ASSESSING HEALTH IMPACTS OF CHANGES IN INDOOR PARTICLE CONCENTRATIONS FROM CHANGES IN ENERGY EFFICIENCY: METHODOLOGICAL CONSIDERATIONS

James Milner, *London School of Hygiene & Tropical Medicine, UK*
Paul Wilkinson, *London School of Hygiene & Tropical Medicine, UK*
Ben Armstrong, *London School of Hygiene & Tropical Medicine, UK*
Zaid Chalabi, *London School of Hygiene & Tropical Medicine, UK*
Sotiris Vardoulakis, *London School of Hygiene & Tropical Medicine, UK*
Michael Davies, *University College London, UK*

Background and Aims: Major changes to the energy efficiency of dwellings are planned in pursuit of greenhouse gas mitigation targets. This has renewed interest in the potential health impact of such changes, specifically the degree to which reduced ventilation may affect exposure to particles derived from outdoor sources. However, for health impact calculations, theoretical considerations suggest that exposure-response coefficients derived from studies of outdoor air pollution need to be adjusted to account for time-activity patterns and the relationship between outdoor concentrations and indoor particles from outdoor sources.
Methods: Our starting point is the use of $PM_{2.5}$-mortality coefficients from published sources, specifically the American Cancer Society. Using evidence on the relationship between indoor and outdoor concentrations, combined with estimates of time-activity patterns, we derive an adjusted coefficient for use in health impact studies. Two key assumptions are: (i) indoor $PM_{2.5}$ of outdoor origin is directly proportional to outdoor concentrations; (ii) indoor $PM_{2.5}$ of indoor origin is independent of outdoor concentration.
Results: Building physics models and empirical data provide sets of estimates for the relationship between outdoor levels of $PM_{2.5}$ and those in the indoor environment derived from outdoor sources. These distributions of estimates suggest that the relative risk suitable for health impact calculations of changes in indoor $PM_{2.5}$ exposures should be up to 50% greater than the published coefficients from semi-ecological cohort studies. Different parameters may be applied to obtain the increment in mortality per unit exposure in different conditions.
Conclusions: For health impact calculations of the effect of changes in dwelling-related air exchange rates on exposure to particles from outdoor sources, it is important to adjust the coefficients of exposure-response relationships derived from published epidemiological studies based on outdoor measurements. This scaling implies the burden of mortality associated with indoor air pollution exposures is appreciably greater than previously estimated.