

How Climate Change Impacts Women and Their Health

Rick Woychik, Ph.D. Director

National Institute of Environmental Health Sciences National Toxicology Program

October 18, 2022

Advisory Committee on Research on Women's Health

National Institutes of Health • U.S. Department of Health and Human Services



The mission of the National Institute of Environmental Health Sciences is to discover how the environment affects people in order to promote healthier lives.



The vision of the National Institute of Environmental Health Sciences is to provide global leadership for innovative research that improves public health by preventing disease and disability.



NIEHS Strategic Plan





What's in our environment that can impact our health?





What's in our environment that can impact our health?

Inter-individual genomic and biological heterogeneity



National Institutes of Health U.S. Department of Health and Human Services



What's in our environment that can impact our health?





- Odor & noise
- Point, line sources
- Air pollution
- Flame retardants
- POPs

- Groundwater contamination
- Surface water contamination
- Occupational exposures

Vermeulen et al., Science, 2020



Women's Health Research Activities Supported by NIEHS

- Women's health is an essential part of the NIEHS research agenda.
- In our intramural and extramural divisions, NIEHS is focused on studying the environmental, lifestyle, and behavioral factors to prevent or reduce the chance of women developing health problems over the life course
- Strong and basic mechanistic research on women's health and reproductive biology
- Integrate the genetic and non-genetic factors that contribute to promoting women's health
- Using the Exposomics framework NIEHS investigates how SES, structural racism, psychosocial stress can exacerbate chemical exposures that impact women's health





Windows of Susceptibility and Developmental Origins of Health and Disease





Environmental Impacts and Women's Health Disparities

IH National Institute of Environmental Health Sciences

Environmental Impacts on Women's Health Disparities and Reproductive Health Workshop (April 27-28,2022)



Key Themes: Access to Care * Community Engagement Environmental Justice * Equity * Exposure Intersectionality * Interventions * Preventions Methodology * Reproductive Justice



Women's Health Awareness at NIEHS

- "Our mission is to inform and empower women to take responsibility for their health, understand their health options, and identify services, thereby increasing equal access to services, resources, and products that best help them prevent and reduce poor health."
- Women's Health Awareness Community Resiliency, Environmental Action, and Collaborations for Health (REACH) Equity—co-funding from OWHR
 - To identify predisposing factors and COVID-19 related factors that contribute to adverse health outcomes within the Women's Health Awareness population





Joan Packenham, Ph.D. Director NIEHS Office of Human Research Compliance



Panel Presentations: Epidemiologic Contributions to Understanding the Environmental Impact on Women's Health

- Dr. Kristen Upson: "Women's Risk of Endometriosis (WREN) Study"
- Dr. Quaker Harmon: "Study of Environment, Lifestyle, & Fibroids (SELF)"
- Dr. Dale Sandler: "The NIEHS Sister Study"



ap denotes the approximate location for each of the 20 se

"Code Red for Humanity"

UN Secretary General on IPCC 2021 report



Impacts of Climate Change on Human Health





Climate Change Affects Health Directly and Indirectly

Direct Effects

- Heat-related illness
- Respiratory disease
- Heart disease
- Food-, water-, and vector-borne diseases
- Injury
- Premature death
- Mental health impacts
- Poor maternal and birth outcomes

Indirect Effects

- Chemical releases into environment
- Changes in air, water, food quality and quantity
- Population displacement
- Interruptions to health care
- Infrastructure and supply chain disruption
- Economic impacts more people living in poverty





Climate Change Affects Us Unequally



Under-served populations with health disparities

(Some communities of color; Low-income populations; Low-educational attainment groups; Immigrant groups; Indigenous populations)



Vulnerability by life stage

(Fetal/pre-natal, infants, young children, pregnant women, elderly)



Exposed workers

(e.g., farmers, construction workers)



Vulnerability associated with chronic medical conditions

(e.g., diabetes, asthma, cardiorespiratory diseases, psychiatric diseases)





Populations in LMICs

(Higher rates of existing diseases, malnutrition, and extreme poverty)



Climate Change Affects Women Differently

Exposure	Physiologic and biologic vulnerabilities	Disparate health impacts
Extreme heat	Women have higher working metabolic rate and reduced heat dissipation through sweating	Heat-related morbidity and mortality
Poor air quality	Women experience greater deposition of particles in the lungs	Respiratory and heart disease
Poor air quality	Air pollutants can cross placenta	Poor birth outcomes
Disasters	Women are more likely to have poor baseline nutritional status and physical health	Higher rate of mortality during disasters, birth complications, poor maternal and neonatal health
Food insecurity	Increased nutritional needs during menstruation, pregnancy, and nursing	Malnutrition, anemia, poor neonatal outcomes
Waterborne diseases	Dehydration and infection during pregnancy	Preterm birth, poor maternal and neonatal outcomes
Vector-borne diseases	Women produce higher CO2 which attracts mosquitos; Hormone changes during pregnancy reduce immune response	Poor reproductive, maternal, and neonatal outcomes



Air pollution Contributes to Infertility, Pregnancy Loss, Neonatal Respiratory Complications

- Chronic exposure in pregnancy to ozone and particulate matter were associated with pregnancy loss (miscarriage and stillbirth).
- In a preconception cohort study, residential exposures to certain types of particulate matter were associated with reduced fecundability.
- Neonatal respiratory complications were associated with prenatal exposure to common air pollutants.



FIGURE 4 Association between residential concentrations of nitrogen oxides (NO_x) and fecundability, fit using restricted cubic splines. NO_x is modelled as (A) the average during the year before baseline, (B) average concentration over each menstrual cycle, and (C) cumulativeaverage exposures. The reference value is the lowest observed value in the cohort, and there are three knots located at the 10^{th} , 50^{th} and 90^{th} percentiles. The x-axis ranges from the minimum value to the 95^{th} percentile. Spline curves are adjusted for age, education, income, parity conditional on gravidity, month of enrollment, year of enrollment, average monthly ambient temperature and concentrations of PM_{2.5} and SO₂



Ambient Temperature Changes Contribute to Maternal Cardiovascular Complications, Low Birth Weight

- Even small changes in temperature during the week prior to delivery were associated with cardiovascular risk for mothers during labor or delivery.
- Non-Hispanic Black women seemed to be more susceptible to temperature increases during the warm season.
- Exposure to atypically high or atypically low ambient temperatures was associated with low birth weight.



Fig. 2. Risk of cardiovascular events in the warm season associated with 1 °C *higher* in average temperature during the week prior to delivery. Asterisk indicates statistical significance at p < 0.05.



Hotter Temperatures During Pregnancy Linked to Lower Fetal Growth

- Study included data from nearly 30 million births across the U.S. between 1989 and 2002
- High ambient temperatures across pregnancy were associated with higher risk of term small for gestational age (SGA) and lower birth weight
- Risks were more strongly associated with temperatures during the 2nd and 3rd trimesters, and in cold climates
- Study provides evidence that temperature may be novel risk factor for lower fetal growth



National Institutes of Health U.S. Department of Health and Human Services



Higher Temperatures Linked to Lower Ovarian Reserve

- Assessed antral follicle count (AFC), a measure of ovarian reserve, in 631 women aged 18-45 years in Massachusetts
- Estimated daily ambient temperature exposures 3 months, 1 month, and 2 weeks before AFC examination
- A 1-degree C increase in average maximum temperature 3 months before ovarian reserve testing was associated with a 1.6% lower AFC
- Results suggest that the steady increase in temperature due to climate change may result in accelerated reproductive aging in women





Occupational Heat Exposure Linked to Breast Cancer

- Examined associations between female breast cancer risk and occupational heat in large case-control study (1,389 breast cancer patients and 1,434 controls)
- Women having ever been exposed to occupational heat had a higher risk of breast cancer
- Risk was higher among women with hormone receptor-positive breast cancer
- Jobs with the highest exposure included operators of furnaces, miners, cooks, and launderers and ironers





Climate Change Associated Natural Disasters Disproportionately Affect Women, Children, People with Disabilities

- Women, teens and young adults, and children more vulnerable to post-traumatic stress after Indian Ocean tsunami
- Children with chronic health conditions, and those who needed mental health care, experienced health care disruptions and unmet care needs after Hurricane Katrina
- At-risk children with higher exposure to natural disaster experienced more longer-term problems controlling aggression





Pregnancy Outcomes Before and After Hurricane Harvey

- Study included data from nearly 30,000 pregnant women – 3,842 of whom delivered within 40 weeks after Hurricane Harvey
- Women delivering after the hurricane were more likely to have adverse outcomes, as were their newborns, compared to women delivering before the storm:
 - 27% higher maternal morbidity
 - 50% higher neonatal morbidity
- Women of low socioeconomic status were most affected





Breast cancer patients living through Hurricane Katrina had a 15% higher mortality rate compared to patients not exposed to the storm

The increase was likely caused by disaster-related disruptions in health care



Associations among all cancer types trended toward higher mortality, but was only significant among breast cancer cases

W Even missing one week of chemotherapy has significant effects on long-term mortality. What does it mean if your access to health care is disrupted for an even longer period of time because of a disaster?

- Sue Ann Bell, Ph.D., study author



Climate Change Disrupts the Women's Care Continuum

- Destroys or damages health care infrastructure
- Power outages, staff shortages, and transportation disruptions reduce access to care, including radiation therapy and preventive cancer screenings
- Overwhelms health system capacity
- Loss of medical records affects follow-up care
- Problems accessing or storing medications
- Disruptions to medical supply chains
- Threatens cancer research infrastructure and disrupts clinical trials



Hospitals face critical shortage of IV bags due to Puerto Rico hurricane



Hiatt and Beyeler, Lancet Oncol, 2020 Schiller et al., JCO Oncol Prior abordutes of Health U.S. Department of Health and Human Services



Proposed ALL of NIH Initiative on Climate Change and Health (CCH)

- Executive Orders Bring Renewed Focus on Climate Change Across Agencies
 - Executive Order 14008 Tackling the Climate Crisis at Home and Abroad
- President's Budget & Congressional Markup
 - President's Budget (\$100M) to NIEHS for CCH Research in Fiscal Year 2023
 - House Markup (\$10M) & Senate Proposed Level (\$50M)
- Seven Institute and Center Directors as NIH Leaders
 - Drs. Bianchi (NICHD), Gibbons (NHLBI), Glass (FIC), Gordon (NIMH), Perez-Stable (NIMHD), Woychik (NIEHS), and Zenk (NINR)
- Re-energized NIH Working Group co-chaired by NIEHS and FIC







Framework Guides Future Climate Change and Health Research

- Outlines four core elements
 - Health Effects Research
 - Health Equity
 - Intervention Science
 - Training & Capacity Building
- Goal is to reduce health threats from climate change across the lifespan and build resilience
- New Funding Announcements posted: <u>www.nih.gov/climateandhealth</u>





Impacts of Climate Change on Human Health and Research Needs





First Projects with FY 2022 Funds from all 7 NIH Initiative Partners

- Research Coordinating Center for the Climate Change and Health Community of Practice
 - The Research Coordinating Center (RCC) will support the development of an inclusive Community of Practice (COP) of climate change and health researchers and trainees that fosters collaboration, capacity building, innovation and research.
- Research Opportunity Announcement Alliance for Community Engagement- Climate and Health (ACE-CH)
 - NIH is soliciting applications from teams to conduct communityengaged research focused on climate change impacts on health and, the co-benefits of identifying the mitigation of climate change risks, vulnerabilities and adaptation.

- Notice of Special Interest: Climate Change and Health
 - NOSI encourages applications that address the impact of climate change on health and well-being over the life course, including the health implications of climate change in the United States and globally.
- Notices of Special Interest: Innovative Technologies for Research on Climate Change and Human Health (SBIR/STTR)
 - NOSI to develop or adapt practical technologies for capturing the effects of climate change and extreme weather events on human health and to reduce the health threats posed by climate change across the lifespan.



2022-2023 NIH Climate and Health Scholars Program

- The program seeks to bring Climate and Health scientists from outside the U.S. federal government to work with NIH staff to share knowledge and help build our capacity in the scientific domains outlined in the NIH Climate Change and Health Initiative's <u>Strategic Framework</u>.
- During their time at NIH, the scholars will be invited to collaborate with NIH staff on one or more of a diverse array of research, training, and policy activities that share their scientific knowledge with NIH laboratories, program offices, and the wider NIH community.
- Applications due September 15, 2022.





Promoting Health Effects of Climate Change Research in the NIH Intramural Research Program

Supporting trans- NIH research	Implement a new competitive funding program, the Intramural Targeted Climate Change & Health (ITCCH) program, that provides seed funding to stimulate research activities from NIH intramural investigators at multiple ICs.
Building intellectual capacity	Establish a new intramural Laboratory/Branch/Center at NIH that focuses on biological mechanisms of health impact of climate change. This branch will serve as a central hub to facilitate research in this area across the entire NIH Intramural Research Program.
DescriptionBuildinginfrastructure	Build infrastructure within the NIH Intramural Research Program to begin to establish the tools necessary to conduct research into the health impact of climate change.



NIH Resources on Climate Change and Health

- NIH Climate Change and Health Initiative
 - Information on the Initiative and Framework www.nih.gov/climateandhealth

• Funding Announcements

 Updated live as announcements are released www.nih.gov/climateandhealth

Public Seminar Series

Promoting transdisciplinary discussion and collaboration against this threat to health.
https://www.nih.gov/climateandhealth#seminar-series

• Climate Change and Health Literature Portal

 Searchable database to provide access to the most relevant scientific literature <u>https://tools.niehs.nih.gov/cchhl/index.cfm</u>





Thank You!



National Institute of Environmental Health Sciences



