2014

Trends in the Association Between Socioeconomic Status and Obesity in U.S. Adults: 2002-2012

Amanda Elaine Ayers
Bucknell University, aea003@bucknell.edu

Trends in the Association between Socioeconomic Status and Obesity

in U.S. Adults: 2002-2012

by

Amanda E. Ayers

A Thesis Submitted to the Honors Council

For Honors in Economics

April 8, 2014

Approved by:

Adviser: Amy Wolaver

Department Chairperson: Tom Kinnaman

Acknowledgements:
I would like to thank Professor Amy Wolaver for her guidance and mentorship at every stage of researching and writing this paper. I would also like to thank my parents for their unwavering love and support in all that I do.

Table of Contents

List of Figures

List of Tables

I. Abstract

Since the 1980s, the prevalence of obesity has more than doubled to over 30 percent of the adult population (Thorpe, 2004). Obesity is a key contributing factor to continually rising national healthcare costs. Addressing its negative implications is essential not only from a cost perspective, but also for the betterment of our nation's general health and wellbeing. Obesity is reportedly associated with a 35% increase in inpatient and outpatient spending, as well as a 77% increase in related necessary medications (Sturm, 2002). Obesity, which some have argued should be classified as a disease in itself, has roughly the same association with the development of chronic health conditions as does 20 years of aging (Sturm, 2002). Defined as ambulatory care-sensitive conditions, these obesity-related chronic health diagnoses – like diabetes, cardiovascular disease, and hypertension – are in turn the primary drivers of current healthcare spending, as well as future predicted health expenditures.

It is well established that lower socioeconomic status (SES) is associated with higher rates of obesity and the subsequent development of aforementioned obesity-related conditions. Socioeconomic status has traditionally been defined by education, income, and occupation (Adler, 2002); however, this study found empirical evidence for education being the most fundamental of these three SES indicators in determining obesity outcomes. For both men and women, as education levels increased, the likelihood of an individual being obese decreased. However, with less education, there was increased disparity between the obesity rates for men and women. Women consistently saw higher rates of obesity and were more impacted in terms of obesity onset by belonging to a lower SES category than men.

In addition, this study assessed whether the impact of one's socioeconomic status on obesity-related health outcomes (specifically the negative impact low-SES as measured by education level) has changed over time. Results deriving from annual data from the National Health Interview Survey (NHIS) for all years from 2002 to 2012 indicate that the association between low-socioeconomic status and negative health outcomes has not increased in magnitude over the past decade. Instead, obesity rates have increased across the overall U.S. adult population, most likely due to a number of larger external societal factors resulting in increased caloric intake and decreased energy expenditure across every SES group. In addition, while the association between low-SES and obesity has not worsened, a consequence of the Great Recession has been a larger percentage of the U.S. population in lower-SES, which is still consistently subject to the same worse health outcomes.

II. Introduction

Since the 1980s, the prevalence of obesity in the United States has more than doubled, reaching over 30 percent of the American adult population (Thorpe, 2004). Addressing its negative implications is essential not only for the betterment of our nation's general health and wellbeing, but also in the interest of reigning in substantive financial costs on the U.S. health care system associated with obesity and obesity-related illnesses.

Obesity is reportedly associated with a 35% increase in inpatient and outpatient spending, as well as a 77% increase in related necessary medications (Sturm, 2002).

Obesity, which some have argued should be classified as a disease in itself, has roughly the same association with the development of chronic health conditions as does 20 years of aging (Sturm, 2002). Defined as ambulatory care-sensitive conditions, these subsequent obesity-related chronic illnesses – diabetes, hypertension, and cardiovascular disease, to name the most prominent – are the primary drivers of morbidity and mortality, as well as current and predicted healthcare spending in the United States. Each year, an estimated 300,000 U.S. adults die of causes related to obesity, contributing to 9.4% of U.S. health care expenditures. Unfortunately, these statistics have and are sure to continue to increase in magnitude (Mokdad, 2001).

It is well established that lower socioeconomic status (SES) is associated with higher rates of obesity (and the subsequent development of aforementioned obesity-related conditions). According to a 2002 study, “the most fundamental causes of health disparities are socioeconomic disparities” (Adler, 2002). There is empirical evidence to suggest that these health disparities among different SES subsets of the American population are applicable to obesity and obesity-related illnesses as well (McLaren, 2007).

Understanding the variation in health outcomes between different SES groups in the United States will be a key insight moving forward given the importance of addressing the ongoing battle with rising national obesity rates. This investigation is especially relevant in light of external factors possibly affecting obesity onset over the past decade such as increasing inequality resulting from the financial crisis of 2007, as well as the phenomenon of changing food prices, whereby lower quality, fast foods have

become cheaper while healthy, higher quality foods and produce have become more expensive (Cawley, 2010).

Knowing that socioeconomic status influences health outcomes to such a great degree, the yet unanswered question of interest becomes whether its impact has increased in magnitude over the past decade, and how so. I will use annual data from the National Health Interview Survey (NHIS) for all years from 2002 to 2012. I will control for SES status, and then classify patients based on their total body mass index (BMI). I will then use separate multivariate regressions for each year between 2002 and 2012 to test whether the association between low-socioeconomic status and obesity has changed over time. The answers to these questions can in turn be used to inform health policy in the United States.

III. Literature Review

Obesity

Obesity is defined as an excessive amount of body fat (Sobal, 1989). In a study on the measures of fatness and obesity in social science research, Burkhauser and Cawley (2008) note that virtually all research related to obesity studies a person's body mass index (BMI) to quantify this. BMI indicates weight in kilograms divided by height in meters squared. If an individual's BMI is greater than 25 but less than 30, he or she can be classified as overweight. Any BMI exceeding 30 is considered obese, with an excess of 40 constituting morbid obesity (Alpert, 2009).

This study will keep consistent with the literature and utilize BMI as an indicator of whether or not an individual is obese. Nevertheless, there are researchers who

advocate for better methods of quantifying fatness and obesity. Burkhauser (2008), for example, notes it is imperative that research in the long-term use obesity measures that distinguish fat from fat-free mass such as muscle; he argues that using BMI is inaccurate and skews empirical results. In addition, Alpert (2009) proposes using waist circumference as a better indicator of obesity because it more accurately predicts health risk. Women with waist circumferences of above 35 inches and men with above 40 inches are considered to be at higher risk for obesity-related diseases than those with smaller waist circumferences. While superior, these biometric measures are not available in the NHIS datasets, which instead consistently report BMI over the years, allowing for the comparison of national health data over a long time frame.

Socioeconomic Status

There is little consensus about conceptualizing and measuring socioeconomic status; however, researchers most frequently use indicators of income and/or education. Occupation is also used, although less frequently (Sobal, 1989).

All of these typical measurements are closely interrelated; however, a number of studies point to education as being the most fundamental of the three indicators in determining health. Adler (2002) demonstrates the importance of the education component of socioeconomic status in particular, arguing that it is the most influential factor of SES to the extent that it alone often shapes future occupational opportunities and earning potential (income). From a policy standpoint, this could suggest that efforts in education reform are simultaneously efforts in health reform (Low, 2005), given that research points to such positive health implications of higher educational attainment.

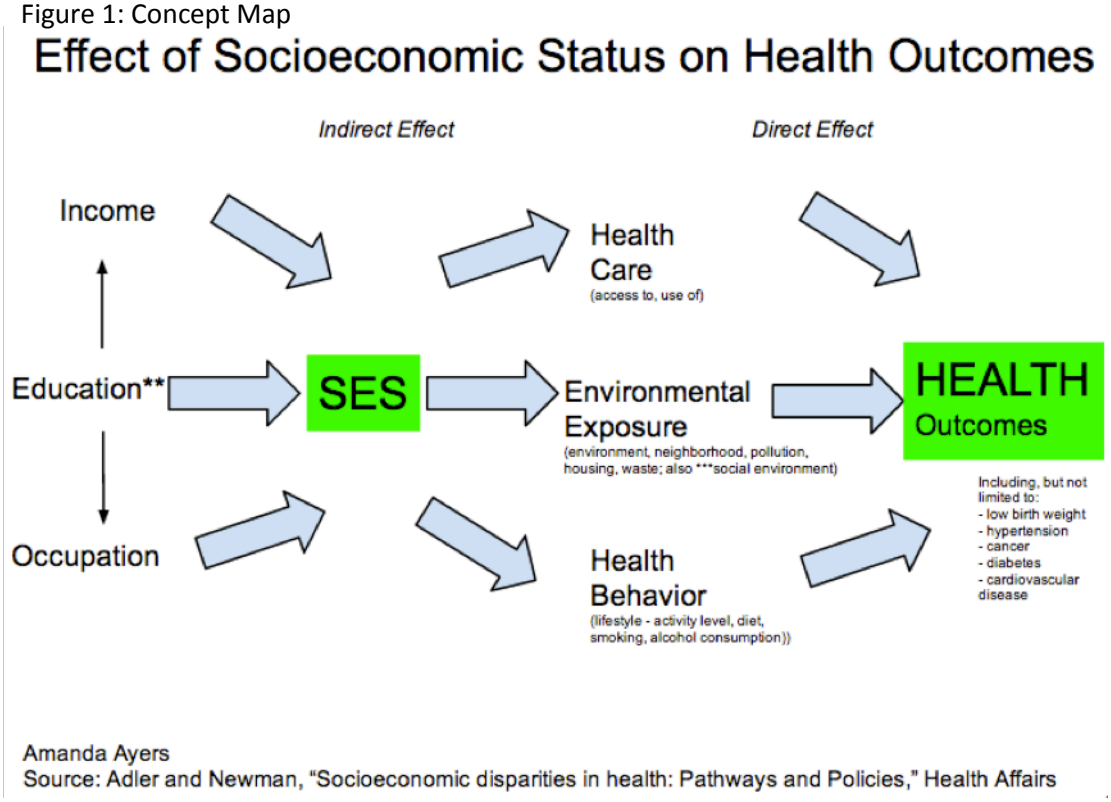
McLaren (2007) also discusses the benefit of using education as a measure of an individual's socioeconomic status for empirical research. One advantage is that education is less likely to be affected by a subject's body weight status, whereas an individual's income might be more affected by weight. There is increasing literature pointing to discrimination based on weight in the workplace, for example, which could affect an individual's occupation and/or income. In addition, education is more comparable across time than income or occupation, which lends itself particularly well to a study of this nature.

It is important to additionally note that racial minorities compose a disproportionate percentage of the U.S. population belonging to lower socioeconomic status. Williams (2006) notes that although SES accounts for much of the observed racial disparities in health, "Racial differences often persist even at 'equivalent' levels of SES."

Socioeconomic Status and General Health: Conceptual

The most fundamental disparities in health outcomes can be traced to varying socioeconomic statuses across population groups (Adler, 2002). Adler (2002) defines the direct determinants of health as health care (access to as well as use of), environmental exposure (both physical and social), and health behavior (lifestyle). Socioeconomic status indirectly affects health outcomes to the extent that it profoundly shapes each of these three direct determinants. The Concept Map in *Figure 1* below is a visual representation of this argument.

Figure 1: Concept Map



Considering health care, earning more or having a higher education can provide the means for purchasing care and utilizing preventive care measures to a greater degree (Kangovi, 2013). There has been significant research regarding the effects of socioeconomic status on access to primary care and the subsequent health implications associated with this. Having access to primary care can contribute positively to health in three ways: (1) it can *prevent* the onset of an illness or condition, (2) it can *control* an acute episodic illness or condition, and (3) it can help patients *manage* a chronic disease or condition (Blustein, 1998). These have the potential to produce more positive health results; however, patients with lower socioeconomic status (SES) use more acute hospital

care and less primary care than patients with higher socioeconomic status. According to Kangovi (2013) this is because they perceive it as less expensive, more accessible, and of higher quality than ambulatory care. Regardless of the incentives, this pattern of care is harmful not only to low-SES individuals' health, but also detrimental to the health care system as a whole in terms of overall costs (Kangovi, 2013).

Environmental exposure is another direct pathway through which an individual's health is determined in Adler's model. This refers to both the physical environment and social environment in which an individual lives, and can vary significantly across differing socioeconomic subsets of the population. Lower-SES groups tend to have higher exposure to damaging physical agents in the environment, including but not limited to: pollution, lead, asbestos, carbon dioxide, and industrial waste. Additionally, according to Adler (2002), "poorer neighborhoods are disproportionately located near highways, industrial areas, and toxic waste sites…Housing quality is also poorer for low-SES families. As a result, compared with high-income families, both children and adults from poor families show a six fold increase in rates of high blood lead levels…" There has been a plethora of policy solutions aimed at specifically targeting this damaging physical environmental exposure experienced by those on the lower end of the socioeconomic status spectrum.

An individual's social environment may in fact be more impactful in shaping health than his or her physical environment (Adler, 2002). Social networks and interactions significantly alter health outcomes, and may or may not provide the supports needed to engage in a healthy lifestyle and consistent positive health behaviors, including

taking the initiative to seek care when it is necessary. These vary across SES groups, again producing varying health results across different subsets of the population.

The final direct determinant of health according to Adler deals with behavioral, or lifestyle, factors (2002). These account for about half of all premature mortality, and include habits like poor dietary behavior, lack of physical activity and a sedentary lifestyle, tobacco use, and heavy alcohol consumption. Influenced by socioeconomic status, individuals reaching higher levels of education and income are less likely to engage in these risky health behaviors; they have better knowledge, life skills, and resources to promote health. Because behavioral factors are essential in the development of many preventable chronic diseases associated with obesity, it is imperative moving forward that we target policy geared to behavior changes given the high correlation between low-SES and these negative health practices (Williams, 2005).

Finally, just as the three factors shaping socioeconomic status in Adler's model are strongly correlated to one another, so are these three direct determinants of health (i.e. none of these contributors are completely independent of each other; their effects overlap). For example, being exposed to a particular social environment will likely cause an individual to engage in a certain lifestyle contingent upon the priority that his or her closest relationships and/or support system place on health.

Socioeconomic Status and General Health: Empirical

There have been a multitude of studies quantifying the negative effect of lower socioeconomic status on general health outcomes. Shi (1999) examined the joint relationship between income inequality and the availability of primary care on various

health indictors. Consistent with Adler's (2002) model of health, income (a component of socioeconomic status) was found to indirectly affect health through health care (a direct determinant of health). The study indicated that primary care exerted a strong and significant direct influence on life expectancy, total mortality, and other health outcome indicators, implying that primary care has the potential to serve at least partially as one pathway to overcome severe adverse effects on health derived from income inequalities (Shi, 1999).

In addition, Blustein, Hanson, and Shea (1998) conducted a study in which 37 percent of participants from the lowest income tercile reported being in fair or poor health, compared to 16 percent of those in the upper income tercile. According to Williams (2005), "Americans with low SES have levels of illness in their thirties and forties that are not seen in groups with higher SES until three decades of age later…Death rates from heart disease are two to three times higher among low-income blacks and whites than among their middle-income peers." In a study on health outcomes measured by the number of preventable hospitalizations (or "ambulatory care-sensitive conditions"), Blustein (1998) also found that low-SES subjects were at much higher risk even when an up-to-date severity of illness adjustment system was used.

Finally, Winkleby (1992) conducted an empirical analysis quantifying the relative impact of each separate dimension of socioeconomic status (education, income, and occupation) on general risk factors for disease. Education was found to have the greatest individual contribution to a set of cardiovascular disease risk factors (cigarette smoking, systolic and diastolic blood pressure, and total and high-density lipoprotein cholesterol),

many of which are associated with obesity. Worse health was associated with lower levels of education, and this correlation was significantly stronger and more consistent than that between income and health outcomes, and occupation and health outcomes. Education was in fact the only measure that was significantly associated with the health risk factors ($p < .05$).

Socioeconomic Status and Obesity: Conceptual

Before the 1990's, the majority of research produced regarding the specific relationship between socioeconomic status and obesity was biological rather than social. While obesity onset is to some degree rooted in genetics, exclusively focusing on the biological aspects of the epidemic fails to consider the other psychological, social, and cultural influences at play. In many cases, obesity is a product of environment, and SES plays a fundamental role in determining that for an individual (Stobal, 1989). Socioeconomic status affects obesity to the same extent that it influences other health outcomes; it determines an individual's access to as well as use of health care, physical and social environmental exposure, and health behavior or lifestyle, all of which have the potential to work for or against the likelihood of an individual being obese.

Socioeconomic Status and Obesity: Empirical

Veblen first raised the possibility that SES might be related to body weight in 1889; he speculated that thinness was an ideal of feminine beauty and served as a status symbol of an emerging leisure class. However, no systematic data specifically about an SES-obesity relationship emerged until a century later. The prior research did shed light on obesity and SES, but only as a byproduct of the examination other topics (Stobal,

1989).

In 1989, however, Stobal and Stunkard produced the first comprehensive empirical study of SES and obesity among men, women, and children. They found that the relationship between SES differs between both developed and developing countries, as well as within developed societies between men and women. In developing countries, obesity among men, women, and children is rare, likely as a result of insufficient food and high levels of energy expenditure. The prevalence of obesity increases with rising wealth and increasingly available food. By contrast, developed societies like the United States show increasing SES as associated with a decreasing prevalence of obesity, particularly among women (Stobal, 1989). Stobal explains that there are similar forces at work to explain this paradox; in the case of both upper-SES women of developing countries and lower-SES women of developed countries, there is abundant food with few normative constraints about body weight, which has led to a high prevalence of obesity in each group. On the other hand, high-SES women in developed countries are more characterized by dietary restraint, increased physical activity, social mobility, and inheritance, rooted in culturally constructed attitudes toward obesity and thinness and the ideal feminine beauty (Stobal, 1989).

Stobal (1989) notes that the relationship between SES and obesity among men and children in developed and developing countries is much more complex and poorly understood. Both this and the aforementioned conclusions about the prevalence of obesity in women of developed societies were further validated in a continuation of this research conducted by McLaren in 2007.

Socioeconomic Status and Obesity over Time

Thus, the literature clearly establishes the link between socioeconomic status and health outcomes, specifically obesity. The contribution of this investigation will be to examine how this association has developed and changed over the last decade (2002-2012). This time period is of particular interest given the economic consequences of the Great Recession. Mishel (2012) calls the early 2000's the "lost decade" for Americans because of the Recession's consequences of weak labor demand and high unemployment, subsequent devastation of key living standards as a result of wage decreases and stagnation, and dim economic growth prospects. The Great Recession has increased inequality in the United States and put more Americans in poverty.

More economics-based research, which tends emphasize changes that give people incentives to consume more or burn fewer calories, speculates that obesity-related health outcomes for low-SES individuals may have deteriorated over this time due to changes in the real price of food (Cawley, 2010). In a study examining the economics of obesity, Cawley (2010) notes that the price of food adjusted for inflation has declined greatly in recent decades, which could account for an overall rise in BMI. According to Cawley, BMI is most sensitive to the price of fast food for families of lower socioeconomic status. On the other hand, "The real price of fruit and vegetables rose 17 percent between 1997 and 2003, an increase that some studies have linked to higher BMI" (2010). Because the majority of farm subsidies are based on historic, not current, production, farmers' incentives have been limited to increase output, influencing the prices of healthy and unhealthy food options (Cawley, 2010). Persons of low-SES are particularly affected by

healthier options becoming more expensive and less healthy choices becoming cheaper, which might help to explain the changing impact of belonging to low-SES on obesity development in the US adult population over time.

Other research similarly notes that the impact on health and obesity of large-scale societal and nutritional changes related to economic growth, modernization, and globalization of food markets has not been equal within populations of developed countries; McLaren (2007) argues that, "key processes related to globalization and the nutrition transition (including production and trade of agricultural goods, foreign direct investment in food processing and retailing, and global food advertising and promotion) serve to worsen inequalities in diet between the rich and the poor." High-income groups tend to benefit from a more dynamic marketplace, while lower-income groups are more likely to bear the brunt of economic and cultural trends toward a lower-quality diet (i.e. use of inexpensive vegetable oils and trans-fats). Again, this is compounded by the fact that the Great Recession has put a larger percentage of the American population in poverty.

However, it is also possible that the negative association between SES and obesity-related health outcomes has not changed over time. Since research like Mokdad's (1999) points to increasing obesity levels across all states, genders, classes, races, etc., the percentage of those experiencing negative health outcomes related to obesity that are of low socioeconomic status could in fact be the same. In other words, there could still be a disproportionate number of those with obesity-related conditions belonging to lower-SES, but that number has increased at the same rate relative to other SES groups,

rendering the percentage unchanged. The impact of SES on obesity may not have changed at all; obesity rates may have increased simply because the Great Depression has increased inequality and put more Americans in poverty, which is known to be associated with the same worse health outcomes as before.

Research points to a number of other external factors contributing to both increased caloric intake and decreased energy expenditure, which could have also increased obesity rates for every SES category of US adults over the last decade. In terms of caloric intake, according to Zhang (2004), one large-scale factor contributing to dramatic increases in nationwide obesity has been the revolution in mass preparation of food. Because food now takes less time to make and there are more food options to eat more frequently, there has been a significant increase in food consumption overall in the United States. Zhang (2004) argues that because people who have had the most ability to take advantage of the technical changes should have the biggest gains in weight, women could be most significantly affected by this revolution in mass preparation of food. “This may help explain why the disparity of obesity across SES was more weakened in women than in men because the revolution reduces the differences between rich and poor women in food preparation and consumption” (Zhang, 2004).

In addition, the U.S. government’s agriculture policies currently subsidize farmers to produce grains and meats and provide them to domestic markets at low prices; this has contributed to people’s excessive intake of food and to the current obesity epidemic in the United States (Zhang, 2004). Another factor contributing to increased caloric intake in all SES groups is the increase in portion sizes in restaurants and in processed food packages

nationwide; thus, “ubiquitous advertisements for energy-dense foods, low prices of unhealthy foods, large portion sizes, and food preparation affect all socioeconomic groups and promote weight gain” (Zhang, 2004).

Regarding energy expenditure, over the past two or three decades, many social, economic, and environmental changes have contributed to the decline of the overall American population’s physical activity level. There have been significant technological developments that have lent themselves to more sedentary lifestyles. In addition, there has been a widespread transfer of labor-intensive industries to developing countries, the use of public transportation or cars as modes of travel over walking or biking, and the overall shift from less engagement in outdoor activities to more time spent in front of the television and playing video games (Zhang, 2004).

Question of Interest

This study aims to conduct an examination of the recent trends in this association between lower socioeconomic status and worse health outcomes with respect to obesity, and in doing so will hopefully shed light on the direction the United States health care system is headed in the near future. These trends are set within a context of contentious debate regarding health care reform at the national level, as well as external factors influencing obesity onset, like food prices and the revolution in mass food preparation, which are changing unfavorably.

I will control separately for varying dimensions of SES (income and education) to measure the trends in their relative impacts on obesity outcomes in the United States over the past decade. The only study conducted to my knowledge that was remotely similar in

nature examined the time period between the 1970s and 2000, and only used variables pertaining to the education level of an individual to quantify his/her socioeconomic status, not controlling for factors like income or race/ethnicity. Understandably, economic conditions within the United States have also changed considerably for the worse over the past decade with the onset of the Great Recession, which renders this time period of particular interest.

The trends over the last 10 years can inform where health policy should be targeted in the future. If the negative association between socioeconomic status and obesity onset has worsened, policy should be focused to reach lower-SES groups. If the association has not changed, however, and obesity rates are rising nationwide across all levels of SES, this would imply that national health policy should be targeted not only at lower income/less educated subsets of the American population for whom a negative correlation is known, but also middle- and high-SES groups. The following section will address economic models of health theory, as they particularly relate to obesity onset.

IV. Theory

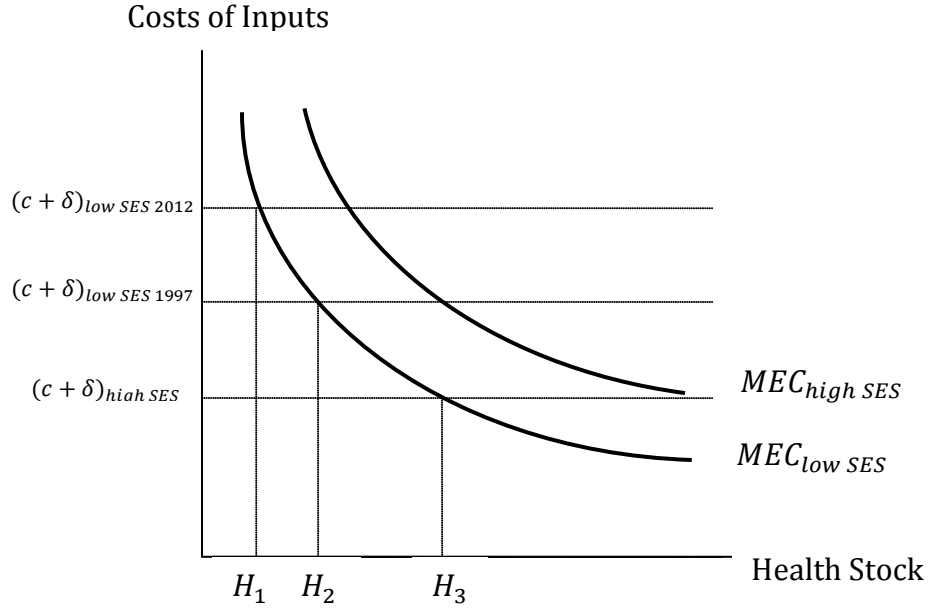
The Grossman Investment Model

Economists generally view health as a human capital investment decision. The Grossman Model (1979), for example, is based on the premise that health is a stock of human capital that yields a stream of healthy days, just as wealth is a stock of financial capital that yields a stream of income. We seek health care (anything that contributes to

producing better health – nutritious food, clean air, exercise, vacation medical care) in order to gain more healthy days.

Rather than be treated as a consumer good, health care is an input into the production of a stock in health, which is the end product, or output; thus, demand for medical care is conditional on the demand for health itself. Grossman (1979) makes the analogy between maintaining health and maintaining a car; the amount of repairs depends on how well you take care of it. Routine maintenance and repairs are necessary to offset depreciation and are part of the gross investment in the body (/car) over its lifetime. In addition, assuming that health is human capital, the marginal efficiency of capital in this case is how much extra expenditure is required to produce an additional unit of health (stock). This concept is presented graphically in *Figure 2* below.

Figure 2: Application of Grossman Model of Health



The quantity of health stock is on the horizontal axis, while the cost (total cost of producing any stock of capital, including what is necessary to offset depreciation $-(c + \delta)$) is along the vertical. The marginal efficiency of capital (MEC) curves are specific to each individual, in this case his/her SES; it depends on his or her initial stock of health at the beginning of the time period under consideration, and takes into account that two different individuals increasing inputs into their health will not necessarily see the same marginal improvement. Wage rate is also taken into consideration in this model; because the rate measures an individual's market efficiency, someone who earns more will get more out of being healthier. In theory, higher wages should increase demand for medical care, as healthy days are more valuable.

This model demonstrates the extent to which socioeconomic status, also correlated with race, can have profound effects on an individual's general health stock. At the start of a given period of time, individuals of lower SES are at lower levels of health than higher-SES individuals, are not putting in equal inputs or using them with the same degree of efficacy, and are experiencing greater health depreciation.

As Adler (2002) explains, the direct determinants of health are health care (access to, use of), environmental exposure (physical and social), and health behavior (lifestyle). The inputs (costs as well as depreciation) will be significantly different for individuals of varying socioeconomic statuses because they access/use health care to different degrees, are exposed to varying environments, and lead different lifestyles, all of which can work for or against higher health stock, in this case investing in decreasing the likelihood of obesity onset. In addition, their MEC curves may be different altogether, given that

persons of different SES start with different health stocks to begin with. This is represented by $MEC_{low\ SES}$ and $MEC_{high\ SES}$ in *Figure 2*.

Since maintaining health is like maintaining a car, for example, a person of lower SES having less access to regular primary care checkups will experience more flare-ups (requiring costly procedures) and expensive medications. Lower SES individuals typically have less access or income to utilize gyms or purchase organic and fresh produce to maintain a healthy diet, resulting in higher depreciation rates on health. This can be seen on the y axis of our model; assuming that that there is an association between low socioeconomic status and negative health outcomes and that it has indeed increased in magnitude over time, $(c + \delta)_{low\ SES\ 2012}$ shows the highest costs and depreciation on the investment in health. Additionally, the environment that an individual of lower-SES is exposed to also typically starts him or her off at a lower level of health than an individual of higher-SES. This would influence the level of health, as shown in the variation in health stock ($H_1, H_2, and\ H_3$) on the x axis of our Grossman model and separate MEC curves. To compound this, research shows that these negative cumulative lifetime effects on health are detrimental; all three direct determinants of health are negatively affected by lower-SES, resulting in higher costs and rates of depreciation.

As suggested in the literature review, education is the most important measure of socioeconomic status to the extent that it affects Adler's (2002) three direct determinants of health the most profoundly. Education is correlated with a lower rate of depreciation in the stock of health, resulting in a downward shift in the MEC schedule. There is a cost reduction typically in producing health for individuals of higher SES who experience

higher levels of attainment in education because they can use their given inputs into health more effectively (i.e. higher education makes people more efficient in producing health). Thus the same input does not yield the same results (marginal efficiency) for two individuals at different levels of health stock. This is evident when we compare various individual points on either MEC schedule, such as the intersections at $H_1, H_2, and\ H_3$ levels of health stock. Education reduces the quantity of medical care needed to produce a given stock of health; although individuals with higher education (/SES) may demand more health with their given knowledge and resources for a healthy lifestyle, their costs of maintenance are less due to this higher health investment in other areas.

Finally, this model can also be used to interpret our specific question of interest: trends in the impact of SES on obesity and obesity-related illnesses. Persons of lower socioeconomic status are likely starting at lower levels of health to begin with at any given point in time on the MEC schedule. This is compounded by higher costs and higher rates of depreciation on this already-low health stock (i.e. they are not getting checkups with a lack of primary care, do not have the resources or knowledge to engage in positive health behavior, do not have the support system needed to support healthy practices, etc.). Should my hypothesis prove correct, these effects have exacerbated over time because of changes in food prices and other large scale societal and nutritional developments that have unequal impacts on the diets of rich and poor people. This is shown in *Figure 2* by the two separate cost levels for low-SES individuals in separate years $((c+\delta)_{low\ SES\ 2012}$ vs. $(c+\delta)_{low\ SES\ 1997})$.

The Grossman Consumption Model

Grossman (1979) also has a consumption model with an indifference curve and budget line for consumption and health investment. The point at which utility is maximized is where the individual has chosen the combination of consumer goods and health investment that puts him or her on the highest indifference curve attainable with that budget.

Age and education, along with initial health and income, are other specific factors that affect the investment in health. Higher education, for example, increases demand for health, but not necessarily for health care.

It additionally takes into account that there can be "negative inputs". Lifestyle effects of wealth, for example, influence health. Contrary to previous findings in the literature review, Grossman argues that there is a *negative* relationship between income level and health. This negative effect is associated only with the *nonwage* component of income; greater wealth is correlated with a lifestyle detrimental to health (eating richer foods, not walking as much, etc.). This is an example of a theoretical approach that does not come to my same conclusion that the resources and knowledge held by those of higher SES tend to positively affect the three direct determinants of health (health care, environmental exposure, and health behavior), and then subsequently health outcomes specifically related to obesity.

V. Methods

Because the dependent variable, obesity, is categorical in nature, it does not

follow a normal distribution. Using OLS would result in heteroskedasticity and predictions from a linear probability model may fall outside reasonable range. For these reasons, Probit modeling was used instead, which would restrict the probability that an individual was obese (BMI≥30) to be between 0 and 1. It is important to note that the only limitation to utilizing a categorical dependent variable in this way is that it assumes that rises in BMI from 28.5 to 29.5, from 29.5 to 30.5, and from 30.5 to 31.5 are all roughly equivalent in their effects on health; however, the obesity variable will only change when BMI increases from 29.5 to 30.5.

The Probit model is represented by $Y_i = \beta_1(\overline{SES_\iota}) + \beta_2(\bar{X}_i) + \varepsilon_i$, where the dependent variable is a measure of obesity (BMI) for each individual *i*, SES is a vector of socioeconomic status indicators for lower SES status, including income and education, $\bar{X}$ is a vector of all other controls in the model (race, age, family status, and gender), and ε_i is the error term.

Given the literature, there are two hypotheses. The first is that $H_0: \hat{\beta}_1 = 0, and\ H_{a\ low\ SES}: \hat{\beta}_1 > 0$ or $H_{a\ high\ SES}: \hat{\beta}_1 < 0$. Lower SES (poverty) exerts a positive, i.e. increases the likelihood of obesity, influence on obesity outcomes. Meanwhile, higher SES (education) exerts a negative, i.e. decreases the likelihood of obesity, influence on obesity outcomes. The second hypothesis is that $H_{0:} \left|\hat{\beta}_{1\ (2002)}\right| = \left|\hat{\beta}_{1\ (2012)}\right|$ and $H_{0:} \left|\hat{\beta}_{1\ (2002)}\right| < \left|\hat{\beta}_{1\ (2012)}\right|$; the negative impact on obesity of belonging to low-SES has worsened over time.

VI. Data and Empirical Model

Data

The data utilized in this study comes from the National Health Interview Survey (NHIS), a cross-sectional household interview survey continuously conducted annually since 1982. The sampling plan allows for representatives of households and noninstitutional group quarters (i.e., college dormitories) from all 50 states and the District of Columbia. The expected NHIS sample size (completed interviews) is currently approximately 35,000 households containing 87,500 people, and participation and confidentiality of responses is maintained. The annual response rate is close to 90 percent of the eligible households in the sample.

Since 1997, the NHIS questionnaire has consisted of self-reported Core questions and Supplements. The Core questions, which remain largely unchanged from year to year, contain four major components: Household, Family, Sample Adult, and Sample Child. The supplemental questions are used to respond to new public health data needs as they arise and vary across years. For the sake of this study, pertinent variables were pulled from the 2002 through 2012 Family and Sample Adult component files only. The Family component collects demographic information on each member in the house and surveys data on topics including health status and limitations, healthcare access and utilization, health insurance, and income and assets. One sample adult was chosen from each family in the NHIS and interviewed further on issues related to health status, health care services, and health behaviors. The household identification number was used to

merge the Family and Sample Adult datasets; this would ensure that a variable response pulled from either dataset of the same year corresponded to the same individual.

The sample was restricted to males and non-pregnant females, as an expecting mother's current BMI would not be an accurate reflection of whether or not she was ordinarily obese. In addition, all adults in the family did not have the same chance of being selected as the sample adult from the given household; a new feature of the sample design is that adults aged 65+ who are black, Hispanic, or Asian have the greatest chance of being selected relative to other groups.

In addition, self-reported data collection methods tend to result in an underestimation of body mass index; data pertaining to obesity likely underestimates the prevalence of the epidemic in the United States (Villanueva, 2001). Fortunately for this study, Reijneveld (2001) notes that self-report offers a reasonably valid estimate of differences in health between SES groups in the general population because no SES group is known to systematically underestimate its BMI more than another. The underreporting of BMI therefore introduces measurement error in the y variable, which does not create bias in the coefficient estimates (Wooldridge, 2013).

Empirical Measures

The literature demonstrates that the three primary socioeconomic status indicators are income, education, and, to a lesser extent, occupation. Thus, the research measures separately for the relative impacts of income and education on obesity outcomes. Since the literature noted that the direct effects of health are access to/use of health care, environmental exposure, and health behavior, variables controlling for smoking and

drinking habits, exercise, and regular access to health care are also incorporated in the model. Finally included are indicators of race/ethnicity, age, region, employment status, and gender, all of which constitute demographic characteristics that may be associated with socioeconomic status and/or potential confounding variables; thus, it is necessary to control for them in an econometric model examining the relationship between socioeconomic status and obesity. All of these variable means and definitions are presented in the tables in Appendix 1.

To measure education, the only data available indicated the highest degree held by any member of an individual's household, rather than the education of each individual. Although using household education is an imperfect measure for a key variable, this proved not to be too detrimental, given that the sample was restricted to only the adults in a household. If there was only one adult, then the education level was known of that individual. Otherwise, in a two-adult household, there was a 50% chance of the education level corresponding to the correct person. In addition, recent years particularly have shown a strong correlation between (and convergence of) the education levels of husbands and wives (Wang 2014).

Education is measured categorically. The variable is separated into whether the highest education level in the household is dropping out of high school (no degree), obtaining a high school degree or GED, obtaining a two or four year college degree, or obtaining a degree beyond college (masters, doctoral, or professional).

Furthermore, income is measured using the ratio of combined household family income to the poverty threshold for each year in order to account for economy-wide price

increases over the years the data was collected (inflation). This ratio is then converted to separate indicators for individuals in true poverty (ratio <1), individuals in near poverty (ratio between 1 and 2), and individuals out of poverty (ratio ≥ 2).

Descriptive Statistics: General

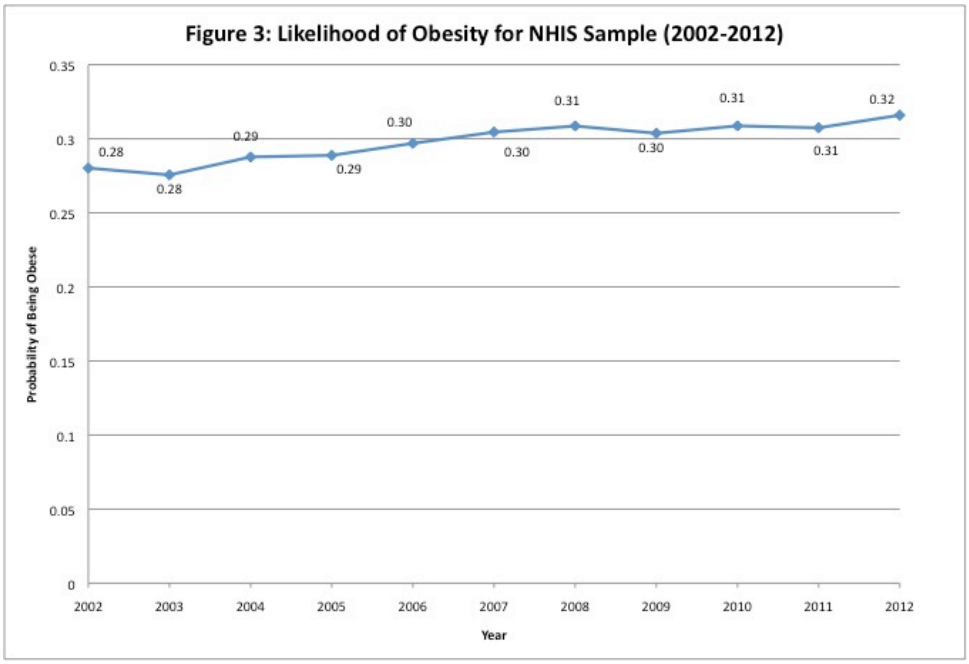
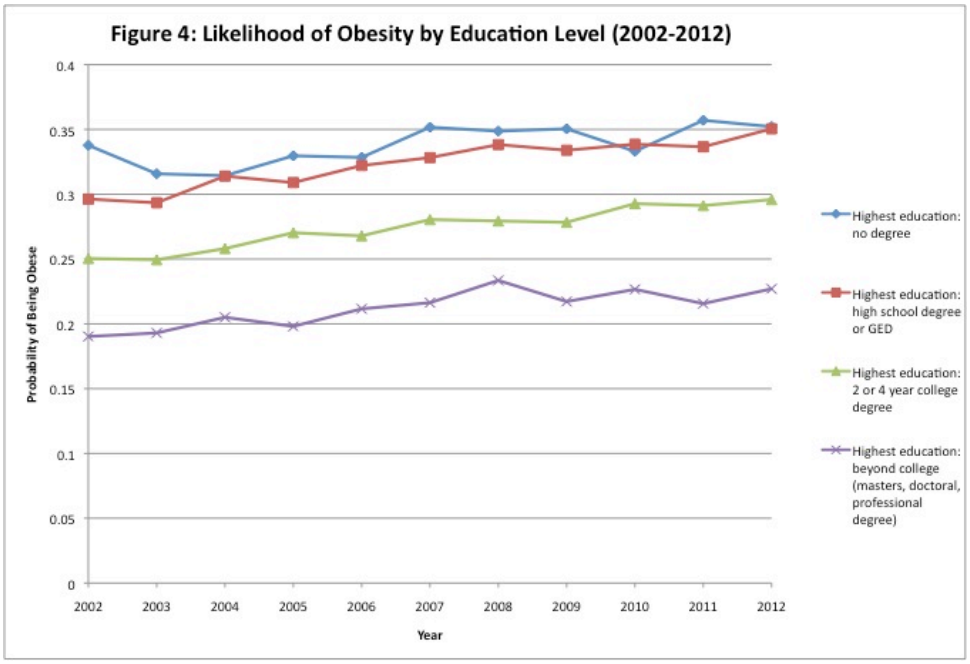


Figure 3 above shows the average rate of obesity in the overall NHIS over the years 2002-2012. Over the 11-year span, the overall sample obesity rate increased by 3.6 percentage points.

Descriptive Statistics: Education

Figure 4 produced below breaks down this overall sample further by education level; it indicates the probability that an individual in the sample is obese based on his or her highest level of education.

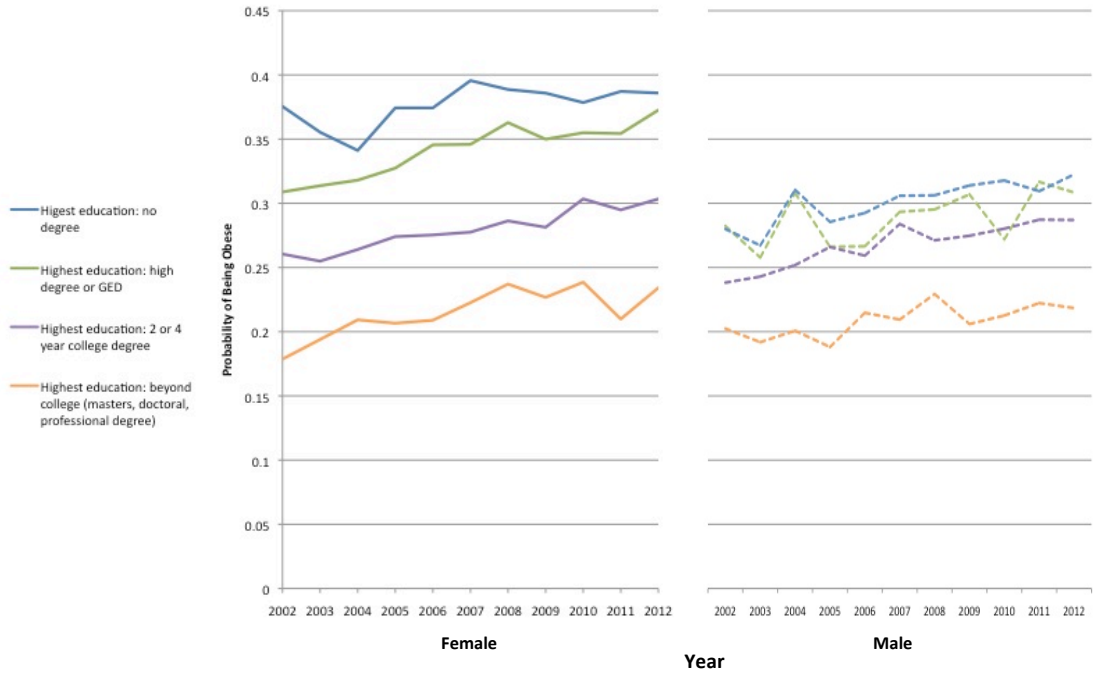


First and foremost, the data show that higher education is consistently associated with lower obesity rates. It appears that with the exception of not having obtained any degree, the obesity rates for the other three levels of education have increased at about the same rate over the years 2002-2012. All three of these overall increases were within one percentage point of each other. In addition, the data suggest that having no degree and having a high school degree/GED produces roughly similar obesity outcomes, while there is a large gap between these and obtaining a two or four-year college degree or beyond a college degree. This may imply that when examining education, either of these latter two levels of attainment is more crucial than just a high school degree in decreasing the likelihood that an individual is obese.

Because both Stobal (1989) and McLaren (2007) note the specific association between low socioeconomic status and higher obesity prevalence in women of developed

countries like the United States, *Figure 4.1* below breaks down the impact of varying education levels on obesity by gender.

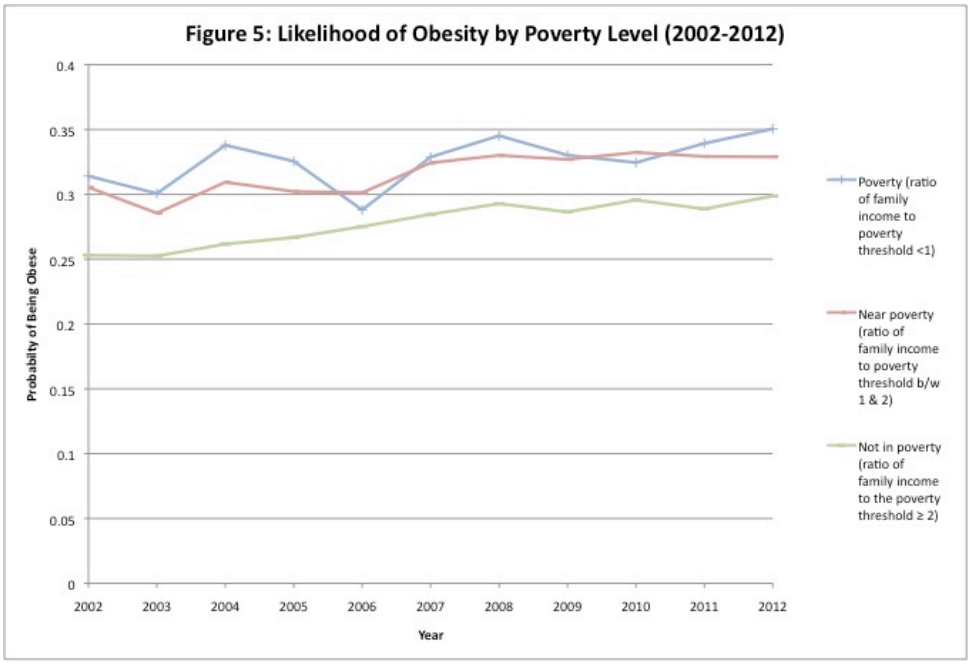
Figure 4.1: Likelihood of Obesity by Education Level, by Gender (2002-2012)



There is a clear impact of education on obesity outcomes at each successive level; however, with less education, there was increased disparity in the obesity rates between men and women. While males and females of the highest education level (beyond college) had comparable rates of obesity, the male rates were significantly lower than women's for each subsequent level of education, particularly for those without a degree at all or with just a high school degree or GED. It appears as though the negative impact on health of belonging to low SES is magnified for women; the experience of higher obesity rates among less educated Americans could be driven by women in this category.

Descriptive Statistics: Income

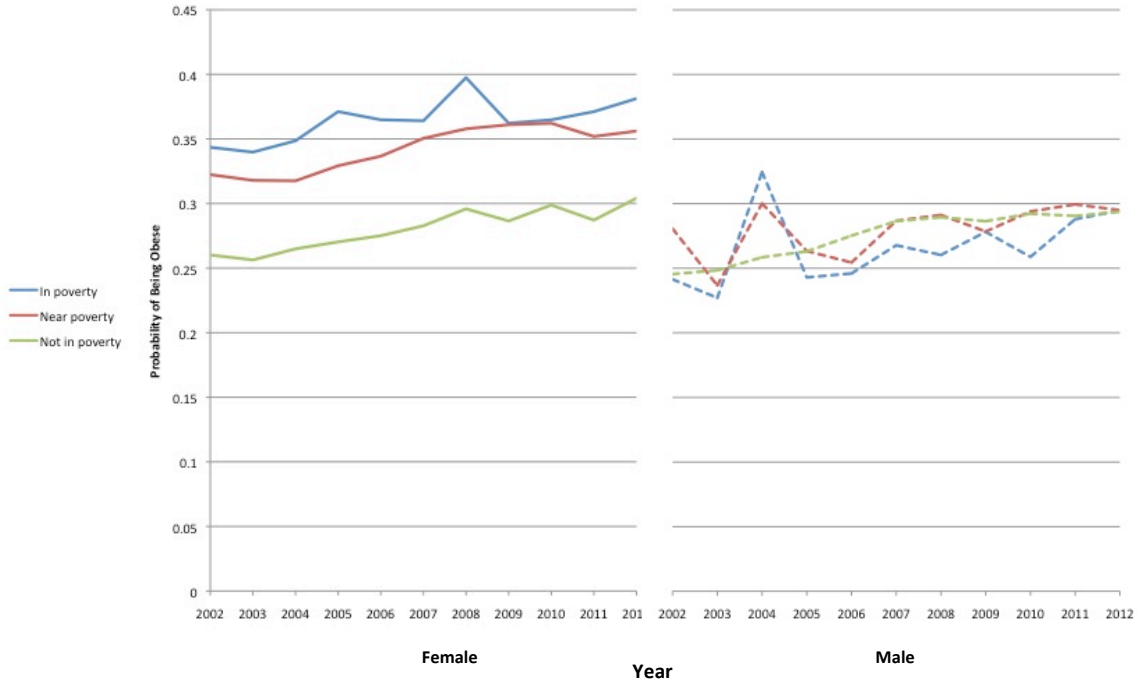
Figure 5 below examines obesity likelihood in the NHIS survey sample based on varying income levels.



Generally speaking, being less poor or, even better, out of poverty led to lower probability of obesity onset. There was more variation over time in the sample obesity rates by poverty status than education; however, each level ultimately increased over time, most significantly for the poverty and not in poverty groups, which both showed an almost five percentage point increase in obesity likelihood from 2002-2012. Additionally, there seems to be a slight convergence between the rates of those in near poverty and those out of poverty, as the rates increase more quickly for the higher income group.

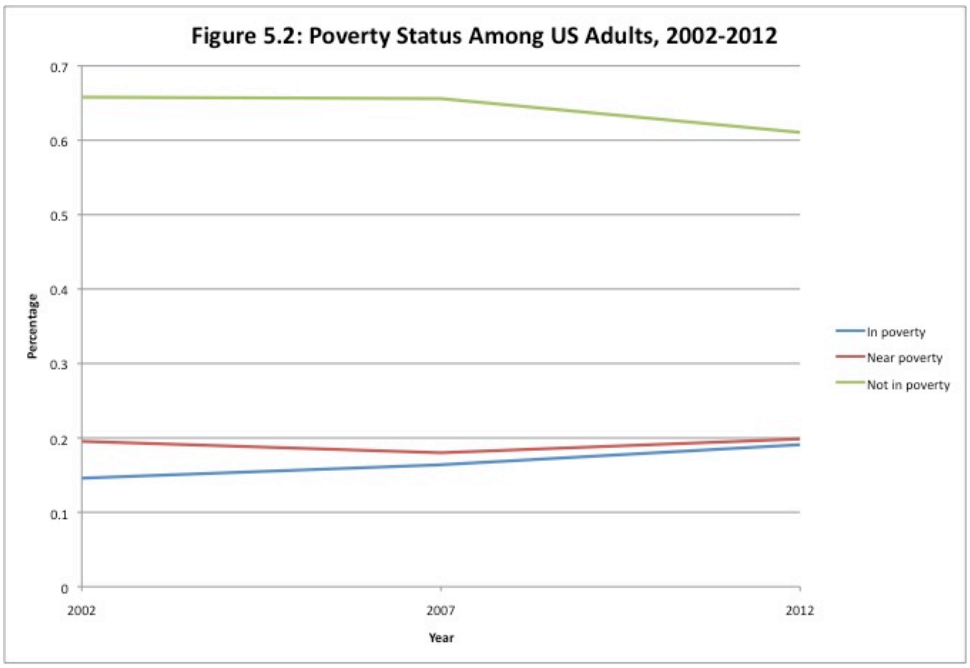
It is interesting to note that the impact of belonging to a certain income group (in poverty, near poverty, or not in poverty) on obesity rates is very much dependent on gender, as shown by *Figure 5.1* below.

Figure 5.1: Likelihood of Obesity by Poverty Level, by Gender (2002-2012)

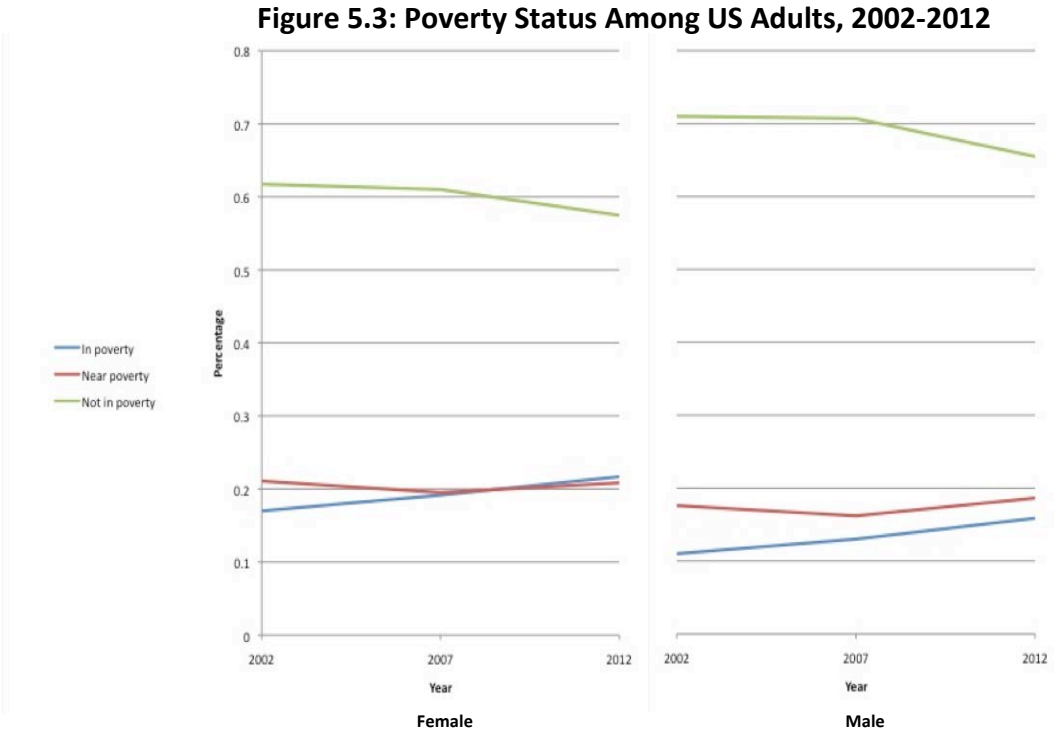


While those not in poverty had relatively similar obesity rates between males and females, there is a large disparity between the rates for those in poverty or near poverty; in each of these latter income groups, females on average are significantly more likely to be obese than males.

Additionally, from the poverty data in the NHIS sample, *Figure 5.2* below shows the poverty status among U.S. adults from 2002-2012.



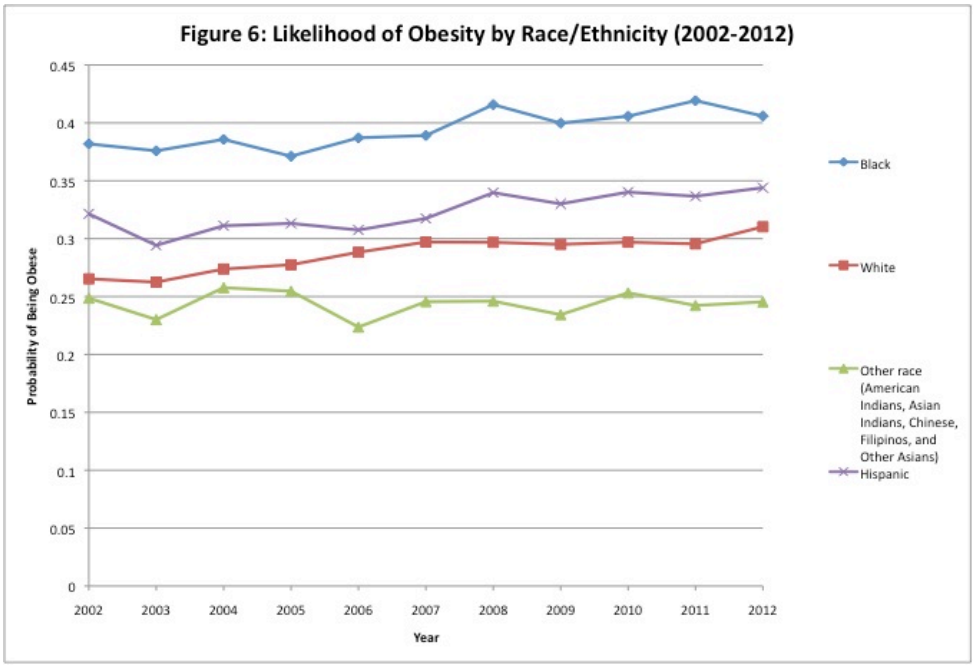
Over the decade, the impact of the Great Recession has been fewer people not in poverty and a higher percentage of U.S. adults in poverty or near poverty. This is consistent with the literature. *Figure 5.3* below splits these rates up further by gender.



Again, for both females and males, the percentage of the population in poverty/near poverty increased from 2002-2012, while the percentage out of poverty decreased for both genders. However, males had a higher percentage of individuals not in poverty over the decade than females. In addition, the rate of growth for those in poverty over 2002-2012 appears faster for males than for females.

Descriptive Statistics: Race/Ethnicity

Figure 6 below examines the average rate of obesity among blacks, whites, Hispanics, or other races (American Indian, Asian Indian, Chinese, Filipino, or Other Asian).

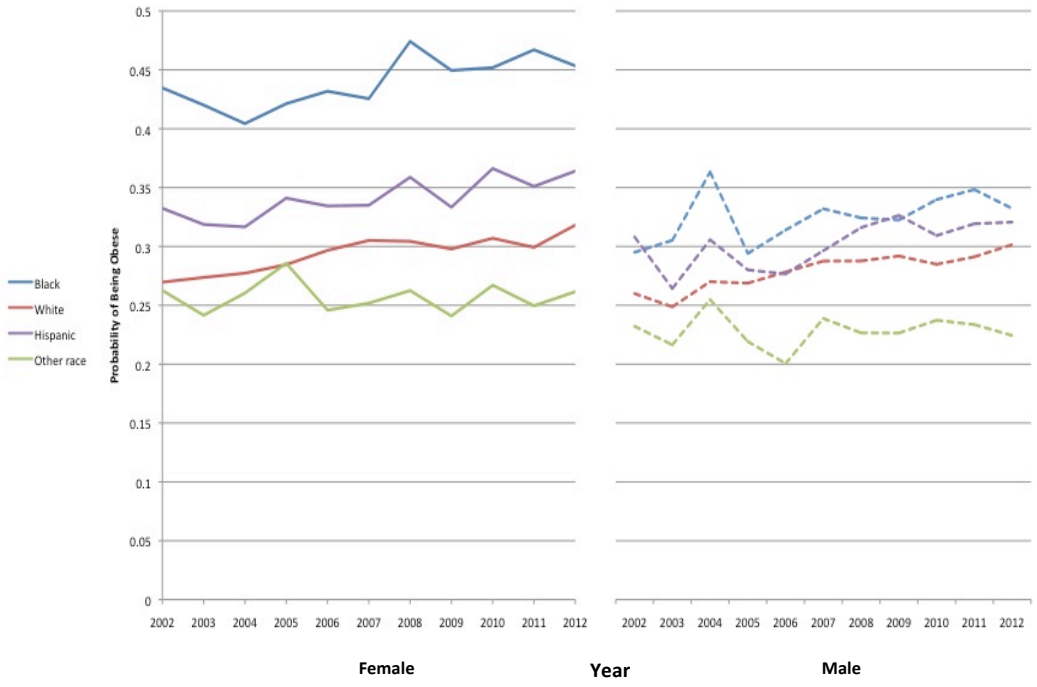


Blacks had the highest rate of obesity, followed by Hispanics, whites, and then members of the other race category. Within the other race category, the obesity rate in 2012 is actually less than in 2002 and disparities remained stable over the course of the decade. This result is contrary to not only the other race/ethnicity indicators (black,

Hispanic, or white) that all saw increases in obesity rates as a whole over the 11 year time span, but also the education and poverty indicators from *Figure 2* and *Figure 3*. An interesting question is what factors are excluding this group from the nationwide trend in increased obesity onset exhibited by this data.

Finally, *Figure 6.1* below separates the obesity rates by race/ethnicity further by gender.

Figure 6.1: Likelihood of Obesity by Race/Ethnicity, by Gender (2002-2012)



First, all of the obesity rates are lower for males than females, with the exception of whites in which the rates are comparable. Again, there is significant disparity between men and women, particularly for blacks. While the black male's average obesity rate was within five percentage points of the overall national population average, hovering between 30 and 35%, a black woman had between 40 and 47% likelihood of being obese.

Again, it seems as though women in lower socioeconomic status are particularly driving the negative health outcomes associated with it.

VII. Results

Appendix 2 presents the results of the full Probit regression. This regression is broken down into separate tables to focus on one variable type at a time, demonstrating the marginal effects of the various socioeconomic status indicators (income and education) and control variables (age, race/ethnicity, gender, employment status, health care access, health behavior) on obesity.

Income

The marginal effects of income determinants of obesity are shown in Table 2B of Appendix 2. For the income variables in the full regression, the coefficients were rarely statistically significant across the 11 year period.

Education

The measured impacts of education are presented in Table 2C of Appendix 2. All but four of the coefficients for each education variable over the 11 year span had negative coefficients; consistent with the literature, attaining higher levels of education decreased the likelihood of an individual being obese, as opposed to having no degree (the omitted category). Interestingly, a high school education/GED as the highest level of attainment was only statistically significantly different from being a high school dropout in two out of the 11 years, and only at the 10% significance level. Meanwhile, obtaining a college or beyond college degree as the highest level of education was statistically significant in all

but one year between the two variables.

Thus, consistent with the mean graphs presented in the Data section, these results seem to indicate that college is the minimum level of education needed to have a protective effect on obesity. Any given person in the sample having obtained a college degree, as opposed to not obtaining any degree, has between 2.2 and 4.2 percentage points lower probability of being obese. In addition, any given person having obtained a degree beyond college will have decreased his/her likelihood of being obese by 5.3 to 9.6 percentage points.

Education Variables Compared to Income Variables

These results can be used as empirical evidence to support the theory that education as opposed to income is the most fundamental indicator of socioeconomic status in determining health outcomes, specifically obesity. I ran an additional model (shown in the tables in Appendix 4) that omitted the education variables. While the poverty variables were rarely statistically significant after 2005 in the original full model, they are statistically significant here in a much greater number of years, as shown in Table 4B. Thus, in analyzing these results, it appears as though having higher education is a more significant driver of one's likelihood to be obese than is income. We can see the effect of intervening variables from these two models; when education is not controlled for, the poverty variable accounts for the direct effect of income on health outcomes, while also absorbing the indirect effect of education on health outcomes. When education *is* controlled for, we see that this income variable no longer becomes statistically significant and that education is a more influential predictor of one's likelihood of being

obese. The primary negative impact of being in poverty or near poverty (as opposed to eluding poverty) seems to be mediating via education.

In addition, after running the full regression, I conducted two different F-tests to determine the joint statistical significance of the education variables and income variables and then compared their respective p-values, the results of which can be found in Table 2M of Appendix 2. The average p-value across the 2002-2012 time period was significantly lower for the group of education variables (0.000) than for the group of income variables (0.4353) which again can validate that higher education in a family in general is a more significant driver than higher income in decreasing the probability that someone is obese.

Control Variables

The marginal effects of the age and gender, race/ethnicity, family status, and region (control variable) determinants of obesity are presented in Tables 2A, 2D, 2E, and 2F, respectively. The sign on the coefficient on the age variable was as expected; as a person's age increases, BMI is also likely to increase for varying reasons (slowing of the metabolism, deterioration in overall health stock, etc.). This resulted in a positive coefficient and increased likelihood of an individual reporting obesity as s/he ages. The age variable was statistically significant in all years and the coefficients were consistent across every model. This was additionally the case for the male, Hispanic, black, and other race variables. The coefficients were in the same range of values (and all statistically significant at the 1% level). Interpreting these coefficients, we can see that being male or of the other race category decreased one's likelihood of being obese

(relative to being female or being white, respectively), while being black (relative to being white) or Hispanic increased an individual's likelihood. These outcomes are consistent with prior literature. Finally, the only region which showed consistent statistically significant marginal effects on obesity was the Midwest; the coefficients were positive, suggesting that an individual in this particular region will have an increased probability of being obese.

Being employed or retired increased the probability that an individual would be obese. Although typically those employed should, according to the literature, have a lower chance of being obese, this variable produced positive coefficients across the 11 years. This is most likely due to the fact that individuals who were retired were also included, meaning this variable was also accounting for the negative effects of aging on obesity outcomes. These results are presented in Table 2G.

Finally, the health behavior variable determinants of obesity (smoking, drinking, exercise) and variable measuring for regular access to health care are presented in Tables 2H-2K. The variables indicating whether a person smoked or did not exercise had positive coefficients across the years; engaging in either of these habits increased the probability that an individual would be obese. Being a moderate drinker, a heavy drinker, or not having regular access to health care, however, resulted in negative coefficients across the 11 years, meaning that as someone moved into any of these respective categories, s/he saw a decrease in the probability of being obese.

Trends over Time

Finally, to examine trends over time, we can see that the impact of education and

race on obesity is consistent over the past decade. Thus, from 2002-2012, the average rates of obesity have increased for people belonging to all levels of socioeconomic status, although the varying effects on obesity of belonging to one of these SES levels have remained relatively the same. This is exhibited by the Descriptive Statistics presented in Section VI and consistent regression coefficients across the 11 years in this section.

In addition, to test formally for trends in the association between socioeconomic status and obesity, interaction terms were created between the year variable and the variables indicating a college degree and beyond college degree, since these variables were shown to be the most important in determining the likelihood that an individual would be obese. Only one of these interaction terms was statistically significant across the decade, further demonstrating that the impact of socioeconomic status on obesity has not changed over time. These results are presented in Table 2N of Appendix 2.

Regressions by Gender

Given the literature that had noted the particular impact of low-SES on obesity for women of developed countries as well as the results from the Descriptive Statistics separated by gender in Section VI, I also ran the regressions separately for men and women. The results from these regressions can be found in the tables in Appendix 3.

The most notable conclusions can be made again regarding the education variables, shown in Table 3B; a high school degree was still not statistically significantly different than having no degree for both men and women. Interestingly, however, a college education was statistically significant only for females, not males, while beyond college was significant for both genders. Additionally, in all education levels, the

estimated effects of SES on obesity were larger for women. This supports the literature and prior graphs demonstrating that women have a higher probability of being obese if they belong to a lower socioeconomic status, in this case measured by education. With less education came increased disparity in the obesity rates between men and women. Finally, again the coefficients split up by gender were stable across the 11 year period for all education levels; the impact of belonging to low SES on obesity doesn't seem to have worsened for men nor women.

Table 3M further demonstrates that the impact of education on obesity outcomes is statistically significantly different between men and women. Separate interaction terms were created between male and high school education, male and college education, and male and beyond college education. All but three of these latter two interaction terms were statistically significant over the 11 year period.

In addition, examining the race variable coefficients confirms the results found in the Descriptive Statistics figures in Section VI. The effect of belonging to each race category on obesity was magnified for women, relative to being white. Being a black or Hispanic woman in particular resulted in much larger marginal effects on obesity than did being a black or Hispanic man.

The coefficients representing the impact of belonging to a certain race/ethnicity on obesity remained constant over the 11 year period. Thus, as seen with education, belonging to a certain race/ethnicity impacted obesity by about the same magnitude across the 2002-2012 time span, although the impacts were higher for women than men. The average obesity rates increased each year for each group by about the same over the

decade.

VIII. Conclusions

It is widely established that lower socioeconomic status is associated with worse health outcomes. One such outcome particularly affected by SES is obesity; obesity along with its related chronic conditions is the primary driver in increasing national health care costs. This study examined trends in the specific relationship between indicators of socioeconomic status and obesity outcomes in U.S. adults between the years 2002 and 2012.

Education and Obesity

Socioeconomic status is traditionally defined in terms of education, income, and occupation; however, most research attributes education to being the most fundamental of these three indicators. This study found empirical evidence of education in turn being the most influential dimension of SES impacting an individual's likelihood of being obese (a health outcome), more so than income earned. The group of education variables was more jointly statistically significant than the group of income variables in the full model regression (Appendix 2), demonstrated by its substantially lower p-values across the 11 years of data.

Additionally, concerning the education variables, this study found that obtaining a college degree or a degree beyond college (masters, professional, doctoral) was statistically significant in decreasing the likelihood that an individual was obese. However, only obtaining a high school degree was not statistically significantly different

than not obtaining a degree at all. Furthermore, running the full regression separately by gender demonstrated that a college degree and beyond college degree were statistically significant for females in decreasing the probability that an individual would be obese, while only a degree beyond college was statistically significant for males. These results were consistent throughout the examined decade.

For both men and women, as education levels increased, the likelihood of an individual being obese decreased. However, with less education, there was increased disparity between the rates for men and women. Women consistently saw higher rates of obesity and were more impacted in terms of obesity onset by belonging to a lower SES category. This is supported by the recurring statistical significance of the interaction terms between the gender variable and the variables indicating the various levels of education; the relationship between education and obesity outcomes is thus statistically significantly different between men and women. The literature points to reasons why women in these lower-SES groups are so much more prone to these worse health outcomes. Stobal, for example, notes that as socioeconomic status (in this case education level) decreases for women in developed countries (like the United States), obesity rates tend to increase as a result of an abundance of often unhealthier food with fewer societal pressures to be thin (1979).

Since education was found to be the primary driver of health outcomes as the literature suggested, from a policy standpoint, particularly given ongoing heightened political tension surrounding health care, education reform has the potential to simultaneously serve as health reform. Public health is defined as “all measures (public or

private) to prevent disease, promote health, and prolong life among the population as a whole" (Milofsky, 2013). In addition to encouraging students to stay in school and pursue a college degree, particularly in areas with lower socioeconomic status where dropout rates tend to be higher, schools can serve as non-health community institutions to create a shared community culture that defines health lifestyles and supports health education and behavior. Schools can promote activities and structure learning to engage children in healthy behaviors, and make being healthy fun. If executed correctly, they have the potential to create a community of support and concern for healthy living, and produce social capital in children, which provides personal support and psychological wellbeing. In these ways, education can serve as a means by which the goals of public health are advanced: assessing and monitoring at-risk communities and populations to target problems and priorities, formulating public policies designed to identify local and national health problems and priorities, and assuring that all populations have access to appropriate, cost-effective care.

Trends in the Impact of SES on Obesity over Time

This study also found that while obesity has increased overall for all SES groups over the years 2002-2012, the impact of socioeconomic status on obesity has not changed. Socioeconomic status still affects obesity, but the disparity among its factors has not grown over the course of the Great Recession in the United States; in other words, the increasing obesity rates across the population that we have seen over the past decade are not driven by changes in the way that socioeconomic status affects obesity, as the association has remained constant over the past decade. This is exhibited by the

parallel increases in obesity rates among varying levels of socioeconomic status across the 11 years in the Descriptive Statistics in Section VI, consistent marginal effects of socioeconomic status determinants of obesity across the decade in the Results in Section VII, and the lack of statistical significance in the interaction terms between the year and the higher level education variable determinants of obesity (Table 2N of Appendix 2).

This could imply that population-based and environmental approaches should be developed for the prevention and management of obesity, rather than individually based approaches (Zhang, 2004). Individuals with all levels of education are still seeing increases in obesity rates, which could mean that both low and high-SES groups need to be targeted. Even though high-SES groups may be more aware of the importance of maintaining a healthy body weight and diet, being active, etc. they are still gaining weight as well. The literature points to a number of larger external societal changes that account for this overall increase in obesity in the U.S. adult population as a whole. Overall increases in caloric intake and decreases in energy expenditure may have derived from a revolution in mass preparation of food, U.S. agriculture policies and subsidies, low prices for unhealthy foods (and vice versa), and the trend toward a more sedentary lifestyle; these factors affect all socioeconomic groups equally and promote weight gain among U.S. adults.

What Now?

The Great Recession has put a larger percentage of Americans in poverty over the past decade than before. Even if the impact of belonging to a lower SES category has not changed over time, there is still subsequently a larger portion of the population subject to

more negative health outcomes associated with lower-SES, particularly obesity onset, which could serve as an explanation for the increases in obesity rates across the board for every SES category.

Nevertheless, while a greater number of Americans are in poverty over the last decade, there have also been increases in the number of U.S. adults obtaining a higher education (college and beyond), as well as a decrease in the number of individuals obtaining no degree or just a high school degree/GED. Because this study found that education is a more influential driver of obesity outcomes than is income, this leads us to believe that the effect of SES on obesity outcomes over the past decade should have been positive (i.e. lowered the predicted rates).

One question moving forward may be to examine why the impacts of other larger external factors contributing to increased caloric intake and decreased energy expenditure have outweighed these positive effects of higher socioeconomic status (education) on obesity outcomes. With better indicator variables to measure for the impact of these trends, we could better tailor policies to address the underlying causes of rising obesity rates among U.S. adults.

IX. References

Adler, N. E., & Newman, K. (2002). Socioeconomic disparities in health: Pathways and policies. *Health Affairs, 21*(2), 60-76. doi:10.1377/hlthaff.21.2.60

Alpert, Patricia. "Obesity." *Home Health Care Management and Practice*. 21.6 (2009): 442-444. Print.

Blustein, J., Hanson, K., & Shea, S. (1998). Preventable hospitalizations and socioeconomic status. *Health Affairs, 17*(2), 177-189. doi:10.1377/hlthaff.17.2.177

Brewer, M. A. (2005). *Variations in ambulatory care of diabetes.* (D.N.Sc., The Johns Hopkins University). *ProQuest Dissertations and Theses, .* (304993143).

Burkhauser, RV, and J Cawley. "Beyond BMI: the Value of More Accurate Measures of Fatness and Obesity in Social Science Research." *Journal of Health Economics*. 27.2 (2008): 519-29. Print.

Cawley, J. (2010). The economics of childhood obesity. *Health Affairs, 29*(3), 364-371. doi:10.1377/hlthaff.2009.0721

Hicken, M., Gragg, R., & Hu, H. (2011). How cumulative risks warrant A shift in our approach to racial health disparities: The case of lead, stress, and hypertension. *Health Affairs, 30*(10), 1895-1901. doi:10.1377/hlthaff.2010.1241

Kangovi, S., Barg, F. K., Carter, T., Long, J. A., Shannon, R., & Grande, D. (2013). Understanding why patients of low socioeconomic status prefer hospitals over ambulatory care. *Health Affairs, 32*(7), 1196-1203. doi:10.1377/hlthaff.2012.0825

Low, M. D., Low, B. J., Baumler, E. R., & Huynh, P. T. (2005). Can education policy be health policy? implications of research on the social determinants of health. *Journal of Health Politics, Policy and Law, 30*(6), 1131-1162. doi:10.1215/03616878-30-6-1131

McLaren, L. "Socioeconomic Status and Obesity." *Epidemiologic Reviews* 29.1 (2007): 29-48. Print.

Mishel, Lawrence R. *The State of Working America*. Ithaca, NY: ILR, 2012. Print.

Mokdad AH, Bowman BA, Ford ES, Vinicor F, Marks JS,Koplan JP. (2001). THe continuing epidemics of obesity and diabetes in the united states. *Jama, 286*(10), 1195-1200. doi:10.1001/jama.286.10.1195

Mokdad AH, Serdula MK, Dietz WH, Bowman BA, Marks JS,Koplan JP. (1999). THe spread of the obesity epidemic in the united states, 1991-1998. *Jama, 282*(16), 1519-1522. doi:10.1001/jama.282.16.1519

Oster, A. M., & Bindman, A. B. M. (2003). Emergency department visits for ambulatory care sensitive conditions: Insights into preventable hospitalizations. *Medical Care, 41(2)*(February), 198.

Reijneveld, Sijmen A, and Karien Stronks. "The Validity of Self-Reported Use of Health Care Across Socioeconomic Strata: a Comparison of Survey and Registration Data."*International Journal of Epidemiology*. 30.6 (2001): 1407. Print.

Shi, Starfield, Kennedy, & Kawachi. (1999). Income inequality, primary care, and health indicators. *The Journal of Family Practice, 48*(4), 275--84.

Sobal, Jeffery, and Albert J. Stunkard. "Socioeconomic Status and Obesity: A Review of the Literature." *Psychological Bulletin* 105.2 (1989): 260-75. Print.

Sturm, R. (2002). The effects of obesity, smoking, and drinking on medical problems and costs. *Health Affairs, 21*(2), 245-253. doi:10.1377/hlthaff.21.2.245

Thorpe, Florence, Howard, & Joski (2004). The Impact of Obesity on Rising Medical Spending, *Health Affairs, 32* (10), 481- 486.

Villanueva, E. (2001). The validity of self-reported weight in US adults: A population based cross-sectional study. *BMC Public Health, 1*(1), 11.

Wang, Wendy. "Record Share of Wives Are More Educated than Their Husbands." *Numbers, Facts and Trends Shaping Your World*. Pew Research Center, 12 Feb. 2014. Web. 12 Mar. 2014. <http://www.pewresearch.org/fact-tank/2014/02/12/record-share-of-wives-are-more-educated-than-their-husbands/>.

Williams, D. R., & Jackson, P. B. (2005). Social sources of racial disparities in health. *Health Affairs, 24*(2), 325-334.

Williams, David R. (2006). Race, Socioeconomic Status, and Health The Added Effects of Racism and Discrimination. *Annals of the New York Academy of Sciences, 896,* 173-188.

Winkleby, Jatulis, Frank, & Fortmann. (1992). Socioeconomic status and health: How education, income, and occupation contribute to risk factors for cardiovascular disease. *American Journal of Public Health, 82*(6), 816--820.

Wooldridge, Jeffrey M. Introductory Econometrics: A Modern Approach. Mason, OH: South-Western Cengage Learning, 2013.

Zhang, Qi, and Youfa Wang. "Trends in the Association between Obesity and Socioeconomic Status in U.S. Adults: 1971 to 2000**." *Obesity* 12.10 (2004): 1622-632. Print.

X. Appendix 1

Table 1A: General Variable Definitions and Means

	Obese (BMI ≥30, where BMI= [Weight(kg)/[Height(m) squared]] rounded to 2 decimal places)	**Age of the individual questioned**	**Pregnant** (for females)	**Male**
2002	0.28	46.54	0.01	0.43
2003	0.28	46.68	0.01	0.44
2004	0.29	35.58	0.01	0.48
2005	0.30	47.37	0.01	0.44
2006	0.30	46.88	0.01	0.44
2007	0.30	47.26	0.01	0.44
2008	0.31	47.79	0.01	0.44
2009	0.30	47.64	0.01	0.44
2010	0.31	47.67	0.01	0.44
2011	0.31	48.05	0.01	0.45
2012	0.32	48.46	0.01	0.44

Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012 (http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 1B: Poverty Variable Definitions and Means

	Poverty (ratio of family income to the poverty threshold ≤1)	**Near poverty** (ratio of family income to the poverty threshold is between 1 and 1.99	**Not in poverty** (ratio of family income to the poverty threshold ≥2)
2002	0.15	0.20	0.65
2003	0.15	0.20	0.64
2004	0.15	0.22	0.63
2005	0.15	0.21	0.65
2006	0.15	0.21	0.62
2007	0.16	0.18	0.66
2008	0.16	0.18	0.66
2009	0.17	0.19	0.64
2010	0.19	0.19	0.62
2011	0.19	0.19	0.62
2012	0.19	0.20	0.61

Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012 (http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 1C: Education Variable Definitions and Means

	No degree	Highest education level of any one member of the household is high school diploma or GED	Highest education level of any one member of the household is a 2 or 4 year college degree	Highest education level of any one member of the household is a masters, professional, or doctoral degree
2002	0.14	0.46	0.29	0.11
2003	0.14	0.46	0.29	0.11
2004	0.14	0.44	0.30	0.12
2005	0.13	0.45	0.30	0.12
2006	0.14	0.44	0.30	0.12
2007	0.13	0.44	0.30	0.13
2008	0.12	0.44	0.32	0.12
2009	0.12	0.43	0.32	0.13
2010	0.12	0.43	0.32	0.13
2011	0.11	0.42	0.33	0.14
2012	0.11	0.42	0.33	0.14

Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012 (http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 1D: Race/Ethnicity Variable Definitions and Means

	Hispanic (Puerto Rican; Mexican; Mexican-American; Cuban/Cuban American; Dominican (Republic); Central or South American; Other Latin American; Other Spanish; Hispanic/Latino/Spanish, non-specific type; Hispanic/Latino/Spanish, type refused; Hispanic/Latino/Spanish, type not ascertained)	**White**	**Black**	**Other Race** (includes American Indians, Asian Indians, Chinese, Filipinos, and Other Asians)
2002	0.17	0.79	0.14	0.08
2003	0.18	0.78	0.14	0.08
2004	0.23	0.74	0.14	0.11
2005	0.18	0.76	0.14	0.10
2006	0.17	0.70	0.17	0.13
2007	0.18	0.70	0.16	0.14
2008	0.17	0.70	0.16	0.14
2009	0.19	0.69	0.16	0.15
2010	0.19	0.68	0.17	0.16
2011	0.18	0.70	0.15	0.15
2012	0.17	0.76	0.16	0.08

Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012 (http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 1E: Family Status Variable Definitions and Means

	Married (spouse could be in household, not in household, or in unknown household)	**Divorced**	**Widowed**
2002	0.47	0.12	0.10
2003	0.47	0.13	0.10
2004	0.41	0.06	0.05
2005	0.47	0.13	0.10
2006	0.47	0.13	0.09
2007	0.46	0.13	0.10
2008	0.45	0.13	0.20
2009	0.45	0.13	0.09
2010	0.44	0.13	0.09
2011	0.44	0.14	0.09
2012	0.43	0.14	0.09

Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012 (http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 1F: Region Variable Definitions and Means

	Northeast	**Midwest**	**West**	**South**
2002	0.18	0.23	0.22	0.37
2003	0.18	0.23	0.22	0.37
2004	0.84	0.10	0.01	0.01
2005	0.17	0.23	0.23	0.37
2006	0.17	0.22	0.23	0.38
2007	0.17	0.22	0.24	0.37
2008	0.16	0.23	0.24	0.37
2009	0.17	0.23	0.24	0.37
2010	0.16	0.22	0.25	0.37
2011	0.16	0.22	0.26	0.36
2012	0.17	0.21	0.26	0.36

Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012 (http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 1G: Occupation Variable Definitions and Means

	Employed/Retired	**Unemployed**
2002	0.79	0.21
2003	0.68	0.32
2004	0.71	0.29
2005	0.68	0.32
2006	0.69	0.31
2007	0.68	0.32
2008	0.68	0.32
2009	0.67	0.33
2010	0.65	0.35
2011	0.65	0.35
2012	0.65	0.35

Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012 (http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 1H: Smoking Variable Definitions and Means

	Smoker (current or former)	**Non Smoker**
2002	0.45	0.55
2003	0.43	0.57
2004	0.39	0.61
2005	0.43	0.57
2006	0.41	0.59
2007	0.40	0.60
2008	0.42	0.58
2009	0.42	0.58
2010	0.40	0.60
2011	035	0.41
2012	0.41	0.59

Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012 (http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 1I: Alcohol Consumption Variable Definitions and Means

	Current Non-Drinker or Very Infrequent Drinker	Current Moderate Drinker	Current Heavy Drinker
2002	0.72	0.26	0.01
2003	0.74	0.25	0.01
2004	0.48	0.47	0.04
2005	0.44	0.50	0.06
2006	0.46	0.49	0.06
2007	0.45	0.49	0.06
2008	0.43	0.51	0.07
2009	0.41	0.53	0.06
2010	0.43	0.51	0.06
2011	0.41	0.53	0.06
2012	0.41	0.52	0.06

Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012 (http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 1J: Regular Physical Activity Variable Definitions and Means

	Exercise	No exercise
2002	0.35	0.65
2003	0.36	0.64
2004	0.33	0.67
2005	0.33	0.67
2006	0.33	0.67
2007	0.33	0.67
2008	0.36	0.64
2009	0.38	0.62
2010	0.39	0.61
2011	0.40	0.60
2012	0.41	0.59

Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012 (http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 1K: Regular Access to Health Care Variable Definitions and Means

	Access to Care	No Access to Care
2002	0.86	0.14
2003	0.86	0.14
2004	0.84	0.16
2005	0.85	0.15
2006	0.84	0.16
2007	0.84	0.15
2008	0.85	0.15
2009	0.84	0.16
2010	0.83	0.17
2011	0.85	0.15
2012	0.83	0.17

Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012 (http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

XI. Appendix 2

Table 2A: Effects of General Variable Determinants of Obesity

Coefficient/Marginal effect (standard error)

	Age	Male
2002	**0.001*** ** (0.000)	**0.006** (0.007)
2003	**0.001*** ** (0.0002)	**-0.005** (0.007)
2004	**0.0004*** ** (0.0001)	**-0.007*** (0.004)
2005	**0.001*** ** (0.0003)	**-0.016** ** (0.007)
2006	**0.001*** ** (0.0003)	**-0.016** ** (0.008)
2007	**0.001*** ** (0.0003)	**0.004** (0.008)
2008	**0.001*** ** (0.0003)	**-0.008** (0.008)
2009	**0.001*** ** (0.0002)	**-0.005** (0.007)
2010	**0.001*** ** (0.0002)	**-0.007** (0.007)
2011	**0.001*** ** (0.0002)	**0.001** (0.006)
2012	**0.001** ** (0.000)	**-0.009** (0.006)

*** Indicates statistical significance at the 1% level, **5% level, *10% level
Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012
(http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 2B: Marginal Effects of Income Variable Determinants of Obesity

Marginal effect (standard error)

	In poverty	Near poverty
2002	**0.014** (0.012)	**0.011** (0.010)
2003	**0.008** (0.011)	**-0.002** (0.009)
2004	**0.030*** ** (0.007)	**0.014** ** (0.006)
2005	**0.018*** (0.011)	**-0.005** (0.009)
2006	**0.015** (0.012)	**-0.002** (0.010)
2007	**0.004** (0.011)	**0.014** (0.010)
2008	**-0.005** (0.012)	**-0.007** (0.010)
2009	**-0.009** (0.010)	**-0.006** (0.009)
2010	**-0.012** (0.010)	**-0.003** (0.009)
2011	**-0.0004** (0.009)	**0.005** (0.008)
2012	**-0.005** (0.009)	**-0.014** (0.008)

*** Indicates statistical significance at the 1% level, **5% level, *10% level
Omitted variable: Not in poverty
Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012
(http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 2C: Marginal Effects of Education Variable Determinants of Obesity
Marginal effect (standard error)

	High school degree/GED	College degree (2 or 4 year)	Beyond college (masters, PhD, etc.)
2002	**-0.013** (0.011)	**-0.042*** ** (0.012)	**-0.090*** ** (0.013)
2003	**-0.003** (0.011)	**-0.029** ** (0.012)	**-0.071*** ** (0.013)
2004	**0.006** (0.007)	**-0.022*** ** (0.008)	**-0.059*** ** (0.009)
2005	**-0.004** (0.011)	**-0.024** ** (0.012)	**-0.084*** ** (0.012)
2006	**0.021*** (0.012)	**-0.028*** (0.013)	**-0.070*** ** (0.014)
2007	**-0.014** (0.012)	**-0.039*** ** (0.013)	**-0.094*** ** (0.014)
2008	**0.004** (0.013)	**-0.041*** ** (0.014)	**-0.087*** ** (0.015)
2009	**-0.002** (0.011)	**-0.036*** ** (0.012)	**-0.091*** ** (0.013)
2010	**0.021*** (0.012)	**0.002** (0.013)	**-0.053*** ** (0.014)
2011	**-0.001** (0.011)	**-0.023** ** (0.011)	**-0.084*** ** (0.012)
2012	**0.007** (0.011)	**-0.031*** ** (0.011)	**-0.096*** ** (0.012)

*** Indicates statistical significance at the 1% level, **5% level, *10% level
Omitted Variable: No degree
Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012
(http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 2D: Marginal Effects of Race/Ethnicity Variable Determinants of Obesity
Marginal effect (standard error)

	Hispanic	Black	Other race
2002	**0.043*** ** (0.010)	**0.096*** ** (0.011)	**-0.041*** ** (0.012)
2003	**0.053*** ** (0.011)	**0.121*** ** (0.012)	**-0.057*** ** (0.012)
2004	**0.071*** ** (0.007)	**0.114*** ** (0.007)	**-0.018** ** (0.007)
2005	**0.050*** ** (0.010)	**0.087*** ** (0.011)	**-0.049*** ** (0.011)
2006	**0.076*** ** (0.012)	**0.101*** ** (0.012)	**-0.099*** ** (0.011)
2007	**0.057*** ** (0.011)	**0.095*** ** (0.011)	**-0.062*** ** (0.010)
2008	**0.095*** ** (0.012)	**0.115*** ** (0.012)	**-0.085*** ** (0.010)
2009	**0.083*** ** (0.010)	**0.100*** ** (0.010)	**-0.085*** ** (0.009)
2010	**0.107*** ** (0.010)	**0.113*** ** (0.009)	**-0.076*** ** (0.009)
2011	**0.091*** ** (0.009)	**0.115*** ** (0.009)	**-0.087*** ** (0.008)
2012	**0.085*** ** (0.009)	**0.097*** ** (0.009)	**-0.089*** ** (0.008)

*** Indicates statistical significance at the 1% level, **5% level, *10% level
Omitted Variable: White
Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012
(http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 2E: Marginal Effects of Family Variable Determinants of Obesity
Marginal effect (standard error)

	Married	Divorced	Widowed
2002	**0.028*** (0.009)	**0.012** (0.012)	**-0.025** (0.016)
2003	**0.039*** (0.009)	**0.018** (0.012)	**-0.034**** (0.015)
2004	**0.009** (0.006)	**-0.007** (0.010)	**-0.041***** (0.012)
2005	**0.020**** (0.008)	**0.010** (0.011)	**-0.040***** (0.014)
2006	**0.022**** (0.009)	**0.018** (0.013)	**-0.058***** (0.016)
2007	**0.020**** (0.009)	**0.030**** (0.012)	**-0.052***** (0.016)
2008	**0.015** (0.009)	**0.001*** (0.013)	**-0.065***** (0.016)
2009	**0.012** (0.008)	**0.016** (0.011)	**-0.035**** (0.014)
2010	**0.038***** (0.008)	**0.041***** (0.012)	**-0.020** (0.015)
2011	**0.016**** (0.007)	**0.031***** (0.010)	**-0.059***** (0.013)
2012	**0.025***** (0.007)	**0.014** (0.010)	**-0.051***** (0.013)

*** Indicates statistical significance at the 1% level, **5% level, *10% level
Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012
(http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 2F: Marginal Effects of Region Variable Determinants of Obesity
Marginal effect (standard error)

	Northeast	Midwest	South
2002	**0.016** (0.011)	**0.025**** (0.012)	**0.021**** (0.009)
2003	**0.020*** (0.011)	**0.026**** (0.011)	**-0.001** (0.009)
2004	**0.118***** (0.008)	**0.052***** (0.015)	**-0.054**** (0.024)
2005	**0.012** (0.011)	**0.040***** (0.010)	**0.015*** (0.008)
2006	**0.032***** (0.012)	**0.055***** (0.012)	**0.020**** (0.010)
2007	**0.015** (0.012)	**0.051***** (0.011)	**0.030***** (0.010)
2008	**-0.009** (0.012)	**0.033***** (0.011)	**0.007** (0.010)
2009	**-0.004** (0.010)	**0.043***** (0.010)	**0.030***** (0.009)
2010	**0.005** (0.010)	**0.047***** (0.010)	**0.028***** (0.009)
2011	**-0.008** (0.009)	**0.040***** (0.009)	**0.028***** (0.008)
2012	**-0.013** (0.009)	**0.031***** (0.009)	**0.011** (0.008)

*** Indicates statistical significance at the 1% level, **5% level, *10% level
Omitted Variable: West
Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012
(http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 2G: Marginal Effects of Occupation Variable Determinants of Obesity
Marginal effect (standard error)

	Employed/Retired
2002	**-0.001** (0.009)
2003	**0.040*** ** (0.008)
2004	**0.009*** (0.005)
2005	**0.020**** (0.009)
2006	**0.027*** ** (0.010)
2007	**0.025*** ** (0.009)
2008	**0.016** (0.010)
2009	**0.042*** ** (0.008)
2010	**0.021*** ** (0.008)
2011	**0.018**** (0.007)
2012	**0.023*** ** (0.007)

*** Indicates statistical significance at the 1% level, **5% level, *10% level
Omitted Variable: Unemployed
Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012
(http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 2H: Marginal Effects of Smoking Variable Determinants of Obesity
Marginal effect (standard error)

	Smoker
2002	**-0.007** (0.007)
2003	**-0.005** (0.007)
2004	**0.004** (0.004)
2005	**0.004** (0.007)
2006	**0.003** (0.008)
2007	**0.011** (0.008)
2008	**0.005** (0.008)
2009	**0.018*** ** (0.008)
2010	**0.016**** (0.007)
2011	**0.031*** ** (0.006)
2012	**0.015**** (0.006)

*** Indicates statistical significance at the 1% level, **5% level, *10% level
Omitted Variable: Nonsmoker
Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012
(http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 2I: Marginal Effects of Activity Level Variable Determinants of Obesity
Marginal effect (standard error)

	No exercise
2002	**0.060*** ** (0.007)
2003	**0.057*** ** (0.008)
2004	**0.055*** (0.004)**
2005	**0.071*** ** (0.007)
2006	**0.030*** ** (0.008)
2007	**0.068*** ** (0.008)
2008	**0.066*** ** (0.008)
2009	**0.079*** ** (0.007)
2010	**0.071*** ** (0.007)
2011	**0.062*** ** (0.006)
2012	**0.074*** ** (0.006)

*** Indicates statistical significance at the 1% level, **5% level, *10% level
Omitted Variable: Exercise
Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012
(http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 2J: Marginal Effects of Alcohol Consumption Variable Determinants of Obesity
Marginal effect (standard error)

	Moderate Drinker	Heavy Drinker
2002	**-0.043*** ** (0.008)	**0.026** (0.026)
2003	**-0.039*** ** (0.008)	**0.039** (0.040)
2004	**-0.046*** ** (0.005)	**-0.094*** ** (0.008)
2005	**-0.048*** ** (0.007)	**-0.070*** ** (0.012)
2006	**-0.039*** ** (0.008)	**-0.045*** ** (0.015)
2007	**-0.044*** ** (0.008)	**-0.094*** ** (0.013)
2008	**-0.045*** ** (0.008)	**-0.038*** ** (0.010)
2009	**-0.049*** ** (0.009)	**-0.049*** ** (0.009)
2010	**-0.045***** (0.007)	**-0.083*** ** (0.013)
2011	**-0.051*** ** (0.007)	**0.028*** ** (0.007)
2012	**-0.043*** ** (0.007)	**-0.084*** ** (0.012)

*** Indicates statistical significance at the 1% level, **5% level, *10% level
Omitted Variable: Non/Infrequent drinker
Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012
(http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 2K: Marginal Effects of Access to Health Care Variable Determinants of Obesity
Marginal effect (standard error)

	No Access to Care
2002	**-0.024**** (0.009)
2003	**-0.016** (0.010)
2004	**-0.045***** (0.005)
2005	**-0.033***** (0.009)
2006	**-0.055***** (0.010)
2007	**-0.059***** (0.009)
2008	**-0.038***** (0.010)
2009	**-0.049***** (0.009)
2010	**-0.035***** (0.009)
2011	**-0.045***** (0.007)
2012	**-0.051***** (0.008)

*** Indicates statistical significance at the 1% level, **5% level, *10% level
Omitted Variable: Access to care
Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012 (http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 2L: Pseudo R-squared Values for Marginal Effects of All Determinants of Obesity

	Pseudo R-squared
2002	*0.0253*
2003	*0.0256*
2004	*0.0280*
2005	*0.0266*
2006	*0.0285*
2007	*0.0295*
2008	*0.0310*
2009	*0.0324*
2010	*0.0317*
2011	*0.0334*
2012	*0.0313*

*** Indicates statistical significance at the 1% level, **5% level, *10% level
Omitted variables: No degree, White, Not in poverty, West, Unemployed, Access to care, Nonsmoker, Non/Infrequent drinker, Exercise
Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012 (http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 2M: Joint Significance of Income and Education Variables on Obesity

	P-values	
	Income Variables	Education Variables
2002	0.3535	0.000
2003	0.7053	0.000
2004	0.0001	0.000
2005	0.1042	0.000
2006	0.3264	0.000
2007	0.3958	0.000
2008	0.7796	0.000
2009	0.6176	0.000
2010	0.5140	0.000
2011	0.7427	0.000
2012	0.2489	0.000
2002-2012 Average	0.4353	0.000

Omitted variables: No degree, White, Not in poverty, West, Unemployed, Access to care, Nonsmoker, Non/Infrequent drinker, Exercise
Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012 (http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 2N: Interaction Effect between Year and Higher Education Variable Determinants of Obesity

	Variable	Marginal Effect	P-value	Standard Error
2003	College degree	0.013	0.236	0.012
	Beyond college	0.023	0.188	0.018
2004	College degree	0.009	0.355	0.009
	Beyond college	0.022	0.188	0.018
2005	College degree	0.017	0.125	0.011
	Beyond college	0.008	0.613	0.016
2006	College degree	0.007	0.517	0.012
	Beyond college	0.018	0.613	0.017
2007	College degree	0.014	0.224	0.011
	Beyond college	0.008	0.644	0.016
2008	College degree	-0.003	0.807	0.011
	Beyond college	0.002	0.890	0.016
2009	College degree	0.006	0.557	0.011
	Beyond college	0.0001	0.994	0.015
2010	College degree	0.024	0.028	0.011
	Beyond college	0.022	0.156	0.016
2011	College degree	0.015	0.147	0.011
	Beyond college	0.002	0.906	0.015
2012	College degree	0.009	0.361	0.010
	Beyond college	-0.003\4	0.796	0.015

Omitted variables: No degree, White, Not in poverty, West, Unemployed, Access to care, Nonsmoker, Non/Infrequent drinker, Exercise
Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012 (http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

XII. Appendix 3

Table 3A: Effects of Age on Obesity, by Gender
Coefficient (standard error)

	Age	
	Male	Female
2002	**0.0002**** (0.0004)	**0.001***** (0.0004)
2003	**0.0003** (0.0004)	**0.002***** (0.0004)
2004	**0.0002** (0.0002)	**0.007***** (0.000)
2005	**-0.00001** (0.0004)	**0.002***** (0.0004)
2006	**0.001***** (0.0004)	**0.001***** (0.0004)
2007	**-0.000** (0.0004)	**0.001***** (0.0004)
2008	**0.001** (0.0005)	**0.001**** (0.0004)
2009	**0.0001** (0.0004)	**0.001***** (0.0003)
2010	**-0.0003** (0.0004)	**0.002***** (0.0003)
2011	**0.00007***** (0.0003)	**0.001***** (0.0003)
2012	**0.001***** (0.0003)	**0.001***** (0.0003)

*** Indicates statistical significance at the 1% level, **5% level, *10% level
Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012 (http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 3B: Marginal Effects of Education Variable Determinants of Obesity, by Gender

Marginal effect (standard error)

	High school degree/GED		College degree (2 or 4 year)		Beyond college degree (masters, PhD, etc.)	
	Male	Female	Male	Female	Male	Female
2002	**0.016** (0.017)	**-0.032**** (0.015)	**-0.022** (0.018)	**-0.054***** (0.016)	**-0.061***** (0.019)	**-0.111***** (0.017)
2003	**0.010** (0.017)	**-0.010** (0.015)	**-0.011** (0.019)	**-0.038**** (0.017)	**-0.063***** (0.019)	**-0.068***** (0.019)
2004	**0.018*** (0.010)	**-0.005** (0.010)	**-0.015** (0.011)	**-0.029***** (0.011)	**-0.052***** (0.012)	**-0.064***** (0.012)
2005	**0.015** (0.017)	**-0.015** (0.015)	**-0.011** (0.018)	**-0.032**** (0.016)	**-0.082***** (0.018)	**-0.081***** (0.017)
2006	**0.014** (0.018)	**0.026** (0.017)	**-0.014** (0.020)	**-0.032*** (0.018)	**-0.066***** (0.021)	**-0.072***** (0.021)
2007	**0.005** (0.019)	**-0.024** (0.016)	**-0.008** (0.021)	**-0.058***** (0.018)	**-0.090***** (0.020)	**-0.088***** (0.019)
2008	**0.012** (0.020)	**-0.001** (0.017)	**-0.030** (0.021)	**-0.049**** (0.019)	**-0.078***** (0.022)	**-0.093***** (0.020)
2009	**0.009** (0.017)	**-0.008** (0.015)	**-0.021** (0.018)	**-0.045***** (0.017)	**-0.094***** (0.018)	**-0.086***** (0.018)
2010	**0.054***** (0.018)	**-0.001** (0.015)	**0.021** (0.020)	**-0.011** (0.017)	**-0.045**** (0.021)	**-0.058***** (0.019)
2011	**-0.0003** (0.016)	**-0.003** (0.014)	**-0.019** (0.017)	**-0.029*** (0.015)	**-0.082***** (0.018)	**-0.088***** (0.016)
2012	**-0.005** (0.014)	**-0.005** (0.014)	**-0.047***** (0.015)	**-0.047***** (0.015)	**-0.103***** (0.016)	**-0.103***** (0.016)

*** Indicates statistical significance at the 1% level, **5% level, *10% level
Omitted variable: No degree
Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012
(http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 3C: Marginal Effects of Poverty Variable Determinants of Obesity, by Gender

Marginal effect (standard error)

	Poverty		Near Poverty	
	Male	Female	Male	Female
2002	**-0.020** (0.017)	**0.022** (0.016)	**0.023*** (0.014)	**-0.002** (0.013)
2003	**-0.034**** (0.016)	**0.031**** (0.015)	**-0.028**** (0.014)	**0.019** (0.013)
2004	**0.026**** (0.010)	**0.033***** (0.010)	**0.013** (0.008)	**0.014*** (0.008)
2005	**-0.045***** (0.016)	**0.051***** (0.015)	**-0.021** (0.013)	**0.008** (0.012)
2006	**-0.021** (0.017)	**0.032**** (0.016)	**-0.027*** (0.014)	**0.017** (0.014)
2007	**-0.024** (0.018)	**0.017** (0.016)	**-0.009** (0.015)	**0.030**** (0.014)
2008	**-0.047***** (0.017)	**0.010** (0.016)	**-0.035**** (0.015)	**0.009** (0.014)
2009	**-0.043***** (0.015)	**0.004** (0.014)	**-0.043***** (0.013)	**0.020** (0.012)
2010	**-0.047***** (0.015)	**-0.004** (0.014)	**-0.028**** (0.013)	**0.016** (0.013)
2011	**-0.028**** (0.013)	**0.008** (0.012)	**-0.023*** (0.012)	**0.023**** (0.011)
2012	**0.003** (0.012)	**0.003** (0.012)	**-0.005** (0.011)	**-0.005** (0.011)

*** Indicates statistical significance at the 1% level, **5% level, *10% level
Omitted variable: Not in poverty
Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012
(http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 3D: Marginal Effects of Race/Ethnicity Variable Determinants of Obesity, by Gender
Marginal effect (standard error)

	Black		Hispanic		Other Race	
	Male	Female	Male	Female	Male	Female
2002	**0.046*** ** (0.017)	**0.125*** ** (0.016)	**0.040*** ** (0.015)	**0.045*** ** (0.015)	**-0.035** ** (0.017)	**-0.051*** ** (0.017)
2003	**0.090*** ** (0.018)	**0.138*** ** (0.016)	**0.032** ** (0.016)	**0.069*** ** (0.015)	**-0.033*** (0.018)	**-0.077*** ** (0.016)
2004	**0.103*** ** (0.010)	**0.123*** ** (0.009)	**0.067*** ** (0.010)	**0.074*** ** (0.010)	**-0.041*** ** (0.009)	**-0.019*** (0.010)
2005	**0.045*** ** (0.015)	**0.120*** ** (0.014)	**0.050*** ** (0.015)	**0.047*** ** (0.014)	**-0.060*** ** (0.015)	**-0.039** ** (0.015)
2006	**0.079*** ** (0.017)	**0.111*** ** (0.015)	**0.075*** ** (0.018)	**0.074*** ** (0.017)	**-0.092*** ** (0.015)	**-0.105*** ** (0.015)
2007	**0.074*** ** (0.017)	**0.104*** ** (0.015)	**0.055*** ** (0.017)	**0.047*** ** (0.015)	**-0.034** ** (0.016)	**-0.084*** ** (0.014)
2008	**0.062*** ** (0.018)	**0.144*** ** (0.016)	**0.098*** ** (0.018)	**0.092*** ** (0.016)	**-0.066*** ** (0.015)	**-0.100*** ** (0.014)
2009	**0.046*** ** (0.015)	**0.132*** ** (0.014)	**0.098*** ** (0.015)	**0.070*** ** (0.014)	**-0.083*** ** (0.013)	**-0.084*** ** (0.013)
2010	**0.058*** ** (0.015)	**0.148*** ** (0.014)	**0.092*** ** (0.015)	**0.148*** ** (0.014)	**-0.069*** ** (0.013)	**-0.081*** ** (0.012)
2011	**0.057*** ** (0.014)	**0.151*** ** (0.013)	**0.086*** ** (0.014)	**0.092*** ** (0.013)	**-0.076*** ** (0.012)	**-0.096*** ** (0.011)
2012	**0.125*** ** (0.012)	**0.044*** ** (0.012)	**0.084*** ** (0.012)	**0.084*** ** (0.012)	**-0.087*** ** (0.011)	**-0.087*** ** (0.011)

*** Indicates statistical significance at the 1% level, **5% level, *10% level
Omitted variable: White
Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012 (http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 3E: Marginal Effects of Family Status Variable Determinants of Obesity, by Gender
Marginal effect (standard error)

	Married		Divorced		Widowed	
	Male	Female	Male	Female	Male	Female
2002	**0.060*** ** (0.012)	**-0.004** (0.012)	**0.027*** ** (0.019)	**-0.005** (0.016)	**-0.020** (0.029)	**-0.052*** ** (0.019)
2003	**0.064*** ** (0.012)	**0.015** (0.012)	**0.041** ** (0.019)	**-0.002** (0.016)	**-0.076** ** (0.028)	**-0.057*** ** (0.018)
2004	**0.016*** (0.009)	**0.005** (0.008)	**0.007** (0.015)	**-0.017** (0.012)	**-0.048*** (0.024)	**-0.047*** ** (0.015)
2005	**0.046*** ** (0.011)	**0.001** (0.012)	**0.009** (0.017)	**0.007** (0.015)	**-0.016** (0.029)	**-0.073*** ** (0.017)
2006	**0.047*** ** (0.013)	**-0.003** (0.013)	**0.047** ** (0.020)	**-0.005** (0.017)	**-0.044** (0.032)	**-0.082*** ** (0.019)
2007	**0.046*** ** (0.013)	**-0.003** (0.013)	**0.029** (0.020)	**0.023** (0.017)	**-0.026** (0.032)	**-0.089*** ** (0.018)
2008	**0.055*** ** (0.013)	**-0.017** (0.013)	**0.035** ** (0.020)	**-0.028*** (0.016)	**-0.027** (0.033)	**-0.095*** ** (0.019)
2009	**0.056*** ** (0.012)	**-0.022*** (0.011)	**0.035** ** (0.018)	**-0.0003** (0.015)	**0.011** (0.030)	**-0.070*** ** (0.017)
2010	**0.087*** ** (0.012)	**0.004** (0.011)	**0.070*** ** (0.019)	**0.017** (0.015)	**0.052*** (0.032)	**-0.064*** ** (0.018)
2011	**0.062*** ** (0.011)	**-0.022** ** (0.010)	**0.052*** ** (0.016)	**0.013** (0.013)	**-0.025** (0.025)	**-0.088*** ** (0.015)
2012	**-0.006** (0.010)	**-0.006** (0.010)	**-0.007** (0.013)	**-0.007** (0.013)	**-0.088*** ** (0.015)	**-0.088*** ** (0.014)

Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012 (http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 3F: Marginal Effects of Region Variable Determinants of Obesity, by Gender
Marginal effect (standard error)

	Northeast		Midwest		South	
	Male	Female	Male	Female	Male	Female
2002	**0.037****	**-0.006**	**0.026***	**0.022**	**-0.022**	**0.018**
	(0.016)	(0.012)	(0.015)	(0.015)	(0.013)	(0.013)
2003	**0.026**	**0.015**	**0.023**	**0.025***	**-0.018**	**0.013**
	(0.017)	(0.016)	(0.015)	(0.015)	(0.013)	(0.013)
2004	**0.123*****	**0.114*****	**0.062*****	**0.042****	**-0.033**	**-0.072****
	(0.013)	(0.013)	(0.021)	(0.020)	(0.036)	(0.032)
2005	**0.027***	**-0.004**	**0.048*****	**0.029****	**0.034*****	**-0.004**
	(0.016)	(0.014)	(0.014)	(0.014)	(0.013)	(0.012)
2006	**0.031***	**0.031***	**0.065*****	**0.045*****	**0.031****	**0.009**
	(0.018)	(0.017)	(0.017)	(0.016)	(0.015)	(0.014)
2007	**0.023**	**0.006**	**0.061*****	**0.040*****	**0.043*****	**0.019**
	(0.017)	(0.016)	(0.016)	(0.016)	(0.014)	(0.017)
2008	**-0.021**	**-0.001**	**0.052*****	**0.016**	**0.019**	**-0.004**
	(0.017)	(0.016)	(0.017)	(0.015)	(0.014)	(0.013)
2009	**0.003**	**-0.012**	**0.039*****	**0.045*****	**0.024***	**0.033*****
	(0.015)	(0.014)	(0.014)	(0.014)	(0.013)	(0.012)
2010	**0.018**	**-0.007**	**0.048*****	**0.046*****	**0.038*****	**0.022***
	(0.016)	(0.011)	(0.015)	(0.014)	(0.013)	(0.012)
2011	**-0.004**	**-0.014**	**0.052*****	**0.028****	**0.040*****	**0.016**
	(0.014)	(0.013)	(0.013)	(0.012)	(0.012)	(0.014)
2012	**-0.021***	**-0.021***	**0.024****	**0.024****	**0.004**	**0.005**
	(0.012)	(0.012)	(0.012)	(0.012)	(0.010)	(0.011)

*** Indicates statistical significance at the 1% level, **5% level, *10% level
Omitted variable: West
Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012
(http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 3G: Marginal Effects of Occupation Variable Determinants of Obesity, by Gender

Marginal effect (standard error)

	Employed/Retired	
	Male	Female
2002	**0.006** (0.015)	**-0.009** (0.012)
2003	**0.034**** (0.015)	**0.012** (0.012)
2004	**0.008** (0.007)	**0.011** (0.007)
2005	**0.013** (0.014)	**0.019*** (0.011)
2006	**0.042***** (0.016)	**0.013** (0.013)
2007	**0.029*** (0.016)	**0.018** (0.012)
2008	**0.002** (0.016)	**0.015** (0.012)
2009	**0.025*** (0.013)	**0.043***** (0.010)
2010	**-0.005** (0.013)	**0.029***** (0.010)
2011	**-0.003** (0.012)	**0.020**** (0.010)
2012	**0.029***** (0.009)	**0.029***** (0.009)

*** Indicates statistical significance at the 1% level, **5% level, *10% level
Omitted variable: Unemployed
Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012 (http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 3H: Marginal Effects of Smoking Variable Determinants of Obesity, by Gender

Marginal effect (standard error)

	Smoker	
	Male	Female
2002	**-0.002** (0.010)	**-0.006** (0.010)
2003	**-0.005** (0.010)	**0.003** (0.010)
2004	**0.001** (0.006)	**0.011** (0.007)
2005	**-0.005** (0.010)	**0.019*** (0.010)
2006	**-0.008** (0.011)	**0.014** (0.011)
2007	**0.008** (0.011)	**0.020*** (0.011)
2008	**-0.027**** (0.011)	**0.034***** (0.011)
2009	**0.001** (0.010)	**0.034***** (0.010)
2010	**-0.003** (0.010)	**0.032***** (0.010)
2011	**0.031***** (0.009)	**0.031***** (0.009)
2012	**0.035***** (0.009)	**0.035***** (0.009)

*** Indicates statistical significance at the 1% level, **5% level, *10% level

Omitted variable: Nonsmoker

Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012 (http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 3I: Marginal Effects of Activity Level Variable Determinants of Obesity, by Gender

Marginal effect (standard error)

	No Exercise	
	Male	Female
2002	**0.037***** (0.010)	**0.084***** (0.010)
2003	**0.051***** (0.010)	**0.062***** (0.010)
2004	**0.053***** (0.006)	**0.058***** (0.006)
2005	**0.061***** (0.010)	**0.079***** (0.010)
2006	**0.006** (0.011)	**0.052***** (0.011)
2007	**0.045***** (0.011)	**0.090***** (0.011)
2008	**0.041***** (0.011)	**0.087***** (0.011)
2009	**0.082***** (0.010)	**0.075***** (0.009)
2010	**0.067***** (0.010)	**0.073***** (0.010)
2011	**0.052***** (0.009)	**0.070***** (0.009)
2012	**0.074***** (0.008)	**0.075***** (0.008)

*** Indicates statistical significance at the 1% level, **5% level, *10% level
Omitted variable: Exercise
Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012 (http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 3J: Marginal Effects of Alcohol Consumption Variable Determinants of Obesity, by Gender

Marginal effects (standard error)

	Moderate Drinker		**Heavy Drinker**	
	Male	Female	Male	Female
2002	**-0.031*** ** (0.010)	**-0.061*** ** (0.012)	**-0.024*** (0.043)	**0.094*** (0.055)
2003	**-0.027*** ** (0.010)	**-0.088*** ** (0.012)	**0.001** (0.050)	**0.098** (0.066)
2004	**-0.043*** ** (0.006)	**-0.048*** ** (0.006)	**-0.090*** ** (0.012)	**-0.096*** ** (0.012)
2005	**-0.016** (0.011)	**-0.066*** ** (0.010)	**-0.022** (0.018)	**-0.109*** ** (0.017)
2006	**-0.021*** (0.012)	**-0.050*** ** (0.011)	**0.001** (0.023)	**-0.078*** ** (0.021)
2007	**-0.011** (0.012)	**-0.065*** ** (0.011)	**-0.032** (0.021)	**-0.144*** ** (0.018)
2008	**-0.016** (0.013)	**-0.062*** ** (0.011)	**-0.021** (0.021)	**-0.129*** ** (0.018)
2009	**-0.002** (0.011)	**-0.072*** ** (0.010)	**-0.033*** (0.019)	**-0.123*** ** (0.017)
2010	**-0.018*** ** (0.011)	**-0.062*** ** (0.010)	**-0.049**** (0.019)	**-0.105*** ** (0.017)
2011	**-0.037*** ** (0.010)	**-0.059*** ** (0.009)	**-0.064*** ** (0.017)	**-0.139**** (0.015)
2012	**-0.065*** ** (0.009)	**-0.065*** ** (0.009)	**-0.114*** ** (0.015)	**-0.114*** ** (0.015)

*** Indicates statistical significance at the 1% level, **5% level, *10% level

Omitted variable: Non/Infrequent drinker

Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012 (http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 3K: Marginal Effects of Access to Health Care Variable Determinants of Obesity, by Gender

Marginal effect (standard error)

	No access to care	
	Male	Female
2002	**-0.032***** (0.043)	**-0.007** (0.015)
2003	**-0.010** (0.013)	**-0.021** (0.015)
2004	**-0.043***** (0.008)	**-0.047***** (0.008)
2005	**-0.053***** (0.011)	**-0.003** (0.014)
2006	**-0.061***** (0.013)	**-0.041**** (0.016)
2007	**-0.068***** (0.012)	**-0.048***** (0.014)
2008	**-0.041***** (0.013)	**-0.026*** (0.015)
2009	**-0.042***** (0.012)	**-0.052***** (0.013)
2010	**-0.027**** (0.012)	**-0.036***** (0.011)
2011	**-0.039***** (0.011)	**-0.044***** (0.012)
2012	**-0.056***** (0.011)	**-0.056***** **(0.011)**

*** Indicates statistical significance at the 1% level, **5% level, *10% level
Omitted variable: Access to care
Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012 (http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 3L: Pseudo R-squared Values for Marginal Effects of All Determinants of Obesity, by Gender

	Pseudo R-squared	
	Male	Female
2002	*0.0174*	*0.0405*
2003	*0.0214*	*0.0377*
2004	*0.0258*	*0.0300*
2005	*0.0211*	*0.0370*
2006	*0.0268*	*0.0347*
2007	*0.0211*	*0.0437*
2008	*0.0224*	*0.0456*
2009	*0.0279*	*0.0436*
2010	*0.0280*	*0.0404*
2011	*0.0252*	*0.0461*
2012	*0.0400*	*0.0400*

Omitted variables: no degree, white, not in poverty, West, Unemployed, Access to care, Nonsmoker, Non/Infrequent Drinker, Exercise
Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012 (http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 3M: Interaction Effect between Gender and Education Level Determinants of Obesity

	Variable	Marginal Effect	P-value	Standard Error
2002	Male*high school degree	0.081	0.000	0.023
	Male* college degree	0.086	0.000	0.025
	Male* beyond college degree	0.127	0.000	0.033
2003	Male*high school degree	0.068	0.002	0.023
	Male* college degree	0.108	0.000	0.026
	Male* beyond college degree	0.090	0.003	0.032
2004	Male*high school degree	0.026	0.050	0.013
	Male* college degree	0.019	0.157	0.014
	Male* beyond college degree	0.018	0.270	0.017
2005	Male*high school degree	0.076	0.000	0.022
	Male* college degree	0.100	0.000	0.024
	Male* beyond college degree	0.078	0.006	0.029
2006	Male*high school degree	0.022	0.361	0.024
	Male* college degree	0.080	0.002	0.027
	Male* beyond college degree	0.081	0.011	0.034
2007	Male*high school degree	0.052	0.030	0.025
	Male* college degree	0.102	0.000	0.027
	Male* beyond college degree	0.053	0.076	0.031
2008	Male*high school degree	0.035	0.164	0.026
	Male* college degree	0.076	0.004	0.028
	Male* beyond college degree	0.091	0.005	0.034
2009	Male*high school degree	0.034	0.124	0.020
	Male* college degree	0.068	0.003	0.021
	Male* beyond college degree	0.043	0.111	0.026
2010	Male*high school degree	0.083	0.000	0.024
	Male* college degree	0.087	0.000	0.025
	Male* beyond college degree	0.087	0.002	0.030
2011	Male*high school degree	0.023	0.258	0.021
	Male* college degree	0.054	0.011	0.022
	Male* beyond college degree	0.064	0.012	0.026
2012	Male*high school degree	0.044	0.037	0.021
	Male* college degree	0.074	0.001	0.022
	Male* beyond college degree	0.064	0.012	0.026

Omitted variables: No degree, White, Not in poverty, West, Unemployed, Access to care, Nonsmoker, Non/Infrequent drinker, Exercise

Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012 (http://www.cdc.gov/nchs/nhis/quest data related 1997 forward.htm)

XIII. Appendix 4

Table 4A: Effects of General Variable Determinants of Obesity (Education variables omitted)

Marginal effect/Coefficient (standard error)

	Age	Male
2002	**0.001*** ** (0.0003)	**-0.004** (0.007)
2003	**0.000*** ** (0.000)	**-0.036*** ** (0.006)
2004	**0.0004*** ** (0.0001)	**-0.006** (0.004)
2005	**0.001*** ** (0.0003)	**-0.014** ** (0.007)
2006	**0.001*** ** (0.0003)	**-0.015*** (0.008)
2007	**0.00*** ** (0.000)	**0.006** (0.008)
2008	**0.001** ** (0.0003)	**-0.005** (0.008)
2009	**0.001*** ** (0.0002)	**-0.003** (0.007)
2010	**0.001*** ** (0.0002)	**-0.006** (0.007)
2011	**0.006*** ** (0.0002)	**0.003** (0.006)
2012	**0.0005** ** (0.0002)	**-0.007** (0.006)

*** Indicates statistical significance at the 1% level, **5% level, *10% level\
Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012
(http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 4B: Marginal Effects of Income Variable Determinants of Obesity (Education variables omitted)

Marginal effect (standard error)

	In poverty	Near poverty
2002	**0.032*** ** (0.011)	**0.025*** ** (0.009)
2003	**0.021** ** (0.011)	**0.009** (0.009)
2004	**0.042*** ** (0.007)	**0.024*** ** (0.006)
2005	**0.030*** ** (0.011)	**0.005** (0.009)
2006	**0.029** ** (0.012)	**0.010** (0.010)
2007	**0.020*** (0.011)	**0.028** ** (0.010)
2008	**0.014** (0.010)	**0.009** (0.010)
2009	**0.007** (0.010)	**0.009** (0.009)
2010	**-0.004** (0.009)	**0.007** (0.009)
2011	**0.014** (0.009)	**0.018** ** (0.008)
2012	**0.016*** (0.009)	**0.004** (0.008)

*** Indicates statistical significance at the 1% level, **5% level, *10% level
Omitted variable: Not in poverty
Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012
(http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 4C: Marginal Effects of Race/Ethnicity Variable Determinants of Obesity (Education variables omitted)
Marginal effect (standard error)

	Hispanic	Black	Other race
2002	**0.056*** ** (0.010)	**0.104*** ** (0.012)	**-0.045*** ** (0.012)
2003	**0.063*** ** (0.011)	**0.127*** ** (0.012)	**-0.060*** ** (0.012)
2004	**0.077*** ** (0.007)	**0.120*** ** (0.007)	**-0.019*** ** (0.007)
2005	**0.060*** ** (0.010)	**0.093*** ** (0.011)	**-0.050*** ** (0.011)
2006	**0.086*** ** (0.012)	**0.106*** ** (0.012)	**-0.102*** ** (0.010)
2007	**0.069*** ** (0.011)	**0.101*** ** (0.011)	**-0.064*** ** (0.010)
2008	**0.108*** ** (0.011)	**0.122*** ** (0.012)	**-0.089*** ** (0.010)
2009	**0.096*** ** (0.010)	**0.105*** ** (0.010)	**-0.089*** ** (0.009)
2010	**0.113*** ** (0.010)	**0.116*** ** (0.010)	**-0.079*** ** (0.009)
2011	**0.102*** ** (0.009)	**0.120*** ** (0.009)	**-0.090*** ** (0.008)
2012	**0.099*** ** (0.009)	**0.103*** ** (0.009)	**-0.092*** ** (0.008)

*** Indicates statistical significance at the 1% level, **5% level, *10% level
Omitted variable: White
Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012 (http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 4D: Marginal Effects of Family Status Determinants of Obesity (Education variables omitted)
Marginal effect (standard error)

	Married	Divorced	Widowed
2002	**0.023*** ** (0.009)	**0.012** (0.012)	**-0.016** (0.016)
2003	**0.035*** ** (0.009)	**0.020*** (0.012)	**-0.027*** (0.016)
2004	**0.007** (0.006)	**-0.005** (0.010)	**-0.038*** ** (0.012)
2005	**0.015** ** (0.008)	**0.013** (0.011)	**-0.033** ** (0.014)
2006	**0.018*** (0.009)	**0.022*** (0.013)	**-0.051** ** (0.016)
2007	**0.013** (0.008)	**0.030** ** (0.013)	**-0.047*** ** (0.016)
2008	**0.009** (0.009)	**0.004** (0.013)	**-0.057*** ** (0.016)
2009	**0.006** (0.008)	**0.018** (0.011)	**-0.029*** (0.015)
2010	**0.033*** ** (0.008)	**0.042*** ** (0.012)	**-0.016** (0.015)
2011	**0.011** (0.007)	**0.034*** ** (0.010)	**-0.053*** ** (0.013)
2012	**0.019** ** (0.007)	**0.017*** (0.010)	**-0.044*** ** (0.012)

*** Indicates statistical significance at the 1% level, **5% level, *10% level
Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012 (http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 4E: Marginal Effects of Region Variable Determinants of Obesity (Education variables omitted)
Marginal effect (standard error)

	Northeast	Midwest	South
2002	**0.014** (0.011)	**0.026**** (0.011)	**0.022**** (0.009)
2003	**0.018** (0.011)	**0.026**** (0.010)	**-0.001** (0.009)
2004	**0.124***** (0.009)	**0.060***** (0.014)	**-0.052**** (0.024)
2005	**0.010** (0.011)	**0.043***** (0.010)	**-0.016*** (0.009)
2006	**0.029**** (0.012)	**0.058***** (0.012)	**0.021**** (0.010)
2007	**0.012** (0.012)	**0.052***** (0.011)	**0.029***** (0.010)
2008	**-0.010** (0.012)	**0.034***** (0.011)	**0.005** (0.010)
2009	**-0.008** (0.010)	**0.046***** (0.010)	**0.029***** (0.009)
2010	**0.003** (0.010)	**0.048***** (0.010)	**0.028***** (0.009)
2011	**-0.009** (0.009)	**0.042***** (0.009)	**0.029***** (0.008)
2012	**-0.014** (0.009)	**0.033***** (0.009)	**0.010** (0.008)

*** Indicates statistical significance at the 1% level, **5% level, *10% level
Omitted Variable: West
Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012
(http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 4F: Marginal Effects of Occupation Variable Determinants of Obesity (Education variables omitted)
Marginal effect (standard error)

	Employed/Retired
2002	**-0.002** (0.009)
2003	**0.019**** (0.009)
2004	**0.009*** (0.005)
2005	**0.018**** (0.009)
2006	**0.025**** (0.010)
2007	**0.023**** (0.009)
2008	**0.013** (0.010)
2009	**0.039***** (0.008)
2010	**0.020**** (0.008)
2011	**0.015**** (0.007)
2012	**0.020***** (0.007)

*** Indicates statistical significance at the 1% level, **5% level, *10% level
Omitted Variable: Unemployed
Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012
(http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 4G: Marginal Effects of Smoking Variable Determinants of Obesity (Education variables omitted)
Marginal effect (standard error)

	Smoker
2002	**-0.0001** (0.007)
2003	**0.0001** (0.007)
2004	**0.010**** (0.004)
2005	**0.010** (0.007)
2006	**0.010** (0.008)
2007	**0.018**** (0.008)
2008	**0.014*** (0.008)
2009	**0.026***** (0.007)
2010	**0.021***** (0.007)
2011	**0.038***** (0.006)
2012	**0.024***** (0.006)

*** Indicates statistical significance at the 1% level, **5% level, *10% level
Omitted Variable: Nonsmoker
Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012
(http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 4H: Marginal Effects of Activity Level Variable Determinants of Obesity (Education variables omitted)
Marginal effect (standard error)

	No exercise
2002	**0.067***** (0.007)
2003	**0.062***** (0.007)
2004	**0.060***** (0.004)
2005	**0.077***** (0.007)
2006	**0.038***** (0.008)
2007	**0.076***** (0.008)
2008	**0.074***** (0.008)
2009	**0.087***** (0.007)
2010	**0.077***** (0.007)
2011	**0.069***** (0.006)
2012	**0.082***** (0.006)

*** Indicates statistical significance at the 1% level, **5% level, *10% level
Omitted Variable: Exercise
Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012
(http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 4I: Marginal Effects of Alcohol Consumption Variable Determinants of Obesity (Education variables omitted)
Marginal effect (standard error)

	Moderate Drinker	Heavy Drinker
2002	**-0.044*** ** (0.008)	**0.031** (0.034)
2003	**-0.051*** ** (0.008)	**0.043** (0.040)
2004	**-0.049*** ** (0.004)	**-0.094*** ** (0.008)
2005	**-0.052*** ** (0.007)	**-0.072*** ** (0.012)
2006	**-0.044*** ** (0.008)	**-0.046*** ** (0.015)
2007	**-0.049*** ** (0.008)	**-0.095*** ** (0.013)
2008	**-0.052*** ** (0.008)	**-0.083*** ** (0.014)
2009	**-0.047*** ** (0.007)	**-0.087*** ** (0.012)
2010	**-0.035*** ** (0.009)	**-0.084*** ** (0.013)
2011	**-0.055*** ** (0.007)	**0.028*** ** (0.007)
2012	**-0.048*** ** (0.007)	**0.031*** ** (0.007)

*** Indicates statistical significance at the 1% level, **5% level, *10% level
Omitted variable: Non/Infrequent drinker
Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012
(http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 4J: Marginal Effects of Access to Health Care Variable Determinants of Obesity (Education variables omitted)
Marginal effect (standard error)

	No care
2002	**-0.022** ** (0.009)
2003	**-0.014** (0.010)
2004	**-0.042*** ** (0.005)
2005	**-0.030*** ** (0.009)
2006	**-0.054*** ** (0.010)
2007	**-0.055*** ** (0.010)
2008	**-0.035*** ** (0.010)
2009	**-0.046*** ** (0.009)
2010	**-0.035*** ** (0.009)
2011	**-0.043*** ** (0.008)
2012	**-0.047*** ** (0.008)

*** Indicates statistical significance at the 1% level, **5% level, *10% level
Omitted Variable: Access to care
Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012
(http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)

Table 4K: Pseudo R-squared Values for Marginal Effects of All Determinants of Obesity (Education variables omitted)

	Pseudo R-Squared
2002	*0.0221*
2003	*0.0234*
2004	*0.0263*
2005	*0.0237*
2006	*0.0251*
2007	*0.0264*
2008	*0.0277*
2009	*0.0290*
2010	*0.0295*
2011	*0.0306*
2012	*0.0272*

*** Indicates statistical significance at the 1% level, **5% level, *10% level
Omitted variables: Out of poverty, No degree, White, High school degree, College degree, Beyond college degree, West, Nonsmoker, Non/Infrequent drinker, Access to care
Source: Author's analysis of NHIS = National Health Interview Survey, 2002-2012 (http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm)