

Health Risk Assessment of Heavy Metals in Atmospheric PM_{2.5} in Tianshan District and Midong District of Urumqi in 2023

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Abstract: To assess the health risks posed by heavy metals in atmospheric PM_{2.5} to the population in Tianshan District and Midong District of Urumqi in 2023, this study referred to the Ambient Air Quality Standards (GB3095-2012) and relevant sections of the U.S. Environmental Protection Agency's Regional Screening Levels (RSL) General Table for ambient air. Toxicological parameters of heavy metals via inhalation were summarized. A benchmark excess cancer risk of 1×10^{-6} and a hazard quotient of 1 were used to calculate screening concentrations and determine whether further assessment was required. Exposure concentrations were computed using relevant formulas, and both carcinogenic and non-carcinogenic risks were evaluated based on the excess cancer risk and hazard quotient formulas. The results showed that the annual average concentrations of 12 heavy metals in PM_{2.5} in both districts followed the order: aluminum > lead > manganese > arsenic > selenium > antimony > chromium > nickel > cadmium > thallium > beryllium > mercury. Statistically significant differences ($P < 0.05$) were observed in the distribution of seven heavy metals (antimony, aluminum, arsenic, beryllium, lead, nickel, and thallium) between the two districts. The annual average concentrations of lead, cadmium, and mercury did not exceed the national standards. Health risk characterization indicated that the excess cancer risks of arsenic and chromium exceeded 1×10^{-4} . The lifetime excess cancer risks at the 95th percentile in Midong District were 1.43×10^{-4} for arsenic and 1.17×10^{-4} for chromium, while in Tianshan District, they were 1.04×10^{-4} for arsenic and 4.83×10^{-5} for chromium. These levels indicate significant carcinogenic risks to the population, necessitating targeted prevention and control measures to mitigate health risks.

Keywords: PM_{2.5}; Heavy metals; Health risk assessment; Excess cancer risk