

# Birth Defect Research for Children, Inc.

## Fact Sheet

### Lead

**What is it?** Lead (Pb) is a soft, malleable blue gray heavy metal that tarnishes in air. It occurs in the environment as many organic and inorganic compounds in addition to the metallic form

**What is it used for?** Much of the inorganic lead found in the environment originated from the combustion of fuels that contain organic lead additives. Some inorganic lead salts are also commonly used as pigments in paints. Although lead in residential paints has been restricted since 1973, it is still allowed at much higher levels in industrial paints. The greatest use of metallic lead is storage batteries. Metallic lead is also found in lead solders, pipes, construction materials, dyes and wood preservatives.

**Adverse human health effects:** Lead toxicity is cumulative and irreversible. The major targets for lead toxicity are the peripheral nervous system and the central nervous system (more commonly in children), the gastrointestinal tract, and the kidneys. Total adult intake from environmental sources is estimated to be 0.1 to > 2mg per day, with the primary source being food and beverages. In 1993, the National Research Council (NRC) stated that there is no safe level of lead in the body. Even very small exposures to lead can produce subtle effects in humans. Maternal lead exposure may also result in a newborn with growth retardation and neurologic deficits.

**Acute effects:** Lead most commonly affects the CNS leading to acute lead encephalopathy, a degenerative brain disease causing failure of muscle coordination. This typically occurs in children manifesting as symptoms such as ataxia, coma and convulsions. Usually, these symptoms are a result of repeated exposures and the blood level lead level (Pbd) is greater than 90 mg/dL. In acute lead encephalopathy, neurological damage can be persistent if patient is not treated until after CNS effects are apparent. Permanent effects in children exposed to lead include mental retardation and hyperactivity. Both animal and human studies indicate that lead can readily

cross the placenta to the fetus. Human data have identified this transfer as early as the 12<sup>th</sup> week of gestation. Also lead exposure may result in elevated levels in breast milk.

**Chronic effects:** Although chronic lead poisoning is often difficult to diagnose in adults and symptoms are often not present at blood lead levels less than 40 mcg/dL, the triad of gout, hypertension, and chronic progressive kidney failure is commonly present in chronic adult lead poisoning. The earliest signs of chronic lead poisoning are effects on the blood forming system. Persons with higher blood lead levels have decreased levels of erythropoietin, a hormone which plays a role in regulation the production of RBC hence resulting in decreased levels of heme and hemoglobin causing anemia. Other signs of chronic lead poisoning include fatigue, disrupted sleep, headache, bone and muscle aches, digestive problems, cramping abdominal pain (lead colic), decreased appetite, Burton's Lines (dark blue lines of lead sulfide in the gums), and subtle impairments of visual and intellectual function.

**Reproductive Effects:** Lead can effect reproduction in males and females, and affects neuro-developmental milestones in children with both prenatal and postnatal exposures. In males, high levels of lead exposure can cause sperm abnormalities. The abnormalities include abnormal sperm forms, decreased mobility, and even absence of sperm. Some studies have reported a significant increase in spontaneous abortion and birth defects when the father was exposed to lead during sperm formation. The risk was further increased if the fathers drank 10 alcoholic drinks per week. Parental lead exposure was associated with an 8.6 fold elevated risk of pre-term delivery, and with a 2.4 fold perinatal death rate, and a 5 fold rate of low birth weight. For more than a 100 years, lead has been known to affect female reproduction. Lead-exposed women have an increased risk of spontaneous abortions, premature births, stunted and abnormal infants, and stillbirths. Studies suggest that prenatal lead exposure may affect postnatal mental development. The greatest effects are seen in fine motor function, visually directed reaching, and social responsiveness. Therefore, in addition to developmental effects of lead exposure, exposure to low levels of lead can negatively impact children's intellectual ability and social adjustment. Based on recent studies, lead is in class A+ for reproductive hazard: human reproductive hazard with no known no-dose effect.

**Carcinogenic Effects:** A study that monitored blood levels of 20,700 workers between the years of 1973 and 1983, concluded that there was a 1.4 fold increased in incidence of all cancers, and a 1.8 fold increase in lung cancers among those who had blood lead of at least 1 mcmol/L. The odds ratio increased for those also exposed to engine exhaust.

**Genetic Effects:** Lead genetic toxicity is difficult to generalize due to the varying characteristics of the wide range of organic and inorganic lead salts. Metallic lead insolubility, for instance, precluded its examination in short-term in vitro genetic assays. Exposure to lead has been reported to cause chromosome aberrations in humans, rats and monkeys.

#### **New Research:**

- According to Dr. Herbert L. Needleman, professor of child psychiatry and pediatrics, at the University of Pittsburgh, Pennsylvania, lead exposure is a significant cause of juvenile delinquency. Needleman's study examined 201 non-delinquent controls from public schools in Pittsburgh, Pennsylvania, and 216 youths convicted in the Juvenile Court of Allegheny County, Pa. Bone lead levels, showed that the delinquent youths had significantly higher mean concentrations of lead in their bones compared to the control group. Those results were true for both whites and African Americans.
- A University of Michigan School of Public health study of candles shows that some candles on the market today, are made with wicks that have either lead cores that emit potentially dangerous levels of lead into the air. Dr. Nriagu, professor of environmental health sciences, examined lead emission from 15 different brands of candles made in the United States, Mexico and China. He concluded that after five hours, these candles emitted unsafe levels of lead into the air that measured an estimated 0.21 to 65.3 micrograms per cubic meter.
- Dr. John Bound, of the Department Of Pediatrics at the Victoria Hospital in Blackpool, England, conducted a study with women in four different districts in the Northwest of England. The study found that women living in communities in which many homes had more than 10 micrograms of lead per liter of drinking water were more likely to have a child with neural

tube defects. Overall, the risk of such birth defects increased 25% for every 10% increase in lead level above 10 mcg/L.

### **Resources**

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