EXAMINING SPATIAL CLUSTERING PATTERNS AND REGIONAL VARIATIONS FOR HEALTHY EATING ENVIRONMENTS IN THE UNITED STATES

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BACKGROUND

Childhood obesity is a major health concern in the United States, with increasing trends in the last three decades.[1-3]

Childhood obesity is a a risk factor for high blood pressure, high cholesterol, type 2 diabetes, and overall mortality in adulthood. [2,4-7]

Individual and behavioral risk factors for obesity were the main focus of research in the past,[8-10] but research now suggests that the environment is the key factor contributing to physical inactivity and unhealthy diets.[11-12]

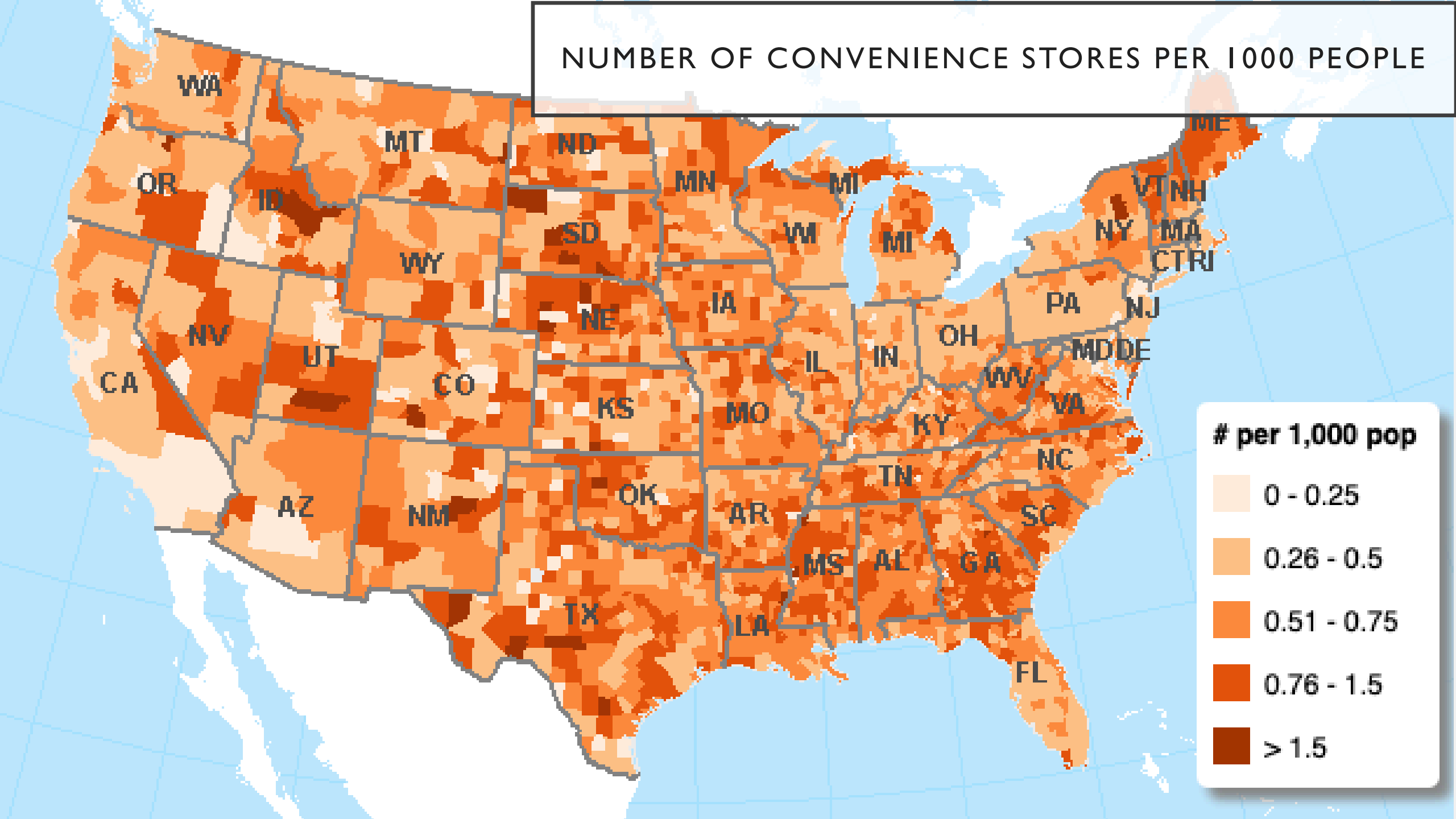
OBESOGENIC ENVIRONMENTS

Defined as the sum of influences that the surroundings, opportunities, or conditions have on promoting obesity in individuals or populations, and focuses on the environmental level for obesity risk.[13-17]

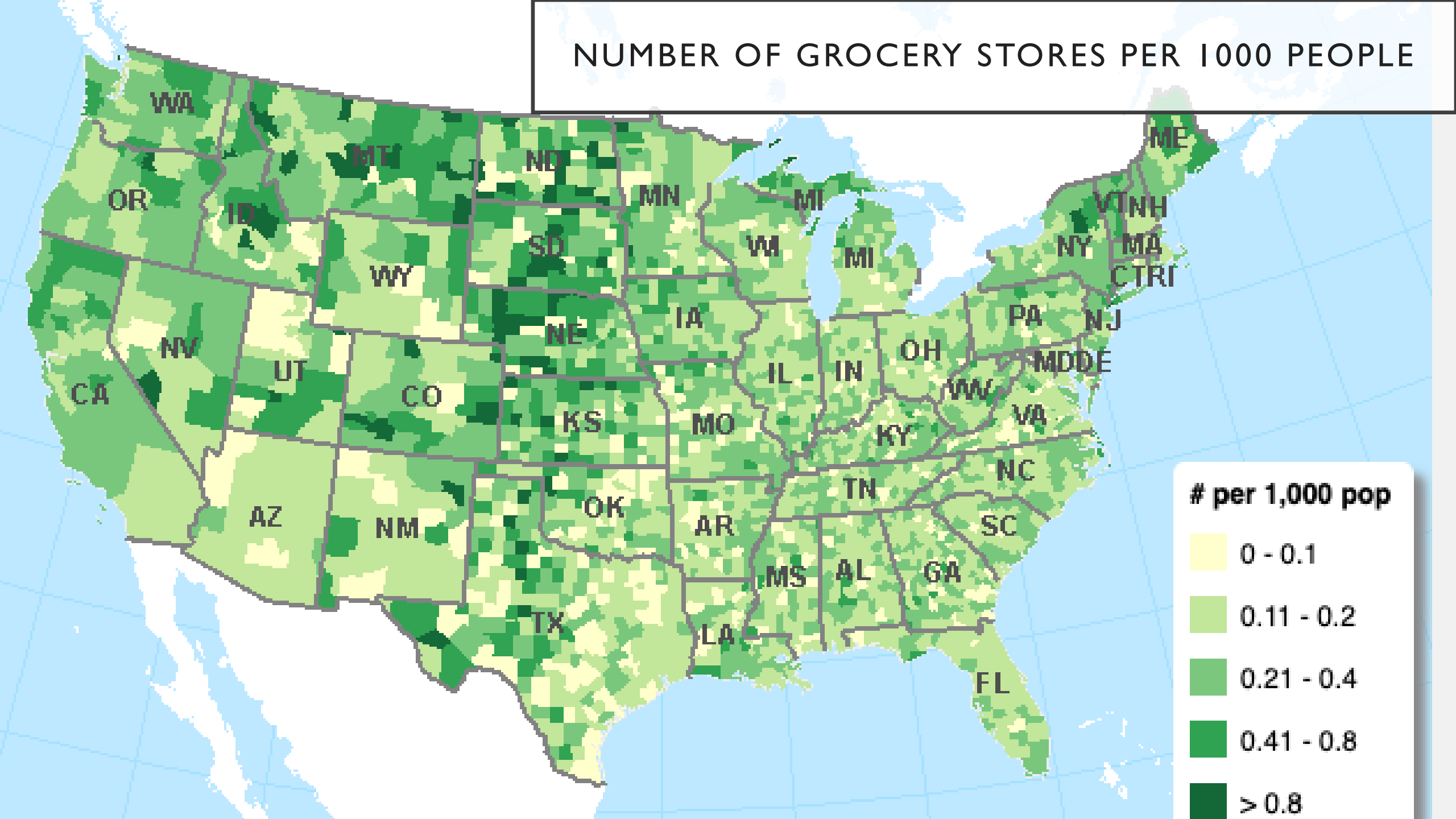
SPATIAL MAPPING AND CLUSTERING

- Spatial clustering analyses have been used to track health outcomes, such as obesity,[22,23] diabetes[24,35] and cancer.[26,27]
  - Used to identify determinants of these outcomes, such as healthy and unhealthy food sources.[23]
- Can examine how environments become centralized according to rurality and region.

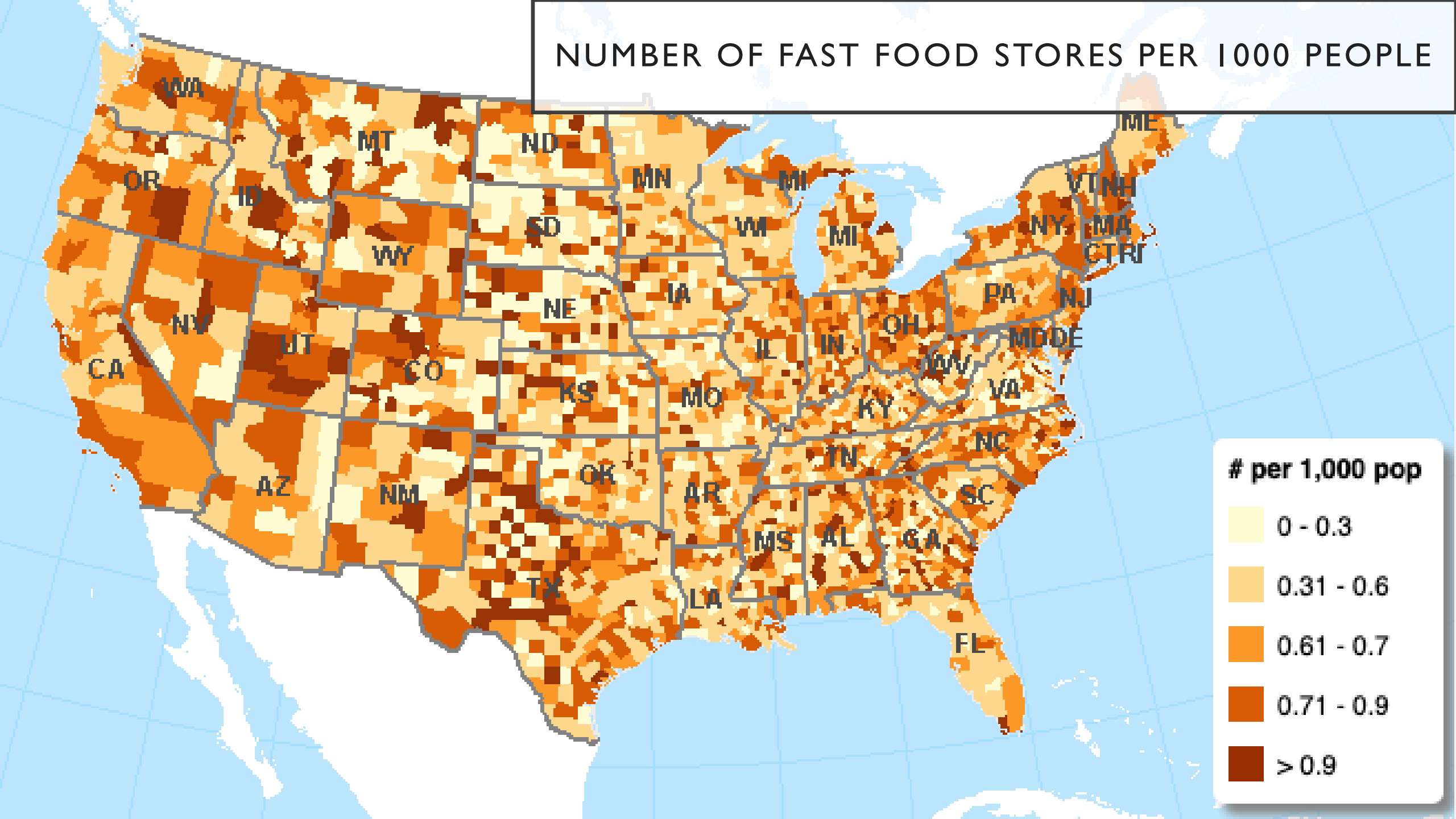
NUMBER OF CONVENIENCE STORES PER 1000 PEOPLE



NUMBER OF GROCERY STORES PER 1000 PEOPLE

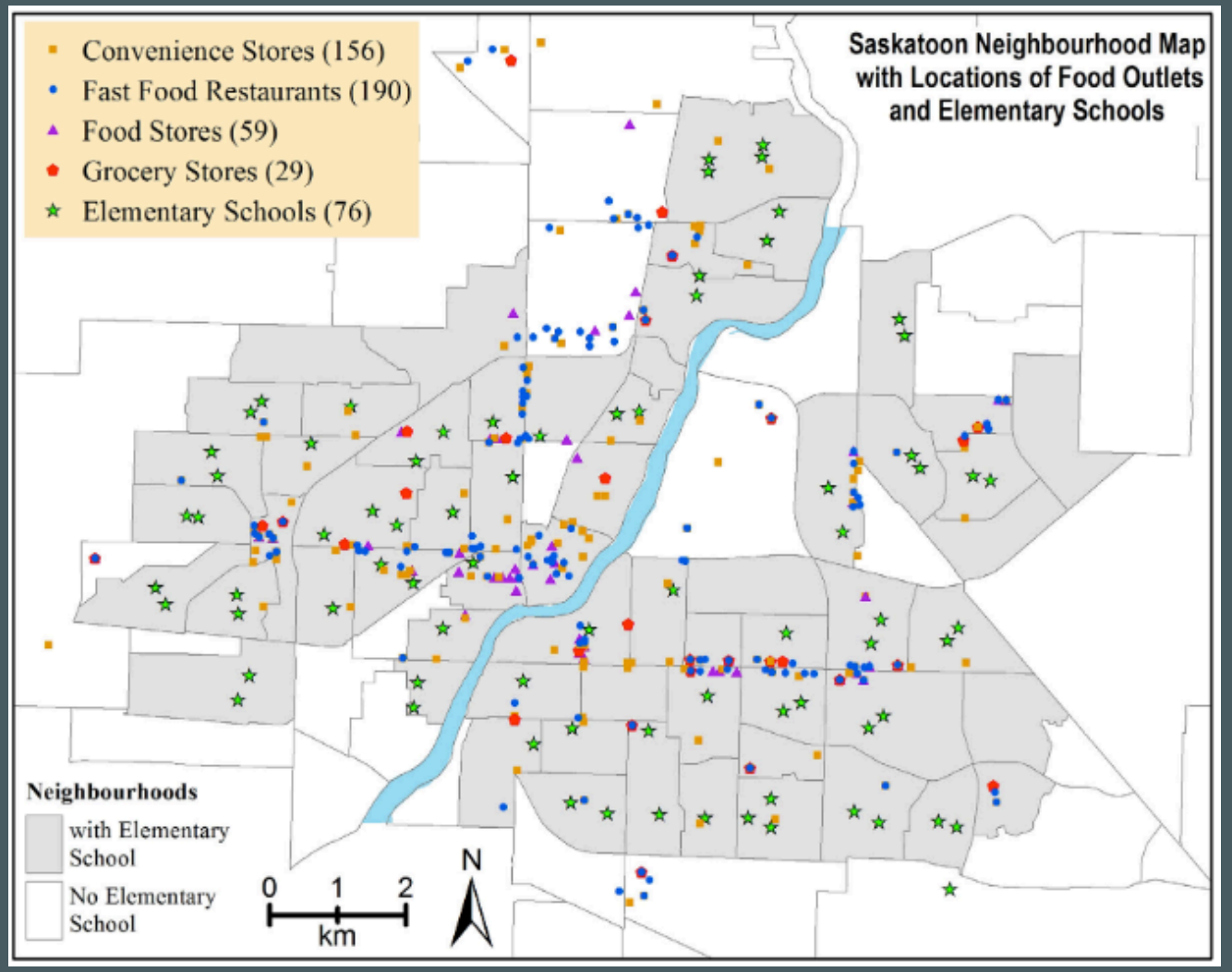


NUMBER OF FAST FOOD STORES PER 1000 PEOPLE



GAPS

- Data & maps available for separate food measures, but no country-wide representation of a composite, food environment measure.
  - Clustering of these food environments
- Research on geographic distribution of childhood obesogenic environments focuses on local levels.



OBJECTIVES

The purpose of this study was to examine county-level spatial patterns of obesogenic environments across the United States.

Objective 1→ To examine the spatial clustering of positive and negative food environments across the United States.

Objective 2→ To explore differences in food environments between regional and rurality divisions of the United States.

DATA COLLECTION

Obesogenic environment index data were collected for all counties across the United States (N=3,142).

Census regions were used to classify counties into four regional distinctions: **Northeast, Midwest, South and West.**

Urban influence codes, were collected from the United States Department of Agriculture, and categorized into: **Metropolitan, Micropolitan and Rural** (consisting of Small Adjacent and Remote Rural).

DEVELOPING THE OBESOGENIC ENVIRONMENT INDEX

A search on PubMed was conducted for review articles on environmental factors related to youth PA, nutrition, and overweight/obesity.

100 unique variables identified during the review were partitioned into categories to create a final list of 24 variables to share with expert reviewers.

Experts reviewed and rated the perceived importance of each variable, resulting in a final list of 10 variables: 6 related to food and 4 related to PA environments.

DATA SOURCES

Variable	Measure	Source	Year
Grocery stores and super centers	Number of grocery stores/supermarkets and supercenters/warehouse club stores in the county per 1,000 county residents	United States Department of Agriculture	2014
Farmers markets	Number of farmers markets in the county per 1,000 county residents	United States Department of Agriculture	2016
Fast food restaurants	Number of fast food restaurants in the county per 1,000 county residents	United States Department of Agriculture	2014
Full-service restaurants	Number of full-service restaurants in the county per 1,000 county residents	United States Department of Agriculture	2014
Convenience stores	Number of convenience stores in the county per 1,000 county residents	United States Department of Agriculture	2014
Births at baby-friendly facilities	Percent births at baby-friendly facilities at the state level	Centers for Disease Control and Prevention	2016

1. **Food Environment Atlas, Economic Research Service, United States Department of Agriculture: https://www.ers.usda.gov/data-products/food-environment-atlas/documentation/**
2. **Breastfeeding Report Card, Division of Nutrition, Physical Activity, and Obesity, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention: https://www.cdc.gov/breastfeeding/pdf/2016breastfeedingreportcard.pdf**

CREATING FOOD ENVIRONMENT SCORES

The values for each variable were ranked, and a percentile value was assigned to each county ranging from 0 to 100.

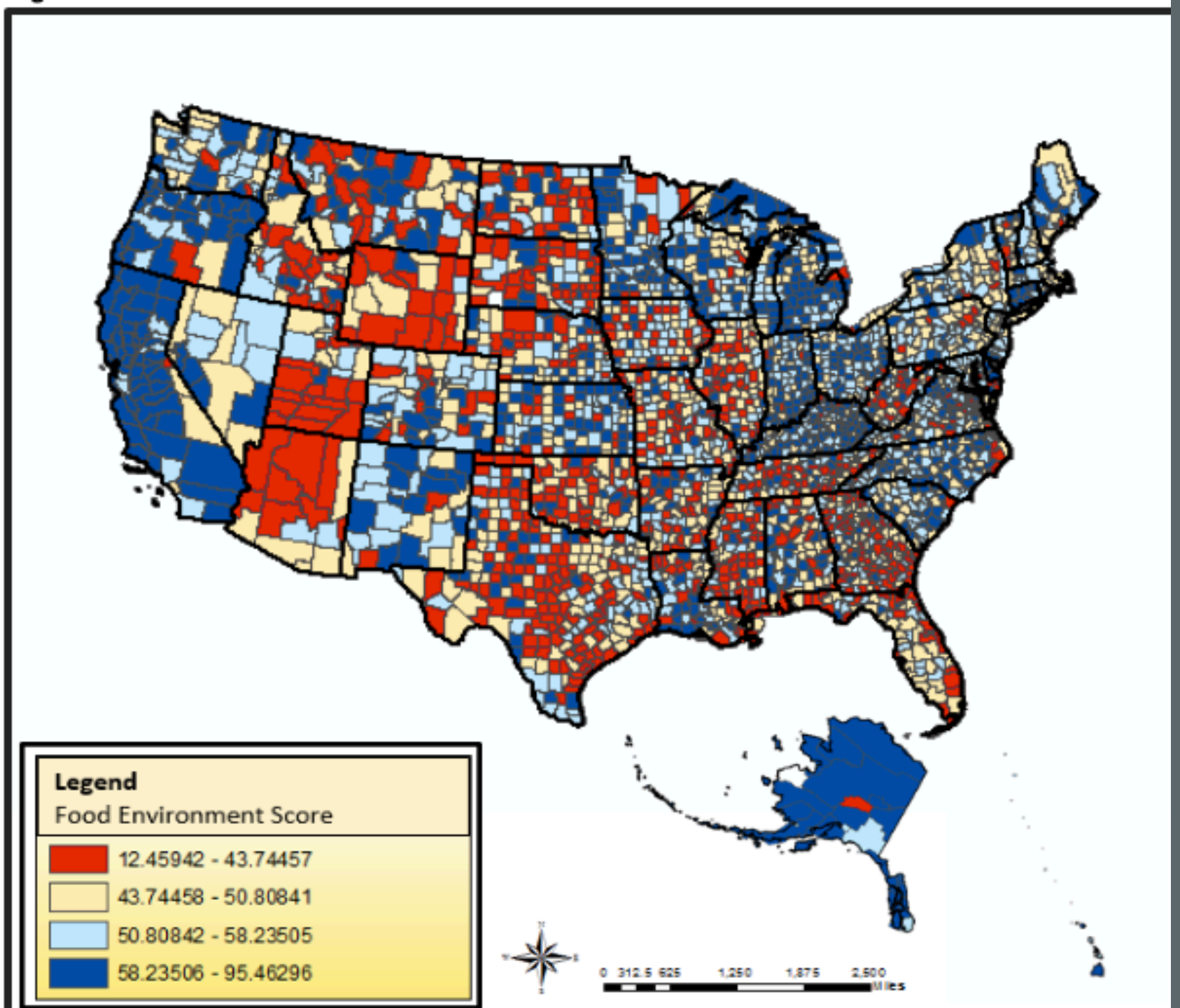
Negative environmental features, such as fast food restaurants, full-service restaurants, and convenience stores were reverse-scored.

Food environment variables were averaged to create a composite score out of 100 (higher = better).

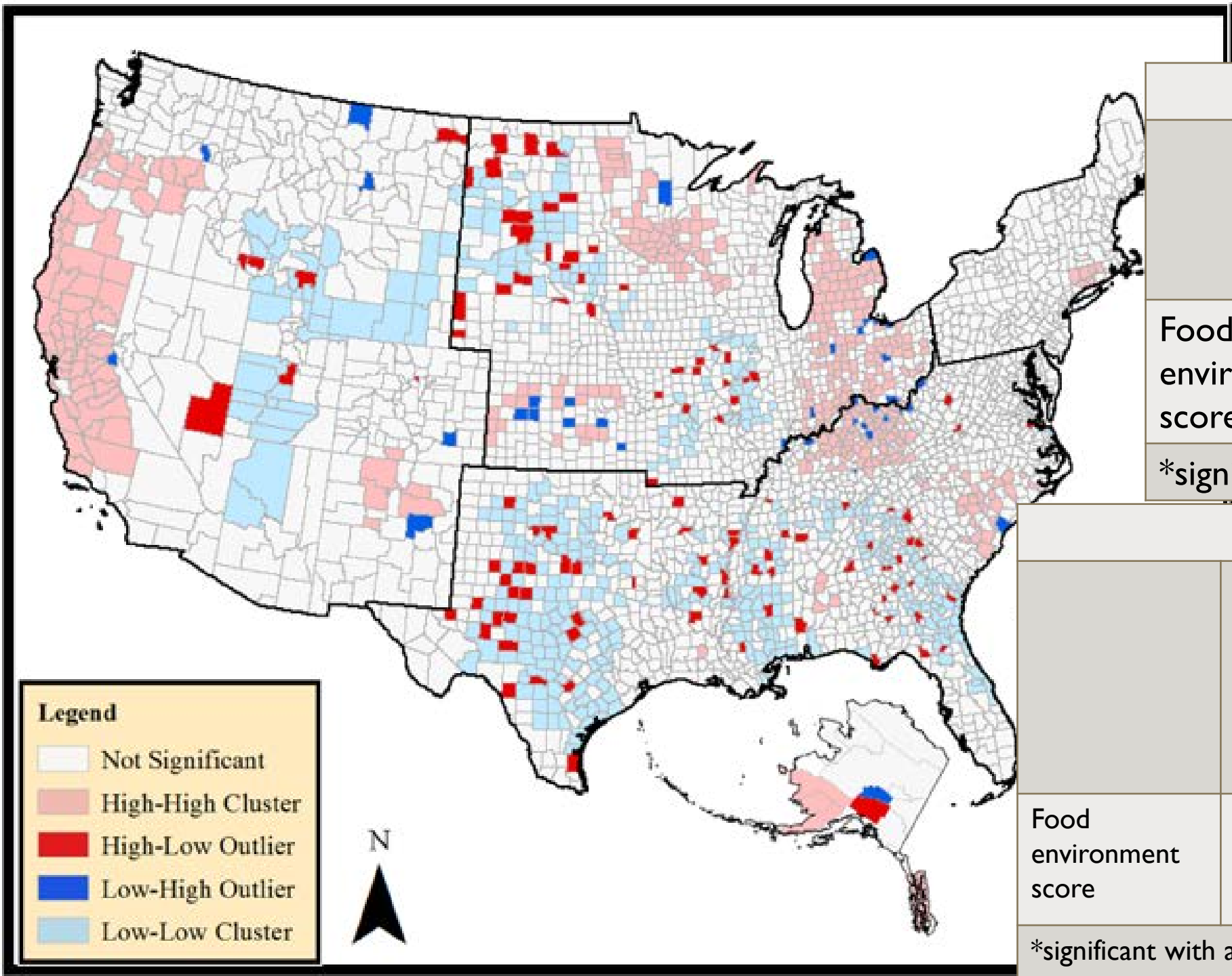
ANALYSES

Objective 1 → To examine the spatial distribution of positive and negative food environments across the United States

- Use of choropleth maps
- Spatial analytic techniques
  - Global Moran's I
  - Anselin's Local Moran's I



FOOD ENVIRONMENT ACROSS UNITED STATES COUNTIES, N=3142



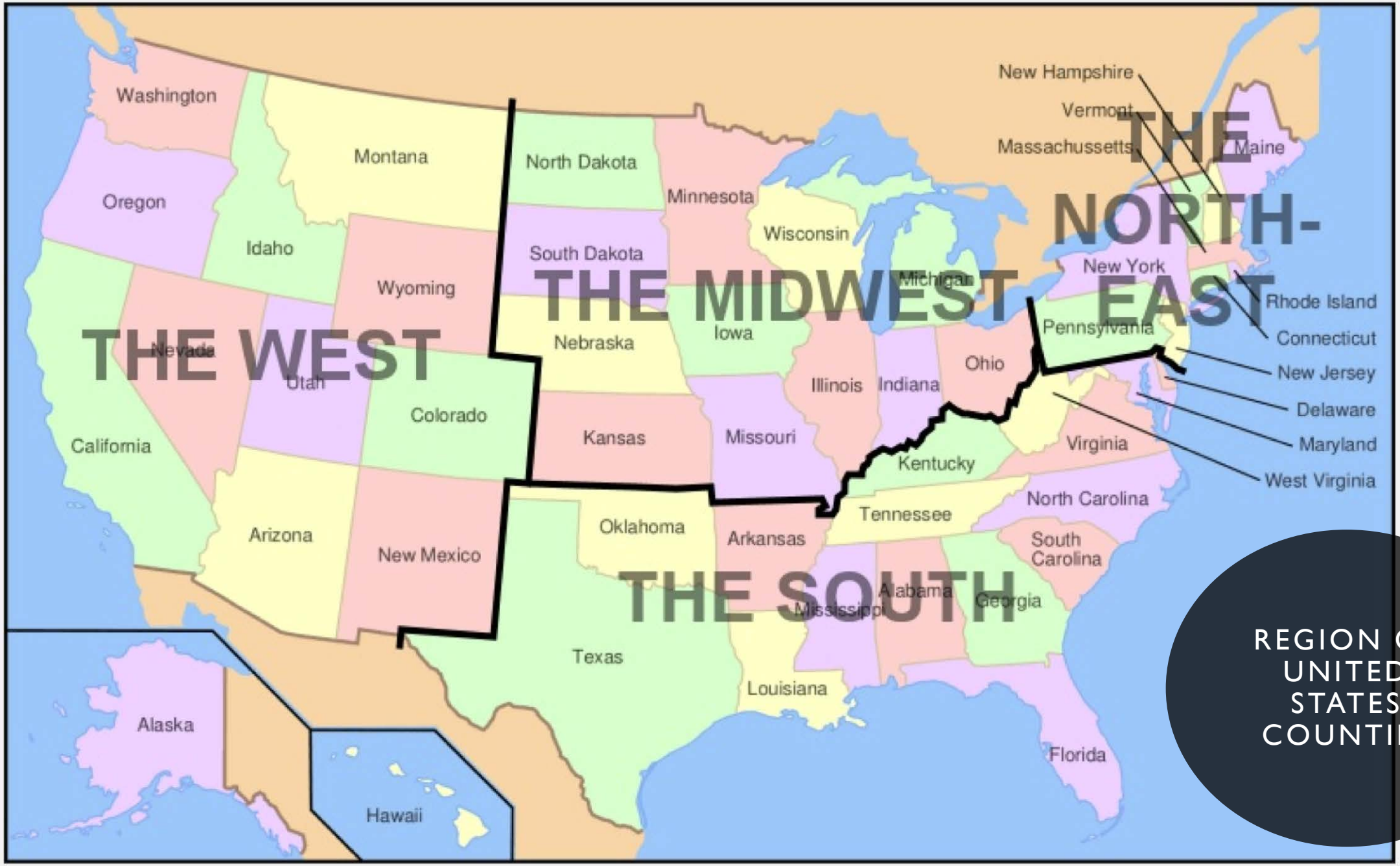
Global Moran's I		
	Index Value	P-value
Food environment score	.19	**<.0001***
*significant with a =.05		

Local Moran's I				
	High-High Cluster Counties (#, %)	High-Low Outlier Counties (#, %)	Low-High Outlier Counties (#, %)	Low-Low Cluster Counties (#, %)
Food environment score	407 (13.0%)	110 (3.5%)	39 (1.2%)	434 (13.8%)
*significant with a =.05				

ANALYSES

Objective 2 → To explore differences in food environments between <u>regional</u> and <u>rurality</u> divisions of the United States.

- ANOVA
- Tukey's Standardized Range



REGION OF UNITED STATES COUNTIES

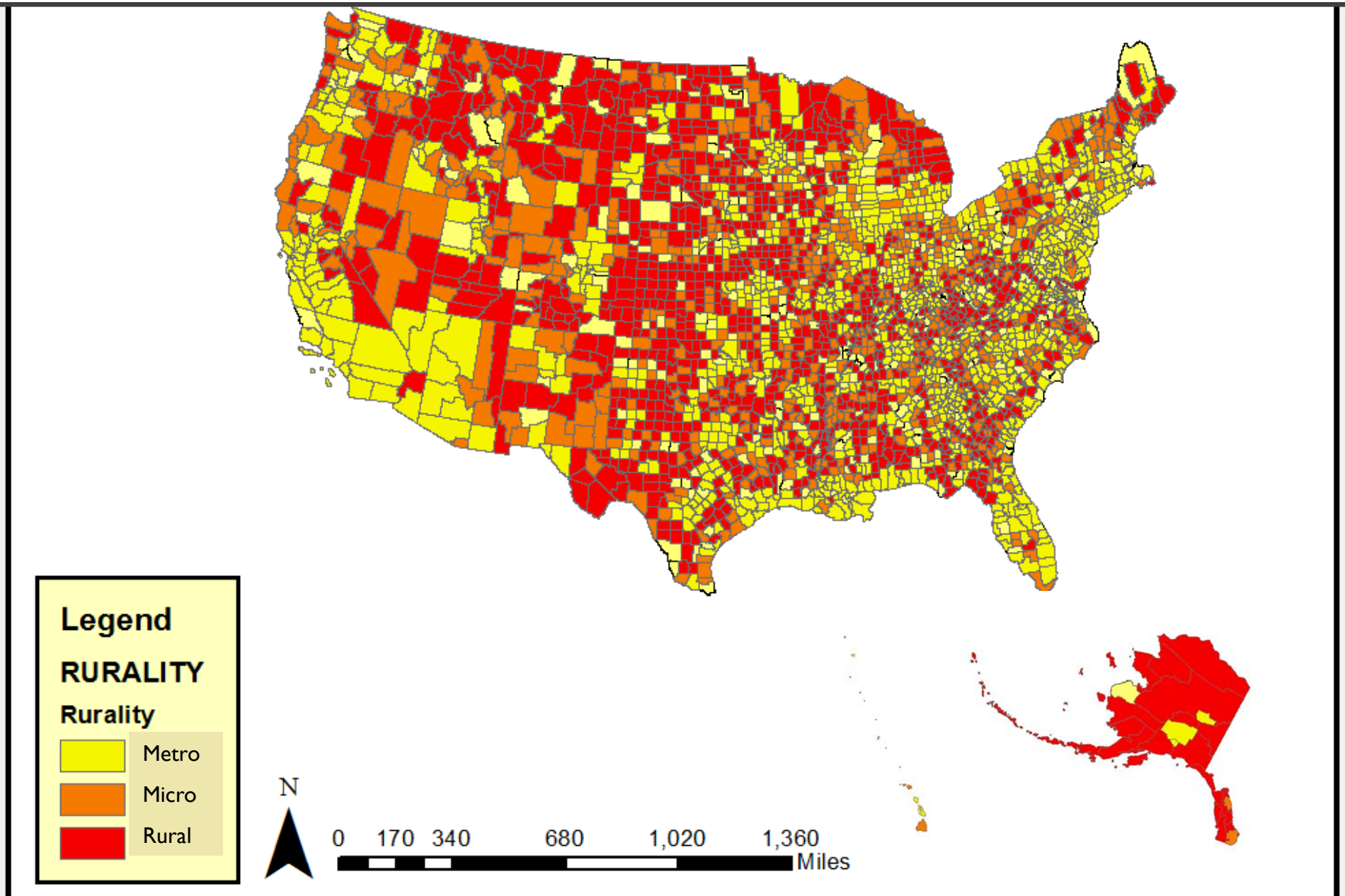
	Average Percentile Rank (SD)
Northeast	65.7 (15.1)
Midwest	54.0 (15.6)
South	46.1 (17.5)
West	50.6 (18.1)
ANOVA F statistic **ANOVA p-value**	38.06 **<.0001***

Overall, there were significant differences in food environment scores according to region.

Looking at individual differences between the regions, each region was significantly different from the others.

FOOD ENVIRONMENT INDEX BY REGION OF THE UNITED STATES, N=3142

RURALITY OF UNITED STATES COUNTIES, N=3142



	Average Percentile Rank (SD)
Metropolitan Counties	49.9 (9.8)
Micropolitan Counties	49.3 (10.6)
Rural Counties	52.8 (13.4)
ANOVA F statistic **ANOVA p-value**	27.16 **<.0001***

Overall, there were significant differences in food environment scores according to rurality.

Metropolitan and Micropolitan counties had similar food environment scores, but were significantly lower (worse) than rural counties.

FOOD ENVIRONMENT INDEX BY RURALITY OF UNITED STATES COUNTIES, N=3142

CONCLUSIONS

Food environment score values were not randomly distributed across the U.S.

More low-low clusters compared to high-high clusters.

Clusters of high food environment scores were located along coastal regions of the Northeast and West.

Significant differences based on region and rurality.

LIMITATIONS

- No outcome measure
- Key food environment variables may not be included/available
- May need smaller scale studies to inform interventions

IMPLICATIONS

Results can inform future public health initiatives by demonstrating the geographic distribution of environments that promote obesity.

Similar methods can be used in future efforts to track obesogenic environments and illustrate their widespread impact on health.

Future research can examine the impact of policy on these food environments to understand reasons behind observed clustering.

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