A Global Exposure-Mortality Model for Ambient Fine Particulate Matter

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 ABSTRACT:

Exposure to ambient fine particulate matter (PM$_{2.5}$) is a major global health concern, accounting for over 4 million deaths in 2015. Analyses of mortality burden, source contributions and policy scenarios, are based on risk models relating exposure to mortality. To construct such risk models, the Integrated Exposure-Response (IER) function was developed by integrating information over several types of particle exposure, including active smoking, second hand smoke, household pollution, in addition to ambient sources, assuming equal toxicity of particles based on equivalent inhaled doses. We present the first PM$_{2.5}$-mortality relative risk model based only on cohort studies of outdoor air pollution that covers the global exposure range, thus not requiring the strong assumptions made by the IER. We modelled the shape of the association between PM$_{2.5}$ and non-accidental mortality for 41 cohorts from 16 countries representing 20 million subjects and 2.5 million deaths, and combined this information into a single model using a new class of Shape Constrained Health Impact Functions (SCHIF). Our new global mortality burden estimates exceed 10 million deaths. The implications for policy are significant with much greater predicted improvements in human health than previous estimates would suggest.