

Environmental and Socioeconomic Influences on Asthma Hospitalization Rates in New York City

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Introduction/Background

Previous research has demonstrated that disparities in asthma outcomes are largely driven by environmental and socioeconomic determinants of health.¹ While ambient air pollution has shown to exacerbate asthma symptoms, data on the effects of air pollution specifically in NYC is limited.² More research on identifying risk factors of asthma at the neighborhood level is needed to identify potential solutions.

Objectives

- Explore the spatial significance of childhood asthma hospitalizations and poverty in NYC.
- Understand how ambient air pollution is associated with the asthma hospitalization burden in children ages 5-17 in NYC.

Methods

Boundary Selection

United Hospital Fund (UHF) Neighborhoods (42) were used for all of the figures in this analysis. The UHF-42 consists of 42 adjoining zip code areas, designated to approximate New York City Community Planning Districts.

Data Analysis

The rate of asthma hospitalizations in children 5-17 is the primary outcome of interest. Statistically significant spatial clusters were assessed for the asthma hospitalizations and poverty. OLS regression was conducted and spatial lag regression was used to account for spatial autocorrelation. Multivariable spatial lag models were constructed (with 1st order Queen contingency weight matrix) and compared using Akaike Information Criterion (AIC).

Figure 1. Asthma Hospitalizations in NYC³

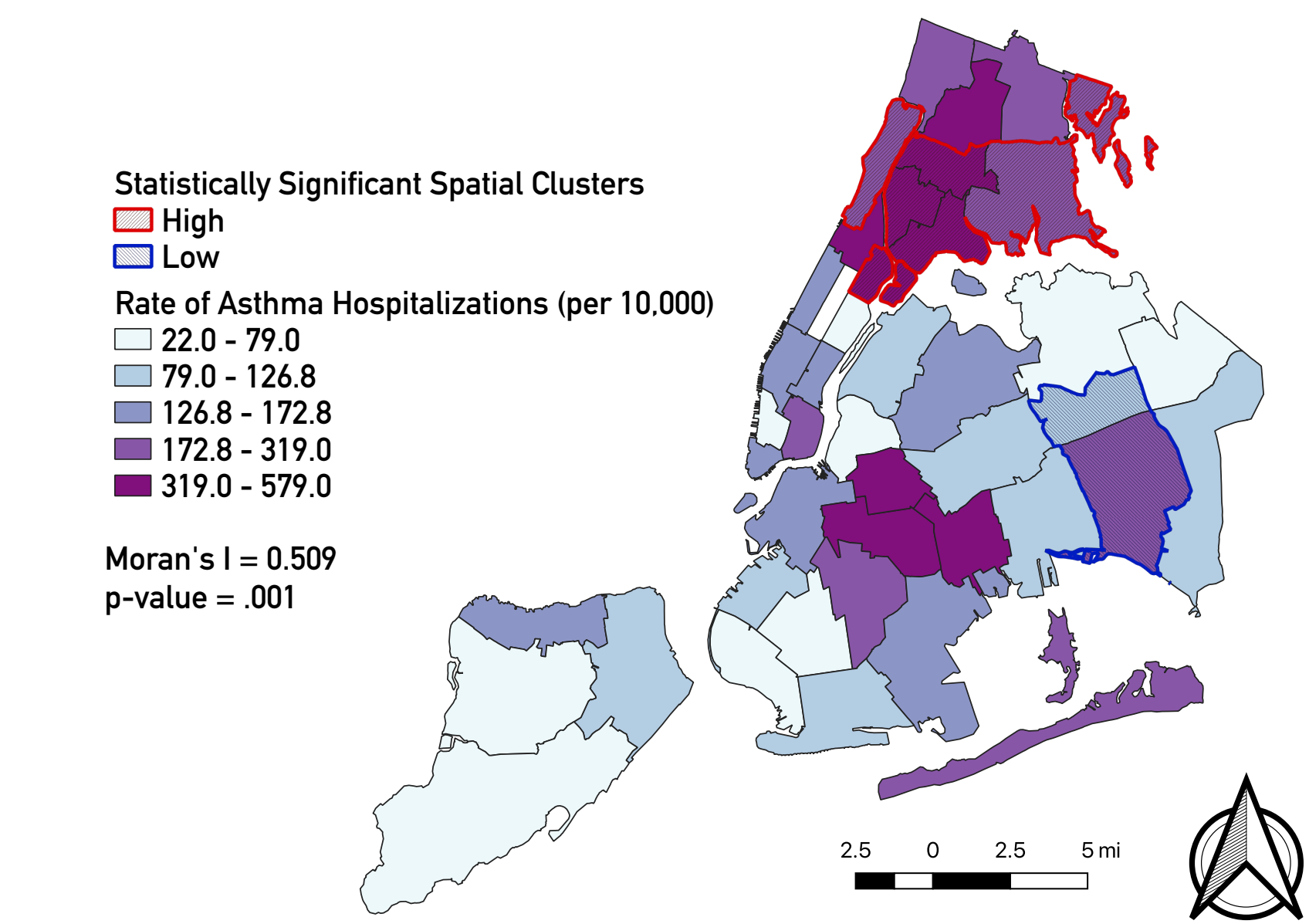


Figure 2. Poverty in NYC⁴

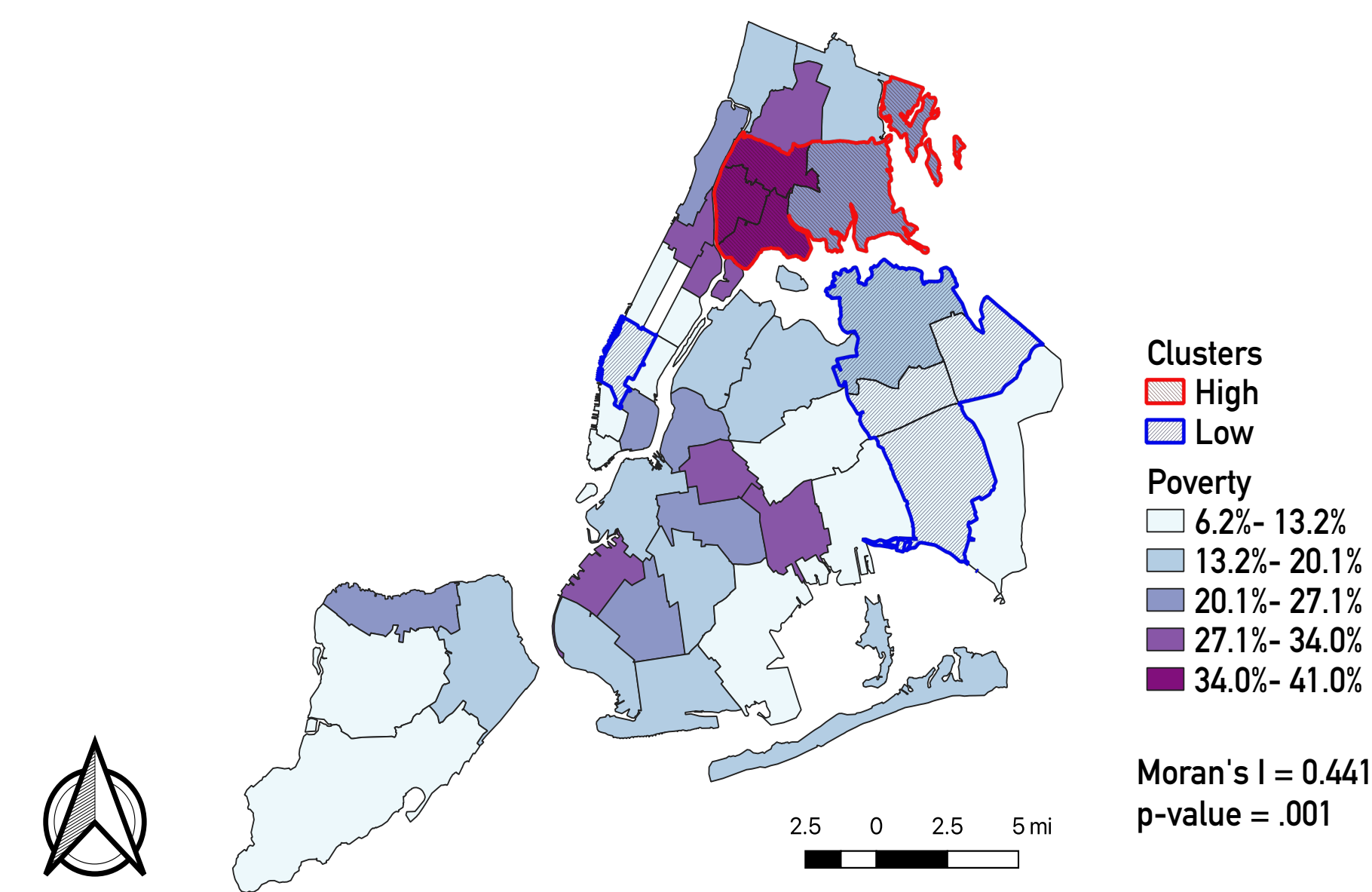


Figure 3. Air Pollution Distribution in NYC⁵

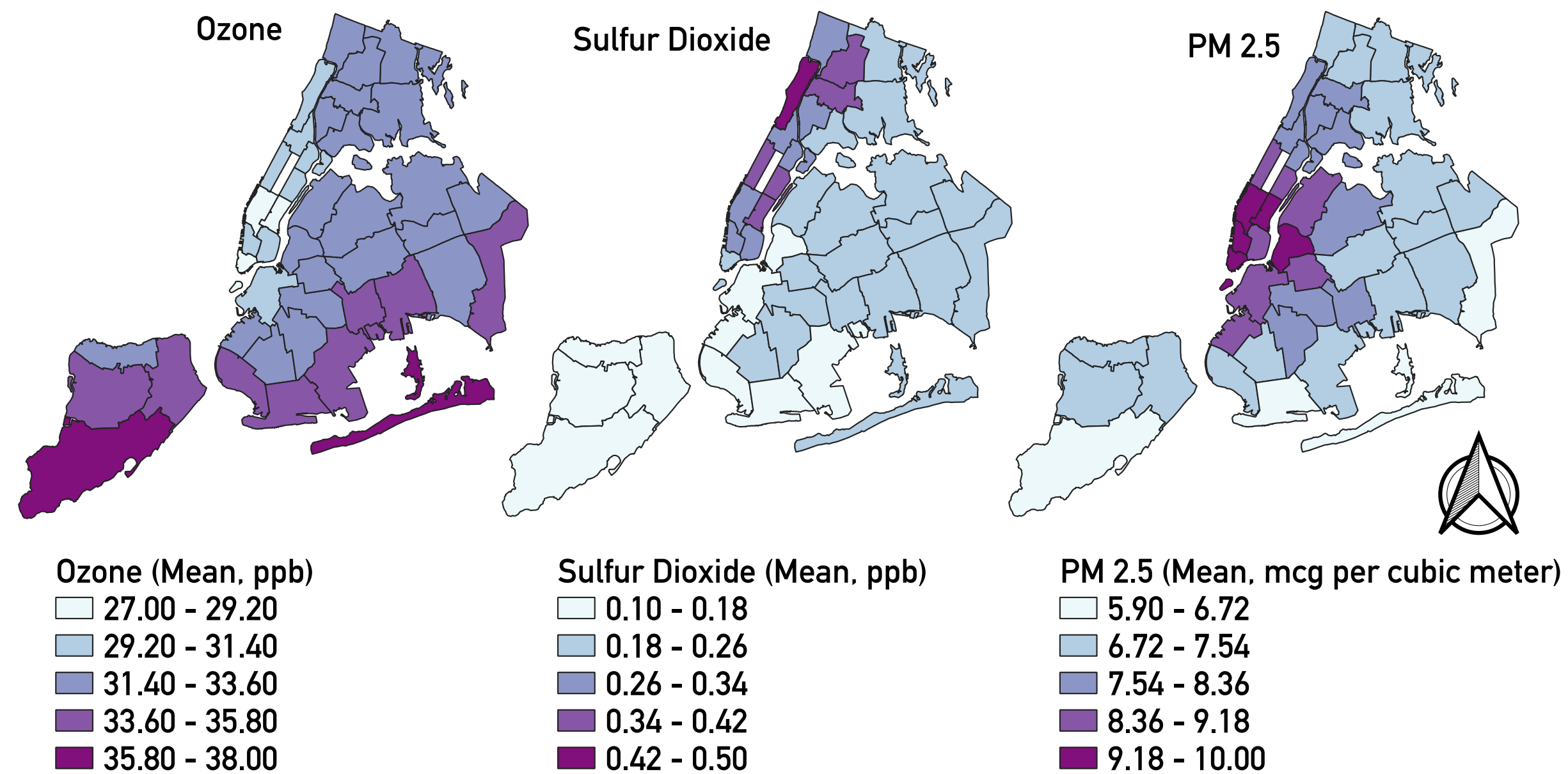


Table 1: Univariable Analyses

Asthma Hospitalization Rate (per 10,000) in Children 5-17						
	OLS Linear Regression			Spatial Lag Regression		
	Estimate	p-value	AIC	Estimate	p-value	AIC
Poverty	12.9212	<.001	503.414	10.4216	<.001	495.396
Ozone	-10.2084	.38830	543.509	0.8067	0.9276	529.548
PM2.5	16.5445	0.5	543.821	-0.574	0.975	529.555
SO2	521.07	.02180	538.707	162.029	.36404	528.855

Table 2: Multivariate Spatial Lag Models

Asthma Hospitalization Rate (per 10,000) in Children 5-17						
	Model 1		Model 2		Model 3	
	Estimate	p-value	Estimate	p-value	Estimate	p-value
Poverty	10.4216	<.001	10.4178	<.001	11.2382	<.001
Ozone					-19.6534	.18408
SO2			166.109	.19301	56.467	.73480
PM 2.5					-36.1189	.16661
AIC	495.396		496.017		498.06	
Lag Coefficient	0.387962		0.313987		.308811	

Results

- Cluster analyses (Figures 1 and 2) and high Moran's I in Figure 1 (0.509, p = 0.001 with 999 permutations) and Figure 2 (.441, p = 0.001 with 999 permutations) revealed statistically significant clusters asthma hospitalizations and poverty in New York City.
- In the univariable analyses, SO2 which was previously significant (p<0.02) in the OLS regression became non-significant in the spatial lag regression. Poverty remained significant in the OLS and spatial lag regression, while the other pollution covariates remained insignificant across analyses.
- Model 1, which was the best fit model that had the smallest AIC, indicated that being spatially adjacent to poverty was significantly associated with higher rates of asthma hospitalizations. Specifically, for every 1% increase in poverty there's an additional 10 per 10,000 asthma hospitalizations in children ages 5-17.
- The relatively modest decrease of AIC across different models suggested the need to improve the model fit by finding more appropriate indicators.

Conclusion

- While statistically significant clusters of asthma hospitalizations in children and poverty are evident, as well as their significant association with one another, further analyses describing how ambient air pollution can contribute to asthma exacerbation is needed.
- Other social determinants of health should be included in future models to understand how they may have a further impact on asthma hospitalization rates.

References

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