



## **Overview of CCCEH Research Studies**

The Columbia Center for Children's Environmental Health (CCCEH) conducts community-based research in the United States and overseas to study the health effects of prenatal and early postnatal exposures to common urban pollutants, with the aim of preventing environmentally related disease in children. We apply the results of our research to interventions that reduce exposure to toxic pollutants; a community education campaign to increase environmental health awareness among local residents, parents, health professionals and educators; and to informing public interest groups, elected officials, and other policymakers who can shape policies to improve the environmental health status of low-income communities. The Center's overall mission is to improve prevention and clinical treatment, and work with community-based organizations to improve their neighborhood's environmental health.

The Center is running prospective research studies of pregnant women and their children in the United States, Europe, and Asia that examine how multiple common urban pollutants are contributing to rising rates of asthma, developmental delays, behavioral disorders, and cancer risk. The Center's team of more than three dozen highly trained scientific investigators in various fields such as environmental exposure assessment, perinatal epidemiology, pediatric oncology, pulmonology, and biostatistics are studying the effects of early-life exposures to urban air pollutants to identify those most harmful and in need of regulation or stricter enforcement. Our research studies are described below.

The **Mothers & Children Study in Northern Manhattan and the South Bronx** examines the respiratory health, cognitive development, and level of cancer risk in children prenatally exposed to common urban air pollutants from fuel burning (e.g. vehicles, industry), environmental tobacco smoke (ETS), residential pesticides, cockroach and mouse allergens, phthalates (chemicals commonly found in plastics), mold, mercury, and lead. Our findings show that prenatal exposures to polycyclic aromatic hydrocarbons (PAHs) produced by vehicular traffic and other combustion sources, ETS, and pesticides significantly reduce fetal growth, increasing risk of developmental delays, and impairing children's learning ability as they enter school. Exposure to multiple pollutants leads to more detrimental health outcomes in children. For example, combined prenatal exposure to PAHs and ETS further reduces fetal growth and increases precursor symptoms to asthma. Prenatal ETS exposure combined with chronic material hardship worsens children's cognitive development. Encouragingly, investigators at CCCEH have documented significant decreases in concentrations of the pesticides chlorpyrifos and diazinon in pregnant women's blood and air and in cord blood since the EPA banned these chemicals from residential pest control products in 2000 and 2001. The study is tracking more than 700 low-income African-American and Dominican children.

The **Sibling/Hermanos Study**, launched in 2008, is a new component of the New York City Mothers & Newborns Study. Some of the confounding variables that CCCEH has previously been unable to examine are shared genes and genetic predispositions that can increase or reduce disease risk. To better account for these factors, we are now recruiting newborn siblings of children who are enrolled in the New York study. The Sibling/Hermanos study should provide valuable new data to help us assess

with more precision the role of environmental exposures on disease risk by quantifying shared environmental, epigenetic and genetic characteristics, which is not possible to evaluate in a study of unrelated children. It may also allow us to study the influence of exposures occurring before the child is conceived because we have already collected comprehensive information about the mother. This research will help us as we continue to explore factors that mediate and modify the relationships between pre-conception, prenatal and postnatal environmental exposures and health outcomes and biomarkers of disease risk.

Our newest research undertaking consists of four coordinated studies that aim to increase our understanding of when and how air pollutants increase the risk for childhood asthma through additional research on the Center's Mothers & Newborns Study cohort.

1) "Time Windows of Asthma Vulnerability" aims to determine at what point in their development young inner-city children are most vulnerable to air pollution exposure. It is also monitoring the effects of recent policy changes on exposure to traffic-related air pollution. Policy changes in 2003 resulted in stricter regulations of diesel emissions from traffic, so our investigators are examining whether the downward trends in traffic-related pollution since then have resulted in decreased exposure on an individual level among children in our study cohort. The results will be translated into useable recommendations for parents on how they can reduce risks in the home, ascertain possible identifiers for children at risk of asthma from air pollutants, and provide information for physicians on the role of air pollutants as triggers for asthma.

2) "New Air Sampling Technology" will develop a small lightweight, personal air sampling system (the size of an iPod) for a group of children in our cohort to wear while at home, in school, and in transit. Data will be collected from asthmatic and non-asthmatic children wearing this system, which should help us better understand how exposure to diesel exhaust can exacerbate asthma symptoms in young children. By monitoring diesel exposure in a variety of settings, scientists will also be able to gauge the importance of these different environments on personal exposure to traffic-related air pollutants. We will provide further information for physicians on the role of certain air pollutants as asthma triggers, including its relationship to obesity and environmental tobacco smoke (ETS). In addition, the results will help us formulate recommendations for parents on how to reduce asthma risks in their home or community, identify cohort children at risk for asthma, and potentially serve as a means for collaboration with community partners and advocacy groups to support diesel reduction initiatives.

3) In the "Genes & Asthma" project, scientists will investigate whether modifications on a genetic level are involved in the process of childhood asthma development. Previous research has shown that prenatal exposure to air pollutants can lead to the development of asthma in young children but the exact cause is not well understood. If changes in specific genes *in utero* are found to predict asthma, researchers may be able to confirm clinically relevant biomarkers that would recognize children at higher risk of asthma. As a result, children and their physicians would be able to recognize and learn to control for asthma symptoms at an earlier age. The Center is collaborating with the Environmental Health Sciences Lab at the University of Cincinnati on this project.

4) "Air Pollution & Asthma Medicine" is examining the effects of traffic related pollutants on specific cell receptors ( $\beta$ 2-adrenergic receptors or  $\beta$ 2AR). These receptors play an important role in airway dilation. When a child has asthma, the medication given contains certain compounds that work with the receptors to relax smooth muscles and promote airway dilation. However, previous

studies have suggested that certain air pollutants interact with these cell receptors and inhibit their ability to function properly. As a result, some asthma medications are ineffective and a child's asthma symptoms can progress or get worse. The analyses of this study will examine if certain traffic-related air pollutants affect the proper function of these cell receptors ( $\beta$ 2AR) and also study if these PAHs alter  $\beta$ 2AR in early life exposures. Once the true effect of air pollutants on these receptors are known, effective asthma medications can be developed and asthma symptoms in young children can be successfully alleviated.

The **World Trade Center (WTC) Pregnancy Study** is assessing the effects of air pollutants released by the destruction of the WTC towers on fetal growth, respiratory health, and cognitive development in 329 newborns whose mothers were pregnant and near the WTC on 9/11/01 and shortly thereafter. We have shown that babies born to women living within two miles of the WTC in the weeks after 9/11 were on average born five ounces lighter and one-third of an inch shorter than babies born to women living further away. In addition, women in the first 13 weeks of pregnancy on 9/11, regardless of where they lived or worked, had slightly shorter pregnancies by an average of 3.6 days. The study is following children's health and development through the age of six.

The **Mothers & Children Study in China** is determining the health benefits to newborns of reducing *in utero* exposure to toxic air pollutants generated by coal burning. Like many rapidly developing countries, China relies heavily on coal for low-cost energy production. In Chongqing Municipality, the Tongliang Power Plant was located in the center of the town of Tongliang, and was the only major source of air pollution in the area. In 2004, local officials shut down the power plant, making Tongliang an ideal site to study the effects of energy-related air pollution in children because they can be studied before and after the closure. Begun in 2002, the study is now tracking three distinct cohorts of pregnant women and their children: one that was enrolled while the plant was still operational, and two that were enrolled after local authorities shut the facility down. It is examining how prenatal exposures to energy-related and other common environmental pollutants affect children's growth, cognitive development, respiratory health, and risk of cancer. This research is being conducted in collaboration with Columbia University's Center for International Earth Science Information, the Chongqing Medical University Children's Hospital, and the Natural Resources Defense Council.

The **Mothers & Children Study in Poland** studies the same pollutants (excluding pesticides) and health outcomes as the New York City study, but in 500 children in Krakow, Poland—a city with high levels of combustion-generated pollutants from coal burning. It also allows us to confirm and compare our findings internationally. Recently published results have shown that pregnant women in Krakow are exposed to 30-fold higher levels of airborne PAHs than women in New York City, and also have higher levels of genetic damage from PAHs measured in maternal and newborn (umbilical cord) blood. In both cohorts, newborn adducts were about 10-fold higher than maternal adducts per estimated unit of exposure. Furthermore, PAHs in air were linked to decreased fetal growth in both cohorts, allowing us to compare effects across a wide gradient of exposure to the same pollutants. In addition to concern this raises over newborns' increased susceptibility to procarcinogenic damage, and babies' longer life course over which cancer can develop, the comparison of these two datasets is showing that prenatal exposure to even low levels of PAHs are adversely affecting fetal growth. The Center collaborates with a research team from Jagiellonian University in Krakow.