Study links low and high levels of manganese to lower IQ scores in children

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Both low and high levels of manganese in blood and hair were associated with lower IQ scores in children living in eastern Ohio, according to new research from the University of Cincinnati (UC).

The study is published in advance online in *Environmental Health Perspectives*, a peer-reviewed journal published with support from the National Institutes of Health's National Institute of Environmental Health Sciences (NIEHS). The corresponding author is Erin Haynes, DrPH, an associate professor in the UC College of Medicine's Department of Environmental Health, Division of Epidemiology.

"These findings suggest that both high and low levels of manganese may impact child neurodevelopment," says Haynes. "That is consistent with a dual role of manganese as a nutrient and a neurotoxicant."

Manganese (symbol Mn) is an element generally found in combination with iron and many minerals. It is used widely in the production of steel, aluminum alloys, batteries and fertilizers and is also added to unleaded gasoline to reduce engine knocking during combustion. It plays a vital role in brain growth and development, but excessive exposure can result in neurotoxicity.

The Communities Actively Researching Exposure Study (CARES) was initiated based on community concern about exposure to manganese from a metallurgical manufacturing company near Marietta, Ohio. A partnership between UC, Marietta College and the community, CARES

has Haynes and Marietta resident Caroline Beidler as co-principal investigators.

"I am thrilled to be part of this scientific team," says Beidler. "It's been a very collaborative process."

Haynes shared findings with the study's stakeholder advisory board this week in Marietta before the findings were released. "It is important that the community partners hear the results of the research before the findings are published," she says.

The study recruited 404 children ages 7-9 from Marietta and Cambridge, Ohio, and their surrounding communities from October 2008 to March 2013. Blood and hair were analyzed for manganese and lead, and serum was analyzed for cotinine, a metabolite of nicotine, which is a component of tobacco.

"Exposures do not occur in isolation," Haynes says, "so we included lead and environmental tobacco smoke because they are well-known neurotoxicants. Including these additional exposures enabled us to determine if the effects were from manganese or from the other exposures that could result in similar effects."

The study team found that the highest quartile of manganese in both hair and blood was associated with lower mean full-scale IQ scores compared with the middle two quartiles. In the lowest quartile of manganese (both hair and blood), mean full-scale IQ was lower than the middle two quartiles but did not reach statistical significance.

Scores for working memory and verbal comprehension were also lower, on average, among children with the lowest and highest values of hair and blood manganese, compared with children in the middle two quartiles of each exposure.

According to Washington County Health Commissioner Richard Wittberg, PhD, "This study is casting light on the health effects associated with manganese exposure, and it appears that there are definite impacts to brains of our children.

"It is my hope that this study continues as we need to know how distance from the emission point is related to the effects we are seeing, how manganese impacts children as they develop into adolescents and the long-term effects on adults who have breathed the air since they were children."

"These findings add to the growing body of evidence suggesting that manganese exposure impacts child intellectual development," Haynes says. "Future studies of manganese exposure should include other neurotoxicants, particularly cotinine and lead, when examining the impacts of manganese exposure in pediatric populations."

More information: "Manganese Exposure and Neurocognitive Outcomes in Rural School-Age Children: The Communities Actively Researching Exposure Study (Ohio, USA)." *Environ Health Perspect*; DOI: 10.1289/ehp.1408993

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