Energy Balance Related Behaviors, Obesity and the Local Neighborhood Environment.

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Obesity related behaviors

- Nutritional behaviors are associated with obesity and related chronic conditions
- Adherence to USDA dietary guidelines is protective
- What is the role of the local food environment in influencing whether persons can eat healthy diets?

Obesity related behaviors

- Physical activity behaviors are associated with obesity and related chronic conditions
- Regular vigorous physical activity is protective
- What is the role of the local public green space environment in influencing whether persons can get enough exercise?

Analysis Plan

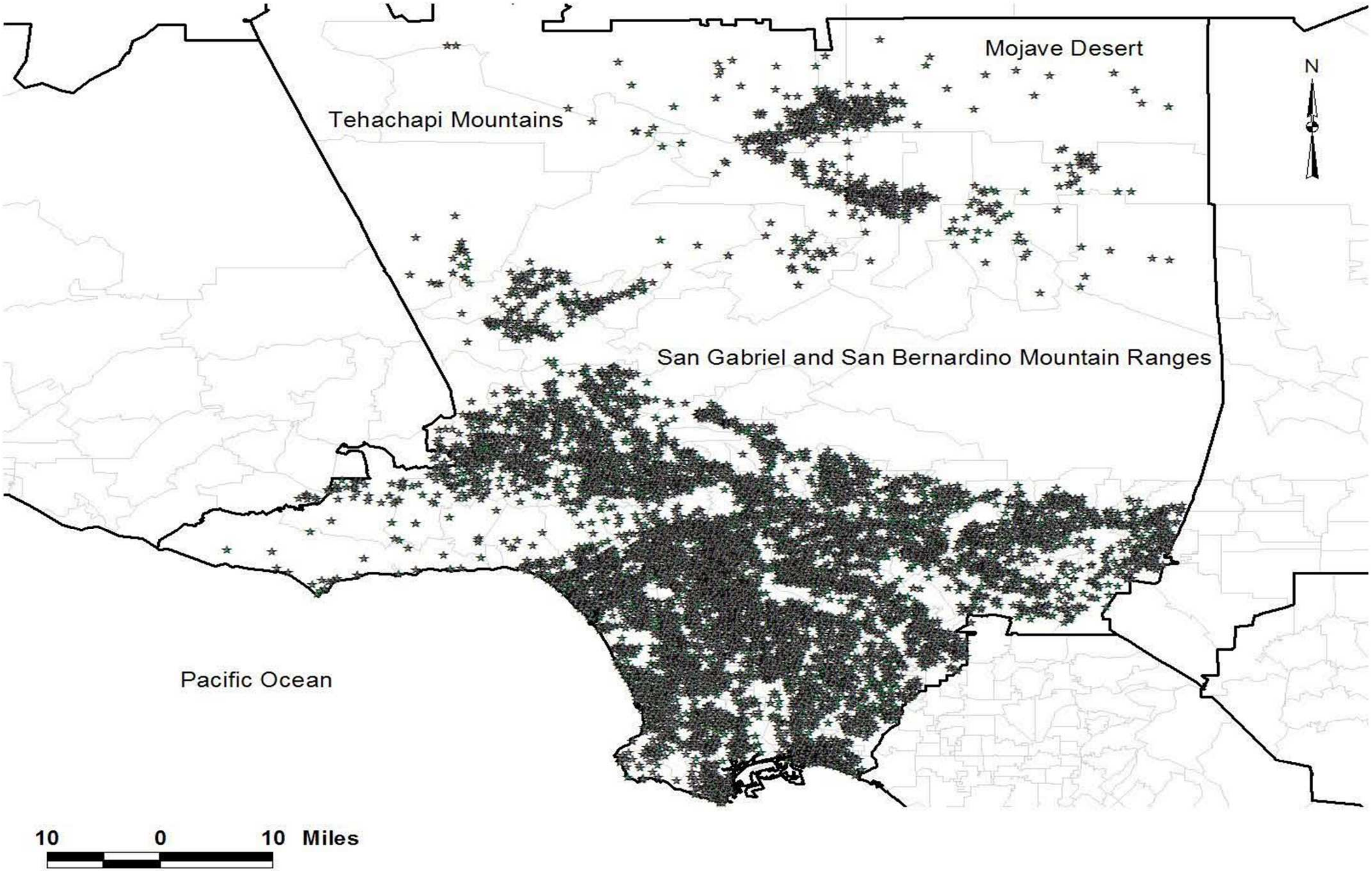
- Contextualizing LA health Survey respondents
- Chain supermarkets, fast food and other food outlets (concept of the retail food environment)
- Physical activity environments (parks and other recreational land uses
- Gravity modeling for creation of relevant neighborhoods
- Multi-level modeling - cross level interactions

LA County Health Survey

- LACHS is one of the largest population based health surveys in the world.
- Single stage, equal probability sample, conducted via random digit dial every two-three years
- Contains a wealth of health related information for individuals
- Local geographic identifiers (nearest cross street)

Appendix 1

Census Blocks containing one or more Los Angeles Health Survey Respondents in 2002 and/or 2005



LA County Env. Health data

- We have established an ongoing relationship with the LA County department environmental health
- They provide longitudinal data on licensed food outlets in the County
- We process this data into outlet type using the NAICS as a guide.

Outcome variable – fruit and vegetable intake

During the questionnaire LA Health survey participants were asked

“how many total servings of fruits and vegetables did you eat yesterday?”

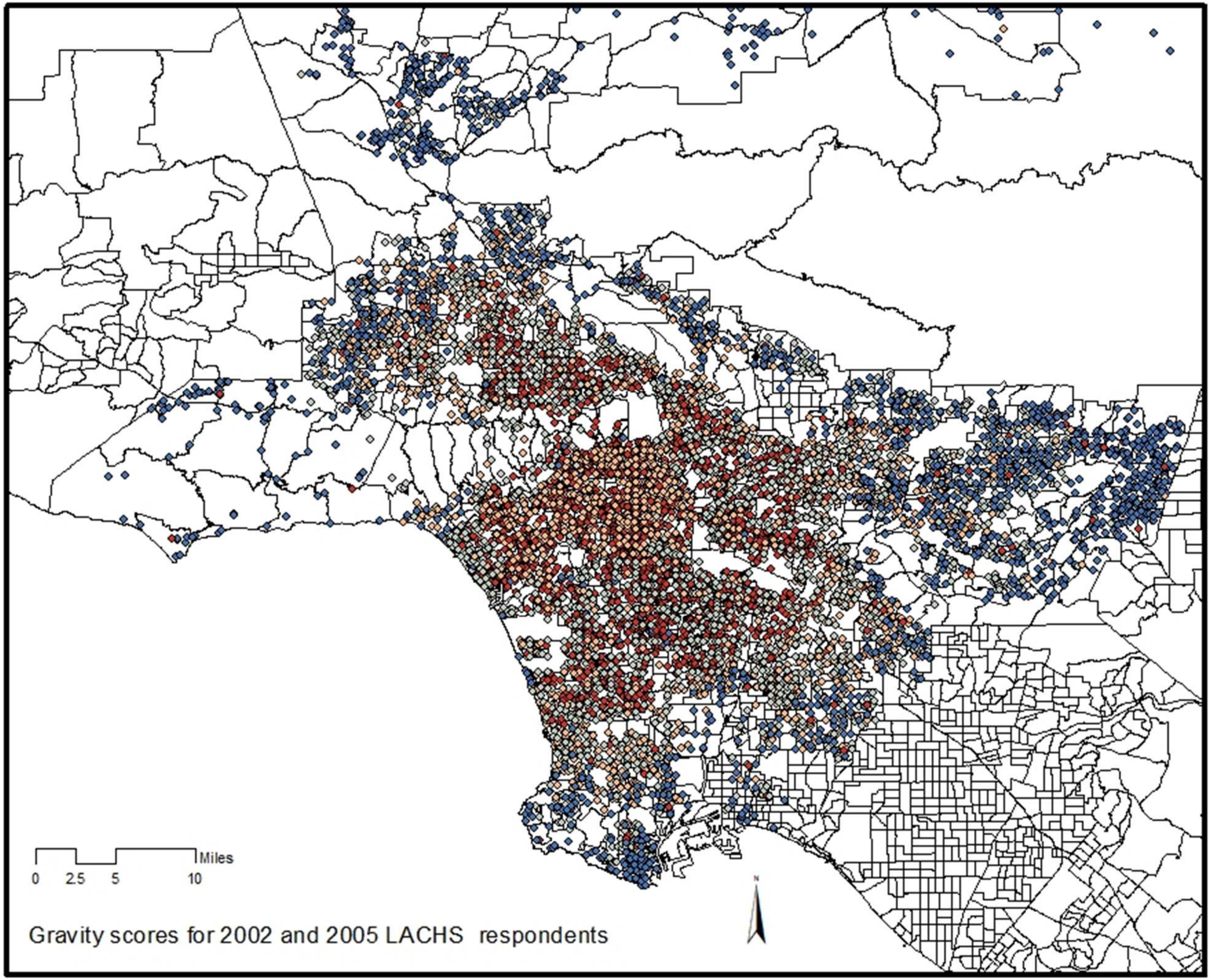
If unsure about serving size, respondents were told that a serving size would equal amounts such as one medium apple, a handful of broccoli, or a cup of cut carrots and that 6 oz of fruit juice counted as a serving.

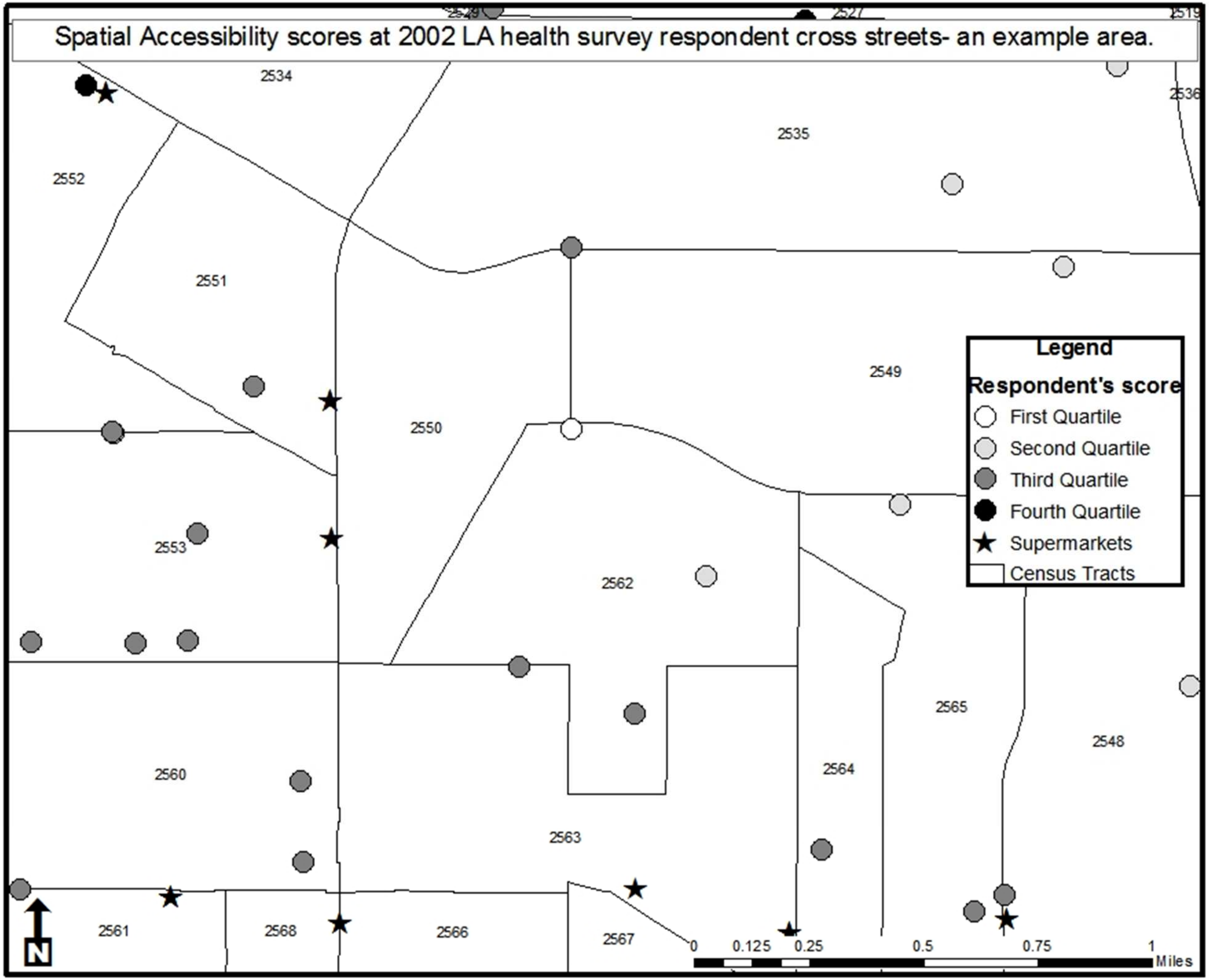
Predictor variable – gravity model accessibility to grocery stores

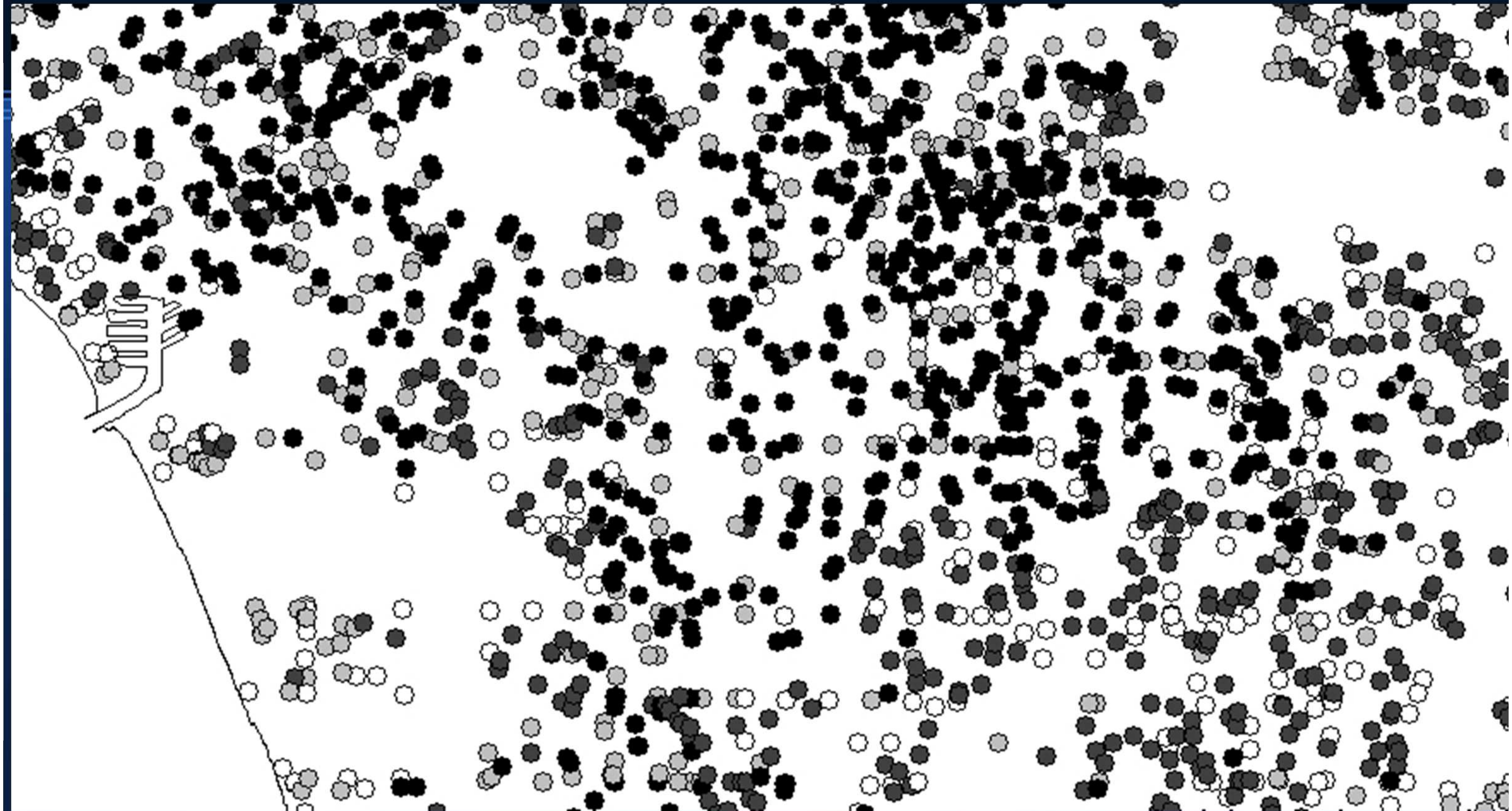
- We generated gravity models of accessibility to chain grocery stores (two or more outlets) for the 2002 and 2005 LACHS respondents
- After testing out different decay functions we found that an arithmetic function of 1 / (d) was appropriate in LA county

Gravity models

The simplest formula for calculating gravity-based accessibility is: $A_i = \sum_j (s_j / d_{ij}^{\beta})$ *Where;* A_i is the spatial accessibility from population point *i*, (an address of residence, a cross street, or the centroid of an area of interest such as zip code), S_j is service capacity at provider location *j*, and d is distance between the subject's location and the amenity or service's location, weighted by β, some relevant distance decay exponent.


Miles
0 2.5 5 10
N
Gravity scores for 2002 and 2005 LACHS respondents


Spatial Accessibility scores at 2002 LA health survey respondent cross streets- an example area.
2529
2527
2519
2534
2536
2535
2552
2551
2549
2550
2553
2562
2565
2548
2560
2564
2563
2561
2568
2566
2567
Legend
Respondent's score
First Quartile
Second Quartile
Third Quartile
Fourth Quartile
Supermarkets
Census Tracts
0
0.125
0.25
0.5
0.75
1
Miles
N



Other independent / control variables

- Age
- Race
- Gender
- Income and Education
- Knowledge
- Neighborhood Safety

Table 1.

Factors associated with Nutritional Status (meeting USDA fruit and Vegetable guidelines)

Patient characteristics	Overall Sample (N= 12289)	Mean Accessibility Score	<= 2 Serving of Fruit & vegetables/day N (%)	>= 3 Serving of Fruit & Vegetables/day N (%)
Gender				
Male	5808(47.3)	1.24	3329(59.7)	2246(40.3)
Female	6481(52.7)	1.25	3009(48.0)	3248 (52.0)
		P=0.15		P***
Race/Ethnicity				
White	5144(42.2)	1.15	2306(46.2)	2685(53.8)
Latino	4718(38.7)	1.32	2643(58.4)	1886(41.6)
African American	1082(8.9)	1.35	645(61.1)	410(38.9)
Asian/pacific islander	1055(8.7)	1.30	599(61.6)	374(38.4)
Other	181(1.5)	1.13	95(53.4)	83(46.6)
		P***		P***
Age				
>=65	1731(14.1)	1.20	750(46.1)	878(53.9)
60-64	721(5.9)	1.20	350(50.7)	340(49.3)
50-59	2047(16.6)	1.19	1021(51.4)	964(48.6)
40-49	2621(21.3)	1.22	1397(54.9)	1149(45.1)
30-39	2847(23.2)	1.28	1516(55.2)	1229(44.8)
25-29	1110(9.0)	1.33	628(58.6)	443(41.4)
18-24	1212 (9.9)	1.29	676(58.0)	491(42.0)
		P***		P***
Education				
College/post Grad/Trade	7405(60.4)	1.33	3528(49.0)	3668(51.0)
High School	2648(21.6)	1.23	1518(60.1)	1007(39.9
<High School	2214(18.0)	1.22	1280(61.2)	811(38.8)
		P***		P***
Marital Status				
Married	7173(58.2)	1.22	3575(52.1)	3286(47.9)
Not Married	5119(41.8)	1.28	2751(55.7)	2191(44.3)
		P***		P*
Federal Poverty Level				
>= 300 FPL	5251(42.7)	1.18	2465(48.3)	2642(51.7)
200-299% FPL	2161(17.6)	1.26	1119(54.0)	953(46.0)
100-199% FPL	2591(21.1)	1.29	1461(59.0)	1015(41.0)
0-99% FPL	2286(18.6)	1.33	1293(59.4)	884(40.6)
		P***		P***
Neighborhood Safety				
Very Safe	4091(33.6)	1.14	1946(49.4)	1996(50.6)
Somewhat Safe	5912(48.5)	1.27	3140(55.1)	2560(44.9)
Unsafe	2185(17.9)	1.37	1202(57.3)	897(42.7)
		P***		P***
Total Serving of Fruit & Vegetables you should eat everyday				
Don't know the Guideline	5152(47.6)	1.25	3709(74.0)	1302(26.0)
Knows the Guideline	5667(52.4)	1.22	1863(33.5)	3701(66.5)
		P**		P***

P* <.05, P <.01, P*** <.001**

Analysis of Variance & Chi-Square Test

Table 2. Logistic regression analysis [OR (95% CI) for Adults meeting USDA fruit and vegetable guideline by Accessibility to grocery store and socio demographic characteristics

Variable	Beta	OR	95% CI	P-Value
Accessibility Score	.0.150	1.16	1.04 – 1.30	**0.010**
Gender				
Male	**referent**			
Female	0.216	1.24	1.13 – 1.36	**<0.0001**
Race/Ethnicity				
White	**referent**			
Hispanic/Latino	-0.103	0.90	0.80 – 1.01	0.089
African-American	-0.379	0.68	0.58 – 0.80	**<0.0001**
Asian/Pacific Islander	- 0.190	0.83	0.70 – 0.98	**0.033**
Other	-0.130	0.88	0.62 – 1.24	0.464
Age				
>=65	**Referent**			
60-64	-0.336	0.71	0.57 – 0.88	**0.002**
50-59	-0.404	0.67	0.57 – 0.78	**<0.0001**
40-49	-0.636	0.53	0.45 – 0.62	**<0.0001**
30-39	-0.697	0.50	0.43 – 0.58	**<0.0001**
25-29	-0.796	0.45	0.37 – 0.55	**<0.0001**
18-24	-0.684	0.50	0.42 – 0.61	**<0.0001**
Education				`
College/post Grad/Trade	**referent**			
High School	-0.248	0.78	0.67 – 0.90	**0.001**
<High School	-0.282	0.75	0.67 – 0.85	**<0.0001**
Marital Status				
Married	**referent**			
Single	-0.208	0.81	0.74 – 0.89	**<0.0001**
Federal Poverty Level				
>= 300 FPL	**Referent**			
200-299% FPL	-0.050	0.95	0.84 – 1.08	0.417
100-199% FPL	-0.137	0.87	0.84 – 0.99	**0.043**
0-99% FPL	-0.061	0.94	081.– 1.09	0.417
Neighborhood Safety				
Very Safe	**referent**			
Somewhat Safe	-0.118	0.90	0.80 – 0.98	**0.018**
Unsafe	-0.115	0.89	0.77 – 1.02	0.099
Total Serving of Fruit & Vegetables you should eat everyday				
Don't know the Guideline	**referent**			
Knows the Guideline	1.713	5.6	5.07 – 6.06	**<0.0001**

CI, confidence interval; OR, odds Ratio

Geographically Weighted Regression

Typical spatial data regression analyses involves estimating the relationship between one variable and a set of predictor variables for a collection of geographical entities (often a set of points, or zones). As an illustration, we might have a model with two predictor variables:

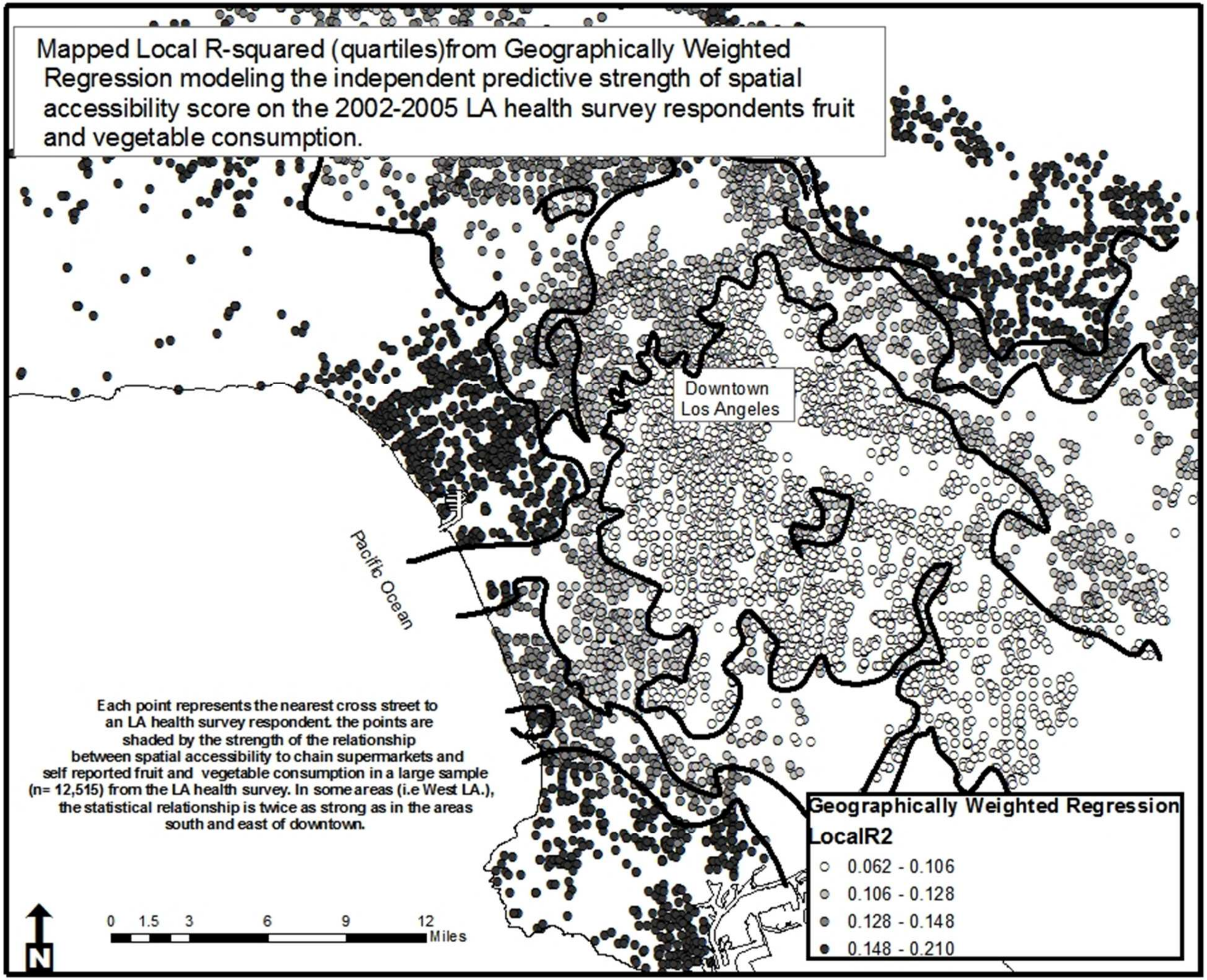
$$y = b_0 + b_1x_1 + b_2x_2 + e$$

where y is the dependent variable, x_1 and x_2 are the independent variables, b_0, b_1 and b_2, are the parameters to be estimated, and e is a random error term, assumed to be normally distributed.

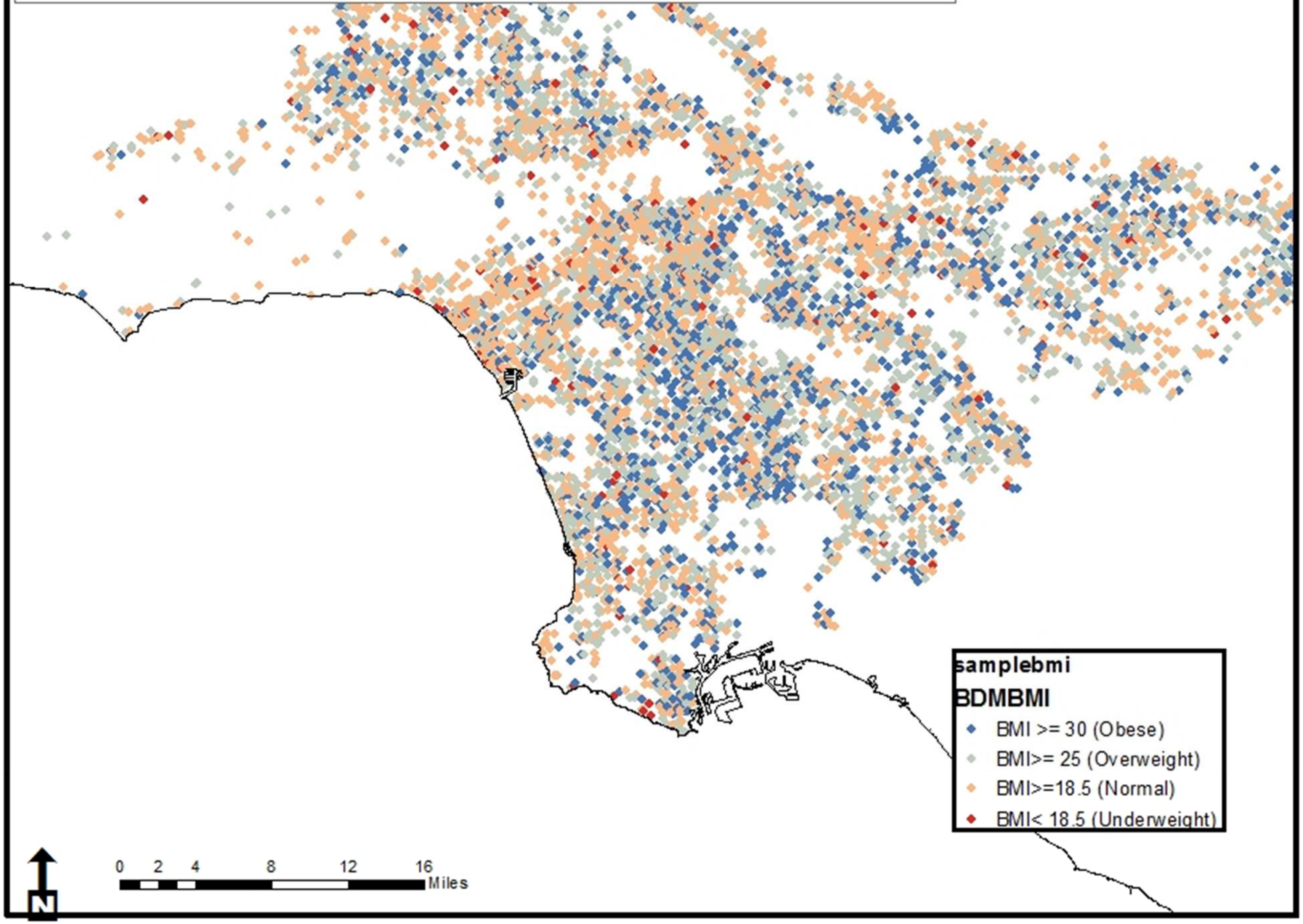
A basic assumption in fitting such a model is that the observations are independent of one another. With much geographical data, this is unlikely to be the case. A second assumption that we make is that the structure of the model remains constant over the study area, in other words, there are no local variations in the parameter estimates. GWR permits the parameter estimates to vary locally; we can rewrite the model in a slightly different form:

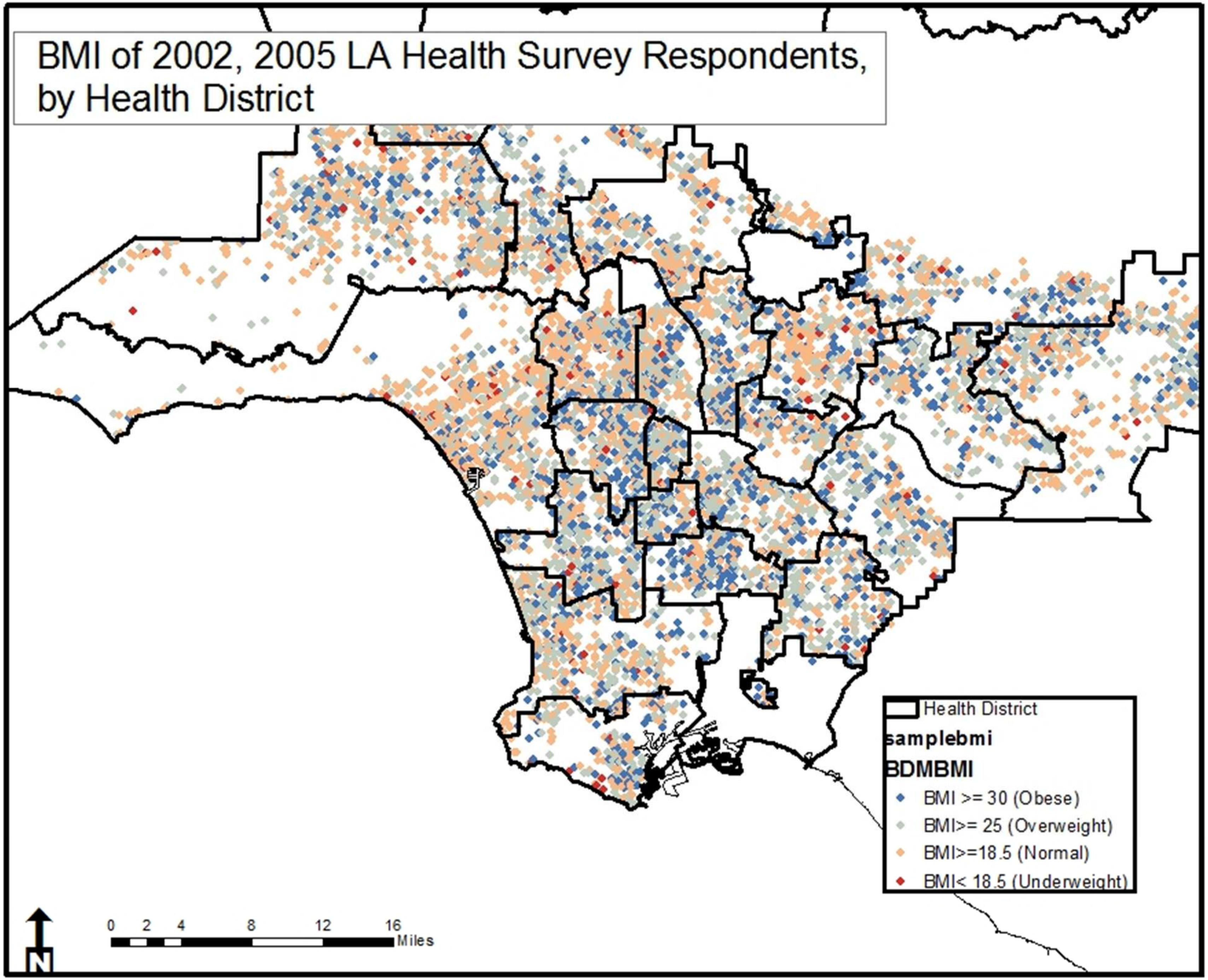
$$y(g) = b_0(g) + b_1(g)x_1 + b_2(g)x_2 + e$$

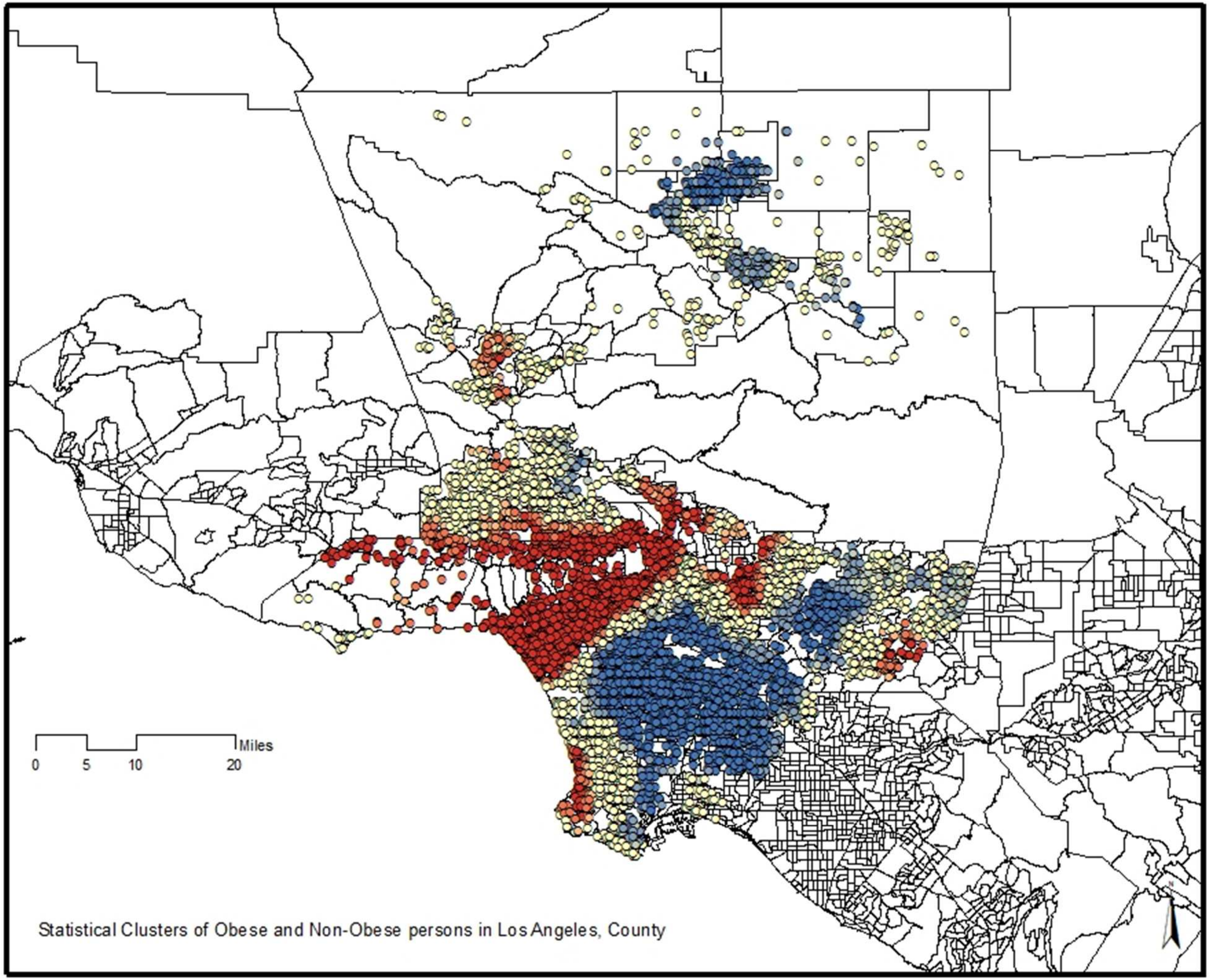
where (g) indicates that the parameters are to be estimated at a location whose coordinates are given by the vector g.


Mapped Local R-squared (quartiles)from Geographically Weighted Regression modeling the independent predictive strength of spatial accessibility score on the 2002-2005 LA health survey respondents fruit and vegetable consumption.
Downtown Los Angeles
Pacific Ocean
Each point represents the nearest cross street to an LA health survey respondent. the points are shaded by the strength of the relationship between spatial accessibility to chain supermarkets and self reported fruit and vegetable consumption in a large sample (n= 12,515) from the LA health survey. In some areas (i.e West LA.), the statistical relationship is twice as strong as in the areas south and east of downtown.
N
0 1.5 3 6 9 12
Miles
Geographically Weighted Regression
LocalR2
0.062 - 0.106
0.106 - 0.128
0.128 - 0.148
0.148 - 0.210

BMI of 2002, 2005 LA Health Survey Respondents




BMI of 2002, 2005 LA Health Survey Respondents, by Health District
Health District
samplebmi
BDMBMI
BMI >= 30 (Obese)
BMI>= 25 (Overweight)
BMI>=18.5 (Normal)
BMI< 18.5 (Underweight)
0 2 4 8 12 16
Miles
N



Statistical Clusters of Obese and Non-Obese persons in Los Angeles, County

Discussion

- A gravity model derived accessibility score independently predicts fruit and vegetable intake even after controlling for known co-variates.
- This approach supports the creation of neighborhood contextual (level II) variables that are independent of administrative geographies (i.e. census) and more accurately capture local behaviorally driven processes and outcomes.

Next Steps

- Creation of exercise space gravity model
- Refinement of raw gravity scores into a set of level II categories, informed by behavioral relationships
- Fitting of hierarchical models with new outcomes (bmi,disease status)

Next steps ctd…

- Examination of cross level interactions
- Expand project to NIH cohort databases (i.e. MESA, ARIC)

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