

Impact of Environmental Chemicals on Children's Learning and Behavior

This focus sheet is to inform policy makers, government agencies, and disease prevention programs about the potential contribution of environmental chemicals to children's learning and behavior problems.

Learning and Behavior Problems are Common in Children

Conditions that make it difficult for children to learn, communicate, or behave properly are wide-spread and increasing in the U.S.^{1,2} These conditions include learning disabilities, attention deficit [hyperactivity] disorder (ADD/ADHD), autism spectrum disorders, and intellectual disability.

The burden of these conditions for families and society includes financial costs related to special education, medical treatment, law enforcement, and the social and emotional toll on the children and caregivers.

Risk Factors for Children

Early life experiences are critical in determining whether a child's brain architecture will provide a strong or weak foundation for all future learning, behavior, and health. Prolonged family stress, absence of a stimulating learning environment, and lack of supportive caregivers in early childhood are well known to impede healthy brain development in children.⁴ Other factors such as poor nutrition, fetal exposure to infectious agents, and exposure to toxic chemicals such as lead and mercury can directly impair brain and neurological development in children.^{4,5} Some disorders, such as Down Syndrome, are clearly linked to genetic abnormalities. Other conditions, like autism and ADHD, appear to result from a complex interaction between genes and the environment.⁴

A child's brain and nervous system develop over a long period – from the first trimester in pregnancy through adolescence. At certain times during this development, environmental chemicals can permanently change the architecture and function of the developing brain.⁴ The National Academy of Sciences suggests that generally a small percentage (about 3%) of developmental disorders may be caused solely by a toxic environmental exposure and another 25% results from a combination of genetic and environmental factors.⁷

Cost of Early Life Exposure to Environmental Chemicals

New York researchers estimated the cost of environmental chemical contribution to several childhood learning and behavioral impairments.⁸ They estimated the cost of intellectual disabilities from lead poisoning and prenatal methyl mercury exposure, and the costs of a fraction of autism, ADD/ADHD, and intellectual disability that was reasonably attributable to environmental chemicals. Costs considered were primarily health care costs and lost economic productivity over the child's lifetime. They estimated \$74.3 billion in annual U.S. costs were attributable to environmental chemicals.

Lowered intelligence from early childhood exposure to lead exposure alone was estimated to result in about \$675 million per year in income lost to those affected in Washington State.⁹

Extent of the Problem

Estimates for U.S. children:

- 1 in 13 children have a learning disability.²
- 1 in 12 children have been told by a doctor that they have ADD or ADHD.²
- 1 in 142 have an intellectual disability.¹
- 1 in 88 are diagnosed with an autism spectrum disorder.³

In Washington State in November 2010 more than 75,000 children (1 in every 14 kids) ages 3-21 were receiving special education services through school districts⁶ for:

- Learning disability.
- Emotional or behavioral disability.
- Autism.
- Intellectual disability.
- Developmental delay.

Environmental chemicals that have been associated with impairment of the developing brain are found in consumer products and a child's environment (for example, in air, food, water, house dust, and soil).

Environmental chemicals *known* to interfere with normal brain development¹⁰ include:

- Lead.
- Methyl mercury.
- Tobacco smoke (contains multiple chemicals).
- Polychlorinated biphenyls (PCBS).
- Manganese.
- Organophosphate insecticides.

Environmental chemicals *suspected* to interfere with normal brain development⁶ include:

- Arsenic.
- Bisphenol A.
- Polybrominated diphenyl ethers (PBDEs).
- Phthalates.

Summary

Inability to learn, communicate, and relate positively to others creates a huge burden on children, their families, our school system, and all of society. Prevention efforts that reduce neurotoxic chemicals in the environment and consumer products will help protect children from harm and conserve our health care and educational resources.

For More Information

- Early Exposure to Toxic Substance Damages Brain Architecture, National Scientific Council on the Developing Child, Harvard University, 2006: http://developingchild.harvard.edu/index.php/resources/reports_and_working_papers/working_papers/wp4/
- Autism, Washington State Department of Health: www.doh.wa.gov/YouandYourFamily/IllnessandDisease/Autism.aspx
- Lead Poisoning, Washington State Department of Health: www.doh.wa.gov/YouandYourFamily/IllnessandDisease/LeadPoisoning.aspx
- Attention-Deficit / Hyperactivity Disorder (ADHD), CDC: www.cdc.gov/ncbddd/adhd/facts.html

References

- ¹Boyle, C. et al. (2011) Trends in the Prevalence of Developmental Disabilities in U.S. Children, 1997-2008. *Pediatrics* 127 (6):1034-42.
- ²CDC. Summary of Health Statistics for U.S. Children: National Health Interview Survey, 2010. *Vital Health Statistics Series 10*, No 250. December 2011.
- ³Baio, Jon et al. (2012) Prevalence of Autism Spectrum Disorders — Autism and Developmental Disabilities Monitoring Network, 14 Sites, United States, 2008. *MMWR* March 30, 2012 / 61(SS03);1-19.
- ⁴Center on Developing Child, Harvard University. A Science-Based Framework for Early Childhood Policy. 2007 http://developingchild.harvard.edu/resources/reports_and_working_papers/policy_framework/
- ⁵American Academy of Pediatrics. *Pediatric Environmental Health*, 3rd Ed, 2012.
- ⁶State of Washington Superintendent of Public Instruction, Special Education. *Individuals with Disabilities Education Act (IDEA) Part B, November 2010 child count report*.
- ⁷National Academies of Science, National Research Council. *Scientific Frontiers in Developmental Toxicology and Risk Assessment*. ISBN 978-0-309-07086-7.
- ⁸Trasande, L. and Y. Liu (2011) Reducing the staggering costs of environmental disease in children, estimated at \$76.6 billion in 2008. *Health Affairs* 30 (5):1-8.
- ⁹Washington State Departments of Ecology and Health. *State Lead Chemical Action Plan: Appendix E – Income Effects from Reduced IQ. Sept 2009.* <http://www.ecy.wa.gov/biblio/0907008e.html>
- ¹⁰Amir Miodovnik (2011) Environmental neurotoxicants and Developing brain. *Mt Sinai J Med* 78:58-77.

Primary Learning and Behavioral Problems

Learning disability describes children with enough difficulty reading, writing or learning math that it significantly interferes with school achievement. Children with learning disabilities may excel in certain areas while they struggle with others.

Attention Deficit [Hyperactivity] Disorder (ADD/ADHD) refers to a persistent pattern of being inattentive and easily distracted. It can manifest with or without impulsivity and hyperactivity. (AAP 2012) Nearly 60% of children with ADD/ADHD also have another developmental disability, most frequently a learning disability.

Children with **Autism Spectrum Disorders (ASD)** have difficulty communicating, interacting, and behaving well with other people. Impairment can be from severe to mild. Like many other developmental disabilities, boys are more likely to be diagnosed with autism. The rate of diagnoses has increased 4-fold in the last decade. It is not known whether this represents improved discovery of autistic children for early intervention or an actual increase in the condition.

Intellectual disability (formerly called mental retardation) is marked by limited intellectual function and adaptive behavior. Children with intellectual disability may have impaired reasoning, literacy, social skills, and practical life skills. Historically it described children with an IQ of 70 or below.