# Prevalence of Obesity, No Leisure-Time Physical Activity, and Short Sleep Duration Among Occupational Groups in 29 States

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**Objective:** The aim of this study was to examine prevalence of obesity (body mass index of 30 or higher), no leisure-time physical activity in the past 30 days (no LTPA), and short sleep duration (averaging less than 7 hours of sleep per 24-hour period) among 22 occupational groups. **Methods:** We analyzed 2013 and 2014 Behavioral Risk Factor Surveillance System (BRFSS) data from 29 states, controlling for sex, age, race/ethnicity, and education. **Results:** By occupation, prevalence ranged from 16.1% to 35.8% for obesity, 11.3% to 28.7% for no LTPA, and 31.4% to 42.9% for short sleep. Only Transportation & Material Moving ranked among the top five occupations for all three risk factors. Obesity and no LTPA varied significantly by sex for several occupations. **Conclusion:** Prevalence of obesity, no LTPA, and short sleep varied by occupation and affected more than one in five U.S. workers.

Obesity, sedentary behavior, and inadequate sleep are all modifiable risk factors for adverse health outcomes. Both obesity and sedentary behavior are associated with poor health and decreased lifespan,[1,2] and each are responsible for an estimated 10% of disease-specific deaths each year.[3] Short sleep is associated with poor general health, hypertension, increased cardiovascular disease mortality, type 2 diabetes, depression, and reduced immune response.[4] The estimated economic impacts on workplaces and health care costs are large. Obesity costs U.S. workplaces an estimated $73.1 billion annually due to medical costs, presenteeism (loss of productivity while at work due to health problems), and absenteeism.[5] Insufficient physical activity costs the U.S. economy an estimated $117 billion in health care costs per year; compared with active adults, inactive adults cost an additional $1313 per year per person.[6] In a sample of four companies, workers with insufficient sleep syndrome had sleep-related losses in productivity averaging an additional $1503 per year above those of good sleepers.[7]

Studies report associations between occupation and the prevalence of obesity,[8–11] lack of leisure-time physical activity (LTPA),[11,12] and short sleep.[13–15] Socioeconomic status is related to occupation and may play a role in these differences,[16] but job characteristics are important as well. Obesity is associated with working long hours (eg, more than 40 hours/week),[9,12,17,18] shift work,[19–25] and sedentary jobs.[26] Leisure-time physical inactivity is associated with long working hours[12] and shift work.[27] Similarly, insufficient sleep is associated with long working hours,[28–30] and shift work.[19,22,25,30,31]

We used data from the 2013 and 2014 Behavioral Risk Factor Surveillance System (BRFSS)[32] to identify specific occupational groups with the highest prevalence of obesity, no LTPA, and short sleep, after controlling for sex, age, gender, education, and race/ethnicity. We hypothesized that some occupational groups would have significantly elevated prevalence for one or more of these risk factors, which may signal an increased risk for negative health outcomes and a need for further research for the affected groups.

## METHODS

The BRFSS is an annual land-line and cell phone survey that measures health outcomes and behavioral risk factors for the noninstitutionalized adult population (18 years of age and older) residing in the US.[33] Detailed documentation for each data year, including state-specific response rates, is available online.[34] In addition to a core set of questions that are asked in all interviews, states may add their own questions, or include one of a number of optional modules on specific topics. Starting in 2013, the National Institute for Occupational Safety and Health (NIOSH) has sponsored an optional module consisting of two questions designed to collect industry and occupation (I/O) data; (1) Industry: ''What kind of business or industry do you work in? (eg, hospital, elementary school, clothing manufacturing, restaurant)'' and (2) Occupation: ''What kind of work do you do? (eg, registered nurse, janitor, cashier, auto mechanic).''[35] These questions were modeled after similar questions used in the National Health Interview Survey.

The main outcomes of interest for this study were the estimated prevalences of obesity, no LTPA, and short sleep by occupational group. Obesity was defined as a body mass index (BMI) of 30 or higher, and was calculated as kilograms of weight per meter of height squared based on self-reported weight and height. No LTPA was defined by a ''no'' response to the LTPA question: ''During the past month, other than your regular job, did you participate in any physical activities or exercises such as running, calisthenics, golf, gardening, or walking for exercise?'' Hours of sleep were obtained by asking the respondents: ''On average, how many hours of sleep do you get in a 24-hour period?'' Short sleep was defined as less than 7 hours of sleep; because responses were rounded to the nearest whole hour, any person reporting less than 6.5 hours of sleep is in the short sleep category. Sex, age, race/ethnicity, and education were included in all analyses as potential confounders.

In 2013 and 2014, BRFSS collected data from a total of 956,437 respondents. Our study population included the 179,619 respondents (18.8%) that (1) participated in one of the 29 states that administered the I/O questions ($n = 412{,}829$), (2) reported that they were either self-employed or working for wages at the time of the interview (205,686 excluded), (3) were not in the Armed Forces industry group, as the BRFSS sampling frame does not provide a representative sample of active duty military personnel (527 excluded), and (4) had occupation information recorded with sufficient detail to assign a 2002 Census Occupation code (26,997 excluded, or 13.1% of the 206,616 individuals eligible to be in the study population).[36] Census Occupation 2002 codes were grouped into the 2007 National Health Interview Survey Occupation groups (22 groups after exclusion of military),[37] which are equivalent to the 2000 Standardized Occupation Classification Major Groups.[38] Members of the study population

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were included in analyses only if they had valid responses to all model variables, resulting in 167,723 respondents in the obesity analysis (6.6% excluded), 175,155 in the no LTPA analysis (2.5% excluded), and 174,982 in the short sleep analysis (2.6% excluded).

The states that contributed occupational data to our analyses in 2013 or 2014 were California, Florida, Wisconsin, Wyoming, Illinois, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Montana, Nebraska, New Hampshire, New Jersey, New Mexico, New York, North Dakota, Oregon, Utah, Washington, Colorado, Connecticut, Georgia, Idaho, Iowa, North Carolina, Tennessee, and Vermont. In 2013, Washington and Wyoming collected their I/O data via equivalent state-added questions,[39,40] and in 2014, all contributing states used the NIOSH I/O module questions.

## Statistical Analyses

Multivariable logistic regression was used to estimate prevalence of obesity, no LTPA, and short sleep by occupational group, adjusted for sex, age, race/ethnicity, and education (see Table 1 for the categories used in the model). Estimates were calculated with 32 bit SAS-callable SUDAAN 11.0.1 using PREDMARG (predicted margins) statements in the RLOGIST (logistic regression) procedure.[41] Sampling weights were incorporated into all analyses, and appropriate statistical procedures were used to account for the complex survey design. For states providing 2 years of data, sampling weights were divided by two so that the population estimates would be the average of both years. Variables were retained in the models only if they were significant (Wald F $P < 0.05$). For each of the three outcomes, the model included sex, age, race/ethnicity, and education, and all two-way interactions were tested. The significant interaction terms that produced the highest $P$ value for the Hosmer–Lemeshow goodness of fit (GOF)[42] were retained in the models. The obesity model included three interaction terms: sex × occupation, sex × race, and sex × education (GOF $P = 0.784$). The no LTPA model included two interaction terms: sex × occupation and sex × race (GOF $P = 0.203$). The short sleep model had the interaction term sex × race (GOF $P = 0.443$). For each outcome, occupations were ranked in order from highest to lowest prevalence estimate; in the case of a tie, both received the same rank. The ranking does not imply statistical significance. When comparing men and women, a difference was considered statistically significant if the two-sample $t$ test produced a $P$ value of 0.05 or less. For occupational groups, statistical significance was determined by one sample inference with alpha = 0.05; if the prevalence for all groups combined did not fall within the 95% confidence interval (95% CI), the difference was statistically significant.

# RESULTS

Table 1 summarizes the sample size and unadjusted prevalence estimates of obesity, no LTPA, and short sleep for the study population. Overall, 27.8% of workers were categorized as having obesity, 20.8% had no LTPA, and 36.7% had short sleep. Age was associated with all three risk factors. Obesity prevalence was highest among non-Hispanic black workers (37.8%), followed by non-Hispanic native Hawaiian, or other Pacific Islanders. Short sleep prevalence was lowest among non-Hispanic white workers (33.3%). College or technical school graduates had the lowest prevalence estimates for all three outcomes. Table 1 also summarizes that among occupations, obesity prevalence was highest for Transportation & Material Moving (TMM) (39%), no LTPA prevalence was highest for Farming, Forestry, and Fishing (FFF) (39.1%), and short sleep prevalence was highest for Production (44.8%). Shading indicates the six occupations with the highest prevalence estimates for each outcome.

The interaction between occupation and sex was significant for both obesity and no LTPA; therefore, results are stratified by sex for these two outcomes. The sex-specific adjusted prevalence estimates for obesity and no LTPA by occupation are summarized in Table 2 (men) and Table 3 (women). Bold text indicates statistically significant differences from the mean estimates, and shading indicates the six occupations with the highest prevalence estimates. Among women, obesity prevalence ranged from 16.1% for Legal to 35.8% for TMM; no LTPA prevalence ranged from 12.6% for Life, Physical, and Social Science to 28.3% for Food Preparation and Serving. Among men, obesity prevalence ranged from 20.2% for Arts, Design, Entertainment, Sports and Media to 37.7% for Health Care Support; no LTPA ranged from 12.7% for Life, Physical, and Social Science to 28.7% for FFF. For both men and women, TMM had significantly higher prevalence of all three risk factors, and was one of the top two occupations for prevalence of both obesity (35.0% for men, 35.8% for women) and no LTPA (25.6% for men, 27.2% for women).

Figure 1 shows that men and women had statistically significant differences in prevalence of obesity for five of the 22 occupational groups: Management; Legal; Protective Service; Building and Grounds Cleaning and Maintenance; and Sales and Related. Figure 2 shows that men and women had statistically significant differences in prevalence of no LTPA for eight occupational groups: Community and Social Services; Education, Training, and Library; Healthcare and Technical; Protective Service; Personal Care and Service; Sales & Related; Office and Administrative Support; and Construction and Extraction.

Table 4 summarizes the adjusted prevalence estimates for short sleep by occupation. Results are for men and women combined, as sex did not interact significantly with occupation for this outcome. Prevalence estimates ranged from 31.4% for Education, Training, and Library to 42.9% for Production. In addition to Production, five other occupations had significantly higher prevalence than All Employed: Food Preparation and Serving (41.7%); Health Care Support (40.5%); Health Care and Technical (40.0%); TMM (39.2%), and Protective Service (39.1%). TMM was ranked fifth highest prevalence for short sleep, making it the only occupation that ranked in the top five for all outcomes for both sexes. Among women alone, Health Care Support and Production were also highly ranked, as they were in the top seven for all three outcomes. The following occupations ranked in the top six for short sleep along with one other risk factor: obesity among workers in Protective Service (men), and no LTPA among workers in Food Prep and Serving (women) (Tables 2 to 4).

# DISCUSSION

The present study found that occupational groups differed significantly in their prevalence of obesity, no LTPA, and short sleep after controlling for age, sex, race/ethnicity, and education. Overall, these three risk factors were prevalent among workers, with one in four workers having obesity, one in five workers not engaging in any LTPA in the past month, and one in three workers averaging less than 7 hours of sleep in a 24-hour period. Men and women differed significantly for prevalence of obesity in five occupations, and prevalence of no LTPA in eight occupations. TMM ranked among the top five occupations for all three risk factors for both men and women, and had a significantly higher prevalence for all three risk factors than all workers. Health Care Support and Production each ranked among the top seven for all three risk factors among women. Furthermore, when compared with all workers, two occupations other than TMM had significantly elevated prevalence for more than one risk factor: Protective Service for obesity and short sleep (men), and Food Prep and Serving for no LTPA and short sleep (women).

Our results suggest that workers in TMM occupations have a high prevalence of obesity (35.0% among men and 35.8% among

**TABLE 1.** Prevalence (Unadjusted) of Obesity, No LTPA, and Short Sleep Among Currently Employed* Adults, 29 States, BRFSS 2013–2014

| | Unweighted Frequency | Obesity | | | No LTPA† | | | Short Sleep | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Estimate % | 95% CI | | Estimate % | 95% CI | | Estimate % | 95% CI | |
| Currently employed | 179,619 | 27.8 | 27.3 | 28.4 | 20.8 | 20.3 | 21.3 | 36.7 | 36.1 | 37.2 |
| Age group, years‡ | | | | | | | | | | |
| 18–24 | 9,523 | 14.6 | 13.1 | 16.1 | 17.6 | 15.8 | 19.5 | 34.5 | 32.3 | 36.7 |
| 25–29 | 10,646 | 25.9 | 24.0 | 27.9 | 18.5 | 16.9 | 20.3 | 39.5 | 37.4 | 41.6 |
| 30–34 | 13,509 | 26.3 | 24.5 | 28.0 | 19.6 | 18.1 | 21.3 | 40.1 | 38.2 | 41.9 |
| 35–39 | 15,099 | 28.5 | 26.8 | 30.3 | 21.0 | 19.4 | 22.7 | 37.2 | 35.4 | 39.2 |
| 40–44 | 17,381 | 32.3 | 30.7 | 34.1 | 20.0 | 18.6 | 21.5 | 38.4 | 36.6 | 40.1 |
| 45–49 | 20,172 | 32.0 | 30.4 | 33.6 | 21.0 | 19.6 | 22.4 | 37.9 | 36.3 | 39.6 |
| 50–54 | 25,345 | 31.8 | 30.3 | 33.2 | 21.4 | 20.1 | 22.8 | 37.0 | 35.5 | 38.5 |
| 55–59 | 26,446 | 30.6 | 29.2 | 32.1 | 20.9 | 19.6 | 22.2 | 34.9 | 33.5 | 36.4 |
| 60–64 | 20,831 | 27.6 | 26.0 | 29.2 | 24.0 | 22.4 | 25.8 | 32.2 | 30.4 | 34.0 |
| 65–69 | 10,776 | 27.7 | 25.5 | 30.0 | 26.6 | 23.7 | 29.8 | 30.2 | 27.3 | 33.3 |
| 70–74 | 4,878 | 27.9 | 25.0 | 30.9 | 27.5 | 24.8 | 30.4 | 28.0 | 24.9 | 31.3 |
| 75–79 | 2,155 | 19.6 | 16.1 | 23.7 | 32.3 | 27.7 | 37.3 | 30.0 | 25.1 | 35.4 |
| 80 or older | 1,386 | 14.9 | 11.4 | 19.4 | 34.9 | 29.4 | 40.9 | 21.2 | 16.9 | 26.3 |
| Sex | | | | | | | | | | |
| Men | 84,643 | 28.5 | 27.8 | 29.3 | 20.4 | 19.7 | 21.1 | 37.6 | 36.8 | 38.4 |
| Women | 94,976 | 27.0 | 26.2 | 27.7 | 21.1 | 20.5 | 21.8 | 35.5 | 34.7 | 36.3 |
| Ethnicity/Race‡ | | | | | | | | | | |
| White only, non-Hispanic | 145,204 | 26.8 | 26.3 | 27.4 | 17.9 | 17.5 | 18.4 | 33.3 | 32.7 | 33.9 |
| Black only, non-Hispanic | 11,221 | 37.8 | 36.0 | 39.6 | 24.0 | 22.4 | 25.6 | 49.9 | 48.0 | 51.7 |
| American Indian or Alaskan Native only, non-Hispanic | 2,523 | 29.6 | 24.5 | 35.2 | 21.0 | 17.0 | 25.7 | 42.5 | 36.7 | 48.6 |
| Asian only, non-Hispanic | 2,955 | 10.5 | 7.9 | 13.8 | 24.1 | 20.5 | 28.0 | 39.4 | 35.3 | 43.6 |
| Native Hawaiian or other Pacific Islander only, non-Hispanic | 250 | 37.1 | 22.1 | 55.0 | 17.3 | 9.2 | 30.2 | 50.9 | 35.7 | 65.9 |
| Other race only, non-Hispanic | 819 | 20.2 | 15.5 | 25.8 | 28.2 | 20.4 | 37.6 | 43.9 | 36.2 | 51.9 |
| Multiracial, non-Hispanic | 2,163 | 29.2 | 24.4 | 34.5 | 14.6 | 11.8 | 18.1 | 40.4 | 34.7 | 46.3 |
| Hispanic | 12,168 | 31.1 | 29.2 | 33.0 | 29.0 | 27.3 | 30.8 | 38.6 | 36.8 | 40.6 |
| Education‡ | | | | | | | | | | |
| No school or only Kindergarten | 183 | 28.8 | 16.7 | 44.9 | 40.5 | 27.5 | 55.0 | 36.1 | 23.7 | 50.8 |
| Grades 1 through 8 | 2,021 | 34.4 | 30.1 | 39.0 | 42.6 | 38.4 | 47.0 | 36.0 | 32.0 | 40.2 |
| Grades 9 through 11 | 5,294 | 31.1 | 28.3 | 34.0 | 34.1 | 31.5 | 36.9 | 40.4 | 37.5 | 43.3 |
| Graduated high school | 42,089 | 31.5 | 30.4 | 32.6 | 27.1 | 26.1 | 28.1 | 38.6 | 37.5 | 39.8 |
| Attended college or technical school | 49,983 | 30.6 | 29.6 | 31.6 | 19.1 | 18.2 | 19.9 | 40.1 | 39.0 | 41.2 |
| Graduated from college or technical school | 79,801 | 21.3 | 20.6 | 22.0 | 12.4 | 11.8 | 13.1 | 31.3 | 30.5 | 32.1 |
| Occupation group | | | | | | | | | | |
| 22 Transportation and Material Moving | 8,014 | 39.0 | 36.3 | 41.6 | 31.2 | 28.7 | 33.9 | 42.5 | 39.9 | 45.2 |
| 12 Protective Service | 3,462 | 36.1 | 32.5 | 39.9 | 12.7 | 10.5 | 15.3 | 42.7 | 38.9 | 46.5 |
| 11 Health Care Support | 4,327 | 32.8 | 29.6 | 36.3 | 22.8 | 20.2 | 25.6 | 43.0 | 39.6 | 46.4 |
| 21 Production | 7,605 | 31.8 | 29.3 | 34.3 | 26.2 | 24.1 | 28.4 | 44.8 | 42.2 | 47.4 |
| 17 Office & Admin. Support | 21,406 | 31.5 | 29.8 | 33.2 | 21.9 | 20.5 | 23.4 | 36.7 | 35.0 | 38.4 |
| 20 Installation, Maint., and Repair | 5,328 | 31.2 | 28.3 | 34.2 | 24.2 | 21.6 | 27.1 | 38.5 | 35.3 | 41.7 |
| 06 Community and Social Services | 4,224 | 31.0 | 27.1 | 35.2 | 16.0 | 13.0 | 19.7 | 31.4 | 27.1 | 35.9 |
| 15 Personal Care and Service | 5,907 | 29.6 | 26.5 | 32.9 | 21.4 | 18.9 | 24.1 | 39.1 | 35.5 | 42.8 |
| 14 Building and Grounds Cleaning and Maint. | 6,265 | 29.2 | 26.6 | 32.1 | 31.4 | 28.6 | 34.3 | 38.3 | 35.4 | 41.3 |
| 01 Management | 21,807 | 27.5 | 26.0 | 29.0 | 16.9 | 15.6 | 18.3 | 33.8 | 32.2 | 35.5 |
| 19 Construction and Extraction | 9,208 | 27.3 | 25.0 | 29.6 | 26.7 | 24.6 | 29.0 | 36.2 | 34.0 | 38.5 |
| 03 Computer and Mathematical | 5,591 | 26.0 | 23.7 | 28.5 | 14.2 | 12.1 | 16.5 | 33.4 | 30.6 | 36.2 |
| 13 Food Prep. and Serving | 5,413 | 25.8 | 22.9 | 29.1 | 29.0 | 26.1 | 32.1 | 42.9 | 39.7 | 46.2 |
| 18 Farming, Fishing, and Forestry | 1,532 | 25.4 | 19.2 | 32.8 | 39.1 | 31.2 | 47.6 | 32.2 | 26.0 | 39.3 |
| 02 Business and Financial Operations | 7,811 | 25.2 | 22.7 | 27.8 | 12.5 | 11.0 | 14.2 | 34.0 | 31.2 | 36.9 |
| 04 Architecture and Engineering | 4,886 | 24.4 | 21.7 | 27.2 | 14.5 | 11.7 | 18.0 | 32.6 | 29.5 | 36.0 |
| 16 Sales and Related | 16,526 | 23.9 | 22.4 | 25.4 | 20.3 | 18.9 | 21.9 | 35.0 | 33.1 | 36.9 |
| 08 Education, Training, and Library | 15,249 | 23.8 | 21.9 | 25.7 | 13.9 | 12.3 | 15.6 | 28.0 | 26.3 | 29.8 |
| 10 Health Care and Technical | 14,975 | 23.8 | 22.3 | 25.4 | 14.6 | 13.3 | 16.0 | 38.2 | 36.1 | 40.4 |
| 07 Legal | 2,694 | 19.0 | 16.2 | 22.2 | 12.0 | 9.6 | 14.9 | 31.1 | 27.5 | 35.0 |
| 09 Arts, Design, Entert., Sports, and Media | 4,124 | 16.9 | 14.5 | 19.6 | 15.3 | 11.2 | 20.6 | 33.6 | 29.0 | 38.7 |
| 05 Life, Phys., and Social Science | 3,265 | 16.0 | 13.7 | 18.7 | 9.3 | 7.6 | 11.4 | 30.3 | 26.7 | 34.1 |

Shaded text indicates the top six prevalence estimates.
CI, confidence interval.
*Currently self-employed or working for pay, excluding military occupations.
†No leisure-time physical activity in the past 30 days.
‡Some participants excluded due to missing data *n* column reports unweighted frequencies.

**TABLE 2.** Adjusted* Prevalence of Obesity and No LTPA† by Occupation Among Working‡ Men in 29 States, BRFSS 2013–2014

| | Unweighted Frequency | Weighted Frequency | Obesity | | | | No LTPA | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Rank | Estimate | 95% CI | | Rank | Estimate | 95% CI | |
| Major occupational groups | | | | | | | | | | |
| All employed men | **84,643** | **38,706,948** | | 28.6 | | | | 19.7 | | |
| 11 Health care support | 465 | 277,651 | 1 | 35.7 | 27.1 | 45.3 | 12 | 17.4 | 11.8 | 24.8 |
| 22 Transportation and Material Moving | 6,557 | 3,413,406 | 2 | **35.0** | 32.3 | 37.9 | 2 | **25.6** | 23.2 | 28.2 |
| 12 Protective Service | 2,601 | 1,347,029 | 3 | **34.7** | 30.8 | 38.9 | 22 | 11.3 | 9.0 | 14.1 |
| 06 Community and Social Services | 1,263 | 461,075 | 4 | 33.2 | 27.3 | 39.7 | 16 | 15.0 | 11.1 | 19.8 |
| 03 Computer and Mathematical | 3,991 | 1,852,702 | 5 | 29.8 | 26.8 | 33.0 | 13 | 16.9 | 14.1 | 20.0 |
| 17 Office and Admin. Support | 4,097 | 2,005,865 | 5 | 29.8 | 26.9 | 32.9 | 9 | 18.8 | 16.3 | 21.6 |
| 01 Management | 12,690 | 4,082,803 | 6 | 29.6 | 27.5 | 31.7 | 8 | 18.9 | 17.0 | 20.9 |
| 20 Installation, Maint., and Repair | 5,086 | 2,639,898 | 7 | 29.1 | 26.3 | 32.0 | 5 | 22.5 | 19.9 | 25.3 |
| 21 Production | 5,161 | 2,663,439 | 8 | 29.0 | 26.4 | 31.8 | 7 | 21.0 | 18.8 | 23.4 |
| 07 Legal | 1,263 | 425,590 | 9 | 28.7 | 23.2 | 35.0 | 15 | 15.2 | 11.1 | 20.6 |
| 08 Education, Training, and Library | 3,517 | 1,130,929 | 10 | 28.5 | 24.6 | 32.9 | 18 | 14.2 | 9.8 | 20.1 |
| 04 Architecture and Engineering | 4,189 | 1,622,555 | 11 | 28.1 | 25.0 | 31.3 | 11 | 17.9 | 14.3 | 22.0 |
| 14 Building and Grounds Cleaning and Maint. | 3,478 | 2,046,985 | 12 | 28.0 | 24.7 | 31.5 | 6 | 22.0 | 19.0 | 25.3 |
| 13 Food Prep. and Serving | 1,840 | 1,591,953 | 13 | 27.5 | 22.8 | 32.8 | 3 | 24.1 | 20.3 | 28.4 |
| 16 Sales and Related | 7,789 | 3,694,097 | 14 | 27.0 | 24.8 | 29.2 | 14 | **16.1** | 14.4 | 18.0 |
| 10 Health Care and Technical | 3,128 | 1,188,739 | 15 | 26.5 | 23.1 | 30.2 | 17 | **14.6** | 11.4 | 18.5 |
| 02 Business and Financial Operations | 3,102 | 1,196,512 | 16 | 26.0 | 22.2 | 30.2 | 20 | **13.5** | 10.9 | 16.6 |
| 15 Personal Care and Service | 928 | 615,597 | 17 | 25.8 | 20.1 | 32.5 | 19 | 14.0 | 9.7 | 19.8 |
| 19 Construction and Extraction | 8,864 | 4,482,230 | 18 | **25.0** | 22.8 | 27.2 | 4 | **22.8** | 20.9 | 24.8 |
| 18 Farming, Fishing, and Forestry | 1,146 | 528,383 | 19 | 24.1 | 17.3 | 32.6 | 1 | **28.7** | 21.0 | 37.8 |
| 05 Life, Phys., and Social Science | 1,742 | 524,060 | 20 | **20.9** | 16.9 | 25.5 | 21 | **12.7** | 9.5 | 16.9 |
| 09 Arts, Design, Entert., Sports, and Media | 1,746 | 915,450 | 21 | **20.2** | 16.6 | 24.4 | 10 | 18.1 | 12.4 | 25.6 |

Shaded text indicates the top six prevalence estimates; bold text indicates statistically significant difference compared with all employed men.
CI, confidence interval.
*Adjusted by age, ethnicity/race, education. Both models include a significant sex × race interaction, and obesity also includes a significant sex × education interaction.
†No leisure-time physical activity in the past 30 days.
‡Currently self-employed or working for pay, excluding military occupations.

women), no LTPA (25.6% among men and 27.2% among women), and short sleep (39.2% for men and women combined). This occupational group employed over 9.5 million U.S. workers in 2015, including 3.6 million workers who move freight and materials by hand, and 3.9 million motor vehicle operators.[43] A similar analysis of 2013 to 2014 BRFSS data reported the prevalence of short sleep among motor vehicle operators as 38.5% and among material movers as 40.5%.[15] Although drivers of heavy trucks and tractor-trailers are only a portion of the TMM population (approximately 17%), our findings were also consistent with results from a recent NIOSH survey reporting a high prevalence of obesity (69%) and short sleep (27%),[44] and zero days with 30 minutes of moderate or vigorous physical activity during work or leisure-time (28% men, 25% women)[45] specifically among long-haul drivers. As with any occupation, the reasons for high prevalence for the three risk factors reported here are multifactorial, and determining causality would require further study. However, working long hours (eg, more than 40 hours/week) is associated with obesity,[9,12,17,18] leisure-time physical inactivity,[12] and insufficient sleep.[28–30] In addition, shift work is associated with obesity,[19–25] leisure-time physical inactivity,[27] and insufficient sleep.[19,22,25,30,31] Previous research suggests that TMM workers are subjected to both long hours and shift work; compared with the average worker, TMM workers were significantly more likely to work 60 or more hours per week, and after adjusting for sex, race/ethnicity, and age, 17.3% worked 48 hours or more per week, 7.5% worked 60 hours or more per week, and 37.1% did not work a regular day shift.[46]

Unlike the analysis of Shockey et al,[15] the current study examined the interaction between sex and occupation. We found that men and women differed significantly in obesity prevalence in five occupations. Of these, women had significantly lower prevalence in all five (Fig. 1). However, when nonemployed individuals were included in the analysis, the overall prevalence of obesity for men and women was virtually the same (27.8% vs 27.6%, respectively, adjusted for age, race/ethnicity, education, and employment status, data not shown). Women with obesity may have more difficulty than men with obesity entering certain occupations due to disproportionate weight discrimination,[47,48] or they may be more likely to have health problems that force them to switch jobs or drop out of the workforce. For example, Tunceli et al[49] found that compared with women who had a normal weight at baseline, women who had obesity at baseline were significantly more likely to report work limitations due to health 10 years later; this effect was not statistically significant for men. Lastly, the risk of obesity increases with long hours,[9,12,17,18] shift work,[19–25] and sedentary jobs[26]; perhaps men and women differed in their exposure to these conditions within the major occupational groups listed here. Further research into the causes of weight disparity between men and women in particular occupations is warranted.

We also found significant differences between men and women in no LTPA prevalence for eight occupations. Of these, men had a significantly lower prevalence in seven (88%) (Fig. 2). Women had a significantly lower prevalence in only one group—Construction and Extraction. Among all employed men and women, the prevalence of no LTPA was lower for men (19.7%, compared with 22.0%, respectively). The reversal seen in Construction and Extraction is due to a significantly higher than average prevalence of no LTPA among men (22.8%) coupled with a lower than average prevalence among women (15.5%). Of the eight occupations with significant differences, Construction and Extraction had the highest

**TABLE 3.** Adjusted* Prevalence of Obesity and No LTPA† by Occupation Among Working‡ Women in 29 States, BRFSS 2013–2014

| | Unweighted Frequency | Weighted Frequency | Obesity | | | | No LTPA | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Rank | Estimate | 95% CI | | Rank | Estimate | 95% CI | |
| Major occupational groups | | | | | | | | | | |
| All employed women | **94,976** | **32,973,955** | | 27.2 | | | | 22.0 | | |
| 22 Transportation and Material Moving | 1,457 | 686,212 | 1 | **35.8** | 30.2 | 41.7 | 2 | **27.2** | 22.2 | 32.9 |
| 06 Community and Social Services | 2,961 | 851,375 | 2 | **33.8** | 28.8 | 39.2 | 9 | 22.6 | 17.4 | 28.7 |
| 03 Computer and Mathematical | 1,600 | 498,963 | 3 | **32.8** | 28.2 | 37.8 | 16 | **17.1** | 13.5 | 21.4 |
| 17 Office and Admin. Support | 17,309 | 5,954,576 | 4 | **31.1** | 29.1 | 33.1 | 8 | 23.0 | 21.3 | 24.9 |
| 11 Health Care Support | 3,862 | 1,601,319 | 5 | 29.8 | 26.5 | 33.2 | 7 | 23.1 | 20.3 | 26.1 |
| 15 Personal Care and Service | 4,979 | 1,986,853 | 6 | 29.7 | 26.1 | 33.6 | 11 | 21.1 | 18.4 | 24.0 |
| 20 Installation, Maint., and Repair | 242 | 92,925 | 7 | 28.3 | 16.9 | 43.2 | 13 | 19.0 | 11.2 | 30.4 |
| 21 Production | 2,444 | 1,015,232 | 7 | 28.3 | 24.2 | 32.8 | 6 | 24.3 | 20.6 | 28.3 |
| 02 Business and Financial Operations | 4,709 | 1,591,622 | 8 | 27.6 | 24.6 | 30.9 | 17 | **16.2** | 13.8 | 18.8 |
| 08 Education, Training, and Library | 11,732 | 3,338,641 | 9 | 27.3 | 24.7 | 30.1 | 12 | 20.0 | 17.8 | 22.4 |
| 12 Protective Service | 861 | 315,959 | 9 | 27.3 | 21.8 | 33.5 | 10 | 21.6 | 16.0 | 28.6 |
| 10 Health Care and Technical | 11,847 | 3,680,492 | 10 | 26.8 | 25.0 | 28.8 | 13 | **19.0** | 17.2 | 21.0 |
| 13 Food Prep. and Serving | 3,573 | 1,586,517 | 11 | 26.1 | 22.6 | 30.0 | 1 | **28.3** | 24.7 | 32.1 |
| 01 Management | 9,117 | 2,771,996 | 12 | 24.9 | 22.6 | 27.4 | 15 | **17.8** | 15.6 | 20.2 |
| 04 Architecture and Engineering | 697 | 252,596 | 13 | 23.1 | 16.1 | 32.0 | 20 | **13.7** | 8.6 | 21.2 |
| 14 Building and Grounds Cleaning and Maint. | 2,787 | 1,341,974 | 14 | **22.4** | 19.2 | 26.1 | 4 | **25.9** | 22.4 | 29.7 |
| 16 Sales and Related | 8,737 | 3,401,080 | 14 | **22.4** | 20.5 | 24.5 | 5 | **24.7** | 22.5 | 27.0 |
| 18 Farming, Fishing, and Forestry | 386 | 181,260 | 15 | 20.9 | 11.7 | 34.6 | 3 | 27.1 | 16.2 | 41.7 |
| 19 Construction and Extraction | 344 | 112,961 | 16 | 20.2 | 13.4 | 29.3 | 19 | 15.5 | 9.9 | 23.4 |
| 05 Life, Phys., and Social Science | 1,523 | 464,353 | 17 | **18.4** | 14.7 | 22.8 | 21 | **12.6** | 9.6 | 16.5 |
| 09 Arts, Design, Entert., Sports, and Media | 2,378 | 741,954 | 18 | **18.3** | 15.0 | 22.3 | 14 | 18.8 | 11.3 | 29.6 |
| 07 Legal | 1,431 | 505,095 | 19 | **16.1** | 13.0 | 19.9 | 18 | **15.6** | 11.9 | 20.2 |

Shaded text indicates the top six prevalence estimates; bold text indicates statistically significant difference compared with all employed women.
CI, confidence interval.
*Adjusted by age, ethnicity/race, education. Both models include a significant sex × race interaction, and obesity also includes a significant sex × education interaction.
†No leisure-time physical activity in the past 30 days.
‡Currently self-employed or working for pay, excluding military occupations.

activity index,[50] and some research suggests that women are more likely to engage in LTPA if they work in physically active jobs,[51,52] while the opposite effect was seen for men.[51] We must acknowledge, however, that the literature on the association between occupational physical activity and LTPA is mixed.[12,26,27,51] LTPA is also negatively impacted by long working hours[12] and shift work,[27] and perhaps men are more likely than women to be subject to one or both of these work characteristics within Construction and Extraction occupations.

The American Academy of Sleep Medicine and Sleep Research Society recommend that adults obtain 7 or more hours of sleep each day to positively impact their physical, emotional, and cognitive health.[4] However, we found that one in three workers slept less than 7 hours per day. Short sleep prevalence was significantly higher than the overall prevalence for six occupational groups; TTM (including motor vehicle operators), Production (including assemblers, fabricators, metal and plastics workers, plant operators), Health Care and Technical (including health diagnosing and treating practitioners), Health Care Support (including nursing, psychiatric, and home health aides), Food Prep. and Serving, and Protective Service (including fire fighters and law enforcement). Many workers in these occupations are shift workers who must sleep during the

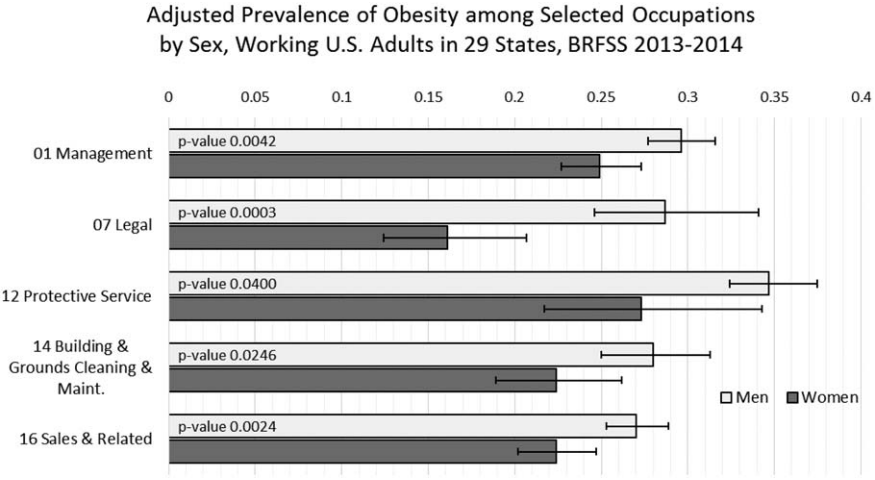


**FIGURE 1.** This figure is a graphical representation of obesity data in Tables 2 and 3 with *P* values added. Adjusted by age, ethnicity/race, education, and sex × race and sex × eduction interaction terms. Error bars represent 95% confidence intervals for the prevalence estimates.

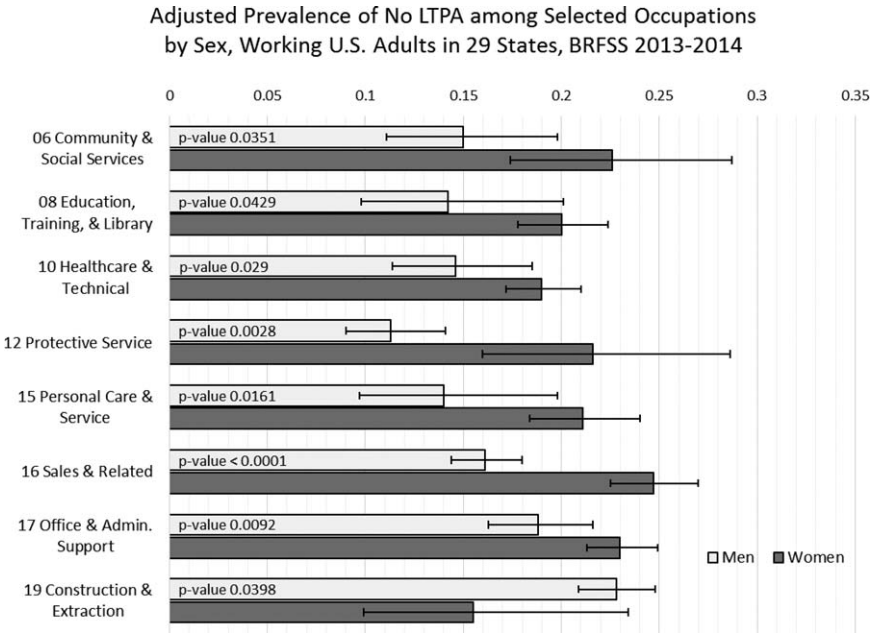


**FIGURE 2.** Figure 2 is a graphical representation of no LTPA data in Tables 2 and 3 with *P* values added. Adjusted by age, ethnicity/race, education, and sex × race interaction term. Error bars represent 95% confidence intervals for the prevalence estimates.

daytime, which may reduce quality and quantity of their sleep.[53] Alterman et al[46] reported that the adjusted prevalence of nonstandard shifts was 37.1% for TMM, 26.7% for Production, 36.4% for Healthcare & Technical, 42.1% for Health Care Support, 50.7% for Food Prep. and Serving, and 46.1% for Protective Service occupations. Furthermore, all of these occupations include workers in safety-critical positions, where slowed reactions or lapses of attention can lead to injury. A recent meta-analysis of nine studies determined that short sleep (less than 6 or 7 hours) increased the odds of work-place injury [odds ratio (OR) 1.35, 95% CI 1.16 to

**TABLE 4.** Adjusted* Prevalence of Short Sleep† by Occupation Among Working‡ Adults in 29 States, BRFSS 2013–2014

| | Short Sleep | | |
|---|---|---|---|
| | Rank | Estimate | 95% CI |
| Major occupational groups | | | |
| All employed | | 35.3 | |
| 21 Production | 1 | **42.9** | 40.3 45.4 |
| 13 Food Prep. and Serving | 2 | **41.7** | 38.5 45.0 |
| 11 Health Care Support | 3 | **40.5** | 37.1 43.9 |
| 10 Health Care and Technical | 4 | **40.0** | 37.8 42.2 |
| 22 Transportation and Material Moving | 5 | **39.2** | 36.7 41.8 |
| 12 Protective Service | 6 | **39.1** | 35.5 42.9 |
| 15 Personal Care and Service | 7 | 38.1 | 34.6 41.7 |
| 17 Office and Admin. Support | 8 | 36.7 | 34.9 38.5 |
| 20 Installation, Maint., and Repair | 9 | 36.3 | 33.3 39.5 |
| 14 Building and Grounds Cleaning and Maint. | 10 | 36.2 | 33.3 39.1 |
| 09 Arts, Design, Entert., Sports, and Media | 11 | 36.0 | 31.4 40.9 |
| 02 Business and Financial Operations | 12 | 35.8 | 33.0 38.7 |
| 01 Management | 13 | 35.0 | 33.3 36.8 |
| 16 Sales and Related | 13 | 35.0 | 33.1 36.9 |
| 19 Construction and Extraction | 14 | 34.4 | 32.1 36.8 |
| 07 Legal | 15 | 34.3 | 30.4 38.4 |
| 04 Architecture and Engineering | 16 | 33.9 | 30.5 37.4 |
| 05 Life, Phys., and Social Science | 17 | 33.4 | 29.5 37.6 |
| 03 Computer and Mathematical | 18 | 33.3 | 30.5 36.2 |
| 06 Community and Social Services | 19 | 32.0 | 27.4 36.9 |
| 18 Farming, Fishing, and Forestry | 20 | 31.6 | 25.2 38.8 |
| 08 Education, Training, and Library | 21 | **31.4** | 29.4 33.6 |

Shaded text indicates the top six prevalence estimates; bold text indicates a statistically significant difference compared with all employed.
CI, confidence interval.
*Adjusted by sex, age, ethnicity/race, and education, and sex × race interaction.
†Averaged less than 7 hours of sleep in a 24-hour period.
‡Currently self-employed or working for pay, excluding military occupations.

1.58], excluding motor vehicle crashes.[54] In a study of commercial vehicle drivers, actigraphy data showed that the drivers' mean hours of sleep had dropped from 6.6 to 5.3 hours in the sleep period before a crash, near-crash, or crash-relevant conflict.[55]

This study had a number of strengths and limitations. Strengths of this study include 1) data that were collected as part of a well-established population-based survey,[56] and 2) a sample size large enough to examine 22 separate occupational groups. Limitations include those inherent in self-reported survey data such as biases in participant recall/reporting and nonresponse error.[57,58] In addition, BRFSS is a cross-sectional survey, so causality cannot be determined. Specific limitations for this study include 1) only 29 states collected information on occupation in 2013 and/or 2014, so our results cannot be generalized to the entire U.S. workforce or to nonparticipating states, and 2) BRFSS does not collect information on numerous potential work-related confounders, such as occupational physical activity, length of time in the occupation, and number of hours worked per week.

## CONCLUSION

Among currently employed workers in 29 states, obesity, no LTPA, and short sleep each affected at least one in five workers, and their prevalence varied by occupation after adjusting for age, sex, race/ethnicity, and education. Women and men had significant differences in obesity and no LTPA within several occupational groups. For both men and women, TMM was the only occupational group to be among the top five occupations for all three risk factors, as well as the only occupational group with a significantly higher prevalence for all three risk factors when compared with all workers. Among women, Food Prep. and Serving had significantly elevated prevalences for both no LTPA and short sleep when compared with all women. Among men, Protective Service had significantly elevated prevalences for both obesity and short sleep when compared with all men. The costs of obesity, inactivity, and insufficient sleep are high, not only in terms of lost productivity and health care costs but also reduced quality of life. Both workers and employers would benefit from efforts to better identify and mitigate workplace factors that interfere with leisure time physical activity, sleep, and maintaining a normal weight.

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