ASSESSMENT OF SPATIOTEMPORAL EXPOSURE ESTIMATES IN SMALL AREA EXPOSURE STUDIES

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Background and Aims: Exposure to air pollutants is often estimated based on location. Either ambient pollutant concentrations measured at the nearest monitoring station or modelled concentrations are, thereby, assigned to a specific location such as residential address. Mobility and time spent in locations away from home, however, greatly influence people's exposure. Ignoring this spatiotemporal element can result in inaccurate exposure estimates, but the magnitude and spatial distribution of the expected exposure error is largely unknown.
Methods: An urban simulation environment was used to compare a location-based exposure proxy to personal exposure. Exposure misclassification due to the use of ambient PM_{10} concentration measurements nearest to the home instead of personal exposure was quantitatively and spatially assessed for a cohort of 500 children. Personal exposure was modelled by predicting daily activity patterns using a probabilistic time-activity model and overlaying the visited locations and trips between locations with hourly PM_{10} concentration surfaces. Indoor particle concentrations were modelled using a stochastic mass-balance model.
Results: Personal exposure varied greatly between weekdays and the weekend due to a shift in the outdoor/indoor activity ratio, although that variation disappeared when averaging personal exposure over a two-week period. Using a location-based exposure proxy over-predicted exposures for those children with the lowest and highest exposures and the accuracy of the location-based proxy strongly depended on the activity patterns of individuals.
Conclusions: The spatial patterns of personal exposure showed that children are exposed to much higher levels of particles when away from home. A location-based proxy offers a reasonable estimate of exposure for children living in inner city areas, however, for children living in suburban areas, where ambient concentrations vary greatly, a single location will introduce spatially biased exposure error. There is a need to characterise this error in future exposure studies and analyses should include spatiotemporal detailed exposure information.