



The Impact of Obesity on Rising Medical Spending in Oregon from 1998 to 2005

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Study Released April 6, 2009

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Introduction

The rising cost of health care, and what to do about it, is perhaps the most challenging health policy issue facing the United States. Health care is projected to account for 16.6 percent of U.S. gross domestic product (GDP) in 2008, compared with 12.3 percent nineteen years ago¹. During this period health care spending increased at an average annual rate of 6.6 percent per year (in nominal dollars). The most common factor cited as driving rising health costs has been the explosion of new medical technologies, which can improve care but tend to cost more than older modalities of treatment². However, total cost is also a function of how many people are receiving treatment for a given condition which in turn is driven by exposure to health risks like obesity, smoking, and environmental pollution, to name a few.

Obesity is closely associated with number of costly chronic conditions including diabetes, gallstones, hypertension, heart disease, hyperlipidemia, stroke, as well as some forms of cancer³. Moreover, the risk of death is higher among moderately and severely overweight men and women, regardless of age. Among the near-elderly (ages 50-69) medical care spending among the severely obese (body mass index, or BMI,

¹ Centers for Medicare and Medicaid Services; Research, Statistics, Data and Systems; National Health Expenditures Data; Historical: <http://www.cms.hhs.gov/NationalHealthExpendData/Downloads/proj2007.pdf> (Retrieved on August 20, 2008)

² J.P. Newhouse, "An Iconoclastic View of Care Cost Containment," *Health Affairs* 12 Supplement (1993):152-171

³ See for instance B. Burton, W. Foster, J. Hirsch, T. VanItallie, "Health implications of obesity: NIH Consensus Development Conference," *International Journal of Obesity Related Metabolic Disorder*. 1985; 9:155-169. Trends in obesity prevalence and total diabetes prevalence are discussed in E. Gregg et al., "Secular Trends in Cardiovascular Disease Risk Factors According to Body Mass Index in U.S. Adults," *Journal of American Medical Association* 293, no. 15(2005):11-29; Also S. Adams, Jr. et al., "Stress, Depression, and Anxiety Predict Average Symptom Severity and Daily Symptom Fluctuation in Systemic Lupus Erythematosus," *Journal of Behavioral Medicine* 17, no. 5 (1994): 459-477; S. Ames et al., "A Prospective Study of the Impact of Stress on Quality of Life: An Investigation of Low-Income Individuals with Hypertension," *Annals of Behavioral Medicine* 23, no. 2 (2001): 112-119; and Institute Of Medicine, *Clearing the Air, Asthma and Indoor Air Exposures* (Washington: National Academies Press, 2000)

35.0 or higher) is 60 percent higher than for those of normal weight⁴. Recent studies have estimated that health care spending is approximately 36 percent higher among obese adults under age sixty-five⁵. These findings lead to the question:

To what degree do increases in obesity prevalence and relative costs contribute to the growth in health care spending in Oregon? Obesity trends in Oregon followed closely the national trends over the last decade, increasing from 10.9 percent in 1990 to 23.8 percent in 2005 compared to 11.6 and 24.4 percent in the U.S.⁶. At the same time health care spending in Oregon grew on average 8 percent per year from 1991 to 2004 reaching \$17.516 million in 2004⁷. The study thus evaluates the impact the doubling of obesity prevalence has had on the increase in the health care outlays in Oregon from 1998 to 2005.

- **Study Data and Methods**
- **Data sources**

The data for the analysis came from the household component of the Medical Expenditure Panel Survey (MEPS-HC) conducted by the Agency for Healthcare Research and Quality (AHRQ). The survey provides nationally representative estimates of healthcare spending, insurance status, utilization of medical services, sources of payment, and disease prevalence along with a broad set of socioeconomic characteristics for the non-institutionalized civilian population in the U.S.⁸. The MEPS-HC uses an overlapping panel design, developing annual estimates by combining information from the first year of the new panel with that from the second year of the previous panel. To improve the quality of estimates

⁴ R. Sturm, "The Effects of Obesity, Smoking, and Drinking on Medical Problems and Costs," *Health Affairs* 21, no. 2 (2002): 245–253; and E.A. Finkelstein, I.C. Fiebelkorn, and G. Wang, "National Medical Spending Attributable to Overweight and Obesity: How Much, and Who's Paying?" *Health Affairs*, 14 May 2004, Web Content: <http://.healthaffairs.org/cgi/content/abstract/hlthaff.w3.219> (20 September 2004).

⁵ R. Sturm, "The Effects of Obesity, Smoking, and Drinking"; Finkelstein et al., "National Medical Spending Attributable to Overweight and Obesity"; N.P. Pronk, W. Tan, and P. O'Connor, "Obesity, Fitness, and Health Care Costs," *Medicine and Science in Sports and Exercise* 31, no. 5 (1999): s66; A. Wolf and G. Colditz, "Current Estimates of the Economic Cost of Obesity in the United States," *Obesity Research* 6, no. 2 (1998): 97–106; and C. Quesenberry, B. Caan, and A. Jacobson, "Obesity, Health Services Use, and Health Care Costs among Members of a Health Maintenance Organization," *Archives of Internal Medicine* 158, no. 5 (1998): 466–472

⁶ Oregon Behavioral Risk Factor Surveillance System, Oregon Department of Human Services; available at <http://www.dhs.state.or.us/dhs/publichealth/chs/brfss.cfm>

⁷ Health Expenditure Data, Health Expenditures by State of Residence, Centers for Medicare and Medicaid Services, Office of the Actuary, National Health Statistics Group, released September 2007; available at http://www.cms.hhs.gov/NationalHealthExpendData/05_NationalHealthAccountsStateHealthAccounts.asp#TopOfPage.

⁸ J.W. Cohen, A.C. Monheit, K.M. Beauregard, S.B. Cohen, D.C. Lefkowitz, D.E. Potter, J.P. Sommers, A.K. Taylor, R.H. Arnett, "The Medical Expenditure Panel Survey: A National Health Information Resource," *Inquiry*, 1996-1997 Winter; 33(4):373-89.

and smooth year-to-year fluctuations in expenditures in part due to random sampling⁹ we combined two years of data for each period, so that our 2005(1998) estimates are generated by pooling together data from 2004(1997) and 2005(1998) year surveys.

Given the scope of the study, we restricted the sample to adults aged 19 and above residing in the West region¹⁰, excluding pregnant women and those that gave birth in the survey. Additionally we excluded several outlier observations with total annual health care spending of over \$150,000 (4 observations in 2004 and 5 observations in 2005) to improve the overall match of our predictive framework. The resulting sample sizes in 1998 analysis amounted to 7,235 observations and 10,334 observations in 2005.

Since MEPS-HC does not allow identification of state of residence we employ a re-weighting procedure using data from the March Supplement to the Current Population Survey (CPS). The CPS is a monthly survey of about 57,000 households conducted by the Bureau of the Labor Statistics. The national probability sample of the civilian non-institutionalized population covered by the survey provides estimates for the nation as a whole, as well as particular states and smaller geographic units. The March Supplement to the CPS is the primary source of detailed information on income and work experience in the U.S. in addition to extensive data on demographics, educational attainment, family structure and health insurance status¹¹. 2004 through 2006 CPS surveys corresponding to 2003 through 2005 reference years were matched with 2004/2005 MEPS-HC samples. Analogously 1997-1999 CPS data were aligned with 1997/1998 MEPS-HC surveys. Identical restrictions were imposed on CPS data leaving us with 70,779 observations for 1998, and 108,293 observations for 2005 analysis.

- **Re-weighting MEPS-HC to resemble Oregon.**

A two-stage re-weighting procedure¹² was used to adjust MEPS-HC weights in a way that population estimates based on the West region data reproduce demographic, socioeconomic, insurance, and ultimately spending profiles of population in Oregon. First we estimate a probit model capturing the probability of Oregon residence among residents of the West region, and then apply the estimated

⁹ Machlin, Steven R., Marc W. Zodet, and J. Alice Nixon. (2003). "Estimates of Medical Expenditures from the Medical Expenditure Panel Survey: Gains in Precision from Combining Consecutive Years of Data." Proceedings of the American Statistical Association, Section on Survey Research Methods. Alexandria, VA: American Statistical Association, 2003.

¹⁰ Combines Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada, Washington, Oregon, California, Alaska, Hawaii;

¹¹ Further details are available at U.S. Census Bureau: <http://www.census.gov/apsd/techdoc/cps/cps-main.html#dbfmnabdm>.

¹² S. Zuckerman, R. Bovbjerg, J. Hadley, M. Cravens, L. Clemans-Cole. "The Cost of Care for Missouri's Uninsured." Missouri Foundation for Health, Cover Missouri Project (2006) at <http://www.mffh.org/CoverMoDataBook2.pdf> (accessed May 25, 2007); R. Bovbjerg, S. Dorn, J. Hadley, J. Holahan, and D. Miller. (2006). "[Caring for Uninsured in New York. What Does It Cost, Who Pays, What Would Full Coverage Add to Health Care Spending?](#)" Report, October 20, 2006. The Urban Institute, Washington DC: Publications

parameters to uniformly defined variables in MEPS-HC. The model conditions on gender, age, race/ethnicity, self-reported health status and disability, insurance status, an indicator for metro residence, indicators for the educational attainment, marital and employment status, family income as a percent of poverty line, family size, and interactions of these variables with race indicators. Insurance definitions differ substantially across the surveys; in particular, CPS insurance questions refer to the full-year coverage whereas MEPS-HC reports insurance status on a monthly basis. However, insurance distribution in the CPS has been shown to be more consistent with point in time rather than the full year status; additionally the CPS data significantly undercounts the number of persons with public coverage¹³. To mitigate these differences, we assign individuals into the publicly insured group based on 12 months status, and into the private category based on 3+ months of private coverage.

Predicted probabilities from the probit models were further used to define Oregon-adjusted weight in the MEPS-HC as follows:

$$OR_{perwt} = MEPS_{perwt} * [(1-P_{cps})/P_{cps}] * [P_{meps}/(1-P_{meps})], \text{ where}$$

$MEPS_{perwt}$ is the unadjusted person weight in MEPS-HC West sample,

P_{cps} is the actual probability of living in Oregon among persons in the CPS West sample,

P_{meps} is the predicted probability of living in Oregon among persons in the MEPS-HC West sample.

Following the initial adjustment we re-scaled the raw Oregon weights in MEPS-HC by key demographics from the CPS sample. Sex, age and race cells in CPS Oregon were matched with the corresponding cells in the MEPS-HC samples, producing scaling ratios based on sum of weights in each cells in CPS and MEPS-HC data. After re-scaling Oregon MEPS-HC weights reflect both the counts and distribution of observable characteristics of the Oregon adult population in each of the survey years.

Estimates in Table 1 illustrate the effect of re-weighting contrasting the distribution of socio-economic characteristics in the West sample in MEPS-HC to the CPS Oregon sample in 2005¹⁴. Oregon population appear to differ from an average resident of the Western region on a number of dimensions, including

¹³ G. Kenney, J. Holahan, and L. Nichols. "Special Section. Federal Health Data: National and State Level Uses and Issues." *Health Research and Educational Trust: Health Services Research* (2006). Vol. 41, No.3, Part I: 918-945

¹⁴ Estimates for 1998 are available upon request.

racial composition, higher high-school graduation rate, lower income and employment, yet substantially higher private insurance rate, percent of population in "Excellent" health, and higher share of elderly adults. The re-weighting procedure eliminates nearly 80 percent of differences between the samples lowering the sum of absolute differences from 129 to 28 points. The differences that persist after the re-weighting lead us to suspect that our estimates would be biased toward the mean for the West region, although given the magnitudes its effect is likely to be rather modest.

- **Decomposition of spending growth over time**

To evaluate the contribution of obesity to the growth in health care spending we decomposed the increase in per capita expenditures from 1998 to 2005 into a portion attributable to changes in weight distribution and all other factors. The decomposition relied on computing a "counterfactual" per capita spending equal to what per capita expenditures would have been, in 2005 if obesity remained at its 1998 level while diagnosis and treatment rates were as of 2005. To obtain the "counterfactual" we started by simulating four spending distributions by sequentially setting BMI indicators to one using a regression model.

A range of specifications were assessed when simulating spending distributions, including a two-part model with a single smearing estimator, as well as a retransformed log-model and a two-part model with a smearing estimator for each of the body-mass categories. Based on the commonly used routines¹⁵ and comparisons of mean squared error across the models, we concluded that a two-part general linear model (GLM) with a log-link transformation was the most appropriate statistical approach. The overall mean prediction generated by the model differed by less than 1 percentage points from the unadjusted mean, and was within 5 percentage points of the unadjusted mean for each BMI category.

The model controlled for weight (underweight, normal, overweight, obese), age (19-29, 30-39, 40-49, 50-64, 65 and older), gender, household head status, family size, marital status (widow, never married), language (language other than English is spoken at home), education (high school drop-out, college degree, graduate degree), number of months with health coverage (private insurance, Medicaid, Medicare, other public insurance, uninsured), race/ethnicity (Hispanic, Asian, Other (includes Black)), family income as a percent of the federal poverty line (less than 100 percent, 100-125 percent, 125-200, 200-399 percent, and 400 percent plus), and an indicator for a metropolitan residence.

Predicted mean spending levels were further scaled by per capita expenditures under the "Normal Weight" scenario to assess spending differentials across the weight groups net of differences in

¹⁵ P. Deb, W. Manning and E. Norton, "Modeling Health Care Costs and Counts," ASHE-Maddison Conference, 2006 (http://harrisschool.uchicago.edu/faculty/articles/ASHE_Minicourse_2006.pdf)

demographic and socioeconomic characteristics. Thus the "counterfactual" at a 1998 obesity distribution was computed as a product of the observed per capita spending for normal weight persons times the weight distribution as of 1998 and the corresponding scaled per capita spending prediction from 2005¹⁶.

▪ Results

By 2005 over half of the adult population in Oregon was categorized as overweight or obese, an increase of about 20percent from the 1998 level (Table 2). It was the obese rather than the overweight population that expanded tremendously gaining nearly 50percent over the 8 year period and affecting a staggering 23percent (604,000) of adults in Oregon. At the same time the share of "Normal Weight" contracted by about 10 percentage points, with only 40percent of adults having a healthy weight in 2005.

Using results from the regression model discussed earlier, we examined the implications of the shifting distribution of body mass among adults over time. We calculated adjusted per capita spending for underweight, normal weight, overweight and obese adults for each of the periods in our study. We found statistically significant differences in mean per capita costs between obese and normal weight adults for 1998 and 2005 (Table 3). The mean difference in inflation adjusted per capita spending between normal weight and obese adults increased sharply from 1998 to 2005¹⁶ rising from 29 to 49 percent higher spending among the obese. Once adjusted for differences in socio-economic and demographic composition between the BMI groups the ratios of mean spending under "Normal Weight" relative to "Obese" constituted half the magnitude of the raw differentials yet the increase in spending differentials over time between the groups held after the adjustment. It appears that in 1998 differences in observed characteristics by BMI status explain nearly in full spending differentials between normal weight and obese or overweight adults¹⁷. As obesity increased its toll over the period, it has started to spread more evenly across all population groups, including individuals with higher SES, educational level, etc., thus we observe the role of the demographics and SES decrease in the latter period revealing substantially higher predicted cost differentials.

¹⁶ In other words, the counterfactual per capita spending for 2005 was computed as follows: 2005 per capita spending for normal weight adults* (1998 proportion of obese adults*2005 per capita obese spending relative to normal weight adults+ 1998 proportion of overweight adults*2005 overweight per capita spending relative to normal weight adults+ 1998 share of normal weight adults*1+ 1998 proportion of underweight adults*per capita underweight spending relative to normal weight adults).

¹⁷ Taking a closer look at demographics across BMI groups we found that the obese in 1998 were on average substantially older, single(either divorce or never married), of lower educational attainment, lower income, worse access to health insurance (fewer months with either forms of coverage), and predominantly US born. Clearly, these dimensions characterize individuals with worse access to care and it least in the short run lower spending, which helps explain lack of variation in predicted health spending differentials. While some of these differences persist through 2005, the magnitude is substantially higher in 1998 analysis.

Turning to per capita growth in health care expenditures (Table 3), we observed that the overall spending was largely driven by spending on obese population which grew on average at about 4.7 percent annually compared to only 2.6 percent for the normal weight adults.

Based on the output from the regression model discussed, we calculated the counterfactual level of per capita spending for 2005 (Table 3) assuming the 1998 distribution of body mass. Using these results, we estimate the share of the rising in real per capita spending associated with the rise in obesity from 1998 to 2005. The rise in obesity accounted for nearly 34 percent of the real per capita growth in health care spending.

- **Conclusion**

What accounts for these differences in the role assumed by rising obesity rates over time? Rising rates of obesity have been associated with a rise in the clinical incidence and prevalence of several key chronic diseases such as diabetes, hypertension, hyperlipidemia, pulmonary disease and co-morbid depression. This higher rate of disease prevalence accounts for about a third of the rise in health care spending between 1998 and 2005. Another explanation lies with innovations in treating hyperlipidemia, depression, diabetes, and asthma/pulmonary diseases that occurred in the 1980s and early 1990s. Dubois and Dean¹⁸ document changes in clinical guidelines relating both to increased treatment intensity and to diagnosis at lower thresholds for conditions like asthma, diabetes, depression, high cholesterol, heart failure and hypertension occurring throughout mid to late 1990s. Growing evidence of the cardiovascular benefits associated with statins in lowering total cholesterol resulted in a sharp rise in their use. Similar trends in rising rates of medication treatment are true for treating hypertension and diabetes occurred through the late 1990s. Moreover, treatment rates among obese diabetics increased sharply during this period. Between 1980 and 2000, the ratio of diagnosed (treated) to total (treated and untreated) diabetes among obese adults increased from 51 to 72 percent.¹⁹ The overall ratio of diagnosed to total diabetes across all weight classes remained constant (about two-thirds) during this period. Both trends óchanges in recommended treatment thresholds and higher rates of detection--resulted in a sharp escalation in spending among obese adults.

Chart1. Changes in Obesity Prevalence among Adults in Oregon from 1989 to 2006.

¹⁸ R. Dubois, R. and B. Dean ., "Evolution of Medicines in Clinical Practice Guidelines: Why More People Use More Medications," *Disease Management*: August 1, 2006, 9(4): 210-223. doi:10.1089/dis.2006.9.210.

¹⁹ E.W. Gregg, "Secular Trends in Cardiovascular Disease Risk Factors According to Body Mass Index in US Adults" JAMA, derived from Table 2.



Source: Author tabulations from the Oregon Behavioral Risk Surveillance System data.

Table1. Comparisons Between MEPS West Sample Pre- and Post- Re-Weighting to OR CPS in 2005 Analysis.

	MEPS WEST Before Reweighting	MEPS WEST After 1st Stage	MEPS WEST After 2nd Stage	CPS OR	MEPS West vs. CPS OR	MEPS after 1st Re- weighting vs. CPS OR	MEPS after 2nd Re- weighting vs. CPS OR
Gender, Race, Ethnicity							
Female	49.82%	50.09%	50.23%	50.23%	-0.42%	-0.15%	
White	61.87%	86.72%	86.25%	86.25%	-24.38%	0.48%	
Hispanic	22.20%	6.48%	7.01%	7.01%	15.18%	-0.54%	
Asian	9.64%	4.48%	4.52%	4.52%	5.12%	-0.04%	
Other race	6.29%	2.32%	2.22%	2.22%	4.07%	0.10%	
Metro Area	88.55%	73.80%	73.88%	75.25%	13.30%	-1.45%	-1.37%
Marital Status							
Married	56.89%	55.29%	55.61%	56.39%	0.50%	-1.10%	-0.78%
Widowed, divorced, separated	19.82%	23.59%	23.73%	22.74%	-2.92%	0.85%	1.00%
Never Married	23.29%	21.12%	20.66%	20.88%	2.42%	0.25%	-0.21%
Education							

	MEPS WEST Before Reweighting	MEPS WEST After 1st Stage	MEPS WEST After 2nd Stage	CPS OR	MEPS West vs. CPS OR	MEPS after 1st Re- weighting vs. CPS OR	MEPS after 2st Re- weighting vs. CPS OR
No HS diploma	18.27%	13.08%	13.12%	12.04%	6.23%	1.04%	1.08%
HS diploma, assoc. degree	54.20%	61.58%	61.42%	62.45%	-8.25%	-0.87%	-1.03%
College degree	18.59%	17.49%	17.47%	17.28%	1.32%	0.21%	0.19%
Graduate degree	8.93%	7.86%	7.99%	8.24%	0.70%	-0.38%	-0.24%
Family Income							
<100% FPL	10.11%	9.65%	9.63%	10.35%	-0.24%	-0.70%	-0.72%
100-200% FPL	17.89%	18.57%	18.64%	19.08%	-1.19%	-0.51%	-0.44%
200-400% FPL	29.27%	32.24%	32.11%	33.24%	-3.97%	-0.99%	-1.12%
>400% FPL	42.73%	39.54%	39.61%	37.33%	5.40%	2.20%	2.28%
Employment and Disability							
Employed	66.43%	65.85%	65.44%	63.33%	3.10%	2.52%	2.11%
Unemployed	3.56%	5.15%	5.17%	4.51%	-0.95%	0.64%	0.66%
Not in labor force	30.01%	29.00%	29.39%	32.16%	-2.15%	-3.16%	-2.77%
Disabled	4.48%	4.21%	4.20%	4.93%	-0.45%	-0.71%	-0.73%
Insurance Status							
Private	66.59%	69.93%	69.86%	69.62%	-3.03%	0.31%	0.24%
Public	14.27%	11.28%	11.37%	12.46%	1.81%	-1.17%	-1.08%
Uninsured	19.14%	18.79%	18.77%	17.92%	1.22%	0.86%	0.84%
Self-Assessed Health							
Excellent	23.69%	25.65%	25.56%	29.49%	-5.79%	-3.83%	-3.93%
Very good	34.67%	33.60%	33.64%	30.72%	3.95%	2.88%	2.92%
Good	28.79%	27.50%	27.50%	25.80%	2.98%	1.69%	1.70%
Fair	9.44%	8.70%	8.71%	9.14%	0.30%	-0.43%	-0.43%
Poor	3.41%	4.54%	4.59%	4.86%	-1.45%	-0.31%	-0.27%
Age Groups							
19-25	12.80%	12.62%	11.82%	11.82%	0.99%	0.81%	
26-35	18.51%	17.45%	18.19%	18.19%	0.32%	-0.74%	
36-45	21.35%	19.64%	19.45%	19.45%	1.90%	0.19%	
46-55	19.89%	20.66%	19.78%	19.78%	0.11%	0.88%	
56-64	11.49%	12.52%	13.25%	13.25%	-1.76%	-0.73%	
65+	15.96%	17.12%	17.52%	17.52%	-1.56%	-0.40%	

	MEPS WEST Before Reweighting	MEPS WEST After 1st Stage	MEPS WEST After 2nd Stage	CPS OR	MEPS West vs. CPS OR	MEPS after 1st Re- weighting vs. CPS OR	MEPS after 2st Re- weighting vs. CPS OR
Sum of Absolute Differences					129.44%	34.14%	28.16%

Source: Tabulations from the pooled 2004/2005 Household Components of the Medical Expenditure Panel Survey and re-weighted and 2004/2006 March Supplements to the Current Population Survey restricted to residents of the Western states and Oregon respectively. See text for details on the re-weighting methodology.

Notes: The data were restricted to adults aged 19 and above, excluding women that gave birth in the survey year, along with observations with missing Body-Mass Index (BMI) information and implausible BMI values of under 10. Resulting samples sizes in Medical Expenditure Panel Survey 1998 analysis were 7,235 observations and 10,334 observations for 2005. The corresponding samples in Current Population Survey constituted 70,779 for 1998, and 108,293 observations for 2005 analysis.

Table2. Changes in BMI Distribution from 1998 to 2005.

Weight Group	Prevalence				Percentage- point change 1998-2005
	1998		2005		
	Prevalence	95% CI	Prevalence	95% CI	
Underweight	1.96%	[1.55%, 2.38%]	1.87%	[1.46%, 2.29%]	-0.09%
Normal Weight	49.14%	[47.42%, 50.86%]	40.08%	[38.17%, 42.00%]	-9.06%***
Overweight	33.22%	[31.64%, 34.79%]	35.11%	[33.60%, 36.63%]	1.90%*
Obese	15.68%	[14.15%, 17.20%]	22.93%	[21.32%, 24.54%]	7.25%***
Population	2,384,818		2,632,304		

Source: Tabulations from the pooled 1997/1998 and 2004/2005 Household Components of the Medical Expenditure Panel Survey re-weighted and standardized using the March Supplements to the Current Population Survey to resemble adult population in Oregon in 1998 and 2005. See text for details.

Notes: The data were restricted to adults aged 19 and above, excluding women that gave birth in the survey year, along with observations with missing Body-Mass Index (BMI) information and implausible BMI values of under 10. “Underweight” refers to persons with BMI under 18.5, “Normal” implies BMI within 18.5 and 24.9, “Overweight” describes persons within 30 to 34 BMI range, and “Obese” refers to BMI at or over 35. The analysis is carried out using Stata SE version 9 accounting for the complex survey design via SVY facility. The sample size for 1998 analysis is 7,235 and 10,334 observations for 2005. *** denotes statistical significance at over 1percent; * significance at 10percent;

Table3. Inflation-Adjusted Per Capita Health Care Spending Across Weight Categories and Simulated Health Spending Levels in 1998 and 2005.

Weight Group	Per Capita Spending						Annual Growth in Per Capita Health Care Spending
	1998			2005			
	I	II	III	IV	V	VI	
	Mean	Predicted Mean(\$)	Predicted Relative to Normal	Mean	Predicted Mean(\$)	Predicted Relative to Normal	
Underweight	\$4,402	\$3,745	1.27	\$4,378	\$4,404	1.24	0.999
Normal weight	\$2,762	\$2,954	1.00	\$3,315	\$3,552	1.00	1.026
Overweight	\$2,885	\$2,934	0.99	\$3,914	\$4,069*	1.15	1.045
Obese	\$3,574	\$3,020	1.02	\$4,936	\$4,271**	1.20	1.047
Total	\$2,962	\$2,979	1.01	\$3,918	\$3,944	1.11	1.041

Source: Tabulations from the pooled 1997/1998 and 2004/2005 Household Components of the Medical Expenditure Panel Survey re-weighted and standardized using the March Supplements to the Current Population Survey to resemble adult population in Oregon in 1998 and 2005. See text for details.

Notes: Per capita mean spending levels displayed in columns II and V illustrate the extent of health care expenditures had the whole population been “Underweight”, “Normal Weight,” etc. simulated via a two-part GLM model as discussed in the Methods Section. *** denotes statistically significant difference from predicted per capita spending under normal weight at 5percent level; * significance at 10percent level;

Table4. Obesity-Attributable Share of Growth in HC Spending from 1998 to 2005.

obesity prevalence at 1998 obesity level	
2005 predicted relative shares	2005
mean spending levels	
Per capita health spending in 2005	\$3,918
Counterfactual per capita spending in 2005	\$3,596
Per capita spending in 1998	\$2,962
Actual increase	\$955
Obesity-attributable increase	\$321
Increase due to other factors	\$634
Obesity-attributable share of spending growth	33.63percent

Source: Tabulations from the pooled 1997/1998 and 2004/2005 Household Components of the Medical Expenditure Panel Survey re-weighted and standardized using the March Supplements to the Current Population Survey to resemble adult population in Oregon in 1998 and 2005. See text for details.