Annual Medical Spending Attributable To Obesity: Payer- And Service-Specific Estimates

Amid calls for health reform, real cost savings are more likely to be achieved through reducing obesity and related risk factors.

by Eric A. Finkelstein, Justin G. Trogdon, Joel W. Cohen, and William Dietz

ABSTRACT: In 1998 the medical costs of obesity were estimated to be as high as $78.5 billion, with roughly half financed by Medicare and Medicaid. This analysis presents updated estimates of the costs of obesity for the United States across payers (Medicare, Medicaid, and private insurers), in separate categories for inpatient, non-inpatient, and prescription drug spending. We found that the increased prevalence of obesity is responsible for almost $40 billion of increased medical spending through 2006, including $7 billion in Medicare prescription drug costs. We estimate that the medical costs of obesity could have risen to $147 billion per year by 2008. [*Health Affairs* 28, no. 5 (2009): w822–w831 (published online 27 July 2009; 10.1377/hlthaff.28.5.w822)]

There is an undeniable link between rising rates of obesity and rising medical spending. In a previous paper, Eric Finkelstein and colleagues[1] demonstrated the extent to which excess weight increased annual medical spending for public and private payers alike. That study showed that the costs of overweight and obesity could have been as high as $78.5 billion in 1998 and that roughly half of this total was financed by Medicare and Medicaid. This analysis updates those previous findings. Our overall estimates show that the annual medical burden of obesity has risen to almost 10 percent of all medical spending and could amount to $147 billion per year in 2008. Other studies have also quantified the extent to which obesity influences aggregate health spending. For example, Kenneth Thorpe and colleagues[2] found that obesity was responsible for 27 percent of the rise in inflation-adjusted health spending between 1987 and 2001.

Eric Finkelstein (finkelse@rti.org) is director of the Public Health Economics Program at RTI International in Research Triangle Park, North Carolina. Justin Trogdon is a research economist in that program. Joel Cohen is director of the Division of Social and Economic Research, Center for Financing, Access, and Cost Trends, Agency for Healthcare Research and Quality, in Rockville, Maryland. William Dietz is director of the Division of Nutrition and Physical Activity, National Center for Chronic Disease Prevention and Health Promotion, at the Centers for Disease Control and Prevention in Atlanta, Georgia.

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Although national, state, and local governments and many private employers and payers have increased their efforts to address obesity since 1998, data from the Centers for Disease Control and Prevention's (CDC's) Behavioral Risk Factor Surveillance System (BRFSS)[3] reveal that obesity rates increased by 37 percent between 1998 and 2006 (from 18.3 percent to 25.1 percent of the population), which suggests that the increased prevalence of obesity is driving increases in total medical spending.

We present nationally representative estimates of per capita and aggregate costs of obesity for all payers and separately for Medicare, Medicaid, and private insurers. We present these costs in total and separately for inpatient, non-inpatient, and prescription drug spending—which was not possible at the time the previous papers were written.[4] This additional detail helps specify the drivers of the costs of obesity. This is especially important for Medicare because of the prescription drug benefit that was added in 2006. Our research shows that obese beneficiaries, on average, cost Medicare over $600 per beneficiary per year more compared to normal-weight beneficiaries.[5] Finally, we estimate the extent to which rising prevalence of obesity is responsible for the increase in obesity costs that occurred between 1998 and 2006.

Study Data And Methods

■ **Data.** This analysis relies on data from the 1998 and 2006 Medical Expenditure Panel Surveys (MEPS). MEPS is a nationally representative survey of the civilian noninstitutionalized population that quantifies a person's total annual medical spending by type of service and source of payment (including Medicare, Medicaid, private, and other sources). The data also include information about each person's health insurance status and sociodemographic characteristics, including age; race/ethnicity; sex; and, most importantly for this analysis, body mass index (BMI) based on self-reported height and weight.[6] As in our prior work,[1] the analysis data set includes all adults age eighteen or older with data on BMI, excluding pregnant women. This includes 10,597 and 21,877 adults in 1998 and 2006, respectively, with weighting variables that allow for the generation of nationally representative estimates.

■ **Methods.** Although our estimation strategy largely tracks the approach used in our earlier work,[1] we have made several modifications to allow for more detailed stratifications. First, that study used a four-equation regression approach to predict total medical spending separately for those who did or did not require an inpatient visit. However, for the 2006 data, in addition to a two-part model on total spending, for this study we ran separate two-part models for inpatient, non-inpatient (outpatient, emergency room, office-based, dental, vision, home health, and other), and prescription drug spending, to quantify the costs of obesity separately for each type of service.[7] The two-part model separately estimated the probability of having a specific type of expenditure (for example, inpatient) in the first part and then estimated total spending conditional on having positive spending in the second part. The predictions from each part were then combined to generate total predicted spending for each type of service.

As is typical with medical spending data, the samples included many people with zero spending for some points of service, especially inpatient services, and some with extremely high spending. We used a two-part model that includes a logit model in the first part and a generalized linear model (GLM) with a log link and gamma distribution in the second part. Application of the specification tests outlined by Willard Manning and John Mullahy[8] supported our choice of models. Therefore, we used that approach to generate the spending estimates for both the 1998 and 2006 data for all regressions.[9]

Separating payers. The specification from our earlier work[1] used total annual medical payments as the dependent variable and dummy variables for BMI category, insurance status, and BMI category/insurance status interaction terms to generate overweight- and obesity-attributable fractions for each payer. However, this approach assumed that, for example, the total increase in costs for people with Medicare coverage is paid for by Medicare. In the current analysis, we ran separate models for each payer and used payer-specific spending as the dependent variable. By running separate models by payer, we did not restrict the coefficients on the sociodemographic variables to be the same across payers, as was done in our prior study. In addition, by running separate models, we could subset the total payment variable in each regression to include only payments made by that payer.

Body mass index. The inclusion of variables depicting each person's BMI category (underweight: BMI <18.5, normal: BMI 18.5–<25 [omitted reference group], overweight: BMI 25–<30, or obese: BMI >30) in the regressions allows for predicting the impact of these variables on annual medical spending. Although our earlier work focused on quantifying costs separately for overweight and obesity, because the overweight expenditure variable was not statistically different from normal-weight spending in that work, for this effort we present results only for those with a BMI greater than 30 kg/m^2.

Respondents' characteristics. All regressions controlled for sex, race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, Asian, other), age, region (Northeast, Midwest, South, West), household income (less than 100 percent of poverty, 100–199 percent, 200–399 percent, 400 percent or more), education (less than high school, high school, some college, college degree), marital status (married, widowed, divorced/separated, single), and smoking status (current smoker, former/never smoker). The total expenditure regression also included dichotomous variables for each person's insurance category (uninsured, privately insured, Medicaid, Medicare, or other payers) and allowed for multiple insurers throughout the year.

Impact on spending by type of service. The regression results allowed for assessing the impact of obesity on annual medical spending for each type of service. The average

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increase in medical spending attributable to obesity for each type of service, compared to normal weight, was calculated by subtracting average predicted spending for obese people with the dichotomous obesity variable set to 1, from average predicted spending for these people with the obesity variable set to 0 (that is, predicted spending for obese people had they been of normal weight). The corresponding percentage increase was generated by dividing this figure by the average predicted spending for obese people had they been of normal weight. The fraction that medical spending would be reduced by if all obese people were suddenly returned to normal weight (termed "attributable fraction") was calculated by dividing total predicted spending attributable to obesity by total predicted spending for the entire sample. The regressions were estimated using Stata. Standard errors were computed via the bootstrap method. Note that these standard errors accounted only for sampling variability and not for any potential household reporting or model specification errors.

Bringing in data from the NHEA. We present obesity-attributable spending estimates at the national level based on aggregate spending in MEPS and based on the higher personal health care spending estimates presented in the National Health Expenditure Accounts (NHEA), generally considered the gold standard for data on aggregate health spending.[10] The NHEA estimates are much higher than the MEPS estimates primarily because NHEA includes spending for people residing in institutions and MEPS does not. The largest difference occurs for Medicaid, which finances the majority of institutionalized costs. The NHEA also includes expenses for services that are not included in MEPS (for example, over-the-counter medications). In addition, household surveys are subject to potential underreporting by respondents. The latest effort to reconcile NHEA and MEPS suggests that MEPS may underestimate spending by roughly 14 percent.[11]

To compute the NHEA estimates, as in our earlier work,[1] we multiplied the attributable fractions generated from MEPS by total spending for the corresponding insurance category reported in the 1998 and 2006 NHEA. Although this requires the strong assumption that the percentage of costs attributable to obesity is the same in institutionalized and noninstitutionalized populations, this assumption was necessary to provide an estimate of the costs of obesity from all types of health care spending. All results are presented in 2008 dollars using the gross domestic product (GDP) general price index as recommended by the Agency for Healthcare Research and Quality (AHRQ), the agency that conducts MEPS.[12]

Obesity prevalence. Because the regression results reveal that the per capita spending attributable to obesity was not statistically different in 2006 versus 1998, we estimate the extent to which increased prevalence of obesity is responsible for the increase in the medical cost of obesity between 1998 and 2006. To compute this estimate, we predicted spending for 2006 using the 2006 two-part model and 2006 sample but with each person's BMI dummy variables set to the average levels in 1998 (0.03 for underweight, 0.35 for overweight, and 0.19 for obese). We then predicted spending in the same way but with each person's BMI dummy variables set to the average levels in 1998 if all obese people were of normal weight (0.03 for underweight, 0.35 for overweight, and 0 for obese). The difference in these predicted expenditures represents hypothetical obesity-attributable costs in 2006 if the prevalence of obesity had remained at 1998 levels.

Results

Exhibit 1 uses the regression results (available upon request) to present estimates of the increase in per capita medical spending attributable to obesity in 1998 and in 2006, using the updated regression specification. For comparison, this figure also presents 1998 estimates as reported in our earlier work.[1]

Across all payers, obese people had per capita medical spending that was $1,429 (42 percent) greater than spending for normal-weight people in 2006. In 1998 the per capita spending increase attributable to obesity was several hundred dollars less than, although not statistically different from, the 2006 estimate. It is important to note that the specification changes between this and our earlier work had almost no impact on the 1998 estimates. In both cases, it was estimated that obesity increased costs by 37 percent.

Exhibit 2 presents estimates separately by payer. With the exception of the percentage increase for private payers, the estimated spending increase attributable to obesity is larger for 2006 than for 1998, although the differences are not statistically significant. For 2006, the per capita percentage increase in annual costs attributable to obesity was estimated to be 36 percent for Medicare, 47 percent for Medicaid, and 58 percent for private payers. Both the 2006 dollar and percentage increases are statistically different from zero for all payers, although none are sta-

EXHIBIT 1
Adult Per Capita Medical Spending Attributable To Obesity (Compared To Normal Weight), 1998 And 2006 (In 2008 Dollars)

Year	Spending difference compared to normal weight ($)	Percent difference compared to normal weight
2006	1,429 (156)	41.5 (4.9)
1998 (updated)	1,145 (270)	36.5 (8.9)
1998 (original)	930[a] (438)	37.4[a] (17.4)

SOURCE: Authors' calculations based on data from the 1998 and 2006 Medical Expenditure Panel Survey.
NOTES: Bootstrapped standard errors are shown in parentheses. Obese is body mass index (BMI) ≥30 kg/m^2. Dollar values were updated to 2008 using the gross domestic product (GDP) price index provided by the Bureau of Economic Analysis, U.S. Department of Commerce. For all data, the increased spending estimate is significantly greater than zero ($p < 0.05$).
[a] Relative standard error is greater than 0.3, indicating that the estimate is unstable.

EXHIBIT 2
Increase In Adult Per Capita Medical Spending Attributable To Obesity, By Insurance Status, 1998 And 2006 (In 2008 Dollars)

Insurance category	Year	Spending increase ($)	Percent increase
Medicare	2006	1,723[a] (345)	36.4[a] (8.5)
	1998	1,006[b] (540)	30.2[b] (18.1)
Medicaid	2006	1,021[a] (303)	46.7[a,b] (15.4)
	1998	284[b] (495)	10.3[b] (15.9)
Private	2006	1,140[a] (143)	58.1[a] (8.4)
	1998	957[a] (193)	67.2[a] (16.0)

SOURCE: Authors' calculations based on data from the 1998 and 2006 Medical Expenditure Panel Survey.
NOTES: Bootstrapped standard errors are shown in parentheses. Obese is body mass index (BMI) ≥30 kg/m^2. Dollar values were updated to 2008 using the gross domestic product price index provided by the Bureau of Economic Analysis, U.S. Department of Commerce.
[a] Increased spending estimate is significantly greater than zero ($p < 0.05$).
[b] Relative standard error is greater than 0.3, indicating that the estimate is unstable.

tistically different from the 1998 estimates. Using the updated regression approach, neither the 1998 Medicare spending increase nor the Medicaid spending or percentage increases are statistically different from zero.

Exhibit 3 presents the 2006 payer-specific estimates by type of service—inpatient, non-inpatient, or prescription drug spending—to identify the cost drivers

EXHIBIT 3
Increase In Adult Per Capita Medical Spending Attributable To Obesity, By Insurance Status And Type Of Service, 2006 (In 2008 Dollars)

Insurance category	Type of service	Spending increase ($)	Percent increase
Medicare	Inpatient	95[b] (296)	4.4[b] (13.0)
	Non-inpatient	693[a] (128)	40.1[a] (8.4)
	Rx drug	608[a] (65)	72.7[a] (10.3)
Medicaid	Inpatient	213[b] (153)	39.2[b] (34.2)
	Non-inpatient	175[b] (172)	14.8[b] (12.8)
	Rx drug	230[a,b] (80)	60.6[a,b] (24.2)
Private	Inpatient	443[a] (85)	90.3[a] (23.9)
	Non-inpatient	398[a] (60)	37.9[a] (6.6)
	Rx drug	284[a] (41)	81.8[a] (12.4)
All payers	Inpatient	420[a] (93)	45.5[a] (12.0)
	Non-inpatient	444[a] (76)	26.9[a] (4.7)
	Rx drug	568[a] (59)	80.4[a] (8.3)

SOURCE: Authors' calculations based on data from the 2006 Medical Expenditure Panel Survey.
NOTES: Bootstrapped standard errors are shown in parentheses. Obese is body mass index (BMI) ≥30 kg/m^2. Dollar values were updated to 2008 using the gross domestic product price index provided by the Bureau of Economic Analysis, U.S. Department of Commerce.
[a] Increased spending estimate is significantly greater than zero ($p < 0.05$).
[b] Relative standard error is greater than 0.3, indicating that the estimate is unstable.

attributable to obesity. For Medicare, non-inpatient services and pharmaceuticals (as a result of the introduction of prescription drug coverage) were major drivers of spending. Our results suggest that spending within these categories for each obese beneficiary was more than $600 per year higher than for a normal-weight beneficiary in 2006. For Medicaid, only prescription drug spending was statistically significant, accounting for a $230 (61 percent) increase in annual spending from 1998 to 2006. However, in part because of the smaller sample size, all Medicaid type-of-service estimates, in addition to the Medicare estimate for inpatient services, are associated with large standard errors and therefore should be interpreted with caution. The spending increase from 1998 to 2006 for private payers was statistically significant for each type of service and ranged from $284 for prescription drugs to $443 for inpatient services. In percentage terms, these increases represent 82 percent and 90 percent increases in costs, respectively, compared with people of normal weight. Estimates for all payers combined range between $420 (inpatient) and $568 (prescription drugs). In percentage terms, the increases for all payers combined range from 27 percent (non-inpatient) to 80 percent (prescription drugs) from 1998 to 2006.

Exhibit 4 combines the per capita cost and obesity prevalence data to present the attributable fractions and aggregate estimates of the costs of obesity separately by payer and by type of service. Focusing on total payments, the attributable fractions indicate that 8.5 percent of Medicare spending, 11.8 percent of Medicaid spending, and 12.9 percent of private payer spending is attributable to obesity. Across all payers, our results indicate that obesity is associated with a 9.1 percent increase in annual medical spending, compared with 6.5 percent in 1998: $86 billion based on the MEPS estimates or as much as $147 billion per year based on the NHEA data. For 1998 these estimates were $42 billion and $74 billion, respectively, when we used the updated regression specification. By point of service, prescription drug spending is the largest cost driver.

Across all payers, we estimate that had obesity prevalence remained at 1998 levels, spending attributable to obesity would have been $47 billion in 2006 rather than $86 billion (based on MEPS spending data). This implies that the rise in obesity prevalence accounted for 89 percent of the increase in obesity spending that occurred during this period.[13]

Discussion

These results reveal that obesity continues to impose an economic burden on both public and private payers. Across all payers, per capita medical spending for the obese is $1,429 higher per year, or roughly 42 percent higher, than for someone of normal weight. In aggregate, the annual medical burden of obesity has increased from 6.5 percent to 9.1 percent of annual medical spending and could be as high as $147 billion per year (in 2008 dollars) based on the NHEA estimate. Moreover, unlike Thorpe and colleagues,[2] who found that the per capita costs of obesity

EXHIBIT 4
Aggregate Medical Spending Attributable To Obesity, By Insurance Status And Type Of Service, In Two Different Data Sets, 2008 Dollars

Insurance category	Type of service	Attributable fraction (%)	MEPS ($ millions)	NHEA ($ millions)
Medicare	Inpatient	1.1[b] (3.5)	1,085	1,888[a]
	Non-inpatient	9.1[a] (1.6)	7,920[a]	13,787[a]
	Rx drug	15.2[a] (1.6)	6,951[a]	12,100[a]
	Total	8.5[a] (1.7)	19,683[a]	34,263[a]
Medicaid	Inpatient	8.8[b] (6.1)	2,054	7,031
	Non-inpatient	3.9[b] (3.8)	1,260	4,314
	Rx drug	11.9[a,b] (4.3)	1,479[a]	5,061[a]
	Total	11.8[a] (3.4)	8,054[a]	27,566[a]
Private	Inpatient	18.1[a] (3.3)	20,942[a]	31,544[a]
	Non-inpatient	8.5[a] (1.3)	16,594[a]	24,828[a]
	Rx drug	17.1[a] (2.1)	11,665[a]	18,250[a]
	Total	12.9[a] (1.6)	49,386[a]	74,615[a]
All payers	Inpatient	10.3[a] (2.3)	27,361[a]	44,654[a]
	Non-inpatient	5.9[a] (1.0)	26,380[a]	45,157[a]
	Rx drug	15.2[a] (1.4)	32,726[a]	59,333[a]
	2006 total	9.1[a] (1.0)	85,739[a]	146,624[a]
All payers	1998 (updated) total	6.5[a] (1.5)	41,840[a]	74,157[a]
	1998 (original) total	5.3[a,b] (2.6)	34,036[a]	60,325[a]

SOURCE: Authors' calculations based on data from the 2006 Medical Expenditure Panel Survey (MEPS) and the 2006 National Health Expenditure Accounts (NHEA).

NOTES: Bootstrapped standard errors are shown in parentheses. Obese is body mass index (BMI) ≥30 kg/m^2. Dollar values were updated to 2008 using the gross domestic product price index provided by the Bureau of Economic Analysis, U.S. Department of Commerce.

[a] Increased spending estimate is significantly greater than zero ($p < 0.05$).

[b] Relative standard error is greater than 0.3, indicating that the estimate is unstable.

increased between 1987 and 2001, our estimates reveal that the 37 percent increase in obesity prevalence, and not per capita cost increases, was the main driver of the increase in obesity-attributable costs between 1998 and 2006. These results also provide new evidence of the important role of prescription drug spending in driving the costs of obesity. For example, as a result of the Part D prescription drug benefit, the obesity-attributable prescription drug costs to Medicare are $7 billion for the noninstitutionalized population (see Exhibit 4).

■ **Effects of obesity treatment.** Although pharmaceutical, medical, and surgical interventions to treat obesity are available, these treatments remain rare. As a result, the costs attributable to obesity are almost entirely a result of costs generated from treating the diseases that obesity promotes. For example, Charles Roehrig and colleagues[14] show that annual medical costs for people with diabetes total $190.5 billion. Although not all of these costs are attributable to obesity, excess weight is the single greatest predictor of developing diabetes. If not for obesity, these costs would be much lower, as would costs for other conditions caused by excess weight.

Although our results indicate that private payers bear the majority of the costs resulting from obesity, public-sector spending remains substantial; Medicare and Medicaid spending would be 8.5 percent and 11.8 percent lower, respectively, in

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the absence of obesity. Given the current budget crisis in most jurisdictions, the high public-sector spending for obesity is a major cause for concern. However, if the motivation to prevent or treat obesity were solely based on cost, then only cost-saving obesity interventions would be implemented once all costs and benefits are taken into account.

From a payer's perspective, although there is increasing evidence suggesting that bariatric surgery may be cost saving,[15] not all obesity treatments will meet this threshold (nor do most treatments for other conditions). This is not to say that these treatments should or should not be offered, but the extent to which greater use of obesity treatments would reduce spending in either the short or the long run remains unknown. The same is true for prevention. Many successful obesity prevention efforts are likely to be cost-effective (that is, have a low cost-effectiveness ratio) but not cost saving. From a public health perspective that focuses on identifying cost-effective strategies for improving the health of the population, these interventions may still be worth pursuing, even at significant cost.

■ **Study limitations.** This analysis has several limitations. One is the reliance on self-reported height and weight. Unfortunately, no nationally representative data set includes both measured height/weight and annual medical spending. In addition, the lack of statistical significance in some regressions may be attributable to the relatively small sample size. For example, the 1998 data set is only half as large as the 2006 data set; in 2006 only 329 (unweighted) Medicaid enrollees had an inpatient visit, compared with 767 (unweighted) individuals in the private-payer regression.

As noted in the methods section, the application of the attributable fractions generated from the MEPS data (on only the noninstitutionalized) to spending estimates from NHEA (including people in institutions) requires the strong assumption that the prevalence and per capita costs of obesity can be equally applied to both populations. This was necessary to present comprehensive estimates of the costs of obesity considering all payment sources. However, if obese people account for a lower percentage of the institutionalized population or the cost profile is smaller relative to those in institutions who are not obese, then the NHEA-adjusted estimates are upwardly biased.

Finally, the regression-based approach allows for quantifying the spending attributable to obesity by payer and point of service, but it does not directly allow for apportioning spending across specific diseases or the underlying behavior that causes excess weight (that is, poor diet and inactivity). This should be an area of future research.

Although these limitations represent important considerations, the connection between rising rates of obesity and rising medical spending is undeniable. The take-home message is that without a strong and sustained reduction in obesity prevalence, obesity will continue to impose major costs on the health system for the foreseeable future. And although health reform may be necessary to address health inequities and rein in rising health spending, real savings are more likely to be achieved through reforms that reduce the prevalence of obesity and related risk factors, including poor diet and inactivity. These reforms will require policy and environmental changes that extend far beyond what can be achieved through changes in health care financing and delivery.

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NOTES

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