolls in the aftermath of climate-related disasters. An increase in adverse climate-related events will result in increased exposure of such populations of concern and an increased likelihood of elevated risk for mental health consequences. There is also **high confidence** that natural-resource-dependent communities and populations living in areas most susceptible to specific climate change events are at increased risk for adverse mental health outcomes.

Climate Change Threats Result in Mental Health Consequences and Social Impacts

Key Finding 3: Many people will experience adverse mental health outcomes and social impacts from the threat of climate change, the perceived direct experience of climate change, and changes to one's local environment [*High Confidence*]. Media and popular culture representations of climate change influence stress responses and mental health and well-being [*Medium Confidence*].

Description of evidence base

A strong combination of mental health epidemiological research, social science-based national survey research, social and clinical psychology, environmental risk perception research, and disaster mental health research supports the finding that the threat of climate change and perceptions of its related physical environment changes and extreme events together constitute a significant environmental stressor.^{3, 7, 10, 11, 69, 70, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107}

A large number of recent studies that have evaluated responses to the hybrid risk (risk that is part natural and part human-caused) of climate change impacts specifically reveal that many individuals experience a range of adverse psychological responses.^{1, 4, 5, 16, 56, 108, 109, 110, 111, 112}

Major uncertainties

Major uncertainties derive from the distinction between people's objective and subjective exposure and experience of environmental threats. The multimedia information environment to which individuals are exposed and its coverage of climate change and related events can contribute to complicated public perceptions and strong emotional responses related to climate change as a social, environmental, and political issue.^{7, 113, 114} If media exposure is inaccurate or discouraging, that could cause undue stress.

However, accurate risk information dissemination can result in adaptive and preventive individual and collective action.^{4, 5, 116, 117, 118, 119} The relative dearth of long term impact assessment and monitoring programs relating to the psychosocial impacts of climate change necessitates reliance on smaller-scale, typically cross-sectional studies and research surveys that are often limited by their use of single-item indicators rather than standardized, climate change-specific, multi-item psychometric measures.

Assessment of confidence and likelihood based on evidence

The large body of well-documented scientific evidence provides **high confidence** that adverse mental health outcomes and social impacts can result from the threat of climate change, the perceived experience of climate change, and changes to one’s local environment. Emerging evidence suggests there is **medium confidence** that media representations of climate change influence stress responses and mental health and well-being.

Extreme Heat Increases Risks for People with Mental Illness

Key Finding 4: People with mental illness are at higher risk for poor physical and mental health due to extreme heat [*High Confidence*]. Increases in extreme heat will increase the risk of disease and death for people with mental illness, including elderly populations and those taking prescription medications that impair the body’s ability to regulate temperature [*High Confidence*].

Description of evidence base

Mental, behavioral, and cognitive disorders can be triggered or exacerbated by heat waves. An increased susceptibility to heat due to medication use for psychiatric and other mental health disorders, as well as for alcohol- and drug-dependent people, is supported by numerous studies,^{81, 189, 193, 194, 195, 196, 197} and the influence of dehydration on the effects of psychotropic medications is well-documented.^{82, 189, 190}

A significant body of evidence shows that the combination of mental illness and extreme heat can result in increases in hospitalizations and even death.^{81, 82, 84, 86, 87} Furthermore, six case-control studies, involving 1,065 heat wave-related deaths, have found that preexisting mental illness tripled the risk of death.⁸⁸ In a more recent heat wave study, close to 52% of the heat-related fatalities were of people with at least one mental illness and half of those were taking a psychotropic medication.¹⁹²

Major uncertainties

Uncertainties include whether pharmaceutical companies will develop new medications to treat mental illness and other health conditions that make individuals less susceptible to heat, whether strategies for prevention of heat-related

illness and death are implemented, and whether individuals begin to adapt over time to increases in heat. Prevention, detection, and treatment of mental illness without the use of medications that negatively impact the body’s ability to regulate heat could moderate the magnitude of extreme heat’s impact on those predicted to have psychiatric and stress related disorders.

Assessment of confidence and likelihood based on evidence

A large body of established scientific evidence shows there is **high confidence** that people with mental illness are at greater risk for poor physical and mental health outcomes from climate change. Similarly, there is **high confidence** that exposure to extreme heat will exacerbate such outcomes, particularly for the elderly and those who take certain prescription medications to treat their mental illnesses. Given predictions of growth in the subgroup of the population who have mental health conditions and who take pharmaceuticals that sensitize them to heat, increases in the number of people experiencing related negative health outcomes due to climate change is expected to occur.

DOCUMENTING UNCERTAINTY

This assessment relies on two metrics to communicate the degree of certainty in Key Findings. See Appendix 4: Documenting Uncertainty for more on assessments of likelihood and confidence.

Confidence Level	Likelihood
Very High Strong evidence (established theory, multiple sources, consistent results, well documented and accepted methods, etc.), high consensus	Very Likely ≥ 9 in 10
High Moderate evidence (several sources, some consistency, methods vary and/or documentation limited, etc.), medium consensus	Likely ≥ 2 in 3
Medium Suggestive evidence (a few sources, limited consistency, models incomplete, methods emerging, etc.), competing schools of thought	As Likely As Not ≈ 1 in 2
Low Inconclusive evidence (limited sources, extrapolations, inconsistent findings, poor documentation and/or methods not tested, etc.), disagreement or lack of opinions among experts	Unlikely ≤ 1 in 3
	Very Unlikely ≤ 1 in 10

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