



# ECHO

Environmental influences  
on Child Health Outcomes

A program supported by the NIH

## Study Summary

### ***Higher Early-Life PM<sub>2.5</sub> Linked to Higher Childhood Blood Pressure, While Prenatal NO<sub>2</sub> Exposure Associated with Lower Blood Pressure, ECHO Study Finds***

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#### Who sponsored this study?

The Environmental influences on Child Health Outcomes (ECHO) Program, Office of the Director, National Institutes of Health supported this research.

#### Why was this study needed?

The prevalence of high blood pressure (HBP) in children is rising globally, with long-term health consequences such as heart disease and impaired kidney function. Childhood high blood pressure has increased by nearly 80% over the past two decades, especially in countries with higher obesity rates like the United States. Since high blood pressure in childhood can both track into adulthood and affect children's health directly, ECHO researchers wanted to understand the influence that environmental factors such as pollution can have on childhood blood pressure. Specific pollutants such as fine particulate matter (PM<sub>2.5</sub>) and nitrogen dioxide (NO<sub>2</sub>) are emitted from vehicles, power plants, and industrial processes. These pollutants are known contributors to heart disease in adults, but their impact on children's blood pressure is less clear. Previous research has been inconclusive, often limited to single-site studies. Researchers used the ECHO Cohort's large, multi-site study structure to help clarify these associations.

#### What were the study results?

Children who were exposed to more PM<sub>2.5</sub> air pollution before and after birth had slightly higher blood pressure on average between ages 5 and 12. Specifically, higher PM<sub>2.5</sub> exposure during the first trimester was linked to a more pronounced increase in systolic blood pressure and a greater risk of high blood pressure in childhood, indicating that early pregnancy may be a particularly sensitive period. When their mothers were exposed to more NO<sub>2</sub> air pollution during pregnancy, children unexpectedly had lower blood pressure. The study found that NO<sub>2</sub> exposure during mid- to late pregnancy was associated with slightly lower blood pressure levels, particularly in the second trimester, and was not linked to a higher risk of high blood pressure. These findings overall suggest that timing of pollution exposure during pregnancy matters for children's blood pressure later in life.

#### What was the study's impact?

The study provides additional evidence that exposure to PM<sub>2.5</sub> may be associated with adverse effects on childhood cardiometabolic health, even at low exposure levels. The observed association between prenatal NO<sub>2</sub> exposure and decreased childhood blood pressure is unexpected and suggests that further

research may be needed to better understand the underlying mechanisms as well as other environmental factors that may influence this relationship.

### Who was involved?

The study included 4,863 U.S. children aged 5–12 years and their mothers, drawn from 20 ECHO Cohort Study Sites.

### What happened during the study?

Researchers estimated how much outdoor air pollution children were exposed to at their homes, focusing on PM<sub>2.5</sub> and NO<sub>2</sub>. They examined exposure during each trimester of pregnancy, across the full pregnancy, and during the child's first two years of life. Children's blood pressure was measured between ages 5 and 12 and compared with typical levels for children of the same age, sex, and height; blood pressure was considered high if it fell within the top 10 percent of the distribution.

Footnote: Results reported here are for a single study. Other studies may provide new information or different results. You should not make changes to your health or medical care without first consulting your healthcare professional.

### What happens next?

More research could help investigators better understand why exposure to nitrogen dioxide during pregnancy was linked to lower, rather than higher, blood pressure in children. This could include exploring possible biological explanations and looking at whether other environmental exposures that occur alongside air pollution may be influencing this finding, such as transportation noise exposure.

### Where can I learn more?

Access the full journal article, titled "Pre- and Postnatal Exposure to PM<sub>2.5</sub> and NO<sub>2</sub> and Blood Pressure in Children: Results from the ECHO Cohort," in [Environmental Research](#).

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