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Modeling the Effect of Temperature on Ozone-Related Mortality.

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Background: Previous studies show ozone and temperature are associated with increased mortality; however, the joint effect has not been well explored. Understanding the nature of this relationship is important for estimating the potential effects of increasing temperatures on ozone-related mortality.

Aims: We propose a model to evaluate ozone-temperature risk in multicity studies and evaluate the impact of temperature on ozone-related mortality.

Methods: We extend the ozone risk model used by the National Morbidity, Mortality, and Air Pollution Study (NMMAPS) to include ozone-temperature risk surfaces for 95 US urban centers. These surfaces are modeled using city specific polynomial basis expansion with closed form derivatives to quantify relative risks. To obtain national and regional estimates, at the second stage we use a spatial process prior for spline coefficients and introduce a monotonicity constraint in the ozone direction. This modeling approach is computationally efficient and enables informative smoothing of the risk surface while avoiding over parameterizing the first-stage models. Closed form estimates of the risk surfaces allow for easy comparison of surfaces between cities and regions at all levels of temperature and ozone.

Results: Preliminary results based on cross-validation with the NMMAPS data and a simulation study show good model performance, particularly at high concentrations. At the 95th percentile of the city-specific ozone and temperature distributions a monotone model reduces the mean width of 95% posterior intervals by 5.3% while the monotone model together with spatial smoothing reduces the width by 29.6%. We will estimate the effect of rising temperature at all levels of ozone, compare regional heterogeneity, and contrast these results to those obtained using linear and additive assumptions.

Conclusions: Initial analysis suggests that the ozone effect is nonlinear and that temperature confounds the ozone effect in a nonlinear manner.

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