Intensity of Occupational Physical Activity and Obesity in US Workers: Behavioral Risk Factor Surveillance System, 2009.

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A thesis
submitted in partial fulfillment of the
requirements for the degree of

Master of Public Health

University of Washington
2012

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Program Authorized to Offer Degree:

Epidemiology

University of Washington

Abstract

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BACKGROUND: Reducing adult obesity is a public health priority in the United States. Occupational energy expenditure is a key component in overall energy balance. US workers have become increasingly sedentary at work.

PURPOSE: The purpose of this study was to examine the association between the intensity of occupational physical activity and obesity.

METHODS: Cross-sectional design utilizing 2009 Behavioral Risk Factor Surveillance System 2009 data employing logistic regression to examine multiple confounders and potential

modification by gender, age and compliance with leisure time physical activity guidelines. The primary exposure was self-reported intensity of occupational physical activity and the outcome of interest was body mass index as determined by self-reported height and weight.

RESULTS: The majority of sedentary jobs were held by women while occupations with vigorous physical activity were held primarily by men. Increased occupational physical activity was associated with significantly lower odds of obesity in US workers. The odds ratio comparing workers with vigorous occupational physical activity to those with sedentary jobs, adjusted for gender, age and education, was 0.82 (95% CI 0.76, 0.89). While over 45% of all study participants reported adequate leisure time physical activity, there was no evidence of interaction with occupational physical activity in its association with obesity.

CONCLUSION: A sedentary occupation is associated with increased odds of being obese in US adult workers.

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BACKGROUND

Combating obesity is a public health priority.[1] The prevalence of obesity has more than doubled over the last three decades.[2] The majority of US adults over the age of 19 weigh more than is recommended and one in three is obese, having a body mass index (BMI) equal to or greater than 30 kg/m^2.[3] Healthy People 2010 established the objective of reducing the overall prevalence of adult obesity to 15%. Coincidentally, 2010 was also the first year no individual state had an obesity rate below 20%.[2,3]

Obese individuals are at increased risk of premature death from cardiovascular disease, kidney disease and some forms of malignancy. [4,5] Furthermore, excess body fat is a major modifiable risk factor in the development of a wide range of chronic diseases including coronary heart disease, hypertension, cerebrovascular disease, diabetes, arthritis and musculoskeletal disease. [6] Obesity impacts quality of life and reduces longevity.[7] Without attenuation in the prevalence of obesity, the steady rise in life expectancy observed in the modern era may soon come to an end and the youth of today may, on average, live less healthy and possibly even shorter lives than their parents.[7,8]

In addition to individual morbidity and mortality, obesity has far reaching societal impacts. In the US an estimated $190 billion dollars are spent annually for obesity related medical care, accounting for over 20% of all healthcare expenditures. [1] Among all payers, obese employees cost an estimated $1,429 dollars more annually than normal weight peers.[9] Each year obesity-related absenteeism costs businesses an estimated $4.3 billion, while presenteeism, or reduced productivity while at work, costs an estimated $8 billion. [1] Obese patients are also more likely to receive work-related disability, and suffer from discriminatory hiring practices.[10]

Excess body fat is the result of an energy imbalance that favors caloric consumption over expenditure. Net energy accumulation is the product of a complex interaction between a range of individual factors and broad cultural and societal influences. Several pathophysiologic conditions and pharmacologic interventions can serve as etiologies of excess fat accumulation. In the absence of an inciting medical condition or treatment, obesity most likely ensues as the result of behavioral and lifestyle choices potentiated by genetic predisposition.[11]

Recent changes in the quality and quantity of total energy intake correspond to national trends in BMI. Americans are more often eating outside the home, and consuming larger portions of highly processed, calorie dense foods.[12] Between 1970 and 2003 as Americans reduced fat intake in favor of carbohydrates and sugars, daily caloric intake rose 30%.[13] Caloric intake from sugar sweetened beverages actually tripled between 1970 and 2000.[14]

Basal metabolic expenditure and physical activity are the primary methods for energy consumption. Though changes in body composition can introduce modest alterations in background energy utilization, physical activity is the primary modifiable factor in total energy expenditure. Physical activity encompasses a spectrum of exertional intensity and can be divided into occupational and non-occupational, or leisure time activities. In 2008 the US Department of Health and Human Services published Physical Activity Guidelines for Americans, the first national guidelines highlighting the benefit of regular leisure time physical activity. Reported rates of compliance with these recommendations have varied. A recent study examining leisure time physical activity in the United States concluded that only 45% of adults were active at recommended levels (at least 30 minutes five or more days per week at moderate intensity or 60 minutes per week of vigorous aerobic exercise) while 16% reported no leisure time physical

activity.[15] Other national data over the past decade suggest only around 20% of US adults comply.[16]

Intensity of occupational physical activity among US workers has been on the decline. Integration of computer technology and focus on workplace efficiency have contributed to the expansion of service related occupations at the expense of more physically demanding agricultural and goods producing jobs. From 1960 to 2008 there was an approximate drop in occupation-related daily energy expenditure of 140 calories for men and 124 calories for women.[17] Whereas more than 30% of US private sector occupations in 1960 required light to moderate physical activity, by 2008 only 12% of US adult workers held such jobs.[17] Occupations that require moderate to vigorous physical activity (e.g., construction, mining) have declined from nearly one half, to less than one quarter of total US private sector jobs over the last 5 decades.[17] Research examining the association between occupational physical activity and the likelihood of compliance with leisure time physical activity guidelines has been inconclusive.[18,19]

The purpose of this study was to examine the association between US working adults' intensity of occupational physical activity and obesity using a large, nationally representative database. Additionally, we examined whether the association is modified by age, gender or compliance with leisure time physical activity guidelines. A better understanding of the relationship between obesity and occupational physical activity could help guide prevention efforts in one of the nation's public health priority areas.

METHODS

Study Population

We conducted a cross-sectional study utilizing the 2009 Behavioral Risk Factor Surveillance System (BRFSS), a state-based, random-digit-dialed telephone survey of US non-institutionalized adults age 18 years and older in the 50 states, the District of Columbia, Guam, Puerto Rico, and US Virgin Islands. Sponsored by the Centers for Disease Control and Prevention (CDC) and conducted by state health departments beginning in 1984, BRFSS obtains information on preventive health practices and risk behaviors related to chronic disease, injury prevention and preventable infectious diseases. The computer-assisted survey contains a set of core questions each respondent is asked in addition to select health modules a state can elect to utilize. In 2009, the BRFSS core questionnaire contained detailed questions about physical activity.

To meet the BRFSS standard for participating states' sample designs, representative sample records must be justifiable as a probability sample of all households with telephones in the state, and every participating area met this criterion in 2009.[20] All 50 states and the District of Columbia used a disproportionate stratified sample design. The CDC assigns a weight to each entry in order to account for the potential that selection and response rates may differ among different segments of a state's population. Utilization of a post-stratification factor accounts for noncoverage and nonresponse, and allows for weighted frequencies to reflect each state's population estimates. Information on quality assurance and other aspects of this survey is available online at www.cdc.gov/brfss/index.htm. BRFSS data are maintained by the CDC, Office of Surveillance, Epidemiology and Laboratory Services and are publically available from their website.

The median response rate for all states included in the 2009 BRFSS was 52.5% (range: 37.9%-66.9%).[21] Developed by the Council of American Survey Research Organizations (CASRO), this rate reflects the efficiency of telephone sampling as well as the degree of cooperation among the eligible respondents contacted.[20]

Data Analysis

The primary exposure evaluated was occupational physical activity level. Each respondent who was currently employed was asked, "When you are at work, which of the following best describes what you do?" to which they could summarize occupational requirements as "mostly sitting or standing", "mostly walking", "mostly heavy labor or physically demanding work", "don't know / not sure" or "refused." This variable was used to characterize occupations that require sedentary (mostly sitting or standing), moderate (mostly walking) or vigorous (mostly heavy labor or physically demanding work) physical activity.

The primary outcome of interest was BMI, defined as weight in kilograms divided by height in meters squared. BMI was as calculated from self-reported height (feet and inches) and weight (pounds) and then dichotomized into non-obese (BMI < 30) or obese (BMI ≥ 30).[22] The non-obese category was further divided into below to normal weight (BMI < 25) and overweight (BMI = 25-29.9).[22]

We evaluated leisure time physical activity as an effect modifier of the association between occupational physical activity and obesity, as defined by compliance with the 2008 Physical Activity Guidelines for Americans. This dichotomous variable was defined by responses to questions on the number of days and minutes respondents engaged in moderate and vigorous physical activity. Recommendations suggest adults get at least 30 minutes of moderate

intensity physical activity five or more days per week or 60 minutes of vigorous aerobic exercise per week.[23] During questioning, respondents were given examples of moderate and vigorous physical activity from which to base their answers. To emphasize the exclusion of occupation-related physical activity, each question was prefaced by the qualifier "when you are not working".

Several socio-demographic factors and medical comorbidities were examined as potential confounders of the association between occupational physical activity level and obesity. Characteristics included age (coded in categories of 18-24, 25-34, 35-44, 45-54, 55-64, ≥ 65); race/ethnicity (white, black, Hispanic, other non-Hispanic, multiracial); education (did not graduate high school, high school graduate only, some college, college graduate); income (< 25,000, 26,000-50,000, 51,000-74,000, ≥ 75,000); smoking status (never, former, current); marital status (married/not-married); children in household (yes/no); health status (poor-fair/good-excellent); cardiovascular disease (yes/no); and diabetes (yes/no).

Statistical incorporation of the survey weights and post-stratification factors associated with complex survey data was accomplished using *svy* commands in Stata 11c statistical package (StataCorp LP., College Station, TX). We used logistic regression to obtain crude and adjusted odds ratios (OR) for the association between each level of occupational physical activity (moderate and vigorous, with sedentary as the referent) and obesity as the outcome. To evaluate the extent to which observed differences in the prevalence of obesity associated with level of occupational physical activity were due to confounding we compared crude odds ratios to odds ratios adjusted for individual covariates. Given an association with both occupational activities and obesity, age and gender were included as confounders *a priori*. Final risk estimates included all confounders found to alter the crude OR by at least 10%. We also examined effect

modification of the relationship between occupational physical activity level and obesity by gender, age and compliance with leisure time physical activity guidelines, through stratified analysis and testing for multiplicative statistical interaction. Statistical significance was established at $p \leq 0.05$. The unadjusted Wald test was used to test the overall model and individual predictors. Previous data indicate the prevalence of obesity in the US adult population to be 35%.[3] With 80% power and two-tailed alpha level 0.05 we estimated that with a total of 32,652 study subjects, we would be able to detect a 1% difference in the prevalence of obesity between levels of occupational physical activity.

We also conducted secondary analysis that examined the association between occupational physical activity and more specific BMI categories. Separate adjusted multivariate logistic regression models were developed to examine risk estimates for obese vs. normal weight and overweight vs. normal weight.

In May, 2012 the University of Washington Human Subjects Division waived all IRB review requirements as set forth by policy on the use of publically available datasets.

RESULTS

432,607 US adults participated in the 2009 BRFSS. We excluded those that did not provide an answer to the occupational physical activity question "When you are at work, which of the following best describes what you do?" Individuals answering yes to the question "Do you have disabilities requiring special equipment?" were also excluded. Those without self-reported height or weight (requisite components of BMI calculation) were also excluded resulting in a study population of 190,994 (Figure 1).

The study sample was 57% female and 80% were of non-Hispanic white race/ethnicity. The study sample had a smaller percentage of females than the entire 2009 BRFSS population (57% vs. 62% overall), but was otherwise similar in demographic and behavioral characteristics. The majority of respondents identifying their occupational physical activity as sedentary or moderate were women (61% and 58% respectively), while men accounted for 70% of those with vigorous work duties (Table 1). College graduates were more likely to be in the highest income level and represented half of those employed in sedentary occupations (50%). Individuals in the lower levels of income tended to have less education and were more likely to be employed in physically demanding jobs. Smoking and excess alcohol consumption were also more common among those employed in vigorous jobs. Other demographic factors and health indicators were distributed evenly across the levels of occupational physical activity (Table 1).

Median BMI did not differ greatly by occupational physical activity level (sedentary 26.7; moderate 26.7; vigorous 27.0). Men were slightly more likely than women to meet leisure time physical activity recommendations (52% vs. 48%). Workers in sedentary jobs were more likely to engage in insufficient levels of leisure time physical activity (Figure 2).

After adjusting for gender, age and education, US workers employed in jobs requiring moderate or vigorous occupational physical activity had 0.83 (95% CI 0.78-0.87) and 0.82 (0.76-0.89) times the odds of being obese, respectively, when compared to sedentary workers (Table 2). Level of education substantially confounded the relationship between vigorous occupational physical activity and obesity. Income had a negligible impact on the adjusted model containing education, and had more missing data. Education was therefore retained along with gender and age as confounders for final risk estimates.

The association between occupational physical activity and obesity was not modified by gender (Table 3). The association of vigorous occupational physical activity with obesity was modified by age (multiplicative statistical interaction p=0.02); ≤ 45 years of age (OR 0.86, 95% CI 0.78-0.95), > 45(OR 0.73, 95% CI 0.67-0.80). The association of moderate occupational physical activity with obesity was modified by compliance with leisure time physical activity (multiplicative statistical interaction p=0.02); compliant with guidelines (OR 0.81, 95% CI 0.75-0.87), noncompliant (OR 0.88, 95% CI 0.81-0.95).

In a model adjusted for gender, age and education, vigorous (vs. sedentary) occupational physical activity was associated with 0.89 (95% CI 0.82-0.96) times the odds of being overweight and 0.77 (95% CI 0.76-0.86) times the odds of being obese compared to normal weight (Table 4).

DISCUSSION

To our knowledge, this is largest study describing the association between occupational physical activity and obesity utilizing a nationally representative sample. Our study demonstrates that sedentary occupation is associated with a significant increase in the odds of being obese (vs. non-obese) in US workers. This association was strengthened when the outcome was redefined to compare obese individuals to those of normal weight (with a BMI $\leq 25 kg/m^2$).

These results provide some support to the hypothesis that low occupational physical activity levels could be contributing to the alarming prevalence of obesity among US adults. An appreciation for this association and the amount of time Americans spend in increasingly sedentary occupations could assist employers and public health authorities in developing obesity prevention strategies targeted toward the occupational environment.

Our study adds to the body of literature examining occupational physical activity and obesity in US working adults. In a sample of 4,995 US adults from the third National Health and Nutrition Examination Survey, King et al. also found that sedentary occupations were associated with an increased prevalence of obesity.[24] More recently, Choi et al. reported a significant association between obesity and sedentary occupation among 3,412 male workers in the National Survey of Midlife Development in the United States (MIDUS II), only among participants working more than 40 hours per week; no significant association was found in female workers.[25] An early cross-sectional study conducted by Jeffery et al. [1991] among 4,647 participants of the Healthy Worker Project, found that the association between occupational physical activity and obesity differed between men (none) and women (reduced occupational physical activity associated with greater prevalence of obesity).[26] In our large study of 190,994 survey

respondents, we observed a similar association in men and women between occupational PA and obesity.

The association between occupational physical activity and obesity was modified by age in our study (significantly so for vigorous physical activity), in that stronger associations between occupational physical activity and obesity were observed in those older than age 45 than in younger participants. It is possible that occupational physical activity is more important in preventing obesity in older than younger persons. It is also possible that this interaction is due to reverse causality, as would happen if the types of older workers who take jobs with physical demands are those who are less likely to be obese (i.e., are more fit) at the outset. Compliance with leisure time physical activity guidelines modified the relationship between sedentary occupation and obesity for moderate occupational physical activity only. Interaction between occupational physical activity and compliance with leisure time physical activity guidelines has been previously described by King et al. among 4,998 healthy working adult participants in NHANES III.[24]

In our study exposure level was determined by self-report in response to a single question identifying 3 broad occupational physical activity examples. This approach using BRFSS data has shown test-retest validity and strong correlation with observed occupational activity (kappa=0.71, 95% CI=0.49, 0.94).[27] Several other methods of assessing occupational physical activity have been used in epidemiologic research.[25] Accelerometers, motion sensors, direct calorimeter or doubly labeled water are each specific and provide quantifiable measures of physical activity, but are impractical when conducting population-wide assessment. In the past, reported occupation has been successfully used to classify level of physical activity, either through committee consensus or according to established occupational classification systems.[25,28]

One potential way to improve quantification of occupational physical activity in large computer-assisted or telephone based surveys like BRFSS would be to offer a representative selection of occupational activities from which respondents could choose. These activities could then be assigned metabolic equivalents based on previously published classification schemes, allowing for a more explicit evaluation of occupational energy expenditure trends and obesity.[29] Additionally, a work history, in which all jobs held during adulthood are recorded (rather than just current job), would provide information to help establish a cause-and-effect time sequence.

The use of self-reported height and weight to determine BMI can potentially introduce both random and systematic bias. The exact nature and impact of this bias remains controversial. Given the common use of self-reported values in epidemiology, numerous studies have attempted to describe reproducible trends in misreporting and develop methods for its correction, but none has been widely accepted. In a recent study comparing NHANES examinations from 2005-2008 to those completed in 1988-1994, Stommel and Osier concluded that the bias towards underreporting one's weight or overestimating of height had declined between the time periods, especially among the obese,[30] These trends were noted to be consistent in all the major demographic categories of age, race/ethnicity and gender.[30]

This study has several limitations. As described previously the reliance on self-reported occupational physical activity, height, and weight introduce potential random and systematic bias. Second, only households with a landline telephone were eligible to participate. Telephone coverage by landline varies by state and also by subpopulation. In 2008, telephone coverage throughout the United States averaged about 94.1%, and noncoverage ranged from 2.8% to 11.6%. The percentage of cellular phone only households was 22.7% in 2009.[31] Cellular phone households are often younger, more commonly minority and more likely to be actively

employed.[32] Third, although confounding was optimally minimized according to the available measured covariates, no attempt was made to adjust for dietary patterns. Finally, the cross-sectional nature of this study precludes the ability to temporally associate employment status and subsequent obesity.

Despite the limitations, this was a very large study that demonstrated a significant contributor to one of our nation's public health priority issues. As experts continue to refine the public health agenda, specifically as it applies to the obesity epidemic, emphasis should be placed on continued research into the impact of sedentary occupation. Longitudinal studies aimed at quantifying thresholds at which physical inactivity directly contributes to the development or exacerbation of obesity could provide critical insight. These efforts will require the integration of population-based assessment and the validation of workplace physical activity measures. Immediate considerations that could improve population-based assessment include a random selection of BRFSS respondents that subsequently undergo objective evaluation and dietary discrimination, inclusion of cellular phone only households, and the inclusion of more extensive occupational information, including all jobs held during adulthood and duration of employment.

CONCLUSIONS

The intensity of occupational physical activity is significantly associated with obesity. Adults working in sedentary jobs have greater odds of being obese than peers working in physically demanding occupations when adjusted for age, gender and level of education.

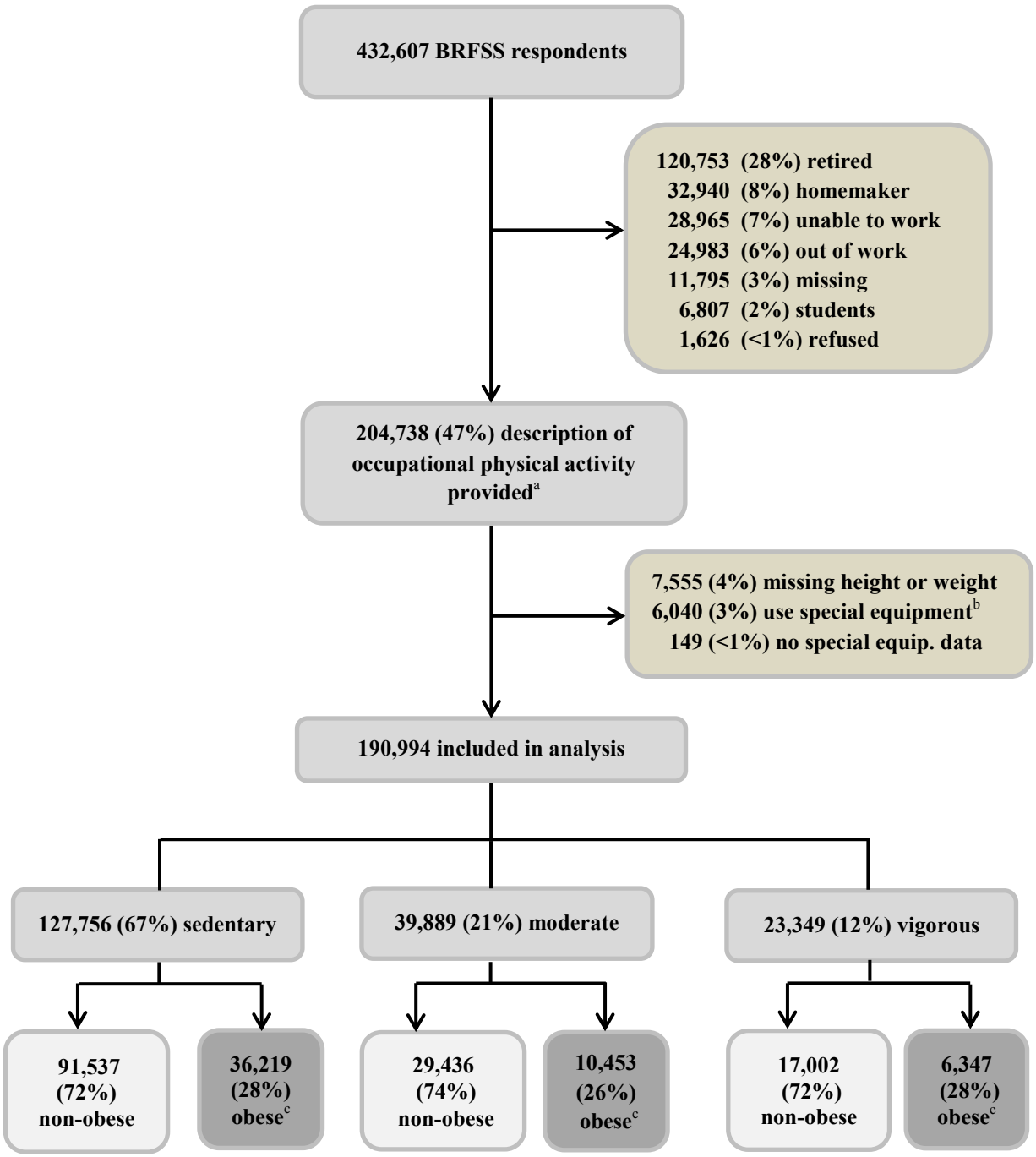

Figure 1. Distribution of occupational physical activity and obesity among Behavioral Risk Factor Surveillance System, 2009.

Note: Percentages indicate proportion of preceding level with the identified characteristic.

[a] Interviewees asked "When you are at work, which of the following best describes what you do? Mostly sitting or standing, mostly walking or mostly heavy labor / physically demanding work?" Responses were then classified as sedentary (mostly walking or sitting), moderate (mostly walking), or vigorous (mostly heavy labor/physically demanding work).

[b] Participants acknowledged a health problem that requires the use of special equipment, such as a cane, a wheelchair, a special bed, or a special telephone.

[c] Obese defined by body mass index (BMI) ≥ 30.

Table 1. Selected characteristics in US workers by intensity of occupational physical activity, Behavioral Risk Factor Surveillance System, 2009.

Characteristic	Occupational Physical Activity[a]					
	Sedentary n=127,756 (66.9%)		Moderate n=39,889 (20.9%)		Vigorous n=23,349 (12.2%)	
	n	Weighted prevalence[c]	n	Weighted prevalence[c]	n	Weighted prevalence[c]
Sex[b]						
Male	50,186	39.3	16,652	41.7	16,375	70.1
Female	77,570	60.7	23,237	58.3	6,974	29.9
Age[b] (years)						
18-24	2,750	2.2	1,668	4.1	1,238	5.3
25-34	14,664	11.5	5,411	13.6	3,488	14.9
35-44	27,200	21.2	8,375	21.0	5,003	21.4
45-54	38,697	30.3	11,495	28.8	7,201	30.8
55-64	33,167	26.0	9,482	23.8	4,996	21.4
≥ 65	11,278	8.8	3,458	8.7	1,423	6.2
Race / Ethnicity						
White	103,632	81.1	29,773	74.6	18,902	81.0
Black	8,984	7.0	3,563	8.9	1,344	5.7
Hispanic	7,093	5.6	3,771	9.4	1,534	6.6
Multiracial	1,835	1.4	667	1.7	520	2.2
Other	5,300	4.2	1,846	4.7	867	3.7
Missing	912	0.7	269	0.7	182	0.8
Education						
Less than high school	3,804	3.0	2,795	7.0	1,931	8.2
High school graduate	26,593	20.8	11,529	29.0	9,781	41.9
Some college	32,929	25.8	11,721	29.4	7,368	31.6
College graduate	64,356	50.4	13,799	34.5	4,247	18.2
Missing	74	<0.1	45	0.1	22	0.1
Currently married						
No	43,714	34.2	15,018	37.7	9,309	39.9
Yes	83,688	65.5	24,787	62.1	13,983	59.9
Missing	354	0.3	84	0.2	57	0.2
Children in household						
No	50,791	39.8	16,860	42.3	9,693	41.5
Yes	76,764	60.0	22,972	57.6	13,616	58.3
Missing	201	0.2	57	0.1	40	0.2

Table 1. continued.

Characteristic	Sedentary n=127,756 (66.9%)		Moderate n=39,889 (20.9%)		Vigorous n=23,349 (12.2%)	
	n	Weighted prevalence[c]	n	Weighted prevalence[c]	n	Weighted prevalence[c]
Income (thousands)						
< 25	13,187	10.3	7,415	18.6	4,752	20.3
26-50	27,896	21.8	10,622	26.6	7,614	32.6
51-74	24,502	19.2	7,617	19.1	4,477	19.2
≥ 75	53,344	41.8	11,222	28.1	4,753	20.4
Missing	8,827	6.9	3,013	7.6	1,753	7.5
Smoking status						
Never	76,305	59.7	22,620	56.7	10,845	46.5
Former	33,666	26.4	9,764	24.5	6,157	26.4
Current	17,351	13.6	7,356	18.4	6,267	26.8
Missing	434	0.3	149	0.4	80	0.3
Excess alcohol consumption[d]						
No	119,384	93.5	37,209	93.3	21,044	90.1
Yes	6,686	5.2	2,118	5.3	1,828	8.0
Missing	1,686	1.3	562	1.4	477	2.0
Health status						
Poor to fair	9,612	7.5	3,516	8.8	2,500	10.7
Good to excellent	117,690	92.1	36,238	90.9	20,774	89.0
Missing	454	0.4	135	0.3	75	0.3
Leisure time physical activity[e]						
Non-compliant	63,358	49.6	18,173	45.6	9,316	39.9
Compliant	61,146	47.9	20,446	51.2	13,139	56.3
Missing	3,252	2.6	1,270	3.2	894	3.8
Cardiovascular disease						
No	124,488	97.4	38,836	97.3	22,695	97.2
Yes	2,882	2.3	905	2.3	562	2.4
Missing	386	0.3	148	0.4	92	0.4
Diabetes						
No	119,094	93.2	37,258	93.4	22,064	94.5
Yes	8,602	6.7	2,605	6.5	1,265	5.4
Missing	60	0.1	26	0.1	20	0.1

[a] Interviewees asked "When you are at work, which of the following best describes what you do? Mostly sitting or standing, mostly walking or mostly heavy labor / physically demanding work?" Responses were then classified as sedentary (mostly walking or sitting), moderate (mostly walking), or vigorous (mostly heavy labor/physically demanding work).

[b] Variable with no missing data.

[c] Adjusted for age, sex and race, probability of selection, nonresponse and noncoverage

[d] Men who reported consuming more than 2 drinks per day or women who reported consuming more than 1 drink daily.

[e] Met 2008 Physical Activity Guidelines for Americans for leisure time physical activity (150 min. moderate or 60 min. vigorous activity per week), based on self-report.

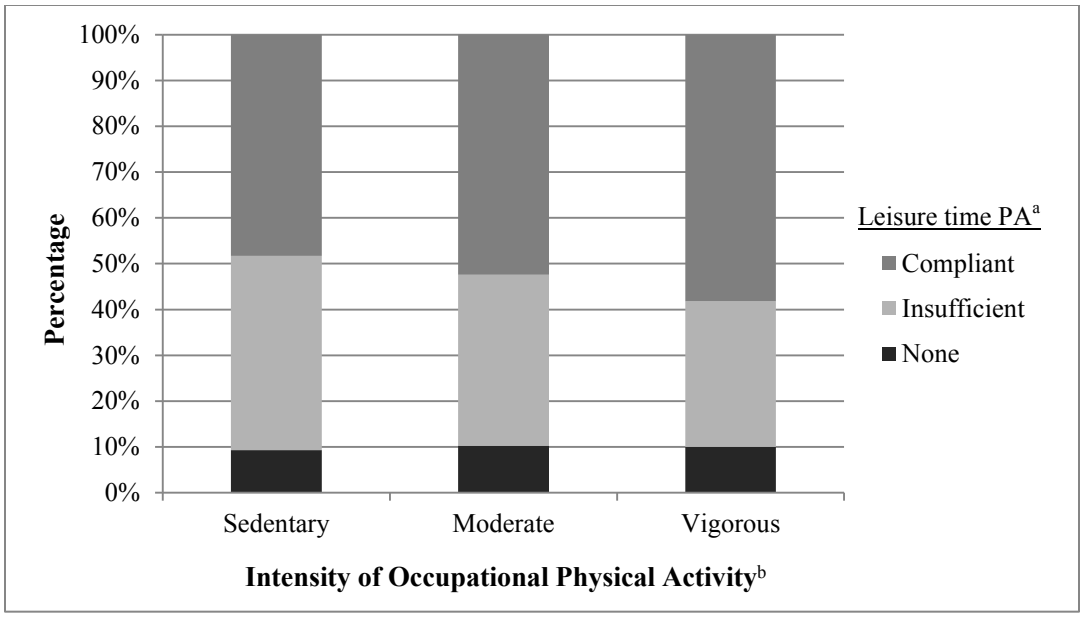

Figure 2. Compliance with 2008 Physical Activity Guidelines for Americans by the intensity of occupational physical activity, Behavioral Risk Factor Surveillance System, 2009.

PA=physical activity

[a] Based on self-reported leisure time physical activity as measured against the 2008 Physical Activity Guidelines for Americans (150 min. moderate or 60 min. vigorous activity per week).

[b] Interviewees asked "When you are at work, which of the following best describes what you do? Mostly sitting or standing, mostly walking or mostly heavy labor / physically demanding work?" Responses were then classified as sedentary (mostly walking or sitting), moderate (mostly walking), or vigorous (mostly heavy labor/physically demanding work).

Table 2. Risk of obesity by intensity of occupational physical activity, Behavioral Risk Factor Surveillance System, 2009.

Occupational Physical Activity[a]	Sample Size n=190,994	Obese (%)	OR[b]	95% Confidence Interval	p-value
Sedentary	127,756	28	Ref	Ref	Ref
Moderate	39,889	26	0.83	0.78-0.87	p<0.001
Vigorous	23,349	28	0.82	0.76-0.89	p<0.001

[a] Interviewees asked "When you are at work, which of the following best describes what you do? Mostly sitting or standing, mostly walking or mostly heavy labor / physically demanding work?" Responses were then classified as sedentary (mostly walking or sitting), moderate (mostly walking), or vigorous (mostly heavy labor/physically demanding work).

[b] Model adjusted for gender, age and level of education.

Table 3. Modification of the association between intensity of occupational physical activity and obesity in US workers, Behavioral Risk Factor Surveillance System, 2009.

Covariate	Occupational Physical Activity[a]					
	Sedentary n=127,756 (66.9%)		Moderate n=39,889 (20.9%)		Vigorous n=23,349 (12.2%)	
	OR	95% CI	OR	95% CI	OR	95% CI
Pooled[b]	1.00	Ref	0.83	0.78-0.87	0.82	0.77-0.88
Gender						
Female[c]	1.00	Ref	0.85	0.80-0.91	0.87	0.78-0.97
Male[c]	1.00	Ref	0.81	0.75-0.88	0.82	0.75-0.89
Interaction term[d]		Ref		p=0.14		p=0.10
Age (years)						
≤ 45[c]	1.00	Ref	0.84	0.78-0.91	0.86	0.78-0.95
> 45[c]	1.00	Ref	0.79	0.74-0.84	0.73	0.67-0.80
Interaction term[d]		Ref		p=0.27		p=0.02
Leisure physical activity[e]						
Insufficient[c]	1.00	Ref	0.81	0.75-0.87	0.86	0.78-0.96
Compliant[c]	1.00	Ref	0.88	0.81-0.95	0.85	0.77-0.94
Interaction term[d]		Ref		p=0.02		p=0.12

CI = confidence interval

[a] Interviewees asked "When you are at work, which of the following best describes what you do? Mostly sitting or standing, mostly walking or mostly heavy labor / physically demanding work?" Responses were then classified as sedentary (mostly walking or sitting), moderate (mostly walking), or vigorous (mostly heavy labor/physically demanding work).

[b] Overall model adjusted for gender, age and education.

[c] From models stratified by variable of interest

[d] P-values for multivariate logistic regression model including multiplicative statistical interaction term.

[e] Met 2008 Physical Activity Guidelines for Americans leisure time physical activity (150 min. moderate or 60 min. vigorous activity per week), based on self-report.

Table 4. Association of occupational physical activity levels with body mass index categories, Behavioral Risk Factor Surveillance System, 2009.

BMI comparison & occupational Physical Activity level[a]	Crude Model			Adjusted Model[b]		
	OR	95% CI	p-value	OR	95% CI	p-value
Overweight vs. normal						
Sedentary	Ref	Ref	Ref	Ref	Ref	Ref
Moderate	0.99	0.94-1.05	p=0.813	0.97	0.91-1.02	p=0.241
Vigorous	1.16	1.09-1.25	p<0.001	0.89	0.82-0.96	p=0.002
Obese vs. normal						
Sedentary	Ref	Ref	Ref	Ref	Ref	Ref
Moderate	0.90	0.85-0.95	p<0.001	0.81	0.76-0.86	p<0.001
Vigorous	1.09	1.01-1.17	p=0.024	0.77	0.71-0.84	p<0.001

BMI=body mass index, CI=confidence interval, OR=odds ratio

[a] Body mass index comparative levels: normal (≤ 24.9), overweight (25-29.9), obese (≥ 30).

[b] Model adjusted for gender, age and education level.

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