Impact of Access to Healthy Food and Lifestyle on Obesity: The Evidence from U.S. Counties

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Abstract: The intent of the present article is to measure the economic impact of access to healthy food on obesity. This study uses a linear regression econometrics model to achieve this purpose. Obesity is considered as the dependent variable and a number of other factors such as the number and availability of farmers markets and Community Supported Agriculture programs in the U.S., the number and accessibility of fast food restaurants, and the availability of recreation and fitness facilities are considered as independent variables. Using the USDA county level data, the results show that beyond access to healthy food, many other factors explain the observed variations in obesity rates in the model. Moreover, the results indicate that the increase of household income and the increase of full service restaurants both have a negative impact on obesity rate. It was also observed that age plays a significant role in explaining obesity with people over 65 who likely eat healthier than people under the age of 18. This study also discusses the factors contributing to the change in obesity rates in order to promote a quality healthy life.

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1. Introduction

Obesity is defined as a medical condition in which excess body fat has accumulated to the extent that it may have an adverse effect on health (WHO, 2000). Obesity is both an important health issue as well as an economic one that the world has faced since mid-1950s. Numerous studies have been conducted since to find out how this problem can be handled. In 2014, the Harvard School of Public Health made the following statement on its website dedicated to obesity: "Once just a problem of wealthy nations, obesity now impacts countries at all economic levels, bringing with it a wave of ill health and lost productivity". This is to warn individuals as well as countries as a whole to this serious issue.

The World Health Organization (WHO) reported in 2010 that obesity was a danger for the entire globe. From developed countries to developing countries, there is no exception even though the rate varies within nations. Since the mid-1950s, medical societies have observed and measured the excessive weight gains among different populations. In the U.S., 9.7% of people were obese in 1960 (Bird, 2013). In England, only 1% of men and 2 % of women were classed as obese in the 1960s compared to today's 25.2% for men and 27.7% for women (Wardrop, 2010). In France, 10% of population were declared obese and near 40% overweight in 2012 (OECD, 2012).

In 2008, the WHO estimated that more than 1.4 billion adults, 20 and older, were overweight. Of these overweight adults, over 200 million men and 300 million women were obese. These numbers indicate that more than 10% of the world population was obese at that time. This problem does not affect only adults, it also affects children. In 2011, the WHO

counted more than 40 million children under the age of five with obesity or overweight. More than 30 million of these overweight children were living in developing countries.

Financially and medically, overweight and obesity cost a significant amount of money for both public institutions and families. In 2013, the WHO reported that obesity was the fifth leading cause of deaths in the world. The same source estimates that 2.8 million adults die each year due to overweight or obesity. Medical professionals attribute 44% of the diabetes burden, 23% of the ischemic heart disease burden, and between 7% and 41% of certain cancer burdens to overweight and obesity (United States Department of Health, 2010).

The National Institute of Health in the U.S. reported in 2013 that an excessive gain of weight is due to multiple factors such as unhealthy food, lack of physical activities, and/or natural ability to become obese due to family medical history, among other factors. It is important to notice that in every case listed above, food plays a central role. Financially, the solution to obesity or being overweight costs a lot of money for both individuals and governments. Medical, psychology, and nutritionist researchers in different societies have spent a lot of time to find out what is needed to be done in order to lower its prevalence. This problem is a worldwide issue even though developed countries are leading the world in percentages of people living with obesity.

This article examines the link between obesity and lack of access to healthy lifestyle. We assume that unhealthy food is in the center of the obesity epidemic due to the development of nations that brought a change in lifestyle and eating habits.

2. Literature review

As mentioned in the introduction, a number of researchers spent a lot of time examining the causes of obesity and overweight. In December 2011, Caplan weight management and obesity symposium editor reported that the prevalence of obesity was 30%. This number is double what it was 20 years ago. 15% of children and adolescents were overweight, and this number has tripled over the same period. In his article, he predicts that the prevalence of obesity is expected to double again in the next 30 years.

Financially, obesity and overweight costs a significant amount of money to both individuals and societies. Often physicians have significant management costs to deal with it. In 1990, the estimated cost of spending on diet programs, products, and foods in the United States was at $30 billion. This number has now doubled at $61 billion (Langland and James, 2013). Health providers associate a number of diseases with overweight and obesity, such as diabetes, high blood pressure (hypertension), high cholesterol (hypercholesterolemia), stroke (cerebrovascular accident or CVA), heart attack, congestive heart failure, cancer, gallstones, gout and gouty arthritis, osteoarthritis (degenerative arthritis) of the knees, hips, and the lower back, and sleep apnea (Balentine, 2012).

In 2010, Bonanno and Goetz examined the relationship between obesity and a panel of parameters that have been analyzed previously by others researchers. They claimed that their analysis included a new comprehensive array of food-providing restaurants including limited and full service restaurants. This study was limited in scope to only one U.S. state. The conclusion from their study showed that the density of food store across states matters.

In 2012, Evans et al analyzed the dramatic increase of health issues in Cook County, Illinois, and the surrounding city of Chicago. The evidence that came out of their study showed that some diseases, including obesity, were also the consequence of unhealthy behaviors, such as choosing unhealthy food or non-participation in physical activities. This study used data from Cook County only and some places surrounding Chicago, Illinois. Currie et al, 2009, demonstrated the negative impact of fast food on obesity in the community that they studied.

In their article "Lifetime Health and Economic Consequences of obesity," Thompson et al (1999) showed that "diseases risks and costs increase substantially with increase of body max index". Currie et al (2009) examined the effects of fast food restaurants on obesity. They investigated the health consequences of changes in supply of fast food using the exact geographical location of fast food restaurants. Their results indicated that restricting fast food near schools could have significant effects on obesity among school students. Allison et al, 1999, concluded in their study, the direct health care cost of obesity in the United States that "increased mortality in obese people should be accounted for in order not to overestimate health care cost."

3. Methodology

In this study we consider the adult obesity rate in 2009 at the county level. We assume $y_i, (i = 1 \dots N)$, the propensity to become overweight, depends on consumer diet and how a person manages to eliminate excessive fat. Diet concepts are not easy to define at the county level. In order to have a good diet, access to healthy food plays an important role. Also access to physical fitness facilities influences the supply of fitness activities that can help consumers who are working to balance their weight.

We consider various measures of access to healthy food at the county level. X_i denotes a vector of variables measuring access to healthy food. We include in X the number of farmers markets and the number of Community-Supported Agriculture (CSA) per thousand inhabitants. Though mainstream grocery stores are increasingly serving fresh and organic foods, farmer markets and CSA farms remain the most important sources of healthy foods in the U.S. Farmers markets are a physical retail market featuring foods sold directly by farmers to consumers (USDA, 2012). Farmers sell the products of their farms, which are typically organic and fresh. CSA farms are networks of individual farmers committed to the production of high quality foods for a local community.

These two structures have become a popular way for consumers to buy local, organic, and seasonal food directly from the farmers. In 2009, in his article entitled: "Healthy Local Food" presented at the Annual Assembly of the Missouri Catholic Conference, Jefferson City, Missouri, he demonstrated that both local and organic foods are healthier than industrially processed foods and foods produced at an industrial scale. We also include in the model the number of recreational and fitness facilities per one thousand inhabitants as proxy for access to physical workout facilities. The model also controls for a variety of demographics and economic characteristics of the county.

Literature related to health behaviors uses a range of econometric models to analyze the relationship between different factors. This study uses a linear regression model similar to the one used by Bonanno and Goetz, 2010 and Evan et al, 2010. Due to the large number of counties that provided data for this study and a set of independent variables (13 in total) used to measure the impact of access to healthy food on obesity, the linear regression model expressed in equation (1) and explained in detail below will be used in order to minimize multicolinearity between independent variables (Burke and Term, 2010).

Assuming a linear relationship between the obesity rate and the set of exogenous variables, the model to estimate can be summarized as follows:

$$y_i = X_i\beta + Z_i\gamma + W_i\delta + \varepsilon_i \tag{1}$$

where y_i represents the adult obesity rate, X_i captures measures of access to healthy foods, Z_i represents access to physical fitness centers and W_i is the set of control variables which are farmers' market/1000 population, CSA farms/100 population, recreation and fitness facilities/1000 population, full-service restaurants, fast-food restaurant/1000 population, % of White, % of Black, % of Hispanic, % of Asian, % of population 65 years and older, % of population under age 18, median household income and poverty rate . The term ε_i designates idiosyncratic error terms that capture the unobserved factors that explain obesity. The parameters of estimation are β, γ, δ. We assume errors are independent and identically distributed with an asymptotic normal distribution. Thus, the model in equation (1) can be estimated using Ordinary Least Squares (OLS). After the estimation, we can test for the validity of the independent errors assumption using an LM test for autocorrelation. We also test whether the variances of the errors are constant across counties using the White test. We investigate the normality assumption, though with a large number of counties the central limit theorem guarantees asymptotic normality. Finally we test the stability of the model and whether there is misspecification using the Ramsey test.

4. Data and Descriptive Statistics

This study uses county level data instead of individual level data to perform differential analysis in order to establish the relation between access to healthy foods and lifestyle and obesity. The

reason for doing this is simply due to lack of access to individual level data. Data that we consider in this study comes from U.S. counties. U.S counties represent the lowest administrative level and constitute statistically an acceptable unit to analyze obesity facts. A total number of 3,144 counties (including 137 county-equivalents) were used in order to collect data. Data that is used in this study is from the USDA Food Environment Atlas, and is available online at http://www.ers.usda.gov/datafiles/Food_Environment_Atlas/Data_Access_and_Documentation_ Downloads/Current_Version/DataDownload.xls. In addition to the main variable described in the methodology section, we also include the expenditure per capita on fast food, and expenditure per capita on full restaurant service. We also include in the model control parameters for demographics and economic characteristics such as ethnicity (the percentage of White, Black, Hispanic and Asian), the proportion of population 65 years or older, the proportion of population under the age of 18, the median household income, and the poverty rate, 2010.

Table 1 below presents some descriptive statistics of the variables used in the analysis. Across all US counties, adult obesity remains a serious health problem. The obesity rate ranges from a minimum of 13.70% in 14 counties of the following states: Kentucky, Georgia, Arkansas, and Mississippi to about 47.6% in many counties of the states of Arkansas and Virginia. Considering the average of consumer, almost one third of the U.S. population is at risk for overweight issues according to their BMI, and the variation between counties is relatively low.

Availability of healthy foods through farmers markets is relatively low in the U.S. About 43.49 % of US counties have no farmer markets to shop for fresh and organic products. The analysis shows an average of one farmers' market for about 25,000 people. However, the average number of CSA per thousand people is higher. The number of recreation and fitness facilities that are supposed to help people to manage their weight is very limited in some U.S. counties. Table 1

indicates an average of 0.9 per 1000 people. The average number of fast food restaurants is 5.9%

per thousand of population with the maximum of 6.97%.

Table 1: Descriptive Statistics of the Model Variables

Variables	Obs	Mean	Std. Dev.	Min	Max
Adult obesity rate (%)	3138	30.34	4.16	13.70	47.60
Farmers' markets/1000 population	3137	0.04	0.07	0.00	1.02
CSA farms/1000 population	3137	0.16	0.30	0.00	6.95
Recreation & fitness facilities/1000 population	3141	0.09	0.09	0.00	1.49
Full-service restaurants	3141	69.87	230.05	0.00	7008.00
Fast-food restaurants/1000 population	3141	0.59	0.32	0.00	6.97
Full-service restaurants	3141	69.87	230.05	0.00	7008.00
% White	3143	78.29	19.89	2.67	99.16
% Black	3143	8.75	14.42	0.00	85.44
% Hispanic	3143	8.28	13.19	0.00	95.74
% Asian	3143	1.14	2.47	0.00	43.01
% Population 65 years or older	3143	15.88	4.19	3.47	43.38
% Population under age 18	3143	23.42	3.38	0.00	41.57
Median household income	3142	43144.87	10742.29	20577.00	119075.00
Poverty rate	3142	16.76	6.24	3.10	50.10

5. Results and Discussions

We estimate equation (1) using OLS. As explained above, the adult obesity rate is represented by

y_i in equation (1) which is the dependent variable; we start the analysis by including access to

healthy food and access to fitness facilities respectively represented by Z_i and W_i in the equation

as independent variables. Then, we add all the control variables identified. The results of the model

are presented in table 2 below. Column (1) presents the results with no control variables.

The model explains about 7% of the variation in obesity rates in the sample. This suggests

that beyond access to healthy food and access to fitness centers, many other factors matter in the

explanation of the variation in obesity rates. The estimated coefficient of access to healthy foods measured by the number of farmers markets per thousand of population appears to be negative. However, the effect of access to healthy food is significant at conventional level. On the other hand, the supply of fitness facilities has a strong negative effect on the obesity rate. Wide availability of centers for exercising appears to significantly lower adult obesity rates. U.S. Counties that have a substantially large number of fitness centers are also those with lower obesity rates.

Next, we used the number of CSA operations per thousand of population as a proxy for access to healthy food. Now, it appears that the access to healthy foods as measured by the number CSA is negatively correlated with the obesity rate. The increase in the number of CSA correlates with a lower obesity rate. Conflicting results of no significant effect on obesity rates by the presence of farmer markets and the strongly significant effect of CSA programs on obesity rates can be explained by the organizational nature of each form of supply of healthy foods. On the one hand, farmers markets are small, operational only a few days a week, available mostly in the summer time in the majority of counties, and supply a small variety of products. Another aspect is that consumers shop less frequently at those markets due to operational times. On the other hand, CSA operations are larger suppliers of healthy foods with a strong reward program for consumers who commit themselves to regular shopping. Thus, CSA programs likely would have a more substantial effect on obesity than farmers markets.

Both the results in columns (1) and (2) have low explanatory power as their R-squared is relatively small. We complete the models by including more factors that affect obesity rates. The results of the full model are presented in column (3) of table 2. As before, farmers markets remain insignificant while CSA programs consistently have a negative effect on obesity rates. As we

observe above in the literature review, after analysis, the unexpected negative sign of fast food restaurants effect on obesity rates seems to oppose some views reported in this study.

However, this can be explained by the fact that a significant number of those structures are concentrated in urban areas. Even though a significant number of the American population is located in urban areas, rural area population has a strong negative impact on obesity. The negative sign means that the more U.S. counties have full service restaurants, the more the obesity rate will be lower, combined with other variables analyzed in this study. The positive sign in table 2 for different class of ages is statistically significant. This means that age is an important factor in obesity according to the analysis. This showed that people under the age of 18 are more susceptible to obesity than elderly people aged 65 +. This result can be interpreted as follows: younger people, especially under 18, are less likely to eat healthy foods than people aged 65+.

In U.S. counties, income plays an important role when it comes to obesity facts. There is evidence according to this analysis that counties with a higher household income are likely to be less affected by obesity. Table 2 column (3) shows the negative sign for median income which means that the increase of household income decreases the obesity rate in the U.S. counties.

Table 2: Model Estimations Results

Dependent variables : Adult obesity rate	(1)	(2)	(3)
Farmers' markets/1,000 pop	-1.81		-0.31
	(1.39)		(0.90)
CSA farms1,000 pop		-0.34*	-0.65***
		(0.20)	(0.18)
Recreation & fitness facilities/1,000 pop	-12.17***	-12.42***	-4.08***
	(1.41)	(1.44)	(0.90)
Full-service restaurants			-0.18***
			(0.05)
Fast-food restaurants/1,000 pop			-1.13***
			(0.22)
% White			-0.01
			(0.01)
% Black			0.07***
			(0.01)
% Hispanic			-0.10***
			(0.01)
% Asian			-0.09**
			(0.04)
% Population 65 years or older			-0.07***
			(0.02)
% Population under age 18			0.31***
			(0.03)
Median household income			-0.01***
			(0.00)
Constant	31.46***	31.47***	32.81***
	(0.16)	(0.14)	(1.36)
Observations	3,137	3,137	3,135
R-squared	0.072	0.072	0.485

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

6. Conclusions

As we expected and a confirmation of what we assumed in the introduction of this study, access to healthy food and lifestyle is important for decreasing the obesity rate. But it is not enough to explain the whole problem related to this matter. According to the analysis that we performed throughout this study, four to five more factors, combined with access to healthy food, are likely

to be more effective. We demonstrated already in this article that the augmentation of the number of recreational areas and fitness facilities is important in decreasing the obesity rate. This would allow people with low incomes to access to these facilities. Even though many U.S. counties have a number of free recreation areas, most of the modern and high quality fitness facilities are private and require a certain amount of money to access them. Economically, a higher number of those structures will increase competition, which will cause a decrease in access fees.

The intent of this article was to analyze the relation between access to healthy food and lifestyle with obesity. As we concluded above, there is evidence that access to healthy food has a negative impact on obesity rates in the U.S. using county level data. The first recommendation for those who intend to use this analysis for different prospective is that U.S. counties need to increase the number of CSA programs which operate on a daily basis during the year. The second is that counties should find possible ways to facilitate broader access to fitness facilities, whether by lowering users' taxes or by acquiring basic materials at low cost to improve their existing recreation area. Also important is encouragement for young people who are more at risk for obesity to eat healthier and to engage in physical activities. We also recommend to the population to do the best they can to increase their income in order to have more quality choices in their eating behaviors. Good health is priceless. It is better to prevent obesity in the first place by practicing healthy behaviors than to try to treat the consequences.

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