

Lead in kids' blood linked with behavioral and emotional problems

By Joe Balintfy

Emotional and behavioral problems show up even with low exposure to lead, and as blood lead levels increase in children, so do the problems, according to an NIEHS-funded study published online June 30 in the journal *JAMA Pediatrics*.

"This research focused on lower blood lead levels than most other studies and adds more evidence that there is no safe lead level," explained NIEHS Health Scientist Administrator Kimberly Gray, Ph.D. "It is important to continue to study lead exposure in children around the world, and to fully understand short-term and long-term behavioral changes across developmental milestones."

The team of researchers included scientists at universities in the U.S. and China, as well as NIEHS lead researcher [Walter Rogan, M.D.](#), head of the Pediatric Epidemiology Group (see [text box](#)).

Measuring blood lead levels

Blood lead concentrations measured in more than 1,300 preschool children in China were associated with increased risk of behavioral and emotional problems, such as being anxious, depressed, or aggressive. The average blood lead level in the children was 6.4 micrograms per deciliter.

While many studies to date have examined health effects at or above 10 micrograms per deciliter, this study focused on lower levels. The Centers for Disease Control and Prevention now uses a reference level of 5 micrograms per deciliter to identify children with blood lead levels that are higher than normal, and recommends educating parents on reducing sources of lead in their environment and continued monitoring of blood lead levels.

"Young children are particularly vulnerable to the toxic effects of lead, because lead can affect children's developing nerves and brains," said senior author [Jianghong Liu, Ph.D.](#), (<http://www.nursing.upenn.edu/faculty/profile.asp?pid=2811>) of the University of Pennsylvania School of Nursing in Philadelphia.

Sources of lead exposure

Lead is a naturally occurring toxic metal, but sources of lead exposure are often due to human activities, including burning fossil fuels, mining, and manufacturing. In the U.S., lead exposure usually comes from lead-containing products, such as paint, caulking, and pipe solder, in older homes. In China, lead exposure is more often related to air pollution.

"The sources of lead exposure may explain why concentrations of lead are different," explained Liu. "In China, we found that blood lead concentrations increased with age in preschool children. In the United States, however, blood lead concentrations increase with age in children up to 2-3 years old and then decline."

For the study, the researchers analyzed one blood sample taken from each child between the ages of 3-5. Behavioral problems were assessed at age 6 using standardized questionnaires. The questionnaires were filled out by the children's teachers and parents, which the authors noted is both a strength and limitation. "The study used scores from two sources, but the ratings do not provide a clinical diagnostic measure of behavioral problems," said Liu.

U.S. studies have reported that lead exposure causes what psychologists call externalizing behavior problems, such as aggressiveness and bullying, which may lead to truancy and even jail time as children get older. In this study, children with higher blood lead levels had internalizing problems, such as anxiety and depression, as well as some externalizing problems. Though not addressed in this study, Liu said these differences could be explained by cultural, genetic, or environmental variations, or research gaps.

For more on this story, read the *JAMA Pediatrics* [press release](#).

(<http://media.jamanetwork.com/news-item/blood-lead-levels-associated-with-increased-behavioral-problem-in-kids-in-china/>)

and the University of Pennsylvania [press release](#).

(<http://www.nursing.upenn.edu/nursingnews/Pages/Even-Low-Lead-Level-Increase-Child-Emotional-and-Behavior-Problems,-Penn-Nursing-Study-Finds.aspx#sthash.yIypIowv.dpbs>)

Citation: Liu J, Liu X, Wang W, McCauley L, Pinto-Martin J, Wang Y, Li L, Yan C, Rogan WJ.

(<http://archpedi.jamanetwork.com/onlineFirst.aspx>)

2014. Blood lead levels and children's behavioral and emotional problems: a cohort study. *JAMA Pediatr*; doi:10.1001/jamapediatrics.2014.332.

(Joe Balintfy is a public affairs specialist in the NIEHS Office of Communications and Public Liaison.)



"Continuing monitoring of blood lead concentrations, as well as clinical assessments of mental behavior during regular pediatric visits, may be warranted," emphasized Jianghong Liu, lead researcher. (Photo courtesy of Penn Nursing News)



Rogan has been a pioneer in lead exposure research. (Photo courtesy of Steve McCaw)



Gray said, "It is well-documented that lead exposure lowers the IQ of children." (Photo courtesy of Steve McCaw)

Pinpointing the cause and effect connections in lead exposure

Rogan, who has studied the effects of environmental chemicals, including lead, on the growth and development of children for almost 40 years, contributed to the data analysis of this paper. He said that, while there is broad agreement that lead exposure lowers IQ in kids, there is less agreement that it alters behavior.

"These things are particularly difficult to study in the U.S., where lead exposure is largely caused by deteriorated housing," he said. "There is always the question of whether you have disentangled the lead from the setting."

Senior author Liu turned to a former Rogan postdoc, child psychiatrist Xianchen Liu, M.D., Ph.D., of Indiana University and Shandong University in China, who in turn invited Rogan to contribute to the data analysis.

"I think Xianchen Liu and I helped frame the question, and provided Jianghong Liu some reassurance that the approach in the analysis would be acceptable to the people interested primarily in lead," explained Rogan.

Rogan is credited with writing one of the few papers that distinguished between a direct effect of lead on behavior, and an indirect effect through lowered IQ. "That was difficult to do in the U.S. data, but a little easier in the Chinese data, because the relative strength of the associations was different," said Rogan.

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(bruskec@niehs.nih.gov)

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