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Editorial

Human Health Risks of Essential Zinc and Copper in the Topsoils: The Need for Continuous Assessments

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Abstract

Topsoil metal pollution has detrimental impacts on human health. Despite the growing numbers of publications on the human health risk assessments (HHRA) of essential zinc (Zn) and copper (Cu) in the topsoils of various land uses, a more detailed understanding of HHRA of the topsoil metals is still relatively scarce. Therefore, this paper aims to review and highlight the importance of soil pollution of essential Cu and Zn for the HHRA. According to selected literature, land uses with high anthropogenic inputs usually exhibited higher hazard quotient values for three pathways (ingestion > skin contact > inhalation ingestion) of the metals Increasing levels of topsoil metal pollution in recent years have concerned scientists and environmental managers because of their significant impacts on the ecosystem and human's health entering the body systems of adults and children. It was evident that the non-carcinogenic risks of essential Cu and Zn had no substantial negative health implications on adults and children. Nevertheless, continuous HHRA of these essential metals in the polluted soils of varied land uses is still necessary to preserve human health and well-being.

Keywords: *Health Risk; Essential Metals; Topsoils*

Introduction

Soil-heavy metal pollution is linked to numerous anthropogenic activities such as industries, households, landfills, and agricultural plantings [1-4]. These activities potentially contribute to urban-level anthropogenic heavy metal pollution [4-7]. Environmental heavy metal pollution is a global issue, as growing industrialisation and human expansion have exacerbated the discharge of potentially dangerous metals into the soils [8,9]. Elevated metal levels in topsoils from diverse land uses could harm the soil's biological system and associated animals and plants. Excessive accumulation of heavy metals in topsoils may enter the body of higher trophic level organisms including humans via multiple pathways, and the long-term exposure to metal contaminants can ultimately implicate human health [10]. Increasing levels of topsoil metal pollution in recent years have concerned scientists and environmental managers because of their significant impacts on the ecosystem and human's health. Topsoils have been identified as practical diagnostic tools for environmental factors that affect human health. These samples included different land uses such as industrial, rubbish heaps, and residential urban areas [11-14]. Direct and indirect connections between metal-contaminated soils and human health risks have been reported [15,16] and the detrimental effects of elevated metal levels on human health were evident in many studies across the globe [1,10,13,15,17-19].

The worldwide publications related to human health risk assessment (HHRA) of essential metals in soils are expected to perpetually increase in the near future [2,19-21]. HHRA of heavy metals in soils from various land uses has been observed predominantly in China [22-24]. There is also a growing body of evidence indicating the significant association between metal-polluted soils and both children's and adults' public health. This paper, therefore, aims to review and highlight the importance of soil pollution of essential zinc (Zn) and copper (Cu) in connection to HHRA.

Human health risk assessment

In particular, three pathways (ingestion, inhalation, and skin contact) have been identified for reaching the human body via the topsoil matrices [1,13,17-19]. The three pathways have been widely used to assess non-carcinogenic risk (NCR) to people. The HHRA has been established based on the guidelines from the US Environmental Protection Agency and the Exposure Factors Handbook [25-28]. The hazard quotient (HQ) is the ratio of a metal's average daily dose (ADD) to its oral reference dose (RfD). The RfD (mg/kg day) is the maximum daily dose of metal from a particular exposure pathway determined not to pose a significant risk of harmful consequences to sensitive individuals throughout their lives. If the ADD is less than the RfD value (HQ < 1), it is assumed that there will be no adverse health consequences. However, if the ADD is greater than the RfD value (HQ > 1), there will almost certainly be negative consequences [25,27].

The NCR is calculated using the hazard index (HI), which is the sum of the HQs in the three exposure pathways [29-31]. A HI of 1.0 indicates no significant risk of non-carcinogenic effects, while HI greater than 1.0 implies non-carcinogenic effects. The increase in HI value is anticipated to have a positive association with non-carcinogenic effects [14].

Due to metals exposures in the topsoils of varied land uses, Yap., *et al*. [4] published the HHRA results in Peninsular Malaysia. They discovered that children had higher HQ of ingestion and HQ of dermal contact values than adults, whereas adults had higher HQ of inhalation values than children. They also claimed that the three different exposure pathways for Zn and Cu decreased following the pathways ingestion > skin contact > inhalation for both adults and children.

Analyses of six heavy metals (including the essential Zn and Cu) in urban soils of steel industrial city in Anshan (China), Qing., *et al*. [13] indicated that the main form of exposure that caused harm to human health was through ingestion. Human health risks of essential metals through ingestion were also evident based on the street dust data from India [12] and Beijing [15]. Ingestion of soil particles, in particular, was identified to impose health risks on the residents of Guangzhou, 17], Angola [29], and Greece [31].

When HI values for children and adults were examined, Yap., *et al*. [4] found that children were at a higher risk of NCR from essential Zn and Cu in the topsoils collected from in rubbish, landfills, and industrial sites than adults [4]. This is because of their behaviour and physiology. Children are more likely to be exposed to topsoils polluted by essential Zn and Cu. Pica, as well as thumb or finger-licking, have been linked to a higher NCR in children than in adults [15,22,32]. The amount of skin exposed to the human body was proportional to the rise in non-carcinogenic health risks. Adedeji., *et al*. [20] also reported that, that children were the most vulnerable to metal soil exposure based on total HI. Nevertheless, the above-mentioned studies found no substantial negative health implications since the HQ < 1.

Conclusion

Land uses with high anthropogenic inputs, such as industrial and landfill regions, exhibited higher HQ values for the three HHRA pathways. Ingestion > skin contact > inhalation are the three main Zn and Cu exposure pathways for children and adults. The HHRA of essential metals at varied land uses is still required to preserve human health and well-being, although the NCR of essential Zn and Cu based on the literature for children and adults had no substantial negative health implications.

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