Title *

Aggregated Exposure Estimates for Fine Particulate Matter from Indoor and Outdoor Sources

Abstract *
Human exposure to fine particulate matter ($PM_{2.5}$) from different indoor and outdoor sources is a major contributor to global disease burden. Addressing this problem requires an improved understanding of the complex, multi-source emission-to-exposure environment. In response, we established a coupled indoor-outdoor emission-to exposure model to provide aggregated exposure factors for archetypal indoor and outdoor, urban and rural source environments. We followed a matrix-based mass balance approach for quantifying exposure to primary $PM_{2.5}$ from indoor and ground-level outdoor sources. Emission-to-exposure archetypes range from global default indoor and outdoor averages, over archetypal urban and residential and occupational indoor settings, to 3646 real-world urban areas in 16 parameterized sub-continental or 8 continental regions and individual building types. Population intake fractions in urban and rural source environments are lowest in Northern regions and Oceania and highest in Southeast Asia with population-weighted means across 3646 cities and 16 sub-continental rural regions of respectively 39 ppm (95% confidence interval: 4.3-160 ppm) and 2 ppm (95% confidence interval: 0.2-6.3 ppm). Intake fractions in residential and occupational indoor source environments range from 470 ppm to 62000 ppm mainly as function of air exchange rate and occupancy. Indoor exposure typically contributes 80-90% to overall exposure from outdoor sources. Our indoor-outdoor emission-to-exposure framework allows for analyzing important exposure variabilities and for identifying trade-offs between different indoor and outdoor, urban and rural environments and emission sources as foundation for improving air pollution reduction strategies and environmental performance of products associated with $PM_{2.5}$ exposures along their life cycles.
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