

Advancing Environmental Justice: Annotated Bibliography

The National Institute of Environmental Health Sciences (NIEHS) released the report “Advancing Environmental Justice” to summarize and communicate the outcomes from its efforts to address environmental justice over the last two decades. The report describes the various research programs, scientific conferences, and public health interventions NIEHS has supported that are aimed at reducing environmental health disparities and promoting environmental justice.

This annotated bibliography was developed as a report compendium to provide researchers, communities, and stakeholders with more accessible information about key outcomes reported in environmental justice projects. The annotated bibliography lists and summarizes peer-reviewed research articles from several of the projects highlighted in the report.

The articles were selected because they related to one or more of the following environmental justice themes:

- Capacity building and the value of community engagement
- Identifying communication approaches and increasing cultural competency
- Informing decision- and policy-makers
- Recognizing social stress, including mental and behavioral health issues

Moving forward, this document will continue to be updated with additional publications to further highlight the progress and emerging themes of environmental justice efforts at NIEHS.

On the following pages, please note that information about key NIEHS program and grant support associated with each publication is provided. This includes the following:

- Environmental Justice: Partnerships for Communication (EJPC)
- Worker Training Program (WTP)
- Superfund Research Program (SRP)
- Children's Environmental Health Center (CEHC)
- Environmental Health Sciences Core Center (EHS Core Center)
- Community-Based Participatory Research in Environmental Health (CBPR)
- RC1 Challenge Grant in Health and Science
- R03 Partners in Research Program

2014

Al-Delaimy WK, Larsen CW, Pezzoli K. 2014. Differences in health symptoms among residents living near illegal dump sites in Los Laureles Canyon, Tijuana, Mexico: a cross sectional survey. *Int J Environ Res Public Health* 11(9):9532-52.

SRP (P42ES010337)

Living near landfills is a known health hazard associated with environmental justice. This exploratory study, conducted by the University of California, San Diego, compared self-reported symptoms of ill health among residents of four haphazardly constructed settlements (*colonias*) with varied proximities to illegal dumpsites within Los Laureles Canyon near Tijuana, Mexico. To conduct the study, the researchers partnered with a local community organization and a local medical school to train students as data collectors, who spoke Spanish and went door-to-door to administer surveys. The residents of one area in particular, San Bernardo, reported significantly higher adverse health symptoms such as confusion/difficulty concentrating; eye, ear, nose, or throat irritations; skin problems; stomach discomfort; and extreme fatigue. The study is the first step toward documenting how toxicants in soil or dust could harm an underserved population. Once documented via a more complex epidemiological study, community approaches and urban remediation efforts such as road paving can be considered by decision- or policy-makers as future preventative actions.

Guerrero J, Madrigal DS, Minkler M. 2014. What is ...?: a research ethics Jeopardy™ game to help community partners understand human subjects protections and their importance. *Prog Community Health Partnersh* 8(3):405-11.

CEHC (P01ES009605)

A challenging, yet important, aspect of performing community-based participatory research (CBPR) is adequately educating participants about processes for protection of human subjects. This education ensures that participants have a complete and informed understanding of the nature and potential risks of research activities. This study evaluated the utility of a Jeopardy-inspired game for teaching youth community partners about the basic principles of ethics and human subjects protections for research. The game was developed by a student at the University of California, Berkeley, while working with Mexican-American, high-school children of farmworker families who were part of the Youth Community Council (YCC) for the Center for Health Assessment for Mother and Children of Salinas (CHAMACOS) study. Before the game, YCC members were divided into small groups to read and discuss a one-page summary about an infamous research study (e.g., the Tuskegee study, the Milgram study). Then, during the game, a facilitator asked questions related to the infamous research studies, and team representatives could respond with an answer in the form of “what is...” or “who is...” Investigators noted that the game was engaging for youth participants, who appeared to collaborate effectively within their teams. This tool may hold promise as an engaging supplement to traditional human subjects’ protection training discussions among youth and other community partners. Further adaptation of the tool among other CBPR projects could help inform participants about research ethics and human subjects’ protections in an engaging, user-friendly way.

Madrigal DS, Salvatore A, Casillas G, Casillas C, Vera I, Eskenazi B, Minkler M. 2014. Health in my community: conducting and evaluating PhotoVoice as a tool to promote environmental health and leadership among Latino/a youth. Prog Community Health Partnersh 8(3):317-29.

CEHC (P01ES009605)

This study evaluated the use of PhotoVoice as tool to promote environmental education, leadership, and participatory research efforts among Latino youth in the agricultural area of Salinas, California. The PhotoVoice project was implemented as part of an environmental health youth empowerment program in the Youth Community Council (YCC) of the Center for Health Assessment for Mother and Children of Salinas (CHAMACOS) study. Fifteen YCC members, ages 14-18, attended 12 training sessions, which included topics related to environmental health, photo ethics, photo composition, and photo sharing. The sessions on environmental health covered how chemicals in air, food, and water can impact health as well as specific exposures of concern (pesticides). Participants were given an inexpensive digital camera, trained on how to use it, and instructed to document problems and assets related to environmental health issues in their community through photographs. They sent 10 digital photographs to the YCC coordinator before each of the three photo sharing sessions, during which common themes were identified and discussed by the group. Each participant was asked to select one of their own photos to describe in a short narrative that answered questions such as why was the photo taken, why is the issue important, and what can you (the YCC) do about it? This project's methodology incorporated a multi-faceted evaluation, which included participants' written reflections at the end of each session, participant observations, and a 43-item questionnaire. Some key themes that emerged from the photos were related to poor access to affordable, healthy foods and limited access to safe spaces for physical activity. Participants' narratives included a broad range of environmental recommendations including novel uses for recycled materials; creating bike lanes for cyclists; and improving work conditions for farmworkers. Photos and narratives were shared through local media and events, including a community forum and meetings with elected officials. Action plans for a 5K run/walk and high school recycling program were developed and implemented by the YCC as a result of the PhotoVoice project. The evaluation showed significant changes in participants' reports of being a group leader and working effectively with other students to improve problems in their city. These findings verify the utility of the PhotoVoice as an effective CBPR method for engaging youth and providing environmental health education in marginalized communities.

Pezzoli K, Kozo J, Ferran K, Wooten W, Gomez GR, Al-Delaimy WK. 2014. One Bioregion/One Health: an integrative framework for civically engaged research, education and governance in the US-Mexico Border 28(4):419-40.

SRP (P42ES010337)

The One Bioregion/One Health framework provides an approach to transboundary regional planning that considers relationships between people and nature in the quest for healthier living spaces. Developed by researchers at the University of California, San Diego, Superfund Research Center, the new framework merges regional planning and ecosystem management to improve public and environmental health. A bioregion is a territory socially and culturally defined by its people, rather than

borders on a map. Bioregions are shaped by global trends, including climate change, food and water issues, economic crisis, large-scale natural disasters, and widespread increases in preventable diseases. The One Health concept acknowledges that human health is interconnected and dependent on the health of animals and the environment. Combining these concepts, One Bioregion/One Health is a modern approach to enable integrative, civically engaged research to create solutions to problems. The authors recommend using the One Bioregion/One Health approach for ecological restoration in metropolitan areas with urban sprawl, such as those found along the United States-Mexico border. To implement the framework and achieve a healthy cross-border region, public health professionals need training in global health diplomacy and cooperation. The authors also suggest that universities, through multidisciplinary programs, can integrate community engagement and research translation into such an effort, leading to the creation of healthier living spaces in a bioregion.

Rosas LG, Trujillo C, Camacho J, Madrigal D, Bradman A, Eskenazi B. 2014. Acceptability of health information technology aimed at environmental health education in a prenatal clinic. *Patient Educ Couns.* 97(2):244-7.

CEHC (P01ES009605)

This study evaluated the acceptability of an interactive computer kiosk for providing environmental health education among low-income, pregnant Latina women living in Salinas, California. The educational content was based on relevant literature and research findings from the Center for Health Assessment of Mothers and Children of Salinas (CHAMACOS), a birth cohort study examining the influence of environmental exposures on pregnancy outcomes and children's health. The kiosk offered a touch-screen with text, graphics, and an interactive game to address food as well as home-, outdoor-, and work-environments. The interactive game was based on a popular, culturally relevant bingo game known as *Loteria*. To ensure accessibility to low-literacy users, audio of all text in the kiosk was programmed to play by default (which could be turned off by users). A pilot study of the interactive kiosk was performed among 152 pregnant Latina patients in waiting/health education rooms during routine prenatal care visits. Over 90 percent of women reported that they learned something new while using the kiosk. For those with some familiarity with the kiosk topics, it reinforced environmental health education. Almost all participants reported that they enjoyed the interactive game, and found it a great way to involve their partners and children. These findings demonstrate waiting room kiosks are an acceptable, feasible strategy for disseminating information about environmental health, particularly to low-income, Spanish-speaking women. Furthermore, this innovative patient health education strategy has several implications as an effective strategy for educating and empowering disadvantaged (low-income, low-literacy) communities.

Thompson MR, Burdon A, Boekelheide K. 2014. Practice-based evidence informs environmental health policy and regulation: a case study of residential lead-soil contamination in Rhode Island. *Sci Total Environ* 468-469:514-22.

SRP (P42ES013660)

This case study evaluated the efficacy of Rhode Island Department of Health soil sampling regulations in determining the extent of lead contamination on residential properties. Prior to 1978, the exteriors of Rhode Island's municipal water towers were painted with paint containing lead. Over time, this paint either flaked off or was mechanically removed and deposited on adjacent residential properties. Fearing soil contamination on their properties, residents challenged inconsistencies across state agencies and federal requirements for collecting and analyzing soil samples. Researchers interviewed key government personnel, reviewed written accounts of events and regulations, and conducted environmental soil sampling on 31 residential properties near six municipal water towers. About 26 percent of properties had lead soil concentrations greater than 1,000 mg/kg, and the potential for misclassification using Rhode Island Department of Health regulations was 13 percent. Modifications to current state soil sampling regulations were recommended by the researchers. This study is an example of how practice-based evidence may inform environmental health policy and regulation.

2013

Eskenazi B, Bradman A, Finkton D, Purwar M, Noble JA, Pang R, Burnham O, Cheikh Ismail L, Farhi F, Barros FC, Lambert A, Papageorghiou AT, Carvalho M, Jaffer YA, Bertino E, Gravett MG, Altman DG, Ohuma EO, Kennedy SH, Bhutta ZA, Villar J; International Fetal and Newborn Growth Consortium for the 21st Century. 2013. A rapid questionnaire assessment of environmental exposures to pregnant women in the INTERGROWTH-21st Project BJOG 120 Suppl 2:129-38.

CEHC (P01ES009605)

Researchers assessed the environmental exposures of participants in the Fetal Growth Longitudinal Study cohort for the multinational INTERGROWTH-21st project. The investigators developed the Maternal Environmental Assessment (MEA) form to screen pregnant women for environmental exposures and then administered it in Brazil, China, India, Italy, Kenya, Oman, United Kingdom, and the United States. The MEA was composed of questions that aimed to ascertain information about exposures in the home, work, or other environments that are known or suspected to affect the health of the fetus or pregnant woman. Findings correlated with selection protocol patterns for the cohort and confirmed that most women had lived in urban environments with low risk of socio-economic constraints and environmental hazards related to adverse pregnancy outcomes. However, the MEA did identify some potential environmental concerns for women (e.g., paint peeling, pest infestations). Use of this tool as a broad, general assessment of environmental concerns in a population of potentially at-risk pregnant women, would be informative for policy and urban planning, and even guide health educators in developing interventions.

Hoover E. 2013. Cultural and health implications of fish advisories in a Native American community. Ecol Process 2(4).

SRP (P42ES013660)

Human health in many Native American communities is connected to the health of the environment. Fish advisories are meant to protect people from exposure to contaminants, but they may bring

unintended health, social, and cultural consequences for Native American communities. This paper focuses on the Mohawk community of Akwesasne, which lies downstream from a New York Superfund site, and explores how fish advisories affected this community's fish consumption and health. In Akwesasne, health was affected even without ingestion of fish because fear of exposure led people to replace the low-fat protein source of fish with high-fat and high-carbohydrate food, leading to increased obesity and diabetes among the population. Some advocates stated that more should have been done to help people find healthier food substitutes. The authors conclude that while fish advisories are often necessary to protect human health in the short term, the overarching concern is to implement more permanent and judicious solutions to contamination problems in the first place. This article points to how targeted community information approaches and cultural competency should be considered in risk avoidance actions for target populations.

Lowman A, McDonald MA, Wing S, Muhammad N. 2013. Land application of treated sewage sludge: community health and environmental justice. *Environ Health Perspect.* 121(5):537-42.

EHS Core Center (P30ES010126), R01ES015469

Treated sewage sludge can be useful for land application as a fertilizer, but it also contains certain toxicants, metals, and pathogens. Environmental Protection Agency (EPA) regulations require periodic monitoring of only certain toxicants and pathogens in treated sewage sludge. This research study utilized qualitative methods to evaluate the health and quality of life for people neighboring land application sites in rural North Carolina, South Carolina, and Virginia. Researchers worked with community-based groups to identify and invite eligible people to respond to in-depth, semi-structured interviews. Using the interview responses, the researchers identified recurring themes related to community concerns and quality of life, including health impacts, environmental impacts, and environmental justice. More than half of the respondents attributed acute, physical symptoms, such as eye, nose, or throat irritations, cough, and difficulty breathing, to sewage sludge application events. Respondents also expressed environmental concerns such as sludge spillage on roadways and private properties. Most described offensive odors associated with the sludge applications and noted that these odors limit daily activities and opportunities to socialize with family and friends. Half of the respondents indicated that the sludge application fields are owned by individuals or entities who do not reside in the neighboring communities and some suggested that their community was being used unfairly as a "dumping ground" or was selected unfairly for land application because of its rural location and low socioeconomic status. Several mentioned that public officials and land appliers had neglected to directly inform them of the sewage sludge application near their homes. In spite of these perceived barriers to obtaining information, over half of the interviewees made suggestions regarding changes that would improve public notification and enhance public and environmental protections. Issues identified by communities near land application sites warrant attention from environmental health scientists and public health officials. Community residents' perspectives offer great input for industry and government officials on how to improve strategies regarding land application and site selection.

Pennell KG, Thompson M, Rice JW, Senier L, Brown P, Suuberg E. 2013. Bridging research and environmental regulatory processes: the role of knowledge brokers. Environ Sci Technol 47(21):11985-92.

SRP (P42ES013660)

Knowledge brokers connect researchers with decision-makers to facilitate the translation of scientific findings into policies and programs. Researchers from Brown University, with support from the NIEHS Superfund Research Program, developed a knowledge broker position within its staff, called the State Agency Liaison. The knowledge broker liaised with regulators and legislators to engage scientific experts in the regulatory process, especially as related to vapor intrusion. The liaison needed a doctoral-level scientific background and a thorough understanding of political and practical environmental issues. The effectiveness of Brown's knowledge broker was exemplified through the facilitation of state and federal representatives participating in scientific and training workshops, regular interactions for information sharing, helping secure additional federal research funding, and tracking how research was taken under advisement and referenced in guidance, policy or a regulation. This study demonstrates that through institutional commitment and by placing the right person in the role, a knowledge broker can effectively translate university-based research into environmental decision- and policy-making.

Ramirez-Andreotta MD, Brusseau ML, Beamer P, Maier RM. 2013. Home gardening near a mining site in an arsenic-endemic region of Arizona: assessing arsenic exposure dose and risk via ingestion of home garden vegetables, soils, and water. Sci Total Environ 454-455: 373-82.

EHS Core Center (P30ES006694); SRP (P42ES004940)

Arsenic uptake from soil into the edible portion of some plants presents a potential health hazard that may affect home gardeners near contaminated sites. The human-health risk posed by gardening near a legacy mine and smelter in an arsenic-endemic region of Arizona was characterized in this study. By testing vegetables grown by local residents and comparing them to those grown in a controlled greenhouse environment, the researchers found an association between arsenic soil concentration and the amount of arsenic accumulated in the edible portion of the plant in certain vegetable families. The authors recommended that home gardeners sample private wells annually, test soils prior to gardening, and, if necessary, modify their gardening behavior to reduce incidental soil ingestion. This study highlights the importance of site-specific risk assessment and the need for community approaches and species-specific planting guidelines.

Sugeng AJ, Beamer PI, Lutz EA, Rosales CB. 2013. Hazard-ranking of agricultural pesticides for chronic health effects in Yuma County, Arizona. Sci Total Environ 463-464:35-41.

EHS Core Center (P30ES006694); SRP (P42ES004940)

Mounting evidence indicates that pesticide exposure is associated with a variety of health effects. This study is the first to provide pesticide hazard-rankings for endocrine disruption and reproductive or developmental toxicity based on pesticide use, toxicity, and exposure potential. The hazard-ranking schemes accounted for pesticide use, toxicity, and exposure potential based on chemical properties of

each pesticide, and can be applied to agricultural communities to identify local pesticide hazards. The rankings can inform decision-making and serve as an effective tool to assess community-specific health risk for a variety of health effects.

Ware D, Lewis J, Hopkins S, Boyer B, Noonan C, Ward T. 2013. Sources and perceptions of indoor and ambient air pollution in rural Alaska. *J Community Health* 38(4):773-80.

Challenge Grant (RC1ES018400)

Exposure to air pollution in both ambient and indoor environments contributes to a variety of respiratory health problems and increased asthma morbidity in children, with American Indian and Alaska Native children facing the highest burden. Over a two-year period, 328 surveys were administered within seven communities in rural Alaska. Questions focused on understanding demographics, home heating practices, indoor and outdoor activities, and air quality perceptions within each community. Top indoor air quality concerns included mold, lack of ventilation or fresh air, and dust. Top outdoor air pollution concerns were open burning/smoke, road dust, and vehicle exhaust. By identifying sources of air pollution exposures in rural areas, tailored community interventions can be designed and implemented.

Wing S, Horton RA, Rose KM. 2013. Air pollution from industrial swine operations and blood pressure of neighboring residents. *Environ Health Perspect* 121(1):92-6.

EHS Core Center (P30ES010126), CBPR (R01ES011359)

Research has shown that swine concentrated animal feeding operations (CAFOs) in North Carolina are unequally distributed in low-income communities of color. This study evaluated the association between swine CAFO air pollution and acute changes in blood pressure for neighboring residents in eastern North Carolina. A partnership with the Concerned Citizens of Tillery, a community-based organization in Halifax County, enabled the organization of community meetings to provide information about the research study to attendees, who were then invited to participate in the study if interested. Participants from 16 rural communities neighboring swine CAFOs were trained on use of a structured diary to record levels of swine odor, stress, and symptoms and on measuring blood pressure with an automated device. For two weeks, 101 study participants recorded odor and symptoms in diaries and measured blood pressure twice daily. During the same study period, levels of hydrogen sulfide and PM₁₀ were measured using air monitors placed at central locations in each neighborhood. Results revealed an association between systolic and diastolic blood pressure and measures of hog odor during time spent outdoors, as well as increases in hydrogen sulfide concentrations within the same hour. Results also showed that reported stress was strongly associated with blood pressure. Findings from this CBPR study suggest that swine CAFO air pollution contributes to acute increases in blood pressure, which may be associated with development of outcomes such as chronic hypertension. These effects may be more commonly experienced in low-income African-American communities, suggesting issues and consequences of environmental justice. Partnerships with community-based organizations who promote the health, environmental and political interests of these communities, and who are involved in the research, are ideal steps to begin addressing these environmental justice issues.

2012

Beamer PI, Canales RA, Ferguson AC, Leckie JO, Bradman A. 2012. Relative pesticide and exposure route contribution to aggregate and cumulative dose in young farmworker children. Int J Environ Res Public Health 9(1):73-96.

CEHC (P01ES009605); SRP (P42ES004940)

While all children may be exposed to pesticides through drinking water, diet, and residential-use pathways, potential sources of additional pesticide exposure for children in farmworker homes include aerosol drift from agriculture and occupational take-home contamination on clothing, shoes, or skin. The Child-Specific Aggregate Cumulative Human Exposure and Dose (CACHED) framework estimates exposure for multiple routes and chemicals by integrating micro-level activity series with mechanistic equations, distributions, and pharmacokinetic components. In this study, the CACHED The framework was used to quantify cumulative and aggregate exposure and dose estimates for a population of young farmworker children and evaluated as a model for chlorpyrifos and diazinon assessment. The risk metrics computed from 115,000 exposure simulations indicate that greater than 95 percent of them might pose a risk to children's health from aggregate chlorpyrifos exposure. The variability observed in the route and pesticide contributions to urine biomarker levels demonstrates the importance of accounting for aggregate and cumulative exposure in establishing pesticide residue tolerances in food. Assessment of route and chemical contribution towards aggregate exposure and dose is important to better understand how and to what pesticides children are exposed to inform future community education or communication approaches.

Brown P, Brody JG, Morello-Frosch R, Tovar J, Zota AR, Rudel RA. 2012. Measuring the success of community science: the northern California Household Exposure Study. Environ Health Perspect 120(3):326-31.

EJPC (R25ES013258)

CBPR uses academic-community partnerships in which the partners share power in all aspects of the research process. This research approach can increase community engagement in environmental health research and generate knowledge that benefits communities through interventions and policy change. However, peer-reviewed publications and clinical outcomes are inadequate criteria for evaluating the successes of the CBPR approach; therefore, new strategies to evaluate the success of CBPR are necessary. In this commentary, investigators reviewed methods to evaluate and identify successful CBPR methods used for the Northern California Household Exposure Study, an exposure and impact study performed in two environmental justice communities in northern California. Metrics such as published articles and invited workshops or conferences were used to examine the project's production of new science. Overall community support was gauged using evaluation forms completed following community meetings. Study participants were interviewed before and after environmental sampling results were returned. Notes were recorded during advisory board meetings, and individual or team interviews conducted among board members and collaborating organizations. Investigators analyzed media coverage and regulatory impacts of the project, such as government and court decisions. The

investigators' self-evaluation of the project's CBPR methods was guided by a series of questions. This case study illustrates the use of meaningful strategies to evaluate the effectiveness of CBPR projects. Investigators conclude that these strategies helped document their project's facilitation of organizational capacity among partners, community education, and changes in regulatory decisions to impact new policies for chemicals in consumer products.

Hoover E, Cook K, Plain R, Sanchez K, Waghiyi V, Miller P, Dufault R, Sislin C, Carpenter DO. 2012. Indigenous peoples of North America: environmental exposures and reproductive justice. Environ Health Perspect. 120(12):1645-9.

EJPC (R25ES014308)

Indigenous communities (American Indians and Alaskan Natives) face disproportionate health burdens, which can be attributed to factors such as poverty, lifestyle, genetics, and an inadequate healthcare delivery system – these factors are compounded by environmental exposures and contamination. This commentary explored linkages between environmental and reproductive justice issues among indigenous communities in North America, as well as the limitations of legal recourse to address these issues. Reproductive justice is a term that does not commonly appear in environmental health literature, and is a concept that involves ensuring a community's reproductive capabilities are not inhibited by environmental contamination. Authors reviewed case studies of five indigenous communities during an Environmental Reproductive Health Symposium and Retreat in July 2011. The focus of the meeting was to explore the common environmental and reproductive health issues within these communities, and to facilitate partnerships among researchers and indigenous community organizations. Tribal jurisdictions are often attractive to corporations seeking lesser degrees of environmental regulation and enforcement imposed by state governments; however, federal and Indian law is insufficient to protect indigenous communities from environmental contamination. Historic distrust towards non-native government agencies and academics among these communities has often resulted in lack of participation in research studies. The meeting made several recommendations to address environmental and reproductive justice impacts in indigenous communities. More community-based research and collaborative partnerships are needed to address the environmental and reproductive health impacts in these communities. Collaborative partnerships among researchers, community members, and health care providers would also provide a means to develop policy regulations to better protect indigenous communities from local and widespread sources of environmental contamination.

Thompson MR. 2012. Mercury contamination: review of a residential response. Prof Saf. 57(2): 50-58.

SRP (P42ES013660)

This article recaps an elemental mercury contamination incident occurring at an apartment complex in Rhode Island in 2004. All 140 residents were initially relocated and then returned after approximately three months of assessment, decontamination, and monitoring of the site. The author reviews the risk communication process and protocols used during and after the incident. In addition to a long list of recommendations related to assessment, decontamination, and state and federal response guidelines, the author provides three recommendations for improving risk communication in similar future

incidents. She also recommends further research to assess the procedural efficacy and long-term outcomes of the recommendations.

2011

Heaney C, Wilson S, Wilson O, Cooper J, Bumpass N, Snipes M. 2011. Use of community-owned and -managed research to assess the vulnerability of water and sewer services in marginalized and underserved environmental justice communities. J Environ Health 74(1):8-17.

Partnerships in Research (R03ES017357)

This study's objective was to use community-owned and -managed research to assess the safety and adequacy of water and sewer services in three low-income African-American communities in Mebane, North Carolina. Community monitor training workshops, household surveys, and drinking and surface water tests of fecal pollution were completed at private (target) and regulated public (referent) service households. Survey results showed a mix of failing private wells and septic systems along with regulated public drinking water and sewer infrastructure. Drinking and surface water fecal pollution levels exceeded limits protecting health at target and referent households. Community-owned and -managed research methods built community capacity to investigate private and regulated public drinking water and sewer service failures. The drinking and surface water fecal contamination levels detected suggest a need for improved water and sewer services to protect health in these underserved and marginalized communities.

Heaney CD, Wing S, Campbell RL, Caldwell D, Hopkins B, Richardson D, Yeatts K. 2011. Relation between malodor, ambient hydrogen sulfide, and health in a community bordering a landfill. Environ Res 111(6):847-52.

EJPC (R25ES008206); EHS Core Center (P30ES010126)

Research has shown that landfills are unequally distributed by race and socioeconomic status across the United States, and more specifically in North Carolina. Researchers investigated the health and quality of life issues for Rogers-Eubanks, a historically African-American community bordering a municipal solid waste landfill in Orange County, North Carolina. This study followed principles of CBPR, and research questions were developed in partnership with the Rogers-Eubanks Neighborhood Association. Community participants made twice-daily diary entries for 14 days, indicating odor intensity, mood states, acute physical symptoms, and alteration of daily activities during 11 months in 2009. Hydrogen sulfide levels were measured and recorded using air monitors placed along the northern border of the community. Researchers correlated these hydrogen sulfide measurements with study participants' reports of odor and further examined the association of odor ratings to reported mood states and physical symptoms. Results showed that when the wind was blowing from the landfill towards the community, landfill odor ratings increased for every 1 ppb increase in hourly average hydrogen sulfide levels. Odor was strongly associated with study participants' reports of altered daily activities and negative mood states (e.g., stressed and angry). Odor was also strongly associated with acute symptoms such as mucosal irritations and upper respiratory symptoms. These findings suggest that air pollutants

from regional landfills negatively impact health and quality of life for neighbors, and that these issues may be disproportionately experienced among communities of color and low socioeconomic status due to site location. Furthermore, the development of partnerships with these communities is likely an ideal step to build capacity for addressing environmental justice issues.

Stingone JA, Wing S. 2011. Poultry litter incineration as a source of energy: reviewing the potential for impacts on environmental health and justice. *New Solut* 21(1):27-42.

EJPC (R25ES008206)

Rising costs in energy and the desire to reduce the national reliance on fossil fuels have contributed to interest in alternatives to meet the energy needs and demands of society. Recent legislation in North Carolina mandated the use of renewable energy sources, such as wind, solar, and animal waste. The state's high concentration of industrial poultry operations consequently leads to large supplies of poultry litter. This review summarizes the environmental health and environmental justice issues that are associated with the incineration of poultry waste to generate electric power. Poultry litter incineration produces emissions containing byproducts that pose health hazards associated with exposure to soil, groundwater, and air pollutants that include particulate matter, bioaerosols, dioxins, heavy metals, polycyclic aromatic hydrocarbons, and nitrogen and sulfur oxides. These exposures have the potential to affect the health of workers as well as neighboring community residents. Comparisons of U.S. Census data to North Carolina demographics suggest that sites for poultry litter incinerators are commonly proposed in rural areas where socioeconomically disadvantaged people reside. These findings suggest the need to examine current policies that intend to reduce reliance on fossil fuels, as they pose potential environmental injustices and hazards to marginalized communities.

2010

Cohen A. 2010. Achieving healthy school siting and planning policies: understanding shared concerns of environmental planners, public health professionals, and educators. *New Solut* 20(1):49-72.

SRP (P42ES013660)

The quality of the physical school environment has been overlooked historically, but research is emerging that connects environmental, health, and academic outcomes with school facility siting and design. Policy decisions regarding the physical school environment rarely consider environmental planning, public health, or education policy together. Environmental planners consider environmental justice issues on a local level and/or consider the regional impact of a school. Public health professionals focus on toxic exposures and populations particularly vulnerable to negative health outcomes. Educators and education policymakers emphasize investing in human capital of both students and staff. Understanding these respective angles and combining these efforts around the common goals of achieving adequacy and excellence can advance work towards a regulatory system for school facilities that recognizes children as a uniquely vulnerable population and seeks to create healthier school environments in which children can learn and adults can work. To help decision- and policy-makers develop and implement regulations concerning school siting and facility design, the author recommends

considering and aligning tactics from exemplars of excellence in public health, environmental planning, and education policy.

Emmett EA, Desai C. 2010. Community first communication: reversing information disparities to achieve environmental justice. *Environ Justice* 3(3):79-84. <http://www.ncbi.nlm.nih.gov/pubmed/21546988>

EJPC (R25ES012591); EHS Core Center (P30ES013508)

A West Virginia manufacturing plant caused downstream perfluorooctanoate (PFOA) pollution in local water sources for a community in Little Hocking, Ohio. The plant's location presented some power disparities, as the Ohio community was disadvantaged by a lack of capacity to influence political power or generate information independent of the industry and regulators. In this article, authors describe the successful implementation of a community-first strategy to communicate preliminary research results to the community in Little Hocking. The study was designed to collect data from a random sample of residents in the Little Hocking Water Association (LHWA) reticulation area to determine the following: 1) if blood PFOA levels were elevated in the Little Hocking community, 2) the source of PFOA exposure, and 3) any changes in biomarkers of potential toxic effects following exposure. An environmental justice partnership was formed between researchers, physicians, and a local community organization to address these concerns. A Community Advisory Committee (CAC) was formed to advise on all aspects of the study from a community perspective, and included representation from the LHWA district, the local school district, state and federal regulatory agencies. Prior to obtaining study results, the CAC developed a community-first communication strategy to guide researchers' process for dissemination of individual and group results based on the community's desires. This strategy incorporated a specific sequence of timed releases for communicating study results. For example, blood PFOA results were first sent to individual participants, followed by a summary of aggregate results sent to relevant authorities and issue of a press release. The press release announced that PFOA levels were found to be high, water was the main source, and encouraged residents to attend a community meeting to learn about detailed study results and recommendations. On the day of the community meeting, the facility responsible for the pollution offered free bottled water to the community, which was accepted by 78 percent of eligible households. Further follow-up showed that 95 percent of study participants made some change in their water source. This study demonstrates the effectiveness of CBPR together with a community-first communication model, which is capable of reversing pre-existing information disparities between government agencies, industries and communities. Adoption of this strategy is also capable of providing powerful motivation for behavioral change at the industry and community level.

2009

Bradman A, Salvatore AL, Boeniger M, Castorina R, Snyder J, Barr DB, Jewell NP, Kavanagh-Baird G, Striley C, Eskenazi B. 2009. Community-based intervention to reduce pesticide exposure to farmworkers and potential take-home exposure to their families. *J Expo Sci Environ Epidemiol* 19(1):79-89.

CEHC (P01ES009605)

This community-based research study evaluated the effectiveness of educational interventions to reduce pesticide exposure for farmworkers who harvest strawberries and their families in California. The intervention included weekly educational health and pesticide presentations; hand cleansers to encourage hand washing; disposable/removable personal protective equipment (gloves, coveralls); and the laundering/storage of personal protective equipment. Cross-sectional sampling of dislodgeable foliar residues, urinary metabolite levels, hand rinse, clothing, and skin patch were used to confirm the potential for workers' exposure to the pesticide malathion and to assess the efficacy of specific intervention components. Sample comparisons between the intervention and control groups revealed loading of malathion on hands and median malathion dicarboxylic acid levels were lower among workers who wore gloves compared to those who did not. Malathion was detected on 76 percent of clothing patch samples and 3 percent of skin patch samples, suggesting the protective capacity for even a single layer of clothing against skin exposure. Findings suggested that wearing and removing protective equipment before returning home could reduce pesticide on skin and worker clothing, and therefore, reduce transport of pesticides to worker homes. This study implies that additional educational and behavioral interventions need to be considered for regulations such as the EPA Worker Protection Standard, which are designed to reduce pesticide exposure and protect the health of farmworkers and their families.

DeLemos JL, Brugge D, Cajero M, Downs M, Durant JL, George CM, Henio-Adeky S, Nez T, Manning T, Rock T, Seschillie B, Shuey C, Lewis J. 2009. Development of risk maps to minimize uranium exposures in the Navajo Churchrock mining district. Environ Health 8:29.

EJPC (R25ES013208); EHS Core Center (P30ES012072), R01ES014565

Historic uranium mining and improper disposal of uranium wastes near the Navajo Churchrock region in New Mexico has left behind a legacy of environmental contamination, resulting in adverse human and ecological health impacts as well as socio-cultural issues. Researchers in this study developed and assessed GIS-based thematic maps as a risk communication tool for informing tribal members about high-risk exposure areas and to offer alternatives for minimizing adverse public and ecological health impacts. To develop the thematic maps, researchers incorporated data derived from environmental and water-use sampling and public health surveys. The environmental sampling data were utilized to define land and water resources that act as routes of uranium exposure, while the surveys helped gauge self-reported activities that were most significant in influencing these exposures (e.g., water hauling, water sources, etc.) To assess the clarity and efficacy of the maps, preliminary feedback was collected from the Navajo working group comprised of project staff and Navajo community advisors. This proved to be a critical step as provided significant insight into how the maps could be improved. Community engagement strategies such as these outline the importance of providing a means to inform decisions made by impacted Native American communities, instead of decisions being made by external agencies. Developing community partnerships also allows these types of assessments to provide realistic alternatives and respects cultural values of the communities.

McQuiston TH, Lippin TM, Bradley-Bull K, Anderson J, Beach J, Beevers G, Frederick RJ, Frederick J, Greene T, Hoffman T, Lefton J, Nibarger K, Renner P, Ricks B, Seymour T, Taylor R, Wright M. 2009.

Beyond Texas City: the state of process safety in the unionized U.S. oil refining industry. *New Solut* 19(3):271-88.

WTP (U45ES006175)

The 2005 British Petroleum Texas City Refinery disaster, in which nearly 200 workers were injured or killed, provided a stimulus to examine safety in the U.S. refining industry. The incident resulted in more than 300 citations for Occupational Safety and Health Administration violations, resulting in a record fine of \$21 million. Participatory action researchers conducted a nation-wide, mail-back survey of United Steelworkers local unions and collected data from 51 unionized refineries. They examined hazardous conditions key to the Texas City disaster, refinery actions to address those conditions, emergency preparedness and response, process safety systems, and worker training. Findings indicate that highly hazardous conditions were pervasive and often resulted in incidents or near-misses. The authors conclude that potential for future disasters remains in the refining industry, and they call for effective proactive regulation to improve refinery process safety. The study shows the value of targeted research in a community of workers to produce data valuable for decision- and policy-making.

2008

Beamer P, Key ME, Ferguson AC, Canales RA, Auyeung W, Leckie JO. 2008. Quantified activity pattern data from 6 to 27-month-old farmworker children for use in exposure assessment. *Environ Res* 108(2):239-46.

CEHC (P01ES009605)

Children are particularly susceptible to various environmental exposures because of their physiology and activity patterns. Children spend time crawling and playing on the floor and have more hand-to and object-to-mouth contact than adults. This study assessed and recorded the exposure prone behaviors and activity patterns of infants and toddlers living in a farmworker community in Salinas, California. The children were videotaped and observed for 2-6 hours and their activity patterns translated into micro-level activity time series to quantify contact duration and frequency for both hands and the mouth. Results showed that infants had increased frequency and contact duration with objects in their immediate environment (clothes, towels, toys) and toddlers with objects and surfaces that require greater mobility for contact (paper, wrappers, rock/brick surfaces). Results also showed differences in gender, with boys having higher contact frequencies and girls having longer contact durations. These findings verify the usefulness of videotaping as an activity data collection tool and validate the importance of accounting for age and gender in exposure assessments for children. The contact frequencies reported in this study are higher than current recommendations in the EPA Child-Specific Exposure Factor Handbook (2006), which questions the protective value of these exposure guidelines for infants and toddlers.

Senier L, Hudson B, Fort S, Hoover E, Tillson R, Brown P. 2008. Brown Superfund Basic Research Program: a multistakeholder partnership addresses real-world problems in contaminated communities. *Environ Sci Technol* 42(13):4655-62.

SRP (P42ES013660)

Research translation and community outreach programs can bring academic scientists into frequent contact with communities surrounding their research sites. Well-coordinated and integrated research translation and community outreach activities can make research more responsive to local needs and help address non-scientific issues at contaminated sites. At the Brown University Superfund Research Program, outreach and research translation teams collaborated with state regulatory agency personnel and community activists on a legislative initiative to mitigate the financial impacts of living in a contaminated community. The Environmentally Compromised Home Ownership program makes home equity loans of up to \$25,000 available to qualified applicants. This collaboration provides a case study in how community-engaged translation and outreach have the potential to make research findings more useful to communities, address some of the social effects of contamination, and empower stakeholders to pursue their individual and collectively held goals for remediation.

2007

Bradman A, Whitaker D, Quiros L, Castorina R, Claus Henn B, Nishioka M, Morgan J, Barr DB, Harnly M, Brisbin JA, Sheldon LS, McKone TE, Eskenazi B. 2007. Pesticides and their metabolites in the homes and urine of farmworker children living in the Salinas Valley, CA. *J Expo Sci Environ Epidemiol* 17(4): 331-49.

CEHC (P01ES009605)

This study tested various sampling and field-based methods to characterize pesticide exposures in farmworker children living in Salinas Valley, California. Researchers measured 29 common agricultural and home use pesticides across various exposure media, including house dust, indoor and outdoor air, dislodgeable residues from surfaces and toys, residues on clothing and food, and spot and overnight diaper urine samples. Measurable levels of pesticides were more frequently detected in house dust, surface wipes, and clothing compared to other media, with chlorpyrifos, diazinon, chlorthal-dimethyl, and *cis*- and *trans*-permethrin detected in 90 to 100 percent of samples. Pesticide residues on clothing were consistently higher among older children (21-27 months) compared to younger children (5-11 months), implying increases in activity patterns for children of older ages. This study is the first to report data on a broad range of pyrethroid pesticides in the home environments of children. These data could potentially inform the development of future pesticide exposure and risk assessment models, particularly for children.

Delemos J, Rock T, Brugge D, Slagowski N, Manning T, Lewis J. 2007. Lessons from the Navajo: assistance with environmental data collection ensures cultural humility and data relevance. *Prog Community Health Partnersh* 1(4):321-6. <http://www.ncbi.nlm.nih.gov/pubmed/19655034>

EHS Core Center (P30ES012072) EJPC (R25ES013208), R01ES014565

The Navajo Nation, home to some of the largest uranium reserves in the world, suffers from a legacy of contamination left behind from uranium mining and milling operations. Proximity to old industrial sites, waste piles, and discharge of contaminated mine water pose adverse health risks to residents.

Researchers in the Dine Network for Environmental Health project developed a field and laboratory campaign to characterize the spatial distribution and geochemistry for a multipathway uranium exposure assessment. Execution of this project used a culturally relevant, community engagement framework. Data collection involved partnership with a bilingual Navajo graduate student and community members. Cultural education was achieved in lessons the Navajo team member taught to non-tribal researchers on demonstrations of cultural respect (e.g., humility and minimized eye contact with elders). A house chapter meeting facilitated introductions of the field team to community members. Field sampling of surface water, sediment, and vegetation required constant input from the Navajo team member to uphold appropriate cultural expectations and approaches. This participatory project recounts the value of the CBPR framework and offers many successes generalizable to cross-cultural projects for other investigators. The partnership facilitated successful data collection and sampling that accurately reflected the Navajo environment and culture. Furthermore, the research team was able to learn important lessons regarding respectful interactions among the Navajo people.

Griffith M, Tajik M, Wing S. 2007. Patterns of agricultural pesticide use in relation to socioeconomic characteristics of the population in the rural U.S. South. *Int J Health Serv* 37(2):259-77.

EJPC (R25ES008206)

Residents of rural, agricultural communities where pesticides are used have greater potential for harmful exposures. In the rural south, these communities may be predominately of color. The authors used county-level expenditure data for pesticides as a proxy to estimate pesticide use in 953 rural counties in 12 southern states. They found that expenditures for pesticides were four times greater in counties where more than 22 percent of the population lived in poverty than in counties with less than 12 percent poverty. The study concludes that such patterns illustrate socioeconomic inequities in pesticide exposures. Studies such as this one that identify and quantify inequities can be used to educate communities and build capacity for advocacy, and to raise awareness among policy and decision makers when considering actions related to public environmental health.

Norton JM, Wing S, Lipscomb HJ, Kaufman JS, Marshall SW, Cravey AJ. 2007. Race, wealth, and solid waste facilities in North Carolina. *Environ Health Perspect* 115(9):1344-50.

EJPC (R25ES008206)

Disposal of solid waste has been a public health issue for some time, but the problem is more pressing because of increased disposal needs related to population growth and a lack of suitable facility locations near cities. This study used U.S. Census data and solid waste permit records to discover that in North Carolina, waste disposal facilities are disproportionately located in underserved communities. At the time of publication, it was one of few studies to explore environmental injustice and location of solid waste facilities. Communities of color and low-income may experience more health effects due to closer proximity to solid waste facilities than those located further away. This article provided an analysis useful for building a case about health disparities and informing policy makers about health issues related to environmental justice.

2006

Lippin TM, McQuiston TH, Bradley-Bull K, Burns-Johnson T, Cook L, Gill ML, Howard D, Seymour TA, Stephens D, Williams BK. 2006. **Chemical plants remain vulnerable to terrorists: a call to action.** *Environ Health Perspect* 114(9):1307-11.

WTP (U45ES006175)

Chemical plants within the United States are highly vulnerable to terrorists or damage from natural disasters. Threats to the nation's chemical infrastructure pose significant hazards to workers and communities neighboring chemical facilities. However, there is limited data to address industrial facilities' progress in prevention, preparedness, or response to potential threats. This commentary presents findings from a nationwide participatory research study among local union leaders at chemical plants, paper mills, oil refineries, and other industries. A survey instrument was used to assess union leaders' perceptions of activities since September 11, 2001 including company actions to improve prevention, emergency response, and effectiveness as well as community or local union involvement in these issues. Findings revealed that companies had only infrequently taken steps to address key vulnerabilities such as reducing volumes of hazardous substances or engineering changes to strengthen chemical containment. In addition, actions to help onsite workers and surrounding communities better address perpetrated site events were infrequent. Participants also reported the rarity of company involvement with local stakeholders, including local union, hour workers, and communities, regarding prevention or response planning for these events. These findings suggest voluntary initiatives have not produced a considerable level of progress for chemical plant security corresponding to the potential threats posed by terrorists or disasters. Expertise in the environmental health research community offers support for these initiatives by providing scientific consultation, informing stakeholders, and advocating for policy changes. Recommendations for regulatory actions include progress towards achieving safer processes; mandates for audit inspections and funds for upgrading emergency communication systems; and the involvement of workers and community members in plan development for incident prevention and response.

2005

Israel BA, Parker EA, Rowe Z, Salvatore A, Minkler M, Lopez J, Butz A, Mosley A, Coates L, Lambert G, Potito PA, Brenner B, Rivera M, Romero H, Thompson B, Coronado G, Halstead S. 2005. **Community-based participatory research: lessons learned from the Centers for Children's Environmental Health and Disease Prevention Research.** *Environ Health Perspect* 113(10):1463-71.

CEHC (P01ES009605)

This article draws on experiences of six NIEHS/EPA-funded Children's Centers (California/Salinas, Maryland, Michigan, New York, New Jersey, and Washington) to describe the rationale and benefits of utilizing the CBPR framework. These Children's Centers exhibited diverse approaches to defining communities or "units of identity," which were in most cases identified using geographic boundaries or common characteristics. The Centers used various strategies to identify community partners and tended

to build on existing working relationships between academia and the communities. Most of the Centers had community advisory boards composed of representatives from diverse organizations. Each Center greatly benefited from community partners' role and participation in the design and implementation of their research studies. Centers' community partners were actively involved in guiding data collection and dissemination of study findings. The experiences of the Children's Centers show that sufficient time, considerable commitment to translating research findings, and acknowledgement of community partners' cultural values are just a few of the factors that are vital for successful implementation of CBPR efforts. These recommendations should be considered when working to maintain community partnerships that can help address the environmental health issues for children in marginalized communities.

1996

Wing S, Grant G, Green M, Stewart C. 1996. Community based collaboration for environmental justice: south-east Halifax environmental reawakening. *Environment and Urbanization* 8(2):29-140.

EJPC (R25ES008206)

Large industries are commonly attracted to rural areas with large minority populations because land and labor are cheap, workers are not unionized, and the neighboring communities lack political power for opposition. These political inequalities coupled with exposure to environmental hazards, result in discriminatory patterns of location for polluting industries, or environmental racism. Environmental racism is representative of a community's interconnected struggles for social justice, ecological sustainability, and public health. This paper describes the Southeast Halifax Environmental Reawakening project, an environmental justice project funded by NIEHS to support isolated, rural, and semi-rural communities in their efforts to recover fundamental environmental values. The Concerned Citizens of Tillery (CCT), a community organization established in 1978, has had success in its historical involvement towards empowering African-American citizens and taking steps to oppose environmental racism in Southeast Halifax and other rural communities in eastern North Carolina. The Environmental Reawakening project involved partnership between the CCT, the Halifax County Health Department, and faculty from the University of North Carolina Gillings School of Global Public Health. The project had a multi-faceted design involving workshops, seminars, environmental health consultation, and educational outreach. During community workshops, University staff made presentations on specific health problems of concern and environmental health and justice issues. They also held research workshops to present basic information on how scientific studies are performed and to reflect the interests of community groups becoming involved in the research process. Medical care provider seminars were helped raise medical professionals' awareness of environmental health issues and to provide education on topics of exposure and prevention. Environmental health consultation and support was provided by the Halifax County Health Department in response to issues related to lead contamination, air pollution, water pollution, soil erosion, and well-water contamination. The Groundwater Festival, an event involving collaboration between university graduate students, health department staff and local students, offered an opportunity for public education on groundwater pollution and served a vehicle to improve community knowledge on environmental health and justice. A quantitative analysis of

environmental justice issues was launched to quantify relationships between location of intensive livestock operations and community demographics (race and socioeconomic status). A speaker's bureau, organized by the county health department, involved different community members speaking on their experiences of environmental threats and injustice. Outreach to other North Carolina communities in the Black Belt region was also continuously performed as a means of strengthening contacts and resources needed to respond to environmental justice issues. Community empowerment is an effective means of addressing the political, economic, and judicial determinants of health. Overall, the Southeast Environmental Reawakening Project provides ideal methods for collaborative research, public health action, and social justice that can be applied by others nationally and internationally.