Statistical Methods for Estimating the Health Effects of Coarse Particulate Matter

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Abstract

Ambient particulate matter (PM) can be characterized into the fine and coarse size fractions that represent distinct pollutant mixtures of different sources and properties. Coarse PM includes traffic dust, biogenic compounds (pollen, endotoxin), and various crustal materials from grinding and crushing. Regulating ambient coarse PM level has endured considerable debate and current epidemiologic evidence on its health effects remains limited and mixed. We begin by conducting a national multi-site time series analysis to estimate the risks of hospital admissions associated with daily coarse PM level. Using Medicare data from 108 US counties, we find a positive association between coarse PM level and same-day emergency admissions for cardiovascular diseases after adjusting for fine PM level. However ambient concentrations of coarse PM can vary spatially within the study region. We describe an approach to estimate the acute health effects of spatially heterogeneous air pollutants that accounts for exposure uncertainty in the risk estimates. We also calculate different measures of daily ambient coarse PM exposure and investigate the sensitivity of the national average effect of coarse PM on hospital admissions. Missing data is a second statistical challenge due to the lack of a national monitoring network for coarse PM. By viewing time series of daily PM measurements at a particular monitor as clustered, we develop a "local" Bayesian model averaging (BMA) approach for clustered data. Our approach extends BMA by allowing the weights of competing models to vary between clusters while borrowing information across clusters to estimate model parameters. We then apply our method to a national dataset of daily ambient coarse PM and estimate the posterior probability of nonattainment status for 95 US counties between 2003 and 2005.