MODELING EXPOSURES TO THE OXIDATIVE POTENTIAL OF AMBIENT PARTICULATE MATTER IN LONDON

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Background and Aims: Differences in the toxicity of ambient particulate matter (PM) due to varying particle composition across locations may contribute to variability in results from air pollution epidemiologic studies. Though most studies have used PM mass concentration as the exposure metric, one which accounts for particle toxicity due to varying particle composition as well as PM mass may better elucidate whether PM from specific sources is responsible for observed health effects.
Methods: The oxidative potential (OP) of PM <10 um (PM_{10}) was measured as the rate of depletion of the antioxidant reduced glutathione (GSH) in a model of human respiratory tract lining fluid. Using a database of GSH OP measures collected in greater London from 2002-2006, we developed and validated a predictive spatio-temporal model of the weekly GSH OP of PM_{10} that included geographic predictors. Predicted levels of OP were then used in combination with those of weekly PM mass to estimate exposure to PM_{10} weighted by its OP.
Results: Using cross-validation, brake and tire wear emissions of PM_{10} from traffic within 50 m and tailpipe emissions of nitrogen oxides from heavy-goods vehicles within 100 m were important predictors of GSH OP levels. Predictive accuracy of the models was high for PM_{10} (cross-validation R^2=0.83) but only moderate for GSH OP (cross-validation R^2=0.47) when comparing weekly levels; however, the GSH OP model predicted spatial trends well (spatial cross-validation R^2=0.80).
Conclusions: Results suggest that PM_{10} emitted from traffic sources, specifically brake and tire wear, has a higher OP than that from other sources, and that this effect is very local, occurring within 50-100 m.
References: