Mapping Vulnerability in Oklahoma City: An Examination of Connections between Demography and Location in an Urban Context

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Background

Demographic factors are organized geographically and contribute to environmental vulnerability according to underlying behavioral and cultural phenomenon. The intrinsic patterns that characterize demographic organization may be useful for understanding the broader social-environmental context in which people are exposed to adverse conditions or pollutants. This study seeks to demonstrate this geographic organization in Oklahoma City through the application of demographic data and computer modeling. The ultimate goal is to determine the efficacy of using geography as a proxy for socio-demographic factors in exposure and vulnerability studies. This paper draws from theoretical and empirical work in the areas of residential segregation, environmental justice, and environmental demography to develop connections between demographic variables, physical location, and environmental vulnerability.

Methods

Census data from the 2000 survey was used along with zoning and planning data from the City of Oklahoma City (OKC) to classify the demographic characteristics of communities in and surrounding Oklahoma City. Variables were selected to describe the demographic and human activity pertaining to heat health and air quality vulnerability. In GIS, census data were combined with OKC data to develop a multivariate data set describing the demographic context for Oklahoma City. Demographic measures in the study include: race, income, age, gender of head of household, primary and secondary language, education level, and household density.

The self-organizing map algorithm (SOM) was used to classify census block groups according to underlying similarities in the distributions of each input variable. SOM classifications occur in mathematical space, and categorize census blocks according to statistical similarity. Classifications were reprojected in geographic space to indicate the spatial distribution of groups. Moran's I was used to test the amount of spatial autocorrelation in the classification.

Results

The SOM algorithm used demographic variables to classify block groups into five statistically similar groups that indicated a significant level of spatial autocorrelation. Each of the SOM categories may be considered a population sub-group with varying levels of vulnerability to environmental conditions.

Conclusions

When demographic characteristics were analyzed spatially, it was observed that the social environment is highly autocorrelated with geography, and therefore the geographic distribution of the demographic variables that describe population sub-groups is an important aspect of environmental exposure analysis. It is widely understood that social status and geography are important determinants of environmental health outcomes. This approach to social-environmental classification provides a method for understanding the distribution of multiple demographic variables which can be used to understand the geo-demography of an area and may be integrated with exposure analysis and risk assessment to further understand the risks for adverse health outcomes.