A Community-Based Participatory Research Approach to Hurricane Katrina: When Disasters, Environmental Health Threats, and Disparities Collide

In 2005, Hurricane Katrina resulted in long-term flooding of 80% of New Orleans, Louisiana. Mold-infested homes gave rise to concerns about increased childhood asthma. To address these concerns, a diverse community–academic partnership used a community-based participatory research (CBPR) approach to implement the Head-off Environmental Asthma in Louisiana (HEAL) study in 2007.

The study examined the relationship between post-Katrina mold and other environmental exposures and asthma morbidity, while testing an asthma counselor (AC) intervention. Both the AC intervention and the CBPR approach were effectively implemented in the postdisaster setting. However, homes had lower levels of mold and other allergens than expected, possibly because of the timing of environmental sampling. Also, HEAL illustrated the vulnerability of the study community, especially to the interconnected threats of health disparities, environmental health stressors, and disasters.

We examine the implications of these threats for public health science, policy, and practice, not only through the lens of Hurricane Katrina but also for future disasters faced by communities in the Gulf Coast and nationally. (*Am J Public Health*. 2020;110:1485–1489. doi: 10.2105/AJPH.2020.305759)

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See also Kim-Farley, p. 1448, and the *AJPH* Hurricane Katrina 15 Years After section, pp. 1460–1503.

Hurricane Katrina made abundantly visible the unique vulnerability facing many residents of the US Gulf Coast, especially children: a historic burden of health and other disparities, persistent environmental health threats, and recurring natural and technological disasters.[1] For example, Louisiana is among the states with the highest rates of chronic health conditions such as asthma, cardiovascular disease, diabetes, obesity, and cancer.[2] Recently, Wallace et al.[3] showed that homicide is the leading cause of death among pregnant and postpartum women in Louisiana, a disturbing and fully preventable outcome. Economically, Louisiana has one of the highest child poverty rates (26%) in the country, with 43% of the state's African American children living in poverty.[4] Differences in average household income between Whites and minorities in Louisiana remain stark.[5] The state is also home to a multitude of operating and abandoned chemical facilities and ranks near the top of the list for toxic releases nationwide.[6] Although it is difficult to establish complete exposure pathways, the mere presence of these facilities drives fear and distrust among many community members.

Extensive, long-term flooding in New Orleans after Katrina resulted in widespread mold infestation of the built environment where children live, learn, and play—homes, schools, libraries, and playgrounds. The flood waters, affecting 80% of the city, remained for two to six weeks and led to environmental conditions never before experienced indoors or out.[7,8] The pre-Katrina prevalence of childhood asthma in New Orleans was among the highest nationally.[9] Community members and public health officials were concerned that the unprecedented levels of indoor mold could exacerbate childhood asthma. To address these concerns, a broad partnership of community leaders, research scientists from academia and private research enterprises, and federal and local government conducted the Head-off Environmental Asthma in Louisiana (HEAL) study from 2007 to 2009.

The HEAL study team developed a novel, field-applicable, hybrid intervention targeting 182 children with moderate to severe asthma, against the backdrop of three interconnected challenges: intransigent health disparities, persistent environmental health threats, and disasters. This post-Katrina pediatric asthma study sought to reduce asthma morbidity by employing evidence-based interventions from previous trials tailored to families facing these interconnected risks. Informed by a clinical evaluation ascertaining the child's asthma and mold allergy status and an environmental assessment documenting exposure risks to mold and other allergens, the intervention consisted of a customized exposure-reduction component and an asthma counseling

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component, both aimed at providing caregivers the knowledge, skills, and motivation to manage their children's asthma.[9,10]

Post-Katrina stressors exacerbated the burden of existing disparities faced by families and children. For example, at baseline, HEAL families moved an average of 3.1 times after the storm.[10] Data from a previously unpublished needs assessment completed by 136 HEAL caregivers showed that 62% of children were attending a different school and 20% had fallen behind a grade or more. Forty-nine percent had a relative who moved away and 20% had a relative who died; 35% had a close friend who moved away and 4% had one who died. Fifty-four percent had lost belongings and 19% had lost a pet.

The families' situations varied greatly, with some in extreme circumstances. In February 2008, 2.5 years after the storm, baseline evaluations were completed on two children. One was a highly atopic boy, still sleeping on his damaged mattress in a home that had flooded and using only expired asthma medications. The other was a girl sleeping in the family's car in the parking lot of an emergency room even though the family owned a house; her asthma was so severe that her mother was afraid to let her sleep at home after the child had been admitted twice the month before.

In this commentary, we revisit HEAL's findings and discuss how the study team implemented community-based participatory research (CBPR) in a postdisaster setting. We then examine the implications of interconnected health disparities, environmental health threats, and disasters in the context of current challenges and opportunities in public health science, policy, and practice.

THE HEAL STUDY

HEAL was a pre–post intervention of children aged 4 to 12 years with persistent moderate to severe asthma (Table 1). The intervention delivered patient-tailored asthma counseling and case management, guidance for reducing exposures to environmental triggers, and resources to meet the needs of families living in the postdisaster setting. Enrollment occurred in 2007 and 2008, and participants remained in the study for one year. Study visits included two clinical evaluations, three home assessments, and at least two asthma counselor visits with follow-up calls. Outcomes were collected by phone quarterly to capture maximum symptom days in the preceding two weeks, defined as the largest number of the following variables: days with wheezing, chest tightness, or cough; nights of sleep disturbance; and days when activities were affected, such as the child slowing down or ending physical activities.[10]

Participants' homes were evaluated by visual inspection, temperature and moisture measurements, and air and dust sampling. Air was collected with vacuum-pump spore traps and analyzed for more than 30 mold taxa using bright field microscopy. Dust was collected from the children's beds and bedroom floors and analyzed for mouse (Mus m 1), dust mite (Der p 1), cockroach (Bla g 1), and mold (Alternaria mix) allergens using ELISA. Alternaria antigen was detected in dust from 98% of homes, with 58% having concentrations higher than 10 micrograms per gram. Geometric mean indoor and outdoor airborne mold levels were 501 and 3958 spores per cubic meter, respectively. Even though mold was found in homes, no children were found living in unhealthy conditions with copious amounts of mold. This may have been because sampling occurred two years after flooding and public awareness programs emphasized that no one should live in mold-ridden homes.[12]

At baseline, participants completed a clinical evaluation that included lung function, allergen skin testing, and study questionnaires. Of those enrolled, 89% of the children tested positive to one or more indoor allergens: 67% tested positive to dust mites and 72% tested positive to at least one of the four primary molds (Alternaria, Penicillium, Cladosporium, and Aspergillus). There was no relationship between allergen concentrations in homes, skin test sensitivities, and asthma morbidity. This lack of relationship points to the complexity of attempting to assess these associations during rapidly changing social and environmental conditions, which was further complicated by home remediations already conducted by most participants.[13]

The asthma counseling intervention provided tailored asthma case management to HEAL families. Community health workers and asthma counselors were paired to enhance rapport with families and optimize care coordination. Training competencies for the asthma counseling team included asthma physiology, medications, devices, cultural competency, communication skills, environmental control procedures, psychosocial issues, personal safety, and proper case management and documentation. Individualized counseling provided by counselors included educational modules tailored to each child's environmental risk (e.g., reported exposures, allergy skin test results), results from the clinical assessment, and the expressed needs of the child's family. Often, counselors had to address a family's social needs before addressing asthma management. Housing, transportation, and parental employment all affected the ability to manage a child's asthma.[14]

Postintervention changes in asthma symptoms (45% reduction in symptoms from baseline to 12 months; $P < .001$) were consistent with similar trials in nondisaster settings. Children whose families had contact with a HEAL asthma counselor by six months from baseline showed a 4.1-day decrease in symptom days, significantly greater than the 1.8-day decrease among those who had not yet seen a counselor ($P < .001$). At 12 months from baseline, the group that had seen a counselor had a 3.14-day improvement, compared with a 1.29-day improvement for those who had not ($P = .06$).[9] Overall, children who attended more visits with the asthma counselor team had the greatest decrease in symptoms. After the intervention, participants were more likely to take medications as prescribed ($P = .003$), have a provider for follow-up care ($P < .001$), experience fewer financial and insurance problems for appointments ($P = .006$), and report fewer problems obtaining asthma medications ($P = .005$).[14]

POSTDISASTER PARTICIPATORY RESEARCH

After HEAL was completed, the research team assessed the degree to which the study applied Israel et al.'s CBPR principles.[15]

Although the principles were not designed for a disaster context, the team was interested in taking stock of the challenges of implementing population-based research and CBPR after Katrina. Perhaps the most important principle, using a cyclical and iterative process (principle 6), was exemplified by the team's redesign of several study components based on community feedback and operational realities. Integrating knowledge and action (principle 4) and disseminating findings and knowledge to all partners (principle 8) were implemented when the team acted on study data and participant input to develop tailored information and a feedback loop encouraging collaboration and communication among study personnel and participants. Recognizing community as a unit of identity (principle 1) and promoting a colearning and empowering process reflective of social inequalities (principle 5) were also essential. When designing the intervention, the team took into consideration the socioeconomic challenges facing residents of inner-city New Orleans and sought to empower study participants to address disparities (e.g., housing, health care access) and modify behavior to reduce asthma triggers.[11]

Building on the community's strengths and resources within the community (principle 2) and facilitating the collaborative, equitable involvement of all partners in all phases of the research (principle 3) had somewhat limited impact. Many study hurdles were successfully overcome by leveraging community resources, such as hiring local staff and heeding the advice of Community Advisory Group members. For example, the Community Advisory Group assisted in bolstering retention by identifying individuals who were employed as community health workers. On the other hand, the study was constrained by the lack of baseline pre-Katrina data on local assets that could be leveraged. Baseline data would have represented pivotal information since communities in the region have experienced repeated natural and technological disasters. Moreover, not all community partners could fully participate in all phases of the research given the unprecedented challenges they were facing.

Addressing health, including the social determinants of health, from positive and ecological perspectives (principle 7) was difficult given the destruction of the city's social and physical infrastructure. Likewise, securing a long-term commitment by all parties (principle 9) beyond the HEAL study was unrealistic considering the still stressed and transitioning communities several years after flooding.[11] Drawing on lessons learned through HEAL, post-disaster health studies utilizing a participatory design should also integrate adisaster plan into the study design, incorporate the community's cultural context, and build on factors influencing community resilience[16] to avoid exacerbating vulnerability.

IMPLICATIONS FOR SCIENCE, POLICY, AND PRACTICE

Fifteen years after Hurricane Katrina, challenges and opportunities can be effectively viewed through the traditional three lenses governing public health: science, policy, and practice. From a science perspective, although much progress has been made, significant research gaps remain. Delayed exposure assessments, evidenced after Katrina as well as the Deepwater Horizon oil spill five years later, continue to frustrate scientists and communities alike. Similarly, investment of financial and human resources to consistently monitor exposure to both chemical and nonchemical stressors during the interdisaster period is lacking, thus depriving public health scientists of valuable baseline data to inform post-disaster environmental epidemiological studies.[1] Compounding these gaps in science is the potentially cumulative impact of climate change. Louisiana, already prone to frequent coastal flooding, faces the consequences of rising sea levels, land loss, and increased atmospheric temperatures. Coastal residents, ever

TABLE 1—Baseline Demographics and Housing Characteristics of Children in the Head-off Environmental Asthma in Louisiana (HEAL) Study: New Orleans, LA, 2006

Characteristic	% or Mean ±SD (n = 182)
Demographics	
Male	54
Race/ethnicity	
African American	67
Hispanic	7
White or other	26
At least 1 household member employed	91
Household income < $15 000	25
At least 1 smoker in household	32
Total no. of people in household	
2–3	29
4–5	57
≥ 6	14
Caretaker married	54
Caretaker completed high school	88
Housing	
No. of times moved since Katrina	3.09 ±2.03
Current housing type	
Single-family detached house	64
Multifamily house (duplex, triplex or row house)	23
Apartment	8
Federal Emergency Management Agency trailer	5
Current housing damage	
Flooding only	23
Roof leak only	25
Flooding and roof leak	14
None	38
Mold air sampling[a]	
Indoor total	502
Outdoor total	3958

Source. Lichtveld et al.[11]

[a]Spores per cubic meter reported as geometric means.

resilient and mobile, are relocating farther inland.[17]

The challenges to effectively respond to Katrina prompted some important policy developments. In 2006, Congress enacted the Pandemic and All Hazard Preparedness Act (PAHPA).[18] As an amendment of the Public Health Service Act, it established the Office of the Assistant Secretary for Preparedness and Response (ASPR) and augmented federal authority regarding the availability of medical counter measures following the H5N1 influenza pandemic. A key aspect of PAHPA was to no longer use siloed, disaster type–driven response strategies; rather, each aspect of the disaster management cycle—from preparedness to recovery—would take a "whole community" approach. PAHPA-related appropriations primarily resulted in greater coordination of disaster response efforts through ASPR as exemplified in the aftermath of Superstorm Sandy.[19] Despite PAHPA and progress at the local level, many Gulf Coast communities lack sufficient resilience and social capital to be fully prepared for the impact of disasters given the underlying disparities and environmental health threats.[16]

Much has improved since Hurricane Katrina with respect to local disaster preparedness and response practice, based in part on the successes and possibilities illustrated by HEAL and other programs. The City of New Orleans received major financial resources through such investments as the federally funded Cities Readiness Initiative.[20] It also created a special needs registry to coordinate evacuation efforts in advance of disasters for this vulnerable subpopulation. Greater coordination now exists among local stakeholders in the government public health and private sectors. Of note is the contribution to the city's disaster management workforce by Tulane University's disaster management degree program.[16] The disaster response to Hurricane Katrina illustrated the infrastructure and disaster management gaps that existed in 2005. Although continuous improvements have been made in subsequent natural disasters—notably, the significant compliance with prestorm evacuations for Hurricane Isaac in 2008 and the identification of pediatric preparedness as a specific area of disaster management[21]—many challenges remain.

One example of public health capacity building after Katrina, in the aftermath of the Deepwater Horizon oil spill, was the Gulf Region Health Outreach Program.[22] The goal of strengthening public health in the most affected counties and parishes was transdisciplinary in nature, addressing both infrastructure—such as implementing electronic health records and expanding primary care capacity—and discipline-specific services in mental health and environmental health. The $105 million program was a five-year allocation as part of the oil spill's medical settlement. The program can serve as a model for mitigating the impact of the interconnected threats facing Gulf Coast communities, and important lessons were learned regarding how best to sustain such investment. Among those lessons are integrating adult and pediatric mental health services—needed but often lacking after a disaster—into primary care clinics[23,24] and embedding community health workers in federally qualified health centers serving as medical homes for minority and underserved individuals.[25]

Given the current and urgent impacts of a changing climate and severe weather events, there is a time-sensitive need for collaborative leadership and an action plan to address the gaps in science, policy, and practice to strengthen Gulf Coast communities' resilience. AJPH

CONTRIBUTORS

M. Lichtveld conceptualized, drafted, and edited the article. H. Covert drafted and edited the article. J. El-Dahr, L. F. Grimsley, R. Cohn, C. Hayes Watson, E. Thornton, and S. Kennedy drafted sections and edited the article.

CONFLICTS OF INTEREST

The authors have no potential or actual conflicts of interest to disclose.

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