

Effects of Lead on Environment

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Abstract:

Lead is one of the most abundant heavy metals and its toxic effects cause environmental and health problems because of its stability in contaminated site and complexity of mechanism in biological toxicity, particularly dangerous for children leading to mental retardation when exist with abnormal concentration in body fluid. Knowledge and awareness of the problem are essential to limit the risk of lead exposure. This article focuses on the adverse effect of lead on various components of the environment like soil, water and human being. Lead is a naturally occurring bluish-gray metal available in small amounts in the Earth's crust.

Key Words: Environment, Lead, Fluid, Soil and Health

1. Introduction

Throughout our environment some amount of lead is found. An increased amount of lead in our environment comes from human activities including burning fossil fuels, mining, and manufacturing. In the United States, the most common source of exposure for lead-poisoned children is lead-based paint, while the majority of adult cases are workplace-related. Lead occurs naturally in the environment. However, most lead concentrations that are found in the environment are a result of human activities. Due to the application of lead in gasoline an unnatural lead cycle has consisted. In car engines lead is burned, so that lead salts (chlorines, bromines, and oxides) will originate. Lead is one out of four metals that have the most damaging effects on human health [1]. Sources of lead pollution in India may be divided into two major categories: Industrial and domestic. The industrial lead exposures are mainly due to the particulates generated by coal burning and roasting of minerals i.e. iron pyrites, dolomite, alumina etc. The domestic lead exposures come mainly from cooking by use of the solid fuels (i.e. coal, biomass, agriculture waste, etc.), paints, ceramic glazes, cosmetic and fold remedies, drinking water and food, etc. Increase amount of lead creates measure environmental health problem in India. Lead is a potent poison and is harmful in even very small amount. Lead is an important environmental contaminant because of its known toxicity to humans and other living organisms. Lead is one of a limited class of elements that can be described as purely toxic. Many other elements, including heavy metals such as chromium, manganese, molybdenum, nickel, and selenium, although toxic at high levels, are actually required nutrients at lower levels. This is clearly not the case for lead. Lead is a relatively corrosion resistant, dense and malleable metal that has been used by humans for at least 5000 years. During this time, lead pollution has increased from an estimated 10 tons per year to 1,000,000 tons per year, accompanying population and economic growth [2]. Lead is a well known non-biodegradable toxic metal in the environment and now, it has become a global health issue [3, 4]. Lead poisoning occurs when people are exposed to lead and chemicals that contain lead, breathing air, taking drinks such as water and milk, eating foods such as fruits, vegetables, meats, grains and seafood, swallowing or touching dust or dirt that contains lead. In this paper some aspects of lead effect on environment like soil, food & water has been presented.

2. Lead and Human

Increased amount of Lead is a major problem in developing countries like India [2]. Lead is a very dangerous poison, particularly for children, when it is actually inhaled or ingested. Rules and regulations prohibit lead in common products like most gasoline and paint so lead poisoning has dramatically declined in the United States. Excessive exposure to lead may be the main environmental health threat to children. Children absorb lead from many sources, including air, drinking water, food, household dust play area soil and dust, interior and exterior paints, and improperly glazed ceramics and toys [5]. In children, lead is most dangerous when they are six years and younger. Children are growing at a very fast rate growing bones, developing stronger muscles and creating many connection in their brain. When lead instead of essential nutrients is "available" to the body to make bones, muscles, and brain connections, permanent harm to health can occur. Even at low levels, lead can be harmful and high levels of lead are life threatening and can cause seizures, unconsciousness and death. Lead is a pervasive environmental contaminant. The adverse health effects of lead effects of lead exposure in children and adults are well documented, and no safe blood lead threshold in children has been identified [6].

The US centres for Disease Control and Prevention has defined an elevated blood lead level in children as $\geq 10\mu\text{g}/\text{dl}$, on the basis of neurologic toxicity. The US Environmental Protection Agency suggests a threshold lead level of $20\text{--}40\mu\text{g}/\text{dl}$ for risk of childhood anemia, but there is little information relating lead levels $<40\mu\text{g}/\text{dl}$ to anemia. Therefore, the authors examined

the association between lead levels as low as $10\mu\text{g}/\text{dl}$ and anemia in Indian children less than 3 years of age [7]. More than 15 million children in developing countries are suffering permanent neurological damage due to lead poisoning [8]. Lead can be ingested from various sources, including lead paints and house dust contaminated by lead paint, as well as soil, drinking water, and food. The concentration of lead, total amount of lead consumed, and duration of lead exposure influence the severity of health effects. Because lead accumulates in the body, all sources of lead should be controlled or eliminated to prevent childhood lead poisoning. Most of the lead entering the body will leave the body in the urine, feces, sweat and as dead skin cells slough off. Lead may also be found in breast milk. The lead that remains in the body tends to accumulate in bone where it can be stored for decades. Lead in bones can be released back into the blood long after the original exposure. It disrupts the function of enzyme systems that use other metals such as calcium, Zinc and Iron. Lead is a recognized environmental pollutant. The combustion in vehicles of petrol containing antiknocking additive lead has become a major source of atmospheric lead [9]. Mahaffey et al. [10], established that children in rural areas blood lead concentration of $13.9\mu\text{g}/\text{dl}$, while those from cities with populations less than one million had values of $16.5\mu\text{g}/\text{g}/\text{dl}$ of blood.

In South Africa, study was carried out to know the blood lead level in the children [11]. It was reported that blood lead levels in these children remained significantly high over the period studied. It was suggested that vigilant control of all sources of lead in the urban environment vitally necessary in South Africa. According to [12], the Young children of urban slums lead poisoning is a major source of brain damage, mental deficiency and serious behavior problems. It is difficult to diagnose, it is often unrecognized and until recently it was largely ignored by physicians and public health officials. Now public attention is finally being focused on childhood lead poisoning, although the difficult task of eradicating it has just begun. Symptomatic lead poisoning is the result of very high levels of lead in the tissues. Among the natural substances that man concentrates in his immediate environment, lead is one of the most ubiquitous. It is reported that [13], the environment pollution is a wide-reaching problem and it is likely to influence the health of human populations is great. It was also found that the insight view about affects of environment pollution in the perspective of air pollution, water and land / soil waste pollution on human by diseases and problems, animals and trees / plants. According to author, still time left in the hands of global institutions, governments and local bodies to use the advance resources to balance the environment for living and initiates the breathed intellectuals to live friendly with environment. It appears that polluted environment is global an issue and world community would bear worst results more as they already faced. As effective response to pollution is largely based on human appraisal of the problem and pollution control program evolves as a nationwide fixed cost – sharing effort relying upon voluntary participation. Education, research, and advocacy, are lacking in the region as preventive strategy for pollution especially in Asia. At present the adoption of auditing in any economic sector is voluntary but future legislation could well make it mandatory and still time available to use technology and information for environmental health decision. Policymakers in developing countries need to carefully adopt available knowledge from other settings, keeping in mind the differences in pollutant mixtures, concentration levels, exposure patterns and various underlying population characteristics. According to [14] lead poisoning is one of the most significant environmental health threats children face. This paper describes the prevalence of lead poisoning among these children living in a rural area that covers about one third of the Philippines. We explore the correlations of lead toxicity in this population and describe an environmental investigation to characterize an unexpectedly common toxic health hazard.

3. Lead and Soil

Lead is a microelement naturally present in trace amounts in all biological materials i.e. in soil, water, plants and animals [15]. It has no physiological function in the organisms. According to Cibulka [16], the main sources of lead contamination are smelting works, application of wastewater treatment sludges to soil, transportation, rain, snow, hail and other. Approximately 98% of lead in the atmosphere originates from human activities. Numerous study have documented increased lead concentration in air, soil, vegetation near street and highways [17, 18, 19 and 20]. Lead concentrations decrease rapidly in soil with distance from streets and highways and in soils with depth in soil profile [18, 21, and 22].

Neuman et al. [23] have extended the sources of lead pollution by paints, lead waste, cell batteries, lead solders and farms. Lead is observed by plants through roots where most of the lead is also accumulated. In the case of other than root uptake (along roads in urban regions) the content of lead decreases as follows: above ground part > roots > products [13]. Intoxication of animals by lead occurs particularly after grazing on pasture contaminated with lead [25]. Lead enters the organisms with food and air. The accumulation in the food grain, vegetables, spices, medicinal and wild species were investigated [26, 27, 28, 29]. The mean lead content in the soil samples lies within typical concentrations of lead in soil. This has been reported to be within the range of $0.5 - 10\mu\text{g}/\text{g}$ [30]. Lead from anthropogenic sources may result in concentrations exceeding $10,000\mu\text{g}/\text{g}$ [31]. In particular, soil in or adjacent to lead smelters, lead mines, houses painted with lead paint, orchards treated with arsenate, and urban, where there has been heavy automobile traffic is likely to contain high concentrations of lead. Sources of lead in dust and soil also include lead that falls to the ground from the air, and withering and chipping of lead based paint from buildings and other structures. Lead in dust may also occur from wind-blown soil [31]. Variation in lead in soil content may also be due to historical factors such as past traffic congestion, industry and the

type of soil. Of these, traffic and its associated use of leaded petrol, has played the most important role in determining where lead is found in city and rural soils [32]. Leaded petrol has been in use in Kenya up to 2006. Studies done in the USA revealed that inner city areas [33]. High soil lead levels means that residents and their children in such areas face a health threat of lead poisoning from soil [32], children are particularly at risk. In a study in the USA, where 7.8% of homes had soil lead levels higher than $0.5\mu\text{g/g}$, it was estimated that a child eating only half a gram of soil would ingest $250\mu\text{g}$ of lead, almost twice the maximum intake limit per day [34].

The result of lead in some vegetables are consistent with those obtained in some other studies, such as that by Leelaphunt et al. [35]. Where they found lead levels of $2.1\mu\text{g/g}$ in tomatoes purchased from Thailand markets, however, the lead levels in vegetables in this study is much higher than those reported by Denmark National Food Agency [36]. This may be due to the successful phasing out of leaded gasoline in the European countries. When leaded fuel is burned, it emits very fine particles of lead into the air, where they may settle on vegetables as they are vended along the streets and next to busy highway. Some of the particles settle on soil where they later contaminate the food when the dust is blown by [32]. Other investigations have also reported high levels of lead content in vegetables sampled near major highways [37]. Perhaps, not surprisingly there is good correlation between average traffic counts and average soil and plant lead content at sites close to the roadside. An inverse relationship between distance from the road and lead content has been observed in various soils and vegetables [37]. In Japan, [38] found lead concentrations of 2.3 and $2.4\mu\text{g/g}$ in spinach-stew and $1.2\mu\text{g/g}$ in cabbage. Mahokha et al. [39] experimented that the exposure to lead (Pb) through food, water, or contaminated air has adverse health impacts that are particularly severe in children. Lead contamination in tap water, and some vegetables was above the WHO maximum limits and may pose a risk for lead poisoning to consumers. The lead content in soil samples from near the roadside was consistently higher than that obtained further from the roadside, indicating motor vehicle pollution is a source of lead pollution. Such high lead levels in soil poses risk for lead poisoning, particularly to children who play in such soils. The lead content was also higher in vegetables grown near the roadside in comparison to that grown away from the roadside, indicating that motor vehicle pollution is a source of lead contamination in foods. Routine monitoring of lead levels in the environment and food samples needs to be established in Kenya, since these levels may change with time.

4. Lead and Water

Lead is unlikely to be present in source water unless a specific source of contamination exists. However, lead has long been used in the plumbing materials and solder that are in contact with drinking water as it is transported from its source into homes. Lead leaches into tap water through the corrosion of plumbing materials that contain lead [40, 41]. The greater the concentration of lead in drinking water and the greater amount of lead-contaminated drinking water consumed, the greater the exposure to lead. In children, lead in drinking water has been associated both with $\text{Blls} \geq 10\mu\text{g/dl}$ [42,43] as well as levels that are higher than the U.S. GM level for children ($1.4\mu\text{g/dl}$) but are $<10\mu\text{g/dl}$ [44,45]. The permissible limits for Pb in the air, drinking water, soil and food reported are $0.10\text{-}0.30\mu\text{g/m}^3$, $5\mu\text{g/l}^{-1}$, $300\mu\text{g/kg}^{-1}$, and 1.1mg/kg^{-1} respectively [46,47]. The rain and runoff water of the industrial cities of central India are contaminated with several folds higher lead than permissible limits of $5\mu\text{g/l}^{-1}$. The medicinal plants, species and leafy vegetables grown in the contaminated soil were found to be loaded with lead beyond permissible limit of 1.1mg/kg^{-1} respectively [46,47]. The rain and runoff water of the industrial cities of central India are contaminated with several folds higher lead than permissible limit of $5\mu\text{g/l}^{-1}$. The medicinal plants, species and leafy vegetables grown in the contaminated soil were found to be loaded with lead beyond permissible limit of 1.1mg/kg^{-1} . Anu et al. [48] studied that was focused on the assessment of water of various water bodies in and around Bhopal. In this study water quality of upper lake, Kolar reservoir, Lower lake, Shahpura Lake and Halali dam was assessed for a period of two years. Heavy metals i.e. copper and lead were studied during the study. Water quality comparison of these five water bodies in and around Bhopal reveals that although the situation is not too worst but it is alarming. The conditions of water bodies which are being used for primary purposes have to be maintained while the other which are being used for secondary purposes have to be improved. As these water bodies are the life line for Bhopal city in one way or the other, proper conservation and management plans and strategies have to be formulated and implemented for the restoration, conservation and management of these water bodies at government and public level. According to Smirjakova et al. [49] our environment is affected by a great variety of pollutants. What they all have in common is that only their absence can eliminate the respective health risk. Therefore it is very important to recognize the problems and take appropriate measures early. The health risk arising from environmental contaminants depends on many factors including absorption and toxicity of contaminated food consumed and duration of exposure. All food of animal origin with the exception of milk contains lead in higher concentration than in that of plant origin. The amount of lead in food has been reduced since 1990 due to the decline in production of some goods, the use of unleaded fuel, and other environmental protection measures. The mean weekly lead intake is less than 70% of the tolerated value (PTWI) calculated on the basis of food consumption and the relevant levels of lead in food. Chemical residue have raised serious problems and risks, which will persist also in the future. The reason for this pessimistic prognosis is the global terrestrial polycontamination of all ecosystems and components of the environment by human activities and local contamination of production areas with a range of chemical contaminants. There is an effort to

decrease to a minimum or eliminate penetration of the most serious contaminants into the food chain and therefore also into the human body.

5. Conclusion

Lead is a soft metal that has known many applications over the years. Lead has wide applications in metal products, cables and pipelines, paints and pesticides. Foods such as fruits, vegetables meat, seafood soft drink and wine may contain significant amount of lead. Cigarette smoke also contains small amounts of lead. As per literature review it is found that has no essential function in the human body, it can merely do the harm after uptake from, air, or water. Lead can cause several unwanted effects such as a rise in blood pressure, kidney damage, Brain damage, Decline fertility of men through sperm damage, diminishing learning ability of children, Behavioral disruption of children, etc. Since human activities increased leading to enhancement of lead amount in to the environment, hence it is recommended to know the lead amount in various important cities so that proper preventive measure can be taken up to reduce the adverse effect of lead on environment and human being.

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