Overweight and Overburdened:

Race and Gender Disparities in the Incidence of the Healthcare Costs of Obesity

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Abstract

The incidence of medical costs of obesity disproportionately falls on women and racial minorities. Prior research has shown that when employers provide health insurance coverage to workers, the additional healthcare costs associated with obesity are passed through to obese workers in the form of reduced wages, relative to their non-obese counterparts. However, estimation of a population-level wage penalty of obesity obscures substantial variation in the relative impact of these wage differences by race and gender. We partition the 1979 NLSY data by race and gender, and find that while the dollar-denominated wage penalty borne by obese workers with health insurance is borne predominantly by white women, these wage offsets disproportionately impact blacks and white women when modeled as a percentage of income.

Background

Obesity is a major contributor to increasing healthcare costs in the United States. Obese individuals incur annual medical expenditures estimated to be more than $700 greater than those faced by normal weight individuals (Finkelstein, Fiebelkorn, & Wang, 2003). Understanding who ultimately pays for this increased expenditure is a vital issue of health economics and policy, particularly given the significant and rising burden of obesity in the US population.

The incidence of medical costs of obesity is however difficult to observe directly, due to complex factors driving labor market outcomes. For example, if an unobserved factor (such as environmental stressors or motivation) contributed to both obesity and other aspects of human capital development, the effect of obesity per se on wages would be overestimated. An additional complication is that because many firms offer insurance coverage to employees, differences in expected healthcare costs will likely factor into compensation decisions made by firms.

Understanding the incidence of these costs – that is, the extent to which insurance markets allocate the burden of obesity healthcare costs to workers, firms, and customers - has profound implications for future health policy. The medical costs of obesity may be borne primarily by insurers; particularly employer-sponsored insurance plans which account for the majority of health insurance coverage for adults under 65. Such plans tend not to risk-adjust individual premiums (i.e. they do not charge obese enrollees more), and thus may transfer the bulk of obesity-related healthcare costs to employers and insurers in the form of higher group plan premiums. This in turn may drive adverse selection of obese individuals into such plans and create moral hazard in personal governance of 'obesogenic' behavior.

Conversely, it may be that medical costs of obesity are transferred to obese individuals through wage penalties that offset the actuarial risk associated with providing employer-sponsored insurance. This in turn may have profound implications for health equity and obesity prevalence rates. Obesity is disproportionately prevalent in groups of lower socio-economic status and in certain racial minorities (Black and Mexican-Americans), with a direct causal relationship being proposed between SES and obesity (Drewnowski & Specter, 2004). Wage penalties associated with obesity may

lead to a reciprocally reinforcing relationship between obesity and income if they fall disproportionately on groups already predisposed to increased risk of being obese. If the costs of obesity are entirely borne by obese individuals in the form of lower wages, this 'efficiency' may actually militate against efforts to lower the prevalence of obesity in these populations. Furthermore, if the cost-shifting effect of obesity is greater than the estimated costs of obesity, such wage discrimination may lead to a socially suboptimal equilibrium that traps certain groups in a low-income/obesity spiral.

Bhattacharya and Bundorf (2009), hereafter BB, use data from the National Longitudinal Survey of Youth (NLSY) to estimate the incidence of the healthcare costs of obesity. In order to do so, the authors employ a difference-in-differences framework, using an analysis of 31,176 observations from 7,153 surveyed individuals. Rather than comparing treated and untreated groups before and after an intervention (the conventional difference-in-differences approach), BB estimates the adjusted hourly wages of obese and non-obese workers, and then compares these differences among active workers with and without employer-sponsored health insurance. The authors conclude that medical costs of obesity are transferred to obese employees through a wage penalty of $1.45 per hour, after controlling for employee characteristics. Using a model predicting log-transformed wages, this translates to roughly a 5% reduction in pay. We build on Bhattacharya and Bundorf's analysis, using Mahalnobis-distance matching to preprocess the data and estimating the obesity-insurance wage penalty by race and gender.

Data & Methods

We use the same sample from NLSY employed by BB, covering all respondents with completely observed data on variables of interest between 1989 and 2002. NLSY is cohort-based, nationally representative, longitudinal survey of 12,686 individuals aged 14-22 years in 1979.

Of relevance to our study, NLSY collects respondent-reported data on a range of biological and socioeconomic characteristics (including height, weight, health insurance status and employment), that allow for analysis of individual level relationships between self-reported body mass index (BMI) and employment income. BB employ list-wise deletion to address for missingness in covariates, citing prior work on the NLSY

indicating that differential attrition was not a major concern. However, because we were unable to rebuild the data set from publicly available NLSY resources and the authors were only able to provide a final, cleaned analysis file which had already undergone list-wise deletion, we are not able to resolve this claim.

To potentially improve the inferential validity of our analysis we implement nearest neighbor Mahalanobis distance matching to better balance observed covariates between obese and non-obese respondents, matching on a number of respondent characteristics: (sex, age, race, presence of children in household, being female with children at home, marital status, education, AFQT score, residing in an urban area, job tenure, occupation, industry, employer size and survey year). We then explore the possibility that any obesity-insurance wage penalty differs by pairs of race and gender, and that the dollar-denominated penalty has differential impact on these groups, when considered as a percent-change in total wages.

Results

Effect of implementing Mahalanobis distance matching on sample characteristics

Matching led to small but potentially important improvements in overall balance between obese and non-obese groups included in our analysis. A balance table summarizing the results appears as Appendix 1. Nearest neighbor matching resulted in an analytic sample of 12,764 observations (6,382 obese, 6,382 non-obese), compared with a pre-match sample of 31,176 observations (6,382 obese, 24,794 non-obese).

Although summary measures of balance suggest the effect of matching was modest (multivariate imbalance measure L1 = 0.998, local common support = 0.1%.), covariate-level balance improved more notably, with 23 variables becoming balanced after matching, 18 variables remaining balanced after matching, 2 variables becoming unbalanced after matching and 15 variables remaining unbalanced after matching.

Importantly, the mean hourly wage difference between obese and non-obese individuals (the principal outcome measure) reduced significantly after matching; ($15.18 for non-obese and $14.13 for obese respondents before matching ($p<0.001$), $14.59 for non-obese and $14.13 for obese respondents after matching ($p=0.08$). This finding suggests that analysis conducted on the pre-matched dataset may bias towards

over-estimating the wage-penalty associated with obesity. We subsequently undertook sensitivity analyses, comparing the results of inferential analyses on the matched and pre-matched datasets but found no significant effect on estimation of our principal outcomes.

Race, Gender, and the Obesity-Insurance Wage Penalty

BB report that the wage penalty estimated when implementing their model using all workers is actually disproportionately borne by women. This significant finding points to opportunities to extend this analysis by estimating the wage penalty by race and by race and gender. However, the analyses from BB suggest two possible dependent variables, with different interpretations - hourly wages, and log-transformed hourly wages.

BB advocate use of untransformed wages, which fit better with their research question and theoretical model. The authors are attempting to estimate the healthcare costs which are passed along to insured employees in terms of dollar spent. Using this metric, is it possible to compare the penalty paid by workers to population estimates of the medical costs of obesity, and ask whether workers are over- or under-burdened by this allocation of costs.

However, for employees themselves, the implication of percent changes in wages may be significantly more important than dollar-denominated differences. A fixed, dollar-denominated penalty represents a much greater burden for low-income workers than for employees at the upper end of the income distribution. Thus expressing the penalty in terms of a percent change in wages – accomplished by using log-transformed wages as the dependent variable – is more informative. Doing so makes direct comparisons between the expected costs of obesity and the wage penalty more difficult, but by combining the use of a log-transformed dependent variable with subsetting the sample by race and gender, we may gain new insights into disparities which are intensified by the incidence of the healthcare costs of obesity.

We proceed with these analyses using the original, non-matched sample due to the similarity of the results from Table 1, and to ensure adequate sample size to analyze relatively small groups, such as black women. The results from these analyses appear in Tables 2 through 7. Beginning with the models predicting untransformed wages and

looking at the results for the obesity effects by race, we see in Table 2, similar to the original results, obesity per se does not significantly impact wages when controlling for the interaction between obesity and insurance coverage. However, we find that the wage penalty (*Obese x Insured*) for obese workers with insurance coverage is concentrated among white respondents. The estimated effect for black is in the same direction, though smaller and no longer significant (and more precisely estimated, despite the smaller sample size).

In Tables 3 and 4, we present the results when estimating the same model separately by race-gender pairs. Using these specifications, we find that only the wage penalty is significant only for white women, and that the effect is roughly twice the size found when estimating the wage penalty for the population as a whole – in other words, obese white women earn more than $3.00 less per hour than their non-obese counterparts. For the other groups, the effects are smaller and non-significant.

Tables 5 through 7 present the results when the dependent variable is log-transformed wages, rather than dollar-denominated wages. In these tables, the coefficient estimates can be interpreted as percent changes in wage. In Table 5, we see that the results have changed – as a percent of employee wages, the obesity-insurance wage penalty represents a significant 10.4% reduction for black employees, more than three times the percent change for white workers. In Tables 6 and 7 which follow, we see that white men's wages are only trivially affected by the *Obese x Insured* term, whereas white women and both black men and women bear statistically significant wage penalties, as a percentage of pay. Black men's wages are reduced by 11.2%, and both black and white women see reductions of roughly 9%.

Discussion

Our analysis builds on the approach used by Bhattacharya and Bundorf (2009). We assess the impact of improving balance on covariates and find that while the high-dimensionality of the matching covariates prevents us from achieving a globally high-quality match, it was possible to improve the balance along a number of covariates. Matching served to reduce model dependency and strengthen inferential capacity, however, as indicated in Table 1, this change did not substantively alter the findings from the original paper.

Partitioning the sample and estimating the obesity-insurance wage penalty by race-gender pairs did however provide new insights into the incidence of medical costs of obesity in the US. In terms of a dollar-denominated wage penalty, the effect is largest and only significant for white women, with an impact of reducing wages by over $3.00 per hour. However, when looking instead at the impact of the wage penalty as a percent of wages, we tell a very different story. For white men, the penalty is nearly zero and statistically insignificant, whereas the penalty is substantial for all other respondents, reaching roughly 9% of wages for women and 11% for black men. Simply by reorganizing the data and critically assessing the dependent variables used, we were able to add substantial granularity to the results from BB, and point to significant disparities in the incidence of the healthcare costs of obesity.

References

Bhattacharya, J., & Bundorf, M. K. (2009). The incidence of the healthcare costs of obesity. *Journal of Health Economics*, *28*(3), 649–58.

Drewnowski, A., & Specter, S. E. (2004). Poverty and obesity: the role of energy density and energy costs. *The American Journal of Clinical Nutrition*, *79*(1), 6–16.

Finkelstein, E. A., Fiebelkorn, I. C., & Wang, G. (2003). National Medical Spending Attributable To Overweight And Obesity: How Much, And Who's Paying? *Health Affairs*.

Table 1: Estimates of the obesity wage offset for health insurance, Original and Matched Samples

	Dependent variable:	
	Original	Matched
	(1)	(2)
Obese	−0.203	0.090
	(0.491)	(0.548)
Insured	2.368***	2.590***
	(0.261)	(0.468)
Obese x Insured	−1.448**	−1.554**
	(0.567)	(0.676)
Constant	24.435***	31.619**
	(7.342)	(13.743)
Note:	*p<0.1; **p<0.05; ***p<0.01	

Table 2: Estimates of the obesity wage offset by race

	Dependent variable:	
	Black	White
	(1)	(2)
Obese	0.231	−0.293
	(0.339)	(0.653)
Insured	1.976***	2.396***
	(0.286)	(0.316)
Obese x Insured	−0.727	−1.556**
	(0.449)	(0.734)
Constant	31.539**	23.130***
	(12.412)	(8.520)
Note:	*p<0.1; **p<0.05; ***p<0.01	

Table 3: Estimates of the obesity wage offset by race - males

	Dependent variable:	
	Black	White
	(1)	(2)
Obese	0.593	−1.007
	(0.536)	(0.615)
Insured	1.788***	2.514***
	(0.353)	(0.430)
Obese x Insured	−0.474	−0.562
	(0.673)	(0.779)
Constant	33.921**	26.372**
	(13.499)	(11.236)
Note:	*p<0.1; **p<0.05; ***p<0.01	

Table 4: Estimates of the obesity wage offset by race - females

	Dependent variable:	
	Black	White
	(1)	(2)
Obese	−0.559	0.723
	(0.390)	(1.337)
Insured	2.073***	2.361***
	(0.466)	(0.394)
Obese x Insured	−0.742	−3.104**
	(0.542)	(1.360)
Constant	25.820	8.772
	(22.005)	(12.229)
Note:	*p<0.1; **p<0.05; ***p<0.01	

Table 5: Estimates of the log obesity wage offset by race

	Dependent variable:	
	Black	White
	(1)	(2)
Obese	0.066^{**}	-0.053^{**}
	(0.027)	(0.026)
Insured	0.228^{***}	0.231^{***}
	(0.017)	(0.015)
Obese x Insured	-0.104^{***}	-0.031
	(0.031)	(0.029)
Constant	2.151^{***}	2.197^{***}
	(0.380)	(0.256)
Note:	*p<0.1; **p<0.05; ***p<0.01	

Table 6: Estimates of the log obesity wage offset by race - males

	Dependent variable:	
	Black	White
	(1)	(2)
Obese	0.115^{***}	-0.052
	(0.041)	(0.034)
Insured	0.229^{***}	0.236^{***}
	(0.020)	(0.019)
Obese x Insured	-0.112^{**}	0.002
	(0.046)	(0.037)
Constant	2.275^{***}	2.160^{***}
	(0.475)	(0.322)
Note:	*p<0.1; **p<0.05; ***p<0.01	

Table 7: Estimates of the log obesity wage offset by race - females

	Dependent variable:	
	Black	White
	(1)	(2)
Obese	0.001	−0.061
	(0.035)	(0.041)
Insured	0.216***	0.221***
	(0.030)	(0.022)
Obese x Insured	−0.089**	−0.093**
	(0.040)	(0.045)
Constant	1.926***	2.049***
	(0.609)	(0.416)
Note:	*p<0.1; **p<0.05; ***p<0.01	

Appendix 1: Results of sample pre-processing with Mahalanobis matching

Table 1: Effect of Mahalanobis matching on weighted mean sample characteristics

Variable	Pre-match non-obese	Pre-match obese	Pre-match p-value	Post-match non-obese	Post-match obese	Matched p-value
Hourly wage*	15.18	14.13	<0.001	14.59	14.13	0.081
Employer coverage in own name	0.8	0.81	0.147	0.79	0.81	0.002
Uninsured	0.2	0.19	0.147	0.21	0.19	0.002
BMI	24.45	34.24	<0.001	24.92	34.24	<0.001
Mildly obese (BMI>30 and BMI<35)	0	0.7	<0.001	0	0.7	<0.001
Morbidly obese (BMI>35)	0	0.3	<0.001	0	0.3	<0.001
Overweight	0.45	0	<0.001	0.52	0	<0.001
Obese * employer coverage (own)	0	0.81	<0.001	0	0.81	<0.001
Female	0.37	0.36	0.233	0.36	0.36	0.398
Any children in household	0.53	0.59	<0.001	0.59	0.59	0.385
Female with children in household	0.21	0.22	0.031	0.22	0.22	0.31
Race - Black	0.12	0.17	<0.001	0.15	0.17	<0.001
Race - Other	0.02	0.03	0.03	0.03	0.03	0.371
Never married	0.25	0.25	0.366	0.25	0.25	0.386
Formerly married	0.21	0.19	<0.001	0.18	0.19	0.282
Age	33.87	35.77	<0.001	34.64	35.77	<0.001
Education: 9-12	0.52	0.6	<0.001	0.61	0.6	0.129
Education: 13 and over	0.46	0.38	<0.001	0.38	0.38	0.396
AFQT: 0-25	0.14	0.18	<0.001	0.16	0.18	0.004
AFQT: 25-50	0.22	0.24	0.002	0.27	0.24	<0.001
AFQT: 50-75	0.29	0.29	0.345	0.29	0.29	0.391
AFQT: 75-100	0.36	0.29	<0.001	0.28	0.29	0.157
Urban residence	0.76	0.69	<0.001	0.74	0.69	<0.001
Job tenure: 0-1 years	0.2	0.17	<0.001	0.19	0.17	0.001
Job tenure: 1-3 years	0.23	0.22	0.048	0.24	0.22	0.014
Job tenure: 3-6 years	0.21	0.2	0.004	0.22	0.2	0.003
Job tenure: 6+ years	0.35	0.41	<0.001	0.35	0.41	<0.001
Employer size: 0-9	0.18	0.17	0.126	0.18	0.17	0.274
Employer size: 10-24	0.14	0.15	0.296	0.14	0.15	0.387
Employer size: 25-49	0.12	0.12	0.207	0.12	0.12	0.352
Employer size: 50-999	0.41	0.45	<0.001	0.44	0.45	0.177
Employer size: 1000+	0.14	0.11	<0.001	0.12	0.11	0.087
Survey year: 1989	0.13	0.07	<0.001	0.09	0.07	<0.001
Survey year: 1990	0.12	0.07	<0.001	0.11	0.07	<0.001
Survey year: 1992	0.11	0.08	<0.001	0.09	0.08	0.05
Survey year: 1993	0.12	0.1	<0.001	0.11	0.1	0.072
Survey year: 1994	0.11	0.1	0.078	0.1	0.1	0.387
Survey year: 1996	0.11	0.13	0.002	0.14	0.13	0.097
Survey year: 1998	0.11	0.14	<0.001	0.13	0.14	0.102
Survey year: 2000	0.1	0.16	<0.001	0.11	0.16	<0.001
Survey year: 2002	0.09	0.16	<0.001	0.12	0.16	<0.001

Variable	Pre-match non-obese	Pre-match obese	Pre-match p-value	Post-match non-obese	Post-match obese	Matched p-value
Industry: Agriculture	0.02	0.02	0.237	0.02	0.02	0.382
Industry: Forestry	0	0	<0.001	0	0	0.01
Industry: Mining	0.01	0.01	0.179	0.01	0.01	0.31
Industry: Construction	0.08	0.06	<0.001	0.06	0.06	0.295
Industry: Manufacturing	0.27	0.28	0.16	0.28	0.28	0.341
Industry: Transport	0.08	0.08	0.39	0.08	0.08	0.388
Industry: Wholesale trade	0.04	0.04	0.295	0.04	0.04	0.098
Industry: Retail trade	0.14	0.16	<0.001	0.16	0.16	0.379
Industry: Finance	0.08	0.06	<0.001	0.06	0.06	0.399
Industry: Business services	0.08	0.08	0.302	0.08	0.08	0.397
Industry: Personal services	0.02	0.03	0.011	0.03	0.03	0.399
Industry: Entertainment	0.01	0.01	0.132	0.01	0.01	0.322
Industry: Professional services	0.16	0.16	0.253	0.17	0.16	0.307
Industry: Public administration	0.01	0.01	0.212	0.01	0.01	0.395
Occupation: Management	0.28	0.22	<0.001	0.22	0.22	0.314
Occupation: Technical	0.14	0.12	0.001	0.12	0.12	0.338
Occupation: Administrative	0.14	0.14	0.219	0.14	0.14	0.396
Occupation: Service	0.08	0.11	<0.001	0.11	0.11	0.386
Occupation: Farming	0.02	0.02	0.265	0.02	0.02	0.228
Occupation: Production	0.15	0.17	<0.001	0.16	0.17	0.194
Occupation: Operators	0.19	0.21	0.007	0.21	0.21	0.345
Occupation: Military	0.01	0.01	<0.001	0.02	0.01	0.164

Results of nearest neighbor Mahalanobis distance matching on sex, age, race, presence of children in household, being female with children at home, marital status, education, AFQT score, residing in an urban area, job tenure, occupation, industry, employer size and survey year. P-values are derived from a weighted Welch 2-sample t-test of differences between means of obese and non-obese groups.

Table 2: Effect of Mahalanobis matching on balance of covariates

Variable	Balanced before matching	Balanced after matching	Balance improved by matching
Hourly wage*	No	Yes	Yes
Employer coverage in own name	Yes	No	No
Uninsured	Yes	No	No
Female	Yes	Yes	No
Any children in household	No	Yes	Yes
Female with children in household	No	Yes	Yes
Race - Black	No	No	No
Race - Other	No	Yes	Yes
Never married	Yes	Yes	No
Formerly married	No	Yes	Yes
Age	No	No	No
Education: 9-12	No	Yes	Yes
Education: 13 and over	No	Yes	Yes

Variable	Balanced before matching	Balanced after matching	Balance improved by matching
AFQT: 0-25	No	No	No
AFQT: 25-50	No	No	No
AFQT: 50-75	Yes	Yes	No
AFQT: 75-100	No	Yes	Yes
Urban residence	No	No	No
Job tenure: 0-1 years	No	No	No
Job tenure: 1-3 years	No	No	No
Job tenure: 3-6 years	No	No	No
Job tenure: 6+ years	No	No	No
Employer size: 0-9	Yes	Yes	No
Employer size: 10-24	Yes	Yes	No
Employer size: 25-49	Yes	Yes	No
Employer size: 50-999	No	Yes	Yes
Employer size: 1000+	No	Yes	Yes
Survey year: 1989	No	No	No
Survey year: 1990	No	No	No
Survey year: 1992	No	No	No
Survey year: 1993	No	Yes	Yes
Survey year: 1994	Yes	Yes	No
Survey year: 1996	No	Yes	Yes
Survey year: 1998	No	Yes	Yes
Survey year: 2000	No	No	No
Survey year: 2002	No	No	No
Industry: Agriculture	Yes	Yes	No
Industry: Forestry	No	No	No
Industry: Mining	Yes	Yes	No
Industry: Construction	No	Yes	Yes
Industry: Manufacturing	Yes	Yes	No
Industry: Transport	Yes	Yes	No
Industry: Wholesale trade	Yes	Yes	No
Industry: Retail trade	No	Yes	Yes
Industry: Finance	No	Yes	Yes
Industry: Business services	Yes	Yes	No
Industry: Personal services	No	Yes	Yes
Industry: Entertainment	Yes	Yes	No
Industry: Professional services	Yes	Yes	No
Industry: Public administration	Yes	Yes	No
Occupation: Management	No	Yes	Yes
Occupation: Technical	No	Yes	Yes
Occupation: Administrative	Yes	Yes	No
Occupation: Service	No	Yes	Yes
Occupation: Farming	Yes	Yes	No
Occupation: Production	No	Yes	Yes
Occupation: Operators	No	Yes	Yes
Occupation: Military	No	Yes	Yes