# **2.63 Assessing Environmental Health Disparities in Vulnerable Groups**

**Project Number & Title**

2.63 - Assessing Environmental Health Disparities in Vulnerable Groups

**Project Lead and Deputy**

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**Project Period**

FY16-FY19

**Project Summary**

This project will provide data and knowledge about how non-chemical stressors modify chemical exposures leading to changes in health and well-being for susceptible and vulnerable groups. Additionally, aligned with SHC projects 2.61 and 2.62, this project will study the underlying causes of vulnerability in places where people live, learn, play, and work to better understand how community-based decisions influence vulnerability in both positive and negative ways. Foundational and translational research will be conducted in this project to show how non-chemical stressors modify chemical exposures leading to changes in health and well-being. Selected emphasis will be placed in three research focus areas: 1) Children’s environmental health: susceptibility and vulnerability associated with early life exposures that set the stage for adult health; 2) Tribal communities: the influence of cultural factors and beliefs that impact environmental quality, health outcomes, and sustainability; and 3) Disproportionately impacted communities: the influence of social and economic factors as modifiers of environmental exposures and associated responses to chemical contaminants, including resiliency at the individual and community levels. These research focus areas will provide data and information to identify and characterize exposures to both chemical and non-chemical stressors, an improved understanding of how non-chemical stressors modify chemical exposures leading to health outcomes, and strategies to reduce exposures to stressors, ultimately improving health and well-being. Research in this project will address four outputs related to these research focus areas. Key products will be used to align research activities with the outputs. Research strategies will be developed that contain research activities and associated deliverables that directly support the key products and outputs. Research in this project will contribute to multiple SHC outputs and outcomes, and inform tool and model development across SHC projects and other ORD national research programs. Stakeholders include decision makers in EPA Programs and Regions, state, local, and Tribal governments, and non-government communities, groups, and individuals. Research in this project will contribute priority research as described in ORD’s Children’s Environmental Health and Environmental Justice Research Roadmaps, which integrate research on these topics that is ongoing in all ORD national research programs.

**Project Description**

Problem and Decision Context

Human health and well-being are inextricably linked to the environment. Implicit in EPA’s mission and explicit in multiple Executive Orders and mandates are the needs to consider vulnerable groups in rulemakings and to ensure that EPA’s rules do not have a differential impact on communities and do not cause or increase health disparities. Goal 3 of EPA’s Strategic Plan addresses cleaning up communities and advancing sustainable development to achieve more livable communities. Additionally, the SHC program is based on the premise that the best way to meet the long-term goals of EPA’s mission is to help communities find effective ways to meet federal requirements; to help the Agency and local governments develop regulations and practices that are less expensive and more socially just and acceptable; and, where possible, to provide innovative and effective non-regulatory approaches that equitably protect human health and the natural environment, while advancing sustainability.

We currently do not fully understand how the built, natural, and social environments interact to influence health and well-being across the human lifecourse. There is growing recognition that environmental and social factors interact in complex ways to determine human health and well-being, and that optimizing environments for healthy and sustainable living requires an understanding of this complexity.

The overall project goal is to understand how non-chemical stressors act as modifiers of chemical exposures, impacting the health and well-being of vulnerable groups.

Outputs

2.63.1: Development of a systems level approach to understanding children’s environmental exposures, health and environmental diseases (FY16)

2.63.2: Translational research to incorporate data and information on children’s environmental health (CEH) into tools to inform community actions (FY19)

2.63.3: Research to inform Tribal sustainability (FY19)

2.63.4: Evaluation of tested approaches to resolving health disparities in vulnerable populations and lifestages (FY19)

Focus Areas

The three research focus areas for this project are 1) Children’s environmental health: susceptibility and vulnerability associated with early life exposures that set the stage for adult health; 2) Tribal communities: the influence of cultural factors and beliefs that impact environmental quality, health outcomes, and sustainability; and, 3) Disproportionately impacted communities: the influence of social and economic factors as modifiers of environmental exposures and associated responses to chemical contaminants, including resiliency at the individual and community levels. These focal areas are aligned with and address problems defined in ORD’s Children’s Environmental Health and Environmental Justice Research Roadmaps which are based on research drivers defined by Agency regulatory requirements and stakeholder priorities.

*Focus Area #1: Children’s Environmental Health -*A complex array of environmental factors contribute to lifelong health and well-being. Among these are exposures to multiple manmade and naturally occurring substances which may occur both at critical windows of development and across the lifecourse. This complexity makes it difficult to assess the extent to which environmental contaminants, relative to other stressors, contribute to health and well-being. Additionally, this complexity confounds decision-making in regards to interventions designed to reduce exposures and improve children’s health and well-being. Furthermore, interventions can be in the form of regulatory actions, policies, and community projects at all levels of government (federal, state, Tribal, community [county, city, local municipality]). Metrics to track public health and to evaluate the effectiveness of interventions or remediation must also take spatial scale into account (from home to neighborhood to region to nation-wide). This multi-dimensional complexity calls for a systems approach to inform decisions designed to optimize our community environments (built, natural, social) for the benefit and sustainability of human health, especially for children who are still developing, and environmental integrity.

This need will be met by output 2.63.1 “Development of a systems level approach to understanding children’s environmental exposures, health and environmental diseases.” This output will draw from a 2015 product to provide a conceptual framework for a systems approach that is specific to children’s environments. It incorporates the contributions of and interactions among diverse environmental stressors (chemical and non-chemical) encountered in child-specific environments and lays these out as determinants of health, along with biological, behavioral and social factors both across the lifecourse and across spatial (local to national) scale. Building upon relationships gleaned from a DPSIR (Driving forces-Pressures-State-Impact-Response) model that considers both economic sectors and social drivers as driving forces (Yee et al., 2012), the framework will include ecosystem service benefits such as those depicted in the SHC Eco-Health Relationship Browser (<http://www.epa.gov/research/healthscience/browser/introduction.html>). This output will also draw from on-going SHC literature syntheses of environmental influences related to children’s health conditions such as obesity (Lichtveld et al., in preparation) and neurodevelopmental disorders (Ruiz et al., in preparation) (causative and exacerbating) and recent ORD research findings including foundational research on children’s exposure factors, impacts of early life exposures in laboratory (*in vivo* and *in vitro*) models, and results from the ongoing EPA/NIEHS Children’s Environmental Health and Disease Prevention Research Centers (Children’s Centers) program (<http://www.epa.gov/ncer/childrenscenters/>).

Key products for output 2.63.1 include a framework containing all components of a systems approach (built, natural, social environments) for characterizing children’s health; a relational database summarizing stressor (chemical, environmental, social) and health relationships based on research publications from the Children’s Centers; new evidence and mechanisms for (or against) early life exposures associated with good health or disease later in life (derived from both in-house and the Children’s Centers programs); and best practices for community outreach, engagement, and communication stemming from the Children’s Centers.

The conceptual framework can be expanded beyond child-specific environments to encompass all environments (built, natural, and social environments) drawing from results of STAR grants investigating the role of non-chemical stressors (<http://www.epa.gov/ncer/cra/recipients/index.html>) and other SHC research on cumulative community risk (SHC project 2.62). This integrated systems approach will lay out the interactions of the built, natural, and social environments that together contribute to human vulnerability and impact lifelong health and well-being which can then be incorporated into SHC research on cumulative community risk (SHC project 2.62). It is expected that the conceptual framework will help SHC integrate and coordinate the specific research undertaken in project 2.63 with relevant projects across SHC (especially projects 2.61, 2.62) and in other national research programs (e.g., CSS AOP [adverse outcome pathway] project), and provide a holistic context for communicating results to stakeholders.

Research in this focus area will also contribute to output 2.63.2 “Translational research to incorporate data and information on children’s environmental health (CEH) into tools to inform community actions.” Research on children’s exposure factors, coordinated with research using *in vitro* and *in vivo* experimental models, as well as epidemiology studies, will explore potential impacts of early life exposures on child development and later disease risks. In-house research will strategically complement the mechanistic and observational studies underway in the Children’s Centers program (<http://www.epa.gov/ncer/childrenscenters/>). In addition, the STAR Healthy Schools Research Program is designed to understand how environmental exposures associated with school buildings link to health and well-being. This research will link environmental exposures to environmental contaminants that children and pregnant women encounter in their daily lives with social and economic factors and health outcomes and conditions in order to evaluate associations between these factors and children’s health and well-being. These associations can then be used to inform the *in vitro* and *in vivo* experimental models to study causation between identified factors and health and well-being. In order to translate new knowledge and methods into SHC tools, relational databases will be created and updated as new publications become available. This is particularly important with respect to the Children’s Centers program where one funding cycle ends in 2015 and others extend to 2019 and beyond.

Key products for output 2.63.2 include a relational database summarizing stressor (chemical, environmental, social) and health relationships based on research publications from the Children’s Centers; new evidence and mechanisms for (or against) early life exposures associated with good health or disease later in life (derived from both in-house and the Children’s Centers programs); and best practices for community outreach, engagement, and communication stemming from the Children’s Centers.

*Focus Area #2: Tribal Communities -* Historical events have adversely changed the environments and traditional food sources specific to many Tribal populations (American Indians and Alaska natives), and have negatively impacted Tribal cultural practices, lifeways, and health. For example, environmental degradation and displacement of Tribes from traditional lands led to elimination of traditional foods in the diet and replacement by less healthy alternatives (e.g., from USDA surplus). Simply stated, impaired features of Tribal environments are not supporting previously sustainable and healthy diets and lifestyles. These changes, combined with social stressors, have led to increased incidences of diabetes, high cholesterol, and obesity in many Tribal communities. It follows that Tribal communities may also be more vulnerable and disproportionately impacted by climate change, especially when it disrupts the ability to depend on surrounding ecosystems for food sources, cultural practices, and unique lifestyles.

In an effort to address Tribal environmental, economic and social problems, Native American institutions have recently increased emphasis on restoring and sustaining traditional, healthy lifeways. This will require evaluation of both environmental conditions and the many factors that contribute to disproportionate exposures and health disparities (e.g., availability of healthy food; restoring traditional foods; differences in exposure factors due to lifestyle and economic pressures). Furthermore, Tribal institutions are raising questions about the impacts of climate change on their communities and lifeways (e.g., sea level rise), and are working with EPA to develop tools that they can use to anticipate and adapt to climate change.

Tribes need evidence-based data and tools to help them identify and anticipate potential environmental problems that may result from changes in their environments and societies. SHC is developing such tools in other SHC projects and adapting them to Tribal needs: Tribal-FERST (SHC project 2.62); EnviroAtlas (SHC project 1.62); the Eco-Health Relationship Browser (SHC project 1.62); and the Tribal Well-Being Index (SHC project 2.64). Tribal case studies are using participatory approaches with Tribal communities in an effort to improve and expand the capabilities of these tools by generating data needed to populate the tools. Likewise, SHC research on optimizing health impact assessments (SHC project 2.62) can be applied in Tribal contexts and incorporated into T-FERST and other SHC tools designed to benefit community decision making in general.

Research in this project will complement and extend these efforts and may leverage research activities with projects in other programs (e.g., AQUATOX in SSWR; remote sensing applications in SHC and ACE; landscape ecology modeling and assessment in SHC; SHEDS [Stochastic Human Exposure and Dose Simulation] modeling in CSS) by generating data needed for tool implementation. Specific to this project, the STAR Tribal Science Program will continue to contribute new information and knowledge about Tribal-specific environmental stressors, including changes in the natural environment (climate change) and cumulative exposures encountered in the built environment (indoor air quality), as well as causal linkages to Tribal health and well-being. In-house research is generating fish consumption data, tribal fish tissue assay data, and dietary exposure modeling that can be incorporated into SHC tools. Other information relevant to Tribal concerns may be provided by research on sea level rise modeling, and on properly functioning condition for riparian areas. For example, Tribes need to understand the consequences of decisions to restore riparian environments, such as removal of dams and channeling of waterways, which could lead to the introduction of new pathogens.

Research in this project, along with related efforts in tool development across SHC, will contribute to output 2.63.3 (“Research to inform Tribal sustainability”) by improving our understanding of environmental, economic, and social determinants of Tribal vulnerability, health, and well-being. This research will fill information gaps; help tailor SHC decision support tools to Tribal needs; and, provide approaches for demonstrating the effectiveness of interventions designed to restore Tribal environmental quality and support sustainable Tribal lifeways.

Key products for output 2.63.3 are a relational database summarizing stressors (chemical, environmental, social) and health relationships based on research publications from the Tribal Science program; best practices for community outreach, engagement, and communication stemming from the Tribal Science program and in-house research.

*Focus Area #3: Disproportionately Impacted Communities -* Environmental health disparities are a consequence of multiple factors contributing to vulnerability. Previous work has focused primarily on disproportionate exposure to chemicals and their associated adverse health effects. However, there is a need to expand this area to understand how social determinants (the conditions in which people are born, grow, live, work, and age) of health can lead to health inequities. These conditions are determined by governmental and business decisions, education, and changes in local ecology. They, in turn, result in differences in health-related factors between advantaged and disadvantaged communities. Accordingly, research is needed to elucidate the relative contribution of these decisions and community stressors in driving health disparities. Relevant stressors may include behaviors, attitudes, clinical care, social and economic factors, as well as factors in the built and natural environments. Since environmental stressors often occur together, a key need is to understand how they act in combination with one another, as well as how they combine with non-environmental stressors. Recent guidance from the National Environmental Justice Advisory Council (NEJAC) and EPA’s Children’s Health Advisory Committee includes recommendations for research on the social determinants of disease and how psychosocial stressors in over-burdened communities may modify sensitivity to the effects of pollution, resulting in health disparities.

Armed with an understanding of the drivers of health disparities, place-based research is needed in order to adequately evaluate strategies for reducing and/or preventing them. Research is being directed towards this end (SHC project 1.61), and will draw from research on health disparities underway in SHC project 2.62 and the Centers of Excellence in Health Disparities program (in this project). These Centers are integrating environmental factors with social factors that together contribute to health disparities, and testing approaches for reducing their negative impacts.

SHC research contributing to output 2.63.4 (“Evaluation of tested approaches to resolving health disparities in vulnerable populations and lifestages”) will address disparities in key health outcomes that are both environmentally and socially mediated. This output also captures research in SHC project 2.62 that identifies community stressors that contribute to key public health outcomes such as asthma and obesity. New research may include epidemiological and/or clinical studies that expand spatial analyses to include social, socioeconomic, or cultural factors; identification of predictive biological markers to aid in the identification of target populations in need of enhanced interventions; animal and other studies that help understand the joint effects of psychosocial stress and environmental contaminant exposures; or, studies to understand the contributions of prenatal exposures common in overburdened communities. Research contributing to this output will assist decision makers in EPA and communities in designing interventions and setting standards to protect at-risk populations.

Key products that address output 2.63.4 include a relational database summarizing stressor (chemical, environmental, social) and health relationships based on research publications from the Centers of Excellence on Environmental and Health Disparities program; case studies demonstrating prevention/mitigation strategies and decision consequences that most impact community decisions; and best practices for community outreach, engagement, and communication stemming from the Health Disparities Centers and in-house place-based studies.

**Nature of the Work**

This work is a combination of ORD intramural research and STAR extramural research. The intramural research effort will focus primarily on children’s environmental health research with consideration of factors disproportionately impacting vulnerable groups, and a small effort in Tribal research. The extramural research will focus on children’s environmental health research, Tribal research, and disproportionately impacted communities’ research. All research efforts involve or draw from both laboratory and field work. It is anticipated that the laboratory work will include *in vitro*, *in vivo* (animal models), and methods development to support field work.

**Collaboration**

As research opportunities are identified, we will explore options for collaboration, especially in regards to place-based studies. We anticipate collaborating with SHC projects 2.61 and 2.62, the CSS AOP project, and SHC projects 3.61, 3.62, and 3.63. The STAR extramural research program is comprised of collaborations with entities both within and outside the Agency, including but not limited to ORD, other EPA program offices and regions, other federal agencies, as well as the grantees who receive the extramural funding and conduct the research.

More information on these collaborations can be found at the listed links:

Children’s Centers program: <http://epa.gov/ncer/childrenscenters/>.

Tribal Science program: <http://www.epa.gov/ncer/tribalresearch/>.

Centers of Excellence on Environmental and Health Disparities program: <http://www.epa.gov/ncer/ehs/disparities/health-disparities.html>

**Assumptions/Constraints**

This project will require access to adequately staffed and stocked in-house laboratories (e.g., genomic, epigenetic, chemical analyses, animal) and ORD expertise in exposure science, toxicology, systems biology, systems thinking, and bioinformatics. Additionally, place-based studies will require expertise in community engagement and sufficient resources for travel and field research. This project would benefit from expertise in social science and social epidemiology which are not currently available in ORD.

It is not clear if needed expertise will be available; however, engaging people currently working in other SHC projects (2.61, 2.62) and national research programs may help fill this need. To add community-based studies as described, current access to statistical and epidemiological support is likely not sufficient. While this project focuses on Tribal vulnerability, Tribal needs extend beyond the scope of this project. A coordinated program, adequately staffed and resourced, would allow for a more comprehensive approach.

**Project Charter Team Members**

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