

Evaluating if the Built Environment has a Substantial Effect on Obesity in Fayette County, Kentucky

Will Warren
Capstone Project Spring 2007

Table of Contents

1.0 Executive Summary.....	3
2.0 Introduction.....	4
• 2.1 Obesity.....	5
• 2.2 Urban Sprawl.....	7
• 2.3 Fayette County Urban Development.....	8
3.0 Literature Review.....	11
4.0 Data and Methods.....	16
• 4.1 Study Area.....	16
• 4.2 Computation of Body Mass Indexes (BMI).....	17
• 4.3 Dependent Variable.....	18
• 4.4 Independent Variables.....	19
5.0 Analysis.....	20
6.0 Limitations.....	22
7.0 Conclusions and Recommendations.....	24
8.0 References.....	26
9.0 Appendix A (Growth Map).....	29
10.0 Appendix B (Urban Service Area Map).....	30
11.0 Appendix C (Zip Code Map).....	31

1.0

Executive Summary

- Background:** Obesity is a major health issue in the United States and Fayette County. As Fayette County has become increasingly obese, it too has had an issue of sprawl within its urban service area and beyond. Relationships between obesity and aspects of the built environment are continuing to be studied.
- Objective:** To evaluate the impact certain factors may have on the body mass index of Fayette County residents, in particular whether urban sprawl has an overriding impact on the weight of residents.
- Methods:** The study area used was Fayette County, which was broken down into its fourteen zip code areas for analysis. Body Mass Index (BMI) averages were calculated from a phone survey for fifty residents in each of Fayette County's fourteen ZIP code areas. A linear regression analysis was performed. The dependent variable used was BMI, with the independent variables being density (sprawl), distance from the downtown area, walking to work, driving to work, educational attainment, income level, and race.
- Results:** Several factors in the study were shown to increase the BMI level in Fayette County, with urban sprawl slightly being one of those factors. However, due to the small sample size of my study, and possible other factors, the results were found to be insignificant. Further research possibly needs to be conducted in order to obtain valid results.
- Conclusion:** It has been widely observed that urban sprawl is associated with higher rates of obesity. This observation has led many researchers to infer that urban sprawl causes obesity. This study examined the impact certain factors may have on the body mass index of Fayette County residents, in particular whether urban sprawl has an overriding impact on the weight of residents. Due to lack of significance, this study needs to be extended in order to make any inferences.

2.0 Introduction:

Throughout the 20th century Lexington has experienced the same growing pains as have many other cities in the United States. With urban sprawl, businesses and residents have migrated to the fringes of the city. Lexington's downtown area experienced a significant decline during the last half of the 20th century. Sprawl has become a major policy issue for Fayette County. With this issue, among the main topics has been farmland and historic preservation. Although these issues are important and deal with the economic future of the city, the health of the citizens is sometimes forgotten. More recently, the health of communities has been in question due to urban sprawl. One major issue that has experienced significant research recently is the effect urban sprawl has had on the weight of citizens in built environments. As Lexington-Fayette County continues to sprawl its obesity rates, coincidentally, continue to rise as well. (1) Obesity is the number two cause of death behind tobacco use in the country and Fayette County, having a significant impact on healthcare costs. (1) The purpose of this study is to examine the possible connection between patterns of urban land development and weight. The research questions answered will be:

- Does the fact that Lexington-Fayette County is becoming increasingly more urbanized and sprawling have a contributing effect on the weight of an individual?
- Are there other factors to take into consideration that are more significant than sprawl when determining the cause of obesity in Lexington-Fayette County?

Throughout the remainder of the introduction I will explain obesity, urban sprawl, and what Fayette County has done with the issue of urban sprawl. In the next section I will explain the relevant literature associated with this study. Following the literature review will be the methods, the analysis, and the conclusion.

2.1 Obesity:

The Center for Disease Control and Prevention defines overweight and obesity as labels for ranges of weight that are greater than what is generally considered healthy for a given height. A person is said to be overweight if their body mass index (BMI) is 25-29.9, and a person is considered obese if their BMI is 30 or above. The BMI of an individual is calculated by their height and weight. Obesity is an individual clinical condition and is increasingly viewed as a serious public health problem. Since the mid-seventies, the prevalence of overweight and obesity has increased sharply for both adults and children. Data from two National Health and Nutrition Examination Surveys (NHANES) show that among adults aged 20–74 years the prevalence of obesity increased from 15.0% (in the 1976–1980 survey) to 32.9% (in the 2003–2004 survey). (1) According to the CDC, nearly two-thirds of all Americans are either overweight or obese. Kentucky has adult obesity rates of 26.7 percent, ranking it the 5th heaviest in the nation, according to a new report by Trust for America's Health. (2) The state is one of 31 states where obesity rates rose in the past year. While 18 states and the District of Columbia remained statistically the same from last year, every state still exceeds the government's national goal to reduce obesity rates to 15 percent by the year 2010. No state experienced a decrease. In nationwide rankings, Mississippi is the heaviest state, with an adult obesity

rate of 29.5 percent and Colorado is the least heavy state, with an adult obesity rate of 16.9 percent. (2)

Obesity is a growing public health crisis, so much so that it is often referred to as the “new tobacco.” (3) Overweight and obesity and their associated health problems have a significant economic impact on the U.S. health care system. (4) In 2004 a report was released by the CDC that increased the estimate of obesity-related deaths to 400,000 (5). However, a recent analysis presented in the *Journal of the American Medical Association (JAMA)* by Katherine Flegal of the CDC and her colleagues calls the severity of the dangers of excess body fat into question, indicating that the number of overweight and obesity-related deaths is actually about 26,000—about one fifteenth the earlier estimate of 400,000. (6) It is also important to point out that there is no argument about medical expenditures related to obesity. According to a study of national costs attributed to both overweight (BMI 25–29.9) and obesity (BMI greater than 30), medical expenses accounted for 9.1 percent of total U.S. medical expenditures in 1998 and may have reached as high as \$78.5 billion (\$92.6 billion in 2002 dollars). (7) Approximately half of these costs were paid by Medicaid and Medicare. Kentucky’s estimated annual obesity-attributed medical expenditures (in 2003 dollars) are \$1.1 billion with \$340 million paid by Medicaid.(7) This represents 6.2% of Kentucky’s adult medical expenditures, 7.5% of Medicare expenditures, and 11.4% of Medicaid expenditures.

Paul Ernsberger, a professor of nutrition at Case Western Reserve University, has been doing research since the 1980s that led him to assert that obesity is not the cause of ill health but rather the effect of sedentary living and poor nutrition, which are the actual causes. (8) There is little argument about the fact that, as a nation, more of us are fatter

than ever before; the disagreement lies in the effect that this has on our health. The campaign to convince us to lose weight gained much of its momentum in 2004; not only were there high-profile public health initiatives devoted to stopping the obesity epidemic, but the idea had pervaded popular culture as well. Movies like Morgan Spurlock's *Super Size Me* (9) were the topic of many a discussion, and there were regular news reports about the dangers of too much fat. One of the biggest policy issues that surfaced during this same time was the idea that the built environment or "urban sprawl" was a cause of obesity.

2.2 Urban Sprawl:

According to Donald Williams in *Urban Sprawl: a reference handbook*, William H. Whyte first used the term "urban sprawl" in an essay in 1958. (10) The presence of urban sprawl, however, has been around for centuries. Defining sprawl is never an easy task as there is no widely accepted definition. For the purpose of this paper we will use the definition presented by David C. Soule, "Sprawl is low density, auto-dependent land development taking place on edges of urban centers, often "leapfrogging" away from current denser development nodes, to transform open, undeveloped land, into single family residential subdivisions and campus style commercial office parks and diffuse retail uses." (11) Urban sprawl has become a major policy issue over the last several decades in the United States. In a 2000 poll of urban residents by the Pew Center for Civic Journalism, sprawl was rated, along with crime and violence, as the most important local issue. (12) In another poll by Smart Growth America in 2000, 78 % of Americans stated that they support efforts by government to limit sprawl. (13) According to the U.S.

Census Bureau, the population of the U.S. in 1980 was 231,106,727, in the year 2000 it had increased to 286,196,812, and as of April 11, 2007 it has reached 301,589,665. According to the same 2000 census, 79% of the population lived in urban areas. (14) As populations continue to grow, especially in urban areas, further urban sprawl is likely. Kentucky's population has increased by a little over 10% in this same time period. (14) In 2006 Kentucky became considered for the first time more urban than rural as over 50% of the population lived in an urban community. (15) Many of the states and metropolitan areas that have the highest levels of urban sprawl are located in the south, according to the sprawl index used by Ewing. As obesity is also found to be more prevalent in the south, this association was one of the first links between levels of urban sprawl and the risk for being obese or overweight.

2.3 Fayette County Urban Development:

Sprawl has been no less of an issue for Fayette County and its residents. Fayette County's population has increased by an average of 30,000 residents a decade since 1950, and as of 2005 the county has 260,080 residents. (See Appendix A) (14) Coincidentally, in 1958 Lexington-Fayette County's City-County Planning and Zoning Commission adopted a comprehensive plan amendment that dramatically influenced planning in Lexington. Upon the advice of the city planning consulting firm, Ladislav Segoe, the Commission defined and established the first "Urban Service Area" in the United States. (See Appendix B) This concept delineates the location of urban growth by dividing the county into an Urban Service Area, where development is encouraged, and a Rural Service Area, where urban-oriented activities are not permitted. Areas of

future growth within the Urban Service Area were identified so that “complex urban services and facilities, public and private, could be developed logically and economically.” In the 1960s and early 1970s, the city began to develop detailed neighborhood area plans for all land in the Urban Service Area. Detailed economic and demographic projections were prepared, as were plans for expansion of public and private facilities throughout the Urban Service Area. The *1980 Comprehensive Plan* focused on the evolving perspective of the growth management process as a tool to guide and coordinate the many public and private development activities that impact the community’s urban fabric.

Lexington-Fayette County has long been aware of the problems associated with uncontrolled sprawl development, particularly with regard to the potentially devastating effects of urban growth on valuable agricultural, horse farm, natural, cultural, and scenic resources. Looking toward the future of Lexington-Fayette County from 1980 to 2000, the community formulated a Growth Planning System to accommodate the projected population, while simultaneously preventing sprawl and maintaining horse farms, agricultural lands and environmentally sensitive areas. The *1988 Comprehensive Plan* provided direction to shape the growth, maintenance and redevelopment of the community.

Again in 1996, the Lexington-Fayette Urban County Government (LFUCG) was on the cutting edge of land use planning. During the preparation of the *1996 Comprehensive Plan*, new concepts for the Urban County emerged. The *Expansion Area Master Plan (EAMP)* was developed in response to the development pressures experienced by the community and the resultant expansion of the Urban Service Area boundary. The detailed

EAMP is intended to provide lands for development and conservation in the designated planning areas. Density and design criteria for housing, town center oriented shopping areas, public facilities, infrastructure, boulevards, greenways and open space were defined for each of the Expansion Areas in order to create livable, cost effective, aesthetic, and safe and travel efficient neighborhoods with a clear sense of community identity. The combined process of developing the *1996 Comprehensive Plan* and the *EAMP* made the community aware of the necessity of looking at the County as a whole. These two planning efforts took place in tandem with the development of a parallel *Rural Service Area Land Management Plan (RLMP)*, which includes a strategy to define areas in the County appropriate for development and areas to be preserved in perpetuity. While being considered a minor update, the *2001 Plan Update* process included a careful review of the policies and strategies set forth in the *1996 Plan* and its amendments. (16) Now in 2007 there is another push to decide whether to expand the urban service area once again or build within the now present service area.

Even with the present policy, the Lexington-Fayette County metropolitan area ranks 10th in sprawl among metro areas with a population above 250,000 and less than 1,000,000 and 27th overall among the 227 measured sprawling metros, according to the USA Today sprawl index. (17) In contrast, the Lexington-Fayette County metropolitan area is listed only slightly above average (for a metro its size) for sprawl, according to Lopez's sprawl index. (18) In the only two sprawl indexes that list Lexington-Fayette County, regardless of its rank, it is above average in sprawl (for a metro its size). In an interview, Jim Duncan of the Long Term Planning Division of the LFUCG stated that because of the increasing population in Fayette County, the city had an estimated 9 years

of future growth within the Urban Service Area. (19) If policy stays the same and the population continues to increase, Fayette County will eventually be forced into further expansion. As Fayette County has developed in this time period, until recently, little attention has been given to the health concerns of citizens impacted by urbanization. This study focuses on Fayette County to see if urbanization or sprawl has had an effect on the body weights of its residents.

3.0 Literature Review:

Recent research has begun to focus on the link between public health and the built environment in an effort to combat increasing rates of overweight and obesity found in many Westernized nations. The CDC released a report that connected urban sprawl and obesity. (20) Others also have concluded that urban sprawl contributes to obesity, but they have not provided factual evidence to support these claims. (21, 22) However, others maintain that urban sprawl is not associated with obesity and argue that affluence and lower-population densities encourage physical activity. (23) It is useful, however, to examine a few of the more prominent efforts.

A study published in the *American Journal of Public Health* in September of 2004 by Russ Lopez, claims the obesity epidemic has many causes but there is an association between urban sprawl and obesity. Lopez conducted a multi-level study, combining data from the metropolitan level and individual level. Lopez's model used BMI as the dependent variable and the independent variables used were the sprawl index along with

controls for gender, race, income, education, and age. Lopez collected his individual level data from the 2000 Behavioral Risk Factor Surveillance System (BRFSS). Lopez suggested that there was no data to show the variability of sprawl within a metropolitan area, but data from Ewing allowed one to see the variability of sprawl within a metropolitan area at the county level. Lopez's study has no data to reflect how urban sprawl may vary across a metropolitan area, or how urban sprawl may affect people differently. Metropolitan areas are not homogenous but differ from inner city to older suburb to outer suburb. (24) Urban sprawl may affect people living, working, or both in these different areas differently. My study attempts to control for this variety of neighborhood characteristics.

One of the more comprehensive examinations of the topic, as stated above, is by Ewing (2003). This is 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 found that people living in counties marked by sprawling development are likely to walk less, have higher blood pressure and weigh more than people who live in less sprawling counties. These results hold true after controlling for factors such as age, education, gender, and race and ethnicity. However, the author states that the degree of sprawl does not influence whether people get any exercise in their leisure hours. "Activity level" must not be interpreted as physical activity as the study did not find a statistically significant relationship between overall exercise and the degree of sprawl. (25) Hence, my study does not delve into this area of daily physical activity being more essential than daily exercise and I did not have the required information for daily exercise among

participants. Actually, research by the CDC found that the main reasons given for not exercising were lack of structures and facilities and fears about safety (20).

Ewing uses a cross sectional and ecologic research design to relate degree of sprawl within counties to levels of physical activity, obesity, body mass index, hypertension, diabetes, and coronary heart disease. This information was taken from the CDC BRFSS surveys for 1998, 1999, and 2000. Although all the data were self reported, as in my particular study, the study had an overall sample size of 206,992 respondents from 448 counties and 175,609 respondents from 83 metropolitan areas. This gave individual counties sample sizes ranging from 6 to 6,429. Ewing's study looks at counties and metropolitan regions, large areas compared to the living and working environments of most people. Ewing himself explains that the effect of the built environment is strongest on a smaller scale. (25) My study tries to capture this by dividing the county into smaller geographical regions by zip codes.

One study on the neighborhood level used walking monitors on individuals to see the difference in high walk ability and low walk ability neighborhoods related to BMI levels. In this study of two nonadjacent neighborhoods in San Diego, Saelens found that sprawl-like characteristics in neighborhoods resulted in adverse effects on physical activity and BMI. (26) Frank conducted another study considering more finely defined neighborhoods, looking at various neighborhood characteristics independent of each other. He studied the likelihood of obesity in a sample of Atlanta residents, employing an individual specific sprawl measure. Street connectivity and land use mix were measured in a 1 kilometer buffer surrounding each respondent's residence. The study found that

residents of mixed use neighborhoods tend to be less obese. However, Frank also states, “to date, little research had been performed that uses individual level data and objective measures of the built environment at a scale relevant to those individuals. Even though we address some of these limitations, the current cross sectional study also cannot show causation.” (27)

One of the more prominent studies done to show that correlation between sprawl and obesity does not imply causation is by Plantinga and Bernell (2005). The study attempts to correct for the sorting of people into neighborhoods. Using cross-sectional data, they allow obesity and landscape characteristics to be simultaneously determined by estimating a two equation model, one in which weight affects landscape and one in which landscape affects weight. It concludes that landscape has only a very small effect on weight, and that weight has a measurable effect on the choice of residential landscape. (28) Although this study addresses the question of whether people choose a neighborhood based on their weight, it still does not follow individual changes of address and weight over time. A lesser known study that actually uses data that tracks individuals over time to study the relationship between urban sprawl and obesity also found no evidence that urban sprawl causes obesity. (29) Although my study does not track individuals over time (for lack of time in performing the study) to see if obese individuals choose to live in sprawling areas as opposed to becoming obese as a cause, it does control for other factors such as economic status, race, and demographics.

There are several sprawl indexes used in studies to show the relationship between sprawl and obesity. Ewing developed a sprawl index based on four measures of

population density and two measures of street block size. The study then regresses BMI on the sprawl index for the individual's county of residence plus variables controlling for gender, age, race, education, smoking status, and diet. (25) Lopez constructs a metropolitan area index based on population density and estimates the effects of the sprawl index and a similar set of individual level variables on the probability that individuals are obese. In both studies, the sprawl index is found to be significantly related to BMI. In particular, residents of counties in metropolitan areas with higher sprawl indices have systematically higher BMI and greater probability of being obese. Released in 2001, the USA Today sprawl index used population density as its only indicator of sprawl. As seen by these studies, sprawl indexes are quite subjective and at the creator's discretion in the ways that they are constructed. The Lopez study and the USA Today studies are the only two that list the Lexington-Fayette County metropolitan statistical area. Both list Lexington above average in sprawl, with the USA Today index listing Lexington-Fayette County much higher. (17, 18)

Two studies that found differing results were performed by Frank and Ross. Frank claims the built environment is found to be the leading factor associated with obesity. Other factors such as driving time and walking were also found to be important. The study basically concludes that the built environment has a higher degree of association with obesity than income, education and age. (27) Ross on the other hand finds that inclusion in the lowest income group is more important than the built environment. (30)

It is evident that the literature is growing, but there does not seem to be consensus on the nature of the relationship between the built environment and obesity. Findings to

date, point to the fact that variables other than sprawl and the built environment are important and it is difficult to identify which are the most important factors. Clearly diet and exercise are important factors but perhaps their measurement is not as precise as the measurement for variables that are used to assess the built environment. Most sprawl measures are relatively accurate and readily available or not difficult to access.

4.0 Data and Methods:

4.1 Study Area:

The study area included Fayette County and its residents. Fayette County residential areas were broken down into 14 geographical regions by zip codes. The zip codes used for this analysis were 40502, 40503, 40504, 40505, 40507, 40508, 40509, 40510, 40511, 40513, 40514, 40515, 40516, and 40517.

(See Appendix C for Zip Code Map)

The objective of the study was to see what factors affected obesity rates in Fayette County, in particular was density the most contributing factor. In order to test this theory, a correlation matrix was performed on the 14 zip code areas using data collected from two primary sources, the U.S. Bureau of the Census and individual surveys taken by phone. The phone surveys were a random sampling from the Lexington-Fayette County residential phone book and were taken in order to obtain the BMI averages for each zip code. In the phone survey the respondent was asked to take part in an academic study on

weight issues in Fayette County by giving their height, weight, and zip code. Only the height, weight, and zip code of each individual was recorded. A sample of 50 respondents from each zip code was taken to arrive at the average BMI levels for each zip code.

4.2 Computation of Body Mass Indexes (BMIs):

BMI is calculated the same way for both adults and children. The calculation is based on the following formulas:

$$\text{BMI} = \text{weight (lb)} / [\text{height (in)}]^2 \times 703$$

Calculating BMI requires dividing weight in pounds (lbs) by height in inches (in) squared and multiplying by a conversion factor of 703. Example: Weight = 150 lbs, Height = 5'5" (65") Calculation: $[150 \div (65)^2] \times 703 = 24.96$. The standard weight status categories associated with BMI ranges for adults are shown in the following table:

Height	Weight Range	BMI	Weight Status
5' 9"	124 lbs or less	Below 18.5	Underweight
	125 lbs to 168 lbs	18.5 to 24.9	Normal
	169 lbs to 202 lbs	25.0 to 29.9	Overweight
	203 lbs or more	30 or higher	Obese

Source: Center for Disease Control

Recently, questions have been raised regarding the appropriate range for normal and the consequences of being in the overweight category. The Journal of American Medical Association suggests that individuals in the overweight category do not have a higher mortality rate than those in the normal range. (31) This implies that the normal range might be too narrowly defined. This study, however, is more focused on geographic patterns than precise interpretation of the BMI statistic. We will leave the interpretation of the BMI level to others.

The correlation matrix model had a single dependent variable and 7 independent variables.

4.3 Dependent Variable: (Self reported survey taken by the author)

- **Body Mass Index** average for zip code area (Calculated by author)

Zip	Pop	BMI
40502	26,695	25.65
40503	27,420	27.65
40504	24,564	28.49
40505	26,313	27.61
40507	2,106	23.25
40508	27,220	28.06
40509	20,322	27.14
40510	1,236	25.88
40511	18,179	28.26
40513	8,300	24.02
40514	11,303	26.77
40515	29,577	27.92
40516	2,386	28.25
40517	35,767	27.31

4.4 Independent Variables: (2002 Census information from U.S. Bureau of Census, for zip code areas)

Urban Characteristics

There were two urban characteristics used in order to describe the built environment. These were population density and the distance from downtown Lexington in miles. Population density is included to capture the density of development in the area. Distance from downtown Lexington is measured from the center downtown to the center of the zip code region in question.

Mode in Work Trip

The mode in the journey to work is included to further indirectly assess the built environment and the likelihood of physical activity in the commute. The three modes that make up most of the commuters were walk, driving or car passenger, and using public transportation. Public transit was excluded from the study because of the miniscule amount of participants in each zip code region.

Socioeconomic Status

Socioeconomic status is included to account for the economic status of a zip code region. It includes people with a bachelor's degree and the median household income in the region.

Personal Characteristics

Personal information is included to account for the type of society that may be prone to being obese. The characteristic included in this category was race. Black, White, and Hispanic make up most of the percentage of race in the Lexington-Fayette County area, with Blacks and Hispanics being more susceptible to being overweight. Because there were a smaller percentage of Blacks and Hispanics they were lumped together in this category.

The independent variables are limited to the information found on the Bureau of Census 2000 Census information. Note again that while we have individual data on BMI, an average is used and the correlation matrix is conducted on data aggregated to Zip code areas. The analysis, therefore, leads to observations about the characteristics of Zip code areas and not of individuals.

List of Independent Variables in the Study

Variable	Abbreviation
<i>Urban Characteristics</i>	
Population density (pop/mi ²)	Density
Distance from downtown Lexington (miles)	Distance
<i>Mode in work trip</i>	
Percent walk to work	Walk
Percent driving or car passenger to work	Drive
Percent using public transportation to work	Transit (excluded)
<i>Socioeconomic characteristics</i>	
Percent with bachelors degree	College
Median household income (1000s\$)	Income
<i>Personal characteristics</i>	
Percent Black	Black
Percent Hispanic	Hisp

5.0 Analysis:

The ranking of the Fayette County zip code areas from lowest to the highest BMI indexes are as follow: (See Appendix B for Zip Code Areas)

Rank	Zip	Pop	BMI
1	40507	2,106	23.25
2	40513	8,300	24.02
3	40502	26,695	25.65
4	40510	1,236	25.88
5	40514	11,303	26.77
6	40509	20,322	27.14
7	40517	35,767	27.31
8	40505	26,313	27.61
9	40503	27,420	27.65
10	40515	29,577	27.92
11	40508	27,220	28.06
12	40516	2,386	28.25
13	40511	18,179	28.26
14	40504	24,564	28.49

The lowest BMI index is found in the core of the city, 40507, as was expected. The highest BMI index was found in the 40504 zip code area, which is only 2 miles from the core of the city. The only other zip code area that was in the normal BMI range was 40513, which is on the far west end of the county. No zip code area averages were in the obese range, but the rest were viewed as overweight. There was no relevant ordering of the zip codes overall. Areas furthest from the inner city had high BMI indexes, such as 40511 on the North side of the county, and areas close to the inner city had high BMI indexes as well, such as 40508 making the outer ring around the inner core. This was also true for low BMI indexes, which were found to be both far and near to the inner core of the city.

In an effort to better understand the geographic variations in ZIP-code BMI levels, a correlation matrix was performed.

	bmi	density	distance	walk	drive	college	income	blackhisp
bmi	1.0000							
density	-0.0877	1.0000						
distance	0.2326	-0.8003	1.0000					
walk	-0.3584	0.4608	-0.6561	1.0000				
drive	0.3868	-0.4320	0.6633	-0.9949	1.0000			
college	-0.3657	-0.1299	0.3040	-0.3468	0.3371	1.0000		
income	-0.1221	-0.6285	0.7174	-0.6769	0.6750	0.5937	1.0000	
blackhisp	0.1637	0.0394	-0.2564	0.5536	-0.5608	-0.7991	-0.6109	1.0000

In a correlation matrix, the closer the variable value is to 1.000 the higher the correlation between the two. As seen from the correlation matrix no variables are particularly correlated or show a sign of significance to BMI. Of particular interest in the correlation matrix, however, is the sign of the variables. Those that have a negative sign indicate that as this variable increases the BMI is expected to decline.

This is true for population density (sprawl), walk to work, college education, and income level. The more people walk to work, the better educated, and the higher the income level are all factors that have been seen to cause obesity to decrease in populations. Of particular interest to this study BMI decreases as population density increases, but as stated previously, there is almost no correlation between the two. The positive signs in the correlation matrix are distance from the city's core, drive to work, and race. These have also been shown to cause BMI levels to increase. With little to no correlation in the matrix there is no reason to run a regression analysis on the data. I did try to perform a stepwise regression, however, to see the validity in this statement and it showed no significance. The possible reasons for this lack of correlation and significance in the study can be found in the limitations section to follow.

6.0 Limitations:

There are several limitations to the analysis of the research study. One of the most overriding limitations was the collection of the BMI data. Originally the driver's license information for all residents in Fayette County was to be obtained (because of the use of height and weight in determining BMI) in order to provide a more comprehensive sampling of individuals from each zip code area. After several attempts to obtain this data from Fayette County and the State of Kentucky, it was found that the information could not be obtained. Because of the factor of time, the subsequent result of 50 people per zip code area was used. In order to reduce a

sampling error more individuals may have been used. Furthermore, the information for BMI data was self reported. It is very likely that the majority of the individuals may have exaggerated in either direction on their heights and weights, or that they were unsure. This is referred to as a respondent error and may have affected the overall averages of the fourteen samples.

A coverage error also occurs when certain groups of subjects are excluded from the listing of surveyed individuals. People that do not have a phone line had no chance of being selected in the survey. This selection bias may have led to a misrepresentation of the actual population.

Another limitation to the study was impacted by time as well. The USA today sprawl index reported the Lexington-Fayette County metropolitan area as being the 10th most sprawling metro of its population size. The population size used in the index was 453,450, which includes the entire metropolitan statistical area. The study, however, just used the area and residents within Fayette County, which has a population of 260,080 residents. Due to this there was only a sample size of 14 (zip code areas). This small sample size was a possible cause for the lack of significance found in the study. Because of time and lack of information it was not possible to obtain the records for the six surrounding county areas that make up the Lexington-Fayette County metropolitan statistical area used in the sprawl index. In order to have a more comprehensive study it would be necessary to use all zip codes in the entire metropolitan statistical area. At this level, it may make the study much more significant.

7.0 Conclusion and Recommendations:

It has been widely observed that urban sprawl is associated with higher rates of obesity. This observation has led many researchers to infer that urban sprawl causes obesity. This study examined the impact certain factors may have on the body mass index of Fayette County residents, in particular whether urban sprawl has an overriding impact on the weight of residents. The signs of the results were as expected, although there was little correlation. Density, walk to work, college education, and income level all had negative signs which meant that as these variables increase the BMI rate goes down. Distance, drive to work, and race, all showed positive signs which was also expected. Unfortunately none of the variables in the study were found to be correlated or significant, most likely due to the fact of such a small sample size.

More studies in the past have shown a positive relationship between urban sprawl and BMI levels. The studies have shown an increase in BMI with a more sprawling built environment. The effect of urban sprawl on weight has important consumer policy implications. Higher medical costs associated with higher BMIs and higher prevalence of consumer obesity is incentive to manage sprawl in order to reduce related health care costs. Because diet and exercise habit are mostly individual choices, there are limited options for public intervention to control BMI (or obesity). Consumer advocates need to encourage growth policies that discourage urban sprawl. Such efforts will help in the long run to constrain medical costs through reduced

obesity. Studies have also shown which demographic groups are most likely to be overweight, so policy efforts to reduce sprawl can be targeted to areas that are most apt to benefit. The built environment in which we live can be adapted towards a healthier community.

Further research is needed in order to view the significance of this study. The study needs to be extended outside Fayette County into the six surrounding counties as well. This would show the sprawl that has taken place from residents that once lived in Fayette County and now reside in the six surrounding counties, either due to overcrowding or lifestyle preference. These zip code areas could be included in the study, which would make for a larger number of observations. Since an average BMI level is used in the study for zip code areas, the larger the individual responses the better in order to rid the study from possible validity threats and outweigh the unknown bias. Although this study neither contradicts nor supports past research on the impact of sprawl on obesity, extending this research may very well do so. There may be possible benefits in determining if Lexington-Fayette County's built environment should be adapted for healthier living.

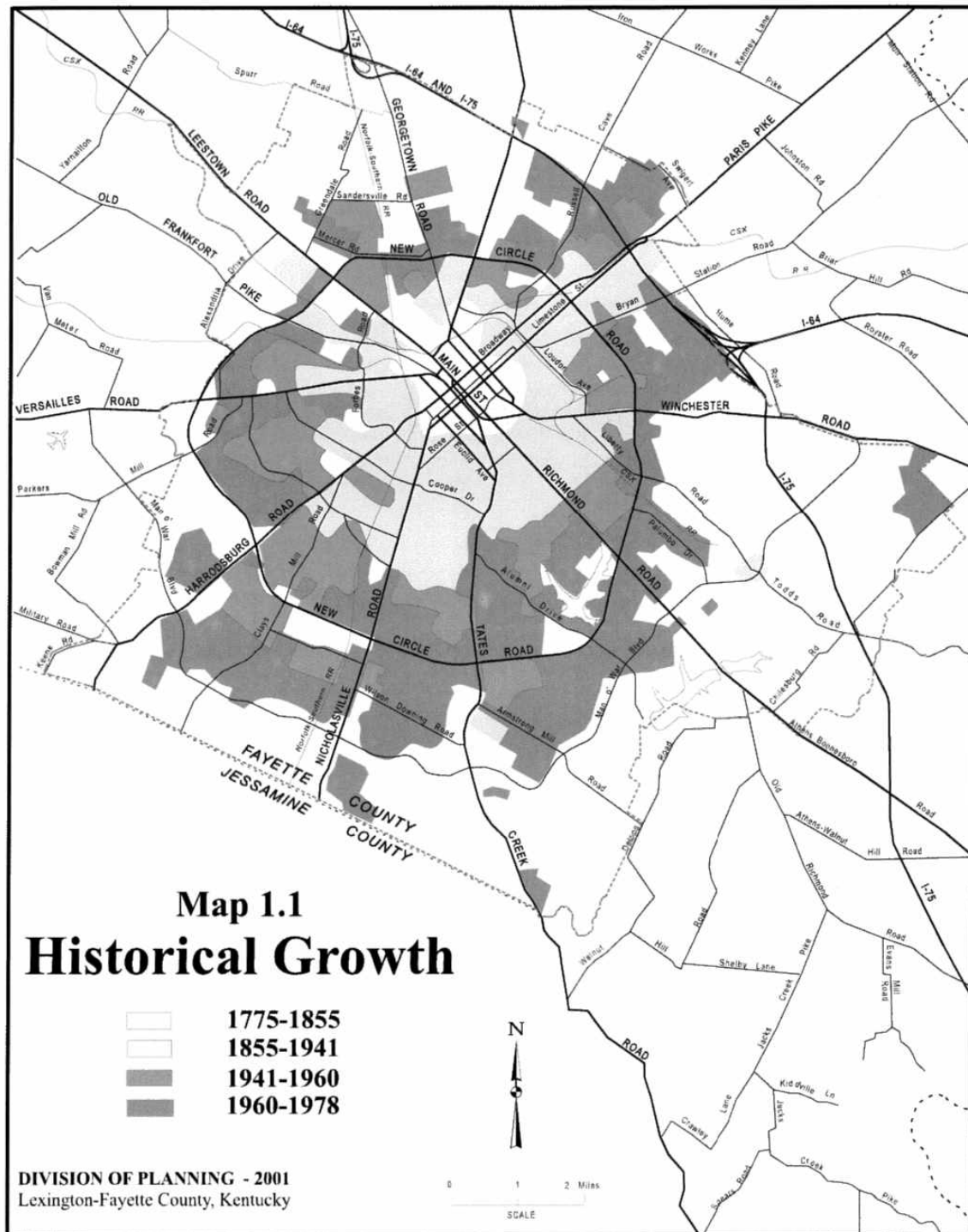
References

- 1) Center for Disease Control and Prevention. *Overweight and Obesity: Home*.
<http://www.cdc.gov/nccdphp/dnpa/obesity/index.htm>
- 2) Trust for America's Health. "Kentucky Ranks 5th Heaviest in the Country, According to a New Report That Finds America's Obesity Epidemic is Getting Worse."
Washington, D.C. August 29, 2006. Available at:
<http://healthyamericans.org/reports/obesity2006/release.php?StateID=KY>
- 3) Heart and Stroke Foundation. "Heart and Stroke Foundation Warns Fat is the New Tobacco", Heart and Stroke Foundation. Available at:
<http://ww2.heartandstroke.ca/Page.asp?PageID=33&ArticleID=2916&Src=new&From=SubCategory>
- 4) U.S. Department of Health and Human Services. The Surgeon General's call to action to prevent and decrease overweight and obesity. [Rockville, MD]: U.S. Department of Health and Human Services, Public Health Service, Office of the Surgeon General; [2001]. Available from: US GPO, Washington.
- 5) Mokdad AH, Marks JS, Stroup DF, et al.: Actual causes of death in the United States, 2000. *Journal of American Medical Association (JAMA)* 291: 1238–1245, 2004.
- 6) Flegal KM, Graubard BI, Williamson DF, et al.: Excess deaths associated with underweight, overweight, and obesity. *JAMA* 293:1861–1867, 2005.
- 7) Finkelstein, EA, Fiebelkorn, IC, Wang, G. "State-level Estimates of Annual Medical Expenditures Attributable to Obesity." *Obesity Research* 2004; 12(1):18–24.
- 8) Ernsberger, Paul. The epidemiology of overweight and obesity: public health crisis or moral panic? *Int J Epidemiol*. 2006 Feb; 35(1):55-60. Epub 2005 Dec 8. Also published papers available at:
http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=PureSearch&db=PubMed&details_term=Ernsberger%20P%5BAuthor%5D
- 9) Spurlock, Morgan. *Super Size Me*. Release Date May 21, 2004. Official Website:
<http://www.supersizeme.com/>
- 10) Williams, Donald C. 2000. *Urban Sprawl: A Reference Handbook*. Santa Barbara, CA: ABC-CLIO.
- 11) Soule, David C. 2006. *Urban Sprawl: A Comprehensive Reference Guide, Defining and Managing Sprawl*. Westport, Connecticut: Greenwood Press.

- 12) Pew Center for Civic Journalism. Research - Straight Talk From Americans – 2000, A National Survey for the Pew Center for Civic Journalism conducted by Princeton Survey Research Associates. http://www.pewcenter.org/doingcj/research/r_ST2000.html
- 13) Belden, Russonello and Stuart. National Survey on Growth and Land Development September 2000 for Smart Growth America. <http://www.smartgrowthamerica.org/poll.pdf>
- 14) U.S. Bureau of the Census. <http://www.census.gov>
- 15) Personal Communication with Steve Austin, Executive Director of Bluegrass Tomorrow (February 23, 2007).
- 16) Lexington-Fayette County Urban Government. 2001 Comprehensive Plan, <http://www.lfucg.com/adminsvcs/planning/CompPlan.asp>
- 17) USA Today. Sprawl Index Study. <http://www.usatoday.com/news/sprawl/main.htm>
- 18) Lopez, Russ and H. Patricia Haynes. “Sprawl in the 1990’s: Measurement, Distribution, and Trends.” *Urban Affairs Review*, January 38(3): pp. 325-355.
- 19) Personal Communication with Jim Duncan, Long Range Planning Director for Lexington Fayette Urban County Government (January 31, 2007).
- 20) Jackson R, Kochitzky C. *Creating a Healthy Environment: The Impact of the Built Environment on Public Health*. Washington DC: Sprawl Watch Clearinghouse; 2002.
- 21) Pierce N. Fight Fat with Well-Planned Communities. *The Charlotte Observer*. April 28, 2001:21.
- 22) Kreling C. Fat city. *Planning*. 2001(June): 4-9.
- 23) O’Toole R. Special interests run with faulty obesity data. *Cascade Commentary*. 2002;9:1.
- 24) Lopez, Russ. 2004. “Urban Sprawl and Risk for Being Overweight or Obese.” *American Journal of Public Health*, September 94(9): pp. 1574-1579.
- 25) Ewing, R., Schmid, T., Killingsworth, R., Zlot, A., and S. Raudenbush. 2003. “Relationship Between urban Sprawl and Physical Activity, Obesity, and Morbidity,” *American Journal of Health Promotion*, Sept./Oct., 47-57.
- 26) Saelens, Brian E., James F. Sallis, Jennifer B. Black, and Diana Chen. 2003. “Neighborhood-Based Differences in Physical Activity: An Environment Scale Evaluation.” *American Journal of Public Health*, September 93(9): pp. 1552-1558.

- 27) Frank, L.D., Engelke, P.O., and T.L. Schmid. 2003. *Health and Community Design: The Impact of the Built Environment on Physical Activity*. Washington, DC: Island Press.
- 28) Plantinga, Andrew J., and Stephanie Bernell. 2005. The Association Between Urban Sprawl and Obesity: Is it a Two Way Street?. *Journal of Regional Science* 45(3):473-492.
- 29) Eid, Jean, Henry G. Overman, Diego Puga, and Matthew A. Turner. 2006. "Fat City: The Relationship Between Urban Sprawl and Obesity." Working Paper, in submission.
- 30) Ross C, Dunning A. *Land Use Transportation Interaction: An Examination of the 1995 NPTS Data*. Washington, DC: Federal Highway Administration: 1997.
- 31) Williams, Joanne, PhD, Melissa Wake, MD, Kylie Hesketh, BA, Elise Maher, PhD, and Elizabeth Waters, DPhil. "Health Related Quality of Life of Overweight and Obese Individuals." *JAMA* 2005; 293: 70-76.

Appendix A



Appendix B

