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Age Differences in the Association Between Body Mass Index Class and Annualized Medicare Expenditures

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Abstract

Objective—The aim of the study is to assess the relationship between body mass index (BMI) class and Medicare claims among young-old (65–69), old (70–74), and old-old (75+) adults over a 10-year period.

Method—We assessed costs by BMI class and age group among 9,300 respondents to the 1998 Health and Retirement Study (HRS) with linked 1998–2008 Medicare claims data. BMI was classified as normal (18.5–24.9), overweight (25–29.9), mild obesity (30–34.9), or severe obesity (35 or above).

Results—Annualized total Medicare claims adjusted for age, gender, ethnicity, education, and smoking history were 109% greater for severely obese young-old adults in comparison with normal weight young-old adults (US$9,751 vs. US$4,663). Total annualized claim differences between the normal weight and severely obese in the old and old-old groups were not statistically significant.

Discussion—Excess Medicare expenditures related to obesity may be concentrated among severely obese young-old adults. Preventing severe obesity among middle and older aged adults may have large cost implications for society.

Keywords

obesity; older adults; expenditures; Medicare

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Introduction

Over the past several decades, obesity prevalence has increased in older adults (Flegal, Carroll, Kit, & Ogden, 2012). In 2011–2012, about 35.4% of men and women aged 60 years or older in the United States were obese (Fakhouri, Ogden, Carroll, Kit, & Flegal, 2012) and about 14% were severely obese (Ogden, Carroll, Kit, & Flegal, 2014). Obesity among older adults increased significantly from 2001 to 2011 (Ogden et al., 2014). This is an alarming trend as the total number of older adults will more than double by 2050 (Vincent & Velkoff, 2010).

While data indicate positive associations between body mass index (BMI; a proxy for estimating percentage of body fat) and chronic disease and disability in older adults (Decaria, Sharp, & Petrella, 2012), data regarding the association between BMI and Medicare expenditures are less clear. Data on spending as self-reported by Medicare Expenditure Panel Survey (MEPS) respondents showed that obese older adults had annual Medicare expenditures that were 37% more than normal weight older adults in 2006 (Finkelstein, Trogdon, Cohen, & Dietz, 2009). However, examinations of participants in the Medicare Current Beneficiaries Survey found that Medicare expenditures were in fact *lower* for overweight and obese older adults in the years 1997 through 2003 and no different from 2004 through 2006 (D. Alley, Lloyd, Shaffer, & Stuart, 2012; Sing, Banthin, Selden, Cowan, & Keehan, 2006). Each of these reports has treated older adults as one age group.

For the current report, we used Medicare claims data linked to the Health and Retirement Study (HRS) data to explore the relationship between BMI and annualized 10-year Medicare claims (1998–2008) in respondents aged 65 to 69, 70 to 74, and 75 or older at their 1998 HRS interview. Using expenditures data adjusted for demographic, education, and chronic disease covariates, we evaluated whether total and subcategory claim differences across BMI classes were statistically significant in each age group.

Method

Sample

The HRS is an ongoing nationally representative study of adults aged 50 years or older in the United States. The sample is constructed from a multistage national area probability sample with oversamples of Black and Hispanic persons and residents of Florida. Data are collected either in-home or by telephone interview and for those who cannot respond for themselves, a proxy respondent may be interviewed. For the analyses reported here, we selected HRS respondents who were 65 years or older at their 1998 interview. We categorized age at 1998 interview into three groups: 65 to 69, 70 to 74, and 75 or older. We refer to these age groups as young-old, old, and old-old, respectively. The Institutional Review Board of Indiana University–Purdue University Indianapolis approved the study protocol. Sampling weights were used in all analyses. Analyses were completed in 2014.

Medicare Claims

Data on Medicare claims for HRS respondents were provided by the Centers for Medicare and Medicaid Services (CMS). Data were matched using a “link” file provided by the HRS team. A match was available for 89.0%, 91.6%, and 92.9% of the 65 to 69, 70 to 74, and 75 or older age groups, respectively. BMI did not differ significantly between respondents with and without a match for any age group. We added claim values across years the respondent was alive for even 1 day of that year and divided by the number of years in our 10-year observation period that the respondent was alive. In all years, we used the dollars CMS actually paid for the claim. Table 1 provides final sample sizes by age group and BMI class available for our analyses.

BMI

BMI was calculated as the ratio of body weight (kilograms) to the square of height (meters) according to World Health Organization (WHO; 1995) guidelines. We used 1998 self-report height and weight to create normal (18.5–24.9), overweight (25–29.9), Obese I (30–34.9), and Obese II or III (35 or over) BMI classes. We refer to Obese I and Obese II/III as mild obesity and severe obesity, respectively. Due to our interest in the relationship between obesity and Medicare costs, we excluded 399 respondents with a BMI of less than 18.5 (i.e., underweight). Among these 399 respondents, 74.4% were in the 75 or older age group.

Covariates

Covariates were selected for availability in the HRS and literature indicating an association with both BMI and health care use. These included age, sex, minority ethnicity, ever smoked, years of education, and chronic illness. Eight chronic illnesses were queried in the HRS using the question stem, “Has you doctor ever told you that you have …”

Data Analyses

Demographic and clinical characteristics were stratified by age groups (young-old: 65–69 years; old: 70–74 years; and old-old: 75 or older) and by weight categories (normal weight: $18.5 \leq BMI \leq 24.9$; overweight: $25 \leq BMI \leq 29.9$; mild obesity: $30 \leq BMI \leq 34.9$; severe obesity: $BMI \geq 35$). Within each age group, we compared characteristics of respondents in the overweight and mild and severely obese categories with the corresponding characteristic of respondents in the normal weight category. Continuous variables were summarized by means and standard deviations and were compared using ANOVA F test; binary variables were reported as percentages and compared using logistic regression analysis. To account for the potential inflation of Type 1 error rate due to multiple testing, we used Dunnett’s adjustment (Hsu, 1999). We used log-rank tests to compare rates of survival across BMI classes within each age group. We used the LOcal regrESSion (LOESS) method to examine the level of annualized total Medicare cost as a smooth function of baseline BMI, which allowed us to visually identify the BMI inflection point associated with significantly increased total costs.

Least square means and standard errors of adjusted annualized total and subcategory costs are presented in Table 3. *P* values were ascertained from linear regression model analysis on the logarithmic transformed medical costs, adjusting for subject’s demographic and clinical characteristics. We first adjusted for all covariates but chronic disease (Model 1) and then adjusted for Model 1 covariates plus chronic disease (Model 2) to assess the extent to which chronic disease is the pathway through which obesity affects costs. To contrast the differences in total Medicare costs for subjects in different age groups and weight categories, we also presented the Model 1 adjusted data in graphic form, as a bar chart.

Sensitivity Analyses

To check the validity of our findings, we (a) estimated our models excluding HRS participants who required a proxy respondent at the 1998 interview, (b) estimated our models excluding current smokers, (c) estimated our models excluding those who died in the first year, (d) estimated our models in the subgroup of participants who did not experience a change in BMI class from 1998–2002, (e) applied inflation multiplies obtained from the Consumer Price Index and re-ran all models, and (f) checked the validity of BMI computed from self-reported height and weight against BMI computed from measured height and weight among respondents who completed the HRS physical measures module in 2006. Intraclass correlation coefficients (ICCs) were calculated to compare the self-reported and measured height and weight within each age and BMI category. Sampling weights were not used in the calculation of the ICCs.

Results

The original HRS sample included 10,755 subjects. Excluding subjects who had missing height or weight (n = 184), were underweight (BMI < 18.5; n = 399), could not be linked to Medicare claims data (n = 846), had sampling weights of 0 (n = 283), or had missing covariates (n = 21), we analyzed data on a sample of 9,022 subjects. Table 1 shows sample sizes for each BMI class by age group cell. All comparisons across BMI classes are in reference to the normal weight class. Log-rank tests comparing survival curves (*not shown*) indicated a survival advantage for the mildly obese over the normal and severely obese among the young-old. In the old, there was a survival advantage for the overweight, mildly obese, and severely obese over the normal weight group. There were no significant differences in survival by BMI in the old-old.

With regard to chronic illness (Table 2), across all age groups, hypertension, diabetes, and arthritis had positive linear associations with BMI class. In the case of diabetes, prevalence rates were just over 2 times greater among the severely obese old and old-old and over 5 times greater in the severely obese young-old.

In Figure 1, we show the relationship between BMI and total Medicare costs with BMI as a continuous variable for each age group. Among the young-old, one can see a small steady upward trend in costs from BMI 29 to 34 and a steep upward inflection in costs at a BMI of 35. Among the old, there is a small steady increase without an inflection point, and among the old-old, there is little evidence of a relationship between BMI and costs.

Table 3 shows mean and standard errors for total and subcategory Medicare costs adjusted for Model 1 covariates (age, gender, ethnicity, education, and smoking). These same values are shown graphically in Figure 2. Total costs were statistically significantly higher among severely obese young-old adults as were durable medical equipment, emergency department, home health, nursing home, inpatient, and outpatient. With chronic illnesses added in Model 2, total, durable medical equipment, home health, and inpatient costs remained significant.

Among the old group, durable medical equipment, emergency department, and home health costs were higher for the severely obese, and durable medical equipment and emergency department remained significant in Model 2. For the old-old severely obese, durable medical equipment and inpatient costs were only significantly higher under Model 1.

Sensitivity Analyses

Sensitivity analyses excluding subjects who required a proxy respondent showed results similar to what we have presented above. Excluding current smokers from the analyses had no practical effect on results. The effect of excluding those who died in the first year was to reduce the Model 1 adjusted mean total costs for the young-old severely obese from US $9,751 to US$8,583. Applying inflation multipliers to each year's cost data increased the cost numbers but did not change findings regarding the relationships between BMI and costs.

One hypothesis regarding age differences in the relationship between BMI class and costs is that the severely obese are more ill and lose weight over time placing them into lower BMI classes at later ages. In the young-old, 79% stayed in the same BMI class, and in the old and old-old, 72% stayed in the same class from 1998 to 2002. None of the severely obese dropped down to the normal weight class. Eliminating from the analyses the severely obese who changed BMI classes resulted in a 20% to 25% reduction in total costs among the severely obese. The 6-year attrition was 22% for both the normal and severely obese, and our earlier reported log-rank survival analyses indicated no difference between the normal and severely obese young-old.

With regard to the validity of self-report height and weight, in 2006, there were 4,169 respondents for whom both a self-report and measured height were available and 4,189 for whom both a self-report and measured weight were available. The ICCs ranged from .94 to .96 for weight and .88 to .94 for height in every age by BMI group. The impact on our results is limited given that our primary analyses use BMI classifications (Craig & Adams, 2009).

Discussion

Prior literature has shown that obesity in older adults is associated with greater medical cost spending. Our results indicate this greater spending may be concentrated in the severely obese of the younger old ages. We found in these nationally representative data that annualized Medicare costs were higher for the severely obese particularly in the 65- to 69-year-old age group where total costs were over 100% greater for the severely obese compared with normal weight respondents.

We are aware of one other data set used to report health care costs by BMI within age groups (i.e., 65–74, 75 and older) among older adults. Cross-sectional data from 22% of 2001–2002 General Motors Corporation employees who responded to a Health Risk Assessment showed obesity was associated with higher costs among the young-old (Wang, McDonald, Reffitt, & Edington, 2005; Wang et al., 2003).

We did not find a consistent pattern of survival related to BMI class across the three age groups. There were no survival differences by BMI class among the young-old, but in the old-old, the overweight and mildly obese had a survival advantage over the normal weight and severely obese. One explanation sometimes provided for health or survival advantages observed among overweight older adults or a lack of mortality risk from obesity (Flegal et al., 2013) relative to normal weight older adults is that the obese older adults lose weight over time related to illness and "drop" into the normal weight reference category (Clark et al., 2014). In the data we used for this report, we did not find that any severely obese older adults in 1998 had dropped down into the normal weight category 5 years later. Our sensitivity analysis found a similar percentage of severely obese older adults in each age group changed BMI class from 1998 to 2002, and excluding those who changed BMI class over time had a limited effect—in the range of 20% reduction—in total costs in each age group.

If confirmed, the considerably elevated costs among the young-old severely obese may present an intervention opportunity in a still relatively small subpopulation; in 2011–2012, 5.6% of the U.S. population aged 60 years or older was severely obese (Ogden et al., 2014). The size of this subpopulation increased 70% from 2000 to 2010 (Sturm & Hattori, 2013), however, and is likely to continue to grow given higher rates of severe obesity among middle-aged adults. Weight loss interventions for middle-aged and young-old severely obese adults are critically needed and have the potential to be cost-effective.

Interventions for the severely obese that may improve health and quality of life are emerging, and the potential exists for reductions in health care use and Medicare costs. For example, a recent randomized trial of lifestyle weight loss among severely obese adults resulted in significant improvements in low-density lipoproteins, triglycerides, hemoglobin A_{1c}, and blood glucose (Unick et al., 2013). Bariatric surgery is an alternative to lifestyle interventions. A recent analysis of severely obese (BMI > 35) adults who underwent bariatric surgery showed a 60% increase in the prevalence of surgery in older adults from 2005 to 2009 and that most of this increase was among 65- to 69-year-olds. However, some experts conclude that too little is known to recommend bariatric surgery as a safe treatment for obese older adults (Han, Tajar, & Lean, 2011), and the proportion of eligible persons receiving this procedure is still very low at <1% (Unick et al., 2013).

Whether lifestyle, medical, or surgical weight loss among severely obese older adults translates into lower Medicare costs is not known. Geriatric care management has proven effective in reducing inpatient costs in older adults with multiple chronic conditions (Counsell, Callahan, Tu, Stump, & Arling, 2009). Severely obese older adults have multiple chronic conditions but more than chronic illness care may be needed. It is likely that elevated Medicare costs are due in part to disability, and this may be independent of chronic illness, particularly for the severely obese. We found an inconsistent association between BMI class and durable medical equipment. A recent trend analysis showed that the association between BMI class and disability had strengthened over the past decades. The authors concluded that improvements in medical care have resulted in increased life expectancy for the obese but not disability free life expectancy (D. E. Alley & Chang, 2007). Significant improvement in disability free life expectancy among obese older adults is likely to require a combination of exercise and weight loss. A recent high quality trial in which obese older adults—most of whom had BMI >35—were randomly assigned to education control, exercise without weight loss, diet without exercise, or exercise and diet with weight loss showed that the diet and exercise treatment was most effective in improving performance-based physical function, peak oxygen consumption, and lean body mass (Villareal et al., 2011). Weight loss over 1 year averaged 9% of baseline weight. There is limited evidence that disability may be reduced following bariatric surgery as well. Combination therapies of geriatric care management, exercise, and weight loss may be an effective approach to improving quality of life while reducing Medicare costs in this high cost subpopulation.

The limitations of our report include a smaller sample size in the oldest obese group, lack of access to Medicaid costs, and reliance on self-reported height and weight. In regard to Medicaid costs, 6.7%, 7.3%, and 8.8% of 65 to 69, 70 to 74, and 75 and older respondents, respectively, reported Medicaid at the 1998 HRS interview. In each age group, Medicaid insurance rates increased with BMI class and were twice as high among the severely obese compared with normal weight respondents. Self-reported height and weight has some bias in the HRS data as we showed above and greater bias among the severely obese. This likely had limited effects on our cost estimates based on BMI categories. And, most importantly, despite our extensive sensitivity analyses, we cannot rule out that age group differences are not the result of changes in illness or BMI that occur with age or whether these findings are unique to these cohorts.

CMS policy provides reimbursement to primary care providers for intensive weight loss counseling in older adults. Given our findings, it appears CMS is experiencing relatively high costs related to severe obesity, particularly among the young-old. In addition to weight loss efforts among older adults, future research might explore whether weight gain prevention among overweight and obese adults approaching Medicare eligibility (i.e., middle and late-middle age) would reduce obesity-related CMS costs.

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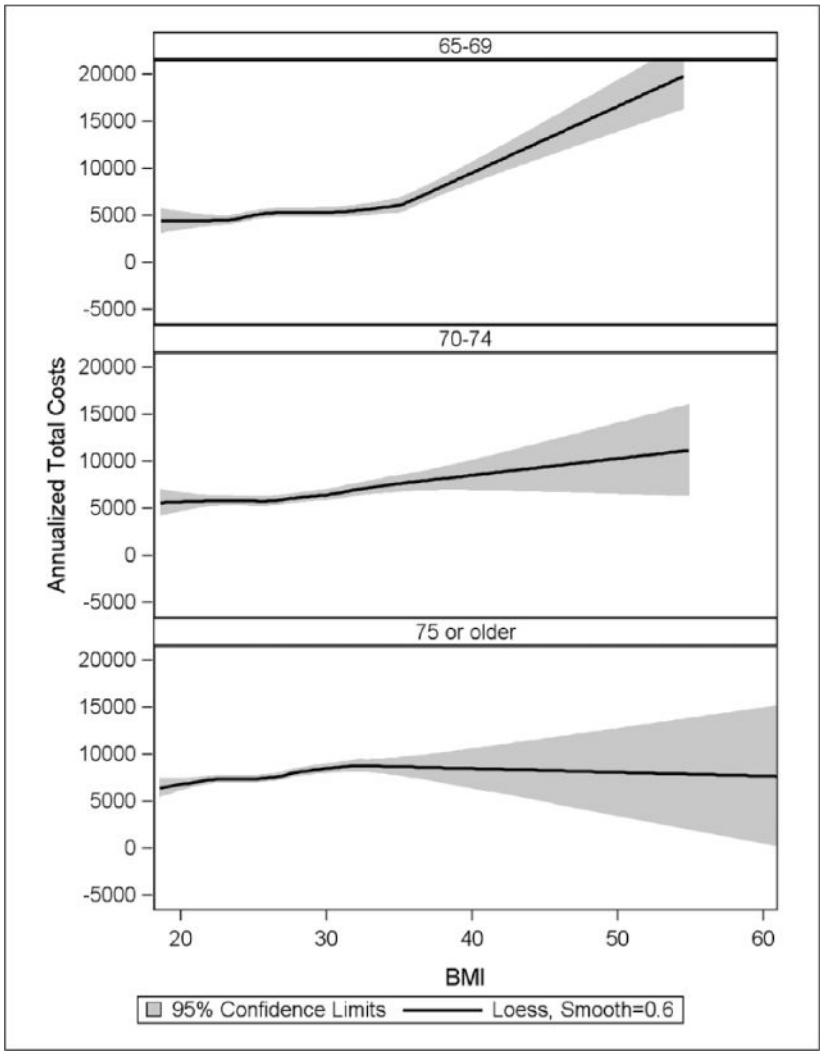

Figure 1.
Annualized total costs by age group and BMI. *Note.* BMI = body mass index.

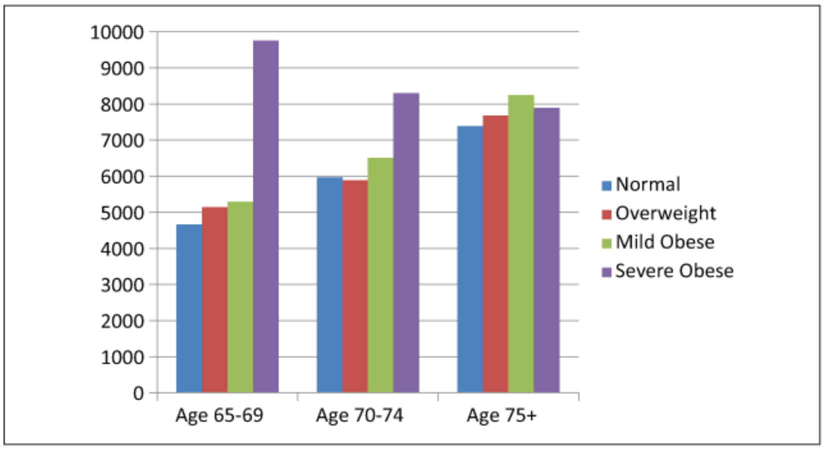

Figure 2.

Annualized mean total Medicare expenditures 1998–2008 for 1998 Health and Retirement Survey respondents by age group and body mass index class adjusted for age, gender, ethnicity, education, and smoking history.

Table 1

Sample Description and Death Over 10-Year Study Period by Age Group and Body Mass Index Class.

	Normal	Overweight	Mild obese	Severe obese
Young-old (65–69) *n* = 2,598				
Sample sizes	877	1,097	454	170
% of population	34.5	42.4	16.7	6.5
% died within 10 years	24.8	22.7	19.4	30.6
% female	60.9	44.6***	53.4*	72.4
% ethnic minority	12.7	15.4	21.2***	28.1***
% ever smoked	35.5	33.3	25.3**	26.0
Mean years of education (*SE*)	12.7 (0.14)	12.1 (0.12)**	11.7 (0.14)***	11.4 (0.27)***
Old (70–74) *n* = 2,377				
Sample sizes	946	977	342	112
% of population	40.3	40.7	14.3	4.8
% died within 10 years	39.6	31.3***	34.2	33.1
% female	62.0	47.5***	54.0	65.3
% ethnic minority	10.5	15.1*	17.4**	25.3***
% ever smoked	44.3	41.1	43.8	37.9
Mean years of education (*SE*)	12.1 (0.12)	11.6 (0.14)**	11.3 (0.21)**	11.3 (0.38)
Old-old (75 or older) *n* = 4,047				
Sample sizes	2,045	1,471	441	90
% of population	51.3	35.7	10.9	2.1
% died within 10 years	66.2	58.7***	54.8***	62.9
% female	63.4	53.0***	65.0	75.5
% ethnic minority	10.1	12.9***	16.2***	21.2***
% ever smoked	10.0	7.8	4.6**	5.7
Mean years of education (*SE*)	11.7 (0.11)	11.2 (0.13)***	10.8 (0.21)***	10.9 (0.44)

Note. All tests of significance in reference to normal weight category.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

Table 2

Chronic Illness Prevalence by Age Group and Body Mass Index Class.

	Normal	Overweight	Mild obese	Severe obese
Young-old (65–69)				
ension	38.06	51.81***	61.54***	71.25***
Diabetes	7.24	14.97***	24.49***	38.28***
Heart condition	21.72	22.19	26.45	28.73
CHF	2.30	2.17	2.96	8.87*
Chronic lung disease	10.32	8.31	12.15	11.89
Arthritis	50.30	56.60	61.38***	82.65***
Cancer not skin	11.31	11.21	11.04	12.80
Stroke	5.66	5.93	5.29	5.87
Old (70–74)				
Hypertension	46.00	54.30**	62.09***	71.40***
Diabetes	10.38	16.60**	24.34***	24.56***
Heart condition	23.02	25.18	32.25***	38.78**
CHF	2.62	3.89	4.50	8.87**
Chronic lung disease	10.68	8.44	8.95	12.66
Arthritis	49.04	55.65*	68.02***	76.85***
Cancer not skin	14.70	12.44	16.84	11.29
Stroke	7.18	7.19	10.65	9.87
Old-old (75 or older)				
Hypertension	51.30	55.48*	66.17***	70.68**
Diabetes	12.56	15.85	22.45***	28.87**
Heart condition	29.13	27.13	28.71	25.94
CHF	5.09	4.76	6.46	8.32
Chronic lung disease	11.65	10.96	11.17	17.88
Arthritis	58.58	64.95**	78.93***	82.16**
Cancer not skin	16.68	17.67	18.41	13.86
Stroke	11.69	9.46	9.80	9.06

Note. All tests of significance in reference to normal weight category. CHF = congestive heart failure.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

Table 3

Adjusted Annualized Mean Medicare Expenditures (US$) 1998–2008 by Age Group and Body Mass Index.

	Normal		Overweight		Mild obese		Severe obese	
	M	*SE*	*M*	*SE*	*M*	*SE*	*M*	*SE*
Young-old (65–69)								
costs	4,663	265	5,141	229	5,290	401	9,751***,†	1,646
Durable medical	187	29	155*	18	168***,†	20	448***,†††	84
Emergency Room	41	3	45	2	51	6	74***	16
costs								
Home health costs	231	77	245**,†	28	215	49	519***,†	110
Hospice costs	96	21	167	34	64†	30	104	45
Inpatient costs	2,177	160	2,267	136	2,518*	246	5,238***,†	1,420
Nursing home costs	234	43	235	28	227	42	359*	92
Outpatient costs	1,697	81	2,027	86	2,047	131	3,008**	425
Old (70–74)								
Total costs	5,971	288	5,889	272	6,509	439	8,301	1,008
Durable medical	171	22	159**,††	19	252**	46	373***,†††	79
ER costs	48	4	54	4	61	5	85**,†	20
Home health costs	239	27	275	27	331	61	784*	286
Hospice costs	178	32	137	20	146	38	193	74
Inpatient costs	2,839	194	2,751	155	3,263	294	3,690	493
Nursing home costs	374	44	322	28	495	73	831	201
Outpatient costs	2,122	108	2 90	124	1,961	114	2,345	263
Old-old (75 or older)								
Total costs	7,382	310	7,676	275	8,245*	568	7,893	772
Durable medical	182	15	196**,††	13	218***,†††	28	314**	65
ER costs	56	4	63	3	55	4	68	12
Home health costs	486	44	535**,†	40	620	79	729	159
Hospice costs	325	29	307	34	351	70	332	147

	Normal		Overweight		Mild obese		Severe obese	
	M	***SE***	***M***	***SE***	***M***	***SE***	***M***	***SE***
Inpatient costs	3,552	181	3,538	172	3,873	305	3,095*	294
Nursing home costs	881	48	908	52	1,067	98	1,297	251
Outpatient costs	1,900	79	2,130	83	2,061	150	2,058	250

Note. Dollars adjusted for Model 1 covariates: age, sex, minority ethnicity, ever smoked, and years of education. All tests of significance in reference to normal weight category are from models using log-transformed costs with appropriate covariates. Model 2 covariates are as follows: age, sex, minority ethnicity, ever smoked, years of education, hypertension, diabetes, heart disease, congestive heart failure, chronic lung disease, arthritis, cancer (not skin), and stroke.

* $p < .05$.

** $p < .01$.

*** $p < .001$ for Model 1.

† $p < .05$.

†† $p < .01$.

††† $p < .001$ for Model 2.