Focus

SPRING 2024

A CLIMATE CHANGE HANDBOOK

FROM THE YALE SCHOOL OF PUBLIC HEALTH

Students Arinze Agu, at right, and Cristina Arnés Sanz, second from right, at the Climate Reality Project in New York City. The event was hosted by former U.S. Vice President Al Gore in April. Arinze and Cristina's essays appear in this handbook. Also pictured next to Cristina from left to right are YSPH students Bryn Redal, Alexandra Nechaev, and Aline Maybank.

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Focus

SPRING 2024
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A CLIMATE CHANGE HANDBOOK: SCIENCE + ACTION

Climate change is the most serious public health challenge of our time. This handbook seeks to inform with rigorous, impactful science from YSPH experts. The handbook also includes actions you can take for a healthy planet.

DOWNLOAD
Scan this QR code with your phone's camera to download a pdf of the handbook.

SUPPORT A HEALTHY PLANET
Give to the Climate Change and Health Fund and support a public health response to a changing climate.

bit.ly/CCCHfund

A publication of the Yale SCHOOL OF PUBLIC HEALTH

DEAN'S WELCOME

USING SCIENCE AND ACTION TO CREATE A HEALTHIER WORLD

Here at the Yale School of Public Health, we're committed to creating systems solutions to the world's most pressing health problems. From innovations in cancer diagnosis, to work on humanitarian crises across the globe, to a new research leadership program in India, to collaboration with New Haven community groups to reduce health disparities, we are using science to create a healthier world.

But an enormous challenge looms: Climate change, perhaps the greatest public health threat of this century.

Exactly because climate change represents an existential challenge to human health, it also presents our greatest opportunity. As Robert Dubrow, professor of epidemiology (environmental health sciences) writes on the following pages, "When we tackle climate change, we simultaneously address some of the other major public health challenges of our time." And here at YSPH, we are doing the work to create change—within and outside of Yale.

This year's Focus magazine by the Yale School of Public Health (YSPH) is therefore presented as a Climate Change Handbook, a compendium of some of the most impactful and rigorous climate change science and action being done by YSPH experts. It contains essays written by YSPH faculty, students, staff, and alumni. Finally, it highlights some of the interdisciplinary work we're undertaking with leaders across campus, including the newly appointed Vice Provost for Planetary Solutions, Julie Zimmerman.

Read on to learn how rising temperatures affect population health; why polluted air may impair brain function; how our favorite snacks may be worsening our planet's health; and more. And then enjoy the stories with solutions—some of which you may be able to implement, or advocate for, in your own community.

This YSPH Climate Change Handbook is designed so that you can download it onto your cellphone and refer to it often. We hope the essays will not only inform you, but also inspire you. For this reason, we've included an Action Item for Change with each essay, and a page where you can create your own action plan. As Sarah Lowe, associate professor of public health (social and behavioral sciences) reminds us in her essay, collective action eases climate anxiety—and makes a difference.

Enjoy this handbook! And let us know what you think, or what new goals you're making.

I look forward to your using science and action to create a healthier world, together.

- Dr. Megan L. Ranney, MD

Dean, Yale School of Public Health
C.-E. A. Winslow Professor of Public Health

SCIENCE

This year's Focus magazine by the Yale School of Public Health (YSPH) is presented as a Climate Change Handbook, a compendium of some of the most impactful and rigorous climate change science and action being done by YSPH experts.

– Dean Megan L. Ranney

+ ACTION

Scan this QR code to watch a video that features several of our essay writers.

THE TREMENDOUS PUBLIC HEALTH OPPORTUNITY OF CLIMATE ACTION

The world is experiencing one climate change-related public health disaster after another. Unprecedented heat, wildfires, floods, Category 5 hurricanes, and extreme droughts are causing increasing illness and death. The declaration by a Lancet Commission of academics and editors of *The Lancet* medical journal in 2009 that climate change is "the biggest global health threat of the 21st century" is becoming more real. Clearly, the world community must urgently reduce greenhouse gas emissions. But we are also facing many other public health challenges. How do we set priorities?

Ambient air pollution from fossil fuels causes more than 5 million deaths per year globally. Fine particulate matter (PM2.5) emitted when fossil fuels are burned causes most of these deaths, from heart and lung disease, stroke, and diabetes. PM2.5 has been linked to preterm birth, low birth weight, dementia, Parkinson's disease, respiratory symptoms, and asthma exacerbations. Two other pollutants formed when fossil fuels are burned—ground-level ozone and nitrogen dioxide (NO_2)—also cause respiratory symptoms and trigger asthma attacks. But there is a technically and economically feasible solution: phase out fossil fuel use in favor of clean, renewable energy.

Indoor air pollution from burning fossil fuels is a related public health challenge. In kitchens with gas stoves, NO_2 levels regularly exceed the Environmental Protection Agency's standard. Children living in a home with gas cooking have a 32% higher risk of asthma than children living in a home without gas cooking. But there is a solution: enact regulations and financial incentives and subsidies to replace gas stoves with electric stoves and require electric stoves in all new buildings.

Heart disease, stroke, and diabetes account for about a third of the world's deaths. A sedentary lifestyle and an unhealthy diet are risk factors, but there are solutions. Although exhorting people to exercise and eat a healthier diet doesn't necessarily work, structural solutions have great potential. We can build attractive, safe walking and cycling infrastructure. We can provide financial incentives to ensure that grocery stores that sell fresh fruits, vegetables, whole grains, and legumes are present in all neighborhoods, and we could encourage consumption of these products by subsidizing them and taxing unhealthy foods such as red meat and processed meat.

To our great good fortune, the solutions to address these non-climate-change public health challenges are the same solutions we need to address climate change. When we phase out fossil fuels, we eliminate the main sources of the two most important anthropogenic greenhouse gases—carbon dioxide (CO_2) and methane (CH_4). When we electrify cooking, we stop emitting CO_2 and CH_4 from gas stoves. When we get people out of their cars, we reduce automobile CO_2 emissions. When we shift from an animal-based to a plant-based diet, we reduce agriculture's energy intensity and greenhouse gas emissions, and CH_4 emissions from cows.

Thus, when we tackle climate change, we simultaneously address some of the other major public health challenges of our time. This is why a 2015 Lancet Commission concluded that "tackling climate change could be the greatest global health opportunity of the 21st century."

- Robert Dubrow

Dr. Robert Dubrow, MD, is a professor of epidemiology, (environmental health sciences) and the faculty director of the Yale Center on Climate Change and Health.

1.5° | THE PARIS AGREEMENT'S GOAL IS TO LIMIT GLOBAL WARMING TO 1.5° CELSIUS.

YOUR ACTION ITEM FOR CHANGE

Walk, bike, or take public transportation.

Living car-free can reduce your carbon footprint by up to 2 tons of carbon dioxide equivalent (CO_2e) per year. Walking or riding a bike instead of driving also will help your health and fitness. *(The United Nations, Actions for a healthy planet)*

THE UNWAVERING VOICE OF YOUTH

The 28th United Nations Climate Change Conference in Dubai last December, known as COP28, was a pivotal moment for public health, with strong and meaningful youth participation. COP28 included the first-ever Health Day, which brought health to the forefront of the global climate agenda. Over 120 countries endorsed the COP28 Declaration on Climate and Health, committing to accelerating climate action and protecting human health.

I had the honor of attending COP28 as a youth representative of YOUNGO, the youth constituency for the United Nations Framework Convention on Climate Change. I would like to share my journey as a climate and health youth advocate, which led me to COP28.

First, as a member of YOUNGO's climate and health taskforce, I collaborated with the Yale Center on Climate Change and Health (YCCCH) at the Yale School of Public Health (YSPH) where I am a first-year student. We organized a meeting for other YSPH students to discuss the adverse health effects of the air pollution, wildfires, and extreme weather that many of us have experienced. The students emphasized the need for climate-resilient infrastructure and health systems; the importance of including climate change in education curriculums; and the burden of climate change on mental health.

I brought their input to the Local Conference of the Youth, a youth-led climate conference in Washington, D.C. As one of the youth delegates from across the U.S., I helped to draft the National Youth Statement that we would present to the U.S. government at COP28. I also included the YSPH students' concerns in the Global Youth Statement, adding their voices to the climate demands of 700,000 other young people from 150 countries.

At COP28, I presented the demands of the Global Youth Statement during Health Day. I spoke on a roundtable about how climate change is affecting our mental health, and what we can do about it. Finally, I discussed my research on climate-sensitive infectious diseases at a panel discussion, as I contributed to the development of a framework to build climate-resilient health systems against zoonotic and vector-borne diseases as a research assistant at Heidelberg University.

Now, I want to take a step forward from COP28, as climate action never stops. In March 2024, young people from Europe, North America, and Central Asia participated in the Regional Forum on Sustainable Development, where governments and stakeholders collaborated in an in-depth review of the Sustainable Development Goals (SDGs) that are scheduled for review by the United Nations, including Goal 13 (climate action). I helped to organize a regional youth assembly for the U.N. Major Group of Children and Youth, which concluded with a Youth Report that voiced the concerns and demands of our region's young people, who reinforced the importance of addressing climate change and health.

The voices of youth are unwavering. We should put health at the center of all climate conversations and negotiations as it is the most compelling reason to propel climate action. As a future MPH graduate, I feel it is both my purpose and responsibility to amplify this message, as we cannot have healthy livelihoods, nor a healthy future, on a sick planet.

- Cristina Arnés Sanz, MPH '25

Cristina Arnés Sanz is a first-year master of public health student in the Department of Epidemiology of Microbial Diseases with a concentration in climate change and health.

YOUR ACTION ITEM FOR CHANGE

Support the Youth Climate Movement.

Support the Local Council of Youth (LCOY) U.S. youth climate statement, a bold vision for climate action and justice. *bit.ly/YouthClimateStatement*

02

THE AGES OF THE 150 DELEGATES FROM ACROSS THE U.S. WHO DRAFTED THE NATIONAL YOUTH STATEMENT.

14-35

CLIMATE CHANGE & MENTAL HEALTH: THINKING BEYOND DISASTERS

My path to researching climate change and mental health was indirect. I applied to graduate programs in clinical psychology with the goal of studying how social determinants of health shape the educational and mental health trajectories of members of marginalized populations. That goal changed when Hurricane Katrina made landfall on the U.S. Gulf Coast on August 29, 2005. Katrina and its aftermath opened my eyes to the ways in which collective crises disproportionately affect low-income and minoritized groups, elucidating and exacerbating health disparities.

As a graduate student, I worked with an interdisciplinary team on a longitudinal study of low-income mothers who were community college students in New Orleans when Katrina hit, demonstrating the hurricane's impact on their physical and mental health, social relationships, education, and employment activities. The project launched me into the field of trauma and mental health, and I have since been involved in other disaster mental health studies, including in the aftermath of other major hurricanes.

Last year, I hosted a webinar on Climate Change and Trauma for the International Society for Traumatic Stress Studies with my colleagues Dana Garfin of the UCLA Fielding School of Public Health, and Betty Lai of Boston College. When asked how the field has evolved over the past decade, Lai replied that climate change was once rarely mentioned in disaster mental health research. This insight resonated with me. With mounting evidence that climate change is increasing the intensity of "natural" events like hurricanes, tropical cyclones, and floods, research on their consequences for health and well-being is increasingly urgent.

Yet disasters are only one of several ways that climate change could undermine mental health. Indicators of climate change are often subtle and slow-creeping—gradual increases in temperatures, years-long changes in ecosystems—and these, too, could contribute to psychological symptomatology. My colleagues and I recently published a systematic review of 57 studies on this topic, a strikingly small number compared to the robust disaster mental health literature. Our review identified several key research gaps, including a dearth of studies conducted in Central and South America and Africa—regions that are projected to face some of the most devastating consequences of climate change.

The mental health impacts of climate change also extend beyond those with direct exposures. The existential threat of climate change—the perception that it could dramatically and permanently reduce the quality of human life on Earth, up to the possibility of human extinction—is undoubtedly contributing to the current mental health crisis. Burgeoning research, for example, has delved into climate change anxiety, defined as negative emotional, cognitive, and behavioral responses associated with concerns about climate change. For example, in a pilot study with Dr. Laelia Benoit, MD, of the Yale School of Medicine, and colleagues at Suffolk University and the College of Wooster, we showed the expansiveness of young adults' worries and their links with clinically significant anxiety and depression.

I am often asked how I can study climate change, trauma, and mental health without succumbing to hopelessness and despair. In answering, I am reminded of a finding from our pilot study: young adults' climate change anxiety was positively associated with depression symptoms, but only among those who were not engaged in collective action. I see collaborative research on the mental health impacts of climate change, whether major disasters like Hurricane Katrina, chronic indicators or existential threats, as a form of collective action. By elucidating links between exposures and symptoms, we can inform how to foster resilience and strength in the face of global challenges.

- Sara Lowe

Sarah Lowe is an associate professor of public health (social and behavioral sciences), associate professor of psychiatry, and associate clinical professor of nursing.

YOUR ACTION ITEM FOR CHANGE

Take collective action.

Working with others towards productive environmental goals channels our concerns constructively, and is therapeutic.

03

65%

THE PERCENTAGE OF PEOPLE IN THE U.S. WHO SAY THE ISSUE OF GLOBAL WARMING IS IMPORTANT TO THEM.

IMPROVING CLIMATE CHANGE COMMUNICATION IN THE GLOBAL SOUTH

Despite its impacts, awareness of climate change is relatively low, particularly in heavily affected regions like the Global South. Research has shown that in this region where most low-emitting, highly impacted countries are located, about 40% to 65% of adults have never heard of climate change, compared to more than 90% of adults in the Global North who are aware of climate change. This essay explores communication barriers as a potential contributor to this gap and suggests evidence-based mitigation strategies for improvement.

Climate change communication in the Global South is often hindered by a lack of tailored communication strategies that resonate with local communities. Evidence shows that when climate information doesn't correspond to peoples' values, it loses its ability to influence behavior. Conversely, when grassroots mobilization is done, effective communication strategies are more likely to result. For instance, the peer-to-peer communication approach employed by the Solar Sister Initiative in sub-Saharan Africa ensures climate change messages are delivered in a culturally relevant and relatable manner.

Many researchers in the Global South face obstacles in conducting and publishing climate research such as poor funding, language barriers, and lack of access to climate data. Consequently, not only are these researchers constrained in their ability to effectively communicate climate impacts to their communities, they are unable to lend their voices to global climate action and partnerships. An example is the poor representation of researchers from the Global South in the Intergovernmental Panel on Climate Change (IPCC) authorship and leadership positions.

A commonality in the Global South among people who are aware of climate change is the tendency to engage in psychological denial. Persistently seeing pictures of polar bears and melting Arctic ice caps gives the impression that climate change only impacts the Global North, and even if it were to affect them, it would not be that bad.

Improving climate change communication in the Global South will require a multi-dimensional approach. Positive messaging can inspire hope and motivation to action amidst the despair associated with climate change.

Targeted messaging and awareness campaigns should be employed, using framing techniques as an essential aspect of climate communication. These techniques include talking about real-world and not abstract ideas; connecting with what matters to the audience; telling a human story; and being a confident communicator. Incorporating indigenous knowledge and local dialects in climate communication promotes inclusivity and behavioral change.

Although the new Global South Climate Database is a progressive step towards bolstering accurate and equitable climate news coverage, more can be done beyond connecting journalists (especially from the Global North) with climate experts from low-emitting, highly impacted communities. Investments should be made in the local science community and media outlets to enhance the bottom-up approach to climate change dialogue, decision-making, and mitigation.

Low-emitting, highly impacted countries should take a significant role in deciding global policies on climate change mitigation. More attention should be paid to local communities that possess unique, practical and ancestral knowledge about ways to live in harmony with nature.

- Arinze Agu, MPH '25

Dr. Arinze Agu, MD, is a first-year master of public health student in the Department of Environmental Health Sciences with a concentration in climate change and health.

YOUR ACTION ITEM FOR CHANGE

Talk about it.

Frame your story about climate change by making the issue relatable to the person you're talking to.

50%

DEATHS FROM HEAT STRESS ARE RISING RAPIDLY, WITH AN INCREASE OF 50% IN INDIA OVER THE LAST TWO DECADES, ACCORDING TO *THE LANCET*.

GAS STOVES, CLIMATE CHANGE, AND HEALTH

Kitchen stoves are mundane appliances, although cooking is often part of our most nostalgic memories. Growing up, my grandfather would pick me up from school. At our Bronx apartment, I would find my grandmother at the stove making me a snack. My "favorite," as I called it, was a plate of cut up hot dogs, French fries, and scrambled eggs. It turns out that this slightly unhealthy (but delicious) snack was not the only health concern in the kitchen. Research now shows that the gas stove she was standing at was likely emitting high levels of indoor air pollution, and phasing out those stoves is a necessary step in the fight against climate change.

I am an environmental health scientist who works on climate, energy, and disparity research, and their intersections. I often think about the home as the site of environmental disparities and an opportunity to work towards health equity. My early work was focused on cookstoves in rural Ghana, where most individuals use wood, dung, or charcoal for cooking. Combustion of those fuels produces high levels of air pollution, which is associated with pneumonia, heart disease, and stroke in low- and middle-income countries, with approximately 3.2 million premature deaths each year. More recently, I have been thinking about household energy transitions in the U.S.

People who are familiar with the struggle for environmental justice know that Black and Latino people tend to be affected by poor ambient air quality. Lesser known is that there are also disparities in indoor air quality. Marginalized and minoritized living spaces tend to be smaller, so air pollutants can build up, and appliances may be older and poorly maintained. There is substantial evidence that gas stoves are among the largest sources of indoor residential air pollution. Work by YSPH Professor Emeritus Brian Leaderer shows, for example, that nitrogen dioxide—a common combustion byproduct from stoves—can cause asthmatic exacerbations for children well below the EPA's ambient air quality guidelines. These stoves rely on natural gas, a fossil fuel that produces greenhouse gases. The climate and health basis for switching from gas stoves to electric or induction stoves is clear. Unfortunately, research also shows disparities in who can access, or chooses to undergo, an energy transition.

In 2022, the U.S. Congress passed the Inflation Reduction Act that includes subsidies to electrify stoves and home heating for low- and middle-income households. This funding is incredibly important to catalyze the phaseout of fossil fuels, but there are many questions. Are the subsidies sufficient? What determines who adopts the new stoves? Will the phaseouts yield improvements in air quality and health? These are among the questions we are trying to answer. Students in the *Clinic on Climate Justice, Law, and Public Health* course are working with the City of New Haven to evaluate a free stove distribution program the city is piloting. Households are receiving free induction stoves, and we are quantifying air quality changes, as well as interviewing the recipients to learn about their perceptions of the new technology. We hope this can inform future distributions.

I am hoping that our work can facilitate clean and equitable transitions for everyone. As for me personally, I cook my "favorite" snack on an induction stove. I'll let the nutritional epidemiologists figure out the rest.

- Daniel Carrión

Daniel Carrión is an assistant professor of epidemiology (environmental health), and the director of the Education, Climate Change and Health program.

05

YOUR ACTION ITEM FOR CHANGE

Switch from a gas to an electric stove.

Check the Inflation Reduction Act to see if you're eligible for a rebate.

32%

CHILDREN LIVING IN A HOME WITH GAS COOKING HAVE A 32% HIGHER RISK OF ASTHMA THAN CHILDREN LIVING IN A HOME WITHOUT GAS COOKING.

STATES ADDRESS CLIMATE CHANGE

In a time defined by climate hazards and their profound impact on community health, the role of state governments in addressing these challenges has never been more crucial. This essay spotlights the measures taken by three health departments to address and lessen the impacts from extreme weather induced by climate change, and foster resilience within their communities.

The Midwest has seen the second largest increase in the number of extreme precipitation days, with the total precipitation on the heaviest 1% of days increasing by 45% from 1958 to 2021, according to a U.S. climate assessment. Extreme precipitation can harm communities in several ways, including physical injury and property damage from flooding, and pollutant runoff in drinking water. To address these and other climate hazards, it is critical to ensure city master plans factor in climate change with a public health lens. In Michigan, the state health department partnered with Michigan State University and the Marquette Climate Adaptation Task Force to pilot a Climate and Health Adaptation Planning Guide. Marquette used the guide to identify community concerns and priorities, make policy recommendations, and outline short- to long-term implementation goals. Marquette's work lays the foundation for the state to start this planning process with two additional communities at the end of 2024.

Canada's 2023 wildfire season was the first time many states in the U.S. responded to a significant increase in poor air quality days due to wildfire smoke. While some states were caught off guard, it was an opportunity for them to turn to their partners in the West for their expertise and resources. One example is the Wildfire Smoke Partner Toolkit developed by the Washington State Department of Health, in collaboration with an interagency advisory group. The toolkit includes a children's activities guide, guidance for canceling outdoor events and closing schools, and flyers for populations most vulnerable to air pollution such as pregnant people and people with lung and heart diseases.

In 2023, Connecticut experienced its warmest January and second-warmest December on record, with temperatures soaring beyond historical averages. The rise in climate change induced-extreme heat, compounded by poor air quality, has exacerbated respiratory issues and led to an increase in emergency room visits for heat-related illnesses, such as heat stroke and exhaustion. The Connecticut Department of Public Health, in collaboration with the Yale Center on Climate Change and Health, is working to implement the Building Resilience Against Climate Effects (BRACE) framework. This initiative aims to partner with local governments in developing heat and air quality response plans to safeguard communities from the health risks of extreme temperatures and elevated ozone levels. To learn more about BRACE activities, read essay 9 in this handbook.

It's imperative that we, as members of the community, actively engage with our local and state governments. Whether by attending town hall meetings or participating in public hearings, our involvement is essential in shaping effective responses to climate hazards. We're excited to work together to build a safer and more climate resilient future for all.

- Caroline Helsen, MPH '23 and Alixandra Rachman, MPH '23

Caroline Helsen is climate and health program manager for the Michigan Department of Health and Human Services. Alixandra Rachman is program administrator for the YCCCH.

YOUR ACTION ITEM FOR CHANGE

Attend a local government meeting.

Help to shape your local government's response to climate change and build a safer future for all.

06

JUNE 1

HURRICANE SEASON IN THE ATLANTIC AND THE CARIBBEAN BEGINS. THE SEASON ENDS ON NOVEMBER 30.

BEYOND HEATWAVES: HOW RISING TEMPERATURES AFFECT OUR HEALTH

The health effects of temperature are two-fold: if it gets too hot or too cold, people can get sick, and people can die. Heat does not have to be extreme to be deadly. Moderately hot temperatures can cause substantial health burdens because we typically experience more moderately hot days than days of extreme heat.

We recently studied the health effects of extreme heat in Connecticut. We found that the number of deaths from extreme heat and moderate heat was 31 and 43 deaths per year, respectively, from 2005 to 2016. Extreme heat is defined as being above the 90th percentile of the warm season temperatures from May to September.

The challenge is not only that the climate is getting warmer, but that the world's population is aging. We recently published a study that shows that an aging global population is expected to be a major driver of climate-related deaths. We found that, relatively speaking, older adults compared to younger adults have higher risks not only from heat, but also from cold.

Older adults are vulnerable to extreme temperatures for several reasons including their more limited thermoregulatory responses. Understanding the impact of population aging and climate change can provide important insights.

What are some effective interventions to reduce heat? First, we need to know which communities are most vulnerable. We recently developed a national metric to gauge heat vulnerability and created a color-coded interactive map.

We found that people living in communities that are historically redlined, or cities with more Black or Latino populations, are more vulnerable to heat. The issue is impacting all of us, but in different ways because of residential disparities.

We want this tool to be used by the public to raise awareness of how vulnerable their communities are and help them take action. Also, we want it to be used by policymakers so they can see the distribution within their state and have certain communities in mind when they implement climate adaptation policies.

One final note about heat. Last June, New York City's sky turned orange due to wildfire smoke from Canada. What was in the smoke? Small particles called fine particulate matter. The wildfire smoke had such a high concentration of particles that it turned the sky orange, which tells you how polluted the air is during a smoke wave.

We looked at EPA monitor stations and saw that the daily average level of fine particulate matter pollution was roughly above 150 micrograms per cubic meter on June 7, 2023. Usually in New York City, that level should be well below 35 micrograms per cubic meter, the EPA daily air quality standard.

Those particles are small enough to penetrate the lungs and circulate throughout the body. This can lead to respiratory illness but also can trigger heart attacks and strokes, aggravate kidney disease, and damage brain health leading to cognitive decline and dementia.

Extreme heat could heighten the health effects of wildfire smoke. With a warming climate, the health burden of exposure to extreme heat and wildfire smoke is expected to increase.

- Kai Chen

Kai Chen is an assistant professor of epidemiology (environmental health). He is also the director of research, and the deputy faculty director of the Yale Center on Climate Change and Health.

YOUR ACTION ITEM FOR CHANGE

07

Review the heat vulnerability map.

Search for your city and zip code. How vulnerable is your neighborhood to heat? Discuss.
bit.ly/HeatVulnerabilityMap

NET ZERO

TO KEEP GLOBAL WARMING TO NO MORE THAN 1.5 °C—AS CALLED FOR IN THE PARIS AGREEMENT—GREENHOUSE GAS EMISSIONS NEED TO BE REDUCED BY 45% BY 2030 AND REACH NET ZERO BY 2050.

AIR POLLUTION, GLOBAL WARMING, AND COGNITION

Cognition is critical to our well-being as it determines an individual's ability to contribute to society, make important decisions, and even run daily errands. But our decision-making and learning processes are vulnerable to environmental stressors.

Cognitive activities often rely on regions in the brain that are sensitive to hot weather. Exposure to heat waves reduces the flow of blood to the brain, causing oxygen deficiency and heat-related fatigue. Also, fine particles in the air often remain airborne longer, and can penetrate buildings. Because they are so small, they are easily inhaled and can accumulate within brain tissue. Over time, this can cause neuroinflammation, leading to symptoms of Alzheimer's disease, one of the most terrifying and expensive forms of cognitive decline, and other forms of dementia.

Extreme temperatures and pollution increase the risk for strokes and then vascular dementia, damage the immune system, hinder neurological development, and impair neuron behavior, which contributes to memory formation.

Air pollution and extreme temperatures disrupt cognitive functioning through psychological pathways as well. Thermal stress may diminish a person's attention, working memory, and information retention and processing. A high concentration of pollutants is associated with headaches, psychiatric distress, and an increased risk of feeling unhappy and depressed.

Studies assessing the impacts of air pollution and high temperatures on cognitive ability often focus on school-age children and young adults, showing that exposure to air pollution lowers both verbal and math skills, while high temperatures mostly disrupt math skills. More recent studies find that such harmful effects become more pronounced as people age, especially for males and less educated individuals, and get worse with continued exposure.

Transitory exposures to polluted air or high temperatures have been found to undermine decision-making in the health insurance market and the stock market, and even encourage the decision to commit a crime or engage in conflict, due to changes in risk attitudes and impulsivity.

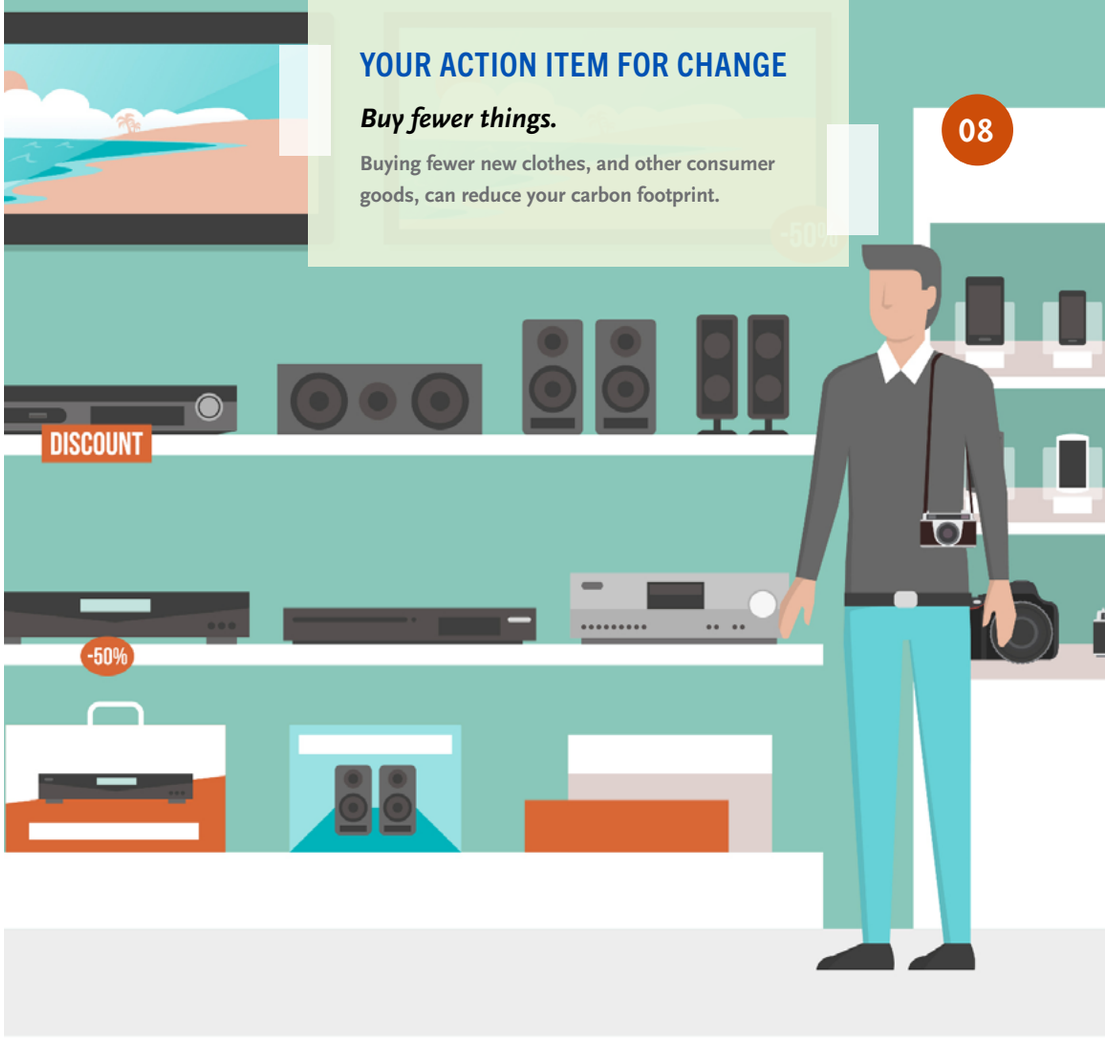
Short-term measures like wearing face masks on polluted days, using air conditioning during heat waves, and flexibly scheduling important tests help offset some of the negative effects of air pollution and high temperatures. But because the ill effects accumulate with continued exposure, short-term interventions can be less effective than improving long-term air quality and addressing global warming.

The profound implications of poor cognitive function may understate the real costs of air pollution and global warming. Realizing the severity of this issue, the U.S. Environmental Protection Agency has called for more research to assess the impact of air pollutants on the central nervous system, and to address the adequacy of the national ambient air quality standards that have been based on narrowly defined health assessments.

Government agencies are often called upon to implement environmental regulations to reduce air pollution and slow down global warming. When introducing more stringent regulations, governments need to gauge the monetary value of better air quality and milder temperatures in order to compare it with the cost of environmental regulations. Because air quality and climate are not standard goods for sale, evaluating their values presents great challenges. Recent economic evaluations estimate an individual's willingness to pay for cleaner air and milder temperatures. With such scientific evidence, policy and interventions will optimize stringent environmental regulations.

- Xi Chen

Xi Chen is an associate professor of public health (health policy). He also is an affiliated faculty member at the Alzheimer's Disease Research Center, and the Yale Department of Economics.



<10%

LESS THAN 10% OF PLASTICS IS RECYCLED. PLASTICS GENERATED 1.8 BILLION METRIC TONS OF GREENHOUSE GAS EMISSIONS IN 2019, 3.4% OF THE GLOBAL TOTAL.

CONNECTICUT BUILDS CLIMATE AND HEALTH RESILIENCY

Connecticut stands at a critical time for building climate and health resiliency. With growing climate-related health risks from heat, extreme weather, vector-borne disease, and air pollution, this is an all-hands moment requiring urgent action and collaboration to ensure everyone is safe, healthy, and resilient in a changing climate.

Recognizing this need, the Connecticut Department of Public Health (DPH) worked with the Yale Center on Climate Change and Health (YCCCH) to secure a CDC Climate-Ready States & Cities Initiative (CRSCI) grant to implement the Building Resilience Against Climate Effects (BRACE) framework in Connecticut. We're excited to share our progress and to suggest how you can take action, too.

Our BRACE work focuses on capacity building and adaptation planning at the state and local levels. In 2023, groundwork was laid with the establishment of DPH's Office of Climate and Health and the publication of the Connecticut Climate Impact Compendium—for the public, academic partners, and state and local officials and policymakers.

We're gaining momentum this year. In January we kicked off the Climate and Health Equity Coalition, a group that will provide strategic, technical, and evaluation advice on all aspects of our BRACE work, including health equity considerations. Coalition members represent the breadth and depth of climate and health expertise found within the state, including public health and health care professionals, advocates, and experts from academia and state agencies.

In March, we hosted the first-ever Connecticut Symposium on Climate Change and Health to share the latest evidence on how climate change is affecting community health in Connecticut, and best practices for building resilience. The nearly 170 participants in this virtual event showed that there's a clear interest in this topic and a need to continue nurturing our statewide climate and health community.

We're now turning our focus to supporting local health departments (LHDs) in responding to climate impacts. One component, led by DPH, will deliver climate and health educational programming for local health departments to increase capacity and reduce community exposure to the health impacts of climate change. To inform curriculum development, DPH recently surveyed LHD directors to understand their interests and concerns. The other component, led by YCCCH, will help local health departments plan for extreme heat and unhealthy air. We just launched an opportunity for local health departments and federally recognized tribes to apply for pilot grants from DPH to develop Local Heat and Air Quality Preparedness and Response Plans, with assistance from YCCCH.

Our BRACE activities serve as the foundation for increasing resiliency against the health impacts of climate change in Connecticut. We're thrilled to be leading this work in collaboration with local health departments and other stakeholders.

And we do mean this is an "all hands" effort, because many people are still unaware of the climate-health connection. Ask your local and state leaders how they're preparing for the health impacts of climate change. Let us know how it goes, and how we can help!

- Hannah Beath, MPH '23 and Jennifer Wang

Hannah Beath is the director of the office of climate and health at the Connecticut Department of Public Health. Jennifer Wang is the executive director of the YCCCH.

YOUR ACTION ITEM FOR CHANGE

Explore public health data.

The Connecticut Climate Impact Compendium contains a wealth of information, from air quality reports to wildfire smoke tracking. *bit.ly/CTClimateData*

6 INCHES

BRIDGEPORT, CONNECTICUT HAS EXPERIENCED 6 INCHES OF SEA LEVEL RISE SINCE 1965, WHICH IS HIGHER THAN CURRENT GLOBAL RATES.

SPEAKING OUT

Quotes from climate experts at Yale School of Public Health

Secretary John Kerry joins **Yale President Peter Salovey** for an Earth Day conversation about his environmental leadership and how to build political will for climate action. ***Watch the video:*** ***bit.ly/JohnKerryClimate***

> We face substantial challenges around energy, climate, food, water, equity, global health and so much more. We at Yale Planetary Solutions also know that the time for action is now, and that action is required of all of us."
>
> ***Julie B. Zimmerman, PhD****, vice provost for planetary solutions at Yale University.*

> Most health professionals did not learn about climate change and its health effects in their formal training, and many other decision-makers lack specific knowledge about how their issue area relates to climate change and health. Incorporating this material into higher education curricula would help close this key knowledge gap and prepare the workforce to make informed decisions under a changing climate."
>
> ***Laura Bozzi, PhD '13, MEM '04, BS '03,*** *senior director of environmental health policy at the New York City Department of Health and Mental Hygiene. Previously, she was director of programs for the Yale Center on Climate Change and Health.*

> The air quality impacts of wildfires are widespread, as are the subsequent public health burdens. Although several studies have examined the impact of the Canadian wildfires on New York City specifically, the smoke plumes and affected populations are much larger."
>
> ***Michelle L. Bell, PhD****, professor of environmental health at the Yale School of Public Health, and Mary E. Pinchot Professor at the Yale School of the Environment.*

> Health care is a major emitter of environmental pollutants that adversely affect health. My work has shown that health care is responsible for nearly 5% of global greenhouse gas emissions and similar fractions of toxic air pollutants. These emissions arise directly from health care facilities as well as indirectly from the supply chains of health care goods and services."
>
> ***Dr. Jodi Sherman, MD****, associate professor of anesthesiology and epidemiology (environmental health sciences).*

> When we ask Americans who they think is most responsible for acting to address climate change, they identify corporations at the very top, above government. In fact, over half of consumers say they are willing to reward or punish companies for their actions, or failure to act, but we know that many are not currently doing so. In other words, it's a communications challenge—and opportunity!"
>
> ***Anthony Leiserowitz, PhD****, director of the Yale Program on Climate Change Communication at the Yale School of the Environment.*

Yale scholars inspire climate change action with art in this **Yale Planetary Solutions** collaboration. ***Watch the video:*** ***bit.ly/YaleMural***

ABOUT THE YALE CENTER ON CLIMATE CHANGE AND HEALTH

The Yale Center on Climate Change and Health (YCCCH) envisions a world with a stable and safe climate in which human health and diverse ecosystems can thrive.

YCCCH uses research, education, public health practice, and policy development to help safeguard the health of human populations from adverse impacts of climate change and human activities that cause climate change.

YCCCH works with academic, government, and civil society partners, and aims to make an impact locally, nationally, and globally. It integrates research and social justice into all of its work, which includes:

- A vibrant research program, based in the **CHEN Lab**, that focuses on revealing the full spectrum of health impacts of climate change.
- An innovative **Program on Healthcare Environmental Sustainability** that seeks to lower greenhouse gas emissions and increase the resilience of the health care sector.
- Its membership in **The Lancet Countdown on Health and Climate Change**, an international collaboration that publishes an annual report in *The Lancet*.
- Its sponsorship of a landmark virtual 2021 **Conference on Climate Change and Health in Small Island Developing States: Focus on the Caribbean** that was held in collaboration with Caribbean and international partners.
- A **Climate Change and Health Concentration** at YSPH offered to all MPH students.
- An online **Climate Change and Health Certificate Program** offered to working professionals. The program has produced 700 graduates from 58 countries and nearly every U.S. state.
- A **Program on Climate Change and Health in Connecticut** that includes a CDC-funded partnership between YCCCH and the Connecticut Department of Public Health to build capacity in local health departments to address the health effects of climate change.
- A **Clinic in Climate Justice and Public Health** that trains interdisciplinary student teams to carry out applied research or practice projects related to the clinic's theme.

TEST YOUR KNOWLEDGE ABOUT CLIMATE CHANGE

01 Five million people die each year because of ambient air pollution caused when fossil fuels are burned.

◯ True ◯ False

02 Which industry is responsible for nearly 5% of global greenhouse gas emissions and similar fractions of toxic air pollutants?

a) Electric power sector b) Health care c) Artificial intelligence

03 Wildfire smoke is only dangerous to people who live near the fire.

◯ True ◯ False

04 Which of the following statements about heat are true?

a) People living in communities that have been historically redlined are more vulnerable to heat.

b) Heat does not have to be extreme to be deadly. c) Both

05 Someone you know is skeptical that climate change is caused by humans. If you were to talk to them about climate change, how would you make the issue relatable? List three ways you would approach the conversation.

1. _____

2. _____

3. _____

06 **What is your action plan for climate change? List the top three actions from this handbook that you can take.**

1. _____

2. _____

3. _____

Answer key: 1. True 2. B 3. False 4. C

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