

REVIEW ARTICLE

Ubiquity of Lead in Our Lives–Lead in Food*Devesh Thakur¹, Thuppil Venkatesh^{1*}**¹National Referral Centre for Lead Projects in India, St John's Medical College Bangalore-560034 (Karnataka) India***Introduction:**

Lead poisoning is classically defined as exposure to high levels of lead typically associated with severe health effects, but being a heavy metal which is potentially toxic, if present at even minor concentrations, it is of great concern to environmentalists and medical professionals alike. Biological scientists are the first ones to come across the root cause of lead poisoning as they have the access to the technology to evaluate the blood lead level. They can correlate the blood lead levels to metabolic derangements. It is they who provide answers to chelate or to mitigate lead at the source itself. Finally biological scientists provide suitable in-puts for the implementation of much needed policies.

The Number One Environmental Poison Lead has Drawn Our Attention for Centuries:

Like every year this year once again in the month of October the whole world will be celebrating Lead Awareness Week (LAW) sponsored by WHO, IPEN and many governmental and non governmental bodies. This is to say 'No' to lead paints. We are also aware that lead is found everywhere in our daily life as we are surrounded by lead to some extent or the other and the interesting fact is that lead has no smell nor can be seen and is the main reason why its attention gets to be lost unless symptoms appear in few. On an average half a ton of lead is required by every human being in his/her life time as lead is used in batteries, paints plumbing Lines, electronic soldering, traditional medicines etc. People are

not aware that this soft and inexpensive metal and various forms of its salt widely used is number one environmental poison. This was first realized centuries ago during Roman period when lead utensils were widely used which resulted in the fall of Roman civilization. Lead poisoning has crossed racial, geographic and socioeconomic boundaries across the globe still most of the developing countries have almost ignored the truth. Researchers and the entire medical profession are now convinced that this toxic heavy metal and its salts have no known beneficiary biological function. Hence everyone is convinced that lead and its salts have deleterious effects. From energy storing lead acid batteries to shiny shirt buttons for comfort we have been using lead.

LEAD in Our Environment and Its Source and Pathway to Living System:

In urbanized environment near every lead based industrial area or heavily trafficked area the air we breathe is found containing lead in particulate form. Particles less than 10 microns in diameter are directly absorbed by our respiratory system. Hence one of the main pathways of lead to humans and animals is through inhalation of lead contaminated air. Inorganic lead through food, some folk and unbranded traditional medicines and water is ingested and directly absorbed by the digestive track. Apart from this organic form of lead from most of the cosmetics is absorbed through the skin. Through these three pathways environmental lead finds its way to almost all organs in the body.

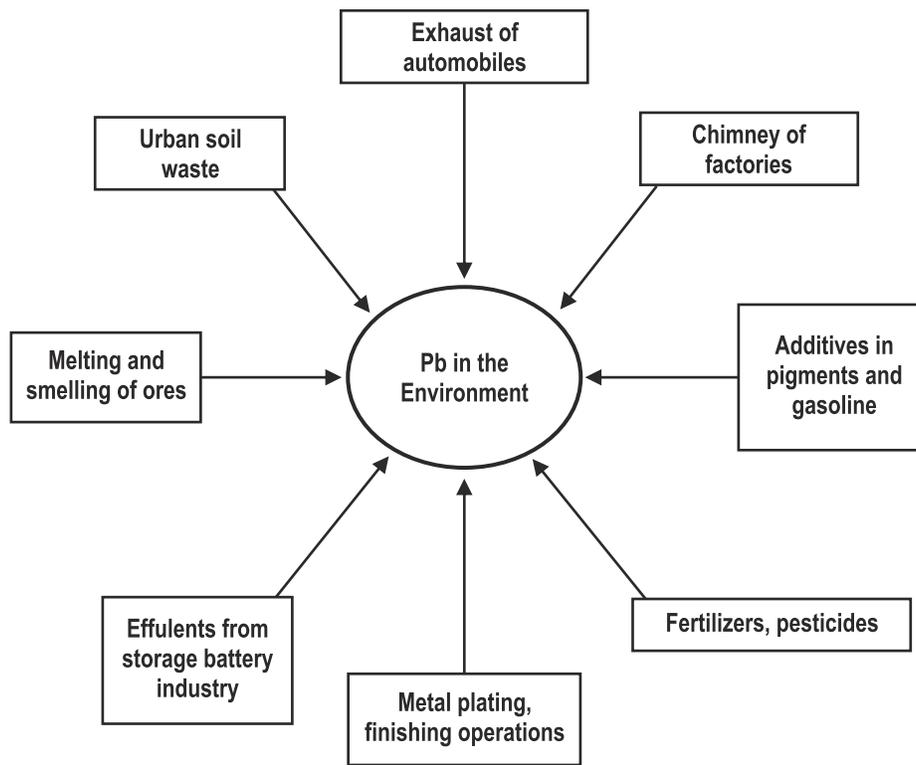


Fig.1: Sources of Lead Pollution in the Environment

It is important to note that there is neither placental barrier nor blood brain barrier for lead. Lead has a half life of over 35 years in bone. The most affected are those who work inside these industries. Though women of reproductive age are not allowed to work in lead acid battery industries, they are found in large number working in textile and electronic industries. Labour class is found living adjoining the led based industries and found most vulnerable and affected population. Lead in our packaged food has disturbed many. Extensive application of industrially-produced pesticides in agriculture has resulted in contamination of soil ecosystems. A variety of both cultivation-dependent and cultivation-independent methods can be applied to measure and interpret the effects of pesticide exposure [1].

A systemic pesticide moves inside a plant following absorption by the plant. With

insecticides and most fungicides, this movement is usually upward (through the xylem) and outward, thus increasing efficiency. Systemic insecticides, which poison pollen and nectar in the flowers may kill bees and other needed pollinators. Lead deposited on the ground is transferred to the upper layers of the soil surface, where it may be retained for many years (up to 2000 years). In undisturbed ecosystems, organic matter in the upper layer of soil surface retains atmospheric lead. In cultivated soils, this lead is mixed with soil to a depth of 25C11l (i.e., within the root zone). Atmospheric lead in the soil will continue to move into the microorganism and grazing food chains, until equilibrium is reached. Activated charcoal prevents lead accumulation in the plants. With the use of activated charcoal lead concentration decreases consistently and cannot pass through the food chain [2].

Lead seldom occurs naturally in water supplies like rivers and lakes. Lead enters drinking water primarily as a result of the corrosion, or wearing away, of plumbing materials containing lead in the water distribution system of households or buildings. These materials include lead-based solder used to join copper pipe, brass and chrome plated brass faucets, and in some cases, pipes made of lead that connect houses and buildings to water mains. In 1986, Congress Govt. banned the use of lead solder containing greater than 0.2% lead, and restricted the lead content of faucets, pipes and other plumbing materials to 8.0%. Older construction may still have plumbing that has the potential to contribute lead to drinking water [3].

In modern times, lead has been used extensively in lead-acid batteries, water pipes, paints, ammunition, cosmetics, alternate and folk medicines and even some low-cost toys. Eventually, the lead in these products disassociates and is able to enter the environment where it has dire consequences. It is thought and even established that drinking water provides a significant pathway for biological lead exposure. Since lead seldom occurs naturally in water supplies like lakes and rivers, contamination is often associated with the presence of lead in service pipes, solders, pipe-fittings and galvanized iron (GI) pipes. Previous research has already confirmed GI pipes as a source of lead contamination [4].

It is recommended that in areas where lead is suspected to have a presence in drinking water, children especially should have their blood lead levels tested at an accredited facility

LEAD Content in Food, Medicine, Blood and National Policies for Regulation:

With the increasing consumption of a number of artificially packed, colored drinks by the present day generation, it is necessary to take precautions

in order to prevent any kind of health hazards specially lead poisoning.

Table 1: Estimation of Lead in Turmeric samples

Sr. No	Turmeric Sample	Pb (ppm)	Statistical (+/-)
1	Sample 1	21	4
2	Sample 2	32	5
3	Sample 3	<LOD	11
4	Sample 4	26	4
5	Sample 5	105	7
6	Sample 6	63	6
7	Sample 7	78	6
8	Sample 8	59	6
9	Sample 9	71	6
10	Sample 10	66	6
11	Sample 11	95	7

This study was done to check for the presence of lead in the samples of turmeric. It was initially hypothesized that lead traces may be present due to artificial coloring agents that are added to them. Such a test is highly relevant, keeping in mind the health of people specially the youth.

Lead, mercury, and arsenic have been detected in a substantial proportion of Indian manufactured traditional Ayurvedic medicines. Metals may be present due to the practice of rasa shastra (combining herbs with metals, minerals, and gems). It is unknown whether toxic metals are present in both US and Indian manufactured Ayurvedic medicines.

One-fifth of both US manufactured and Indian manufactured Ayurvedic medicines purchased via the ‘Internet’ contain detectable lead, mercury, or arsenic [5].

Lead poisoning is classically defined as exposure to high levels of lead typically associated with severe health effects, but being a heavy metal which is potentially toxic, if present at even minor concentrations, it is of great concern to environmentalists and medical professionals alike. In most of the developing countries there is no established recommendation for lead levels including the level of lead in food or blood. Lead in food might come from the soil where the food is grown as the soil or the land where agricultural activities are in place might get lead from the nearby lead based industries or the lead in the soil could be from the any previous lead related activities such as lead smelter etc. Activated charcoal has been known to absorb heavy metals and thus, was used in this study as well. Such study promotes a cost effective process to treat agricultural lands polluted with leaded pesticides. Water purifiers, refrigerator etc. contain varying amounts of activated charcoal, after usage of these appliances it can be recycled and used as a source of activated charcoal. This can be applied in pesticide contaminated fields either in the form of slurry or by spraying [6, 7]. Even though there is some kind of recommendations they are found voluntary in nature. There is lack of regulation and implementation of standards. Even today in India we do not have uniformly accepted lead content in paints manufactured for decorative purposes. Acceptable levels of lead in food are not known to many. Even the bulk producers of traditional medicines do not display the lead content. Lead content of bottled water to children toys are never disclosed. Every year during the 'International Lead Poisoning Awareness Week' efforts are made to raise awareness about lead poisoning across various sectors of society and highlight countries and partners' efforts to prevent childhood lead poisoning and urge further action to eliminate lead paint. In 2006 a report on the analysis for lead in

80 new residential paints from four countries in Asia revealed high levels in three of the countries (China, India and Malaysia) and low levels in a fourth country (Singapore) where a lead in paint regulation was enforced. The authors warned of the possible export of lead painted consumer products to the United States and other countries and the dangers the lead paint represented to children in the countries where it was available for purchase. The need for a worldwide ban on the use of lead in paints was emphasized to prevent an increase in exposure and disease from this very preventable environmental source [8].

LEAD and its Effect on Health:

The "World Health Organization has estimated that over 120 million people are overexposed to lead and 99 percent of the most serious cases are in the developing world". WHO had considered reaching blood lead level of $<10\mu\text{g/dL}$ as an adequate goal; researchers calling on WHO to halve that level with an ultimate goal to have it below $2\mu\text{g/dL}$ of blood. Any increment above $10\mu\text{g/dL}$ decreases kids IQ by 7.4 pts, so this is aptly called "The Age of Stupid". Lead replaces minerals (notably iron and calcium) within the body prevents hemoglobin formation in red blood cells producing anemia. Even as low as $2\mu\text{g/dL}$ of lead in the blood increases risk of early death. More than 50% of people alive today in lead contaminated area have probably a blood lead above $10\mu\text{g/dL}$.

- At levels above $80\mu\text{g/dL}$, serious, permanent health damage may occur (extremely dangerous).
- Between 40 and $80\mu\text{g/dL}$, serious health damage may be occurring, even if there are no symptoms (seriously elevated).
- Between 25 and $40\mu\text{g/dL}$, regular exposure is occurring. There is some evidence of potential physiologic problems (elevated).

- Between 10 and 25 µg/dL, lead is building up in the body and some exposure is occurring.

The typical level for U.S. adults is less than 10 µg/dL (mean = 3 µg/dL) [9, 10].

We would all be smarter and live longer were it not for lead and Lead poisoning is entirely preventable. Lead exposure has resulted in 0.6% of the global burden of all diseases with the highest burden in developing regions. Childhood lead exposure is about 600,000 new children with intellectual disabilities/year. Even though there is wide recognition of this problem and many countries have taken action, exposure to lead, particularly in childhood, remains key concern to health care providers and public health officials. Most children with lead poisoning do not show any outward symptoms unless blood lead levels are extremely high. Consequently, many cases of children with lead poisoning go undiagnosed and untreated as the symptoms of lead poisoning include, headache, stomachache, nausea, tiredness and irritability which are symptomatically treated as these symptoms are seen in other diseases. Though there is treatment for lead poisoning which in developing countries is unaffordable to majority.

Clinicians are focusing on the low lead exposure especially amongst children even before birth. The state of art technology has made it possible to measure lead at much lower concentrations at

µg/dl. More cases are diagnosed with exposure to toxic levels of lead. Efforts are also made to reduce the amount of lead in the biosphere. However lead from day to day consumables and processed food is a major concern [11].

LEAD Poisoning Ultimate Solution:

For the diseases like lead poisoning, where the symptoms are not as obvious and many times go undiagnosed, the dietary exclusion or consumption and awareness prove to be beneficial for the various populations facing this problem [12].

On war footing there is a need for the urgent mass awareness across the country on lead related issues especially at school level through well trained Teachers as Lead Educators (Leader programme) as awareness alone will prevent up to 60% of any problem. Apart from this providing at all district level hospitals facilities to test and monitor the Blood Lead Levels (as on now only 30 testing facilities are available in our country established by the National Referral Centre for Lead Projects (NRCLPI) using the state of art technology which is available in our country. Recommendation is already made to the Health ministry on this requirement by the Indian National Society for Lead Awareness and Research (InSLAR) and the Association of Health Care Providers of India (AHPI). It is only when a mass casualty happens regulations and legislations come in to effect.

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