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ABSTRACT

Growing consumption of increasingly less expensive food, and especially "fast food", has been cited as a potential cause of increasing rate of obesity in the United States over the past several decades. Because the real minimum wage in the United States has declined by as much as half over 1968-2007 and because minimum wage labor is a major contributor to the cost of food away from home we hypothesized that changes in the minimum wage would be associated with changes in bodyweight over this period. To examine this, we use data from the Behavioral Risk Factor Surveillance System from 1984-2006 to test whether variation in the real minimum wage was associated with changes in body mass index (BMI). We also examine whether this association varied by gender, education and income, and used quantile regression to test whether the association varied over the BMI distribution. We also estimate the fraction of the increase in BMI since 1970 attributable to minimum wage declines. We find that a $1 decrease in the real minimum wage was associated with a 0.06 increase in BMI. This relationship was significant across gender and income groups and largest among the highest percentiles of the BMI distribution. Real minimum wage decreases can explain 10% of the change in BMI since 1970. We conclude that the declining real minimum wage rates has contributed to the increasing rate of overweight and obesity in the United States. Studies to clarify the mechanism by which minimum wages may affect obesity might help determine appropriate policy responses.

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Since 1970, the rate of obesity in the US increased from about 14% to over 25% and has come to be recognized as a major public health concern.[1,2,3,4,5,6,7,8,9] Understanding the causes of obesity is important because it may suggest strategies to address the increase in obesity. Increases in body weight are the result of an excess of caloric intake relative to caloric expenditure. Changes in both caloric expenditure and caloric intake have been hypothesized to have contributed to increasing obesity in the United States. Factors that have been suggested to have decreased caloric expenditure include the development of a more sedentary lifestyle due to the decreasing role of physical labor in work and increasingly sedentary nature of leisure activities due to the growth of television and video games. Factors affecting food consumption that have been emphasized include the greater consumption of “fast food” away from home and the declining cost of eating a diverse set of foods at home due to the increased availability of low-cost prepared and highly processed foods.[10,11,12,13]

The consumption of fast food has received particular attention as a cause of obesity. Chou, Grossman and Saffer (2004) found that people who live in closer proximity to fast food restaurants are more likely to be obese.[14] However, this finding might not reflect a causal effect of the presence of fast food restaurants on obesity but instead a tendency for fast food restaurants to locate in areas where the demand for their products will be greater. Even if this association were viewed to reflect a causal effect of fast food restaurants on obesity, it would not explain why the number of fast food restaurants should have increased.

Because minimum wage labor makes up about one third of the cost of fast food and because the real minimum wage has varied nationally and across states over time due to changes in state and federal minimum wage laws and inflation that would not seem to have any independent reasons to affect obesity, variation in real minimum wages may provide a powerful mechanism to provide a test for the hypothesis that fast food consumption may play a role in increasing obesity in the United States. While the variation in the real minimum wage across states over time is the critical element for this test of the hypothesis, the fact that the real minimum wage in 2007 constant dollars fell from a maximum of about $9.15 in 1968 to a low of about $5.80 in 2007 suggests that it is possible that the decline in real minimum wage itself may have played a role in the long-term increase in obesity over this period.[15] Although our analysis does not support a direct test of the hypothesis that a decline in the minimum wage could affect obesity by increasing the consumption of fast food, we complement this analysis in our discussion by calibrating them against the results of other studies that have examined how declines in the minimum wage would translated into lower prices for food away from home[16,17,18,19] and how increased consumption of food away from home would increase obesity.[20] Since the results of this calibration exercise are similar in magnitude to the results of our primary analysis of the association of minimum wages and obesity, this helps provide confidence that the association we observe may reflect a causal pathway to obesity through increased consumption of fast food.

METHODS

Real minimum wages were calculated using data on nominal minimum wages and consumer price indices (CPI) from 1984-2006, the years for which our obesity data were available. Nominal minimum wage data by state was obtained from the Bureau of Labor Statistics.[21] We then calculated the real wage rates in 2006 dollars by dividing the nominal wage rates by the census-region-specific all items CPI.[22] Because most fast food restaurants are part of chains that are classified as interstate commerce and are therefore subject to Federal minimum wage legislation,[23] we used the higher of the Federal minimum wage and the state minimum wage. Figure 1 reports the trends in mean nominal and real minimum wage rates across states weighted to reflect the distribution of population in our obesity data, which is intended to be representative of the US non-institutionalized adult population. The pattern of changes in these average real minimum wages reflects a combination of Federal nominal minimum wages increases in 1990 and 1996 (denoted by large squares) and multiple state increases over time, and the tendency for inflation to erode the average real minimum wage in the absence of legislated increases. Despite the two increases in the Federal minimum wage and numerous increases in state minimum wages, the mean real minimum wage rate faced by respondents in our sample declined from $6.40 in 1984 to $5.82 in 2006. Although this overall change was modest, the powerful effect of the Federal minimum wage caused much larger variations in average real minimum wages over shorter time periods. For example, from September 1997 when the federal minimum was raised to $5.15 an hour, to the end of the period studied the average real minimum wage fell from $6.47 to $5.82. Seventeen states had state minimum wage rates above the federal minimum wage by April 2006. Oregon, Vermont, and Washington automatically adjust minimum wage rates each year using state consumer price indices.[21]

We studied the effects of these minimum wage changes among respondents to the Behavior Risk Factor Surveillance System (BRFSS) from 1984-2006.[24] The BRFSS surveys health risk behaviors among non-institutionalized American civilian adults age 18 and older and is the most commonly used source of data for national studies of obesity and physical activity in the United States.[14] Data for BRFSS is collected by state health departments using computer assisted telephone interviewing with coordination by the Centers for Disease Control and Prevention. When data collection for BRFSS began, only 15 states participated. However, by 1994, all 50 states, the District of Columbia, and 3 territories participated.

The 1984-2006 BRFSS includes 3,256,947 valid interview records. We excluded pregnant women (33,385) and records with missing information on weight, height, and key confounding factors (165,410). We also excluded records with values of body mass index (BMI) (weight in kilograms divided by height in meters squared) that we considered implausible: 863 with BMI < 14 and 8,911 with BMI > 50. This left a final study sample of 3,048,378, individuals with complete information. The BRFSS group provides a final sampling weight to control for the sampling bias.[24] Figure 2 illustrates the trend of the weighted mean of BMI and proportion of obesity individual among the BRFSS sample and sub-samples by gender group.

Statistical Analysis

Multivariable linear regression models were used to study the effects of the real minimum wage on BMI. Regressions controlled for race and ethnicity, age, marital status, education, income, state fixed effects, and year effects, with coding as described in Table 1. Categories for household income interval indicators were obtained from the original surveys. Due to changes in survey design over time, the indicator for household income greater than $50,000 applies only to responses after 1984, and the indicator for income greater than $75,000 applies only from 1994-2006. We assign zero to these variables when they are not applicable. Because the categorical nature of these income variables makes adjustment for inflation difficult, we include interaction terms of categorical income indicators and years. In addition, we also examined specifications that did not include income and that interacted income with indicators for time period. Furthermore, because the minimum wage could have a direct effect on income, especially for low income persons,[25] we also examined specifications that divided the sample into high and low income groups. We estimated all models on the full sample and on male and female samples separately. Because health status and weight may decline with advancing age and more rapidly among older persons, we also estimated models without persons older than 60. Robust or Huber-White errors are used in calculating the confidence intervals and the p-values to account for serial correlation and state/year clustering in the linear models.[14,26]

Because we expected that the effects of the minimum wage on bodyweight might not be uniform across different parts of the bodyweight distribution, we also examined BMI using quantile regression models.

Statistical analyses were performed using the survey data analysis commands of Stata software, version 9 (Stata Corporation).

Results

The summary statistics are presented in Table 1. Over the study period, the average BMI is 25.8 for the full sample, 26.4 for males, and 25.2 for females. The percentage of obese individuals is roughly 17% for the full sample and for both genders. The weighted mean age is 44.8 for full sample but the male sample is significantly younger than the female sample. This presumably reflects the greater life expectancy of females.

Table 2 provides the estimates of the linear regression models for BMI. The results suggest that a one-dollar increase in minimum wage is associated with a 0.06 decrease in mean BMI. The results for male and female samples separately are similar.

Quantile regression results showed that the effects vary by BMI, with the effects increasing steadily across the BMI distribution to a maximum effect of one dollar increase in the real minimum wage on BMI of 0.13 in the 90th percentile. Results were again similar when men and women were analyzed separately.

Contribution of Minimum Wage Decreases to Increasing BMI and Obesity.

During the period covered by the BRFSS data, the average real minimum wage fell from a maximum of \$6.40 in 1984 to \$5.82 in 2006, with the Federal minimum real wage falling even further, from \$6.30 to \$5.20. From when the Federal minimum wage was last increased during our study period (1997) to the conclusion of our study period in 2006, the average real minimum wage fell from \$6.50 to \$5.82 and the real value of the Federal minimum wage fell from \$6.40 to \$5.20. Multiplying these changes in the average real wage by the estimates from the linear model suggest that the \$0.58 decline in the real minimum wage from 1984 to 2006 would produce a \$0.58 x 0.06 = 0.035 increase in BMI. Since average BMI increased by about 2.6 from 1984 to 2006 (from about 24.4 to 27.0), this is only 1-2% of the increase in BMI over the period. If we consider the most recent period during which the real minimum wage has been continuingly decreasing, 1997-2006, the \$0.68 decline can explain 0.68 × 0.06 = 0.04 (4%) of the 1.3 (25.7 to 27) increase in BMI. However, both these periods exclude the major decline in the real minimum wage that occurred from about 1970 to 1984. If the longer term \$3.33 decline in the real minimum wage from its peak at \$9.15 in 1968 to \$5.82 in 2006 is considered, it can explain 3.33 × 0.06 = 0.2 (10%) of the total increase in average BMI from 25.0 to

27.0 over the period.[5,27]

Table 3 presents results of the sensitivity analysis. The first two specifications show that the results are robust to whether they include the controls for income. Specifications 3 and 4 show the results are stronger for persons below age 60 than for older persons. Specifications 5-8 show that, excluding persons older than 60 in whom income is more likely to be a misleading measure of financial resources, the effects of minimum wage on BMI are greatest among persons with at least a high school education and with incomes above $30,000.

Discussion

The association we observe between changes in the real minimum wage and BMI among BRFSS respondents are consistent with our hypothesis that a decrease in real minimum wages can increase bodyweight. Although we cannot prove that this relationship is causal, several lines of evidence argue against alternative interpretations, such as that changes in body weight influence real wages or that a third factor influences both real wages and body weight. The first possibility seems unlikely because there is no apparent reason why changes in obesity would cause changes in minimum wage laws or inflation. It does seem possible that some third factor could lead to both decreases in the real minimum wage and increases in BMI. One candidate might be that falling incomes within states that we somehow do not adequately control for could both cause states to allow the minimum wage to drift downward and lead to increases in obesity if declines in socioeconomic status due to falling incomes caused people to substitute cheaper but more fattening foods for more expensive ones that are less likely to cause obesity. Arguing against this is that we control for both state effects and time trends, so that changes in state minimum wage legislation or local price levels would have to be explained by changes in income over time within states. We also performed additional sensitivity analyses that included state-specific time linear time trends and these generally confirmed our overall findings, though these specifications did have difficulties converging in some of the quantile regressions.

The hypothesis that changes in the minimum real wage could cause changes in obesity, in contrast, seems highly plausible. Here there are at least two stories one could tell. The first is the one that we have emphasized -- that decreases in the minimum wage would lower the price of fast food and thereby increase its consumption and thus obesity. The second is that a decrease in the minimum wage could raise obesity by lowering incomes of people who earn minimum wage and encouraging them to eat more unhealthy food. However, this second argument is not a convincing explanation of the results we observe because the effect of the minimum wage is greater among high income persons than among low income persons, who would be most likely to earn minimum wage. In addition, low income persons consume so little food away from home, (<$250 per family of four per year), that it seems unlikely to be enough to contribute to obesity.[28] In addition, it is interesting that even though lower income persons are more likely than higher income persons to be obese,[29,30,31] obesity has increased most among higher income persons in recent years, as might be expected if changes in the price of food away from home were driving increases in obesity.[32]

Further evidence supporting the hypothesis that the decline in real minimum wage has increased obesity by encouraging food away from home (FAFH) is that the effect we observe can be assessed by calibrating it against the published literature on how the price of food away from home affects the quantity of it consumed and how that, in turn affects obesity. To do this, the effect of the minimum wage on BMI can be approximated by:

$$\Delta \text{ BMI} / \Delta \text{ minimum wage} = \Delta \text{ BMI} / \%\Delta \text{ calories intake} \cdot \%\Delta \text{ calories intake} / \%\Delta \text{ quantity of FAFH} \cdot \%\Delta \text{ quantity of FAFH} / \%\Delta \text{ price FAFH} \cdot \%\Delta \text{ price FAFH} / \%\Delta \text{ minimum wage}$$

Assuming a median height of person in the US of 1.78 meters and average caloric intake of about 2000 calories per day and estimates by Cutler, Glaeser and Shapiro[10] that the approximately 5 kg (= 1.6 BMI unit) increase in median weight over past two decades requires a net caloric imbalance of about 100 - 150 calories per day, the change in BMI per percent increase in caloric intake can estimated as $(5 \div 1.78^2) \div (125/2000) = 25$. Estimates of the elasticity of FAFH with respect to price are available from a recent study on demand of food consumption, which suggested estimates of price elasticity as from −2.03 to −1.16.[1,20] Estimating how total calories consumed increases as FAFH increases is difficult because FAFH may substitute for food at home. However, assuming it does not places an upper bound on the increase in total calories. Aaronson and colleagues have provided fairly consistent estimates of the effect of minimum wage on food price, ranging from elasticity estimates of 0.73% for full service establishment to 1.56% for limited service establishment for ten percent change of minimum wage. An alternative study suggested that 1% change of food price per $0.50 change in minimum wage rate, consistent again with about a 1% change.[19] Multiplying these (25 × (-1 to -2) × 0.01 = -0.25 to -0.48, about five times the size of the 0.06 effect we estimate. This seems likely to reflect the extent to which our calculations fail to account to the extent to which calories for FAFH reduce calories consumed at home, but suggests that the hypothesis that increased consumption of food away from home could explain the increase in bodyweight we find with increases in the minimum wage even if as little as 20% of the increase in calories consumed away from home represents a net increase in total caloric consumption.

Our analysis has several limitations. First, BRFSS bodyweight and height information was self-reported, which could lead to bias in estimates of weight and height.[33] However, there is no obvious reason why such bias would change our findings. Another limitation is that BRFSS excludes children and youth, institutionalized populations and households without phone service. Finally, our analysis assumes that changes in minimum wages affect obesity currently and it may well be that there is some lag structure to effects that we have failed to account for and would be complex to implement empirically given the serial correlation of wages within states over time.

Potential Policy Implications

If the decline in minimum wages has contributed to increasing obesity in the United States then it is tempting to consider whether increases in the minimum wage might reduce obesity in the United States, producing benefits in both better health and lower health care costs. Indeed, the Federal real minimum wage has already increased by about 40% since 2006. Real minimum wages would have to rise by an additional 60% to restore them to their 1968 levels, and such increases could have adverse effects on employment, companies that depend on minimum wage labor, and the prices of other goods and services that are heavily dependent on minimum wage labor.[34,35,36]

To put the potential policy implications of a minimum wage increase in context, it is useful to consider the expected effects of minimum wage on health outcomes, such as mortality. Precisely forecasting the effects of a minimum wage change on mortality is complex because minimum wage may change obesity differently across different groups and those changes may have varying effects on health outcomes across those groups.[8] However, using published estimates that there is an average reduction in life expectancy of about 6 months with each 1 unit increase in BMI,[37] the change of 0.07 over the population for each dollar increase in the minimum wage would increase life expectancy in the United States by 15 days, producing an additional 12 million life-years over the US population. To the extent that BMI would decrease most among the most obese, as suggested by our quantile regressions, and that the health benefits of BMI reduction would be greatest at the highest levels of BMI, these estimates of the mortality reductions from an increase in the real minimum wage would be conservative

Were an increase in the minimum wage to be viewed as a health intervention, it would be useful to consider its benefits from the perspective of cost-effectiveness. As a back of the envelope calculation, using common estimates that a year of life is valued at $100,000[38] and assuming that the added year of life would occur on average 40 years from now (since the average age of the U.S. population is slightly above 35 and life expectancy at birth is slightly above 75),[39] and discounting future benefits at 3%,[40] this increase in life expectancy would be valued at about $375 Billion. Reductions in morbidity with decreasing levels of obesity have also been quantified and are probably roughly on the same order of magnitude as reductions in mortality.[41] Health care costs related to obesity are smaller, probably less than $50 billion annually, so the value of these savings would be small compared to the value of health improvements.[42,43] Dividing these benefits that would accrue across all cohorts evenly among all the cohorts suggests an annual health benefit valued at about $50 billion. The total of these societal benefit is clearly very large but need to be interpreted in light of an estimated annual cost of a one dollar increase in minimum wage increases of about $195 Billion per year assuming that there are 13 million minimum wage workers who each work about 1,500 hours per year.[44] This suggests that an increase in the minimum wage would cost consumers on average more than they would gain in health benefits, but does not include the benefits to minimum wage workers. To the extent these are transfer payments from consumers paying higher costs for minimum wage earners, such benefits to minimum wage earners would completely offset the costs of a minimum wage increase. However, to the extent higher minimum wages induce unemployment or other inefficiencies in labor and product markets, a result suggested by classical microeconomic theory but still controversial empirically,[45] such losses would have to be viewed as arguing against increases in the minimum wage. Unfortunately, estimates of the magnitude of such welfare losses due to a higher minimum wage are not available. For this reason, and because an increase in the minimum wage might have a series of complex distributional effects on different subgroups in the population, recommendations about the desirability of a further increase in the minimum wage are beyond the scope of this paper.

Whether or not additional minimum wage increases would be a desirable policy option, our results may have important policy implications if they focus attention on the mechanisms by which an increase in the minimum wage might affect obesity. While we have emphasized food away from home, we recognize that other explanations could be produced. For example, it is possible that prices for food at home could also be influenced by changes in the minimum wage, though this seems less likely given the smaller share for minimum wage labor in the manufacture of food at home. If we are willing to focus on the price of food away form home as a determinant of obesity then perhaps policy changes such as better labeling, public health education, regulation of serving size, or “sin taxes” on food away from home might worth greater attention.[46]

Although prior studies have suggested association between obesity and increased consumption of food away from home, the direction of causation has been unclear. Our findings on the relationship of obesity to minimum wage changes support the argument that association of increased consumption of food away from home and obesity may reflect a causal relationship. Our results also increase the importance of experiments to test approaches to control obesity by changing the consumption of food away from home, whether through changes in prices, availability, or information about health consequences.

That our findings explain only a moderate percent of the observed change in bodyweight suggest that other explanations, such as decreased physical activity, may also play important roles in the increase in obesity. Peer effects have also recently received significant attention in the literature,[47,48] though these would presumably be reflected in the total response we observe in response to a change in the minimum wage, only perhaps more broadly distributed over time. Peer effects also cannot explain why a trend towards increasing obesity may have started; it is possible that decreases in the minimum wage may have had local effects that explain only 10-20% of the increase in BMI as we identify here, but larger effects across the country through peer effects that we are unable to identify using the approach we apply here. Finally, we should note that labor saving approaches to the production of fast food have presumably also played a major role in decreasing its cost and increasing its consumption. To the extent such labor saving continues, minimum wage labor may be an increasingly less important contributor to the cost of food away from home over time regardless of wage increases. While this may decrease the potential impact of minimum wage policies on obesity, our findings highlight the possibility that policies that focus on the consumption of food away from home deserve particular attention in public health efforts to control obesity.

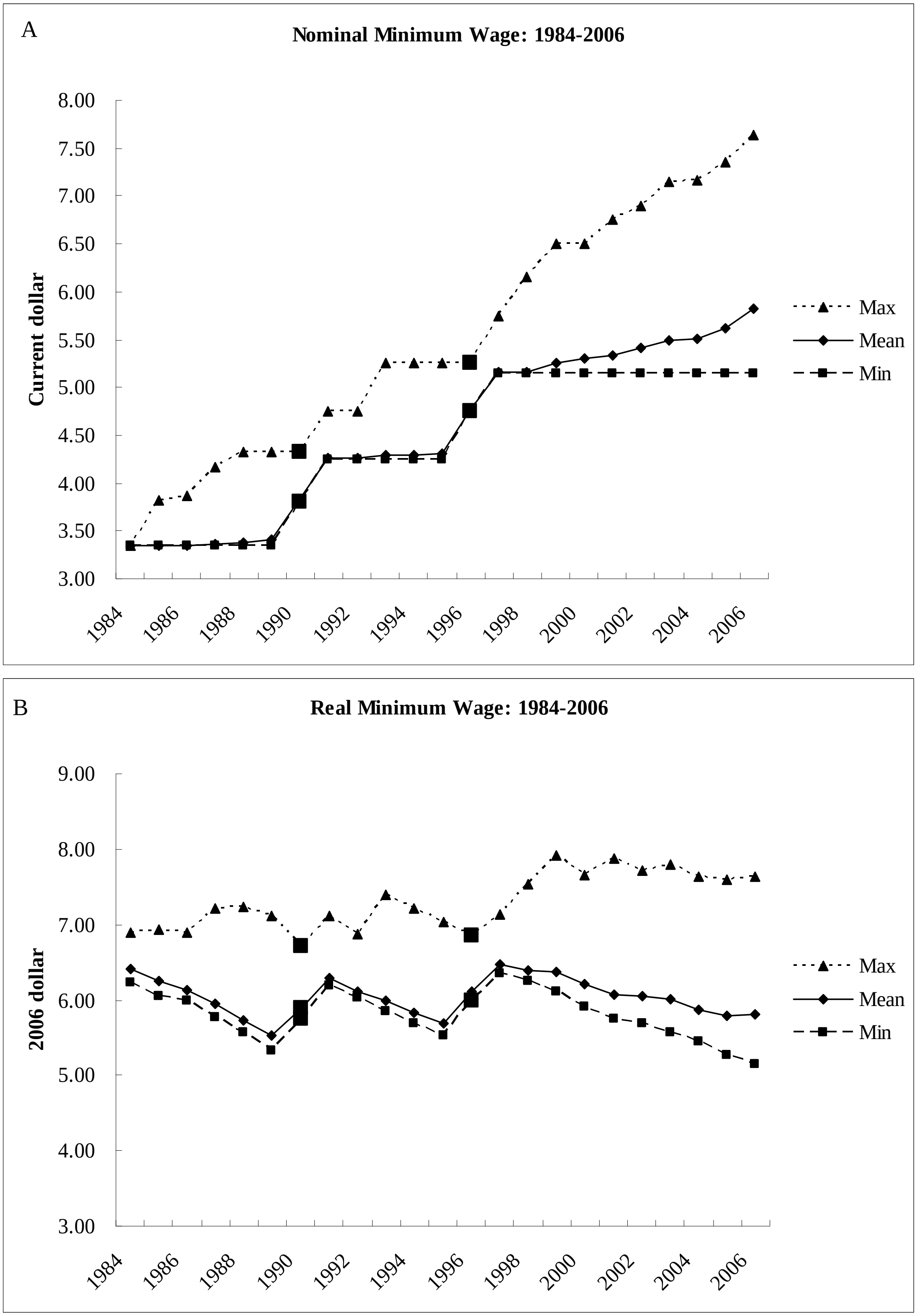

Figure 1. Nominal (Panel A) and Real (Panel B) Minimum Wage in the United States. Enlarged squares indicate values at 1990 and 1996, when increases in federal minimum

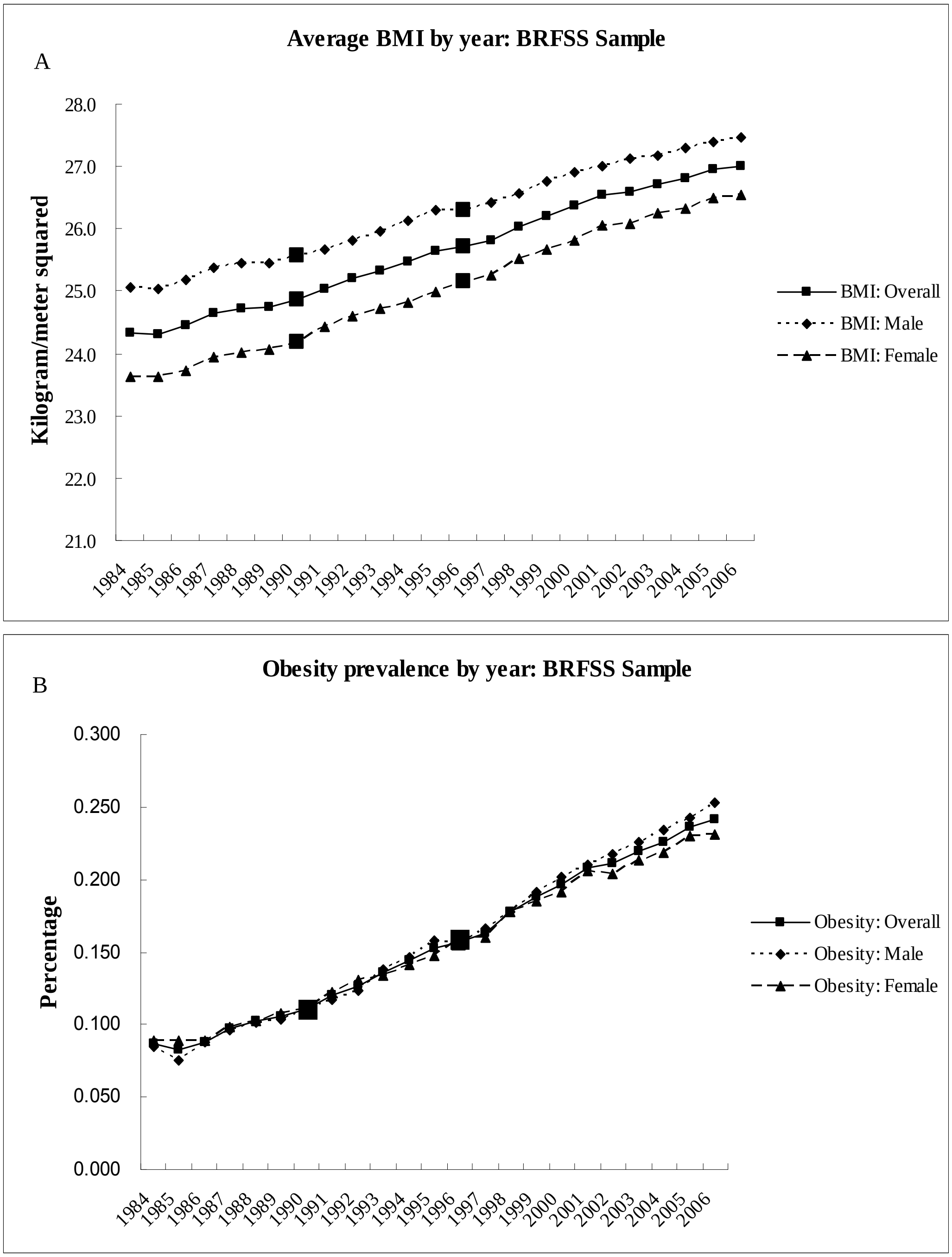

Figure 2. Average BMI (Panel A) and Obesity Prevalence (Panel B) among the BRFSS sample. Enlarged squares indicate values at 1990 and 1996, when increases in federal minimum wage occurred.

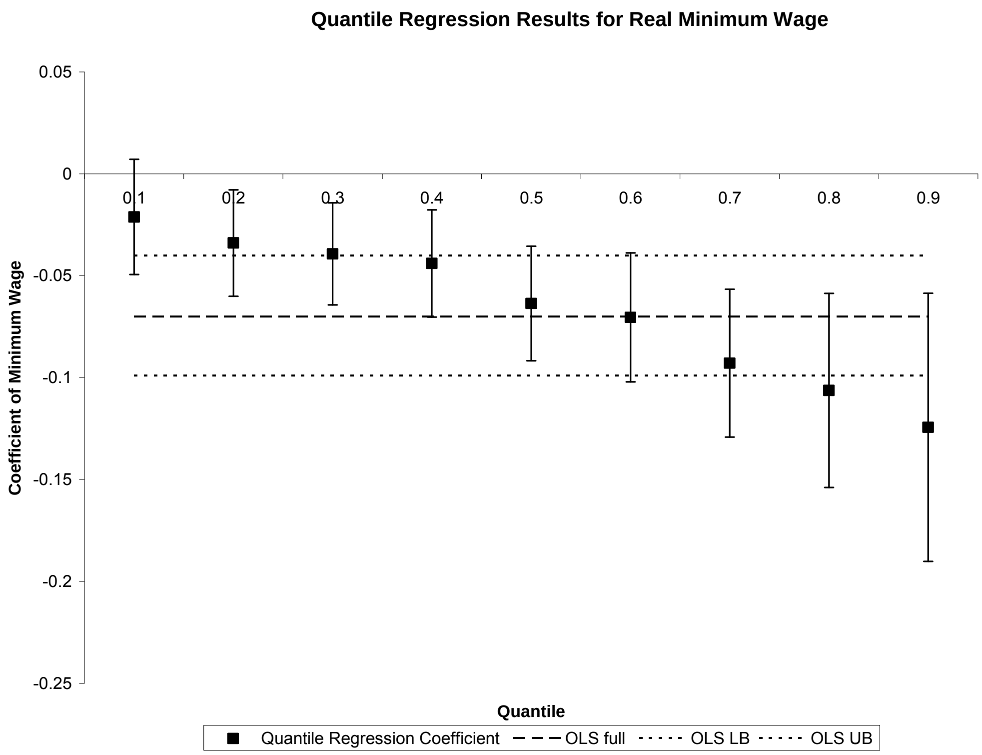

Figure 3: Quantile Regression Effects of Minimum Wage on BMI

Table 1. Summary Statistics of the BRFSS Sample: 1984-2006*			
Characteristics	**Overall (N=3,048,378)**	**Male (N=1,274,462)**	**Female (N=1,773,916)**
Body mass index	25.812±0.005	26.401±0.007	25.231±0.007
Obese	0.166	0.169	0.163
Minimum wage: CPI adjusted, 2006 dollar	6.032±0.001	6.033±0.001	6.032±0.001
Minimum wage: nominal	4.714±0.001	4.72±0.002	4.708±0.001
Age	44.787±0.019	43.432±0.028	46.127±0.026
White (reference)	0.765	0.764	0.766
Black	0.093	0.086	0.101
Hispanic	0.097	0.102	0.093
Others	0.044	0.048	0.040
Less than high school (reference)	0.051	0.051	0.050
Some high school	0.089	0.087	0.092
High school or GED	0.323	0.310	0.336
Some college	0.262	0.253	0.271
College or above	0.275	0.300	0.251
Married (reference)	0.090	0.077	0.101
Divorced	0.090	0.077	0.101
Widowed	0.071	0.027	0.115
Separated	0.022	0.018	0.026
Never been married	0.192	0.221	0.162
Member of an unmarried couple	0.026	0.028	0.025
Income less than $10k (reference)	0.079	0.061	0.098
Income btw $10k and $15k	0.069	0.061	0.077
Income btw $15k and $20k	0.081	0.076	0.085
Income btw $20k and $25k	0.093	0.093	0.094
Income btw $25k and $30k	0.142	0.148	0.137
Income greater than $35k	0.413	0.458	0.369
Income missing	0.122	0.104	0.141
Income greater than $50k	0.148	0.165	0.131
Income greater than $75k	0.107	0.123	0.092
Male	0.497		

* All mean values are weighted. Plus-minus values are weighted means±Taylor linearized standard errors.

Table 2. **Effects of Minimum Wage Rates on Bodyweight (BMI)**

Sample	**Full sample**			**Male sample**			**Female sample**		
	Coefficient Estimate (95% CI)		p-value	Coefficient Estimate (95% CI)		p-value	Coefficient Estimate (95% CI)		p-value
Minimum Wage	-0.060	(-0.091−-0.028)	0.000	-0.055	(-0.099−-0.011)	0.015	-0.063	(-0.107−-0.020)	0.004
Male	1.307	(1.288−1.325)	0.000						
Black	1.518	(1.481−1.555)	0.000	0.561	(0.510−0.613)	0.000	2.322	(2.271−2.374)	0.000
Hispanic	0.622	(0.579−0.665)	0.000	0.413	(0.354−0.472)	0.000	0.859	(0.797−0.920)	0.000
Others	-0.702	(-0.752−-0.653)	0.000	-0.900	(-0.966−-0.834)	0.000	-0.475	(-0.548−-0.402)	0.000
Some High School	-0.187	(-0.250−-0.123)	0.000	-0.087	(-0.177−0.003)	0.057	-0.481	(-0.569−-0.393)	0.000
High School or GED	-0.526	(-0.582−-0.469)	0.000	-0.104	(-0.184−-0.025)	0.010	-1.137	(-1.216−-1.059)	0.000
Some College	-0.670	(-0.728−-0.612)	0.000	-0.155	(-0.236−-0.074)	0.000	-1.352	(-1.432−-1.272)	0.000
College or above	-1.384	(-1.442−-1.326)	0.000	-0.810	(-0.891−-0.729)	0.000	-2.176	(-2.257−-2.095)	0.000
Divorced	-0.405	(-0.436−-0.373)	0.000	-0.568	(-0.611−-0.525)	0.000	-0.413	(-0.458−-0.369)	0.000
Widowed	0.215	(0.175−0.254)	0.000	-0.145	(-0.218−-0.072)	0.000	-0.090	(-0.139−-0.041)	0.000
Separated	-0.188	(-0.259−-0.117)	0.000	-0.666	(-0.765−-0.566)	0.000	-0.052	(-0.148−0.044)	0.290
Never Been Married	-0.211	(-0.244−-0.178)	0.000	-0.605	(-0.648−-0.562)	0.000	0.087	(0.037−0.136)	0.001
Member of An Unmarried Couple	-0.271	(-0.339−-0.203)	0.000	-0.529	(-0.627−-0.430)	0.000	0.010	(-0.081−0.102)	0.823
Constant	22.248	(21.903−22.593)	0.000	23.604	(23.055−24.152)	0.000	22.409	(21.975−22.844)	0.000

* (1) The federal minimum wage is used when it is greater than the state level. Minimum wages are adjusted to 2006 dollars with the Consumer Price Index (All components). (2) Coefficient estimates of age, year and state fixed effects, income, and income*year interaction terms are not shown. Reference groups are: female, white, less than high school, married, and aged between 18 and 20, Alabama, Year 1984, respectively. (3) CI denotes confidence interval.

Table 3. **Sensitivity Analyses: Coefficient Estimate of Real Minimum Wage (**Dependent Variable: Body Mass Index)

Model	# observations	Full sample			Male sample			Female sample		
	Total (Men; Women)	Coefficient Estimate	(95% CI)	p-value	Coefficient Estimate	(95% CI)	p-value	Coefficient Estimate	(95% CI)	p-value
(1)	3,048,378 (1,274,462; 1,773,916)	-0.060	(-0.091−-0.028)	0.000	-0.055	(-0.099−-0.011)	0.015	-0.063	(-0.107−-0.020)	0.004
(2)	3,048,378 (1,274,462; 1,773,916)	-0.059	(-0.091−-0.028)	0.000	-0.058	(-0.102−-0.014)	0.010	-0.060	(-0.104−-0.017)	0.007
(3)	2,233,856 (973,421; 1,260,435)	-0.071	(-0.107−-0.034)	0.000	-0.072	(-0.122−-0.021)	0.005	-0.065	(-0.117−-0.014)	0.013
(4)	860,256 (319,940; 211,380)	-0.022	(-0.079−0.034)	0.437	-0.010	(-0.089−0.069)	0.811	0.021	(-0.137−0.178)	0.799
(5)	484,206 (200,042; 284,164)	-0.037	(-0.135−0.061)	0.457	0.015	(-0.123−0.152)	0.836	-0.083	(-0.219−0.053)	0.232
(6)	379,137 (178,824; 200,313)	-0.017	(-0.107−0.074)	0.720	-0.050	(-0.175−0.075)	0.435	0.026	(-0.104−0.155)	0.700
(7)	908,468 (412,579; 495,889)	-0.086	(-0.134−-0.038)	0.000	-0.096	(-0.163−-0.030)	0.005	-0.074	(-0.141−-0.007)	0.031
(8)	416,311 (163,077; 253,234)	-0.121	(-0.217−-0.025)	0.014	-0.062	(-0.196−0.071)	0.359	-0.178	(-0.313−-0.043)	0.010

(1) Baseline: with full set of covariates; (2) Baseline: do not control for income; (3) Excluding elderly (age>60), full set of covariates; (4) Excluding elderly, do not control for income; (5) Age < 60, Income < $30,000 and education is less than high school; (6) Age < 60, Income > $30,000 and education level is less than high school; (7) Age < 60, Income > $30,000 and education level is more than high school; (8) Age < 60, Income < $30,000 and education level is more than high school. *Coefficient estimates for age, year and state fixed effects, race and ethnicity, marital status, education, income, and income*year interaction terms (when included) not shown. Reference groups are: female, white, less than high school, married, and aged between 18 and 20, Alabama, Year 1984, white, married, less than high school, and income < $10,000.

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