Drought and Health: Focus on Heat

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Relationship of Climate to Health
Climate is Affecting Your Health

Direct
- Affecting Health Directly
  - Extreme Heat
  - Air Pollution
  - Extreme Weather

Indirect
- Spreading Disease
  - Diseases Spread by Insects, Ticks, and Rodents
  - Contaminated Water
  - Contaminated Food
- Destroying & Disrupting Food Supplies
  - Hunger and Malnutrition
- Disrupting Well-Being
  - Mental Health Problems
  - Conflict and Displacement
Drought has shaped society
“Floods kill people, but droughts destroy civilizations.”
~U.S. Government Official at a Drought Meeting
Dust Bowl of the 1930s
Extreme Heat and Drought

Heat Wave Index: 4-day, 1-in-5yr

Dust Bowl

Bell et al., 2018
Connecting Drought to Health

The difference between the fields on either side of dairy farmer Tom Bancillos is water, [Tomas Ovalle / For The Times]
Percentage of disaster-deaths worldwide according to each category of climate-related hazard, (1900-2013)

- Drought: 59.60%
- Floods: 34.64%
- Storm: 4.95%
- Wildfire: 0.01%
- Heat: 0.67%
- Landslide: 0.14%

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

Estimated Deaths and Billion Dollar Losses from Extreme Events in the U.S., 2004–2013

Bell et al., 2016
Billion-Dollar Disasters are Increasing
# Summary Statistics

**Billion-dollar events to affect the United States from 1980 to 2021 (CPI-Adjusted)**

<table>
<thead>
<tr>
<th>Disaster Type</th>
<th>Events</th>
<th>Events/Year</th>
<th>Percent Frequency</th>
<th>Total Costs</th>
<th>Percent of Total Costs</th>
<th>Cost/Event</th>
<th>Cost/Year</th>
<th>Deaths</th>
<th>Deaths/Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drought</td>
<td>29</td>
<td>0.7</td>
<td>9.4%</td>
<td>$285.4B</td>
<td>13.2%</td>
<td>$9.8B</td>
<td>$6.8B</td>
<td>4,139†</td>
<td>99†</td>
</tr>
<tr>
<td>Flooding</td>
<td>35</td>
<td>0.8</td>
<td>11.3%</td>
<td>$164.2B</td>
<td>7.6%</td>
<td>$4.7B</td>
<td>$3.9B</td>
<td>624</td>
<td>15</td>
</tr>
<tr>
<td>Freeze</td>
<td>9</td>
<td>0.2</td>
<td>2.9%</td>
<td>$32.8B</td>
<td>1.5%</td>
<td>$3.6B</td>
<td>$0.8B</td>
<td>162</td>
<td>4</td>
</tr>
<tr>
<td>Severe Storm</td>
<td>143</td>
<td>3.4</td>
<td>46.1%</td>
<td>$330.7B</td>
<td>15.3%</td>
<td>$2.3B</td>
<td>$7.9B</td>
<td>1,880</td>
<td>45</td>
</tr>
<tr>
<td>Tropical Cyclone</td>
<td>56</td>
<td>1.3</td>
<td>18.1%</td>
<td>$1,148.0B</td>
<td>53.2%</td>
<td>$20.5B</td>
<td>$27.3B</td>
<td>6,697</td>
<td>159</td>
</tr>
<tr>
<td>Wildfire</td>
<td>19</td>
<td>0.5</td>
<td>6.1%</td>
<td>$120.2B</td>
<td>5.6%</td>
<td>$6.3B</td>
<td>$2.9B</td>
<td>401</td>
<td>10</td>
</tr>
<tr>
<td>Winter Storm</td>
<td>19</td>
<td>0.5</td>
<td>6.1%</td>
<td>$78.6B</td>
<td>3.6%</td>
<td>$4.1B</td>
<td>$1.9B</td>
<td>1,277</td>
<td>30</td>
</tr>
<tr>
<td><strong>All Disasters</strong></td>
<td>310</td>
<td>7.4</td>
<td>100.0%</td>
<td><strong>$2,159.9B</strong></td>
<td>100.0%</td>
<td><strong>$7.0B</strong></td>
<td><strong>$51.4B</strong></td>
<td>15,180</td>
<td>361</td>
</tr>
</tbody>
</table>

†Deaths associated with drought are the result of heat waves. (Not all droughts are accompanied by extreme heat waves.)

Flooding events (river basin or urban flooding from excessive rainfall) are separate from inland flood damage caused by tropical cyclone events.

The confidence interval (CI) probabilities (75%, 90% and 95%) represent the uncertainty associated with the disaster cost estimates. Monte Carlo simulations were used to produce upper and lower bounds at these confidence levels (Smith and Matthews, 2015).
1980-2021* NOAA Billion-Dollar Drought Disasters (CPI-Adjusted)

- 29 Events
- $285 Billion Lost
- 4,139 Deaths

Health Surveillance Data

- Drought can be a slow evolving
- The impacts are not immediate
- Can require multiple steps for health outcomes
- Surveillance is not designed to connect drought and health
Health Outcomes

Exposure Pathways
- Increase in Dust and Dust Storms
- 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 & Behavioral Context
- Social Determinants of Health
- Occupation
- Rural/Urban
- Race/Literacy/Age
- Dependence on Caregivers and Medication

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

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

Socio-economical Drought

Drought Types

Social & Behavioral Context
Health Risks from Drought Change

Vulnerability | Hazard:
- High | High (High Risk)
- Low | Low (Low Risk)
- Low | High
- High | Low

Fard et al. Evaluating Changes in Health Risk from Drought Over the Contiguous United States. IJERPH just accepted
Increase in Mortality with Drought

Drought Mortality in Nebraska

- white females aged 45-54
- white males aged 45-64

Courtesy of Dr. Azar Abadi
Compromised Quantity and Quality of Water

Surface Water

Groundwater

Courtesy of USGS

Courtesy of USDA
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

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Secondary/Related Events

- Extreme heat
- Wildfires
- Dust storms/haboobs
- Rain/storm effects

Courtesy of FCC

Courtesy of USGS

Courtesy of NOAA
Climate Change Impacts Air Quality: Wildfire Smoke

Wildfire Activity Since 1970

- Western US wildfire season increased by 78 days
- Average duration of fires increased five fold

Westerling et al. Warming and earlier spring increase western U.S. forest wildfire activity Science. 2006 Aug 18;313(5789):940-3
Increased Disease Incidence

- Infectious disease
- Chronic disease
- Vectorborne and zoonotic disease

Courtesy of NSF

Notice
An algae bloom has made this area potentially unsafe for water contact. Avoid direct contact with visible surface scum.

Courtesy of USGS
Life Cycle of Coccidioidomycosis
Additional Health Risks

- Sanitation and hygiene
- Recreational risks
- Mental and behavioral health
Complex Pathways: Mental Health

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 CST
Updated: May 21, 2018 10:34 PM CST

Farmer's recovery from depression which led to two suicide attempts shows cost of drought at family level

STEVE Germon left a suicide note on the porch and set about putting down calves he couldn’t feed before turning the gun on himself. Then a ute screamed towards him, his 17-year-old daughter at the wheel.

JACK MORPHET

DAIRY farmer Steve Germon knows what it’s like to be on the brink of suicide. He has been there twice in the past three years.

But saved him in 2015, but those lonely moments last year.
Drought Causes Stress in Farmers

The effect estimate for drought was 4x greater magnitude than people reporting pain in multiple body parts.
Engagement
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)
Future Needs:

- Still much to be learned about drought and public health
  - What do public health departments need?
- Research is needed in many different areas:
  - Analysis of surveillance data
  - Improved environmental monitoring
  - Role of public health departments
  - Economic impact of drought on public health
  - Lessons learned and best practices
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All of the state and local partners

All of the federal and academic partners