PARTICULATE AIR POLLUTION AND SURVIVAL: PROPORTIONALITY ASSUMPTION, TIMING OF DOSE, AND DOSE-RESPONSE RELATIONSHIP IN THE HARVARD SIX CITIES STUDY

Johanna Lepeule, Department of Environmental Health, Harvard School of Public Health, Boston, MA, United States
Francine Laden, Department of Environmental Health, Department of Epidemiology, Harvard School of Public Health, Boston, MA, United States
Channing laboratory, Brigham and Women’s Hospital, Harvard Medical School, Boston, MA, United States
Joel Schwartz, Department of Environmental Health, Department of Epidemiology, Harvard School of Public Health, Boston, MA, United States

Background and Aims: The association of fine particulate air pollution (PM$_{2.5}$) with mortality is well established, however questions have been raised about the sensitivity of results to model specification, including whether covariates are proportional and whether the dose-response is linear. We addressed these issues using an extended follow-up of the Harvard Six Cities Study through 2006, incorporating more recent lower exposures.

Methods: 8111 white adults were included. Personal characteristics were collected at enrollment (1974). Vital status has been updated using the National Death Index. Annual PM$_{2.5}$ was measured by study or US EPA monitors. We replicated the original results for PM$_{2.5}$ and all-cause mortality using a Cox regression and repeated with a Poisson survival analysis with separate hazard rates for each year of follow-up. To relax the proportionality assumption, we included interactions between year of follow-up and smoking, sex, and education. We examined the shape of the dose response relationship using penalized splines and the fit of models with different lags.

Results: Poisson and Cox models produced similar results, which did not change with time-varying covariate effects. Akaike's information criterion was lower for models using current year's PM$_{2.5}$ than for the models including earlier years. Each 10µg/m$^3$ increase in PM$_{2.5}$ exposure in the year of death was associated with an adjusted RR=1.13 (95% CI, 1.06-1.20). The penalized spline model chose one degree of freedom, indicating a linear dose-response relationship. The results did not show any rationale for threshold in the association, and the effects of PM$_{2.5}$ did not change by time period.

Conclusions: Including more recent observations with exposures below the US standard (15µg/m$^3$), we found a strong linear association without any threshold between PM$_{2.5}$ and all-cause mortality. Results showed that current year was the best exposure window and that the toxicity of PM$_{2.5}$ has not changed over time.

References: