



Departments of Psychology & Neuroscience and Psychiatry & Behavioral Sciences, and Center for Genomic and Computational Biology

**ARTICLE:** Childhood Blood Lead Level Predicts Mild Cognitive Decline and Downward Socioeconomic Mobility by Midlife

A research team led by Aaron Reuben, Avshalom Caspi and Terrie E. Moffitt at Duke University reports that cognitive impairment associated with childhood lead exposure may persist into adulthood and be accompanied by downward social mobility by middle age. These findings are based on a study that followed a birth cohort of 1,000 children, born in one city in New Zealand in the early 1970s and followed to midlife. In 1983, 565 of the children were tested for lead. Because of high lead-in-gasoline levels in New Zealand at the time, childhood lead exposure was widespread and the degree of lead exposure was not related to a child's socioeconomic status in this cohort. This study suggests that childhood lead exposure may have long-term intellectual and socioeconomic ramifications for lead-exposed individuals. Short-lived public responses to community lead exposure events may not be enough.

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**FINDINGS:**

We conducted our study in a 1972-1973 New Zealand birth cohort. During the 1970's and 1980s New Zealand had some of the highest lead-in-gasoline levels in the developed world and cohort children with elevated lead levels were found at all socioeconomic levels, rich or poor.

- (1) Study members with greater lead exposure in childhood tended to have poorer cognitive function at midlife.
  - a. For individuals with childhood blood-lead levels above the historic international level of concern (>10 micrograms of lead per deciliter of blood,  $\mu\text{g}/\text{dL}$ ), adult IQ scores were 4.25 points lower on average than their less exposed peers.
- (2) Lower midlife IQ scores reflected actual IQ decline. When we compared age 38 individuals to their childhood selves we found that lead exposure was associated with IQ decline. Childhood IQ was measured at ages 7 and 9, before lead exposure measurements were taken, at age 11 years.
  - a. For each  $5\mu\text{g}/\text{dL}$  increase in childhood blood-lead level there was a 1.61 point decline in IQ.

- (3) Lead-linked IQ decline was accompanied by downward social mobility. Lead-exposed study members' occupations tended to move down the socioeconomic ladder relative to their parents' occupations.
- (4) Lead effects on IQ decline and downward social mobility could not be attributed to low socioeconomic status of the children's families or the IQ scores of their mothers.

### **WHY ARE THESE FINDINGS IMPORTANT?**

- (1) We have found that exposure to lead can predict negative impact on children's lives for decades.
- (2) Exposure to lead may exert a downward pull on children's intellectual ability and socioeconomic life trajectories regardless of where they start out in life.
- (3) These lasting effects suggest that effective public-policy responses to community lead exposure events may need a long-term strategy.
- (4) In our study some of the most socially advantaged children experienced high lead exposure. Today, for children throughout the world, social disadvantage and lead exposure often go hand in hand. Our findings suggest that lead exposure may be one factor curtailing upward social mobility for vulnerable children.

### **LIMITATIONS:**

- (1) Although mean blood-lead levels in this New Zealand cohort were comparable to other developed-city cohorts born in the early 1970's, the lead levels in the Dunedin cohort were nearly entirely above the current blood-lead reference value for clinical attention today (94% of participants had blood lead above  $5\mu\text{g/dL}$ ). This study's results may not, therefore, be informative about the long-term consequences of very low lead exposures (i.e., those below  $7.5\mu\text{g/dL}$ ).
- (2) We only had one measure of childhood lead exposure, blood-lead levels measured at age 11 years. Other research suggests, however, that our measure provided a reasonable approximation of lifetime lead-exposure in our cohort up to that point.
- (3) Our cohort, born in the 1970s, likely experienced on-going lead exposure during their childhood. Our findings may not be indicative of the consequences of acute, short-term lead exposure.
- (4) Our research is based on only one cohort in one part of the world.

### **SUPPORTING DETAILS:**

**PARTICIPANTS:** Participants were members of the Dunedin Multidisciplinary Health and Development Study, an investigation of the health and behavior of a representative cohort of 1037 consecutive births between April 1972 and March 1973 in Dunedin, New Zealand. This birth cohort's families represented the full range of socioeconomic status in the general population. Follow-ups have been carried out at ages 3, 5, 7, 9, 11, 13, 15, 18, 21, 26, 32, and most recently 38, when 95% of the living cohort members took part.

**DOCUMENTARY FILM:** We invite you to view a new documentary about the Dunedin Study, called “Predict My Future: The Science of Us,” available via Curiosity Stream (<https://app.curiositystream.com/video/1268>).

**MEASURING CHILDHOOD BLOOD-LEAD LEVELS:** Our measure of childhood lead exposure was blood-lead level assessed at age 11 years. Approximately 30 ml of venous blood was drawn from each 11-year-old who participated in the assessment carried out at the Research Unit and who freely agreed to give blood.

**MEASURING COGNITIVE PERFORMANCE:** Cognitive performance was assessed at age 38 years using the Wechsler Adult Intelligence Scale –IV (WAIS-IV). Cognitive performance was also assessed in childhood, using the Wechsler Intelligence Scale for Children-Revised (WISC-R) at ages 7 and 9 years (prior to blood-lead evaluation). Change in IQ from childhood to adulthood was calculated by subtracting childhood IQ scores from adult IQ scores.

**MEASURING SOCIOECONOMIC STATUS:** Socioeconomic status scores were assigned to each participant based on their current occupation at age 38 years using the New Zealand Socioeconomic Index (NZSEI-06), which codes occupations based on their associated education-level and income in the NZ Census. Participants’ childhood socioeconomic status was defined as the mean of the highest occupational status level of either parent during their childhood, measured using the forerunner of NZSEI. Change in socioeconomic status from childhood to adulthood was calculated by subtracting childhood scores from adult scores where both scores were matched on a six-category scale.

**MEDIA CONTACT:** Aaron Reuben ([asr28@duke.edu](mailto:asr28@duke.edu)) or Terrie E. Moffitt ([tem11@duke.edu](mailto:tem11@duke.edu)) or Avshalom Caspi ([ac115@duke.edu](mailto:ac115@duke.edu)).

**UNIVERSITIES INVOLVED:** Duke University, USA; U. of Otago, NZ; King’s College London, UK.

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**INDIVIDUALS WHO CAN COMMENT ON THE NEW RESEARCH** (individuals not involved in the research):

**Maitreyi Mazumdar, MD, MPH**  
Assistant Professor of Neurology, Department of Environmental Health  
Harvard Medical School  
Tel: 617-355-2758  
Email: [maitreyi.mazumdar@childrens.harvard.edu](mailto:maitreyi.mazumdar@childrens.harvard.edu)

**David Bellinger, PhD**

Professor of Neurology, Department of Environmental Health  
Harvard Medical School

Tel: 617-730-0618

Email: [david.bellinger@childrens.harvard.edu](mailto:david.bellinger@childrens.harvard.edu)

**Kim Dietrich, PhD**

Professor and Director of Epidemiology and Biostatistics  
University of Cincinnati College of Medicine

Tel: 513-558-0531

Email: [kim.dietrich@uc.edu](mailto:kim.dietrich@uc.edu)