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Size partitioned particulate matter with potential sources and threats of total and bioavailable metals inside varied residences of Northern India

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To assess the extent of air quality within residential environments in Northern India, size fractionated particulate matter (PM) pollutant in coarse (>2.5 μm) and fine (quasi-accumulation ranges) (2.5-1.0, 1.0-0.5, 0.5-0.25 μm) have been analyzed during heating season of 2016 in domestic homes of Agra, India. PM samples were collected on PTFE filters with Sioutas cascade impactor at urban and roadside sites and used in tandem with a health risk assessment model to study the impact of size segregation of PM on the extent of metal bound risk in both adults and children residing in varied residences; that were further stratified through their 'socio-economic strata'. The study presented that indoor activities and discrepancy in lifestyle affected indoor particle mass concentration level dependent upon the source and house characteristics. Results revealed increased exposure (26-41%) in low-income groups with elevated loading for smaller size particulates (PM0.5-0.25= 54.08 μg/m3). Size partitioning trend of elements allowed the recognition of three main behavioral groups (a) elements: Fe, Ca, Cr, Cu concentrated in coarser particles (b) elements distributed mainly within fine particle ranges: Zn, K, Al, Pb, Ni and (c) elements: Mn and Mg exhibiting indefinite partitioning pattern. Higher non-carcinogenic and carcinogenic risk were found within Mn (HQ= 12.1) and Cr(VI) (ELCR= 1.21*10-3 (adults); 3.63*10-4 (child)) in fine (PM2.5-1.0) and coarser (PM>2.5) fractions respectively. In addition, the 'ammonium acetate' extraction of bioavailable elements accounted lower risks relative to total metal concentration thus implying its application in further health toxicology studies. Besides, bioavailability varied with an element (highest for Pb (21%)) with stronger dependency for particle size (PM0.5-0.25) which also supported the construal of an observed increase in aerosol enrichment to the finest particle. Results of this work provide insight into size segregated particulate monitoring and address need for an inclusive investigation to study its toxicity and control measures in establishing the safer indoor environment.

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