



HEAVY METALS AND THEIR IMPACT ON HUMAN HEALTH

Dr. Vandana Rathore

Department of Zoology, Government Girls Degree College, Rampur (U.P.)

Email id- vandanacric@gmail.com

<https://doi.org/10.59436/jsiane.135.2583-2093>

Abstract

Due to the deleterious consequences it is having on a global scale, the presence of heavy metals has become a matter of significant concern. Due to the rapidly expanding agriculture and metal sectors, as well as inappropriate waste management, fertilisers, and pesticides, these inorganic pollutants are being dumped into our water, soil, and environment. Heavy metals interfere with biological functions such as growth, proliferation, differentiation, damage repair, and apoptosis. Multiple industrial, residential, agricultural, medical, and technical applications have resulted in their widespread presence in the environment, generating concerns regarding their possible consequences on human health and the environment. Heavy metals occur naturally and are vital to life, but buildup in organisms can render them hazardous. The most prevalent heavy metals that damage the environment include arsenic, cadmium, chromium, copper, nickel, lead, and mercury. Due to its capacity to travel large distances in the atmosphere, mercury, lead, and cadmium pose the most threat. Mining, industrial output (foundries, smelters, oil refineries, petrochemicals plants, pesticides production, chemical industries), untreated sewage sludge, and diffuse sources such as metal pipelines, traffic, and combustion byproducts from coal-burning power plants are all sources of heavy metals. Mercury, lead, chromium, cadmium, and arsenic have caused human poisoning more frequently than any other heavy metals. Apoptosis, development, proliferation, differentiation, damage healing, and apoptosis are all affected by heavy metals. Instabilities in the genome have been linked to heavy metals like chromium and cadmium, as well as arsenic.

Keywords - Heavy metals, human exposure, use and production, carcinogenicity, health effects.

Received 15.10.2021

Revised 20.10.2021

Accepted 07.11.2021

Introduction

They can build in life forms such as flora and fauna since they can be found everywhere on the planet, including its atmosphere and crust. Metals are a natural part of the Earth's ecosystem. In order to make the cations, they give up their electrons, which are extremely electrically conductive. The dispersion of these heavy metals in the environment is influenced by a variety of natural and artificial factors, including volcanism, spring water, erosion, and bacterial activity. The accumulation of these heavy metals in living organisms and the physical figure has negative consequences. Toxic heavy metals are taken up by the body and stored in various organs and tissues, where they bond to macromolecules like proteins and nucleic acid, causing damage and affecting normal biological processes. Occupational and human activities have increased access to heavy metals that are harmful to human health. People around the world are harmed by the pollution of water and air by hazardous metals. Food contamination with heavy metals is another health concern for both humans and animals. Heavy metal levels in water, air, and food are being assessed in this context. Like other types of pollutants, metals are capable of occurring naturally and remaining in the environment for long periods of time. Even at extremely low levels, metals such as arsenic and cadmium can cause disease or death to humans, creatures, and plants, even if they are found in the environment. Arsenic is widely referred to as "King's poison" due to both its damaging and useful applications. Heavy metals are naturally occurring components of the earth's crust, but human actions have severely disrupted their geochemical cycles and biological

equilibrium. Heavy metals refer to all hazardous metals. Since heavy metals have a tendency to concentrate in specific organs of the body. The average levels of safety in food and water are frequently deceptively high.

Properties of Heavy Metals

They are found close to the bottom of the periodic table. • They have large densities. • They are toxic and nondegradable.

Note: Arsenic is a semimetal, which means that its properties are midway between those of metals and nonmetals.

Heavy Metals and Living Organisms

Variable levels of heavy metals are required by all forms of life. The human body requires iron, copper, manganese, and zinc. For example, plutonium and lead are poisonous elements with no known vital or helpful effects on living beings. They collect and disrupt the function of our body's essential organs and glands, such as the heart, brain, kidneys, bone, and liver, among others. They dislodge essential dietary minerals from their native location, so hindering their biological function. There are numerous routes by which these poisons might enter the body, including eating of various foods, exposure to household items, personal products, and a variety of industrial products and chemicals.

Heavy Metals Contamination of Vegetables

Vegetables are an essential part of the human diet, hence their contamination with heavy metals must not be understated. Vegetables are abundant in vitamins, minerals, and fibre, and they also possess antioxidative properties. The

contamination of food with heavy metals is one of the most critical components of ensuring food quality.

Heavy Metals and Environmental Pollution

Heavy metals are essential to life and occur naturally in the environment, but when they accumulate in organisms, they can become harmful. Mercury, cadmium, arsenic, chromium, nickel, copper, and lead are a few of the most prevalent heavy metals that poison the environment. Typically, the concentration of metals in soil ranges from less than one to more than one hundred thousand mg/kg. The usage of pesticides, fertilisers, and emissions from municipal waste incineration and smelting companies has poisoned a huge amount of land with heavy metals.

Heavy Metals Effects on Water and Consequences

Heavy metals are present in geological structures and can therefore infiltrate the water supply via natural processes. For instance, intense precipitation or water flow can drain heavy metals from geological strata. These processes are worsened by the distribution of this geology through economic activities such as mining.

General Sources of Heavy Metals

Heavy metal contamination is mostly caused by industrial operations and accumulates gradually in the surrounding water, air, and soil. Indoor sources include old lead-based and latex-based paints, home water supply, wood combustion, and tobacco smoke. Indoors, pesticides and fungicides are significant sources of arsenic and mercury.

Arsenic

Oral administration of several arsenic compounds (especially inorganic arsenic) results in rapid absorption in humans. There is some evidence that inhaled arsenic can be absorbed through mucociliary clearance (respiratory mucociliary clearance) and that the bulk of arsenic is absorbed through the stomach. Following consumption, arsenic builds up in the body's tissues and fluids. The liver, renal, lungs, spleen, aorta, and skin are the primary distribution sites. Arsenic chemicals are very easily deposited in hair and nails. In animals, dimethylarsinic acid (DMA) is the most frequently excreted metabolite (> 90%).

Symptoms of Toxicity

Acute toxicity:

The symptoms of acute reaction to arsenic compounds include a burning sensation in the mouth and throat as well as nausea, vomiting, stomach discomfort, muscle cramps, dysentery (rice-water stools), breath that tastes like garlic, thirst, and a metallic taste. People who come into contact with arsenic compounds get skin irritation, skin lesions, and irritation.

Chronic toxicity:

It has been demonstrated that repeated exposure to arsenic compounds leads to the development of several organ dysfunctions, including- Dementia, cognitive deficits, and hearing loss are neutral Pharyngitis, laryngitis, pulmonary insufficiency are respiratory conditions. Abnormalities of the skin: darkening of the skin and the development of little "warts" or "corns" on the palms and soles (palmar keratosis). Also present on the fingernails are pale lines (Mees lines) that resemble traumatic wound

Carcinogenic: The connection between arsenic exposure and malignancies of the skin, liver, respiratory system, kidney, bladder, and gastrointestinal tract is widely known.

Lead toxicity:

Lead is ranked and on "the Top Hazardous Substances"

Lead is one of the oldest chemical poisons, and lead poisoning is perhaps the most significant chronic environmental ailment impacting children today. Lead appears in both organic and inorganic molecules in the environment. Inorganic lead compounds are less poisonous, and direct ingestion of lead compounds or lead-contaminated objects is the primary cause of lead poisoning.

Sources of Exposure

Occupational exposure	Non-occupational exposure
Battery makers	Battery burning
Cable makers	Cooking in leaden pots
Glass makers/polishers	Traditional Chinese Medicines Containing Lead
Painters	The ingestion of paints
Pigment makers	Several countries still utilise them as fuel additives.
Printers	

Lead Distribution

Primarily, lead is exchanged between the following three compartments:

Blood

Soft tissue (liver, kidneys, lungs, brain, spleen, muscles and heart)

Mineralizing Tissues (Bones and Teeth)

Lead rapidly penetrates the placenta and is found in breast milk, with the foetus accumulating lead during pregnancy. Certain health issues, like as malnutrition and iron insufficiency, might lead to increased lead absorption by the mother. The distribution of lead to the foetus is increased when maternal lead levels are elevated.

Health Effects

Lead poisoning can cause developmental delays or reversals, persistent learning difficulties, seizures, coma, and even death. The greatest long-term impacts of lead exposure occur during the first two or three years of life, when the growing brain is at its most formative stage. Patients exposed to acutely high amounts of lead develop abdominal pain, appetite loss, vomiting, constipation, headache, coma, etc. The growing brain of a kid is unusually sensitive to high-level lead toxicity, which is characterised by cerebellar haemorrhage and increased blood-brain barrier permeability in the microvasculature. The toxicity of lead has been linked to lower fertility and higher miscarriage rates.

Chronic lead poisoning symptoms include:

Constipation, intermittent abdominal cramping, and vomiting Appetite loss and reduced libido In addition to weight loss and anaemia, systolic blood pressure rises. Extensor surface tremors and peripheral neuropathy manifesting as wrist

and/or foot drop (most common neurological symptom in adults) Depression is associated with impaired short-term memory cerebral edoema (headache, incoordination)

Mercury

Mercury is the third most deadly substance on the list. Volcanic eruptions cause the vacuum distillation of the earth's crust, which releases mercury into the atmosphere. There are three distinct types to choose from (elemental, inorganic salts and organic mercurial compounds). Smelting, mining, and other forms of industrial activity are all potential causes of pollution in the area. When mercury from the atmosphere travels to other parts of the world by wind, it comes to the earth as precipitation, where it can harm organs such as the brain and nervous system, the kidneys, and the digestive system.

Sources

Compounds of mercury were previously used in paintings as fungicides (these compounds are now prohibited, although old paint supplies and surfaces painted with these old supplies still exist). Florescent bulb bulbs, disc cells and electrical switches are all examples of mercury-based products. Dental amalgams and thermometers are all mercury-based products. Antimicrobials (mercurochrome and Merthiolate) and some immunizations are still readily available to the general public today.

Elemental Mercury

Inhaling vapour at high concentrations causes acute necrotizing bronchitis, pneumonitis, and at extremely high doses, mortality. Burns or irritations of the skin and nose may occur.

Long-term exposure can have a negative impact.

Early: insomnia, impaired memory, anorexia, mild tremor

Late: nervousness, increased salivation, and renal toxicity are all symptoms of the condition known as erythrocyte toxicity (or nephrotic syndrome).

The breakdown of mucosal barriers leads to an increase in absorption and distribution to kidneys (proximal tubular necrosis and anuria). Skin exposure is the most prevalent cause of Acrodynia (Pink illness, erythroedema, or Feer's disease). Peripheral neuropathy, hypertension, and renal tubular failure occur as a result of the pink, maculopapular rash and pus-filled skin eruptions on the fingertips, toes, and nose.

Control Methods

- Vacuuming the house on a regular basis is an efficient way to remove harmful toxins.
- Wood-burning stoves can be replaced with a gas or electricity device.
- Removing old paints containing lead and mercury.
- For mercury removal, a compacted bed of absorbent materials is the most efficient approach.

Conclusions

Heavy metals harm biological life. So, within reason. Heavy metals enter the body through water, air, food, and skin. Acute or chronic metal poisoning can occur. Heavy metals affect growth, proliferation, differentiation, damage-repair,

and apoptosis. Toxic metals can also change epigenetics and gene expression. Arsenic, lead, mercury, cadmium, and chromium affect humans. Effective legislation, rules, and heavy metal detection are needed. Heavy metals can create significant consequences if not controlled. Heavy metals can infiltrate drinking water, air, and foods based on concentration and significant sources. In traces, these metals are essential for cellular, metabolic, and hormonal functioning in humans, but excess leads to significant health risks. The toxicity of these metals kills soil microbes that improve fertility and nutrition. Mercury causes brain, lung, skin, and colorectal cancer. Lead causes colon, CNS, and lung malignancies. Hair and urine samples can detect heavy metals. Too much heavy metal consumption can cause toxicity; follow legal limitations.

References

- Jessica Briffa and Renald Blundell, 2020. Heavy metal pollution in the environment and their toxicology effects on humans. *Heliyon*, Vol 6, Issue 9, *Review article*.
- Godwill Azeh Engwa, Paschaline Udako Ferdinand, Friday Nweke Nwalo and Marian N. Vnachukwu; 2019 Mechanism and health effects of heavy metal toxicity in humans; *open access peer-reviewed chapter*.
- Gharami – Azam, A; Riahi-Zanjami, B; and Balali-Mood, M, (2016). Effects of air pollution on human health and practical measures for prevention in *Iran.J.Res. Med. Sci.* 21, 65. doi: 10. 4103/1735-1995_189646.
- Luo, L; Wang, B; Jiang, J; Huang, Q; Yu, Z; Li, H; etal (2020). Heavy metals contamination in herbal medicines: determination, comprehensive risk assessments. *Front Pharmacol.* 11, 595335. doi:10.3389/fphar.2020.595335
- Mousavi, S.R; Balali-Mood, M; Rihi-Zanjam; B Yousefzadeh, H; and Sadeghi, M. (2013). Concentration of mercury, lead, chromium, cadmium, arsenic and aluminium in irrigation water wells and waste water used for agriculture in Mashhad, northeastern Iran. *Int.J,Occup.Environ.Med.*4(2 April), 80-86.
- Harris CC. Chemical and physical carcinogenesis : advances and perspectives. *Cancer Res.* (1991); 51: 5023s-5044s
- Hazelhoff M.H; and Torres, A.M.(2018). Gender differences in mercury induced hepatotoxicity: potential mechanisms. *Chemosphere* 202, 330-338. Doi:10.1016/j. chemosphere, 2018. 03,106.
- Zhitkovich, A. (2011). Chromium in drinking water: sources, metabolisms and cancer risks. *Chem. Res. Toxicol.* 24(10), 1617-1629. doi:1021/tx200251t.