Association Between Leisure-Time Physical Activity and Occupation Activity Level, National Health Interview Survey—United States, 2020

Jasmine Y. Nakayama[1], **Miriam E. Van Dyke**[1], **Tyler D. Quinn**[2], **Geoffrey P. Whitfield**[1]

[1]Division of Nutrition, Physical Activity, and Obesity, Centers for Disease Control and Prevention, Atlanta, GA, USA;

[2]Department of Epidemiology and Biostatistics, West Virginia University School of Public Health, Morgantown, WV, USA

Abstract

Background: Physical activity for any purpose counts toward meeting Physical Activity Guidelines (PAG). However, national surveillance systems traditionally focus on leisure-time physical activity. There is an incomplete understanding of the association between meeting PAG in leisure time and occupation activity level among US workers.

Methods: We used cross-sectional 2020 National Health Interview Survey data to examine US adults aged 18–64 years who worked the week before the survey (n = 14,814). We estimated the proportion meeting aerobic and muscle-strengthening PAG in leisure time by occupation activity level (low, intermediate, and high). Using logistic regression, we examined the association between meeting PAG in leisure time and occupation activity level, adjusted for sociodemographic characteristics and stratified by hours worked. We compared the sociodemographic characteristics of adults working 40 hours (the previous week) in high-activity occupations to those in lower intermediate-activity occupations.

Results: Adults working in high-activity occupations were less likely to meet PAG in leisure time (26.1% [24.3–28.1]) versus those in low-activity (30.6% [29.1–32.2], *P* < .01) or intermediate-activity (32.4% [30.8–34.2]) occupations. In stratified, adjusted models, adults working 40 hours in low- and intermediate-activity occupations were 13% and 20%, respectively, more likely to meet PAG in leisure time versus those in high-activity occupations. Among those working 40 hours, adults in high-activity occupations were more likely to be Hispanic or Latino, male, younger, and have a high school education or lower compared with those in less active occupations.

Conclusion: Traditional surveillance may underestimate meeting PAG among people working in high-activity occupations, potentially disproportionately affecting certain groups.

Keywords

exercise; public health surveillance; health surveys

Nakayama (qdt2@cdc.gov) is corresponding author.

Physical activity (PA) has numerous health benefits, including increasing physical and mental well-being, improving sleep, and reducing risk for several chronic diseases.[1] The 2018 Physical Activity Guidelines for Americans, second edition (PAG), recommends that adults participate in at least 150 to 300 minutes per week of moderate-intensity aerobic PA, 75 to 150 minutes per week of vigorous-intensity aerobic PA, or an equivalent combination of moderate- and vigorous-intensity aerobic PA in addition to doing muscle-strengthening PA at least twice a week.[1] However, only 25% of adults met recommendations for both aerobic and muscle-strengthening PA during leisure time in 2020.[2,3]

The PAG states that PA for any purpose, including PA as part of one's occupation, counts toward meeting recommendations. However, national public health surveillance systems often focus on leisure-time PA,[4,5] and assessments of leisure-time PA purposefully exclude any occupational PA.[6] Work time constitutes a large proportion of working adults' nonleisure waking hours and potentially contributes a large volume of daily moderate to vigorous PA among adults working in highly active occupations.[7–10] Assessing only leisure-time PA typically underestimates total PA, disproportionately affecting workers in high-activity occupations (eg, farming). Further, if workers in high-activity occupations are also less likely to participate in leisure-time PA than workers from less active occupations (eg, social services), then they will appear to be less likely to meet PAG when assessment only considers leisure-time PA. If certain sociodemographic subgroups tend to work in high-activity occupations, using leisure-time PA as a proxy for total PA may lead to incorrect comparisons of meeting PAG among subgroups. Identifying and improving weaknesses in PA surveillance can lead to more accurate conclusions, guide tailored interventions, and support allocation of public health resources to increase PA in the nation.

There is a mixed body of literature on leisure-time PA among workers across occupations of varying activity levels. Results from some studies indicate that workers in highly active occupations have lower leisure-time PA participation, whereas results from one study suggested no association between occupational PA category and leisure-time PA participation after controlling for sociodemographic characteristics.[11–15] A study using time-use data identified that higher sedentary time and lower light-intensity PA outside of work were associated with higher occupational activity intensity; however, the study was unable to assess the outcome of meeting PAG given the single-day nature of the data.[16] Another study identified that US workers working 30 to 50 hours per week have a lower overall prevalence of meeting the aerobic PAG in leisure time than those working <30 or >50 hours per week.[11] These mixed results may be due to variation in defining occupational categories and accounting for hours worked. None of the studies used accelerometer-derived PA data to define occupation activity level.

There is currently an incomplete understanding of the association between meeting PAG in leisure time and occupational factors, such as occupation activity level, among US workers, which may have implications for equitably reporting PA levels. This study estimated the proportion of US adults working in occupations with varying activity levels who met the combined aerobic and muscle-strengthening PAG in leisure time and described the sociodemographic characteristics and hours worked of adults who are in the occupation

activity level group (categorized using accelerometer-derived PA data from a previous study) least likely to meet the combined PAG in leisure time.

Methods

Study Design

Data were from the 2020 National Health Interview Survey (NHIS), an annual, cross-sectional household survey conducted by the National Center for Health Statistics.[17,18] NHIS uses geographically clustered sampling techniques to obtain a nationally representative sample of the noninstitutionalized, civilian population residing in the 50 states and District of Columbia. Ineligibility criteria for NHIS include incarceration, placement in institutional group quarters for physical or mental health problems, lack of a fixed household address, living on military bases, and active duty in the military. NHIS was redesigned in 2019, and the 2020 survey was the first redesigned edition to ask questions about PA and occupation.

Analytic Sample

The analytic sample included all survey participants aged 18–64 years who did not report a current pregnancy, worked >0 hours the week prior to completing the NHIS survey (or usually worked >0 h/wk if temporarily absent from their job due to illness, vacation, family leave, or other reason), did not have a military occupation, and had complete PA and occupation data (Figure 1). Compared with participants excluded from the study, the analytic sample included a higher proportion of adults who were Hispanic or Latino, male, younger, and had higher education levels and a lower proportion of non-Hispanic Black/African American adults.

Measurements

Meeting PAG in Leisure Time—Participants reported the frequency (times per day, week, month, or year) and duration (in minutes or hours per session) of moderate-intensity PA (causing "moderate increases in breathing or heart rate") and of vigorous-intensity PA (causing "large increases in breathing or heart rate") performed during leisure time (eg, exercise, sports, or physically active hobbies or recreational activities). In alignment with PAG, we calculated the total moderate-intensity equivalent minutes per week of aerobic PA for each participant, with vigorous-intensity aerobic PA minutes counting twice (eg, 1 min of vigorous-intensity aerobic PA was equivalent to 2 min of moderate-intensity aerobic PA). We considered participants who reported an inability to participate in moderate-, vigorous-intensity, or both types of leisure-time aerobic PA to have 0 minutes for the respective type of PA.

Participants then reported the frequency (per day, week, month, or year) of muscle-strengthening PA performed during leisure time. We calculated the total number of times per week each participant participated in muscle-strengthening PA. We considered participants who reported an inability to participate in muscle-strengthening PA to have participated 0 times. For both aerobic and muscle-strengthening PA, we considered as missing data:

responses that were extreme values (eg, frequency of vigorous-intensity PA >28 times/wk), not ascertained, did not know, or refusal to answer.

We categorized participants into 2 groups: meeting the combined PAG (ie, participating in at least 150 min/wk of moderate-intensity equivalent aerobic PA and participating in muscle-strengthening activity at least twice a week) in leisure time (henceforth, meeting PAG in leisure time) or not meeting PAG in leisure time.

Occupation Activity Level—The US Census Bureau classified participants' self-reported information about their jobs into occupational categories using 2018 Standard Occupational Classification codes.[17] We then grouped Standard Occupational Classification codes into occupation activity levels (low, intermediate, or high) based on a previous study that categorized various occupational categories by accelerometer-derived total daily PA data in a nationally representative US sample.[7]

Low-activity occupations included those categorized as health care practitioners and technical; computer and mathematical; life, physical, and social science; management; office and administrative support; health care support; legal; and community and social services occupations. Intermediate-activity occupations included installation, maintenance, and repair; business and financial operations; arts, design, entertainment, sports, and media; production; architecture and engineering; protective service; and sales and related occupations. High-activity occupations included farming, fishing, and forestry; building and grounds cleaning and maintenance; construction and extraction; food preparation and serving; personal care and service; transportation and material moving; and education, training, and library occupations. Participants reporting working in military-specific occupations (n = 13) were excluded from this analysis due to the heterogeneity of the tasks and structures in military versus civilian occupations.

Hours Worked—Participants reported the number of hours worked in the week before their NHIS interview, and participants who were temporarily absent from their job reported the number of hours they usually work per week. We categorized hours worked: 1 to 29, 30 to 39, 40, 41 to 49, or 50 hours.

Sociodemographic Characteristics—We selected sociodemographic characteristics that identify subgroups with historical differences in PA levels.[9] Participants self-reported race/ethnicity, which was categorized as: non-Hispanic American Indian or Alaska Native (alone or multiracial), non-Hispanic Asian alone, non-Hispanic Black/African American alone, non-Hispanic White alone, Hispanic or Latino (of any race), or another single and multiple races. Other self-reported sociodemographic characteristics included sex (female and male); age (categorized as 18–34, 35–44, 45–54, and 55–64 y); and education level (categorized as high school graduate, GED, or lower; some college or associate degree; bachelor's degree or higher).

Statistical Analysis

First, we described the characteristics of working adults and estimated the proportion who met PAG in leisure time by occupation activity level and sociodemographic characteristics.

Then, we estimated the proportion who met PAG in leisure time, stratified by both occupation activity level and hours worked. We used pairwise comparisons to determine differences between adult groups meeting PAG in leisure time. Second, using a logistic regression model estimating prevalence ratios (PRs), we examined the association between meeting PAG in leisure time and occupation activity level, adjusted for categorical sociodemographic characteristics and hours worked (dichotomized as 1 to 39 h or 40 h). We assessed statistical interaction between hours worked and occupation activity level in this regression model using Wald chi-square testing. We observed interaction at an alpha of .10 and stratified adjusted models by hours worked. Last, we described the sociodemographic characteristics of adults working 40 hours by occupation activity level; within each sociodemographic group (eg, non-Hispanic American Indian or Alaska Native [alone or multiracial] adults), we estimated PRs and 95% CIs comparing the prevalence of adults in high-activity occupations to the prevalence of adults in low-activity and also to the prevalence of adults in intermediate-activity occupations.

We set statistical significance at an alpha of .05 for comparisons and considered PRs with a 95% CI excluding 1.0 as statistically significant. We conducted analyses accounting for the complex survey design and nonresponse in SAS (version 9.4) and SUDAAN (version 11.0.3). The Centers for Disease Control and Prevention determined that this secondary analysis of de-identified data was not human subject research and did not require institutional review board review.

Results

The analytic sample consisted of 14,814 participants, representing a weighted population of 131,826,378 working US adults. A majority identified as non-Hispanic White (62.4%) and male (53.1%) (Table 1). The largest percentage (37.3%) of adults was aged 18–34 years. Adults were approximately evenly distributed by education (34.0% with high school graduate, GED, or lower; 31.0% with some college or associate degree; and 35.1% with bachelor's degree or graduate degree) and by occupation activity levels (38.9% in low, 29.8% in intermediate, and 31.3% in high). Overall, 71.1% of adults worked 40 hours and 29.8% met PAG in leisure time.

In unadjusted analyses, adults working in high-activity occupations were overall less likely to meet PAG in leisure time (26.1% [95% CI, 24.3–28.1]) compared with those in low-activity (30.6% [29.1–32.2], pairwise $P < .01$) or intermediate-activity occupations (32.4% [30.8–34.2], pairwise $P < .01$), a pattern also identified among males and adults aged 35–44, 45–54, or 55–64 years (Table 2). When stratified by hours worked, there were no significant differences in meeting PAG in leisure time by occupation activity level among those working 1 to 29 or 30 to 39 hours (Figure 2). Among those working 40 hours, adults in high-activity occupations were less likely than those in intermediate-activity occupations to meet PAG in leisure time (pairwise $P < .01$); the proportion meeting PAG in leisure time in low-, intermediate-, and high-activity occupations was 28.6% (26.5–30.8), 31.6% (29.0–34.2), and 25.8% (22.7–28.9), respectively. For those working 41 to 49 and 50 hours, adults in high-activity occupations were significantly less likely than those in low- and intermediate-activity occupations to meet PAG in leisure time (all pairwise $P < .05$).

Among those working 41 to 49 hours, the proportion meeting PAG in leisure time was 32.7% (28.6–36.8), 31.4% (26.8–36.0), and 22.8% (17.0–28.6) for low-, intermediate-, and high-activity occupations, respectively; comparable values for those working 50 hours were 34.3% (31.2–37.3), 37.7% (34.3–41.2), and 22.9% (19.3–26.4).

Logistic regression identified interaction between hours worked and occupation activity level in the unadjusted model ($P = .01$) and the adjusted model ($P = .06$). In models stratified by hours worked and adjusted for sociodemographic characteristics, adults working 40 hours in low- and intermediate-activity occupations were 13% and 20%, respectively, more likely to meet PAG in leisure time compared with those working in high-activity occupations (Figure 3). We did not observe associations between meeting PAG in leisure time and occupation activity level for adults working 1 to 39 hours.

Among adults working 40 hours, several sociodemographic groups were overrepresented in high-activity occupations (Table 3). By race/ethnicity, the proportion of adults in high-activity occupations who identified as Hispanic or Latino was over 2-fold higher than the proportion in low-activity occupations (PR: 2.15 [1.87–2.49]) and 75% higher than the proportion in intermediate-activity occupations (PR: 1.75 [1.52–2.02]). Conversely, the proportion of adults in high-activity occupations who identified as non-Hispanic Asian was lower than the proportion in low- or intermediate-activity occupations (PR: 0.48 [0.37–0.63] and PR: 0.65 [0.49–0.85], respectively). Similarly, the proportion of adults who identified as non-Hispanic White in high-activity occupations was lower than the proportion in low- or intermediate-activity occupations (PR: 0.86 [0.82–0.92] and PR: 0.84 [0.79–0.89], respectively).

Men comprised a 44% larger share of the adults in high- versus low-activity occupations (PR:1.44 [1.37–1.51]). Adults aged 18–34 years made up an 18% larger share of the workforce in high-compared with low-activity occupations (PR: 1.18 [1.08–1.29]). Finally, by education, the proportion of adults in high-activity occupations with a high school education, GED, or lower was 2.5 times that in low-activity occupations (PR: 2.49 [2.28–2.72]) and 72% higher than the proportion in intermediate-activity occupations (PR: 1.72 [1.59–1.87]).

Discussion

Assessing only leisure-time PA in public health surveillance likely underestimates meeting PAG. In this analysis, US adults working 40 hours in high-activity occupations were less likely to report meeting PAG in leisure time than their counterparts in less active occupations. Among adults working 40 hours, adults who were Hispanic or Latino, male, <35 years of age, and with a high school education or lower were overrepresented in high- versus low-activity occupations. Underestimation of meeting PAG may be worse for these groups.

Our study builds on previous ones in several important ways. First, we classified occupation activity levels by accelerometer-derived total daily PA data from another nationally representative surveillance system.[7] Second, we included hours worked as a modifying

variable and identified effect modification on the relationship between occupation activity level and meeting PAG in leisure time. This finding prompted us to stratify the adjusted models by hours worked. Finally, our study examined occupation activity level and meeting the combined PAG in leisure time, including both aerobic and muscle-strengthening components.

Our primary finding—that adults working 40 hours in high-activity occupations were less likely to report meeting PAG in leisure time than their counterparts working in less active occupations—confirms results from other studies using NHIS data that identified an association between meeting PAG in leisure time and occupational category.[11,12,14] Another study identified differences by hours worked, though they did not stratify by occupational category and used different categories for hours worked during a week than our study.[11] Our finding differs from a previous study suggesting no association between occupational PA category and leisure-time PA participation after controlling for sociodemographic characteristics.[13] However, that previous study defined occupational PA category through researcher consensus opinion, not through accelerometer-derived PA data, and did not account for hours worked during a week, which may explain the diverging results.

Our primary finding has potential implications for PA surveillance. The PAG states that the purpose of PA does not affect whether it counts toward meeting recommendations. However, limiting PA assessment to a single domain underestimates meeting PAG for some adults.[9,19] Our results suggest this underestimation of meeting PAG is likely worse for adults working 40 hours in high-activity occupations compared to those working 40 hours in low-activity occupations. Future PA surveillance efforts may more appropriately represent meeting PAG by including assessments of total PA.

Our secondary finding—that among adults working 40 hours, certain subgroups are more likely to work in high-activity occupations than others—has implications for equitable reporting of meeting PAG. In our study, the proportion of Hispanic or Latino adults working 40 hours in high-activity occupations was 2-fold higher than the proportion of Hispanic or Latino adults working 40 hours in low-activity occupations. This suggests that Hispanic or Latino adults may be particularly likely to accrue PA in the workplace, and reliance on leisure-time PA assessments as indicators of meeting PAG may be an underestimation for this group. Traditional surveillance systems focusing on only leisure-time PA may identify Hispanic or Latino adults as not meeting PAG. Considering occupational factors can lead to more effective public health data and more accurate conclusions to inform tailored interventions designed to promote PA across priority populations.

Additional evidence supports this contention. For example, a relatively higher level of physical inactivity during leisure time has been highlighted as a potential health problem among Hispanic or Latino adults in the United States, but previous national surveillance using device-based measures of total PA (accelerometer counts per minute) indicated that a specific Hispanic or Latino subgroup (Mexican American) of working-age adults had higher total PA than non-Hispanic White or non-Hispanic Black adults.[20,21] This study suggests a need to better align PA assessment, which is often limited to leisure-time PA, with the recommendations of PAG, which include all PA domains. Future surveillance efforts may

consider using measures of total PA to develop a better understanding of which groups are not meeting PAG, which could guide additional public health action.

Public health surveillance is foundational for public health strategies and policies. More comprehensive surveillance can lead to more accurate conclusions of which groups can benefit from tailored interventions and appropriate allocation of public health resources. Understanding which groups are at risk for not meeting PAG when accounting for all activity can guide environmental design strategies, such as mixed land-use environments and public transit infrastructure and access, to promote safe and accessible PA in communities primarily composed of priority populations.[22] Additionally and especially for those accumulating much of their PA as occupational PA, tailored programmatic, workplace, or workforce policies can accompany the environmental strategies to encourage increased leisure-time PA that complements occupational PA.[23]

Work, an important social determinant of health, affects aspects of health such as chemical exposure, health care access, social status, economic status, and also occupational PA. There are many complex factors influencing work, and some people have limited autonomy in their occupations and how much occupational PA is involved.[24,25] Our results indicate that certain subgroups are more likely to work in high-activity occupations and also less likely to meet PAG in leisure time than others; these groups may be disproportionately affected by the effects of occupational PA. Growing evidence suggests that occupational PA may not provide the same health benefits as PA in other domains.[26] Specifically, an umbrella review of 17 systematic reviews of observational data identified that occupational PA has unfavorable effects on all-cause mortality, poor mental health, osteoarthritis, and sleep[27]; this science, along with accounting for various domains of PA, may warrant further evaluation in future guidelines. Specifically, future work can explore the health implications of accruing high occupational PA and low leisure-time PA among US workers to support equitable consideration of health for all people.[28]

This study is subject to several limitations. First, no information on individual-level occupational PA was available in the 2020 NHIS data; rather, we relied on adults' self-reported occupation as an indicator of possible occupational PA. We categorized occupation activity levels based on accelerometer-derived total daily PA data from another study, which had limited ability to identify heterogeneity in PA within an occupation activity level category or to differentiate occupational PA from other domains of PA. As such, we could not estimate the magnitude of underestimates or biases by sociodemographic characteristics. Further, those accelerometer-derived data were from 2005 to 2006, and patterns of occupation activity levels may have changed since then. Specifically, occupation activity levels may have decreased if 1960–2008 trends in occupation-related PA continued.[29] Second, this study was limited to an assessment of leisure-time PA, as NHIS does not assess transportation- or household-related PA. Third, data on time of day of work were unavailable in NHIS, precluding assessment of how shift work (eg, rotating hours and working overnight) can affect associations. Fourth, data collection occurred during the COVID-19 pandemic, which may have affected how adults work and participate in leisure-time PA (eg, some workers who were able to work from home increased their leisure-time PA[30]). Because the pandemic's impact on the relationship between occupational and leisure-

time PA is unknown, results from this study may not be generalizable to other contexts. However, patterns largely align with those found in a previous study of occupational and leisure-time PA.[31]

Strengths of this study include a large, nationally representative sample of adults and categorization of occupation activity levels based on accelerometer-derived daily PA from another nationally representative surveillance system.

Conclusions

Adults working 40 hours in high-activity occupations were less likely to report meeting PAG in leisure time than their counterparts in less active occupations. Among adults working 40 hours, those who were Hispanic or Latino, male, <35 years of age, and with a high school education or lower were overrepresented in high-versus low-activity occupations. When only leisure-time PA assessments are used to assess compliance with PAG that counts PA performed for any purpose, the potential for underestimating PA may be more pronounced for these groups. Future surveillance efforts may consider assessments of self-reported or device-based total PA to better assess compliance with PAG.

Acknowledgment

References

1. U.S. Department of Health and Human Services. Physical Activity Guidelines Physical Activity Guidelines for Americans, 2nd ed. 2018. U.S. Department of Health and Human Services. https://health.gov/sites/default/files/2019-09/Physical_Activity_Guidelines_2nd_edition.pdf

2. Quickstats: age-adjusted percentage of adults aged 18 years who met the 2018 federal physical activity guidelines for both muscle-strengthening and aerobic physical activity, by urbanization level - National Health Interview Survey, United States, 2020. MMWR Morb Mortal Wkly Rep. 2022;71(27):887. doi:10.15585/mmwr.mm7127a6 [PubMed: 35797205]

3. Elgaddal N, Kramarow EA, Reuben C. Physical activity among adults aged 18 and over: United States, 2020. NCHS Data Brief. 2022;(443):1–8.

4. Centers for Disease Control and Prevention. Behavioral Risk Factor Surveillance System. Accessed October 18, 2022. https://www.cdc.gov/brfss/

5. Centers for Disease Control and Prevention. National Health Interview Survey. https://www.cdc.gov/nchs/nhis/index.htm

6. Centers for Disease Control and Prevention. NHIS—Adult Physical Activity—Overview of Topics. 2023. https://www.cdc.gov/nchs/nhis/physical_activity/pa_overview.htm

7. Steeves JA, Tudor-Locke C, Murphy RA, et al. Daily physical activity by occupational classification in US adults: NHANES 2005–2006. J Phys Act Health. 2018;15(12):900–911. doi:10.1123/jpah.2017-0465 [PubMed: 30453820]

8. Quinn TD, Pettee Gabriel K, Siddique J, et al. Sedentary time and physical activity across occupational classifications. Am J Health Promot. 2020;34(3):247–256. doi:10.1177/0890117119885518 [PubMed: 31726849]

9. Whitfield GP, Ussery EN, Saint-Maurice PF, Carlson SA. Trends in aerobic physical activity participation across multiple domains among US adults, national health and nutrition examination survey 2007/2008 to 2017/2018. J Phys Act Health. 2021;18(S1):S64–S73. doi:10.1123/jpah.2021-0173 [PubMed: 34225255]

10. Prince SA, Roberts KC, Reed JL, Biswas A, Colley RC, Thompson W. Daily physical activity and sedentary behaviour across occupational classifications in Canadian adults. Health Rep. 2020;31(9):13–26. doi:10.25318/82-003-x202000900002-eng

11. Gu JK, Charles LE, Ma CC, et al. Prevalence and trends of leisure-time physical activity by occupation and industry in U.S. workers: the national health interview survey 2004–2014. Ann Epidemiol. 2016; 26(10):685–692. doi:10.1016/j.annepidem.2016.08.004 [PubMed: 27659584]

12. Caban-Martinez AJ, Lee DJ, Fleming LE, et al. Leisure-time physical activity levels of the US workforce. Prev Med. 2007;44(5):432–436. doi:10.1016/j.ypmed.2006.12.017 [PubMed: 17321584]

13. Marquez DX, Neighbors CJ, Bustamante EE. Leisure time and occupational physical activity among racial or ethnic minorities. Med Sci Sports Exerc. 2010;42(6):1086–1093. doi:10.1249/MSS.0b013e3181c5ec05 [PubMed: 19997031]

14. Blackwell DL, Clarke TC. Occupational differences among employed adults who met 2008 federal guidelines for both aerobic and muscle-strengthening activities: United States, 2008–2014. Natl Health Stat Report. 2016;(94):1–12.

15. Kirk MA, Rhodes RE. Occupation correlates of adults' participation in leisure-time physical activity: a systematic review. Am J Prev Med. 2011;40(4):476–485. doi:10.1016/j.amepre.2010.12.015 [PubMed: 21406284]

16. Tudor-Locke C, Leonardi C, Johnson WD, Katzmarzyk PT. Time spent in physical activity and sedentary behaviors on the working day: the american time use survey. J Occup Environ Med. 2011; 53(12):1382–1387. doi:10.1097/JOM.0b013e31823c1402 [PubMed: 22104979]

17. National Center for Health Statistics. Survey Description, National Health Interview Survey, 2020. 2021. National Center for Health Statistics.

18. National Center for Health Statistics. National Health Interview Survey, 2020. Public-use data file and documentation. 2021. https://www.cdc.gov/nchs/nhis/data-questionnaires-documentation.htm

19. Whitfield GP, Ussery EN, Carlson SA. Combining data from assessments of leisure, occupational, household, and transportation physical activity among US adults, NHANES 2011–2016. Prev Chronic Dis. 2020;17:E117. doi:10.5888/pcd17.200137 [PubMed: 33006543]

20. Centers for Disease Control and Prevention. Adult Physical Inactivity Prevalence Maps by Race/Ethnicity. Updated February 17, 2022. 2023. https://www.cdc.gov/physicalactivity/data/inactivity-prevalence-maps/index.html

21. Troiano RP, Berrigan D, Dodd KW, Masse LC, Tilert T, McDowell M. Physical activity in the United States measured by accelerometer. Med Sci Sports Exerc. 2008;40(1):181–188. doi:10.1249/mss.0b013e31815a51b3 [PubMed: 18091006]

22. O'Toole TP, Lavinghouze SR, Pejavara A, Petersen R. State and local chronic disease programs adapt and pivot to address community needs during the COVID-19 pandemic: examples from CDC funded SPAN, REACH, and HOP programs. Health Promot Pract. 2022; 23(suppl 1):12S–20S. doi:10.1177/15248399221116090 [PubMed: 36374609]

23. Centers for Disease Control and Prevention. Employers | Active People, Healthy Nation | Physical Activity | CDC. 2023. https://www.cdc.gov/physicalactivity/activepeoplehealthynation/everyone-can-be-involved/employers.html

24. Alonso-Villa O, Del Rio C, Gradin C. The extent of occupational segregation in the united states: differences by race, ethnicity, and gender. Ind Relat J Econ Soc, 2012;51(2):179–212. doi:10.1111/j.1468-232X.2012.00674.x

25. Weeden KA, Newhart M, Gelbgiser D. Occupational segregation. In: Grusky D, Varner C, Mattingly M, Garlow S, eds. Pathways: a magazine on poverty, inequality, and social policy. 2018:30–33. Stanford Center on Poverty and Inequality. https://inequality.stanford.edu/sites/default/files/Pathways_SOTU_2018.pdf

26. Cillekens B, Huysmans MA, Holtermann A, et al. Physical activity at work may not be health enhancing. a systematic review with meta-analysis on the association between occupational physical activity and cardiovascular disease mortality covering 23 studies with 655 892 participants. Scand J Work Environ Health. 2022;48(2):86–98. doi:10.5271/sjweh.3993 [PubMed: 34656067]

27. Cillekens B, Lang M, van Mechelen W, et al. How does occupational physical activity influence health? An umbrella review of 23 health outcomes across 158 observational studies. Br J Sports Med. 2020;54(24):1474. doi:10.1136/bjsports-2020-102587 [PubMed: 33239353]

28. Quinn TD, Barone Gibbs B. Context matters: the importance of physical activity domains for public health. J Meas Phys Behav. 2023; 2023:1–5. doi:10.1123/jmpb.2023-0030

29. Church TS, Thomas DM, Tudor-Locke C, et al. Trends over 5 decades in U.S. occupation-related physical activity and their associations with obesity. PLoS One. 2011;6(5):e19657. doi:10.1371/journal.pone.0019657 [PubMed: 21647427]

30. Younes H, Noland R, Von Hagen LA, Sinclair J. Working from home and walking during and after COVID. Findings. 2023. doi:10.32866/001c.78110

31. Centers for Disease Control and Prevention (CDC). Prevalence of leisure-time and occupational physical activity among employed adults—United States, 1990. MMWR Morb Mortal Wkly Rep. 2000;49(19):420–424. [PubMed: 10905821]
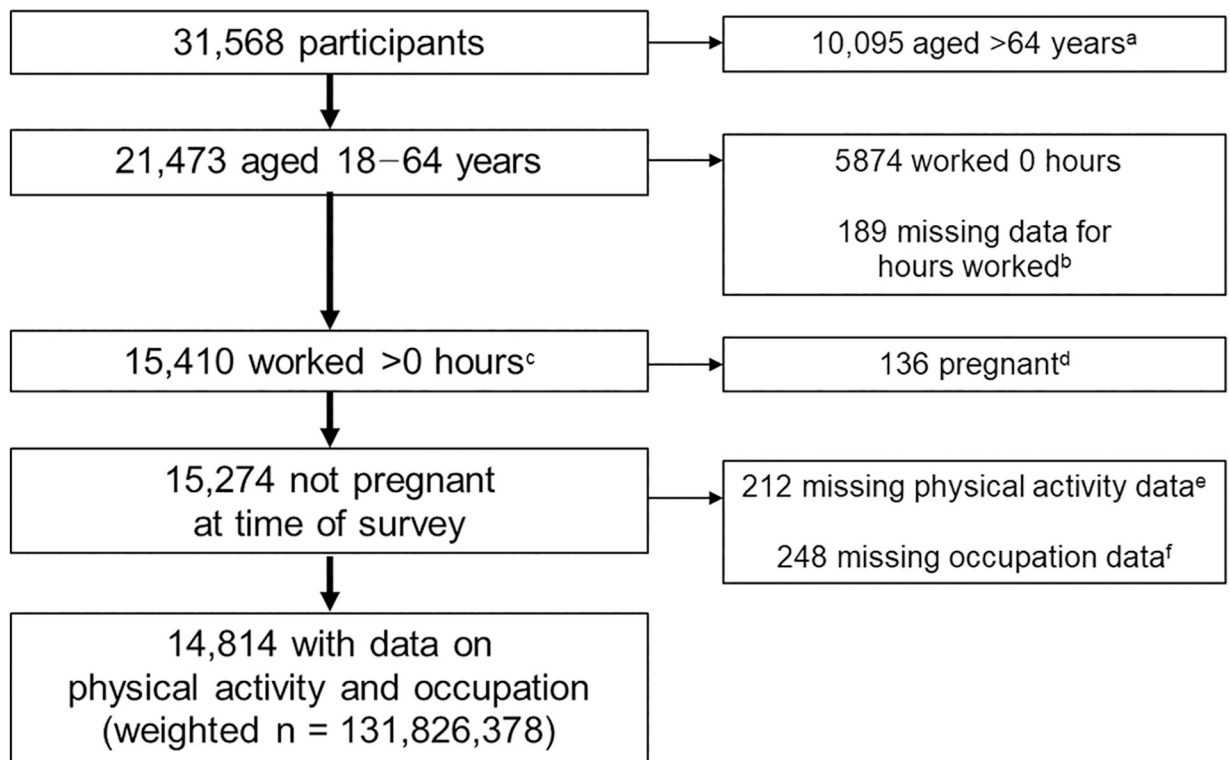
Figure 1 —.

Selection of analytic sample of working US adults, National Health Interview Survey—
United States, 2020. [a]This criterion excluded 10,025 participants aged 65 years or older
and 70 participants who refused to answer, who did not know age, or for whom age was
not ascertained.[b]This criterion excluded 95 participants who did seasonal/contract work,
22 who worked not for pay in the week prior to survey completion, 53 who did not
know, 18 who refused to answer, and 1 for whom data were not ascertained. [c]Participants
reported the number of hours worked in the week before their interview, and participants
who were temporarily absent from their job reported the number of hours they usually
work per week. [d]This criterion excluded 115 participants who reported a current pregnancy
and 21 participants who refused to answer, who did not know pregnancy status, or for
whom pregnancy status was not ascertained. [e]Physical activity data were missing if data for
aerobic physical activity or muscle-strengthening physical activity were extreme values (eg,
frequency of vigorous-intensity PA >28 times/wk) or not ascertained or if participant did
not know or refused to answer. [f]This criterion excluded 13 participants in military-specific
occupations (which do not have a corresponding occupation activity level for the Standard
Occupational Classification code) and 235 participants who refused to answer, whose
answers were classified, who did not know occupation, or for whom occupation was not
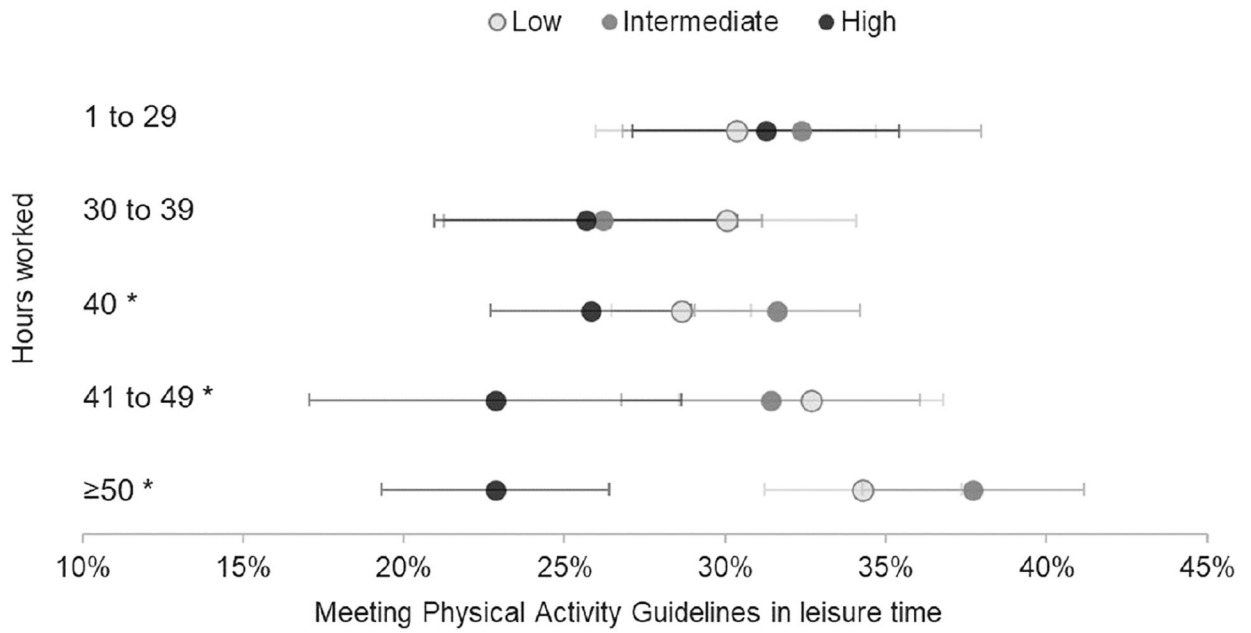ascertained.

Figure 2 —.
Unadjusted percentage of working US adults meeting Physical Activity Guidelines in leisure time[a] by occupation activity level and hours worked,[b] National Health Interview Survey —United States, 2020.[c] [a]Meeting Physical Activity Guidelines in leisure time refers to participating in at least 150 minutes per week of moderate-intensity equivalent aerobic physical activity and participating in muscle-strengthening activity at least twice a week in leisure time only. [b]We grouped self-reported occupations into occupation activity level categories using the US Census Bureau 2018 Standard Occupational Classification codes. We categorized hours worked based on adults' self-report of the number of hours worked in the week before their interview. [c]Data are from working adults aged 18–64 years from the 2020 National Health Interview Survey. Weighted percentages account for complex survey design and nonresponse. *Pairwise comparison identified differences in Physical Activity Guidelines in leisure time by occupation activity level for these categories of hours worked: 40 hours (high vs intermediate $P < .01$), 41 to 49 hours (high vs low $P < .01$, high vs intermediate $P = .02$), and   50 hours (high vs low $P < .01$, high vs intermediate $P < .01$).
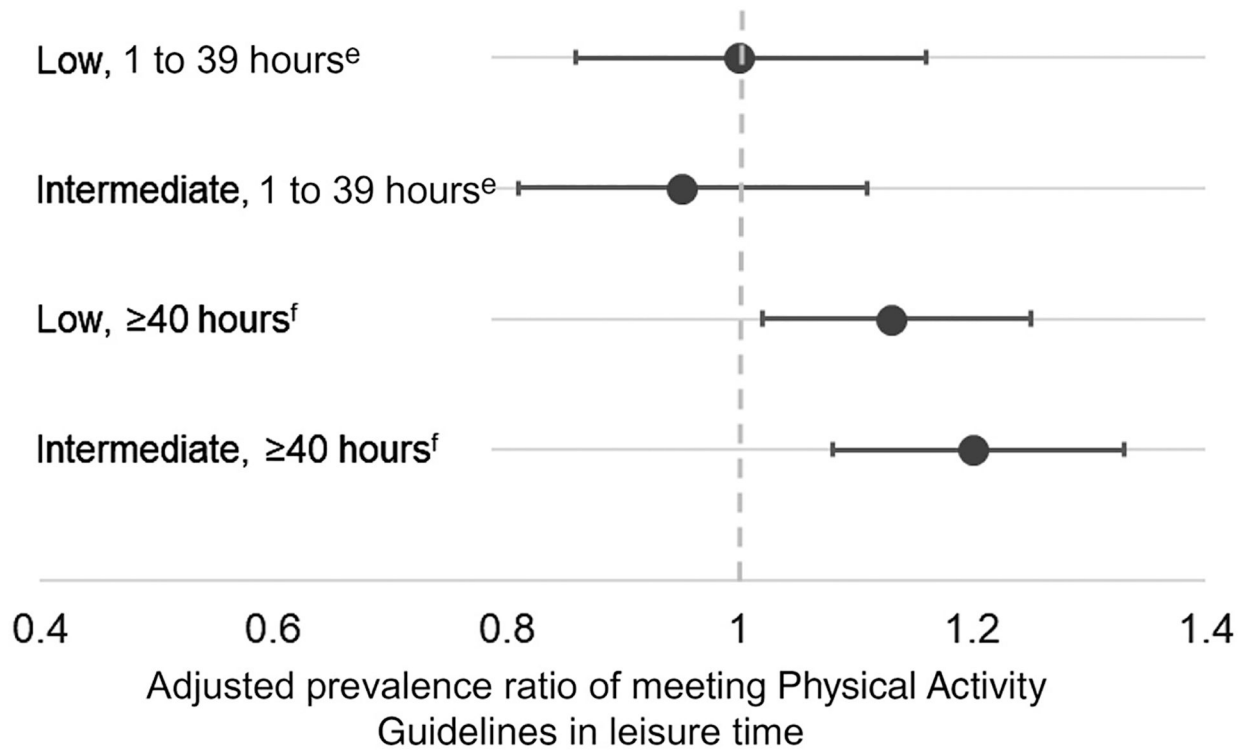
Figure 3 —.

Adjusted prevalence ratios[a] of meeting Physical Activity Guidelines in leisure time[b] by occupation activity levels and by hours worked,[c] National Health Interview Survey —United States, 2020.[d] [a]Weighted prevalence ratios account for complex survey design and nonresponse. Logistic regression models estimating prevalence ratios adjusted for race/ethnicity, sex, age, and education. [b]Meeting Physical Activity Guidelines in leisure time refers to participating in at least 150 minutes per week of moderate-intensity equivalent aerobic physical activity and participating in muscle-strengthening activity at least twice a week in leisure time only. [c]We categorized self-reported occupations into occupation activity levels using the US Census Bureau 2018 Standard Occupational Classification codes. We categorized hours worked based on adults' self-report of the number of hours worked in the week before their interview. [d]Data are from working adults aged 18–64 years from the 2020 National Health Interview Survey. [e]Reference group is working 1 to 39 hours in high-activity occupation. [f]Reference group is working 40 hours in high-activity occupation.

Table 1

Characteristics of Working US Adults Aged 18–64 Years, National Health Interview Survey—United States, 2020

Characteristic	Unweighted n (N = 14,814)	Weighted percent (95% CI)[a]
Race/ethnicity		
Non-Hispanic American Indian or Alaska Native (alone or multiracial)	179	1.3 (1.0–1.7)
Non-Hispanic Asian alone	926	6.0 (5.4–6.8)
Non-Hispanic Black/African American alone	1384	10.6 (9.6–11.6)
Hispanic or Latino (of any race)	2156	18.5 (17.0–20.0)
Non-Hispanic White alone	9983	62.4 (60.7–64.0)
Another single and multiple races	186	1.3 (1.0–1.5)
Sex		
Female	7219	46.9 (45.9–47.9)
Male	7595	53.1 (52.1–54.1)
Age, y		
18–34	4311	37.3 (36.3–38.4)
35–44	3666	22.8 (22.0–23.6)
45–54	3362	21.6 (20.8–22.4)
55–64	3475	18.3 (17.6–19.0)
Education[b]		
High school graduate, GED, or lower	3710	34.0 (32.8–35.2)
Some college or associate degree	4139	31.0 (29.9–32.1)
Bachelor's degree or higher	6909	35.1 (33.9–36.3)
Occupation activity level[c]		
Low	6385	38.9 (37.8–40.0)
Intermediate	4475	29.8 (28.9–30.8)
High	3954	31.3 (30.2–32.4)
Hours worked[d]		
1–29	1982	15.0 (14.2–15.8)
30–39	1854	13.8 (13.0–14.6)
40	6195	40.3 (39.3–41.3)
41–49	1626	10.7 (10.1–11.4)

Characteristic	Unweighted n (N = 14,814)	Weighted percent (95% CI)[a]
50	3157	20.1 (19.3–20.9)
Met Physical Activity Guidelines in leisure time[e]		
Yes	4523	29.8 (28.8–30.8)
No	10,291	70.2 (69.2–71.2)

Abbreviation: GED, general educational development.

[a] Weighted percentages account for complex survey design and nonresponse. Some percentages do not add up to 100.0% due to rounding.

[b] Fifty-six participants were missing data on education and excluded from analysis of this characteristic.

[c] We categorized self-reported occupations into occupation activity levels using the US Census Bureau 2018 Standard Occupational Classification codes.

[d] We categorized hours worked based on adults' self-report of the number of hours worked in the week before their interview.

[e] Meeting Physical Activity Guidelines in leisure time refers to participating in at least 150 minutes per week of moderate-intensity equivalent aerobic physical activity and participating in muscle-strengthening activity at least twice a week in leisure time only.

Table 2

Unadjusted Percentage of Working US Adults Meeting Physical Activity Guidelines in Leisure Time[a] by Occupation Activity Level[b] and Sociodemographic Characteristics, National Health Interview Survey—United States, 2020[c]

Characteristic	Low occupation activity level % (95% CI)	Intermediate occupation activity level % (95% CI)	High occupation activity level % (95% CI)
Overall	30.6 (29.1–32.2)	32.4 (30.8–34.2)	26.1 (24.3–28.1)
Race/ethnicity			
Non-Hispanic American Indian or Alaska Native (alone or multiracial)	—d	—d	29.9 (17.4–46.3)
Non-Hispanic Asian alone	29.7 (25.2–34.6)	30.1 (24.2–36.8)	18.9 (13.1–26.5)
Non-Hispanic Black/African American alone	29.9 (25.1–35.2)	33.2 (27.7–39.2)	28.3 (22.4–35.0)
Hispanic or Latino (of any race)	27.6 (23.3–32.3)	29.1 (24.8–33.8)	21.9 (18.2–26.1)
Non-Hispanic White alone	31.2 (29.5–33.0)	33.6 (31.6–35.8)	28.2 (25.9–30.6)
Another single and multiple races	41.9 (29.7–55.3)	28.1 (16.3–44.0)	—d
Sex			
Female	26.4 (24.6–28.3)	27.6 (25.1–30.2)	23.4 (20.8–26.3)
Male	36.5 (34.2–38.8)	35.3 (33.1–37.6)	28.1 (25.7–30.6)
Age, y			
18–34	38.0 (35.0–41.1)	38.6 (35.4–42.0)	35.8 (32.5–39.3)
35–44	30.3 (27.7–33.1)	36.2 (32.7–39.8)	21.7 (18.8–24.8)
45–54	26.9 (24.2–29.7)	26.8 (23.8–30.1)	20.2 (17.1–23.6)
55–64	22.7 (20.2–25.5)	22.0 (19.4–24.9)	14.8 (12.4–17.6)
Education[e]			
High school graduate, GED, or lower	21.7 (18.5–25.2)	19.8 (17.0–23.0)	21.0 (18.4–23.8)
Some college or associate degree	27.0 (24.5–29.6)	32.3 (29.2–35.6)	29.5 (25.9–33.3)
Bachelor's degree or higher	37.6 (35.6–39.7)	43.3 (40.7–45.9)	34.8 (31.6–38.2)

[a] Meeting Physical Activity Guidelines in leisure time refers to participating in at least 150 minutes per week of moderate-intensity equivalent aerobic physical activity and participating in muscle-strengthening activity at least twice a week in leisure time only.

[b] We categorized self-reported occupations into occupation activity levels using the US Census Bureau 2018 Standard Occupational Classification codes.

[c] Data are from working adults aged 18–64 years from the 2020 National Health Interview Survey. Weighted percentages account for complex survey design and nonresponse.

[d] We suppressed this estimate in alignment with National Center for Health Statistics guidelines (https://www.cdc.gov/nchs/data/series/sr_02/sr02_175.pdf).

[e] Fifty-six participants were missing data on education and excluded from analysis of this characteristic.

Table 3

Occupational Activity Level by Sociodemographic Characteristics Among US Adults Working ≥40 Hours,[a] National Health Interview Survey—United States, 2020[b]

Characteristic	% of total[c] (n = 10,978)	Low occupation activity level % (95% CI)[c]	Intermediate occupation activity level % (95% CI)[c]	High occupation activity level % (95% CI)[c]	High vs low activity (reference is low) Prevalence ratio (95% CI)[d]	High vs intermediate activity (reference is intermediate) Prevalence ratio (95% CI)[d]
Race/ethnicity						
Non-Hispanic American Indian or Alaska Native (alone or multiracial)	1.2	1.2 (0.8–1.8)	1.2 (0.7–1.8)	1.4 (0.9–2.1)	1.12 (0.63–2.01)	1.18 (0.65–2.15)
Non-Hispanic Asian alone	6.2	8.0 (7.0–9.2)	6.0 (5.0–7.1)	3.9 (3.0–5.0)	**0.48 (0.37–0.63)**	**0.65 (0.49–0.85)**
Non-Hispanic Black/African American alone	10.3	11.3 (9.9–12.8)	9.2 (7.9–10.8)	10.1 (8.5–11.9)	0.90 (0.75–1.07)	1.09 (0.90–1.34)
Hispanic or Latino (of any race)	17.6	12.7 (11.2–14.3)	15.6 (13.7–17.7)	27.3 (24.6–30.3)	**2.15 (1.87–2.49)**	**1.75 (1.52–2.02)**
Non-Hispanic White alone	63.3	65.1 (62.9–67.3)	67.0 (64.5–69.5)	56.3 (53.3–59.2)	**0.86 (0.82–0.92)**	**0.84 (0.79–0.89)**
Another single and multiple races	1.3	1.7 (1.3–2.2)	1.1 (0.7–1.5)	—[e]	0.65 (0.37–1.14)	1.03 (0.57–1.87)
Sex						
Female	40.6	52.9 (51.1–54.6)	32.0 (30.2–33.9)	32.4 (30.2–34.6)	**0.61 (0.57–0.66)**	1.01 (0.93–1.10)
Male	59.4	47.1 (45.4–48.9)	68.0 (66.1–69.8)	67.6 (65.4–69.8)	**1.44 (1.37–1.51)**	1.00 (0.95–1.04)
Age, y						
18–34	33.8	31.0 (29.3–32.8)	35.1 (33.0–37.1)	36.5 (34.0–39.1)	**1.18 (1.08–1.29)**	1.04 (0.95–1.14)
35–44	24.4	25.7 (24.3–27.2)	23.6 (22.0–25.2)	23.4 (21.5–25.4)	0.91 (0.82–1.01)	0.99 (0.89–1.11)
45–54	23.4	23.9 (22.6–25.4)	22.6 (20.9–24.3)	23.5 (21.6–25.5)	0.98 (0.89–1.09)	1.04 (0.93–1.16)
55–64	18.4	19.3 (18.1–20.5)	18.8 (17.4–20.3)	16.6 (15.1–18.2)	**0.86 (0.77–0.96)**	0.88 (0.78–1.00)
Education[f]						
High school graduate, GED, or lower	31.6	20.5 (19.0–22.1)	29.6 (27.5–31.7)	51.0 (48.4–53.5)	**2.49 (2.28–2.72)**	**1.72 (1.59–1.87)**
Some college or associate degree	29.4	31.4 (29.6–33.2)	30.2 (28.2–32.2)	25.6 (23.5–27.8)	**0.81 (0.73–0.90)**	**0.85 (0.76–0.94)**
Bachelor's degree or higher	38.9	48.1 (46.1–50.1)	40.3 (38.3–42.3)	23.5 (21.7–25.4)	**0.49 (0.45–0.53)**	**0.58 (0.53–0.64)**

Abbreviations: GED, general educational development.

[a] We categorized self-reported occupations into occupation activity levels using the US Census Bureau 2018 Standard Occupational Classification codes.

[b]Data are from working adults aged 18–64 years from the 2020 National Health Interview Survey.

[c]Weighted percentages are column percentages that account for complex survey design and nonresponse. Some percentages do not add up to 100.0% due to rounding. We used chi-square tests to determine statistically significant differences in representation in a respective occupation activity level across each sociodemographic characteristic (all P < .01). Some percentages do not add up to 100.0% due to rounding.

[d]Weighted prevalence ratios from unadjusted multinomial logistic regression models account for complex survey design and nonresponse. We considered prevalence ratios with a 95%CI excluding 1.0 as statistically significant and presented them in boldface.

[e]We suppressed this estimate in alignment with National Center for Health Statistics guidelines (https://www.cdc.gov/nchs/data/series/sr_02/sr02_175.pdf).

[f]Fifty-six participants were missing data on education and excluded from analysis of this characteristic