Global climate change and mental health
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Although several empirical studies and systematic reviews have documented the mental health impacts of global climate change, the range of impacts has not been well understood. This review examines mental health impacts of three types of climate-related events: (1) acute events such as hurricanes, floods, and wildfires; (2) subacute or long-term changes such as drought and heat stress; and (3) the existential threat of long-lasting changes, including higher temperatures, rising sea levels and a permanently altered and potentially uninhabitable physical environment. The impacts represent both direct (i.e. heat stress) and indirect (i.e. economic loss, threats to health and well-being, displacement and forced migration, collective violence and civil conflict, and alienation from a degraded environment) consequences of global climate change.

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Impacts of acute climate-related events
There exists a substantial literature documenting the mental health consequences of extreme weather events and natural disasters lasting for days, such as hurricanes [8**,9*,10], floods [11], wildfires [12], and short-duration heat waves [13*,14]. These consequences include elevated rates of anxiety and mood disorders, acute stress reactions and post-traumatic stress disorders, sleep disruption, suicide and suicidal ideation, as well as a decreased sense of self and identity from loss of place and grief reactions [1*,2*,3,4,5**,15]. These outcomes can linger for months or even years [16]. Risk factors for developing mental illness in the aftermath of such disasters include the magnitude of the traumatic event, exposure to the injury or death of a loved one, female gender, younger age, lower socioeconomic status, less education, minority or ethnic status, psychiatric history, family instability, and inadequate social support [1*,2*,6**,7,17**]. Residents of low and middle-income countries are especially vulnerable to these outcomes due to their increased exposure to extreme weather events, high levels of poverty, and lack of access to services [10,16,18,19]. Between 25% and 50% of those exposed to extreme weather events will experience negative mental health outcomes; these outcomes will diminish over time for most but not all individuals [7,8**,12,16].
One of the most recent examples of how extreme weather events combine with pre-existing vulnerabilities is Puerto Rico. Even before the arrival of Hurricane Maria in October, 2017, Puerto Rico was struggling with an increase in mental illness amid a 10-year recession that brought soaring unemployment, poverty, and family separation caused by emigration. Public health officials and caregivers say that Maria exacerbated the problem [20]. One study reported a 16% increase in the suicide rate from 2016 and a 26% increase in the number of suicides over the same period after Maria [21]. Another study by Scaramuzzi et al. [22] found rates of PTSD to be higher among displaced Puerto Rican residents living in Florida than those living in Puerto Rico (OR, 2.94; 95% CI, 1.67–5.26), perhaps due to their having suffered the greatest personal and property losses during and after the storm. Among participants in both Florida and Puerto Rico, those living in urban areas were more likely than those in rural/suburban areas to meet criteria for PTSD and generalized anxiety disorder. A cross-sectional survey of 74 households in the low-income community of Punta Santiago conducted six months after the storm found that 54.1% of study participants scored in the clinically significant range for major depression, 48.6% for generalized anxiety disorder, and 41.9% for PTSD [23]. Another study of 96 108 students representative of grades 3–12 across all 7 educational regions of Puerto Rico found 83.9% of youths saw houses damaged, 57.8% had a friend or family member leave the island, 45.7% reported damage to their own homes, 32.3% experienced shortages of food or water, 29.9% perceived their lives to be at risk, and 16.7% still had no electricity 5–9 months after the hurricane. Overall, 7.2% of youths reported clinically significant symptoms of PTSD [9].

**Impacts of subacute climate-related events**

Depending on their duration, heat waves can be viewed as an acute or subacute event. However, the mental health impacts of heat waves can be expected to be more profound as they increase in duration. Obradovich et al. [15] examined the relationship between historic climatic conditions and mental health of two million randomly sampled US residents between 2002 and 2012. They found that shifting from monthly temperatures between 25°C and 30°C to greater than 30°C increased the probability of mental health difficulties by 0.5%, and that 1°C of five-year warming is associated with a 2% increase in the prevalence of mental health issues.

Increasing ambient temperatures is likely to increase rates of aggressive and criminal behavior, which may lead to increased rates of physical assaults and homicides [24,25], as well as an increase in suicide rates, especially among men and older adults [26,27]. Heat also suppresses thyroid hormones, resulting in functional hypothyroidism, which may be manifested as lethargy, low mood, and cognitive impairment [28]. Heat also stimulates growth hormone and prolactin, which can also cause lethargy [29]. Body dehydration that occurs with heat stress can produce significant deterioration in cognitive functioning [30].

One segment of the population that is especially vulnerable to the mental health impacts of heat stress is those with pre-existing mental health problems. Heat waves are known to exacerbate underlying mental illnesses and behavioral disorders, contributing to higher rates of morbidity, mortality, and hospitalizations among individuals with these conditions, especially among those with dementia, schizophrenia, and substance use disorders [14], due to poor thermoregulation associated with psychotropic medication and heat-related cognitive impairment [14,31].

Another form of exposure to long-term changes in the environment has been the increasing occurrences of prolonged drought. Studies conducted primarily in Australia have demonstrated that prolonged droughts due to climate change can lead to more psychosocial distress, generalized anxiety, depression and an increased incidence of suicide in rural areas [1**,32,33]. Older adults appear to be particularly vulnerable to these negative mental health outcomes [7].

The mental health outcomes associated with drought also highlight the importance of understanding and responding to the indirect impacts of climate-related events. A review conducted by Vins et al. [34] found evidence supporting an economic effects pathway, particularly its impacts on rural farming populations, as well as the migration pathway, linking drought to mental health. The causal pathways model proposed by Berry et al. [1**] identified two specific indirect pathways likely to occur in response to subacute events: (1) physical health, through increased heat stress, injury, disease, and disruption to food supply, and (2) community well-being, through damage to the economic and, consequently, the social fabric of communities. Impacts to physical health and well-being associated with prolonged heat stress, respiratory illnesses, vector-born infectious disease and malnutrition are causally and reciprocally related to mental health [1**,7]. Impacts to community well-being will occur through economic losses associated with property damage, loss of income and employment opportunities, and reduced economic productivity, especially in agriculture and fisheries [34,35]; population displacement [36**]; loss of attachment to the natural environment [37,38]; and social conflict and inter-group violence [39**,40,41**], each of which significantly impact mental health. These effects will fall disproportionately on those who are already vulnerable, including indigenous peoples and those living in developing countries [2**,18,37,41**]. Children are especially vulnerable to these indirect
Impacts because of their biological sensitivity, immature physiology, unique ways of interacting with their environment, limited adaptive capacity, dependence on stressed adults, and lifelong exposure [42].

Impacts of long-lasting climate-related events

Even if planned mitigation efforts are successful, higher temperatures and rising sea levels are anticipated to persist into the next century and beyond [43]. Even regions not currently experiencing acute extreme weather events or subacute events like droughts will nevertheless be impacted by the economic losses, displacement, conflicts, and environmental degradation associated with these changes, producing increases in the mental health problems associated with the other climate-related events on a global scale [44]. In the long term, however, poor countries will continue suffer economically from climate change much more than rich countries due to their greater exposure to very high temperatures, reliance on agriculture, and other industrial sectors that are vulnerable to extreme weather variability, and limited access to infrastructure and resources that are critical to risk management [10,41**]. Economic disparities, in turn, will lead to greater threats to health and well-being, population displacement and civil and international conflicts [35,36].

Perhaps the greatest mental health outcome associated with long-lasting events, however, is the existential threat associated with climate change. Psychological distress and anxiety about the future may result from acknowledging climate change as a global environmental threat [3,6**,37,38]. A report by the American Psychological Association and ecoAmerica proposed that the worsening state of the environment is already causing a sense of stress that influences the way people interact in their communities [3]. Worry about climate change itself may exacerbate the environmental impacts on mental well-being [2*,45]. “The overarching threats of a changing climate can also incite despair and hopelessness as actions to address the ‘wicked problem’ of climate change seem intangible or insignificant in comparison to the scale and magnitude of the threats” [6**, p. 2]. This awareness contributes to ‘psychoterratic’ syndromes, including phenomena such as ‘ecoanxiety’, ‘ecoparalysis’, and ‘solastalgia’, the distress, and isolation caused by the gradual removal of solace from the present state of one’s home environment [6**,46*,47*]. Young people, including those living in high-income countries, are believed to be especially vulnerable to these syndromes [42].

Conflict of interest statement

Nothing declared.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References and recommended reading

Papers of particular interest, published within the period of review, have been highlighted as:

- of special interest
- of outstanding interest


The framework introduced by the authors is considered a standard in the literature for assessing and describing the direct and indirect mental health impacts of three types of climate-related changes.


This article highlights some climate-sensitive impacts that may be encountered by mental health professionals and suggests potential avenues for public mental health in light of current and projected changes.


Conclusion

Understanding the scope and scale of mental health impacts associated with climate change is an important first step to developing and implementing services designed to treat or prevent these impacts [48,49,50*]. The impacts represent both direct (i.e. heat stress, exposure to extreme weather events) and indirect (i.e. economic loss, threats to health and well-being, displacement and forced migration, collective violence and civil conflict, and alienation from a degraded and potentially uninhabitable environment) consequences of three types of climate-related events: acute, subacute, and long lasting. Some of the mental health impacts and services employed as forms of adaptation to climate change will be specific to each type of event, while other impacts and services will cross cut all three event types. While delivery of services in response to acute and extreme weather events may appear to be of greater priority at the present time, what services are developed, how they are implemented and by whom will have important implications for addressing longer duration events. Subacute and long-lasting climate-related events will also require development and implementation of new types of mental health services like planned relocation of communities, public health education, violence prevention, risk communication, personal engagement in environmental conservation, and promotion of positive psychological outcomes associated with climate change.
This article describes three classes of psychological impacts: direct (e.g., acute or traumatic effects of extreme weather events and a changed environment); indirect (e.g., threats to emotional well-being based on observation of impacts and concern or uncertainty about future risks); and psychosocial (e.g., chronic social and community effects of heat, drought, migrations, and climate-related conflicts, and postdisaster adjustment).

This article provides an overview of the current and projected climate change risks and impacts to mental health and offers recommendations for priority actions to address the mental health consequences of climate change.


This classic in the disaster mental health literature identifies sociodemographic and event exposure characteristics of populations that are especially vulnerable to mental health impacts of natural disasters.


This article provides three case illustrations of the impacts of population displacement related to climate change in low resource settings. Particular emphasis is placed on the economic and conflict drivers of displacement.


This study attributes the economic impacts of prolonged drought in Eastern Syria as one of the factors contributing to the civil conflict and mass migration of refugees from Syria.


This excellent review summarizes the research on the association between climate change and collective violence and identifies future research needs and challenges.


Describes three syndromes: ecoanxiety—anxiety people face when constantly being surrounded by the wicked and threatening problems associated with a changing climate; ecoparalysis—complex feelings of not being able to take effective action to significantly mitigate climate change risks; and solastalgia—distress and isolation caused by the gradual removal of solace from the present state of one’s home environment.


This book includes chapters that focus on post-traumatic growth and resilience in the face of natural disasters and identify characteristics that strengthen community resilience to the threats and challenges of climate change.


This position paper outlines a strategy for the development of new evidence-based interventions and practices designed for children who have been exposed to natural disasters and other traumatic events.