Obesity and Environment in Indianapolis: An Analysis of Neighborhood Indicators

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Introduction

Obesity is presently one of the most serious and challenging health problems facing the developed world. According to the World Health Organization, 55 percent of U.S. adults are overweight with minority women being the most affected. The prevalence of overweight in U.S. children, estimated between 22 and 30 percent, has doubled since 1980.[1, 2-4] The alarmingly high rate of obesity and its rapid rise are present here in Indiana. In the year 2000, 21 percent of adults in Indiana were considered obese and 35 percent were considered overweight.[5] These figures rank Indiana as the twelfth fattest state in the nation.

What is causing the dramatic and threatening rise in obesity among the population? One researcher concisely captured the causes of obesity in a metaphor: "Genes load the gun, the environment pulls the trigger."[6] Genetic factors are important, but it is highly improbable that changes in genetic factors explain the rapid increases in obesity prevalence over the past two decades.[7] Rather, there is increasing evidence that the obesity epidemic is rooted in environmental factors that promote excessive caloric intake and sedentary lifestyle.[8-10] There also is evidence that these environmental factors are worsening, so that the already high rate of obesity is expected to climb.[11]

Children's lifestyles are becoming strikingly sedentary as well. Studies have found that the amount of television viewing is directly related to the likelihood of obesity. Children watch an average of 28 hours of television per week.[9] In 1977, children aged 5 to 15 years walked or biked for 15.8 percent of all their trips; by 1995, children made only 9.9 percent of their trips by foot or bicycle.[12]

The Central Indiana Project

What does this mean for Central Indiana? This is one of the questions facing a team of researchers from Indiana Children's Health Services Research (ICHSR; www.ichsr.org), a division of the Indiana University School of Medicine's Department of Pediatrics. The team formed a partnership with The Polis Center to use the SAVI Community Information System to examine how environmental factors are associated with physical activity, dietary behaviors, and ultimately weight and height in children. The partnership received funding from the Urban Institute and the National Institutes of Health to determine:

1. What are the trends in childhood overweight in Marion County, IN?

2. Is obesity is more prevalent in settings where the physical environment lacks infrastructure, such as sidewalks and public recreational facilities, that provides opportunities for physical activity?

3. Is obesity more prevalent where the social and built environment does not support routine exercise (i.e., high crime rates, less organized exercise opportunities, etc)?

4. Is obesity is more prevalent in settings where the built environment promotes over-consumption of energy-dense food products through greater exposure to fast-food restaurants, and lower accessibility to fresh fruits and vegetables?

The team identified both individual-level and community-level variables to examine as potential factors for significant association with BMI, or body mass index, a standard measure for obesity using height and weight measurements. In children, BMI percentiles have been developed that take into account typical patterns of human growth. The community-based variables were linked to individuals by the corresponding census tract in which the study subjects resided. All individual patient data will remain confidential.

Using SAVI to Study Obesity

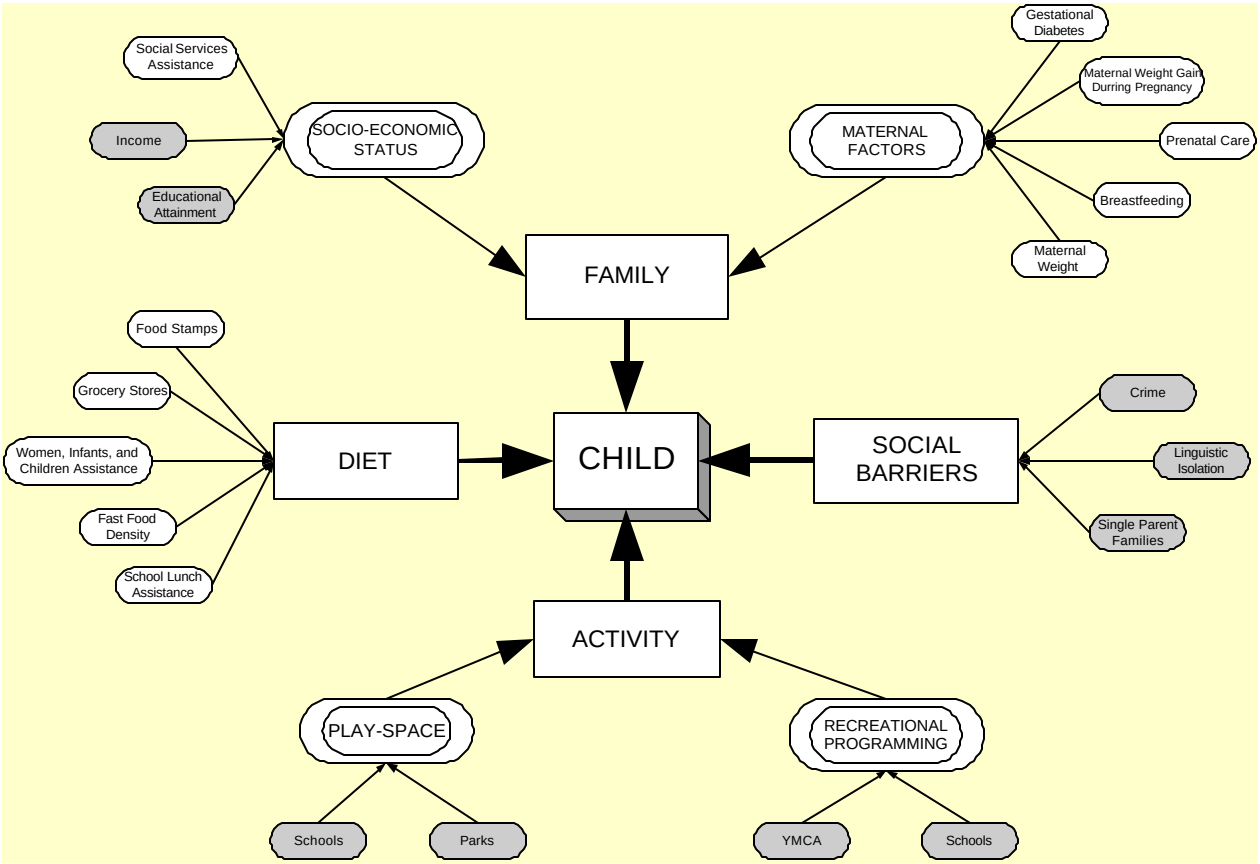
SAVI is an important part of this study. It contains a vast quantity of health-relevant environmental data as well as support staff skilled in data management and spatial analysis.

SAVI data allow researchers to conduct an ongoing analysis of the roles of patient characteristics (e.g., age, gender, and race) and neighborhood socioeconomic characteristics (e.g., educational attainment, single parenting, median income, and crime) in the development of obesity. The study population is drawn from children receiving health maintenance in six urban primary care clinics in Marion County. SAVI mapped the locations of the patients using their home address and to obtain data describing socioeconomic characteristics of the neighborhoods in which these patients live.

Data

Figure 1 shows a conceptual model that categorizes potential risk factors for obesity. This report investigates community-based variables in three of the major categories in the model: neighborhood socioeconomic status, physical activity opportunities, and social barriers to exercise. All of the community variables were obtained from SAVI.

Figure 1: Conceptual Model of Environmental and Social Factors Predicting Childhood Obesity. Bubbles Containing Factors Included in this Analysis are Shaded.



The following data were included for all patients for years 1996-2000.

Individual (Patient)-level Indicators
Age (4-18years)
Race (Caucasian, African American, Latino, Other)
Gender (Male, Female)
Body Mass Index (BMI)

The following data were included for year 2000 by census tract and block group. See the Appendix for a detailed description of the data items.

Socioeconomic Indicators
Percent of population age 25 and older without a high school degree
Median household income
Median family income (categorized: extremely low, very low, low, moderate, middle and upper)

Physical Activity Opportunity Indicators
Distance to nearest YMCA
Distance to nearest city park
Distance to nearest greenway
Distance to nearest after-school program with physical education curricular components
Barriers to exercise indicators
Percent of families that are single-parent families
Percent of households that are linguistically isolated
Violent crime rate (per square mile)

Understanding the Data

The team first looked at descriptive statistics (e.g., average, standard deviation, etc.) to ensure the data are representative of the general patient population by age, race, and gender. It conducted various statistical analyses:

1. Bivariate analysis to test the relationship between two variables: using patient demographics such as race, age, and gender, as well as environmental variables of the patients' neighborhoods, defined as the census tract or block group in which they live.

2. Regression analysis to study the relationship between multiple variables: multivariate logistic regression analysis using only those variables with significant association in bivariate analyses.

Using the final model, the research team calculated the odds ratios for obesity across various segments of the population based on the variables in the model.

Findings

Obesity Rates:

- The number of census tracts where over 20 percent of the patients are obese increased between 1996 and 2000. (See Appendix, Maps 1-5).

Individual-level Factors:

- Females are more likely to be obese than males.
- Older children are more likely to be obese than younger children. (See Figure 1)

- Hispanics, as a race category, are most likely to be obese. (See Figures 2 and 3)
- African Americans are more likely to be obese than Caucasians.

Socioeconomic Factors:

- Children living in areas of lower income are more likely to be obese than other children. For each $10,000 increase in median household income, the odds of obesity decrease by 11 percent.
- Educational attainment in census tracts is not significantly predictive of childhood obesity.

Opportunities for Exercise:

- Proximity to the nearest play space (specifically parks, greenways, after-school programs, and YMCAs) is not significantly predictive of obesity.

Social Barriers:

- Both crime and single parenting are significantly associated with obesity in bivariate analyses. When median income was included in a multivariate model as a covariate, neither crime nor single parenting is significantly predictive of obesity.

Initial analysis of the results ruled out access to play space as an influence on childhood obesity. Based on an analysis of numerous variables, the team found evidence that certain children, such as older children, racial minority youth, and those living in areas of poverty, are at significantly increased risk for obesity (see Figures 2-4). The fact that minority youth seem at increased risk suggests that obesity prevention efforts should be targeted and may need to be tailored to such things as culture. The fact that impoverished areas increase obesity risk stands in sharp contrast to previous studies in the 1980s which found that children with higher socioeconomic status were at increased risk for obesity.

Figure 2: Patients by Weight and Age, Years 1996-2000

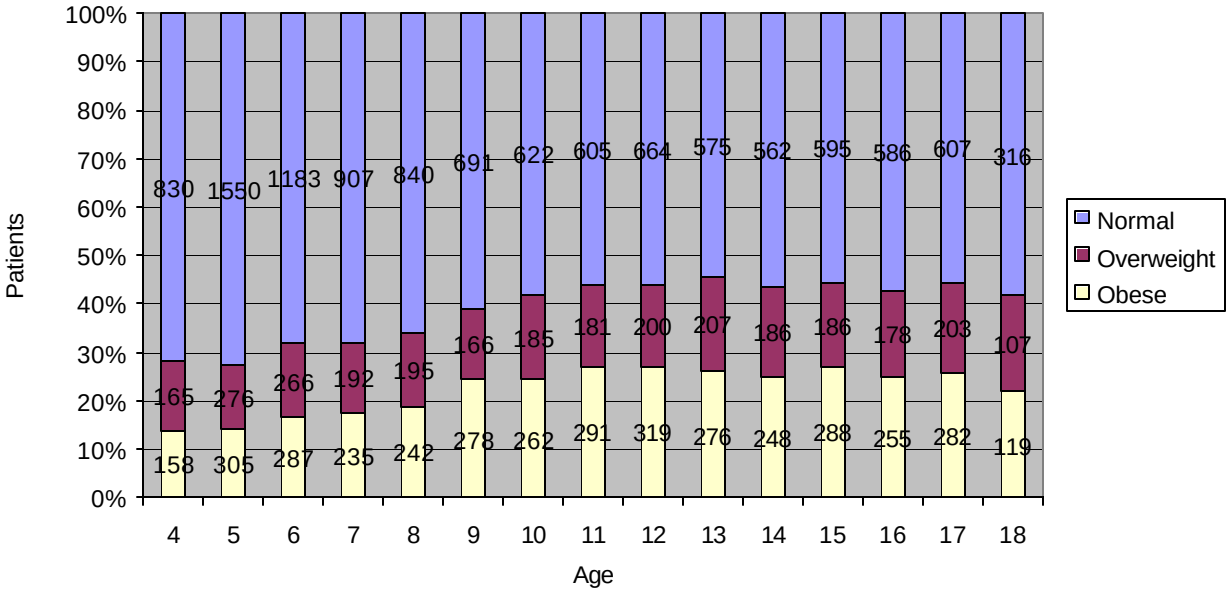


Figure 3: Male Patients by Weight and Race, Years 1996 - 2000

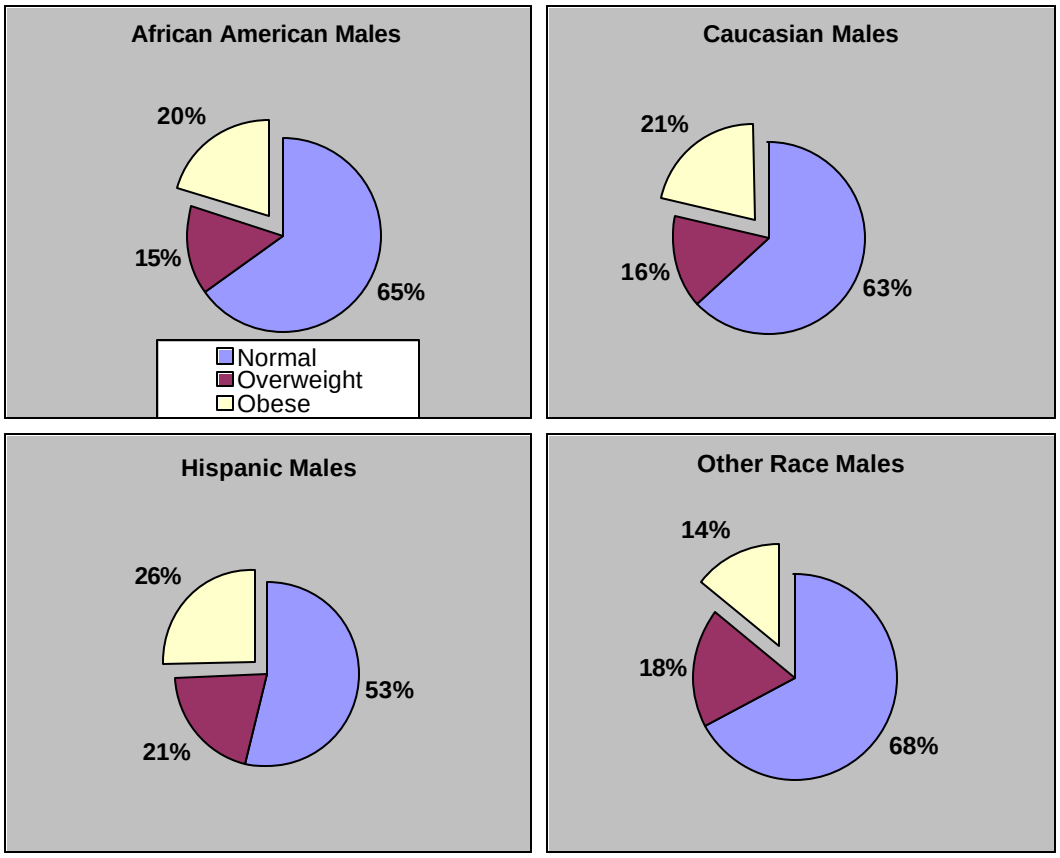
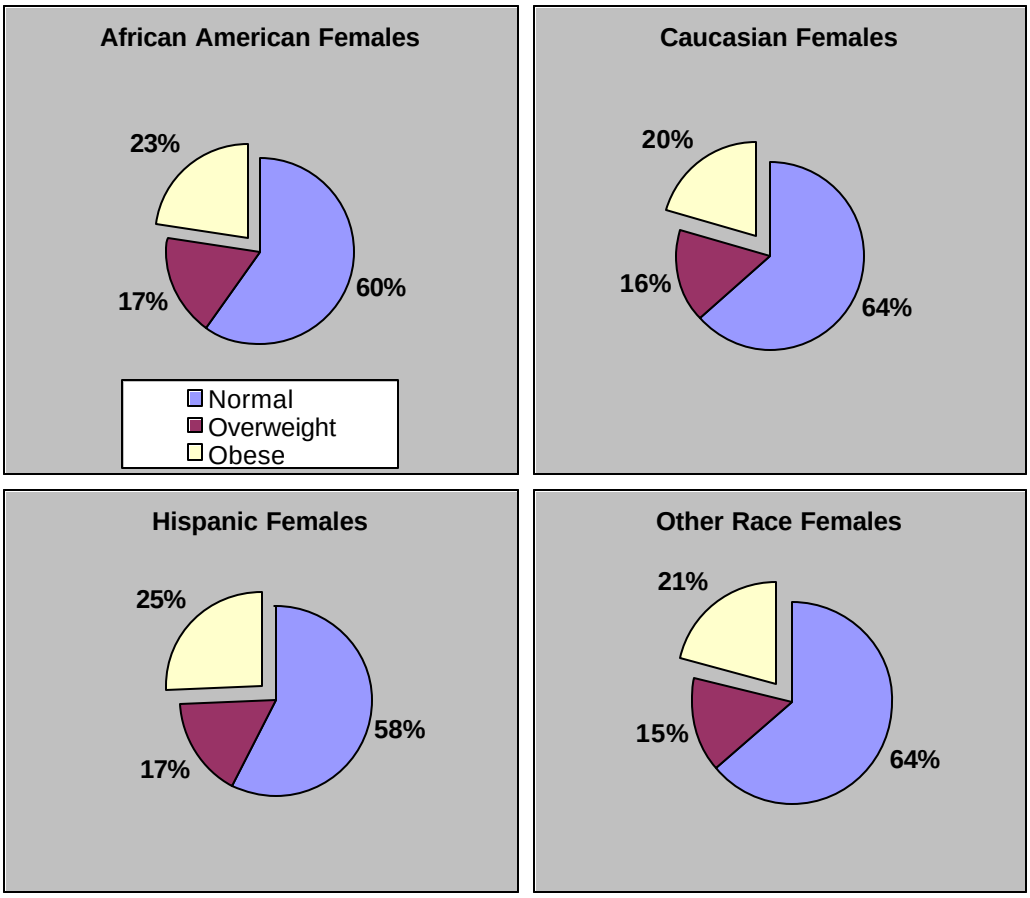


Figure 4: Female Patients by Weight and Race, Years 1996 - 2000



The odds of obesity (Table 1) relative to normal weight or overweight are highest for the Hispanic racial group (1.4 times higher for Hispanic males than for white males, 1.3 times higher for Hispanic females than for white males). The odds of obesity relative to normal or overweight are lowest for the males in the "Other" racial group (0.654 times lower for "Other" race males than for white males). As noted previously, an inverse relationship exists between census block Median Family Income and prevalence of obesity. However, those children residing in block groups that had "extremely low" income had a lower risk of obesity compared to children residing in the block groups with "very low" and "low" median family income.

Table 1: Point Estimates and 95 percent Confidence Intervals for Odds Ratios for Year 1996 - 2000 Study Cohort

Factor	Estimate	95% Confidence Interval
Extremely low income	1.441	(1.104, 1.881)
Very low income	1.550	(1.265, 1.898)
Low income	1.471	(1.212, 1.785)
Moderate income	1.345	(1.078, 1.677)
Middle income	1.335	(1.071, 1.664)
Upper income	1.000	Reference Group
Race and Gender		
White Male	1.000	Reference Group
White Female	0.931	(0.822, 1.055)
Hispanic Male	1.437	(1.114, 1.852)
Hispanic Female	1.374	(1.050, 1.799)
Black Male	0.955	(0.852, 1.070)
Black Female	1.059	(0.948, 1.184)
Others Male	0.654	(0.433, 0.987)
Others Female	1.097	(0.756, 1.592)

The work to date suggests that there are indeed spatial patterns associated with obesity. The team anticipates that further analysis will demonstrate that there are community influences on obesity that can be changed, thus leading to targeted intervention.

Some powerful products of this research effort are maps of study data and findings. One particularly compelling image is Map 6 (see Appendix), which shows distribution of the patient population by race. Another is a series of maps that shows the continual increase in the number of census tracts where more than 20 percent of the patients are obese (see Appendix Maps 1 – 5).

Implications for Policy and Programs

The overall goal of this project is to guide both public policy efforts in reducing rates of obesity as well as to guide intervention efforts focused at the community and broader systems level. The knowledge gained from this research effort will inform the design of future research:

1. Screening studies linking environmental characteristics, such as descriptions of the built environment (e.g., sidewalks, streets, buildings), with disease, such as obesity,

2. Interventional studies that modify physical environmental infrastructure, such as greenways and sidewalks, to promote healthy behavior such as routine physical activity and healthy diet, and

3. Social support programs in community settings that promote healthy behavior such as routine physical activity and healthy diet.

The study findings will contribute to the understanding of the status of childhood obesity, especially in Indianapolis. It also will provide guidance on specific neighborhoods and populations that should be considered for educational programs and local obesity initiatives from groups such as Strategic Thinking on Obesity formed by the Alliance for Health Promotion and the Indianapolis Health Foundation. By partnering with and informing these groups, the research provides a means to affect communities in insightful ways.

United Way of Central Indiana, a partner in the SAVI project, is interested in the implications of this analysis for local health initiatives. United Way will be pleased to share the results of this analysis with our community partners who are concerned about childhood obesity and are working collaboratively to develop an array of strategies to effectively address this serious community health problem.

Indianapolis has developed an extensive greenway system throughout the city with the goal of promoting physical activity and non-motorized travel. Indy Parks is involved in research monitoring the use of the trail system and has researched predictors of trail usage including demographics, weather, days of the week, and local events in the area. The department, among others, is interested in monitoring obesity around the trails. The findings of this study along with subsequent research efforts may be used to determine where to locate greenways and to establish baseline data for monitoring the impact of the greenways on obesity in the surrounding areas.

Conclusion

SAVI data can be used to address important public health issues and to suggest what the implications of the research are for human service agencies that work in this arena. The national funding that the team has received for researching childhood obesity not only validate the scientific merit of the research, but also add to the Central Indiana's economic development strategy of becoming a center of excellence for research in the life sciences. Finally, knowledge gained from this study will assist communities and neighborhoods to develop environments designed to optimize health for both children and adults who live in them.

Other related work that furthers the efforts of this study includes analysis of the following, among others, and their relation to obesity:

- Land use
- Neighborhood walkability
- Distance to food sources (grocery stores, fast food, etc.)
- Green space

The research team is working to disseminate the results to the medical community to further research in this and related fields. Other researchers will apply the methodology used in this study to analyze social and environmental predictors of asthma, diabetes intervention and prevention, and other health factors. The findings will be presented at various teaching conferences and in professional journals.

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AUTHOR PROFILE

Dr. Liu received his MD from the University of Mississippi. He completed an internship and residency in pediatrics at the University of North Carolina (UNC) School of Medicine. He stayed on at UNC to complete a fellowship in medical informatics and a master's degree in biomedical engineering.

At the completion of his fellowship, Dr. Liu joined the faculty of the Indiana University Department of Pediatrics. He is an affiliate scientist of the Regenstrief Institute. Dr. Liu serves on many national and local boards including the AAP's Medical Pediatric Leadership Alliance and the Southeast Neighborhood School of Excellence. His research interests include obesity prevention, environmental health, spatial analysis, and medical educational methods.

APPENDIX

Notes on Data

Individual Indicators:
The data in the medical records system treat “Hispanic” as a race category.

Socioeconomic Indicators:
Median Household Income is treated as a continuous variable at increments of $1,000.

Median Family Income (MFI) only reports income for related people and is more likely to include a larger subset of the population of interest (families with children) than median household income. Furthermore, MFI is less likely to be diluted with single person households, which do not include children. The income indicator was calculated by dividing the MFI of the block group by the MFI of the Indianapolis Metropolitan Statistical Area (MSA) ($55,191). We classified each block group into one of the following categories, which are based on the definitions used by the US Department of Housing and Urban Development:

Extremely Low: < 30% MSA MFI
Very Low: = 30% and < 50% MSA MFI
Low: = 50% and < 80% MSA MFI
Moderate: = 80% and < 95% MSA MFI
Middle: = 95% and < 120% MSA MFI
Upper: = 120% MSA MFI.

Physical Activity Opportunity Indicators:
Proximity to Play Space was chosen to represent opportunities for exercise. Several play spaces were selected from the SAVI database, including locations of Young Men’s Christian Associations (YMCA), city parks, greenways, and after-school programs with physical education curricular components. GIS was used to calculate the distance from each patient’s home to his/her nearest play space.

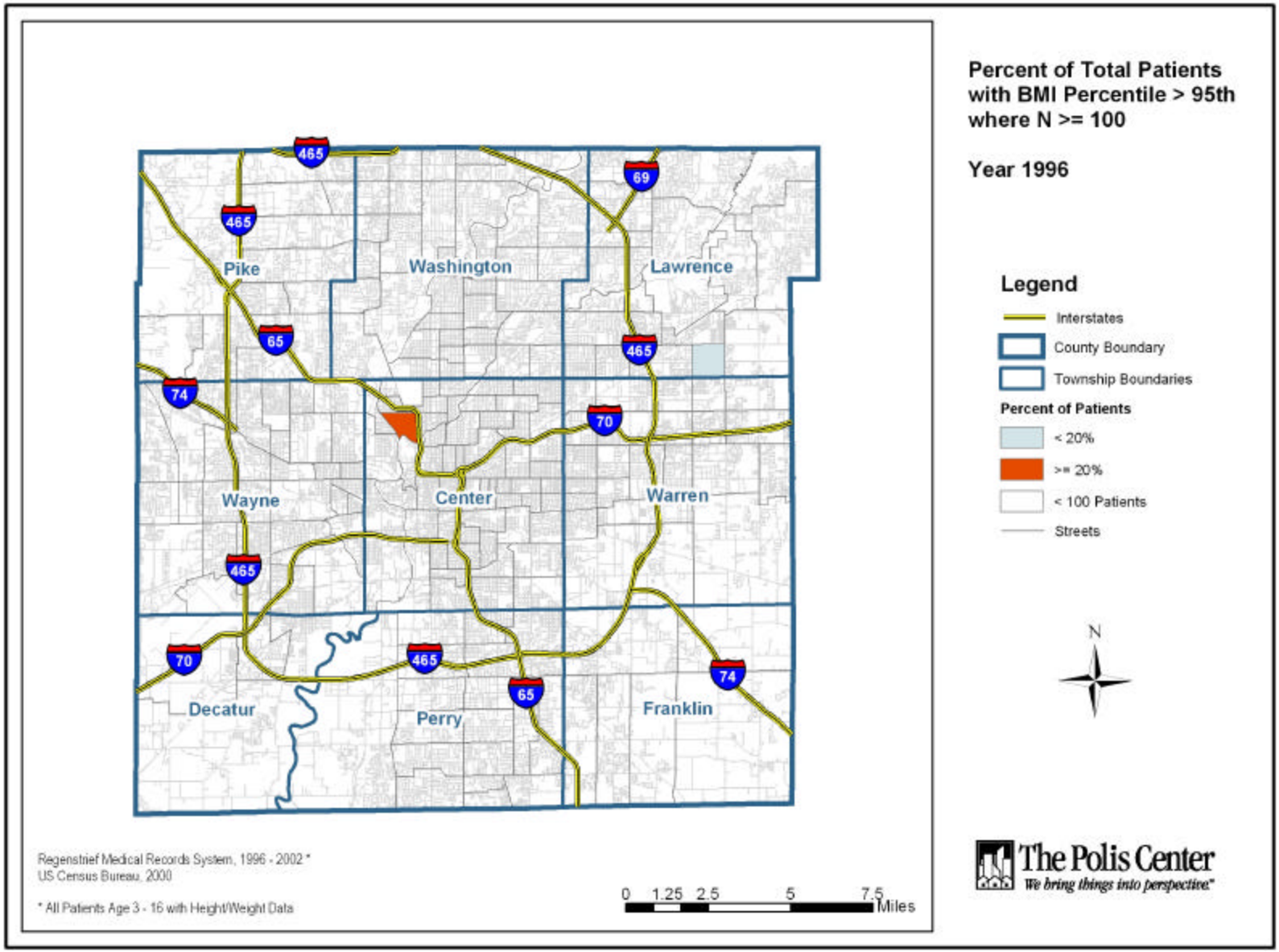
Social Barriers to Exercise Indicators:
Violent crimes include criminal homicide, robbery, aggravated assault, burglary, larceny, motor vehicle theft, rape, and simple assaults. The crime data are only reported for the Indianapolis Police Department service area, which does not cover the entire county.

A *linguistically isolated* household is one in which no member 14 years old and over (1) speaks only English or (2) speaks a non-English language and speaks English "very well." In other words, all members 14 years old and over have at least some difficulty with English (US Census Bureau).

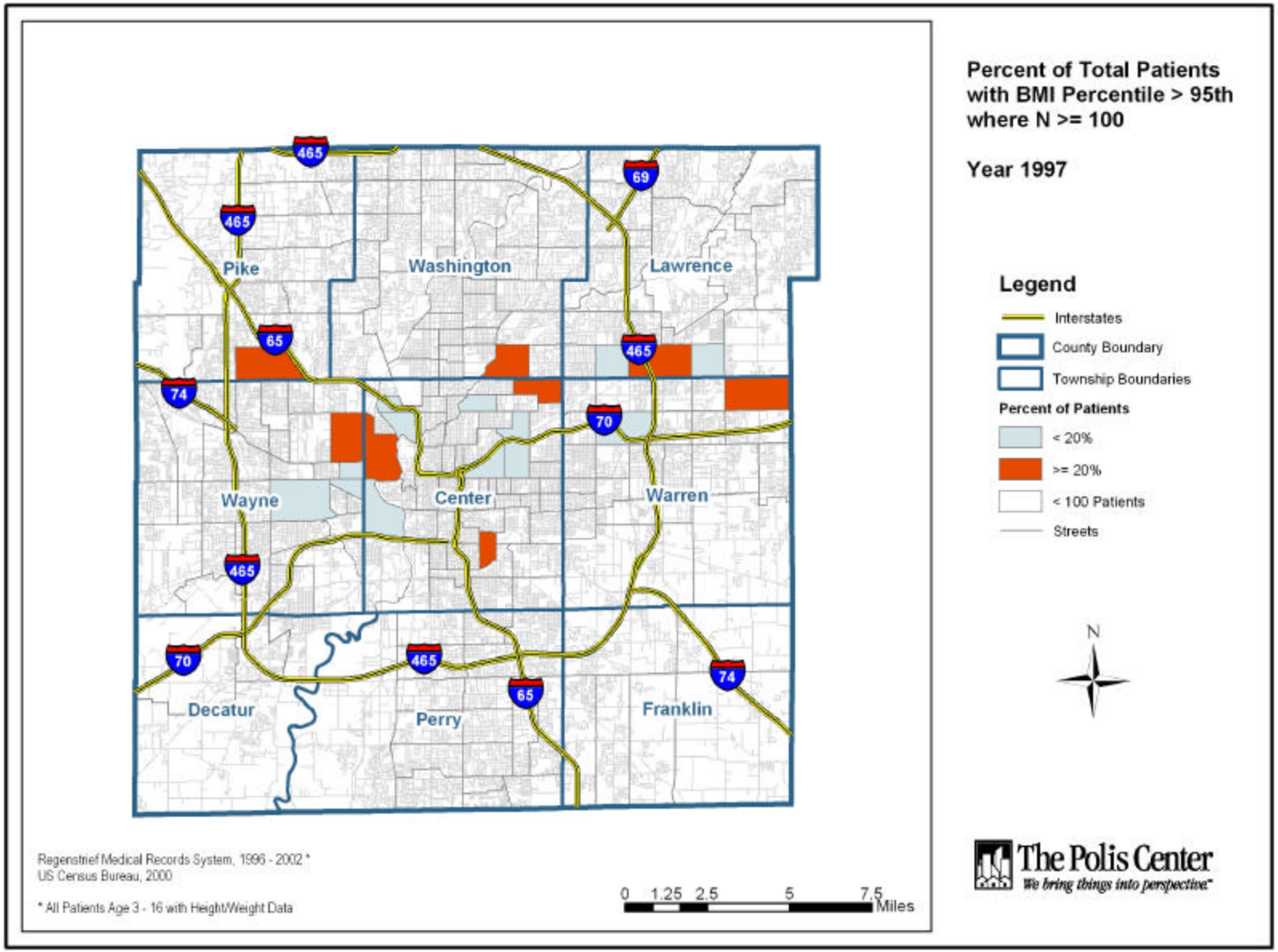
Maps

Maps 1 – 5: Percent of Patients that are Obese by Census Tract: 1996 – 2000
Map 6: Race of Patients Age 4 – 18 by Census Block Group

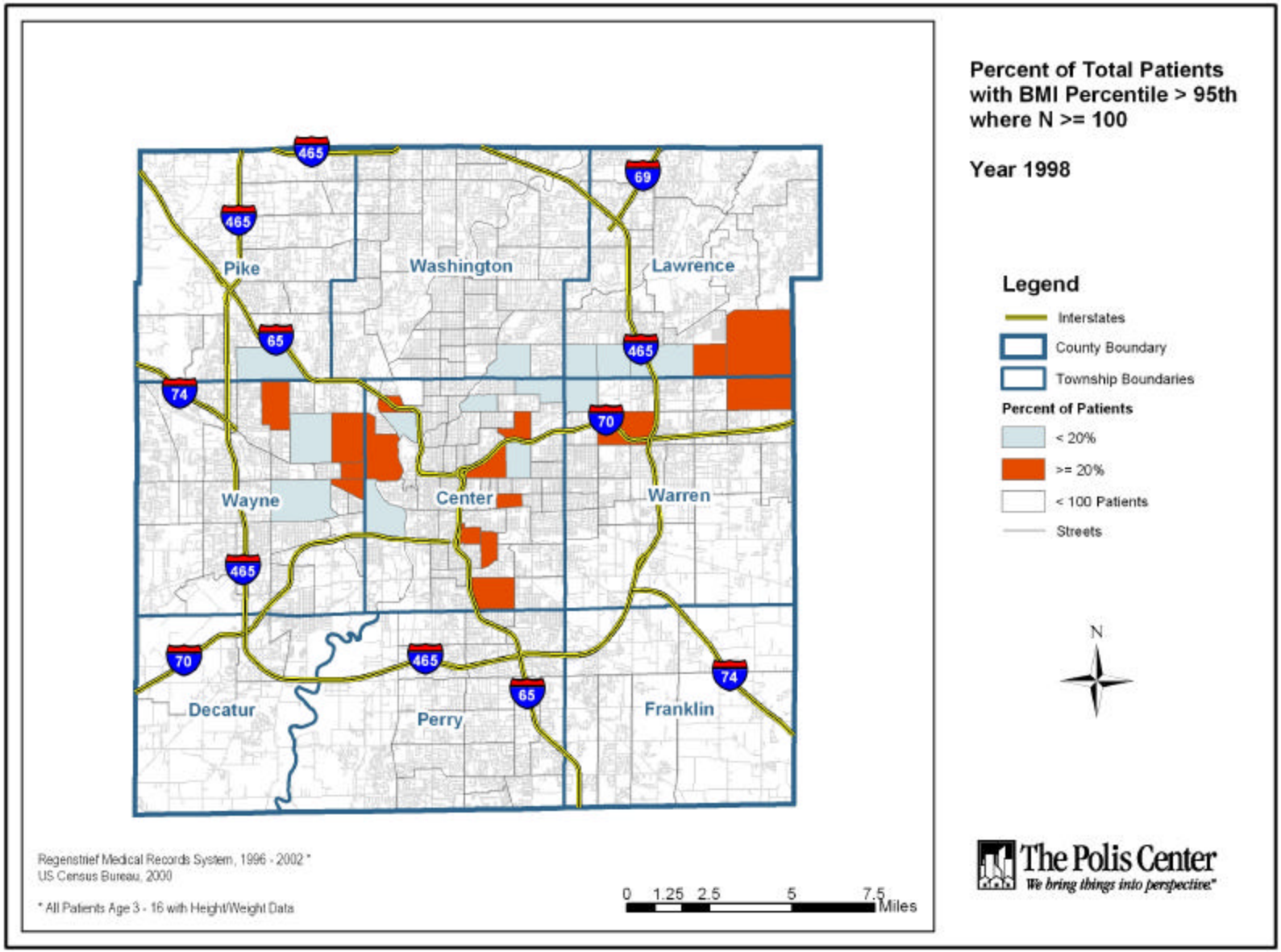
Map 1: Percent of Patients that are Obese by Census Tract: 1996



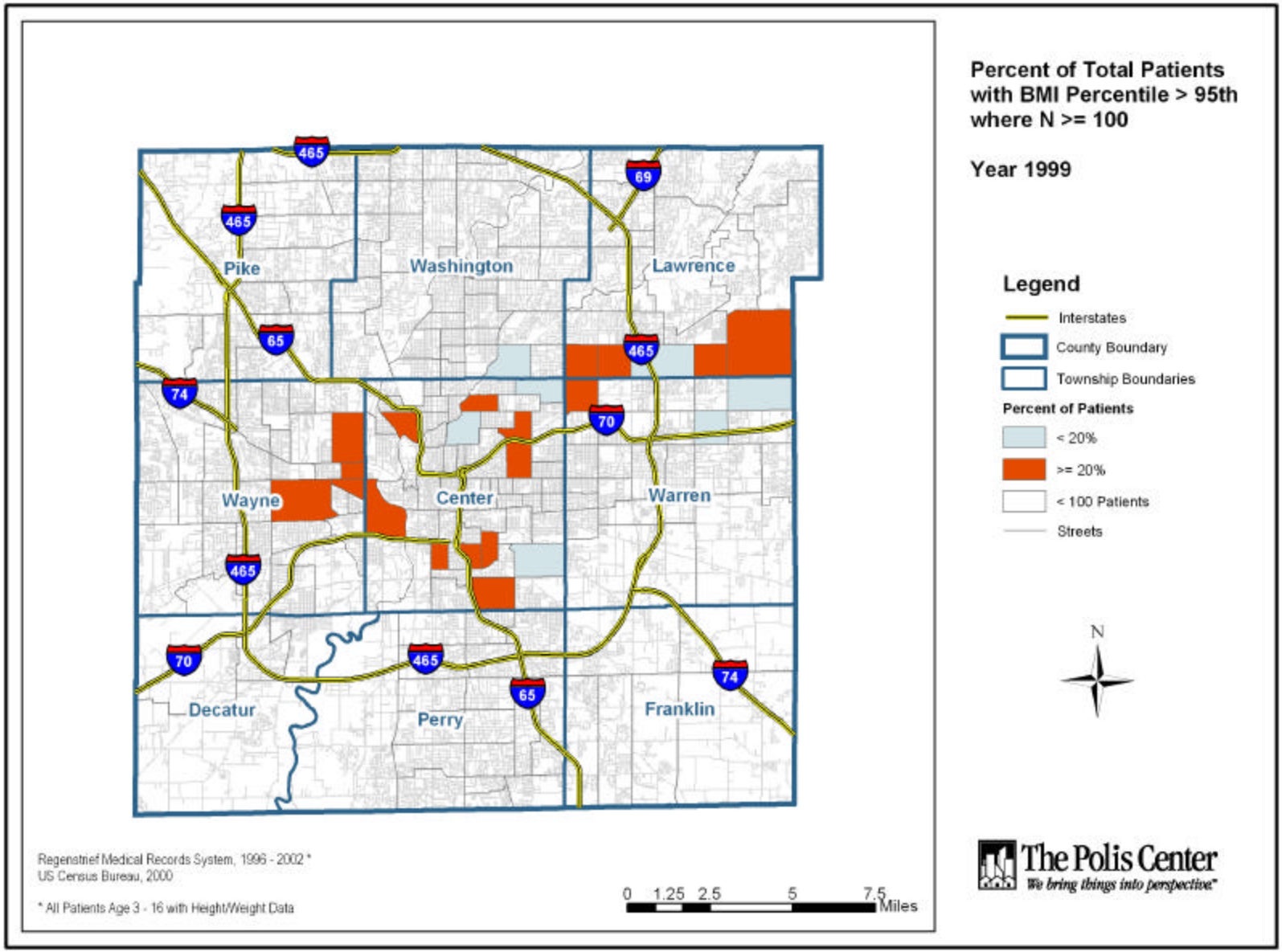
Map 2: Percent of Patients that are Obese by Census Tract: 1997



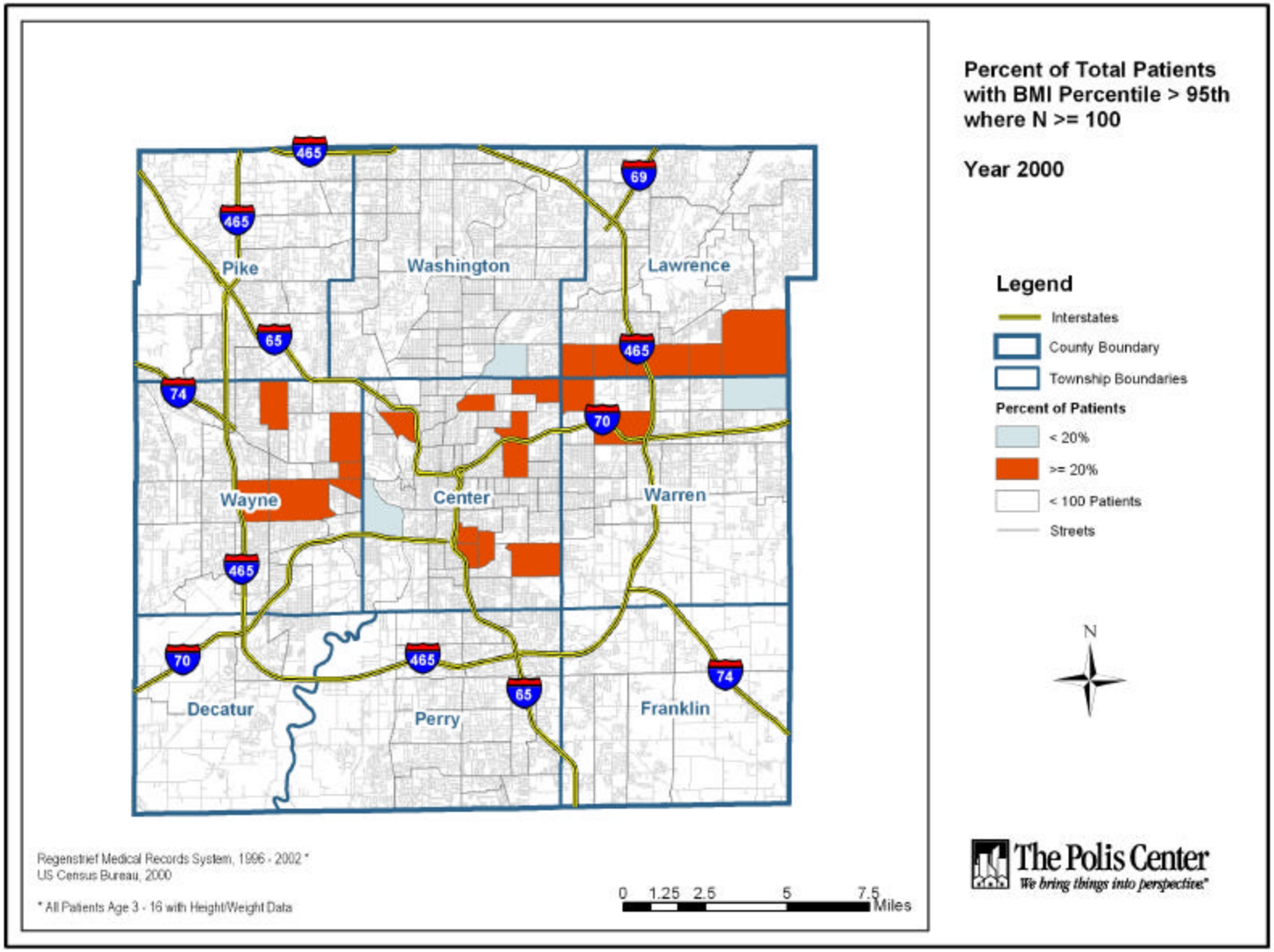
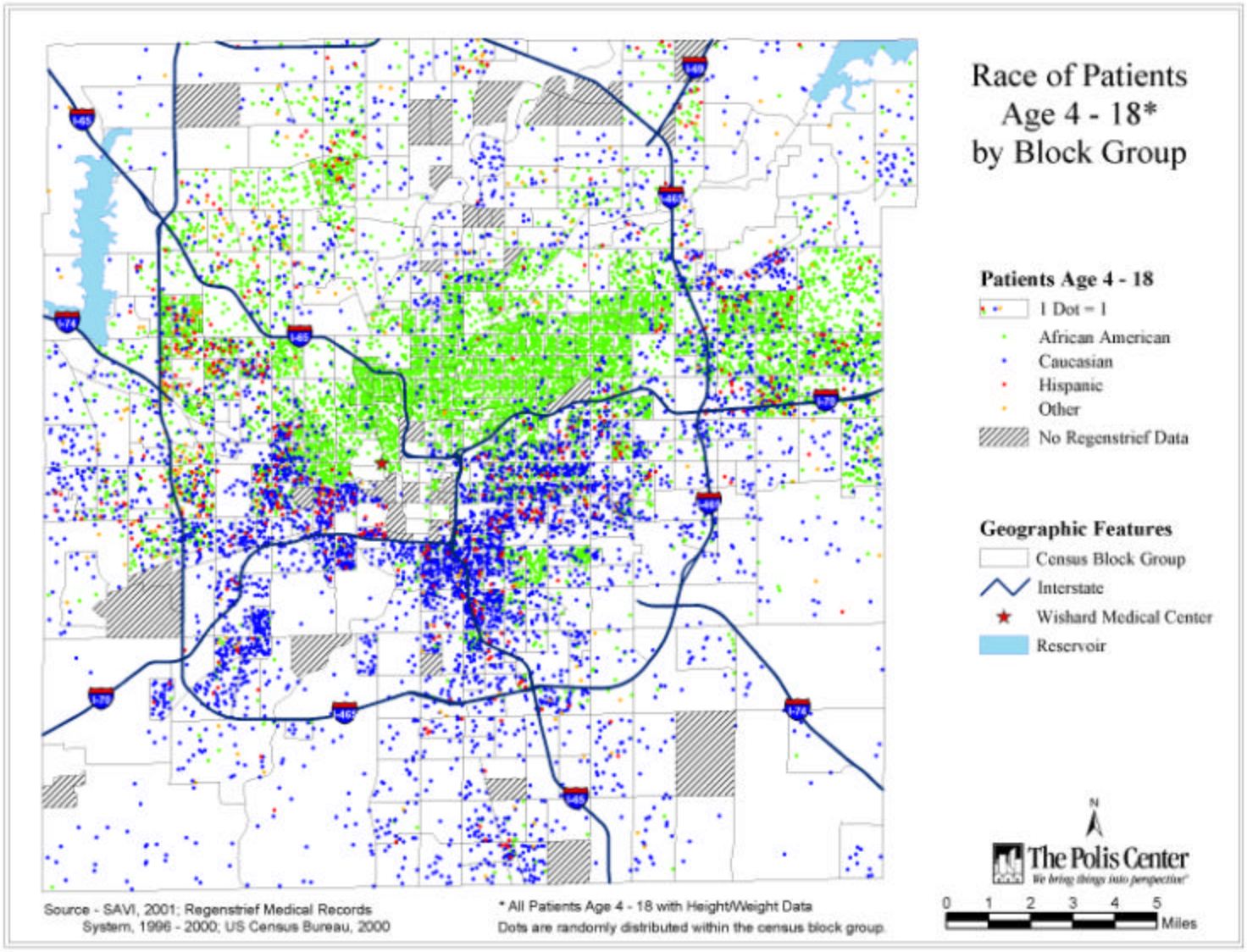
Map 3: Percent of Patients that are Obese by Census Tract: 1998



Map 4: Percent of Patients that are Obese by Census Tract: 1999



Map 5: Percent of Patients that are Obese by Census Tract: 2000



Map 6: Race of Patients Age 4 – 18 by Census Block Group: 1996-2000