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CHAPTER 25

Mental Health in Our Changing Climate

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Learning Objectives

1. Understand how climate change impacts our mental health.
2. Learn about resiliency solutions that benefit mental health.
3. Develop a personal resiliency plan, which is very important in our changing climate.

Overview

In this chapter, we will cover four topics. Topic 1 will describe chronic mental health impacts of climate-change-accelerated extreme events such as the now-frequent wildfires in California. In topic 2 we will take a more holistic viewpoint and explore the links between mental health, physical health, and community health in the context of our changing climate. In topic 3 we will learn about climate-forward community solutions that benefit mental health. And finally, we will learn how to develop our very own individual climate resiliency solutions.

Given the emphasis of the Bending the Curve course on solutions, we will spend more time on topics 3 and 4, while topics 1 and 2 are important for building a basic foundation on the current science in this field.

25.1 Chronic Mental Health Impacts of the Changing Climate

Natural disasters have occurred on Earth for millennia. Human mental health has been studied in the context of natural disasters since the 1980s. These studies have shown increasing prevalence of post-traumatic stress disorder, or **PTSD**, and depression in the aftermath of natural disasters, as reviewed by Lowe and colleagues in 2019.

However, as our climate is changing, the intensity and frequency of natural disasters is increasing. Figure 25.1.1 shows the increase in natural disasters that has been especially striking since the 1980s.

Scientists have shown that climate change is certainly involved in this increase in natural disaster frequency. The western United States has become increasingly vulnerable to wildfires. There has been a 1,000% increase in western US wildfires over the last 30-year period. Further, climate models project that large land areas and human populations will suffer from deadly heat in the future.

For the sake of survival of our species, it is very important to understand how people are mentally coping with these extreme events. Our intact mental health is key for survival, as it is what enables the cognitive capacity to rebuild livelihoods after disasters and also to develop strategies that prevent future disasters, especially from human (anthropogenic) causes.

In 2022, the World Health Organization, or **WHO**, released a mental health and climate change policy brief, which stated that we need to be increasingly concerned about mental health in the context of climate change. In this regard, my research lab has led studies in California to quantify the impact of the recent wildfires on mental health.

How I, a brain scientist, started on this research journey is also an interesting story. In the fall of 2018, the Camp Fire occurred in the Paradise area in Butte County in California. The Camp Fire has been documented as the deadliest wildfire in California history. It burned more than 150,000 acres of land, nearly 19,000 buildings were destroyed,

Number of recorded natural disaster events, 1900 to 2022

The number of global reported natural disaster events in any given year. This includes those from drought, floods, extreme weather, extreme temperature, landslides, dry mass movements, wildfires, volcanic activity and earthquakes.



Source: EM-DAT, CRED / Université catholique de Louvain, Brussels (Belgium)

OurWorldInData.org/natural-disasters • CC BY

FIGURE 25.1.1 Increase in number of natural disasters over the last century. The frequency of disasters has followed an exponential curve since the 1980s. Reproduced from Our World in Data.

52,000 people were evacuated, and 85 people lost their lives. These statistics are four to eight times graver than for any other wildfire in California history. My 6-year-old son brought a penny drive flyer from his school, which joined in the effort to provide aid to survivors. The penny drive was being organized by Joe Picard, the director of the Basic Needs Project at Chico State University, which is within 10 miles of the impacted wildfire area. I dialed Joe's number to learn more about the situation in the area, and he described how distressed the community was feeling from the wildfire event. At that time I decided that I would like to quantify these mental health impacts better for everyone to understand what we are dealing with.

Thus began a collaboration between my research team at UC San Diego and faculty in the Chico State University psychology department. Together, we published a first study characterizing the mental health

impacts of the Camp Fire—a wildfire that was undeniably driven by climate-change-accelerated extreme weather conditions. We enrolled 725 Californians in our study, and we studied impacts in individuals who reported they were directly exposed to the Camp Fire, in those who were indirectly exposed, and in unexposed individuals, who served as a control group. Those who were directly exposed were people who directly suffered personal loss from the wildfire. Those who were indirectly exposed were people who witnessed the wildfire in their community but did not suffer direct personal loss. Unexposed control individuals were not exposed to the Camp Fire at all and were studied at the same time to establish baseline mental health in the region.

Our findings were striking (Figure 25.1.2):

- We found that PTSD was three times more prevalent in the wildfire-exposed individuals than in unexposed individuals, and there was a grade of prevalence such that directly exposed individuals showed greater prevalence of PTSD than indirectly exposed individuals. This finding of a wildfire-exposure-related gradation of symptoms is important because it helps us to have confidence that the effects were not just nonspecific effects in that particular community. Because we were not able to study the state of mental health *before* the wildfires, the graded effect found in the aftermath of the wildfire event is the best way for us to decipher the specificity of the findings.
- We also found a similar graded increase in prevalence of anxiety and depression in the wildfire-exposed community, in which prevalence was 1.5 to 2 times greater than in unexposed controls. The increase was greater in the directly exposed individuals than in those indirectly exposed.
- Importantly, we found that these mental health effects were chronic and long-lasting. We observed these effects 6 months to 1 year after the Camp Fire disaster. Thus, these communities were still suffering, even when the wildfire had long been contained and there was no trace of smoke in the air. This quantitative evidence is in line with personal accounts—people in these communities have reported feeling post-traumatic stress from any burnt smell, even if from an electric stove in their own home long after the wildfire event.

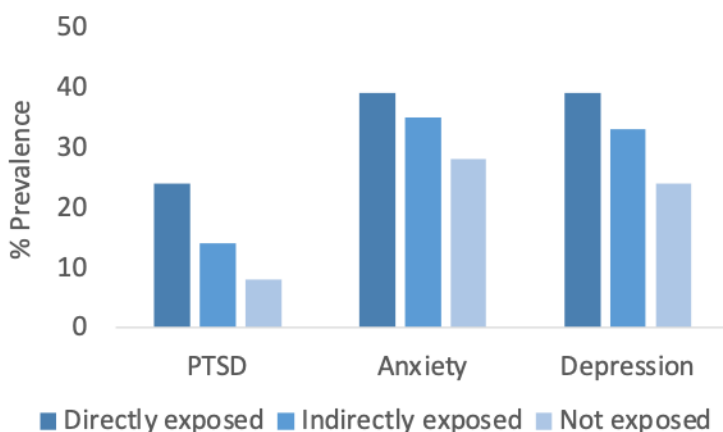


FIGURE 25.1.2 Heightened prevalence of PTSD, anxiety and depression in individuals impacted by the deadliest wildfire in California. In our 725 person study of the 2018 Camp Fire, directly fire-exposed individuals showed nearly 3 times greater PTSD and 1.5 times greater anxiety and depression prevalence relative to unexposed controls. Indirectly exposed individuals, who witnessed the wildfire in their community but did not suffer personal loss, also showed aggravated symptom prevalence, to a lesser extent than those directly exposed. From Silveira et al. 2021.

Being a brain scientist who studies human cognition, I also wanted to understand whether the wildfire is impacting mental health beyond symptoms. To understand this, I had a subset of the individuals who participated in the above research also participate in a follow-up study of cognitive and brain function. In this second study, individuals took part in a suite of cognitive assessments that measured how they paid attention, how they exercised short-term (working) memory, and how they responded when faced with distractions from either nonemotional stimuli or emotional faces.

Interestingly, we found that both directly and indirectly exposed individuals differed from unexposed control individuals in their ability to perform in the face of distractions. Wildfire-exposed individuals performed 20% worse than unexposed controls who were exactly matched for age and gender. This means that wildfire-exposed individuals were much more distractible.

When we studied their underlying brain function using electroencephalography, or **EEG**, a technology that provides a reading of brain

activity, we also discovered a graded impact on brain function (Figure 25.1.3). The frontal part of the brain in exposed individuals was intensely active; the greater the fire exposure, the more frontal brain activity was observed. This greater frontal brain activity readout suggests greater cognitive effort to perform the task at hand, but even this greater brain effort was not enough to support normal cognitive functioning, as wild-fire-exposed individuals performed 20% worse than controls.

We can understand this greater frontal brain activity readout in fire-exposed individuals as a sign of hyperarousal that has been previously observed in PTSD. When the brain is undergoing a stress response, everything in the environment can appear threatening. One is unable to distinguish goal-relevant information from distractions. The brain is overactive trying to process all stimuli, yet failing at the task at hand. These findings are important because they provide the first-ever objective report of impacts on cognitive and brain functioning in the context of a climate-change-accelerated extreme weather event.

Notably, these findings provide a biological basis for **climate trauma**, anxiety about impending environmental doom. Future work will need to answer whether these biological impacts are long-term and here to stay or whether there are effective interventions that can lead to recovery from these impacts.

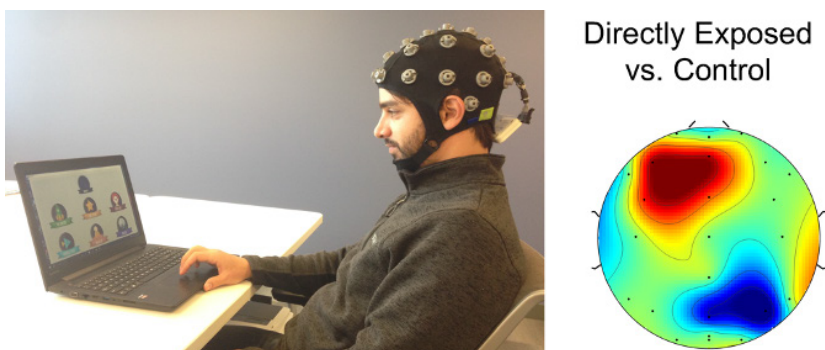


FIGURE 25.1.3 Electrodes placed on the scalp (left) provide an electroencephalography (EEG) recording of brain activity (right) as a person responds to cognitive tests. The image on the right shows a significant differences between individuals directly exposed to the Camp Fire and unexposed controls, with greater activity in the left frontal scalp region (red) showing intensely greater activity and therefore greater cognitive effort in the directly exposed group. From Grennan et al. 2023.

Given that climate-change-accelerated disasters are relatively new phenomena, emergence of the term *climate trauma* helps us to understand their mental health impacts.

Climate trauma encompasses the mental health effects of climate-change-accelerated events. Coined by climate psychology researcher Zhiwa Woodbury in 2019, it is more apt a term than, say, *PTSD*, because it suggests we are not separate from the Earth, its ecosystems, and its climate. Woodbury argues that with climate trauma, we are both the problem and the solution. We are the traumatizer and the traumatized. What affects the planet affects us.

Climate trauma also represents a form of trauma that may supersede or intersect with all other traumas. This consideration allows us to see how there is another layer of disadvantage for the communities that will be facing the worst of climate change and have done the least to cause it. Notably, these are the communities that are already dealing with high levels of non-climate trauma driven by socioeconomic determinants and poor access to health care resources.

Summary

Let us summarize what we have learned in this section:

- The mental health impacts of climate change are real, quantifiable, and chronic, that is, persisting in the long term even after the climate-change-accelerated extreme event has passed. These effects are also graded; that is, maximum impact is felt by people who are directly exposed to the extreme event, while indirectly exposed individuals also suffer but to a lesser extent.
- In recent research, we have found that cognition and brain health can also be affected—there can be specific impacts on how we process distractions. Hence, our ability to focus can be weakened, which may also result in anxiety and depression.
- Acknowledging these effects as climate trauma, distinct from other forms of trauma, is very important for finding solutions, especially equitable solutions for our vulnerable communities. These communities have done the least to cause the climate change and yet are the prime sufferers. In this regard, climate change impacts on

mental health intersect with climate justice for our most climate vulnerable communities.

- *Climate trauma* is a term that encompasses the mental health impacts of climate change. Acknowledging such trauma is a first step toward developing effective solutions to the climate-induced mental health crisis.

Reflection

At this point, take a moment to reflect on how you identify with climate trauma—as a personal experience or as an observation within your larger community.

25.2 Interconnected Links between Mental Health, Physical Health, and Community Health

Mental health does not exist in isolation. Chronic mental health problems are closely tied to physical health problems like cardiovascular disease, respiratory health, and overall reduced physical fitness. In fact, when we take the case of depression, which accounts for the largest global burden of all mental disorders in the general population, then 50% of cases of depression have a comorbid physical condition. Sometimes unique socioeconomic factors within communities, such as poverty and poor health care access, can lead to comorbid conditions such as depression and diabetes, producing what is referred to as **syndemic suffering**—two disease clusters occurring in a population and exacerbating the burden of disease. Specifically, a syndemic is defined as an interaction between several diseases that makes each disease worse.

Overall, mental health is not tied to just physical health but also to the health of our communities (Figure 25.2.1). Where there is poor mental health, there is greater aggression and community violence observed, alongside a disrupted sense of belonging. In this context, climate change is expected to increase rates of crimes and decrease community cohesion, leading to greater social instability.

One of the most prominent ways in which climate change affects mental health and community health is encompassed in the term **solastagia**. This term was coined by the Australian environmental philosopher Glenn Albrecht in the early 2000s to describe the unique mental anguish and emotional and existential distress caused by living with the experience of negative environmental change, particularly displacement caused by climate change. According to the United Nations, 80% of those displaced by climate change are women, highlighting inequities in climate migrations and in the experience of solastagia. Being a woman, being poor, and having immigration-related stress can certainly precipitate depression, as has been shown in specific Mexican immigrant communities in the United States.

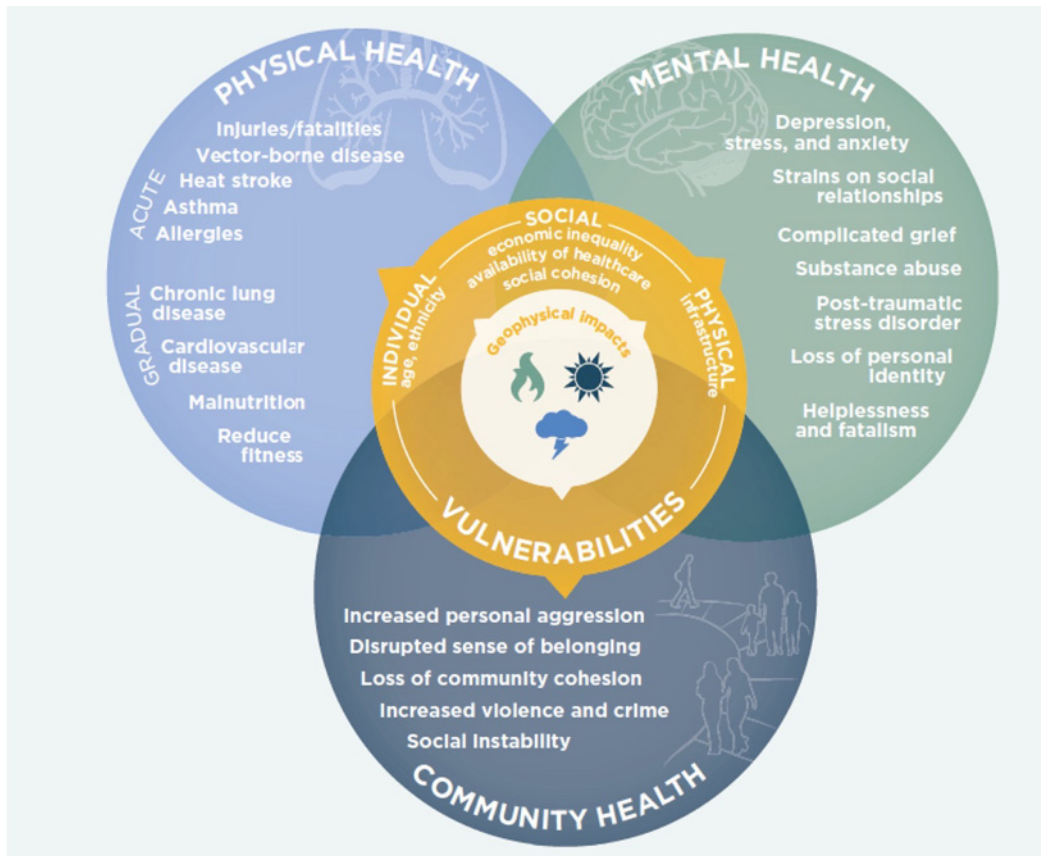


FIGURE 25.2.1 The nexus of mental health, physical health, and community health. From Clayton Whitmore-Williams et al. 2017.

Our well-being is interconnected with the health of our community primarily because we live in a system of limited natural resources that are accessible to us and that are sustained by our climate systems. Our climate system governs temperature, precipitation, extreme weather, ice cover, ocean currents, and sea levels. These variables in turn sustain and stress natural resources, including water and land ecosystems, biodiversity, and marine resources as well as nonrenewables. Human security with regard to water, food, energy, health, income, and livelihood are impacted by natural resources. Further, human security is critical for social stability and cooperation, and without it there is risk for greater violence, conflict, and migrations. This interactive system is shown in Figure 25.2.2, demonstrating dynamic links between climate sensitivity, environmental and human vulnerability, and social conflict sensitivity.

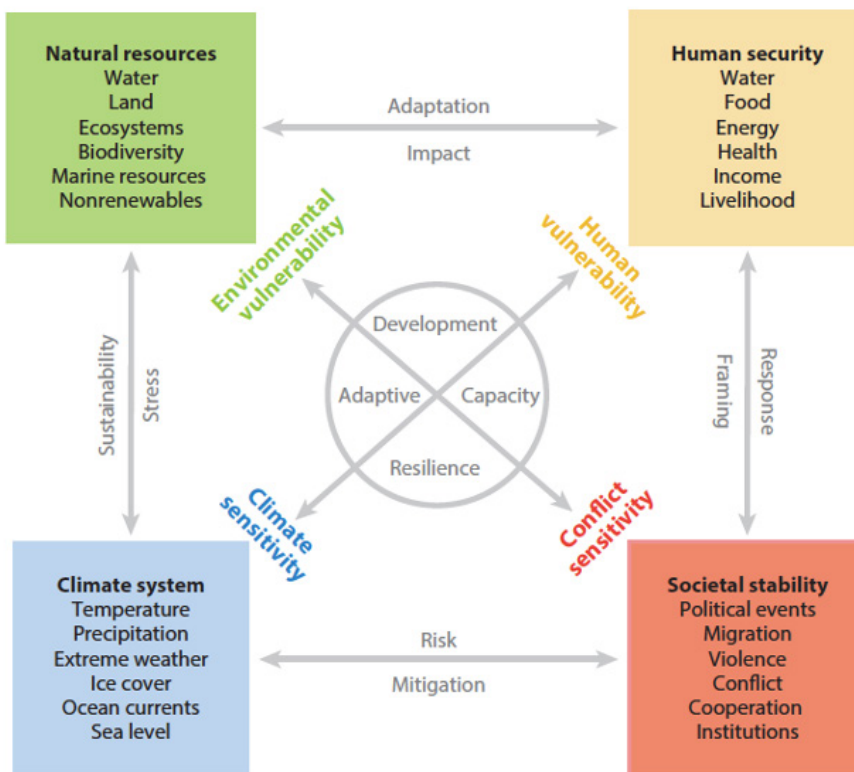


FIGURE 25.2.2 The interactions between climate systems, natural resources, human security, and social stability. From Levy et al. 2017.

A lived-experience quote regarding this interconnected system comes from the Inuit community. The Inuit say, “We are the people of the sea ice. If there’s no more sea ice, how can we be its people?” This quote is striking because it shows how the identity of the people, their society, and the resources they depend on are intimately related as they interact with the natural climate system.

In a study in 2018, Rupa Basu and colleagues evaluated how an increase in temperature changes the risk for mental disorders, suicide, and community violence. They looked at data from nearly 2 million emergency room visits in California with seasonal temperature changes of 10F in the 2005–2013 time period. The researchers found that mental health disorders, self-injury/suicide cases, and inflicted injury/homicide cases were all significantly greater in the warmer temperatures, with 5%–10% increase in risk for these conditions. They further found that the effects were more pronounced for Hispanics, for children, and

for women, again highlighting socioecological disparities. Additionally, noncoastal climate zones had the majority of emergency room visits, approximately 75%, while coastal climate zones had the remaining 25% of visits, showing geographical disparity in climate stress. The study did not find an increased risk for the elderly, partly because they analyzed emergency room visits but not mortality or hospital visits. Interestingly, elderly persons with mental health disorders in California typically reside in medical care facilities where they spend most of their time indoors, usually in climate-controlled environments, with lower risk of morbidity/mortality following heat waves compared with younger age groups. Overall, we understand that multiple factors can lead to poorer mental health outcomes with temperature rise. Basu and colleagues discuss how as temperatures rise, stresses from everyday life in the home, social networks, and the workplace are all likely exacerbated, particularly for people who already have mental health problems. In periods of extended temperature increase such as heat waves, irritability and psychological distress (including risky behaviors such as alcohol consumption), violence, and aggression become more common. Hence, as more frequent extreme heat days are projected over this century, our personal mental health as well as the health and well-being of the community in which we live are at risk.

Summary

Let us summarize what we have learned in this section:

- Chronic mental health impacts are very closely tied to physical ailments like respiratory disease and cardiovascular disease. The underlying biological mechanisms of the co-occurring mental and physical disorders can interact and exacerbate health conditions. This interaction is referred to as a syndemic. Deteriorating climate systems can contribute to the proliferation of syndemic disorders.
- *Solastagia* is a relevant term in the context of interactions between the changing climate and mental health. It refers to the mental anguish and existential distress felt when one experiences negative environmental change, especially displacement caused by climate change. It is a common feeling in climate refugees who must leave

their native land because it is no longer habitable due to climate change.

- Climate sensitivity interacts with vulnerability of natural resources that threatens human security. These stressors can precipitate poor mental health, which in turn interacts with community health and can generate violence, aggression, inflicted injury, and overall greater social instability. Studies find that women, children, and ethnic minority populations are especially at risk.

Reflection

Reflect on whether you have observed links between your personal mental and physical health and even community health. How do these interconnections tie in with social inequities present in the community? If you have not had a personal experience, it is also worth reflecting on an experience of a family, friend, or acquaintance.

25.3 Community Solutions for Climate Mental Health Resiliency

In the first section we defined climate trauma as encompassing the mental health impacts of extreme environmental events caused by climate change. Climate trauma is characterized by heightened symptoms of PTSD, anxiety, and depression. While these symptoms may emerge *after* an extreme environmental event, many humans today are also anxious about impending environmental doom even when they have not yet personally suffered from any disaster. This latter phenomenon is termed **climate anxiety** or eco-anxiety.

Climate anxiety, like climate depression or climate rage, is actually not a pathology, especially if it doesn't debilitate the individual and hinder daily activities. Climate anxiety is actually a very reasonable and healthy response to an existential threat and can motivate us toward action. In fact, political psychology research shows that opinion shift regarding the impact of climate change is more likely in individuals with greater climate anxiety. More climate anxiety alongside greater political knowledge and political interest can stimulate the greatest collective action (Figure 25.3.1). This research has also found that these political action effects can be more pronounced in left-leaning than right-leaning individuals.

Here is a concrete example of how climate anxiety has mobilized political change. In Virginia during the senate elections in 2019, the Green New Deal was put forward. It connected climate impacts to practical solutions with regard to health care and jobs. The campaign's mandate was

- to prioritize a just and equitable 100% renewables plan that leaves no workers behind;
- to prioritize large investment and job training in renewables, and energy efficiency;
- to prioritize clean water, air, land, and equitable and affordable housing and transportation systems.

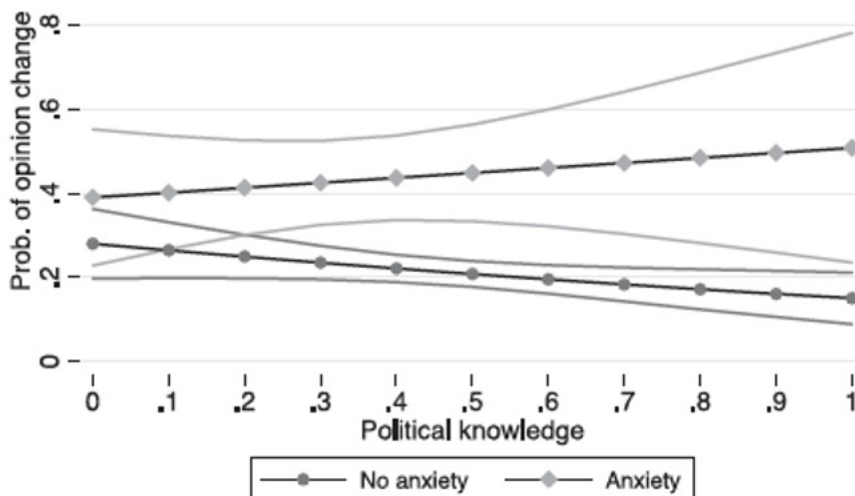


FIGURE 25.3.1 Greater political knowledge along with greater climate anxiety produces greater probability of political opinion change in the context of climate change, showcasing how climate anxiety can be beneficial for climate action and is not necessarily a pathology. From Nai et al. 2017.

Several advertisements showed need for greater health care mobilization in the context of the climate emergency. Notably, health care is a bipartisan issue, and new studies suggest that we can get even climate skeptics on board when climate-change-related policies are framed in the context of health. Ultimately, the Green New Deal campaign in Virginia was successful, bringing new solutions that benefit community security, stability, and mental health.

Another great example of a community solution is when physical commuting is emphasized. We know that physical exercise is good for the body and for the mind! In Arlington, Virginia, and the Washington, DC, area, the Capital Bikeshare program was introduced in 2010. One study sampled 3,000 individuals from the DC community and found that weekly exercise increased as individuals in the community joined the Capital Bikeshare program. Alongside the increase in exercise, greater health and well-being was also observed, with a higher percentage of individuals reporting very good and excellent health after joining the Capital Bikeshare physical commuting program.

Yet another example comes from introducing public transportation options in our communities. It is well known that in cities and countries,

especially in Europe, that have greater walking and public transit opportunities, the obesity rates are much lower. This is important because of the tight associations between physical and mental health that we covered in the previous section. Obesity has a high likelihood of being associated with poor mental health, especially depression and anxiety. Hence, implementing public transportation solutions can contribute to lowering national obesity and thereby contribute to overall better mental well-being.

Finally, a study in England in 2018 showed that public transport users have lower depression scores than nonusers, regardless of obesity, and that this difference is especially striking in old age (Figure 25.3.2). For the elderly, public transportation can be an excellent opportunity to socialize and, thereby, even be part of the solution for the loneliness epidemic gripping our society.

Next, we will discuss green spaces. In a study from the United Kingdom, in which 1,064 households participated, it was found that community green spaces benefit mental health. Households were surveyed once a year every year for 5 years. It was found that in individual households that moved to a greener community, there was significant improvement in mental health. In contrast, individual households that moved to less green areas showed no related change in mental health. The level of

greenness around the homes was derived from the Generalised Land Use Database (GLUD) for England. In this database, land use is divided into nine categories: green space, domestic gardens, water, domestic buildings, nondomestic buildings, roads, paths, railways, and other area. For the study, green spaces included gardens. The study rigorously controlled for socioeconomic factors, including income, employment, education, and crime as well as individual differences in age and households with/without children.

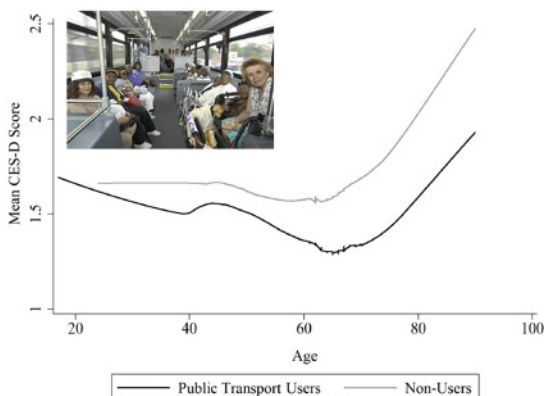


FIGURE 25.3.2 Public transportation users exhibit lower depression scores (on the Center for Epidemiologic Studies Depression Scale, CES-D), and this benefit is especially prominent in older adults. From Reinhard et al. 2018.

In another study of green spaces, researchers in Barcelona, Spain, observed the cognitive development of 2,500 elementary school children. Elementary school age is a critical time for the development of cognitive abilities. The researchers observed the children and conducted cognitive assessments every 3 months, four times during the full year. The study found that children going to school in greener spaces had better cognitive development. For those schools that had access to greener space, children showed significantly greater working memory, and this ability even improved over the course of the year of observation (Figure 25.3.3). Working memory is the capacity to remember and manipulate information for brief periods of time and is a core aspect of human cognition. Thus, the positive impact of green spaces on cognitive ability can have important policy implications for both health and education. Importantly, the researchers controlled for differences in socioeconomics between observed children. The study further showed that this relationship between community greening and better cognition was mediated by reductions in traffic-related air pollution as measured by assessing the levels of ultrafine air pollution particles and nitrogen dioxide in the area. Other research has shown that cognition can be negatively impacted by living in polluted cities, so city greening can be an excellent community solution to enhance mental health and related cognitive abilities. Overall, the study authors wrote that “our findings

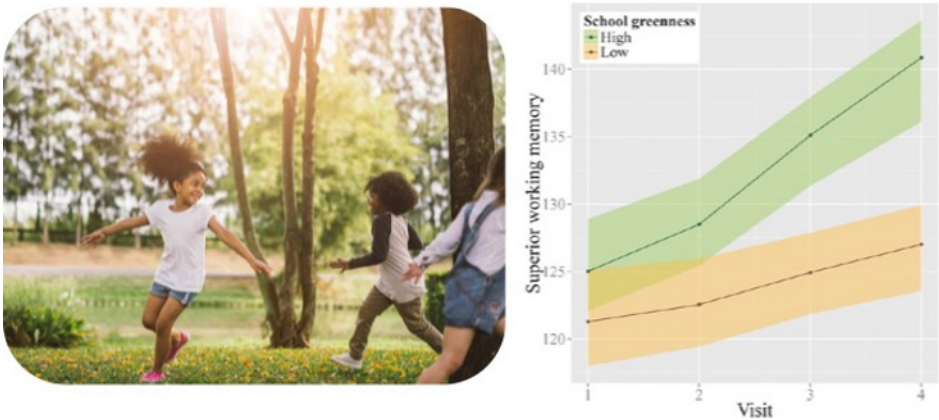


FIGURE 25.3.3 Green spaces benefit cognition of elementary school children measured every 3 months, four times over the course of a year. From Dadvand et al. 2015.

provide policymakers with evidence for feasible and achievable targeted interventions such as improving green spaces at schools to attain improvements in mental capital at the population level.”

Finally, in one study from Austria, researchers observed the effect of “green breaks” provided to high school students. A green break was when students took a classroom break within a green space. Sixty-four high school adolescents participated in this study and took 1 hour lunch breaks in a small urban park, a large urban park, or a forest area. The small urban park was a heavily used park with few trees and was surrounded by heavily used streets and dense residential areas. The large urban park had several trees but was still located in the urban area, while the forest was a larger area with broad-leaved trees and some scattered meadows and had low visitor numbers. The study’s main finding was that breaks in any of these green spaces produced significantly improved concentration from a baseline of zero that was measured in the classroom before the breaks. Interestingly, concentration performance was most improved after breaks in the large urban park—a practical lesson that you can apply to your own classroom breaks as well.

Overall, this section has aimed to highlight with several evidence-based examples that when we implement climate-forward community solutions, they greatly benefit public health and mental health. When we champion clean air solutions in our communities through energy-efficient power generation; have better waste management; and provide universal access to affordable and clean technologies for cooking, heating, and lighting, then we also alleviate health burdens in our communities and, further, reduce related anxiety and depression. This has been evidenced in several studies and is promoted by the World Health Organization.

Interestingly, in the United States a new bill was introduced for consideration by Congress in 2023, the Community Mental Wellness and Resilience Act. This is a landmark bill proposing to fund community-led initiatives that use a public health approach to prevent and heal mental health problems caused by toxic stresses, emergencies, and disasters. If enacted, this policy will, for the first time, authorize the Centers for Disease Control and Prevention to fund and support community-led initiatives all over the US that use public health approaches to

proactively build mental wellness and resilience and heal mental health problems generated by climate-related emergencies and disasters. An act of this type is urgently needed because mental health problems have reached an epidemic level today; nearly 20% of all adults have a mental health problem, 5% of adults have a severe mental illness, and over 11 million adults report serious thoughts of suicide. The climate emergency causing historic storms, heat waves, droughts, floods, wildfires, hazardous smoke events, and other disasters in the US is only exacerbating these problems and creating new ones. It is estimated that in 2021, 40% of Americans lived in a county that was impacted by a major natural disaster. My team's own research has shown that both directly exposed individuals and those indirectly exposed can suffer from climate trauma, and up to 40% of the affected population can develop mental health problems. Thus, the number of people who experience mental health problems as a result of a climate-change-driven disaster can often surpass the number of people with physical injuries by 40 to 1. Notably, there will never be enough mental health providers to meet this burgeoning mental health need with one-on-one therapy, and the need is only projected to grow. Thus, support for community-led and community-integrated initiatives is urgently needed, and this need is exactly what the Community Mental Wellness and Resilience Act aims to meet.

Summary

In this section, we learned about community-led and evidence-based solutions for health and mental well-being. These are our main takeaways:

- Climate anxiety can be good in that it serves a specific purpose—it can help individuals change their political opinions toward adopting climate-forward solutions and stimulate collective climate action.
- Examples of climate-forward community-benefiting solutions include the Green New Deal policy in Virginia, access to public transport, physical commuting, green spaces, and clean air, which in turn benefit multiple facets of health, including physical health and mental well-being, and further lay the foundations for greater cognitive fitness.

- We need support for new policies such as the Community Mental Wellness and Resilience Act introduced to the US Congress to meet the growing mental health needs in the face of the climate crisis. In this regard, community-led solutions can be effective and scalable to a greater extent than trying to provide access to clinical mental health experts. Such a community-led model has previously been shown to be effective in global mental health settings as well, and there is new evidence that it will be effective at the intersection of climate and health, which has stimulated support for the new congressional bill.

Reflection

At this point, pause and reflect on how you can leverage your own climate anxieties toward positive community action. Remember that for effective community action, we must think globally (in terms of scalable solutions) and act locally (within the communities that we know and love).

25.4 Individual Solutions for Climate Mental Health Resiliency

In this section, we will discuss how we can develop our personal mental health resiliency in the context of climate change and especially when major news and media may focus on doom and gloom. Developing and sustaining personal resilience can be very important in this context.

A changemaker is someone who turns ideas into action for the good of all. To become climate champions or climate changemakers—individuals who proactively partake in climate action—we must first focus on the health and well-being of our minds and a strong learning and growth-oriented mindset. The first essential step in the process is climate awareness and education, and I congratulate you for already taking that step by engaging with the Bending the Curve course.

My research team has found that while climate-change-accelerated extreme events are associated with PTSD, depression, and anxiety that fall under the umbrella of climate trauma, there are certain personal factors that can be protective of well-being in this context (Figure 25.4.1). These factors include belief in personal resilience, which is the cultivated self-confidence that you can bounce back from a stressor, mindfulness in the present moment, and physical exercise.

There are many studies showing the benefits of mindfulness on mental health and brain health, and there are several ways to practice mindfulness. Our own research has even demonstrated that mindfulness can be helpful to alleviate the cognitive and brain health impacts of childhood trauma. Here are five beneficial mindfulness practices that you may incorporate in your life:

1. The most intuitive mindfulness practice is attention to breathing. How you breathe can turn on or off your response to threat, so being mindful of your breathing and keeping it slow and paced can keep you relaxed when under stress. In general, it is advisable to practice daily mindfulness in a safe, seated, and

comfortable position, never while operating heavy machinery or during strenuous exercise. Also, there is no self-judgment during mindfulness. If your mind is distracted, become aware of the distraction, do not involve yourself in that distracted thought, and simply revert back to attentive breathing.

2. Diaphragmatic breathing, or inhaling from your belly, can help to balance the nervous system and shut down your fight-or-flight response to threat. In ancient Hindu culture, it is also called *pranayama*. *Prana* implies “vital life force” (the breath), and *yama* means “control.” You can add a count to the attentive breathing; for example, inhale for 3 seconds, hold for 1 second, exhale for 4 seconds. A recent study showed that cyclic sighing, which emphasizes prolonged exhalations, practiced 5 minutes a day can be very effective for improving mood.
3. Also integral to mindfulness is sensory grounding—stopping and becoming aware of all five senses: sight, hearing, smell, taste, and touch.
4. Then there is the practice of slowly scanning your body and observing all of your bodily sensations from the toe, foot, shin, knee, upper leg, hip, belly, chest, neck, chin, mouth, nose, eyes, gradually working upward to the head. The core focus here is again mindful observant practice, in this case attending to internal sensations of the body that we often take for granted.
5. Finally, the mindful sensing of the grape exercise is famous and can be enjoyable as well. Select a grape, observe it in your fingers, and then slowly place it in your mouth but don’t eat it. Imagine its color and shape. Notice its smell and its texture, then carefully and slowly bite it and be mindful of what you taste. Take your time with this exercise—up to 5 minutes to mindfully reveal what a single grape has to offer. This exercise can be helpful in cultivating mindfulness.

An important practice for developing resilience for times of stress is to have a list of what works for us individually, and what doesn’t. For example, my personal list includes attention to breathing, being outdoors with all my senses of observation, and being fully present with my

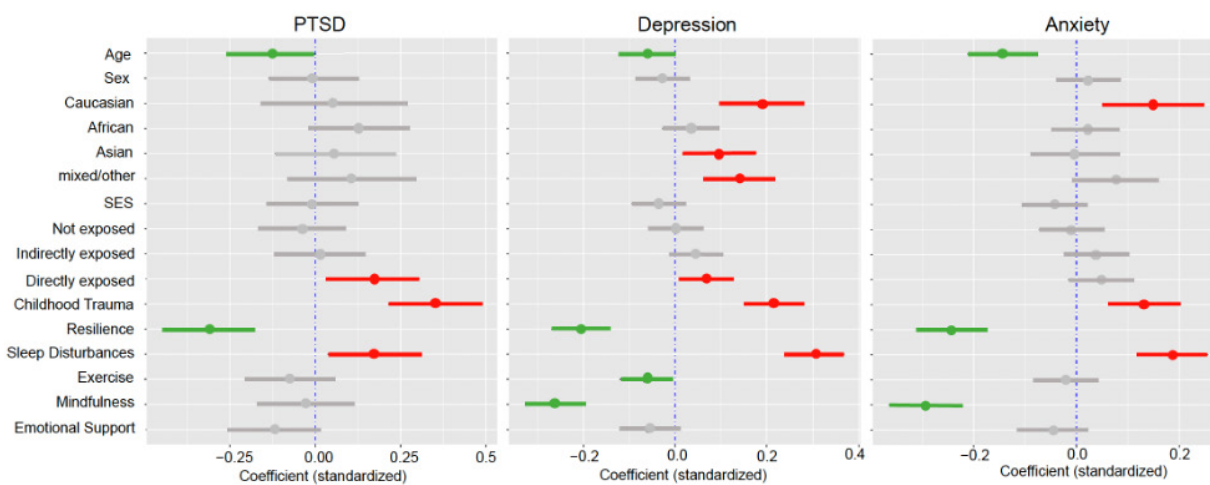


FIGURE 25.4.1 These charts show the factors that influence development of PTSD, depression, and anxiety in the context of climate trauma experienced after climate-change-accelerated wildfires. Variables in red significantly contribute to poorer symptoms; these include ethnicity, direct exposure to the fires, prior exposure to childhood trauma driven by neglect or abuse, and poor sleep. On the other hand, variables in green significantly contribute to well-being and protection from symptom development; these include older age, personal resilient beliefs, exercise, and mindfulness. Distance from the zero line indicates magnitude of influence. The gray variables do not have a significant effect on mental health. Note that resilient beliefs and mindfulness have very large contributions to well-being. From Silveira et al. 2021.

family, especially my children. Exercise, dance, and a good night's sleep also greatly calm my mind. My never list when under stress includes social media scrolling, eating junk food, and consuming excess alcohol—while these may be feel-good engagements in the short term, they only distract from the stress and do not allow me to refresh and rest. It is essential to have such a personal list that you can go back to as a reminder to rebalance when you are feeling stressed.

In our climate trauma research, we also find that individuals who have stronger family support systems and feel emotionally supported by their family members as well as close friends show greater mental health resilience and well-being. Thus, practicing reciprocal kindness, love, and generosity toward our family and friends can go a long way in protecting our mental well-being. In this regard, families can also plant the seeds for sustainable climate action. It is important to discuss

climate change and its impacts within our family conversations, for what is not discussed is really not important! This can certainly influence participation in climate action. At the University of California, we have many climate action campaigns, and my family has actively participated in the Green New Deal movement on campus to promote sustainable practices including divestment from fossil fuels and electrifying our campuses with renewables. In this regard, the UC system can be a role model for universities worldwide, showcasing how grassroots action from students and employees can stimulate meaningful climate action. In fact, climate science and policy experts acknowledge that we already have the technologies in place to mitigate climate change, but what is missing is strong public and political support, for which collective action is essential.

Further, the family can be the place of origin for sustainability skills, such as the backyard composting that my children regularly help me with. Proper composting and taking care that food waste does not end up in landfills is actually a very important climate action. Food waste in landfills generates gases such as methane, a short-lived climate pollutant, or **SLCP**, that contributes to global warming. Did you know that food waste makes up 44% of global waste?!

Research on SLCPs as significant contributors to global warming—apart from the major climate pollutant, carbon dioxide (CO₂)—has been led by renowned climate scientist and founder of the Bending the Curve course V. Ramanathan. Beyond his research, Dr. Ramanathan has actively engaged our state leaders in climate policy and SLCP reduction strategy such that California recently passed a law to enhance composting and reduce food waste.

Beyond the family, our research also shows, a stronger sense of community can protect our well-being in the context of climate trauma. Sense of community is best developed by being active participants within our communities. Caring for our communities can involve sharing and creating resources for one another, and creating dependable relationships.

Here are some examples of community care:

- Cook or clean for a loved one who is going through a tough time.
- Carpool.

- Ask for help from your community support system when you need it, and reciprocate it.
- Get to know your neighbors.
- Use digital or in-person spaces that offer bonding and connection over a particular topic or for a specific group of people.
- Donate or organize donations for community members who have experienced a crisis.
- Volunteer.
- Host a regular community gathering.

Importantly, community groups can take climate action, especially within climate vulnerable settings to help organize and assist community members in developing household emergency action plans, such as California's wildfire action plan. Research has shown that having such emergency plans in place can allow individuals to bounce back resiliently after a disaster.

Finally, I want to discuss nature-based therapy, also known as the practice of forest bathing, which has its roots in Japan as *Shinrin-Yoku*. **Forest therapy** is an evidence-based practice shown to promote mental health and well-being. It is actually being practiced and offered in California in climate-trauma-impacted communities by registered ecotherapy guides such as those who are part of the Chico State Ecotherapy program (Figure 25.4.2). Forest therapy, or ecotherapy, is important because it can help to reestablish a positive human-Earth connection that is destroyed in the context of climate trauma. In climate trauma, even after the environmental disaster has long passed, the natural environment that is meant to rejuvenate us can itself lead to post-traumatic stress. Thus, it is very essential to reconnect positively with the environment as part of the healing process.

To describe forest therapy, we start with what it is not. It is not simply a hike, or a nature walk. The intention is to slow down and mindfully experience the natural world through all your senses. Many times having a certified guide is very helpful, but you can also try to practice forest therapy on your own. The guide offers a series of invitations to help participants cultivate deeper sensory experiences and find their own authentic way of interacting with the nature around them. These



FIGURE 25.4.2 Participants in a mindful ecotherapy session in the Chico State Ecotherapy program. Photograph by Xxxx Xxxx.

opportunities are very purposefully called invitations because there is no right or wrong way to interact with the surrounding nature. There are no grades or evaluations. At several points during the natural engagement, sense how it makes you feel, what you notice. If you feel comfortable, you can also share this in a group in words in any language, silence, dance, song—it's all welcome. Forest therapy can provide profound opportunities to really listen to each other and learn from each other's natural healing process.

This model of nature therapy advocates for a relational rather than prescriptive model for healing. This implies collective and connected healing within our community, helping us strengthen our feelings of belonging, purpose, and fulfillment. The forest is the therapist, and we use the language of invitation to experience it with full attention and mindfulness. In this natural connection, we value unique discovery, all our individual stories, and different ways of experiencing. When individuals partake in the Chico State Ecotherapy program for multiple sessions, the later sessions also focus on Indigenous tribal practices that help them to become responsible stewards of the surrounding environment, to nurture it and actively participate in ecological restoration. In this

way, we can give back to, take care of, and nourish the environment that is healing us.

As we witness the impact of many severe wildfires in Canada that are likely to occur annually, it is interesting to note that as of 2022, Canadian physicians can prescribe positive engagement with nature to their patients. This means that the Canadian health system can provide people with free passes to visit national parks when it is safe to do so, as a way to relieve stress. A positive and mindful human-Earth connection is an essential component of climate mental health resiliency.

Summary

Here is a recap of what we have learned in this section:

- Developing a plan for individual climate mental health resiliency is very important, especially in current times when climate-related stress, trauma, and eco-anxiety can be unavoidable. The first step in the resilience process is climate awareness and education. Congratulations on taking this first step, and we hope you will spread the information you are learning.
- We find that individual well-being can stem from a sense of personal resilience—the belief that you can bounce back from stressors—as well as from mindfulness practice and from physical exercise. Make a plan based on what works for you, practice it, and revisit it often to ensure it is relevant.
- Family ties and community connection are also highly protective of well-being in the context of climate stress and trauma. Develop these ties and leverage them to inculcate sustainable climate action and also have emergency plans in place for future disasters.
- Connecting with nature can be therapeutic. Forest bathing, or ecotherapy, is an important practice that can help to rejuvenate a positive human-Earth connection. While this section has described components of a guided ecotherapy session, you can also practice mindful immersion on your own in your local park or other natural environment. Take the time to experience nature around you with all your senses.

Reflection

Finally, for your own reflection and well-being, shape and customize your own individual mental health resiliency plan with the resources provided to you in this section.

Sources for the Figures

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Figure 25.1.2: Silveira, S., et al. 2021. Chronic mental health sequelae of climate change extremes: a case study of the deadliest Californian wildfire. *International Journal of Environmental Research and Public Health* 18, 1487.

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Figure 25.3.3: Dadvand, P., et al. 2015. Green spaces and cognitive development in primary schoolchildren. *Proceedings of the National Academy of Sciences USA* 112, 7937–7942.

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Chapter Glossary

Following is a list of terms and acronyms used in the chapter.

TABLE 25.1.1 Glossary Items

Term	Definition
Climate anxiety	Anxiety about impending environmental doom
Climate resilience	Ability to bounce back in the aftermath of a stressful climate event
Climate trauma	Mental health impacts of climate-change-accelerated extreme weather events
EEG	Electroencephalography
Forest therapy	A nature-based practice that cultivates mindfulness and positive reconnection with our natural environment
PTSD	Post-traumatic stress disorder
SLCP	Short-lived climate pollutant
Solastagia	Mental anguish and emotional and existential distress caused by living with the experience of negative environmental change, particularly displacement caused by climate change
Syndemic suffering	Health consequences of the biological interactions that occur when two or more diseases or health conditions, such as depression and diabetes, co-occur within a population
WHO	World Health Organization