Drought and Public Health: A Roadmap For Advancing Engagement and Preparedness

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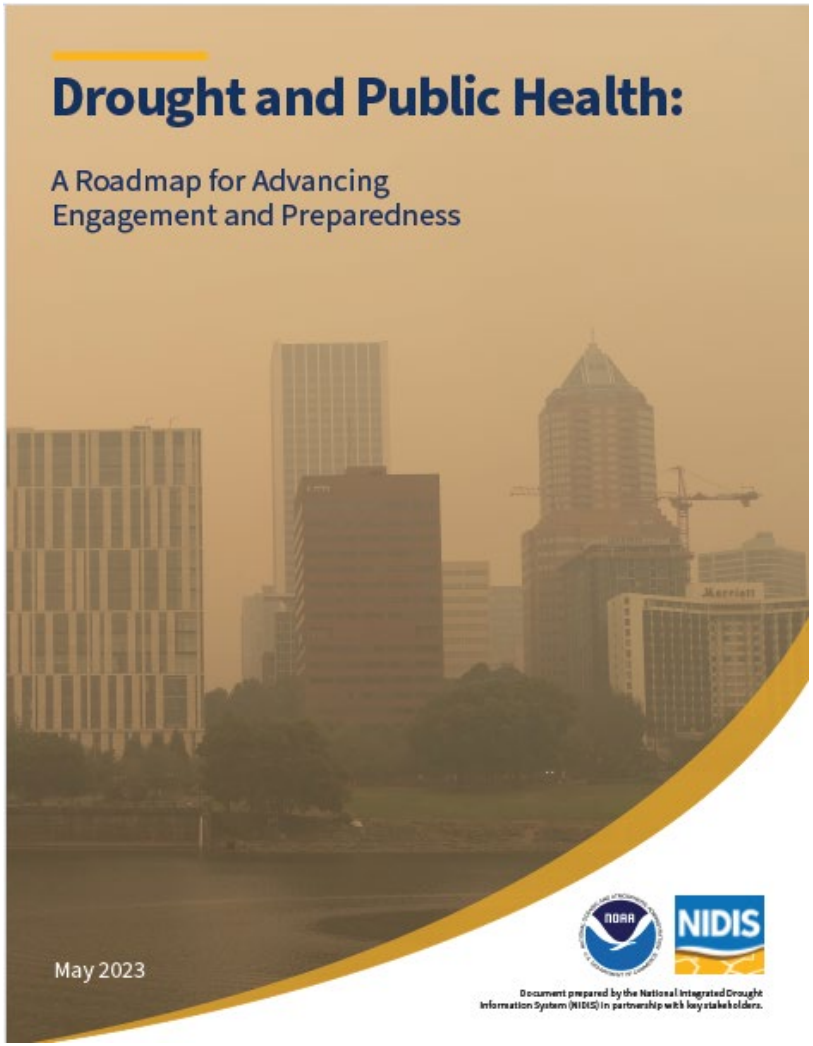
Water, Climate, and Health Program

College of Public Health

University of Nebraska Medical Center

Drought and Health Roadmap

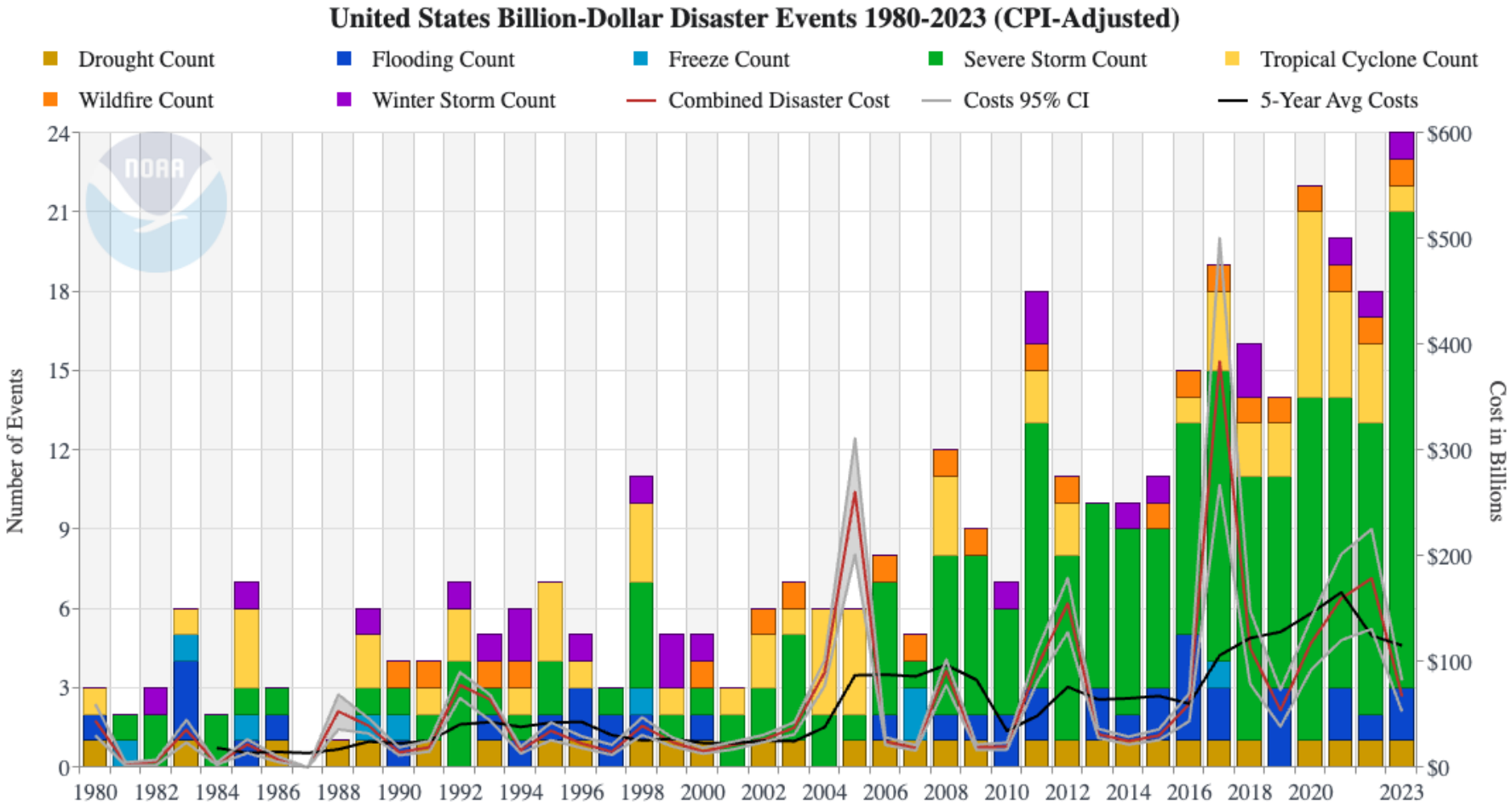
- Partnership between National Integrated Drought Information System (NIDIS) and University of Nebraska Medical Center (UNMC)
- Culmination of public health engagement efforts from 2019-2022
- Purpose: Inform and direct future efforts and investments in drought and public health



Today's Webinar

- Overview of Drought and Health
- Drought and Health Outreach Activities
- Key Recommended Actions
- Next Steps

Overview of Drought and Health



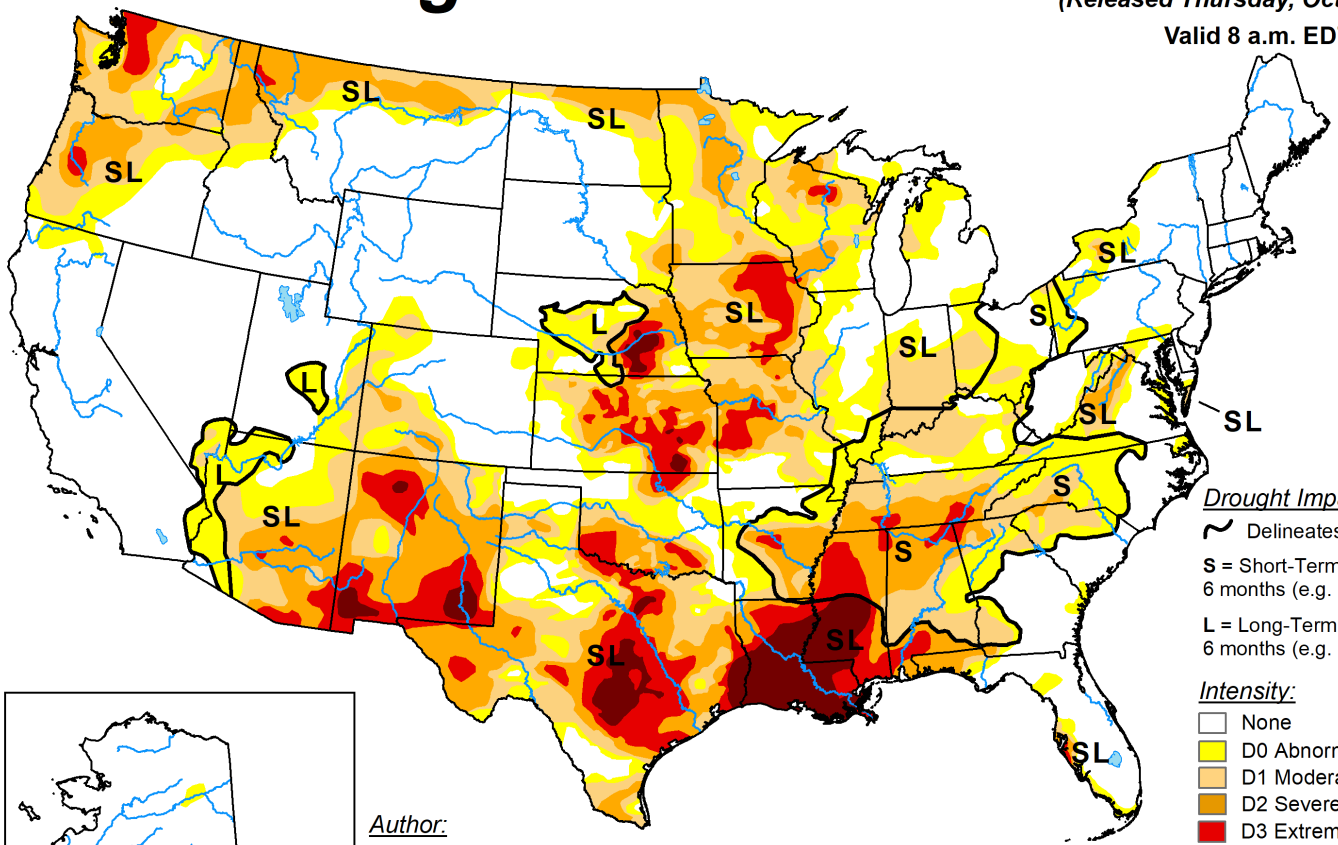
Updated: October 10, 2023

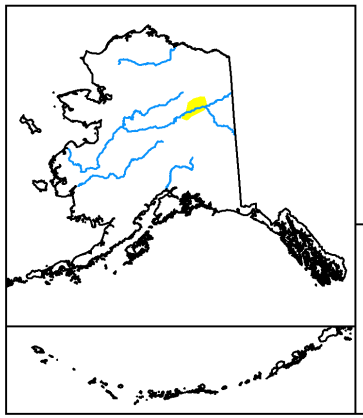
U.S. Drought Monitor

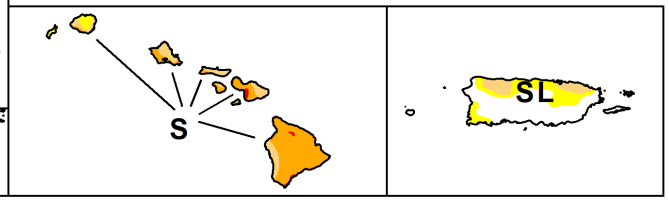
October 24, 2023

(Released Thursday, Oct. 26, 2023)

Valid 8 a.m. EDT







Drought Impact Types:

Delineates dominant impacts

S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)

L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

Intensity:

- None
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

Author:
Rocky Bilotta
NCEI/NOAA

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. For more information on the Drought Monitor, go to https://droughtmonitor.unl.edu/About.aspx

USDA NDMC NOAA

droughtmonitor.unl.edu

“Floods kill people, but droughts destroy civilizations.”

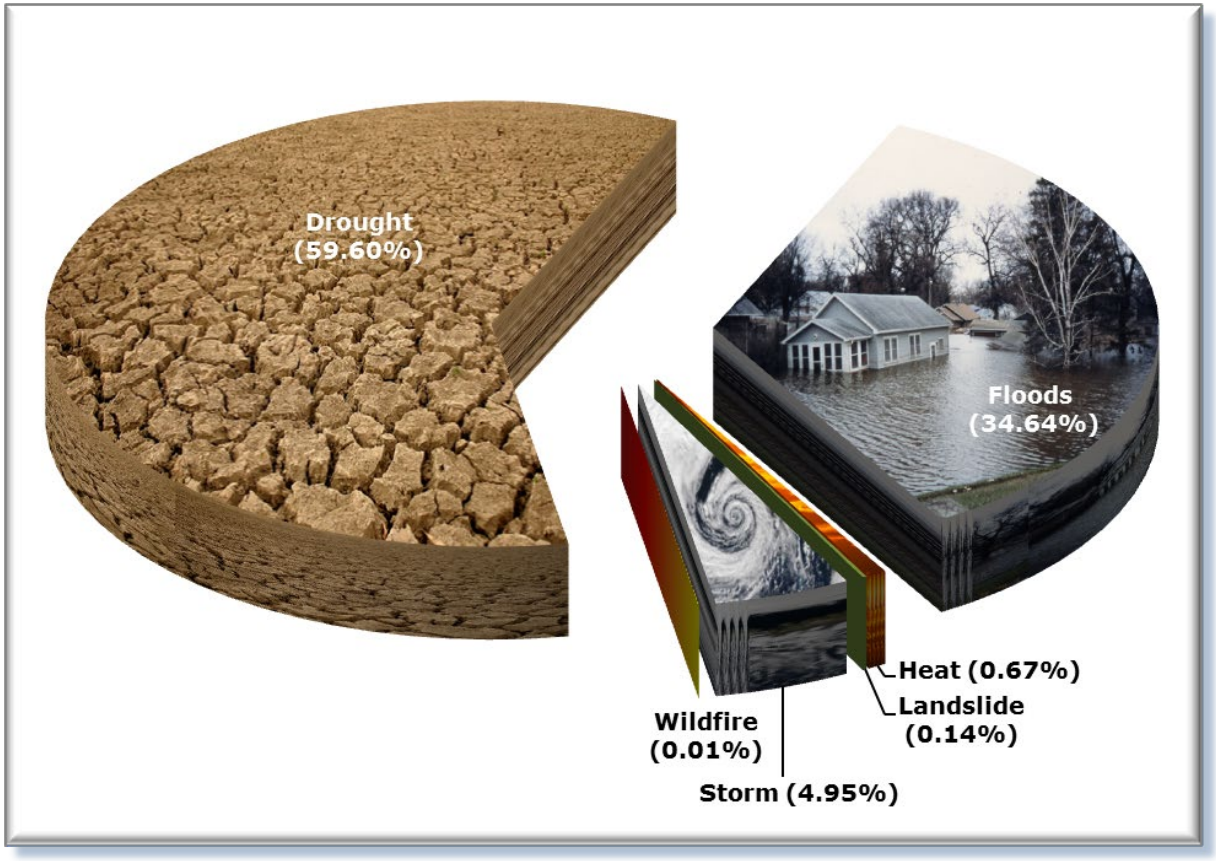
~U.S. Government Official at a Drought Meeting

Dust Bowl of the 1930s

Connecting Drought to Health

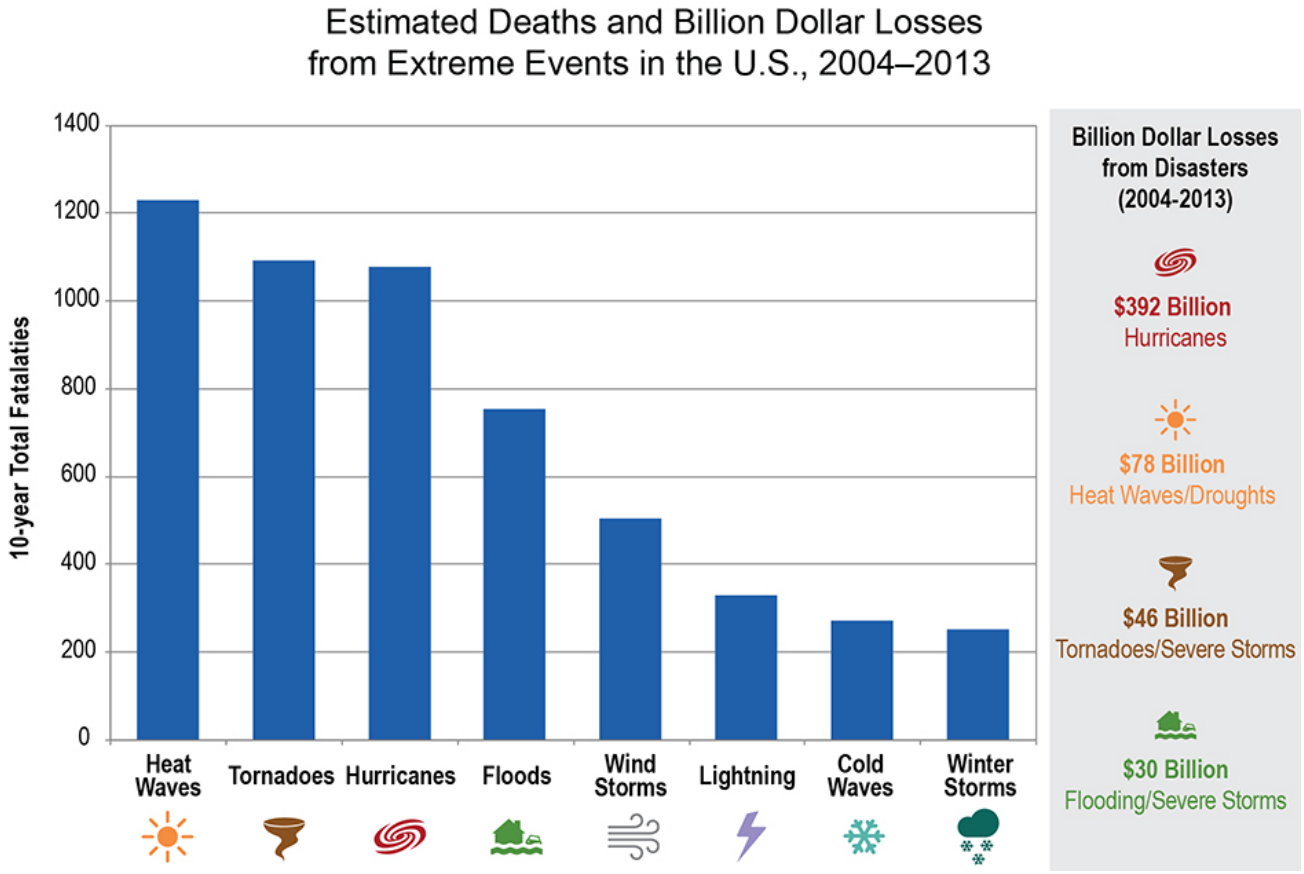
he difference between the fields on either side of dairy farmer Tom Barcellos is water. (Tomas Ovalle / For The Times)

Percentage of disaster-deaths worldwide according to each category of climate-related hazard, (1900-2013)



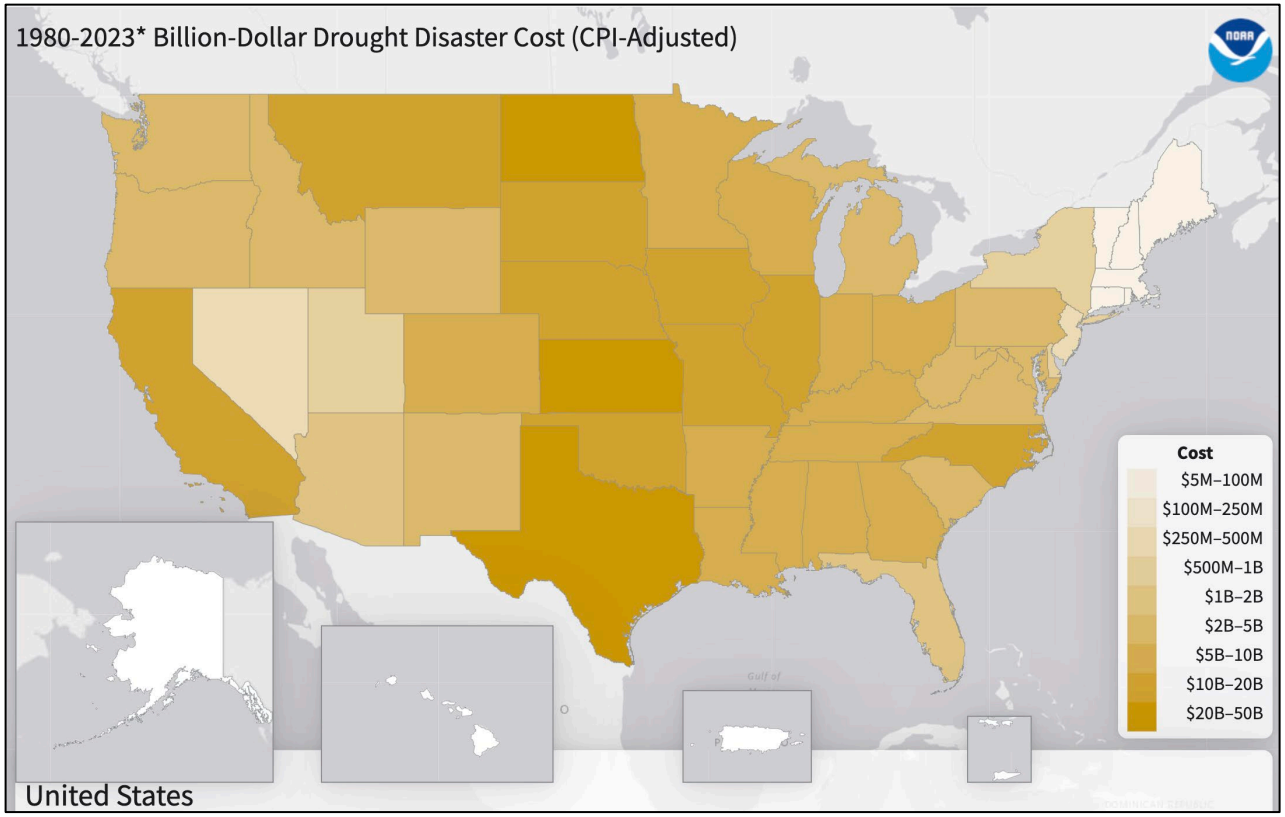
Source: Adapted from EM-DAT: The OFDA/CRED International Database, Belgium 2012
Keim, ME Extreme Weather Events: the role of public health

Drought Impacts



Bell et al., 2016

Drought & Health



31 Events

$343 Billion Lost

4,413 Deaths

NOAA National Centers for Environmental Information (NCEI) U.S. Billion-Dollar Weather and Climate Disasters (2018). https://www.ncdc.noaa.gov/billions

Health Surveillance Data

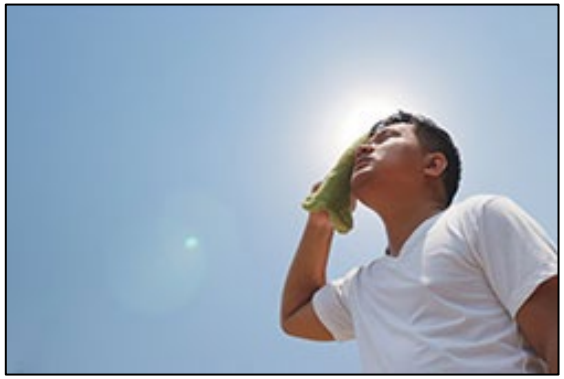
Drought can evolve slowly

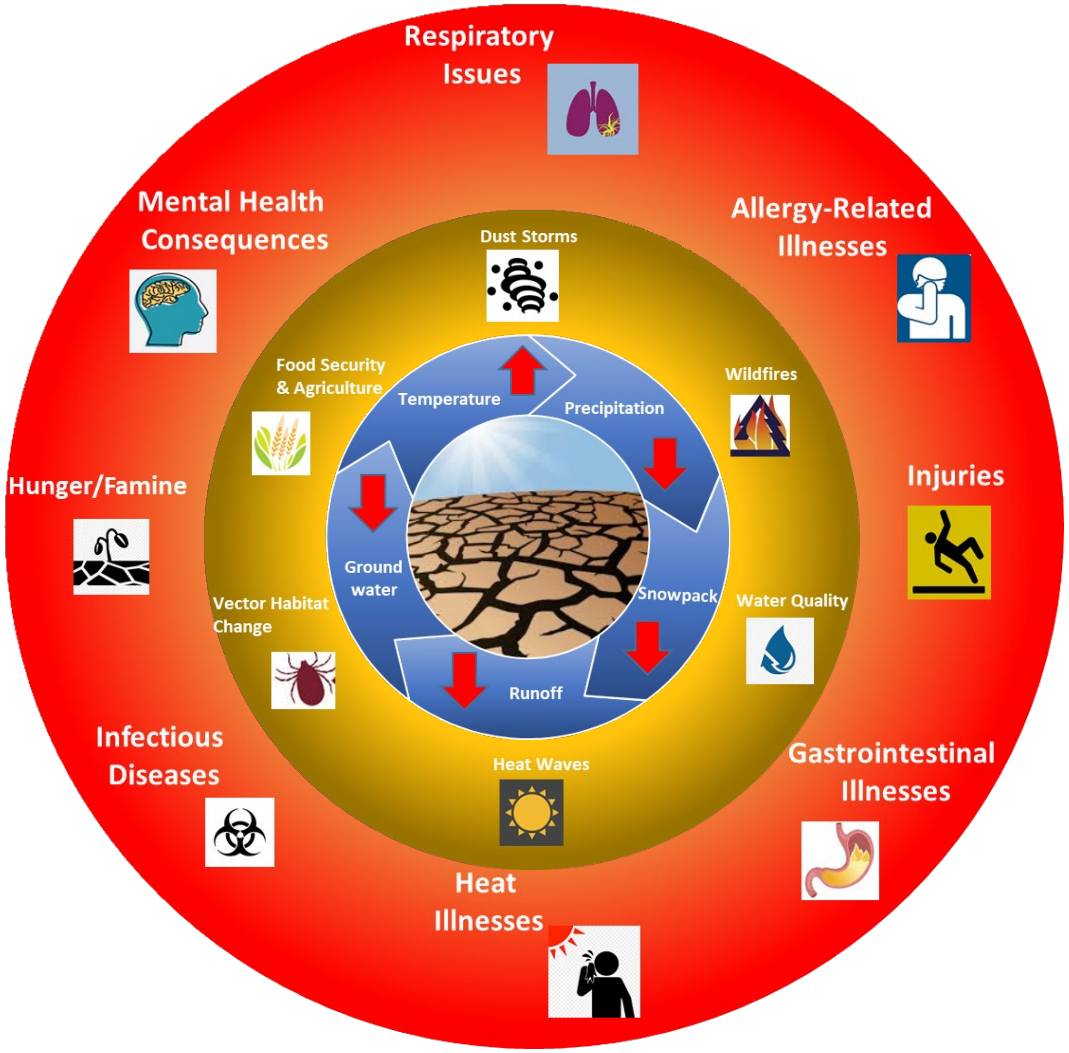
The impacts are not immediate

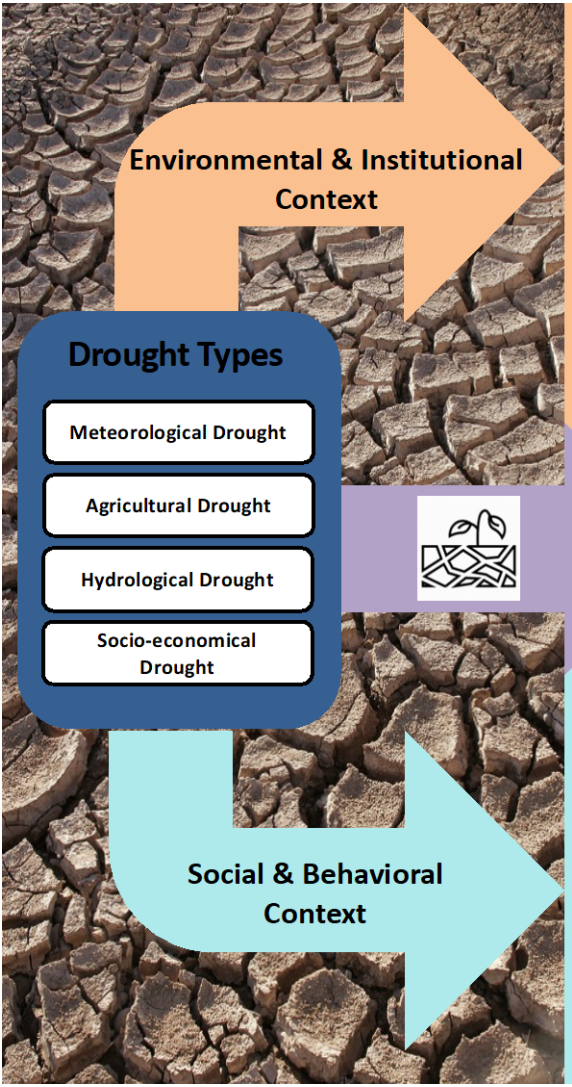
Can require multiple steps for health outcomes

Surveillance is not designed to connect drought and health

Threat Multiplier




Respiratory Issues
Mental Health Consequences
Allergy-Related Illnesses
Dust Storms
Food Security & Agriculture
Temperature
Precipitation
Wildfires
Hunger/Famine
Injuries
Ground water
Snowpack
Vector Habitat Change
Water Quality
Runoff
Infectious Diseases
Heat Waves
Gastrointestinal Illnesses
Heat Illnesses



Environmental & Institutional Context

Drought Types

- Meteorological Drought
- Agricultural Drought
- Hydrological Drought
- Socio-economical Drought

Social & Behavioral Context

- Water Supply
- Local Environmental Conditions
- Preparedness of Health Departments
- Agricultural Management Practices
- Power, Transportation, Communication and Healthcare Infrastructure

Exposure Pathways

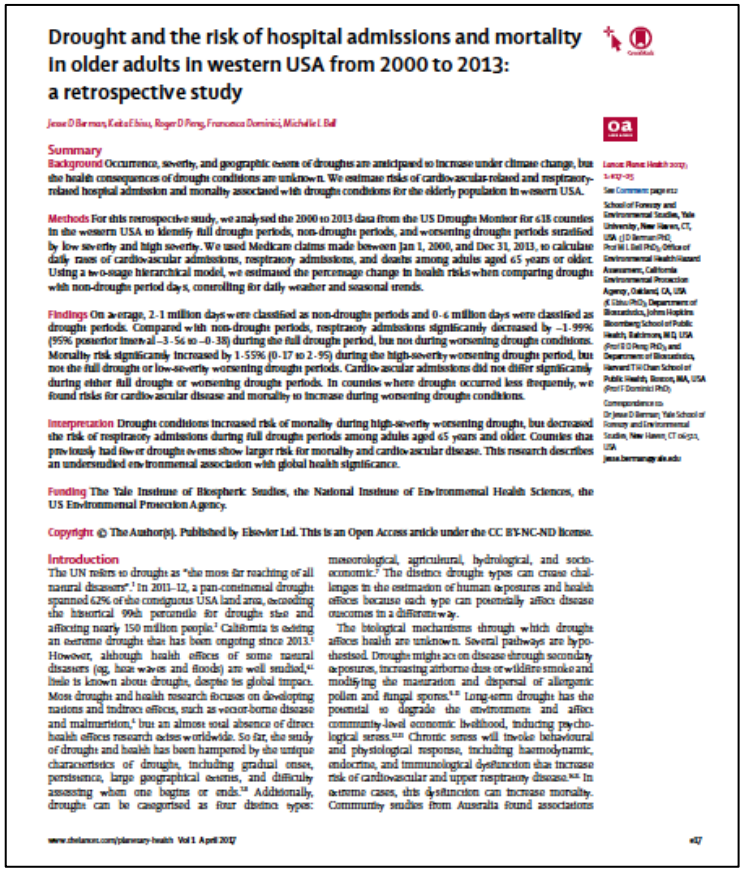
- Increase in Dust and dust Storms
- More Frequent Wildfires
- Decrease in Water Quality and Quantity
- More Frequent and More Intense Heat Waves
- Change in Vector Habitat and Range
- Loss of Agriculture and Food Security

Health Outcomes

- Respiratory Issues
- Allergy-related Illnesses
- Injuries
- Infectious Disease
- Hunger/Famine
- Heat Illnesses
- Gastrointestinal Illnesses
- Mental Health Consequences

- Social Determinants of Health
- Occupation
- Rural/Urban
- Race/Literacy/Age
- Dependence on Caregivers and Medication

WCHP Research: Increase in Mortality with Drought



Drought and the risk of hospital admissions and mortality in older adults in western USA from 2000 to 2013: a retrospective study

Jesse D Berman, Keita Ebisu, Roger D Peng, Francesca Dominici, Michelle L Bell

Summary

Background Occurrence, severity, and geographic extent of droughts are anticipated to increase under climate change, but the health consequences of drought conditions are unknown. We estimate risks of cardiovascular-related and respiratory-related hospital admission and mortality associated with drought conditions for the elderly population in western USA.

Methods For this retrospective study, we analysed the 2000 to 2013 data from the US Drought Monitor for 618 counties in the western USA to identify full drought periods, non-drought periods, and worsening drought periods stratified by low severity and high severity. We used Medicare claims made between Jan 1, 2000, and Dec 31, 2013, to calculate daily rates of cardiovascular admissions, respiratory admissions, and deaths among adults aged 65 years or older. Using a two-stage hierarchical model, we estimated the percentage change in health risks when comparing drought with non-drought period days, controlling for daily weather and seasonal trends.

Findings On average, 2·1 million days were classified as non-drought periods and 0·6 million days were classified as drought periods. Compared with non-drought periods, respiratory admissions significantly decreased by −1·99% (95% posterior interval −3·56 to −0·38) during the full drought period, but not during worsening drought conditions. Mortality risk significantly increased by 1·55% (0·17 to 2·95) during the high-severity worsening drought period, but not the full drought or low-severity worsening drought periods. Cardiovascular admissions did not differ significantly during either full drought or worsening drought periods. In counties where drought occurred less frequently, we found risks for cardiovascular disease and mortality to increase during worsening drought conditions.

Interpretation Drought conditions increased risk of mortality during high-severity worsening drought, but decreased the risk of respiratory admissions during full drought periods among adults aged 65 years and older. Counties that previously had fewer droughts events show larger risk for mortality and cardiovascular disease. This research describes an understudied environmental association with global health significance.

Funding The Yale Institute of Biospheric Studies, the National Institute of Environmental Health Sciences, the US Environmental Protection Agency.

Lancet Planet Health 2017; 1: e17–25

See Comment page e12

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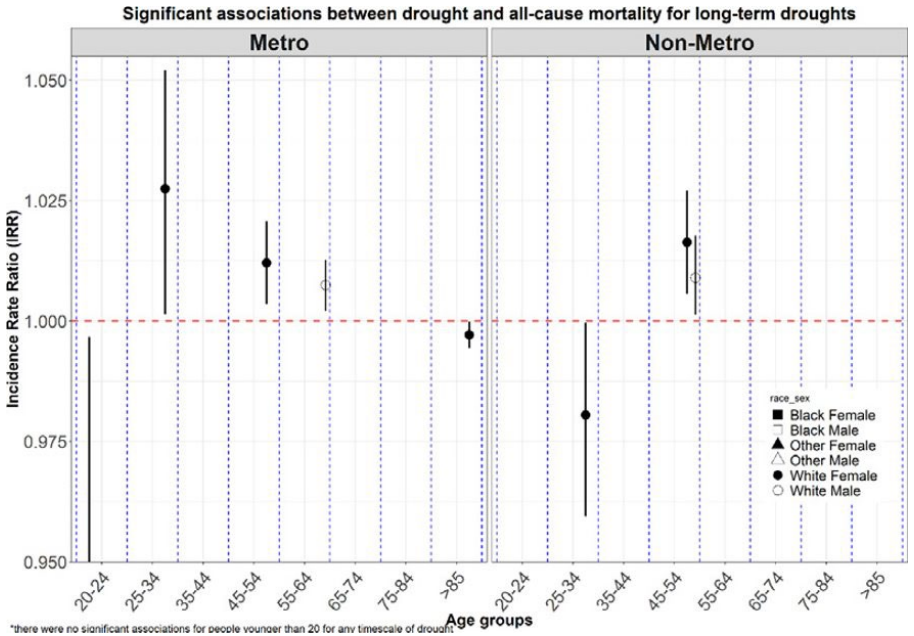
Introduction

The UN refers to droughts as "the most far reaching of all natural disasters".[1] In 2011–12, a pan-continental drought spanned 62% of the contiguous USA land area, exceeding the historical 99th percentile for drought size and affecting nearly 150 million people.[2] California is existing an extreme drought that has been ongoing since 2013.[3] However, although health effects of some natural disasters (eg, heat waves and floods) are well studied,[4,5] little is known about droughts, despite its global impact. Most droughts and health research focuses on developing nations and indirect effects, such as vector-borne disease and malnutrition,[4] but an almost total absence of direct health effects research exists worldwide. So far, the study of droughts and health has been hampered by the unique characteristics of droughts, including gradual onset, persistence, large geographical extents, and difficulty assessing when one begins or ends.[3,6] Additionally, droughts can be categorised as four distinct types: meteorological, agricultural, hydrological, and socioeconomic.[7] The distinct drought types can create challenges in the estimation of human exposures and health effects because each type can potentially affect disease outcomes in a different way.

The biological mechanisms through which droughts affects health are unknown. Several pathways are hypothesised. Droughts might act on disease through secondary exposures, increasing airborne dust or wildfire smoke and modifying the maturation and dispersal of allergenic pollen and fungal spores.[8,9] Long-term droughts has the potential to degrade the environments and affect community-level economic livelihood, inducing psychological stress.[10,11] Chronic stress will invoke behavioural and physiological response, including haemodynamic, endocrine, and immunological dysfunction that increase risk of cardiovascular and upper respiratory disease.[8,12] In extreme cases, this dysfunction can increase mortality. Community studies from Australia found associations

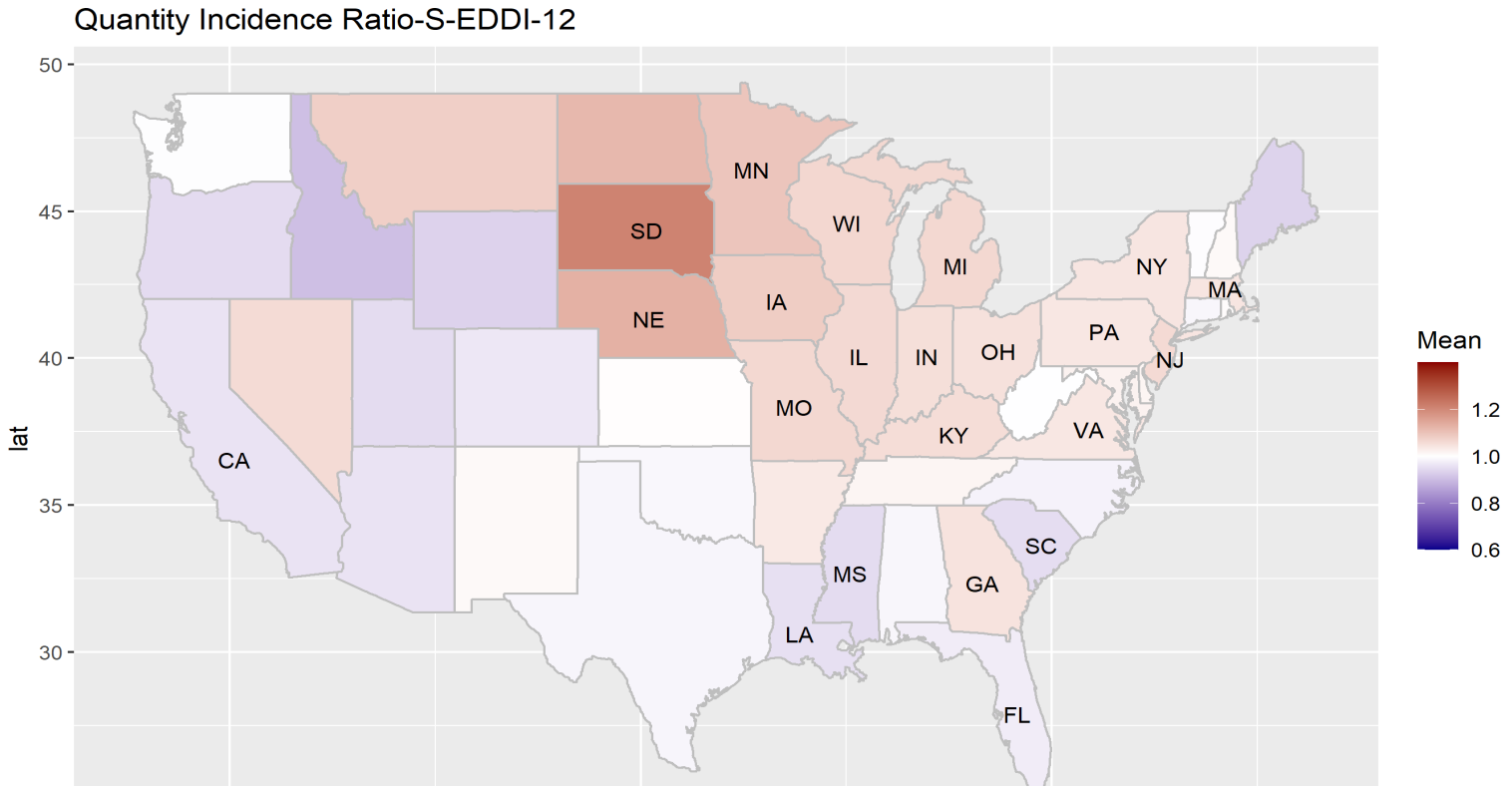
Drought Mortality in Nebraska



- White population aged 25–34 (female) and 45–64 (female and male) in metro counties
- 45–54 (female and male) in non-metro counties in Nebraska

Abadi et al. 2022 Science of the Total Environment 840(2022)156660

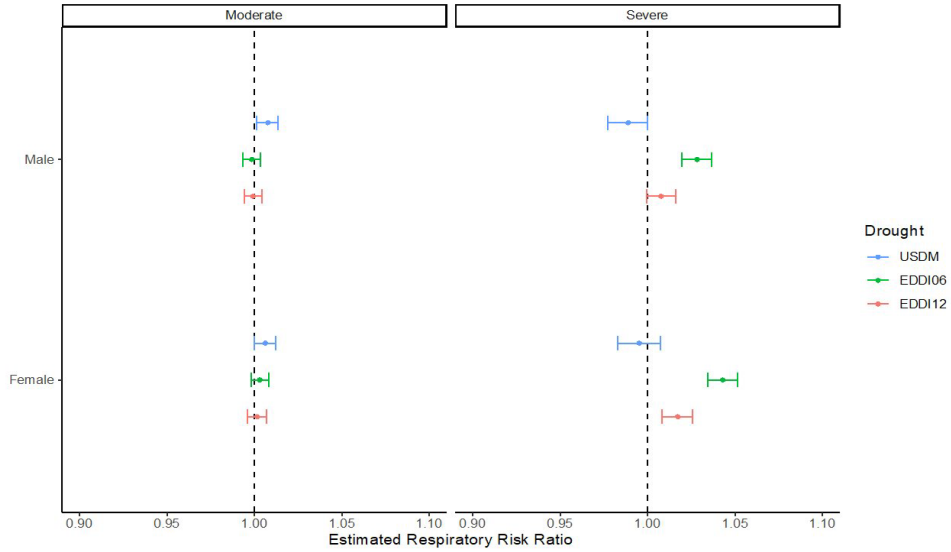
Increased Respiratory Mortality with Drought Events



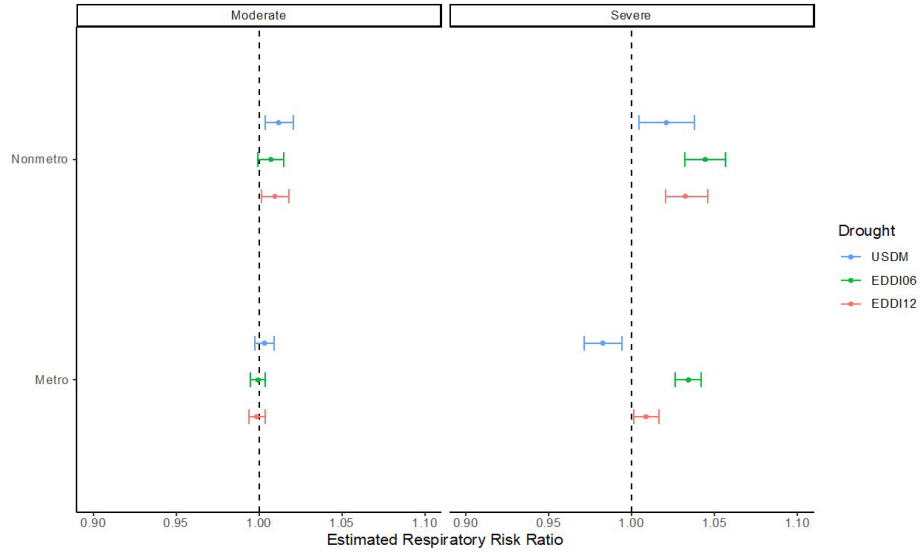
Research Interests

Gwon et al. (2023). The Association between Drought Exposure and Respiratory-Related Mortality in the United States from 2000 to 2018. *International Journal of Environmental Research and Public Health*, *20*(12), 6076.

Respiratory Mortality Outcomes



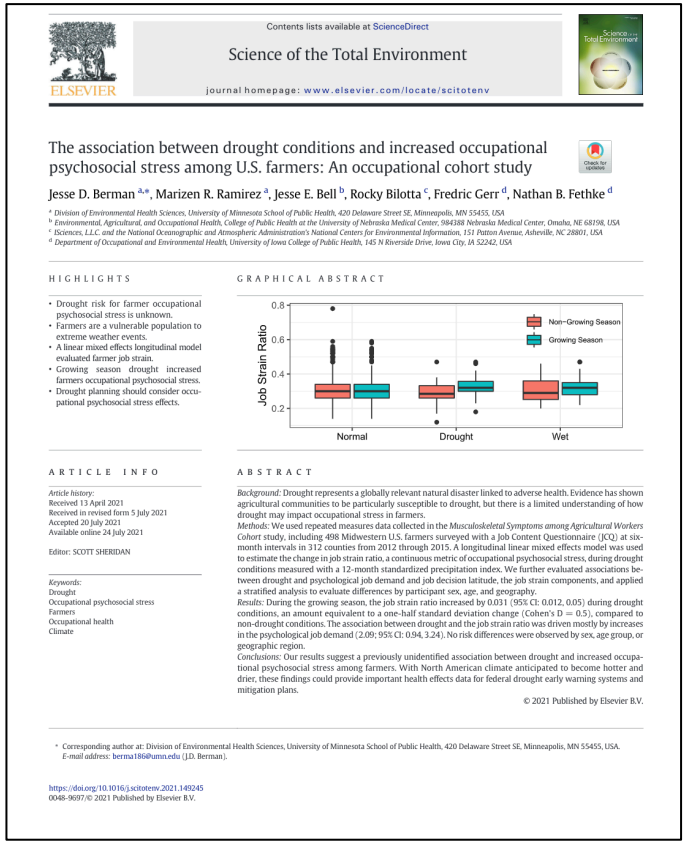
- Males and Females had increased respiratory related mortality with severe drought.
- Females had a larger effect.



- Respiratory mortality increase in metro and nonmetro areas during severe drought.
- Nonmetro had a larger effect.

Gwon et al. (2023). The Association between Drought Exposure and Respiratory-Related Mortality in the United States from 2000 to 2018. *International Journal of Environmental Research and Public Health*, *20*(12), 6076.

WCHP Research: Drought & Stress in Farmers



Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

The association between drought conditions and increased occupational psychosocial stress among U.S. farmers: An occupational cohort study

Jesse D. Berman [a,*], Marizen R. Ramirez [a], Jesse E. Bell [b], Rocky Bilotta [c], Fredric Gerr [d], Nathan B. Fethke [d]

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[b] Environmental, Agricultural, and Occupational Health, College of Public Health at the University of Nebraska Medical Center, 984388 Nebraska Medical Center, Omaha, NE 68198, USA
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[d] Department of Occupational and Environmental Health, University of Iowa College of Public Health, 145 N Riverside Drive, Iowa City, IA 52242, USA

HIGHLIGHTS

- Drought risk for farmer occupational psychosocial stress is unknown.
- Farmers are a vulnerable population to extreme weather events.
- A linear mixed effects longitudinal model evaluated farmer job strain.
- Growing season drought increased farmers occupational psychosocial stress.
- Drought planning should consider occupational psychosocial stress effects.

GRAPHICAL ABSTRACT

ARTICLE INFO

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Farmers
Occupational health
Climate

ABSTRACT

Background: Drought represents a globally relevant natural disaster linked to adverse health. Evidence has shown agricultural communities to be particularly susceptible to drought, but there is a limited understanding of how drought may impact occupational stress in farmers.
Methods: We used repeated measures data collected in the *Musculoskeletal Symptoms among Agricultural Workers Cohort* study, including 498 Midwestern U.S. farmers surveyed with a Job Content Questionnaire (JCQ) at six-month intervals in 312 counties from 2012 through 2015. A longitudinal linear mixed effects model was used to estimate the change in job strain ratio, a continuous metric of occupational psychosocial stress, during drought conditions measured with a 12-month standardized precipitation index. We further evaluated associations between drought and psychological job demand and job decision latitude, the job strain components, and applied a stratified analysis to evaluate differences by participant sex, age, and geography.
Results: During the growing season, the job strain ratio increased by 0.031 (95% CI: 0.012, 0.05) during drought conditions, an amount equivalent to a one-half standard deviation change (Cohen's D = 0.5), compared to non-drought conditions. The association between drought and the job strain ratio was driven mostly by increases in the psychological job demand (2.09; 95% CI: 0.94, 3.24). No risk differences were observed by sex, age group, or geographic region.
Conclusions: Our results suggest a previously unidentified association between drought and increased occupational psychosocial stress among farmers. With North American climate anticipated to become hotter and drier, these findings could provide important health effects data for federal drought early warning systems and mitigation plans.

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https://doi.org/10.1016/j.scitotenv.2021.149245
0048-9697/

Berman et al. 2021 Science of the Total Environment

Local

Kansas farmer on alarming suicide rate: 'Nothing gets farmers more down than a drought'

By: Emily Younger

Posted: May 21, 2018 09:34 PM CDT
Updated: May 21, 2018 11:34 PM CDT

Drought causes stress in farmers

The effect estimate for drought was 4x greater magnitude than people reporting pain in multiple body parts.

Research Interests

Compromised Quality & Quantity of Water

USGS science for a changing world

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Drought May Lead to Elevated Levels of Naturally Occurring Arsenic in Private Domestic Wells

Release Date: MARCH 18, 2021

An estimated 4.1 million people in the lower 48 states are potentially exposed to arsenic levels that exceed EPA's drinking water standards

A new U.S. Geological Survey study highlights the importance of homeowners testing their well water to ensure it is safe for consumption, particularly in drought-prone areas. The first-of-its-kind national-scale study of private well water, conducted in collaboration with the Centers for Disease Control and Prevention, showed that drought may lead to elevated levels of naturally occurring arsenic and that the longer a drought lasts, the higher the probability of arsenic concentrations exceeding U.S. Environmental Protection Agency's standard for drinking water.

Researchers estimate that during drought conditions, 4.1 million people in the lower 48 states who use private domestic wells are potentially exposed to unsafe levels of arsenic. This is an increase of 54% from the estimated 2.7 million people exposed to unhealthy arsenic levels in private wells during normal, non-drought conditions.

Arsenic is a metal that can occur naturally in bedrock and sediments around the world and is commonly reported in drinking-water supply wells. However, chronic exposure to arsenic from drinking water is associated with an increased risk of several types of cancers, including bladder, lung, prostate and skin cancers. Other adverse effects include developmental impairments, cardiovascular disease, adverse birth outcomes and impacts on the immune and endocrine systems.

The study's findings can help public health officials and emergency managers notify well owners in areas potentially affected and further refine their strategies for addressing the issue. The EPA regulates public water supplies, but maintenance, testing and treatment of private water supplies are the

Jacks Pond in Hancock, New Hampshire. Groundwater from this area supplies nearby private wells. (Credit: Melissa Lombard, USGS.

Contacts

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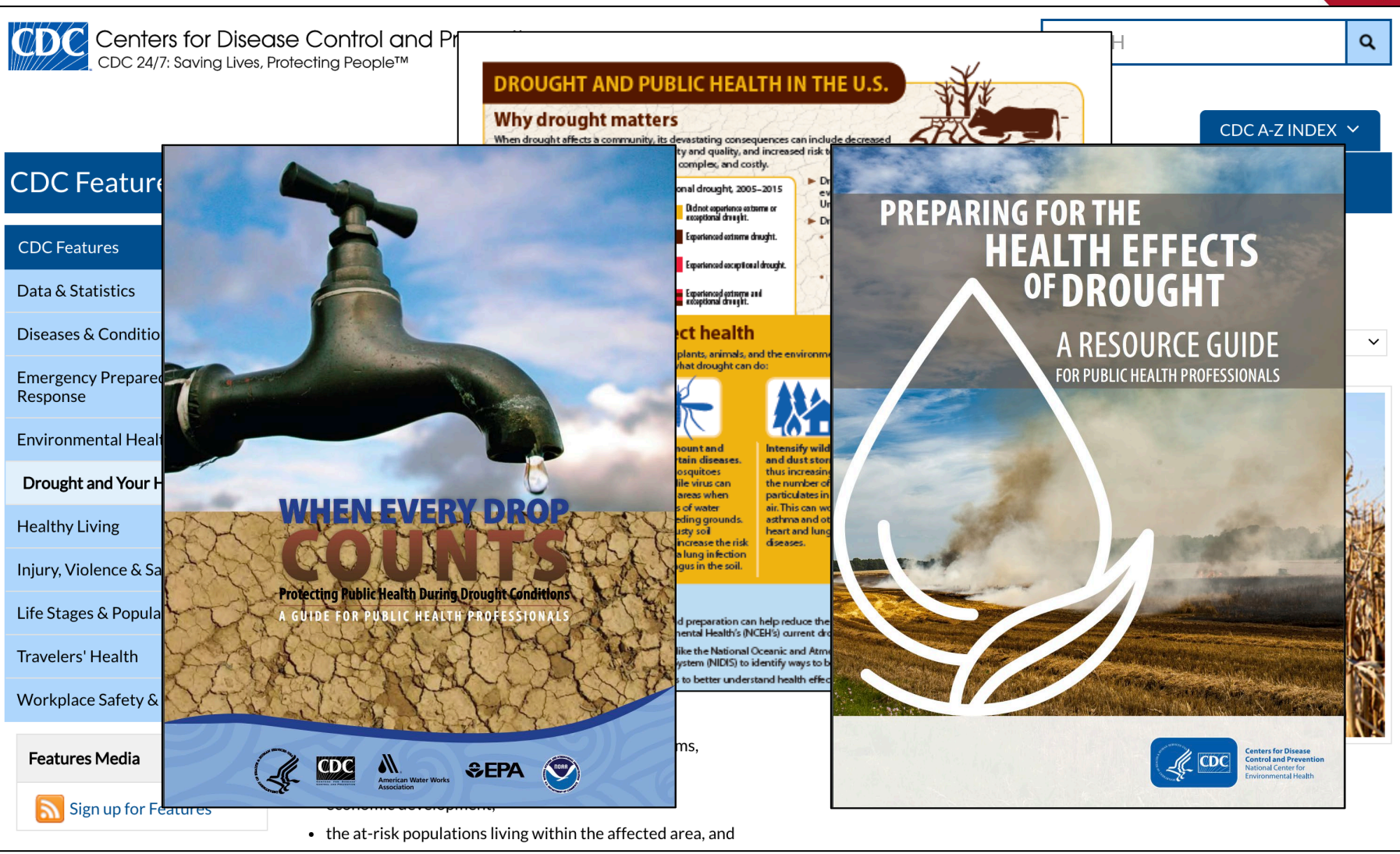
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Emergency Prepared
Response
Environmental Healt
Drought and Your H
Healthy Living
Injury, Violence & Sa
Life Stages & Popula
Travelers' Health
Workplace Safety &
Features Media
Sign up for Features
DROUGHT AND PUBLIC HEALTH IN THE U.S.
Why drought matters
When drought affects a community, its devastating consequences can include decreased
complex, and costly.
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Did not experience extreme or exceptional drought.
Experienced extreme drought.
Experienced exceptional drought.
Experienced extreme and exceptional drought.
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plants, animals, and the environme
what drought can do:
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a lung infection
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Intensify wild
and dust storm
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the number of
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like the National Oceanic and Atm
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WHEN EVERY DROP
COUNTS
Protecting Public Health During Drought Conditions
A GUIDE FOR PUBLIC HEALTH PROFESSIONALS
CDC
American Water Works Association
EPA
NOAA
PREPARING FOR THE
HEALTH EFFECTS
OF DROUGHT
A RESOURCE GUIDE
FOR PUBLIC HEALTH PROFESSIONALS
CDC
Centers for Disease Control and Prevention
National Center for Environmental Health
the at-risk populations living within the affected area, and

Drought and Health Outreach Activities

Drought and Health Outreach Activities

- Two-fold purpose:
  - Assess needs and gaps
  - Convene stakeholders
- Approach:
  - National Drought and Health Summit
  - Regional Drought and Health Workshops
  - Health Department Interviews

NATIONAL DROUGHT & PUBLIC HEALTH SUMMIT

June 17-19, 2019 | Atlanta, GA

Thank you to our Summit Planning Partners:

Centers for Disease Control and Prevention (CDC)
National Integrated Heat Health Information System (NIHHIS)
Environmental Protection Agency (EPA)
Natural Resources Defense Council (NRDC)
UNL National Drought Mitigation Center (NDMC)

NOAA
NIDIS
Water for Food
DAUGHERTY GLOBAL INSTITUTE
at the University of Nebraska
UNMC
COLLEGE OF PUBLIC HEALTH

Drought and Health Workshops

Workshop	When	Where	Attendees	Regional Topics
Midwest Drought and Human Health Workshop	November 2019	St. Paul, Minnesota	~40 attendees	Emergency response Mental health Water quality/quantity Tribal impacts
Southwest Drought and Human Health Workshop	February 2020	Tucson, Arizona	~40 attendees	Extreme heat Air quality Water quality/private wells Vector-borne diseases Tribal engagement
Carolinas Drought and Human Health Workshop	September 2020	Virtual	~20 attendees	Vector-borne diseases Mental health Drought indicators/definitions Vulnerable populations
Upper Missouri River Basin Drought and Human Health	April 2022	Bozeman, Montana	~40 attendees	Tribal engagement Health equity Mental health Water conservation
Pacific Northwest Drought and Human Health Workshop	October 2022	Portland, Oregon	~80 attendees	Environmental justice Air quality Wildfire Tribal engagement

Health Department Interviews

- From 2021-2022, conducted 16 interviews with state public health departments across U.S.

Primary Question	Secondary Question
What impacts has drought had on your region?	N/A
Has drought caused other secondary impacts (such as wildfires, dust storms, heat waves, etc.)?	Specifically, has drought caused human health impacts in your region?
	Is that information available because of surveillance systems that are in place, or because of "one-off" research that has been done?
	What systems or data collection activities would need to be in place for you to answer that question?
What populations or communities in your region are most vulnerable to the impacts of drought?	What public health/emergency management/other agencies have a close working relationship with those communities?
	Do you have a working relationship with them?
Are you currently conducting any drought and human health activities in your region, and if so, what activities are you conducting?	What partners have you worked with regarding issues of drought and human health?
	What sources of funding support your drought and human health activities in your region?
If you have not yet, would you be interested in conducting drought and human health activities in your region? What activities would you want to see conducted in your region?	What resources would be helpful to you to address the human health impacts of drought?
	What partnerships would help make these activities happen?
What research do you think needs to be conducted relating to drought and health?	N/A

Key Recommended Actions

Primary Focus Areas

Partnership and Collaboration

Communication and Outreach

Interdisciplinary Research and Applications

Planning and Preparedness

Partnership and Collaboration

Build community of practice

Expand public health representation at drought-related meetings

Increase adoption of early warning systems

Incorporate drought into vulnerability and Community Health Needs Assessments (CHNAs)

Communication and Outreach

Develop impact-based communication resources

Tailor communication tools for vulnerable populations

Increase drought and health resources for health departments

Utilize federal agency websites to share resources

Interdisciplinary Research and Application

Improve understanding of drought indicators

Conduct a comprehensive review of past drought events

Improve understanding of how drought impacts private wells

Address barriers to data access

Planning and Preparedness

Incorporate health impacts into drought vulnerability assessments

Utilize tabletop exercises for drought events

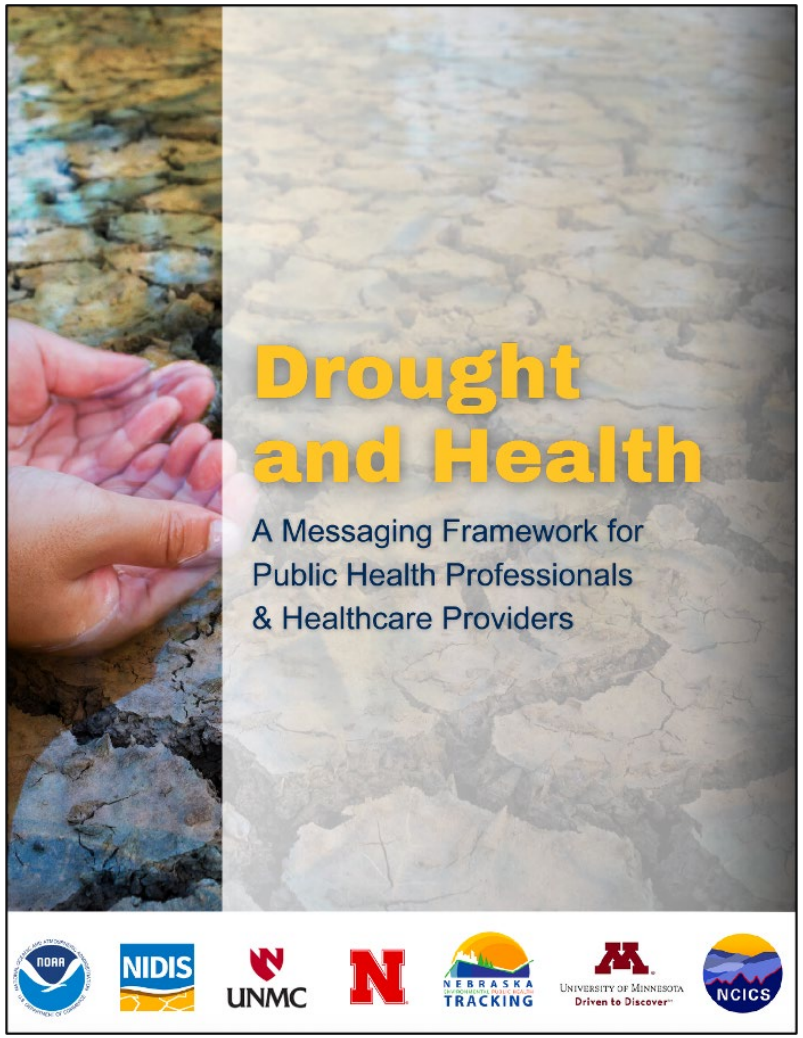
Engage with tribal nations

Create sample drought and health questions for community health needs assessments

Next Steps

Next Steps

- Continuing research looking at health impacts associated with droughts
- Release of **Drought and Health: A Messaging Framework for Public Health Professional & Healthcare Providers**
- Workshop in 2024 on drought and health tool development
- Much more to come!



Thank you!

- Our co- authors:
  - Keith Hansen, UNMC
  - Britt Parker, NIDIS
  - Sylvia Reeves, NIDIS
  - Amanda Sheffield, NIDIS
  - Molly Woloszyn, NIDIS
- The 130+ organizations and agencies who collaborated with us over the course of this project

Thank you!

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EARTH SCIENCE
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HEALTH & AIR QUALITY

The Claire M. Hubbard Foundation

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NIDIS
NATIONAL INTEGRATED DROUGHT INFORMATION SYSTEM

Our Key Partners:

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AND NATURAL RESOURCES

Access the Roadmap

https://www.drought.gov/documents/drought-and-public-health-roadmap-advancing-engagement-and-preparedness

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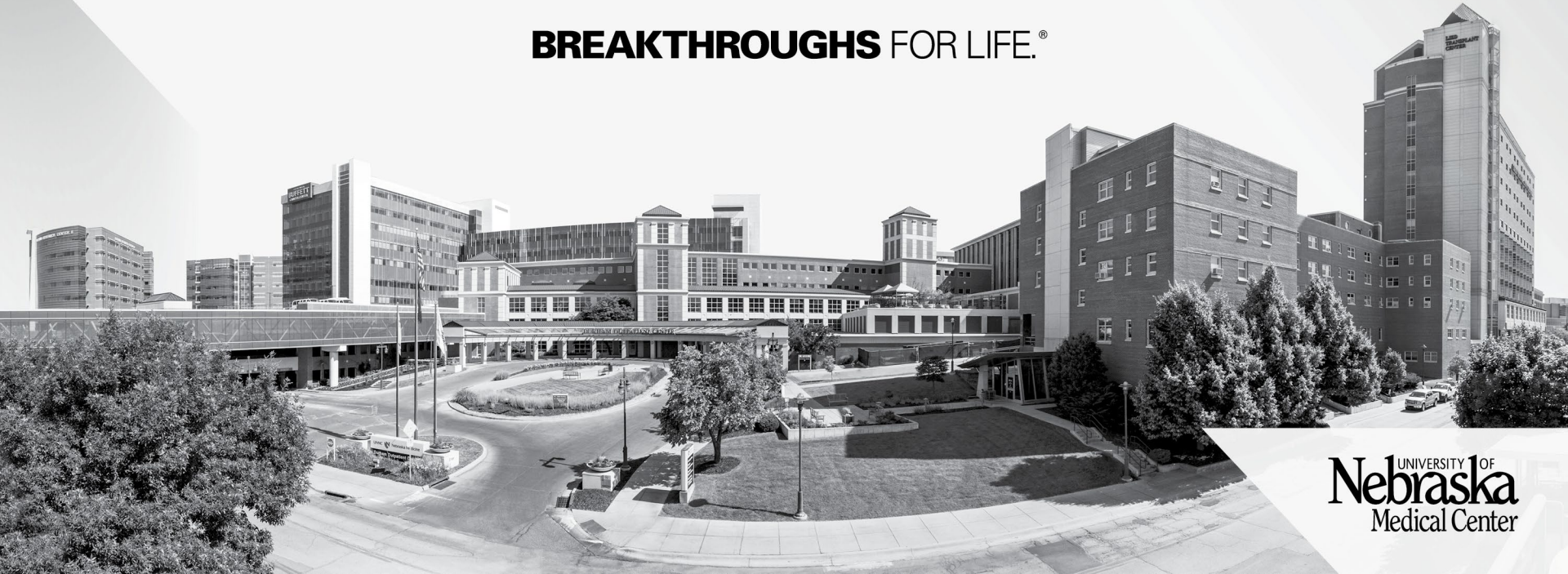

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