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Job strain, occupational category, and hypertension prevalence: The Multi-Ethnic Study of Atherosclerosis

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Abstract

Objective—To assess associations of occupational categories and job characteristics with prevalent hypertension.

Methods—We analyzed 2,517 Multi-Ethnic Study of Atherosclerosis (MESA) participants, working 20+ hours per week, in 2002–4.

Results—Higher job decision latitude was associated with a lower prevalence of hypertension, prevalence ratio (PR)=0.78 (95% CI 0.66–0.91) for the top vs. bottom quartile of job decision latitude. However, associations differed by occupation: decision latitude was associated with a

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higher prevalence of hypertension in healthcare support occupations (interaction p=.02). Occupation modified associations of gender with hypertension: a higher prevalence of hypertension in women (vs men) was observed in healthcare support and in blue-collar occupations (interaction p=.03).

Conclusions—Lower job decision latitude is associated with hypertension prevalence in many occupations. Further research is needed to determine reasons for differential impact of decision latitude and gender on hypertension across occupations.

Keywords

job strain; occupation; blood pressure; hypertension

INTRODUCTION

Since the 1980s, work stressors have become recognized as important risk factors for cardiovascular disease (CVD)(1) and hypertension.(2, 3) The demand-control model(4) predicts that job strain, the combination of high job demands with low job decision authority (sometimes termed *job control*), increases the risk for ill health, including CVD.(5) Although the model has been widely applied, the findings are not always consistent with the model's prediction. Significant associations between job strain and blood pressure (BP) or hypertension have been observed in about half of studies among men and in a smaller proportion of studies among women.(2) Several previous ambulatory BP studies have suggested that job strain may interact with socioeconomic status (SES)(6–8) and age,(9, 10) indicating a more complex set of pathways leading to hypertension. Such interactions may result from lower SES being a proxy measure for a host of other occupational and non-occupational stressors,(6) or age being a proxy variable for chronic exposure to stressors, or greater vulnerability of older workers to stressors.(10)

Lower SES workers (variously defined by education, income, or occupation) have been found to have higher age-adjusted mean systolic BP (by 2–3 mm Hg)(11) or prevalence of hypertension(11, 12) than employees in higher SES groups. Associations of BP with occupation are difficult to investigate because often only very broad categorizations of occupation are used resulting in very heterogeneous groups and loss of information. Typically a small number of status-ordered occupational categories have been used, such as the Registrar-General's classification used in the British Whitehall studies.(13) However, the use of finer (more "granular") categories is likely to be productive given important differences in job tasks within broad occupational categories. Five studies have examined the association of prevalence of hypertension with more detailed (>6) occupational categories,(14–18), however, only two of those studies used the current definition of systolic BP≥140 mm Hg, or diastolic BP≥90 mm Hg, or current use of anti-hypertensive medication.(14, 17)

Therefore, we used data from the population-based Multi-Ethnic Study of Atherosclerosis (MESA) to test the following hypotheses:

1) Hypertension prevalence is associated with lower job decision latitude, higher job demands, and job strain,(11, 19, 20) (arrows A, B in Figure 1)

2) Hypertension is more prevalent in blue-collar jobs than in management and professional jobs(11, 21) in analyses of both broad and more detailed occupational categories (arrows C, B in Figure 1).

3a) The association of job strain with hypertension prevalence would be stronger among older participants.(9, 10) (arrow D in Figure 1)

3b) The association of job strain with hypertension prevalence is greater among blue-collar workers,(6, 7) and among workers with lower levels of income and education.(11) (arrows E and F in Figure 1)

The directions of possible effect modification by gender, race/ethnicity, or detailed occupational category have not been reported previously and, thus, analysis of heterogeneity according to these variables should be considered as exploratory (and thus are not specified in Figure 1). Potential confounders (age, gender, race, foreign-born, primary language spoken at home, menopause, birth control pills, and hormone replacement therapy) are also specified in Figure 1.

METHODS

Study Participants

MESA is a multi-center cohort study of 6,814 adults, designed to investigate prevalence and progression of subclinical CVD.(22) Participants were recruited from six US communities (Forsyth County, North Carolina; Northern Manhattan and Bronx, New York; Baltimore City and County, Maryland; St. Paul, Minnesota; Chicago, Illinois; and Los Angeles, California). At the time of enrollment between 2000 and 2002 (Exam 1), the participants were 45 through 84 years old and free of clinical CVD. The cohort includes four racial/ethnic groups: whites (38%), Chinese American (11%), blacks (28%), and Hispanics (23%).

The current analysis uses data from MESA Exam 2, conducted in 2002 through 2004, when detailed job characteristics were assessed. Of the 6,233 MESA participants at Exam 2, 57 (0.9%) never worked outside the home, and 30 (0.5%) did not provide occupational information, and thus were excluded from the analyses. Because of the inclusion of older individuals in the MESA cohort, more than half of the respondents were no longer working or working less than 20 hours per week. The sample for the current analysis is restricted to individuals reporting current employment at a job for pay and working at least 20 hours per week at Exam 2 (n=2,703). The MESA study protocol was approved by the Institutional Review Board in each field center and at the National Heart, Lung, and Blood Institute; written informed consent was obtained from each participant.

Blood pressure and hypertension

Resting BP was measured in the field clinic with an automated sphygmomanometer (Dinamap®, Critikon/GE Medical Systems, Tampa, FL) three times at 5-minute intervals. Readings were taken after 5 minutes of rest, with the participant seated and relaxed in a

comfortable chair, and not talking, eating, or drinking during the procedure. The average of the last two measurements was used. Participants were asked to bring their medications to each MESA Exam. Hypertension medication use was identified using a medication inventory. Following the guidelines of the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure,(23) we defined hypertension as: a) systolic BP ≥ 140, or b) diastolic BP ≥ 90, or c) current use of anti-hypertensive medication regardless of recorded BP.

Occupational category

Occupational information was collected in a self-administered questionnaire. Four open-ended questions modeled on the U.S. Census occupation questions were asked to determine the respondent's current occupation. The responses were coded using Census 2000 Occupation Codes. A single participant in the "farming, fishing, and forestry" category, two reporting unpaid labor, and 83 participants missing occupational category data were removed from analysis, leaving 2,617 participants. Participants were categorized into 13 occupational categories, which were then collapsed into four larger categories for specific analyses, according to the Census system: 1) management/professional, 2) service, 3) sales/office, and 4) blue-collar (including construction, extraction, maintenance, production, and transportation and material moving).

Job characteristics

The Job Content Questionnaire was administered to obtain data on job demands and job decision latitude. (24) The job demands scale has 5 items (My job requires working very fast, My job requires working very hard, I am not asked to do an excessive amount of work (−), I have enough time to get the job done (−), I am free from conflicting demands others make (−)). The job decision latitude scale had 9 items (My job requires that I learn new things, My job involves a lot of repetitive work (−), My job requires me to be creative, My job requires a high level of skill, I get to do a variety of things on my job, I have an opportunity to develop my own special abilities, My job allows me to make a lot of decisions on my own, On my job I am given a lot of freedom to decide how I do my work, I have a lot to say about what happens on my job). Scale scores were computed using formulas developed by Karasek. (24) All items had a 4-point response scale, ranging from "never/almost never" to "often." Both scales had an acceptable level of internal consistency (Cronbach's alpha=0.70 for job demands, 0.84 for job decision latitude). The skewness of the job demands scale was negligible (−0.11), while that of the job decision latitude scale was modest (−0.81); thus, neither scale required transformation.

Job demands and job decision latitude scores were standardized (transformed into z scores) and used as continuous variables in analyses. The demand-control model defines "job strain" as a combination of high job demands and low job decision latitude. Job strain was principally modeled as a continuous variable ([Job Demands score] minus [Job Decision Latitude score multiplied by 0.5], to equivalently scale the two constructs). This is referred to henceforth as "Job Strain-linear term"(20) and standardized for analysis.

In addition, in exploratory analyses, other formulations of job strain used in prior research were computed and analyzed by dichotomizing the two constructs into “high” and “low” using two alternative cut offs 1) Job Strain defined as job demands above the sample median, and job decision latitude below the sample median; and 2) job strain defined as job demands above the national mean, and job decision latitude below the national mean, based on the 1969, 1972 and 1997 U.S. Quality of Employment Surveys.(20) Lastly, the ratio of job demands (multiplied by 2 to scale results) divided by job decision latitude was calculated and is referred to as “Job Strain-quotient term”.(20)

Other risk factors and confounders

Additional covariates included established risk factors for BP elevation.(25) Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared, using height and weight measured with light clothes on and shoes off at each field center. Diabetes was defined as either a) fasting serum glucose equal or greater than 126 mg/dL, b) self-reported physician diagnosis, or c) diabetes medication use. Self-report was used to determine smoking status (current smoker, former smoker, or never smoker), physical activity (total moderate and vigorous activity, MET-minutes per week), and alcohol use (current use (yes/no); number of glasses of wine, number of beers and number of liquor/ mixed drinks per week). A five-category measure of alcohol use was constructed consisting of: never (if no current use and “never” use reported at Exam 1), former (if no current use and “former” or “current” use reported at Exam 1), <1 drinks per day, 1–2 drinks per day, and >2 drinks per day. Female participants reported on the questionnaire their menopause status (yes/no), use of hormone replacement therapy (yes/no) and use of birth control pills (yes/no).

The following sociodemographic information was used: age, gender, race/ethnicity (Whites, Blacks, Hispanic, and Chinese-American), place of birth (born in one of the 50 states in the U.S., born in Puerto Rico or another country), language spoken at home (English, Spanish or Chinese), hours worked per week (number of hours worked in a day multiplied by number of days worked in a week, with values truncated at 100), education level (9 categories), and household income (13 categories). If Exam 2 income data was missing, Exam 1 income data was used in the current analysis if the participant reported they had not changed jobs since Exam 1.

Data analysis

Poisson regression with robust standard errors was used to assess the adjusted prevalence ratio of hypertension in relation to occupational category, job demands, job decision latitude, and job strain. These occupational exposure variables were assessed separately. We used Poisson regression rather than logistic regression because the odds ratio is a biased estimate of the prevalence ratio when the prevalence is high (the prevalence of hypertension in our sample was 38.9%).(26)

The initial model was adjusted for age (Model 1), then for other potential confounders: gender, race/ethnicity, foreign-born, language spoken at home, menopause, use of birth control pills and use of hormone replacement therapy (Model 2). Next, we adjusted for

potential mediators: BMI, smoking, diabetes, physical activity, alcohol use, and hours worked per week (Model 3). Since cross-sectional analyses of longitudinal mediation can introduce biases (27), we do not present formal tests of mediation in our Results section. However, an exploratory assessment of mediation is described in the Discussion section. Finally, we adjusted for possible confounding by income and education (Model 4). If continuous job characteristics measures were significantly associated with hypertension, we also categorized the continuous variable into four groups using quartiles of the distribution and contrasted the extreme quartiles. All main effects analyses were performed with SPSS v20 (IBM, Armonk, NY),

To estimate and test interactions on an additive scale of job characteristics by age, gender, race/ethnicity, income, education, and occupational category, and of occupational category by age, gender, and race/ethnicity, we used a linear (rather than logistic) link model using PROC GENMOD in SAS (v. 9.4, SAS Institute, Cary, NC) so that estimates are on the probability difference (additive) scale rather than odds ratio (multiplicative) scale. Robust standard errors were used for inference to allow for the non-normality of the dichotomous outcome variable. Effect modification was assessed twice, first adjusting for age, and then adjusting for all the covariates in Model 3.

Analyses of systolic BP in relation to occupational exposures are described in the Supplemental Digital Content.

RESULTS

About half (53.4%) of the employed Exam 2 MESA sample (working at least 20 hours per week) was male (Table 1). The sample ranged in age from 46–86 years. Half were classified as “management, professional”, with 15.0% in service occupations, 20.4% in sales and office occupations, and 14.5% in blue-collar occupations. 23.8% had only a high school education or less, 17% had at least one alcoholic drink per day, 11% had been diagnosed with diabetes, and 34.8% had a BMI of at least 30.0 kg/m^2. Mean systolic and diastolic blood pressures were 120.0 and 71.5 mm Hg, and 32.3% of the sample were taking anti-hypertensive medications. The prevalence of hypertension was 38.9%.

Occupational categories

The prevalence of hypertension did not significantly differ between the four broad occupational categories. However, protective service occupations had a significantly increased prevalence of hypertension (prevalence ratio (PR) = 1.34, 95% CI 1.00–1.80) compared to management occupations when controlling for age. There were no significant differences between occupations when additional covariates were added in models 2–4 (Table 2).

Job characteristics

Higher job decision latitude was associated with a significantly lower prevalence of hypertension, with a PR=0.92 (95% CI 0.88–0.97) per each standard deviation higher job decision latitude, and a PR=0.78 (95% CI 0.66–0.91) for the top vs. bottom quartile of job decision latitude in the fully adjusted model (Table 3). There were no significant

associations between prevalence of hypertension and job demands. Job strain (linear term) was only associated with prevalence of hypertension in Model 2, which we attribute to the job decision latitude component, not the job demands component. Exploratory analyses of other versions of the job strain variable revealed no significant associations with prevalence of hypertension.

Tests of additive interaction

Only two statistically significant interactions were observed between job characteristics, occupational categories and demographic variables. First, there was a significant interaction between job decision latitude and occupational category both for the 4-category occupational variable (p=.003 in the age adjusted model and p=.02 in the fully adjusted model) and for detailed occupational categories (p=.009 in the age adjusted model and p=.02 in the fully adjusted model). Job decision latitude was associated with a lower prevalence of hypertension among management/professional, sales/office and blue-collar workers (as hypothesized), but with a higher prevalence of hypertension among service workers (data not shown). Figure 2 indicates that job decision latitude was associated with a lower prevalence of hypertension among workers in many occupations. However, among healthcare support workers (in the service sector) job decision latitude was positively associated with prevalence of hypertension.

Second, there was a significant interaction between gender and detailed occupational category in the fully adjusted model (p=.033) and a borderline significant interaction in the age-adjusted model (p=.054). Significant interaction terms were observed between gender and occupational categories 2 (professional), 3 (healthcare support), 12 (installation, repair and maintenance) and 13 (production) in both the age-adjusted and fully adjusted models. Figure 3, based on the fully adjusted model, indicates that while men overall had a higher prevalence of hypertension than women, women had a higher prevalence of hypertension than men in occupational categories 3, 12, and 13.

DISCUSSION

In this large population-based, multi-racial and multi-ethnic U.S. cohort, job decision latitude (also referred to as “job control”) was associated with lower prevalence of hypertension (and SBP), but job strain (in most models) and psychological job demands were not. Thus, only partial support was provided for our first hypothesis (arrows A, B in Figure 1). The null findings for job strain were consistent with the majority of cross-sectional studies of casual BP,(2) although significant associations for job strain are more likely to be observed in prospective(2, 3) and ambulatory BP(37) studies.

No significant associations were observed between broad occupational categories and prevalence of hypertension, a finding not consistent with other studies that found an increased prevalence of hypertension in lower SES groups.(11, 12) (However, workers in blue-collar and sales/office jobs in our sample had 2–4 mm Hg higher SBP than workers in management and professional jobs, Supplemental Digital Content). Elevated prevalence of hypertension (and SBP) was observed in protective services workers (e.g., firefighter, police officer, corrections officer), although the association was statistically significant only in the

age-adjusted model. This finding is consistent with the increased prevalence of self-reported hypertension among men in protective services in the U.S. Health and Retirement Survey,(15) Protective service workers also ranked among the lowest in awareness, treatment and control of hypertension in the U.S. National Health and Nutrition Examination Survey.(17) Thus, very limited support was provided for our second hypothesis (arrows C, B in Figure 1).

No statistically significant effect modification by age was observed in the association between job strain and prevalence of hypertension, thus, our hypothesis 3a was not supported (arrow D in Figure 1). Similarly, no significant effect modification by income or education was observed in the association between job strain and prevalence of hypertension (arrows E, F in Figure 1). However, the job decision latitude component of job strain did significantly interact with occupational category, although not in the way indicated by our hypothesis 3b. We observed that among service workers, particularly healthcare support workers, prevalence of hypertension increased as job decision latitude increased. The healthcare support SOC category includes home health aides, nursing assistants, occupational and physical therapy aides, dental assistants, medical transcriptionists, pharmacy aides, and phlebotomists.

The prevalence of hypertension was overall higher among men than among women, however, the prevalence of hypertension was higher among women than men in healthcare support occupations and in two blue-collar occupations (installation, repair and maintenance; and production). This finding is consistent with results seen in a large U.S. manufacturer, where women in hourly jobs tended to be from lower SES backgrounds, have greater financial need, and were more likely to hold lower-skilled jobs than were hourly men.(28) While healthcare support occupations are not typically categorized as “blue-collar”, they do have relatively low job decision latitude, ranked 10th out of the 13 occupational categories studied (Supplemental Digital Content), likely due, in part, to the high proportion of women (86%) in this occupational group (US Census Bureau, Census 2000 Special Equal Employment Opportunity (EEO) Tabulation). Further research is needed on the characteristics of healthcare support jobs, including gender segregation, which may result in higher job control not operating as a buffer for women against stress-related health outcomes, such as hypertension.

The association of occupational variables with prevalence of hypertension did not differ by race/ethnicity. Prior U.S. studies have found conflicting results, including stronger associations between lower occupational status and BP among blacks,(29) or weaker associations among black men.(30) We did not explore additional explanatory theories such as structural segregation by occupation, differential job tasks by race within the same job, or “John Henryism” (high-effort coping in black workers). Our analysis was also not designed to explore additional factors related to ethnicity, such as the acculturation hypothesis, suggested by prior analyses of MESA data showing higher SBP(31) and prevalence of hypertension(32) among foreign-born Hispanics who have lived a greater proportion of their life in the U.S.

The association between low job decision latitude and prevalence of hypertension was reduced by 12–14% after adjustment for health behaviors (potential mediators), such as smoking, alcohol use and physical activity (Model 3 in Table 3), suggesting a quite modest extent of mediation by health behaviors. However, unbiased assessments of mediation will require prospective analyses of MESA data.

Our estimates of associations between occupational exposures and prevalence of hypertension are adjusted for factors such as gender, race/ethnicity, foreign birth and education (models 2–4), which select individuals into higher or lower SES occupations and into jobs with more or less decision latitude. Further analyses are needed to determine to what extent the associations of gender, race/ethnicity, immigration status or education level and hypertension are mediated by occupational exposures. It is also possible that model 4 is over-specified or over-adjusted, since income is a consequence of occupation.

Major strengths of this study include a large, multi-ethnic, population-based sample with a distribution of occupational categories similar to the U.S. employed population, a reliable system to code job titles by census occupation codes, and well-established measures of job characteristics. However, the study may not have had sufficient statistical power for subgroup analyses for some occupation groups, especially those blue-collar groups where an older cohort is less likely to still be working.

An important limitation was the cross-sectional design, precluding clear assessment of a temporal sequence, and potential selection (survival) bias. In addition, like other large-scale epidemiological studies, MESA relies on clinic measures of BP, which are have poorer reliability and validity than BP measures using ambulatory BP monitoring.(33, 34) However, the high cost of automated ambulatory monitoring(33) has precluded such monitoring in large-scale population-based studies. Studies of job characteristics have found stronger relationships with ambulatory BP (ABP), presumably due to more measurements, reduced “white coat” effect, and the ability to capture the dynamic fluctuations of BP in relation to daily life.(33, 34) A recent meta-analysis found that job strain was associated with a 4.5 mm Hg higher ABP in population-based cross-sectional studies.(35) The associations observed in this study between hypertension (based on clinic BP) and job characteristics are likely to be underestimates of true associations due to the error inherent in clinic BP measurement.

The decision latitude scale had an acceptable level of internal consistency for all racial/ethnic groups (Cronbach’s alpha = 0.78–0.83). However, while the psychological job demands scale had a Cronbach’s alpha of 0.75 for U.S.-born workers, values were much lower for immigrant workers (Cronbach’s alpha = 0.42–0.65), who constituted 31% of the study sample. Lower scale reliability for job demands may have contributed to the lack of an association observed between job demands (and thus job strain) and prevalence of hypertension.

In addition, data was available only for one psychosocial work stressor, job strain. Other work stressors, such as effort-reward imbalance, have also been associated with BP and hypertension(2) in a limited number of studies. Measurements of such other psychosocial

work stressors are necessary to ascertain the full impact of psychosocial work stressors on BP and prevalence of hypertension.

Data on current job was used in our analysis. If the reported job was different from a participant's longest-held job, this may have resulted in misclassification of occupational status or job characteristics. Current job may be an imperfect proxy for chronic exposure to occupational stressors, which are hypothesized to cause increases in BP.(19) Analysis of National Health Interview Survey data revealed a wide range of concordance of current job and longest held job across 41 occupational groups, with kappa statistics ranging from 25.6 to 85.6.(36)

The major sources of error in this study (clinic BP measurements, limited reliability of the job demands scale, and lack of historical measures of exposure to stressful occupational characteristics) are likely to result in non-differential misclassification. The associations observed in this analysis would then be underestimates of the true association between occupational factors and hypertension.

Job characteristics such as job decision latitude are alterable through policy or workplace interventions. Job redesign, employee participation in decision-making, autonomous work groups, collective bargaining, and legislation have all been advanced as means by which inequities in the workplace can be reduced. (37–39) Our findings suggest that increasing job decision latitude should be considered in the primary prevention of hypertension.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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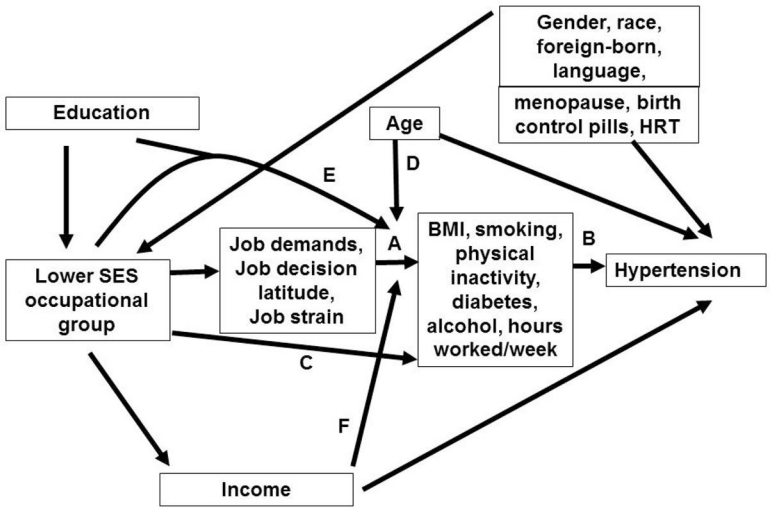

Figure 1.

Model of causal pathways between socioeconomic factors, occupational group, job characteristics and prevalence of hypertension.

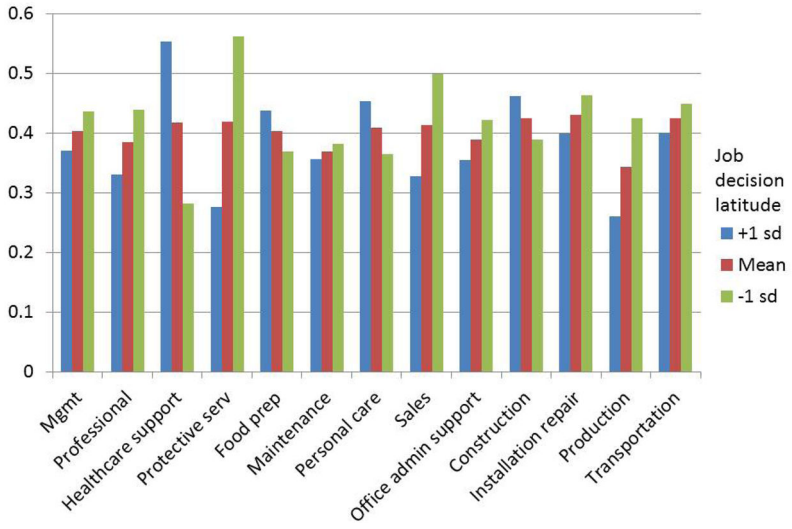

Figure 2.

Prevalence of hypertension by job decision latitude and detailed occupational category, adjusted for age, gender, race, foreign-born, language spoken at home, menopause, birth control pills, HRT, BMI, current smoker, physical activity, diabetes, alcoholic drinks/week, and hours worked/week.

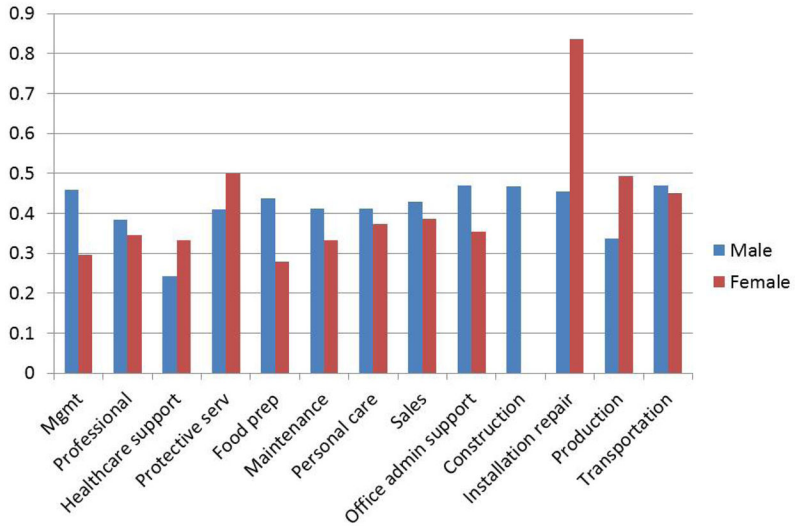

Figure 3.

Prevalence of hypertension by gender and detailed occupational category, adjusted for age, race, foreign-born, language spoken at home, menopause, birth control pills, HRT, BMI, current smoker, physical activity, diabetes, alcoholic drinks/week, and hours worked/week.

Table 1

Characteristics of employed MESA study participants at Exam 2 (2002–2004) working 20+ hours per week with complete blood pressure data (n=2,517)

	Mean (SD)	n (%)
Demographics		
Age in years, mean (SD)	57.0 (7.53)	
Female, n (%)		1172 (46.6%)
Male, n (%)		1345 (53.4%)
Race/ethnicity		
White, n (%)		1033 (41.0%)
Chinese American, n (%)		290(11.5%)
Black, n (%)		683 (27.1%)
Hispanics, n (%)		511 (20.3%)
Foreign-born, n (%)		778 (30.9%)
Years lived in US, mean (SD)	26.8 (14.81)	
Language spoken at home		
English		2073 (82.4%)
Spanish		232 (9.2%)
Chinese		212 (8.4%)
Occupational category, n (%)		
Management, professional		1231 (50.0%)
Service		385 (15.0%)
Sales and office		520 (20.4%)
Blue-collar		381 (14.5%)
Job Characteristics		
Job Demands (range 12–48), mean (SD)	29.2 (7.41)	
Job Decision Latitude (range 24–96), mean (SD)	74.7 (15.12)	
Job Strain n (%)		
Defined with the sample median, n (%)		645 (25.8%)
Defined with the national mean, n (%)		373 (14.9%)
Quotient term [Demands/latitude], mean (SD)	0.82 (0.31)	
Linear term [Demands–0.5* latitude], mean (SD)	−8.19 (10.31)	
Hours worked per week, mean (SD)	42.0 (13.35)	
Socioeconomic indicators		
Gross household income, n (%)		
<$20,000		242 (9.7%)
$20,000 – $49,000		889 (35.5%)
$50,000 – $99,999		830 (33.1%)
≥$100,000		545 (21.7%)
Education, n (%)		
High school diploma or less		600 (23.8%)
Some college		762 (30.3%)

	Mean (SD)	n (%)
College degree or higher		1154 (45.9%)
Standard risk factors		
Smoking status, n (%)		
Never smoker		1167 (46.7%)
Former smoker		1008 (40.3%)
Current smoker		326 (13.0%)
Alcohol use, n (%)		
Never use		352 (14.0%)
Former use		714 (28.4%)
Current use: <1 drink/day		1022 (40.6%)
Current use: 1–2 drinks/day		302 (12.0%)
Current use: >2 drinks/day		127 (5.0%)
* Physical Activity (MET-min/wk), mean (SD)	6449.4 (5999.72)	
Diabetes, n (%)		
Normal		1845 (73.7%)
Impaired fasting glucose		383 (15.3%)
Untreated diabetes		58 (2.3%)
Treated diabetes		218 (8.7%)
Body Mass Index (BMI), continuous	28.71 (5.69)	
Body Mass Index (BMI), n (%)		
<25.0		672 (26.7%)
25.0 – 29.9		969 (38.5%)
≥30.0		876 (34.8%)
Measures of blood pressure		
Systolic blood pressure, mm Hg, mean (SD)	120.0 (19.16)	
Diastolic blood pressure, mm Hg, mean (SD)	71.5 (9.98)	
Hypertension medication use, n (%)		813 (32.3%)
** Hypertension by JNC VII, n (%)		980 (38.9%)
Hypertension Stage, n (%)		
Stage 2 or 3 (SBP ≥ 160 or diastolic BP ≥ 100)		96 (3.8%)
Stage 1 (SBP = 140–159 or DBP = 90–99)		283 (11.2%)
High-normal (SBP = 120–129 or DBP = 85–89)		333 (13.2%)
Normal (SBP = 120–129 or DBP = 80–84)		436 (17.3%)
Optimal (SBP < 120 and DBP < 80)		1369 (54.4%)
For Female Participants Only (n = 1,172)		
Menopause, n (%)		810 (69.1%)
Use of birth control pills, n (%)		17 (1.5%)
Use of Hormone Replacement Therapy, n (%)		275 (23.5%)

* MET= metabolic equivalent of task. One MET is the energy equivalent expended by an individual while seated at rest.

** Hypertension by JNCVII Criteria: DBP ≥ 90 or SBP ≥ 140 or use of hypertension medication.

Note: There were no missing data on age, race/ethnicity, gender, occupational group, work hours, language spoken at home, physical activity, alcohol use, blood pressure, hypertension and BMI. There were small numbers of missing data for the following variables: Foreign born (n=1), Years lived in US (n=60), Income (n=11), Education (n=1), Smoking (n=16), Job Demands (n=13), Job Control (n=11), Job Strain (n=18), Diabetes (n=13), and Use of birth control pills (n=1).

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Table 2

Risk (prevalence ratio, PR) of hypertension[#] by occupational category: MESA study participants employed at Exam 2 (2002–2004) and working 20+ hours/week (n=2,517)

			Model 1: age adjusted			Model 2: + gender, race, foreign-born, language spoken at home, menopause, birth control pills and HRT adjusted			Model 3: + BMI, current smoker, physical activity, diabetes, alcoholic drinks/week, and hours worked/week adjusted			Model 4: + education, income adjusted		
Occupational category	**SOC***	**N**	**PR**	**95%CI**		**PR**	**95%CI**		**PR**	**95%CI**		**PR**	**95%CI**	
Thirteen-category classification														
Management (referent)	11–13	515	---			---			---			----		
Professional	15–29	716	0.90	0.79	1.04	0.91	0.79	1.04	0.93	0.81	1.06	0.93	0.81	1.07
Healthcare support	31	95	1.04	0.80	1.36	0.96	0.73	1.26	0.87	0.66	1.14	0.83	0.63	1.10
Protective services	33	48	**1.34**	**1.004**	**1.80**	1.12	0.83	1.52	1.06	0.80	1.40	1.06	0.80	1.41
Food preparation & serving related	35	76	0.78	0.56	1.08	0.90	0.65	1.26	0.88	0.62	1.23	0.85	0.60	1.20
Building & grounds cleaning & maintenance	37	97	0.87	0.65	1.16	0.90	0.68	1.21	0.95	0.71	1.28	0.92	0.68	1.24
Personal care & service	39	69	0.96	0.71	1.31	0.94	0.69	1.28	1.00	0.75	1.33	0.97	0.72	1.31
Sales	41	178	0.99	0.81	1.21	1.06	0.87	1.30	1.05	0.87	1.27	1.03	0.85	1.25
Office & administrative support	43	342	1.09	0.92	1.28	1.05	0.89	1.23	1.01	0.86	1.19	0.99	0.83	1.16
Construction & extraction	47	62	1.03	0.75	1.40	1.09	0.80	1.48	1.16	0.85	1.58	1.13	0.82	1.55
Installation, repair & maintenance	49	58	1.07	0.78	1.49	1.13	0.81	1.57	1.13	0.82	1.56	1.10	0.79	1.53
Production	51	161	0.90	0.72	1.13	0.94	0.75	1.19	1.00	0.80	1.26	0.96	0.75	1.23
Transportation & material moving	53	100	1.21	0.97	1.49	1.10	0.89	1.36	1.08	0.88	1.33	1.04	0.83	1.31
Four-category classification														
Management/Professional (referent)	11–29	1231	---			---			---			----		
Service	31–39	385	1.00	0.87	1.16	0.99	0.86	1.15	0.97	0.84	1.12	0.93	0.79	1.09
Sales/Office	41–43	520	1.10	0.97	1.24	1.10	0.98	1.24	1.05	0.94	1.19	1.02	0.90	1.16
Blue-collar	47–53	381	1.06	0.93	1.22	1.07	0.93	1.23	1.08	0.94	1.25	1.03	0.88	1.21

*2-digit Standard Occupational Classification (SOC) codes used by the U.S. census

#systolic blood pressure ≥140, or diastolic blood pressure ≥90, or current use of anti-hypertensive medication.

Note: Estimates for 4 occupational categories and for 13 occupational categories from separate regression models.

Note: Prevalence Ratio (PR) and 95% confidence intervals (CI) in **boldface** are statistically significant at p<.05.

Table 3

Risk (prevalence ratio, PR) of hypertension[#] by job characteristics, employed Exam 2 (2002–2004) MESA study participants working 20+ hours/week (n=2,517)

	Model 1: age adjusted			Model 2: + gender, race, foreign-born, language spoken at home, menopause, birth control pills and HRT adjusted			Model 3: + BMI, current smoker, physical activity, diabetes, alcoholic drinks/week, and hours worked/week adjusted			Model 4: + education, income adjusted		
Job characteristics	**PR**	**95%CI**		**PR**	**95%CI**		**PR**	**95%CI**		**PR**	**95%CI**	
Job demands (standardized)	0.97	0.92	1.02	0.98	0.93	1.03	0.98	0.93	1.03	0.98	0.93	1.03
Job decision latitude (standardized)	**0.95**	**0.91**	**0.996**	**0.91**	**0.87**	**0.96**	**0.92**	**0.88**	**0.97**	**0.92**	**0.88**	**0.97**
Job decision latitude (top v. bottom quartile)	**0.82**	**0.71**	**0.94**	**0.74**	**0.64**	**0.85**	**0.77**	**0.67**	**0.89**	**0.78**	**0.66**	**0.91**
Job strain linear term (demands – 0.5*latitude) (standardized)	1.01	0.97	1.06	**1.05**	**1.00**	**1.11**	1.04	0.99	1.10	1.04	0.98	1.09

[#]Systolic blood pressure ≥140, or diastolic blood pressure ≥90, or current use of anti-hypertensive medication.

Note: Estimates for each job characteristic obtained from separate Poisson regression models.

Note: One standard deviation of Job Decision Latitude equals 15.12 points on a scale ranging from 24–96

Prevalence Ratio (PR) and 95% confidence intervals (CI) in **boldface** are statistically significant at p<.05.