L'inférence causale en présence de dépendance et de structure de réseau
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Spatial variations in the estimated production of reactive oxygen species in the epithelial lung lining fluid by $PM_{2.5}$ iron and copper

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Background: Certain metals may play an important role in the adverse health effects of fine particulate air pollution ($PM_{2.5}$) but few models are available to predict spatial variations in these pollutants.

Methods: We conducted large-scale air monitoring campaigns during summer 2016 and winter 2017 in Toronto, Canada to characterize spatial variations in iron (Fe) and copper (Cu) concentrations in $PM_{2.5}$. Information on Fe and Cu concentrations at each site were paired with a kinetic multi-layer model of surface and bulk chemistry in the lung epithelial lining fluid to estimate the possible impact of these metals on the production of reactive oxygen species (ROS) in exposed populations. Land use data around each monitoring site were used to develop predictive models for Fe, Cu, and their estimated combined impact on ROS generation.

Results: Spatial variations in Fe, Cu, and ROS greatly exceeded that of $PM_{2.5}$ mass concentrations. In addition, Fe, Cu, and estimated ROS concentrations were 15, 18, and 9 times higher during summer compared to winter with little difference observed for $PM_{2.5}$. In leave-one out cross validation procedures final multivariable models explained the majority of spatial variations in annual mean Fe (R^2=0.68), Cu (R^2=0.79), and ROS (R^2=0.65).

Conclusions: The combined use of $PM_{2.5}$ metals data with a kinetic multi-layer model of surface and bulk chemistry in the human lung epithelial lining fluid may offer a novel means of estimating $PM_{2.5}$ health impacts beyond simple mass concentrations.

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