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Melissa Bianchi
Otterbein University, melissa.bianchi@otterbein.edu

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Neurological, Nutritional and Cognitive Effects of Environmental Lead Exposure in Infants and Children

Melissa Bianchi, RN, CLC
Otterbein University, Westerville, Ohio

Signs, Symptoms and Risk Factors

Lead is known to have acute and chronic effects including loss of appetite, convulsion, abdominal colic, decreased I.Q., behavioral problems (moodiness, hyperactivity or disinhibited behavior), irritability, anorexia, constipation, digestive problems and encephalopathy. Children under three years of age are particularly vulnerable to lead's neurotoxic effects, due to their developing nervous system. (Schmidt & John, 2014, p. 20).

Children are more likely to have elevated lead levels as compared to adults for several reasons. Children have increased hand-to-mouth behaviors; lead exposure from paint, which is commonly found in household dust, leads to greater neurotoxicity, increased lead absorption and concomitant iron deficiency anemia. (Bennett, Lewis, & Estes, 2015, p. 119). As compared to the adult population, the role of lead in the child's development is more pronounced.

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Lead absorption is dependent on several factors, including the physical form of lead, particle size ingested, gastrointestinal transit time and the nutritional status of the person ingesting the lead. Lead is absorbed in the presence of iron, zinc and calcium deficiency as well as malnutrition, high-fat intake and calcium deficient diets (Binggeli, Huff, Brown, & O'Malley, 2015, p. 1). Lead absorption is decreased if phosphorus, riboflavin, vitamin C and vitamin E are in the diet.

Absorbed lead is excreted primarily among blood, soft tissue, including the liver, kidneys, lungs, brain, spleen, muscles and bone, and excretes in tissues such as bones and teeth. In the blood, lead is primarily found within the red blood cells. Lead is distributed throughout the body and made available to other tissues via the blood supply. Lead has an effect on bone homeostasis, causing anemia at high blood levels. Lower levels of lead in the system cause microcytosis (i.e. decreased mean corpuscular volume or hematocrit) and a compensatory increase in the number of red blood cells. Lead irreversibly binds to the amino terminal portion of the erythrocyte protein... (Bennett et al., 2015, p. 120). The enzymes delta-aminolevulinic acid dehydratase, which catalyzes the formation of iron... (Bennett et al., 2015, p. 120).

Lead's impact on the auditory nervous system may contribute to the learning delays seen in children with elevated lead levels. Saliba and colleagues have noted that pediatric audiologic processing could have profound effects on learning. Knowledge of lead's detrimental effects on the hearing process may trigger a clinician to refer for a referral for evaluation in a child with a confirmed elevated lead level. Lead's inhibition of ferrochelatase and delta-aminolevulinic acid dehydratase in the blood leads to a decrease in the generation of heme, which results in a decreased ability of the blood to deliver oxygen to vital tissues and organs (Bennett et al., 2013). Decreases in heme adversely affect fat metabolism and increased cognitive activities (Bennett et al., 2015, p. 120).

More than 99% of blood lead accumulates in erythrocytes. Iron deposition in the kidney is found in pathologic renal disease (Schmidt & John, 2014, p. 238). Lead absorption is increased in persons with iron deficiency anemia and the degree of anemia, as compared to healthy persons, is correlated with increased lead absorption. (Bennett et al., 2015, p. 120). Decreases in heme adversely affect fat metabolism and increased cognitive activities (Bennett et al., 2015, p. 120).

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Nursing Implications

• Screen all children for lead exposure assessment
• Dietician referral if needed
• Lead source education
• Risks of lead exposure
• Provide referrals to State agency/health Deps.

Additional Sources

