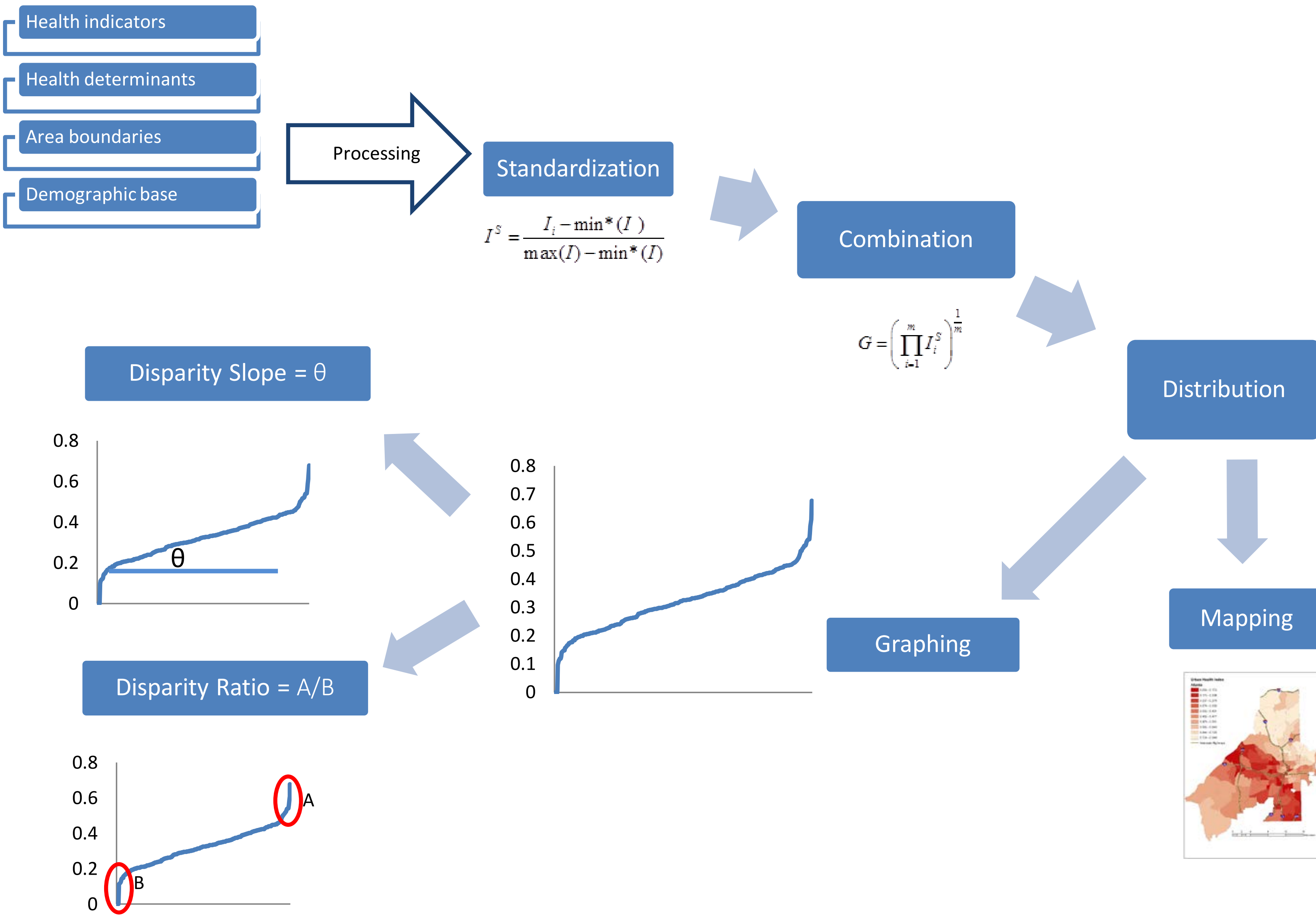
An Urban Health Index (UHI)

Flow Diagram for construction of an Urban Health Index



This approach leads to the need for at least TWO Indices of Urban Health:

An Urban Health Index (UHI) for the LEVEL of health

An Urban Health Index (UHI) for the DETERMINANTS of health

Within each of these, there needs to be a built-in mechanism for demonstrating DISPARITIES.

The approach to LEVELS, DETERMINANTS, and DISPARITIES

For LEVELS of Health:

- The major measures of mortality (overall, adult, neonatal, infant, maternal)
- The major measures of morbidity (highly variable and idiosyncratic but (hypothetically) interchangeable

The approach to LEVELS, DETERMINANTS, and DISPARITIES

For DETERMINANTS of Urban Health

Example: The determinants from Urban HEART

- Access to safe water
- Access to improved sanitation
- Completion of primary education
- Skilled birth attendance
- Fully immunized children
- Prevalence of tobacco smoking
- Unemployment
- Government spending on health

The approach to LEVELS, DETERMINANTS, and DISPARITIES

For DISPARITIES in Urban Health Distribution

Ratio of rates or values
Difference of rates or values
Effect index (e.g. regression slope)
Population attributable risk (e.g. a given rate compared to the lowest rate)
Index of dissimilarity (percent of cases that would have to be redistributed to have the same rate for all SES groups)
Slope Index of Inequality (SII) (slope of the regression line of a health measure against rank ordered SES category)
Relative Index of Inequality (SII divided by, alternatively, the mean or the highest level of the health measure).
Lorenz curve (cumulative proportion of the population plotted against cumulative proportion of a health variable; the 45^o line represents uniform distribution)
Gini coefficient (twice the area between the empirical Lorenz curve and its diagonal, a summary measure of deviation that corresponds to the amount of inequality)
Concentration curve and concentration index (similar to Lorenz curve and Gini coefficient, but health variable is plotted against ordered socioeconomic status.)
Relative Distribution Measures A more general class of measures that permit direct comparison of two distributions.

Formation of the UHI

A two step process, adopted from the method used by the Human Development Index

Step One:

Standardize each indicator as the proportion of some maximum or ideal that an area has achieved.

$$\text{Standard Value (SV)} = \frac{\text{Value}_I - \text{min}}{\text{max} - \text{min}}$$

To standardize, take the value for the indicator, subtract the minimum value for that indicator among all the geographic units, and divided by the maximum minus the minimum.

NOTE: This is a commonly used method to provide a standard metric for defining the rank order of a unit among other units.

Formation of the UHI

Step Two

Combine the standardized indicators by calculating the geometric mean.

Why a geometric mean?

Arithmetic mean (A): $$\frac{\sum_{i=1}^{n} I_i}{n} = \frac{I_1 + I_2 + I_3}{3}$$

Geometric mean (G): $$\left(\prod_{i=1}^{n} I_i\right)^{\frac{1}{n}} = (I_1)(I_2)(I_3)^{\frac{1}{3}}$$

Harmonic mean (H): $$\frac{n}{\sum_{i=1}^{n} \frac{1}{I_i}} = \frac{3}{\frac{1}{I_1} + \frac{1}{I_2} + \frac{1}{I_3}}$$

If all the elements in the set are the same, then

A = G = H

If at least one element differs from the others, then

A > G > H

Method of construction of the UHI

1. Choose a source of data

For this initial development, we have used
Community Health Status Indicators 2009
(http://www.communityhealth.hhs.gov/homepage.aspx?j=1)

The CHSI provides >500 Indicators on all 3,141 counties in the United States.

To construct the indices, we used data from 403 counties that are highly urbanized.

Method of Construction of the UHI

2. Choose a set of Indicators

Total Mortality
Infant Mortality
Diabetes
Coronary Heart Disease
Stroke
Homicide
Delayed prenatal care
Lacking HS diploma
Smokers
Unemployed
Diabetes
Infant Mortality
Injury
Coronary Heart Disease
Black-White Differences
Infant Mortality
Coronary Heart Disease
Cancer

3. Standardize the values for each geographic unit:

$$\text{Standard Value (SV)} = \frac{\text{Value}_I - \text{min}}{\text{max} - \text{min}}$$

Method of Construction of the UHI

4. Select indicators for construction of the Index

Total Mortality
Infant Mortality
Diabetes
Coronary Heart Disease
Stroke
Homicide

5. Calculate Index

$$\text{Urban Health Index} = \left(I_1 \cdot I_2 \cdot I_3 \cdot I_4 \cdot I_5 \cdot I_6\right)^{\frac{1}{6}}$$

Each geographic unit now has an UHI that is the geographic mean of the Standardized Values of the Indicators

Method of Construction of the UHI

6. Rank Order the geographic units by their Urban Health Index

	Indicator
1	0.1483
2	0.1576
3	0.1589
4	0.1624
5	0.1683
6	0.1693
7	0.1750
8	0.1765
9	0.1851
10	0.1892
11	0.1928
12	0.1943
13	0.1949

The UHI is thus a value between 0 and 1. The higher the value for a geographic unit, the more seriously affected it is.

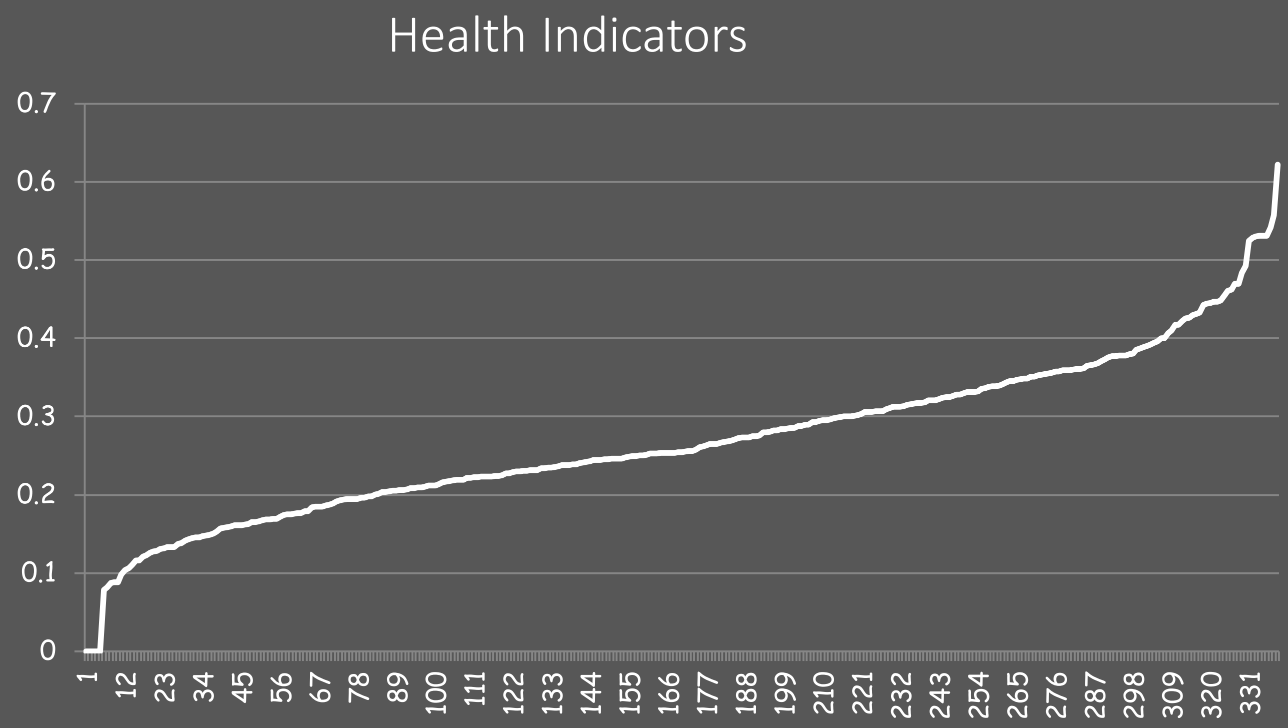
7. Evaluate the characteristics of the distribution:

Graph
Ratio
Slope
Geography

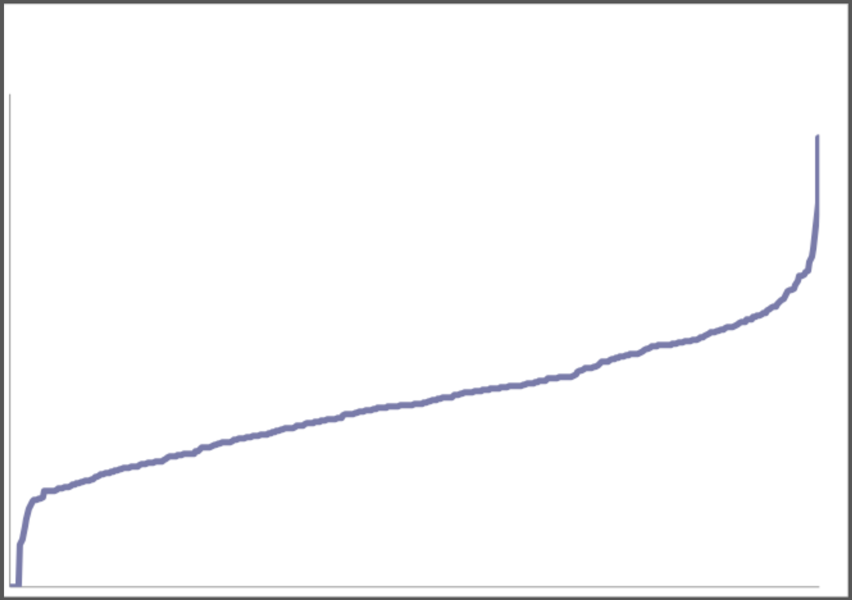
Urban Health Index: Outcomes

Components:

Total Mortality
Infant Mortality
Diabetes
Coronary Heart Disease
Stroke
Homicide



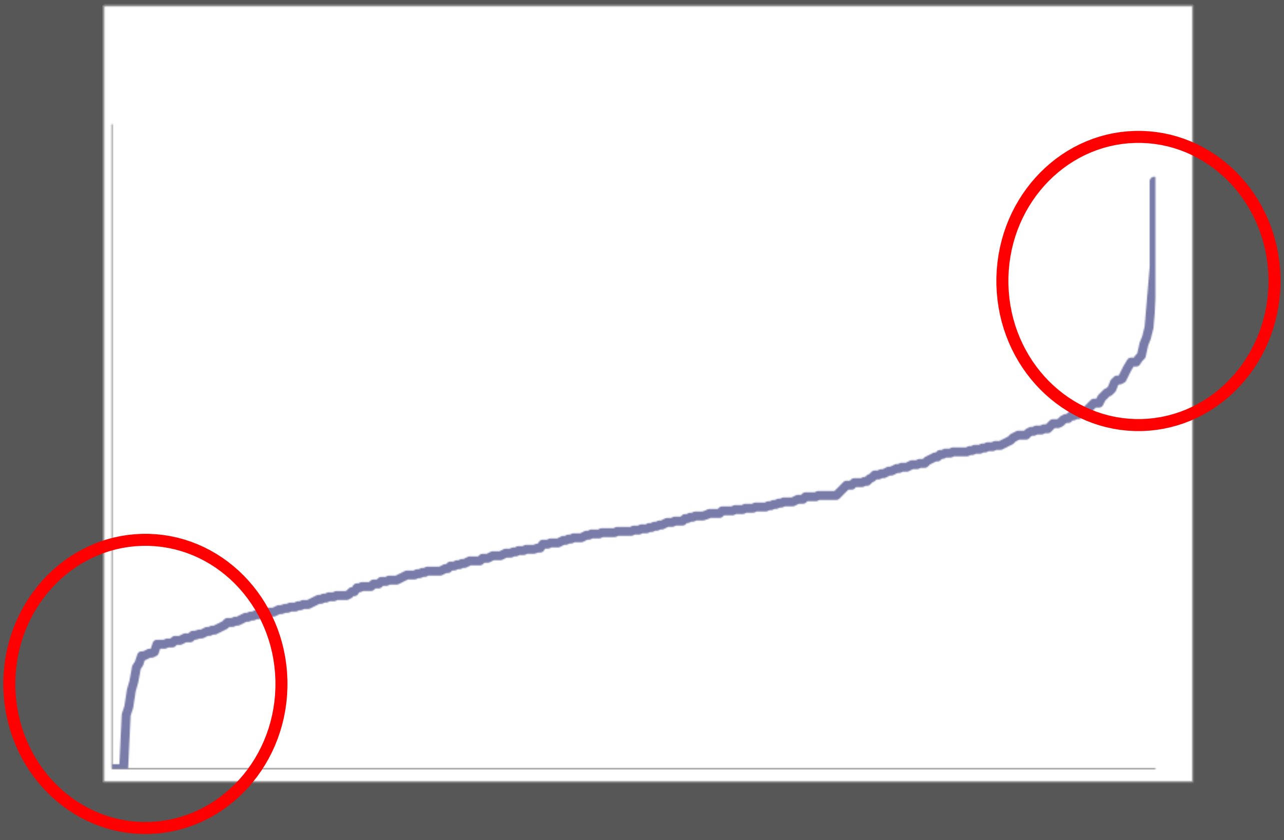
Finding Health Disparity in the graph



There are 3 distinct segment: low end, high end, and gradually rising mid-section.

Note that outliers, often reviled, are embraced here.

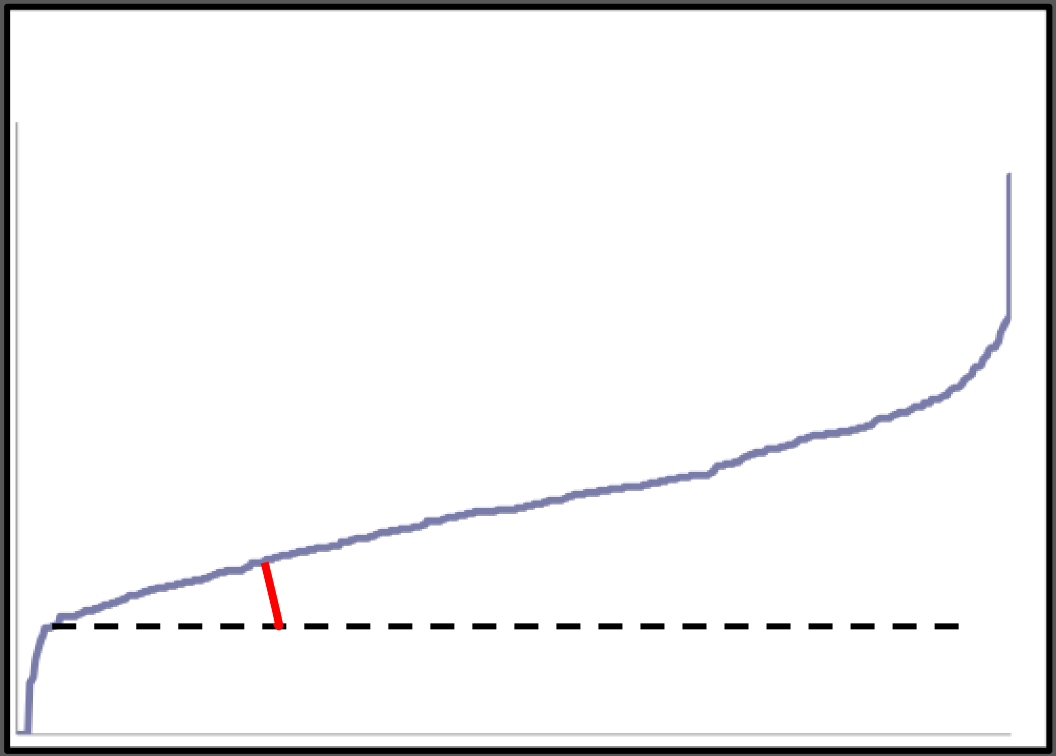
The Health Disparity Ratio



compare
The upper 10% to the lower 10% : (90th percentile) / (10th percentile).

We use the means of the upper and lower 10% to construct the Health Disparity Ratio

The Health Disparities Slope

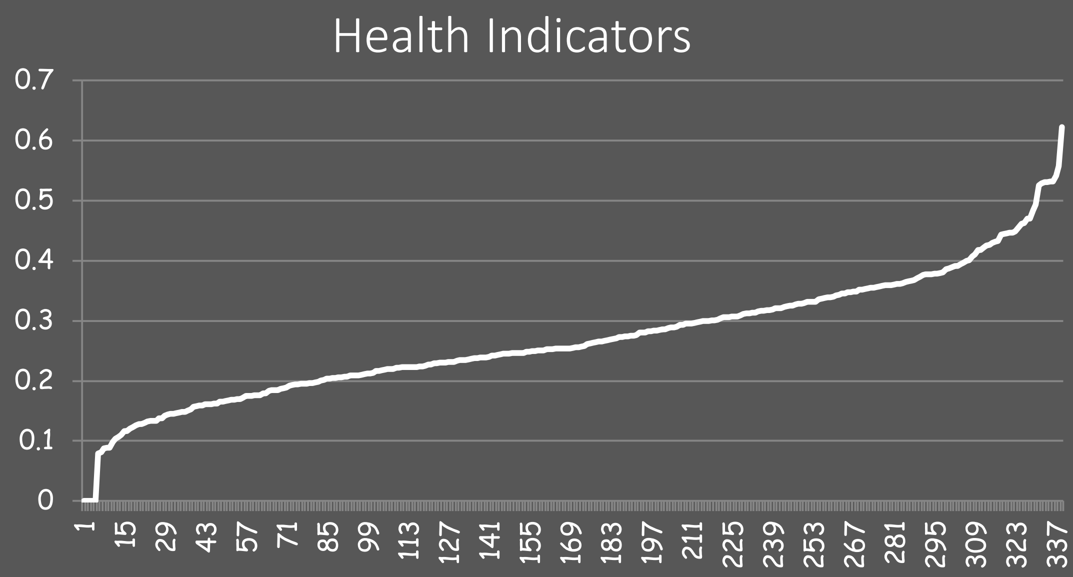


The Slope defines how heterogeneous the overall area is.

A steep slope implies that the difference between those better off and those worse off changes rapidly along a continuum and there is considerable variation along that continuum.

A mild slope implies that the large middle group of areas are relatively homogeneous.

Urban Health Index: Outcomes



Components:

Total Mortality
Infant Mortality
Diabetes
Coronary Heart Disease
Stroke
Homicide

Health Disparities Ratio: 4.53

Health Disparities Slope: 0.0008

Application to Urban Areas

Atlanta, GA, USA

Tokyo, Japan

Shanghai, China

Other megacities

Applying the UHI to the Urban Metropolitan Area of Atlanta, Georgia, USA

Data Source:

- Selected from 2009 5-year (2005-2009) American Community Survey (ACS)

Small Area Unit

- Census tract
  - 129 census tracks fully or partially within the city of Atlanta
  - 1 tract omitted due to missing data
  - Based on Census 2000 boundaries

Indicators

- Economic, Demographic, and Education variables
  - Direction of relation between indicators and health outcomes must be consistent
  - 7 UHI Determinant Indicators selected

Selected variables for Atlanta

Economic

1. % Employed
2. % above poverty-level
3. Household Median Income
4. Household Mean Income

Education

5. % High School graduate or higher education
6. % with Bachelors or higher degree

Demographic

7. % of households NOT single-female headed households with children under 18 yo.

Review: Calculating the UHI

1. Standardize Indicators

$$I^s = \frac{I - \min^*(I)}{\max(I) - \min^*(I)}$$

Where min*(I) is the sample minimum minus small constant to prevent zero values for I^S. .01 and $10 were subtracted for indicators in percentage and dollar units, respectively.

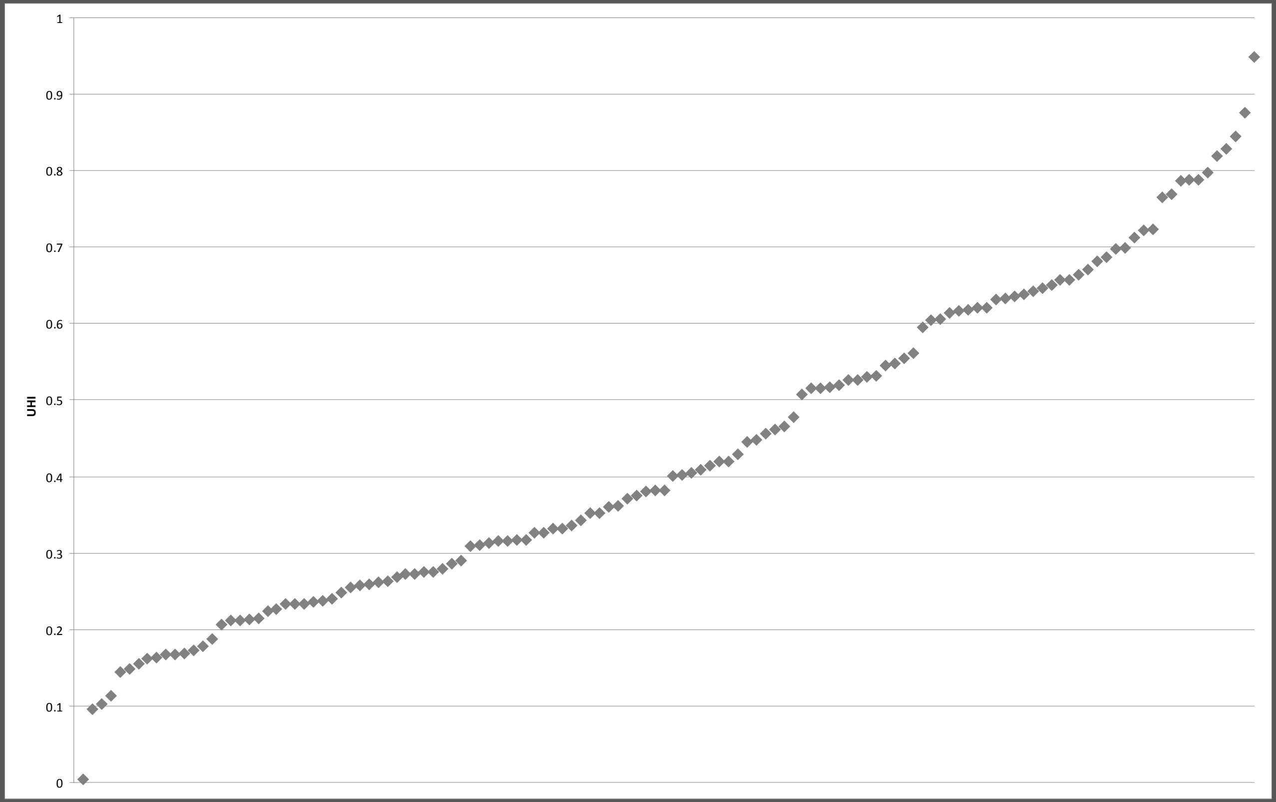
2. Compute Geometric Mean Standardized Indicators

$$UHI = \left(\prod_{i=1}^{n} I_i^S \right)^{\frac{1}{n}}$$

Urban Health Disparities Index for Atlanta

Health Disparities Ratio: 0.80/0.13 = 5.92

Health Disparities Slope*: $\frac{\Delta y}{\Delta x} = 0.54$



***Note**: Rank is rescaled to have equal-spaced interval of [1/n, 1] for calculation of the health disparities slope.

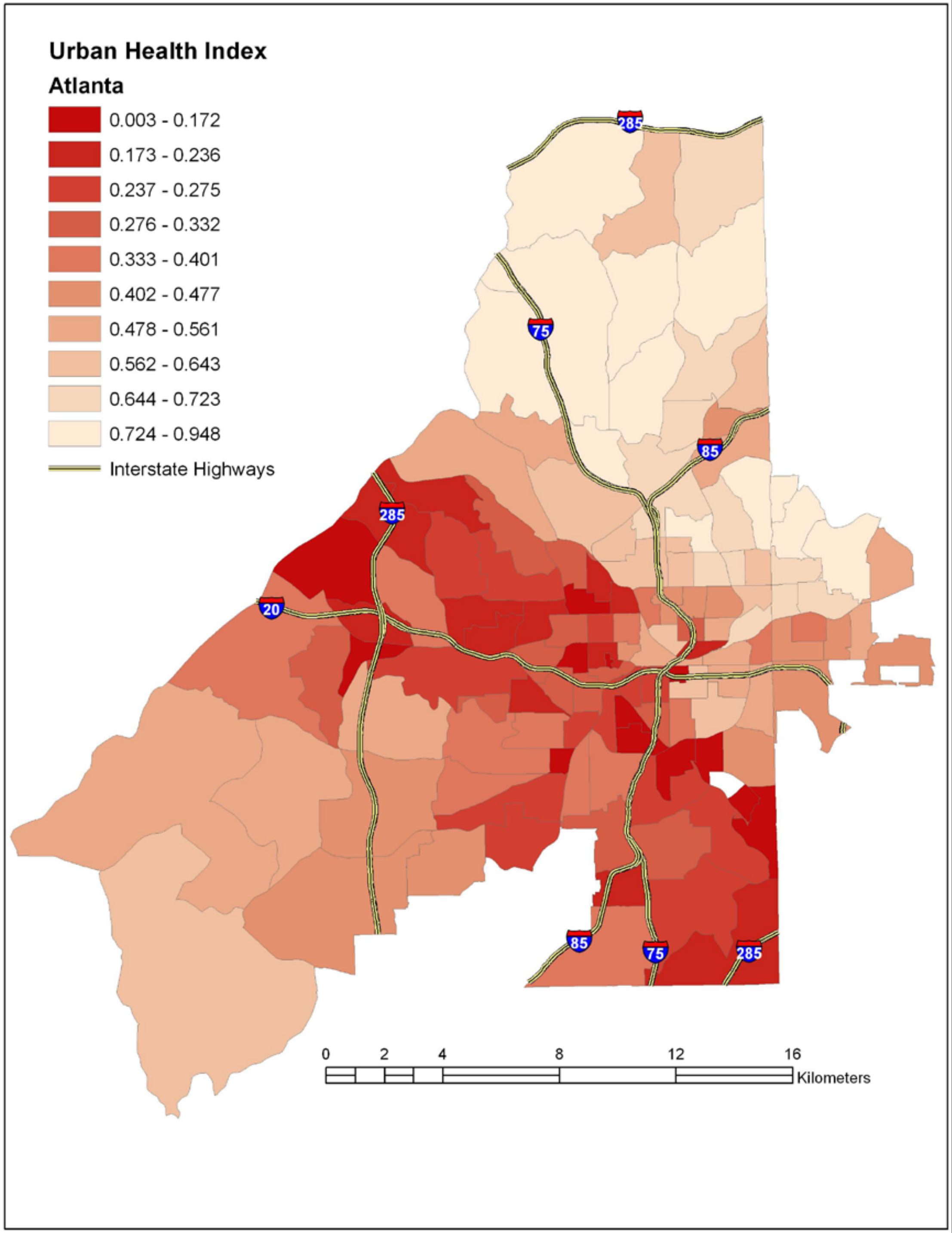
Descriptive statistics for the UHI

	Mean	Std Dev	Minimum	P10	Median	P90	Maximum
UHI1	0.43	0.21	0.00	0.17	0.39	0.72	0.95

P10 and P90 indicate the 10^{th} and 90^{th} percentiles, respectively.

UHI:

Visual depiction for Atlanta



Applying the UHI to Japan

Data Sources

- Selected from the 2003-2007 National Japanese Health Statistics Database
  - Source: National Statistics Center and the Statistics Bureau, Ministry of Internal Affairs and Communications
  - http://www.e-stat.go.jp/SG1/estat/eStatTopPortalE.do

Indicators

- Selected 5 Standardized Mortality Ratios for each sex (10 indicators)
  - All causes of death
  - Malignant Neoplasm
  - Hearth Disease (excluding hypertension)
  - Cerebrovascular Disease
  - Pneumonia

Calculation

$$SMR = \frac{\text{number of deaths by region (1/1/03-12/31/07)}}{\sum_{i=1}^{P}\left[\text{national mortality rate(03-07)}_i \times \text{population(10/1/05)}_i\right]\times 5}\times 100,$$

where i denotes the age group.

Applying the UHI to Japan

Small area unit

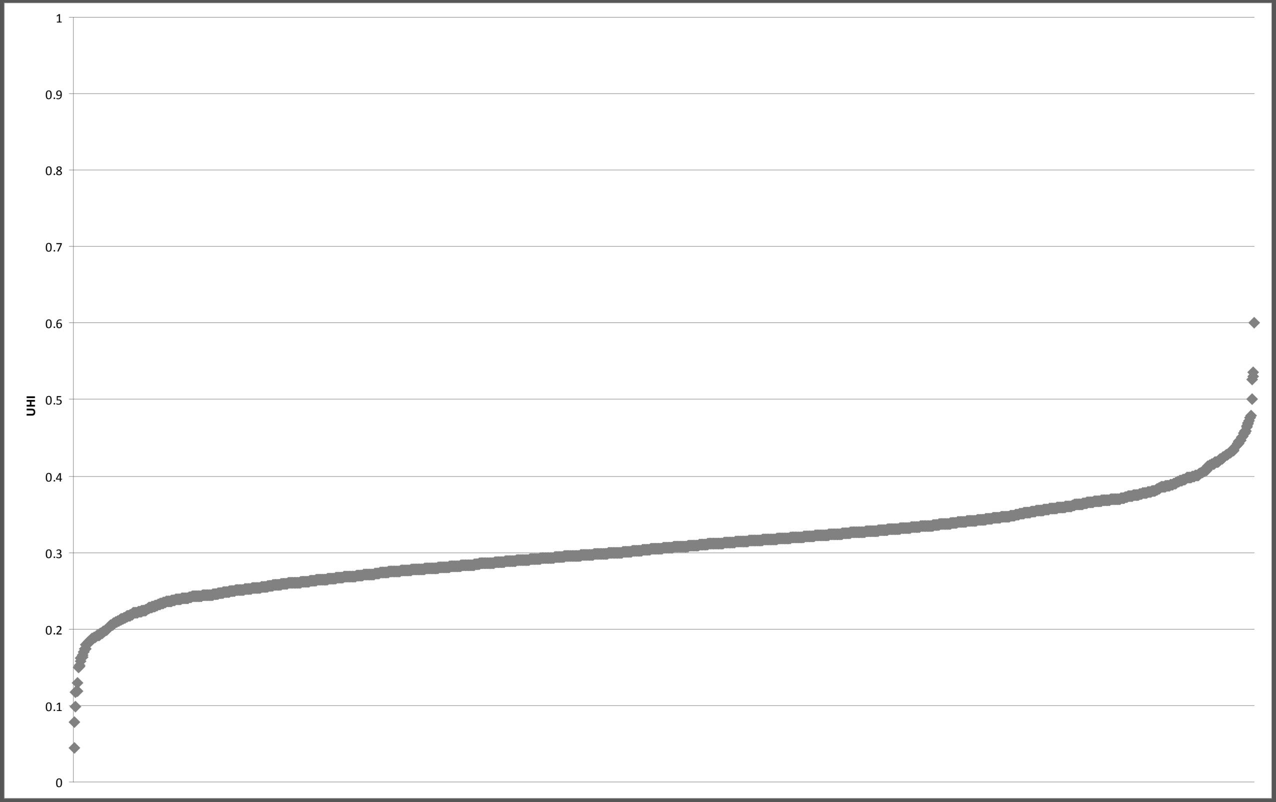
- Smallest-area subdivisions and municipalities within each of the 47 prefectures of Japan
  - Villages **村** (-son, -mura)
  - Towns **町** (-chō, -machi)
  - Wards **区** (-ku)
    - Some designated cities, **政令指定都市** -- seirei-shitei-toshi (pop > 500,000), are subdivided into wards (sub-municipal unit)
  - Special wards for Tōkyō **特別区** (tokubetsu-ku)
    - Tōkyō-to contains 23 special words, each a municipality
  - Cities **市** -shi (pop > 50,000)
  - Special cities **特例市** – tokurei-shi(pop > 200,000)
  - Core cities **中核市** – chuokaku-shi (pop > 300,000)

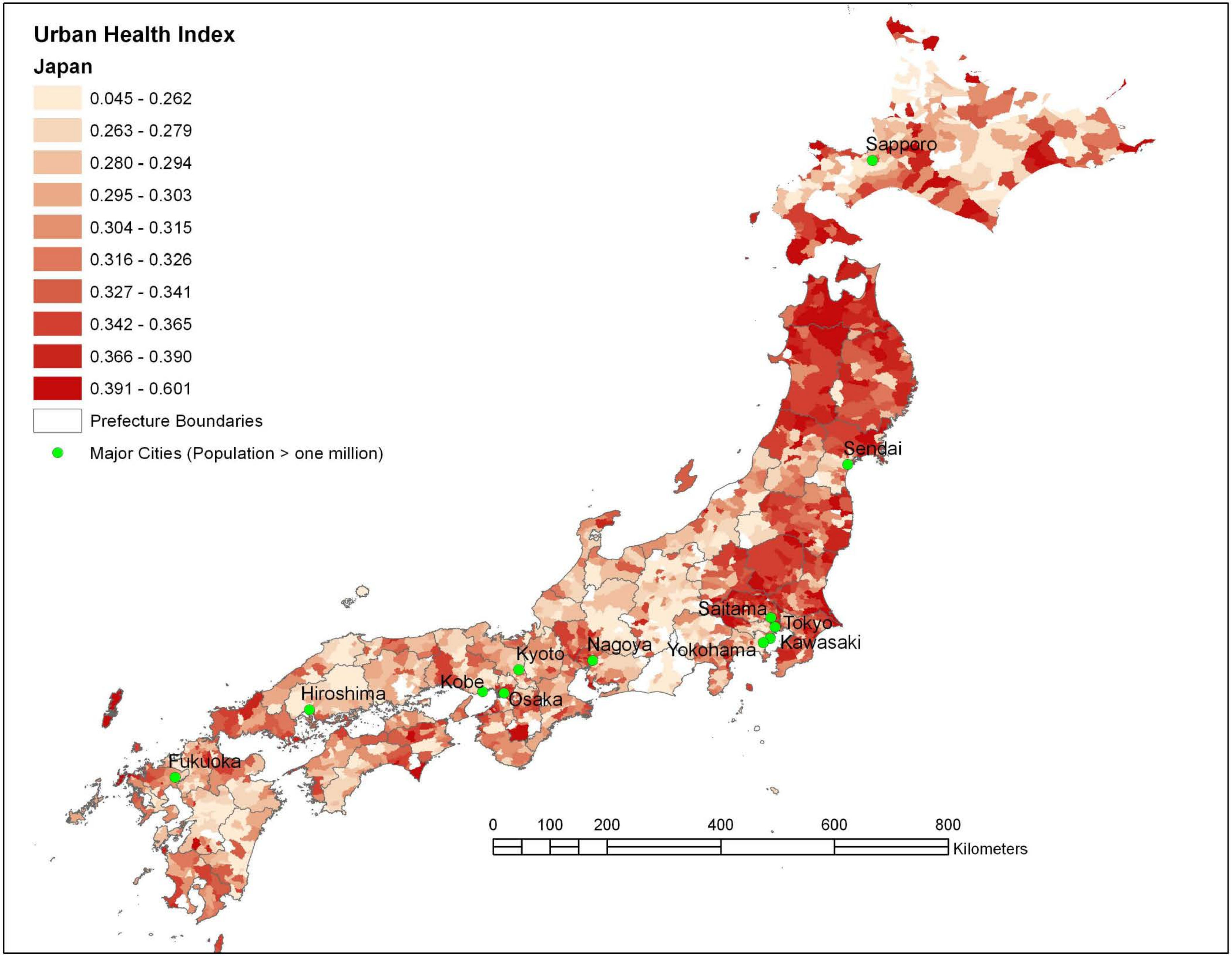
- Based on 2008 municipal boundaries with 1,970 units
  - **1,857** units remaining after those with missing data are dropped

Japan (mortality outcomes)

Ratio = 1.95

Slope = 0.12




Urban Health Index
Japan
0.045 - 0.262
0.263 - 0.279
0.280 - 0.294
0.295 - 0.303
0.304 - 0.315
0.316 - 0.326
0.327 - 0.341
0.342 - 0.365
0.366 - 0.390
0.391 - 0.601
Prefecture Boundaries
Major Cities (Population > one million)
Sapporo
Sendai
Saitama
Tokyo
Kawasaki
Yokohama
Nagoya
Kyoto
Kobe
Osaka
Hiroshima
Fukuoka
0
100
200
400
600
800
Kilometers

Applying the UHI to Tokyo

Data Source

- Selected from the 2003-2007 National Japanese Health Statistics Database
  - Source: National Statistics Center and the Statistics Bureau, Ministry of Internal Affairs and Communications
  - http://www.e-stat.go.jp/SG1/estat/eStatTopPortalE.do

Indicators

- Selected 5 Standardized Mortality Ratios for each sex (10 indicators)
  - All causes of death
  - Malignant Neoplasm
  - Hearth Disease (excluding hypertension)
  - Cerebrovascular Disease
  - Pneumonia

Applying the UHI to Tokyo

Small Area Unit

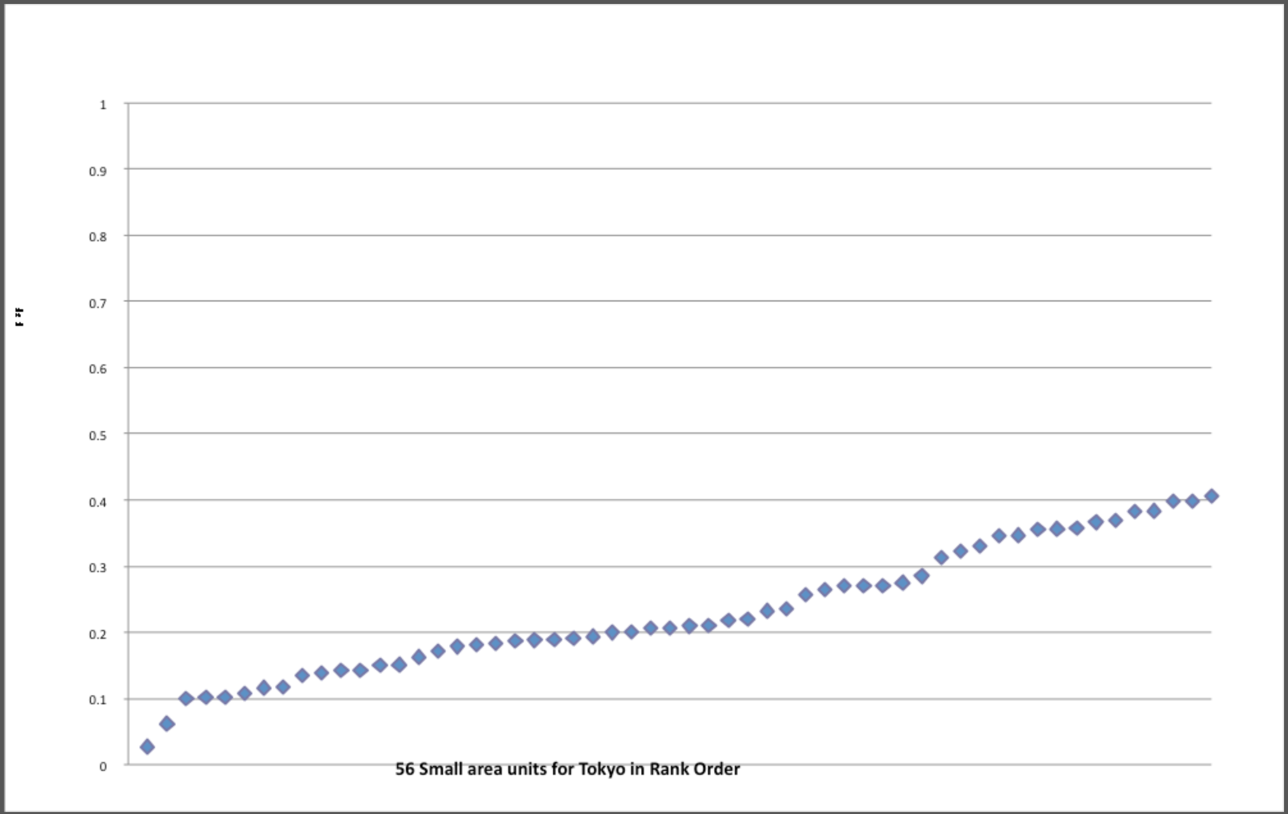
- Geographic Level of Analysis: Smallest-area subdivisions and municipalities within the Tōkyō-do prefecture
  - 8 Villages **村** (-son, -mura)
  - 5 Towns **町** (-chou, -machi)
  - 23 Special wards **特別区** (tokubetsu-ku)
    - These wards constitute the area of the former city of Tōkyō
    - Each has a mayor, council, and city-like status (but differs from other cities in their sharing of administrative functions with the Tōkyō Metropolitan Government)
  - 26 Cities **市** -shi (pop > 50,000)
    - http://en.wikipedia.org/wiki/Tokyo

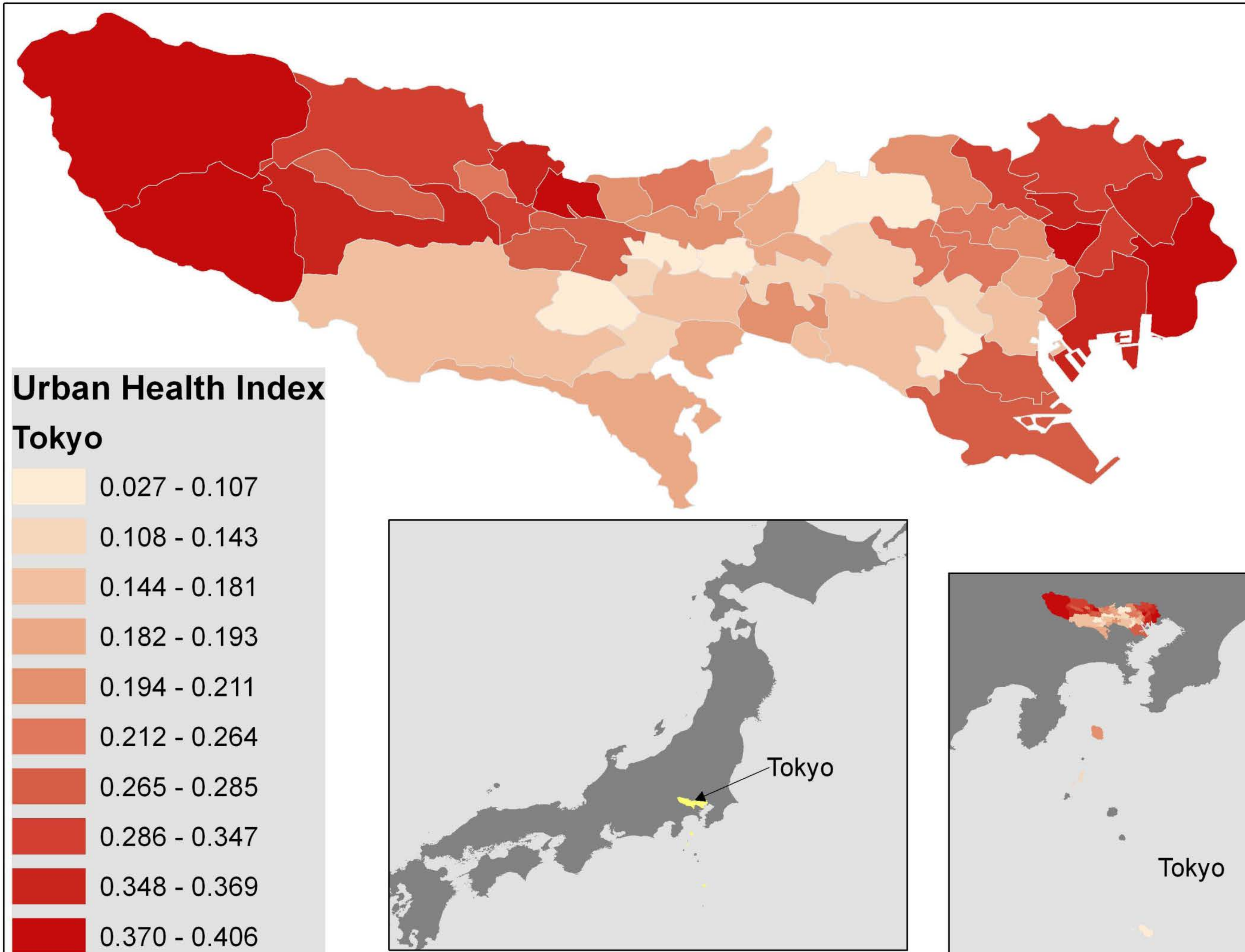
- UHI is based on 56 municipalities
  - 6 municipalities were dropped due to missing data.

Tokyo (mortality outcomes)

Ratio = 4.70

Slope = 0.24




Urban Health Index
Tokyo
0.027 - 0.107
0.108 - 0.143
0.144 - 0.181
0.182 - 0.193
0.194 - 0.211
0.212 - 0.264
0.265 - 0.285
0.286 - 0.347
0.348 - 0.369
0.370 - 0.406
Tokyo
Tokyo

Summary: three area results

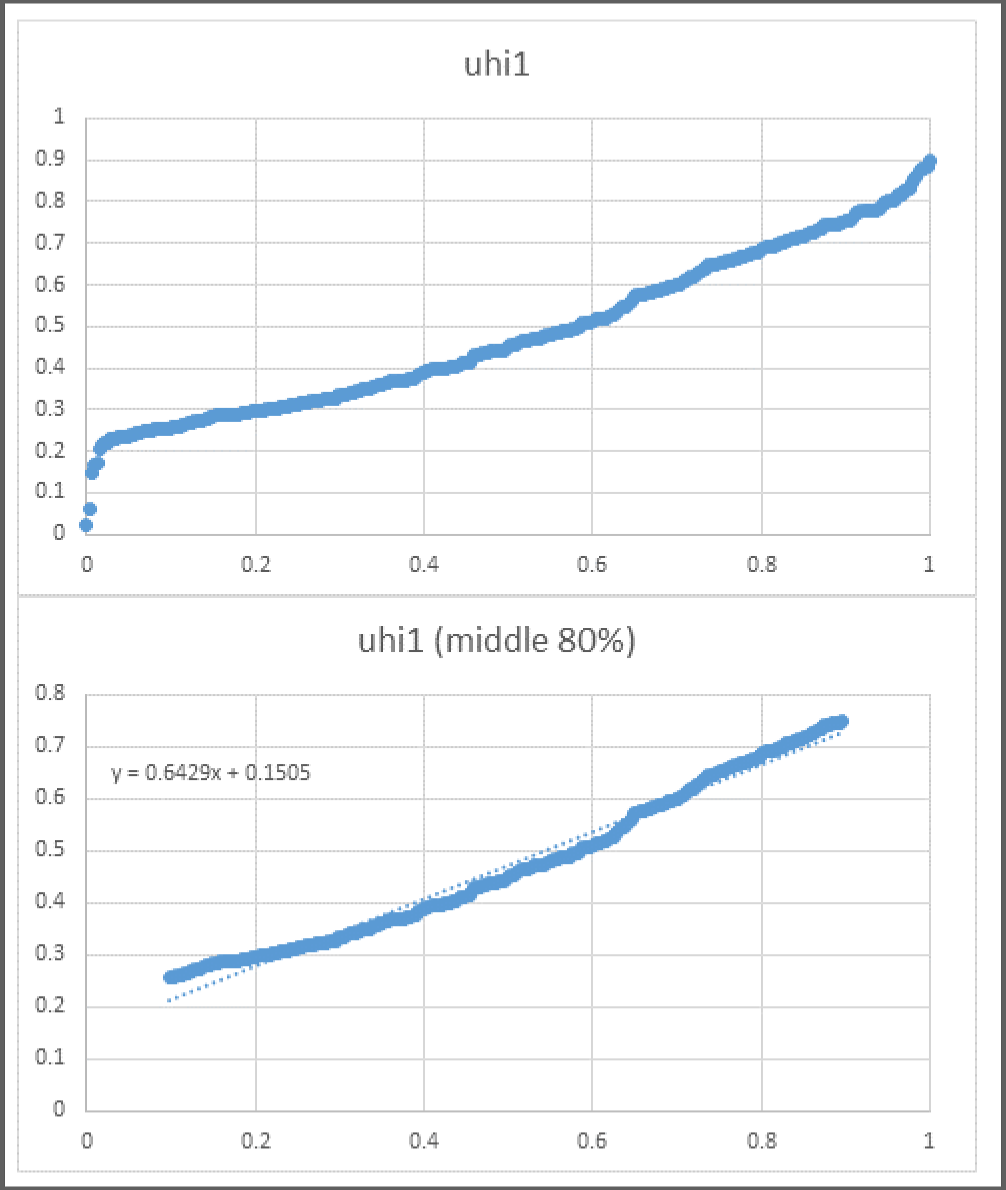
	Health Disparity	
	Ratio	Slope
Atlanta	5.92	0.54
Japan	1.95	0.12
Tokyo	4.70	0.24

Applying the UHI to Shanghai

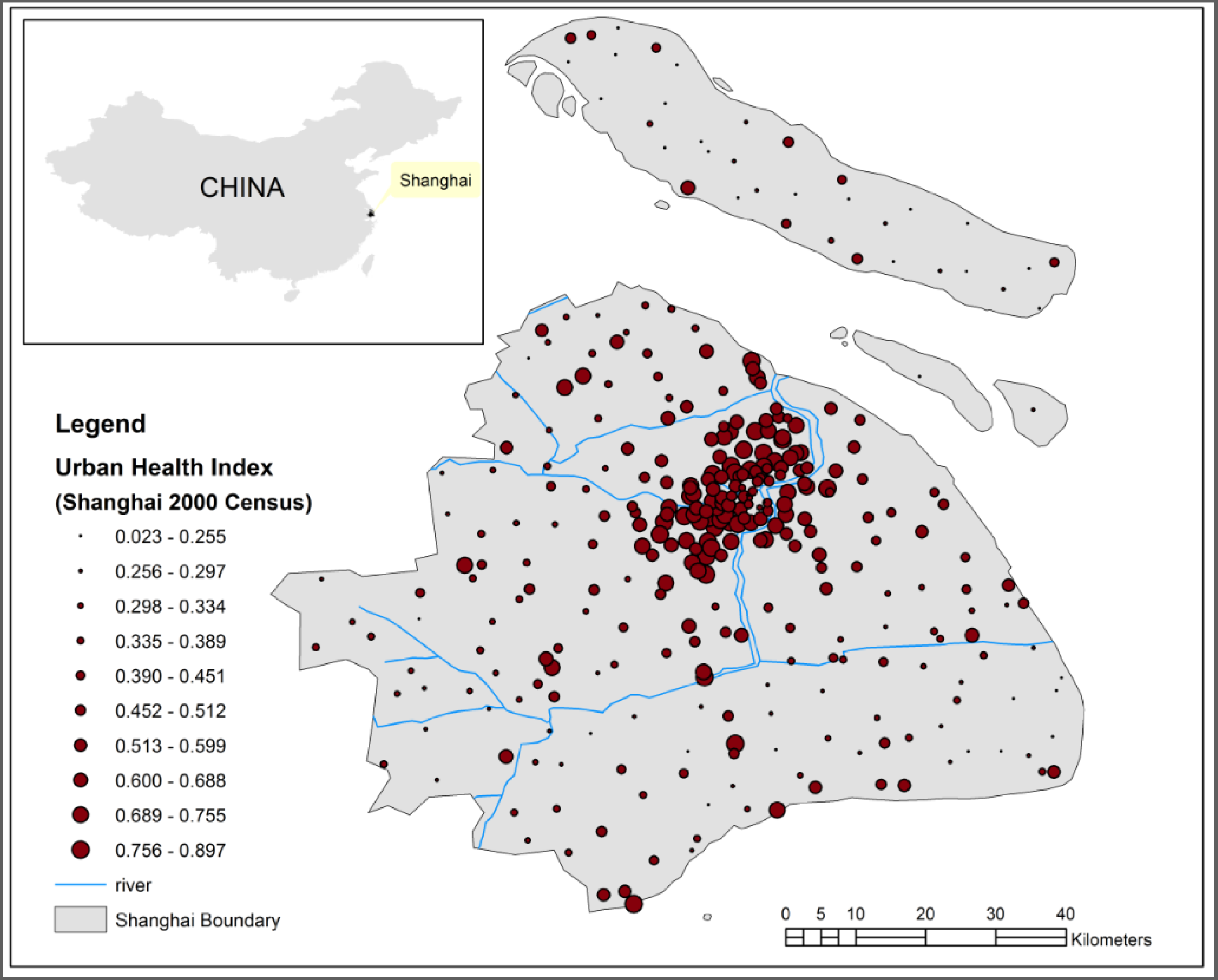
A new wrinkle: data were collected through cluster sampling.

This was actually liberating, since jurisdiction could be ignored and spot maps and density maps could be used instead.

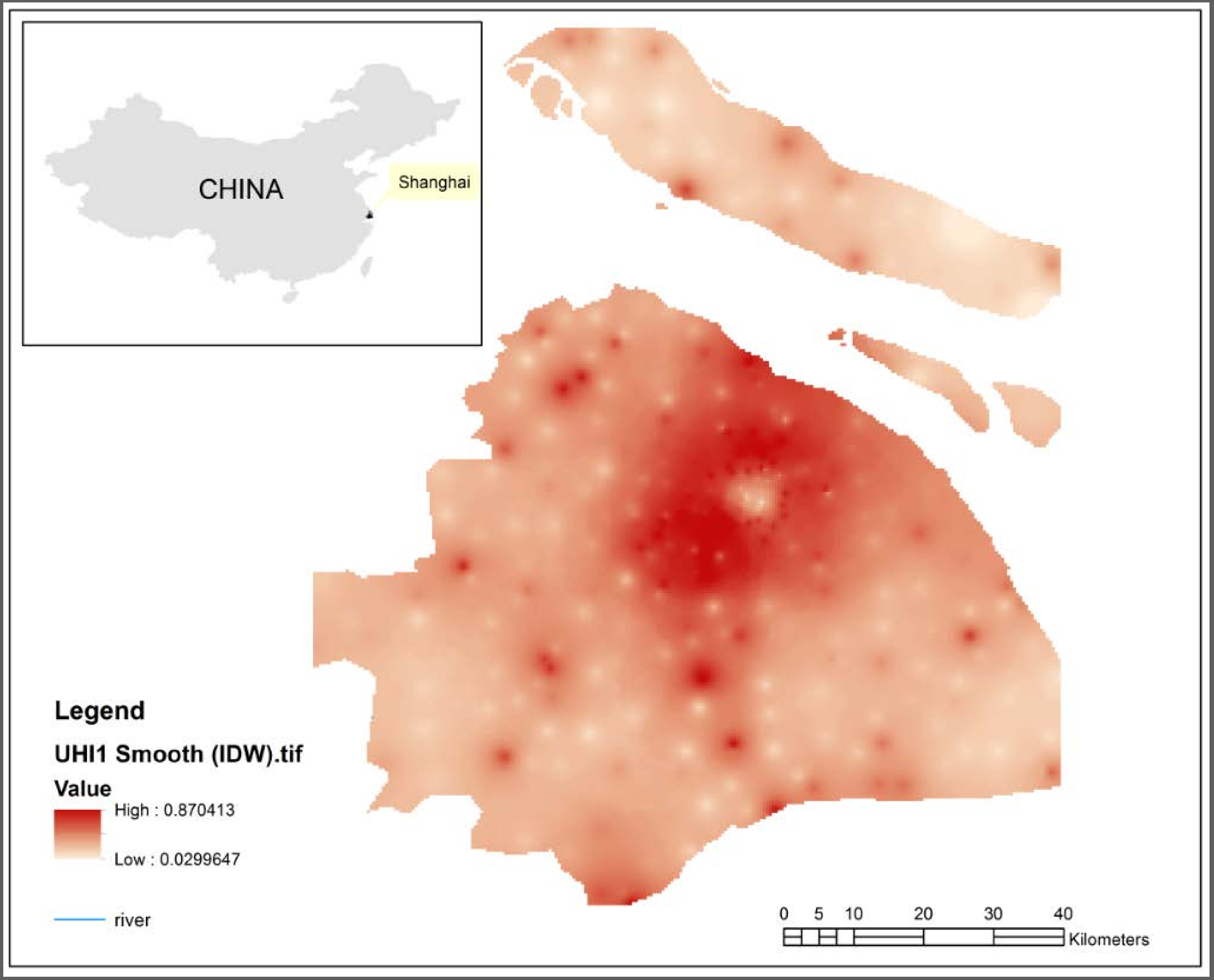
Using the cluster in Shanghai, the distribution of the UHI is slightly different from those seen before.



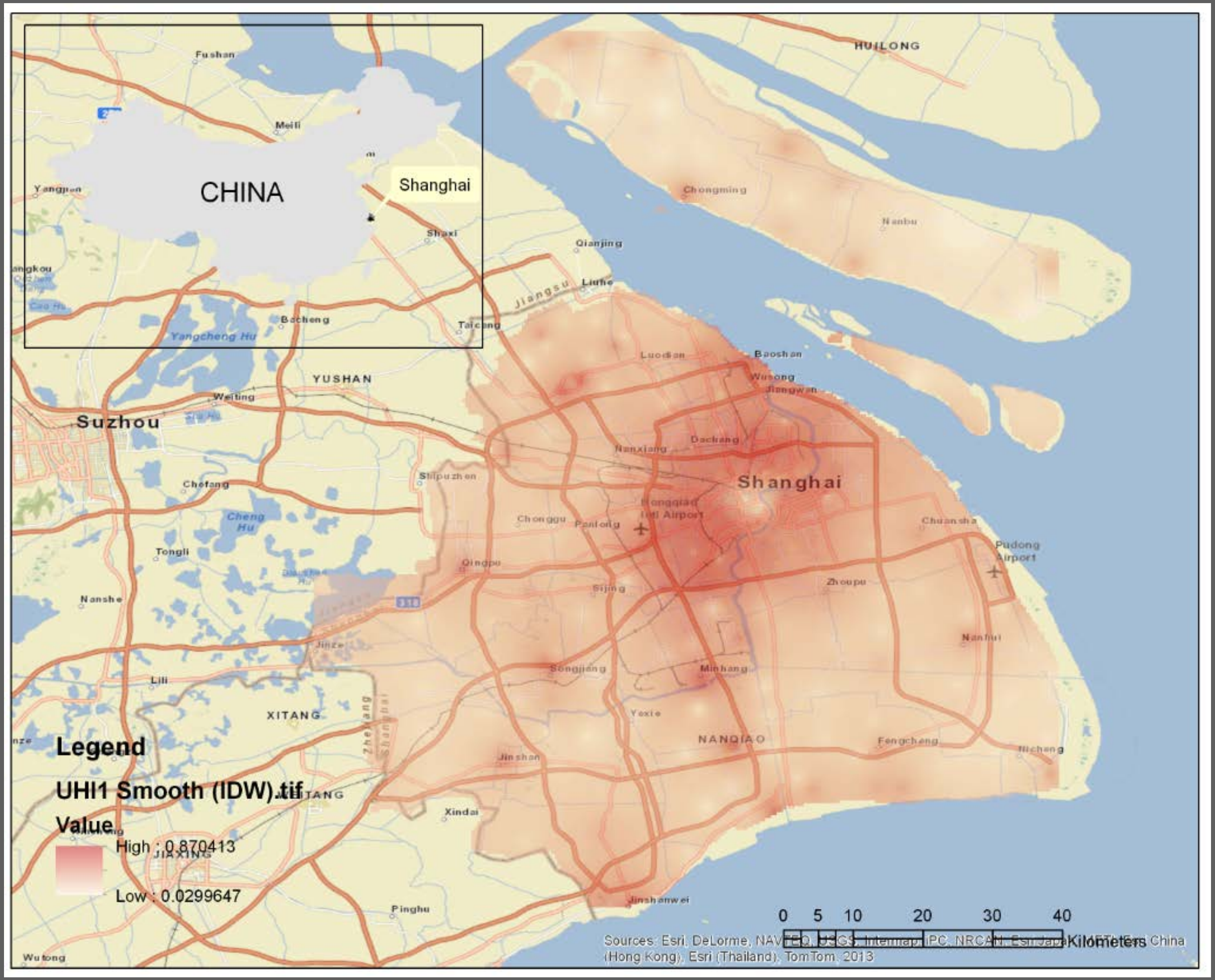
A spot map associating each cluster with its UHI gives a general sense of the distribution of the the areas



If these are converted to density maps, a clear distribution of the where disparities exist is evident.



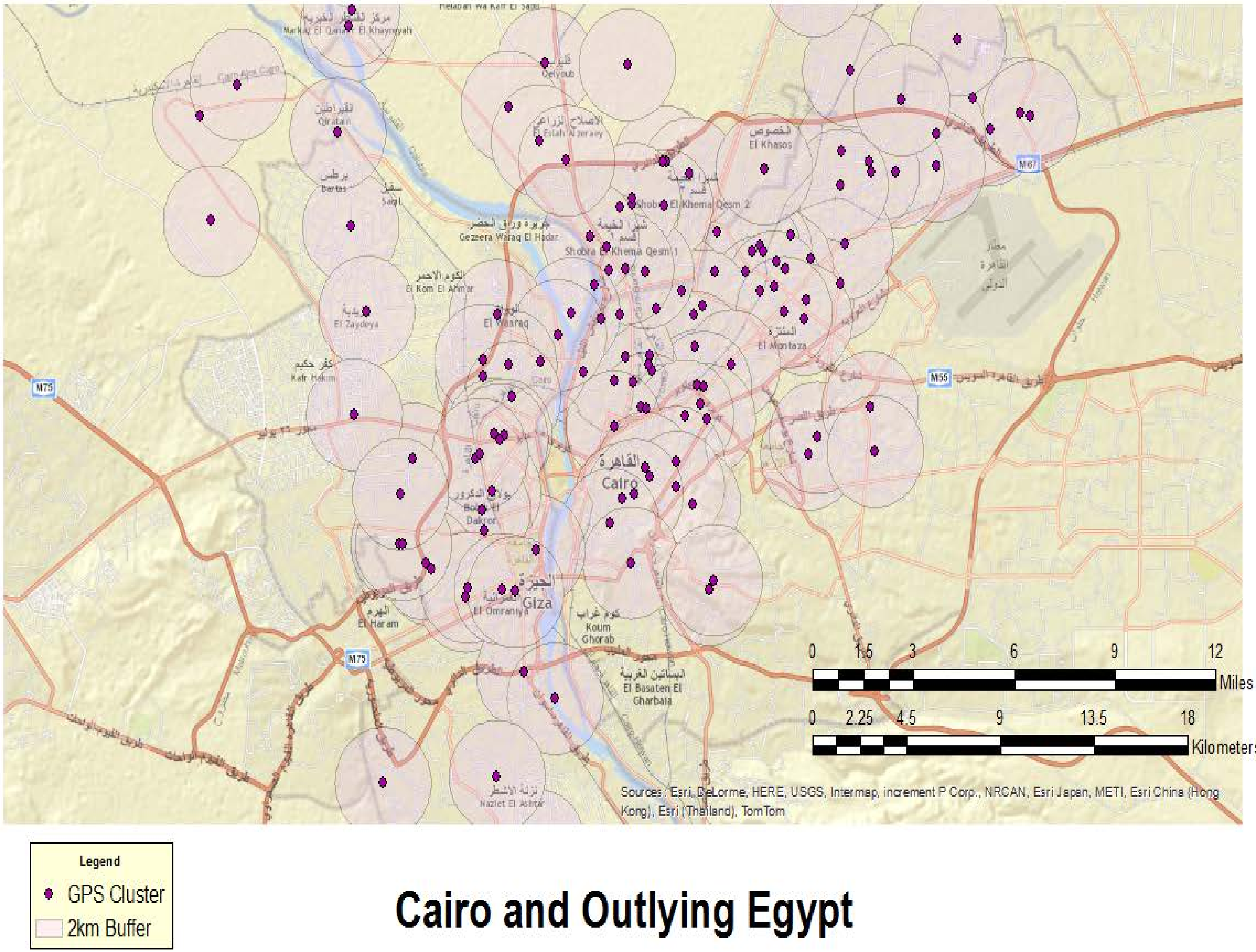
Density map, superimposed on the actual map of Shanghai



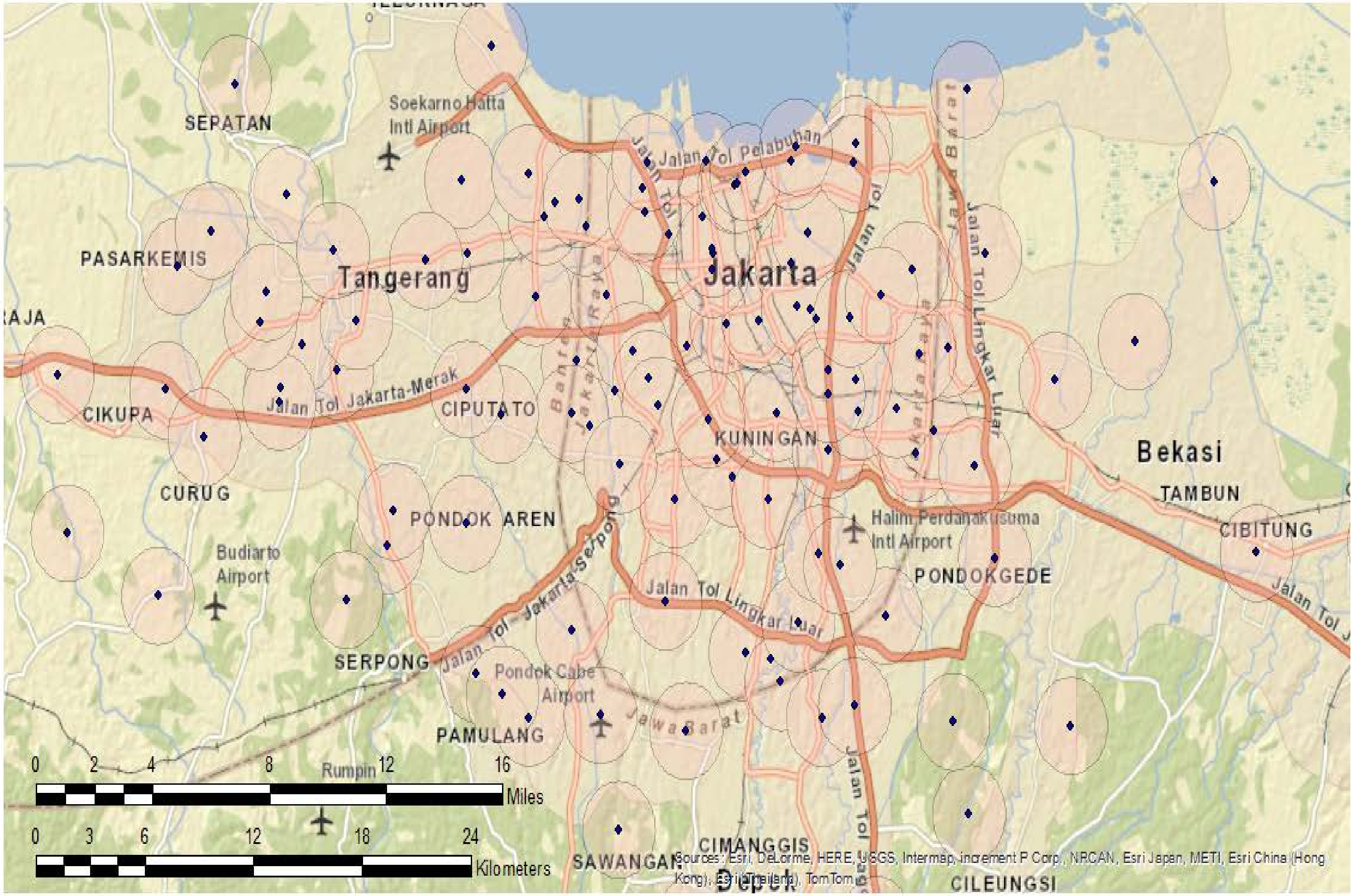
Applying the UHI to other areas

It turns out that a rich source of health and sociodemographic data is the set of USAID Demographic Health Surveys.

These also use a cluster sampling technique, and several megacities have sufficient numbers of clusters to permit calculation of the UHI with a wide variety of variables.



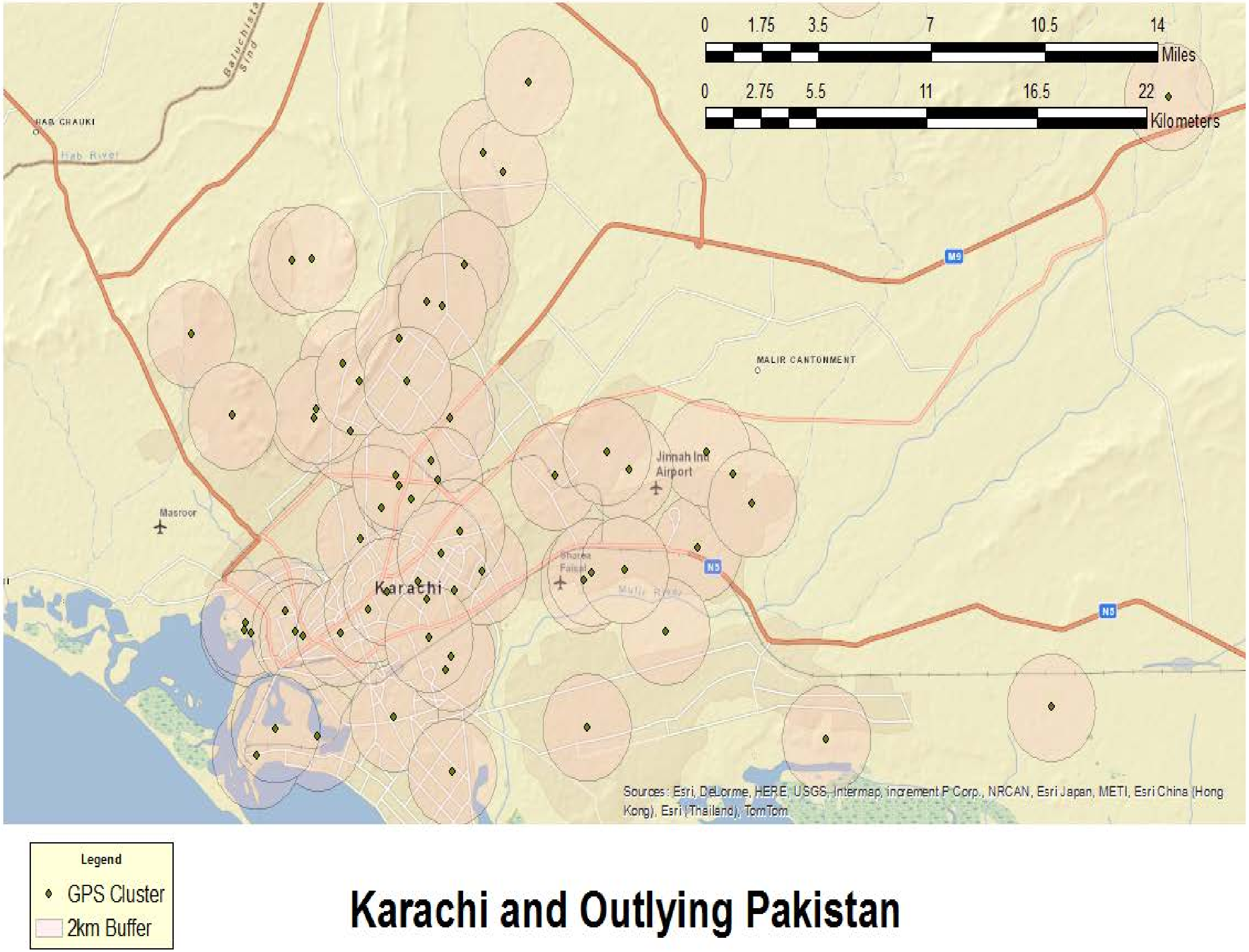
Cairo and Outlying Egypt



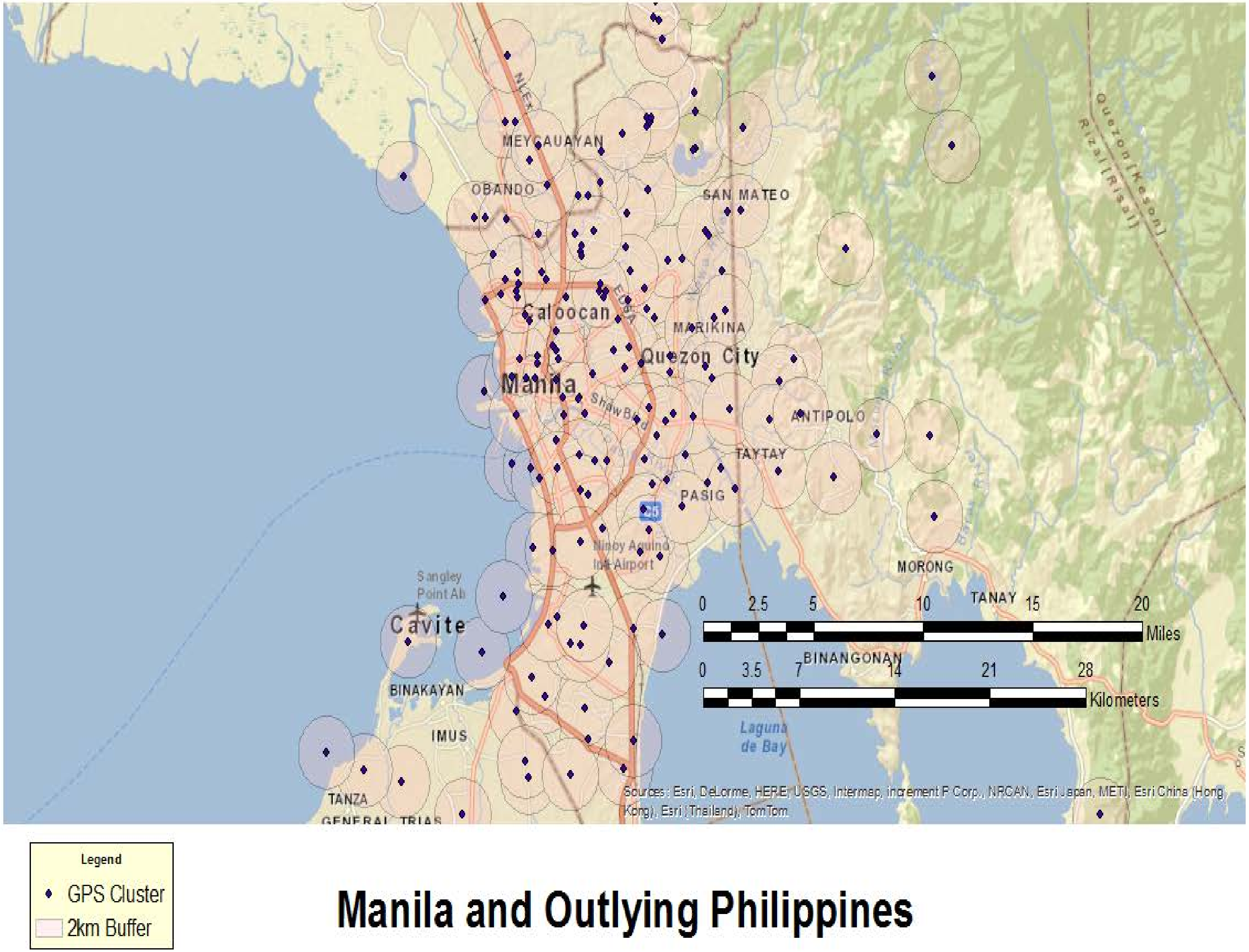
Legend

- GPS Cluster
- 2km Buffer

Jakarta and Outlying Indonesia

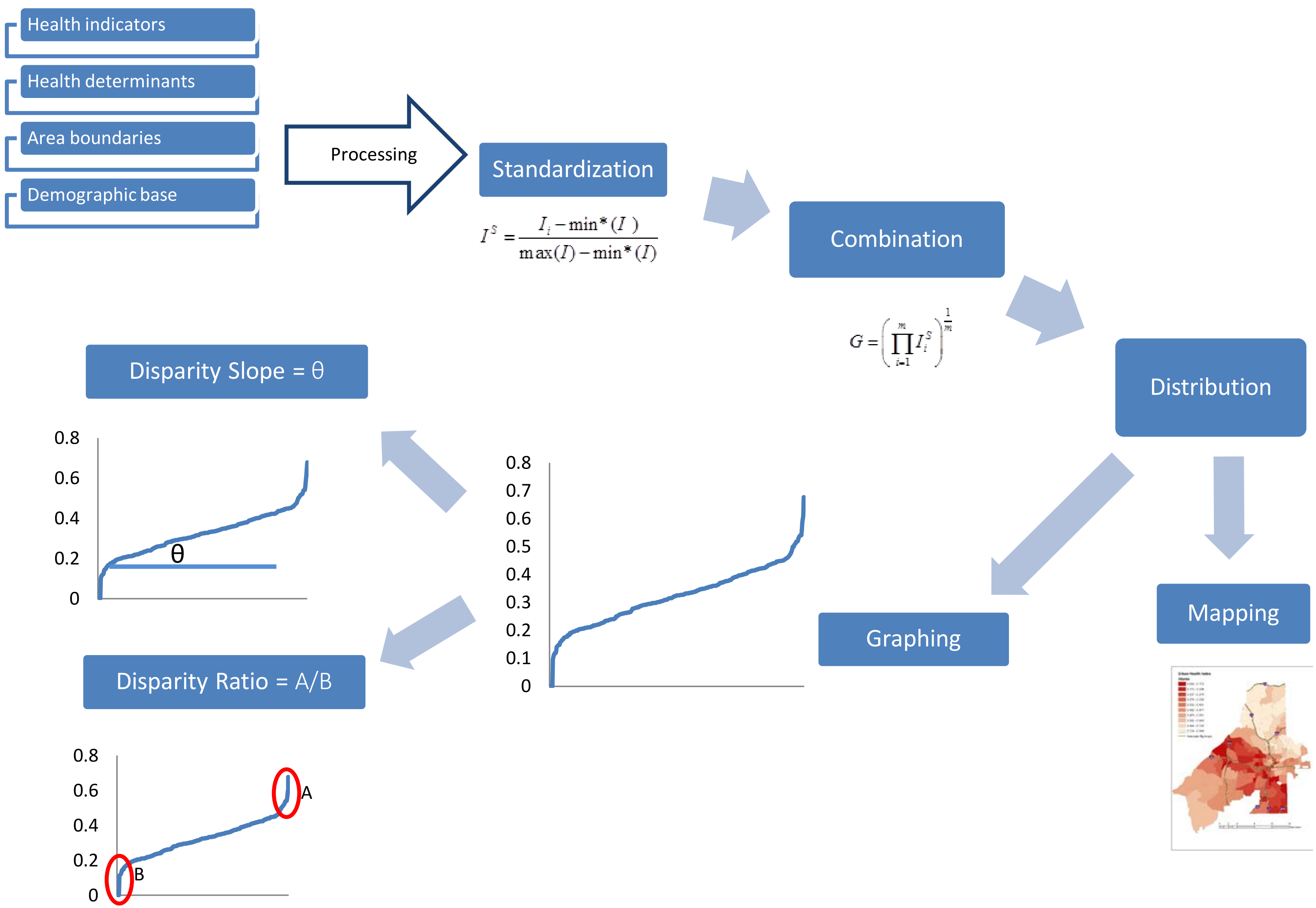


Karachi and Outlying Pakistan



Manila and Outlying Philippines

Flow Diagram for construction of an Urban Health Index



Potential applications

Identifying heat islands and persons at greatest risk for heat injury

Neighborhood approaches to reducing urban disaster risk

Application of mHealth tools

Linking neighborhoods with deteriorating built environment to health effects

Linking health effects to toxic waste

Demonstrating a mismatch between health needs and health services

Displaying overlapping disparities (syndemics)

To evaluate the hypotheses we are exploring, we examined four areas:

1. Adjusting the minimum value
2. Multiple correlation of Indicators
3. The effect of weighting schemes
4. Sensitivity to alteration of Indicators

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1. Adjusting the minimum value
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3. The effect of weighting schemes
4. Sensitivity to alteration of Indicators

If we change the value of "min" in the formula for standardization from the smallest value (UHI1) to zero (UHI0)

$$I^s = \frac{I - \min^*(I)}{\max(I) - \min^*(I)}$$

Atlanta

	Mean	Std Dev	Minimum	P10	Median	P90	Maximum
UHI1	0.43	0.21	0.00	0.17	0.39	0.72	0.95
UHI0	0.49	0.18	0.13	0.27	0.45	0.74	0.96

$$\hat{\rho}_{\mathrm{UHI1,UHI0}} = .996$$

Japan

	Mean	Std Dev	Minimum	P10	Median	P90	Maximum
UHI1	0.31	0.06	0.04	0.24	0.31	0.38	0.60
UHI0	0.41	0.05	0.23	0.36	0.41	0.47	0.68

$$\hat{\rho}_{\mathrm{UHI1,UHI0}} = .993$$

Tokyo

	Mean	Std Dev	Minimum	P10	Median	P90	Maximum
UHI1	0.23	0.10	0.03	0.11	0.21	0.37	0.41

To evaluate the hypotheses we are exploring, we examined four areas:

1. Adjusting the minimum value
2. Multiple correlation of Indicators
3. The effect of weighting schemes
4. Sensitivity to alteration of Indicators

Atlanta: Correlation of UHI Indicators

	% Employed	% Above Poverty	% Non-Single Female headed household	% Graduates or higher	% Bachelors or higher	Household Median Income
% Above Poverty	0.58					
% Non-Single Female Headed Household	0.58	0.83				
% HS Graduates or higher	0.54	0.75	0.61			
% Bachelors or higher	0.70	0.74	0.71	0.83		
Household Median Income	0.55	0.67	0.59	0.68	0.81	
Household Mean Income	0.57	0.66	0.58	0.67	0.81	0.96

Pearson’s correlation coefficients (r). All correlations are statistically significant at $p < .001$.

Atlanta: Multivariate overlap among Indicators

Dependent Variable	% Variance Explained
% Employed	51.5
% Above poverty	81.9
% Non-single female headed households	72.5
Household median income	93.3
Household mean income	94.1
% High School graduate or higher	74.5
% with Bachelor's or higher degree	86.7

Calculated by using OLS multiple regression with each indicator as the dependent variable and the remaining indicators as the independent variable

Japan: Correlation of UHI Outcomes

	SMR - Overall (Male)	SMR - Overall (Female)	SMR - Cancer (Male)	SMR - Cancer (Female)	SMR - Heart Disease (Male)	SMR - Heart Disease (Female)	SMR - Cerebrovascular Disease (Male)	SMR - Cerebrovascular Disease (Female)	SMR - Pneumonia (Male)
SMR - Overall (Female)	0.57								
SMR - Cancer (Male)	0.68	0.34							
SMR - Cancer (Female)	0.28	0.47	0.44						
SMR - Heart Disease (Male)	0.55	0.38	0.24	0.13					
SMR - Heart Disease (Female)	0.34	0.60	0.20	0.17	0.53				
SMR - Cerebrovascular Disease (Male)	0.51	0.37	0.11	0.02	0.24	0.18			
SMR - Cerebrovascular Disease (Female)	0.30	0.56	0.03	0.04	0.23	0.25	0.61		
SMR - Pneumonia (Male)	0.47	0.32	0.24	0.13	0.19	0.20	0.12	0.07	
SMR - Pneumonia (Female)	0.28	0.47	0.19	0.21	0.15	0.24	0.08	0.11	0.58

Japan: Multivariate overlap among Outcomes

Dependent Variable	% Variance Explained
SMR - Overall (Male)	85.6
SMR - Overall (Female)	67.1
SMR - Cancer (Male)	56.4
SMR - Cancer (Female)	62.6
SMR - Heart Disease (Male)	51.7
SMR - Heart Disease (Female)	82.5
SMR - Cerebrovascular Disease (Male)	48.9
SMR - Cerebrovascular Disease (Female)	59.1
SMR - Pneumonia (Male)	63.6
SMR - Pneumonia (Female)	50.1

Calculated by using OLS multiple regression with each indicator as the dependent variable and the remaining indicators as the independent variable

Tokyo: Correlations of UHI Indicators

	SMR - Overall (Male)	SMR - Overall (Female)	SMR - Cancer (Male)	SMR - Cancer (Female)	SMR - Heart Disease (Male)	SMR - Heart Disease (Female)	SMR - Cerebrovascular Disease (Male)	SMR - Cerebrovascular Disease (Female)	SMR - Pneumonia (Male)
SMR - Overall (Female)	0.74								
SMR - Cancer (Male)	0.46	0.13							
SMR - Cancer (Female)	-0.08	-0.10	0.43						
SMR - Heart Disease (Male)	0.84	0.74	0.37	0.05					
SMR - Heart Disease (Female)	0.63	0.83	0.02	-0.12	0.74				
SMR - Cerebrovascular Disease (Male)	0.84	0.85	-0.03	-0.30	0.69	0.69			
SMR - Cerebrovascular Disease (Female)	0.73	0.85	0.02	-0.15	0.66	0.79	0.88		
SMR - Pneumonia (Male)	0.57	0.77	-0.13	-0.19	0.43	0.69	0.66	0.62	
SMR - Pneumonia (Female)	0.38	0.68	-0.26	-0.29	0.24	0.56	0.55	0.48	0.87

Tokyo: Multivariate Overlap among Outcomes

Dependent Variable	% Variance Explained
SMR - Overall (Male)	97.6
SMR - Overall (Female)	95.0
SMR - Cancer (Male)	85.8
SMR - Cancer (Female)	63.1
SMR - Heart Disease (Male)	86.7
SMR - Heart Disease (Female)	87.1
SMR - Cerebrovascular Disease (Male)	96.8
SMR - Cerebrovascular Disease (Female)	89.9
SMR - Pneumonia (Male)	88.1
SMR - Pneumonia (Female)	88.7

Calculated by using OLS multiple regression with each indicator as the dependent variable and the remaining indicators as the independent variable

To evaluate the hypotheses we are exploring, we examined four areas:

1. Adjusting the minimum value
2. Multiple correlation of Indicators
3. The effect of weighting schemes
4. Sensitivity to alteration of Indicators

Motivation

- Local officials may deem some indicators to be more or less important than other indicators and weight them accordingly

- Weights may be determined empirically or by human judgment

- The effect of using weighting the indicators on the UHI, rank ordering, and health disparities indices were investigated.
  - To what extent does choice of weights affect the UHI and its derivatives?
  - To what extent are comparisons across different weighting schemes possible?

- As there would be no universally agreed upon set of weights, this investigation simulated various weighting schemes

Weighting: Approach

- 1,000 sets of 7 indicators weights were simulated
  - Each weight, *v*, independent drawn from a standard uniform distribution U[0,1] using SAS (seed value = 42)
  - Each set of weights were rescaled to sum to the number of indicators *n* (i.e., 7)

$$w_i = \left(v_i \Big/ \sum_{i=1}^{n} v_i \right) \times n$$

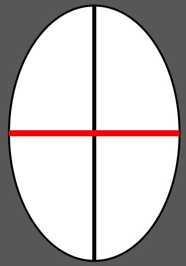
- A weighted geometric mean of the standardized indicators was computed for each set of weights for all 128 census tracts

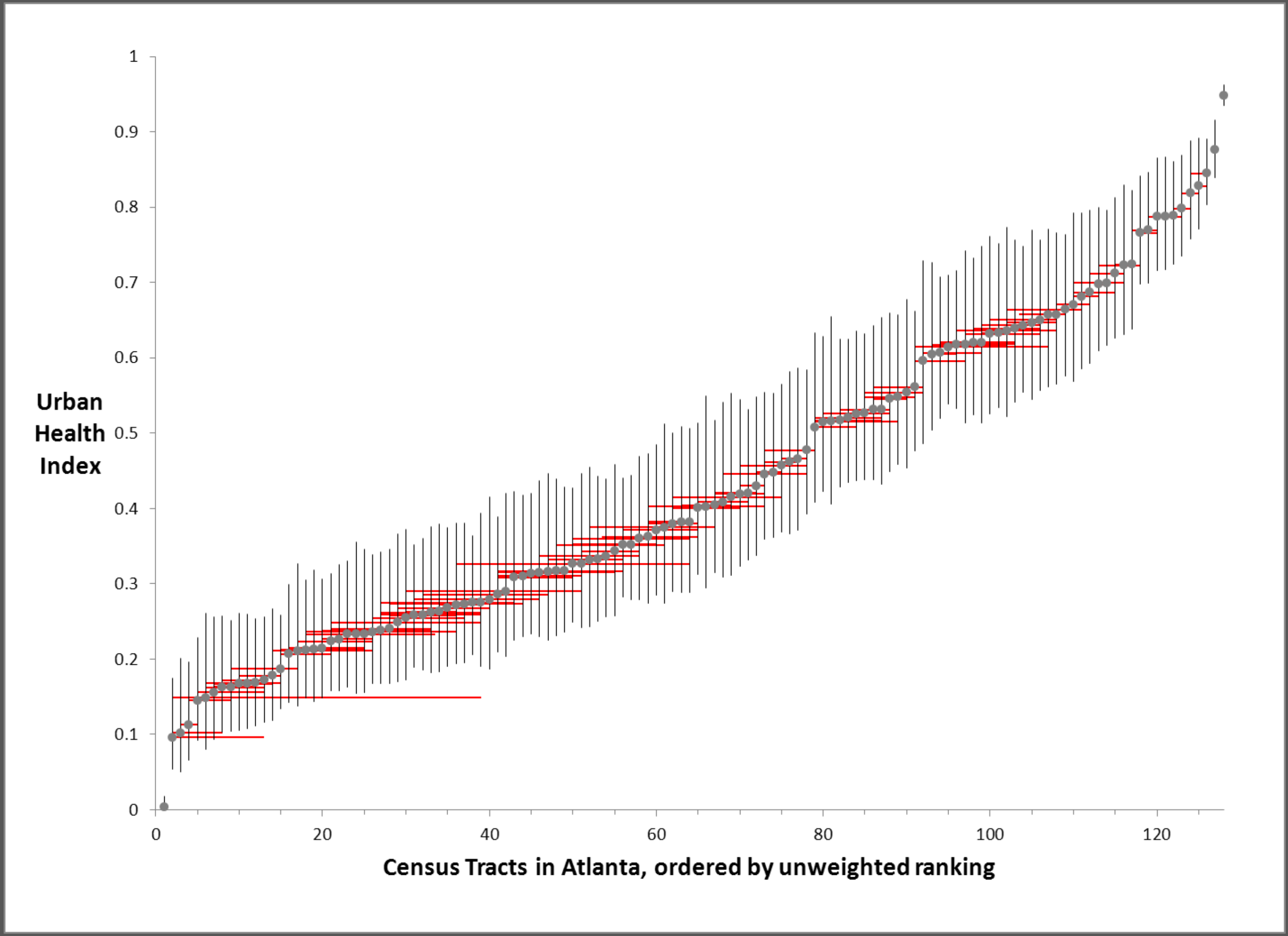
$$UHI' = \left(\prod_{i=1}^{n} {}_S I_i^{w_i} \right)^{1 \Big/ \sum_{i=1}^{n} w_i}$$

- Variability in UHI, ranks, and health disparities indices across weights were examined with summary statistics and graphics

Results of weighting scheme:

The UHI for each unit, showing the 10th to 90th percentile and the range of its rankings



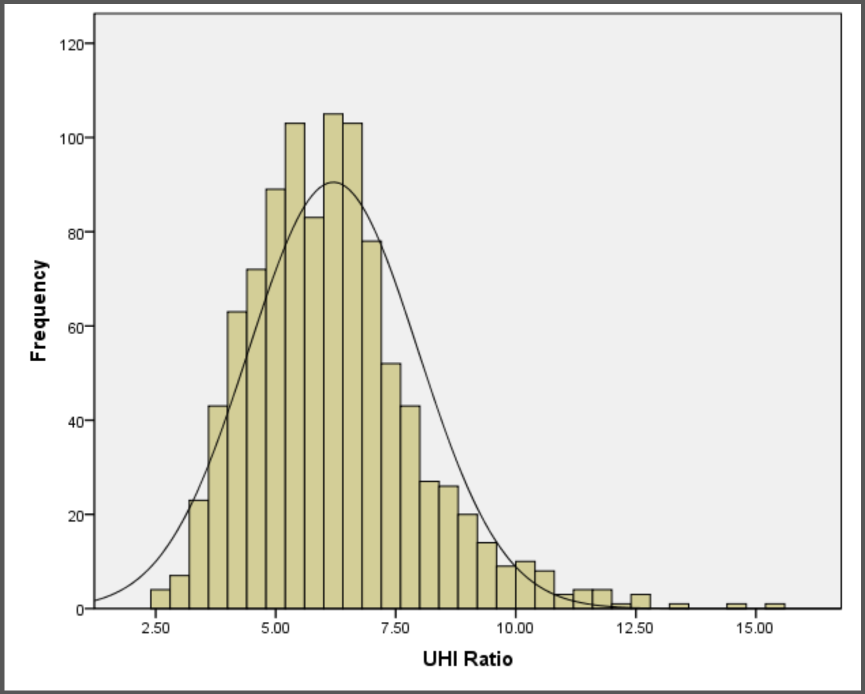


Distribution of simulated Health Disparity RATIOS (Atlanta data)

Unweighted UHI HD Ratio: 5.92

Weighted UHI—simulated distribution:

Mean	Median	Std Dev	Minimum	Maximum	Range	10th Pctl	90th Pctl
6.20	6.04	1.76	2.61	15.55	12.94	4.17	8.45

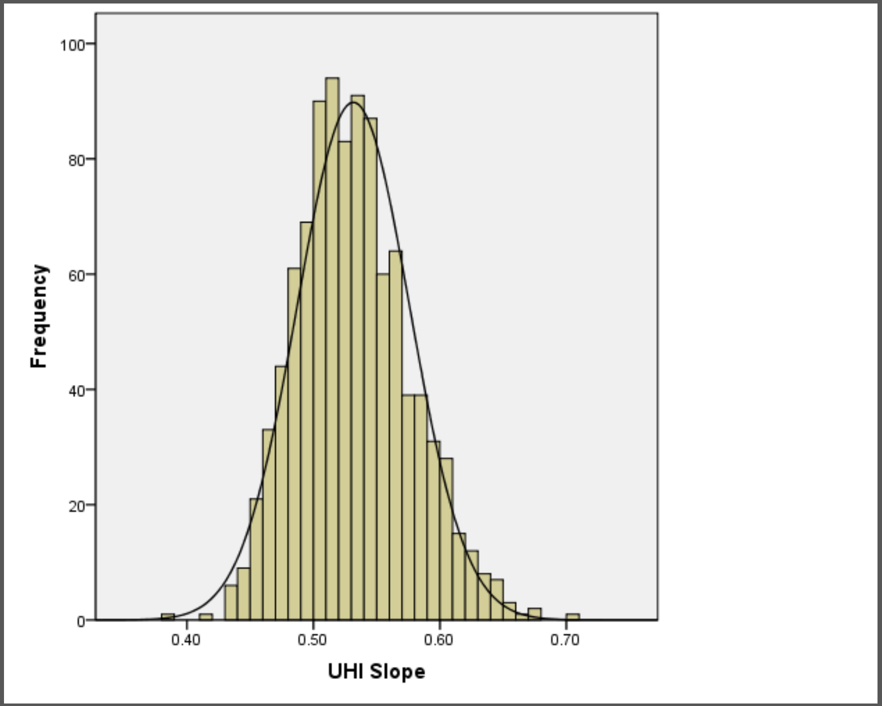


Distribution of simulated Health Disparity SLOPES (Atlanta data)

Unweighted UHI HD Ratio: 0.54

Weighted UHI—simulated distribution:

Mean	Median	Std Dev	Minimum	Maximum	Range	10th Pctl	90th Pctl
0.53	0.53	0.04	0.39	0.71	0.32	0.48	0.59



To evaluate the hypotheses we are exploring, we examined four areas:

1. Adjusting the minimum value
2. Multiple correlation of Indicators
3. The effect of weighting schemes
4. Sensitivity to alteration of Indicators

Motivation

To what extent do the actual indicators matter, given that there appears to be such high correlation among indicators and outcomes?

The fact that data availability will be a major impediment, and the indicators for one area are likely to be different from those of another, interchangeability would be an asset.

Approach

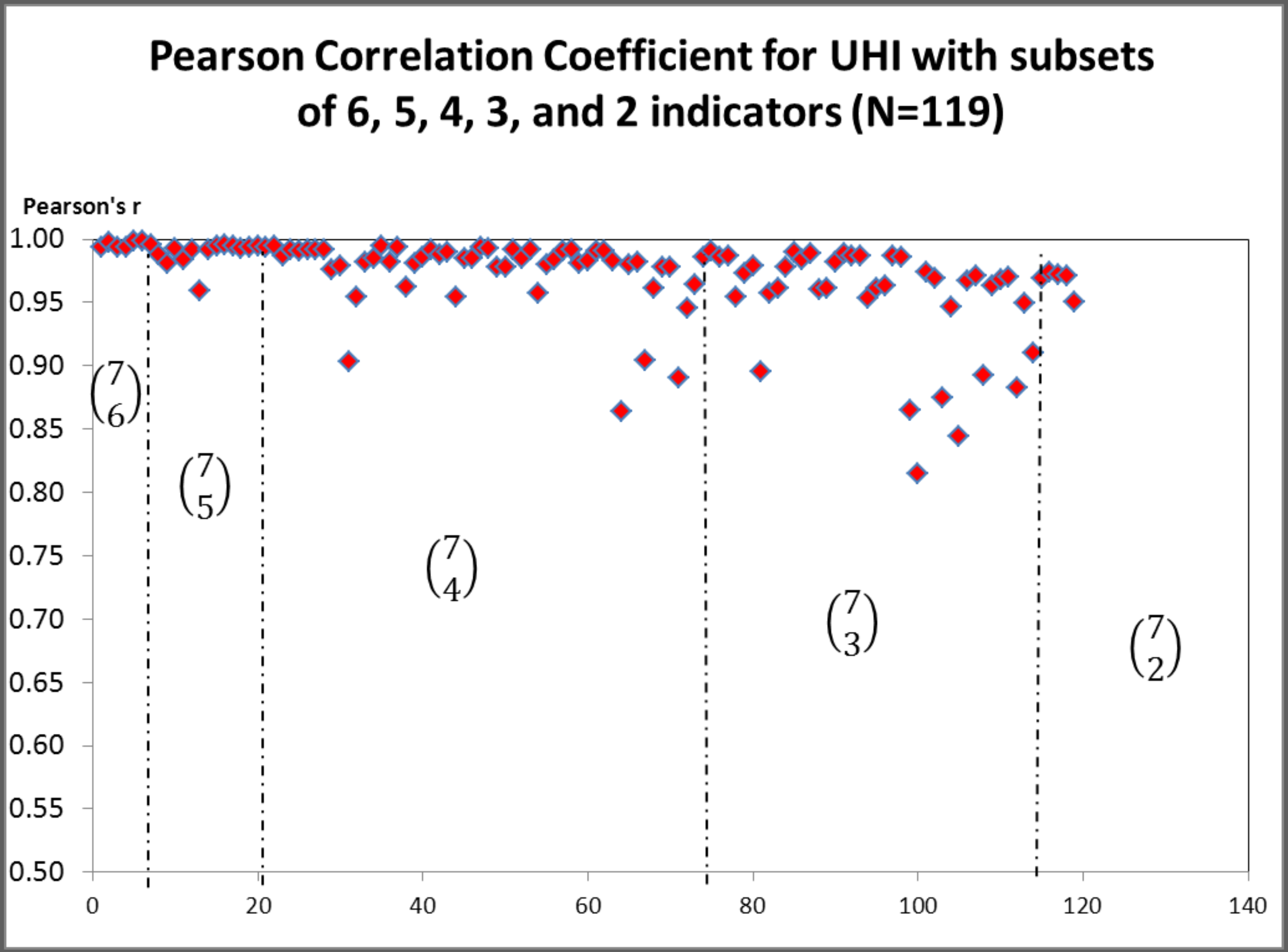
Using Atlanta data (7 indicators), we systematically calculated the UHI and its rank for each of the 127 census tracts, taking all possible groupings of 7 indicators:

7 taken 6 at a time
7 taken 5 at a time
7 taken 4 at a time
7 taken 3 at a time
7 taken 2 at a time

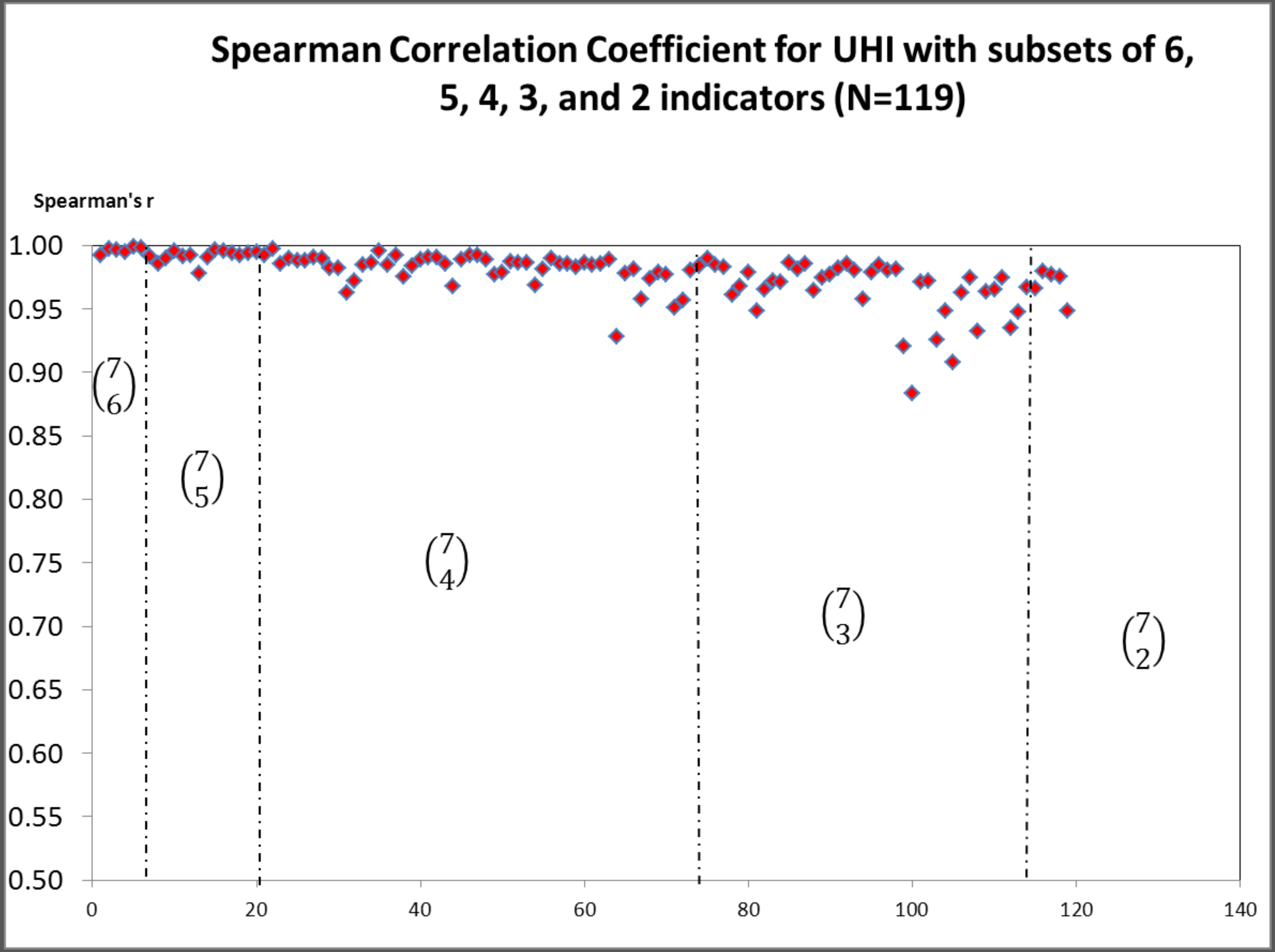
for a total of 119 estimates of the UHI and its rank for each census tract.

We calculated the correlation coefficients of these UHIs with the original UHI7 (Pearson's r) and correlation coefficient for their ranks (Spearman's r)

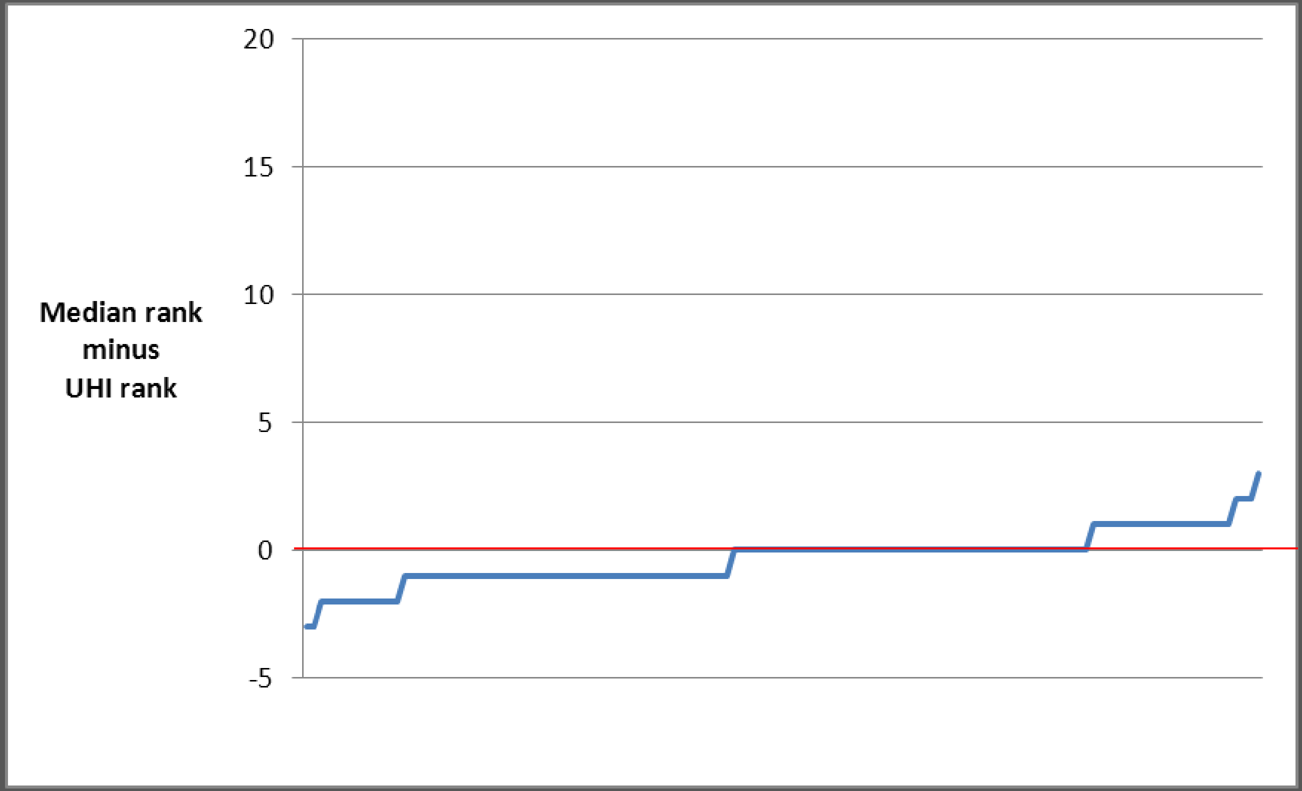
The correlation of UHI values is very high (> 0.9), with some deterioration as the number of indicators gets smaller.



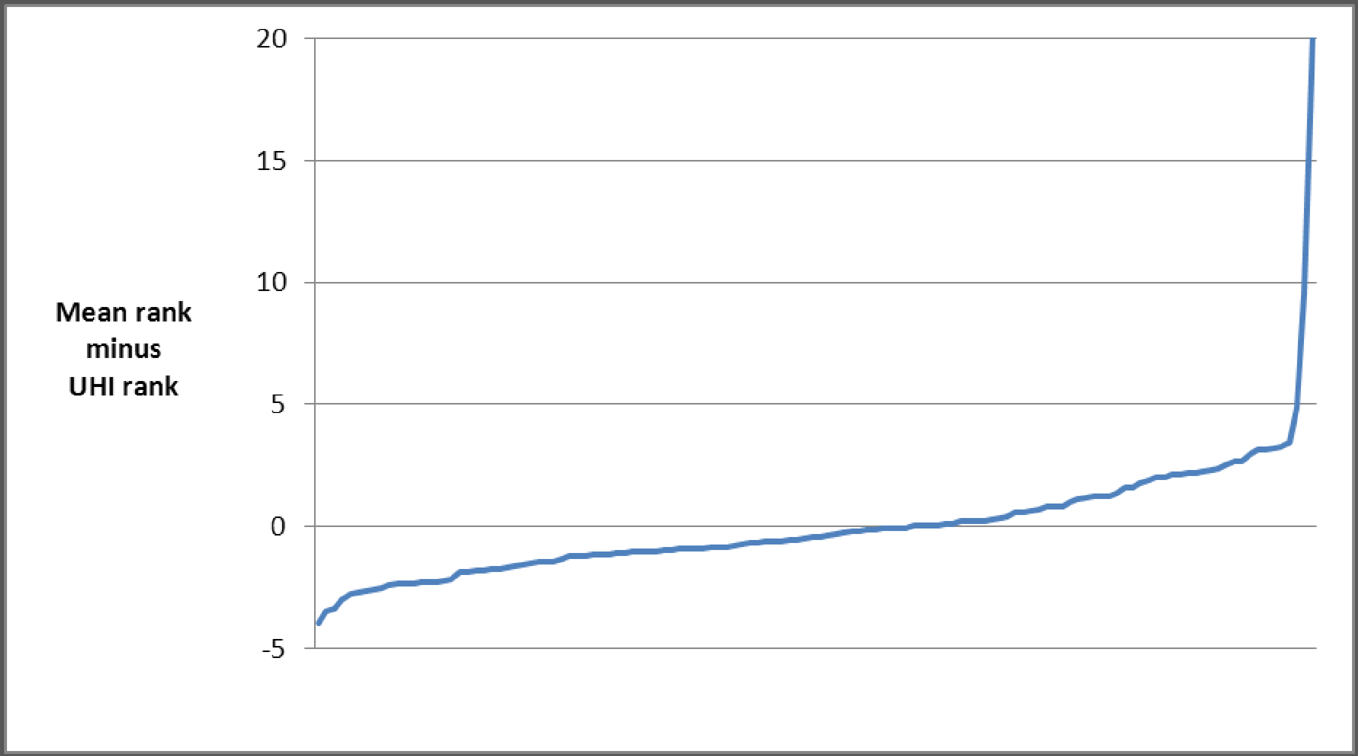
The correlation of UHI ranks is even higher, but with the same deterioration for smaller numbers of indicators.



Difference between the median rank for the simulated UHIs and the rank for the UHI7

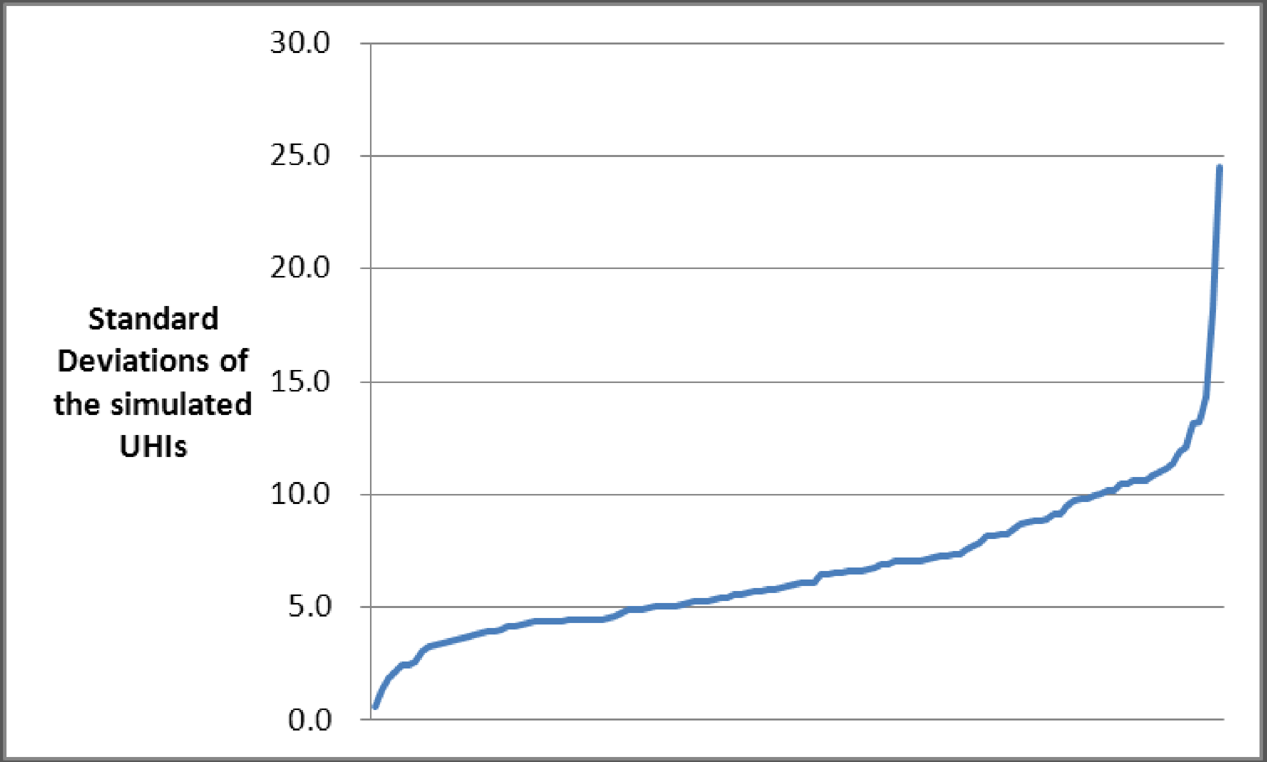


Difference between the mean rank for the simulated UHIs and the rank for the UHI7



When ordered by difference of means, a small group of simulated results vary markedly from the original UHI.

This result is mirrored in a plot of the simulated standard deviations.



A small group of simulation results exhibit considerable variation.
Approximately 20% of small area unit will move out of the top or bottom 10% as a result of altering the indicators used.

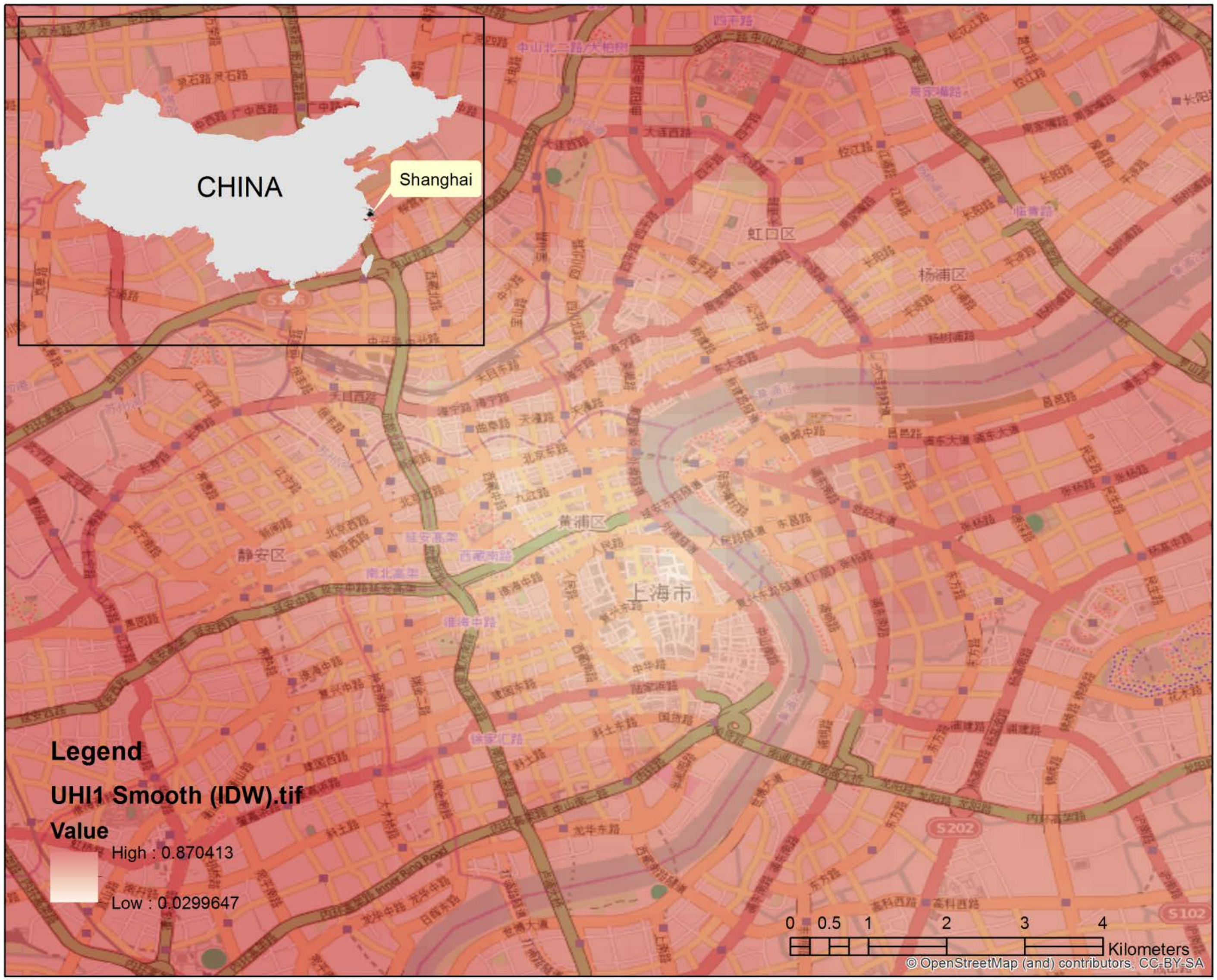
Some tentative conclusions

- The UHI, as constructed, is a flexible tool for constructing small area evaluations of health and health disparities.
- There is initial empirical evidence that the number of indicators, the type of indicators, and weighting schemes may not play as great a role as is usually assumed in recognizing and visualizing disparities.
- This approach may be more useful within an area that for comparing areas.
- Data availability will undoubtedly be the Achilles’ heel.

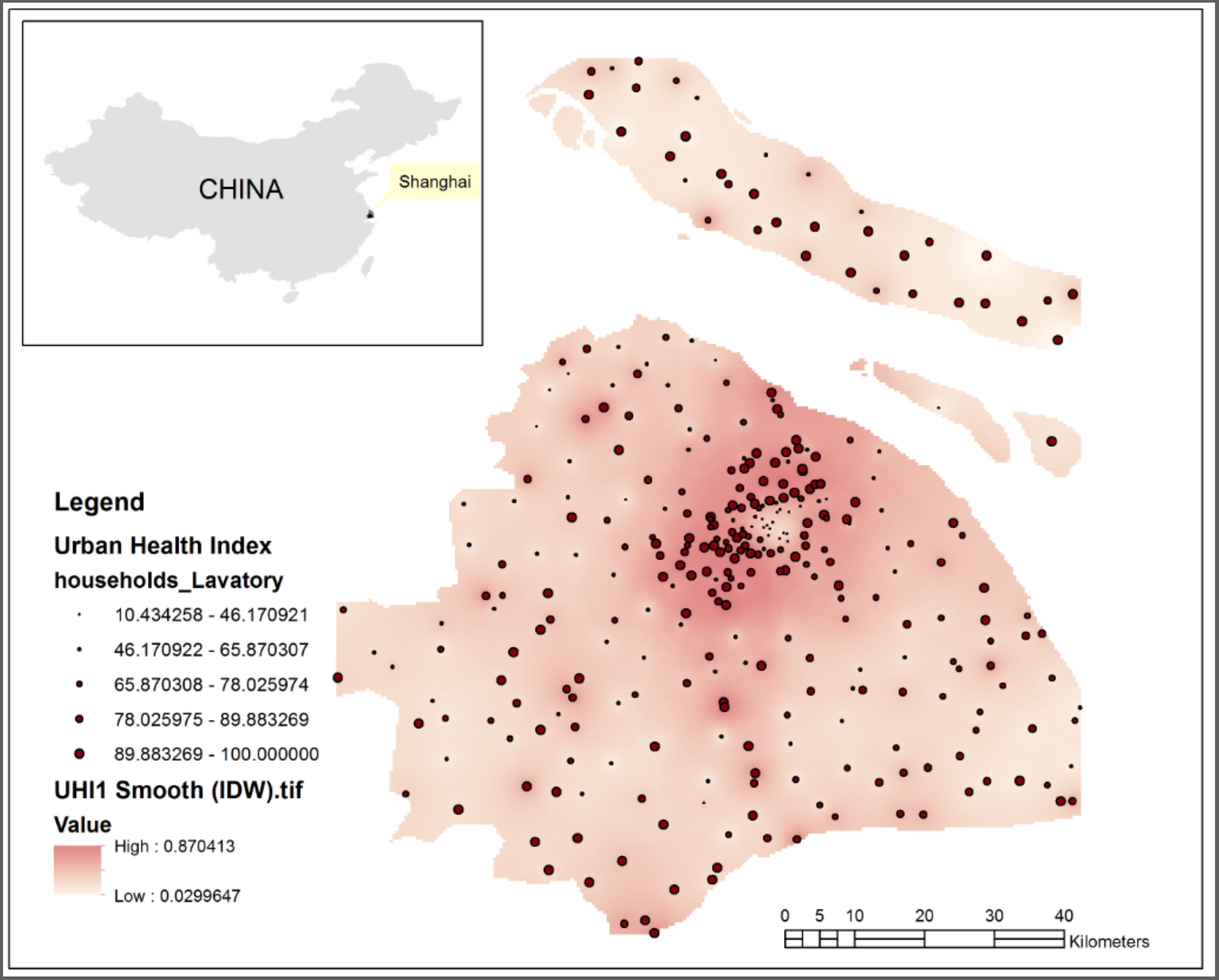
To be done

- See if this approach holds up with other areas and data sets
- Continue to explore the interchangeability and potential for substitution (an empirical question, probably never subject to definitive "proof").
- Expand the geographic utility of such measures and use the Index in conjunction with other geographic and environmental data.
- Explore how this approach can be used as an adjunct to other major efforts, such as Urban HEART, to assess and alter urban health disparities.

Downtown Shanghai



lavatory


CHINA
Shanghai
Legend
Urban Health Index
households_Lavatory
10.434258 - 46.170921
46.170922 - 65.870307
65.870308 - 78.025974
78.025975 - 89.883269
89.883269 - 100.000000
UHI1 Smooth (IDW).tif
Value
High : 0.870413
Low : 0.0299647
0 5 10 20 30 40
Kilometers