


# The Impact of Obesity on Health Care Utilization and Expenditures in a Medicare Supplement Population

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## Abstract

**Objective:** Obesity is a contributor to increased chronic conditions resulting in higher utilization of medical services among broad populations of older adults. The objective of this study was to evaluate the magnitude of the impact of weight on health care use patterns among Medicare Supplement insureds. **Method:** We estimated the impact of weight as a function of body mass index (BMI) on health care utilization and expenditures using propensity weighted multivariate regression models. The outcomes were controlled initially for demographics and socioeconomics and then additionally for chronic conditions and health status. **Results:** Among the 9,484 survey respondents, 22.9% were obese. 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. The excess utilization and expenditures associated with obesity were explained by chronic conditions and poor health status. **Conclusion:** Obesity-related expenditures associated with medical management are largely preventable and may benefit from interventions that target lifestyle behaviors and weight management among older adults.

## Keywords

obesity, older adults, health care utilization, health care expenditures, Medicare Supplement

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## Introduction

Obesity is a growing problem within the United States, steadily increasing since the 1990s across all subgroups including among older adults. Obesity rates for Medicare beneficiaries aged 65 years and older were estimated at 13% in the early 1990s (Luchsinger, Lee, Carrasquillo, Rabinowitz, & Shea, 2003) and at 15% between 1992 and 2001 (Yang & Hall, 2008), with other more recent studies indicating that obesity rates have increased from 21% (1997) to 29% (2006) and may be as high as 35% (2007-2010; Alley, Lloyd, Shaffer, & Stuart, 2012; Bell, Zimmerman, Arterburn, & Maciejewski, 2011; Bottone et al., 2014; Fakhouri, Ogden, Carroll, Kit, & Flegal, 2012; Flegal, Carroll, Kit, & Ogden, 2012; Pearson, Bhat-Schelbert, Ford, & Mokdad, 2009; Stuart, Lloyd, Zhao, & Kamal-Bahl, 2008; Wilkins, Rust, & Sambamoorthi, 2012). Obesity appears to compromise longevity, with fewer obese above 75 years of age and a higher prevalence among those aged 60 to 74 years (Flegal et al., 2012; Luchsinger et al., 2003; Ogden et al., 2006).

Obesity is a risk factor for a variety of both physical and mental chronic conditions, including arthritis, cancer, depression, diabetes, heart disease, hyperlipidemia, hypertension, and stroke (Malnick & Knobler, 2006; Mehrotra, Remington, Naimi, Washington, & Miller, 2005; Must et al., 1999; Stuart et al., 2008; Vulcano, Lee, Yamany, Lyman, & Della Valle, 2013). Multiple chronic physical conditions can lead to an earlier functional decline and reduced mobility, potentially affecting common activities of daily living (ADLs), such as bathing, dressing, or walking (Nafiu et al., 2011; Schafer & Ferraro, 2007; Zacharias et al., 2005). Depression is also more prevalent among obese older adults than among

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their normal-weight peers, often associated with reduced mobility and functional abilities (Anderson, Wiener, Khatutsky, & Armour, 2013). Consequently, obesity affects quality of life among older adults (Bottone et al., 2014; Giuli et al., 2014).

Obesity and related chronic conditions have been associated with increased inpatient admissions and utilization of other medical services (Alley et al., 2012; Callahan, Stump, Stroupe, & Tierney, 1998; Stuart et al., 2008). Orthopedic procedures are more common among obese older adults compared with those of normal weight; increased weight often associated with osteoarthritis and a higher prevalence of orthopedic replacement procedures (Mehrotra et al., 2005; Vulcano et al., 2013). In addition, obese individuals are at a higher risk of a variety of medical complications, longer hospital stays, and post-surgical issues related to increased weight (Kalanithi, Arrigo, & Boakye, 2012; Kelz et al., 2013; Kurtz et al., 2012; Maradit Kremers, Visscher, Kremers, Naessens, & Lewallen, 2014; Reinke et al., 2012; Silber et al., 2012). Several studies have also linked higher prescription drug utilization among Medicare populations with chronic conditions related to obesity, such as diabetes, hypertension, heart disease, and arthritis (Stuart et al., 2008).

Continued gains in life expectancy (Jacobsen, Mather, Lee, & Kent, 2011) have led to increased health care expenditures as older obese adults live longer with their chronic conditions. In one study, it was estimated that US\$1,723 in excess medical and pharmacy expenditures could be attributed to obesity among Medicare beneficiaries, with most of these obesity-related costs paid by Medicare (Finkelstein, Trogon, Cohen, & Dietz, 2009). This spending attribution model predicted that obese older individuals cost Medicare an estimated 8.5% more than normal-weight individuals, with the greatest obesity-related costs (15.2%) going toward pharmaceutical utilization (Finkelstein et al., 2009).

Few research studies have focused exclusively on older adults (65 years and older) and the relationship between weight, chronic conditions, and health care utilization and expenditures. Furthermore, we found no studies investigating the relationship between weight and the use of medical services among older adults with Medicare Supplement plans (i.e., Medigap). In the United States, adults 65 years and older are eligible for a government-funded Medicare system covering about 80% of medical expenditures; prescription drug expenditures are not covered by Medicare. Consequently, about 90% with fee-for-service Medicare coverage (about 77% of all Medicare beneficiaries) have some type of supplemental insurance coverage or prescription drug coverage to reduce or eliminate patient copayments. Of these, about 10.2 million (28%) have purchased a Medigap plan (Kaiser Family Foundation, 2013). We hypothesize that patient demographics, health status, and benefit levels likely differ by Medigap plan type and, therefore, may affect prevalence of obesity and related health care utilization and expenditures.

## Statement of Purpose

In the present study, we estimated the magnitude of the impact of weight, as a function of body mass index (BMI) calculated from self-reported weight and height, on health care utilization (i.e., inpatient admissions, emergency room [ER] visits, and orthopedic procedures) and expenditures including medical and pharmacy claims in a group of older adults with Medicare Supplement plans. We used two regression models to estimate the impact of health status on the use of medical services associated with weight. In a partial model, we adjusted for demographics and socioeconomic, and in a second full model, we added health status variables including self-reported treated chronic conditions, ADLs, general physical/mental health, and smoking.

## Method

### Study Population

In 2013, approximately 3.5 million of those Medicare insureds were covered by an AARP® Medicare Supplement plan insured by UnitedHealthcare Insurance Company (for New York residents, UnitedHealthcare Insurance Company of New York). These plans are offered in all 50 states, Washington, D.C., and various U.S. territories. In the present study, between 2009 and 2011, we surveyed a random sample of 53,286 insured adults living in 10 states (Arizona, California, Colorado, Florida, Missouri, North Carolina, New Jersey, New York, Ohio, and Texas). Those surveyed were 65 years or older at the time of survey distribution and were required to have had a minimum of 3 months of AARP Medicare Supplement plan eligibility.

To be included in this study, survey respondents were additionally required to have had a minimum of 3 months continuous enrollment in AARP Medicare Supplement plans prior to the survey, a minimum of 1 month of plan enrollment after the survey, and to have AARP Medicare Part D prescription drug coverage. Qualified surveys were then linked to medical and pharmacy claims to estimate health care utilization of medical services (i.e., inpatient admissions, ER visits, and orthopedic procedures) and health care expenditures adjusted to 2012 dollars. Health care expenditures included medical and pharmacy claims paid by the patient, as well as Medicare, Medicare Supplement, and Medicare Part D plans. Inpatient admissions and ER visits were defined from place of service; orthopedic procedures were defined from diagnosis codes as any procedure of the back, hip, shoulder, and/or knee including both inpatient admissions and outpatient procedures (e.g., steroid injections for pain management). Medical utilization was defined as any inpatient, ER visit, or orthopedic procedure within the next 12 months post survey date. Because weight categories are a focus of this study, those without height and weight information from the survey

response were excluded from the analysis. The final study population included 9,484 survey respondents.

### **Consumer Assessment of Health Care Providers and Systems (CAHPS) Survey**

A modified version of the CAHPS survey was utilized as the basis of our survey. The CAHPS survey, funded and overseen by the U.S. Agency for Healthcare Research and Quality (AHRQ), queries patients and health care consumers to report on and evaluate their experiences and satisfaction with Medicare delivery systems, including physicians, health plans, and supplemental health plans. The survey has become the national standard for measuring and reporting on patient experiences and satisfaction with quality of medical delivery. To learn more about the health issues of AARP Medicare Supplement insureds, we began administering a modified version of the survey including additional questions relevant to current and evolving research agendas (e.g., satisfaction with AARP Medicare Supplement plans, AARP website, and AARP Nurse Healthline services; utilization of advance directives; and screening for health literacy).

### **Covariates**

Covariates were included to adjust for factors that may have influenced health care utilization and/or expenditures across the weight categories. Demographic and socioeconomic questions on the survey included age, gender, race, living arrangements, and education level. Health status variables from the survey included calculated BMI, self-reported physical and mental health, as well as smoking status. Four standard BMI weight categories were defined: underweight (BMI at or below 18.5), normal weight (BMI = 18.6-24.9), overweight (BMI = 25-29.9), and obese (BMI = 30 or greater; National Heart, Lung, and Blood Institute [NHLBI], & Obesity Task Force, 1998). Insufficient numbers (<2% morbidly obese) were available to analyze by obesity class (i.e., obesity classes I-III). Modified Katz Activities of Daily Living (ADLs; difficulties with bathing, dressing, eating, transferring in and out of a chair, walking, and using the toilet) were assessed as a measure of disability. ADL disabilities requiring assistance were categorized as none, one, two or three, or more. The survey also included a question on whether the person needed help to complete the survey and an assessment of confidence in getting necessary medical care, both of which could be considered proxies for health literacy and/or health condition (e.g., disability). Treatment for common health conditions were self-reported on the survey (e.g., diabetes, hypertension, and respiratory disorders). See Table 1 for the full list of chronic conditions. Information on income levels (low, medium low, medium high, and high) and location (metropolitan and other) were coded from zip codes.

### **Statistical Methods**

*Adjusting for survey non-response and/or Medicare Part D coverage bias.* Differences in characteristics between survey respondents and non-respondents and/or enrolling in AARP Medicare Part D coverage could introduce a bias into the study sample, limiting the generalizability of the results. To adjust the results to the broader AARP Medicare Supplement insured population, a two-stage propensity weight adjustment was utilized. First, a logistic model computed the propensity to respond to the survey based on attributes of both respondents and non-respondents. The propensity weight, which was the inverse of the probability of survey response, was estimated for non-response adjustment. In the second stage, a separate propensity weight was derived to adjust for enrollment in AARP Medicare Part D coverage. The enrollment propensity weight was computed similarly to reflect the attributes of those with AARP Medicare Part D coverage. In the last step, the final propensity weight was obtained by multiplying the separate propensity weights together (Yansaneh, 2003).

*Estimating medical utilization across weight categories.* Propensity weighted multivariate logistic regression models were used to evaluate health care utilization (i.e., inpatient admissions, ER visits, and orthopedic procedures) across the weight categories. To estimate the independent impact of each weight category on health care utilization, weight categories were used as independent variables in a propensity weighted logistic regression model for each of the utilization outcome variables: inpatient admissions, ER visits, and orthopedic procedures. We ran separate models to assess the impact of health status across weight categories on these outcomes. The logistic regression models were run initially controlling for demographics and socioeconomics (partial model), and then additionally controlling for health status including treated chronic conditions listed in Table 1 and all other health and functional status variables (i.e., ADLs, general physical and mental health, and smoking; full model).

*Estimating health care expenditures across weight categories.* Exponential conditional mean (ECM) models were used to estimate the independent impact of each weight category on total health care expenditures, similar to that reported elsewhere (Berndt et al., 2005; Orsini, Rousculp, Long, & Wang, 2005). Similar to the utilization models, the expenditure models were run initially controlling for demographics and socioeconomics (partial model), and then additionally controlling for treated chronic conditions in Table 1 and additional health and functional status variables (i.e., ADLs, general physical and mental health and smoking; full model).

## **Results**

### **Sample Characteristics**

The demographic, socioeconomic, and health status characteristics of the eligible survey respondents are

**Table 1.** Unadjusted Descriptive Characteristics of the Total Study Population and by Weight Categories.

	Total study sample	Underweight	Normal	Overweight	Obese	p
Number of respondents (n)	9,484	256	3,549	3,502	2,177	
Gender (%)						
Male	37.7	18.8	30.4	45.8	38.8	<.0001
Female	62.3	81.3	69.6	54.2	61.2	
Age group (%)						
65-69	20.1	10.2	15.9	20.2	27.7	<.0001
70-74	26.3	20.7	23.1	27.2	30.8	
75-79	18.6	14.1	17.7	19.5	19.0	
80-84	17.5	24.6	18.6	17.7	14.5	
85 plus	17.6	30.5	24.7	15.4	8.0	
Average age (years)	76.6	80.2	78.2	76.3	74.4	<.0001
Income <sup>a</sup> (%)						
High	49.8	47.7	51.4	50.0	47.3	.08
Upper medium	23.0	24.2	22.9	22.6	23.6	
Lower medium	15.1	18.8	14.2	15.0	16.2	
Low or missing	12.1	9.4	11.5	12.4	12.9	
Location <sup>a</sup> (%)						
Metro	91.2	92.2	91.4	91.2	90.8	.81
Race (%)						
White	92.6	89.1	92.1	92.8	93.7	<.0001
Education attainment (%)						
High school graduate	38.6	41.8	36.9	37.9	42.0	<.0001
Some college	28.0	28.1	27.6	27.3	29.8	
Four or more years college	32.6	29.3	34.6	33.9	27.5	
Living arrangement (%)						
Personal home	93.0	87.1	92.0	94.0	93.6	<.0001
Need help to complete survey (%)						
Yes	8.8	16.0	9.3	7.7	9.1	<.0001
Treated comorbidities (%)						
Any cancer	5.9	7.8	5.6	5.9	6.1	.47
Arthritis of a joint	20.1	16.4	16.9	18.9	27.6	<.0001
Breathing or lung problems	11.5	17.6	11.1	10.1	13.7	<.0001
Depression	7.9	9.0	6.9	7.4	10.3	<.0001
Diabetes	14.5	5.1	8.3	13.7	26.8	<.0001
Digestive or bowel problems	7.1	10.6	7.7	6.3	7.1	.02
High blood pressure	53.2	38.7	45.5	54.0	66.1	<.0001
Heart problems	20.6	24.6	19.3	19.9	23.2	<.0001
Low back pain	11.8	9.0	11.0	10.5	15.8	<.0001
Osteoporosis	11.6	18.8	15.3	9.5	7.9	<.0001
Stroke	1.9	2.3	1.9	1.8	2.1%	.80
General physical health (%)						
Excellent	8.3	5.1	11.3	8.3	4.0	<.0001
Very good	31.9	27.7	34.5	34.4	23.9	
Good	38.1	33.6	34.0	39.1	43.8	
Fair/poor	18.0	29.3	16.4	14.8	24.8	
General mental health (%)						
Excellent	31.4	26.6	31.8	32.6	29.5	<.0001
Very good	35.2	28.1	33.5	38.2	33.9	
Good	23.3	30.5	23.3	20.9	26.6	
Fair/poor	7.0	10.9	7.9	5.5	7.2	
Number of ADLs requiring assistance (%)						
0 ADLs	59.8	51.2	64.7	63.8	46.2	<.0001
1 ADL	13.0	12.1	11.6	12.3	16.5	
2 ADLs	10.1	9.4	7.6	9.1	15.8	
3 or more ADLs	12.4	20.3	11.2	10.5	16.7	
Smoke cigarettes (%)						
Every day/some days	5.2	10.9	6.0	4.6	4.3	<.0001

Note. The analysis was also controlled for year surveyed, state of residence, additional medical coverage, visits to personal doctor, medication non-adherence due to finances, and a proxy for health literacy. Digestive or bowel problems included Crohn's disease or inflammatory bowel disease. Breathing or lung problems included emphysema, asthma, or chronic obstructive pulmonary disease. Heart problems included chest pain or coronary artery disease, congestive heart failure, heart attack, weak heart, or other heart conditions. Missing response rows were deleted to simplify the table thus frequencies may not add to 100%. Individuals may have had multiple treated comorbidities. ADL = activity of daily living.

<sup>a</sup>Geocoded from participant's zip code.



detailed in Table 1. The 20,044 respondents to the survey resulted in a response rate of 37.6%. After eligibility criteria for minimum AARP Medicare Supplement plan and AARP Part D prescription drug coverage were applied, 9,484 (47.3%) of the surveys were used in the analysis. Respondents were primarily female, White, living in a metropolitan area, highly educated, and 70 to 74 years of age (Table 1). The most common comorbid condition among the study population was high blood pressure, followed by arthritis of a joint, diabetes, and low back pain, all of which are often comorbid with excess weight.

The weight category distribution for respondents included 2.7% underweight, 37.4% normal weight, 36.9% overweight, and 22.9% obese. The strongest associations between specific conditions and weight categories were for hypertension, arthritis, diabetes, and low back pain, all of which increased with increasing weight. Osteoporosis, however, was inversely associated with increasing weight. In contrast, depression and ADLs showed a U-shaped association with higher prevalence among underweight, then increasing with increasing weight from normal to obese categories. The obese group was younger relative to the normal-weight group, with mean ages of 74.4 and 78.2 years, respectively. Relative to normal-weight respondents, those in the obese category were less likely to report excellent or very good general physical health and more likely to have problems performing ADLs.

### Health Care Services Utilization

Considering health care utilization, obese respondents were more likely to have an inpatient admission (odds ratio [OR] = 1.15,  $p < .0001$ ) or an orthopedic procedure (i.e., procedure of the back, hip, shoulder, and/or knee; OR = 1.30,  $p < .0001$ ) than those at normal weight (Table 2). However, they were no more likely than normal-weight respondents to have an ER visit (OR = 1.02,  $p = .48$ ). When results were additionally controlled for chronic conditions and health/functional status, obesity no longer significantly predicted higher inpatient utilization ( $p = .58$ ); however, orthopedic procedures remained highly significant among obese respondents ( $p < .0001$ ).

Although the focus of this study is on obesity, it is notable that the underweight group exhibited a somewhat different utilization pattern. Underweight respondents were more likely to have inpatient admissions (OR = 1.38,  $p < .0001$ ) and ER visits (OR = 1.22,  $p = .001$ ), but less likely to have orthopedic procedures (OR = 0.63,  $p < .0001$ ). Controlling for additional health status variables had little impact on the underweight utilization measures.

**Health care expenditures across weight categories.** Compared with the normal-weight category, annualized health care expenditures were US\$1,496 greater (US\$18,914 vs.

US\$17,418) for those in the obese weight category ( $p = .03$ ) controlling for demographics and socioeconomic (Table 3). Annualized health care expenditures for the underweight category were higher (US\$1,907; US\$19,325 vs. US\$17,418) but not statistically significant ( $p = .18$ ), possibly due to the small sample size of the underweight group. Controlling for chronic conditions and health/functional status resulted in health care expenditures that were not significantly higher for those in the obese weight category ( $p = .93$ ). Thus, obesity-related excess costs were explained primarily by expenditures associated with managing comorbid chronic conditions. Likewise, expenditures for the underweight group controlled for health status were reduced to normal-weight levels ( $p = 1.00$ ), supporting the notion that although utilization patterns were somewhat different for the underweight, the excess costs were explained by health status differences.

### Discussion

In our study population of AARP Medicare Supplement insureds, the prevalence of obesity in 2009 to 2011 was 22.9%. These results are somewhat lower than obesity estimates for general Medicare populations without Medicare Supplement coverage. The Medicare Current Beneficiary Survey (MCBS) data placed the obesity rate among Medicare beneficiaries aged 65 years and older at 29% in 2006 (Alley et al., 2012) with 2007 to 2010 estimates as high as 35% for adults aged 65 years and older (Fakhouri et al., 2012). The higher education and socioeconomic status of Medicare Supplement insureds may partially explain these differences (about 50% were categorized as high income; Table 1).

Similar to other studies of obesity among older adults, our obese population was characterized by more chronic conditions and disabilities: rates among obese adults with high blood pressure, arthritis, diabetes, and depression of 66.1%, 27.6%, 26.8%, and 10.3% compared with normal-weight rates of 45.5%, 16.9%, 8.3%, and 6.9%, respectively. Obese adults were also significantly younger at 74.4 years compared with 78.2 years for those of normal weight. In addition, fewer obese respondents reported very good to excellent mental or physical health and significantly more ADL disabilities. Other studies have reported similar results for hypertension, diabetes, and arthritis (Stuart et al., 2008; Vulcano et al., 2013). Depression rates in our study were similar to those reported in the literature for older obese adults (Centers for Disease Control and Prevention, 2005-2006; Simon et al., 2006; Zhao et al., 2011). Elsewhere, age distributions across the weight categories indicated that obesity compromises longevity (Villareal, Apovian, Kushner, & Klein, 2005; Vulcano et al., 2013).

Obese AARP Medicare Supplement insureds had significantly increased inpatient admissions and orthopedic procedures. These results were similar to other research studies, including Luchsinger et al. (2003), who reported

**Table 2.** Effect of Weight Categories on Health Care Utilization Using Propensity Weighted Adjusted Logistic Regression Models: (A) Partial Model and (B) Full Model.

At least one utilization in the last 12 months	Weight category	Odds ratio	95% CI	<i>p</i>
<b>(A) Partial model controlling for demographics and socioeconomics</b>				
Any inpatient admissions	Underweight	1.38	[1.220, 1.556]	<.0001
	Normal weight	1.00		n/a
	Overweight	0.97	[0.928, 1.022]	.28
	Obese	1.15	[1.079, 1.225]	<.0001
Any ER visits	Underweight	1.22	(1.084, 1.377)	.001
	Normal weight	1.00		n/a
	Overweight	0.91	[0.865, 0.949]	<.0001
	Obese	1.02	[0.961, 1.089]	.48
Any orthopedic procedure	Underweight	0.63	[0.548, 0.717]	<.0001
	Normal weight	1.00		n/a
	Overweight	1.16	[1.111, 1.214]	<.0001
	Obese	1.30	[1.230, 1.380]	<.0001
<b>(B) Full model additionally controlling for comorbidity, health/functional status</b>				
Any inpatient admissions	Underweight	1.27	[1.124, 1.443]	<.0001
	Normal weight	1.00		n/a
	Overweight	1.01	[0.961, 1.061]	.69
	Obese	1.02	[0.954, 1.087]	.58
Any ER visits	Underweight	1.12	[0.987, 1.262]	.08
	Normal weight	1.00		n/a
	Overweight	0.93	[0.888, 0.977]	.004
	Obese	0.93	[0.871, 0.991]	.03
Any orthopedic procedure	Underweight	0.63	[0.546, 0.721]	<.0001
	Normal weight	1.00		n/a
	Overweight	1.20	[1.143, 1.252]	<.0001
	Obese	1.23	[1.153, 1.301]	<.0001

Note. Normal weight is the reference category. Model (A) controls for demographic and socioeconomic variables and Model (B) additionally includes self-reported chronic conditions, self-reported perception of physical and mental health ADLs and smoking status. A full list of variables included is given in Table 1. CI = confidence interval; n/a = not applicable; ER = emergency room; ADL = activities of daily living.

that moderate to severe obesity (BMI  $\geq 35$ ) significantly increased hospitalization rates (OR = 1.50). This compares with our results of significantly increased inpatient admissions among those with BMI  $\geq 30$  (OR = 1.15). These authors also indicated that the excess hospitalizations were related to inpatient admissions associated with cardiovascular disease, parallel to our results that showed when we controlled for chronic conditions and health/functional status, the differences disappeared. For orthopedic utilization related to obesity, however, the increase of the likelihood of procedures remained, indicating a more diverse pattern of causation. Other studies have indicated that obese patients comprise a disproportionately large percentage of those with orthopedic joint replacement surgeries (Bostman, 1994).

Excess utilization of health care services resulted in higher health care expenditures among obese AARP Medicare Supplement insureds. Prior to adjusting for chronic conditions and health/function status, the average annualized total expenditures incurred by these obese older adults were US\$1,496 or 8.5% higher than those in the normal-weight category. These results are

consistent with prior research findings that a higher prevalence of chronic conditions related to obesity drives higher expenditures among obese Medicare members (Alley et al., 2012). Finkelstein et al. (2009) also estimated 8.5% of health care and pharmacy expenditures to be attributable to obesity among Medicare beneficiaries.

Elsewhere, Lakdawalla, Goldman, and Shang (2005) reported that obese 70-year-olds spent, on average, US\$7,503 on health care compared with the US\$6,899 spent by those at a normal weight—a difference in 2005 of about US\$904, which is within range of our expenditure estimate of US\$1,496 associated with obesity. Our results are also consistent with previous obesity research that these higher expenditures are driven primarily by the chronic conditions that often occur with increasing weight (Stuart et al., 2008). At an individual level, a 2006 study estimated medical and pharmacy spending at US\$1,723 higher among the obese than those of normal weight for Medicare beneficiaries (Finkelstein et al., 2009)—slightly higher than our estimates but in line with an expectation of differences in health status that

**Table 3.** Annualized Health Care Expenditures by Weight Categories Estimated Using Propensity Weighted Adjusted ECM Regression Models: (A) Partial Model and (B) Full Model.

Weight categories	Annualized health care expenditures (in US\$)	95% CI	Cost difference from normal weight (in US\$)	<i>p</i>
(A) Partial model controlling for demographics and socioeconomic				
Underweight	19,325	[US\$15,810, US\$23,606]	1,907	.18
Normal weight	17,418	[US\$15,149, US\$20,020]	n/a	n/a
Overweight	16,856	[US\$14,646, US\$19,392]	-563	.25
Obese	18,914	[US\$16,299, US\$21,938]	1,496	.03
(B) Full model additionally controlling for comorbidity, health/functional status				
Underweight	18,409	[US\$14,737, US\$23,017]	814	1.00
Normal weight	17,595	[US\$14,800, US\$20,944]	n/a	n/a
Overweight	17,425	[US\$14,648, US\$20,757]	-169	.71
Obese	17,751	[US\$14,828, US\$21,275]	157	.93

Note. Normal weight is the reference category. Model (A) controls for demographic and socioeconomic variables and Model (B) additionally includes self-reported chronic conditions, self-reported perception of physical and mental health ADLs, and smoking status. A full list of variables included is given in Table 1. ECM = exponential conditional mean; CI = confidence interval; n/a = not applicable; ADL = activity of daily living.

may be associated with the Medicare Supplement population (i.e., improved health status with higher socioeconomic status). Overall, the increased expenditures associated with obesity in this subgroup of AARP Medicare Supplement insureds could amount to US\$1.2 billion in excess health care expenditure dollars.

Obesity-related chronic conditions are largely preventable and should be amenable to prevention strategies and programs. Broader prevention programs designed to address lifestyle behaviors and prevention are warranted among older adults but have received little attention. Several research studies have demonstrated the positive combined effects of moderate weight loss and physical activity on mobility, weight management, physical function, and quality of life in obese older adults (Bouchonville et al., 2014; Han, Tajar, & Lean, 2011; Nguyen et al., 2008; Rejeski, Marsh, Chmelo, & Rejeski, 2010). Utilizing these findings, UnitedHealthcare and AARP Services, Inc. (ASI) have launched a joint pilot program targeting telephonic health coaching, community activities, online support, and access to gyms to promote healthy behaviors among older adults. Alternatively, the Medicare-funded annual wellness visits designed to help members develop personalized prevention plans with their providers may be a good option for implementing a broader population-based health management approach among obese older adults (Hain, 2014); however, low implementation rates have been problematic from both patient and physician perspectives (Chung et al., 2015).

## Limitations

As in other obesity studies, reliance upon self-reported height and weight data may underestimate BMI (Gorber, Tremblay, Moher, & Gorber, 2007). However, the use of

BMI is sufficiently accurate to categorize individuals into the appropriate weight categories (Fakhouri et al., 2012; Flegal et al., 2012). The slightly higher rate of obesity at 29% in 2006 reported by Alley et al. (2012) or 35% in 2007 to 2010 by Fakhouri et al. (2012) than that reported here (22.9%) can potentially be explained by the fact that our population is somewhat healthier and of higher socioeconomic status than the general Medicare population (Bottone et al., 2013).

Although we utilized propensity weighting for survey non-response bias and AARP Part D pharmacy coverage, other limitations include the relatively low response rate of this study and self-reported treatment for chronic conditions. In addition, the study sample consisted only of beneficiaries 65 years of age or older enrolled in an AARP Medicare Supplement plan and AARP Medicare Part D prescription drug plan. Thus, the sample may not be generalizable to all Medicare enrollees.

## Conclusion

Although obesity rates in our AARP Medicare Supplement study sample were somewhat lower than overall Medicare populations, the obese individuals were characterized by more chronic conditions and significantly higher health care utilization and expenditures than their normal-weight counterparts. The higher utilization of medical services associated with obesity leads to largely preventable costs primarily associated with the management and treatment of chronic conditions related to obesity. Although the detrimental impact of obesity on health has been well established, few viable preventive strategies or programmatic solutions exist for older adults. Further emphasis on health management for obese older adults, targeting lifestyle behaviors and

weight management, may be warranted to help reduce costs for the individual as well as for Medicare.

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