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Understanding the relationship of high blood pressure prevalence and access to park and forest

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Abstract

Abstract

High blood pressure is the most common risk factor to lead to cardiovascular disease (CVD), the primary cause of death in the U.S. and the world (Roth et al., 2017). Regular physical activity is one of the important measures that people can prevent and treat high blood pressure (Diaz & Shimbo, 2013; Piercy & Troiano, 2018; Zou et al., 2021). Physical environment, such as parks and forests, is necessary as encouraging people to be more physically active (Chandrabose et al., 2019). This study aims to analyze the relationship between high blood pressure prevalence and access to park and forest.

Method

This study utilizes secondary data and applies aspatial and spatial regression methods to explore the relationships of hypertension and demographic, socioeconomic, and environmental variables. Table 1 shows variables and related data sources. The dependent variable, high blood pressure prevalence, is provided by Behavioral Risk Factor Surveillance System. Demographic and socioeconomic variables of a community are retrieved from American Community Survey (ACS). Environmental variables, including access to park and land covered by forest, are extracted from National Environmental Public Health Tracking Network.

Table 1 Variables and related data sources (county level)

Variable Name	Data description	Source
High Blood Pressure Prevalence	County level age-adjusted high blood pressure rate	Behavioral Risk Factor Surveillance System, 2017
Age (18 to 34)	Percent of young adult population (age 18-34)	American Community Survey, 2015-2019
Age (65 or over)	Percent of senior population (age 65 or over)	American Community Survey, 2015-2019
Black or African American	Percent of Black or African American	American Community Survey, 2015-2019

Educational attainment (BA or higher)	Percent of individual who obtained bachelor's degree or higher	American Community Survey, 2015-2019
Unemployed rate	Unemployed rate	American Community Survey, 2015-2019
Household income (Lower than 25K)	Percent of annual household income lower than 25K	American Community Survey, 2015-2019
Access to park	Percent of population living within a half mile of a park	National Environmental Public Health Tracking Network, 2015
Land covered by forest	Percent of land covered by forest	National Environmental Public Health Tracking Network, 2016

This study has three stages of analysis. First, spatial cluster analysis was employed to detect the spatial prevalence of adults with high blood pressure across the U.S. Next, Ordinary least squares (OLS) regression was utilized to explore the global relationships between the selected variables. Finally, geographically weighted regression (GWR) will be conducted for examining local relationships between the variables.

The datasets were merged with the U.S. County shapefile in ArcMAP 10.7.1. The resulting shapefile was then exported and analyzed (including global can local Moran's I statistics) in GeoDa (Anselin, Syabri & Youngihn Kho, 2006). Visualizations were generated in ArcMAP 10.7.1. GWR will be processed in MGWR 2.2 (Oshan et al., 2019).

Results

Spatial cluster patterns of adult high blood pressure prevalence

The global Moran's I value for adult high blood pressure was 0.652, confirming that adults with high blood pressure was spatial clustered (Figure 1). Furthermore, local spatial cluster analysis detected that the south-east states and counties (Arkansas, Mississippi, Alabama, Tennessee, West Virginia, and South Carolina) had higher high blood pressure rates, while the western states (California, Washington, Utah, and Colorado), Great Lakes region, and northeastern areas (Pennsylvania and New York) showed lower high blood pressure rates (Figure

2). Specifically, our results implied that high blood prevalence could have spatial disparities in health issues.

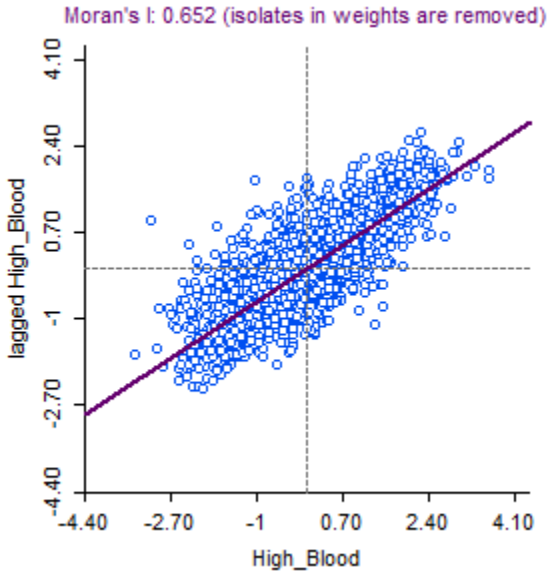

Figure 1 Moral's I Index

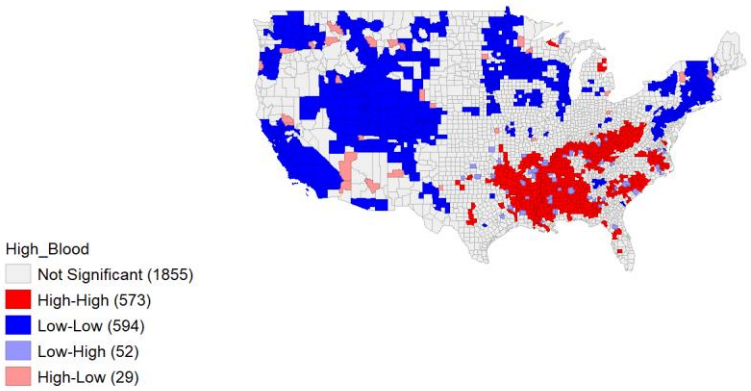

Figure 2 Spatial Cluster Patterns of Adult High Blood Pressure

Results of the OLS analysis

In response to identify the factors that contribute to high blood pressure prevalence, we examined and selected the following independent variables: 1) percent of senior population; 2) percent of Black or African American; 3) education attainment; 4) unemployed rate; 5) access to park; and 6) percent of land covered by forest for the final OLS model. The baseline OLS model is presented in Table 2. The results from a Breusch-Pagan test (172.484, $p < 0.0001$) indicated that the model had statistically significant non-stationary suggesting that spatial regression should be employed to reflect more accurate relationship (Fotherinham et al., 2002).

Table 2 Summary of OLS results

Variables	Coefficient	SE	t-value	VIF
Intercept	0.301***	0.003	95.340	
Age (65 years or over)	0.492***	0.011	43.732	1.139
Black or African American	0.145***	0.004	38.657	1.265
Educational attainment (BA or higher)	-0.222***	0.006	-36.555	1.437
Unemployed rate	0.296***	0.023	13.097	1.432
Access to park	-0.044***	0.002	-18.848	1.268
Land covered by forest	0.031***	0.002	15.426	1.089
R^2	0.756			
Adjusted R^2	0.756			
AIC	-13601.300			

Conclusion

This study examines the relationship between high blood pressure prevalence and access to park and forest and demographic variables. The OLS results reveals that there is a statistically significant negative relationship between access to park, indicating that access to park is helpful to prevent high blood pressure prevalence. In addition, according to the Moral's I and Breusch-Pagan test's results, the OLS model results in biased statistical extrapolation due to non-stationary relationships and a level of spatial autocorrelation of residuals. Therefore, spatial regression model is necessary for a continuous study.

References

Diaz, K. M., & Shimbo, D. (2013). Physical activity and the prevention of hypertension. *Current Hypertension Reports*, *15*(6), 659–668. https://doi.org/10.1007/s11906-013-0386-8

Chandrabose, M., Rachele, J. N., Gunn, L., Kavanagh, A., Owen, N., Turrell, G., Giles-Corti, B., & Sugiyama, T. (2019). Built environment and cardio-metabolic health: Systematic review and meta-analysis of longitudinal studies. *Obesity Reviews*, *20*(1), 41–54. https://doi.org/10.1111/obr.12759

Roth, G. A., Johnson, C., Abajobir, A., Abd-Allah, F., Abera, S. F., Abyu, G., Ahmed, M., Aksut, B., Alam, T., Alam, K., Alla, F., Alvis-Guzman, N., Amrock, S., Ansari, H., Ärnlöv, J., Asayesh, H., Atey, T. M., Avila-Burgos, L., Awasthi, A., … Murray, C. (2017). Global, regional, and national burden of cardiovascular diseases for 10 Causes, 1990 to 2015. *Journal of the American College of Cardiology*, *70*(1), 1–25. https://doi.org/10.1016/j.jacc.2017.04.052

Piercy, K. L., & Troiano, R. P. (2018). Physical activity guidelines for Americans from the US Department of Health and Human Services. *Circulation: Cardiovascular Quality and Outcomes*, *11*(11), e005263. https://doi.org/10.1161/CIRCOUTCOMES.118.005263

Oshan, T. M., Li, Z., Kang, W., Wolf, L. J., & Fotheringham, A. S. (2019). mgwr: A Python Implementation of Multiscale Geographically Weighted Regression for Investigating Process Spatial Heterogeneity and Scale. *ISPRS International Journal of Geo-Information, 8*(6), 269. https://doi.org/10.3390/ijgi8060269

Anselin, L., Syabri, I., & Kho, Y. (2006). GeoDa: An introduction to spatial data analysis. *Geographical Analysis*, 38 (1), 5-22.

Zou, Q., Wang, H., Su, C., Du, W., Ouyang, Y., Jia, X., Wang, Z., Ding, G., & Zhang, B. (2021). Longitudinal association between physical activity and blood pressure, risk of hypertension among Chinese adults: China Health and Nutrition Survey 1991–2015. *European Journal of Clinical Nutrition*, *75*(2), 274–282. https://doi.org/10.1038/s41430-020-0653-0