Addressing Air Pollution and Asthma

NIEHS-Funded Researchers Bring Solutions to Children in Rural Agricultural Communities

The National Institute of Environmental Health Sciences (NIEHS) supported a study that may lead to improved health for children suffering from asthma. Asthma is a serious respiratory disease that affects about 6 million children in the U.S., causing wheezing, difficulty breathing, and coughing. Asthma can lead to permanent lung damage and can be fatal – more than 200 child deaths per year are attributed to asthma.

NIEHS-supported researchers found that agricultural practices contribute to poor air quality and asthma among children. The team combined high-efficiency particulate air (HEPA) cleaners and a home-based education program to reduce children's exposure to pollutants in the home and improve lung health.

Then and Now

Then:
- Research largely focused on urban environments where cars, trucks, and industrial sources contribute to poor air quality and asthma.
- Little information on how air quality in rural agricultural communities affects children with asthma, and few strategies to improve health.

Now:
- Scientists understand that poor air quality in rural agricultural areas can contribute to health problems in children.
- HEPA cleaners combined with home education programs can significantly improve children's health and well-being.

Impacts of Addressing Air Pollution in Agricultural Communities

Pinpointing the Problem
Particulate matter, ozone, pesticides, and ammonia, a common product of animal farming, can worsen asthma. Air pollution is elevated in rural agricultural communities; linked to poor respiratory health in children.

Identifying Solutions
Portable HEPA cleaners can reduce indoor triggers of asthma.

Improving Health
Combining HEPA cleaners with in-home asthma education programs can reduce asthma symptoms and improve asthma control in children.

Sharing Results
Disseminated findings through community events, health fairs, infographics, radio reports, a radionovela, and meetings with agency leaders.

Building Community Capacity
Built capacity in partner organizations to conduct health assessments, collect samples, and work with air quality monitoring equipment.

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Karr administers an asthma test in the clinic.

(Photocourtesy of Catherine Karr)

“This rural, primarily Latino community is exposed to worse air pollution than people in urban Seattle, which contributed to health problems among children,” explained Catherine Karr, M.D., Ph.D., who led the team. “The home education program helps families understand asthma and how environmental factors affect the disease. Combined with HEPA cleaners, families feel empowered to improve the quality of life for their children.”
Addressing Childhood Asthma in Rural Agricultural Communities

**Fundamental Questions**
- Observed connection between air pollution and asthma in urban children.¹
- Developed and validated new outdoor air sampler to handle multiple exposures in rural environments.²
- Created and optimized new electrostatic dustfall collectors technique for large-scale, in-home exposure assessment for endotoxin, a risk factor for asthma.³,⁴
- Collaborated with community partners to establish a cohort to examine air pollution and child asthma health in rural agricultural communities.⁵

**Application and Synthesis**
- Measured high ammonia levels in homes near industrial-scale dairy operations.⁶,⁷
- Identified LTE4 as a sensitive and noninvasive inflammatory biomarker associated with asthma.⁸
- Developed and validated method to estimate exposure to animal feeding operations and the relationship with health effects in children with asthma.⁹
- Worked with community partners to develop an intervention study to improve pediatric asthma.¹⁰

**Implementation and Adjustment**
- Used MicroPEM samplers to allow low-burden indoor PM exposure assessment.¹⁰,¹¹
- Linked PM2.5 exposure to increased reported asthma symptoms and decreased lung function in rural agricultural community children.¹²
- Tested urinary LTE4 as a biomarker for inflammatory response to exposures.¹⁵,¹⁶
- Linked reduced lung function and high rates of exposure to ammonia in children’s neighborhoods.⁶

**Policy and Practice**
- Adapted local Community Health Worker asthma education program to include HEPA air cleaners to reduce exposure to ammonia and PM.¹⁰
- Tested education program combined with HEPA intervention.¹⁰
- Used LTE4 as biomarker; identified link between combined exposure to PM, ozone, and OP pesticides, and OP pesticides alone, and increased asthma morbidity among children.¹¹,¹⁴
- Combination of HEPA and education intervention reduced PM2.5 and PM10 exposure levels in homes.¹⁵,¹⁶
- Improved asthma control, reduced asthma symptoms, decreased LTE4.¹⁷
Challenges and Lessons Learned

**Challenge:** Researchers had to address families’ logistical concerns about participating in the study.

**Lessons Learned:** Researchers purposefully found a sensor that met the needs of family members. The MicroPEM technology was developed by other NIEHS researchers and is small, quiet, and unobtrusive.11

**Challenge:** The families who would most benefit from this intervention — immigrant Latino children with asthma living in rural agricultural Washington — can be reluctant to participate in medical research.

**Lessons Learned:** The research team built and sustained a long-standing partnership with the Northwest Communities’ Education Center, Radio KDNA, the Yakima Valley Farmworkers Clinic, and Heritage University. The families were more willing to participate in the study because of the trust and goodwill established over time.

“**The outdoor air monitors were very loud and not acceptable for use indoors in sleeping areas,**” Karr recalled. “**Finding a sensor that was not disruptive or burdensome to the families was crucial to a successful intervention.**"

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**Engaging With Communities**

The research team trained and fostered job skills within local partner organizations, building their capacity to conduct community-based research and enabling them to tackle other challenges within their community.

“**By involving our community partners in all aspects of the research, we helped nurture important skills that they can use to address new and emerging community needs,**” Karr explained. “**For example, they were better equipped to quickly identify and begin responding to the community’s needs surrounding COVID-19.**”

For references, supplementary information, and more on the impact of NIEHS research, please visit [https://niehs.nih.gov/research/programs/translational/examples](https://niehs.nih.gov/research/programs/translational/examples).