

Even low lead levels in children negatively affect test scores

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Deteriorating lead paint and its dust can be inhaled or ingested by young children, with negative cognitive effects that last for years. Credit: Brown University

A decrease in the average level of lead in a preschooler's blood reduces the probability of that child being substantially below proficient in reading by the third grade, a new National Bureau of Economics Research working paper reports. And because poor and minority children are more likely to be exposed to lead, the study suggests that lead poisoning may be one of the causes of continuing gaps in test scores between children from different socioeconomic groups.

"This study underscores the importance of looking at factors outside the educational setting to help explain persistent gaps in test scores," said Anna Aizer, professor of economics at Brown University.

Aizer co-authored the study, "Do Low Levels of Blood Lead Reduce Children's Future Test Scores?" with economist Janet Currie of Princeton University and Brown colleagues Dr. Peter Simon and Dr. Patrick Vivier.

Rhode Island's lead abatement and testing programs

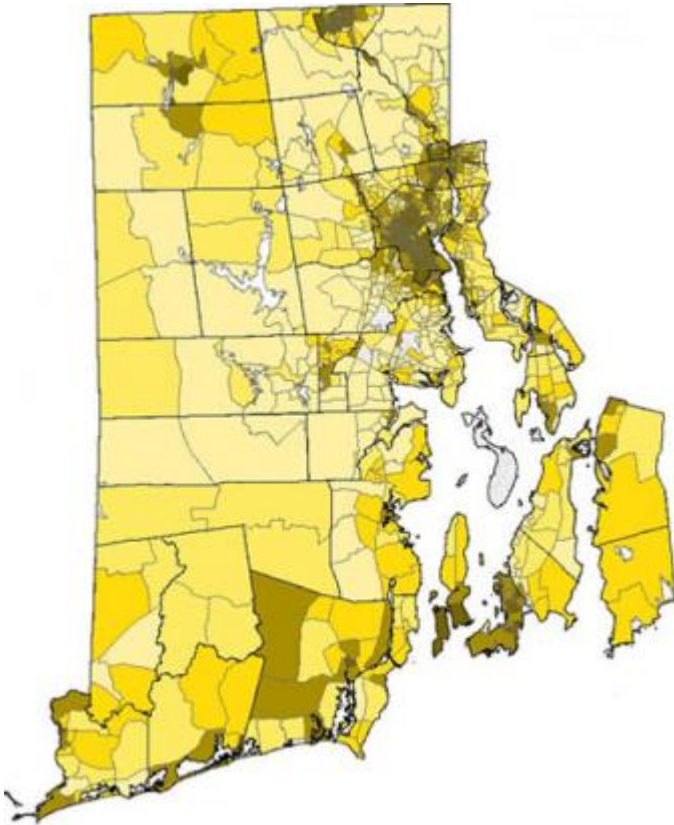
The study looked at eight cohorts of Rhode Island

children born between 1997 and 2005, a timeframe whose beginning coincides with two statewide remediation programs. One mandated that landlords in buildings where elevated levels of lead had been found remediate the lead, with the aid of state loans, or face prosecution. The other required all landlords to mitigate lead hazards in the homes they rented regardless of whether an elevated lead level had been reported.

Although lead was outlawed as a paint additive in 1978, much of Rhode Island's housing stock predates that ruling. According to the study, U.S. Census data reveals that 81 percent of the homes in Providence County were built prior to 1978 and 49 percent before World War II.

Minority and low-income children were disproportionately exposed to deteriorating lead-based paint, the authors wrote, because of "residential segregation of the poor, and especially of African Americans, in the four core urban areas of the state located within Providence County."

Rhode Island, the authors note, "had a particularly aggressive program of testing for lead, and 80 percent of all three-year-old children in the state have at least one [blood lead level](#) measurement." Most Rhode Island children have repeated tests for lead, according to the authors, so they were able to "match information on preschool blood lead levels from the R.I. Department of Health with the child's test scores from the R.I. Department of Education in order to examine the effects of preschool blood lead levels on third grade test scores."



The darker areas on this map, using 1993-2005 data, show where higher incidences of lead poisoning occurred. A previous study led by Patrick Vivier looked at geographic and demographic disparities in lead poisoning cases. Credit: Vivier et al. / Brown University

Measuring lead in blood

Lead, which the authors note has been known to be toxic to the human body since Roman times, affects many of the body's systems, including the renal, endocrine and cardiovascular, "but the nervous system appears to be the most sensitive target," the authors wrote.

Blood lead levels (BLLs) are measured by micrograms of lead per deciliter. "The mean BLL is 3.1, which is well below the Center for Disease Control's threshold for medical intervention of 5 micrograms per deciliter," according to the study.

At the outset of the study, African American children had a mean BLL 5.77, while Hispanic children had a mean BLL of 4.91. By 2005, those

concentrations had declined to 2.95 and 2.52 respectively, a decrease of 42 percent.

"This is a very rapid decline, which we attribute in part to the introduction of the lead-safe certificate program," Aizer and her colleagues wrote, noting that the most groups saw a dramatic increase in the percentage of children who lived in a home with a certificate in place at the time of the birth.

"In the 1997 birth cohort only two percent of sample African American children lived in a home that had been certified lead-safe at the time of their birth; by 2005, 12 percent of sample African American children lived in a home that had been certified as lead-safe from the time of their birth," the authors wrote.

Rising test scores in reading

The authors found that by third grade, test scores rose for all children in the study, regardless of demographic group, while the fraction scoring substantially below proficient declined. The greatest gains, the researchers found, were made by the children who were most affected by the certificate program.



A previous study by Brown researchers and RI-based organizations studied compliance with the lead hazard mitigation laws. Credit: Brown University

The authors found different effects among different economic groups, including that "among children who never participated in the free lunch program, reading test scores rose by 5.9 percent and the percent who were not proficient in reading fell from six to four percent."

On the other hand, among children "who were always eligible for the free lunch program, reading test scores rose by 11.2 percent and the percent who were substantially below proficient in reading fell from 27 to 18 percent, a remarkable improvement."

The authors wrote that they recognized that positive parenting practices or educational policies that targeted poor and minority children could cause gains in reading scores. The researchers also acknowledge that children with higher lead levels "are more likely to come from minority groups, to be poor, to live in single parent homes, and to have less educated mothers. Such a bias would tend to cause researchers to overstate the dangers of lead."

To address these multiple concerns, the authors wrote, "we control for the average reading test scores of all the other students in a child's school and grade. This control captures potential changes in schools (policies, resources, student composition, etc.) that might be relevant to the index child's [test scores](#)." The researchers also discounted the additional reduction in blood lead levels in cases where it seemed as though parents were making a special effort to take advantage of the lead certificate program.

The negative effects of even historically low levels of lead

The researchers note that even though blood lead levels are at historically low levels, the negative impact on academic performance is significant.

Aizer, Currie, Simon and Vivier found a one point decline in reading scores for each one unit increase in the mean of a child's blood lead levels, as well as a 3.1 percentage point increase in the probability of being "substantially below proficient" in reading.

According to the study, estimates on blood lead levels' impact on math scores "are imprecisely estimated, though still suggestive of negative effects of lead."

The group's results suggest that Rhode Island's lead-safe certificate program, whose annual cost, they estimate, is about \$500,000, caused lead levels to fall faster among disadvantaged children than among other children, and accounted for a third of the gain in reading scores among African American children and a fifth of the gain among Hispanic children over this period.

More information: Do Low Levels of Blood Lead Reduce Children's Future Test Scores? [DOI: 10.3386/w22558](https://doi.org/10.3386/w22558)

Provided by Brown University

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