

Chronic Lead Poisoning Problems – A literature review

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Abstract

Poisoning due to lead occurs mainly by ingestion of food or water contaminated with lead. However accidental ingestion of contaminated soil, dust or lead based paint may also result in poisoning. Lead is thought to be quickly absorbed in the blood stream and is believed to have adverse effects on certain organ systems like the central nervous system, the cardiovascular system, kidneys, and the immune system.

Lead is a common environmental pollutant. Exposure to lead occurs mainly at occupational sites, production of lead-acid batteries or pipes, metal recycling and foundries.

In cases of chronic exposure, lead often sequesters in the highest concentrations first in the bones then in the kidneys. According to the US Centre for Disease Control and Prevention and the World Health Organization, a blood lead level of 10 µg/dL or above is a cause for concern. However there is no threshold value below which lead

exposure can be considered safe. It has been found to impair development and have harmful effects even at lower levels.

Organic lead poisoning is now very rare around the world because of withdrawal of organic lead compounds as gasoline additives. Nevertheless, such compounds are still used in industrial settings. Organic lead compounds cross the skin and respiratory tract easily and quickly, affecting predominantly the central nervous system.

Pregnant women who have elevated blood lead levels are at a risk of premature birth or of babies with a low birth weight. The foetus may be adversely affected at blood lead concentrations well below 25 µg per deciliter.

Key Word. *Saturnism, PB, Chronic poisoning with Lead.*

Background

Lead poisoning, also known as 'saturnism', is a type of metal poisoning caused by lead in the body. The brain is the most sensitive. Symptoms may include abdominal pain, constipation, headaches, irritability, memory problems, infertility, and tingling in the hands and feet. It causes almost 10% of intellectual disability of otherwise unknown cause and can result in behavioral problems. Some of the effects are permanent. In severe cases, anemia, seizures, coma, or death may occur.

Chronic Overexposure Effects - Chronic overexposure to lead may result in severe damage to blood-forming, nervous, kidney and reproductive systems. Some common symptoms of chronic overexposure include loss of appetite, metallic taste in the mouth, anxiety, constipation and nausea.

Unfortunately, there is no cure and exposure cannot be fixed. But the effects can be reduced by removing the lead source, getting early intervention, and eating a diet high in iron and calcium. If lead levels are very high, x-ray or chelation therapy may help to remove some of the lead out of the blood.

Causes of Poisoning with Lead (Pb)

- Water, mainly due to older lead tubes and use of lead connector.
 - Soil contaminated with lead or benzene paint, perishable lead paint, leaded gasoline residues, used engine oil, tire weight or past pesticides, contaminated landfills or industries close as foundries
 - Exposure of the profession to mines, smelters or production facilities involving lead
 - Imported ceramics and ceramics used for dinner

- Lead crystal is used for decanted liquids or for food storage
- Ayurvedic and folk remedies, some of which contain lead for “curative” benefits and others which are contaminated during production
- Imported toys, cosmetics, candy and household products produced in countries without lead restrictions
- Paints and varnishes for paintings
- Industry of production of bullets and fuses
- Lead-contaminated opium

Lead poisoning occurs especially when inhaled vapors or lead-containing powders, for example, during the processing of lead-based paints. But lead can also enter the body through contact skin or food. For example, lead-containing ointments used in beauty care can cause lead poisoning (1, 2).

Periodic Table of the Elements www.elementdatabase.com

1 Hydrogen

2 Helium

3 Lithium

4 Beryllium

5 Boron

6 Carbon

7 Nitrogen

8 Oxygen

9 Fluorine

10 Neon

11 Sodium

12 Magnesium

13 Aluminum

14 Silicon

15 Phosphorus

16 Sulfur

17 Chlorine

18 Argon

19 Potassium

20 Calcium

21 Scandium

22 Titanium

23 Vanadium

24 Chromium

25 Manganese

26 Iron

27 Cobalt

28 Nickel

29 Copper

30 Zinc

31 Gallium

32 Germanium

33 Arsenic

34 Selenium

35 Bromine

36 Krypton

37 Rubidium

38 Strontium

39 Yttrium

40 Zirconium

41 Niobium

42 Molybdenum

43 Technetium

44 Ruthenium

45 Rhodium

46 Palladium

47 Silver

48 Cadmium

49 Indium

50 Tin

51 Antimony

52 Tellurium

53 Iodine

54 Xenon

55 Cesium

56 Barium

57 Lanthanum

58 Cerium

59 Praseodymium

60 Neodymium

61 Promethium

62 Samarium

63 Europium

64 Gadolinium

65 Terbium

66 Dysprosium

67 Holmium

68 Erbium

69 Thulium

70 Ytterbium

71 Lutetium

72 Hafnium

73 Tantalum

74 Tungsten

75 Rhenium

76 Osmium

77 Iridium

78 Platinum

79 Gold

80 Mercury

81 Thallium

82 Lead

83 Bismuth

84 Polonium

85 Astatine

86 Radon

87 Francium

88 Radium

89 Actinium

90 Thorium

91 Protactinium

92 Uranium

93 Neptunium

94 Plutonium

95 Americium

96 Curium

97 Berkelium

98 Californium

99 Einsteinium

100 Fermium

101 Mendelevium

102 Nobelium

103 Lawrencium

Legend:

- Hydrogen
- alkali metals
- alkali earth metals
- transition metals
- post-transition metals
- nonmetals
- noble gases
- halogens
- metalloids

Physio-Pathology of the spread of Pb in the body

Organic lead poisoning is now very rare, because countries across the world have phased out the use of organic lead compounds as gasoline additives, but such compounds are still used in industrial settings. Organic lead compounds, which cross the skin and respiratory tract easily, affect the central nervous system predominantly.

Exposure occurs through inhalation, ingestion or occasionally skin contact.

Lead may be taken in through direct contact with mouth, nose, and eyes (mucous membranes), and through breaks in the skin. Tetraethyllead, which was a gasoline additive and is still used in aviation gasoline, passes through the skin; however inorganic lead found in paint, food, and most lead-containing consumer products is only minimally absorbed through the skin. The main sources of absorption of inorganic lead are from ingestion and inhalation. In adults, about 35–40% of inhaled lead dust is deposited in the lungs, and about 95% of that goes into the bloodstream. Of ingested inorganic lead, about 15% is absorbed, but this percentage is higher in children, pregnant women, and people with deficiencies of calcium, zinc, or iron. Infants may absorb about 50% of ingested lead, but little is known about absorption rates in children.

Chronic lead poisoning in adults occurs when an amount of lead of about 500 nanograms or more is swallowed. 95% of the lead that enters the blood is bound to erythrocytes (red blood cells) and proteins in the blood.

- Lead then travels through the bloodstream to organs such as the brain, liver and lungs, where it has a half-life of 20 days.
- While some bullets are secreted, some are also deposited in teeth and bones. There, the half-life is 5 to 20 years.
- If the bone substance is degraded to a greater extent, the level of lead in the blood can increase even without the new lead being supplied from outside the body.
- Because lead also crosses the placenta, lead poisoning can be passed from mother to unborn child ([https://mjekesor.com/pulmon- poisoning-causes-treatment-of-symptoms/](https://mjekesor.com/pulmon-poisoning-causes-treatment-of-symptoms/)).
- Lead can also enter the body through contact skin or food. Exposure occurs through various routes such as absorption, ingestion or skin contact
- Human exposure to lead occurs in lead-related professions, from gasoline, ceramics, shipbuilding, lead-based painting, battery recycling, metal recycling, and book printing, to name a few.
- One of the main causes for lead pathology is that it interferes with the activity of an essential enzyme called delta-amino levulinic acid dehydratase, or ALAD (see image of enzyme structure), which is important in heme biosynthesis cofactor found in hemoglobin. Lead also inhibits the enzyme ferro chelatase, another enzyme involved in heme formation (3).

How humans are exposed to chemicals in the environment and their effect on human health

Acute lead poisoning occurs only when very large amounts of lead or lead components are ingested once. In adults, for example, a Dose of 5 to 30 grams of lead salt lead acetate, which is easily soluble in water, has a lethal effect.

K Chronic poisoning in contrast, daily intake of 1 microgram, e.g. through food, after a longer period of time.

Health world organization estimates risk-free daily oral intake of an average of about 100 to 500 micrograms.

Pharmaceutical companies give the maximum daily dose of Pb up to 1.0 $\mu\text{g} / \text{g}$, but prolonged daily intake with this dose is dangerous for humans (4).

- Various organs of the human body are affected by lead poisoning as SNQ, Bone marrow where blood is formed, Gastro-intestinal tract, Gonads (testicles and ovaries), Skin, Kidneys.
- Long-term exposure can lead to problems with mental and physical development, and in severe cases can result in coma or death.



Pb intoxication in children

In children as well as adults, the nervous system is most exposed to lead toxicity. Children up to the age of six are, however, particularly vulnerable to lead poisoning because of their rapid rate of growth and development (6).

- Developmental delays
- Learning disabilities cause behavioral problems
- Abdominal pain
- Loss of Appetite
- Laziness or fatigue - children who look like Lazy.
- Pica- is an eating disorder in which people eat things that have no nutritional value like paint or plaster, and 'Pb intoxication'.
- Anemia
- SNC - Encephalopathy and coma
- Along with bones, teeth, and blood, many other tissues store lead, such as the brain, spleen, kidneys, liver, and lungs (7).

Women who were exposed to lead before or during pregnancy have it stored in their bones. According to the World Health Organization (WHO), during pregnancy, lead is restored to the bloodstream, exposing the fetus to premature birth or a low birth weight (<https://sq.thomson-intermedia.com/10-symptoms-of-lead-poisoning-in-children-2058>).

Symptoms of Acute and Chronic Poisoning

Symptoms of lead poisoning are often subtle and difficult to identify. In some people, there may be no symptoms. Most often seen:

- Irritability. Fatigue
- Headache
- Loss of concentration
- Short-term memory deficit
- Dizziness and loss of coordination.
- Unusual taste in the mouth
- A blue line along the gum (known as the Burton line)
- Tingling or numbness (neuropathy)
- Abdominal pain
- Decreased appetite

- Nausea and vomiting
- Diarrhea or constipation e Clumsy speech

Occupational exposure to lead increases the risk of cardiovascular disease, in particular: stroke and high blood pressure (8, 9).

Symptoms in Children

Children who have lead poisoning may have poor appetite and may lose weight. They may also have stomach pain, constipation and vomiting. In addition, they can be very tired and nervous.

Caregivers may notice that the child is very pale, which occurs as a result of anemia. Children with lead poisoning may also experience learning difficulties.

Symptoms in Adults

Adults exposed to too much lead may experience headaches, memory loss, mood swings, stomach aches and fatigue. They may also have tingling, numbness, or pain in the hands and feet. Men may have a lower than normal sperm count and the sperm may be abnormal. Women exposed to too much lead while pregnant may experience a miscarriage or premature birth.

Acute lead poisoning is characterized by:

- Headaches, limb pain, severe abdominal pain, and silence. In severe cases, coma and circulatory failure can occur with death. Spastic ileus (intestinal obstruction) is also possible.

Acute lead poisoning can be treated with gastric lavage. However, chronic lead poisoning is more insidious (10).

- Long-term lead contamination can lead to a variety of symptoms. Since heavy metal has an inhibitory effect on blood formation, so-called lead anemia develops in chronic lead poisoning. Like all forms of anemia, this leads to fatigue and reduced physical and mental performance.
- A layer of gray-gray to black lead sulfur is deposited in the gums. the cardiovascular system is damaged due to vasodilator hormones released by lead.

- Cardiac arrhythmia, heart failure and myocardial infarction may occur. Furthermore, due to damage to the brain nervous system, symptoms such as disorientation, headache, aggression, hyperactivity, insomnia or apathy occur.
- Severe cases of nerve damage are characterized by delirium, coma or convulsions, which can lead to death from circulatory failure
- Furthermore, numbness and sensory disturbances in the extremities,
- As well as motor deficits are possible. Finally, kidney damage can also develop in the long run over a certain lead concentration in the blood.

Chronic Poisoning. Effects on children

As lead safety standards become more stringent, fewer children in the US are found to have elevated lead levels.

A pregnant woman who has elevated blood lead levels is at greater risk of a premature birth or with a low birth weight. Children are more at risk for lead poisoning because their smaller bodies are in a continuous state of growth and development. Young children are much more vulnerable to lead poisoning, as they absorb 4 to 5 times more lead than an adult from a given source. Furthermore, children, especially as they are learning to crawl and walk, are constantly on the floor and therefore more prone to ingesting and inhaling dust that is contaminated with lead.

The classic signs and symptoms in children are loss of appetite, abdominal pain, vomiting, weight loss, constipation, anemia, kidney failure, irritability, lethargy, learning disabilities, and behavioral problems. Slow development of normal childhood behaviors, such as talking and use of words, and permanent intellectual disability are both commonly seen. Although less common, it is possible for fingernails to develop leukonychia striata if exposed to abnormally high lead concentrations (11).

On July 30, 2020, a report by UNICEF and Pure Earth revealed that lead poisoning is affecting children on a “massive and previously unknown scale.” According to the report, one in three children, up to 800 million globally, have blood lead levels at, or above, 5 micrograms per deciliter ($\mu\text{g} / \text{dL}$), the amount at which action is required

Chronic or acute poisoning occurs, depending on the severity and duration of lead exposure

Chronic poisoning usually presents with symptoms that affect multiple systems, but is associated with three main types of symptoms: gastrointestinal, neuromuscular and neurological.

The central nervous system and neuromuscular symptoms usually come from intense exposure, while gastrointestinal symptoms usually come from exposure for longer periods. Signs of chronic exposure include short-term memory or concentration loss, depression, nausea, abdominal pain, loss of coordination, and numbness and tingling sensation in the extremities. Fatigue, sleep problems, headaches, dizziness, slurred speech and anemia are also found in chronic lead poisoning. “A” lead color “of the skin with pale and / or livid is another feature. A blue stripe along the gums with a bluish black tip on the teeth, known as the Burton stripe, is another indicator of chronic lead poisoning. Children with chronic poisoning may refuse to play or may have hyperkinetic or aggressive behavioral disorders Visual disturbance may present with blurred vision that progresses gradually as a result of central scotoma, caused by toxic optic neuritis (12, 13).

Diagnostic

Diagnosis of lead poisoning is best done by a Blood Test, but can also be done by analyzing urine, hair or teeth.

In urine, however, lead can be dispersed irregularly due to the body’s not necessarily using fluids, so measurement inaccuracies in lead poisoning cannot be ruled out.

Lead poisoning is the accumulation of lead in the body, which usually develops over months or years. While lead poisoning is common in the developing world, causing over 800,000 deaths a year, it can also affect US households.

Blood lead concentration is measured in micrograms (μg) per deciliter (dL) of blood. The current acceptable range is (blood lead level (BLL):

- Less than 5 μg / dL for children
- Less than 25 μg / dL for adults

For this, your doctor may order non-invasive X-ray fluorescence (XRF), essentially a form of high-energy X-ray that can assess how much lead is in your bones and detect areas of calcification that indicate long-term exposure (14).

Complications

Chronic lead poisoning should be suspected if a person feels constantly stressed for no apparent reason, complains of widespread headaches and abdominal pain, and shows signs of anemia.

- Typical symptoms also include a yellow discoloration of the skin and the so-called lead fringe, a blue-black stain on the gums. Anyone observing such symptoms should see a doctor immediately.
- Lead poisoning usually causes fatigue, nausea and vomiting immediately. In the long run, improper treatment of poisoning can cause further complications.

In children, even a small amount of lead can cause permanent physical and mental damage. The main complications are developmental disorders, hearing problems, concentration coordination difficulties.

In addition, behavioral problems such as aggression and hyperactivity may occur. Typical physical complications of lead poisoning include kidney damage and during illness rarely lead poisoning can lead to life-threatening sepsis with severe consequences. Higher amounts of lead also pose a risk of kidney failure, which can also be fatal if left untreated.

Chronic lead poisoning reduces overall well-being and is associated with loss of appetite, fatigue, headache, abdominal pain constipation. In addition, because lead reduces the formation of red blood cells, the risk of anemia increases. Furthermore, permanent kidney damage and other complications can develop.

The extent of the symptoms depends mainly on the amount of lead ingested and the composition of the affected person; prompt treatment significantly reduces the risk of permanent damage and usually leads to a complete recovery of the patient.

Treatment

Lead poisoning is preventable. This includes individual efforts such as removing lead-containing items from the home, workplace efforts such as improved ventilation and monitoring, state laws that ban the use of and national policies such as laws that ban lead in products such as paint, gasoline, ammunition, wheel weights, and fishing weights reduce allowable levels in water or soil, and provide for cleanup of contaminated soil. Workers' education could be helpful as well. [The major treatments are removal of the source of lead and the use of medications that bind lead so it can be eliminated from the body, known as chelation therapy. Chelation therapy in children is recommended when blood levels are greater than 40–45 µg / dl. Medications used include dimercaprol, calcium disodium edetate, and succimer (15).

In 2016, lead is believed to have resulted in 540,000 deaths worldwide. It occurs most commonly in the developing world

Therapy can be given either orally or intravenously. Chelation therapy is indicated in people with severe lead poisoning or signs of encephalopathy. It can

also be considered for anyone whose BLL is above 25 µg / dL. Chelation therapy has less value in chronic cases below this value.

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 - Bal in oil (dimercaprol) u Calcium disodium
 - Chemet (dimercaptosuccinic acid) u D-penicillamine
 - EDTA (ethylene diamine tetra-acetic acid)
- Side effects may include headache, fever, chills, nausea, vomiting, diarrhea, shortness of breath, irregular heartbeat, and chest tightness. In rare cases, seizures, respiratory failure, kidney failure, or liver damage have occurred.
- In acute lead poisoning, the fluid used for gastric lavage consists of three percent sodium sulfate solution. Activated charcoal is administered at the same time, which causes lead components - converted to lead sulfate, which is more difficult to digest - to bind to activated charcoal.
- If the lead has already passed beyond the stomach and entered the body, the patient is administered drugs such as penicillamine, which bind the lead to his body and thus make it harmless, so that the heavy metal can be secreted back through the kidneys. .
- Treatment of iron, calcium and zinc deficiency, which are associated with increased lead absorption, is another part of treatment for lead poisoning.
- If lead encephalopathy is present, anticonvulsants may be given to control seizures, and treatments to control brain swelling include corticosteroids and mannitol.

- Administration of dimercaprol, DMSA (Succimer) or DMPS before calcium EDTA is necessary to prevent redistribution of lead into the central nervous system.
- At this point, blood provides an ideal means of monitoring whether therapy is working as desired. Antispasmodics (antispasmodics) are used to treat abdominal pain.
- If kidney damage has occurred, blood washing may be required temporarily or even permanently. It is imperative that the patient avoid any further contact with the heavy metal bullet (17).

To do this, however, it is necessary to clearly identify the source of the lead poisoning.

Prognosis

The prognosis for lead poisoning depends on the amount of lead in the body and the duration of exposure. The earlier lead poisoning is identified and treated, the better the prognosis is (18).

Addition to abdominal pain, brain damage can occur in children, making their prognosis less favorable and requiring even faster action. Chronic lead poisoning will lead to death after a while if left untreated. Nerve and kidney damage in particular plays a role here, as they ultimately make the affected person unable to live. However, even severe cases of chronic lead intoxication can be treated with complexing agents and chelation therapy. However, organ damage that has already occurred at a structural level cannot be reversed with this, so the affected persons will continue to live with post-therapy limitations (19). Chronic lead intoxication can also recur in the affected person and lead to symptoms if the source of the damage cannot be found.

Prevention

Meanwhile, to further reduce your family's risk:

- Make sure everyone washes their hands often.
- Teach children not to put their hands or fingers in their mouths. To give everyone a daily supplement of iron and calcium. . Vacuum and wet wash frequently.
- Encourage children to play on the ground around the house if the exterior paint is raw or deteriorating.

- Place an entrance inside and outside the entrance to your home.
- Encourage everyone to take off their shoes before entering.
- If you work in a factory or factory where there is a risk of lead exposure, take a shower and change your clothes before going home.

Lead poisoning can be prevented primarily by avoiding the release of lead. The use of many lead-containing materials is restricted or prohibited. Remaining lead-containing materials (e.g., in old car batteries) are disposed of separately (20).

Water pipes that still contain lead, which can contaminate leaded drinking water to a considerable extent, need to be replaced. Pregnant women and young children in particular should avoid drinking lead-containing water.

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