



“The dangers of lead to the human brain became increasingly clear in the 1970s, leading to federal legislation restricting its use in gasoline and paint. Exposure of children to lead can be at many levels. Lead passes through the placenta during pregnancy and through mother’s milk during nursing. Children are especially vulnerable because of their small size and increasing possibility of exposure from dust or paint chips. The consequences of exposure include learning disabilities, mental retardation, decreased growth, ADHD and behavioral disorders.

Despite these federal restrictions, lead can still be found in peeling leaded paint chips and dust in pre-1980 buildings, in drinking water through plumbing systems, and in many other sources, such as toys, jewelry and lunchboxes, discussed in this review. Children, especially those in urban areas and among lower socioeconomic groups, are at greatest risk. But any child anywhere can be exposed.

Do your part to minimize exposure of your child to lead. This article will provide the information you need to do this as well as offer resources to go to for greater details.”

- Larry B. Silver, MD

## What is lead?

Lead is a metal found naturally in the earth’s crust. In nature, it is found more often in chemical compounds than as a pure metal. When released into the air, it may travel long distances before settling to the ground, where it can contaminate water and soil.<sup>1</sup>

Lead has been used extensively throughout human history because it is easy both to extract and to work with. Since the time of the Roman Empire, lead has been used in everything from building materials and cosmetics to pots and pans and coloring agents for food. In 1921, General Motors pioneered the addition of lead to gasoline to make cars run more efficiently.<sup>2</sup> Even though adverse health effects

began to be noticed soon after, the United States did not begin to phase out the use of lead in gasoline until 1980. Since 1996, its use as a fuel additive has been banned.

The use of lead in paints, ceramics and pipe solder has also been reduced because of health concerns. It was banned in house paint, on products marketed to children and in dishes or cookware made in the United States in 1978.<sup>3</sup> Unfortunately, lead may still be found in items manufactured outside the US, as seen in recent toys recalls. Even within the US, lead is still used in the manufacturing of products such as batteries, ammunition, devices that provide protection from X-rays<sup>1</sup> and plastics.<sup>3</sup>

## How does lead affect children’s health?

Lead can affect almost every organ and system in your body, but the main target for lead toxicity is the nervous system. High levels of lead in children can lead to anemia, stomach and kidney problems, muscle weakness, brain damage and ultimately death. Even very low levels of exposure can affect a child’s mental and physical growth.<sup>1</sup> Recent studies have linked elevated blood-lead

levels in children with reduced intelligence, slowed mental development,<sup>4</sup> attention deficit hyperactivity disorder,<sup>5</sup> increased risk for delinquency and criminal behavior,<sup>6</sup> heightened risk of obesity<sup>7</sup> and delayed onset of puberty.<sup>8</sup>

The effects of lead poisoning can vary greatly, depending on the age of the person exposed and the amount of the metal they

are exposed to. Children are more vulnerable to lead poisoning than adults for two reasons: they are more likely to be exposed to dangerous quantities of lead, and their bodies are not as well-equipped as those of adults to rid themselves of this toxic. Children can absorb a higher percentage of the

lead that is swallowed (40 to 50 percent as compared to three to 10 percent in adults), so similar exposure levels for a parent and child may lead to drastically different blood lead levels.<sup>4</sup> As yet, there has been no measurable blood-lead level considered safe for children.<sup>4,9</sup>

## How can children be exposed to lead?

The most common source of lead exposure for children is **lead-based paint** that has deteriorated into paint chips and lead dusts.<sup>4</sup> Houses built before 1978 most likely have been painted with lead-based paint. Paint flakes or chips, or paint dust created during scraping or renovating painted surfaces, can be swallowed or inhaled by children. A single paint chip the size of a staple can have enough lead to bring a child's blood-lead level above 10 micrograms per deciliter ( $\mu\text{g}/\text{dL}$ ) – the level at which medical action is recommended by the CDC. Lead has also been found in **painted toys** that are manufactured outside the US and in metal charms and other **children's jewelry**.

**Plastic toys, bibs, lunchboxes, miniblinds and other vinyl objects** may have lead added to stabilize the plastic or to make it more flexible. Lead is obviously a hazard in objects that children suck on or put in their mouths, but in some cases, such as in vinyl miniblinds, the plastic deteriorates from exposure to sunlight and heat to form lead dust on the surface of the object.<sup>10</sup> Children who touch the dust and then put their fingers in their mouths can be exposed to lead.

Plumbing systems which were constructed with **lead pipes or solder** can also expose children to lead through water. In houses where the plumbing system has lead components, the first flush of water which has been sitting in the pipes overnight may have a particularly high concentration of lead.<sup>1</sup>

**Soil** can be a significant source of lead exposure for children who live or spend their time in buildings or playgrounds that were near heavy traffic when lead was added to gasoline.<sup>11</sup> Children can swallow lead from the soil when eating or putting dirty fingers or toys into their mouths. Soil lead can also be carried indoors on shoes, clothes and toys from

outdoors or as dust through open windows. Lead may be brought into the house through various **hobbies** such as soldering glass or metal, making bullets or glazing pottery.<sup>2</sup>

Lead contaminates some imported **candy**, especially from Mexico.<sup>12</sup> Lead has also been found in some **traditional (folk) medicines** used by East Indian, Indian, Middle Eastern, West Asian and Hispanic cultures. Lead and other heavy metals may be intentionally put into certain folk medicines to treat some ailments, especially arthritis, infertility, upset stomach, menstrual cramps and colic. There is no way to tell by looking or tasting if a medicine contains lead, and the person who sold the medicine may not know whether lead was used in the manufacture. The only way to know if a medicine has lead is to have it tested in a laboratory.<sup>13</sup>

Lead may be found in a few **cosmetics** such as kohl. Some of the red lipsticks manufactured in the United States contain high levels of lead, according to recent product tests conducted in several cities in the US.<sup>14</sup> Lead acetate is also used as a color additive in "progressive" hair dye products.<sup>15</sup>

Lead can accumulate in the bones and teeth of individuals who are exposed. Women who have been exposed to lead at any time may have enough lead in their bones and teeth to be toxic to their children. During pregnancy, calcium from the mother provides materials for the child's developing bones. If the mother does not have a sufficient supply of calcium in her diet, her own bones and teeth may be resorbed to provide calcium. If the **mother's bones and teeth** contain lead, this toxic material may also be mobilized from her bones and circulated to the developing child.<sup>16</sup>

## What can you do to reduce your child's risk?

**Diet.** Studies have shown that children who consume a healthful and balanced diet full of vitamins and minerals, particularly calcium and iron, absorb less lead than those with an unhealthy diet.<sup>17</sup> Good sources of these minerals are spinach, broccoli, raisins, beans and low-fat dairy products. Also help yourself or women you know get an ample supply of calcium and iron, especially during pregnancy and breastfeeding.

**Toys and other products.** Check for recalls of toys and other items that have been found to contain lead. See the Consumer Product Safety Commission website: [www.cpsc.gov/](http://www.cpsc.gov/). Carefully consider whether to purchase imported or domestically manufactured toys, jewelry, lunchboxes, candy, ceramics, lipstick and other items that may contain lead.

**Hand washing.** If you work in a profession that brings you in contact with lead, wash your hands thoroughly after working, and remove work clothes and shoes and keep them away from children.

**Cleaning.** Damp-mop floors, damp-wipe surfaces and frequently wash a child's hands, pacifiers and toys to reduce exposure to lead. Have everyone remove shoes when in the house to prevent the transfer of lead from soil onto floors and carpets.

**Drinking water.** Use only cold water from the tap for drinking, for cooking and for making baby formula. Hot tap water is more likely to contain higher levels of lead. If you suspect that your plumbing system contains lead solder or pipes, run water taps for 30 seconds in the morning before drawing water for drinking or cooking. Carbon water filters are also effective in removing lead.

**Testing for lead in your home.** If your home was built before 1978, keep the paint in good repair so that you minimize the amount of paint chips or dust. Do not attempt to rid your home of lead paint on your own, but contact a professional if you want to remove lead paint or renovate in a way that may create paint chips or dust. Also consider having your home tested for lead. The National Lead Information Center can recommend laboratories equipped to test paint, dust and water samples (see [www.epa.gov/lead/pubs/nlic.htm](http://www.epa.gov/lead/pubs/nlic.htm)).

**Testing for lead in your child.** If you suspect lead poisoning in your child, your doctor can test blood levels. Children are considered to have an elevated blood-lead level at 10 µg/dL or higher, though scientists at the EPA and CDC agree now that there is actually no safe level of exposure to lead.<sup>9</sup>

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For more information or for other Practice Prevention columns, visit the Institute for Children's Environmental Health (ICEH) online at [www.iceh.org/resources.html](http://www.iceh.org/resources.html) or call 360-331-7904.



ICEH serves as the national coordinator for the Collaborative on Health and the Environment's Learning and Developmental Disabilities Initiative.



**Footnoted resources**

1. Agency for Toxic Substances and Disease Registry. Lead ToxFAQs sheet. August 2007. [www.atsdr.cdc.gov/tfacts13.html](http://www.atsdr.cdc.gov/tfacts13.html), viewed November 14, 2007.
2. Lewis J. Lead poisoning: a historical perspective. *EPA Journal*, May 1985. [www.epa.gov/history/topics/perspect/lead.htm](http://www.epa.gov/history/topics/perspect/lead.htm), viewed February 1, 2007.
3. US Centers for Disease Control and Prevention. Toys and childhood lead exposure. [www.cdc.gov/nceh/lead/faq/toys.htm](http://www.cdc.gov/nceh/lead/faq/toys.htm), viewed November 15, 2007.
4. Agency for Toxic Substances and Disease Registry. Toxicological profile for lead. September 2005. [www.atsdr.cdc.gov/toxprofiles/tp13.html](http://www.atsdr.cdc.gov/toxprofiles/tp13.html), viewed November 15, 2007.
5. Braun J, Kahn R, Troehlich T, Auinger P, Lanphear B. Exposures to environmental toxicants and attention deficit hyperactivity disorder in US children. *Environmental Health Perspectives*. 2006; 114(12): 1904-1909.
6. Needleman H, Reiss J, Tobin M, Biesecker G, Greenhouse J. Bone lead levels and delinquent behavior. *Journal of the American Medical Association*. 1996; 275(5): 363-369.
7. Kim R, Hu H, Rotnitzky A, Bellinger D, Needleman H. A longitudinal study of chronic lead exposure and physical growth in Boston children. *Environmental Health Perspectives*. 1995; 103(10): 952-957.
8. Selevan S, Rice D, Hogan K, Euling S, Pfahles-Hutchens A, Besthel J. Blood lead concentration and delayed puberty in girls. *New England Journal of Medicine*. 2003; 348(16): 1527- 1536.
9. US Centers for Disease Control and Prevention. Lead: questions and answers. [www.cdc.gov/lead/qanda.htm](http://www.cdc.gov/lead/qanda.htm), viewed November 15, 2007.
10. US Consumer Product Safety Commission. CPSC finds lead poisoning hazard for young children in imported vinyl miniblinds. June 25, 1996. [www.cpsc.gov/cpsc/pub/prerel/prhtml96/96150.html](http://www.cpsc.gov/cpsc/pub/prerel/prhtml96/96150.html), viewed November 15, 2007.
11. Mielke HW, Reagan PL. Soil is an important pathway of human lead exposure. *Environmental Health Perspectives*. 1998; 106(Supplement 1): 217-229.
12. US Centers for Disease Control and Prevention. Candy and childhood lead exposure. August 15, 2007. [www.cdc.gov/nceh/lead/faq/candy.htm](http://www.cdc.gov/nceh/lead/faq/candy.htm), viewed November 15, 2007.
13. US Centers for Disease Control and Prevention. Folk medicine and childhood lead exposure. August 15, 2007. [www.cdc.gov/nceh/lead/faq/folk%20meds.htm](http://www.cdc.gov/nceh/lead/faq/folk%20meds.htm), viewed November 14, 2007.
14. Environment News Service. Red lipstick spreads the lead. October 15, 2007. [www.ens-newswire.com/ens/oct2007/2007-10-15-04.asp](http://www.ens-newswire.com/ens/oct2007/2007-10-15-04.asp), viewed November 15, 2007.
15. US Food and Drug Administration Center for Food Safety and Applied Nutrition. Lead acetate in hair dye products. January 9, 2002. <http://vm.cfsan.fda.gov/~dms/cos-lead.html>, viewed November 15, 2007.
16. Silbergeld EK. Lead in bone: implications for toxicology during pregnancy and lactation. *Environmental Health Perspectives*. 1991; Feb;91:63-70.
17. National Safety Council. Lead Poisoning and Nutrition. February 19, 2004. [www.nsc.org/issues/lead/leadnutrition.htm](http://www.nsc.org/issues/lead/leadnutrition.htm), viewed November 15, 2007.