

Office of Research and Development



Children's Environmental Health Research

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Outline

- Slides 3: EPA Research
- Slides 3-8: Healthy Schools and Daycares
- Slides 8-10: The Total Environment
- Slides 11-17: Climate Change
- Slides 20-23: Chemicals of Immediate Concern
- STAR Children's Environmental Health Centers
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Informs public health decisions.

EPA's Research

- Advances scientific understanding
 of potential early life susceptibility
 to environmental stressors.
- Informs community efforts that
 create sustainable and healthy
 environments protective of
 children's health.





EPA research is addressing children's health in the locations where children spend much of their time—including homes, schools, and daycares

STAR Grant: *Environmental Factors, Children's Health and Performance, and Sustainable Building Practices (Healthy Schools).*

Intramural Research: *Health assessments at Tribal childcare centers.*

Cumulative Risk: Workshop planning for cumulative assessment of non-chemical and chemical stressors.



STAR Grant: Healthy Schools

Expected Outcome: Risks of environmentally-induced illness and injury to students, teachers, and other school staff are diminished or avoided. Optimal learning environments are provided in schools that maximize student achievement and teacher/staff effectiveness.

- Seven grants totaling close to \$7 M awarded to universities and other institutions/agencies.
- Inform K-12 educational facilities' design, construction, and operation practices to foster safe and healthy school environments.
- Included a conference with grantees and school practitioners to discuss progress, real-world research benefits, and remaining challenges and research gaps.

Environmental Factors, Children's Health and Performance, and Sustainable Building Practices (2014-2020)



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STAR Grant: Healthy Schools

Research Takeaways

Security Measures	The existence of secure entry processes is negatively associated with student performance.
Test Scores	Proxies for individual socio-economic status are strongly associated with standardized test scores.
Emergency Room Visits	Schools within 1-5 miles from industrial facilities and 1 mile of airports have increased risks of emergency department visits due to respiratory diseases after controlling for socio-demographics.
Classroom Environment	Only 20-25% of the measured 220 classrooms exhibited acceptable ventilation rates, only 5% exhibited acceptable background noise levels, and about 85% exhibited acceptable reverberation.



Intramural Research: Tribal Childcare Center Health Assessments

Environmental health assessment for concentrations of pesticides, PCBs, lead, and allergens at Indian Country childcare centers in the Pacific Northwest to characterize childrens' potential exposures to chemical and biological agents in childcare centers.

Preliminary Results:

Pesticides: At least one was detected at all childcare centers regardless of reported pesticide use.

PCBs: None were detected.

Lead: Detected at all childcare centers where samples were collected and analyzed for lead.





EPA is using a Total Environment Approach – examining chemical stressors, social stressors, and health effects – to study and address children's health.

STAR Grants

Intramural Research

Cumulative Risks: Workshop planning for cumulative assessment of non-chemical and chemical stressors.

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Research on the Total Environment

Using the Total Environment Framework to Assess Life-long Health Effects of Chemical Exposures (2018-2021)—\$2.2 M to three institutions.

Researchers have explored the complex interactions, stresses, and health impacts that can arise across the total environment.

 Using an Exposome Approach to Assess the Effects of PM2.5 on CVD Outcomes
 Paul Juarez, Darryl Hood, Meharry Medical College (HBCU)

- Southeast Wisconsin Interdisciplinary Study of Children's Health, Ecological Exposures and Social Environment Sheryl Magzamen, et al, Colorado State University
- Building Water Infrastructure to Improve Childhood
 Outcomes: Interventions to Decrease Childhood Lead
 Exposure from Private Wells
 Jaqueline MacDonald Gibson, UNC-Chapel Hill



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Total Environment: Intramural Research

- Development of a Conceptual Framework Depicting a Child's Total (Built, Natural, Social) Environment in Order to Optimize Health and Well-Being. Tulve, N. et al. (2016), J Env Health Sci, 2:1-8.
- Contributions of a Child's Built, Natural, and Social Environments to Their General Cognitive Ability: A Systematic Scoping Review. Ruiz, et al. (2016), PLoS ONE.
- Chemical and Non-Chemical Stressors Affecting Childhood Obesity: A Systematic Scoping Review. Lichtveld, K.; Thomas, K.; Tulve N. (2018), JESEE 28:1-12.
- A Meta-Analysis of Stressors from the Total Environment Associated with Children's General Cognitive Ability. Nilsen F.J.; Ruiz, J; Tulve, N. (2020), Int. J. Environ. Res. Public Health, 17:5451.
- A Systematic Review and Meta-Analysis Examining the Interrelationships Between Chemical and Non-Chemical Stressors and Inherent Characteristics in Children with ADHD. Nilsen, F.J.; Tulve, N. (2020), Env Res. 180:108884.
- A Systematic Review and Meta-Analysis Investigating the Relationship between Exposures to Chemical and Non-Chemical Stressors During Prenatal Development and Childhood Externalizing Behaviors. Nilsen, F.M.; Frank, J.; Tulve, N. (2020), Int. J. Environ. Res. Public Health, Mar 31;17(7):2361.





EPA is furthering understanding of impacts on children from climate change, protecting children's health in the face of climate change, and building resilience in communities.



Climate Change and Children's Health

EPA is furthering understanding of impacts on children from climate change, protecting children's health in the face of climate change, and building resilience in communities.



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The boxes on the left provide examples of social determinants of health associated with different elements of vulnerability. The boxes on the right illustrate examples of the implications of social determinants on increased exposure, increased sensitivity, and reduced adaptive capacity. Adaptive capacity can affect exposure and sensitivity and the resilience of individuals or populations experiencing health impacts by influencing access to care and preventive services (USGCRP, 2016, Chapter 9).



Children's vulnerability to climate change results from distinct exposures, biological sensitivities (developing bodies and immune systems), and limitations to adaptive capacity (dependency on caregivers) at different life stages.



STAR Grants

Contaminated Sites, Natural Disasters, Changing Environmental Conditions and Vulnerable Communities (\$4.8 M, 6 projects), e.g. *Predicting Drinking Water Contamination from Extreme Weather to Reduce Early Life Contaminant Exposures.*

Notice of Intent: The Intersection of Climate Change, Environmental Justice, and Vulnerable Lifestages/Groups.



Climate Change Research Collaborations

ORD collaborations with EPA regional scientists:



Caño Martin Peña community citizen monitoring of indoor fungal and bacterial microbiome levels to assess reductions in asthma triggers before and after remediation of flooding events, including those occurring after natural disasters

- Caño Martin Peña community in Puerto Rico is experiencing poor environmental conditions due to an inadequate sewage system and damage from Hurricanes Irma and Maria.
- The research is focused on improving the lives of the people of the community through citizen science and education by reducing indoor microbial populations after flooding events.

Enhanced Post-Flooding Risk Communication to Reduce Indoor Air Health Hazards

- In Region 4, EPA researchers are working with the Florida Department of Health, University of Florida, and Louisiana State University Extension Office to create an interactive outreach tool that promotes community resilience after a flooding occurrence.
- Tool will be applicable across the nation after other natural disasters.

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Asthma Prevalence Indicator



ORD researchers have released an update to the Asthma Prevalence indicator for EPA's <u>Report on the Environment</u>

- Two additional years (2017 2018) of data.
- Continued downward trend in childhood asthma prevalence with rates reaching a low of 75 cases/1,000 in 2018.
- Disparities still exist Black and Native American/Alaska Native children continue to report higher asthma and asthma attack prevalence than Whites and Asians.

Explore the Asthma Prevalence indicator here.

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Mold Exposures and Asthma

EPA researchers are examining the impact of mold exposure on asthma development and looking for ways to prevent the development of asthma and reduce symptoms.

Research Highlights:

- Shown that mold exposures in infancy were significantly associated with the development of asthma.
- Identified socioeconomic disparities, including
 - higher mold levels in low-income housing in cities and in Hispanic-immigrant housing in Coachella, CA correlated with a higher prevalence of asthma;
 - pulmonary function lower for children exposed to mold in the wake Hurricane Katrina; and
 - prevalence of asthma was higher in a school with higher levels of mold compared to lower levels.
- Shown that the use of HEPA filtration units in either the bedroom or classroom of a child with asthma reduced asthma symptoms and improved their lung function.



Reduce mold to reduce the impact of asthma on Children 16



Equitable Resilience

Children suffer negative impacts from disasters This research is working to help communities conduct resilience planning using outreach and engagement and incorporating social relationships.

- Existing mapping tools show where vulnerable groups are located but do not
 - shed light on why vulnerabilities exist/how they are produced, or
 - show what kinds of actions can reduce vulnerability for the most exposed.
- Increasing interest among local jurisdictions in incorporating equity and social vulnerability into resilience planning.

Social Vulnerability

The ways in which people and communities are vulnerable to the effects of hazards and disasters that go beyond physical exposure, including social, economic, health, cultural, and historical factors.



Chemicals of Immediate Concern: Lead

ORD science supports and aligns with Federal Lead Action Plan (FLAP) research (Goal 4) actions

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Lead: Mapping for Targeting

Where do lead exposure problems remain and what are the key drivers in those locations?

Problem: While childhood blood lead levels have dropped across America, many children are still exposed to various sources of lead.

Approach:

- Science-based approaches for identifying communities with high exposure potential and key sources of exposure in those communities.
- Include EJ SCREEN, socioeconomic and demographic data.
- Technical support to 5 EPA Regions, maps of 24 states.

Why this is important:

- Identify locations where sources other than old housing may be key.
- Identify potential hot spots in the absence of blood lead level data. Very limited blood lead level data available (recent NY Times article on COVID and Pb in children).
- Inform joint EPA and state planning for Pb exposure reduction actions.
- Dovetails with environmental justice efforts.



Lead: Support for Regulatory Actions

- Integrated Science Assessment (ISA) for Lead
- Updated Blood Lead Level models: Update and evaluate Integrated Exposure Uptake Biokinetic and All Ages Lead Model; Combine with stochastic exposure modeling.
- Estimate blood lead levels for children of different ages (national-scale analysis) resulting from exposure through drinking water, soil, dust, air and food to evaluate source contribution.
- 2020 STAR RFA: <u>Estimating Children's Soil and Dust Ingestion Rates for Exposure Science</u>; \$8.1 M funding 7 research projects, soon to be announced.

Why this is important:

- The Lead ISA is the scientific foundation for the Lead National Ambient Air Quality Standard (NAAQS).
- BLL modeling used to support LCR benefits analysis and Dust Lead Hazard Standard, site-specific cleanup levels
- Modeling supports the coordinated development of lead rules accounting for aggregate exposure across environmental media.
- Soil and dust ingestion rates remain an important data gap



Zartarian, et al. 2017 EHP https://doi.org/10.1289/EHP1605 20



National Children's Study: Secondary Data Analysis for Lead and PFAS

Researchers are utilizing Existing National Children's Study Lead (and other metals) environmental and biospecimen analysis results, along with extensive survey data, to better understand source-to-exposure relationships for pregnant women and to inform exposure models and modeling approaches.

Approach:

- Elucidate distributions of Pb for maternal blood samples, maternal urine samples, home surface wipe samples during pregnancy and early childhood, and house dust vacuum samples.
- Assess associations between maternal biological samples and concentrations in home environmental samples.
- Identify potential determinants of maternal exposure using NCS survey data in modeling approaches



HEALTH GROWTH ENVIRONMENT





Measurements to Support PFAS Human Exposure Modeling

NCS and AHHS Study:

Researchers are analyzing archived National Children's Study (NCS) data/samples and American Healthy Home Survey (AHHS) samples to address gaps in human exposures to PFAS.

Research includes the following:

- Performing secondary data analyses of archived serum PFAS results and questionnaire data for pregnant women in the NCS to assess social, household, and geographic determinants of exposure.
- Analyzing serum samples and matched vacuum dust samples to examine the relationships between home environment and biomarkers of exposure.
- Analyzing matched water and house dust samples analyzed for PFAS to better understand residential exposures.



Chemical Safety and Children's Health

ORD is developing tools for chemical evaluation, advancing understanding of complex systems, providing information translation and delivering a chemical knowledge infrastructure.

Childrens Environmental Health Research:

- High-Throughput Toxicology (HTT)
 Examples: Endocrine Disruption (Thyroid Pathway), Developmental Neurotoxicity.
- Adverse Outcome Pathways (AOP)
 Examples: Integrating New Approach Methodologies in AOP Framework, Developing PODs, Susceptibility Factors.
- Virtual Tissue Models (VTM)

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Examples: VTMs for developmental Outcomes, In Silico Models and Simulations of Development.



Center for Early Lifestage Vulnerabilities to Environmental Stressors

EPA STAR Request for Applications (RFA) for Children's Research Centers at \$1.9 million: FY20, FY21

Joint effort between EPA's Office of Research and Development (ORD) and Office of Children's Health Protection (OCHP), Office of Environmental Justice (OEJ), and Office of Land and Emergency Management (OLEM).

Focus: Address scientific gaps in understanding relationships between environmental exposures and age-group-specific health effects.

- Early life stage (including prenatal) vulnerabilities to exposures to chemical and non-chemical stressors that may cause health effects later in life.
- Use of existing epidemiological data and other public health, environmental, and social data to understand early life vulnerabilities and adverse health outcomes.
- Cumulative prenatal exposures to chemicals and health effects across lifestages: infants, toddlers, early childhood, adolescents, and teens.

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QUESTIONS?