Are obese elders working more or less, and why?

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Abstract

Old-age obesity is prevalent and increasing; there is no systematic research on the labor market outcomes of obese elders. Using the data on men aged 70-79 from the Health and Retirement Study and panel econometrics allowing for individual fixed-effects, we present evidence that obesity increases labor supply at old-age: an increase among the obese, compared to the normal weight, of 3.8 percentage points in labor force participation, 1.8 percentage points in holding a second job, and 4.2 percentage points in self-employment, as well as 1.347 and 0.5 hours worked each week at the main and second job, respectively. We then attempt to uncover potential pathways that may link obesity with labor market outcomes, such as chronic diseases, depressive symptoms, health status, incomes and wealth, medical expenses, expected life expectancy, job market attachment and health behaviors, and find strong evidence supporting that the estimated obesity-work link operates through these hypothesized pathways.

JEL Classification: J14, J20, I12.

Keywords: obesity, old-age, labor force participation, labor market outcomes.

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1. INTRODUCTION

Obesity (body mass index ≥ 30) at old-age is prevalent and increasing (Mokdad, Serdula, and Dietz, 1999; Mokdad et al., 2000, 2001, 2003; Flegal et al., 1998; Flegal and Carroll, 2002). Among adults aged 60 and older, about 23.6% were obese in 1990 but 32.0% were obese in 2000; an estimated 37.4% will be obese in 2010 (Arteburn et al., 2004). Social Security Administration regulations state that obesity is in itself medically determinable impairment when it significantly limits an individual's physical or mental ability to do basic work activities. A risk factor for numerous chronic diseases and elevated healthcare costs, old-age obesity presents a tremendous challenge to the health and economic well-being of aging individuals, as well as the solvency of Social Security and Medicare.

In this study, we examine the relationship between obesity and labor market outcomes in the elderly population. Later-life labor force participation is important for the economic well-being of aging individuals as well as the society as a whole to maintain adequate incomes, especially when life expectancy is increasing and the American population is aging rapidly. An average of about 19% of men aged 70-79 participated in labor force during the period of 1994-2004 (author's calculation). The need for additional income through earnings is amplified by sharp declines in wealth brought about by the economic crisis. Obese older Americans are a particularly vulnerable subpopulation in their deteriorating health and eroding economic resources, and understanding the labor market outcomes among this subpopulation is of great relevance and importance to many aging policies in improving the quality of later-life. However, there is no systematic research on the well-being in general and labor supply outcomes in particular, of obese elders, a subpopulation that is vulnerable economically but growing rapidly in size.

We ask two questions: Are obese elders working more or less than non-obese elders? What are the potential pathways that explain elders' obesity-work relationship? Economic theory provides ambiguous predictions of the effect of obesity on labor force participation in old age. On one hand, obesity is a substantial risk factor for poor health. which is associated with reduced labor force participation. On the other hand, obesity and poor health are associated with fewer socioeconomic resources and higher medical expenses, necessitating prolonged employment or re-entrance into the labor force post-retirement to augment the often low retirement incomes. The relationship between obesity and labor market outcomes at old-age is an empirical question.

There is a voluminous literature on the labor supply of older adults has primarily focused on the effects of financial incentives, health insurance, and poor health (Burkhauser and Quinn 1983; Diamond and Hausman 1984; Gustman and Steinmeier 1986; Bound 1989; Rust and Phelan 1997; Bound et al. 1999; Currie and Madrian 1999; Blau and Gilleskie 2001b). Studies on economic consequences of adult obesity have focused on the impact of obesity on two areas. One is the employment and wages of young and middle-aged adults (Register and Williams 1990; Avertt and Korenman 1996; Cawley 2000; Baum and Ford 2004; Cawley 2004; Conley and Glauber 2005; Norton and Han 2008; Atella et al. 2008; Han, Norton and Stearns 2008). The other is the claim behavior of public assistance and pension programs, such as disability insurance program enrollment, and early receipt of Social Security retirement benefits, of the under-65 population (Burkhauser and Cawley 2004; Burkhauser and Cawley 2006; Burkhauser, Cawley, and Schmeiser 2008). This research fills the gap in the literature by addressing the impact of obesity on labor market outcomes of the Social Security-eligible 65+ population. The labor market outcome of obese elders, which has been largely unexplored, is the focus of this study.

We focus on men aged 70-79 as the study sample for several reasons. A primary reason is that old-age labor market activities are influenced by the economic incentives and disincentives provided by Social Security, and Social Security underwent several major changes targeting the population aged 65-69 during the same period of 1994-2004. The spillover effects of these changes on the 70-79 population are possible but are likely to be negligible. Other reasons are many substantial gender differences in labor market behavior, and increasing survival selection with the 80+ population. We find that obese elder men work more than non-obese counterparts with evidence in a wide range of labor market outcomes, and that several these hypothesized pathways—particularly, health, medical expenses and expected life expectancy—appear to be contributing to the estimated labor market effect of obesity. Robustness checks are performed and policy implications are discussed.

2. METHODS

2.1 Empirical Specifications

Our empirical framework in examining the effect of body weight or obesity on labor market activities is to relate the labor market outcomes to body mass index (BMI) or obesity status. Let y_{it} and $obese_{it}$ (bmi_{it}) represent the labor market outcome and obesity status (BMI) at time t for individual i, respectively. Suppose that labor market outcome is determined by a relation in the form:

$$y_{it} = \alpha + \beta bmi_{it} + \phi x_{it} + \gamma z_i + \tau t_t + \omega_i + \varepsilon_{it} \quad (1a)$$

Where z_i represents time-varying personal traits (race, ethnicity, educational attainment, and veteran status), x_{it} represents a set of measured personal traits that varies over time (age, marital status, residential region, as well as chronic health condition indictors and economic resource

variables), t_t represents a set of time-related controls (dummy variables for survey years), ω_i represents a permanent individual-specific effect, and ε_{it} random error term. Among the coefficients $\alpha, \beta, \phi, \gamma, \tau$ to be estimated, β is the coefficient of interest.

The estimates of the effect of obesity on labor market outcome depends on the modeling assumptions of individual effect, ω_i, and obesity status (BMI); we consider the following four modeling assumptions and the corresponding specifications:

	Individual effects	**Obese (BMI)**
Specification (1)	Random effects	Exogenous
Specification (2)	Fixed effects	Exogenous
Specification (3)	Random effects	Endogenous
Specification (4)	Fixed effects	Endogenous

where the random (fixed) individual effects model assumes individual effect, ω_i, is uncorrelated (correlated) with all the covariates in equation (1a); an exogenous (endogenous) obesity assumes that obesity is uncorrelated (correlated) with the error term in (1a). Coefficient β is estimated using a random effect generalized least square estimator and fixed effect within estimator in specification (1) and (2), respectively.

While the first-difference estimation purges out the individual factors that are permanent and time-invariant, there might be time-varying individual factors that are correlated with obesity (BMI) and labor market outcomes, leading to biased estimates of obesity-work relationship. We use an instrumental variable method to account for the potential endogenous nature of obesity, and the instrument variable is individuals' own twice-lagged obesity as follows:

$$bmi_{it} \not\perp \varepsilon_{it}, bmi_{it} = a_0 + a_1 bmi_{it-2} + a_3 x_{it} + a_4 z_i + a_t t_t + e_{it}, \varepsilon_{it} \perp e_{it} \qquad (1b)$$

The use of own lagged obesity as instruments has been practiced in the obesity literature (Avertt and Korenman 1996; Conley and Glauber 2005). The relevance criteria of valid instrument variables that they are correlated with the endogenous variable is easily established because individual obesity tends to be serially correlated across adjacent time periods. The exclusion criteria of valid instrument variables that they are uncorrelated with the error term in determining the outcome is un-testable, and we suppose that it is a reasonable assumption that the two-lagged (four-years prior) obesity is uncorrelated with the error term in equation (1a) in determining the obesity-work relationship at current period conditional on the observable. Coefficient β is estimated using generalized two-stage least square instrument variable and fixed-effects within instrument variable estimation in models (3)-(4), receptively. Among the four models, model (1) is the most restrictive while (4) the least restrictive; model (2) is more general than (1), (3) more general than (1), and (4) more general than (2). Using Hausman tests, we compare each of these three pairs of models, from which the best model can be determined.

2.2 Data and Variables

We use data from the eight waves of Health and Retirement Study (1994-2004), a biennial, longitudinal, nationally representative population-based survey of U.S adults above age 50. Study details of Health and Retirement Study (HRS) are provided elsewhere (Juster and Suzman, 1995). The HRS data provide the detailed longitudinal information on labor market outcomes, body weight and height, health morbidities, disabilities, pension incomes and earnings, and medical expenditures of older individuals. HRS is uniquely suitable for examining the longitudinal obesity-work relationship among the elderly population.

The HRS provides self-reported body weight and height at each survey wave, from which BMI, and various indicators for obesity as defined below:

Weight/obesity variables	Definitions
Body mass index (BMI)	Body weight (in kilograms) divided by height (in meters) squared
Underweight	1 if BMI $\leq$ 18.5, and 0 otherwise
Normal weight	1 if 18.5 $\leq$ BMI < 25, and 0 otherwise
Overweight	1 if 25 $\leq$ BMI < 30, and 0 otherwise
Obese	1 if BMI $\geq$30, and 0 otherwise
Mildly obese	1 if 30 $\leq$ BMI < 35, and 0 if otherwise
Moderately obese	1 if 35 $\leq$ BMI < 40, and 0 otherwise.
Severely obese	1 if BMI $\geq$40, 0 if no second job

In addition, we account for a standard set of demographic variables in our analysis, including race, Hispanic origin, educational attainment in years of completed schooling, and military service status, as well as time-varying variables of age, residential region, marital status (married and non-married), and a set of dummy variables to indicate each HRS survey wave to account for time-specific effects related to the surveys as well as macroeconomic conditions that might affect labor force participation.

We examine the obesity-work relationship using a wide range of labor market outcomes: labor force participation, intensity and extensity of labor market activities such as hours worked per week and weeks worked per year, holding a second job and weeks and hours worked at the second job, and self-employment. These dependent variables are defined below:

Dependent variables	Definitions
Labor force participation	1 if respondents were working full-time, part-time, unemployed or partially retired, and 0 if respondents were fully retired
Working for pay	1 if respondents were working for pay, and 0 otherwise
Hours per week	Number of hours worked each week at main job, 0 if not working
Weeks per year	Number of weeks worked each year at main job, 0 if not working
Holding a second job	1 if respondents were working at a second job, and 0 otherwise.
Second job—hours	Number of hours worked each week at second job, 0 if no second job

Dependent variables	Definitions
Second job—weeks	Number of weeks worked each year at second job, 0 if no second job
Self employed	1 if respondents were self employed, and 0 otherwise.

There are 11,826 person-wave observations of male respondents aged 70-79 that are nationally representative with valid sampling weights available from HRS 1994-2004 including the Assets and Health Dynamics among the Oldest Old 1993-1995. Among the study sample, 10,055 person-wave observations have valid labor market outcomes and are available for regression analysis. Table 1 presents the summary statistics of our study sample. About 89.8% are white, 72.2% are veterans, 4.7% are of Hispanic origin, and 77.0% are married. Our sample has an average age of 74.2, and completed an average of 11.9 years of schooling. The average height is 1.77 meters, the average body weight is nearly 82.96 kilograms, and the average body mass index is 26.55. About 1.0% are underweight, 32.3% normal weight, 47.4% overweight, and 17.2% obese. Particularly, 13.5% are mildly obese, 3.1% moderately obese, and 0.6% severely obese. About 19.4% of the study sample participated in the labor force, and 16.9% worked for pay. Our study sample worked an average of a little over 4 hours a week and 8.4 weeks a year at their main job. About 1.2% hold a second job, and the study sample spent 0.17 hours a week and 0.45 weeks a year at their second job. About 8.5% of the study sample are self-employed.

2.3 Identification sources

Our primary purpose is to estimate the effect of obesity status (BMI) on labor market outcomes using within-individual temporal variations in obesity status (BMI). To assess whether there is a sufficient amount of variations in obesity status (BMI), we present the distributions of unadjusted obesity status (BMI) and within-individual cross-period changes in obesity status (BMI) in Table A1a (Figure A1) in the Appendix. The unadjusted BMI resembles a normal

distribution, and there is a considerable cross-period within-individual variations in BMI. While 76.11% of the study sample exhibit no cross-period changes for the overweight status, 16.81% change from being not-overweight to being overweight, and 7.08% change from overweight to not-overweight. For obesity status, while 91.05% of the study sample exhibit no cross-period changes, 6.12% change from not-obese to obese, and 2.82% change from obese to not-obese. The variations in cross-period changes in the categories of obesity decreases as the severity of obesity increases. For example, for mild obesity, about 5.98% change from not-mildly-obese to mildly-obese, and 3.55% change in the opposite direction; for moderate obesity, about 1.51% change from not-moderately-obese to moderately-obese, and 3.55% have a change of the opposite direction; and finally, 0.31% change from not-severely-obese to severely-obese, and 0.21% change in the opposite direction. Overall, these data indicate there is a sufficient amount of variations in intra-person inter-period changes in BMI and obesity.

Similarly, as we relate within-individual temporal variations in labor market outcomes to those in obesity status to obtain the estimates of the obesity-work relationship, we examine the variations in labor market outcomes, and present the distributions of the unadjusted intra-person inter-period changes in dichotomous labor market outcomes among the study sample in Table A1b in the Appendix. While an average of about 90.25% of the study sample exhibit no change in their labor force participation status, 2.53% re-enter the labor market and 7.22% exit the labor market; similarly, 2.90% change from not-working-for-pay to working-for-pay, and 6.90 change in the opposite direction. For self-employment, about 3.51% change from non-self-employment to self-employment, and 3.20% have an opposite change. The variations in holding second job is quite small—only 0.80% change from not-holding-second-job to holding-second-job, and 0.95% have the change in the opposite direction. With the exception of holding-second-job, these data

suggest that there is a sufficient amount of variations in intra-person inter-period changes in these labor market outcomes.

3. RESULTS

We investigate the obesity-work relationship using specifications (1)-(4) and present the results for a range of labor market outcomes in Table A2 in the Appendix with two weight indicators of overweight and obese using underweight and normal weight (thereafter referred to as normal weight) as the base category. With the exceptions in the outcomes of hours and weeks worked at the second job, the Hausman specification tests suggest that model (2)—individual fixed-effect with obesity status assumed to be exogenous—fits the data best and considered our preferred specification. We thus report the results of specification (2) in Panel A in Table 2, referred to our main results, with four findings. First, obesity increases labor force participation rate. Obese men have an increase of 3.8 percentage points in labor force participation rate, or a nearly 20% increase calculated at the average among the study sample, and this increase is statistically significant. Overweight men have an about 1.8 percentage points higher in labor force participation rate though the estimate is boardline significant. This finding is also evident in the outcome of working for pay. Second, obesity increases labor market activity intensity. Obese men spend 1.347 significantly more hours each working week at their main job, or 27% higher; overweight men spend 0.844 significantly more weeks in a year at their main job, or about 10% greater. Obese (Overweight) men also work more weeks (hours) though the estimate is not significant at the conventional level. Third, obesity increases labor market activity extensity. Overweight and obese men are about 0.7 and 1.6 percentage points more likely to work at a second job; spend about 0.228 and 0.365 more hours a week at their second job; and work 0.342 and 0.365 more weeks at their second job; all estimates are significant except in the

case of overweight men's holding a second job and weeks worked at the second job. Fourth, obesity increases labor market activity depth. Overweight and obese men are about 2.2 and 3.8 percentage points more likely to be self-employed, respectively, or 26% and 45% increase.

We next examine whether our four main findings hold in the context of potential nonlinear effect of obesity on labor market outcomes. We present in Panels B-D in Table 2 the results using our preferred specification (2) with finer categories of obesity by using three indicators (overweight, mildly and moderately-severely obese) and four indicators (overweight, mildly, moderately, and severely obese). We find that our main results are robust to finer categories of obesity, and that there is some evidence on the non-linearity in the obesity-work relationship. First, the labor force participation effect of obesity seems to be concentrated and strongest among the mildly obese with a significant increase of 4.0 percentage points. The moderately and/or severely obese appear to work no differently from, or even less than their normal weight counterparts, though the estimates are insignificant. Second, the labor market activity intensity effect of obesity also appears to be pronounced among the mildly obese on hours worked and among the overweight on weeks worked. The moderately and/or severely obese work less intensively than their normal weight counterparts, though the estimates are insignificant with one exception—the severe obesity reduces the weeks worked and the reduction is significant and large. Third, the labor market activity extensity effect of obesity is found to concentrate among mildly as well as moderately obese men, including a higher probability of working at a second job and a greater time working at the second job both in hours and weeks worked. All of these effects are significant, and there also seems to be a gradient: this labor market activity extensity effect of obesity increases in magnitude with increasing body mass index or the degree of obesity. Compared to normal weight men, overweight, mildly obese, and

moderately obese men are about 0.7, 1.5, and 4.3 percentage points more likely to work in a second job, respectively; they spend 0.228, 0.355 and 0.609 more hours each work at the second job, respectively; and they work 0.340, 0.844, and 1.579 weeks at the second job, respectively. These estimates are significant in mildly and moderately obese not in overweight category (except hours at the second job). Fourth, the labor market depth effect of obesity is most pronounced among overweight and mildly obese men, who are 2.2 and 4.0 significant percentage points more likely to be self-employed, respectively. The moderately or severely obese are no different from the normal weight in self employment.

4. ECONOMETRIC ISSUES AND ROBUSTNESS CHECKS

We investigate our findings in milieu of Social Security pension, which provides retirement benefits to those aged 62 or older who worked at least 10 years, and spouse or widow benefits. The proportion of our study sample who never received Social Security incomes during our study period is 2.3%, a proportion that decreases with body weight—2.94% among normal weight, 2.30% among overweight, and 1.00% among obese men. The fraction of our study sample who received Social Security income and did so prior to age 62 is 12.19%, a fraction that is higher among the obese—11.84% and 11.40% among normal and overweight, respectively, compared to 14.65% among the obese. The share of our study sample who received Social Security income and did so by age 70 is 95.68%, a share that increases with body weight—95.79% among normal weight, 97.35% among overweight, and 98.87% among obese men. There might be systematic difference between those who did and who did not receive Social Security incomes, as well as between those received Social Security incomes before and after the eligibility age of the retirement benefits. Social Security programs provide economic incentives to those aged 65-69 in their benefits claiming behavior and those incentives programs underwent

substantial changes during the sturdy period, while the 70+ population is unaffected by those programs. We present in Table 3 results with specification (2) on subgroups of the study sample—among those who received Social Security incomes, and those who claimed Social Security benefits after age 62, by age 70, and between 62 and 70 in Panel A-D, respectively. Our results mainly carry over when we limit the sample to those who received Social Security incomes; however, our results are amplified when we further limit the sample to those who received Social Security incomes after age 62, by age 70 or both. The amplification is most pronounced on the obesity effects on all labor market outcomes, and the effects of overweight also increase in all outcomes except labor market activity intensity.

Our estimates of the obesity-work relationship might be biased in the case of sample selection resulting from obesity-related mortality. It is commonly stated in the literature that obesity causes about 300,000 deaths per year in the United States and is second to only smoking as a preventive cause of death, but recent studies find that relative mortality risks of obesity decrease with increasing age, and that higher BMI may not be an important adverse prognostic factor for mortality in the elderly (Heiat et al., 2001; Flegal et al., 2004, 2005). The two-year and four-year mortality rate among our study sample is To assess the obesity-mortality relationship in our study sample, we use a logistic probabilistic model and regress the two (four)-year mortality probability on obesity and demographics with results presented in Table A3 in the Appendix. These results indicate that there is no evidence that obesity during ages 70-79 increases mortality, and that moderate or severe obesity seems to be protective in mortality. The negative obesity-mortality relationship indicates that our study sample might be subject to a negative mortality selection, which implies that our estimates on the positive labor market effects of obesity might be upward biased. To check the sensitivity of our results to obesity-related

mortality, we limit the analysis to those who survived in the two (four) year follow-up with results in the top two panels in Table 4, and find that our main results mostly carry over with slight reductions in the magnitudes of the labor market effects of obesity in the case of excluding those who died in the two-year follow-up.

Involuntary weight loss of large magnitude, which has been recognized as a marker for frailty and associated with disability (Fried et al. 2004), poor health (Kahng, Dunkle, and Jackson, 2004), and mortality (Calle et al., 1999; Wedick et al., 2002; Corrada et al., 2006), may reflect an underlying cause that deteriorates one's capacity to work and bias our results. Large weight gain at old-age may also bias our results upward. To evaluate whether our main results are sensitive to the issues of excessive weight changes, we limit the analysis to those who lost and gain no more than 5 kilograms in weight during the previous two-year period with results in the bottom two panels in Table 6. We find that our results are mostly unchanged when the observations with excessive weight loss are excluded, but increase when observations with excessive weight gain are excluded.

5. POTENTIAL MECHANISMS

We explore the potential pathways that may mediate the old-age obesity-work relationship: the ability to work, the necessity of working, and the preference for work. The ability to work refer to whether one *can* work, that is, whether one possesses the physical and cognitive capacities that are sufficient to make one a productive worker in the workplace. We consider the following health capacities: health status, chronic conditions, and depressive symptoms. The necessity of working refer to whether one *has* to work, that is, whether one's wealth and non-earnings incomes are sufficient to maintain the quality of life without

participating in the labor market. We consider the following incomes factors: private pensions and annuity incomes, social security retirement incomes, public disability insurance incomes, and other government transfers, in addition to household wealth. We also consider out-of-pocket and total medical expenditures. In Table 5, we seek to examine these potential mechanisms which may link obesity and labor market outcomes where we focus on labor force participation, labor market activity intensity (hours worked at the main job) and extensity (holding a second job and hours worked at the second job), as well as self-employment.

First, obesity is associated with poor psychological health (Stunkard et al., 2003; Simon et al., 2006; Scott et al., 2008) bedsides it is a well-known risk factor for hypertension, diabetes, cardiovascular diseases and other chronic conditions (Dey et al., 2002; Felson et al., 1992; Lapidus et al., 1984; Larsson et al., 1984), functional impairments and disability (Blaum et al., 2003; Davison et al., 2002; Himes, 2000; Jenkins, 2004).. We explore whether the presence of chronic conditions might explain the obesity-work relationship by including indicators for physician-diagnosed hypertension, diabetes, heart disease, stroke, arthritis, lung disease, cancer, and psychological problems in the analysis, as well as depressive symptoms and self-evaluated health status. We find that certain chronic conditions, depressive symptoms and poor health status are negatively associated with labor market outcomes. These obesity-related health variables provide some important explanation of the estimated impact of obesity on labor force participation and labor market activity intensity, and the inclusion of those variables reduces the effect of obesity by about 8% in labor force participation, but 35% in hours worked at the main job, while these health variables appear to accentuate the effect of obesity on other labor market outcomes, namely, the chance of holding a second job and hours at the second job as well as the chance of self-employment.

Second, obesity is associated with lower labor force participation rates and labor market earnings at pre-retirement ages (Paraponaris et al., 2005; Morris, 2007; Averett and Korenman, 1996; Baum and Ford, 2004; Cawley, 2004), and lower lifetime wealth (Zagorsky, 2004, 2005). We investigate whether the positive impact of obesity on labor market outcomes is due to the decrease in incomes and lifetime wealth accumulations. We include total household wealth , and all sources of incomes except labor market earnings, specifically, incomes from private pensions, Social Security retirement pension, Social Security Disability Insurance, unemployment and workers' compensations insurance, and other government transfers. The results suggest that incomes and wealth give no additional explanation on the estimated obesity-work relationship.

Third, obesity-related health conditions would increase the need for health service utilization and thus health care expenditures. We probe into the role of medical expenses in linking obesity with labor market outcomes and find that the inclusion of out-of-pocket and total medical expenses reduces the effect of obesity by about 25% on labor force participation, nearly 40% on hours worked at the main job, but increases the effect of obesity slightly on having a second job and hours at the second job, and slightly reduces the obesity effect on self-employment.

Fourth, there might be obesity-related difference in expected life expectancy though we have found no evidence in our data that obesity increases two- or four-year mortality. A longer planning horizon period, or, a greater expected life expectancy, increases labor supply. There seems an inverse U-shaped difference in the unadjusted expected life expectancy among our study by their weight status: the average expectation of living until 100 years old is about 46.5 among normal weight, 49.2 among overweight, and 46.9 among obese, particularly, 47.2 among mildly obese and 45.5 among moderately or severely obese men. The higher self-evaluated

expected life expectancy of overweight and mildly obese men, compared to normal weight men, may provide additional explanation to the obesity-work relationship. Indeed we find that the self-assessed probability of living till age 100 shows to be the single most important factor in explaining the estimated labor market effect of obesity: its inclusion in the regression analysis reduces the effect of obesity by about one-third on labor force participation, three-quarters on working for pay, half in hours at the second job and self-employment, and reverses the sign of the effect obesity on hours worked at the main job. The prominence of expected life expectancy is also evident in explaining the effects of overweight on virtually all labor market outcomes examined here.

Lastly, we investigate the role of the preference for labor market, or the extent one *wants* to work, in the estimated obesity-work link. The preference for work is mostly unobservable, difficult to measure and unavailable in the data. The individual fixed effect accounts for unobserved factors including preferences for work, but assumes these unobserved factors remain unchanged throughout the study period. It is possible that individuals alter their preferences for work during ages 70-79, though there has no evidence documented in the literature. We use variables related to job market attachment—longest job tenure and health behavior of cigarette smoking as a proxy to the preference for work. The longest job tenure varies little by weight—about 28.7 years among normal weight and 28.4 among overweight and obese men (with 28.8 years among mildly obese and 26.7 among moderately or severely obese men). In contrast, there is a strong gradient on smoking status by weight; consistent with the literature, the prevalence of current smokers among men aged 70-79 is about 17.3% among normal weight, 7.8% among overweight and 5.6% among obese men (with 6.0% among mildly obese and 4.2% among

moderately and serve rely obese men). The results indicate that these preference proxy variables offer little additional explanation to the estimated obesity-work link.

Taken together, these potential mechanisms—chronic diseases, depressive symptoms, health status, incomes and wealth, medical expenses, expected life expectancy, job market attachment and health behaviors—explain a good portion of the estimated effect of obesity on labor market outcomes, particularly, on labor force participation (with 60% explained) and working for pay (with over 80% explained), labor market intensity in hours worked (nearly completely explained), self-employment (with 40% explained), and labor market extensity in hours worked at the second job (with 20% explained). The strongest pathways are found to be health (chronic conditions, depression and health status), medical expenses and life expectancy.

6. DISCUSSION

In this study, we present evidence on the positive effects of obesity on labor market outcomes at old-age. We find an increase of 3.8 percentage points in labor force participation, 1.347 hours worked each week at the main job, 1.8 percentage points in holding a second job, nearly 0.5 hours at the second job, and 4.2 percentage points in self-employment among obese men aged 70-79 compared to their normal weight counterparts. We then attempt to uncover potential pathways that may link obesity with labor market outcomes, such as chronic diseases, depressive symptoms, health status, incomes and wealth, medical expenses, expected life expectancy, job market attachment and health behaviors, but find strong evidence that the estimated obesity-work link operates through these hypothesized pathways. Our findings are based on a rich nationally representative longitudinal data and a fixed effects estimation model

on a wide range of outcomes from labor force participation and labor market activity intensity, extensity and depth.

Our study has several limitations. First and foremost, this research is an observational study, and cautions must be taken in interpreting our findings as causal. The individual fixed-effects to purge permanent individual heterogeneity can help mitigate the selection and other sources of biases that are inherent in observational studies. A true causal obesity-work relationship would be attainable only under experimental designs where obesity status is randomly assigned. Second, our definition of obesity is based on body mass index, and recent studies (e.g., Srikanthan et al., 2009) suggest that alternative measures, such as waist-to-hip, might be better than body mass index to predict certain outcomes such as premature mortality among high-functioning older adults. This study focuses on the effect of obesity defined as having body mass index of 30 or high, on labor market outcomes. When additional data become available on physical measures such as waist and hip measures and body fat composition, future investigation of the effects of alternative measures of obesity or excessive body weight on labor market outcomes can be conducted. Third, we use the self-reported body weight and height in calculating body mass index. A recent review of Gorber et al., (2007) shows the evidence for under-reporting weight and over-reporting height, but the report bias among older adults is primarily characterized by overstated height (Gunnell et al., 2000; Ezzati et al., 2006). The 2006 wave of Health and Retirement Survey collects both measured and self-reported height and weight; on average, reported height is about one inch taller than the measured height, and the correlation is 0.89; reported weight is about three pound less than the measured weight, and the correlation is 0.97 (Weir, 2007). This evidence suggests that the reporting error in body weight and height is unlikely to be an important issue for our data. Fourth, focusing on men aged 70-79,

our findings may not be applicable to women as there is a substantial gender difference in obesity, labor market outcomes, and likely the relationship between the two. Future research might extend the analysis to older women.

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Table 1: Demographics, BMI, and labor market outcomes of the study sample

	Mean	Standard deviation
Demographics		
White (0-1)	0.898	0.009
Years of schooling	11.860	14.987
Veteran (0-1)	0.722	0.240
Hispanic (0-1)	0.047	0.032
Age (years)	74.232	9.359
Married (0-1)	0.770	0.229
Body weight & obesity status		
Height (meter)	1.767	0.006
Weight (kilogram)	82.964	244.286
BMI (kg/m_2)	26.546	20.904
Underweight (0-1)	0.010	0.015
Normal weight (0-1)	0.323	0.273
Overweight (0-1)	0.474	0.309
Obese (0-1)	0.135	0.144
Mildly obese (0-1)	0.303	0.271
Moderately obese (0-1)	0.031	0.036
Severely obese (0-1)	0.006	0.008
Labor market outcomes		
Labor force participation (0-1)	0.194	0.204
Working for pay (0-1)	0.169	0.183
Holding a second job (0-1)	0.012	0.016
Hours per week worked at main job	5.004	208.500
Weeks per year worked at main job	8.436	443.426
Hours per week worked at main job	0.167	5.181
Weeks per year worked at main job	0.454	26.980
Self-employed (0-1)	0.085	72.647

Notes: Data source is HRS 1994-2004 including AHEAD 1995.Presented are population averages and standard deviations of demographics, body weight and obesity status, and labor market outcomes of the study sample—male respondents aged between 70 and 79 at time of the interview—using sampling weight to adjust for complex survey designs. See the main text for the detailed construction of the study samples and data description.

Table 2: The effects of obesity on labor market outcomes using specification (2)

Dependent variables	Labor force participation	Working for pay	Main job—hours	Main job—weeks	Having second job	2nd job—hours	2nd job—weeks	Self-employed
Panel A: 2 obesity categories								
	0.018	0.019 *	0.502	0.844 *	0.007	0.228 **	0.342	0.022 ***
Overweight	(0.011)	(0.011)	(0.354)	(0.506)	(0.004)	(0.112)	(0.216)	(0.008)
	0.038 **	0.037 **	1.347 **	0.546	0.016 **	0.365 **	0.875 ***	0.038 ***
Mildly obese	(0.018)	(0.018)	(0.567)	(0.808)	(0.007)	(0.175)	(0.337)	(0.013)
Panel B: 3 obesity categories								
	0.018	0.019 *	0.508	0.851 *	0.007	0.228 **	0.340	0.022 ***
Overweight	(0.011)	(0.011)	(0.354)	(0.506)	(0.004)	(0.112)	(0.216)	(0.008)
	0.039 **	0.040 **	1.415 **	0.629	0.015 **	0.355 **	0.844 **	0.040 ***
Mildly obese	(0.018)	(0.018)	(0.568)	(0.810)	(0.007)	(0.175)	(0.338)	(0.013)
	0.008	-0.015	-0.056	-1.224	0.043 ***	0.608 **	1.575 ***	-0.002
Moderately or severely obese	(0.032)	(0.031)	(0.977)	(1.340)	(0.012)	(0.290)	(0.600)	(0.023)
Panel C: 4 obesity categories								
	0.018	0.019 *	0.509	0.855 *	0.007	0.228 **	0.340	0.022 ***
Overweight	(0.011)	(0.011)	(0.354)	(0.506)	(0.004)	(0.112)	(0.216)	(0.008)
	0.040 **	0.040 **	1.418 **	0.643	0.015 **	0.355 **	0.844 **	0.040 ***
Mildly obese	(0.018)	(0.018)	(0.568)	(0.810)	(0.007)	(0.175)	(0.338)	(0.013)
	0.010	-0.013	-0.005	-1.007	0.043 ***	0.609 **	1.579 ***	-0.003
Moderately obese	(0.032)	(0.031)	(0.290)	(1.402)	(0.012)	(0.291)	(0.561)	(0.023)
	-0.053	-0.058	-0.952	-5.008 *	0.036	0.573	1.489	-0.000
Severely obese	(0.063)	(0.058)	(1.859)	(2.660)	(0.012)	(0.559)	(1.077)	(0.043)
Panel D: body mass index								
	0.001	0.002	0.046	0.034	0.002 **	0.025	0.098 ***	0.002
BMI	(0.002)	(0.002)	(0.062)	(0.089)	(0.001)	(0.019)	(0.037)	(0.001)

Notes: Presented are the marginal effects and heteroskedasticity-robust standard errors clustering at individuals in parentheses of obesity-related variables using specification (2). Results with two, three and four weight categories are in Panels A-C, respectively, and with BMI in Panel D. *** p<0.01, ** p<0.05, * p<0.1.

Table 3: The obesity-work relationships: the role of Social Security retirement income

Dependent variables	Labor force participation	Working for pay	Main job—hours	Main job—weeks	Having second job	2nd job—hours	2nd job—weeks	Self-employed
Panel A: among those who claimed Social Security retirement income								
	0.019 *	0.019 *	0.506	0.851 *	0.007	0.234 **	0.352	0.023 ***
Overweight	(0.011)	(0.011)	(0.359)	(0.514)	(0.004)	(0.115)	(0.221)	(0.008)
	0.039 **	0.039 ***	1.405 **	0.591	0.017 **	0.375 **	0.896 ***	0.039 ***
Obese	(0.018)	(0.018)	(0.575)	(0.820)	(0.007)	(0.178)	(0.344)	(0.013)
Panel B: among those who claimed Social Security retirement income after age 62								
	0.036	0.036 *	0.867	1.734 **	0.009	0.153	0.324	0.034 **
Overweight	(0.019)	(0.018)	(0.596)	(0.849)	(0.008)	(0.169)	(0.327)	(0.013)
	0.077 ***	0.077 ***	2.440 ***	2.003	0.024 **	0.305	1.171 **	0.056 ***
Obese	(0.028)	(0.028)	(0.911)	(1.294)	(0.012)	(0.257)	(0.496)	(0.020)
Panel C: among those who claimed Social Security retirement income by age 70								
	0.037 **	0.037 **	1.190 **	2.010 **	0.011	0.228	0.563 *	0.023 *
Overweight	(0.018)	(0.017)	(0.545)	(0.785)	(0.007)	(0.159)	(0.306)	(0.012)
	0.077 ***	0.080 ***	2.783 ***	2.693 **	0.024 **	0.360	1.279 ***	0.048 **
Obese	(0.026)	(0.026)	(0.823)	(1.182)	(0.011)	(0.239)	(0.459)	(0.019)
Panel D: among those who claimed Social Security retirement income between age 62 and 70								
	0.043 **	0.044 **	1.309 **	2.239 **	0.010	0.162	0.358	0.037 ***
Overweight	(0.019)	(0.019)	(0.604)	(0.865)	(0.008)	(0.177)	(0.335)	(0.014)
	0.087 ***	0.087 ***	2.781 ***	2.568 **	0.026 **	0.320	1.230 **	0.056 ***
Obese	(0.028)	(0.028)	(0.915)	(1.306)	(0.012)	(0.266)	(0.504)	(0.020)

Notes: Presented are the coefficients and heteroskedasticity-robust standard errors of *overweight* and *obese* using specification (2) on subsamples of the study sample indicated in panels A-D. See notes in Table 2. *** p<0.01, ** p<0.05, * p<0.1.

Table 4: Robustness checks of obesity-work relationships: mortality and excessive weight loss

Dependent variables	Labor force participation	Working for pay	Main job—hours	Main job—weeks	Having second job	2nd job—hours	2nd job—weeks	Self-employed
Panel A: exclude those who died in the two-year follow-up								
	0.015	0.016	0.434	0.777	0.007 *	0.239 **	0.363	0.020 **
Overweight	(0.012)	(0.011)	(0.360)	(0.514)	(0.004)	(0.115)	(0.221)	(0.008)
	0.031 *	0.031 *	1.027 *	0.217	0.017 **	0.381 **	0.919 ***	0.032 **
Obese	(0.019)	(0.018)	(0.580)	(0.825)	(0.007)	(0.181)	(0.347)	(0.013)
Panel B: exclude those who died in the four-year follow-up								
	0.015	0.015	0.453	0.784	0.007	0.233 **	0.352	0.021 **
Overweight	(0.012)	(0.011)	(0.360)	(0.515)	(0.004)	(0.115)	(0.217)	(0.008)
	0.035 *	0.034 *	1.157 **	0.457	0.017 **	0.373 **	0.899 ***	0.033 **
Obese	(0.019)	(0.018)	(0.579)	(0.826)	(0.007)	(0.180)	(0.343)	(0.013)
Panel C: exclude those who lost 5 kilograms or more in body weight in the two-year follow-up								
	0.016	0.019 *	0.261	0.685	0.007 *	0.190 *	0.289	0.021 **
Overweight	(0.012)	(0.011)	(0.369)	(0.530)	(0.004)	(0.115)	(0.233)	(0.009)
	0.037 *	0.040 **	1.239 **	0.569	0.014 *	0.290	0.784 **	0.045 ***
Obese	(0.019)	(0.018)	(0.597)	(0.855)	(0.007)	(0.181)	(0.367)	(0.014)
Panel D: exclude those who gained 5 kilograms or more in body weight in the two-year follow-up								
	0.062 ***	0.057 ***	1.063 *	2.041 **	0.007	0.099	0.109	0.049 ***
Overweight	(0.019)	(0.018)	(0.588)	(0.830)	(0.008)	(0.168)	(0.328)	(0.014)
	0.089 ***	0.083 ***	1.822 *	0.929	0.027 **	0.355	1.248 **	0.064 ***
Obese	(0.031)	(0.030)	(0.980)	(1.373)	(0.013)	(0.275)	(0.538)	(0.023)

Notes: Presented are the coefficients and heteroskedasticity-robust standard errors of *overweight* and *obese* using specification (2) on the study sample with exclusion of observations indicated in panels A-D. See notes in Table 2. *** p<0.01, ** p<0.05, * p<0.1.

Table 5: Potential mechanisms of the impact of obesity on labor market outcomes

Dependent variables		Labor force participation	Working for pay	Main job—hours	Having second job	2nd job—hours	Self-employed
Baseline	Overweight	0.018	0.019 *	0.502	0.007	0.228 **	0.022 ***
		(0.011)	(0.011)	(0.354)	(0.004)	(0.112)	(0.008)
	Obese	0.038 **	0.037 **	1.347 **	0.016 **	0.365 **	0.038 ***
		(0.018)	(0.018)	(0.567)	(0.007)	(0.175)	(0.013)
Plus chronic conditions, depressive symptoms, and health status	Overweight	0.018	0.020	0.381	0.008 *	0.293 **	0.026 ***
		(0.012)	(0.011)	(0.390)	(0.005)	(0.118)	(0.009)
	Obese	0.035 *	0.031	0.869	0.018 **	0.496 **	0.042 ***
		(0.020)	(0.020)	(0.628)	(0.008)	(0.185)	(0.015)
Plus incomes, transfers, and wealth	Overweight	0.019	0.020	0.383	0.009 *	0.291 **	0.026 ***
		(0.012)	(0.011)	(0.390)	(0.005)	(0.118)	(0.009)
	Obese	0.035 *	0.031	0.864	0.018 **	0.493 ***	0.042 ***
		(0.020)	(0.020)	(0.627)	(0.008)	(0.185)	(0.015)
Plus medical expenses	Overweight	0.008	0.010	0.063	0.011 **	0.335 **	0.022 **
		(0.014)	(0.014)	(0.425)	(0.005)	(0.142)	(0.010)
	Obese	0.024	0.022	0.503	0.020 **	0.516 **	0.037 **
		(0.022)	(0.022)	(0.691)	(0.008)	(0.223)	(0.016)
Plus life expectation	Overweight	-0.001	-0.004	-0.268	0.008	0.105	0.017
		(0.019)	(0.019)	(0.585)	(0.006)	(0.181)	(0.014)
	Obese	0.016	0.005	-0.719	0.022 **	0.282	0.022
		(0.030)	(0.031)	(0.965)	(0.010)	(0.290)	(0.023)
Plus job market attachment and health behaviors	Overweight	-0.000	-0.003	-0.269	0.008	0.107	0.018
		(0.019)	(0.020)	(0.605)	(0.006)	(0.189)	(0.014)
	Obese	0.018	0.007	-0.763	0.023 **	0.295	0.024
		(0.032)	(0.032)	(1.004)	(0.010)	(0.304)	(0.023)

Notes: Presented are the coefficients and heteroskedasticity-robust standard errors of *overweight* and *obese* using specification (2) with additional covariates indicated in the row heading,. Each row that begins with the title "Plus" report estimates that add the denoted variables to the specification estimated in the row directly above. Chronic conditions are indicators for hypertension, diabetes, heart disease, stroke, arthritis, lung disease, cancer, and psychological problems. Depressive symptom is an index score that sums five negative indicators (whether the respondent experienced the following sentiments all or most of the time: depression, everything is an effort, sleep is restless, felt alone, felt sad, and could not get going) minus two positive indicators (whether the respondent felt happy and enjoyed life, all or most of the time). Health status is a five-point categorical variable with 1 indicating excellent and 5 indicating poor. Incomes and household wealth are in logs of nominal dollars. Medical expenses (out-of-pocket and total) are in logs with linear and quadratic terms. Life expectancy is the self-assessed probability of living to100. Job market attachment is the longest job tenure in years and health behavior is an indicator for currently smoking. *** p<0.01, ** p<0.05, * p<0.10.

Appendix Table A1a: Within-individual cross-period changes in (dichotomous) weight and obesity status

	Underweight	Normal weight	Normal or underweight	Overweight	Obese	Mildly obese	Moderately obese	Severely obese
Definition	BMI < 18.5	18.5 ≤BMI < 25	BMI < 25	25 ≤BMI < 30	BMI ≥ 30	30 ≤BMI < 35	35 ≤BMI < 40	BMI ≥ 40
Unchanged cross-period	0.9897	0.8284	0.8325	0.7611	0.9105	0.9068	0.9755	0.9948
Change from 'No' from 'Yes'	0.0081	0.1297	0.1355	0.1681	0.0612	0.0598	0.0151	0.0031
Change from 'Yes' from 'No'	0.0022	0.0419	0.0320	0.0708	0.0282	0.0355	0.0094	0.0021

Appendix Table A1b: Within-individual cross-period changes in (dichotomous) labor market outcomes

	Labor force participation	Working for pay	Holding second job	Self employed
Unchanged cross-period	0.9025	0.9020	0.9826	0.9453
Change from 'No' from 'Yes'	0.0253	0.0290	0.0080	0.0351
Change from 'Yes' from 'No'	0.0722	0.0690	0.0095	0.0320

Notes: Presented are the within-individual cross-period changes in weight and status indicators in Table A1a and dichotomous labor market outcomes in Table A1b.

Appendix Table A2: Estimates of obesity-work relationship using four specifications and Hausman specification checks

Dependent variables		Labor force participation	Working for pay	Main job—hours	Main job—weeks	Having second job	2nd job—hours	2nd job—weeks	Self-employed
Specification (1)									
		0.023 **	0.026 ***	0.647 **	1.182 ***	0.006 **	0.128 **	0.233 *	0.021 ***
	Overweight	(0.009)	(0.008)	(0.261)	(0.374)	(0.003)	(0.054)	(0.119)	(0.006)
		0.024 *	0.026 **	0.857 **	0.563	0.014 ***	0.288 ***	0.543 ***	0.022 **
	Obese	(0.012)	(0.012)	(0.380)	(0.543)	(0.004)	(0.072)	(0.161)	(0.009)
Specification (2)									
		0.018	0.019 *	0.502	0.844 *	0.007	0.228 **	0.342	0.022 ***
	Overweight	(0.011)	(0.011)	(0.354)	(0.506)	(0.004)	(0.112)	(0.216)	(0.008)
		0.038 **	0.037 **	1.347 **	0.546	0.016 **	0.365 **	0.875 ***	0.038 ***
	Obese	(0.018)	(0.018)	(0.567)	(0.808)	(0.007)	(0.175)	(0.337)	(0.013)
Specification (3)									
		0.044	0.047	2.167	3.163	0.004	0.113	0.175	0.036
	Overweight	(0.089)	(0.092)	(3.124)	(4.415)	(0.010)	(0.142)	(0.409)	(0.069)
		0.010	0.018	-0.297	0.785	0.022 **	0.333 ***	0.899 **	0.018
	Obese	(0.054)	(0.054)	(1.779)	(2.544)	(0.009)	(0.136)	(0.368)	(0.040)
Specification (4)									
		-0.030	-0.027	-1.978	-2.531	0.022	0.467	0.530	0.023
	Overweight	(0.105)	(0.101)	(3.220)	(4.583)	(0.044)	(0.897)	(1.737)	(0.074)
		-0.073	-0.072	-1.516	-4.922	-0.019	0.210	-1.328	0.027
	Obese	(0.190)	(0.180)	(5.909)	(8.336)	(0.079)	(1.611)	(3.123)	|(0.132)
Hausman specification checks									
Spec. (1) vs. Spec. (2)		61.45	109.94	59.90	68.12	19.72	5.17	14.37	28.73
test statistic		$p < 0.0000$	$p < 0.0000$	$p < 0.0000$	$p < 0.0000$	$p < 0.0726$	$p < 0.9519$	$p < 0.2774$	$p < 0.0043$
Spec. (1) vs. Spec. (3):		21.93	6.91	385.48	4.50	21.93	38.84	1.63	8.14
test statistic		$p < 0.1456$	$p < 0.9601$	$p < 0.0000$	$p < 0.9956$	$p < 0.1456$	$p < 0.0007$	$p < 1.0000$	$p < 0.9179$
Spec. (2) vs. Spec. (4)		5.54	7.5449	17.14	7.80	5.54	1.90	1.99	8.39
test statistic		$p < 0.9024$	$p < 0.7583$	$p < 0.1037$	$p < 0.7310$	$p < 0.9024$	$p < 0.9988$	$p < 1.0000$	$p < 0.6779$

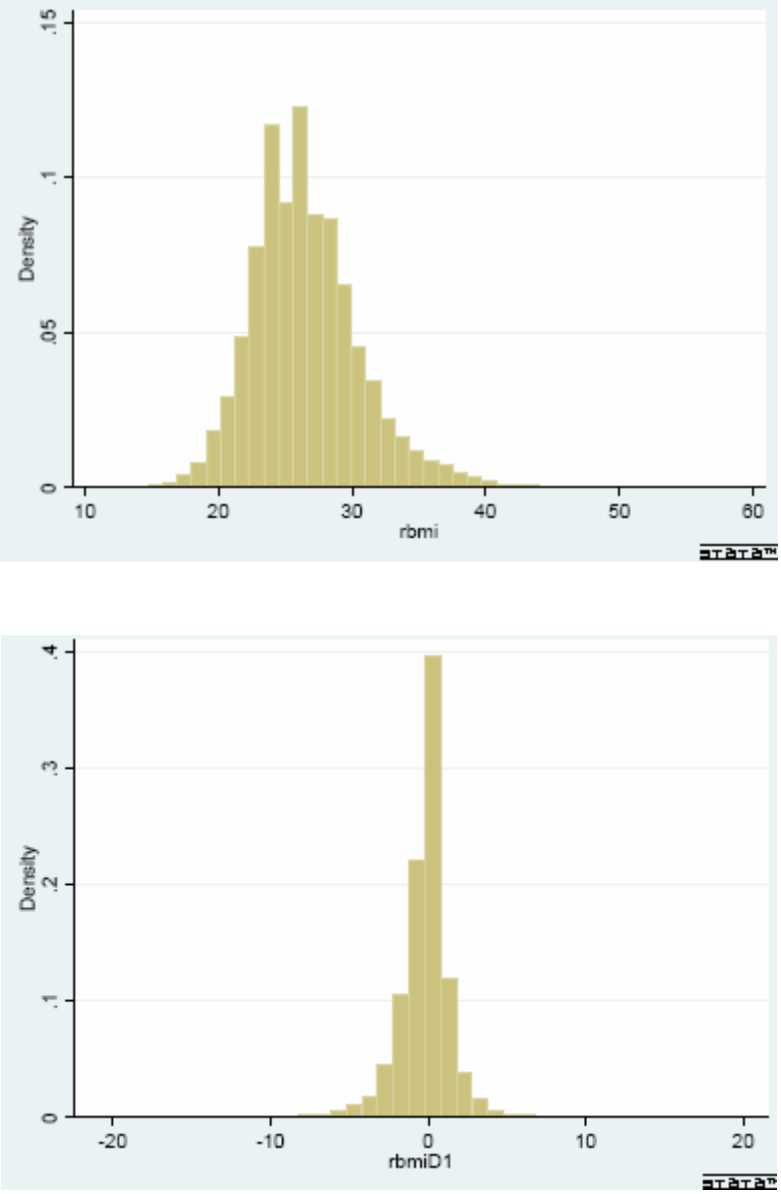
Notes: Presented are the coefficients and robust standard errors clustering at individuals in parentheses in specifications (1)-(4). *** p<0.01, ** p<0.05, * p<0.1.

Appendix Table A3: Obesity and mortality risk

Dependent variables	2-yrs morality	4-yrs mortality
	(1)	(2)
Panel A: body mass index		
	-0.0007	-0.0008 *
BMI	(0.0004)	(0.0004)
Panel B: 2 weight categories		
	-0.0017	0.0043
Overweight	(0.0038)	(0.0040)
	-0.0001	-0.0046
Obese	(0.0050)	(0.0052)
Panel C: 3 weight categories		
	-0.0017	0.0043
Overweight	(0.0038)	(0.0040)
	0.0042	-0.0020
Mildly obese	(0.0057)	(0.0057)
	-0.0158 **	-0.0139 *
Moderately or severely obese	(0.0067)	(0.0073)
Panel D: 4 weight categories		
	-0.0017	0.0044
Overweight	(0.0038)	(0.0040)
	0.0042	-0.0020
Mildly obese	(0.0057)	(0.0058)
	-0.0148 **	-0.0108
Moderately obese	(0.0073)	(0.0085)
	-0.0207	--
Severely obese	(0.0138)	
Sample size	11,708	11,670

Notes: Presented are the marginal effect and standard errors of the logistic probabilistic regression of two- and four- year mortality probability in columns (1)-(2), respectively, on body mass index in Panel A and various weight and obesity categories in Panel B-D and basic demographics (age, white, education, ethnicity, veteran status, marital status and residential region indicators). *** p<0.01, ** p<0.05, * p<0.10.

Appendix Figure A1: Distribution of BMI and intra-person inter-period changes in BMI



Notes: Presented are the distribution profile of the body mass index (top), and the within-individual between-period changes in body mass index (bottom) among the study sample.