Linking emissions to admissions: P[M.sub.2.5] and respiratory health - Science Selections

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It may seem self-evident that living close to a busy street with its many automotive pollutants can have adverse effects on respiratory health, but documenting such a relationship with sufficient rigor to be considered scientifically valid has proven to be an elusive undertaking due to the many seemingly incompatible variables involved. In this month's issue, Canadian researchers from the University of Toronto led by David Buckeridge (now affiliated with Stanford University) report the results of their study of the relationship between proximity to vehicle emissions and respiratory health [EHP 110:293-300]. Their unique approach of using a geographic information system (GIS) to model that relationship could serve as a basis for future studies, and adds a convincing piece of evidence suggesting that chronic exposure to urban air can cause respiratory disease.

The authors chose to study exposure to a single pollutant emitted by vehicles: particulate matter smaller than 2.5 microns (P[M.sub.2.5]), which had been linked to detrimental respiratory effects in previous research. They examined the correlation between exposure to P[M.sub.2.5] emissions and respiratory hospitalization while controlling for socioeconomic status. Their study area was the socioeconomically diverse southeastern section of Toronto, which had been divided into 334 "enumeration areas" during the 1991 Canadian census. The Toronto enumeration areas, each the geographic area covered by one census canvasser, had a median population of 400.

By incorporating a wide range of data, including population information, traffic volume, vehicle type mix, and distances of residences from streets, the scientists were able to develop a refined GIS exposure model to estimate the average daily exposure to P[M.sub.25] in each enumeration area. The GIS model allowed them to account for the critical fact that exposure drops off dramatically with increasing distance from the street, falling by about half within 10 meters of the roadway.

They used statistical analysis to cross-reference the exposure estimates with hospitalization rates for three diagnostic groups--all respiratory conditions, a subset of respiratory conditions known to be related to P[M.sub.2.5] exposure (asthma, bronchitis, chronic obstructive pulmonary disease, pneumonia, and upper respiratory tract infection), and genitourinary conditions, a type of condition chosen as a control because the authors assumed they would not be associated with exposure to vehicle emissions.

The data showed no correlation between socioeconomic status and residential proximity to busy streets (and thus higher P[M.sub.2.5] exposure). The researchers did find that exposure to P[M.sub.2.5] at the enumeration area level had a significant positive correlation with hospital admission rates for the subset of respiratory diagnoses. They also found a weaker correlation between P[M.sub.2.5] exposure and hospitalization for all respiratory conditions, and no such correlation with hospitalization for genitourinary conditions.

While the use of hospital admission rates is a valid measure of health effects, the authors point out that these rates probably give a conservative estimate of the health impact of exposure compared with other markers such as disease prevalence estimates or self-reported health status data. Given that most of the respiratory conditions they found to be associated with P[M.sub.2.5] exposure are typically chronic and often ambulatory in nature, and thus do not necessarily involve admission to the hospital, it seems likely that the link may be even stronger than that documented in this study.

The study results are limited by factors such as traffic flow fluctuations (such as rush hour), indoor air quality, meteorologic conditions, or exposure to other pollutants present in automobile exhaust, and that exposure data did not account for individual

activity (such as times that people were at home to be exposed). The authors suggest that future research include these potential confounders, along with other refinements in exposure modeling and analysis.