

Toxicological Status of Children with Autism vs. Neurotypical Children and the Association with Autism Severity

James B. Adams · Tapan Audhya · Sharon McDonough-Means ·
Robert A. Rubin · David Quig · Elizabeth Geis · Eva Gehn ·
Melissa Loresto · Jessica Mitchell · Sharon Atwood ·
Suzanne Barnhouse · Wondra Lee

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Abstract This study investigates both the level of toxic metals in children with autism and the possible association of those toxic metals with autism severity. This study involved 55 children with autism ages 5–16 years compared to 44 controls with similar age and gender. The study included measurements of toxic metals in whole blood, red blood cells (RBC), and urine. The autism group had higher levels of lead in RBC (+41 %, $p=0.002$) and higher urinary levels of lead (+74 %, $p=0.02$), thallium (+77 %, $p=0.0001$), tin (+115 %, $p=0.01$), and tungsten (+44 %, $p=0.00005$). However, the autism group had slightly lower levels of cadmium in whole blood (−19 %, $p=0.003$). A stepwise, multiple linear regression analysis found a strong association of levels of toxic metals with variation in the degree of severity of autism for all the severity scales (adjusted R^2 of 0.38–0.47, $p<0.0003$). Cadmium (whole blood) and mercury (whole blood and RBC) were the most consistently

significant variables. Overall, children with autism have higher average levels of several toxic metals, and levels of several toxic metals are strongly associated with variations in the severity of autism for all three of the autism severity scales investigated.

Keywords Autism · Toxic metals · Mercury · Lead · Thallium · Tungsten

Background and Significance

Determination of toxic metal exposure in classic lead poisoning, such as due to ingestion of lead paint, is relatively easy and involves measuring blood levels of lead. However, in autism, the problem appears to usually not be high exposure, but rather decreased excretion. The half-life of lead, mercury, and other toxic metals in the blood is weeks to months, so those metals rapidly leave the blood and accumulate in tissue and/or bone. Since biopsies of those tissues are invasive, this makes assessment of toxic metal exposure in autism more complex.

Many studies suggest that children with autism have a decreased ability to excrete toxic metals, leading to a higher body burden. The decreased ability to excrete toxic metals is partly due to low glutathione [1–4] since glutathione conjugation (and subsequent excretion in the feces) is the primary pathway for removal of some toxic metals. Another factor that also decreases ability to excrete toxic metals in feces is increased use of oral antibiotics [5–8] since oral antibiotics have been shown (in rats) to almost completely inhibit excretion of mercury [9, 10] due to their effect on altering gut flora. This is consistent with two studies which found lower levels of mercury in the baby hair of children with autism, [8, 11], one study which found decreased lead,

J. B. Adams (✉) · E. Geis · E. Gehn · M. Loresto · S. Atwood ·
S. Barnhouse · W. Lee
Arizona State University, PO Box 876106,
Tempe 85287-6006 AZ, USA
e-mail: jim.adams@asu.edu

T. Audhya
Health Diagnostics, South Amboy, NJ, USA

S. McDonough-Means
Integrative Developmental Pediatrics, Tucson, AZ, USA

R. A. Rubin
Department of Mathematics, Whittier College, Whittier, CA, USA

D. Quig
Doctor's Data, St. Charles, IL, USA

J. Mitchell
Southwest College of Naturopathic Medicine, Tempe, AZ, USA