The association between neighborhood characteristics and gonorrhea incidence

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Introduction

Sexually transmitted diseases in the United States continue to be characterized by immense racial, social, and geographic disparities in the burden of disease. National rates of gonorrhea are 20 times higher in blacks than whites and generally concentrated among the most disadvantaged populations.

Richmond is an independent city located in central Virginia with persistently high gonorrhea incidence. Richmond's gonorrhea rate in 2007 was 612 per 100,000, approximately 7.5 times the state average and 5.1 times the national average.

This disproportionately large burden of disease within a relatively small metropolitan area lends itself to further study of the associated geographic and social factors involved. Identification of neighborhood characteristics associated with elevated gonorrhea disease burdens may greatly enhance the efficacy and effectiveness of STD prevention efforts.

Objective

Determine whether there is an association between gonorrhea rates in the Richmond City area and neighborhood characteristics as captured by area-based socioeconomic measures.

Data Sources

Data on gonorrhea cases from 2000 to 2007 were collected by the Virginia Department of Health as part of routine STD surveillance activities. Residential addresses of gonorrhea cases were geocoded, aggregated to the block group level, and used to calculate area-specific rates of disease.

These rates were then linked to data on area-based socioeconomic measures (ABSMs) derived from the 2000 U.S. Census Summary File 3. Census block groups were used to approximate residential neighborhoods. The unit of analysis for all geographic and statistical analyses was the block group.

The following measures were included as potential predictors of gonorrhea rates: percentages of residents who were living below the poverty level, black, without a high school diploma, unemployed, married, and between the ages of 15 and 24 years. All predictors were selected based on prior research linking them to elevated risk of gonorrhea at both the individual and population levels.

Figure 1. Reported Gonorrhea Incidence Rate per 100,000 by Census Block Group, Richmond City, Virginia, 2000-2007

Incidence Rate per 100,000
- 0 - 1,606
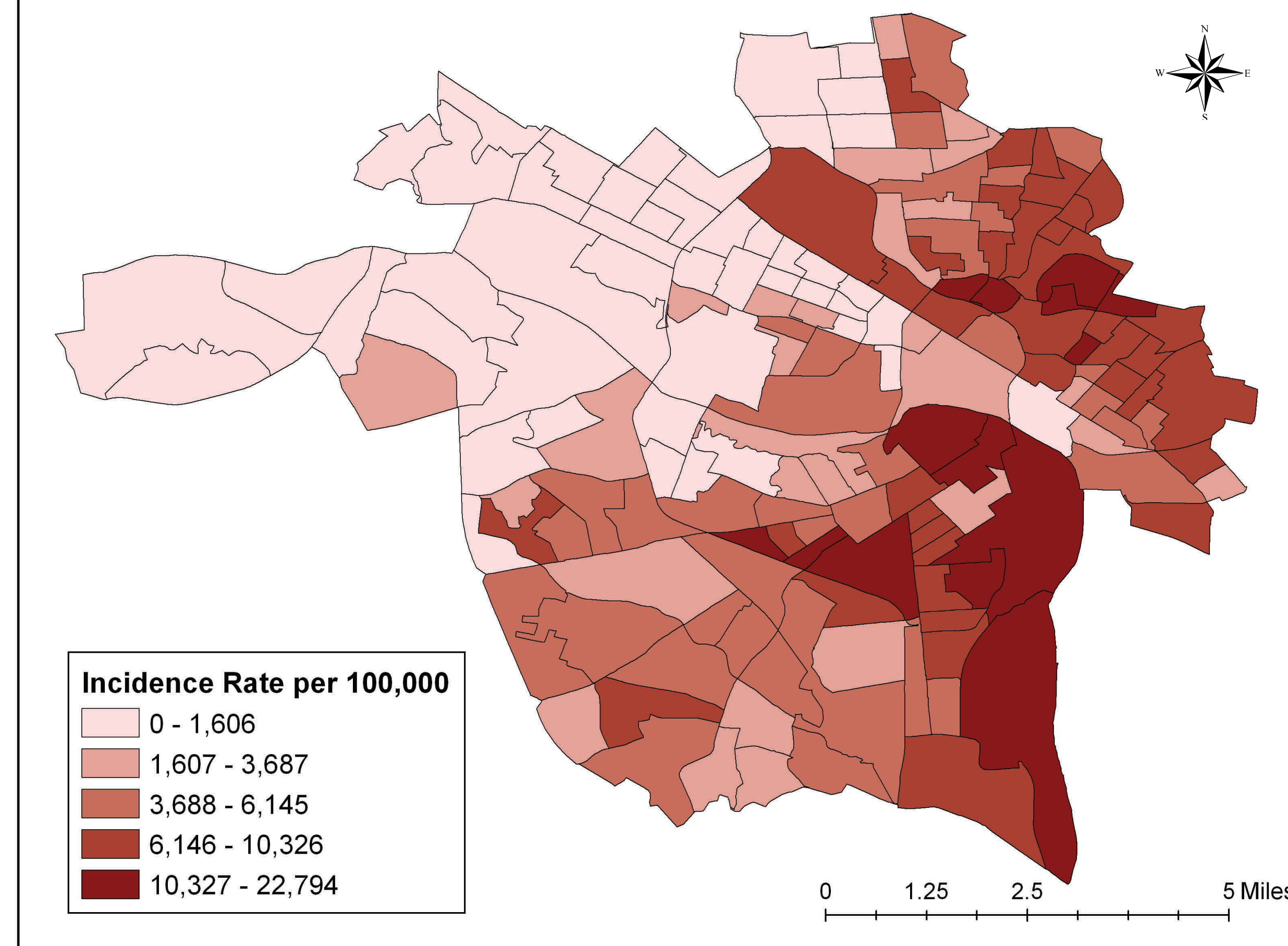- 1,607 - 3,687
- 3,688 - 6,145
- 6,146 - 10,326
- 10,327 - 22,794

Figure 2. Percent of Population Living Below the Poverty Level by Census Block Group, Richmond City, Virginia, 2000-2007

Percent Below Poverty Level
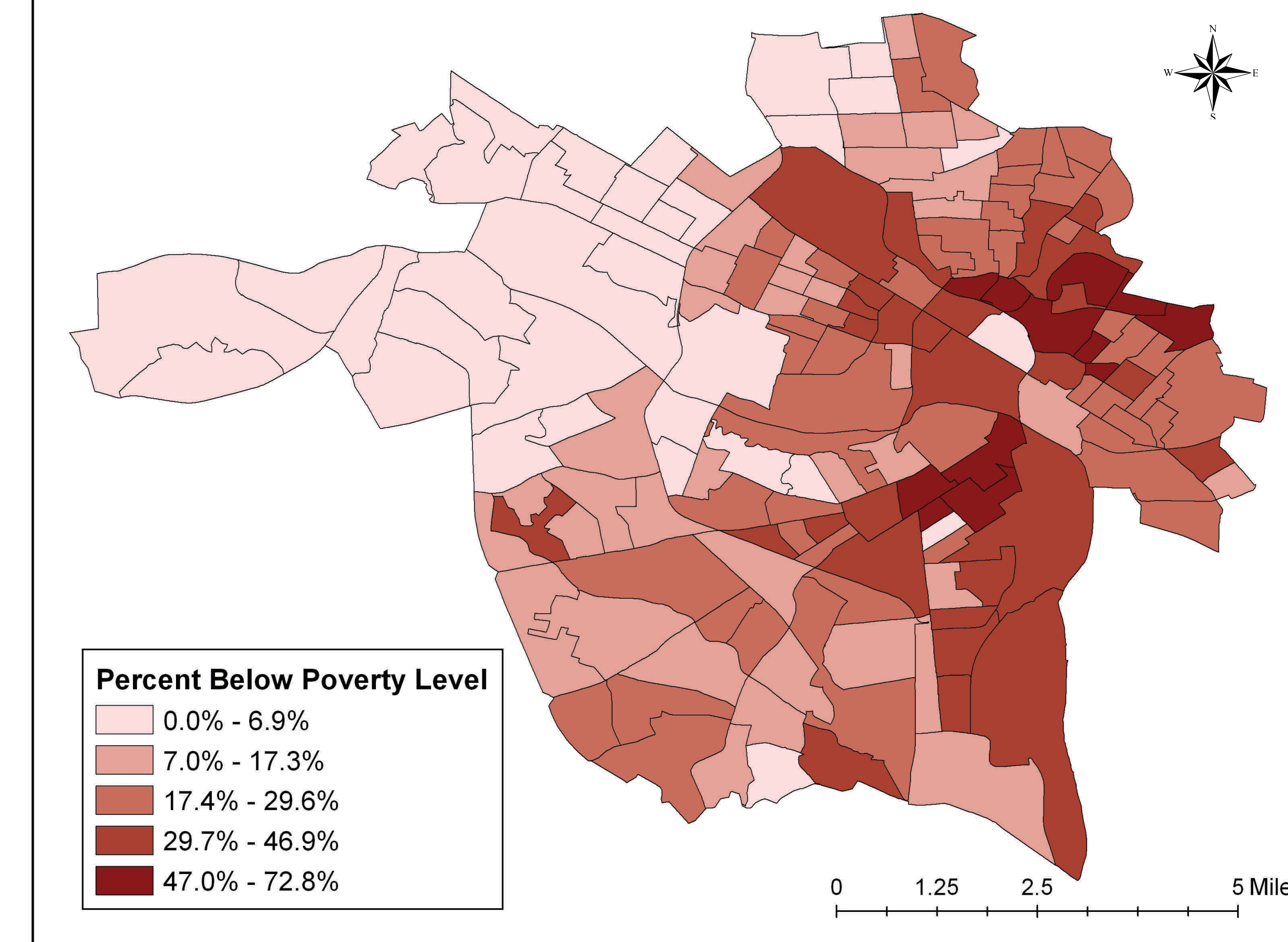- 0.0% - 6.9%
- 7.0% - 17.3%
- 17.4% - 29.6%
- 29.7% - 46.9%
- 47.0% - 72.8%

Figure 3. Percent of Population of Black Race by Census Block Group, Richmond City, Virginia, 2000-2007

Percent Black
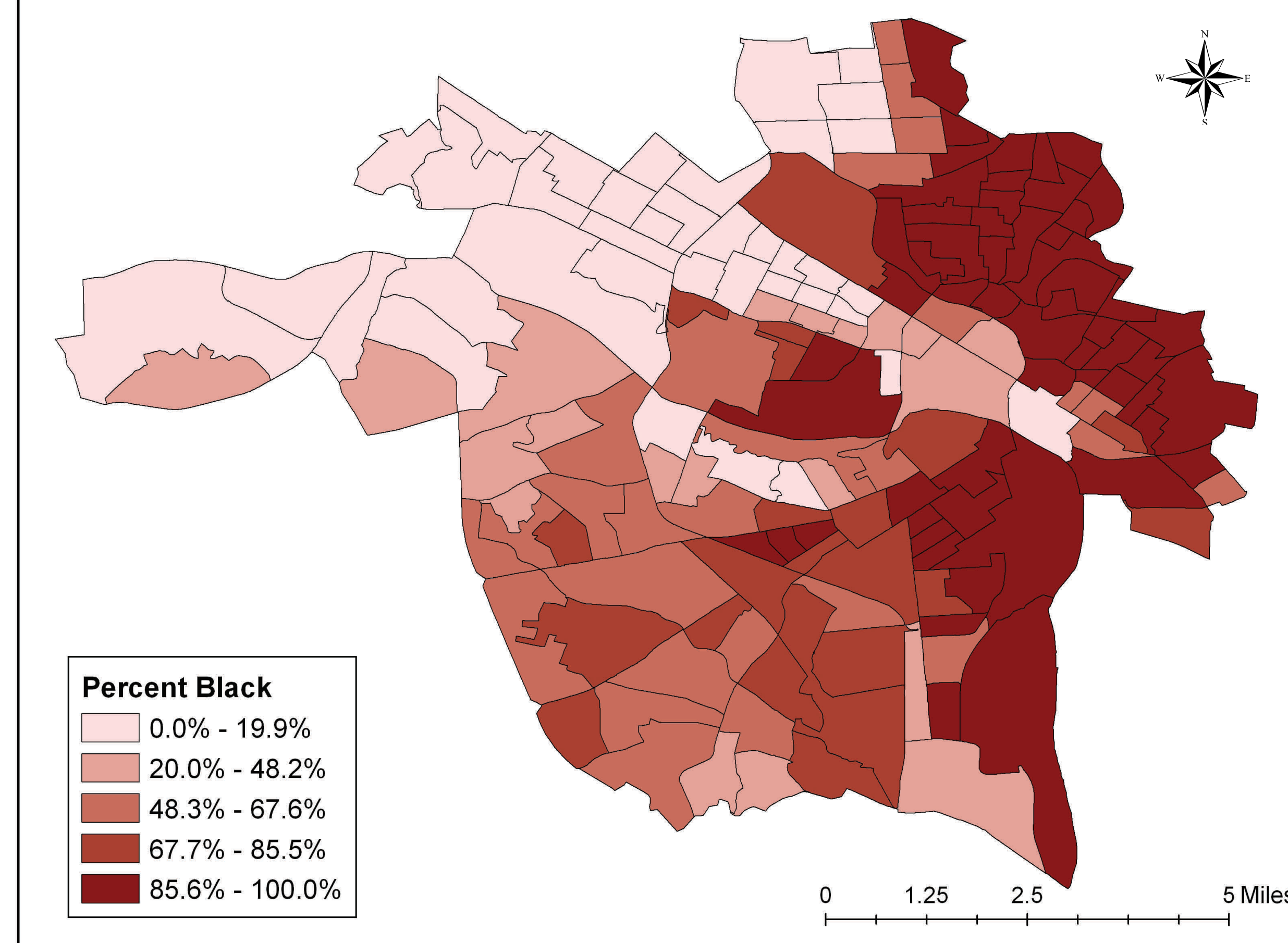- 0.0% - 19.9%
- 20.0% - 48.2%
- 48.3% - 67.6%
- 67.7% - 85.5%
- 85.6% - 100.0%

Figure 4. Percent of Population Without High School Education by Census Block Group, Richmond City, Virginia, 2000-2007
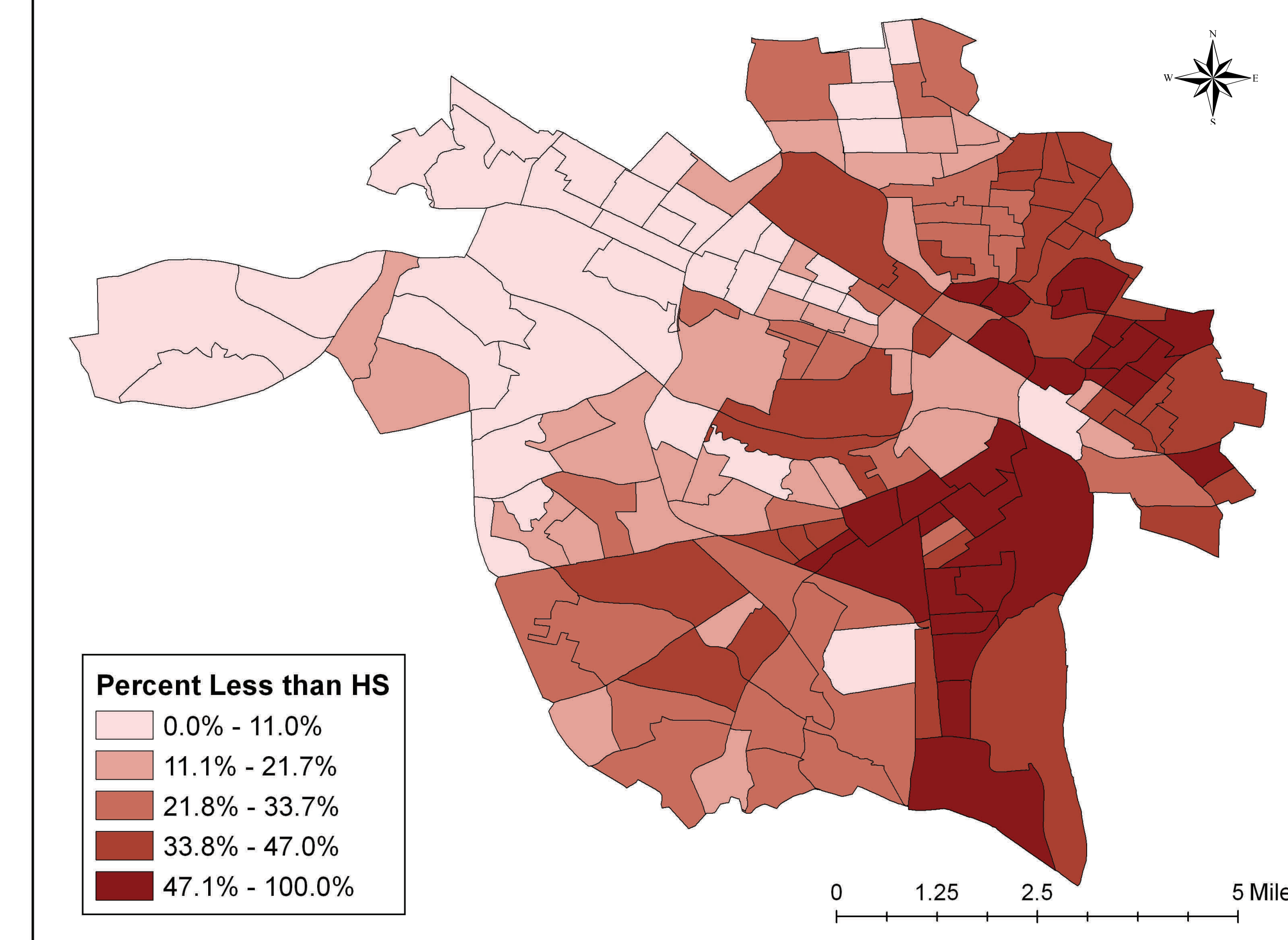

Percent Less than HS
- 0.0% - 11.0%
- 11.1% - 21.7%
- 21.8% - 33.7%
- 33.8% - 47.0%
- 47.1% - 100.0%

Table 1. Descriptive Statistics and Correlations for 163 Census Block Groups*

	Mean	SD	Min	Max	Correlation w/Gonorrhea r	(p)	Correlation w/Poverty r	(p)	Correlation w/Race r	(p)
Gonorrhea rate (per 10,000), 2000-07	467.6	395.2	0.0	2,279.4	--	--	--	--	--	--
Population under poverty level, %	21.6	16.2	0.0	72.8	0.714	(<.001)	--	--	--	--
Black, %	59.3	35.0	0.0	100.0	0.894	(<.001)	0.651	(<.001)	--	--
Population unemployed, %	9.3	9.0	0.0	56.5	0.627	(<.001)	0.524	(<.001)	0.625	(<.001)
Population w/o HS diploma, %	27.9	18.0	0.0	100.0	0.851	(<.001)	0.665	(<.001)	0.774	(<.001)
Population married, %	38.9	13.6	12.6	80.5	-0.410	(<.001)	-0.518	(<.001)	-0.362	(<.001)
Population aged 15-24 years, %	14.8	13.6	0.0	99.6	0.258	(<.001)	0.261	(<.001)	0.202	(0.010)
Population density (people/sq mile)	5,265.3	3,794.1	340.0	21,425.0	0.061	(0.443)	0.281	(<.001)	0.085	(0.280)

* Correlations refer to the transformed varaibles used in the regression analysis. Most variables were log-tranformed to reduce skewness.

Methods

ArcGIS 9.2 software was used for exploratory geographic visualization of gonorrhea rates and ABSM distributions. Jenk's Natural Breaks classification method was used to visualize the geographic distribution of the block group characteristics.

Bivariate relationships between all variables were examined, using Pearson correlation coefficients, to identify potential confounding and determine the extent of any collinearity. All variables were transformed prior to analysis.

Linear regression models were used to statistically quantify the relationship between ABSMs and gonorrhea incidence rates. A backward elimination method was applied to determine the best set of predictors, with gonorrhea rate as the dependent variable. SAS 9.1 was used for all statistical analyses.

Results

A total of 8,643 gonorrhea cases were included in the analysis, representing 86.6% of cases reported in the Richmond metropolitan area from 2000-2007. Unadjusted incidence rates of gonorrhea varied from 0 to 2,279 per 10,000 by census block group. The average yearly rate was 681 cases per 100,000.

Geographic visualization indicated correlation between high gonorrhea rates and high levels of poverty, race, education, unemployment, and marital status (Figures 1-4).

Statistically significant bivariate correlations were observed between gonorrhea rates and all predictors, with the exception of population density (Table 1).

In the final linear regression model predicting gonorrhea rates from ABSMs, the following predictors were statistically significant and positively associated with gonorrhea rates: percentage living below the poverty level, percentage black, percentage with less than a high school education, and percentage aged 15-24 years.

Conclusions

Contextual neighborhood factors, here represented by ABSMs, provide a greater understanding of the influences underlying the observed geographic distribution of gonorrhea incidence.

Identification of neighborhood factors pertinent to the spread of gonorrhea and other STDs may allow for better focusing of STD prevention efforts, including targeted screening activities, which may help to alleviate the spread of disease as well as conserve limited public health resources.

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