



RESEARCH

Open Access

Social stressors and air pollution across New York City communities: a spatial approach for assessing correlations among multiple exposures

Jessie LC Shmool^{1*}, Laura D Kubzansky², Ogonnaya Dotson Newman³, John Spengler⁴, Peggy Shepard³ and Jane E Clougherty¹

Abstract

Background: Recent toxicological and epidemiological evidence suggests that chronic psychosocial stress may modify pollution effects on health. Thus, there is increasing interest in refined methods for assessing and incorporating non-chemical exposures, including social stressors, into environmental health research, towards identifying whether and how psychosocial stress interacts with chemical exposures to influence health and health disparities. We present a flexible, GIS-based approach for examining spatial patterns within and among a range of social stressors, and their spatial relationships with air pollution, across New York City, towards understanding their combined effects on health.

Methods: We identified a wide suite of administrative indicators of community-level social stressors (2008–2010), and applied simultaneous autoregressive models and factor analysis to characterize spatial correlations among social stressors, and between social stressors and air pollutants, using New York City Community Air Survey (NYCCAS) data (2008–2009). Finally, we provide an exploratory ecologic analysis evaluating possible modification of the relationship between nitrogen dioxide (NO₂) and childhood asthma Emergency Department (ED) visit rates by social stressors, to demonstrate how the methods used to assess stressor exposure (and/or consequent psychosocial stress) may alter model results.

Results: Administrative indicators of a range of social stressors (e.g., high crime rate, residential crowding rate) were not consistently correlated ($\rho = -0.44$ to 0.89), nor were they consistently correlated with indicators of socioeconomic position ($\rho = -0.54$ to 0.89). Factor analysis using 26 stressor indicators suggested geographically distinct patterns of social stressors, characterized by three factors: violent crime and physical disorder, crowding and poor access to resources, and noise disruption and property crimes. In an exploratory ecologic analysis, these factors were differentially associated with area-average NO₂ and childhood asthma ED visits. For example, only the 'violent crime and disorder' factor was significantly associated with asthma ED visits, and only the 'crowding and resource access' factor modified the association between area-level NO₂ and asthma ED visits.

Conclusions: This spatial approach enabled quantification of complex spatial patterning and confounding between chemical and non-chemical exposures, and can inform study design for epidemiological studies of separate and combined effects of multiple urban exposures.

Keywords: Air pollution, GIS, Social stressors, Spatial confounding, Susceptibility

* Correspondence: jlcarr@pitt.edu

¹Department of Environmental & Occupational Health, University of Pittsburgh Graduate School of Public Health, 100 Technology Drive, Pittsburgh, PA 15219, USA

Full list of author information is available at the end of the article

