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Effects of Lead and Mercury Poisoning on Human Body — an Overview

Lida Anwari, (MD, MRCOG)

Consultant Obstetrician and Gynaecologist

Mediclinic Parkview Hospital, Dubai, UAE

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Abstract: **This article briefly reviews the most common health risks associated with the accumulation of toxic trace metals lead (Pb) and mercury (Hg) in human bodies. Although these trace metals can trigger any body organ, soft tissues are apparently more vulnerable to their toxicity due to changing in chemistry and metabolic activities of the body. Due to marked sensitivity of the body to Pb and Hg poisoning, the body tissues, especially those with soft nature must be avoided of exposure to these elements at all times even at their low levels of accumulation.**

Keywords: **trace metals, trace elements, lead, mercury, poisoning.**

1. INTRODUCTION

Exposure to trace metals of human body can usually results in its poisoning at different levels depending on the duration and extent of the exposure, and the oxidation-reduction state of the element (Rehman et al., 2021). Although trace elements accumulate in soft body tissues in small amounts as catalysts in enzymatic systems, significant damage to the body occurs if they reach high levels in the tissue (Varkouhi and Amin Sobhani, 2005; Varkouhi et al., 2006a; Varkouhi, 2007a). Among toxic trace elements, lead (Pb) and mercury (Hg) have been the subject of numerous research due to their several severe and chronic toxic effects on various body organs. The human body can be exposed to these trace metals through food chain (in particular the consumption of aquatic biota), water, air, soil, and sediment, given their potential to accumulate in different tissues (Varkouhi et al., 2006b, Varkouhi, 2007a). Former works confirm these metals can also accumulate in the environment through anthropogenic practices, such as mining activities, construction, urban/rural water systems, industrial effluents, and agricultural wastes (Varkouhi et al., 2006b; Varkouhi, 2007b; Varkouhi, 2009, 2010), and enter the food chain. Comparable with anthropogenic activities, these trace metal along with other elements (e.g., aluminium and iron) are known to be emitted to the environment via natural sources, e.g., chemical weathering of continental silicates, sea-salt scattering, biogenous sources, and wind-driven soil particles (Masindi and Muedi, 2018). Amongst these, weathering of continental source aluminosilicates is a dominant process, which leads to precipitation of these elements commonly as oxides, authigenic silicates, sulphates, sulphides, phosphates, and organic components (Varkouhi et al., 2017; Varkouhi, 2018; Varkouhi and Wells, 2020; Varkouhi et al., 2020a, 2020b, 2021a, 2021b).

Given their harmful consequences for human health, the following sections are dedicated to a brief discussion of the origin of Hg and Pb release into urban/rural systems, with their level of impacts on body tissues.

Hg

The common source of Hg release to human body is seafood, and consumption of excessive contents of the seafood, e.g., more than 2 weekly average servings, absorbs high amounts of Hg (Anwari, 2023). Hair Hg levels > 0.3 ppm suggest a potentially excessive body burden, and the increasing risk of methyl-mercury poisoning. Although the threshold levels of Hg vapour less than 0.05 mg/m^3 are considered to be safe values, these concentrations do still not adequately protect vulnerable bodies. Enzymatic imbalances and nerve excitement have been documented in adults exposed to 0.01 to 0.05

mg/m^3 of Hg, and thus one needs to avoid being exposed to Hg concentrations above 0.01 mg/m^3, Zhou et al., 2014). Mercury can damage different parts of human organs, including lungs, kidneys, and nervous system, and can even cause hearing and vision deficiencies (Fernandes Azevedo et al., 2012). Microbial communities in planktonic or the biofilm state, solitary or in consortium, in-situ occurred or introduced as genetically modified organisms under aerobic or anaerobic conditions and even extremophiles, are able to detoxify Hg and alter its phase to less-toxic valence through various metabolic scenarios, including biosorption and bioaccumulation (Varkouhi, 2006; Eltarahony et al., 2023).

Pb

The presence of Pb in the blood is mainly the result of consumed Pb-contaminated drinking water. The water can be contaminated with Pb in urban/rural residential regions, where the water is supplied to the drinking waters via leaded pipes and source lines. The drinking water can be contaminated by Pb when affected by effluents, sewages, and combustion of fossil fuels, too (Varkouhi, 2009). No safe concentrations of Pb exposure are presently detected for human bodies and there is no threshold for the adverse Pb effects. Nevertheless, for the blood Pb >0.05 ppm, the origin of Pb exposure need to be detected and the affected person should avoid further exposure. In addition, unsafe Pb levels in the human blood can lead to baby birth as well as hurting the baby's brain, kidneys, and nerves, and causing the child to develop learning or behavioural deficiencies (Bellinger, 2008; Landrigan et al., 2022). The excessive levels of Pb in the blood circulation can also develop uterine anomalies, which may result in prolonged intraperitoneal bleeding (Anwari, 2021).

2. DISCUSSION AND REMARKS

The present work discussed the impact of toxic trace metals Pb and Hg on the health of human body. Although non-essential trace elements are harmful to the body tissues at levels exceeding their safe threshold, these toxic metals highly affect the body even under very low toxicant concentrations. These contrasts between the response of the body to toxic-metal contamination as compared with vulnerable human tissues is related to alterations in the metabolism and chemistry of the body as well as the imbalanced health behaviours due to metabolic variations. Hence, in consultation with toxicology experts, the exposure to toxicant metals even in situations that toxicity falls below the unsafe values is highly recommended. Future studies on the basis of broad data collection from different age groups is necessary to come up with more realistic results on the health outcome for Pb- and Hg-contaminated human body.

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