eAppendix for Association Between Area Resources and Cardiometabolic Risk: A Machine

Learning and Multi-Level Modeling Analysis

Technical Appendix

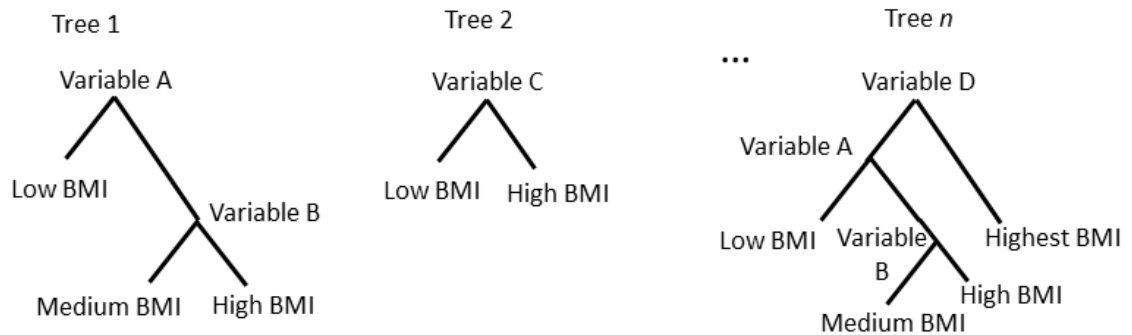VSURF

The foundation of the VSURF technique is the decision tree (eFigure 1).[21] To construct a single decision tree, the procedure selects a random subset of variables from the total number of available variables, and selects a variable that best explains the variation in outcome of a bootstrap resample drawn from the derivation sample. For the next split, the variable that best explains the variation within each 'branch' of the tree created in the first split is selected. This process is continued until optimal separation is achieved. A 'forest' is grown by repeating this process 2000 times, each time randomly drawing a subset of variables and bootstrap resample of the derivation cohort. In the VSURF procedure, 50 forests of 2000 trees were grown in the initial 'thresholding' step, which focuses on removing irrelevant variables. Then, 25 forests of 2000 trees, using the remaining variables, were grown to select all variables associated with the response. Finally, 25 forests of 2000 trees were grown, selecting among the remaining variables to eliminate redundancy. After all three steps were completed, we selected up to the top three area resources, as indicated by variable importance factors in the final step, for hypothesis testing in the independent, 'testing' sample.

A major advantage of VSURF is that it directly addresses the correlation among variables, as the single best variable is selected at each split and thus the explanatory power is not divided amongst two or more related variables, as in linear regression. Secondly, VSURF allows one to screen through a number of candidate variables while preserving type I error rate, as statistical

significance testing is not used in the selection of variables, unlike p-value-based selection
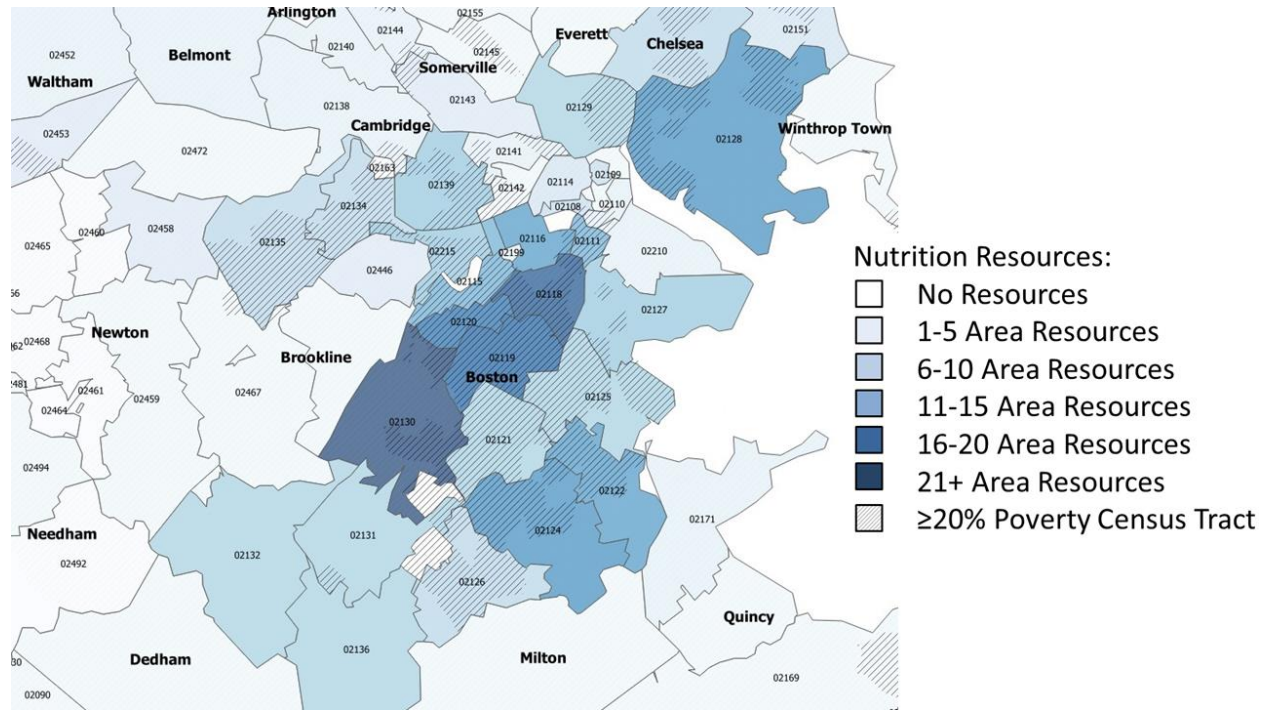
algorithms.

eFigure 1: Depiction of the Variable Selection Using Random Forest (VSURF) Method

From a random subset of variables and a bootstrap resample of individuals in the derivation cohort, a decision tree that optimally splits the sample is created. This process is repeated in a second bootstrap resample with a second randomly selected subset of variables, and so on until *n* trees (n=2000 in this study) are aggregated to create one forest. The forest-growing procedure is repeated 50 times. Then, using variable importance factors, which indicate the variables that are most useful in minimizing the error of predicted values in the 'out-of-bag' sample (those observations that, due to chance, were not selected in the bootstrap resample). After removing the least important variables, the entire process is repeated again, this time growing 25 forests of 2000 trees, in the 'interpretation' step, which focuses on selecting all variables associated with the response. Finally, to deal with correlations between variables, the process is repeated again, growing 25 more forests of 2000 trees, in the 'prediction' step, which focuses on removing redundancy in the final set of variables.

eFigure 2: Employment Resources by ZIP

eFigure 3: Nutrition Resources by ZIP

eTable 1: Demographics for Hypertension Study Sample

	N=43,509
	Mean (SD) or n (%)
Age	64.67 (14.05)
Male	21299 (49.0)
Race/ethnicity	
Asian/Multi/Other	1755 (4.0)
Non-Hispanic Black	3138 (7.2)
Hispanic	1983 (4.6)
Non-Hispanic White	36633 (84.2)
Education	
College or >	15660 (36.0)
High School Diploma	15900 (36.5)
Less than High School Diploma	7422 (17.1)
Unknown/Declined	4527 (10.4)
Insurance	
Private	17256 (39.7)
Medicare and Medicaid	6200 (14.2)
Medicaid	6292 (14.5)
Medicare	13756 (31.6)
Self-pay	5 (0.0)
English is Primary Language	39492 (90.8)
History of Coronary Heart Disease	8373 (19.2)
History of Diabetes Mellitus	11085 (25.5)
History of Depression	4745 (10.9)
History of Osteoarthritis	14931 (34.3)
Charlson Comorbidity Score	3.22 (2.57)
Clinic Visits	9.58 (6.77)
Clinic Connectedness	
Connected to specific physician	36233 (83.3)
Connected to specific practice	6978 (16.0)
Other	298 (0.7)
Lives in Urban Area	32075 (96.4)
ZIP-level Unemployment Rate, %	4.85 (1.63)
ZIP-level Median Household Income, $	80247.61 (31190.75)
ZIP-level Poverty Rate, %	8.67 (6.63)
ZIP-level Segregation	69.19 (21.92)
Body Mass Index, kg/m^2	29.68 (6.40)
History of Obesity	19314 (45.2)
Systolic Blood Pressure, mm Hg	131.60 (15.75)

LDL cholesterol, mg/dL	102.73 (39.82)
Hemoglobin A1c, %	6.25 (1.34)

eTable 2: Demographics for LDL Study Sample

	N=46940
	Mean (SD) or n (%)
Age	63.96 (14.33)
Male	22916 (48.8)
Race/ethnicity	
Asian/Multi/Other	1971 (4.2)
Non-Hispanic Black	3401 (7.2)
Hispanic	2285 (4.9)
Non-Hispanic White	39283 (83.7)
Education	
College or >	16940 (36.1)
High School Diploma	17032 (36.3)
Less than High School Diploma	8075 (17.2)
Unknown/Declined	4893 (10.4)
Insurance	
Private	18909 (40.3)
Medicare and Medicaid	6561 (14.0)
Medicaid	7169 (15.3)
Medicare	14296 (30.5)
Self-pay	5 (0.0)
English is Primary Language	42468 (90.5)
History of Hypertension	43509 (92.7)
History of Coronary Heart Disease	9275 (19.8)
History of Diabetes Mellitus	13127 (28.0)
History of Depression	5160 (11.0)
History of Osteoarthritis	15695 (33.4)
Charlson Comorbidity Score	3.14 (2.54)
Clinic Visits	9.46 (6.71)
Clinic Connectedness	
Connected to specific physician	38851 (82.8)
Connected to specific practice	7746 (16.5)
Other	343 (0.7)
Lives in Urban Area	34532 (96.4)
ZIP-level Unemployment Rate, %	4.86 (1.63)
ZIP-level Median Household Income, $	80079.26 (31173.63)
ZIP-level Poverty Rate, %	8.72 (6.64)
ZIP-level Segregation	68.98 (21.98)
Body Mass Index, kg/m^2	29.63 (6.42)
History of Obesity	20611 (44.7)
Systolic Blood Pressure, mm Hg	130.88 (15.75)

| LDL cholesterol, mg/dL | 102.85 (39.81) |
| Hemoglobin A1c, % | 6.28 (1.36) |

eTable 3: Demographics for Diabetes Study Sample

	N=13127
	Mean (SD) or n (%)
Age	64.12 (14.10)
Male	6722 (51.2)
Race/ethnicity	
Asian/Multi/Other	729 (5.6)
Non-Hispanic Black	1415 (10.8)
Hispanic	986 (7.5)
Non-Hispanic White	9995 (76.1)
Education	
College or >	3691 (28.1)
High School Diploma	5115 (39.0)
Less than High School Diploma	3085 (23.5)
Unknown/Declined	1236 (9.4)
Insurance	
Private	4247 (32.4)
Medicare and Medicaid	2609 (19.9)
Medicaid	2654 (20.2)
Medicare	3617 (27.6)
Self-pay	0 (0.0)
English is Primary Language	11138 (84.8)
History of Hypertension	11085 (84.4)
History of Coronary Heart Disease	3316 (25.3)
History of Diabetes Mellitus	13127 (100.0)
History of Depression	1685 (12.8)
History of Osteoarthritis	4605 (35.1)
Charlson Comorbidity Score	4.34 (2.94)
Clinic Visits	11.59 (7.52)
Clinic Connectedness	
Connected to specific physician	10778 (82.1)
Connected to specific practice	2234 (17.0)
Other	115 (0.9)
Lives in Urban Area	9467 (97.4)
ZIP-level Unemployment Rate, %	5.24 (1.67)
ZIP-level Median Household Income, $	72660.30 (28239.05)
ZIP-level Poverty Rate, %	10.19 (6.83)
ZIP-level Segregation	63.62 (23.80)
Body Mass Index, kg/m^2	31.48 (6.85)
History of Obesity	7427 (57.7)
Systolic Blood Pressure, mm Hg	130.17 (16.09)

LDL cholesterol, mg/dL	89.25 (37.45)
Hemoglobin A1c, %	7.08 (1.52)

eTable 4: Demographics of study sample by number of food resources in ZIP code tabulation area

	0 food resources	1 to 7 food resources	≥8 food resources	p
	N=65011	N=42794	N=13028	
	Mean (SD) or n (%)	Mean (SD) or n (%)	Mean (SD) or n (%)	
Age	53.93 (16.13)	51.05 (17.69)	47.95 (16.92)	<0.001
Male	28050 (43.1)	17330 (40.5)	5163 (39.6)	<0.001
Race/ethnicity				<0.001
Asian/Multi/Other	3559 (5.5)	2501 (5.8)	709 (5.4)	
Non-Hispanic Black	2553 (3.9)	2710 (6.3)	1605 (12.3)	
Hispanic	2306 (3.5)	2859 (6.7)	2707 (20.8)	
Non-Hispanic White	56593 (87.1)	34724 (81.1)	8007 (61.5)	
Education				<0.001
College or >	31782 (48.9)	18895 (44.2)	4837 (37.1)	
High School Diploma	18400 (28.3)	13355 (31.2)	3767 (28.9)	
Less than High School Diploma	7373 (11.3)	6762 (15.8)	3449 (26.5)	
Unknown/Declined	7456 (11.5)	3782 (8.8)	975 (7.5)	
Insurance				<0.001
Private	44051 (67.8)	24062 (56.2)	6600 (50.7)	
Medicare and Medicaid	3485 (5.4)	3551 (8.3)	1188 (9.1)	
Medicaid	7319 (11.3)	9011 (21.1)	4075 (31.3)	
Medicare	10128 (15.6)	6093 (14.2)	1149 (8.8)	
Self-pay	28 (0.0)	77 (0.2)	16 (0.1)	
English is Primary Language	61559 (94.7)	38982 (91.1)	9923 (76.2)	<0.001
History of Hypertension	22195 (34.1)	15367 (35.9)	4342 (33.3)	<0.001
History of Coronary Heart Disease	4663 (7.2)	3385 (7.9)	817 (6.3)	<0.001
History of Cerebrovascular Disease	1628 (2.5)	1148 (2.7)	316 (2.4)	0.114
History of Congestive Heart Failure	1941 (3.0)	1793 (4.2)	460 (3.5)	<0.001
History of Diabetes Mellitus	5735 (8.8)	4757 (11.1)	1735 (13.3)	<0.001
History of Depression	4598 (7.1)	4024 (9.4)	1377 (10.6)	<0.001
History of Osteoarthritis	12179 (18.7)	8386 (19.6)	2331 (17.9)	<0.001
Charlson Comorbidity Score	1.70 (2.17)	1.72 (2.28)	1.56 (2.15)	<0.001
Clinic Visits	5.93 (5.18)	7.14 (6.21)	7.19 (6.11)	<0.001
Clinic Connectedness				<0.001
Connected to specific physician	41292 (63.5)	28457 (66.5)	8593 (66.0)	
Connected to specific practice	14727 (22.7)	14337 (33.5)	4435 (34.0)	
Other	8992 (13.8)	0 (0.0)	0 (0.0)	
Lives in Urban Area	52165 (94.3)	29291 (99.4)	7118 (99.9)	<0.001
ZIP-level Unemployment Rate, %	4.27 (1.41)	4.89 (1.51)	5.82 (1.83)	<0.001
ZIP-level Median Household Income, $	96937.11 (34242.61)	71648.83 (21514.21)	58606.22 (17651.59)	<0.001

ZIP-level Poverty Rate, %	4.91 (4.58)	11.12 (6.26)	15.94 (5.58)	<0.001
ZIP-level Segregation	80.59 (15.85)	65.17 (15.29)	39.16 (20.13)	<0.001
Body Mass Index, kg/m^2	27.64 (6.03)	27.82 (6.34)	28.30 (6.63)	<0.001
History of Obesity	18693 (30.1)	12765 (30.8)	4148 (33.2)	<0.001
Systolic Blood Pressure, mm Hg	124.47 (14.92)	124.27 (15.03)	123.44 (14.80)	<0.001
LDL cholesterol, mg/dL	112.17 (42.48)	109.92 (37.14)	108.83 (35.34)	<0.001
Hemoglobin A1c, %	5.86 (1.12)	5.98 (1.25)	6.13 (1.43)	<0.001

Robustness checks (eTable 5-7)

Results from analyses, adjusted for the same factors as in main model presented in the manuscript, comparing the association of food resources and BMI with different specifications of ZIP-level food resources (count, count per capita, and count per capita living in poverty) show that the association between more area food resources and lower BMI is robust to different specifications of number of resources

eTable 5: Analyses comparing the association of food resources and BMI with different specifications of area-resources

Estimated difference in BMI associated with 1 additional ZIP-level resource (95% CI), kg/m^2 (main model from manuscript)	Estimated difference in BMI associated with 1 additional ZIP-level resource per 10000 people (95% CI), kg/m^2	Estimated difference in BMI associated with 1 additional ZIP-level resource per 10000 people living in poverty (95% CI), kg/m^2
-0.08 (-0.13 to -0.03)	-0.19 (-0.29 to -0.085)	-0.02 (-0.03 to -0.01)

Analyses, adjusted for the same factors as in main model presented in the manuscript, including a quadratic and/or cubic term, or restricted cubic splines, to represent the number of ZIP-level resources resulted in worse model fit by Akaike information criterion and Bayes information criterion, suggesting that a linear approximation of the relationship between ZIP-level resources and the modeled outcome is reasonable.

eTable 6: Model fit statistics from different specifications of ZIP-level food resources		
	Akaike information criterion (smaller represents better fit)	Bayes information criterion (smaller represents better fit)
Linear term only	468646.6	468640.6
Linear plus quadratic	468656.5	468650.5
Linear, quadratic, and cubic	468667.8	468661.8
Restricted cubic spline	468656.0	468650.0

Analyses, adjusted for the same factors as in main model presented in the manuscript, restricted to those with indicators of lower socioeconomic status show that the estimates for the association between additional ZIP-level food resources and BMI are slightly larger than in the overall population, which is consistent with the idea that these resources are beneficial for those with lower socioeconomic status

eTable 7: Analyses of association between ZIP-level food resources and body mass index, restricted to those with indicators of lower socioeconomic status

Estimated difference in BMI associated with 1 additional ZIP-level resource (95% CI), kg/m^2 (main model from manuscript)	Estimated difference in BMI associated with 1 additional ZIP-level resource (95% CI), restricted to those with high school diploma or lower educational attainment, kg/m^2	Estimated difference in BMI associated with 1 additional ZIP-level resource (95% CI), restricted to those living in ZIP with > 15% living in poverty, kg/m^2
-0.08 (-0.13 to -0.03)	-0.09 (-0.15 to -0.04)	-0.11 (-0.17 to -0.06)

eTable 8: Full models for association between ZIP-level food resources and body mass index

	Estimate	Standard Error	p-value	Lower 95% Confidence Interval	Upper 95% Confidence Interval
Intercept	28.2196	1.1796	<.0001	25.9071	30.5320
ZIP-level food resources	-0.08429	0.02512	0.0010	-0.1340	-0.03460
ZIP-level afterschool resources	0.009484	0.02203	0.6674	-0.03404	0.05301
Age, years	-0.04950	0.002011	<.0001	-0.05344	-0.04556
Female	-1.3794	0.04395	<.0001	-1.4656	-1.2933
Race/ethnicity					
Asian/Multi/Other	-2.5117	0.09328	<.0001	-2.6945	-2.3288
Non-Hispanic Black	0.9600	0.09753	<.0001	0.7688	1.1511
Hispanic	0.7277	0.1081	<.0001	0.5157	0.9396
Non-Hispanic White	reference	n/a	n/a	n/a	n/a
Education					
College or >	-0.2793	0.07082	<.0001	-0.4181	-0.1404
High School Diploma	0.09622	0.07549	0.2025	-0.05175	0.2442
Less than High School Diploma	0.3871	0.09117	<.0001	0.2084	0.5658
Unknown/Declined	reference	n/a	n/a	n/a	n/a
Insurance					
Private	0.1890	1.0208	0.8531	-1.8118	2.1898
Medicare and Medicaid	0.06964	1.0240	0.9458	-1.9374	2.0767
Medicaid	0.6961	1.0215	0.4956	-1.3061	2.6983
Medicaid	-0.4968	1.0230	0.6272	-2.5019	1.5083
Self-pay	reference	n/a	n/a	n/a	n/a
English is Primary Language	0.7128	0.09604	<.0001	0.5246	0.9011
History of Hypertension	2.7291	0.05550	<.0001	2.6203	2.8379
History of Coronary Heart Disease	-0.4141	0.08601	<.0001	-0.5827	-0.2455
History of Diabetes Mellitus	2.4217	0.07471	<.0001	2.2752	2.5681

eTable 8: Full models for association between ZIP-level food resources and body mass index

	Estimate	Standard Error	p-value	Lower 95% Confidence Interval	Upper 95% Confidence Interval
History of Depression	0.5488	0.07350	<.0001	0.4048	0.6929
History of Osteoarthritis	1.3188	0.05467	<.0001	1.2116	1.4260
Charlson Comorbidity Score	0.06713	0.01268	<.0001	0.04227	0.09198
Clinic Visits	-0.00068	0.004383	0.8770	-0.00927	0.007911
Clinic Connectedness					
Connected to specific physician	0.3184	0.05024	<.0001	0.2200	0.4169
Connected to specific practice	reference	n/a	n/a	n/a	n/a
Lives in Urban Area	0.2640	0.1580	0.0949	-0.04583	0.5739
Lives in Area with Low Physical Food Access	0.09426	0.07794	0.2265	-0.05851	0.2470
Percentage of Area Living in Group Quarters	-0.00020	0.000060	0.0009	-0.00032	-0.00008
Lives in Area with Low Vehicle Access	0.1189	0.05577	0.0331	0.009564	0.2282
ZIP-level Unemployment Rate	0.2608	0.03829	<.0001	0.1855	0.3361
ZIP-level Median Household Income	-0.00001	1.936E-6	<.0001	-0.00002	-8.81E-6
ZIP-level Poverty Rate	-0.03254	0.01370	0.0183	-0.05952	-0.00555
ZIP-level Segregation	0.002536	0.003897	0.5158	-0.00514	0.01021

eTable 9: Full models for association between ZIP-level employment resources and body mass index

	Estimate	Standard Error	p-value	Lower 95% Confidence Interval	Upper 95% Confidence Interval
Intercept	28.1779	1.1847	<.0001	25.8554	30.5004
ZIP-level employment resources	-0.05415	0.02624	0.0407	-0.1060	-0.00231

eTable 9: Full models for association between ZIP-level employment resources and body mass index

	Estimate	Standard Error	p-value		Lower 95% Confidence Interval	Upper 95% Confidence Interval
ZIP-level afterschool resources	0.01083	0.03215	0.7366		-0.05269	0.07436
Age, years	-0.04951	0.002011	<.0001		-0.05345	-0.04557
Female	-1.3795	0.04395	<.0001		-1.4656	-1.2933
Race/ethnicity						
Asian/Multi/Other	-2.5089	0.09330	<.0001		-2.6918	-2.3260
Non-Hispanic Black	0.9669	0.09755	<.0001		0.7757	1.1581
Hispanic	0.7300	0.1081	<.0001		0.5181	0.9420
Non-Hispanic White	reference	n/a	n/a	n/a		n/a
Education						
College or >	-0.2787	0.07083	<.0001		-0.4175	-0.1399
High School Diploma	0.09646	0.07549	0.2013		-0.05150	0.2444
Less than High School Diploma	0.3880	0.09117	<.0001		0.2093	0.5667
Unknown/Declined	reference	n/a	n/a	n/a		n/a
Insurance						
Private	0.1930	1.0208	0.8500		-1.8078	2.1938
Medicare and Medicaid	0.07527	1.0240	0.9414		-1.9318	2.0823
Medicaid	0.7010	1.0215	0.4926		-1.3012	2.7032
Medicaid	-0.4922	1.0230	0.6304		-2.4973	1.5128
Self-pay	reference	n/a	n/a	n/a		n/a
English is Primary Language	0.7126	0.09604	<.0001		0.5243	0.9008
History of Hypertension	2.7296	0.05550	<.0001		2.6208	2.8383
History of Coronary Heart Disease	-0.4138	0.08601	<.0001		-0.5824	-0.2452
History of Diabetes Mellitus	2.4215	0.07471	<.0001		2.2751	2.5680
History of Depression	0.5493	0.07350	<.0001		0.4052	0.6933
History of Osteoarthritis	1.3190	0.05467	<.0001		1.2118	1.4261

eTable 9: Full models for association between ZIP-level employment resources and body mass index

	Estimate	Standard Error	p-value	Lower 95% Confidence Interval	Upper 95% Confidence Interval
Charlson Comorbidity Score	0.06713	0.01268	<.0001	0.04227	0.09198
Clinic Visits	-0.00069	0.004383	0.8744	-0.00928	0.007897
Clinic Connectedness					
Connected to specific physician	0.3181	0.05024	<.0001	0.2197	0.4166
Connected to specific practice	reference	n/a	n/a	n/a	n/a
Lives in Urban Area	0.2569	0.1589	0.1059	-0.05456	0.5684
Lives in Area with Low Physical Food Access	0.09945	0.07799	0.2023	-0.05342	0.2523
Percentage of Area Living in Group Quarters	-0.00019	0.000060	0.0013	-0.00031	-0.00008
Lives in Area with Low Vehicle Access	0.1198	0.05586	0.0320	0.01027	0.2293
ZIP-level Unemployment Rate	0.2601	0.03946	<.0001	0.1825	0.3377
ZIP-level Median Household Income	-0.00001	1.988E-6	<.0001	-0.00002	-8.84E-6
ZIP-level Poverty Rate	-0.03147	0.01401	0.0255	-0.05905	-0.00389
ZIP-level Segregation	0.003079	0.003968	0.4385	-0.00473	0.01089

eTable 10: Full models for association between ZIP-level nutrition resources and body mass index

	Estimate	Standard Error	p-value	Lower 95% Confidence Interval	Upper 95% Confidence Interval
Intercept	28.1161	1.1836	<.0001	25.7958	30.4364
ZIP-level nutrition resources	-0.07146	0.03122	0.0234	-0.1331	-0.00980
ZIP-level afterschool resources	0.002639	0.02650	0.9208	-0.04967	0.05495
Age, years	-0.04949	0.002011	<.0001	-0.05344	-0.04555
Female	-1.3792	0.04395	<.0001	-1.4654	-1.2931
Race/ethnicity					
Asian/Multi/Other	-2.5116	0.09329	<.0001	-2.6944	-2.3287
Non-Hispanic Black	0.9650	0.09756	<.0001	0.7738	1.1562
Hispanic	0.7272	0.1081	<.0001	0.5152	0.9392
Non-Hispanic White	reference	n/a	n/a	n/a	n/a
Education					
College or >	-0.2787	0.07082	<.0001	-0.4175	-0.1399
High School Diploma	0.09695	0.07549	0.1991	-0.05102	0.2449
Less than High School Diploma	0.3870	0.09117	<.0001	0.2083	0.5657
Unknown/Declined	reference	n/a	n/a	n/a	n/a
Insurance					
Private	0.1858	1.0208	0.8555	-1.8150	2.1866
Medicare and Medicaid	0.06642	1.0240	0.9483	-1.9406	2.0735
Medicaid	0.6927	1.0215	0.4977	-1.3095	2.6948
Medicaid	-0.5000	1.0230	0.6250	-2.5050	1.5051
Self-pay	reference	n/a	n/a	n/a	n/a.
English is Primary Language	0.7143	0.09604	<.0001	0.5261	0.9026
History of Hypertension	2.7290	0.05550	<.0001	2.6202	2.8378
History of Coronary Heart Disease	-0.4139	0.08601	<.0001	-0.5825	-0.2453
History of Diabetes Mellitus	2.4211	0.07471	<.0001	2.2747	2.5676

eTable 10: Full models for association between ZIP-level nutrition resources and body mass index

	Estimate	Standard Error	p-value	Lower 95% Confidence Interval	Upper 95% Confidence Interval
History of Depression	0.5484	0.07350	<.0001	0.4044	0.6925
History of Osteoarthritis	1.3187	0.05467	<.0001	1.2115	1.4259
Charlson Comorbidity Score	0.06712	0.01268	<.0001	0.04227	0.09197
Clinic Visits	-0.00069	0.004383	0.8750	-0.00928	0.007900
Clinic Connectedness					
Connected to specific physician	0.3185	0.05024	<.0001	0.2200	0.4170
Connected to specific practice	reference	n/a	n/a	n/a	n/a.
Lives in Urban Area	0.2529	0.1588	0.1113	-0.05838	0.5642
Lives in Area with Low Physical Food Access	0.1009	0.07792	0.1955	-0.05185	0.2536
Percentage of Area Living in Group Quarters	-0.00020	0.000060	0.0009	-0.00032	-0.00008
Lives in Area with Low Vehicle Access	0.1176	0.05585	0.0352	0.008130	0.2271
ZIP-level Unemployment Rate	0.2684	0.03881	<.0001	0.1921	0.3447
ZIP-level Median Household Income	-0.00001	1.972E-6	<.0001	-0.00002	-8.48E-6
ZIP-level Poverty Rate	-0.03270	0.01396	0.0199	-0.06020	-0.00521
ZIP-level Segregation	0.003113	0.003967	0.4332	-0.00470	0.01092

eTable 11: Full models for association between ZIP-level housing resources and systolic blood pressure

	Estimate	Standard Error	p-value		Lower 95% Confidence Interval	Upper 95% Confidence Interval
Intercept	115.70	11.1188	<.0001		93.9116	137.50
ZIP-level housing resources	-0.04612	0.05585	0.4106		-0.1567	0.06446
ZIP-level afterschool resources	-0.03286	0.04586	0.4755		-0.1240	0.05828
Age, years	0.1521	0.009429	<.0001		0.1337	0.1706
Female	-0.6839	0.1930	0.0004		-1.0622	-0.3055
Race/ethnicity						
Asian/Multi/Other	-1.2014	0.4952	0.0153		-2.1720	-0.2308
Non-Hispanic Black	2.8013	0.3960	<.0001		2.0251	3.5774
Hispanic	0.5064	0.5619	0.3675		-0.5950	1.6078
Non-Hispanic White	reference	n/a	n/a	n/a		n/a.
Education						
College or >	0.02428	0.3181	0.9392		-0.5992	0.6478
High School Diploma	0.1732	0.3236	0.5924		-0.4610	0.8074
Less than High School Diploma	0.6220	0.3914	0.1121		-0.1452	1.3893
Unknown/Declined	reference	n/a	n/a	n/a		n/a.
Insurance						
Private	8.3527	10.9765	0.4467		-13.1616	29.8671
Medicare and Medicaid	7.8728	10.9784	0.4733		-13.6453	29.3910
Medicaid	8.5660	10.9772	0.4352		-12.9499	30.0818
Medicaid	8.4728	10.9781	0.4402		-13.0447	29.9903
Self-pay	reference	n/a	n/a	n/a		n/a.
English is Primary Language	-0.01463	0.4091	0.9715		-0.8165	0.7873
History of Coronary Heart Disease	-2.7190	0.2620	<.0001		-3.2325	-2.2055
History of Diabetes Mellitus	0.1079	0.2325	0.6426		-0.3478	0.5635
History of Depression	-0.9568	0.3076	0.0019		-1.5596	-0.3539

eTable 11: Full models for association between ZIP-level housing resources and systolic blood pressure

	Estimate	Standard Error	p-value		Lower 95% Confidence Interval	Upper 95% Confidence Interval
History of Osteoarthritis	-0.5000	0.2009	0.0128		-0.8939	-0.1062
Charlson Comorbidity Score	-0.05959	0.04502	0.1856		-0.1478	0.02865
Clinic Visits	-0.02840	0.01601	0.0760		-0.05978	0.002975
Clinic Connectedness						
Connected to specific physician	-1.9594	0.2580	<.0001		-2.4651	-1.4538
Connected to specific practice	reference	n/a	n/a	n/a		n/a.
Lives in Urban Area	0.2234	0.5896	0.7049		-0.9332	1.3799
Lives in Area with Low Physical Food Access	-0.6380	0.3321	0.0548		-1.2892	0.01327
Percentage of Area Living in Group Quarters	-0.00025	0.000262	0.3352		-0.00077	0.000261
Lives in Area with Low Vehicle Access	0.2689	0.2251	0.2324		-0.1725	0.7102
ZIP-level Unemployment Rate	0.1919	0.1055	0.0702		-0.01598	0.3998
ZIP-level Median Household Income	5.33E-7	4.993E-6	0.9151		-9.33E-6	0.000010
ZIP-level Poverty Rate	0.003603	0.03442	0.9168		-0.06460	0.07180
ZIP-level Segregation	-0.00127	0.01007	0.8999		-0.02117	0.01863

eTable 12: Full models for association between ZIP-level nutrition resources and systolic blood pressure

	Estimate	Standard Error	p-value		Lower 95% Confidence Interval	Upper 95% Confidence Interval
Intercept	115.52	11.1170	<.0001		93.7336	137.31
ZIP-level nutrition resources	0.01167	0.07270	0.8728		-0.1325	0.1559
ZIP-level afterschool resources	-0.06660	0.05852	0.2582		-0.1829	0.04971
Age, years	0.1522	0.009429	<.0001		0.1337	0.1707
Female	-0.6823	0.1930	0.0004		-1.0606	-0.3039
Race/ethnicity						
Asian/Multi/Other	-1.2077	0.4952	0.0147		-2.1782	-0.2371
Non-Hispanic Black	2.7981	0.3960	<.0001		2.0218	3.5744
Hispanic	0.5101	0.5622	0.3643		-0.5919	1.6120
Non-Hispanic White	reference	n/a	n/a	n/a		n/a.
education						
College or >	0.01868	0.3181	0.9532		-0.6048	0.6421
High School Diploma	0.1716	0.3236	0.5958		-0.4626	0.8059
Less than High School Diploma	0.6218	0.3915	0.1122		-0.1455	1.3891
Unknown/Declined	reference	n/a	n/a	n/a		n/a.
Insurance						
Private	8.3894	10.9765	0.4447		-13.1251	29.9038
Medicare and Medicaid	7.9053	10.9784	0.4715		-13.6130	29.4235
Medicaid	8.6004	10.9773	0.4334		-12.9155	30.1163
Medicaid	8.5087	10.9781	0.4383		-13.0089	30.0263
Self-pay	reference	n/a	n/a	n/a		n/a.
English is Primary Language	-0.01592	0.4094	0.9690		-0.8183	0.7865
History of Coronary Heart Disease	-2.7161	0.2620	<.0001		-3.2295	-2.2026
History of Diabetes Mellitus	0.1087	0.2325	0.6399		-0.3469	0.5644
History of Depression	-0.9576	0.3076	0.0019		-1.5605	-0.3547

eTable 12: Full models for association between ZIP-level nutrition resources and systolic blood pressure

	Estimate	Standard Error	p-value	Lower 95% Confidence Interval	Upper 95% Confidence Interval
History of Osteoarthritis	-0.5002	0.2009	0.0128	-0.8940	-0.1063
Charlson Comorbidity Score	-0.05975	0.04502	0.1845	-0.1480	0.02849
Clinic Visits	-0.02845	0.01601	0.0756	-0.05982	0.002932
Clinic Connectedness					
Connected to specific physician	-1.9589	0.2580	<.0001	-2.4645	-1.4532
Connected to specific practice	reference	n/a	n/a	n/a	n/a.
Lives in Urban Area	0.1603	0.5860	0.7845	-0.9893	1.3098
Lives in Area with Low Physical Food Access	-0.5789	0.3269	0.0768	-1.2201	0.06231
Percentage of Area Living in Group Quarters	-0.00025	0.000262	0.3343	-0.00077	0.000261
Lives in Area with Low Vehicle Access	0.2662	0.2251	0.2371	-0.1752	0.7076
ZIP-level Unemployment Rate	0.2065	0.1045	0.0493	0.000612	0.4124
ZIP-level Median Household Income	1.008E-6	4.966E-6	0.8395	-8.8E-6	0.000011
ZIP-level Poverty Rate	0.003660	0.03453	0.9158	-0.06473	0.07205
ZIP-level Segregation	-0.00086	0.01007	0.9325	-0.02075	0.01904

eTable 13: Full models for association between ZIP-level nutrition resources and low density lipoprotein cholesterol

	Estimate	Standard Error	p-value		Lower 95% Confidence Interval	Upper 95% Confidence Interval
Intercept	103.76	38.1863	0.0066		28.9153	178.61
ZIP-level nutrition resources	0.09859	0.2309	0.6699		-0.3573	0.5545
ZIP-level afterschool resources	-0.00381	0.1854	0.9837		-0.3706	0.3630
Age, years	-0.3600	0.03023	<.0001		-0.4193	-0.3008
Female	11.7432	0.5645	<.0001		10.6367	12.8497
Race/ethnicity	0	.	.		.	.
Asian/Multi/Other	-2.6927	1.4423	0.0619		-5.5197	0.1343
Non-Hispanic Black	0.7350	1.2077	0.5428		-1.6323	3.1022
Hispanic	0.3468	1.7794	0.8455		-3.1409	3.8345
Non-Hispanic White	reference	n/a	n/a	n/a		n/a.
Education						
College or >	-0.1046	0.9328	0.9107		-1.9329	1.7237
High School Diploma	-0.2598	0.9497	0.7844		-2.1212	1.6016
Less than High School Diploma	-0.8496	1.1612	0.4644		-3.1256	1.4264
Unknown/Declined	reference	n/a	n/a	n/a		n/a.
Insurance						
Private	37.5148	37.8147	0.3212		-36.6052	111.63
Medicare and Medicaid	36.1970	37.8181	0.3385		-37.9296	110.32
Medicaid	37.4872	37.8163	0.3216		-36.6360	111.61
Medicaid	35.4040	37.8171	0.3492		-38.7206	109.53
Self-pay	reference	n/a	n/a	n/a		n/a.
English is Primary Language	0.6482	1.2438	0.6023		-1.7897	3.0861
History of Hypertension	-4.3457	1.1538	0.0002		-6.6072	-2.0842
History of Coronary Heart Disease	-14.8429	0.7275	<.0001		-16.2689	-13.4170
History of Diabetes Mellitus	-16.1429	0.6619	<.0001		-17.4404	-14.8455

eTable 13: Full models for association between ZIP-level nutrition resources and low density lipoprotein cholesterol

	Estimate	Standard Error	p-value	Lower 95% Confidence Interval	Upper 95% Confidence Interval
History of Depression	1.0979	0.9513	0.2485	-0.7668	2.9626
History of Osteoarthritis	1.0828	0.5853	0.0643	-0.06449	2.2302
Charlson Comorbidity Score	-0.9716	0.1366	<.0001	-1.2394	-0.7038
Clinic Visits	-0.1983	0.04901	<.0001	-0.2944	-0.1023
Clinic Connectedness					
Connected to specific physician	-1.4526	0.8446	0.0855	-3.1081	0.2029
Connected to specific practice	reference	n/a	n/a	n/a	n/a.
Lives in Urban Area	-0.4909	1.7202	0.7754	-3.8649	2.8831
Lives in Area with Low Physical Food Access	0.2234	1.0117	0.8252	-1.7604	2.2073
Percentage of Area Living in Group Quarters	0.001870	0.000788	0.0177	0.000325	0.003414
Lives in Area with Low Vehicle Access	-1.1732	0.6607	0.0759	-2.4686	0.1222
ZIP-level Unemployment Rate	0.1519	0.3138	0.6287	-0.4659	0.7698
ZIP-level Median Household Income	-0.00001	0.000015	0.3460	-0.00004	0.000015
ZIP-level Poverty Rate	-0.06528	0.1068	0.5418	-0.2760	0.1454
ZIP-level Segregation	-0.00654	0.03045	0.8301	-0.06656	0.05347

eTable 14: Full models for association between ZIP-level substance abuse resources and hemoglobin A1c

	Estimate	Standard Error	p-value	Lower 95% Confidence Interval	Upper 95% Confidence Interval
Intercept	7.0576	0.3362	<.0001	6.3986	7.7166
ZIP-level substance abuse resources	-0.00251	0.01460	0.8634	-0.03113	0.02611
ZIP-level afterschool resources	0.01106	0.007376	0.1336	-0.00339	0.02552
Age, years	-0.01059	0.001940	<.0001	-0.01440	-0.00679
Female	-0.1380	0.03843	0.0003	-0.2133	-0.06263
Race/ethnicity					
Asian/Multi/Other	-0.08503	0.08123	0.2952	-0.2443	0.07420
Non-Hispanic Black	0.07012	0.06209	0.2588	-0.05160	0.1918
Hispanic	0.06593	0.08944	0.4611	-0.1094	0.2413
Non-Hispanic White	reference	n/a	n/a	n/a	n/a.
Education					
College or >	-0.1646	0.06820	0.0158	-0.2983	-0.03090
High School Diploma	-0.01912	0.06665	0.7742	-0.1498	0.1116
Less than High School Diploma	-0.07235	0.07528	0.3366	-0.2200	0.07529
Unknown/Declined	reference	n/a	n/a	n/a	n/a.
Insurance					
Private	0.2134	0.05612	0.0001	0.1034	0.3234
Medicare and Medicaid	0.03459	0.05765	0.5486	-0.07842	0.1476
Medicaid	0.3912	0.06811	<.0001	0.2577	0.5247
Medicaid	reference	n/a	n/a	n/a	n/a.
English is Primary Language	-0.1599	0.06505	0.0140	-0.2874	-0.03232
History of Hypertension	0.2365	0.05985	<.0001	0.1191	0.3538
History of Coronary Heart Disease	-0.03921	0.04940	0.4274	-0.1361	0.05764

eTable 14: Full models for association between ZIP-level substance abuse resources and hemoglobin A1c

	Estimate	Standard Error	p-value	Lower 95% Confidence Interval	Upper 95% Confidence Interval
History of Depression	-0.03705	0.05766	0.5205	-0.1501	0.07598
History of Osteoarthritis	-0.1499	0.04010	0.0002	-0.2285	-0.07134
Charlson Comorbidity Score	0.01588	0.008146	0.0513	-0.00009	0.03185
Clinic Visits	0.006502	0.002846	0.0224	0.000922	0.01208
Clinic Connectedness					
Connected to specific physician	-0.08553	0.05430	0.1153	-0.1920	0.02092
Connected to specific practice	reference	n/a	n/a	n/a	n/a.
Lives in Urban Area	0.3470	0.1270	0.0063	0.09804	0.5959
Lives in Area with Low Physical Food Access	-0.07748	0.06097	0.2039	-0.1970	0.04205
Percentage of Area Living in Group Quarters	-0.00001	0.000060	0.8418	-0.00013	0.000106
Lives in Area with Low Vehicle Access	0.04455	0.04429	0.3145	-0.04228	0.1314
ZIP-level Unemployment Rate	0.03710	0.01932	0.0549	-0.00078	0.07499
ZIP-level Median Household Income	1.636E-6	Unable to estimate	Unable to estimate	Unable to estimate	Unable to estimate
ZIP-level Poverty Rate	-0.00359	0.005890	0.5418	-0.01514	0.007953
ZIP-level Segregation	-0.00001	0.001802	0.9950	-0.00354	0.003522

eTable 15: Full models for association between ZIP-level mental health resources and hemoglobin A1c

	Estimate	Standard Error	p-value	Lower 95% Confidence Interval	Upper 95% Confidence Interval
Intercept	7.0641	0.3371	<.0001	6.4033	7.7250
ZIP-level mental health resources	-0.00348	0.01130	0.7582	-0.02564	0.01868
ZIP-level afterschool resources	0.01159	0.006992	0.0974	-0.00212	0.02530
Age, years	-0.01058	0.001940	<.0001	-0.01438	-0.00678
Female	-0.1382	0.03843	0.0003	-0.2135	-0.06283
Race/ethnicity					
Asian/Multi/Other	-0.08415	0.08130	0.3007	-0.2435	0.07522
Non-Hispanic Black	0.07084	0.06217	0.2545	-0.05103	0.1927
Hispanic	0.06543	0.08946	0.4646	-0.1099	0.2408
Non-Hispanic White	reference	n/a	n/a	n/a	n/a.
Education					
College or >	-0.1647	0.06820	0.0158	-0.2984	-0.03095
High School Diploma	-0.01936	0.06665	0.7715	-0.1500	0.1113
Less than High School Diploma	-0.07325	0.07536	0.3312	-0.2210	0.07454
Unknown/Declined	reference	n/a	n/a	n/a	n/a.
Insurance					
Private	0.2135	0.05612	0.0001	0.1035	0.3235
Medicare and Medicaid	0.03499	0.05767	0.5440	-0.07805	0.1480
Medicaid	0.3913	0.06810	<.0001	0.2578	0.5248
Medicaid	reference	n/a	n/a	n/a	n/a.
English is Primary Language	-0.1597	0.06502	0.0141	-0.2871	-0.03218
History of Hypertension	0.2365	0.05985	<.0001	0.1191	0.3538
History of Coronary Heart Disease	-0.03931	0.04940	0.4262	-0.1362	0.05753
History of Depression	-0.03699	0.05766	0.5212	-0.1500	0.07604

eTable 15: Full models for association between ZIP-level mental health resources and hemoglobin A1c

	Estimate	Standard Error	p-value	Lower 95% Confidence Interval	Upper 95% Confidence Interval
History of Osteoarthritis	-0.1498	0.04009	0.0002	-0.2284	-0.07123
Charlson Comorbidity Score	0.01585	0.008146	0.0518	-0.00012	0.03182
Clinic Visits	0.006518	0.002846	0.0220	0.000939	0.01210
Clinic Connectedness					
Connected to specific physician	-0.08559	0.05429	0.1150	-0.1920	0.02085
Connected to specific practice	reference	n/a	n/a	n/a	n/a.
Lives in Urban Area	0.3477	0.1268	0.0061	0.09914	0.5962
Lives in Area with Low Physical Food Access	-0.07867	0.06091	0.1966	-0.1981	0.04074
Percentage of Area Living in Group Quarters	-0.00001	0.000060	0.8517	-0.00013	0.000107
Lives in Area with Low Vehicle Access	0.04534	0.04440	0.3072	-0.04169	0.1324
ZIP-level Unemployment Rate	0.03660	0.01940	0.0592	-0.00143	0.07462
ZIP-level Median Household Income	1.599E-6	Unable to estimate	Unable to estimate	Unable to estimate	Unable to estimate
ZIP-level Poverty Rate	-0.00359	0.005889	0.5423	-0.01513	0.007956
ZIP-level Segregation	-0.00002	0.001802	0.9931	-0.00355	0.003517

eTable 16: Full models for association between ZIP-level food resources and systolic blood pressure in those without hypertension

	Estimate	Standard Error	p-value	Lower 95% Confidence Interval	Upper 95% Confidence Interval
Intercept	118.75	2.4411	<.0001	113.96	123.54
ZIP-level food resources	-0.08047	0.03550	0.0262	-0.1511	-0.00980
ZIP-level afterschool resources	0.06047	0.03336	0.0730	-0.00574	0.1267

eTable 16: Full models for association between ZIP-level food resources and systolic blood pressure in those without hypertension

	Estimate	Standard Error	p-value		Lower 95% Confidence Interval	Upper 95% Confidence Interval
Age, years	0.1657	0.005420	<.0001		0.1550	0.1763
Female	-5.2802	0.1186	<.0001		-5.5126	-5.0477
Race/ethnicity						
Asian/Multi/Other	-2.6721	0.2363	<.0001		-3.1353	-2.2089
Non-Hispanic Black	0.6111	0.2706	0.0239		0.08082	1.1415
Hispanic	-0.7475	0.2728	0.0061		-1.2822	-0.2129
Non-Hispanic White	reference	n/a	n/a	n/a		n/a.
Education						
College or >	-0.02240	0.1940	0.9080		-0.4026	0.3577
High School Diploma	0.4658	0.2125	0.0284		0.04932	0.8823
Less than High School Diploma	0.9903	0.2550	0.0001		0.4905	1.4901
Unknown/Declined	reference	n/a	n/a	n/a		n/a.
Insurance						
Private	-4.3672	2.1456	0.0418		-8.5725	-0.1618
Medicare and Medicaid	-4.2024	2.1674	0.0525		-8.4505	0.04573
Medicaid	-4.6349	2.1479	0.0309		-8.8449	-0.4248
Medicaid	-2.2777	2.1596	0.2916		-6.5105	1.9551
Self-pay	reference	n/a	n/a	n/a		n/a.
English is Primary Language	0.9827	0.2700	0.0003		0.4536	1.5119
History of Depression	-0.1126	0.2130	0.5970		-0.5301	0.3048
History of Osteoarthritis	0.5132	0.1754	0.0034		0.1695	0.8570
Charlson Comorbidity Score	0.1840	0.04369	<.0001		0.09834	0.2696
Clinic Visits	-0.05715	0.01445	<.0001		-0.08548	-0.02882
Clinic Connectedness						
Connected to specific physician	-0.6938	0.1282	<.0001		-0.9450	-0.4425

eTable 16: Full models for association between ZIP-level food resources and systolic blood pressure in those without hypertension

	Estimate	Standard Error	p-value		Lower 95% Confidence Interval	Upper 95% Confidence Interval
Connected to specific practice	reference	n/a	n/a	n/a		n/a.
Lives in Urban Area	-0.4004	0.3700	0.2793		-1.1261	0.3254
Lives in Area with Low Physical Food Access	0.2289	0.1896	0.2274		-0.1429	0.6006
Percentage of Area Living in Group Quarters	-0.00031	0.000146	0.0348		-0.00060	-0.00002
Lives in Area with Low Vehicle Access	-0.00646	0.1455	0.9646		-0.2917	0.2788
ZIP-level Unemployment Rate	0.2795	0.07224	0.0001		0.1373	0.4218
ZIP-level Median Household Income	-0.00002	3.286E-6	<.0001		-0.00002	-9.76E-6
ZIP-level Poverty Rate	-0.02364	0.02254	0.2968		-0.06835	0.02108
ZIP-level Segregation	0.01658	0.006771	0.0154		0.003208	0.02995