Performance of Multi-City Land Use Regression Models for Nitrogen Dioxide and Fine Particles

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Land use regression (LUR) models have been developed mostly to explain intraurban variations in air pollution based on often small local monitoring campaigns. Transferability of LUR models from city to city has been investigated, but little is known about the performance of models based on large numbers of monitoring sites covering a large area.; We aimed to develop European and regional LUR models and to examine their transferability to areas not used for model development.; We evaluated LUR models for nitrogen dioxide (NO2) and particulate matter (PM; PM2.5, PM2.5 absorbance) by combining standardized measurement data from 17 (PM) and 23 (NO2) ESCAPE (European Study of Cohorts for Air Pollution Effects) study areas across 14 European countries for PM and NO2. Models were evaluated with cross-validation (CV) and hold-out validation (HV). We investigated the transferability of the models by successively excluding each study area from model building.; The European model explained 56% of the concentration variability across all sites for NO2, 86% for PM2.5, and 70% for PM2.5 absorbance. The HV R2s were only slightly lower than the model R2 (NO2, 54%; PM2.5, 80%; PM2.5 absorbance, 70%). The European NO2, PM2.5, and PM2.5 absorbance models explained a median of 59%, 48%, and 70% of within-area variability in individual areas. The transferred models predicted a modest-to-large fraction of variability in areas that were excluded from model building (median R2: NO2, 59%; PM2.5, 42%; PM2.5 absorbance, 67%).; Using a large data set from 23 European study areas, we were able to develop LUR models for NO2 and PM metrics that predicted measurements made at independent sites and areas reasonably well. This finding is useful for assessing exposure in health studies conducted in areas where no measurements were conducted.
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