ASSESSMENT OF POLLUTION LEVELS AND HUMAN HEALTH RISK OF HEAVY METALS IN SNOW DUST (CASE STUDY, YEREVAN)

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Introduction

Dust is known as the main pollutant of urban air. Also, dust is a carrier of toxic elements emphasizing heavy metals, which can produce a negative impact on humans.

Snow has good sorption properties for accumulation of pollutants from atmosphere and hence acts as a natural filter for chemical elements and particles. Therefore snow cover can serve as a good alternative medium of airborne dust and metals investigation.

Yerevan, to which this research is directed, is an industrial center with dense population and heavy traffic. The goal of this research was to evaluate snow dust heavy metals pollution levels and to assess associated health risks to different groups of population (children and adults).

Methods

Wholly 24 snow samples were collected from the entire are of the city of Yerevan in 2011. Total concentrations of Cd, Pb, Cr, Ni, Co, Zn, Cu, Ag, Hg and Mo were determined by AAnalyst 800 AAS PE, USA. Single heavy metal contamination was estimated by pollution index (PI) and geoaccumulation index (Igeo), while summary pollution level - by contamination index (Zc) (Johnson et al. 2011). Non-carcinogenic and carcinogenic risks assessment was done consistent with a health risk model developed by US Environmental Protection Agency (US EPA 1989) considering three main pathways of exposure.

Results

Ni, Co, Ag, Cr, Pb, Mo, Cd, Zn, Cu were detected in all samples. Mean contents of all studied elements except Co, Cr and As have PI greater than 1. According to the mean values of I_{geo} Co, Ni and Cr belongs to the unpolluted level, Zn - moderately polluted, Cu - moderately to strongly polluted, Hg and Pb - strongly polluted, Ag and Cd - strongly to extremely polluted, Mo - extremely polluted.

Zc values ranges from 18 to 15368 averaging 760.3 (extremely hazardous level). Moreover, Zc of 21% of all samples exhibit very high, 17% - high, 12% - medium, 50% - low level of pollution (Fig. 1). Relatively large share in the Zc mainly belongs to Mo, Pb, Hg and Ag.

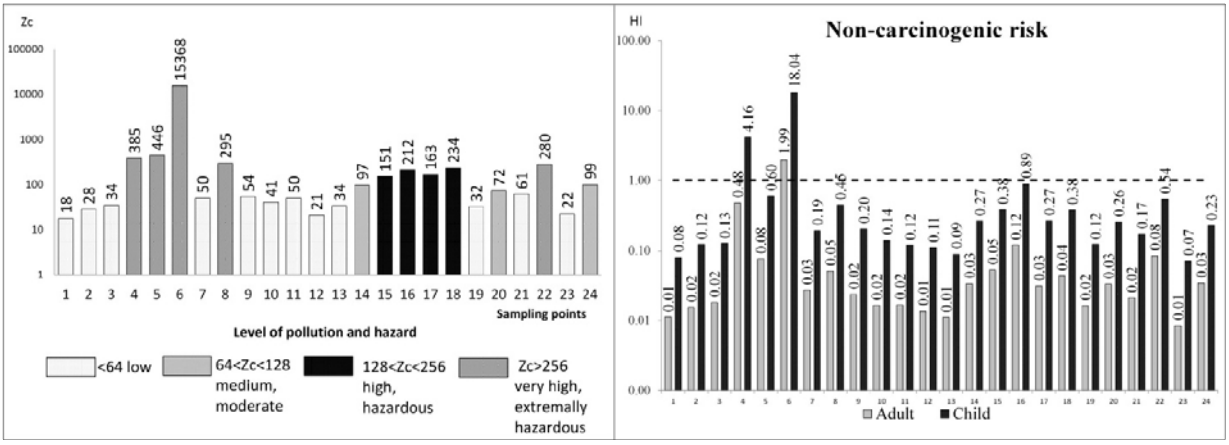

Figure 1. Contamination index (left) and Non Carcinogenic risk for child and adult (right)

Multi-elemental HI value (Fig. 1) varies 0.07 to 18.04 for children and 0.01 to 1.99 for adults. Moreover, a probable heavy metal-induced non-carcinogenic risk in children and adults is posed by 2 and 1 dust samples, respectively. For children major risk is determined by Mo and Co. HI>1 was in 1 sample both for Mo and Co (17.22 and 3.78, respectively). For adults major risk is determined by Mo in 1 sample (HI = 1.85). Carcinogenic risk from inhalation pathway was less than acceptable level of 10^{-6} for Cr, Ni, Co in all samples. In case of ingestion pathway low level (10^{-6} - 10^{-5}) of carcinogenic risk from Cr was observed in 16 samples, while in 14 remained samples risk was at acceptable level.

Conclusion

The obtained results indicating that except Co, Cr and Ni for other studied elements significant values of PI and I_{geo} were detected. Although the territory of the city is characterized mainly by low levels of contamination, there exist areas with high and very high pollution levels. Relatively large share in the contamination index mainly belongs to Mo, Pb, Hg and Ag.

Non-carcinogenic risk was observed for children (Mo and Co) and for adults (Mo). From all studied elements carcinogenic risk was determined only in case of Cr, particularly low level carcinogenic risk from ingestion pathway was observed in 16 samples.

References

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