Impact of Obesity on Health Care Utilization and Spending among the Elderly

Eldor Fozilov

Student ID: 20192032

19 June 2021

Abstract

Obesity is a major problem affecting people that negatively affected people in the past and continues doing so now and probably in the future too if preventative and mitigating issues are not taken. The problem of obesity is especially related to the elderly today and how it affects not only their health, but their economic life as well. In this paper, we explored the relationship between obesity and health care spending, also accounting for many other variables, using the data provided by the Medical Expenditure Panel Survey in 2005, and found that the partial effect of obesity is insignificant when we account for health-related variables such as blood pressure, cholesterol levels, physical limit and also diseases such as diabetes and chronic heart diseases.

I. Introduction

Over the past few decades, obesity became a major problem in the globe. Close to 500 million people over the globe were considered as overweight by 2002. Also, US, rates of obesity have doubled since 1970 to over 30%. The prevalence of obesity in older people has dramatically increased in recent years: in the United States, more than 30% of men and women aged 60 years and over are obese. A significant increase in the prevalence of extreme degrees of obesity also has been observed in older ages. Also, Medicare, the federal health insurance program for the elderly in the United States, is the fastest-growing expense in the U.S. federal budget. We will try to answer the question of how obesity is influencing the elderly from an economic point of view, specifically how obesity impacts healthcare utilization by the elderly. We are going to use the OLS multiple regression, and the data acquired from Medical Expenditure Panel Survey in 2005 to answer that important question.

II. Data

The Medical Expenditure Panel Survey, which began in 1996, is a set of large-scale surveys of families and individuals, their medical providers (doctors, hospitals, pharmacies, etc.), and employers across the United States. MEPS collects data on the specific health services that Americans use, how frequently they use them, the cost of these services, and how they are paid for, as well as data on the cost, scope, and breadth of health insurance held by and available to U.S. workers.

MEPS has two major components: the Household Component and the Insurance Component. The Household Component provides data from individual households and their members, which is supplemented by data from their medical providers. The Insurance Component is a separate survey of employers that provides data on employer-based health insurance.

The data used for this paper was collected by the Household Component (HC). This HC collected data from a sample of senior people in US (2005), drawn from a nationally representative subsample of households that participated in the prior years' National Health Interview Survey (2004), conducted by the National Center for Health Statistics. During the household several rounds of interviews, MEPS collected detailed information for each person in the household on the following: age, income, education, marital status, ethnicity, health conditions, BMI measure, use of medical services and total expenditure on these services[1].

In the data set, there is no big difference in proportions of males and females are close : males constitute 41 percent of the sample, while females constitute 59 percent of the sample. Most of study participants live in city area (78.18%) and belong to white and non-Hispanic race (71.68%). The minimum age in the dataset is 65, the average is 74 and the

[1] Detailed information about the variables of interest can be found in Table 1 in the appendix.

maximum income is 85. In terms of income, although there are some outliers (min. value is 3$ and the maximum is 180045$), but most of the values are not very far from the mean (22938$): 25th percentile for income is 9028$ and 75th percentile is 30000$. Years of education among the elderly are also close to each other (median and mean are 12 and 11.55, respectively). When it comes to the value of medical care utilized by the sample members, the mean value was 8358$, while the median value was less than half of the mean (3935). Although, there are exist some outliers (the min total expenditure was 1$ and the maximum was 295392$), most of the data values were close to the mean and median. In the dataset, the BMI[2] measure was given in quantitative form. The average BMI measure of study participants is 26.60, whereas its min and max values are 15.10 and 70.30, respectively. However, for our analysis, we will categorize it and divide sample members into 4 groups[3]:

- If BMI is less than 18.5, then we will assign the person to the **underweight** range.
- If BMI is 18.5 to <25, then we will assign the person to **normal weight** range.
- If BMI is 25.0 to <30, then we will assign the person to **overweight** range.
- If BMI is 30.0 or higher, then we will assign the person to **obesity** range.

We discovered that in the sample, only 2% of study participants are underweight, 33% have normal weight, 38% are overweight, and 27% are obese people. As we can see, overweight and obese people constitute of more than 50% of the sample. After doing the categorization, we saw that there were no significant differences in median and mean values of the groups in terms of hospital visits, while some variation existed in doctor visits and total expenditure[4].

---

2 Body Mass Index (BMI) is a person's weight in kilograms divided by the square of height in meters. A high BMI can indicate high body fatness.
3 The major US health organization, "Centers for Disease Control and Prevention" follows such categorization.
4 Mean and median statistics can be found in Table 5. Also, information about other variables of interest can be found in Tables 2-4 in the Appendix.

III. Related Literature

In the past, a good amount of research was conducted to examine obesity, especially its economic consequences. Quesenberry and Jacobson (1998) estimated that individuals who are moderately obese (30 kg/m2 ≤ BMI ≤ 34.9 kg/m2) and severely obese (BMI ≥ 35 kg/m2) have 14% and 25% more physician visits than individuals of normal weight (20 kg/m2 ≤ BMI ≤ 24.9 kg/m2), respectively, while Thompson (2001) found that obese adults (BMI ≥ 30 kg/m2) have 38% more visits to primary care physicians than normal-weight people. Sturm (2002) used nationally representative data from the 1997– 1998 Healthcare for Communities survey and found that obese adults aged 18–65 years incur annual medical expenditures that are 36% higher than expenditures of normal-weight individuals. Similarly, Finkelstein et al. (2003) used data from the 1998 Medical Expenditure Panel Survey (MEPS) linked to the National Health Interview Survey (NHIS) and found that the average increase in annual medical expenditures associated with obesity is 37.4% ($732). In his later research, Finkelstein et al. (2008) used data from 2006 Medical Expenditure Panel Surveys (MEPS) along with National Health Expenditure Accounts data on health spending to construct a regression that controls for demography, smoking status, and insurance status. They divided cost estimates among payers (Medicare, Medicaid, or private) and cost category (inpatient, outpatient, or prescription). Estimated medical costs of obesity were as high as $147 billion a year for 2008, or almost 10% of all medical spending. This was a substantial increase from their 1998 estimate of $78.5 billion a year. The authors attribute the majority of this increase to higher prevalence of overweight. Private payers bear the majority of estimated costs, although public-sector spending is also substantial – Medicare spending would be an estimated 8.5% lower and Medicaid spending 11.8% lower in the absence of obesity. Across all payers, comparison of the obese to healthy-weight individuals shows 2006 medical spending that is 41.5% higher as a result of obesity.

Rather than providing a point-estimate of obesity's impact on spending, Thorpe et al (2004) focused on assessing the link between increases in obesity prevalence and increases in spending over time. They used self-reported data on both medical conditions and BMI from two nationally representative surveys (the National Medical Expenditure survey and the Household Component of the MEPS), and constructed a two-part regression controlling for key individual variables (such as demography, smoking, and insurance status). The regression estimated the "obesity-attributable" portion of per-capita health care spending increases between 1987 and 2001 to be 27% (adjusted for inflation), with 12% due solely to increases in prevalence of obesity. Most of this increase was found to be due to spending on diabetes or hypertension specifically. At the beginning of the study period in 1987, per capita health care spending was estimated to be 15.2% higher for the obese than for healthy-weight individuals. By 2001, this gap had grown to 37%. The rate of growth in spending among the obese group was much higher than overall per capita spending growth.

Researchers, namely Nortoft, Chubb and Borglykke (2017), analyzed the impact of increasing BMI on healthcare utilization (hospitalizations, PCP contacts and prescriptions) using large population-based electronic medical record (EMR) data from both the UK and the USA. The study contained 1,878,017 UK and 4,414,883 US individuals. Compared with body mass index (BMI) (18.5–24.9 kg m^{-2}), significant ($p < 0.0001$) increases in healthcare usage were observed with increasing BMI. Individuals with BMI 30–34.9 kg m^{-2} had higher PCP contact rate (rate ratios [RR] 1.27 and 1.28 for UK and USA, respectively), higher prescription rate (RR 1.61 and 1.51) and higher hospitalization rate (RR 1.10 and 1.13) than individuals with BMI 18.5–24.9 kg m^{-2}. Individuals with BMI >40 kg m^{-2} also had higher PCP contact rate (RR 1.56 and 1.64), prescription rate (RR 2.48 and 2.14) and hospitalization rate (RR 1.27 and 1.30) than individuals with BMI 18.5–24.9 kg m^{-2}. Latest research on economic impact of obesity was conducted by Shirley et al. (2016). They surveyed 9,484 people for their study, 22.9% of whom were classified as obese (BMI = 30 or greater). Those categorized as obese were significantly more likely to incur inpatient admissions and orthopedic procedures. Annualized health care expenditures were US$1,496 higher for obese compared with normal weight (BMI = 18.6-24.9). The excess utilization and expenditures associated with obesity were explained by chronic conditions and poor health status.

Another economic effect of obesity is related to wages and employment. There is evidence that obese individuals' occupations, primarily women's, differ from those of normal-weight individuals. Pagan and Davila (1997) reported that obese women work mostly in relatively low-paying occupations and are largely excluded from high-paying managerial/professional and technical occupations. Haskins and Ransford (1999), using data from one employer in the aerospace industry, reported that 65% of normal-weight women are in managerial/professional positions compared with only 39% of overweight women (defined as 10% or more over the upper limit of ideal body weight range). Sarlio-Lahteenkorva and Lahelma (1999) found that obese women are 2.5 times more likely to report long-term unemployment and have higher rates of poverty.

There was less compelling evidence of a negative relationship between earnings and weight for men; studies done by Register & William (1990) and Mitra (2001) found no significant relationship. When Averett & Korenman (1996) examined the effect of obesity in 1981 on the wages of men in 1988, they found a statistically significant negative relationship; however, the effect becomes insignificant when differences for social class and family background are controlled. Gortmaker (1993) reported that men overweight (BMI > 95th percentile for age and sex) in adolescence have 9% ($2876) lower annual household incomes seven years later than do men of normal weight. Work done by labor economist Morris (2007) suggests that the total impact of obesity on employment may be much larger than previously estimated. Using a large sample of individual level data, this work has shown that the probability of being in employment is significantly lower (up to 25%) for those who are obese than those of normal weight. This relationship holds for both men and women, although the magnitude of the effect is larger for women.

IV. Model

We are going to use the OLS multiple regression for our analysis and our general population model[5] is going to be the following:

$$log(totalexp) = \beta_0 + \beta_1 obese + \beta_2 overwieght + \beta_3 underweight + \beta_4 chd + \beta_5 diabetes$$

$$\beta_6 high\_bp + \beta_7 high\_chol + \beta_8 phy\_lim + \beta_9 male + \beta_{10} \log(income) + u$$

We divide sample participants into 4 distinct groups based on their BMI results, as mentioned in the section 2 (Data), and our base group is normal weight participants. We are interested in the partial effect of being obese holding other variables in the model as fixed. We are controlling for health-related variables (chronic heart disease, diabetes, high blood pressure, high cholesterol, and physical limit) because we expect them to be correlated with our variable of interest (***obese***) and also largely effect total expenditure. We also control for the gender variable (***male***) and income because we expect them to effect total expenditure. We take the log of total expenditure and income variables because we saw that the median and mean values differed significantly in those variables (there are several outliers in the dataset), and taking the logarithm helps us mitigate the problem with outliers, and also doing that help us see the average difference in total expenditure between obese and normal-weight people. We did not include education as a control variable because income and education were considerably correlated (0.4), so since we only care about the parameter

[5] To see the full definitions of the variables, look at Table 1 in the Appendix.

of ***obese*** variable, we decided only to include income. We do not include the ***msa*** variable into our model because close 80% of the elderly live in such areas and thus controlling that variable would not be very helpful. Also, we did not control for doctor and hospital visits because we assume that total expenditure already incorporates doctor visits and hospital visits and thus controlling these variables would not be reasonable. If we look at the actual relationship between those variables in the data and regress total expenditure on doctor and hospital visits, we get statistically and economically significant results[6]. We do not include age as a control variable because there is no significant difference in the age distribution among the elderly in the sample. Also, we do not account for marital status, self-report health and ethnicity of sample participants, because we are interested in the general impact of obesity without considering those factors.

The classical linear model assumptions are likely to hold because we have a large enough random sample, enough control variables, and also the problem of outliers is mitigated thanks to using log form. Multicollinearity is not an issue since the variance inflation factor of each variable in the model is less than 1.5.

We will create multiple versions of our general population model. First, we will only regress total expenditure on **obese, overweight** and **underweight** variables without controlling for any other variable and then gradually add control variables to see how the partial effects will change. All of the regression models and estimates will be provided in the Appendix (Table 6).

[6] $\underset{}{totalexp} = \underset{(252.5)}{2459.5} + \underset{(15.3)}{275}\,drvisits + \underset{(303.6)}{12210}\,\mathrm{hospvis}$

* the quantities below the estimates are the standard errors.

V. Results

We created 8 versions (refer to the Table 6 in the Appendix) of the general model and estimated their corresponding parameters. In the first model (1), where we do not include control variables, we can observe that the estimated parameter of our variable of interest, obese, is equal to 0.34, which is statistically significant at 1% level. This means that, obese old people utilize health care services 34% more than the normal weight old people. In the (2) and (3) models, where we control for income and gender in the former and occurrence of chronic heart disease in the latter, there is no big difference in the estimated parameter value of the obese variable in those models as compared to the first model. However, as we control for diabetes in (4) model, the estimated parameter of the obese variable changes dramatically and becomes 0.14, which is not statistically significant even at 10% level. In the (7) model, where we control for all health-related variables (chronic heart disease, diabetes, high blood pressure, high cholesterol, and physical limit), then surprising the estimated partial effect of obesity becomes negative (-0.15), and it is statistically significant at 10% level. This means that holding other variables fixed, obese elderly utilizes health care services 15% less than normal weight elderly. This is also true for overweight in the (7) model, but the estimated partial effect is a bit different (-0.18), and it is significant at 5% level. In the (8) model, where we control for all existing chosen variables, the estimated parameter of the obese variable is equal to -0.13, and it is now statistically insignificant. However, in this model, the estimated parameter of the overweight variable is equal to -0.16, and it remains statistically significant at 5% level. This means that overweight elderly spends 16% less on health care than normal weight elderly holding all other variables fixed.

VI. Conclusion

In summary, we discovered that if we do not control for disease and health related variables in the regression model, then the estimated partial effect of obesity is going to be positive and statistically significant as expected. However, if we start including those variables in the regression equation, the estimated parameter of obesity drastically changes and even becomes negative and at the same time statistically significant. So, we might conclude that the partial effect of obesity on health care expenditure is close to being negligible if all or some chosen control variables are included and what actually serve as major contributing factors to the increase in total health care expenditure are health problems such as having physical limit, high blood pressure and high cholesterol, and diseases such as chronic heart disease and diabetes.

However, our analysis might be biased because we did not control for other possibly important variables outside of the dataset, which might affect both obesity and total expenditure. Also controlling for health problems such as high blood pressure and high cholesterol, and also diabetes might not be very appropriate because there is some research evidence that shows that obesity plays one of the key roles in determining whether a person will get diabetes and health problems mentioned earlier, and thus controlling for those variables might not be reasonable when we consider the ceteris paribus interpretation of the estimated coefficients in a regression model. So actually, our models (2) and (3), which are without those control variables, might capture the real effect of obesity, and in that case, we can say that there is considerably large positive effect of obesity on health care utilization and spending. Thus, to stop at one definitive answer, further research exploring the relationship of obesity, health problems, and diabetes is necessary.

VII. References

1. Thompson D, Brown JB, Nichols GA, Elmer PJ, Oster G. 2001. Body mass index and future healthcare costs: a retrospective cohort study. Obes. Res. 9(3):210–18
2. Quesenberry CP Jr, Caan B, Jacobson A. 1998. Obesity, health services use, and health care costs among members of a health maintenance organization. Arch. Intern. Med. 158(5):466–72
3. Sturm R. 2002. The effects of obesity, smoking, and drinking on medical problems and costs. Obesity outranks both smoking and drinking in its deleterious effects on health and health costs. Health Aff. 21:245–53
4. Finkelstein EA, Fiebelkorn IC, Wang G. 2003. National medical spending attributable to overweight and obesity: how much, and who's paying? Health Aff. Suppl. W3-219–26
5. Nørtoft E, Chubb B, Borglykke A. Obesity and healthcare resource utilization: comparative results from the UK and the USA. Obes. Sci. Pract. 2017; **4**: 41– 5
6. Musich, S., MacLeod, S., Bhattarai, G. R., Wang, S. S., Hawkins, K., Bottone, F. G., & Yeh, C. S. (2016). The Impact of Obesity on Health Care Utilization and Expenditures in a Medicare Supplement Population. Gerontology and Geriatric Medicine.
7. Morris, S. (2007). The impact of obesity on employment. Labour Economics, 14(3), 413–433
8. Pagan JA, Davila A. 1997. Obesity, occupational attainment, and earnings. Soc. Sci. Q. 78(3):756–70
9. Haskins K, Ransford HE. 1999. The relationship between weight and career payoffs among women. Sociol. Forum 14(2): 295–318
10. Sarlio-Lahteenkorva S, Lahelma E. 1999. The association of body mass index with social and economic disadvantage in women and men. Int. J. Epidemiol. 28(3):445–49

11. Averett S, Korenman S. 1996. The economic reality of the beauty myth. J. Hum. Resour. 31(2):304–30
12. Mitra A. 2001. Effects of physical attributes on the wages of males and females. Appl. Econ. Lett. 8:731–35
13. Register CA, Williams DR. 1990. Wage effects of obesity among young workers. Soc. Sci. Q. 71(1):130–41
14. Gortmaker SL, Must A, Perrin JM, Sobol AM, Dietz W. 1993. Social and economic consequences of overweight in adolescence and young adulthood. N. Eng. J. Med. 329(14):1008–12
15. Finkelstein EA, Trogdon JG, Cohen JW, Dietz W. Annual medical spending attributable to obesity: payer- and service-specific estimates. *Health Aff (Millwood)* 2009;**28**(5): w822–w831
16. Thorpe KE, Florence CS, Howard DH, Joski P. The impact of obesity on rising medical spending. *Health Aff (Millwood)* 2004: W4–w480
17. Agency for Healthcare Research and Quality. (n.d.). Medical Expenditure Panel Survey Background. https://www.meps.ahrq.gov/mepsweb/about_meps/survey_back.jsp.
18. Centers for Disease Control and Prevention. (2020, September 17). *About Adult BMI*. https://www.cdc.gov/healthyweight/assessing/bmi/adult_bmi/index.html.

VIII. Appendix

Table 1 - Variable Definitions (meps_senior.Rdata)

Variable name	**Definition**
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 in dollars (year 2005)
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)
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

Notes: Refer to this table to see the definitions of all the variables used in the tables below. Total number of observations for each variable in the sample is 2970.

Table 2 – Summary Statistics (Dummy Variables)

Dummy Variables	male	high-bp	high_chol	phy_lim	diabetes	chd	msa
1	41.01 (1218)	67.04 (1991)	52.69 (1565)	38.08 (1131)	20.64 (613)	12.83 (381)	78.18 (2322)
0	58.99 (1752)	32.96 (979)	47.31 (1405)	61.92 (1839)	79.36 (2357)	87.17 (2589)	21.82 (648)

Notes: The values in the first row are the percentages of people who have a particular characteristic, and the second row are the percentage of people who do not have that characteristic. The values in parentheses are exact number of people who have or do not have a particular characteristic.

Table 3 – Summary Statistics (Other Categorical Variables)

Categorical Variables	martial	race_grp	sr_health	mntl_health
1	52.12 (1548)	71.68 (2129)	15.39 (457)	22.32 (663)
2	32.73 (972)	12.83 (381)	26.26 (780)	30.91 (918)
3	11.31 (336)	4.48 (133)	32.02 (951)	34.44 (1023)
4	3.84 (114)	11.01 (327)	18.32 (544)	9.19 (273)
5	___	___	8.01 (238)	3.13 (93)

Notes: The values without parentheses are the percentages of people who belong to a particular group. The values in parentheses are the exact number of people who belong to a particular group.

Table 4 – Summary Statistics (Quantitative Variables)

Variables	Min	25th percentile	Median	Mean	75th percentile	Max
age	65	69	74	74	79	85
income	3	9028	15225	22938	30000	180045
educ	0	10	12	11.55	14	17
bmi	15.10	23.70	26.60	27.37	30.20	70.30
dr_visits	0	3	7	10.34	13	175
hosp_vis	0	0	0	0.2502	0	7
totalexp	1	1732	3935	8358	8839	235392

Table 5 - Average and Median Statistics based on BMI Results

Variables	BMI < 18.5	18.5 ≤ BMI < 25	25 ≤ BMI < 30	BMI ≥ 30
dr_visits	8.32 (5)	9.82 (7)	10.27 (7)	11.22 (8)
hosp_vis	0.45 (0)	0.24 (0)	0.23 (0)	0.27 (0)
totalexp	10963 (5842)	8365 (3827)	7777 (3491)	8970 (4670)

Notes: The values in parentheses are the median values and the values without parentheses are the mean values.

Table 6 – OLS Results. Dependent Variable: log(totalexp)

Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
underweight	0.32 (0.25)	0.31 (0.25)	0.24 (0.25)	0.37 (0.25)	0.29 (0.24)	0.19 (0.24)	0.33 (0.23)	0.35 (0.23)
overweight	-0.02 (0.08)	0.02 (0.08)	-0.05 (0.08)	-0.10 (0.08)	-0.12 (0.08)	-0.10 (0.08)	-0.18** (0.08)	-0.16** (0.08)
obese	0.34*** (0.09)	0.35*** (0.09)	0.31*** (0.09)	0.14 (0.09)	0.12 (0.09)	0.02 (0.09)	-0.15* (0.08)	-0.13 (0.08)
chd			1.11*** (0.10)		1.03*** (0.10)	0.93*** (0.10)	0.65*** (0.10)	0.68*** (0.10)
diabetes				0.95*** (0.09)	0.89*** (0.08)	0.78*** (0.08)	0.58*** (0.08)	0.60*** (0.08)
high_bp							0.70*** (0.07)	0.69*** (0.07)
high_chol							0.68*** (0.07)	0.67*** (0.07)
phy_lim						0.85*** (0.07)	0.80*** (0.07)	0.79*** (0.07)
log(income)		0.05* (0.03)						0.08*** (0.02)
male		-0.28*** (0.07)						-0.16** (0.07)
Constant	7.95*** (0.06)	7.56*** (0.26)	7.83*** (0.06)	7.84*** (0.06)	7.73*** (0.06)	7.47*** (0.06)	6.81*** (0.07)	6.15*** (0.25)
Observations	2970	2970	2970	2970	2970	2970	2970	2970
Adjusted R^2	0.006	0.011	0.043	0.045	0.077	0.122	0.189	0.192

Notes: underweight **:** BMI < 18.5; normal weight (base group): 18.5 ≤ BMI < 25; overweight: 25 ≤ BMI < 30; obese: BMI ≥ 30. The quantities below the estimates are the standard errors.
*** p< 0.01, ** p < 0.05, * p < 0.1