Lagged PM2.5 effects in mortality time-series: Critical impact of covariate model

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The two most common approaches to modeling the effects of air pollution on mortality are the Harvard and the Johns Hopkins (NMMAPS) approaches. These two approaches, which use different sets of covariates, result in dissimilar estimates of the effect of lagged fine particulate matter (PM2.5) on non-accidental mortality. We have assembled daily data on air quality, meteorology and mortality for 384 US metropolitan areas for the period 1985 through 2005 to assess the pattern of associations obtained by both covariate models and improve understanding of the basis of these differences. PM2.5 monitoring was not available throughout the time period and only 101 areas had daily PM2.5 data. The observed associations with non-accidental mortality for a 10 micrograms per cubic meter increment in 24-hour average PM2.5 concentrations at lag 1, +0.75% (95% prediction interval (PI) 0.55 to 0.96%) with the Harvard model and +0.25% (95% PI 0.11 to 0.39%) with the NMMAPS model, were similar to those reported in previous publications. We examined the results for these two standard models and six intermediate variant models and found that the magnitude of effects at individual lags 0 to 4 was largely determined by the choice of a single covariate. With unconstrained lags (0-4), the two models produced nearly identical effects: +0.59% (95% PI 0.21 to 0.98%) with the Harvard model and +0.72% (95% PI 0.41 to 1.02%) with the NMMAPS model. Regardless of the covariate model employed, the city-specific effect estimates were highly correlated (Pearson correlation > 0.91) across all lags. Nevertheless, we recommend caution in the interpretation of PM2.5 effects at individual lags in models with different covariates.

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