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SOCIOECONOMIC ENVIRONMENT AND OBESITY ON THE US WEST AND EAST COASTS

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ABSTRACT

The objective of this paper is to examine the association between obesity in the US West and East Coasts and access to grocery stores, fast food, convenience stores, recreational facilities, as well as the medium household income. A multivariate regression model based on aggregate county level observations for the West and the East Coasts based on the data from the US Department of Agriculture is estimated. Empirical results show that there is a positive association between obesity and convenience stores per county, while the rest of the variables showed negative association in the regression model. The elasticity between medium household income and obesity is the largest in magnitude for both geographic areas. These findings suggest policy recommendations for the short- and long-run that may be deployed to combat the obesity epidemic.

Contribution/Originality: This study contributes to the existing literature on obesity by focusing on the socioeconomic aspects rather than traditional clinical aspects of obesity. An empirical result of the econometric model shows that association between obesity and income, availability of grocery stores, fast food, and recreational facilities is negative. The elasticity between medium household income and obesity is the largest in magnitude for both West and East coasts of the US. These findings suggest policy recommendations for the short- and long-run that may be deployed to combat the obesity epidemic.

1. INTRODUCTION

According to the US Center for Disease Control (CDC) obesity is a leading cause of death in the United States, along with being a major risk factor for heart disease, depression, diabetes, cancer, and generally reduced lifespans[1]. Obesity is defined by using Body Mass Index or BMI to measure weight relative to height. Overweight is designated as having a BMI between 25-30, whereas "obese" is defined by BMIs at 30 kg/m2 or above[2]. BMIs generally correlate to levels of excess body fat, but there can be variation depending on muscle mass. BMI is a

[1] https://www.cdc.gov/obesity/adult/defining.html

[2] https://www.hsph.harvard.edu/obesity-prevention-source/obesity-definition/

useful measurement as it provides a good estimate of obesity and tends to correlate with the usual symptoms and diseases associated with obesity.

Finkelstein, Ruhm, and Kosa (2005) document that the rapid rise in obesity rates began in the 1980s. From 1980 to 2005, obesity rate rose by more than 100%. Figure 1 confirms the sharp increase in obesity in the US since the 1980s. Flegal, Carroll, Kuczmarski, and Johnson (1998); Flegal, Carroll, Ogden, and Johnson (2002) state that during the late 1980s and early 1990s, prevalence of obesity, i.e., percentage of adults with BMI greater than 30 kg/m2, reached an alarming 31% according to 2000 census. Grade III obesity (BMI ≥ 40.0 kg/m2) grew even more rapidly, rising from 1.3% in the late 1970s to 4.7% in 2000. According to Field et al. (2001) and Visscher and Seidell (2001) among others, the prevalence of obesity has led to other serious and costly complications, including type 2 diabetes, cardiovascular disease, several types of cancer (endometrial, postmenopausal breast, kidney, and colon cancers), musculoskeletal disorders, sleep apnea, and gallbladder disease. As a result, obesity now accounts for approximately 400,000 deaths per year, second only to tobacco.

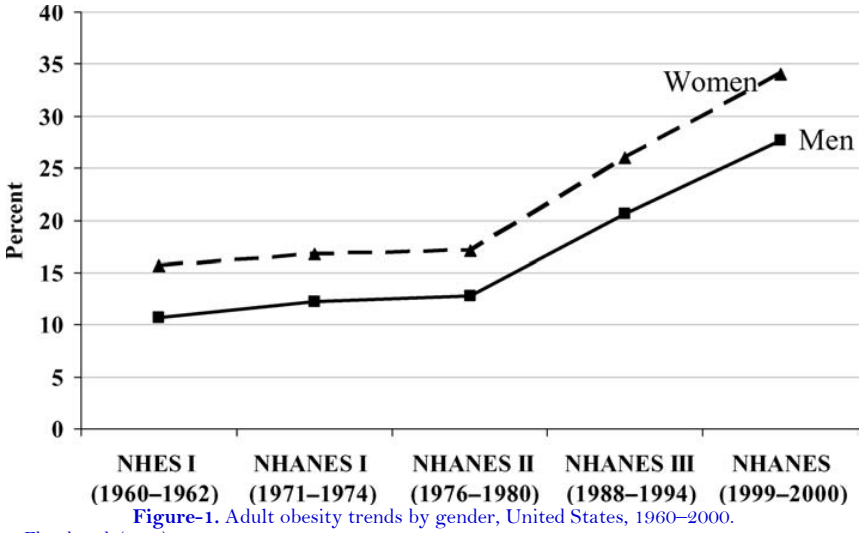

Figure-1. Adult obesity trends by gender, United States, 1960–2000.
Source: Flegal et al. (2002).

In addition to its negative effects such as self-worth, obesity also imposes high costs on the economy (Waters & DeVoi, 2016). According to CDC, in 2014, it was estimated that between treatment costs for health consequences associated with the condition and loss of productivity, the cost of obesity on the US economy exceeded 1.4 trillion dollars, or roughly eight percent of the GDP. Finkelstein et al. (2005) and Waters and DeVoi (2016) among others, conclude that obesity is not only a health but also an economic phenomenon.

Obesity is a nuanced problem to tackle because of its many links to genetics, environment, socioeconomic factors, and social behavior. CDC reports that obesity cannot be explained by mere genetics, though it is thought that it may result from interactions between many genetic factors and certain environments[3].

Because it is not a purely genetic disease, there may be hope for solutions. Families cannot change their genes, but they may be able to change the environment for their children to prevent it from pre-disposing them to obesity. Public policy may be necessary to assist households overcome obesity by targeting some of the root factors contributing to the obesity epidemic. However, to initiate effective policy strategies to tackle the epidemic requires further research to ferret out the socioeconomic structural variables that may be associated with obesity.

Epidemiologists, public health researchers, nutrition researchers, among others, have been studying the obesity epidemic for the last three decades. Research during this period has produced valuable information and has shed light mainly on nutritional factors that contribute to the spread of obesity.

[3] www.cdc.gov/genomics/resources/diseases/obesity/index.htm.

As there is a social and cultural element to obesity, we focus on the West Coast to keep the culture more homogenous than branching out across the rest of the United States. The East Coast data are used for comparison purposes, but the focus of this study is on Oregon, Washington, and California.

This paper aims to present statistical evidence on the association of socioeconomic variables and obesity. Previous research provides only anecdotal and circumstantial evidence for such association. Our paper proposes an econometric model that formally tests the association of socioeconomic variables that previous research has merely suggested as possible determinants of obesity in the US. In this sense, our paper is unique in its methodology and findings.

The remainder of the paper is organized as follows. Section II offers a brief review of the relevant literature. Data are explained in Section III. Methodology and the analysis of the empirical findings are the subject of the fourth section. Section V consists of policy implications. The last section is devoted to the summary and conclusions.

2. REVIEW OF THE RELEVANT LITERATURE

There is a substantial body of literature on obesity. However, while some research alludes to economic conditions and obesity, the association between the two is not empirically tested. The past research papers fall into two general categories. The bulk of research in the first track is focused on the clinical and nutritional aspects of the obesity epidemic. This line of research, while relevant, is not the focus of the current study. Notable in this category are papers by Joshipura et al. (2001); Ludwig, Peterson, and Gortmaker (2001); Drewnowski.. and Darmon (2005); Drewnowski. and Darmon (2005); Putnam, Allshouse, and Kantor (2002);Nielsen, Siega-Riz, and Popkin (2002); Kant (2000); Visscher and Seidell (2001); Flegal et al. (1998); Field et al. (2001) among others. These researchers examine the glycemic index of foods, the energy density of various foods, energy intakes (megajoules per day (MJ/day)), body mass index (BMI), sensory preference of consumers for fat and sugar, and other health indicators. The aim of these researchers has been to understand foods that may be deemed as culprits for obesity. We summarize a few of the findings from these papers.

A diet high in vegetables, fruits, whole grains, poultry, and fish has been associated with a lower risk of coronary heart disease and with better overall health. Conversely, refined grains, sugar-sweetened drinks, and corn syrup, have been linked to a higher risk of heart disease and type 2 diabetes. They also find causal links between fats and sweets consumption and the worldwide obesity epidemic. Drewnowski and Gomez-Carneros (2000) discuss the health benefits of dietary phytonutrients found in vegetables and fruit seem to lower the risk of cancer and cardiovascular disease. However, most of the beneficial bioactive compounds found in vegetables and other fruits are bitter, acrid, or astringent, which consumers do not consider tasteful. Consequently, the food industry eliminates these compounds through various interventions. Thus, research on health benefits of food compounds need to take consumer preferences for taste into consideration. This may lead to breeding, or possibly genetic improvements of plant foods that are health-promoting as well and agreeable to consumer tastes.

While this line of research provides information on the nutritional content of various food options, typically it has not considered the diet costs. It is commonly known that fats and sweets are a source of energy at a low cost, however, the energy cost of lean meats, fish, vegetables, and fruit is likely to be higher. Switching from processed and high energy density foods to fresh diet entails cost considerations.

The policy recommendation flowing out of the first group of studies mainly aims to eliminate the supply of high-energy-density fatty and sugar laden foods by levying taxes like vice taxes to discourage consumption through rising costs. This strategy only considers the substitution effect of higher prices, whereby consumers replace higher- priced items with low-prices items. However, the income effect of higher prices for inferior high-energy-density foods may have the opposite consequence for low-income households. Reducing the supply of high-energy- density foods and raising their cost, may diminish the purchasing power of the low-income consumers.

Thus, they may be forced to consume even more low-quality food. Without attending to the underlying poverty and socioeconomic conditions that are associated with obesity may exacerbate the obesity problem. This phenomenon was first observed during the Irish famine in the eighteenth century and gave rise to the term "Geffen good" in the economic literature.

The second category of research complements the first track by suggesting that the socioeconomic factors lead to the consumption of high-energy-density foods. Many of these researchers mention that income inequities, lack of economic opportunities are contributors to an environment that leads to higher rates of obesity and related diseases among the economically poor geographic regions and deprived segments of the population. However, they rarely offer empirical evidence to demonstrate the association of obesity with socioeconomic conditions.

Their general conclusion is that the rates of obesity and related diseases such as type 2 diabetes in the United States and other countries are linked to low incomes, low education, and higher rates of poverty. Similarly, geographically, obesity rates are higher in lower-income neighborhoods, legislative districts, and low-income states.

Papers by Paeratakul, Lovejoy, Ryan, and Bray (2002); Myers, Slack, Martin, Broyles, and Heymsfield (2015); Drewnowski, Darmon, and Briend (2004); Drewnowski, Aggarwal, Hurvitz, Monsivais, and Moudon (2012); Drewnowski (2009); Reynolds, Buckley, Weinstein, and Boland (2014); Faria et al. (2016) among others, fit this track. In the following we summarize a few papers in this line of inquiry that offer some empirical findings.

Paeratakul et al. (2002) examine the disease burden of obesity in the US population based on gender, race and socioeconomic status. Their findings show that generally there is a significant prevalence of diseases such as diabetes, hypertension, heart disease associated with high body weight in all gender, racial and socioeconomic groups. Paeratakul et al. (2002) conclude that the substantial disease burden related to obesity varies significantly and depends on gender, race, and socioeconomic factors.

Myers et al. (2015) set out to investigate the significance of regional differences in adult obesity prevalence in the US using county level data. Their regression estimation shows that the elevated adult obesity prevalence was notably higher in in the southern states, spanning Arkansas, Louisiana, Mississippi, Alabama, Kentucky, West Virginia, and Carolinas. They call for special attention to the social, economic, political, and culture factors that are linked to poor population health in the "Deep South."

A serious shortcoming of research papers on obesity is that many empirical investigations on the subject, (for example, Drewnowski. and Darmon (2005); Drewnowski.. and Darmon (2005)) primarily depend on correlation analysis between obesity and other socioeconomic variables. While these findings suggest association between obesity and socioeconomic variables, they may suffer from the limitations of the bilateral association rather than building a multivariate approach.

A multivariable regression model coefficients allow for examining the association between obesity with each variable, holding the influence of the remaining variables constant. In the following we develop and estimate a regression model that includes several socioeconomic variables mentioned in the literature.

3. DATA

The cross-sectional data set for the paper is taken from the US department of agriculture. All counties in Oregon, California, and Washington for the West Coast and Maine, New Hampshire, Massachusetts, Road Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, and Florida in the East Coast are included in the sample. Deleting missing observations for various counties resulted in hundred fifty observations in the West coast sample and seven hundred forty observations for the East coast counties.

The socioeconomic explanatory variables included in the econometric modeling are described below.

The number of convenience stores per county (2010).

The number of fast food establishments per 1000 people in the county (2012).

Number of grocery stores per county (2012).
Number of recreational facilities per county (2012).
Household medium income per county (2010).

We use the numbers of various facilities as a proxy for the ease of access to these establishments. For instance, one may be more inclined to shop at grocery stores or visit an athletic club, if it is easily accessible and does not require a long trip.

The rationale behind including these explanatory variables in the econometric model are as follows. The number of convenience stores is a proxy that measures the ease of access to mostly low- quality food. Generally, these stores are purveyors of low nutritional value food at relatively higher 32price than grocery stores.

The abundance of fast food availability in a county may aggravate the problem of obesity in two ways. First, easy access to low- price for low- quality, high-energy density food dissuades consumers from looking for healthier substitutes. Second, the ease of access to these establishments is in direct competition with grocery stores, which may not be so ubiquitous. Thus, the limited food budget, especially for low income households, may be absorbed by fast food establishments. It is noteworthy, however, that in recent years with the national attention to diabetes II and the role of fast food restaurants in spreading obesity in the US and around the globe, many fast food giants have introduced healthier fare at affordable price. Given their ubiquitous presence in almost all neighborhoods and low- cost food, there may be some health benefits from access to these restaurants.

The number of available grocery stores in a county is a proxy for possible ease of access to healthy unprocessed food, vegetables, and fruits. We expect the higher this number in a county, the lower obesity. Thus, the expected association of this variable with obesity is negative.

The number of recreational facilities is expected to reduce obesity. The rationale is that the more facilities, the easier access to them. It is anecdotally known that recreational facilities tend to be in large urban settings and gravitate toward higher income neighborhoods. The geographic bias against lower income areas in favor of concentration in affluent parts, may thwart some of the benefits in reducing obesity.

The median household income has been identified as a factor in reducing obesity. It is conceivable that higher household income is negatively correlated with obesity. Higher income could signify access to better food, recreation, lower stress, and better health in general.

Education also plays a role in influencing obesity. However, our model does not include education as an explanatory variable. There is some evidence that income and education are highly correlated. Thus, including education variable as an explanatory variable my leas to collinearity between the income and education variables.

The dependent variable in our econometric models is the percentage of obese adults, i.e., those with BMI greater than 30 percent in 2010. The data for variables included in the model are not always available in the same year. Therefore, the sample data for some variables are for 2010 and for others 2012. Given the nature of our variables, the two- year gap does not distort our empirical results because these number do not change dramatically in two years.

4. METHODOLOGY AND EMPIRICAL FINDINGS

Our regression model in implicit form is written as,

Obesity = f(cstore, ff, gstore, HHI, recfacility), (1)

where variables are defined as

Obesity = percentage of adults in a county with BMI>30%,
The number of convenience stores per county.
The number of fast food establishments per 1000 people in the county.
Number of grocery stores per county.
Household medium income per county.

Number of recreational facilities per county, respectively.

In the next section we will report the estimation results of the implicit function stated in Equation 1.

Table 1 column (1) reports the estimation results of the Equation 1 formulated as a multivariate linear function. The Newey-West Heteroscedastic- Autocorrelation- Consistent (HAC) methodology is deployed to eliminate the possible problem of heteroscedasticity. This methodology successfully eliminates any estimation biases in the coefficient standard errors. Breusch-Pagan-Godfrey (B-P-G) Lagrange Multiplier (LM) statistic is insignificant indicating that possible heteroscedasticity dose not distort our estimates or their standard errors. While the results seem plausible, Ramsey RESET three- factor test indicates that the linear functional form may not be the appropriate one. The LM test statistic for the Ramsey RESET test is 8.884, which is greater than the critical value of the Chi-squared statistic with three degrees of freedom at the 5 percent significance level. Thus, the nonlinear functional form is statistically superior to a linear formulation.

We propose Equation 2 as follows.

$$Obesity = \alpha.cstore^{\beta_1} ff^{\beta_2} gstore^{\beta_3} HHI^{\beta_4} recfacility^{\beta_5} e^{u} \quad (2)$$

The variable definitions are denoted as follows:

cstore =The number of convenience stores per county.

ff= The number of fast food establishments per 1000 people in the county.

gstore = Number of grocery stores per county.

HHI= Household medium income per county.

recfacility= Number of recreational facilities per county.

u = The random regression error term.

α= model coefficient accounting for the total effect of other variables not included in the model.

Column (2) in Table 1 presents the estimation results of Equation 2 after a natural logarithmic transformation and applying the HAC methodology. Estimated coefficients are elasticities of obesity with respect to each variable. For instance, the percentage change in obesity with respect to percentage change in the number of fast food establishments is measured by β_1.

The F statistic shows that the model is significant at the 1 percent level. The value of R-squared is consistent with a high explanatory power of the model given the cross-sectional data. The B-P-G LM statistic (4.99) indicates that the estimation results are not influenced by heteroscedasticity. Overall, the estimation results show that this functional form adequately captures the underlying relationship between obesity and the socioeconomic variables included in the model.

Returning to coefficient estimates, the income and availability of grocery stores reduce the incidence of obesity in the sample as shown by their negative sign. For instance, a percentage increase in income is associated with roughly a thirty basis points (0.30%) decline in obesity. The relatively huge influence of income on obesity confirms the observations of nutrition and epidemiology literature regarding the income and the prevalence of obesity among lower income segments of the population. The availability of grocery stores also reduces obesity, albeit at a rate of 0.10 percent per one percent increase in the availability. In recent years, grocery stores have provided many healthy prepared meals that are mostly low cost. It is conceivable that the access to hot meals at grocery stores at a reasonable cost may lead to healthier diets and contribute to obesity reduction. These facilities offer viable fast food sources as a substitute to other options. We conclude that access to grocery stores is an important factor in encouraging healthier diet for two reasons. First, ease of access to non-processed basic ingredients. Secondly, access to healthy low- cost prepared meals.

As would be expected, convenience store presence in a county appears to contribute to obesity significantly with an elasticity of 0.08. It is well known that convenience stores often are purveyors of high-energy-density items that tend to be loaded with sugar and fat.

Fast food store availability is negatively and statistically significantly associated with obesity. At the first glance, this finding may appear counter-intuitive. However, considering that almost unanimously, fast food restaurants are offering healthier items on their menu at a reasonable price, this finding is not implausible. The finding somewhat exonerates the fast food establishments regarding their role in obesity. The popular narrative also supports this finding as seen in various fast food advertisements. For instance, Subway restaurants introduced relatively healthy meals at low cost decades ago.

Alternatively, it is likely that the negative association between obesity and the availability of fast is due to the concentrations of these establishments in cities, which in turn are associated with higher income levels and lower birth rates. As income levels were negatively associated with obesity, it is conceivable that any positive effects from the fast food restaurants were compensated for by city incomes.

The availability of recreational facilities does not seem to be statistically associated with the reduction in obesity on the West Coast. Generally, recreational facilities tend to be patronized by a health-conscious, habitual exercisers segments of the population with relatively higher disposable income. On the contrary, the obese segment of the population may be those who do not frequent these facilities for income, travel time, or life style reasons. Therefore, the data and empirical results may not be able to address the association between obesity and this variable.

Column (3) in Table 1 presents the estimation results of Equation 2 for seven hundred forty counties in the Eastern US. Overall, the estimation results are consistent with the findings for the West Coast indicating that the empirical findings are robust. The magnitudes of the R-squared and F statistics are virtually identical. Obesity shows the highest elasticity with respect to income as was the case for the West Coast sample. The coefficient magnitudes are roughly in the same order for both the East and West Coast samples. However, the results also show that the access to grocery stores is not significantly associated with obesity reduction, while availability of recreational facilities is. These differences could be an indication of life style differences between the two geographic samples.

Table-1. Estimation results of alternative formulations of equation (1), Newy- West Heteroscedastic Autocorrelation Consistent (HAC) Method.

(1)		(2)		(3)
Linear West Coast		**Log-Linear West Coast**		**Log-Linear East Coast**
Dependent Variable: Obesity				
Intercept	35.907 [a]	Intercept	6.362[a]	5.178 [a]
	(1.455)		(0.659)	(0.222)
convstores	0.022 [a]	LN(convstores)	0.082[a]	0.040 [a]
	(0.006)		(0.021)	(0.009)
FF	-1.790 [a]	LN(FF)	-0.088[a]	-0.067 [a]
	(0.536)		(0.017)	0.009
Gstore	-0.015 [a]	LN(Gstore)	-0.095[a]	-0.006
	(0.004)		(0.025)	(0.007)
HHI	-0.022 [a]	LN(HHI)	-0.291[a]	-0.174 [a]
	(0.008)		(0.062)	(0.020)
Recfacility	-0.0001[a]	LN(Recfacility)	-0.003	-0.048 [a]
	$(2.3*10^{-5})$		(0.024)	(0.007)
F	27.007[a]		25.612[a]	153.125 [a]
R^2	0.366		0.502	0.513
B-P-G	3.333			
RESET	8.884[b]			

Notes: Columns (1) reports the estimation results of a linear functional form by Newy-West HAC methodology. Columns (2) and (3) report the results of the variations of Equation 2 estimated by the Newy-West heteroscedastic and autocorrelation consistent methodology (HAC). B-P-G stands for the Breusch-Pagan-Godfrey Lagrange Multiplier (LM) test of Heteroscedasticity.
[a] significant at 1% level, [b] significant at 5% level, significant at 10% level.

5. POLICY RAMIFICATIONS

Research on obesity concludes that the rise in obesity rates in America is a largely an economic issue. It may be related to the growing gap in the income distribution and price disparity between healthy and unhealthy foods. This paper presents empirical evidence in support of this hypothesis.

The strategies for obesity prevention may need to be carefully designed. Encouraging low-income groups to adopt healthier diets, but at high cost, may be misguided. Similarly, policies aimed at discouraging the consumption of low-quality food, fats, and sweets, through taxes may not produce the desired results. The broader problem may be rooted in deteriorating income and wealth distributions, declining real wages, and other socioeconomic complexities that poverty engenders.

The Healthy People 2010 report[4] acknowledged that obesity rates were higher among minority groups and poor households relative to more affluent households. The dietary behaviors of obese groups may not be a medical, physiological and behavioral matter. The lack of access to supermarkets and grocery stores in poverty stricken neighborhoods, the lack of access to healthy foods, and unavailability of free time may be in the core of unhealthy dietary habits.

Findings of our paper concur with the conclusions of the report cited above. These findings may suggest some guidelines for policy makers to combat obesity in the short- and long-runs.

In the short- run moral suasion may be effective in persuading fast food establishments to increase the variety of healthy items. Convenience stores and grocery stores present another avenue for preventative steps regarding obesity. As grocery stores have shown a negative correlation with obesity rates, increasing access to grocery store offerings (healthier food options) could help. However, grocery stores are profit maximizing businesses that are attracted to demand for their goods. Tax incentives may be applied to encourage grocery stores to expand into economically- deprived areas of the cities and counties. The obstacle may be that grocery businesses only locate in areas that security and purchasing power are conducive to operate profitability. Thus, their location may be tied to high- income neighborhoods. Again, rising incomes that may result in higher standards of living, and possibly safer neighborhoods, may have a positive externality in terms of access to grocery stores.

As convenience stores demonstrated a positive correlation with obesity, moral suasion may be necessary to persuade convenience stores to stock products that may promote healthier eating habits. Social pressures and conversations regarding the ill effects of low-quality food on health have been relatively successful in persuading fast food establishments to provide healthier fare at an affordable price.

In the long-run, structural changes in employment and income distribution may be needed. As research has suggested (see (Darmon & Drewnowski, 2008)), and the present study), obesity has a socioeconomic trajectory. The most important variable with the highest role in the percentage rise in obesity in our samples is income. This relationship was born out for both data sets for the West and East Coasts. It is therefore, logical to conclude that the most important policy approach to obesity reduction or eradication would be improving economic opportunities for economically-deprived segments of the population. While the details of such policies are beyond the scope of this research, deploying the scarce policy resources in that direction may provide much desired results.

Given that the negative externalities of obesity on the economy and the health care system are significant, the investments in these policies may generate significant dividend. Furthermore, a positive externality of the income improvement policy may be better education. Higher education tends to be highly correlated with lower BMIs. Complexity of systemic policy measures that may impact the income disparities may require implementation over the long-run.

[4] https://www.cdc.gov/nchs/healthy_people/hp2010/hp2010_indicators.htm

It should be noted that while the results for the East Coast data are not identical to the West Coast findings, they support the messages of our findings for the West Coast. For instance, the role of income, fast food establishments, and convenience stores are consistent for both Coasts.

6. SUMMARY AND CONCLUSIONS

This paper investigates the association between obesity and a set of socioeconomic variables. We estimate a multivariate regression model to accomplish this objective. Past research suggests that obesity has an economic trajectory. However, our paper is the only one in the literature that rigorously tests this hypothesis in a multivariate context. Our sample data consists of hundred fifty county-level observations from the states of California, Washington, and Oregon. Seven hundred observations from the East Coast comprise the East Coast sample. The data are from the US Department of Agriculture. The socioeconomic variables included in the multivariate model are access to grocery stores, fast food, convenience stores, recreational facilities, as well as medium household income. These variables are chosen based on the suggestions from the previous studies.

For the West Coast, the income and availability of grocery stores reduce the incidence of obesity in the sample. For instance, a one percent increase in income is associated with a roughly 0.30% decline in obesity. The huge influence of income on obesity confirms the suggestions by nutrition and epidemiology literature regarding the prevalence of obesity among lower income segments of the population. The availability of grocery stores also reduces obesity, albeit at a rate of 0.10 percent per one percent increase in the availability. In recent years, grocery stores have provided many healthy prepared meals that are mostly affordable. As would be expected, ease of access to convenience stores appears to contribute to obesity significantly with an elasticity of 0.08 percent per one percent availability. It is well known that convenience stores often are stocked with high-energy- density items that tend to be loaded with sugar and fat.

Fast food store availability is negatively and statistically significantly associated with obesity. This finding may appear counter-intuitive. However, considering that fast food restaurants are offering healthier items on their menu at a reasonable price, this finding is not implausible. The popular anecdotal information also supports this finding as seen in various fast food advertisement. For instance, Subway restaurants introduced relatively healthy meals at low cost decades ago. Furthermore, it is likely that the negative association between obesity and the availability of fast food is due to the concentrations of these establishments in cities, which in turn are associated with higher income levels. As income levels were negatively associated with obesity, it is conceivable that any positive effects from the fast food restaurants were compensated for by city incomes. This evidence suggests that limitations on fast food restaurant in cities is relatively ineffective at combatting obesity.

The availability of recreational facilities does not seem to be statistically associated with reduction in obesity on the West Coast. Generally, recreational facilities tend to be patronized by a self-selecting group of clients that are health-conscious and tend to be the higher income segment of the population. This segment of the population are habitual exercisers and less likely to be obese. Therefore, it is conceivable that lower income groups would have limited or no access to recreational facilities, which may make it impossible statistically to measure the association between obesity and these facilities. Alternatively, it is plausible that the temperate climate of the West Coast offers many opportunities for exercise without having to use recreational facilities.

The estimation results for the East Coast are generally consistent with the findings for the West Coast, indicating that the empirical findings are robust. Obesity shows the highest elasticity with respect to income as was the case for the east coast sample, highlighting the negative association of income levels with obesity. The coefficient magnitudes are roughly in the same order for both the East and West Coast samples. However, the results also show that the access to grocery stores is not significantly associated with obesity reduction, while availability of recreational facilities is. These differences could be an indication of life style differences between the two geographic samples. For instance, the climate of the East Coast may limit the opportunities for exercise

without joining recreational facilities. Given that recreational facility membership and locations depend on income, these facilities may not be easily accessible lower income groups, contributing to incidences of obesity among them.

The policy ramifications of our findings may fall into short-run and long-run options. In the short-run tax incentives may attract grocery stores to economically- deprived areas. Fast food outlets maybe encouraged to offer more healthy choices thorough moral suasion by various public health agencies. On the East coast recreation facilities may be provided in public parks, especially in economically disadvantaged areas of cities and counties.

In the long-run, policies should be designed to provide more economic opportunities for the disadvantaged segments of the population. These efforts call for political will and ideological shifts, which are structural changes and cannot be achieved rapidly. Improved income levels of the disadvantaged population groups may create demand for quality food and other services such as recreational facilities. Grocery stores may find favorable and safe business environments in neighborhoods that experience economic boost and surging incomes. Therefore, improving economic conditions and incomes among the disadvantaged groups may have positive externalities such as general health, reduced obesity, lower GDP loss, and less-burdened health care system.

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