New model could help fill data gap in predicting historical air pollution exposure

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In a study that analyzed relationships between air quality and unemployment levels, a Tufts University researcher has developed a new statistical model that retrospectively estimates air pollution exposure for previous time periods where such information is not available.

Mary Davis, an associate professor of urban and environmental policy and planning at Tufts University School of Arts and Sciences, analyzed traffic-related air pollution levels and unemployment rates in four separate regions of California for which extensive air monitoring data was available: San Francisco Bay, Sacramento Valley, San Joaquin Valley, and the south-central coast between 1980 and 2000.

Davis focused on predicting trends in pollutants that are emitted by engines and known to negatively impact human health—haze, carbon monoxide, and nitrogen dioxide. She integrated into her model other variables such as weather, population density, unemployment levels, and environmental regulations. Air pollution data came from the California Air Resources Board.

The unemployment data was provided by the federal Bureau of Labor Statistics. It showed broad shifts in overall unemployment with highs in the early 1980s and 1990s. Unemployment levels for the trucking industry, which were tracked separately, matched the overall trend.

Davis's analysis revealed a pattern. During the highest periods of unemployment—early 1980s and early 1990s—concentrations of the

three pollutants decreased in small but discernible amounts for every one percent increase in unemployment. The reason for the decrease, she says, was due to slowdowns in commercial trucking and car trips to work, shopping malls, or recreational destinations.

Importantly, Davis says the model allows epidemiologists to look backwards in time to predict public exposure to pollution in a geographical area. This data would ultimately help researchers discern public health trends.

"We can retrospectively estimate exposure levels for previous periods where direct data is lacking," says Davis, author of the paper titled "Recessions and Health: The Impact of Economic Trends on Air Pollution in California," which will be published in the October issue of the journal "*American Journal of Public Health*" (available online on August 16). "Without an accurate and historically relevant exposure model it is difficult to obtain estimates of lifetime human exposure which is critical in studies of chronic disease," she adds.

As an example of how the model could be used, Davis applied her formula to the years between 2006 and 2010—when unemployment rose from 4.9 percent to 12.4 percent in California. According to the model, there would have been a 16.8 percent decline in ambient concentrations of carbon monoxide and a 12.2 percent decline in concentrations of nitrogen dioxide.

Her findings were not independently validated but Davis says that "the comparison provides perspective on what the predicted change in air pollution would be during a major economic downturn based on the results of the model."

Davis also looked for relationships between unemployment in the trucking industry and air quality. With trucking, she included estimates

for haze, which is a marker for diesel-powered truck emissions. Here, she found a similar pattern of lower predicted pollution levels between 2006 and 2010.

Davis says that the results of her work provide evidence linking the economy to air pollution. In a 2010 study of air pollution levels and economic trends in New Jersey between 1971 and 2003, Davis found a similar relationship between pollution and unemployment.

"This is evidence that cyclical economic activity has an impact on concentrations of pollutants that the general public is exposed to," says Davis. "There is a net benefit for public health in terms of air pollution when unemployment rises."

In the context of environmental policy, Davis suggested that environmental regulating agencies should consider the relationship between air quality and unemployment as they evaluate the effectiveness of clean air regulations. "Air quality regulations have an impact but they don't happen in a vacuum," she continues. "Policies aimed at improving air quality may act to speed up or slow down the underlying trend set by the economy."

Davis, who is participating in a National Institutes of Health-funded study of the trucking industry, air pollution and cancer rates with a team of Harvard University scientists, said the methodology she used in this research could be applied to other regions of the country where data is available.

More information: Davis ME. Recessions and Health: The Impact of Economic Trends on Air Pollution in California. *Am J Public Health.* 2012; 102(10):1951-1956

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