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WEIGHT AND WAGES: FAT VERSUS LEAN PAYCHECKS

EUNA HAN[a,*], EDWARD C. NORTON[b,c] and SALLY C. STEARNS[d]

[a]*Institute for Health Research and Policy, University of Illinois at Chicago, Chicago, IL, USA*
[b]*Department of Health Management and Policy, University of Michigan, Ann Arbor, MI, USA*
[c]*Department of Economics, University of Michigan, Ann Arbor, MI, USA*
[d]*Department of Health Policy and Administration, University of North Carolina at Chapel Hill, NC, USA*

SUMMARY

Past empirical work has shown a negative relationship between the body mass index (BMI) and wages in most cases. We improve on this work by allowing the marginal effect of non-linear BMI groups to vary by gender, age, and type of interpersonal relationships required in each occupation. We use the National Longitudinal Survey of Youth 1979 (1982–1998). We find that the often-reported negative relationship between the BMI and wages is larger in occupations requiring interpersonal skills with presumably more social interactions. Also, the wage penalty increases as the respondents get older beyond their mid-twenties. We show that being overweight and obese penalizes the probability of employment across all race–gender subgroups except black women and men. Our results for the obesity–wage association can be explained by either consumers or employers having distaste for obese workers. Copyright © 2008 John Wiley & Sons, Ltd.

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1. INTRODUCTION

The dramatic growth in the obesity rate over the last several decades has raised concerns about the resulting economic and health effects. From 1984 to 1998 in the United States, the average Body Mass Index (BMI: weight in kilograms divided by height in meters) increased by 9% and the number of obese adults more than doubled as in Chou *et al.* (2002). The Office of the Surgeon General Public Health Service (2001) reports that the increase in the number of overweight and obese persons holds for all ages, racial, and ethnic groups, and both genders. While the health outcomes of obesity are well studied in the clinical literature, the economic effects of obesity have not been as extensively studied.

Obesity affects wages if employers do not want to hire obese people due to concerns about either low marginal productivity or high health-care costs, particularly when the employer provides health insurance. Being obese may also signal a high discount rate. People with a high discount rate are less likely to be concerned about long-term adverse health effects, and accordingly, are more likely to be obese. More importantly for the labor market, they may also be less likely to invest in their human capital. Consumers may also prefer to interact with slender workers. Everett (1990) and Puhl and Brownell (2001) demonstrated that employers perceived obese persons as unfit for public sales positions and as more appropriate for telephone sales involving little face-to-face contact. The extent to which

*Correspondence to: Institute for Health Research and Policy, University of Illinois at Chicago, 1747 West Roosevelt Road, Room 449, Chicago, IL 60608, USA. E-mail: eunahan@uic.edu

obese people are paid less, for any of these reasons, is then an empirical question. This study investigates the effect of obesity on labor market outcomes, specifically wages.

The wage penalty of obesity, if it exists, should vary in predictable ways. Some occupations, such as sales and teaching, require more interaction with customers or colleagues than other occupations, such as computer programming. Any potential wage penalty for being overweight or obese may differ by the extent of social interactions or the type of interpersonal relationships required in each occupation. Age also plays an important role in both body weight and labor market outcomes. People tend to gain weight with age, especially women following childbirth. The prevalence of many chronic diseases, which may affect labor productivity, increases with age. We explore the extent to which the effect of obesity on labor market outcomes varies with age and characteristics of interpersonal skills in each occupation group.

Several studies have linked obesity to labor market outcomes, typically wages. Averett and Korenman (1996), Cawley (2004), Baum and Ford (2004), and Conley and Glauber (2005) all found a wage penalty for obesity in the range of 0.6–12%. In contrast, Behrman and Rosenzweig (2001) and Bhattacharya and Bundorf (2005) report no effect of body weight on hourly wages. This study improves the literature in two ways. First, we explore how the effect of body weight on hourly wages varies by occupational characteristics, particularly interpersonal skills. None of the previous literature estimated whether the marginal effect of obesity on hourly wages differs by interpersonal skills in occupations where being obese may penalize workers for their obesity. We sort occupations by the type of interpersonal relationship required and by the extent of social interaction with customers or colleagues using the Dictionary of Occupational Titles (DOT). Estimation by characteristics of interpersonal skills in each occupation helps to identify the effect of consumer or employer distaste separately from the effect of unobserved productivity for obese people. A difference in the effect of obesity on wages by interpersonal skills required in occupations implies that consumer or employer distaste is important.

Second, we identify the changing effect of obesity on labor market outcomes at different points in the life cycle by estimating models that include interactions of age with obesity. Because people tend to gain weight as they get older, the amount of consumer or employer distaste for obese employees may differ by the employees' age. Age also has an important role for individuals' choice for labor market participation, such as job mobility and job tenure.

We controlled for labor market characteristics in state-level variables that are omitted from the prior literature, such as per capita average income by state. An individual fixed-effects model is used to sweep out any unobserved permanent individual heterogeneity. The results confirm an employment penalty for overweight ($25 \leq \mathrm{BMI} < 30$) and obesity ($\mathrm{BMI} \geq 30$) in all race and gender subgroups except black women and black men. The wage penalty for obesity appears for the sample persons in their mid-twenties or older with the effect increasing over age. The wage penalty for obesity is larger in occupations requiring interpersonal skills with presumably more social interactions, specifically in white and black women. The increase in the wage penalty by age appears larger in occupations requiring interpersonal skills with supposedly more social interactions.

2. BACKGROUND

Several studies have linked obesity to labor market outcomes, mostly wages. Older studies by Register and Williams (1992), Loh (1993), Gortmaker *et al.* (2001), and Sargent and Blanchflower (1994) did not control for the endogeneity of obesity. Recently, a few studies have attempted to control for the endogeneity of obesity, as in Cawley (2004), Averett and Korenman (1996), Conley and Glauber (2005), Baum and Ford (2004), Pagan and Davila (1997), and Behrman and Rosenzweig (2001). Most of those studies found a negative effect of BMI or body weight on hourly wages for women, but no significant

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effect for men. The direction and the magnitude of the effect were also different by races within each gender, and the wage penalty for obesity was found only in white women (Cawley, 2004).

Most of those studies used weak or just-identified instruments to control for potential endogeneity of obesity. The just-identifying instruments used in the previous literature include a lag of respondents' own body weight or BMI (Averett and Korenman, 1996; Conley and Glauber, 2005), or siblings' or children's BMI (Cawley, 2000, 2004). However, a lag of current BMI will not be a valid instrument if there is any serial inter-temporal correlation in the wage residuals. Likewise, children's body weight will not be a valid instrument if unobserved heterogeneity in the wage residual associates with both children's body weight and the mother's employment disability. Siblings' BMI also would not be a valid instrument if siblings share the unobserved earning endowment factors.

Only one study by Cawley (2000) estimated the external marginal effect of obesity on employment disability, measured by limitations on the amount of paid work and limitations on types of paid work. This study found no statistically significant effect of obesity in the external margin. There are two studies – Baum and Ford (2004) and Bhattacharya and Bundorf (2005) – that modeled potential factors mediating obesity to hourly wages. The mediating factors included less productivity due to health problems from obesity, less investment in human capital by obese workers, employer distaste for obese employees due to high health-care cost, consumer distaste for obese workers, and health-care cost differentials offsetting wages. While Baum and Ford (2004) found significant effects of those four potential pathways linking obesity to labor market outcomes, Bhattacharya and Bundorf (2005) found no statistically significant wage differential between obese and non-obese individuals.

3. RESEARCH DESIGN AND METHODS

3.1. Estimation models

We used the likelihood of employment and log hourly wages as the dependent variables, which are modeled as a function of weight status, age, other covariates, and individual fixed effects. The main equations are

$$\Pr(\text{Employment}_{it}) = g(\text{BMI}_{it}, \text{Age}_{it}, X_{it}, X_{st}, \epsilon_{it}) \tag{1}$$

$$\ln(\text{Wage}_{it}) = h(\text{BMI}_{it}, \text{Age}_{it}, \text{SkillType}_{it}, X_{it}, X_{st}, \mu_i, \epsilon_{it}) \tag{2}$$

where suffixes i and t stand for individual and time, respectively. BMI in Equations (1) and (2) stands for two dummy variables for overweight ($25 \leq \text{BMI} < 30$) and obese ($\text{BMI} \geq 30$), with normal weight or underweight ($\text{BMI} \leq 25$) as the reference groups. We opt to use categorical variables to measure incremental effects of moving up one clinical weight classification on the probability of employment and log wages. This specification does not impose a constant marginal effect of a one-unit increase in BMI on the probability of employment or log wages across the entire BMI range. As a robustness check, we also ran models with a continuous measure of BMI, and found substantially the same results. SkillType is a vector of dummy variables representing interpersonal skills required in each occupation. X_{it} and X_{st} denote other control variables at the individual and state levels, respectively. Individual-level covariates include marital status, the number of children, duration between the last pregnancy and the time of interview (for women), years of education, years of work experience, part-time work status (for wage equation only), current school enrollment, and blue-/white-collar job types (for wage equation only), urban/rural status, region in the USA, and unemployment rate in the residential unit. The unemployment rate in the residential area is at a metropolitan area level for the respondents residing in a metropolitan area. Otherwise, the unemployment rate is the state unemployment rate (not including Census metropolitan areas) in which the respondent resides (US Department of Labor, 2001). State-level covariates include per-capita state average income, the Consumer Price Index, the number of

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business establishments. μ stands for time-invariant individual fixed effects and ε stands for independently identically distributed error terms. Further, we modify Equation (2) by including interactions of BMI groups and age and a three-way interaction of BMI groups, age, and characteristics of interpersonal skills required in each occupation. The modifications allow estimating any changes in the effect of BMI groups on hourly wages with age and characteristics of interpersonal skills in each occupation. We run estimations separately by three race subgroups (white, back, and Hispanic) and gender.

3.2. Statistical methods

The appropriate statistical methods depend largely on whether obesity is endogenous. Obesity is endogenous, first, if current wages or employment status causes or prevents obesity. Ruhm (2000, 2004) argues that many individual health conditions are countercyclical with macroeconomic conditions because unemployed persons have more time to exercise and eat well, and less income to drink alcohol. Employed adults are more likely to have health insurance than unemployed adults, but also to have less time to seek medical care.

Second, unobserved genetic and non-genetic factors would also cause obesity to be endogenous (Cawley, 2004). Linking back to the economic theory, lower discount rates make a person invest more in all facets of human capital, creating a correlation between economic outcomes and obesity. Persons with low discount rates are more likely to invest in education, yielding higher average wages. They are also more likely to invest in health inputs, such as diet and exercise, which help to lower obesity. Obesity is also endogenous if unobserved health conditions relate to both obesity and labor market outcomes.

We controlled for state-level labor market characteristics, such as per-capita average income, the Consumer Price Index, and the unemployment rate at the current residential area. State-level macroeconomic conditions control for time-varying macroeconomic shocks that could affect individual health conditions. We also controlled for individual fixed effects to remove time-invariant individual heterogeneity, including genetics and the individual discount rate. Remaining omitted variables related to both obesity and labor market outcomes are included in a time-varying error. We cannot specify how much the time-varying error component contributes to endogeneity of obesity. However, studies in behavioral genetics suggest that the genetic effect on variation in BMI is relatively strong. For example, Stunkard *et al*. (1990), MacDonald and Stunkard (1990), and Price and Gottesman (1991) all reported that correlations in the BMI of monozygotic twins reared apart were similar to those for monozygotic twins reared together, suggesting a dominant genetic effect on BMI. Therefore, we argue that we controlled for a large portion of the endogeneity of BMI by including individual fixed effects and controls for state-level economic characteristics.

One can use instrumental variable estimation to control for the time-varying portion of endogeneity in the wage equation only if valid and strong instrumental variables are found. Valid instrumental variables should strongly affect obesity but should not affect wages. The validity of instrumental variables can be tested only with over-identifying instrumental variables. Weak instrumental variables would cause the estimation results with instrumental variables biased back toward OLS, or worse (Staiger and Stock, 1997). As previously noted, most of the prior studies adopting the instrumental variable estimation used weak or just-identifying instruments such as siblings' BMI or lagged values of a respondent's own BMI. We attempted to identify valid instruments at the state level, but none were found to be both strong predictors of obesity and validly excluded from the main equation. Therefore, all relevant state-level variables are included in the main equation. Given the lack of valid and strong instruments, we opt not to use instrumental variable estimation methods.

Many studies of hourly wages in the labor force estimate Heckman selection models to control for the unconditional effect of independent variables on wages. The Heckman selection model requires identifying instruments. The identifying instruments should be correlated with the propensity to

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participate in the labor force, but not be correlated with explanatory variables in the wage equations. There are few, if any, plausible variables in the National Longitudinal Survey of Youth 1979 (NLSY79) that determine whether people work but are unrelated to their wages conditional on working. Models that have no such identifying variables rely solely on function form for identification, and are notoriously unstable (Puhani, 2000; Dow and Norton, 2003). Therefore, we report a wage equation conditional on employment, and the results in the wage equation are all conditional on employment and do not generalize to all people in and out of the work force.

4. DATA

4.1. National Longitudinal Survey of Youth 1979 (NLSY79)

This study uses the NLSY79. The NLSY79 is a nationally representative sample of 12 686 young men and women who were 14–22 years of age when first surveyed in 1979. Blacks, Hispanics, and economically disadvantaged non-black and non-Hispanics were over-sampled. The cohort was interviewed annually from 1979 through 1994 and biennially from 1996 onwards (US Department of Labor, 2001). In addition to the publicly available data, we also used confidential Geocode data with state identifiers. Data from 13 years (1981, 1982, 1985, 1986, 1988, 1989, 1990, 1992, 1993, 1994, 1996, 1998, and 2000) were pooled to create the samples for this study. We do not use the 2002 and 2004 data because the NLSY started to use the 2000 Census occupational codes exclusively. We use the 1970–1990 Census occupational codes throughout this paper, and the 1970–1990 Censuses use fundamentally different occupational taxonomy from the 2000 Census (Lakdawalla and Philipson, 2007).

The analysis file for the model of the likelihood of being employed included 112 229 person-years (57 172 person-years for women and 55 057 person-years for men) from the original sample of 164 918 person-years (81 679 person-years for women and 83 239 person-years for men) after excluding sample who was younger than 18 years old, pregnant within a year from the time of interview including pregnant at the time of interview, or in military service at the time of interview. Only observations for employed persons with occupation information were used for log hourly wages (92 685 employed person-years from the sample of 112 229 eligible person-years). Over a half (55%) of the final sample are whites, and black and Hispanic are represented well as they are composed of 28% and 17% of the final sample, respectively, for both genders. Men and women were equally represented within each race.

4.2. Dependent variable: log wages

For this study, wages were measured by the hourly rate of pay at the most current or the most recent job (CPS job). We deflated hourly wages to year 2000 dollars. Hourly wages greater than \$400 before the yearly inflation adjustment were truncated to \$400 as was done in Cawley (2004). Table I provides descriptive statistics for the sample. On average, a man earned \$12.16 per hour at the current job, and a woman earned \$9.79 as the 2000 dollars. Hourly wages increased with age for both genders in the employed final sample.

4.3. Explanatory variable of interest: BMI

The variable of primary interest is BMI. In the NLSY79, height information was collected only three times, 1981, 1982, and 1985. Because respondents were between 20 and 27 years old in 1985, height in 1985 was used as the respondents' adult height on the assumption that height typically stops changing by age 20 as in Cawley (2004). The BMI was categorized into three groups to measure the non-linear effect of the BMI: underweight or normal weight, overweight, and obese. Throughout the estimation, we combine underweight and normal weight as the reference group. The proportion of underweight was less than 1% for men, and only 4.5% for women.

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Table I. Weighted summary statistics

Variables	Mean		Range
	Men	Women	
Dependent variable			
Employed	0.88	0.77	[0, 1]
Hourly wage[a]	12.16	9.79	[1, 501]
Ln (hourly wage)	2.37	2.12	[0, 6.15]
Independent variable of interest			
BMI	26.06	24.43	[17.27, 45.73]
Overweight ($25 \leq BMI < 30$)	0.40	0.21	[0, 1]
Obese ($30 \leq BMI$)	0.16	0.13	[0, 1]
Interpersonal skills required in occupation[b]			
Mentor, negotiate, instruct	0.04	0.05	[0, 1]
Supervise	0.05	0.04	[0, 1]
Persuade	0.05	0.06	[0, 1]
Speak–signal	0.39	0.42	[0, 1]
Serve	0.03	0.12	[0, 1]
Take instructions–help	0.45	0.31	[0, 1]
Race			
Non-Hispanic white	0.55	0.55	[0, 1]
Non-Hispanic black	0.28	0.28	[0, 1]
Hispanic	0.17	0.17	[0, 1]
Age	28.58	28.69	[18, 43]
Marital status related			
Married	0.44	0.52	[0, 1]
Number of children	0.76	0.98	[0, 9]
Years to the last pregnancy	–	4.95	
Human capital			
Highest grade completed	13.22	13.41	[0, 1]
Enrolled at school	0.19	0.16	[0, 1]
Year of experience	6.37	6.01	[0, 13]
Working part time	0.14	0.28	[0, 1]
Working in a blue-collar job	0.51	0.16	[0, 1]
Mother's highest grade completed	11.52	11.66	[0, 20]
Father's highest grade completed	11.74	11.92	[0, 20]
Regional variables			
Northeast	0.19	0.19	[0, 1]
North-central	0.31	0.28	[0, 1]
South	0.31	0.36	[0, 1]
Urban	0.77	0.77	[0, 1]
Unemployment rate: $>15\%$	0.02	0.02	[0, 1]
Unemployment rate: $12-15\%$	0.05	0.05	[0, 1]
Unemployment rate: $9-12\%$	0.12	0.12	[0, 1]
Unemployment rate: $6-9\%$	0.35	0.35	[0, 1]
Unemployment rate: $<3\%$	0.04	0.05	[0, 1]
State per capita average yearly income in \$1000	20.98	20.91	[11.86, 33.41]
Consumer Price Index (at the state level)	1.35	1.35	[0.95, 1.73]
Number of business establishments per 10 000 state populations	246.74	246.36	[181.92, 378.00]
N	55 057	57 172	

[a]Sample size for hourly wages is 44 266 and 48 419 person-years for women and men, respectively.
[b]There are nine categories in the DOT codes for interpersonal skills required in each occupation. We collapsed the first three categories – mentor, negotiate, and instruct – due to a small sample size for each of those three categories. We also did not have any observation for the interpersonal skill category of 'diverting' in our final sample.

Both body weight and height in the NLSY79 are reported values by the respondents. Several previous studies using the NLSY79, including Cawley (2004), used the third National Health and Nutrition Examination Survey (NHANES III) to try to adjust potential measurement errors on self-reported height and weight in the NLSY79. We do not adjust for self-reported data because the size or magnitude of the errors in self-reported height and weight in the NHANES III may be different than in

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the NLSY79; in particular, the respondents in the NHANES III were aware that their weight and height would be measured after their self-reports of weight and height (U.S. Department of Health and Human Services, 1996). In the final sample, the average BMI was 26 for men, 24 for women, and varied between 17 and 46 overall. The BMI increased with age, and the proportion of the sample that was overweight or obese increased with age until age 39 for both genders.

4.4. Characteristics of interpersonal skills required in occupation

We measured characteristics of interpersonal skills required in each occupation to identify occupations where slimness is rewarded, based on the DOT. Hamermesh and Biddle (1994) used the same measure of interpersonal skills. The DOT was developed by the US Employment Service, Department of Labor to standardize occupational information. Detailed occupational characteristics were compiled in the DOT by fieldwork and expert knowledge of occupational analysts. The first edition of the DOT was published in 1939, and several revisions have followed. We use the fourth (and the most recent) revision, which was released in 1991. In the DOT, blocks of jobs were assigned to the 9-digit occupational codes that are based on the nature of the work performed and the physical demands of such work activities upon the workers. Among the 9 digits of each DOT code, the fifth digit reflects the relationship to people, which is categorized as a nine-point scale: mentoring (scale = 0), negotiating (1), instructing (2), supervising (3), diverting (4), persuading (5), speaking–signaling (6), serving (7), and taking instructions–helping (8) (Office of Administrative Law Judges Law Library, 1991). To help understand the coding system of the relationship to people in the DOT code, consider two examples in each scale of the fifth digit: attorney, doctor (mentoring); property manager, solicitor (negotiating); program director or sales supervisor (supervising); coach or faculty in college or university (instructing); comedian or tap dancer (diverting); broker or pharmaceutical detailer (persuading); mathematician or economist (speaking–signaling); hair stylist or waiter (serving); clerk or boiler operator (taking instructions–helping). We assume all but the last (taking instructions–helping) as interpersonal skills that require social skills with customers or colleagues, following Hamermesh and Biddle (1994). After creating dummy variables representing each scale of the relationship to people, we collapsed the first three scales (mentoring, negotiating, and instructing) due to small sample size for these scales. We used the last scale (taking instructions–helping) as the reference. In the final sample, the two most frequent jobs for both genders were jobs requiring 'speaking–signaling' (42% for women and 39% for men) and 'taking instructions' (31% for women and 45% for men). There was no one in our final sample having an occupation requiring 'diverting' interpersonal skills. The overall distribution of interpersonal skills required in occupations was similar among race subgroups within each gender (results are not shown). Jobs requiring other interpersonal skills ('mentor, negotiate, instruct', 'supervise', 'persuade', 'serve') were composed of less than 10% for both genders (see Table I).

4.5. Other control variables

As previously described, we controlled for demographic characteristics, pregnancy status, the human capital measures, and regional characteristics. Among those covariates, we defined blue-collar jobs using the US Census occupation codes. Blue-collar jobs include occupation codes belonging in the sectors described as (1) precision production, craft, repair, (2) operations: machine, assemblies, inspectors, (3) technical, (4) farming, forestry, and fishing, (5) operations: transportation, material moving, and (6) operations: handlers, helpers, laborers. The state-level variables were obtained from the Census *County and City Data Books* by the US Census Bureau (2000). Forty-one percent of blue-collar occupations were occupations requiring interpersonal skills other than 'taking instructions–helping'. Dummy variables representing for each year are included in the model to control for yearly trend in the BMI. The average age of the sample after adjusting for sampling weights was 29, with age ranging between 18 and 43 years old. Nearly half of the sample (52% of women and 44% of men) was married

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at the time of the interview. On average, people in the final sample had less than one child. The average highest grade completed was just over 13 years. The school enrollment rate was slightly higher for men (19%) than women (16%). Two-thirds of the final sample lived in urban areas. The state per-capita average yearly income was $21 000 (see Table I).

5. RESULTS

For women, being obese, relative to underweight or normal weight, decreases the likelihood of employment except blacks, while being overweight has mixed results. Obese white and Hispanic women are less likely to be employed by 1.5 and 4.5 percentage points, respectively. Being overweight, compared with underweight or normal weight, increases the likelihood of employment by 2.5 percentage points in black women, while the likelihood of employment is 2.4 percentage points lower in overweight Hispanic women. For men, no clear direction is found in the effect of weight status on the probability of employment except for black men who show a 1.6 and 3.0 percentage point higher likelihood of employment for being overweight and obese, respectively (see Table II).

The estimates from an individual fixed effects model show that white and black obese women (compared with normal weight or underweight women) have significantly lower hourly wages by 7.5 and 4.9%, respectively (see column 2 in Table III). The effect of the overweight and obese status on hourly wages is lowered when controlling for individual fixed effects except Hispanic women (see column 1 in Table III). For men, no significant effect of being overweight and obese on hourly wages is found in any race subpopulation when individual fixed effects are controlled (see column 4 in Table III). In all race–gender subpopulations, coefficients on other variables have the expected sign (results are not shown). The hourly wages are lower for sample persons who are younger or who have lesser education.

In our first modification, we allow the marginal effect of weight status on hourly wages to vary by characteristics of interpersonal skills required in each occupation within the race and gender subgroup, in an individual fixed effect model. As previously described, we have the following six categories of interpersonal skills: (1) take instructions; (2) mentor, negotiate, instruct; (3) supervise; (4) persuade; (5) speak–signal; and (6) serve. Following Hamermesh and Biddle (1994), we assume that occupations requiring 'taking instructions' involve less interpersonal interactions than occupations requiring other skills. Thus, we assume more wage penalty for being overweight or obese for occupations requiring skills other than 'taking instructions'. Our results generally support our hypothesis in obese white women and black women, but not in other race–gender subgroups.

Table II. Marginal effect of BMI groups on the likelihood of employment from logit model

		White	Black	Hispanic
Men	Overweight	−0.006**	0.016**	0.006
		(0.003)	(0.007)	(0.006)
	Obese	−0.004	0.030**	−0.002
		(0.003)	(0.010)	(0.009)
N		30 171	15 291	9595
Women	Overweight	0.007	0.025**	−0.024*
		(0.006)	(0.009)	(0.013)
	Obese	−0.015**	−0.002	−0.045***
		(0.006)	(0.008)	(0.013)
N		31 550	15 796	9826

Notes: Standard errors in parentheses are obtained by bootstrapping the calculated marginal effects from the estimates in the logit model. The unit of analysis is person-years. p-Value <0.1: *, p-value <0.05: **, p-value <0.01: ***. We run separate models by race and gender subgroups.

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Table III. Effect of BMI groups on log hourly wage

		Women		Men	
		OLS	FE	OLS	FE
Race	Variables	Column 1	Column 2	Column 3	Column 4
White	Overweight	−0.050***	−0.017	0.032**	0.011
		(0.015)	(0.012)	(0.014)	(0.010)
	Obese	−0.109***	−0.075***	−0.039*	−0.001
		(0.022)	(0.021)	(0.020)	(0.017)
N		25 367	25 367	27 296	27 296
Black	Overweight	0.003	0.005	0.022	0.018
		(0.018)	(0.016)	(0.021)	(0.016)
	Obese	−0.064**	−0.049*	0.028	0.014
		(0.026)	(0.025)	(0.027)	(0.027)
N		11 548	11 548	12 608	12 608
Hispanic	Overweight	−0.023	0.016	−0.042*	−0.016
		(0.025)	(0.023)	(0.025)	(0.019)
	Obese	−0.065*	0.032	−0.053	0.008
		(0.034)	(0.035)	(0.035)	(0.032)
N		7351	7351	8515	8515

Notes: The unit of analysis is person-years. Standard errors are in parentheses. All models controlled for individual fixed effects. *p*-Value <0.1: *, *p*-value <0.05: **, *p*-value <0.01: ***. We run separate models by race and gender subgroups.

For men, overweight or obese status rarely affects hourly wages regardless of interpersonal skills required in each occupation. As one exception, overweight Hispanic men in occupations requiring skills of 'mentor, negotiate, and instruct' have a 17.9% lower hourly wages compared with underweight or normal weight Hispanic men, with $p = 0.0359$ (see the top panel of column 3 in Table IV). For women, obesity has a significant wage penalty in white women and black women in occupations requiring interpersonal skills of 'speak–signal' and 'serve' with the size of the decrease in hourly wage in the range of 6.7 and 11.9%, and the differences were statistically significant at the 5% level (see the bottom panel of column 4 and column 5 in Table IV). On the contrary, obese Hispanic women have a significant wage increase in occupations requiring interpersonal skills of 'supervise' ($p = 0.0593$), 'speak–signal' ($p = 0.0269$), and 'serve' ($p = 0.0272$) (see the bottom panel of column 6 in Table IV).

In our next modification, we introduce interactions between BMI groups and age to explore whether the marginal effects of weight status on hourly wages vary by age in the range between 18 and 43 years old. Results are displayed by race. For whites, obese men have a 6.4% higher hourly wage at age 18 than the underweight or normal weight men, and the wage rewards remain significant until 22 years of age. However, overall, the wage reward for obesity significantly decreases by a 0.70 percentage point for each year increase in age, which leads to a significant wage penalty after the respondents become 33 years or older (see the top panel of Figure 1(a)). For women, both overweight and obesity penalize hourly wages, particularly for women who are 30 years or older. Hourly wages are approximately 2.6 and 4.0% lower in overweight and obese white women, respectively, at age 31. The wage penalty remains persistent in overweight women, but it increases by 0.81 percentage point as the obese women become 1 year older after age 31 (see the bottom panel of Figure 1(a)).

For blacks, we find a 6.8% higher hourly wage for obese men aged 36 years, with a significant increase in the wage reward by a 0.75 percentage point by a 1 year increase in age (see the top panel of Figure 1(b)). Overweight black women have 3.6% higher hourly wages compared with underweight or normal weight black women at age 30, and the size of the positive effect increases by a 0.58 percentage point as the respondents become 1 year older. Obese black women have 7.3% lower hourly wages

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Table IV. Marginal effect of BMI groups on log hourly wage by interpersonal skill type

	Men			Women		
BMI groups	White	Black	Hispanic	White	Black	Hispanic
Overweight						
Take instructions–help	0.020	0.017	0.008	−0.014	0.030	−0.036
	(0.014)	(0.023)	(0.028)	(0.019)	(0.025)	(0.034)
Mentor, negotiate, instruct	0.011	0.082	−0.179*	−0.071	−0.003	0.239***
	(0.043)	(0.143)	(0.097)	(0.053)	(0.059)	(0.072)
Supervise	0.045	0.014	−0.029	0.032	−0.081	0.201*
	(0.045)	(0.062)	(0.092)	(0.043)	(0.074)	(0.103)
Persuade	0.010	0.069	0.020	−0.064	0.096	−0.025
	(0.037)	(0.060)	(0.076)	(0.041)	(0.078)	(0.073)
Speak–signal	0.001	0.032	−0.026	−0.017	−0.009	0.033
	(0.014)	(0.023)	(0.026)	(0.017)	(0.023)	(0.032)
Serve	0.036	0.013	0.040	0.036	−0.066	−0.010
	(0.048)	(0.059)	(0.074)	(0.035)	(0.047)	(0.061)
Obese						
Take instructions–help	−0.016	0.011	0.031	−0.051	−0.016	0.016
	(0.021)	(0.034)	(0.041)	(0.031)	(0.038)	(0.046)
Mentor, negotiate, instruct	0.044	0.027	−0.048	−0.103	0.106	0.133
	(0.087)	(0.187)	(0.120)	(0.090)	(0.075)	(0.081)
Supervise	−0.001	−0.063	−0.094	−0.037	−0.124	0.284**
	(0.055)	(0.067)	(0.114)	(0.080)	(0.078)	(0.124)
Persuade	0.009	0.152	−0.072	−0.048	−0.024	0.010
	(0.065)	(0.102)	(0.094)	(0.059)	(0.082)	(0.094)
Speak–signal	−0.004	0.037	−0.024	−0.067**	−0.070**	0.090**
	(0.022	(0.037)	(0.040)	(0.028)	(0.032)	(0.044)
Serve	0.060	0.004	0.152	−0.108**	−0.119**	0.169*
	(0.073)	(0.110)	(0.096)	(0.046)	(0.058)	(0.089)

Notes: We run separate models by race–gender subgroups, controlling for individual fixed effects. The unit of analysis is person-years. Standard errors are in parentheses. Estimates displayed in the table are calculated marginal effects from the interaction terms of interpersonal skill categories with BMI groups, using the category of 'take instructions–help' as the reference group. *p*-Value <0.1: *, *p*-value <0.05: **, *p*-value <0.01: ***.

compared with underweight or normal weight black men, and the size of the wage penalty increases by 0.63 percentage points as they get 1 year older (see the bottom panel of Figure 1(b)).

For Hispanics, overweight men have a significant wage penalty starting at age 25 (3.9% lower hourly wages compared with underweight or normal weight Hispanic men), but we do not find a significant difference in the extent of the wage penalty over the respondents' age. Hispanic women do not have any significant marginal effect of weight status on hourly wages in any of the ages explored in this study (results are not shown).

We modify our results further by introducing an interaction of BMI groups and age and characteristics of interpersonal skills in each occupation. We hypothesize that the age gradient of the marginal effect of weight status on hourly wages would vary by characteristics of interpersonal skills required in each occupation. We also hypothesize a negative and greater age gradient for occupations requiring interpersonal skills other than 'taking instructions'. Overall, we rarely find an age gradient for the overweight group in all race–gender subgroups, while our hypothesis is generally supported for obese white women and white men among the race–gender subpopulations (results are not shown).

5.1. Robustness checks

We tried various combinations of state-level variables (such as costs of fast food, number of full-service or limited-service restaurants, or total sales in all types of restaurants) as potential instruments for the BMI. We could not find any valid set of instruments, based both on the direction of the estimated effects

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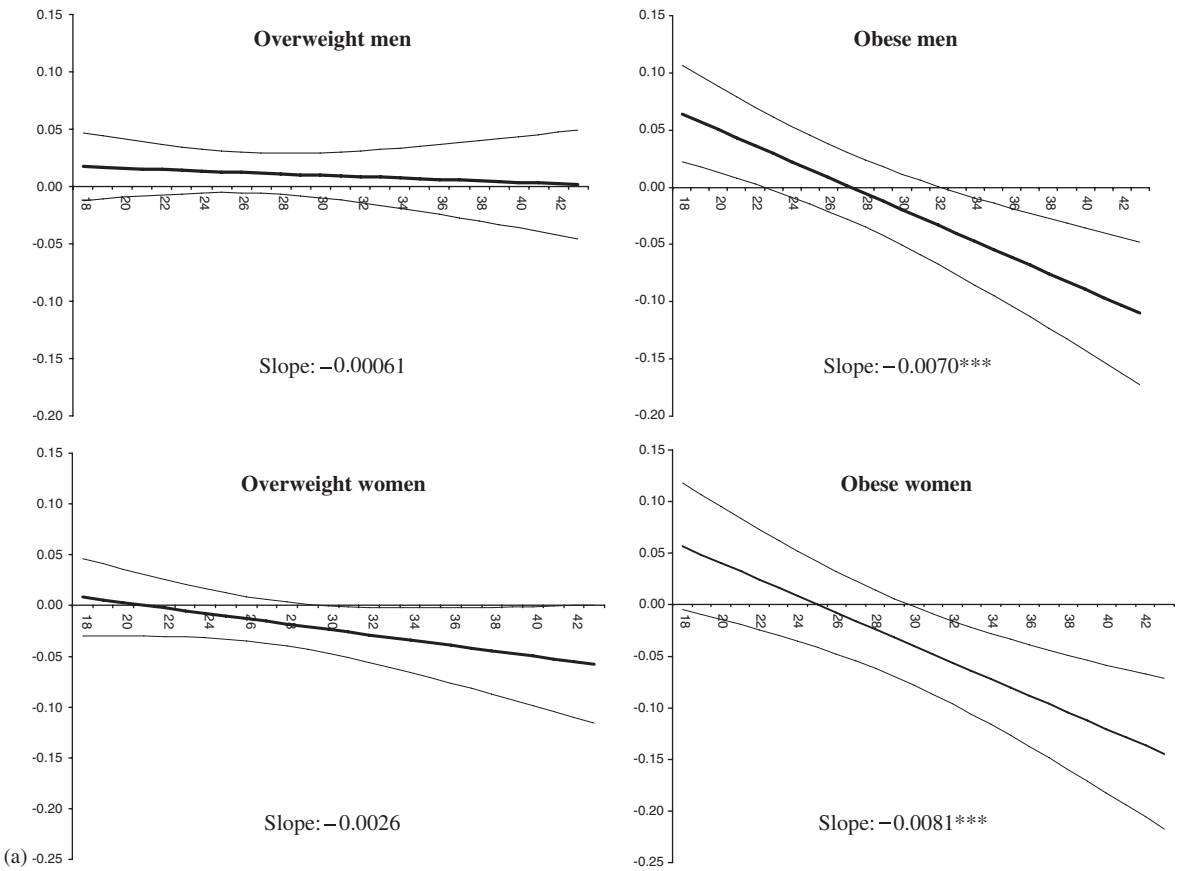

Figure 1. (a) Marginal effect of BMI groups on hourly wages by age for whites and (b) marginal effect of BMI groups on hourly wages by age for black. *Notes*: Age (ranged between 18 and 43) is on the *X*-axis, and the marginal effect of the overweight and obese status on hourly wages is on the *Y*-axis. The marginal effect of two BMI groups on hourly wages at each age are calculated from the estimates of interaction terms of BMI groups and age in the individual fixed effects model by race–gender subpopulations. Slopes in each graph display the estimates of the interaction terms of each BMI group and age. The solid line in the middle represents the marginal effects of a unit increase in the BMI. The upper and bottom lines are for 90% confidence intervals. *p*-Value <0.1: *, *p*-value <0.05: **, *p*-value <0.01: ***

and passing the over-identification tests. Considering the important role of pregnancy in labor force participation decision and the BMI (especially for women), we performed an analysis modeling the effect of BMI groups on log hourly wages for the subgroup of women who had never reported being pregnant in every survey. We also ran models with continuous, instead of categorical, BMI. The results are not quantitatively different and are available upon request.

6. DISCUSSION

In summary, the evidence presented here suggests that being overweight and obese penalizes the probability of employment across most race and gender subgroups except black women and men. Obesity decreases hourly wages for white women and black women, but no significant effect is found for men in any race. The wage penalty for obesity is larger in occupations requiring interpersonal skills that

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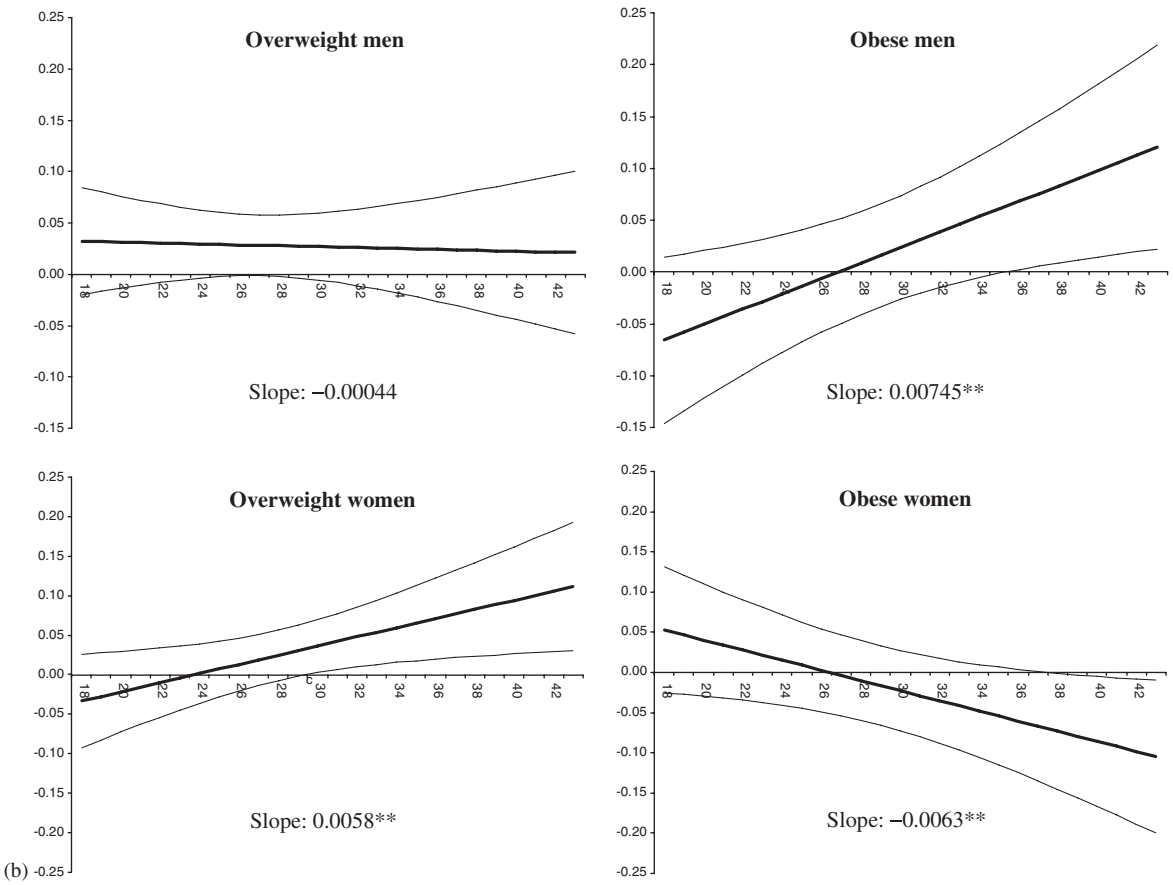

Figure 1. *Continued.*

potentially involve more social interactions than other occupations, particularly in white and black women. The wage penalty for being overweight and obese, if present, increases as the respondents get older in all race–gender subgroups except overweight black women and obese black men. Overall, we do not find a wage penalty in early adulthood younger than 25 years of age in any of race–gender subpopulations.

Cawley (2004) uses the same data and applies similar sample selection rules, with seven minor variations from this study: (1) Cawley adjusts for potential measurement error in reported height and weight in the NLSY79 using the third NHANES III, while we do not for reasons explained above; (2) Cawley excludes women who were pregnant at the time of interview, while we exclude women who were pregnant within a year from the time of interview; (3) Cawley includes sample persons younger than 18 years old, while we do not; (4) Cawley includes sample persons who serve in the military, while we do not; (5) Cawley controls for a linear measure of time, while we control for a non-linear measure of time by including dummy variables representing the year of interview; (6) Cawley controls for the total number of biological children, while we opt to control for the total number of biological, adopted or step children; and (7) we control for some additional state-level macroeconomic conditions. Despite these differences, the direction, size, and significance of our estimates are similar in all race and gender subgroups to those in Cawley's (2004) study except black men and Hispanic men. Both studies find striking race and gender variation in the association between the body weight status and hourly wages.

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We also perform additional analyses to replicate Cawley's (2004) results and find that we obtain very similar results. Therefore, this exploration provides a solid base to dissect further the association between body weight status and hourly wages by characteristics of interpersonal skills in each occupation and age.

This study advances our understanding of the sources of the wage penalty for different BMI groups. First, we extend the theory of why obesity would affect labor market outcomes, exploring the different effects of obesity on hourly wages by characteristics of interpersonal skills required in each occupation. The estimates support the hypothesis that distaste for obese workers on the consumer or employer side would be a potential mechanism for the wage penalty. We also show that the interacted effect of obesity on hourly wages with characteristics of interpersonal skills varies by age. We do not differentiate skills requiring social interaction with colleagues from the skills requiring social interaction with customers. Obesity may cause a wage penalty in jobs requiring interactions with customers but may not have an effect on wages in jobs requiring interactions only with colleagues. If obese workers would be less likely to occupy jobs requiring social interactions (especially with customers), obese workers in those jobs may have higher job skills than underweight or normal weight workers in the same jobs, *ceteris paribus*. Alternatively, if obese workers could observe a wage penalty for obesity, they might have more incentive to develop job skills to compensate the obesity effect. Our results indicate that one underlying reason for the race–gender variation in the association between body weight and hourly wages is the different extent of the consumers or employers' distaste for obese workers' race and gender. This advances our previous understanding for the race–gender variation in the potential wage penalty. One previous study by Cawley (2003) suggests a different effect of body weight on physical health or disability by race and gender as a potential reason for the race–gender variations. Although the same study tests potential weight-based employment discrimination, they do not identify employment characteristics.

Second, we further explore how the extent and significance of the effect of weight status on hourly wage varies at different ages. Plots of the marginal effect of being overweight and obese on hourly wages against age show a negative gradient in all race–gender subgroups except overweight black women and obese black men. The extent of an increase in wage penalty over ages is bigger for obese persons than for overweight persons. We also find a greater increase in the wage penalty by age in occupations requiring interpersonal skills with supposedly more social interactions than occupations requiring interpersonal skills with supposedly less social interaction. The increasing wage penalty by age for obesity implies that the conventional wisdom of further weight gain with age does not attenuate the wage penalty.

Our study results should be interpreted with caution if any time-varying individual heterogeneity remains uncontrolled, which could introduce biases in our individual fixed effects estimates. Furthermore, an individual's time preference may vary with age, which would complicate the dynamic relationship between body weight and labor market outcomes over the life cycle. This study does not try to disentangle the direct effect of body weight on hourly wages from the indirect effect because some of our covariates, such as marital status or the number of children, are arguably endogenous. We acknowledge that this paper only attempts to look at variations in the requirement of social interaction with customers or colleagues across occupations, but do not look at any possible variation within occupations.

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