Measuring the Health Effects of SPRAWL

A National Analysis of Physical Activity, Obesity and Chronic Disease

Barbara A. McCann
Reid Ewing

Smart Growth America
Surface Transportation Policy Project
SEPTEMBER 2003

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Copies of *Measuring the Health Effects of Sprawl* can be obtained at Smart Growth America's website, **www.smartgrowthamerica.org**. Hard copies can be obtained for $15 by calling or writing SGA, 1200 18th St. NW Suite 801, Washington DC 20036, (202) 207-3350, or by emailing sga@smartgrowthamerica.org.

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Table of Contents

Executive Summary

Health experts agree: most Americans are too sedentary and weigh too much. Obesity has reached epidemic levels, and diseases associated with inactivity are also on the rise. What is creating this public health crisis? Much of the focus to date has been on whether Americans are eating too much fattening food. But researchers are starting to pay attention to the other half of the weight-gain equation: Americans' low levels of physical activity. A pressing question for public health officials is whether the design of our communities makes it more difficult for people to get physical activity and maintain a healthy weight.

This report presents the first national study to show a clear association between the type of place people live and their activity levels, weight, and health. The study, *Relationship Between Urban Sprawl and Physical Activity, Obesity, and Morbidity,* found that people living in counties marked by sprawling development are likely to walk less and weigh more than people who live in less sprawling counties. In addition, people in more sprawling counties are more likely to suffer from hypertension (high blood pressure). These results hold true after controlling for factors such as age, education, gender, and race and ethnicity.

Researchers measured the degree of sprawl with a county 'sprawl index' that used data available from the US Census Bureau and other federal sources to quantify development patterns in 448 counties in urban areas across the United States. Counties with a higher degree of sprawl received a lower numerical value on the index, and county sprawl index scores range from 63 for the most sprawling county to 352 for the least sprawling county. Sprawling counties are spread-out areas where homes are far from any other destination, and often the only route between the two may be on a

The findings presented here are from the article, *Relationship Between Urban Sprawl and Physical Activity, Obesity and Morbidity,* by Reid Ewing, Tom Schmid, Richard Killingsworth, Amy Zlot, and Stephen Raudenbush, published in the September 2003 issue of the *American Journal of Health Promotion.*

This report is intended to make this important piece of research more accessible to the general public. In addition to presenting research findings, this report summarizes recent research done by others on the links between the way we've built our communities, physical activity, and health. It also includes recommendations for change and resources for those interested in further exploration of this topic.

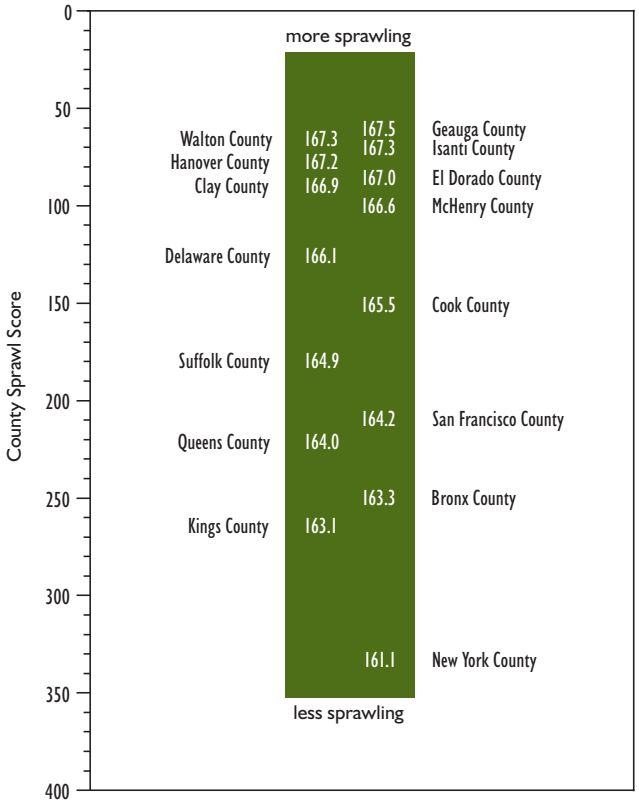
busy high-speed arterial road that is unpleasant or even unsafe for biking or walking. People who live in these areas may find that driving is the most convenient way to get everything done, and they are less likely to have easy opportunities to walk, bicycle, or take transit as part of their daily routine.

Indeed, previous research has shown that people living in sprawling areas drive more, while people living in compact communities are more likely to walk. Medical research has shown that walking and similar moderate physical activity is important to maintaining healthy weight and bestows many other health benefits. What is groundbreaking about this study is that it is the first national study to establish a direct association between the form of the community and the health of the people who live there.

Analysis shows sprawl is linked to health

The study compared the county sprawl index to the health characteristics of more than 200,000 individuals living in the 448 counties studied, using a large national health survey, the Behavioral Risk Factor Surveillance System (BRFSS), which is maintained by the Centers for Disease Control and Prevention (CDC).

FIGURE 1. Sprawl and Weight
Expected Weight for a 5'7" Adult (lbs.)

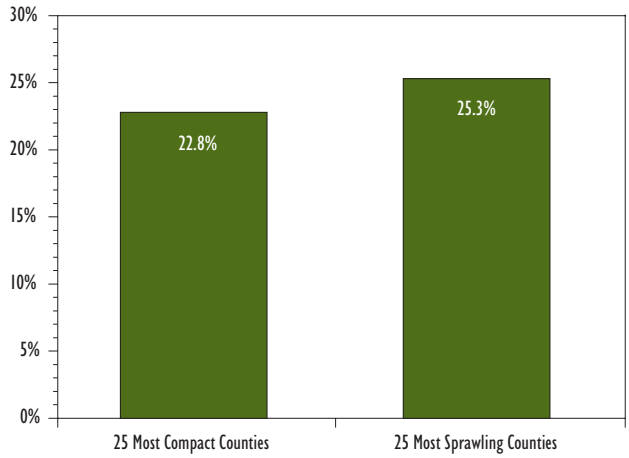


The results show that people in more sprawling counties are likely to have a higher body mass index (BMI), a standard measure of weight-to-height that is used to determine if people are overweight or obese. A 50-point increase in the degree of sprawl on the county sprawl index was associated with a weight gain of just over one pound for the average person. Looking at the extremes, the people living in the most sprawling areas are likely to weigh six pounds more than people in the most compact county. Expected differences in weight for an average person living in different counties are shown in Figure 1, left. Obesity, defined as a BMI of 30 or higher, followed a similar pattern. The odds that a county resident will be obese rises ten percent with every 50-point increase in the degree of sprawl on the county sprawl index.

The study also found a direct relationship between sprawl and chronic disease. The odds of having hypertension, or high blood pressure, are six percent higher for every 50-point increase in the degree of sprawl. The 25 most sprawling counties had average

hypertension rates of 25 per 100 while the 25 least sprawling had hypertension rates of 23 per 100. The researchers did not find any statistically significant association between community design and diabetes or cardiovascular disease. While all three chronic conditions are associated with being inactive and overweight, many other factors including heredity may moderate the relationship between sprawl and chronic diseases.

FIGURE 2. Sprawl and Blood Pressure
Percent of Adult Population with Hypertension



Source: BRFSS Hypertension rates, weighted by county (1998-2000).

People in sprawling areas walk less for exercise, which may help explain the higher obesity levels. But routine daily activity, such as walking for errands, may have a bigger role. When the researchers controlled for the amount of walking for exercise that people reported, they found that people in more sprawling counties weigh more whether or not they walk for exercise. This suggests that people in sprawling areas may be missing out on significant health benefits that are available simply by walking, biking, climbing stairs, and getting physical activity as part of everyday life.

These results point toward the need to continue investigating how our communities may be affecting our health. Additional studies are needed to better understand the relationship between sprawling development and the risk of being overweight, and to more precisely measure physical activity.

People living in counties marked by sprawling development are likely to walk less, weigh more, and are more likely to have high blood pressure.

Creating Healthy Communities

We know that people would like to have more opportunities to walk and bicycle: recent national polls found that 55 percent of Americans would like to walk more instead of driving, and 52 percent would like to bicycle more. Leaders looking to reshape their communities to make it easier to walk and bicycle have many options. They can invest in improved facilities for biking and walking, install traffic calming measures to slow down cars, or create Safe Routes to School programs that focus on helping kids walk and bike to school. They also can create more walkable communities by focusing development around transit stops, retrofitting sprawling neighborhoods, and

revitalizing older neighborhoods that are already walkable. When paired with programs that educate people about the benefits of walking, these changes can help increase physical activity.

Addressing these issues is essential both for personal health and for the long-term health of our communities. Physical inactivity and being overweight are factors in over 200,000 premature deaths each year. The director of the CDC recently said obesity might soon overtake tobacco as the nation's number-one health threat. Meanwhile, rising health care costs are threatening state budgets. Getting decision makers to consider how the billions spent on transportation and development can make communities more walkable and bikeable is one avenue to improving the health and quality of life of millions of Americans.

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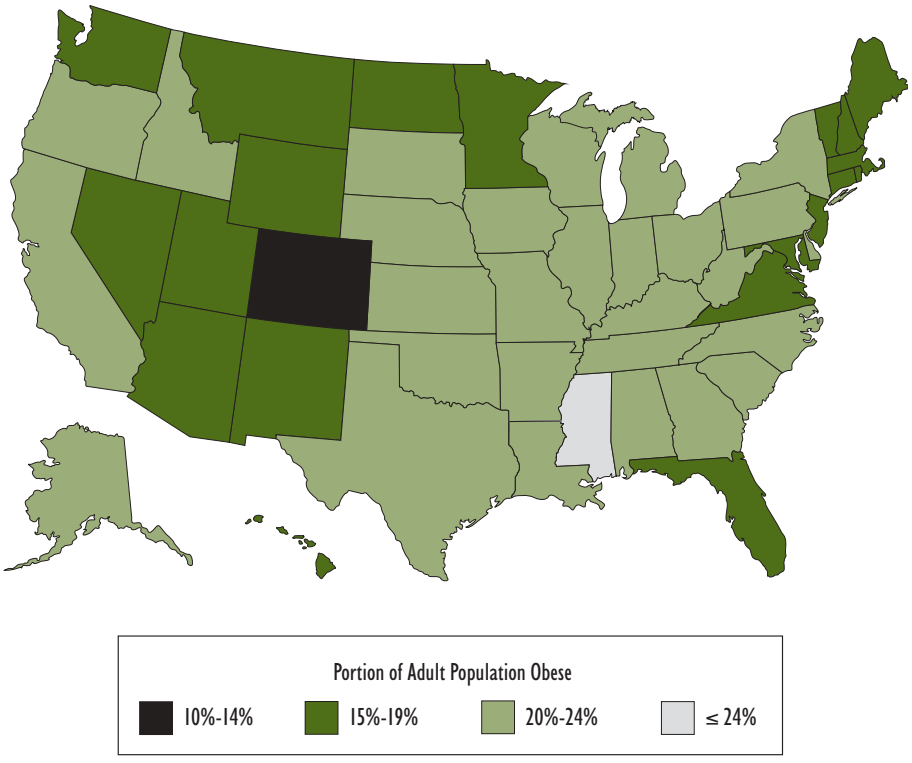
1. Introduction

More Than a Personal Problem

Weight loss is an American obsession, one that has played out almost exclusively at the individual level. Diet books and programs are ubiquitous, and each January gyms burst with new members determined to stick to their New Year's resolutions. Yet the American waistline has continued to expand at an alarming rate, and obesity has been declared an epidemic.[1] Recent data from a national survey found that almost 65 percent of the adult population is overweight and almost one in three people is obese.[2] In the past 25 years, the portion of children 6-11 who are overweight has doubled, while the portion of overweight teens has tripled: now 15 percent of children and teenagers aged 6 to 19 are overweight.[3] And this epidemic is far from a cosmetic concern: being overweight is a contributing factor to many chronic

FIGURE 3. Obesity* Among U.S. Adults

*BMI≥30 or ~30lbs overweight for a 5'4" woman



Source: Mokdad A H, et al. *J Am Med Assoc* 2001;286:10.

diseases and conditions, including hypertension, type-2 diabetes, colon cancer, osteoarthritis, osteoporosis, and coronary heart disease.[4] The director of the CDC recently said that obesity and physical inactivity are gaining on tobacco and may soon overtake tobacco as the nation's number one health threat.[5]

While Americans traditionally have seen weight as a personal concern, public health advocates have begun looking at how factors beyond our personal control may be making it harder to stay fit. Much of the public debate around obesity has focused on the constant availability of fattening snacks, the 'super sizing' of portions, and the marketing practices of fast-food restaurants. Now, health advocates are looking to our physical surroundings as a contributor to weight gain as well: If the environment is making it too easy to overeat, might there be something about our communities that is making it too difficult to get the physical activity needed to stay fit?

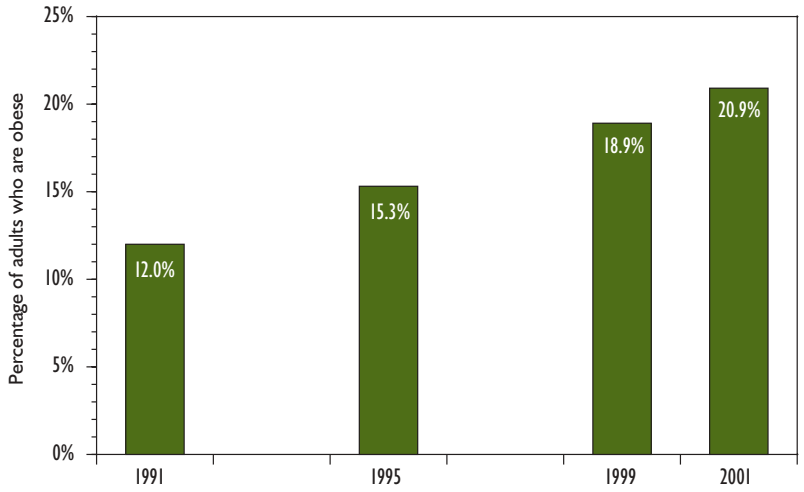
Physical Activity and Sprawl

There is good reason to suspect that a lack of physical activity is contributing to obesity and other health problems. Three in four Americans report that they do not get enough exercise to meet the recommended minimum of either 20 minutes of strenuous activity three days a week or 30 minutes of moderate activity five days a week.[6] About one in four Americans remains completely inactive during their leisure time. Yet these alarming statistics are not new. Reported exercise levels have remained steady for decades.[7]

What may be changing is the amount of physical activity people get in the course of everyday life. People move about as part of doing their jobs, taking care of their homes and families, and especially as they travel from place to place. One hint that this type of movement may be in decline comes from a recent poll that found that while 71 percent of parents of school-aged children walked or biked to school when they were young, only 18 percent of their children do so.[8] Also, according to the US Census, between 1990 and 2000 the portion of working Americans who walked to work dropped from 3.9 to 2.9 percent.

Preliminary studies show that the movement from compact neighborhoods to spread-out, automobile-dependent

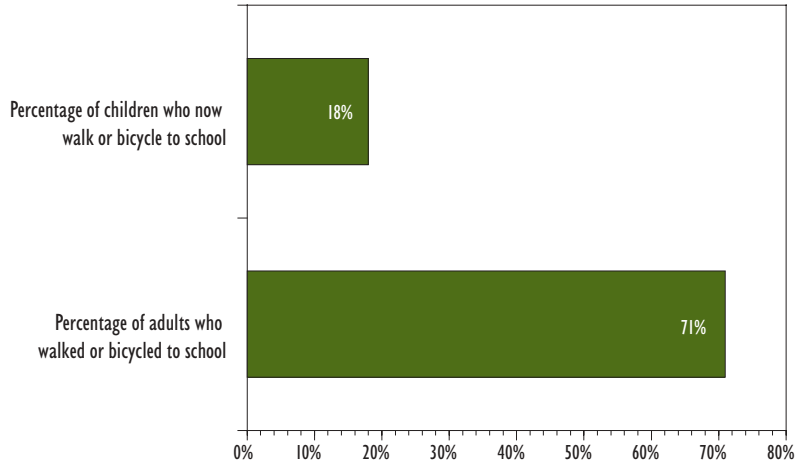
FIGURE 4. Trend in Adult Obesity, 1991-2001



Source: National Center for Chronic Disease Prevention and Health Promotion, CDC. BRFSS data 1991-2001.

communities has meant a decline in daily physical activity. A common denominator of modern sprawling communities is that nothing is within easy walking distance of anything else. Houses are far from any services, stores, or businesses; wide, high-speed roads are perceived as dangerous and unpleasant for walking; and businesses are surrounded by vast parking lots. In such environments, few people try to walk or bicycle to reach destinations. Urban planning research shows that 'urban form' – the way streets are laid out, the distance between destinations, the mix of homes and stores – is linked to physical activity because it influences whether people must drive or are able to choose more physically active travel, such as walking.[9]

FIGURE 5. Fewer Children are Walking to School



Source: Surface Transportation Policy Project. *American Attitudes Toward Walking and Creating Better Walking Communities.* April 2003.

Even as routine physical activity seems to be declining, recognition of its importance is growing in the public health community. Evidence is mounting that moderate activity can have a significant impact on health, an impact that goes far beyond weight control. People who are active are less likely to suffer from coronary heart disease, non-insulin dependent diabetes, high blood pressure, or to get colon

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or pancreatic cancer. Physical activity helps relieve the symptoms of arthritis, and can help lift depression, relieve anxiety, and result in an overall improvement in mood and well-being.

Public health researchers have just begun to conduct research on how the built environment affects physical activity.[10-15] They are asking: Have we "engineered" movement out of our daily lives to such a degree that our neighborhoods are now contributing to the obesity epidemic and other health problems?[16] This study is an important step toward answering this question because it is the first rigorous nationwide investigation of the potential relationship between urban form, physical activity, and health.

Moderate Physical Activity


U.S. Department of Health and Human Services.

US Health and Human Services Secretary Tommy Thompson recently released a report that urged Americans to get moving: "Simply walking 30 minutes a day can have a measurable impact on a person's health and in preventing diseases such as diabetes. You don't need to join a gym or be a great athlete to get active and make a difference in your health."[1] Public health advocates have coined the term "active living" to describe a way of life that integrates physical activity into daily routines. It can mean walking to the store or to work, climbing stairs instead of taking the elevator, or biking to school. For decades, health experts have advocated getting physical activity through vigorous aerobic exercise, but recent research shows that even moderate activity yields significant benefits, especially for those who are generally inactive.

II. How the Study Was Done

This report is based on a study that required an intensive and unusual collaboration between urban planning researchers and public health researchers. Reid Ewing, then at Rutgers University and now Research Professor at the National Center for Smart Growth, University of Maryland, was the principal investigator and spent many months in Atlanta working with researchers from the CDC, finding ways for the two very different fields to speak a common language and design a rigorous research methodology. He worked with Tom Schmid and Amy Zlot of the Physical Activity and Health Branch of the CDC and Rich Killingsworth of Active Living by Design at the University of North Carolina. Statistician Stephen Raudenbush of the University of Michigan, the nation's foremost authority on hierarchical modeling, provided valuable assistance in the statistical analysis. The first peer-reviewed article based on the study was published in the September/ October 2003 issue of the *American Journal of Health Promotion.* The study was an outgrowth of a project begun at the Surface Transportation Policy Project and continued at Smart Growth America to quantify sprawl and its impact on quality of life. This report is intended to make an important piece of research more accessible to the general public. It addition to the study findings, it includes other recent research on the degree of sprawl, physical activity, and health. For a detailed methodology of the original study, please refer to the published article (**www.HealthPromotionJournal.com**).

Urban Form Data: The county sprawl index

The study's urban form data is derived from a landmark study of metropolitan sprawl that Rutgers and Cornell Universities conducted for Smart Growth America (SGA), a national public interest group working for smart growth policies. Unlike previous studies, which attempted to evaluate sprawl based on one or two statistics, the SGA metropolitan sprawl index uses 22 variables to characterize four 'factors' of sprawl for 83 of the largest metropolitan area in the US for the year 2000. The sprawl 'scores' for each metropolitan area show how much they spread out housing, segregate homes from other places, have only weak centers of activity, and have poorly connected street networks. The factor scores, along with an overall sprawl index for the metro areas, represent the most comprehensive, academically rigorous quantification of sprawl in

This is the first rigorous nationwide investigation of the potential relationship between urban form, physical activity, and health.

TABLE 1. County Sprawl Index Variables

FACTOR	VARIABLE	SOURCE
Residential Density	Gross population density in persons per square mile	US Census
	Percentage of population living at densities less than 1,500 persons per square mile (low suburban density)	US Census
	Percentage of population living at densities greater than 12,500 persons per square mile (urban density that begins to be transit supportive)	US Census
	Net population density of urban lands	USDA Natural Resources Inventory
Connectivity of the Street Network	Average block size in square miles	Census TIGER files
	Percentage of small blocks (≤ 0.01 square mile)	Census TIGER files

the United States. The first report based on this research, *Measuring Sprawl and Its Impact,* was released in October 2002 and can be found at Smart Growth America's website, **www.smartgrowthamerica.org**.

For this study, however, researchers wanted a finer grain of information: while the sprawl index measures sprawl across an entire metropolitan region, residential and health data are available at the county level. So they used relevant data from the metropolitan sprawl study to create a county-level index that scores 448 counties. Because fewer data are available at the county level, the index is less comprehensive than the metropolitan index, but is nevertheless the most complete measurement of sprawl available at the county level. The county sprawl index uses six variables from the US Census and the Department of Agriculture's Natural Resources Inventory to account for residential density and street accessibility (for more information, see the published paper).

A review of the county sprawl index shows that the most sprawling counties in urban regions in the US tend to be outlying counties of smaller metropolitan areas in the Southeast and Midwest. Goochland County in the Richmond, Virginia metro area, and Clinton County in the Lansing, Michigan region, received very low numerical scores on the index, indicating a high degree of sprawl. At the most compact end of the scale are four New York City boroughs; San Francisco County; Hudson County (Jersey City, NJ); Philadelphia County; and Suffolk County (Boston). Falling near the median are central counties of low-density metro areas, such as Mecklenburg County in the Charlotte, NC area; counties of small metro areas, such as Allen County in the Fort Wayne, IN area;

and inner suburban counties in large metros such as Washington County in the Minneapolis-St. Paul area.

Counties with a higher degree of sprawl received a lower numerical value on the index. County sprawl scores ranged from the highly compact 352 for Manhattan, to a very sprawling score of 63 for Geauga County outside of Cleveland, Ohio. But Manhattan, and to a lesser degree Geauga, are outliers: most counties are clustered near the middle of the index, around the average score of 100. A complete listing of the county sprawl scores is provided in the Appendix.

Health Data: The Behavioral Risk Factor Surveillance System

The Behavioral Risk Factor Surveillance System, or BRFSS, is the primary US source of scientific data on adult behaviors that can endanger health. The survey collects self-reported information about current health risk factors and status, and is the largest continuous telephone survey in the world. The BRFSS allows the CDC, which conducts the survey, to monitor national and state trends in health risk and health outcomes. (For more information about the BRFSS, see **http://www.cdc.gov/brfss/about.htm**.) For this study, data from 1998 to 2000 were pooled to create a database of 206,992 respondents from 448 counties.

Researchers looked at the eight BRFSS variables that are believed to be part of the causal chain between the physical environment and health, including health risk factors such as obesity, behaviors such as leisure-time walking, and chronic health problems such as hypertension. People responding to such surveys tend to underestimate their weight, so the overweight and obesity levels reported may be low. Respondents were considered to have a health condition if their doctor or other health professional had

The Importance of Streets that Connect

One factor used to assess the degree of sprawl in a community is the degree to which streets form a grid that provides many alternate routes. This is especially important for encouraging bicycling and walking because a lack of direct routes will discourage people from walking. These two neighborhoods in Atlanta show a one-kilometer "as the crow flies" circle from a home, and then the one-kilometer distance the resident of that home could travel on the road network. In the sprawling neighborhood, travel is dramatically constricted by the lack of through streets.

From *Health and Community Design* by Lawrence D. Frank, Island Press June 2003.

diagnosed it. Researchers also used six additional variables from the database in order to control for gender, age, race and ethnicity, smoking, diet, and education (as a proxy for income and access to health information).

This study evaluated thousands of individual respondents in relation to the degree of sprawl in their home counties.

Analyzing the Data

The analysis conducted to relate the BRFSS data to the county sprawl index was far more than a simple correlation. This study linked the thousands of individual respondents to their home county. This allowed researchers to evaluate each individual in relation to the degree of sprawl where they live. To account for both personal and place-related influences on behavior and health, researchers used multi-level modeling. The level 1 model looks within each county and relates the characteristics of the people surveyed (such as their age, gender, etc.) to their behavior and health characteristics. The level 2 model takes the level 1 relationships for each county and explains them in terms of the county sprawl index. This kind of modeling is often referred to as hierarchical. Hierarchical or multi-level modeling is used in cases like this where respondents are not independent of one another (as assumed in ordinary modeling) but instead share characteristics of a given place. A more detailed description of the methodology can be found in the published paper.

III. Findings

How Sprawl Relates to Weight, Physical Activity, and Chronic Disease

The researchers found that people living in sprawling places were likely to weigh more, walk less, and have a greater prevalence of hypertension than people living in counties with more compact development patterns.

Sprawl Is Linked to Weight

This study used data on body mass index (BMI) to determine if the degree of sprawl had any influence on weight. BMI is a common measurement of weight to height that reliably predicts levels of body fat (see box).

The study found that people who live in more sprawling counties were likely to be heavier than people who live in more compact counties. For every 50-point increase in sprawl as measured by the sprawl index, the BMI of residents would be expected to rise by .17 points. This translates into an increase in weight of just over one pound for the average person.

Body Mass Index

Body Mass Index measures weight in relation to height. It is a mathematical formula that divides a person's body weight in kilograms by the square of his or her height in meters. BMI is highly correlated with body fat, and can indicate that a person is overweight or obese. People with a Body Mass Index of 25 or higher are considered overweight, while those with a BMI of 30 or higher are considered obese. According to the National Institutes of Health, all adults who have a BMI of 25 or higher are considered at risk for premature death and disability as a consequence of being overweight.

The average BMI of the more than 200,000 people in this study was 26.1. In general within this sample, BMI was higher among men. Both men and women tend to get heavier through middle age, and BMI tends to decline after age 64. African Americans and Hispanics tend to have a higher BMI than whites, while Asians are apt to have a lower BMI. Also, people who are college educated, or who eat three or more servings of fruits and vegetables in a day tend to have lower BMIs. All of these factors were controlled for in this study so that the association between weight and the degree of sprawl might be better isolated. To learn more about BMI and to calculate your own, visit **http://www.cdc.gov/nccdphp/dnpa/bmi/bmi-adult.htm**.

Table 2. Sprawl, BMI and Expected Weight

COUNTY	COUNTY SPRAWL SCORE	EXPECTED BMI	EXPECTED WEIGHT OF AVG PERSON (5'7")
New York, NY	352.07	25.23	161.1
San Francisco, CA	209.27	25.72	164.2
Suffolk, MA	179.37	25.83	164.9
Cook, IL	150.15	25.93	165.5
Delaware, PA	125.34	26.01	166.1
McHenry, IL	100.08	26.10	166.6
Clay, FL	87.51	26.14	166.9
El Dorado, CA	85.67	26.15	167.0
Hanover, VA	74.97	26.19	167.2
Isanti, MN	70.12	26.20	167.3
Walton, GA	69.61	26.20	167.3
Geauga, OH	63.12	26.23	167.5

Table 2, above, places a person of average BMI at the center of the sprawl index - which happens to be McHenry County outside of Chicago - in order to show how expected BMI differs for selected counties according to their sprawl ranking. The average BMI for all respondents in the study is 26.1, and the average height is 5'7". The study itself was based on individuals, not on averages, so these figures are provided to illustrate the difference in weight expected for persons of the same gender, age, and other characteristics living in different places.

The sprawl scale shows us that Hanover County, near Richmond Virginia, is 50 points more sprawling than Delaware County, outside of Philadelphia. An average person

People living in sprawling areas may be missing out on significant health benefits that are available simply by walking, bicycling, climbing stairs, and getting physical activity as part of everyday life.

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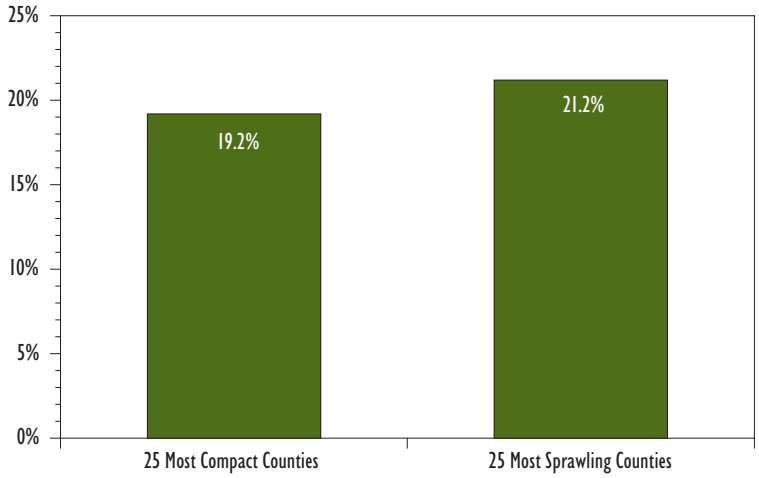
living in Hanover County would be expected to have a BMI of 26.19; for an otherwise identical person who is 5'7" this translates into a weight of just over 167 pounds. His or her counterpart in less-sprawling Delaware County would be expected to have a BMI of 26.01, and would weigh in at 166.1 pounds, or about one pound less. This would be true even after controlling for gender, age, diet, and other factors.

FIGURE 6. Sprawl and Obesity
Percent of Adult Population Who Are Obese



Source: BRFSS obesity rates, weighted by county (1998-2000).

Looking at extremes, the difference in BMI between people living in the most and least sprawling counties was just under 1 BMI unit. That means a person living in the most sprawling county, Geauga County outside Cleveland Ohio, would be expected to weigh 6.3 pounds more than a person living in the most compact county, New York County (Manhattan). However, Manhattan is an exceptional example in that it is far more compact than any other county in the United States. A more typical compact county is Suffolk County in central Boston. A person living in Suffolk County would be expected to weigh about 2.6 pounds less than a person living in Geauga County, Ohio. A table with the expected BMI for each county is located in the Appendix.

The odds that a county resident will be obese rises ten percent with every 50-point increase in the degree of sprawl.

Sprawl and Obesity

The researchers found a similar pattern for adult obesity. Regardless of gender, age, education levels, and smoking and eating habits, the odds of being obese were higher in more sprawling counties. For example, they were ten percent higher for a person living in Hanover County, with above-average sprawl, than in Delaware County, with below-average sprawl. While this study examined the health conditions at the individual level, the weighted averages for entire counties illustrate the relationship. In the 25 most-sprawling counties, 21 percent of the population was obese; in the 25 least sprawling, 19 percent of the population was obese.

Recommended Physical Activity: Who is getting it?

The US Surgeon General now recommends getting 30 minutes of moderate activity at least five days a week to maintain a basic level of health. Almost two-thirds of Americans don't reach this goal. Men are more likely to be physically active than women, and non-Hispanic whites report more activity than people of other races. Younger people and those with higher education levels also are more likely to be active. But people over 65 are more likely to say they get the recommended amount of exercise, mainly because they walk so much. Women walk for exercise more than men, with walking increasing up to 75 years of age. Walking is almost equally popular among all races, but people with higher education levels tend to walk more.

Men are more likely to report having high blood pressure, diabetes, and coronary heart disease, and older people and those with lower education levels are also more likely to have these conditions.

Evidence from Other Studies

While this study used data at the county level to look at relationships across the United States, another research project is underway in Atlanta that looks at health status at the neighborhood level.[17] While most of the results have not yet been released, the study has found that the proportion of white men who are overweight declined from 68 to 50 percent as housing density in neighborhoods increased from two units per acre to eight units per acre, and the proportion of obese men declined from 23 to 13 percent in those more compact neighborhoods.[18] Similar relationships hold for white women and African American men, but the sample size on African American women was too small to determine a relationship.

Sprawl is Linked to Physical Activity

The most likely way that the design of our communities may influence weight is by encouraging or discouraging physical activity, particularly routine physical activity that is involved in daily life – what is referred to as 'active living.' For most people, this means the simple act of walking to the store, to work, or to other places that are a part of their daily routine.

This study tested this idea by analyzing some of the physical activity data from the Behavioral Risk Factor Surveillance System. The survey asks whether people got any leisure-time physical activity within the past month, and if so, what kind of activity, how often they participated in it, and how long they spent on each occasion. It is important to note that these questions focus on intentional exercise during leisure-time, as opposed to routine daily activity. The BRFSS has not measured routine physical activity such as walking to the store or to a transit stop, climbing stairs in a building, or bicycling to work. A recent federal survey found that more than 40

percent of walking trips fall into this category.[19] Later in the report, we'll explain why this study shows that such routine activity deserves much closer examination.

Sprawl and Walking for Exercise

The study suggests that the degree of sprawl does not influence whether people get any exercise in their leisure hours. When asked about running, golf, gardening, walking, or any other leisure-time physical activity in the past month, people in sprawling and compact areas were equally likely to report that they had exercised in some way. While more people in compact areas reported reaching the recommended level of physical activity, this result was not statistically significant.

However, the study did show that the degree of sprawl makes a difference in how much people engaged in the most common form of exercise – walking. People in more sprawling places reported that they spent less time walking in their leisure time than people living in compact locations. For every 50-point increase in the county sprawl index, people were likely to walk fourteen minutes less for exercise in a month. This result is not a consequence of different demographics; the researchers controlled for gender, age, education, ethnicity, and other factors. This means that between the extremes of Manhattan and Geauga County Ohio, New Yorkers walked for exercise 79 minutes more each month. Looking at the weighted averages for the population as a whole, people in the 25 most sprawling counties walked an average of 191 minutes per month, compared to 254 minutes per month among those who live in the 25 most compact counties.

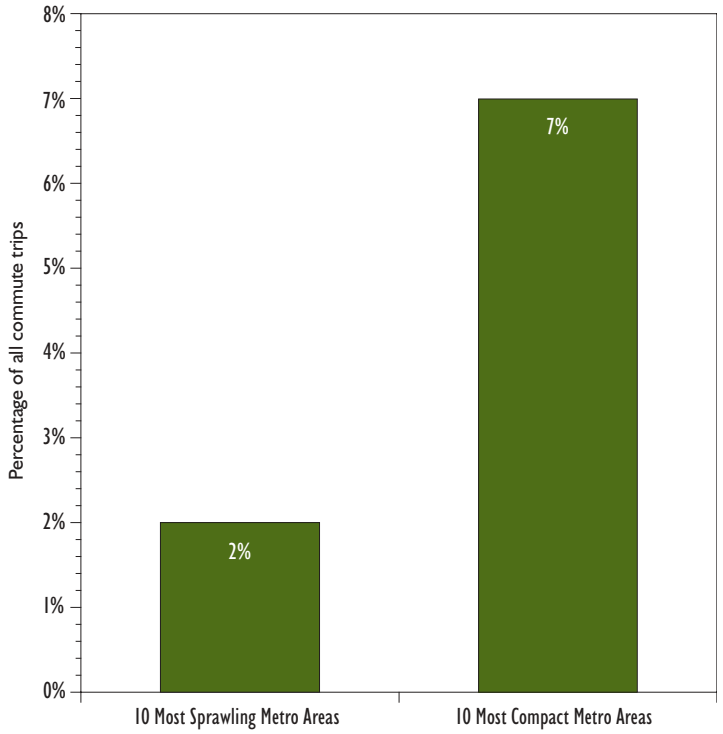
Sprawl and Walking for Transportation

Further analysis of the relationships between walking, weight, and location points to the probability that routine physical activity is a significant factor in the lower BMIs of people who live in more compact communities. The researchers found that the lower levels of walking for exercise among those living in sprawling counties only accounted for a small fraction of the higher BMIs in these areas. Both body mass index and obesity levels were higher in the more sprawling counties, independent of how much people walked in their leisure time.

The Question of Self-Selection

People walk more in more walkable neighborhoods, but is this just a matter of self-selection? Do people who want to get that type of physical activity choose to live in places that provide it? Some studies indicate that walking and biking facilities actually encourage people to be more active. In a survey of US adults using a park or walking and jogging trail, almost 30 percent reported an increase in activity since they began using these facilities.[2] A recent poll found that, if given a choice, 55 percent of Americans would rather walk than drive to destinations. And most people said inconvenience (61%) and time pressures (47%) kept them from walking more.[3]

FIGURE 7. Share of Commute Trips by Transit



Source: Ewing R, Chen D. Measuring Sprawl and it's Impact. Smart Growth America. October 2002.

In this study, urban form has a stronger relationship to BMI than does leisure-time walking. Sprawl may be affecting other types of physical activity, such as walking for transportation, that are, in turn, influencing weight. This study was unable to directly measure other types of walking that may be contributing to better fitness and lower weight: the walking trips that people take to go to the store, to visit friends, or to get to work. Many people may not consider such moderate activity, taken in the course of the day, as part of their exercise regimen. Yet medical research shows such modest exercise is important, and this may help explain why, regardless of how much they walked in their leisure time, those living in sprawling counties were likely to weigh more. It suggests people living in sprawling areas may be missing out on significant health benefits that are available simply by walking, biking, climbing stairs, and getting other types of physical activity as part of everyday life.

Other Evidence of the Link Between Sprawl & Walking

A closely related study found that the degree of sprawl influences how much people walk in everyday life. The first study using the metropolitan-level sprawl index found that in more compact places, people are far more likely to walk to work.[20] The portion of commuters walking to work is one-third higher in more compact metropolitan areas than in metro areas with above average sprawl. Public transit trips also typically involve some routine physical activity because most transit trips include a walk to or from a train or bus stop. The metropolitan sprawl study found that in the top 10 most sprawling metropolitan regions an average of just two percent of residents took a bus or train to work, while in the ten most compact regions (excluding the extreme cases, New York and Jersey City), an average of seven percent took the bus or train.[21]

Many transportation studies show that in places with a better pedestrian environment – with sidewalks, interconnected streets, and a mix of businesses and homes, people tend to drive less. For example, a study of two pairs of neighborhoods in the San Francisco Bay Area found that people walked to shopping areas more frequently in older neighborhoods with nearby stores and a well-connected grid street network.[22] Another

THE EUROPEAN EXPERIENCE

The study discussed in this report found that in more compact counties in the United States, people tend to walk more and weigh less. However, in the US, most counties are quite spread out, and truly compact counties are very few. A simple comparison with places that tend to be far more compact – European cities – shows striking differences in physical activity and obesity levels, even though the data cannot control for the many other variables that influence activity and health on the two continents.[4]

Transportation systems in Europe do far more to provide for and encourage people to walk or bicycle to get around. The density of housing and jobs in a sampling of European Union cities are, on average, three times higher than in a sample of American cities. Consequently, the levels of walking and bicycling for daily transportation are about five times higher in European Union countries than in the United States. In Europe, people make 33 percent of their trips by foot or bicycle, while in the United States the portion is about 9.4 percent. The difference in bicycling is particularly stark: rates in Europe average about 11 percent, while in the US less than one percent of trips are made by bicycle. The travel habits of older people, who would be expected to be especially sensitive to safety and comfort, are revealing as well. Americans over 75 years old take six percent of their trips by foot or bicycle, while Dutch and German citizens of the same age make about half their trips by foot and bicycle.[5] The difference is clearly not in the physical and mental limitations that come with age.

While Europeans engage in more physically active travel, they also have much lower rates of obesity, diabetes, and hypertension than in the US. A recent study found that obesity rates in the Netherlands, Denmark, and Sweden are one-third of the American rate, and Germany's rate is one-half the American rate.[6]

Obviously, many factors besides physical activity influence weight and health. Research shows that Americans consume eight percent more food each day than do Europeans. Other factors may include differences in dietary customs, health care systems, genetic predisposition, and the ability to afford health care and a nutritious diet. Europeans and Americans also smoke, drink, and consume caffeine and drugs at different rates. But the raw figures do suggest that the Europeans may have something to teach us about controlling weight and improving health through routine physical activity, particularly by walking and biking to get where we are going.

study that focused specifically on physical activity found that urban and suburban residents who lived in older neighborhoods (measured by whether their homes were built before 1946) were more likely to walk long distances frequently than people living in newer homes.[23] A recent poll asking people about their walking habits found that just 21 percent of self-described suburban residents walked to a destination in the previous week, while 45 percent of city residents had taken a walk to get somewhere.[24]

A recent review that evaluated results from studies of neighborhoods in four metropolitan areas estimated that communities designed for walking encourage an extra 15 to 30 minutes of walking per week. For a 150-pound person, that extra exercise could mean losing – or keeping off – between one to two pounds each year.[25] Another study also confirmed the importance of this type of activity: it found that walking or bicycling to work was associated with lower weight and less weight gain over time among middle-aged men, whether or not they engaged in more vigorous exercise.[26]

Sprawl and Chronic Disease

Extensive medical research shows that physical inactivity contributes to a variety of chronic health conditions in addition to obesity. Since this study found that a county's development pattern is associated with higher weights and lower levels of physical activity, could urban form also be associated with higher levels of disease? This study used BRFSS data to explore that question, looking at the prevalence of hypertension, diabetes, and coronary heart disease.

People who live in more sprawling counties were more likely to suffer from hypertension than people in more compact counties, even after controlling for age, education, gender, and other demographic factors. Hypertension, commonly known as high blood pressure,

The odds that a resident will have high blood pressure increases six percent for every 50-point increase in the degree of sprawl.

increases the risk of heart attack and stroke. Both obesity and physical inactivity are risk factors for hypertension. The odds of a resident having high blood pressure are about 6 percent higher in a county that is less sprawling than average than in a county more sprawling than average (25 units above and below the mean sprawl index, respectively). Comparing the most and least compact places, the odds of having high blood pressure were 29 percent lower in Manhattan than in Geauga County, Ohio. While this study examined the health conditions at the individual level, the weighted averages for entire counties illustrate the differences found: the 25 most-sprawling counties had average hypertension rates of 25 per 100 while the 25 least sprawling had hypertension rates of 23 per 100. Just as the tendency toward obesity may be exacerbated by a sedentary lifestyle in sprawling places, so may the tendency toward high blood pressure. The relationship

between hypertension and sprawl is not as strong as the association between obesity and sprawl, but the existence of any relationship between urban form and a disease associated with physical inactivity is still noteworthy when so many other factors impinge on health.

The researchers found weak associations between diabetes and urban form, and between coronary heart disease and urban form, but these associations did not reach the level of statistical significance. Factors outside the scope of this study may obscure any relationship between admittedly complex diseases and the degree of sprawl.

Why Sprawl May be Linked to Chronic Disease

The potential relationship between community design and chronic disease is most likely through sprawl's impact on physical activity, a proven factor in many chronic diseases. A 1996 Surgeon General's report cited hundreds of studies showing the link between physical activity and health.[27] Inactivity contributes to being overweight or obese, and is also connected to a host of health problems. Diseases associated with being overweight and physically inactive reportedly account for over 200,000 premature deaths each year, second only to tobacco-related deaths.[28-29]

Sprawl and Health at the Metropolitan Level

In addition to the analysis using the county sprawl index, the researchers related health data to the metropolitan level sprawl index to see if any relationships held at the much larger regional level. This analysis found only one statistically significant association at the metropolitan level – people walk less for exercise in more sprawling metropolitan areas.

The fact that sprawl measured at the county level is significant in many cases, and sprawl measured at the metropolitan level is not, suggests that the built environment "close to home" is most relevant to public health. The association may be even stronger at the neighborhood level. This project has been on the macro scale; other studies of sprawl and health at a finer scale are showing strong associations between the built environment, physical activity, and health.

IV. The Need for Further Research

The goal of this study was to explore the possibility that the way we've built our communities could have a direct impact on health. As a broad national study, it does not give a definitive answer in several areas, but points the way toward research that is needed to show whether these relationships hold true.

Does sprawling development actually cause obesity, disease, or lower rates of walking? Since a cross-sectional study of this sort cannot control for all the possible differences between people living in different places, it is premature to say that sprawl causes obesity, high blood pressure, or other health conditions. These results show that sprawl is associated with these conditions, but studies using control groups or that look at changes in individuals' weight and health over time are needed to explore causality.

What is the impact of physical activity that falls outside the definition of leisure-time exercise? As mentioned above, the BRFSS only measures walking as a leisure-time activity. Other types of physical activity include walking for transportation; performing physical labor on the job; or doing work around the house, such as cleaning or gardening. Future studies should look for greater precision in characterizing physical activity. The newest version of the BRFSS asks questions about these many types of physical activity. Similarly, researchers need better measures of walking. In looking at minutes walked, this study only included those who listed walking as one of their top two forms of exercise, missing those who walk for exercise less frequently.

Are there any threshold effects in changing physical activity rates? Does a change from one level of compactness to another yield major differences in activity levels or health? It may well be that the relationship between sprawl and physical activity or health is not linear: that communities must reach certain thresholds of compactness in order to make any significant difference in physical activity. For example, moving from a neighborhood with one or two houses per acre to one with three or four houses per acre may not be enough to trigger any changes in behavior.

What does research at the neighborhood level tell us? This study looks at counties and even metropolitan regions, large areas compared to the living and working environments of most people. If the effect of the built environment is strongest on a smaller scale, we need studies done at that level. The Active Living Research program at San Diego State University is sponsoring such studies, and the "SMARTRAQ" research project at Georgia Tech is starting to show results for neighborhoods in Atlanta.

How do other factors in the environment influence physical activity, weight, and disease? Because they are not directly measured in the sprawl index, this study does not account for many things that may influence physical activity, such as the availability of

parks, sidewalks, or multi-use trails, or even climate, topography, and crime. Future research is needed to fill this void.

Is there any relationship between location and what or how much people eat? This study only partially accounted for food intake – the other half of the weight equation. The only diet-related variable available was the number of fruit and vegetable servings per day. It may be that people in compact and sprawling places eat differently. Future research may, for example, relate the density of fast food restaurants and availability of food choices to diet and obesity.

Did the sampling design of the BRFSS have any influence over the results? The complex nature of the BRFSS study reinforces the need to be cautious in interpreting these early findings. The CDC is in the process of developing methods to adjust state-based weights so the BRFSS can be used with more confidence at the local level.

The strong and growing interest in this field is an encouraging sign that research to answer these questions is on the way. Two notable efforts are coming from the CDC and The Robert Wood Johnson Foundation (RWJF). The CDC has established an Active Communities Research Group, which is investigating some of these connections. RWJF has devoted $70 million to academic research and on-the-ground strategies to encourage physical activity. For example, Active Living Research has supported a series of carefully targeted research grants to expand understanding of what makes a community activity-friendly. The RWJF also has established Active Living By Design, a program that will award grants to 25 communities to plan and modify the built environment to support and promote increased physical activity. Information about these programs and more can be found through the Active Living Network, at **www.activeliving.org**.

The strong and growing interest in this field is an encouraging sign that more research to answer these questions is on the way.

PHOTOS: www.pedbikeimages.org/Dan Burden

V. Considering health when we plan our communities

This study shows that the way our communities are built – the urban form – may be significantly associated with some forms of physical activity and with some health outcomes. After controlling for demographic and behavioral characteristics, these results show that residents of sprawling places are likely to walk less, weigh more, and are more likely to have high blood pressure than residents of compact counties. The way that communities are built appears to have an impact on health. Public health research shows that even a small shift in the health of the overall population can have important public health implications.[30] In addition, changes to the built environment can have an effect that lasts far beyond individual resolve to diet or exercise.

Increasing Physical Activity: Benefits for individuals and the community

The potential for improving health through physical activity is enormous. A major National Institutes of Health study of more than 3,200 patients at high risk for type-2 diabetes found that by losing weight and increasing exercise (primarily through walking), participants reduced their risk of getting diabetes by 58 percent. Among older people, the risk was reduced by 71 percent. The study was halted early because the findings were so dramatic and conclusive that researchers felt they had to be shared.[31]

Perhaps most fundamentally, physically fit people simply live longer. A landmark study published in the *New England Journal of Medicine* in 2001 found that physical fitness is a better predictor of the risk of death than smoking, hypertension, heart disease, and other risk factors. Physical activity improved survival for people with every disease studied. "No matter how we twisted it, exercise came out on top," said lead author Jonathan Myers of Stanford University.[32]

Beyond the obvious benefits to individuals, finding ways to help more people be more active could have benefits for the entire health care system. A new analysis found that treatment of conditions tied to being overweight or obese costs an estimated $78 billion annually.[33] Health-care costs associated with obesity are estimated to be higher than those associated with either smoking or drinking,[34] and another study found that helping people lose weight and become more active could save more than $76 billion in health care costs annually.[35] These savings are desperately needed: health care costs are accelerating rapidly,[36] with costs related to caring for people who are overweight or obese accounting for an estimated 37 percent of the increase.[37] Up to 75 percent of health care costs are associated with chronic diseases, many of which are tied to obesity and physical inactivity.

Meanwhile, governments and private-sector developers are spending billions to build the infrastructure that shapes our communities – the roads, homes, offices, and buildings where people spend their daily lives. For example, the federal government spent about $35 billion in 2001 on transportation, and the transportation funding legislation is one of the largest spending bills passed by Congress. State and local governments spend another $124 billion on transportation infrastructure. Using just a small fraction of such investments to create more walkable and bikeable communities is an efficient way to increase physical activity and improve health.

Seeking Solutions

The good news is that the potential for getting exercise as part of daily life is already enormous. More than a quarter of all trips in urbanized areas are a mile or less, and fully half of all trips are under three miles, an easy bicycling distance.[38] Yet most of those trips are now made by automobile.

Converting more trips to biking and walking is possible, as evidenced by the experience in Europe (see special section, page 19). Recent research identifies six ways that the Netherlands and Germany have achieved their high rates of biking and walking: heavy investment in better walking and biking facilities; traffic calming of residential neighborhoods; urban design sensitive to the needs of non-motorists; restrictions on automobile use in cities, rigorous traffic education and strict enforcement of strong traffic laws protecting pedestrians and cyclists.

How can communities in the United States re-shape themselves to promote physical activity? The CDC is developing a *Guide for Community Preventive Services*, which is gathering evidence from case studies and other research to highlight some of the most effective. Smart Growth America's website (**www.smartgrowthamerica.org**) serves as portal to many groups and activities. A few primary strategies are listed below.

Narrowing streets at intersections, creating raised crosswalks, and installing traffic circles makes streets safer and more pleasant for pedestrians.

Oregon Department of Transportation, Pedestrian & Bicycle Program

Invest in Bicycle and Pedestrian Infrastructure

In many states, sidewalks and bicycle lanes or wide shoulders are not routinely included when a road is built or improved.[39] But many communities are creating networks of sidewalks and bike lanes that help people on foot and bicycle get where they are going safely. To learn about creating bike- and pedestrian-friendly streets, see *Increasing Physical Activity through Community Design* by the National Center for Bicycling and Walking (www.bikewalk.org), or visit the Pedestrian and Bicycle Information Center at **www.walkinginfo.org**.

Calm Traffic

Traffic engineers are using a variety of new techniques to slow traffic and give pedestrians and cyclists priority on neighborhood streets. Narrowing streets at intersections, creating raised crosswalks, and installing traffic circles makes streets safer and more pleasant for pedestrians. In Seattle, for example, engineers installed hundreds of traffic circles on neighborhood streets, decreasing traffic crashes by roughly 77 percent. Learn about traffic calming approaches by visiting the Institute of Traffic Engineers at www.ite.org.

Create Safe Routes to School

The trip to school can be one of the first places to help kids get active, every day. Childhood obesity and inactivity have reached epidemic proportions, and transportation studies show that young children are spending more time in cars than ever before. Communities across the country are trying to change that through Safe Routes to School programs that create a safe walking and biking environment for the trip to school, and encourage children and their parents to get in the habit of walking. In California, one-third of federal traffic safety funds are devoted to creating Safe Routes to School. A bill has been introduced in Congress to create a nationwide program; for information visit **http://www.americabikes.org/saferoutes.asp**. The National Highway Traffic Safety Administration has created a toolkit for communities interested in creating Safe Routes to School programs. For more information, http://www.nhtsa.dot.gov/people/injury/pedbimot/ped/saferouteshtml/overview.html.

Build Transit-Oriented Development

Many communities around the country are concentrating a mix of housing and businesses around train or bus stations. This makes it more convenient for people to walk to and from transit, and to pick up a quart of milk or drop off dry cleaning along the way. For example, Dallas, Texas is using its new light-rail line as a launching point for creating new, walkable neighborhoods. Overall community design is also important, especially in developing places where walking and bicycling is convenient. See the book *Solving Sprawl* by Kaid Benfield (Natural Resources Defense Council, 2001) for a wealth of examples of these types of projects.

Also, Reconnecting America's Center for Transit-Oriented Development has conducted innovative research and developed numerous tools to help communities pursue such development solutions. See **www.reconnectingamerica.org** for more details.

PHOTOS: www.pedbikeimages.org/Dan Burden

Retrofit Sprawling Communities

Millions of Americans live in places where it is difficult to walk anywhere. A recent poll found that 44 percent of those surveyed said it was difficult for them to walk to any destination from their home.[40] Communities can create pedestrian cut-throughs that allow people who live on cul-de-sacs to reach shops, parks and offices on foot. Foundering shopping malls, isolated from neighborhoods by expansive parking lots, are being reborn as developers cut new streets through the once-massive buildings, remodeled to hold apartments and businesses as well as shops. The Congress for the New Urbanism's web site gives many good examples of these types of projects (**www.cnu.org**).

Revitalize Walkable Neighborhoods

Many cities and towns have downtowns and main streets with the basic attributes of a walkable and bikeable community, but they lack economic investment. These struggling communities may have dozens, if not hundreds, of vacant buildings; a lack of good retail outlets; and high crime rates. Local governments are concentrating on revitalizing these neighborhoods through commercial investment, bringing vacant property back to productive use, and creating new housing for a mix of income levels. Smart Growth America and several partners have formed a national Vacant Properties Campaign to address some of these issues. See **www.vacantproperties.org**.

Historic preservation has also proven to be an effective strategy for revitalizing Main Streets, traditional downtowns and historic corridors. The National Trust for Historic Preservation offers many tools to local practitioners through their network and web site at **www.nthp.org**.

Educate and Encourage

While changing community design is critical, making sure that people understand the benefits of physical activity and seek it out is also essential. Many programs combine environmental changes with outreach to inform and motivate people. For example, many communities undertaking Safe Routes to School programs celebrate 'Walk a Child to School Day' in October. In addition, the CDC has launched a national youth media campaign aimed at helping young teenagers make healthy choices that include physical activity (http://www.cdc.gov/youthcampaign/index.htm).

Conclusion

The way we build our communities appears to affect how much people walk, how much they weigh, and their likelihood of having high blood pressure. These findings are in line with a growing body of research which shows that community design influences how people travel and how physically active they are in the course of the day. While more research is needed, urban planners, public health officials, and citizens are already looking to change communities to make it easier to get out on a bicycle or on foot. Ultimately, such long-term changes may help more Americans lead healthier and happier lives.

Endnotes

[1] Mokdad AH, Serdula MK, Dietz WH, Bowman BA, Marks JS, Koplan JP. The spread of the obesity epidemic in the United States, 1991-1998. *JAMA*. 1999;282:1519-1522.

[2] Flegal K, Carroll M, Ogden C, Johnson C. Prevalence and trends in obesity among US adults, 1999-2000. *JAMA*. 2002;288:1723-1727.

[3] National Center for Health Statistics, Centers for Disease Control and Prevention. Prevalence of overweight among children and adolescents: United States, 1999-2000. Available at: http://www.cdc.gov/nchs/products/pubs/pubd/hestats/overwght99.htm. Accessed on July 15, 2003.

[4] Must A, Spadano J, Coakley EH, Field AE, Colditz G, Dietz WH. The Disease Burden Associated with Overweight and Obesity. *JAMA*. 1999;282:1523-1529.

[5] Orr A. CDC: Obesity fastest-growth health threat. Reuters. June 5, 2003. Available at: **http://www.ucsfhealth.org/childrens/health_library/reuters/2003/06/20030605elin026.html**.

[6] Pratt M, Macera CA, Blanton C. Levels of physical activity and inactivity in children and adults in the United States: Current evidence and research issues. *Med & Science in Sports & Exercise*. 1999;31(11 Suppl): S526-S533. (Physical Activity Levels for U.S. Overall. Available at: **http://apps.nccd.cdc.gov/dnpa/piRec.asp?piState=us&PiStateSubmit=Get+Stats**. Accessed October 31, 2002).

[7] Centers for Disease Control and Prevention. Physical Activity Trends—United States, 1990-1998. *Morbidity and Mortality Weekly Report*. March 9, 2001;50(9):166-169.

[8] Surface Transportation Policy Project. American attitudes toward walking and creating better walking communities. April 2003. Available at: **http://www.transact.org/report.asp?id=205**. Accessed July 15, 2003.

[9] Ewing R, Cervero R. Travel and the built environment. *Transportation Research Record 1780*. 2001:87-114.

[10] Sallis JF, Owen N. *Physical Activity and Behavioral Medicine*. Thousand Oaks, CA: Sage Publications; 1999. Footnotes 13-18 in paper.

[11] Humpel N, Owen N, Leslie E. Environmental factors associated with adults' participation in physical activity. *Am J Prev Med*. 2002;22:188-199.

[12] King AC, Jeffery RW, Fridinger F, Dusenbury L, Provence S, Hedlund SA, Spangler K. Environmental and policy approaches to cardiovascular disease prevention through physical activity: Issues and opportunities. *Health Ed Quarterly*. 1995; 22(4): 499-511.

[13] Schmid TL, Pratt M, Howze E. Policy as intervention: Environmental and policy approaches to the prevention of cardiovascular disease. *Am J Pub Health*. 1995; 85(9): 1207-1211.

[14] Sallis JF, Owen N. Ecological models. In: Glanz K, Lewis FM, Rimer BK, eds. *Health Behavior and Health Education: Theory, Research, and Practice. Second edition*. San Francisco: Jossey-Bass, 1997:403-424.

[15] Sallis JF, Bauman A, Pratt M. Environmental and policy interventions to promote physical activity. *Am J Prev Med*. 1998;15(4): 379-397.

[16] Killingsworth RE, Lamming J. Development and public health—could our development patterns be affecting our personal health. *Urban Land*. July 2001:12-17.

[17] Strategies for Metropolitan Atlanta's Regional Transportation and Air Quality (SMARTRAQ). Available at: **http://www.smartraq.net**.

[18] Frank L, Engelke P, Schmid T. *Health and Community Design*. Washington, DC: Island Press; 2003:187.

[19] National Highway Traffic Safety Administration, Bureau of Transportation Statistics. National Survey of Pedestrian and Bicyclist Attitudes and Behaviors. May 2003. Available at: **http://www.bicyclinginfo.org/survey2002.htm**.

[20] Ewing R, Pendall R, Chen, D. Measuring sprawl and its impact. Smart Growth America. October 2002. Available at: http://www.smartgrowthamerica.org.

[21] Ewing, Pendall and Chen, 19.

[22] Handy, SL. Understanding the link between urban form and nonwork travel behavior. *J. Planning Ed and Res* 1996; 15: 183-198.

[23] Berrigan D, Troiano RP. The association between urban form and physical activity in U.S. adults. *Am J Prev Med.* 2002;23(2S):74-79.
[24] Surface Transportation Policy Project. American attitudes toward walking and creating better walking communities. Additional data analysis by Belden, Russonello and Stewart.
[25] Saelens B, Sallis J, Frank L. Environmental correlates of walking and cycling: Findings from the transportation, urban design, and planning literatures. *Annals of Behavioral Medicine*; Mar/Apr. 2003.
[26] Wagner, A, Simon C, Ducimetiere P, et al. Leisure-time physical activity and regular walking or cycling to work are associated with adiposity and 5 y weight gain in middle-aged men: The PRIME study. *International Journal of Obesity and Related Metabolic Disorders.* 2001, 25:940-948.
[27] U.S. Department of Health and Human Services. *Physical Activity and Health: A Report of the Surgeon General.* Atlanta, GA: Centers for Disease Control and Prevention; 1996.
[28] McGinnis JM, Foege WH. Actual causes of death in the United States. *JAMA*. 1993;270:2207-2212.
[29] Allison DB et al. Annual deaths attributable to obesity in the United States. *JAMA*. 1999;282:1530-1538.
[30] Rose G. Sick individuals and sick populations. *Int J of Epidemio* 1985; 14(1):32-38.
[31] National Institutes of Health. Diet and exercise dramatically delay type 2 diabetes. Available at: **http://www.nih.gov/news/pr/aug2001/niddk-08.htm**; and Squires S. Exercise, diet cut diabetes risk by 58%. *Washington Post*. August 9, 2001.
[32] Reid B. High risk inactivity. *Washington Post.* March 26, 2002:F1.
[33] Finkelstein EA, Fiebelkorn IC, Wang G. National medical spending attributable to overweight and obesity. *Health Affairs web exclusive.* May 14, 2003. Available at: http://www.healthaffairs.org/WebExclusives/Finkelstein_Web_Excl_051403.htm. Accessed July 15, 2003.
[34] Sturm R. The effects of obesity, smoking, and drinking on medical problems and costs. *Health Affairs March/April 2002*;21(2):245-253.
[35] Pratt M, Macera CA, Wang G. Higher direct medical costs associated with physical inactivity. *The Physician and Sportsmedicine.* 2000; 28:63-70.
[36] Matthews T. Health care's perfect storm. *State Government News*. February 1, 2003
[37] Finkelstein, Fiebelkorn, Wang, National medical spending.
[38] Clarke A. National Household Transportation Survey, original analysis. Data available at: **http://nhts.ornl.gov/2001/index.shtml**.
[39] Wilkinson B, Chauncey B. Are we there yet? Assessing the performance of state departments of transportation on accommodating bicycles and pedestrians. National Center for Bicycling & Walking. February, 2003. Available at: **http://www.bikewalk.org/assets/pdf/AWTY031403.pdf**. Accessed July 15, 2003.
[40] Surface Transportation Policy Project. American Attitudes Toward Walking.

Endnotes from Boxes

[1] Office of the Assistant Secretary for Planning and Evaluation, US Department of Health and Human Services. Physical Activity Fundamental to Preventing Disease. June 20, 2002. Available at **http://aspe.hhs.gov/health/reports/physicalactivity/**.
[2] Brownson R et al. Environmental and policy determinants of physical activity in the United States. *American Journal of Public Health*. 2001;91(12): 1995-2003.
[3] Surface Transportation Policy Project. American Attitudes Toward Walking.
[4] Pucher J. Comparison of public health indicators in Europe, Canada, and the United States as a function of transport and land use characteristics: An exploratory analysis." New Brunswick, NY Bloustein School of Planning and Public Policy, Nov. 30, 2001. Unpublished working paper commissioned to supplement this study.
[5] Pucher J, Dijkstra L. Promoting safe walking and cycling to improve public health: Lessons from the Netherlands and Germany. *American Journal of Public Health*. July 2003;93(7).
[6] Pucher J, Dijkstra L. Promoting Safe Walking and Cycling.

Appendix

State	County	Metro Area	Sprawl Index Score	Expected BMI	Expected Weight	Percent difference in odds of hypertension from Average	Percent difference in odds of obesity from Average
ALABAMA	Baldwin	Mobile, AL	83.16	26.16	167.01	2.02%	3.63%
	Jefferson	Birmingham, AL	108.45	26.07	166.46	-1.00%	-1.78%
	Mobile	Mobile, AL	98.85	26.10	166.67	0.14%	0.24%
	Shelby	Birmingham, AL	87.16	26.14	166.92	1.54%	2.76%
	St. Clair	Birmingham, AL	83.76	26.16	167.00	1.95%	3.50%
	Walker		84.98	26.15	166.97	1.80%	3.24%
ARIZONA	Maricopa	Phoenix-Mesa, AZ	111.51	26.06	166.39	-1.36%	-2.41%
	Pima	Tucson, AZ	101.73	26.09	166.60	-0.21%	-0.37%
ARKANSAS	Crittenden	Memphis, TN-AR-MS	94.07	26.12	166.77	0.71%	1.27%
	Faulkner	Little Rock-North Little Rock, AR	83.45	26.16	167.01	1.99%	3.57%
	Lonoke	Little Rock-North Little Rock, AR	81.22	26.16	167.05	2.26%	4.06%
	Pulaski	Little Rock-North Little Rock, AR	108.04	26.07	166.47	-0.95%	-1.69%
	Saline	Little Rock-North Little Rock, AR	82.00	26.16	167.04	2.17%	3.89%
CALIFORNIA	Alameda	Oakland, CA	136.64	25.97	165.84	-4.27%	-7.47%
	Contra Costa	Oakland, CA	115.77	26.05	166.30	-1.86%	-3.29%
	El Dorado	Sacramento, CA	85.67	26.15	166.96	1.72%	3.09%
	Fresno	Fresno, CA	98.02	26.11	166.69	0.24%	0.42%
	Kern	Bakersfield, CA	95.07	26.12	166.75	0.59%	1.05%
	Los Angeles	Los Angeles-Long Beach, CA	141.74	25.96	165.73	-4.85%	-8.47%
	Marin	San Francisco, CA	111.80	26.06	166.38	-1.39%	-2.47%
	Napa	San Francisco-Oakland-San Jose, CA	107.01	26.08	166.49	-0.83%	-1.48%
	Orange	Orange County, CA	131.74	25.99	165.94	-3.71%	-6.51%
	Placer	Sacramento, CA	95.58	26.12	166.74	0.53%	0.94%
	Riverside	Riverside-San Bernardino, CA	101.34	26.10	166.61	-0.16%	-0.28%
	Sacramento	Sacramento, CA	116.35	26.04	166.28	-1.93%	-3.41%
	San Bernardino	Riverside-San Bernardino, CA	100.49	26.10	166.63	-0.06%	-0.10%
	San Diego	San Diego, CA	119.73	26.03	166.21	-2.32%	-4.10%
	San Francisco	San Francisco, CA	209.27	25.72	164.24	-12.19%	-20.68%
	San Joaquin	Stockton-Lodi, CA	110.94	26.06	166.40	-1.29%	-2.29%
	San Mateo	San Francisco, CA	132.09	25.99	165.94	-3.75%	-6.58%
	Santa Barbara	Santa Barbara-Santa Maria-Lompoc, CA	115.84	26.05	-0.35	-1.87%	-3.30%
	Santa Clara	San Jose, CA	127.28	26.01	-0.60	-3.19%	-5.62%
	Santa Cruz	San Francisco-Oakland-San Jose, CA	111.63	26.06	-0.25	-1.37%	-2.44%
	Solano	San Francisco-Oakland-San Jose, CA	110.41	26.06	-0.23	-1.23%	-2.18%
	Sonoma	San Francisco-Oakland-San Jose, CA	101.84	26.09	-0.04	-0.22%	-0.39%
	Stanislaus	Modesto, CA	109.91	26.07	-0.22	-1.17%	-2.08%
	Ventura	Los Angeles-Riverside-Orange County, CA	112.72	26.06	-0.28	-1.50%	-2.66%
	Yolo	Sacramento-Yolo, CA	105.60	26.08	-0.12	-0.66%	-1.18%
COLORADO	Adams	Denver, CO	125.56	26.01	-0.56	-3.00%	-5.27%
	Arapahoe	Denver, CO	114.56	26.05	-0.32	-1.72%	-3.04%
	Boulder	Denver-Boulder-Greeley, CO	108.15	26.07	-0.18	-0.96%	-1.71%

The average BMI for the population sampled was 26.1. This chart shows the difference in BMI that is expected due to sprawling development patterns, holding all other factors equal. The expected weight is based on a 5'7" person, the average height for the men and women sampled in the study.

State	County	Metro Area	Sprawl Index Score	Expected BMI	Expected Weight	Percent difference in odds of hypertension from Average	Percent difference in odds of obesity from Average
	Douglas	Denver, CO	94.83	26.12	166.76	0.62%	1.10%
	El Paso	Colorado Springs, CO	105.29	26.08	166.53	-0.63%	-1.12%
	Jefferson	Denver, CO	112.59	26.06	166.37	-1.49%	-2.63%
CONNECTICUT	Fairfield	New York-Northern New Jersey-Long Island, NY-NJ-CT-PA	107.34	26.07	166.48	-0.87%	-1.54%
	Hartford	Hartford, CT	102.75	26.09	166.58	-0.33%	-0.58%
	Middlesex	Hartford, CT	90.28	26.13	166.86	1.16%	2.08%
	New Haven	New York-Northern New Jersey-Long Island, NY-NJ-CT-PA	107.10	26.08	166.49	-0.84%	-1.49%
	Tolland	Hartford, CT	81.77	26.16	167.04	2.19%	3.94%
DELAWARE	New Castle	Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD	114.83	26.05	166.32	-1.75%	-3.09%
FLORIDA	Brevard	Melbourne-Titusville-Palm Bay, FL	104.77	26.08	166.54	-0.57%	-1.01%
	Broward	Fort Lauderdale, FL	127.01	26.01	166.05	-3.16%	-5.57%
	Clay	Jacksonville, FL	87.51	26.14	166.92	1.50%	2.68%
	Dade	Miami, FL	136.17	25.98	165.85	-4.21%	-7.38%
	Duval	Jacksonville, FL	114.74	26.05	166.32	-1.74%	-3.08%
	Hernando	Tampa-St Petersburg-Clearwater, FL	94.97	26.12	166.75	0.60%	1.07%
	Hillsborough	Tampa-St Petersburg-Clearwater, FL	114.31	26.05	166.33	-1.69%	-2.99%
	Nassau	Jacksonville, FL	80.31	26.17	167.07	2.37%	4.26%
	Orange	Orlando, FL	115.05	26.05	166.31	-1.78%	-3.14%
	Osceola	Orlando, FL	105.55	26.08	166.52	-0.66%	-1.17%
	Palm Beach	West Palm Beach-Boca Raton, FL	110.38	26.06	166.41	-1.23%	-2.18%
	Pasco	Tampa-St Petersburg-Clearwater, FL	110.22	26.06	166.42	-1.21%	-2.14%
	Pinellas	Tampa-St Petersburg-Clearwater, FL	126.64	26.01	166.06	-3.12%	-5.49%
	Polk	Lakeland-Winter Haven, FL	105.24	26.08	166.53	-0.62%	-1.10%
	Seminole	Orlando, FL	112.13	26.06	166.38	-1.43%	-2.54%
	St. Johns	Jacksonville, FL	99.33	26.10	166.66	0.08%	0.14%
	Volusia	Daytona Beach, FL	104.77	26.08	166.54	-0.57%	-1.01%
GEORGIA	Barrow	Atlanta, GA	77.67	26.18	167.13	2.69%	4.85%
	Butts		78.71	26.17	167.11	2.57%	4.62%
	Catoosa	Chattanooga, TN-GA	85.61	26.15	166.96	1.73%	3.10%
	Cherokee	Atlanta, GA	85.22	26.15	166.97	1.77%	3.18%
	Clayton	Atlanta, GA	99.61	26.10	166.65	0.05%	0.08%
	Cobb	Atlanta, GA	101.01	26.10	166.62	-0.12%	-0.21%
	Columbia	Augusta-Aiken, GA-SC	87.30	26.14	166.92	1.52%	2.73%
	Coweta	Atlanta, GA	80.87	26.17	167.06	2.30%	4.14%
	Dade	Chattanooga, TN-GA	77.61	26.18	167.13	2.70%	4.86%
	De Kalb	Atlanta, GA	103.94	26.09	166.56	-0.47%	-0.83%
	Douglas	Atlanta, GA	80.29	26.17	167.07	2.37%	4.27%
	Fayette	Atlanta, GA	75.74	26.18	167.17	2.93%	5.28%
	Forsyth	Atlanta, GA	72.04	26.20	167.26	3.38%	6.11%
	Fulton	Atlanta, GA	105.46	26.08	166.52	-0.65%	-1.15%
	Gwinnett	Atlanta, GA	93.76	26.12	166.78	0.75%	1.33%

The average BMI for the population sampled was 26.1. This chart shows the difference in BMI that is expected due to sprawling development patterns, holding all other factors equal. The expected weight is based on a 5'7" person, the average height for the men and women sampled in the study.

State	County	Metro Area	Sprawl Index Score	Expected BMI	Expected Weight	Percent difference in odds of hypertension from Average	Percent difference in odds of obesity from Average
	Henry	Atlanta, GA	74.13	26.19	167.21	3.13%	5.64%
	McDuffie	Augusta-Aiken, GA-SC	78.00	26.18	167.13	2.65%	4.78%
	Newton	Atlanta, GA	79.44	26.17	167.09	2.48%	4.46%
	Paulding	Atlanta, GA	82.10	26.16	167.03	2.15%	3.87%
	Richmond	Augusta-Aiken, GA-SC	102.47	26.09	166.59	-0.29%	-0.52%
	Rockdale	Atlanta, GA	82.82	26.16	167.02	2.07%	3.71%
	Spalding	Atlanta, GA	85.19	26.15	166.97	1.78%	3.19%
	Walker	Chattanooga, TN-GA	81.26	26.16	167.05	2.25%	4.05%
	Walton	Atlanta, GA	69.61	26.20	167.31	3.68%	6.66%
HAWAII	Honolulu	Honolulu, HI	126.76	26.01	166.05	-3.13%	-5.52%
ILLINOIS	Clinton	St Louis, MO-IL	86.69	26.15	166.93	1.60%	2.86%
	Cook	Chicago, IL	150.15	25.93	165.54	-5.79%	-10.09%
	Du Page	Chicago, IL	114.64	26.05	166.32	-1.73%	-3.06%
	Grundy	Chicago, IL	87.74	26.14	166.91	1.47%	2.63%
	Kane	Chicago, IL	108.53	26.07	166.45	-1.01%	-1.79%
	Kendall	Chicago, IL	90.37	26.13	166.85	1.15%	2.06%
	Lake	Chicago, IL	108.92	26.07	166.45	-1.06%	-1.87%
	Madison	St Louis, MO-IL	102.62	26.09	166.58	-0.31%	-0.55%
	McHenry	Chicago, IL	100.08	26.10	166.64	-0.01%	-0.02%
	Monroe	St Louis, MO-IL	85.64	26.15	166.96	1.72%	3.09%
	St. Clair	St Louis, MO-IL	104.41	26.08	166.54	-0.52%	-0.93%
	Will	Chicago, IL	98.81	26.10	166.67	0.14%	0.25%
INDIANA	Allen	Fort Wayne, IN	97.44	26.11	166.70	0.31%	0.55%
	Boone	Indianapolis, IN	78.10	26.18	167.12	2.64%	4.75%
	Clark	Louisville, KY-IN	102.63	26.09	166.58	-0.31%	-0.56%
	De Kalb	Fort Wayne, IN	80.34	26.17	167.07	2.37%	4.26%
	Dearborn	Cincinnati, OH-KY-IN	84.42	26.15	166.98	1.87%	3.36%
	Floyd	Louisville, KY-IN	97.71	26.11	166.69	0.27%	0.49%
	Hamilton	Indianapolis, IN	93.90	26.12	166.78	0.73%	1.30%
	Hancock	Indianapolis, IN	82.44	26.16	167.03	2.11%	3.79%
	Harrison	Louisville, KY-IN	74.37	26.19	167.20	3.10%	5.58%
	Hendricks	Indianapolis, IN	85.56	26.15	166.96	1.73%	3.11%
	Johnson	Indianapolis, IN	96.44	26.11	166.72	0.42%	0.76%
	Lake	Chicago-Gary-Kenosha, IL-IN-WI	110.99	26.06	166.40	-1.30%	-2.30%
	Marion	Indianapolis, IN	113.13	26.05	166.35	-1.55%	-2.74%
	Morgan	Indianapolis, IN	88.06	26.14	166.90	1.43%	2.56%
	Porter	Chicago-Gary-Kenosha, IL-IN-WI	94.09	26.12	166.77	0.71%	1.26%
	Shelby	Indianapolis, IN	88.18	26.14	166.90	1.42%	2.54%
	Whitley	Fort Wayne, IN	72.38	26.20	167.25	3.34%	6.03%
IOWA	Dallas	Des Moines, IA	81.68	26.16	167.04	2.20%	3.96%
	Polk	Des Moines, IA	105.34	26.08	166.52	-0.63%	-1.12%

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State	County	Metro Area	Sprawl Index Score	Expected BMI	Expected Weight	Percent difference in odds of hypertension from Average	Percent difference in odds of obesity from Average
	Pottawattamie	Omaha, NE-IA	93.73	26.12	166.78	0.75%	1.34%
	Warren	Des Moines, IA	79.86	26.17	167.08	2.43%	4.36%
KANSAS	Butler	Wichita, KS	79.81	26.17	167.09	2.43%	4.37%
	Harvey	Wichita, KS	73.89	26.19	167.22	3.16%	5.69%
	Johnson	Kansas City, MO-KS	103.50	26.09	166.57	-0.42%	-0.74%
	Leavenworth	Kansas City, MO-KS	94.46	26.12	166.76	0.66%	1.18%
	Miami	Kansas City, MO-KS	71.03	26.20	167.28	3.51%	6.33%
	Sedgwick	Wichita, KS	106.18	26.08	166.51	-0.73%	-1.30%
	Wyandotte	Kansas City, MO-KS	111.25	26.06	166.39	-1.33%	-2.36%
KENTUCKY	Boone	Cincinnati, OH-KY-IN	92.11	26.13	166.82	0.94%	1.69%
	Bullitt	Louisville, KY-IN	86.26	26.15	166.94	1.65%	2.96%
	Campbell	Cincinnati, OH-KY-IN	109.57	26.07	166.43	-1.13%	-2.01%
	Jefferson	Louisville, KY-IN	110.08	26.07	166.42	-1.19%	-2.11%
	Kenton	Cincinnati, OH-KY-IN	108.82	26.07	166.45	-1.04%	-1.85%
	Oldham	Louisville, KY-IN	84.27	26.15	166.99	1.89%	3.39%
	Shelby		87.61	26.14	166.91	1.48%	2.66%
LOUISIANA	Ascension	Baton Rouge, LA	87.25	26.14	166.92	1.53%	2.74%
	East Baton Rouge	Baton Rouge, LA	105.67	26.08	166.52	-0.67%	-1.20%
	Jefferson	New Orleans, LA	124.23	26.02	166.11	-2.84%	-5.01%
	Livingston	Baton Rouge, LA	82.76	26.16	167.02	2.07%	3.72%
	Orleans	New Orleans, LA	149.47	25.93	165.56	-5.72%	-9.96%
	St. Bernard	New Orleans, LA	113.59	26.05	166.34	-1.60%	-2.84%
	St. Charles	New Orleans, LA	91.16	26.13	166.84	1.06%	1.89%
	St. John the Baptist	New Orleans, LA	98.13	26.11	166.68	0.22%	0.40%
	St.Tammany	New Orleans, LA	96.48	26.11	166.72	0.42%	0.75%
	West Baton Rouge	Baton Rouge, LA	91.68	26.13	166.82	1.00%	1.78%
MARYLAND	Anne Arundel	Baltimore, MD	107.75	26.07	166.47	-0.92%	-1.63%
	Baltimore	Baltimore, MD	107.02	26.08	166.49	-0.83%	-1.48%
	Baltimore city	Baltimore, MD	162.76	25.88	165.26	-7.20%	-12.46%
	Calvert	Washington, DC-MD-VA-WV	90.84	26.13	166.84	1.10%	1.96%
	Carroll	Baltimore, MD	81.92	26.16	167.04	2.17%	3.91%
	Cecil	Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD	86.87	26.15	166.93	1.57%	2.82%
	Charles	Washington, DC-MD-VA-WV	89.72	26.14	166.87	1.23%	2.20%
	Frederick	Washington, DC-MD-VA-WV	87.09	26.14	166.93	1.55%	2.77%
	Harford	Baltimore, MD	92.47	26.13	166.81	0.90%	1.61%
	Howard	Baltimore, MD	93.65	26.12	166.78	0.76%	1.36%
	Montgomery	Washington, DC-MD-VA-WV	112.70	26.06	166.36	-1.50%	-2.66%
	Prince George's	Washington, DC-MD-VA-WV	112.42	26.06	166.37	-1.47%	-2.60%
	Queen Anne's	Baltimore, MD	77.24	26.18	167.14	2.75%	4.94%
MASSACHUSETTS	Bristol	Boston, MA-NH	113.62	26.05	166.34	-1.61%	-2.85%
	Essex	Boston, MA-NH	118.56	26.04	166.23	-2.18%	-3.86%

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State	County	Metro Area	Sprawl Index Score	Expected BMI	Expected Weight	Percent difference in odds of hypertension from Average	Percent difference in odds of obesity from Average
	Hampden	Springfield, MA NECMA	108.58	26.07	166.45	-1.02%	-1.80%
	Hampshire	Springfield, MA NECMA	87.77	26.14	166.91	1.47%	2.63%
	Middlesex	Boston, MA-NH	121.56	26.03	166.17	-2.53%	-4.47%
	Norfolk	Boston, MA-NH	113.64	26.05	166.34	-1.61%	-2.85%
	Plymouth	Boston, MA-NH	100.26	26.10	166.64	-0.03%	-0.06%
	Suffolk	Boston, MA-NH	179.37	25.83	164.90	-9.01%	-15.49%
	Worcester	Boston, MA-NH	99.44	26.10	166.65	0.07%	0.12%
MICHIGAN	Bay	Saginaw-Bay City-Midland, MI	95.10	26.12	166.75	0.59%	1.05%
	Clinton	Lansing-East Lansing, MI	66.63	26.21	167.37	4.05%	7.33%
	Eaton	Lansing-East Lansing, MI	77.36	26.18	167.14	2.73%	4.92%
	Genesee	Detroit-Ann Arbor-Flint, MI	99.04	26.10	166.66	0.11%	0.20%
	Ingham	Lansing-East Lansing, MI	103.26	26.09	166.57	-0.39%	-0.69%
	Kent	Grand Rapids-Muskegon-Holland, MI	98.44	26.11	166.68	0.19%	0.33%
	Lapeer	Detroit, MI	71.56	26.20	167.27	3.44%	6.22%
	Livingston	Detroit-Ann Arbor-Flint, MI	82.72	26.16	167.02	2.08%	3.73%
	Macomb	Detroit, MI	107.27	26.07	166.48	-0.86%	-1.53%
	Midland	Saginaw-Bay City-Midland, MI	82.25	26.16	167.03	2.14%	3.84%
	Monroe	Detroit, MI	83.45	26.16	167.01	1.99%	3.57%
	Oakland	Detroit, MI	105.71	26.08	166.52	-0.68%	-1.20%
	Ottawa	Grand Rapids-Muskegon-Holland, MI	87.36	26.14	166.92	1.52%	2.72%
	Saginaw	Saginaw-Bay City-Midland, MI	96.22	26.11	166.72	0.45%	0.80%
	St.Clair	Detroit, MI	88.30	26.14	166.90	1.40%	2.51%
	Washtenaw	Detroit-Ann Arbor-Flint, MI	99.27	26.10	166.66	0.09%	0.16%
	Wayne	Detroit, MI	123.22	26.02	166.13	-2.72%	-4.80%
MINNESOTA	Anoka	Minneapolis-St Paul, MN-WI	95.92	26.11	166.73	0.49%	0.87%
	Carver	Minneapolis-St Paul, MN-WI	85.66	26.15	166.96	1.72%	3.09%
	Chisago	Minneapolis-St Paul, MN-WI	79.39	26.17	167.09	2.48%	4.47%
	Dakota	Minneapolis-St Paul, MN-WI	98.09	26.11	166.68	0.23%	0.41%
	Hennepin	Minneapolis-St Paul, MN-WI	119.74	26.03	166.21	-2.32%	-4.10%
	Isanti	Minneapolis-St Paul, MN-WI	70.12	26.20	167.30	3.62%	6.54%
	Ramsey	Minneapolis-St Paul, MN-WI	123.09	26.02	166.13	-2.71%	-4.78%
	Scott	Minneapolis-St Paul, MN-WI	90.36	26.13	166.85	1.15%	2.07%
	Washington	Minneapolis-St Paul, MN-WI	96.80	26.11	166.71	0.38%	0.68%
	Wright	Minneapolis-St Paul, MN-WI	79.85	26.17	167.08	2.43%	4.36%
MISSISSIPPI	De Soto	Memphis, TN-AR-MS	82.01	26.16	167.04	2.16%	3.89%
	Hinds	Jackson, MS	97.30	26.11	166.70	0.32%	0.58%
	Madison	Jackson, MS	80.16	26.17	167.08	2.39%	4.30%
	Rankin	Jackson, MS	81.66	26.16	167.04	2.21%	3.96%
MISSOURI	Cass	Kansas City, MO-KS	83.70	26.16	167.00	1.96%	3.52%
	Clay	Kansas City, MO-KS	98.39	26.11	166.68	0.19%	0.34%
	Franklin	St Louis, MO-IL	83.89	26.16	167.00	1.94%	3.48%

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State	County	Metro Area	Sprawl Index Score	Expected BMI	Expected Weight	Percent difference in odds of hypertension from Average	Percent difference in odds of obesity from Average
	Jackson	Kansas City, MO-KS	113.43	26.05	166.35	-1.58%	-2.81%
	Jefferson	St Louis, MO-IL	93.97	26.12	166.77	0.72%	1.29%
	Lafayette	Kansas City, MO-KS	85.00	26.15	166.97	1.80%	3.23%
	Platte	Kansas City, MO-KS	90.26	26.13	166.86	1.17%	2.09%
	Ray	Kansas City, MO-KS	74.60	26.19	167.20	3.07%	5.53%
	St. Charles	St Louis, MO-IL	108.45	26.07	166.46	-1.00%	-1.77%
	St. Louis	St Louis, MO-IL	118.14	26.04	166.24	-2.14%	-3.77%
NEBRASKA	Douglas	Omaha, NE-IA	118.10	26.04	166.24	-2.13%	-3.77%
	Sarpy	Omaha, NE-IA	101.76	26.09	166.60	-0.21%	-0.37%
	Washington	Omaha, NE-IA	76.51	26.18	167.16	2.84%	5.11%
NEVADA	Clark	Las Vegas, NV-AZ	114.46	26.05	166.32	-1.71%	-3.02%
NEW JERSEY	Bergen	Bergen-Passaic, NJ	130.41	26.00	165.97	-3.55%	-6.24%
	Burlington	Philadelphia, PA-NJ	101.58	26.09	166.61	-0.19%	-0.34%
	Camden	Philadelphia, PA-NJ	123.76	26.02	166.12	-2.79%	-4.91%
	Cumberland	Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD	94.16	26.12	166.77	0.70%	1.25%
	Essex	Newark, NJ	152.13	25.92	165.50	-6.02%	-10.46%
	Gloucester	Philadelphia, PA-NJ	101.53	26.09	166.61	-0.18%	-0.32%
	Hudson	New York-Northern New Jersey-Long Island, NY-NJ-CT-PA	190.06	25.79	164.66	-10.16%	-17.38%
	Hunterdon	Middlesex-Somerset-Hunterdon, NJ	81.28	26.16	167.05	2.25%	4.05%
	Mercer	New York-Northern New Jersey-Long Island, NY-NJ-CT-PA	116.27	26.04	166.28	-1.92%	-3.39%
	Middlesex	Middlesex-Somerset-Hunterdon, NJ	121.71	26.03	166.17	-2.55%	-4.50%
	Monmouth	Monmouth-Ocean, NJ	110.86	26.06	166.40	-1.28%	-2.28%
	Morris	Newark, NJ	101.20	26.10	166.62	-0.14%	-0.25%
	Ocean	Monmouth-Ocean, NJ	112.14	26.06	166.38	-1.43%	-2.54%
	Passaic	Bergen-Passaic, NJ	140.41	25.96	165.75	-4.70%	-8.21%
	Salem	Philadelphia, PA-NJ	89.71	26.14	166.87	1.23%	2.20%
	Somerset	Middlesex-Somerset-Hunterdon, NJ	97.01	26.11	166.71	0.36%	0.64%
	Sussex	Newark, NJ	91.77	26.13	166.82	0.98%	1.76%
	Union	Newark, NJ	136.13	25.98	165.85	-4.21%	-7.37%
	Warren	Newark, NJ	96.66	26.11	166.72	0.40%	0.71%
NEW MEXICO	Bernalillo	Albuquerque, NM	112.10	26.06	166.38	-1.43%	-2.53%
NEW YORK	Albany	Albany-Schenectady-Troy, NY	105.13	26.08	166.53	-0.61%	-1.08%
	Bronx	New York, NY	250.72	25.58	163.33	-16.42%	-27.35%
	Erie	Buffalo-Niagara Falls, NY	106.81	26.08	166.49	-0.81%	-1.43%
	Greene		76.67	26.18	167.15	2.82%	5.07%
	Kings	New York, NY	263.65	25.54	163.05	-17.70%	-29.31%
	Livingston	Rochester, NY	76.56	26.18	167.16	2.83%	5.10%
	Madison	Syracuse, NY	75.57	26.18	167.18	2.95%	5.31%
	Monroe	Rochester, NY	103.62	26.09	166.56	-0.43%	-0.76%
	Montgomery	Albany-Schenectady-Troy, NY	89.71	26.14	166.87	1.23%	2.21%
	Nassau	Nassau-Suffolk, NY	136.56	25.97	165.84	-4.26%	-7.46%

The average BMI for the population sampled was 26.1. This chart shows the difference in BMI that is expected due to sprawling development patterns, holding all other factors equal. The expected weight is based on a 5'7" person, the average height for the men and women sampled in the study.

State	County	Metro Area	Sprawl Index Score	Expected BMI	Expected Weight	Percent difference in odds of hypertension from Average	Percent difference in odds of obesity from Average
	New York	New York, NY	352.07	25.23	161.11	-25.92%	-41.40%
	Niagara	Buffalo-Niagara Falls, NY	98.52	26.11	166.67	0.18%	0.31%
	Onondaga	Syracuse, NY	101.73	26.09	166.60	-0.21%	-0.37%
	Ontario	Rochester, NY	79.85	26.17	167.08	2.43%	4.36%
	Orange	New York-Northern New Jersey-Long Island, NY-NJ-CT-PA	98.10	26.11	166.68	0.23%	0.40%
	Orleans	Rochester, NY	79.66	26.17	167.09	2.45%	4.41%
	Oswego	Syracuse, NY	83.93	26.16	166.99	1.93%	3.47%
	Putnam	New York, NY	92.69	26.13	166.80	0.87%	1.56%
	Queens	New York, NY	218.90	25.69	164.03	-13.19%	-22.28%
	Rensselaer	Albany-Schenectady-Troy, NY	99.04	26.10	166.66	0.11%	0.20%
	Richmond	New York, NY	162.89	25.88	165.26	-7.21%	-12.48%
	Rockland	New York, NY	110.19	26.06	166.42	-1.21%	-2.14%
	Saratoga	Albany-Schenectady-Troy, NY	88.90	26.14	166.89	1.33%	2.38%
	Schenectady	Albany-Schenectady-Troy, NY	108.87	26.07	166.45	-1.05%	-1.86%
	Suffolk	Nassau-Suffolk, NY	109.88	26.07	166.42	-1.17%	-2.07%
	Wayne	Rochester, NY	74.63	26.19	167.20	3.06%	5.52%
	Westchester	New York, NY	128.37	26.00	166.02	-3.32%	-5.84%
NORTH CAROLINA	Cabarrus	Charlotte-Gastonia-Rock Hill, NC-SC	89.47	26.14	166.87	1.26%	2.26%
	Davidson	Greensboro—Winston-Salem—High Point, NC	85.42	26.15	166.96	1.75%	3.14%
	Davie	Greensboro—Winston-Salem—High Point, NC	70.99	26.20	167.28	3.51%	6.34%
	Durham	Raleigh-Durham-Chapel Hill, NC	99.12	26.10	166.66	0.10%	0.19%
	Forsyth	Greensboro—Winston-Salem—High Point, NC	96.58	26.11	166.72	0.41%	0.73%
	Franklin	Raleigh-Durham-Chapel Hill, NC	76.50	26.18	167.16	2.84%	5.11%
	Gaston	Charlotte-Gastonia-Rock Hill, NC-SC	93.06	26.12	166.79	0.83%	1.48%
	Guilford	Greensboro—Winston-Salem—High Point, NC	97.26	26.11	166.70	0.33%	0.58%
	Lincoln	Charlotte-Gastonia-Rock Hill, NC-SC	78.56	26.17	167.11	2.58%	4.65%
	Mecklenburg	Charlotte-Gastonia-Rock Hill, NC-SC	96.82	26.11	166.71	0.38%	0.68%
	Orange	Raleigh-Durham-Chapel Hill, NC	86.21	26.15	166.94	1.65%	2.97%
	Randolph	Greensboro—Winston-Salem—High Point, NC	77.32	26.18	167.14	2.74%	4.93%
	Rowan	Charlotte-Gastonia-Rock Hill, NC-SC	87.22	26.14	166.92	1.53%	2.75%
	Stokes	Greensboro—Winston-Salem—High Point, NC	71.26	26.20	167.27	3.48%	6.28%
	Union	Charlotte-Gastonia-Rock Hill, NC-SC	75.93	26.18	167.17	2.91%	5.24%
	Wake	Raleigh-Durham-Chapel Hill, NC	95.89	26.11	166.73	0.49%	0.87%
	Yadkin	Greensboro—Winston-Salem—High Point, NC	69.17	26.21	167.32	3.74%	6.75%
OHIO	Butler	Cincinnati-Hamilton, OH-KY-IN	102.29	26.09	166.59	-0.27%	-0.48%
	Carroll	Canton-Massillon, OH	79.10	26.17	167.10	2.52%	4.53%
	Clark	Dayton-Springfield, OH	96.10	26.11	166.73	0.46%	0.83%
	Clermont	Cincinnati, OH-KY-IN	86.90	26.15	166.93	1.57%	2.82%
	Cuyahoga	Cleveland-Lorain-Elyria, OH	115.84	26.05	166.29	-1.87%	-3.30%
	Delaware	Columbus, OH	81.99	26.16	167.04	2.17%	3.89%
	Fairfield	Columbus, OH	85.77	26.15	166.95	1.71%	3.06%

The average BMI for the population sampled was 26.1. This chart shows the difference in BMI that is expected due to sprawling development patterns, holding all other factors equal. The expected weight is based on a 5'7" person, the average height for the men and women sampled in the study.

State	County	Metro Area	Sprawl Index Score	Expected BMI	Expected Weight	Percent difference in odds of hypertension from Average	Percent difference in odds of obesity from Average
	Franklin	Columbus, OH	116.72	26.04	166.27	-1.97%	-3.48%
	Fulton	Toledo, OH	66.83	26.21	167.37	4.03%	7.29%
	Geauga	Cleveland-Lorain-Elyria, OH	63.12	26.23	167.45	4.49%	8.13%
	Greene	Dayton-Springfield, OH	91.03	26.13	166.84	1.07%	1.92%
	Hamilton	Cincinnati, OH-KY-IN	112.45	26.06	166.37	-1.47%	-2.61%
	Lake	Cleveland-Lorain-Elyria, OH	96.84	26.11	166.71	0.38%	0.67%
	Licking	Columbus, OH	84.56	26.15	166.98	1.85%	3.33%
	Lorain	Cleveland-Lorain-Elyria, OH	94.50	26.12	166.76	0.66%	1.17%
	Lucas	Toledo, OH	111.48	26.06	166.39	-1.36%	-2.40%
	Madison	Columbus, OH	83.00	26.16	167.02	2.04%	3.67%
	Mahoning	Youngstown-Warren, OH	98.13	26.11	166.68	0.22%	0.40%
	Medina	Cleveland-Lorain-Elyria, OH	76.59	26.18	167.16	2.83%	5.09%
	Miami	Dayton-Springfield, OH	86.81	26.15	166.93	1.58%	2.84%
	Montgomery	Dayton-Springfield, OH	108.47	26.07	166.46	-1.00%	-1.78%
	Pickaway	Columbus, OH	84.74	26.15	166.98	1.83%	3.29%
	Portage	Cleveland-Akron, OH	83.97	26.16	166.99	1.93%	3.46%
	Stark	Canton-Massillon, OH	106.62	26.08	166.50	-0.78%	-1.39%
	Summit	Cleveland-Akron, OH	106.62	26.08	166.50	-0.79%	-1.39%
	Trumbull	Youngstown-Warren, OH	93.59	26.12	166.78	0.77%	1.37%
	Union		79.11	26.17	167.10	2.52%	4.53%
	Warren	Cincinnati, OH-KY-IN	89.95	26.13	166.86	1.20%	2.15%
	Wood	Toledo, OH	84.24	26.15	166.99	1.89%	3.40%
OKLAHOMA	Canadian	Oklahoma City, OK	81.11	26.16	167.06	2.27%	4.09%
	Cleveland	Oklahoma City, OK	95.07	26.12	166.75	0.59%	1.05%
	Creek	Tulsa, OK	91.30	26.13	166.83	1.04%	1.86%
	Logan	Oklahoma City, OK	80.83	26.17	167.06	2.31%	4.15%
	McClain	Oklahoma City, OK	79.97	26.17	167.08	2.41%	4.34%
	Oklahoma	Oklahoma City, OK	106.31	26.08	166.50	-0.75%	-1.33%
	Osage	Tulsa, OK	98.63	26.10	166.67	0.16%	0.29%
	Pottawatomie	Oklahoma City, OK	88.26	26.14	166.90	1.41%	2.52%
	Rogers	Tulsa, OK	87.03	26.14	166.93	1.56%	2.79%
	Tulsa	Tulsa, OK	108.64	26.07	166.45	-1.02%	-1.81%
	Wagoner	Tulsa, OK	88.89	26.14	166.89	1.33%	2.38%
OREGON	Clackamas	Portland-Vancouver, OR-WA	98.45	26.11	166.68	0.18%	0.33%
	Multnomah	Portland-Vancouver, OR-WA	131.41	25.99	165.95	-3.67%	-6.44%
	Washington	Portland-Vancouver, OR-WA	108.29	26.07	166.46	-0.98%	-1.74%
	Yamhill	Portland-Vancouver, OR-WA	98.23	26.11	166.68	0.21%	0.38%
PENNSYLVANIA	Adams		81.01	26.17	167.06	2.29%	4.11%
	Allegheny	Pittsburgh, PA	120.99	26.03	166.18	-2.47%	-4.35%
	Beaver	Pittsburgh, PA	105.52	26.08	166.52	-0.66%	-1.16%
	Bucks	Philadelphia, PA-NJ	100.15	26.10	166.64	-0.02%	-0.03%

The average BMI for the population sampled was 26.1. This chart shows the difference in BMI that is expected due to sprawling development patterns, holding all other factors equal. The expected weight is based on a 5'7" person, the average height for the men and women sampled in the study.

State	County	Metro Area	Sprawl Index Score	Expected BMI	Expected Weight	Percent difference in odds of hypertension from Average	Percent difference in odds of obesity from Average
	Carbon	Allentown-Bethlehem-Easton, PA	93.99	26.12	166.77	0.72%	1.28%
	Chester	Philadelphia, PA-NJ	89.84	26.13	166.87	1.22%	2.18%
	Columbia	Scranton—Wilkes-Barre—Hazleton, PA	92.46	26.13	166.81	0.90%	1.61%
	Cumberland	Harrisburg-Lebanon-Carlisle, PA	97.64	26.11	166.69	0.28%	0.50%
	Dauphin	Harrisburg-Lebanon-Carlisle, PA	113.77	26.05	166.34	-1.63%	-2.88%
	Delaware	Philadelphia, PA-NJ	125.34	26.01	166.09	-2.97%	-5.23%
	Fayette	Pittsburgh, PA	98.66	26.10	166.67	0.16%	0.28%
	Lackawanna	Scranton—Wilkes-Barre—Hazleton, PA	111.01	26.06	166.40	-1.30%	-2.31%
	Lancaster	Lancaster, PA	94.09	26.12	166.77	0.71%	1.26%
	Lebanon	Harrisburg-Lebanon-Carlisle, PA	102.33	26.09	166.59	-0.28%	-0.49%
	Lehigh	Allentown-Bethlehem-Easton, PA	119.67	26.03	166.21	-2.31%	-4.08%
	Luzerne	Scranton—Wilkes-Barre—Hazleton, PA	107.09	26.08	166.49	-0.84%	-1.49%
	Monroe		86.35	26.15	166.94	1.64%	2.94%
	Montgomery	Philadelphia, PA-NJ	107.06	26.08	166.49	-0.84%	-1.49%
	Northampton	Allentown-Bethlehem-Easton, PA	110.65	26.06	166.41	-1.26%	-2.23%
	Perry	Harrisburg-Lebanon-Carlisle, PA	82.91	26.16	167.02	2.05%	3.69%
	Philadelphia	Philadelphia, PA-NJ	187.78	25.80	164.71	-9.92%	-16.98%
	Washington	Pittsburgh, PA	100.95	26.10	166.62	-0.11%	-0.20%
	Westmoreland	Pittsburgh, PA	100.53	26.10	166.63	-0.06%	-0.11%
	Wyoming	Scranton—Wilkes-Barre—Hazleton, PA	78.64	26.17	167.11	2.57%	4.63%
	York	York, PA	94.78	26.12	166.76	0.62%	1.11%
RHODE ISLAND	Bristol	Providence-Fall River-Warwick, RI-MA	118.66	26.04	166.23	-2.20%	-3.88%
	Kent	Providence-Fall River-Warwick, RI-MA	115.99	26.04	166.29	-1.89%	-3.33%
	Providence	Providence-Fall River-Warwick, RI-MA	130.56	25.99	165.97	-3.57%	-6.27%
	Washington	Providence-Fall River-Warwick, RI-MA	92.45	26.13	166.81	0.90%	1.61%
SOUTH CAROLINA	Aiken	Augusta-Aiken, GA-SC	86.39	26.15	166.94	1.63%	2.93%
	Berkeley	Charleston-North Charleston, SC	90.12	26.13	166.86	1.18%	2.12%
	Charleston	Charleston-North Charleston, SC	110.28	26.06	166.42	-1.22%	-2.16%
	Dorchester	Charleston-North Charleston, SC	87.82	26.14	166.91	1.46%	2.62%
	Greenville	Greenville-Spartanburg-Anderson, SC	94.35	26.12	166.77	0.68%	1.21%
	Lexington	Columbia, SC	86.41	26.15	166.94	1.63%	2.92%
	Pickens	Greenville-Spartanburg-Anderson, SC	83.78	26.16	167.00	1.95%	3.50%
	Richland	Columbia, SC	101.86	26.09	166.60	-0.22%	-0.39%
	Spartanburg	Greenville-Spartanburg-Anderson, SC	86.73	26.15	166.93	1.59%	2.85%
	York	Charlotte-Gastonia-Rock Hill, NC-SC	84.11	26.15	166.99	1.91%	3.43%
TENNESSEE	Anderson	Knoxville, TN	90.20	26.13	166.86	1.17%	2.10%
	Blount	Knoxville, TN	89.51	26.14	166.87	1.26%	2.25%
	Carter	Johnson City-Kingsport-Bristol, TN-VA	97.93	26.11	166.69	0.25%	0.44%
	Cheatham	Nashville, TN	74.75	26.19	167.20	3.05%	5.50%
	Davidson	Nashville, TN	101.17	26.10	166.62	-0.14%	-0.25%
	Dickson	Nashville, TN	80.92	26.17	167.06	2.30%	4.13%

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State	County	Metro Area	Sprawl Index Score	Expected BMI	Expected Weight	Percent difference in odds of hypertension from Average	Percent difference in odds of obesity from Average
	Grainger		80.10	26.17	167.08	2.40%	4.31%
	Hamilton	Chattanooga, TN-GA	99.83	26.10	166.65	0.02%	0.04%
	Hawkins	Johnson City-Kingsport-Bristol, TN-VA	86.81	26.15	166.93	1.58%	2.84%
	Jefferson		82.45	26.16	167.03	2.11%	3.79%
	Knox	Knoxville, TN	99.34	26.10	166.66	0.08%	0.14%
	Robertson	Nashville, TN	77.32	26.18	167.14	2.74%	4.93%
	Rutherford	Nashville, TN	85.34	26.15	166.96	1.76%	3.16%
	Sevier	Knoxville, TN	88.16	26.14	166.90	1.42%	2.54%
	Shelby	Memphis, TN-AR-MS	103.98	26.09	166.55	-0.47%	-0.84%
	Sullivan	Johnson City-Kingsport-Bristol, TN-VA	93.28	26.12	166.79	0.80%	1.43%
	Sumner	Nashville, TN	87.09	26.14	166.93	1.55%	2.77%
	Tipton	Memphis, TN-AR-MS	77.54	26.18	167.14	2.71%	4.88%
	Unicoi	Johnson City-Kingsport-Bristol, TN-VA	104.18	26.09	166.55	-0.50%	-0.88%
	Union	Knoxville, TN	84.39	26.15	166.98	1.87%	3.36%
	Washington	Johnson City-Kingsport-Bristol, TN-VA	92.36	26.13	166.81	0.91%	1.63%
	Williamson	Nashville, TN	83.12	26.16	167.01	2.03%	3.64%
	Wilson	Nashville, TN	78.67	26.17	167.11	2.57%	4.63%
TEXAS	Bexar	San Antonio, TX	112.72	26.06	166.36	-1.50%	-2.66%
	Brazoria	Houston-Galveston-Brazoria, TX	96.02	26.11	166.73	0.48%	0.85%
	Collin	Dallas, TX	101.00	26.10	166.62	-0.12%	-0.21%
	Comal	San Antonio, TX	92.67	26.13	166.80	0.88%	1.57%
	Dallas	Dallas, TX	114.55	26.05	166.32	-1.72%	-3.04%
	Denton	Dallas, TX	98.68	26.10	166.67	0.16%	0.28%
	El Paso	El Paso, TX	110.26	26.06	166.42	-1.21%	-2.15%
	Ellis County	Dallas, TX	88.64	26.14	166.89	1.36%	2.44%
	Fort Bend	Houston, TX	100.63	26.10	166.63	-0.08%	-0.13%
	Galveston	Houston-Galveston-Brazoria, TX	109.98	26.07	166.42	-1.18%	-2.09%
	Guadalupe	San Antonio, TX	91.01	26.13	166.84	1.08%	1.92%
	Harris	Houston, TX	113.25	26.05	166.35	-1.56%	-2.77%
	Hays	Austin-San Marcos, TX	88.93	26.14	166.88	1.33%	2.37%
	Hidalgo	McAllen-Edinburg-Mission, TX	100.30	26.10	166.64	-0.04%	-0.06%
	Johnson	Fort Worth-Arlington, TX	89.94	26.13	166.86	1.20%	2.16%
	Kaufman	Dallas, TX	88.42	26.14	166.90	1.39%	2.49%
	Liberty	Houston, TX	85.00	26.15	166.97	1.80%	3.23%
	Montgomery	Houston, TX	88.10	26.14	166.90	1.43%	2.56%
	Parker	Fort Worth-Arlington, TX	80.94	26.17	167.06	2.29%	4.12%
	Rockwall	Dallas, TX	90.98	26.13	166.84	1.08%	1.93%
	Tarrant	Fort Worth-Arlington, TX	110.62	26.06	166.41	-1.26%	-2.23%
	Travis	Austin-San Marcos, TX	106.79	26.08	166.49	-0.80%	-1.43%
	Waller	Houston, TX	94.45	26.12	166.76	0.66%	1.18%
	Williamson	Austin-San Marcos, TX	98.61	26.10	166.67	0.17%	0.30%

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State	County	Metro Area	Sprawl Index Score	Expected BMI	Expected Weight	Percent difference in odds of hypertension from Average	Percent difference in odds of obesity from Average
UTAH	Davis	Salt Lake City-Ogden, UT	107.27	26.07	166.48	-0.86%	-1.53%
	Salt Lake	Salt Lake City-Ogden, UT	114.43	26.05	166.32	-1.70%	-3.01%
	Weber	Salt Lake City-Ogden, UT	106.07	26.08	166.51	-0.72%	-1.28%
VIRGINIA	Chesapeake city	Norfolk-Virginia Beach-Newport News, VA-NC	103.17	26.09	166.57	-0.38%	-0.67%
	Chesterfield	Richmond-Petersburg, VA	93.89	26.12	166.78	0.73%	1.30%
	Dinwiddie	Richmond-Petersburg, VA	72.45	26.19	167.25	3.33%	6.02%
	Fairfax	Washington, DC-MD-VA-WV	117.81	26.04	166.25	-2.10%	-3.70%
	Gloucester	Norfolk-Virginia Beach-Newport News, VA-NC	82.82	26.16	167.02	2.07%	3.71%
	Goochland	Richmond-Petersburg, VA	67.59	26.21	167.35	3.93%	7.11%
	Hanover	Richmond-Petersburg, VA	74.97	26.19	167.19	3.02%	5.45%
	Henrico	Richmond-Petersburg, VA	100.73	26.10	166.63	-0.09%	-0.16%
	James City	Norfolk-Virginia Beach-Newport News, VA-NC	90.41	26.13	166.85	1.15%	2.05%
	Loudoun	Washington, DC-MD-VA-WV	94.57	26.12	166.76	0.65%	1.16%
	New Kent	Richmond-Petersburg, VA	76.49	26.18	167.16	2.84%	5.11%
	Norfolk city	Norfolk-Virginia Beach-Newport News, VA-NC	131.92	25.99	165.94	-3.73%	-6.54%
	Portsmouth city	Norfolk-Virginia Beach-Newport News, VA-NC	124.93	26.01	166.09	-2.92%	-5.15%
	Powhatan	Richmond-Petersburg, VA	72.48	26.19	167.25	3.33%	6.01%
	Prince George	Richmond-Petersburg, VA	105.81	26.08	166.51	-0.69%	-1.23%
	Prince William	Washington, DC-MD-VA-WV	99.98	26.10	166.64	0.00%	0.00%
	Richmond city	Richmond-Petersburg, VA	127.18	26.01	166.04	-3.18%	-5.60%
	Scott	Johnson City-Kingsport-Bristol, TN-VA	89.47	26.14	166.87	1.26%	2.26%
	Stafford	Washington, DC-MD-VA-WV	87.90	26.14	166.91	1.45%	2.60%
	Suffolk city	Norfolk-Virginia Beach-Newport News, VA-NC	89.16	26.14	166.88	1.30%	2.32%
	Virginia Beach city	Norfolk-Virginia Beach-Newport News, VA-NC	113.91	26.05	166.34	-1.64%	-2.91%
	Washington	Johnson City-Kingsport-Bristol, TN-VA	94.38	26.12	166.77	0.67%	1.20%
	York	Norfolk-Virginia Beach-Newport News, VA-NC	110.62	26.06	166.41	-1.26%	-2.23%
WASHINGTON	Clark	Portland-Vancouver, OR-WA	103.44	26.09	166.57	-0.41%	-0.73%
	King	Seattle-Bellevue-Everett, WA	118.01	26.04	166.25	-2.12%	-3.75%
	Pierce	Seattle-Tacoma-Bremerton, WA	107.59	26.07	166.48	-0.90%	-1.60%
	Snohomish	Seattle-Bellevue-Everett, WA	100.73	26.10	166.63	-0.09%	-0.15%
WISCONSIN	Dane	Madison, WI	102.46	26.09	166.59	-0.29%	-0.52%
	Kenosha	Chicago-Gary-Kenosha, IL-IN-WI	106.16	26.08	166.51	-0.73%	-1.30%
	Milwaukee	Milwaukee-Waukesha, WI	132.54	25.99	165.93	-3.80%	-6.67%
	Ozaukee	Milwaukee-Waukesha, WI	88.43	26.14	166.90	1.39%	2.48%
	Racine	Milwaukee-Racine, WI	103.10	26.09	166.57	-0.37%	-0.66%
	St. Croix	Minneapolis-St Paul, MN-WI	76.22	26.18	167.16	2.87%	5.17%
	Washington	Milwaukee-Waukesha, WI	80.75	26.17	167.06	2.32%	4.17%
	Waukesha	Milwaukee-Waukesha, WI	90.44	26.13	166.85	1.14%	2.05%

The average BMI for the population sampled was 26.1. This chart shows the difference in BMI that is expected due to sprawling development patterns, holding all other factors equal. The expected weight is based on a 5'7" person, the average height for the men and women sampled in the study.

Smart Growth America is a coalition of nearly 100 advocacy organizations that have a stake in how metropolitan expansion affects our environment, quality of life and economic sustainability. Our diverse coalition partners include national, state and local groups working on behalf of the environment, historic preservation, social equity, land conservation, neighborhood redevelopment, farmland protection, labor, town planning, and public health. SGA'a website provides introductory and in-depth information on all aspects of smart growth. Visit **www.smartgrowthamerica.org**

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