Making the Connection: How Climate and Weather Extremes Affect Human Health

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The National Institute of Environmental Health Sciences

- One of the National Institutes of Health, but located in Research Triangle Park, NC

- Wide variety of programs supporting our mission of environmental health:
  - Intramural laboratories
  - Extramural funding programs
  - National Toxicology Program
  - Superfund Research Program
My goal today: to make you comfortable delivering health messages!
Visual imagery of climate change matters....
You probably know....

- Heat events are the most lethal extreme weather events
Risk of death increases at temps below extreme heat waves
Increased temp variability associated with death

Guo et al, 2016
High mean summer temperature and variability raise risk

Shi et al., 2016
Indoor HI can exceed outdoor HI at night and at end of heat wave

Quinn et al, 2017
You probably know....

• **High pollen counts cause asthma and allergy attacks**

VICTORIAN AUTHORITIES HAVE CONFIRMED EIGHT PEOPLE HAVE NOW DIED FOLLOWING WEATHER EVENT ‘THUNDERSTORM ASTHMA’
3-4% increase in asthma visits in Atlanta with thunderstorms

Figure 1.
Relative risk of asthma ED visits following days with a) thunderstorms [●], b) thunderstorms in combination with rainfall (in 4 categories) [▲], and c) thunderstorms in combination with wind speed from maximum 5-second wind gusts (in 3 categories) [■], compared to days with no thunderstorms. Relative risks and p-values are presented for each model result.

Grundstein, et al., 2008
You probably know….

• Extreme events and floods cause drownings and other injuries

http://www.dailymail.co.uk/news/article-3097091/12-missing-flooding-Texas-sweeps-away-vacation-home.html
Special Focus: Climate Change and Pregnant Women

Pregnant and postpartum women and their infants are uniquely vulnerable to the health impacts of climate change, due to the many physiologic and social changes that occur as a result of pregnancy. Climate-related exposures may lead to adverse pregnancy and newborn health outcomes, including spontaneous abortion, low birth weight, preterm birth, increased neonatal death, dehydration and associated renal failure, malnutrition, diarrhea, and respiratory disease.

**DID YOU KNOW?**

Flooding places pregnant women at increased risk of exposure to environmental toxins and mold, reduced access to safe food and water, psychological stress, and disrupted healthcare.

**Heat-related impacts**

- Pregnant women are vulnerable to temperature extremes and are especially susceptible to dehydration, which releases labor-inducing hormones. Newborns are especially sensitive to ambient temperature extremes because their capacity for regulating body temperature is limited.
- Extreme heat events are also associated with adverse birth outcomes, such as preterm birth, low birth weight and infant mortality.

**Drought and flood risks**

- **Drought** endangers pregnant women's access to safe and reliable water sources for drinking and sanitation, increasing their vulnerability to dehydration (leading to pre-term labor) and infectious agents.
- Pregnant women and newborns are uniquely vulnerable to **flood** health hazards. Flooding can increase exposure to infectious diseases, including waterborne and vector-borne illnesses.

Source: Public Health Institute
Vulnerability of Senior Residences and Health Infrastructure

Flooding in nursing homes and hospitals can be devastating. These facilities need to be prepared for potential flooding to protect the health and safety of residents.

LaSalle County Nursing Home roads closed after flooding

Flooding causes Holly Hill Nursing Home residents to be moved to Lake Charles facility

Dramatic rescue at Lisle nursing home


http://www.toledoblade.com/image/2015/06/28/600x600/n2flood3.jpg
Impact of Climate Change on Human Health

- Injuries, fatalities, mental health impacts
- Asthma, cardiovascular disease
- Heat-related illness and death, cardiovascular failure
- Malaria, dengue, encephalitis, hantavirus, Rift Valley fever, Lyme disease, chikungunya, West Nile virus
- Forced migration, civil conflict, mental health impacts
- Respiratory allergies, asthma
- Extreme heat
- Changes in Vector Ecology
- Environmental Degradation
- Increasing Allergens
- Water and Food Supply Impacts
- Rising Temperatures
- Water Quality Impacts
- More Extreme Weather
- Rising Sea Levels
- Increasing CO2 Levels
- Cholera, cryptosporidiosis, campylobacter, leptospirosis, harmful algal blooms

Slide courtesy of Dr. George Luber, CDC
THE IMPACTS OF CLIMATE CHANGE ON HUMAN HEALTH IN THE UNITED STATES: A SCIENTIFIC ASSESSMENT
Climate change affects human health in two main ways:

1. Changing the severity or frequency of health problems that are already affected by \textit{climate} or \textit{weather} factors

2. Creating unprecedented or unanticipated health problems or health threats in places where they have not previously occurred.

Climate and Health Assessment, 2016
1 Climate Change and Health

Projected Changes in the Hottest/Coldest and Wettest/Driest Day of the Year

Coldest Night of Year

Hottest Day of Year

Temperature Change (°F)

Temperature Change (°F)

3 4 5 6 7 8 9

3 4 5 6 7 8 9

Wettest Day of Year

Annual Longest Dry Spell

Precipitation Change (%)

Change in Number of Days

3 6 9 12

0 1 2 3
Significant Findings

Quantifies future increases in temperature-related deaths
- Confirms very high confidence in association between hotter- and colder-than-normal temperature and increased illness and death
- Quantifies the increase of thousands to tens of thousands of premature heat-related deaths projected in the summer due to climate change
- Assesses the impact of changes in tolerance to extreme heat on future deaths from heat

Confirms air quality impacts and provides likelihood for ozone, wildfire impacts
- Provides new likelihood assessment (likely) and high confidence that climate change will make it harder for any given regulatory approach to reduce ground-level ozone pollution, and that increased wildfires increase risk of premature death, adverse cardiovascular/respiratory outcomes
- Confirms high confidence that increases in airborne allergens will worsen allergy and asthma conditions and confirms indoor air health risks as significant emerging area

Connects changes in extreme events to increased exposure to health impacts
- Describes health impacts to extreme events with high confidence, including death, injury, or illness; exacerbation of underlying medical conditions; and adverse effects on mental health
- Identifies impacts to health from disruption of essential infrastructure
- High confidence that coastal flooding will impact vulnerable communities
Significant Findings

Provides likelihood of changing vector distribution, expands discussion of WNV
- Likely, high confidence in changing geographic and seasonal distribution of ticks carrying Lyme, and likely, medium confidence in increases in risk to human exposure
- Assessment of impacts of West Nile virus show very likely, high confidence in climate change influence on distribution, abundance, and prevalence of infection in mosquitoes

Details sources and pathways (drinking, recreational) of waterborne illness risk
- Disaggregates confidence and likelihood for changes in multiple water-related illnesses from *Vibrio* bacteria, marine harmful algae, freshwater harmful algae, and runoff sources
- Describes health impacts of water infrastructure damage or failures

First assessment of rising CO$_2$, climate on quality (nutritional value) of food
- Describes impacts of pathogens, toxins, and chemical contaminants in US food chain
- Assesses the large body of research establishing very likely, high confidence that nutritional value of food crops, such as wheat and rice, will decrease as rising levels of atmospheric CO$_2$ reduce concentrations of protein and essential minerals in most species
Significant Findings

**Presents an important emerging area: increased mental health consequences**

- Confirms Very High Confidence in extreme weather and climate related impacts including post-traumatic stress disorder (PTSD), depression, and anxiety, often at the same time
- Introduces issue of mental health impacts from the real and perceived threats of climate change and risks of heat exposure to people with pre-existing mental health illnesses or prescription medications

**Details the ways in which climate change affects the health of us all**

- People experience different inherent sensitivities to the impacts of climate change at different ages and life stages. For example, the findings confirm with very high confidence the very young and old are particularly sensitive to climate-related health impacts.
Intersection of Social Determinants of Health and Vulnerability

**Climate Drivers**
- Exposure
  - Poverty, Occupation, Racial Discrimination
- Sensitivity
  - Underlying Health Disparities
- Adaptive Capacity
  - Education, Social Norms, Governance, Social, Health, and Economic Policy

**Exposure Pathways**
- People in poorer neighborhoods are generally more likely to be exposed to climate change health threats.
- People with chronic medical conditions are more likely to have a serious health problem during a heat wave than healthy people.
- People with reduced access to care and preventative services are more likely to have a severe health outcome from their illness.

**Health Impacts**

**Health Outcomes**

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Climate and Health Assessment, 2016
Climate Change | A Human Health Perspective

A Student Exploration of the Impacts of Climate Change on Human Health in the United States

Summary
This module follows the 5E instructional model to promote student discovery and learning about the complex interactions between climate change, the environment and human health. Using content from the US Global Change Research Program’s 2016 report, The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment (CHA, 2016), students are prompted to describe the impacts of changing climatic conditions on human health with emphasis on vulnerable populations and apply systems thinking to create a visual model of the various health implications arising from climate change. Students also consider the benefits of climate mitigation on human health and are thus introduced to the concept of co-benefits. Students are invited to identify and evaluate adaptation strategies that are protective of human health. To provide a solutions focus to the module, a culminating activity is offered that enables students to engage with local, state or regional data and the US Climate Resilience Toolkit to evaluate climate adaptation and mitigation strategies and, if desired, plan a resilience building project to address a climate change related human health impact relevant to their local community.

Grade Level
Grades 9-12, with options for differentiation provided

Learning Objectives
One environmental condition can lead to multiple health outcomes.
Climate Change and Human Health Literature Portal

The Climate Change and Human Health Literature Portal is a knowledge management tool for locating the most relevant scientific literature on the health implications of climate change. It provides access to a database of studies from around the world, published between 2007 and 2014. The National Institute of Environmental Health Sciences (NIH) developed the database as a technical input to the U.S. Global Change Research Program's (www.globalchange.gov) Sustained Assessment process. The portal is an effort to make this database more accessible to a wider global audience, and to provide updates on a regular basis to further the study of climate impacts on human health.

https://tools.niehs.nih.gov/cchhl/
Meet the Challenges of a Changing Climate

Find information and tools to help you understand and address your climate risks.

BUILD YOUR CLIMATE RESILIENCE >

SEE WHAT OTHERS ARE DOING >

EXPLORE CLIMATE IN YOUR LOCATION >

EXPLORE THE TOOLKIT >

Toolkit.climate.gov
Conclusions

• Weather extremes and variability have multiple, serious health effects

• Trends and climate projections suggest extremes and variability will continue to increase

• Broadcast meteorologists are unique communicators of public health messages about weather and climate change

• Extensive resources exist in US and globally to assist resilience activities
Resources for information, data and tools

• USGCRP Climate Health Assessment

• NIEHS Lessons in Climate Change and Health
  – http://www.niehs.nih.gov/lessonsinclimatetechchange

• NIEHS Climate and Health Literature Portal

• CDC’s BRACE framework and guidance documents
  – http://www.cdc.gov/climateandhealth/default.htm

• Climate Resilience Tool Kit
  – https://toolkit.climate.gov/topics/human-health
Thank you for your attention!

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