APPLICATION OF DISTRIBUTED LAG MODELS TO INVESTIGATE THE TIME COURSE OF FINE PARTICULATE MATTER ON CARDIAC ELECTROPHYSIOLOGY

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Background and Aims: Environmental variables and health outcomes collected for epidemiological studies may give rise to intensive longitudinal data, where the number of repeated measures exceeds the values typical in clinical studies. Well-established methods exist for the analysis of repeated measures; however, methods typically employed for clinical studies with a small number of time points may be difficult to apply or inadequate, as they frequently assume instantaneous effects. We describe methods for handling intensive longitudinal data using the Air Pollution and Cardiac Risk and its Time Course (APACR) study for illustration. The APACR study collected individual-level, real-time $PM_{2.5}$ data and cardiac electrophysiology outcomes over a 24-hour period, with $PM_{2.5}$ and outcome summaries recorded every 30 minutes, producing 48 repeated measures.
Methods: We constructed polynomial distributed lag models, which include models that assume instantaneous effects and moving average models as special cases. For continuous outcomes (e.g., heart rate-corrected QT intervals) we used a linear mixed-effects models framework. For binary (e.g., any ectopic beat) or count (e.g., PVC count, total ectopy count) data we used a generalized estimating equations (GEE) framework. Model selection included examination of competing covariance structures.
Results: Distributed lag models fit to describe QTI% showed lag 0-1 and lag 6-7 $PM_{2.5}$ effects were significantly associated with QTI%, while the middle lags (2-5) were not. The distributed lag models fit to describe PVC count and total ectopy count found only lag 0-1 $PM_{2.5}$ effects to be significantly associated with the counts. These patterns may have been missed by examining only the cumulative effects of the lags or using moving average models, which implicitly assume equal weighting of lags. **Conclusions:** By allowing examination of individual and cumulative lag effects, and not assuming equal weighting of lags, distributed lag models enable us to identify the time course of air pollution effects.