Fat and Getting Fatter:

An Analysis of Obesity Rates, Income and Population Density

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I. INTRO

In the past two decades, the United States has seen the problem of obesity grow from a major crisis into an epidemic. The most recent National Health and Nutrition Evaluation Survey (NHANES III) released by the Center for Disease Control revealed that between 1980 and 1994 obesity among adults increased by 50%. A follow-up study conducted in 1998 showed a 49.8% increase in adult obesity between 1991 and 1998, with some regions like the South Atlantic and the Pacific showing increases of 67.2% and 66.8%, respectively. This same 1998 study found that 17.5% of all adults in the United States were obese, or in medical terms, thirty percent above their ideal body weight.

Because obesity has been found to be associated with a variety of risk factors for cardiovascular disease, such as hypertension, elevated cholesterol, and type 2 diabetes, as well as an increased risk of cancer and other diseases, the recent upward trend in obesity signals a deterioration of American health. The epidemic has reached such alarming levels that the risk factors associated with obesity cause 300,000 deaths annually, second only to tobacco. In addition to the human death toll, the costs associated with obesity have been estimated at almost $100 billion per year, or approximately 8% of the national health care budget. (Dietz 2000).

What has caused this steady increase in the American people's waistlines over the past two decades? Many different factors have been examined in the field of public health to try to answer this question. Stunkard and Sobal (1989) found that there is a strong inverse relationship between socioeconomic status and obesity. Socioeconomic status (SES) was generally determined by one's income and education levels. In their review of 144 SES/obesity studies, it was found that lower income levels resulted in

higher levels of obesity. In support of these findings, French and Jeffrey (1996) argued that low-SES subjects had a lack of access to healthy foods, safe exercise and sound nutritional knowledge which caused their higher rates of obesity. The introduction of this "access hypothesis" offered one explanation for why income has an effect on obesity levels.

Another explanation of this relationship is the physical activity levels of the subjects. Regular physical exercise has repeatedly demonstrated beneficial results on health. Since changes in body weight are the direct result of changes in energy balance, more physical activity will result in a decrease in body weight. Studies done on this particular variable have found a direct relationship between socioeconomic status and physical activity. Ford et al. (1991) found that higher SES women spent significantly more time each week in leisure-time, job-related, and household physical activity than lower SES women. In males, a higher socioeconomic status implied higher levels of leisure time physical activity. The lower physical activity levels caused by lower levels of income, results in higher rates of obesity.

Other factors contributing to obesity include cultural influence, genetic influence, television viewing, and fast-food intake. Certain cultural norms (i.e. thinness not being equated with beauty) or cultural cuisines (i.e. Southern cooking) could possibly be causes of rising obesity (French and Jeffrey 1996). The role of genetics could also be a major factor in explaining obesity rates, since many twin studies have found that genes play a stronger role in determining one's body mass index than social forces such as income, diet, and physical activity levels (Price et al. 1987) (Stunkard et al. 1990). Finally, the

increase of television viewing and fast food consumption has also been cited as a cause of rising obesity levels in the United States (Jeffrey and French 1998).

While all of the factors from previous studies provide useful explanations of changes in obesity levels, they fall short in explaining the whole story of the recent U.S. trend. In a decade of economic growth and rising income, obesity has risen dramatically. This is puzzling when researchers have found that there is an inverse relation between income and obesity. Similarly, televisions and fast-food have been around since the United States' leaner years and it is hard to see how they could account for the rise in obesity. There has to be some other factor driving these forces.

This paper argues that current "location patterns" produced by suburban sprawl are a primary cause of rising obesity rates. New location patterns are such that work, school and social activities are not as easily accessible by foot. As a result, the physical activity levels of the people living in these sprawl areas falls causing obesity to rise. The effect has been so significant it has evidently offset the downward pull that a rising national income has on obesity levels.

II. RESULTS

Data for this study was obtained for all 50 states in order to provide a cross-sectional analysis of the obesity epidemic. The dependent variable (percentage of obese adults) was gathered from the NHC's Behavioral Risk Factor Surveillance System of 1997. All of the other variables used to explain obesity were obtained from the Statistical Abstract of the United States for 1990 and 1996. The first regression was a 50 state cross-sectional regression of obesity for 1996. Its aim was to explain what factors are

most significant in determining the obesity level of a state. The second regression examined how the change in the independent variables from 1990 to 1996, affected the change in obesity rates for the 50 states from 1991 to 1998. Data for the change in obesity levels was only available for the period of 1991-1998. It was collected from research by the Centers for Disease Control and Prevention reported in a 1998 New York Times article (Kolata 1998), and included data for 45 of the 50 states.

MODEL 1 – CROSS SECTIONAL ANALYSIS

Five different independent variables were chosen in order to explain the obesity levels among the 50 states. Data for these variables was compiled for the year 1996 for all 50 states. All of the variables in this regression have been cited repeatedly in public health literature as significant factors contributing to the obesity rate of a particular sample. The aim of the regression was to see which variables were the best in explaining the obesity rate (% of obese adults) of a state.

The five variables in this first regression were per capita income, population density, average summer temperature, percentage of the population that is black, and the percentage of the population over the age of 65. Stunkard and Sobal (1989) and French and Jeffery (1996) show that income is inversely related with obesity levels. Higher average summer temperatures in a state may allow for more physical activity and also lower obesity levels. The latter two variables in the model, the percentage of the black race in the population and the percentage of the population over 65 have been shown to be positively correlated with obesity rates (Burke 1996) (Kuczmarski 1992). The effect of population density on obesity is ambiguous. Higher density may allow for better

parks. Moreover, older central cities with high density often have a pedestrian friendly layout. On the other hand, new location patterns that are generally unfriendly to pedestrians also increase density.

The results of the multiple regression are reported in Table 1. Since population density is highly correlated to the income variable, we estimate the equations using a two-stage least squares (2SLS) procedure. Consequently, the density variable considers only the variation in density that is not explained by changes in income. Overall, a significant portion of the variation in the dependent variable (obesity rate for 1997) is explained (R-square = 0.29, adjusted R-square = 0.205). The model as a whole ends up being very useful in explaining obesity levels (F-value = 3.44, t-value = .0108). As expected, income per capita exerted a significant negative effect on the obesity rate, while the percentage of the population in the black race and the percentage of the population over 65 both had significant positive effects on the dependent variable. Population density (residual) has no effect on the obesity rate. Similarly, the average summer temperature variable has no effect on obesity levels.

TABLE 1

Regression Coefficients and t-values

Constant	20.150 (3.79) **
Income	-0.0002 (-2.45) *
Population density	-0.0016 (-0.90)
% black in population	0.127 (3.18) **
summer temperature	-0.07 (-1.11)
% of population over 65	0.418 (2.23)*
	n=50
	R-squared = 29%

(* = significant at the .05 level, ** = significant at the .01 level).

MODEL II – CHANGES IN OBESITY LEVELS

Given the results of the cross-sectional analysis, this study turns to the examination of the factors contributing to changes in obesity levels. This model is of particular interest because it provides possible explanations for why recent obesity levels in the United States have changed so dramatically. While the first regression provides a static view of what causes obesity to be at a certain level, the second regression offers a glimpse into what is causing obesity rates to rise.

The independent variables in this model represent the change in their values from the year 1990 to 1996. The dependent variable represents the percentage change in obesity levels from 1991 – 1998 for 45 of the 50 states. No data was available for these five states.[i] All of the variables used in the cross-sectional model were used in this model, except for average summer temperature. Once again, because of the relationship between population density and income the equation was estimated using a two-stage least squares method.

As can be seen from Table 2, this model yielded some very interesting results. The overall model was not as strong as the cross-sectional regression (R-squared = 0.209, Adjusted R-squared = 0.13). However, the model was still useful in accounting for the changes in obesity levels from 1991 –1998 (F-value = 2.65, t = 0.04). Once again, income played a very significant role in the regression. Changes in income among the states from 1990 to 1996 had a significant negative effect on changes in obesity rates. The income variable's strong performance in both models validates it as a very important negative influence on obesity rates. Since income per capita has been on the rise in the

past decade, however, there has to be some other factor offsetting its downward pull and accounting for the recent rise in obesity.

From the results of this second regression, change in population density seems to be that factor. In the model, this variable surprisingly exerted a significant positive effect on changes in obesity levels among the 45 states examined. This result is very much in accordance with the United States recent epidemic, since there has been nationwide increases in population densities (especially in the Southern States) accompanied by an almost two-fold increase in the national obesity level. Two possibilities exist in explaining the positive relationship between changes in population density and changes in obesity levels. One possibility is that people are moving to high obesity areas (i.e. Southern States) and picking up bad habits like lack of dietary restraint and indulgence in high fat foods. This explanation, however, cannot be the case because change in population density and the obesity rate for 1997 are negatively correlated ($r = -0.30$, $p = .03$). This means that people are actually moving away from high-obesity areas.

The second possibility is that higher population density captures the new location patterns that are considerably displaced from a "town center". This makes it more difficult to reach one's work, school, or place of socialization by foot. Because the size of states is fixed, changes in population density reflect population growth. Consequently, fast growth (new location patterns) is associated with increases in obesity rates. The results of this suburban sprawl are decreases in physical activity levels and changes in lifestyle that promote more sedentary behavior (i.e. increase in television viewing). These changes cause obesity levels to reach the alarming levels they have reached in the United States in the past decade.

The other two variables in this model (changes in % black and changes in the percentage of the population over 65) were not significant.

TABLE 2

Regression Coefficients and t-values

Constant	72.22 (7.45) **
Change in income	-70.17 (-2.35) *
Change in population density	115.23 (2.14) *
Change in % black	-20.44 (-0.85)
Change in % population over 65	-37.16 (-0.70)
	n = 45
	R-squared = 20.9%

(* = significant at the 0.05 level, ** = significant at the 0.01 level)

III. CONCLUSION

The dramatic rise in obesity levels over the past decade gives public health officials reason for concern. As they watch the national obesity statistics increase year by year, the field of public health scrambles to find the best solution to stop this dangerous epidemic. While most proposals focus on changing the nation's diet and exercise routine, this study suggests that more attention should be given to the source of the problem: suburban sprawl.

The rising population densities in the United States are causing people to move to new "location patterns" which are not as "pedestrian friendly". As the nation becomes more reliant on cars to reach their destinations, their physical activity levels decrease and

lifestyles become more sedentary. Since lack of physical activity has been cited many times as a factor contributing to higher obesity levels, its decrease in this scenario explains the recent rise in obesity rates.

A possible policy implication of this study is that city officials across the country should discourage the development of residential areas that are significantly displaced from a "town center". This change would put more of the population in areas where they can walk to their different daily activities. Thus, changes in location patterns could be the answer to the obesity problem.

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NOTES

[i] The five states that were not included in the second regression were Arkansas, Kansas, Nevada, Rhode Island and Wyoming