Champaign-Urbana Health Impact Assessment

rpc CHAMPAIGN COUNTY REGIONAL PLANNING COMMISSION

Health Impact Assessment

- Tool to integrate community health consideration into urban planning and policy-making
- Quantifies relationship between public policy and public health
- Analyze and predict public health impact of transportation and land-use policies

Determinants of Health

1. Genes and biology
2. Health behaviors
3. Social environment
4. Physical environment
5. Health services or medical care.

Our task is to model impact of built environment on health while controlling for other determinants of health.

Health Data

- Health data for the years 2008 to 2012 for the specific diseases codes
- Only unique records were geocoded to account for one person having multiple records
- Records aggregated at the TAZ level for analysis
- Records grouped into six broad categories

Hospital Data

Total Records: 4,728
Unique Records: 4,727

Clinic Data

Total Records: 79,991
Unique Records: 59,914

Total Unique Records: 64,641

Successfully Geocoded: 60,744

Disease Categories

Obesity

Includes obesity, overweight and adiposity

Hypertension

Includes all subcategories of hypertension

Diabetes Type I

Includes all subcategories of Type 1 diabetes

Diabetes Type II

Includes all subcategories of Type 2 diabetes

Pulmonary Diseases

Includes acute and chronic pulmonary embolism and infarction

Lung Diseases

Includes bronchitis, emphysema, and asthma

Input Data

Socioeconomic

Per Capita Income
Median Age
Black Population %
Asian Population %
Less than Bachelor's degree %
Unemployment %
Household Size
Vehicles per household

Built Environment

Population Density	Land-use
Land-use Mix	
Residential Mix	
Block Size	
Urban Design	
Transit Connectivity Index	Transportation
Bike Index/Miles	
Sidewalk Network	
Beta Index	
Four-way Intersections %	
Service Access Index	Accessibility
Employment Center Distance	
Center Driving Distance	
Parks Coverage	
Grocery Store Access	
School Proximity	Safety
Crime Rate in 2013	
Streetlights	

Methodology

- Count data cannot be reliably modeled with ordinary linear regression.
- Epidemiological studies often employ Poisson, Quasi-Poisson, Negative-binomial regression
- Poisson regression model was used in this study

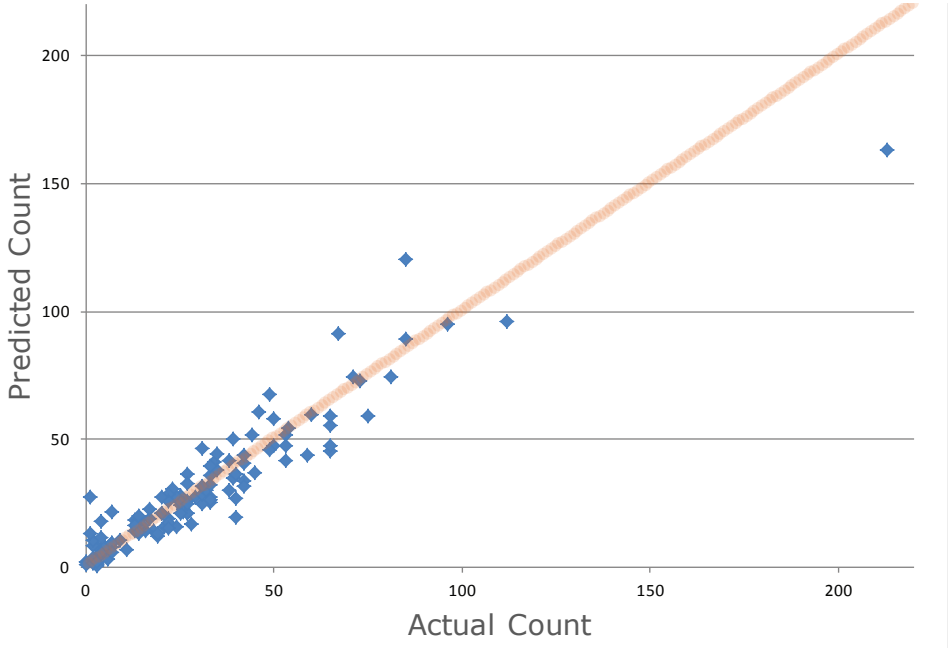
```
Call:
glm(formula = (Count_2) ~ log(Age_Median) + (PC_Black) + PC_Asian +
    (PC_UnBC) + (PopDensity) + (TCI) + log(PerCap_Inc) + (MedianBloc) +
    (LandUseMix) + (Grocery_Mean) + log(Four_way) + log(Crimes_2013) +
    log(EmpCenter_) + log(Parks_Coverage) + BikeMilesTotal +
    log(ServiceAcc), family = poisson(link = log), data = df,
    offset = log(Pop_2010))

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-6.8413  -1.0975   0.0130   0.9768   3.9919

Coefficients:
                    Estimate Std. Error z value Pr(>|z|)
(Intercept)       -9.537e+00  9.324e-01 -10.228  < 2e-16 ***
log(Age_Median)    4.247e-01  1.330e-01   3.194 0.001403 **
PC_Black           3.614e-03  1.483e-03   2.437 0.014791 *
PC_Asian          -5.401e-03  2.507e-03  -2.154 0.031217 *
PC_UnBC            6.990e-03  1.690e-03   4.136 3.54e-05 ***
PopDensity        -1.381e-02  5.675e-03  -2.433 0.014972 *
TCI               -5.068e-05  6.020e-05  -0.842 0.399791
log(PerCap_Inc)    4.432e-01  1.059e-01   4.185 2.85e-05 ***
MedianBloc         4.874e-04  3.243e-04   1.503 0.132830
LandUseMix        -1.507e-01  9.477e-02  -1.590 0.111746
Grocery_Mean      -4.789e-02  2.822e-02  -1.697 0.089737 .
log(Four_way)     -7.121e-02  2.138e-02  -3.330 0.000868 ***
log(Crimes_2013)   6.141e-02  1.121e-02   5.477 4.33e-08 ***
log(EmpCenter_)    8.078e-02  5.289e-02   1.527 0.126701
log(Parks_Coverage) -5.630e-03  3.703e-03  -1.520 0.128429
BikeMilesTotal    -1.135e-06  1.839e-06  -0.617 0.537303
log(ServiceAcc)   -2.014e-02  4.631e-02  -0.435 0.663653
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

(Dispersion parameter for poisson family taken to be 1)

    Null deviance: 771.15  on 121  degrees of freedom
Residual deviance: 325.65  on 105  degrees of freedom
AIC: 940.71
```



Interpretation

Variable	Correlation	Significance
Median Age	Positive	**Very High**
% Black Population	Positive	**High**
% Asian Population	Negative	**High**
% Under Bachelor's Degree	Positive	**Very High**
Per Capita Income	Positive	**Very High**
Transit Connectivity	Negative	**Low**
Bike Miles	Negative	**Low**
% Four-way Intersections	Negative	**Very High**
Population Density	Negative	**High**
Land Use Mix	Negative	**Medium**
Block Size	Positive	**Medium**
Grocery Stores Access	Negative	**High**
Parks Access	Negative	**Medium**
Service Access	Negative	**Low**
Employment Center Distance	Positive	**Medium**
Crime Rate	Positive	**Very High**

Obesity Rate

Increases with

Block Size

Employment Center Dist

Crime Rate

Decreases with

Transit Connectivity

Bike Miles

% Four-way Intersections

Population Density

Land-use Mix

Grocery Store Access

Park Access

Services Access

Health Index

- Regression model is not the best way to communicate analysis.
- An Index can present the analysis in an accessible and comprehensible format.
- Index can be developed using factor analysis, principal component analysis, etc.
- The proposed health index is based on the standardized regression approach.

Standardized Regression Model

- Based z-score of each variable
- All input variables have the same scale and are unit-less
- Coefficients can be used to compare relative impact of variables

Built Environment Variables

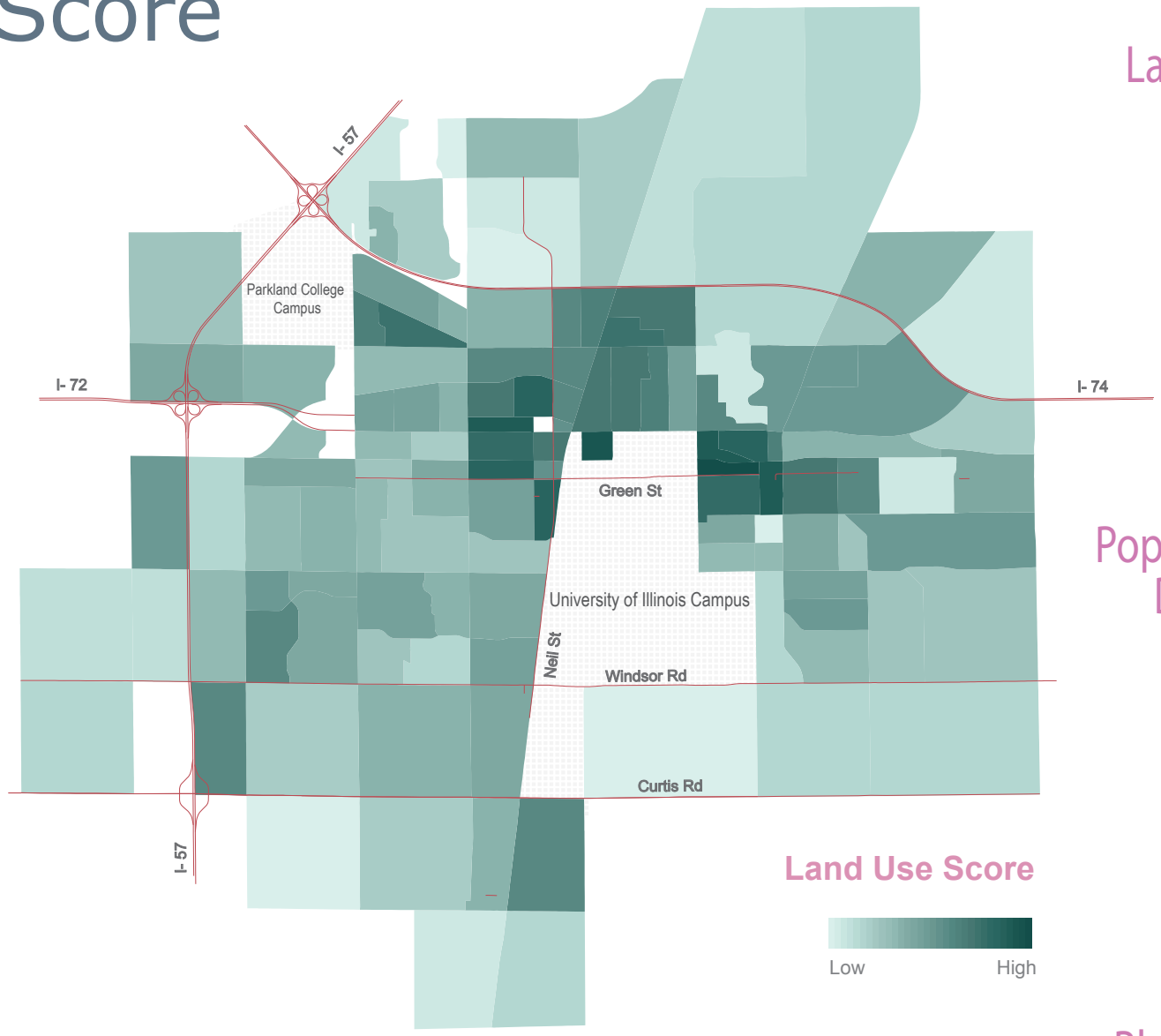
Service Access Index
Crime Rate
Block Size
Grocery Store Access
Transit Connectivity
Population Density
Land-use Mix
Four-way Intersections %
Bike Miles
Employment Center Distance
Parks Access

Health Index

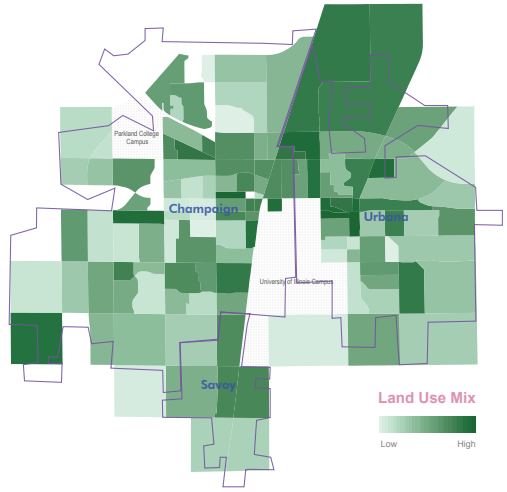
Land-use	Block Size	10	31
	Population Density	8	
	Land-use Mix	8	
	Urban Design	5	
Transportation	Transit Connectivity	12	27
	Bike/Trails Miles	6	
	Four-way Intersections %	6	
	Sidewalks	3	
Accessibility	Service Access Index	12	28
	Grocery Store Access	10	
	Parks Access	3	
	Employment Access	3	
Safety	Crime Rate	12	14
	Streetlights	2	

Maximum Score 100

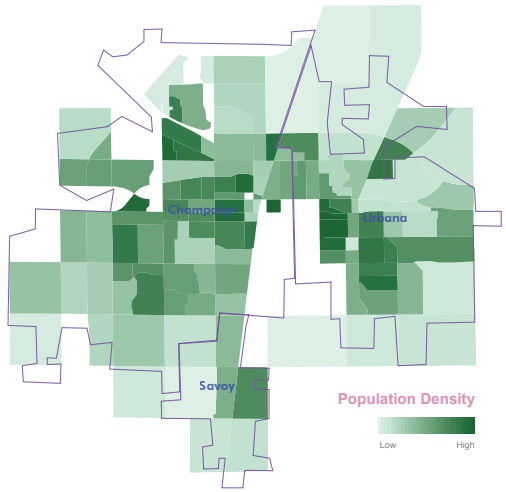
Land-use Score



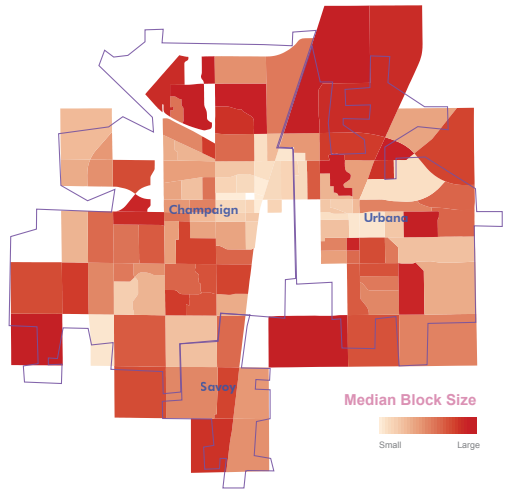
Land-use mix



Population Density

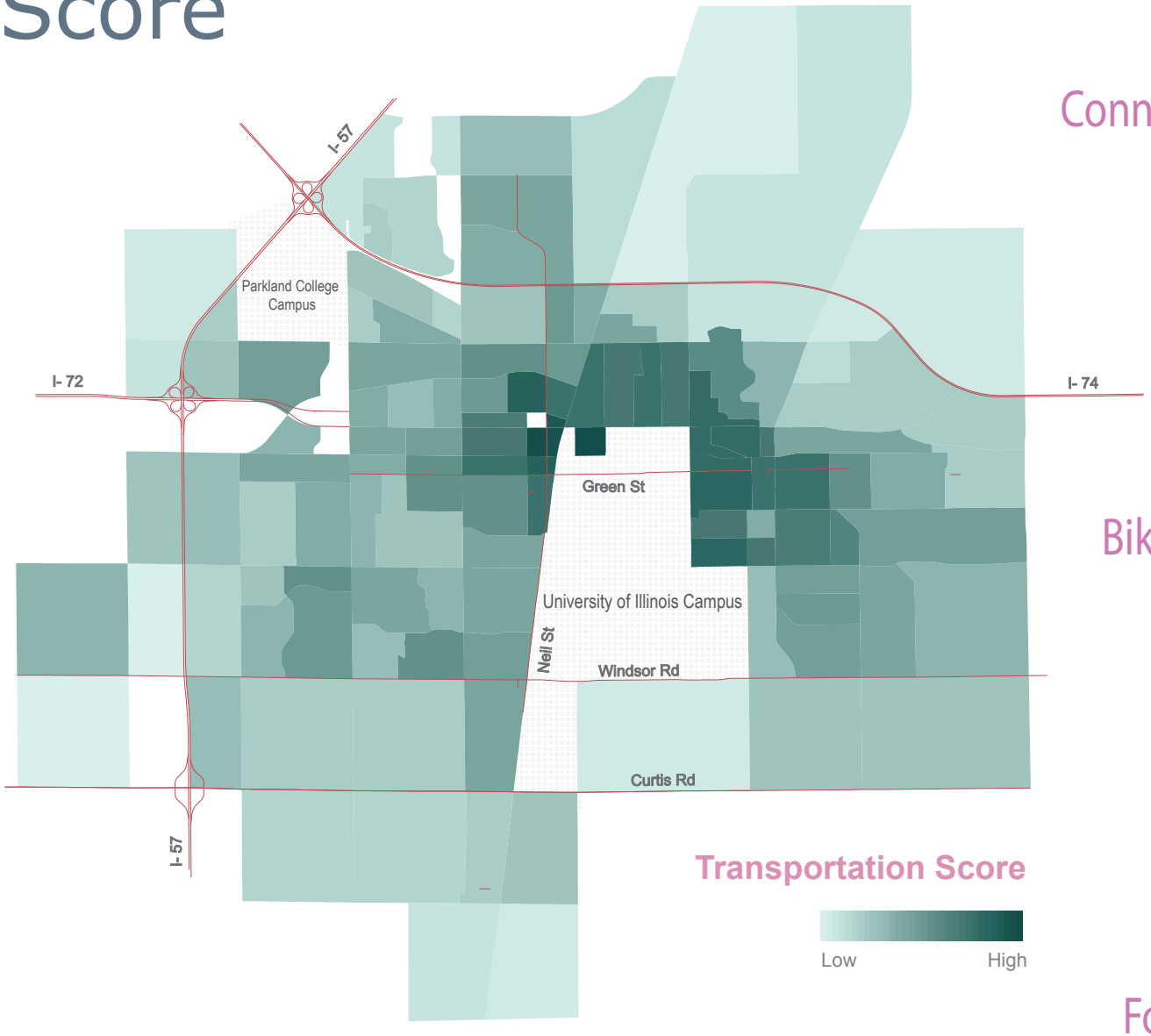


Block Size

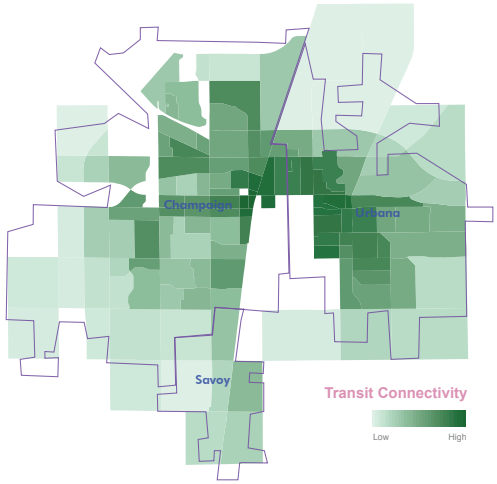


Transportation

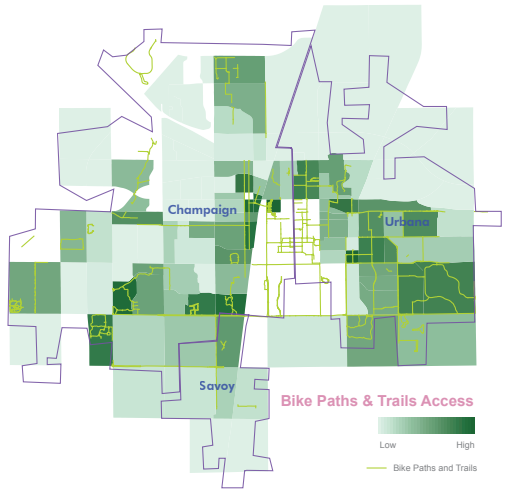
Score



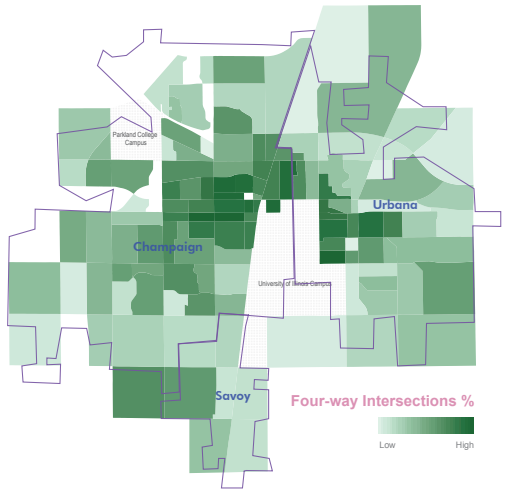
Transit Connectivity



Bike Paths & Trails

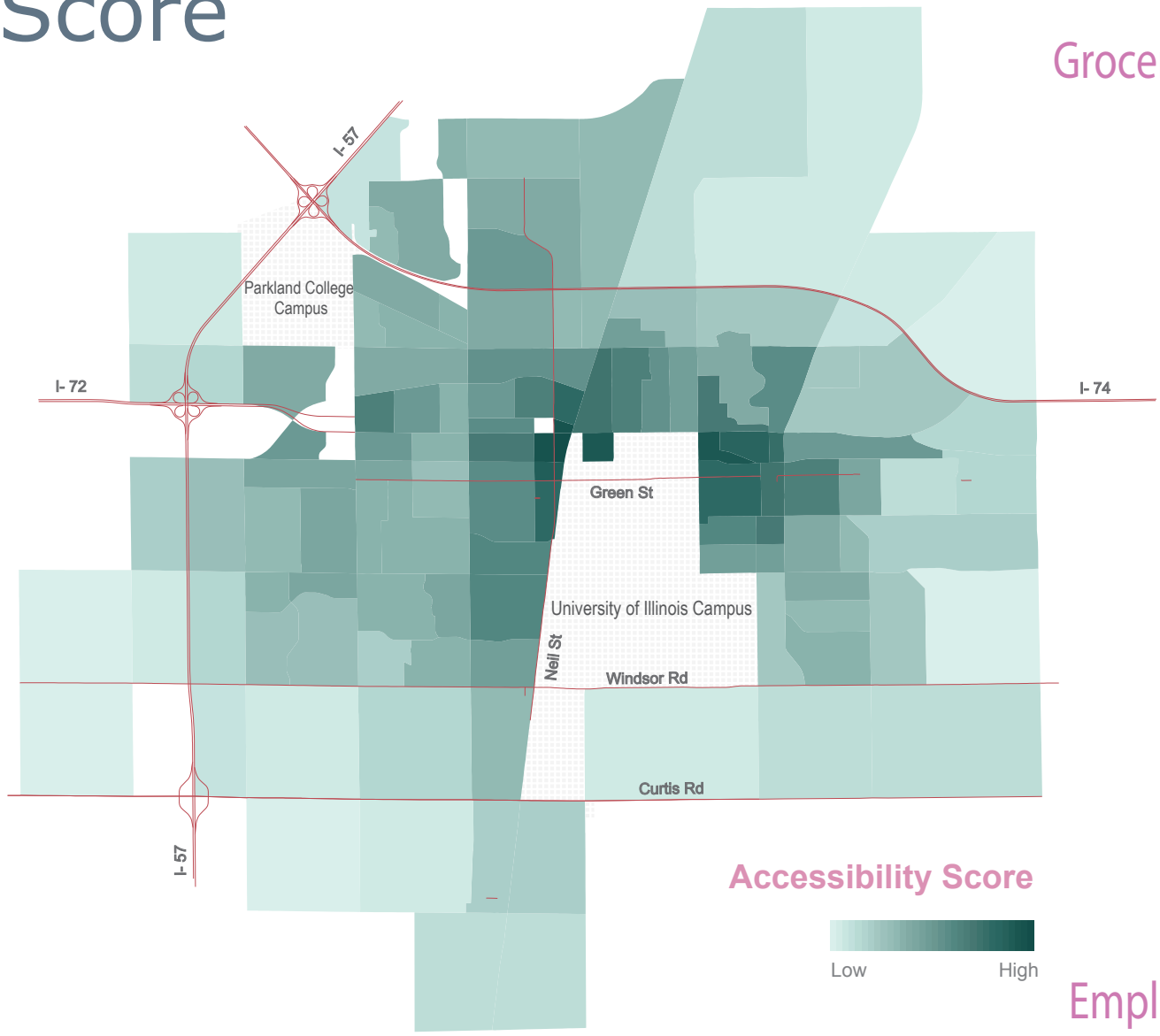


Four-way Intersections %

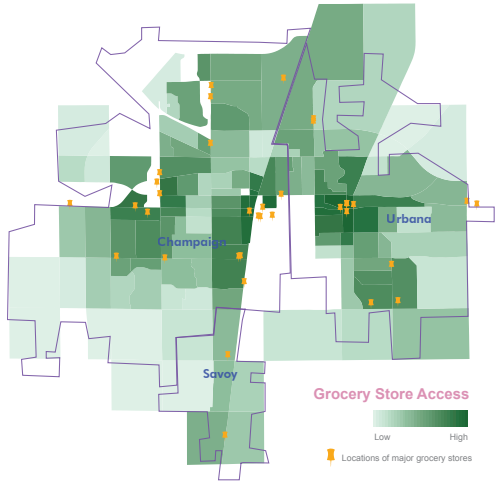


Accessibility

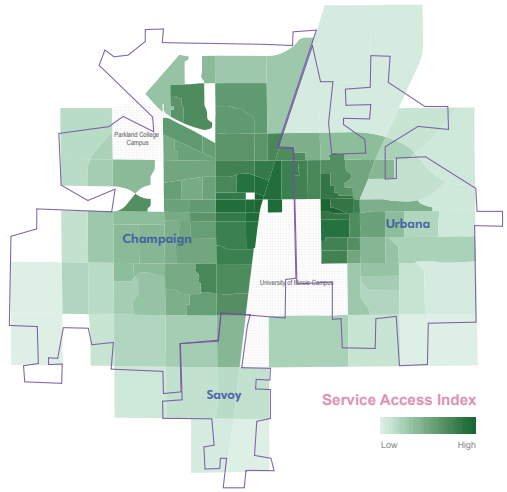
Score



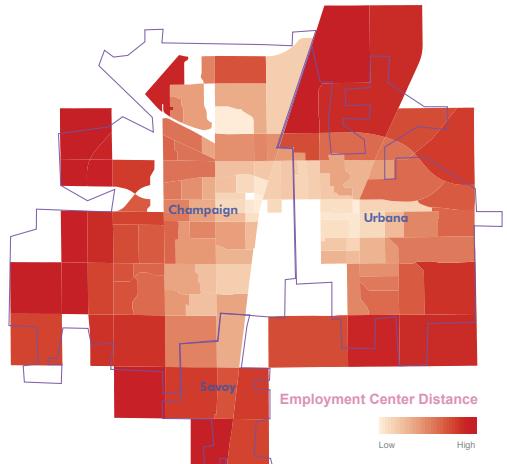
Grocery Store Access



Service Access Index

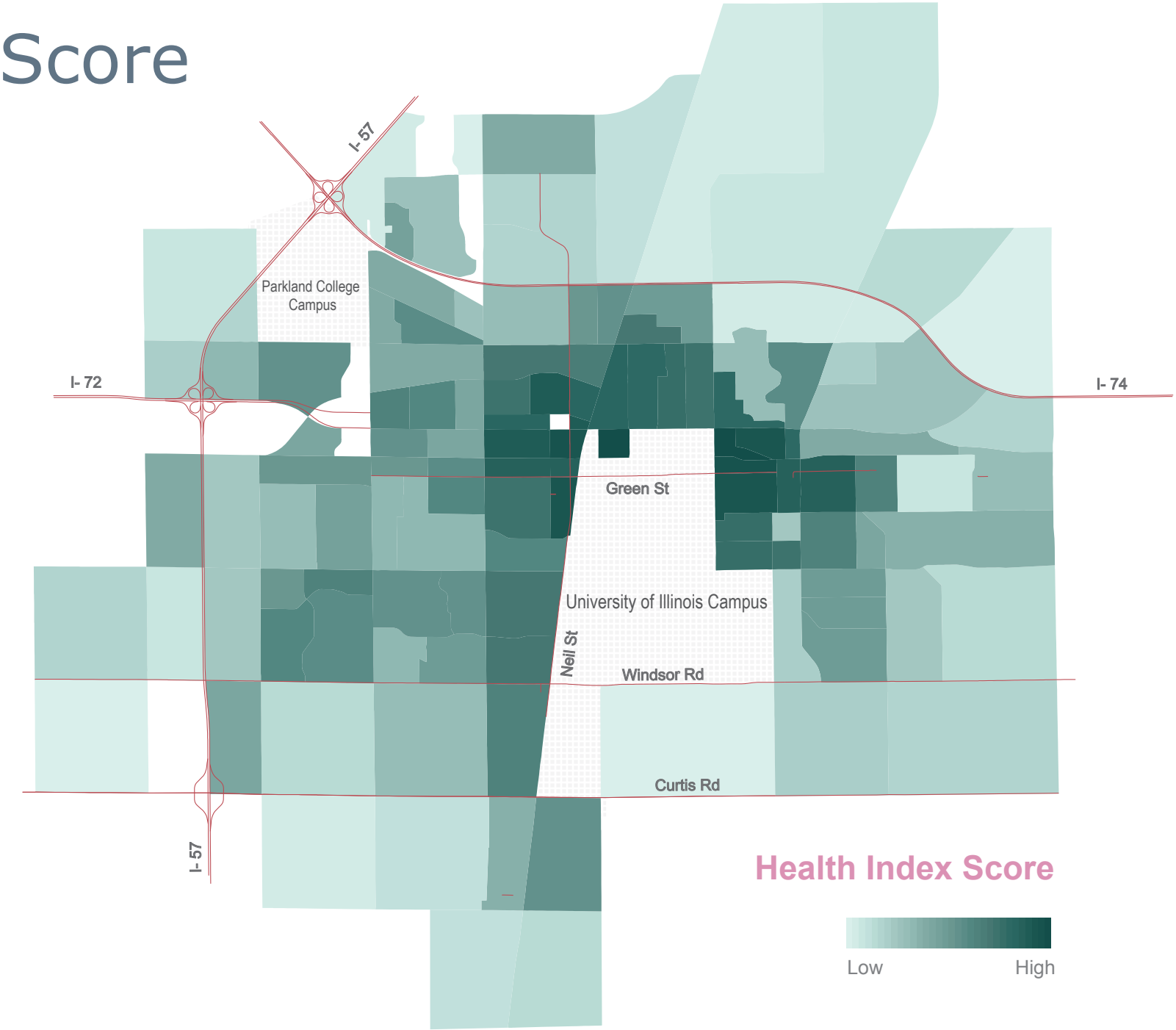


Employment Center Distance

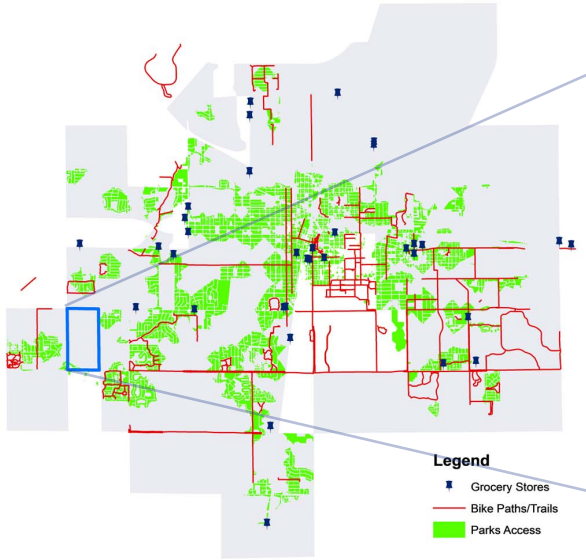


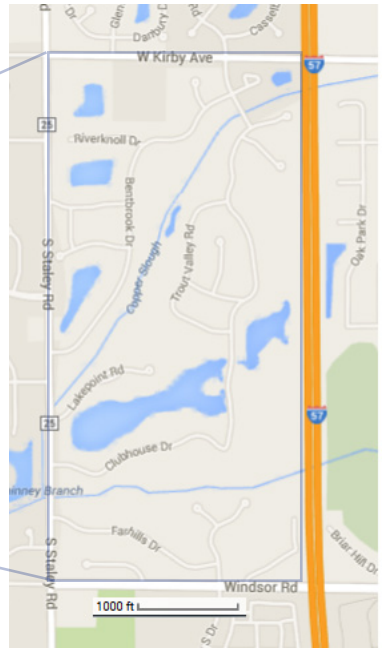
Health Index

Total Score



Results



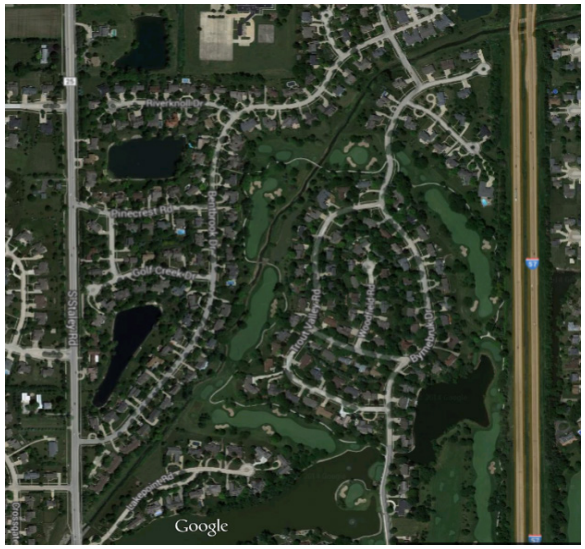


West of I-57 between Windsor and Kirby

- Very low health index score
- Zero points for transportation infrastructure
- No service-oriented businesses

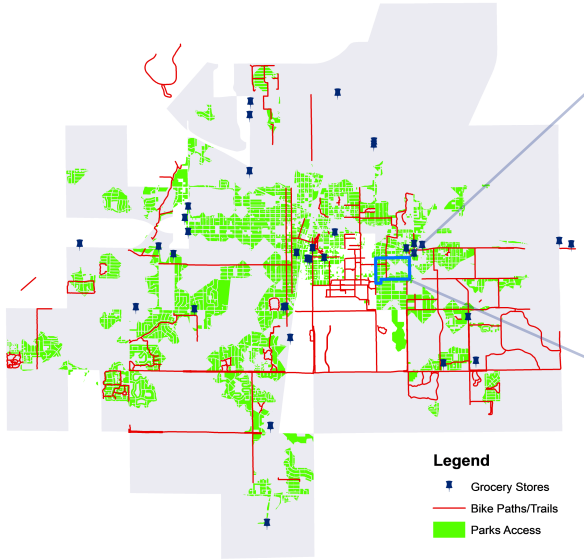
Health Index Score	
Block Size	1
Population Density	2
Land-use Mix	3
Transit Connectivity	0
Bike/Trails Miles	0
Four-way Intersections	0
Sidewalks Network	0
Service Access Index	2
Grocery Store Access	0
Parks Access	0
Employment Access	0
Crime Rate	12
Total Score	**20**

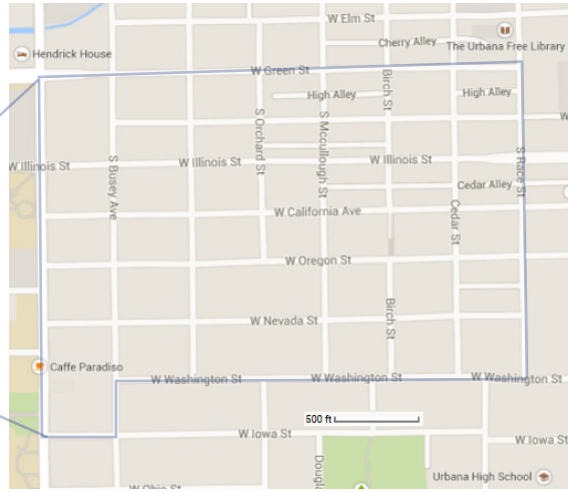
- Irregular disconnected street network
- Very large block sizes
- Homogenous land-use



- No transit service
- Far from employment center
- No incentive to walk or bike even for recreation

Results





West of Race bound by Green and Washington

- Very high health index score
- Close to downtown Urbana and the campus
- Very high accessibility to services and businesses

Health Index Score	
Block Size	8
Population Density	8
Land-use Mix	4
Transit Connectivity	9
Bike/Trails Miles	3
Four-way Intersections	5
Sidewalks Network	3
Service Access Index	9
Grocery Store Access	9
Parks Access	2
Employment Access	3
Crime Rate	7
Total Score	**70**

- Regular grid street network with small block sizes
- High transit connectivity
- Good combination of accessibility and transportation facilities

- Good mix of single and mutli-family residential uses
- Compact and vibrant neighborhood that supports walking and biking

Results & Limitations

Results

- Assessment confirms and quantifies the impact of built environment on the prevalence of obesity.
- Built enviornment also impacts prevalence of other related diseases.
- Existing epidemiological studies suggest similar correlationships which help prove causality.
- Planning for healthy communities is planning for inclusive, sustainable and livable communites.

Limitations

- Does not account for possible interactions between input variables.
- Neglects variations within a TAZ.
- The relationship between input variables and health was assumed to be geographically static.
- Urban design and streetlights not included in the regression model due to lack of data.
- Difficult to account for self-selection.

Recommendations & Future Work

Recommendations

- Planning should focus on both mobility and accessibility
- Develop an integrated active transportation network
- Use health impact studies to promote infill development and other such land-use policies
- Fill gaps in spatial distribution of service-oriented businesses
- Complementary initiatives such as Safe Routes to School to encourage use of active modes of transportation

Future Work

- Add a health impact dimension to scenario planning analyses
- Develop more targeted healthy communities plans for certain groups or neighborhoods
- Add more population health indicators
- Partner with local health agencies to collect data every few years and map changes over time
- Combine with qualitative feedback from residents and other stakeholders