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Review Article

Heavy metals and their side effects on human beings

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ABSTRACT

Metals are useful substances that occur in nature in different forms. Some useful metals are iron, copper, aluminum, and chromium. They are used in various industries like food, pharmaceutical, cosmetics, leather, automobiles, etc. For accelerated economic growth, humans introduced these metals into various natural resources. This resulted in various problems like biological magnification, health disorders, soil fertility reduction, etc. Therefore, it is mandatory that the use production, and release of these metals should be controlled and monitored through strict rules and regulations.

Keywords: Cardiovascular disorders, Electropositive, E-waste, Hexavalent ions, Toxicity

INTRODUCTION

Metals are those substances that are electropositive in nature. They are found in nature in abundant quantities in the earth's crust and in oceans. They are mostly found in the form of chemical compounds except for noble metals which include Gold, Platinum, Palladium, etc. Metallic ions are useful for organisms in form of micronutrients. But their excess quantity is also harmful to organisms[1]. The toxicity of heavy metals is very dangerous for organisms even in micro quantities. Some common heavy metals are mercury, cadmium, arsenic, copper, lead, etc. Exposure to these metals can result in health disorders in various vital organs like

the brain, heart, lungs, kidneys, etc. These metals are useful in various industries like automobiles, electronics, textiles, cosmetics, food, pharmaceuticals, etc[2]. These metals act as pollutants and are responsible for the degrading quality of various natural resources like soil, pond, river, air, etc. Sometimes they directly enter into the food chain and became lethal for organisms. Side effects and uses of some heavy metals are discussed as follows:

1. **Arsenic**

It is an element that is a metalloid in nature. Its atomic number is 33. Its symbol is As. It is widely found in the earth's crust. Most often, it is found in underground water. It is used as an N-type semiconductor in electric devices[3]. It is also used in textiles, paper, glass, adhesive industries, etc. Side effects: Arsenic is a type A carcinogen. It can cause skin cancer, lung cancer, bladder cancer, and liver cancer[4]. Recent studies showed that it is also responsible for cardiac disorders, neurological side effects, diabetes, etc. It is also stated that mostly its toxicity is associated with water. It can be found in the air, water, and soil. Hopenhayn et al. studied the relationship between the use of arsenic in drinking water and infant birth weight[5]. Higher accumulation of arsenic negatively affected children's weight by approximately 57 g.

2. **Mercury**

It is a metal and its symbol is Hg. Its atomic number is 80. It is also called quicksilver. Its physical state is different from other metals[6]. Most metals are solid at room temperature but mercury exists as a liquid at room temperature[7-9]. Its specific density is 13.6 which makes it exceptionally denser than other elements. It is widely used in lights, switches, thermometers, barometers, batteries, etc.

Side effects: Mercury is highly toxic in nature. Its special ability to form

coordination compounds makes it more dangerous[10]. It bonds with useful ions and degrades enzymes in the body. Its major side effects include insomnia, neurodegenerative disorders, memory loss, motor dysfunction, etc. Reports confirmed that mercury is largely accumulated through the consumption of shellfish and fish[11]. A study conducted in China revealed that mercury accumulation in children's blood depends on the region and on the rate of fish consumption. The quantity of organic mercury (e.g., methylmercury) depends on the species of fish[12-14].

3. Cadmium

Cadmium is another heavy metal. Its atomic number is 48 and its symbol is Cd. It occurs naturally in the earth's crust. Its main uses include electric cells and batteries, electro-plating, semiconductors, etc.

Side effects: Cadmium has been found to induce the risk of cardiac disease. Li et al. showed the link between cadmium in tobacco as a cardiovascular disease factor. In China, cadmium is mainly ingested via the consumption of rice[16]. Furthermore, the dismantling of Chinese e-waste exposes those in the vicinity to higher concentrations of cadmium, and those that consume rice grown in the area display a 60% increase in hazard quotient[17]. Food contamination with cadmium can occur through natural sources, as well as from sewage and pesticides or insecticides that mixes in groundwater and runoff from fields into water bodies, thus causing the presence of cadmium in fish and oysters. One-third of the total Cd amount in the human body is accumulated in the liver and in the kidneys[18].

4. Lead

Lead is another heavy metal. Its atomic number is 82 and its symbol is Pb. It is

physically softer but denser than other elements. It is widely used in paints, solders, batteries, cosmetics, food additives, etc. Lead poisoning is often associated with gasoline, mining and batteries, and other electric devices, but the source of the poisoning may be different and unexpected[19].

Side effects: In the Middle East, people produce households using a stone mill, but, the stone is held with a lead binder, which causes contamination. Lead and cadmium are responsible for decreasing amounts of calcium and abnormal bone metabolism. Exposure to lead is especially dangerous for children, as it interferes with the development, growth, and differentiation of the nervous system and it causes damage to bone tissue[20].

5. Chromium

Chromium is a metal. Its atomic number is 24 and its chemical symbol is Cr. It is lustrous hard and grey-colored metal. Its melting point is 1097 degree Celsius. It is mostly found in trivalent and hexavalent ionic forms. It possesses anti-corrosive properties Anticorrosive properties of chromium make it suitable for making alloys like stainless steel. It is also used in the preparation of dyes and paints[21].

Side effects: Trivalent chromium is found in nuts, broccoli, whole-grain products, and eggs. It is found that chromium ions interfere with glucose metabolism and fat metabolism. Hexavalent ions are toxic and carcinogenic. Chromium is primarily generated by industrial activity and is used in leather tanning, wood preservation, etc. Areas with tanning industries are frequently affected by chromium (VI) where sewage waste degrades the composition of groundwater and soil. In Kanpur, India, drinking water contains high concentrations of chromium (VI)

exceeding the average by approximately 390-fold, and causes digestive, and skin problems[22].

CONCLUSION

In this study, it is found that many metallic ions are harmful to human beings and the environment. Their unregulated exposure to air, water, and soil degraded their quality. Excess introduction of these toxic ions resulted in various harmful disorders like kidney failure, neurodegeneration, cancer, motor dysfunction, cardiac and gastrointestinal disorders, etc. Most often their introduction is associated with industrial activity although they also occur naturally. Therefore, it is suggested that strict guidelines should be issued for the industries which produce and use these elements in their products. Also, the quality of water and soil should be monitored at regular intervals so that it should cause diseases in human beings.

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