

*Lead tied to criminal behavior
Poisoning damages crucial brain matter, studies find*

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Baltimore Sun

May 28, 2008

Two new studies of young adults who grew up in poor, inner-city neighborhoods in Cincinnati have found that childhood exposure to lead is linked to a significant loss of critical brain matter and to an increased risk of criminal behavior.

Researchers followed hundreds of children from the womb into their 20s and found an average loss of 1.2 percent in the volume of gray matter in the brain by the time they reached adulthood.

That sounds minor, but researchers at the University of Cincinnati said the losses were concentrated in brain regions responsible for critical "executive" functions, such as impulse control, emotional regulation, judgment and the anticipation of consequences. That squares with previous research linking childhood lead exposure to behavioral problems. The research found that the losses were greater - 1.7 percent - among males.

A second study of the same young adults found evidence that such brain damage might also have grave consequences for society. The higher their blood lead concentrations during childhood, the study found, the more likely and the subjects were to be arrested during adulthood, especially for violent offenses. The correlations held even when the data were controlled for such factors as the mother's IQ, education and socioeconomic status.

Taken together, the two studies provide powerful evidence for the potentially devastating consequences of childhood lead exposure, said Ellen K. Silbergeld, professor of health sciences at the Johns Hopkins Bloomberg School of Public Health. Silbergeld has studied Baltimore's similar lead poisoning problem but was not involved in either Cincinnati study.

Because researchers followed the same group into adulthood and controlled for so many other factors, "we have ... a fair degree of confidence that these findings are very likely to be related specifically to lead and are not explainable by other possible exposures these adults could have had," she said.

Silbergeld said the findings also suggest that the Bush administration's recent refusal to lower key lead safety levels to standards recommended by many scientists was inconsistent with the latest research. These two studies "strongly challenge these recent decisions, and in the minds of many of us indicates there was very little scientific justification for these decisions," she said.

Both studies were published yesterday by the online journal [PLoS](#), sponsored by the Public Library of Science, a nonprofit organization founded to provide free and immediate access to peer-reviewed studies.

The first, led by Kim M. Cecil, an imaging scientist at the University of Cincinnati College of Medicine, conducted MRI scans of the brains of 157 people. All had been part of the Cincinnati Lead Study since infancy.

The scans broke each of the participants' brain images into millions of volume elements and compared them to one other. Those data were then compared with blood lead levels measured every three months until the participants were 5 years old, every six months until they were 6 or 7 years old, and several more times during their teen years.

There was strong statistical evidence that those who had the highest lead exposures as children had significantly smaller brain volumes. And the deficits were focused mainly in areas of the brain called the pre-frontal cortex and anterior cingulate cortex, associated with judgment, attention, decision-making, and impulse control.

That "corresponds nicely," Cecil said, with previous epidemiological and psychological studies that have found those kinds of behavioral problems among children exposed to lead.

And because they had a wealth of other data gathered during their subjects' childhood, the researchers were able to sort through potential factors that might explain the brain losses, such as birth weight, smoking, alcohol or drug use by mothers or children as they grew up.

The fact that nearly all of the subjects were black and grew up in inner-city poverty eliminated other socioeconomic variables that might obscure the links between lead and brain loss.

In the second study, researchers led by Kim N. Dietrich, also at the University of Cincinnati College of Medicine, followed the same subjects and measured their blood lead exposure against their arrests at age 18 and older.

Although previous studies have found correlations between lead exposure in urban settings and crime rates, this is the first to measure lead exposure in specific children and track their criminal behavior as adults.

While 45 percent of the subjects had no arrest record, Dietrich's team found that for every increase of 5 micrograms per deciliter in a child's blood lead level, there was a 30 percent increase in arrest rate for violent offenses.

Although children now generally have lower lead exposure than those in the 1980s, when these Cincinnati youths grew up, Dietrich said, "we have seen effects of lead below 5 micrograms [per deciliter]." They include attention deficit disorder, hyperactivity,

and conduct and cognition disorders. The federal "action" standard for medical concern remains 10 micrograms.

The studies provide a warning, he said. "It doesn't take a lot of imagination to suspect that this [level of exposure] will also cause problems and affect conduct later on."

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