

SAMHSA

Disaster Technical Assistance Center

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Climate Change and Behavioral Health

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The focus of the *Supplemental Research Bulletin* is to provide an overview of the current literature on a specific topic and make it easy to understand for disaster behavioral health professionals who are not otherwise exposed to the research. The product aims to assist professionals and paraprofessionals involved in all-hazards planning, disaster behavioral health response and recovery, and/or Crisis Counseling Assistance and Training Program grant activities.

Would you like to see a *Supplemental Research Bulletin* on a topic we haven't yet covered? Contact us with topic ideas and feedback via email at dtac@samhsa.hhs.gov or phone at 1-800-308-3515.

INTRODUCTION

This issue of the *Supplemental Research Bulletin* focuses on the impact of climate change on mental health and substance use (behavioral health). To investigate this topic, in September 2023 we conducted an initial exploratory query for literature related to climate change, disparities, and geographic and climatological trends in extreme weather and weather disasters. Using those initial articles, our team created a modified snowball sample (using a sample of relevant articles to identify additional articles for inclusion) using the National Library of Medicine’s “similar articles” function in PubMed.¹

We limited our review to articles that:

- Were published in the last 10 years (in and after 2013)
- Were published in English
- Focused on behavioral health topics (i.e., mental health, substance use, treatments)
- Described research in U.S. settings (though we included global studies where relevant)
- Focused on climate-related disaster events and general climate change trends

This review is not an exhaustive observation of the plethora of ways in which behavioral health is impacted by climate change. We sought to highlight at a high level the many challenges to behavioral health faced by communities during and in the aftermath of climate-related disasters and in light of climate change. The review also explores ways to enhance resilience in relation to climate change.

CLIMATE CHANGE AND DISASTERS

Global climate change involves phenomena that increase the likelihood of extreme weather and more frequent and intense weather disasters. For example, a gradual rise in mean global temperatures, low humidity, and persistently warm night temperatures have caused increased severity and frequency of heat waves (Bell et al., 2018). The United States has seen trends of steady increases in the past decades in the geographical area affected by higher temperatures, both in the summer and the winter, as well as record high temperatures throughout the year (Bell et al., 2018). Historical models and readouts of the Earth’s surface temperature indicate that anthropogenic warming (warming caused or influenced by human activities) is associated with an increased frequency of extreme weather events (U.S. Geological Survey, 2015; Mann et al., 2017).

Global climate change and its associated trends are projected to continue and even increase. The Fifth National Climate Assessment states that “the effects of human-caused climate change are already far-reaching and worsening across every region of the United States. . . . Without rapid and deep reductions in global greenhouse gas emissions from human activities, the risks of accelerating sea level rise, intensifying extreme weather, and other harmful climate impacts will continue to grow” (Jay et al., 2023).

1 More information on how the National Library of Medicine’s National Center for Biotechnology Information (NCBI) computes and identifies “similar articles” in relation to the reference article can be found in the *PubMed User Guide* at <https://pubmed.ncbi.nlm.nih.gov/help/#computation-of-similar-articles> (NCBI, 2023).

At the same time as global climate change is occurring, researchers are noticing and predicting greater frequency and intensity of several types of weather-related disasters. For example, researchers note that with increasing global greenhouse gas emissions, the risk of drought is also increasing in regions of the United States (Marvel et al., 2023). Studies suggest that high emissions of greenhouse gases will increase the frequency and severity of droughts. Decline of precipitation in high greenhouse gas emission zones has been observed globally, covering areas in North and Central America (Vicente-Serrano et al., 2022). Although droughts tend to be more gradual, their occurrence has profound effects on human life via multiple pathways (Vicente-Serrano et al., 2022).

Also, it is well known that warmer temperatures enable the atmosphere to hold greater moisture, resulting in more extreme cases of precipitation. The severity and frequency of heavy rain has increased in the past decades, and prediction models point toward a continuation of this trend (Kunkel et al., 2013). Rising sea levels are projected to increase the frequency of coastal flooding events (Marvel et al., 2023).

Hurricanes are associated with extreme rainfall (Hall et al., 2020; Reed, Wehner, & Zarzycki, 2022), and hurricanes have been intensifying since the 1980s and causing heavier rainfall and higher storm surges (Marvel et al., 2023). Other concerning trends related to hurricanes include more rapid intensification of storms into hurricanes, as well as decreased speed of movement of storms, causing them to inflict more damage as they linger over specific areas (Marvel et al., 2023).

Wildfires have become more frequent due to changing climate conditions and weather patterns, and they are predicted to become more frequent, as well as severe, with time (Clayton et al., 2021).

Severe weather events take an enormous economic toll—both directly and indirectly. Also according to the Fifth National Climate Assessment, “In the 1980s, the country experienced, on average, one (inflation-adjusted) billion-dollar disaster every four months. Now, there is one every three weeks, on average. . . . Extreme events cost the US close to \$150 billion each year—a conservative estimate that does not account for loss of life, healthcare-related costs, or damages to ecosystem services” (Jay et al., 2023). Over time these events translate into decreased industrial production and increased inflation and unemployment.

IMPACTS OF CLIMATE CHANGE ON BEHAVIORAL HEALTH

Widespread and long-term effects of climate change are manifested as compromised physical and mental well-being in impacted communities.

Mechanisms of Impacts

Several mechanisms explain the relationships research has found between aspects of climate change and behavioral health. For example, physiological changes caused by heat affect the functioning of the central nervous system, potentially leading to cognitive and emotional changes (Löhmus et al., 2018). The relationship between temperature and behavioral health outcomes depends on factors such as baseline temperature and humidity. Furthermore, temperature may affect mental well-being via different pathways, including biological pathways (e.g., reduced sleep, and in more extreme cases, heat stress), cognitive pathways (e.g., emotional and cognitive changes), and social pathways (e.g., reduced economic output, increased violence, and conflict) (Lawrance et al., 2022).

Indirect influence of extreme weather on behavioral health occurs via social and environmental determinants of health, such as lack of or loss of access to safe homes and livelihoods. Climate change

and the increases in frequency and intensity of disasters it may cause may lead to destruction of homes in the short term, followed by, over the longer term, resource limitation and displacement, affecting behavioral health of the impacted populations (Clayton et al., 2021). Some populations are more affected than others as social, economic, and health disparities mean that some communities go through more direct and potentially distressing experiences linked to disasters associated with climate change, and people in these communities may have less access to resources needed for coping with temporary and/or permanent changes due to climate-related disasters (Clayton et al., 2021).

Behavioral health outcomes related to climate change have a bidirectional association with physical health. For example, increased air pollution causes asthma, which is in turn associated with increased risk of depression and anxiety (Crandon et al., 2022).

Impacts of Climate Change on Behavioral Health

Higher temperatures have been associated with higher suicide rates and increased rates of aggressive crimes such as shootings (Towers et al., 2018). By correlating daily maximum temperatures with rates of expressed sentiment in approximately 2.4 billion Facebook status updates from 2009 to 2012, a study showed association of negative sentiment with higher temperatures (Baylis et al., 2018). Evidence from global studies suggests that extreme temperatures worsen mental health outcomes (Crandon et al., 2022). Heat waves have been associated with anxiety and mood disorders (Löhmus et al., 2018). Research has also found heat wave periods to be associated with a 9.7 percent higher incidence of hospital attendance for mental illness compared to non-heat wave periods (Thompson et al., 2023).

A study using self-reported mental health data from the Centers for Disease Control and Prevention's (CDC's) Behavioral Risk Factor Surveillance System (BRFSS) between 2002 and 2012 found that an average maximum temperature greater than 30°C (86°F) increases the chance of mental health problems by 1 percent compared with maximum average of 10°C to 15°C (50°F to 59°F) (Obradovich et al., 2018). If extrapolated across the U.S. population, this figure would translate to 2 million more people reporting mental health problems over a 30-day period. The study found that the effect of a gradual shift in temperature on mental health is half the size of the effect produced by exposure to Hurricane Katrina (Obradovich et al., 2018). A meta-analysis of literature by Liu et al. (2021) found that behavioral health-related morbidity and mortality increased with every 1°C rise in temperature. A meta-analysis by Thompson et al. (2023) revealed a 1.5 percent increase in the incidence of attempted and completed suicides for every 1°C rise in mean monthly temperature and a 1.7 percent increase in incidence of attempted and completed suicides for every 1°C increase in mean daily temperature.

Via mechanisms of neuronal inflammation and injury, air pollution, specifically high particulate matter and nitrogen oxides, has been associated with higher rates of behavioral health problems, neurodegenerative disorders, and higher rates of attempted and completed suicides (Lawrance et al., 2022; Braithwaite et al., 2019). People living in polluted air have presented with psychotic and mood disorders over time (Lawrance et al., 2022). Analogous to other climate-related mental health challenges, air pollution also affects populations unequally. Lower income populations have greater exposure to indoor and outdoor pollution (Lawrance et al., 2022).

Vulnerable Populations Impacted by Climate Change

Higher temperature exacerbates negative outcomes for people living with mental health conditions (Liu et al., 2021), and evidence indicates association of high temperature with increased emergency department (ED) visits for mental illnesses and behavioral health conditions, such as bipolar disorder, schizophrenia, and alcohol and substance misuse (Nori-Sarma et al., 2022). Research has found people with mental illnesses to be more likely to die in a heat wave than those without mental illnesses (Clayton et al., 2021).

To understand the interconnectedness of climate change risks and the factors that reduce resilience of individuals exposed to disasters, a recent paper by Lewis et al., 2023, integrated public health, social, environmental, and climate data to develop the Climate Vulnerability Index (CVI). The study found that although climate risks are present everywhere, the CVI demonstrated a connection between longstanding disparities and greater risks linked to climate change. Socioeconomically disadvantaged communities are likely to be more severely and frequently impacted due to higher costs of housing and transportation and lower access to health care (Lewis et al., 2023).

The ambient temperature that an individual is exposed to depends on the environment where they live and work (Lawrance et al., 2022). Individuals with housing insecurity, those with low socioeconomic status, populations of color, and incarcerated individuals are less likely to have access to air conditioning, urban green spaces, and quality housing. They are more likely to be exposed to the levels of heat that can affect mental well-being. Black and Hispanic communities have been shown to report more ED visits due to heat- or cold-related negative mental health outcomes than White communities. Hispanics are overrepresented in construction and agricultural industries, where there is a risk for high heat mortality (Lawrance et al., 2022).

IMPACTS OF CLIMATE-RELATED DISASTERS ON BEHAVIORAL HEALTH

Various types of disasters expected to increase in frequency and intensity due to climate change are associated with specific behavioral health impacts. For example, flooding can have profound effects on mental health (Cianconi et al., 2020). Global studies have shown that floods bring psychological stress due to mourning and displacement (Shultz et al., 2013), which are risk factors for posttraumatic stress disorder (PTSD). Survivors of floods have been diagnosed with anxiety, depression, and PTSD, and floods have been shown to increase incidence of substance misuse and domestic violence cases (Senthilingam, 2017).

Hurricanes damage existing healthcare infrastructure and disrupt public health services, leading to increased illness, disability, and death, as well as behavioral health issues (Nomura, 2019). Hurricane Sandy has been found to have caused prenatal maternal stress and depression, as well as infant anxiety, fear, and sadness (Nomura, 2019). Survivors of hurricanes also experience PTSD, anxiety, depression, suicidal ideation, and increased likelihood of substance misuse (Cianconi et al., 2020; Ruskin et al., 2018; Clayton et al., 2021). Displacement to shelters in the aftermath of a hurricane results in loss of a familiar environment and established social support networks, leading to increased psychological stress (Cianconi et al., 2020). Evacuees from New Orleans after Hurricane Katrina were found to be more likely to drop out of drug treatment programs, compared with existing Texas inhabitants (Zolopa et al., 2021). After Hurricane Sandy, physical relocation of people who use drugs (PWUD) led to conflicts between different institutional cultures and unequal distribution of resources for opioid agonist therapy (OAT) (Salamanca-Buentello et

al., 2022). Poor communication between staff and patients, and between the OAT clinics and government agencies, resulted in inadequate response in assisting PWUD at the clinics in the wake of the disaster.

Droughts decrease crop yields, leading to long-term economic disadvantage (Wilcox et al., 2013). The immediate brunt of a drought is borne by the farmer, and worldwide studies have shown that farmers are vulnerable to mental health deterioration because of decreased crop productivity (Wilcox et al., 2013). Droughts have been associated with increased suicide rates (Lawrance et al., 2022). Examples from situations in Australia and India have demonstrated that conditions created by drought that led to higher suicide rates operate over a mechanism distinct from heat-related suicidal ideation (Lawrance et al., 2022). The effect of heat on crop yield is the primary driver of suicides in farming communities rather than conditions created by working outdoors in hot weather (Lawrance et al., 2022).

Wildfires cause irreversible loss of carbon dioxide holding capacity of the forest. The burnt vegetation is replaced by grasslands with reduced potential to turn into a forest again or be used for cultivation (Mekonnen et al., 2019). Mental health problems, such as PTSD, psychosomatic stress—a condition where psychological stress adversely affects functioning of the body—and alcohol misuse have been observed in the years following wildfire (Cianconi et al., 2020). Californian wildfires have been shown to cause depression and PTSD. Chronic disassociation, detachment, sadness, and hyperarousal are some of the mental health problems that have been observed in children (Cianconi et al., 2020). After the 2018 wildfires in Oregon, exposure to more than 4 weeks of heavy smoke was associated with a 34 percent increase in the prevalence of feeling anxious and nervous (Mirabelli et al., 2022). Compared to heavy smoke exposure for less than 2 weeks, exposure for more than 4 weeks caused a 4 percent increase in associated depressive disorder prevalence (Mirabelli et al., 2022).

How Climate-related Disasters Impact Behavioral Health Differently

Climate change affects behavioral health via multiple pathways. Longer-term effects of climate-related disasters relate to disruption of social and economic determinants of mental health. These include conflict and violence, forced migration, disruption of food and water systems, and community breakdown (Lawrance et al., 2022). More indirect effects of climate change on mental health relate to the awareness of extreme weather events and their impacts and witnessing changing ecosystems and landscape.

As people experience more disasters and disasters cause greater destruction, the likelihood is greater that more people will choose to or be forced to relocate to a new state, region, or even country. Although a planned migration has better mental health outcomes than forced migration due to a weather or a geopolitical emergency, it affects the individuals concerned (Lawrance et al., 2022). Extreme weather events may even lead to displacement of entire communities outside national borders, causing downstream conflicts over natural resources (Rall and Horne, 2018). Climate-related migration is predicted to displace 200 million people globally by 2050 (Lawrance et al., 2022). From displacement data collected by the Federal Emergency Management Agency (FEMA); state, county, and local authorities; and the American Red Cross, as reported by these actors themselves or by media outlets, the Internal Displacement Monitoring Centre (IDMC) reported 675,000 internal displacements in the United States in 2022 attributable mostly to hurricanes and wildfires but also to tornadoes, floods, landslides, winter storms, volcanic activity, and an earthquake (IDMC, n.d.). As people are forced to change their livelihoods, they may encounter new social challenges exacerbating the existing toll on behavioral health by climate-related migration. For example, people from rural communities can find new and complex social and

economic risks in their newly adopted urban communities (Lawrance et al., 2022). The degree of negative mental health outcomes would also depend on whether the migration was planned or an emergency response, whether it was voluntary or involuntary, and whether it was international or domestic (Lawrance et al., 2022). Loss of a home, a community, and a culture, along with the challenges of navigating an unknown and uncertain path to the future, would come at the cost of severe stress and loss of identity.

Hurricanes Katrina and Rita have caused displacement of Native American communities from coastal regions and islands to more inland regions, destroying their sense of belonging to a landscape they were culturally connected to for decades and centuries (Solecki and Friedman, 2021). Attempts to find suitable places for relocation have been challenging, as residents' way of life is connected to subsistence living and to the natural landscape that is being lost to climate change. Race-based inequity is evident in research after Hurricanes Katrina and Sandy, where the housing market displacement brought in community change and caused stress for displaced people who could not return to their previous homes. Impacts of weather hazards on displacement have been amplified in recent decades by gentrification of urban coastal areas, where returning communities have found their original areas of habitation unaffordable. This was observed with Black communities in New Orleans after Hurricane Katrina. Similarly, after Hurricane Sandy, rebuilding efforts in New York City favored projects for higher-income residents, displacing former communities that lived in lower-income housing. Analyses have found that individuals who rebuild their homes in the same place they got displaced from were less likely to experience stress. On the other hand, a sizeable portion of relocated communities moved to areas that were as or more exposed to weather hazards than their original homes, increasing their overall vulnerability (Solecki and Friedman, 2021).

Populations at Greater Risk In and After Climate-related Disasters

Inequities brought on by climate change have a broad and significant impact on populations experiencing climate-related disasters. Some groups shoulder a higher burden of the impacts of climate-related adverse weather events based on factors related to historical and current socioeconomic disadvantage (Clayton et al., 2021). Generally, vulnerability factors constrain an individual's access to the resources they need to overcome the disruptions brought on by a disaster. Effects of climate-related disasters on different populations could be understood not by the exposure of the populations to the disaster but by identifying cases where the outcome from the exposure is unequally distributed following the same exposure event. For example, communities concentrated in flood-prone areas of a city are more likely to encounter greater flooding, and its concomitant effects on physical and mental health after a hurricane, than populations living in areas of the city with better civic infrastructure.

Factors that increase the likelihood that someone will develop mental health issues or conditions after a disaster include being a first responder, being part of a historically marginalized racial or ethnic population, having prior experience of deprivation, belonging to a low-income group, and being a woman, especially when pregnant or after giving birth (Weir, 2016). Greater risk of flooding in a neighborhood is associated with areas of higher rates of unemployment, where economically disadvantaged populations are likely to live (Berberian et al., 2022). Among survivors of Hurricane Katrina, Blacks had a higher likelihood of developing depression and PTSD compared to Whites (Ali et al., 2017; Alexander et al., 2017). Research in the Houston metropolitan area found that non-Hispanic Blacks reported more PTSD experience compared to non-Hispanic Whites after Hurricane Harvey (Berberian et al., 2022). Negative mental health outcomes were reported more in Blacks than Whites after Hurricane Sandy as well.

Repeated exposure to adverse weather events may result in long-term mental health challenges and take additive psychological tolls (Fernandez et al., 2015; Leppold et al., 2022). Symptoms of worsening mental health tend to be more severe and appear sooner after the second or subsequent exposure to an adverse weather event (Lawrance et al., 2022). Mental health problems may even present themselves some time after an adverse event has passed. A temporal heterogeneity of peak symptom presentation has been observed, ranging from 6 to 12 months to 2.5 to 5 years after flooding events (Lawrance et al., 2022).

Intersections of Disaster Risk Disparities and Health, Social, and Economic Disparities

Factors that more severely expose certain populations to weather-related disasters and restrict the resources they need to rehabilitate in the wake of the disaster relate to health, demographic, geographical, and socioeconomic factors—which are often interlinked.

Research indicates that neighborhoods with higher proportions of flooded area in Harris County after Hurricane Harvey had significantly higher proportions of individuals with disabilities, after accounting for geographic clustering, race, ethnicity, and socioeconomic status (Chakraborty et al., 2019). Within the population with disabilities, individuals with cognitive and ambulatory disabilities were more likely to reside in flood-prone neighborhoods than those with other disability types. Although the research does not identify the factors that led to higher flooding in areas where individuals with disabilities are disproportionately located, there may be a correlation with subsidized housing within Houston Housing Authority's public housing developments, where many such individuals in Harris County live. Most public housing projects in Harris County are in non-White and low-income neighborhoods, the same ones that experienced greater flooding after Hurricane Harvey (Chakraborty et al., 2019).

A study of households in the Greater Houston area found that Hispanics, non-Hispanic Blacks, and other racial minorities experienced significantly greater flooding around their homes than non-Hispanic Whites after Hurricane Harvey (Collins et al., 2019). Being non-Hispanic Black was the strongest predictor of home site flooding. Low socioeconomic status households and those within the National Flood Insurance Program (administered by FEMA) experienced significantly higher flooding than other households. The latter was explained by the fact that households that adopted a more structured approach to flood protection had witnessed past flooding in their areas of residence (Collins et al., 2019).

A survey study in New York areas affected by Hurricane Sandy found that non-White individuals experienced more flooding than White individuals (Lieberman-Cribbin et al., 2021). Older adults emerged as the largest group to experience flooding, on both self-reported and FEMA measures. A higher proportion of respondents with existing mental health conditions before Hurricane Sandy experienced greater flooding after Hurricane Sandy on both self-reported and FEMA measures compared to respondents without prior mental health conditions. This was also true for those who did not complete high school compared to those who did, according to FEMA measures only. The areas with lowest income quartiles in the region were associated with those who had not completed high school, correlating with socioeconomic status of flood-prone communities as well. The highest proportion of survey respondents with existing mental health conditions resided in the lower income quartile areas (Lieberman-Cribbin et al., 2021).

A study of U.S. West Coast wildfires from 2000 to 2021 found that urban dwellers were less vulnerable to wildfire and smoke exposure than rural residents in Washington and California (Modaresi et al., 2023). People aged 65 years or older and those with disabilities were more likely to have a worse experience of wildfire incidents due to diminished or compromised ability to timely detect and/or evacuate in response to

a wildfire threat (Modaresi et al., 2023). For example, the 2018 Camp Fire of California killed mostly people above the age of 65 (Miller, 2020). People with disabilities face challenges during mitigation, evacuation, and recovery phases of the fire (Flanagan et al., 2018). People residing in group quarters (prisons, nursing homes, workers' dormitories) and those with limited English-speaking skills were shown to be more vulnerable during wildfires in the West Coast states of California, Washington, and Oregon (Méndez et al., 2020). An example from a 2014 fire in Washington demonstrates limited accessibility for Spanish-speaking farmworkers of evacuation notices issued in English.

Overall exposure to heavy wildfire smoke has increased significantly in the United States from 2011 to 2021, and the exposure was greatest in the most disadvantaged communities (Vargo et al., 2023). A study using CDC's Social Vulnerability Index suggests increased likelihood of smoke exposure and decreased capacity to adapt to heavy smoke days in populations with language barriers, historically marginalized racial and ethnic populations, those dwelling in multiunit and crowded housing, those with transportation disadvantages, and communities with fewer economic resources to protect themselves from smoke hazards (Vargo et al., 2023).

Populations Susceptible to Post-disaster Behavioral Health Issues

The interplay of behavioral health issues occurring after a disaster event is complex and dependent on a mix of social, economic, health, and geographical factors. A survey study of people living in New York City boroughs who were affected by Hurricane Sandy found that mental health issues 13–16 months after the hurricane were predominantly observed in neighborhoods that were more exposed to the ocean (Gruebner et al., 2015). The study looked at posttraumatic stress (PTS) and depression outcomes and concluded that the geographical hotspots for the two did not overlap entirely. Individuals living in hurricane-affected areas at the time of Hurricane Sandy were more prone to PTS symptoms, whereas depression was caused by both the impact of the hurricane and ongoing mental health issues. In an added layer of complexity, Asian ethnicity was associated with both PTS and depression. A vulnerability factor in one geographical area was a resilience factor in another—being a parent at the time of Hurricane Sandy was associated with higher rates of depression in Brooklyn and lower rates in the Bronx (Gruebner et al., 2015).

Another survey study of individuals exposed to Hurricanes Irma and Michael found that repeated direct and indirect exposures to weather disasters and hurricane-related media exposures were associated with PTS and symptoms of worry, distress, and functional impairment (Garfin et al., 2022). Prior mental illnesses, experience of loss, injury, evacuation, and knowing someone directly exposed to the hurricanes were associated with ongoing symptoms. The findings support the observation that with repeated exposures to disasters, people show more sensitized response.

A survey study after Hurricane Harvey showed that more than half the respondents exhibited PTS symptoms that manifested as repeated, disturbing memories, thoughts, or images (Flores et al., 2020). Older adults had higher odds of having PTS, and so did non-Hispanic Blacks, compared to non-Hispanic Whites. Individuals with household members who experienced job loss had higher odds of PTS, and each additional adverse experience after Hurricane Harvey resulted in increased chances of developing PTS. Additionally, having an existing disability that hindered evacuation was associated with high odds of living without healthcare access after the hurricane (Flores et al., 2020).

EMOTIONAL RESPONSE TO CLIMATE CHANGE

Eco-anxiety is experienced as an awareness of changing ecosystems and worry for the ecological future. It is a broad term that includes climate anxiety, relating to reactions to climate change, within a broader context of the awareness of environmental pollution and species loss (Clayton et al., 2021). A literature review on eco-anxiety found that youth from vulnerable communities, especially Indigenous youth with strong ties to the land, were emotionally impacted by climate change and associated disasters. They were shown to use conflicting coping mechanisms, such as denial or constructive hope (Léger-Goodes et al., 2022). A scoping review of global literature has revealed that anxiety and worry were the most prominent of the negative emotions exhibited by children impacted by climate change (Martin et al., 2022). Despair and concern were other negative emotions that children experienced. Some studies showed that optimism and pro-environmental behaviors significantly helped in building strategies to cope with climate change (Martin et al., 2022).

Eco-grief—the grief experienced due to ongoing or anticipated ecological losses attributed to climate change—has been shown to mostly impact Indigenous communities witnessing environmental destruction (Lawrance et al., 2022). A qualitative study of the Inuit community in the Nunatsiavut region of Labrador, Canada, has showed that weather-impacted mental health shaped daily experiences, where weather and local climate contributed to personal and collective identities (Middleton et al., 2020). Weather was shown to transiently alter mood because of work or leisure being disrupted by inclement weather. Seasonal distress due to weather was also observed.

Feelings of fear, anger, powerlessness, and exhaustion are felt even by people who are not directly exposed to climate-related disaster events (Clayton et al., 2021). Although these negative emotions do not constitute mental illness, they create stress for current and future generations.

BUILDING A RESILIENT BEHAVIORAL HEALTH SYSTEM

Some research findings suggest best practices in providing climate-informed behavioral health care through hospitals in areas affected by climate-related disasters. Findings come from research both on mental health services and also on programs and protocols involving medication as part of treatment for substance use disorder. A study by He et al. (2016) utilized data on mental health-related ED visits and inpatient hospitalization data from the New York Statewide Planning and Research Cooperative System to assess impacts on mental health services during and after Hurricane Sandy. Results indicated that hospital closures during Hurricane Sandy led to increased volume of patients living in the service areas of closed hospitals going to the EDs of the hospitals that remained open, and this increased volume continued for up to 6 months after the hurricane. The researchers note that their findings suggest the need for strategic resource allocation to EDs of hospitals remaining open after disasters that are near to hospitals that have been closed, as surges in mental health need are probable (He et al., 2016).

The closure of Bellevue Hospital in New York City during Hurricane Sandy necessitated merging of the opioid and other substance use disorder treatment programs temporarily with the programs at Metropolitan Hospital for continuation of care (Gupta et al., 2017). Despite significant challenges of the merging process, patient retention was high, and low rates of positive urine toxicology reports indicated successful continuity of care during and after the hurricane (Gupta et al., 2017). Staff interviews from both hospitals regarding the temporary merger found that key factors leading to success in continuity of care and treatment

included clear communication between hospital administration and staff; maintenance of provider continuity with their patients throughout reorganization of hospital services; and not taking new patients, allowing providers to focus on their existing patients (Gupta et al., 2017). In a report on a review study, Salamanca-Buentello et al. (2022) relate a recommendation of having a staff member in OAT clinics designated as disaster preparedness deputy. This person would be charged with communicating about changes in OAT scheduling; service locations; and other important updates via the program's voicemail greeting, website, and social media accounts and through the mainstream media. They would also maintain contact information for program participants. Strategies utilizing multiple lines of communication with patients during an emergency would help PWUD sustain OAT therapy during a disaster. Additionally, provision of mental healthcare services for both PWUD and their care providers at OAT clinics would help address increased anxiety, depression, and PTSD rates in these populations during and after a disaster (Salamanca-Buentello et al., 2022).

A scoping review by Leppold et al. (2022) of research on sites affected by multiple disasters—sites that can be expected to increase as climate change leads to more disasters—allowed the team to generate recommendations for supporting public health in settings affected by multiple disasters, including establishment of psychosocial support programs, proactive offering of mental health services in communities impacted by multiple disasters, and screening protocols for the many behavioral health issues and conditions that may increase in disaster-affected populations along with depression and PTSD, including alcohol misuse and panic disorder.

Additionally, education and awareness of community groups, such as people experiencing climate-related disasters, first responders, and policymakers, should focus on research findings indicating the current and probable future mental health impacts of climate change; such education and heightened awareness could help community members build initiatives that support communities in coping with the climate crisis (Lawrance et al., 2022). Other research has also elucidated or offered implications for capacity building for the behavioral healthcare workforce, including both behavioral health professionals and non-behavioral health professionals who can offer psychosocial support and help foster resilience in their community. Crandon et al. (2022) describe mechanisms of enhancing post-disaster resilience, some of which are educating the community and health professionals regarding the expected psychosocial impacts after a disaster and the accompanying functional impairments; planning for a predictable increase in the need for mental healthcare staff post-disaster; and training community members to serve as part of social support networks to deliver interventions that can be provided by non-behavioral health professionals, thus freeing up mental healthcare professionals to focus on individuals in need of more intensive, professional mental health support.

Psychosocial interventions specifically designed for climate-related mental health impacts could provide a targeted approach to help with coping mechanisms (Lawrance et al., 2022). Although such interventions exist, they have not been adequately evaluated. Once interventions are developed and evaluated, support is needed to scale them up and tailor them for appropriateness for various cultures and contexts.

Research suggests areas to target in enhancing preparedness for climate-related disasters, one important element of a resilient behavioral health system. Some of this research has focused on household-level disaster preparedness and its correlation with other factors. Using nationally representative survey data, a cross-sectional study found that wealthier households and those with older adults had higher resource-based disaster preparedness, such as emergency kits, food, and water stockpiles (Zamboni and Martin,

2020). The same household types had lower action-based disaster preparedness—for example, a lack of the ability to rapidly evacuate. Households with children had lower resource-based preparedness, potentially due to a lower disposable income available for resource-based items. However, these households had better action-based preparedness, such as having an alternate communication plan or meeting place in the event of disaster. The observation may be due to school requirements which facilitate having the above arrangements in place during regular circumstances. Households headed by people with higher education levels also had higher odds of having the financial resources for evacuation—such as a vehicle. It was the opposite in Black and Hispanic/Latino households and households with people with disabilities (Zamboni and Martin, 2020).

Policies, behaviors, and activities designed to support adaptation to climate change and mitigation of its effects can help reduce negative impacts of climate change on behavioral health (Lawrance et al., 2022). Healthcare systems that are more embedded within a community could improve connectedness and resilience to climate change (Lawrance et al., 2022). For example, community rewilding programs, such as maximizing urban green spaces and restoring wild spaces, could both address mental health benefits by connectedness to nature and be a step toward climate action (Lawrance et al., 2022). Discussing the interrelatedness of climate and health care, Yellowlees (2022) notes that the U.S. healthcare system is responsible for approximately 8.5 percent of U.S. carbon emissions and suggests key approaches to minimizing the system’s carbon footprint when addressing patient mental healthcare needs. For example, a hybrid model of psychiatric care, combining in-person visits and telephone, video, and/or email consultations, could help save time and fuel for patients and providers, and at the same time offer patients the safe environment of their home to receive consultations when possible. The benefits of telehealth approaches were widely observed during the COVID-19 pandemic (Yellowlees, 2022). Drawing from findings of a scoping review, Bessaha, Hayward, and Gatanas (2022) recommend involving youth and young adults in the planning and development of disaster risk reduction activities and interventions. This would not only prepare future generations on what to expect from climate-related disaster events, but also enable them to provide support, resilience, and well-being to the community. They also suggest that disaster mitigation and response strategies be integrated into school curricula and programs (Bessaha et al., 2022). Corvalan et al. (2022) suggest using a cross-sectoral approach focused on climate action and mental health. Integrating climate action strategies and plans into mental health programs and integrating mental health considerations into programs addressing climate-related mental health issues and conditions would help strengthen climate resilience.

LIMITATIONS

In this review we attempt to highlight behavioral health challenges that arise in response to climate change. However, the review is not an exhaustive summary of the wide spectrum of climate-related behavioral health issues and coping methods. We have included literature pertaining to the United States, but some global studies were also considered to provide broader context. The review excludes literature published before 2013. Although recent literature covers the major weather disasters of the 21st century, older articles would provide deeper context and enhanced understanding of how the behavioral health impacts of climate change have grown and developed over the past decades. We provide an overview of individual and system-wide practices and policies designed to address existing challenges in resilience in relation to climate change and climate-related disasters. However, this bulletin does not make policy recommendations.

CONCLUSIONS

Climate change is causing increasing frequency and intensity of extreme weather, as well as several types of disasters. Disasters take a major economic toll as well as affecting well-being and mental health and substance use issues and conditions. Through complex mechanisms, climate change affects behavioral health in ways ranging from increased incidence of violence and risk of suicide to higher rates of neurodegenerative disorders. People may be more vulnerable to the impacts of climate change if they have preexisting behavioral health conditions, have low incomes or are of low socioeconomic status, are part of historically marginalized racial or ethnic groups, or are incarcerated. Climate-related disasters have effects on behavioral health such as anxiety, depression, and PTSD, along with service disruptions both for people using behavioral health services in place before the disaster as well as for people with emergency needs. Their effects differ slightly from those of disasters in general in that repeated and more intense disasters may increase disaster displacement and relocation, disrupting communities and the social supports that typically constitute an important part of post-disaster recovery and resilience. Populations who may be at greater risk during and after climate-related disasters include first responders, members of historically marginalized racial or ethnic populations, people with low incomes, people with chronic health conditions, and people with disabilities. Disaster risk intersects with health, social, and economic disparities, and overall ease of access to resources, which becomes especially crucial when a community's resources are constrained in the aftermath of a disaster. People may also struggle with emotional reactions to climate change. Research points to many potential ways to enhance resilience of behavioral health systems of care in light of climate change. These ways include strategic resource allocation after disasters to accommodate likely areas of increased need, practices in support of continuity of care, proactive offering of climate-informed behavioral health services, and efforts to educate the many groups involved in response to climate change about the likely behavioral health effects of climate change and ways to foster resilience. Programs to support climate change adaptation and mitigation, where they allow for public participation, may also serve to foster resilience.

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