HOW DOES OBESITY AND BEING OVERWEIGHT IMPACT HEALTH CARE UTILIZATION SPENDING AMONG THE ELDERLY?

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Abstract

Objective: Theories and evidence suggest that the obese elderly population contribute a large amount to total health care expenditures. The objective of this study is to examine health care utilization and expenditures of the elderly in under- weight patients, normal-weight patients, overweight patients, and obese patients. In this study a cross-sectional analysis of 2,970 elderly adults (older than age sixty-five) is performed to examine the causality of obesity on total expenditure. Obesity is a contributor to increased chronic conditions resulting in higher utilization of medical services among the population of older adults.

Method: Using 2005 Medical Expenditure Panel Survey data, I implemented a log-linear model to estimate annual health care expenditures associated with high body mass index (BMI). I examined interactions between demographic factors, health factors and BMI additionally.

Results: Among the 2,970 survey respondent's twenty-seven percent were obese. Those categorized as obese were significantly inclined to have higher health care expenditure. It is expected for an obese person to spend approximately nineteen percent more than someone who is not obese.

Conclusion: Obesity related expenditures associated with chronic conditions are preventable and people may benefit from interventions that target lifestyle choices and weight management among the elderly.

Keywords: Obesity, Health Care Utilization, Health Care Expenditures, Medicare,

1. Introduction

Obesity is an exponentially growing problem in the United states as the rates have doubled in the past thirty years. The prevalence of obesity has become so severe that it has become officially recognized as a disease by the American Medical Association. Obesity is the second-leading cause of preventable death in the United States and it is a major cause of morbidity and disability (Allison). It has caused a public health crisis that is fueled not just by individual behaviors and circumstances, but also by state and federal policies regarding culture and practices. Obesity is a risk factor for many chronic conditions such as high blood pressure, diabetes, chronic heart disease, and high cholesterol to name a few. This is directly associated with an increase in medical costs which includes more impatient admissions, longer hospital stays and essentially, higher risks of medical complications. Consequently, Medicare is the fastest growing expense in the federal budget placing a heavy financial burden on the United States health care system. According to Finkelstein et al "the average increase in annual medical spending associated with obesity is 37.4 percent ($732) and ranges from 26.1 percent ($125) for out-of-pocket to 36.8 percent ($1,486) for Medicare". Medicare is the primary insurer for virtually all Americans aged sixty-five and up. In addition to insuring the elderly, Medicare also covers individuals with certain disabilities and/or diseases regardless of their age. This study is going to examine the relationship between weight, chronic conditions, and health care utilization and expenditures exclusively on elderly adults. The estimated magnitude of the impact of weight is a function of body mass index (BMI) which is divided into four categories: Underweight; Normal; Overweight; and Obese. The natural assumption is that patient health status, demographics, and financial

circumstance are strongly correlated to the total amount of health expenditure. The general notion is that an individual who is obese may be at risk for other chronic diseases which will lead to being treated. The amount of money used to get treated for these diseases increases medical spending.

It is critical to recognize the effects that obesity has on medical spending as it has become a burden on the federal budget. Treating obesity and obesity-related conditions costs billions of dollars a year. According to Cawley and Meyerhoefer, the U.S. spent $190 billion on obesity related health care expenses in 2005(Cawley and Meyerhoefer), double the previous estimates by Finkelstein et al. The reason it is important to understand the effect that obesity has on expenditure is because that capital could potentially be saved by prevention and treatment of obesity. This would allow the federal government to reallocate funds to other important entities ranging from education to infrastructure. A reduction in health expenditure would allow for more flexibility within the budget. I would like to produce a transparent understanding of the cost of obesity to both, lower health expenditure and combat obesity. “Policies, laws, and regulations are often needed to drive the environmental and social changes that eventually will have a sustainable impact on reducing obesity (Boyd).” The United States federal government has already taken initiative with a few programs that were introduced to fight obesity such as Michelle Obama’s *Let’s Move* campaign. The campaign was created with the idea of fighting childhood obesity by offering a variety of plans to help the cause. The campaign provided support for parents, required healthier food options in school, and increased physical activity for children. The main focal point of the *Let’s Move* s campaign were children; In stark contrast with the present study

that is examining obesity in elderly people and its effects on health expenditure. Although the two demographics are different in terms of age, it is important to instill healthy habits as a youth so they will age with the mentality of caring for themselves physically. With more knowledge about obesity and it how it affects income, it will encourage the population in being mindful about their personal health which in turn will decrease health care expenditure.

2. Literature Review

The Beginning of the literary search was conducted on the website of The National Center for Biotechnology Information and health https://www.ncbi.nlm.nih.gov/. The search identified over two thousand journals while only a few met the necessary requirements. One of the most interesting studies that I came across was by Eric A. Finkelstein et al.4. Finkelstein and his colleagues performed a study on the national medical spending attributable to overweight and obesity in the United States. In 1998, obesity related expenditures accounted for approximately nine percent of total medical expenditures which equates to $92.6 billion dollars in 2002. Of that $92.6, Medicare and Medicaid paid half of the costs (Finkelstein et al). I would assume that the total is even greater now given that obesity rates have risen. This generation will be the first generation that will have worse health problems than the preceding generation before it. Finkelstein et al reported that fifty-six percent of the respondents enrolled in Medicare are either overweight or obese. That is an alarming rate which is probably only going to increase. The last interesting element about their study that I would like to discuss is that Finkelstein et al estimated that “Obese people who survive to age sixty-five have much larger annual Medicare expenditures than those of normal weight.” This is hypothetically what I will be discussing and determining based on

my own study. The notion that the older an individual gets is the more medical expenditure they will have is extremely intuitive because every visit to the doctor and every procedure performed adds up. It is not possible for expenditure to decrease over time or become negative so it can only increase. I believe that there is a strong positive correlation between age and expenditure.

3. Data Description

The data for this study comes from the 2005 Medical Expenditure Panel Survey (MEPS). MEPS is a nationally representative survey of the civilian noninstitutionalized civilian population that quantifies healthcare expenditures and utilization, health insurance, health status, and sociodemographic factors. The dataset contains 2,970 observations, all of which are for cohorts aged sixty-five and older. By focusing on the elderly, we can assess the role obesity has on health care expenditure as Medicare covers most of the costs.

Health care expenditure is the dependent variable of this study which is measured as the sum of final consumption of health care goods and services. The units for Expenditure will be measured by the United States Dollar ($). The overall distribution of the health care expenditure is heavily skewed to the right. As a result, I will take the natural log (ln) of total expenditure to produce a distribution closer to normal. The sample mean for total expenditure is equal to $8,358, with a standard deviation equaling $14,109. There is a significant amount of variation as the minimum value of expenditure recorded was $1, in stark contrast with the maximum value of $235,392. Seventy-three percent of the Medicare expenditures falls below the mean. This data set is heavily influenced by outliers skewing the results significantly. There are twenty-one observations whose expenditures are greater than

$70,000, if they are removed, the mean becomes $7,636. A $749 decrease from a measly twenty-one observations. However, fifteen of those observations are either overweight or obese demonstrating how physical health is a major factor. The study will not omit any data regarding outliers because each observation assists in painting the overall picture.

For the primary independent variable, we identified obesity status based on the constructed body mass index, which is measured by an individual's weight in kilograms divided by the square of their height in meters (kg/m^2). The cohorts are classified into four standard weight classes: underweight: BMI < 18.5, normal weight: BMI 18.5–< 25, overweight: BMI 25 –< 30, or obese: BMI >30. A binary variable was created to indicate the presence of one of the previous weight classes mentioned. The average BMI for the dataset is equal to 27.3 which falls into the overweight category. Approximately thirty-eight percent of the participants are overweight while another twenty-seven percent is categorized as obese. Totaling for sixty-five percent of the distribution. Many of the observations fall into the main areas of interest for determining the effects of obesity on expenditure.

In addition to BMI, there are several other potential confounding factors that can be categorized to examine the impact on the magnitude of medical expenditure and utilization. This study accounts for: i) demographic factors, such as age, sex, and race, ii) socioeconomic factors such as education, income, and marital status, iii) morbidity conditions as well as additional factors such as location. Out of the 2,970 observations seventy-eight percent of the participants live in a Metropolitan statistical area (MSA). I wanted to highlight this because of the differences in culture and lifestyles between rural and urban areas, which may have an impact on obesity. In addition, seventy-one percent of the cohorts are White, thirteen percent

Black, eleven percent Hispanic, and four percent other/non-Hispanic. Moving on to other demographic controls, age is averaged at seventy-four years old. With respect to the socioeconomic factors of this study, income, education, and marital status will be accounted for when determining the medical expenditure. Theoretically, an individual who has a limited amount of income may not be able to pay for treatment for obesity derivatives. Although Medicare pays for a substantial amount of expenditure, there are still other expenses that need to be paid such as co-pays. Cohorts may not be able to afford to get treated in the long run, so they will hold out on treatment, sacrificing their health due to their lack of funds. Income is usually associated with education. The more years of education you have, the more income that will be generated as education is an investment. The last set of confounding factors that will be controlled for are morbidity conditions. These conditions include high blood pressure, high cholesterol, chronic heart disease, and diabetes. An astonishing Eighty-two percent of the individuals has at least one morbidity demonstrating the poor health status of the sample. There are more people with a morbidity than there are obese and overweight people. The discrepancy begs the question, is the cause of high expenditure caused by higher obesity rates or higher morbidity rates. This is tough to determine because obesity can be directly correlated or even causal with the various morbidities as obesity is one of the leading causes for chronic heart disease, diabetes, high blood pressure, and high cholesterol According to the data set, the average total health care expenditure of a morbid individual is $8,989, Twenty more dollars than a person who is obese which is $8,969. The two numbers are extremely close and cannot be properly assessed through observation.

4. Empirical Model

At the outset, the two possible specifications for the empirical model considered were a linear and a log-linear model. Between the two specifications, I believe that the log-linear model is better suited for producing an accurate estimate of the effect of weight as a function of BMI on individual health care expenditure. For this study, the linear model does not properly encapsulate the true relationship between obesity and expenditure. There are many other variables to consider when determining the impact of obesity on expenditure, which is why a linear model may oversimplify the relationship between the covariate and response variables. One of the main concerns with having a log-linear specification is that zeros cannot be logged, however the minimum value of health expenditure is equal to one. This eliminates the problem of having to manipulate the data to enhance the regressions. The results of the empirical estimations are illustrated and discussed in the results section. I will be using a simple ordinary least squares estimator on the log-linear model.

The general econometric specification to measure the effect of BMI on health care expenditure is specified as:

$$Y_i = \beta_0 + \beta_1 x_{i,1} + \beta_2 x_{i,2} + \beta_3 x_{i,3} + \beta_4 x_{i,4} + \varepsilon \qquad (1)$$

Where Y_i is the natural log of health care expenditure of interest against the explanatory variables. Estimating parameters for continuous variables on the natural log of expenditure can be interpreted as percentage change for each unit of change in the independent variable. However, the effect of dummy variables in terms of percentage of expenditure can be estimated by exponentiating the regression coefficients of dummy variables and subtracting

one(e^{β}-1). X_1 is a continuous nonrandom variable controlling for BMI. X_2 is a vector of dummy variables equaling one if the respondent has a morbidity, that includes diabetes, high blood pressure, high cholesterol, and chronic heart disease. It also controls for physical limitations which is a dummy variable denoted by 1 if a physical limit exists. X_3 is a vector of demographic variables such as age, sex, and race. Clearly age is a continuous variable, sex is a dummy variable equaling one if the cohort is male. Race is an ordinal variable equaling one if the correspondent is white, two if they are black, three if their non-Hispanic/other, and four if they are indeed Hispanic. X_4 controls for socioeconomic factors such as income, education, and marital status. The marital status is a set of dummy variables for separated or divorced, never married, and widowed. The education level is a set of dummy variables for high school, some college, and college. ε is an unobserved random error term that is functionally independent of the explanatory variables. The disturbance may result from errors in implementation, random occurrences, errors in measurements, specification errors, omitted variables, or errors in the design and collection of data.

To estimate the effect of BMI on individual health care expenditure, I will refine equation (1) to include variable names and interaction terms to analyze the relationships between the response and explanatory variables. The final model is the following:

$$Y_i = \beta_0 + \beta_1 bmi + \beta_2 obese + \beta_3 morbid + \beta_4 phy\_lim + \beta_5 income + \beta_6 age + \beta_7 white \quad (2)$$

$$+ \beta_8 male + \beta_9 (morbid \times visits) + \beta_{10} (phy\_lim \times visits) + \beta_{11} (income \times visits)$$

$$+ \beta_{12} married + \varepsilon$$

With this specification (2) , the OLS (Ordinary Least Squares) estimator, β_2 captures the effect of obesity on expenditure In equation (2), β_9 is an interaction term estimates the effects of having a morbidity on the number of visits to the doctor and/or hospital. If having a morbidity boosts the number of visits to the hospital or doctor, then β_9 should be positive and significant, increasing total expenditure as β_9 increases. β_{10} is also an interaction term that estimates the effects of having physical limitations on the number of visits to the doctor and/or hospital. I believe that having physical limitations will diminish that number of visits to the doctor, creating a negative relationship. β_{10} will probably be significant. The number of visits in both β_9 and β_{10} is potentially correlated with expenditure as money is being spent each visit to a hospital or doctor. I am interested in examining the effect income has on expenditure. One could assume that an individual who makes more money would potentially spend more money on medical care. I believe this assumption to be true because of the ability of richer folks to afford medical treatment.

5. Results

Main Results

I ran separate models to assess the impact of health status across weight categories on expenditure outcomes. Table four reports the estimates of parameters in equation (2), the final model. The set of estimates reported under each column within the panel are from separate regressions. Each regression controls for individual characteristics that are included in summary statistics in Table 3 and in the descriptive statistics in Table two. Variable labels are reported in Table 1. The r squared value of equation (2) is equal to forty-eight percent which is a pretty good fit for our problem. As previously mentioned, I

thought the log-linear model was the best specification due to expenditures natural tendency to be skewed to the right. I will be using OLS estimators to examine the relationship between obesity and health care expenditure.

For the main independent variables in the study, BMI and obese, have contrasting results. BMI has a coefficient of -.0033, which is statistically insignificant at the five percent level via t test. The p-value is very large at sixty-four percent. For every unit increase in BMI, total expenditure is expected to decrease by three tenths of a percent. It seemingly has no effect however this insignificance may be a result of also controlling for obesity in the same regression equation, as obesity is a function of BMI. Additionally, BMI may not be the best indicator for someone's overall health. The index is extremely objective and does not distinguish fat from muscle. For example, the average height and weight of an NFL running back is five feet eleven inches and two hundred sixteen pounds. According to the BMI chart, this will categorize the running back as obese which is true on the index but not in reality. The running back is arguably the most athletic player on the field so it is not likely that they will be suffering from the same traditional symptoms as an obese person. obesity is not statistically significant at the five percent level which comes as a surprise as one would assume, obesity would have a substantial impact on expenditure. However, it is significant at the ten percent level with a probability just above five percent via t-test. Obesity still has a large effect as being obese results in an approximately nineteen percent increase in expenditure holding everything else constant. I believe that if there were additional interaction terms such as physical limitations and morbidity associated with obesity, it would become significant at the five

percent level. I mentioned physical limitations because according to the data, thirty-five percent of people who are obese also have physical limitations, this might hinder the ability to visit the doctor or hospital. interacting the two may produce very significant results.

Physical limitations typically impede on a person's physical health as they would lack the necessary exercise to maintain good health. Generally, they will start to gain weight and become susceptible to risk factors for poor health such as heart disease, diabetes, high blood pressure, and high cholesterol. These factors are all correlated to obesity as all the conditions mentioned are typically the results of being obese. In the regression equation (2), the parameter physical limitation is statistically significant at the one percent level with a coefficient of 1.56. This value is also very large relative to the other variables.

The most statistically significant variable is the number of visits to the doctor or hospital with a coefficient of 6.03. It is significant at both the one percent and five percent level. The number of visits is a strong indicator of how much expenditure is incurred because each visit costs money. This a natural transaction and is very intuitive. For every visit to either a doctor or the hospital, there is a five hundred three percent increase in expenditure. The variable may suffer from bias based on how large the coefficient is. There must be an alternative interaction that will properly portray the true image of the effect of the number of visits on expenditure. Another reason why it may be so large is that I combined both hospital visits and doctor visits into one variable. Each entity may be statically significant on its own and now they are strongly influencing the

regression estimates. Although there may be some bias, the relatively large effect still makes sense. For instance, if an individual is morbid, they potentially have more visits to the hospital or doctor than someone who is not. Theoretically a morbid individual should visit medical institutions more frequently than someone who is not to keep up with their health status. With Conditions such as diabetes and chronic heart disease, it is expected for an individual to routinely visit the doctor and or hospital. Even if doctor visits and hospitals were separated, I think they will still be robust to any changes because most of the health expenditure comes at a doctor office or hospital so consequently it makes sense that visits are statically significant. In some cultures, in the United States, some people only go to the doctor or hospital when something severe has occurred, such as surgery, heart attacks, liver failure, or even cancer. These different cases may have been prevented by getting routine checkups to adjust for any internal threats to their health. Getting routine checkups could essentially be cheaper in the long run as well instead of having to pay an absurd amount of money for a procedure. Aggregately, there will be less expenditure if society took preventive measures with their health. According to Heart, Heart surgery in the United States costs $106,385. This was back in 2013, I could only imagine the number has inflated due to the culture of poor habits in America.

With the interaction term between morbidity and the number of visits is also statistically significant at the one percent level. However, the coefficient is negative at -2.4437. This corresponds to a ninety-one percent decrease of total expenditure ceteris paribus. The drastic percentage decrease contradicts the theory of having more visits to the hospital or doctor if suffering from a morbidity. This counterintuitive result may be a

result of omitted variable bias as the coefficients of the variables visit and morbid are extremely large relative to the other regressors in the regression. If we look at the coefficient of morbid, which is 3.127, it is approximately half of the visit's coefficient and still disproportionately larger than the rest of the regressors. The coefficient is statistically significant at the one percent level denoting its extensive impact on total expenditure. For a cohort who is morbid, the resulting effect ceteris paribus is a increase of two hundred twelve percent. Relatively large, like visits, I believe these two variables suffer from omitted variable bias due to the coefficients extremely large nature. It may be necessary to control for additional factors to reduce any form of bias. Creating additional interaction terms for visits should drastically shift the coefficient closer to zero allowing us to see a less biased estimate.

Another interaction in the equation is between physical limits and visits, with a coefficient of -.955. It is statistically significant at the ten percent level. I believe the parameter is negative to help control for how large both coefficient variables are. The intuition behind interacting the two is that people are less mobile may opt to not visit the doctor because it is a lot stress involved with the whole process. The last interaction term is between income and visits with an incredibly small coefficient of -.0000178, which is statistically significant at the ten percent level. I believe income plays a mild factor in determining expenditure because someone with more income can afford more treatments. Understandably, Medicare covers a large portion of the medical expense for the elderly, but money still must come out of pocket to make up for what Medicare does not cover.

This may cause a decrease in expenditure as reported due to its nature. If someone cannot visit a doctor than the expenditure will potentially decrease.

Shifting focus to the demographic factors such as age, race, and sex, the regression estimates that if the respondent is white, there is a thirty-two percent increase in total expenditure. The estimated effected is significant at the one percent level. It is possible that this effect is significant because of a lack of interacting terms such as specifying being white and male. This may reduce the significance because white woman may be healthier and in turn not incurring as much expenditure as white men. Another reason why white is significant is because generally, white people have more access to funds than black people due to poverty and lack of resources. The result being that white people could afford to visit the doctor as I have been reiterating throughout this section. Alternatively, the reasoning could be that the white people in the study are generally unhealthy. Sixty-five percent of the cohorts that are obese, are also white. This could possibly be attributed to the difference in the number of observations between race. White people account for seventy-one percent of the data, whereas black people only account for approximately thirteen percent of the data. I ran an F-test to determine if being both white and male are significant in this regression. The F-stat being 27.38, with a probability less than .001, so we will reject the null that they are not significant at the five percent level. There is plenty of speculation as to why being white increases expenditure, introducing more interactive terms would give a better scope to a better estimate. Regarding age, the variable is statistically significant at the one percent level with a coefficient estimate of .204. This signifies a two percent increase for every

additional year. Economically, this an extremely sound estimation because as you get older the amount of money spent on medical care can only accumulate, which increases expenditure. Additionally, as you age the more susceptible you become to chronic health conditions. This also increases total expenditure.

The other regressions in Table 3 are equations with vastly different characteristics to determine the effect of obesity on expenditure. Equation (3) strictly controls for different demographics to see how obesity along with factors such as race and sex as opposed to equation (4) which strictly reports health statuses. It seems as if there are more controls in the regression the obesity becomes less significant than other factors such as morbidity and the number of doctor or hospital visits.

6. Concluding Remarks

The motivation for this study and its main contribution to the literature, is estimating the effects that obesity and various characteristics play in determining health expenditure. These characteristics include controlling for health status as well as demographic and socioeconomic factors. We examine these effects to determine how much of a financial burden obesity projects on the federal budget. According to equation (2) of my regression model, it's estimated that being obese is estimated to significantly increase health care expenditure by nineteen percent. The reason obesity is such a financial is because it directly leads to other chronic diseases which are all known to be preventable given the correct diet and lifestyle. American culture glorifies fast food culture and heavily processed foods. Consistently eating these kinds of foods is detrimental to your health, leading to ailments like

obesity which directly leads to chronic conditions like previously mentioned. obesity is a butterfly effect that can be prevented by shifting the culture of health in America.

One caveat I would like to mention is about the explanatory variable, obesity. Although my estimates display elevated expenditures among obese individuals, the results from adding additional control variables in a regression with obesity suggests that the relationship between obesity and expenditure becomes weaker. Even practically non-existent when the analysis controls for obesity related comorbidities along with demographics. My findings are consistent with other studies such as Heithoff et al. Heithoff and colleagues found that there were no statistically significant differences in expenditures between normal weight and obese individuals in separate analyses of weight related diseases such as diabetes and hypertension.9. However, my conclusion remains the same, health care costs associated with overweight and obesity are substantial as it places a financial burden on the United States health care system. I strongly believe that Obesity related expenditures associated with chronic conditions are preventable and people may benefit from interventions that target lifestyle choices and weight management among the elderly.

7. Works Cited

1. Cawley J, Meyerhoefer C. The medical care costs of obesity: an instrumental variables approach. J Health Econ. 2012; 31:219-30.
2. Boyd A Swinburn Obesity prevention: the role of policies, laws and regulations, Austalia & New Zealand Health Policy
3. Finkelstein EA, Trogdon JG, Cohen JW, Dietz W. Annual medical spending attributable to obesity: payer- and service-specific estimates. Health Aff (Millwood). 2009; 28:w822-31.
4. Finkelstein EA et al 2003 National Medical Spending Attributable To Overweight And Obesity: How Much, And Who's Paying?. https://doi.org/10.1377/hlthaff.w3.219
5. The Impact of Obesity on Health Care Utilization and Expenditures in a Medicare Supplement Population
6. Shirley Musich, Stephanie MacLeod, Gandhi R. Bhattarai, Shaohung S. Wang, Kevin Hawkins, Frank G. Bottone, Jr., Charlotte S. Yeh Gerontol Geriatr Med. 2016 Jan-Dec
7. Shen, Chan & Sambamoorthi, Usha & Rust, George. (2008). Co-occurring Mental Illness and Health Care Utilization and Expenditures in Adults with Obesity and Chronic Physical Illness. Disease management : DM. 11. 153-60. 10.1089/dis.2007.0012
8. Gokhale K. Heart surgery in India for $1,583 costs $106,385 in U.S. Bloomberg. July 28, 2013. http://www.bloomberg.com/news/2013-07-28/heart-surgery-in-india-for-1-583-costs-106-385-in-u-s-.html
9. Heithoff KA, Cuffel BJ, Kennedy S, Peter J. The association between body mass and health care expenditures. Clin Ter. 1997;19:81 1-820.
10. Allison DB, Fontaine KR, Manson JE, Stevens J, VanItallie TB JAMA. 1999 Oct 27; 282(16):1530-8.
11. Christina C. Wee, Russell S. Phillips, Anna T. R. Legedza, Roger B. Davis, Jane R. Soukup, Graham A. Colditz, Mary Beth Hamel Am J Public Health. 2005 Jan; 95(1): 159–165. doi: 10.2105/AJPH.2003.027946

Table 1:
Variable Descriptions

Variable name	Description
age	Age in years
male	Dummy variable, =1 if male, 0 otherwise
race_grp	Race categorical variable, =1 if the respondent is white non-Hispanic, =2 if black non-Hispanic, =3 if other non-Hispanic, =4 if Hispanic
marital	Marital status categorical variable, =1 if married, =2 if widowed, =3 if divorced or separated, =4 if never married
income	Annual family income
educ	Years of education
msa	Dummy variable, =1 if live in MSA, =0 otherwise
bmi	Body mass index, weight in kilograms/(height in cm-squared)
Obese	Dummy variable, =1 if respondent is obese, =0 otherwise
Overweight	Dummy variable, =1 if respondent is overweight, =0 otherwise
Normal	Dummy variable, =1 if respondent is normal , =0 otherwise
high_bp	Dummy variable, =1 if respondent has high blood pressure, =0 otherwise
high_chol	Dummy variable, =1 if respondent has high cholesterol, =0 otherwise
phy_lim	Dummy variable, =1 if respondent has a physical limitation, =0 otherwise
diabetes	Dummy variable, =1 if respondent has diabetes, =0 otherwise
chd	Dummy variable, =1 if respondent has chronic heart disease, =0 otherwise
srhealth	Self-reported health status, =1 if excellent, =2 if very good, =3 if good, =4 if fair, =5 if poor
mntl_hlth	Self-reported mental health, =1 if excellent, =2 if very good, =3 if good, =4 if fair, =5 if poor
dr_visits	Doctor visits in 2005. This variable is an integer value (0,1,2…)
hosp_vis	Hospital visits in 2005. This variable is an integer value (0,1,2…)
totalexp	Total expenditures on medical care in 2005. This variable measures the value of medical care consumed by the respondent, not what they paid out of pocket.

Table 2:
Variable Descriptions

	Total study sample	Underweight	Normal	Overweight	Obese	*p*
Number of respondents (*n*)	2,970	60	990	1,121	799	
BMI (%)	2,970	2.0%	33.3%	37.7%	27%	
Gender (%)						
Male	59%	25%	37%	49%	37%	<.0001
Female	41%	75%	63%	51%	63%	
Race (%)						
White	72%	73.3%	76.3%	72.0%	65.2%	<.0001
Black	13%	8.3%	9.6%	12.4%	17.6%	
Non-Hispanic / Other	4%	10%	0.6%	3.8%	3.3%	
Hispanic	11%	8.3%	8.0%	11.7%	13.9%	
Average age (years)	74	76	75	73	72	<.0001
Income ($)	$22,938	$16,588	$23,837	$23,832	$20,057	.08
Comorbidities (%)						
High Blood Pressure	67%	48.3%	57%	66.6%	80.7%	
High Cholesterol	52.7%	38.3%	47.8%	54.3%	57.6%	
Diabetes	20.6%	6.7%	11.9%	20.4%	32.8%	
Chronic Heart Disease	12.8%	18.3%	11%	13.7%	13.3%	
Physical Limitations	38.1%	46.7%	34.3%	33%	49.2%	

Table 3: Summary Statistics

Variable	Observations	Mean	Standard Dev	Min	Max
BMI	2,970	27.3	5.55	15.1	70.3
Obese	2,970	.269	.44	0	1
Overweight	2,970	.37	.48	0	1
Normal	2,970	.33	.47	0	1
Age	2,970	74.0	6.22	65	85
Income	2,970	22,938.29	22,209.09	3	180,045
Education	2,970	11.54	3.73	0	17
Male	2,970	.41	.49	0	1
White	2,970	.71	.45	0	1
Total Expenditure	2,970	8,358	14,109.34	1	235,392
Hospital Visit	2,970	.25	.65	0	7
Doctor Visits	2,970	10.36	12.94	0	175
High Blood Pressure	2,970	.67	.47	0	1
High Cholesterol	2,970	.52	.49	0	1
Diabetes	2,970	.21	.40	0	1
Chronic Heart Disease	2.970	.13	.33	0	1
Note: The variables with a minimum of zero and a maximum of one are dummy variables. Their means are listed as proportions.					

Table 4: Regression Estimates

Independent Variable	(1)	(2)	(3)	(4)
BMI	.006 (0.123) [-.017, 0.03]	-.0033 (0.007) [-.017, .01]	0.03 (.006) [.02, .045]	
Obese	.239 (.17) [-.10, .58]	.1709 (.087) [-.0008,.34] *		-.09 (.06) [-.22, .04]
Overweight	-.06 (.10) [-.26, .13]			
Normal				
Visits		6.03 (.349) [5.34, 6.71] ***		4.19 (.10) [3.9, 4.4] ***
Morbid		3.12 (.443) ***		
Physical Limit		1.56 (.568) ***		.64 (.05) [.53, .74] ***
Income		.0000172 (.0002) *	-.0001 (.0001) [-.000012, .00001]	
Morbid * visits		-2.44 (.449) ***		
Phy_limit * visits		-0.955 (.568) *		
Income * visits		-.0000178 (.0012) *		
Male		-.0749 (.057)	-.57 (.134) ***	

Independent Variable	(1)	(2)	(3)	(4)
White * Male			.434 (.157) [.12, .74] ***	
White		.276 (.06) ***	.202 (.11) [-.02, .43] *	
Black			.025 (.130) [-.22, .28]	
Married		.120 (.057) **		
Age		.02 (.004) ***	.037 (.005) [.026, .04] ***	
High Blood Pressure				.402 (.057) [.28, .51] ***
High Cholesterol				.39 (.05) [.28, .49] ***
Chronic Heart Disease				.57 (.07) [.41, .72] ***
Diabetes				.50 (.06) [.37, .62] ***
Notes: Standard errors are displayed in parentheses and 95% confidence intervals are shown in brackets. The asterisk represents estimates that are statistically significant at each level One asterisk = 10% significance, Two asterisk = 5% significance, Three asterisk = 1% signifcance				