INFLUENCE OF NETWORK DESIGN ON HEALTH EFFECT ESTIMATES FROM PREDICTED EXPOSURES

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Background and Aims: Estimated health effects for long-term air pollution exposure predictions vary across cities in cohort studies. This may be due to features of network designs. In this simulation study, we hypothesized that distributions of land use characteristics in networks affect health effect estimation and investigated the impact on estimates of relative risks (RRs) of cardiovascular event occurrences for PM2.5 exposures in 29 U.S. cities as a function of monitor and subject distributions.
Methods: We explored the impact of assumed distributions for a land use variable in hypothetical cities and then considered the existing distributions in 29 Women's Health Initiative (WHI) study cities. We chose a land use variable that is spatially rough and assumed it was associated with PM2.5. Given distributions of this variable in each city, PM2.5 exposures were simulated using underlying geostatistical models also incorporating spatial correlation at subject and monitoring locations. Then, we predicted PM2.5 at 1500 subject homes given PM2.5 exposures at 30 monitoring locations. Survival times to cardiovascular events of subjects were simulated using underlying models conditional on simulated exposures. RRs of cardiovascular event occurrences for true and predicted PM2.5 were estimated in Cox proportional hazard models. Finally, we assessed the relationship between standard deviation of the land use covariate and properties of RR estimates across cities.
Results: We found improved performance of health effect estimates with increasing standard deviations of our spatial covariate in hypothetical networks. As variability in the spatial covariate at monitoring locations increased, bias and variance decreased, and coverage approached 95 percent. This pattern was similar but less clear in WHI cities.
Conclusions: Our simulation study showed that network designs determining distributions of a land use characteristic associated with air pollution exposures affected performance of health effect estimates of predicted exposures.

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