Chapter 12
Health Effects of Heavy Metals Contamination in Children

Jutishna Bora
Amity University, Ranchi, India

Masum Kumari
Amity Institute of Biotechnology, Amity University, Ranchi, India

Ipsita Panda
Amity Institute of Biotechnology, Amity University, Ranchi, India

Shruti Gupta
Amity Institute of Biotechnology, Amity University, Ranchi, India

Swati Priya
Amity Institute of Biotechnology, Amity University, Ranchi, India

Sagar Mondal
https://orcid.org/0009-0000-8943-3950
Amity Institute of Biotechnology, Amity University, Ranchi, India

Sumira Malik
Amity Institute of Biotechnology, Amity University, Ranchi, India

Smita Lata
Amity Institute of Biotechnology, Amity University, Ranchi, India

ABSTRACT

Heavy metals are naturally occurring elements with a high atomic weight and a minimum density five times greater than that of water. Many heavy metals are known to be highly toxic and can be absorbed by humans through ingestion, inhalation, or skin contact, leading to various health issues. Children are particularly vulnerable to the health effects of heavy metal exposure compared to adults. The detrimental impact of these elements on children's health encompasses conditions such as intellectual disabilities, neurocognitive impairments, behavioural issues, respiratory ailments, cancer, and cardiovascular disorders. Given their potent toxicity, extensive utilization, and widespread occurrence, heavy metals warrant significant attention. This review thus investigates the pathways of exposure and health ramifications associated with mercury (Hg), lead (Pb), chromium (Cr), cadmium (Cd), and barium (Ba) in children, elucidating their toxic effects. In addition, different treatment methods are being discussed.

DOI: 10.4018/979-8-3693-1471-5.ch012

INTRODUCTION

Metals with particular density of greater than 5g per centimetre cube or atomic weight or numbers are referred to as heavy metals (National Research Council. (1991)). Examples of some heavy metals are copper (Cu), lead (Pb), chromium (Cr), arsenic (As), cadmium (Cd), mercury (Hg), barium (Ba) and aluminium (Al). For thousands of years, heavy metals have been utilised in a wide range of applications. lead has been utilised in many purposes such as construction materials, pigments for glazing ceramics and in pipes used for water transport for over thousands of years. Many regions of Latin America still employ mercury in their gold mining operations. While its use has drastically declined in affluent nations, tetraethyl lead is still often added to petrol and arsenic is still commonly found in wood preservatives. Concerns about the environment and public health brought on by heavy metal poisoning have grown in recent years. Heavy metal emissions to the surroundings occur through a variety of activities and channels, including those to the soil in the form of groundwater and crops, air- during processing, combustion & extraction, surface waters runoff and releases from transport & storage. Because of the significant amounts involved, as well as the vast spreading and risk of exposure, atmospheric emissions are often the most concerning in terms of human health. Anthropogenic activities such as mining, agriculture, mining, manufacturing and smelting all add considerably to their discharge into the environment (Tchounwou et al (2012)). Contamination can also occur as a result of corrosion, air deposition, sediment re-surfacing, leaching, corrosion, ion erosion, and metal evaporation from a contaminated source of water into the soil and groundwater supplies (Cai et al(2019)). Natural occurrences such as weathering & volcanic outburst also contribute to its environmental pollution. Exposure, however, is caused by more than just the presence of a dangerous chemical in the environment. Contact is the crucial term in the description of exposure. There needs to be contact between the substance and the human body's exterior boundary, such as the mouth, airways or skin. Exposure is often described as a combination of concentration & time: “a condition that takes place when a contaminant of a particular concentration comes into contact at an interface between outside world and the human for a certain period of time”. Heavy metals have been shown to block cellular organelles and systems such as the mitochondria, endoplasmic reticulum, nuclei, lysosomes, cell membrane and a number of enzymes involved in the damage repair, body's metabolism & bodily cleansing (Tchounwou et al (2012)). They also communicate with proteins & DNA, causing damage to the genome and conformational changes that might lead to cycle regulation, apoptosis, cancer and damage to genome (Tchounwou et al., 2012).

MERCURY (HG)

Mercury can be found in three distinct forms- organic, inorganic, and elemental mercury compound (Al Osman, M., Yang, F., & Massey, I. Y. (2019)). Mercury enters the environment because of the innate degassing of the crust of the earth. Human activities might also generate mercury contamination. According to estimates, human actions are responsible for hundreds of tonnes of mercury discharged into the environment. It prevails as mercury vapour in the air we breathe, which is the principal route of global pollution transport. It remains unchanged in the air for roughly a year. It then transforms into a water-soluble state and returns to the earth's surface. Microorganisms, primarily bacteria, then transform it back to mercury vapour or mono-methyl mercury compounds. Mono-methyl mercury can enter the food web of aquatic animals via aquatic species such as fish & phytoplankton. As a consequence,