

Interrelations of Socioeconomic Position and Occupational and Leisure-Time Physical Activity in the National Health and Nutrition Examination Survey

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Background: The interrelations between various physical activity domains have received little empirical attention in the United States. Of particular interest, given the potential applicability to traditionally underserved communities, is the nature of the association between occupational physical activity (OPA) and leisure-time physical activity (LTPA). **Methods:** 5448 adult men and women who participated in NHANES 1999–2000 were included in analyses. Linear regression was used to examine the bivariate and multivariable associations of OPA and education with LTPA. Generalized logit models were used to examine the association of education with OPA. **Results:** We found no association between education and LTPA. OPA was significantly positively associated with LTPA ($P < .001$). The association between OPA and LTPA was not strongest among those with low education and held only for men in gender-stratified analysis. Education was inversely associated with OPA ($P < .001$) in multivariable analysis. **Conclusions:** Our findings lend preliminary support to the hypothesis that OPA is an important determinant of LTPA, particularly in men. This provides additional support to calls for assessment of OPA, particularly among individuals of low social class.

Keywords: NHANES, socioeconomic status, exercise

Regular physical activity (PA) is associated with a reduced risk of obesity, numerous chronic diseases (eg, cardiovascular disease, diabetes, and some cancers), and premature mortality.¹ Despite this, low rates of PA remain pervasive in the United States,^{2,3} with the lowest rates found among individuals of lower socioeconomic position (SEP).^{1,4-7} Emerging research suggests that individuals in low SEP and racial/ethnic minority groups might be more likely to accumulate PA through their occupational pursuits.⁸ Despite this, US population-level surveillance studies that assess PA trends have not historically measured occupational PA (OPA), perhaps underestimating the proportion of the population meeting recommended

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PA levels.^{9,10} Indeed, emerging evidence suggests that when total PA is assessed by summing activity accumulated in multiple domains, racial/ethnic minority populations show higher than expected total PA levels.^{5,11} Results have similarly indicated that higher SEP individuals are no more likely to meet recommended PA levels when all PA domains are measured.¹²

The interrelations between various PA domains have received very little empirical attention, particularly in the United States. Of particular interest is the nature of the association between OPA and LTPA, as some have posited that individuals who are active at work might be less likely to be active outside of work.¹³ Particularly for those with high OPA jobs, which might be accompanied by considerable physical and psychosocial fatigue, lower levels of LTPA might be expected. To illustrate, a study of Australian adults found that the occupational group with the highest levels (mean h/wk) of occupational or household PA had lower LTPA compared with those with lower rates of occupational or household PA.¹⁴ One might expect this association to be strongest among those of low SEP, who also display the highest OPA levels.¹⁵⁻¹⁸ However, a recent study found that US adults employed in physically active jobs were more likely to be active in their leisure time.¹⁹ Kruger et al did not account for whether participants were working full- or part-time, which might exert a sizeable impact on OPA.

In the current study, conducted using National Health and Nutrition Examination Survey (NHANES) data, we aimed to extend previous research in this area by exploring potential variation in the OPA–LTPA relation across gender and SEP strata.

Methods

NHANES is a stratified, multistage probability sample of the civilian noninstitutionalized US population. Details of the NHANES protocol and all testing procedures are available elsewhere.²⁰ This analysis is limited to the 5448 adult men and women 18 years of age or older in the NHANES 1999–2000 survey.

LTPA

Participants reported the frequency and duration of their vigorous- (eg, running, lap swimming, aerobics, or fast bicycling) and moderate- (eg, brisk walking, bicycling for pleasure, golf, and dancing) intensity LTPAs in the past 30 days. For each activity, the frequency of participation was multiplied by the duration of participation to obtain an h/mo value. The h/mo for all activities were summed and multiplied by 4.29 to obtain a total h/wk score for each participant. We modeled LTPA as a continuous variable to explore the magnitude of the difference in LTPA across OPA and SEP strata.

OPA

Participants reported their employment status as employed, retired, homemaker, or other; those who were employed also reported the number of hours worked each week. OPA data were only collected among those who reported being employed (either full- or part-time). Employed participants self-reported their

usual occupational activities as either “sit during the day and not walk about very much,” “stand or walk about a lot during the day but not carry or lift things very often,” “lift light loads or climb stairs or hills often,” or “heavy work or carry heavy loads.” The OPA variable was treated categorically in all analyses in which it was the exposure or covariate, with sitting modeled as the reference category.

Demographics

Participants reported their age (in years), gender, race/ethnicity (non-Hispanic Black, non-Hispanic White, Mexican American, other Hispanic, other), and education (categorized in the 3 levels available in public release data: less than high school, high school diploma, more than high school).

Statistical Analysis

We considered 3 sets of analyses. First, we used linear regression models to examine the individual and joint associations of education and LTPA with OPA; age, race/ethnicity, and sex were included as covariates. Second, we used generalized logit models to examine the association between education and OPA. OPA was modeled as an ordinal outcome variable, with heavy lifting as the referent group. Finally, we conducted exploratory analyses of the association of OPA with LTPA in models stratified by gender, education, and both gender and education. All models that included OPA also adjusted for work status (full-time [40+ h/wk] versus part-time [0–39.9 h/wk] employment). Overparameterization prevented a full multivariable model in the generalized logit models with OPA as the outcome. SUDAAN software version 9.0 (Research Triangle Park, NC) was used to carry out all statistical analyses, which were weighted using the NHANES-recommended variables.

Results

Table 1 presents characteristics of the study population. Most participants were White (69.5%) and had at least a high school diploma (75.0%). Approximately one-tenth (11.2%) of participants reported heavy lifting as their usual OPA. Fewer women (3.2%) than men (17.7%) reported heavy lifting OPA. Participants reported an average of 5.5 h/wk of LTPA, with men reporting higher mean LTPA than women (6.5 versus 4.5 h/wk).

LTPA Outcome

In bivariate analyses, there was no association between education and LTPA (β comparing <high school to >high school = 1.07, overall $P = .19$; Tables 2A–2C). The association remained nonsignificant after adjusting for covariates ($P = .83$) and in gender-stratified multivariable models (Table 3).

OPA Outcome

We observed a significant association between education and OPA ($P < .001$; Table 4) in a work-status adjusted analysis. The odds of performing heavy lifting

Table 1 Participant Characteristics and Estimated Population Demographics, National Health and Nutrition Examination Survey, 1999–2000

| | Overall, N = 5448 (weighted %) | Men, n = 2550 (weighted %) | Women, n = 2898 (weighted %) |
|---|--------------------------------------|----------------------------------|------------------------------------|
| Race | | | |
| Black | 1035 (10.9) | 477 (10.2) | 558 (11.5) |
| White | 2329 (69.5) | 1121 (70.4) | 1208 (68.7) |
| Mexican American | 1553 (6.5) | 721 (6.9) | 832 (6.1) |
| other Hispanic | 337 (8.1) | 137 (7.3) | 200 (8.9) |
| other | 194 (5.0) | 94 (5.2) | 100 (4.8) |
| Education | | | |
| less than high school | 2185 (25.0) | 1072 (25.7) | 1113 (24.3) |
| high school | 1269 (26.0) | 568 (25.1) | 701 (26.9) |
| more than high school | 1968 (49.0) | 898 (49.2) | 1070 (48.8) |
| Occupational physical activity | | | |
| sitting | 555 (21.4) | 232 (18.0) | 323 (25.7) |
| walking | 1533 (49.2) | 726 (42.4) | 807 (57.6) |
| light lifting | 543 (18.2) | 348 (22.0) | 195 (13.6) |
| heavy lifting | 312 (11.2) | 263 (17.7) | 49 (3.2) |
| Work status | | | |
| full-time | 1972 (73.6) | 1180 (81.6) | 792 (63.8) |
| part-time | 862 (26.4) | 340 (18.4) | 522 (36.2) |
| Age, mean (SE) | 44.0 (0.33) | 43.2 (0.46) | 44.8 (0.46) |
| Leisure-time physical activity (h/wk), mean (SE) | 5.5 (0.2) | 6.5 (0.3) | 4.5 (0.2) |

versus sitting were greater for those with less education. More specific, the odds of performing heavy lifting versus sitting were nearly 10 times greater for those with less than a high school education compared with those with greater than a high school education (OR = 9.90, 95% CI: 5.97–16.42). Similarly, the odds of performing light lifting versus sitting in those with less than a high school education (compared with those with greater than a high school education) were 3 times greater (OR = 3.05, 95% CI: 2.04–4.55). Finally, the odds of walking versus sitting were nearly 3 times greater for those with less than a high school education compared with those with more than a high school education (OR = 2.77, 95% CI: 1.89–4.05). The association between education and OPA persisted in work status–adjusted, gender-stratified analyses (data not shown), in which the pattern of association was the same in women. Among men, the stronger associations were in men with a high school education, but significant association persisted for both those with less than a high school education and those with a high school education.

Mean LTPA increased with increasing OPA intensity. Participants reporting mostly sitting at work reported the fewest mean hours of LTPA (4.4 h/wk), compared with those reporting mostly heavy lifting (7.3 h/wk LTPA, Table 2A). The association persisted in analyses adjusting for work status ($P < .0001$, Table 2B). In multivariable analyses adjusting for gender, race, age, work status, and education, OPA remained significantly associated with LTPA ($P = .0004$, Table 2C). Participants reporting heavy lifting at work reported two and a half h/wk more of

Table 2A Associations of Occupational Physical Activity and Education With Leisure-Time Physical Activity, National Health and Nutrition Examination Survey, 1999–2000

| | Mean (SE) h/wk | Median h/wk | Bivariate | | | | <i>P</i> ^a |
|--------------------------------|-------------------|----------------|-----------|------|---------------|--|-----------------------|
| | | | h/wk | SE | 95% CI | | |
| Education | | | | | | | .19 |
| <high school | 6.5 (10.5) | 3.0 | 1.07 | 0.67 | –0.36 to 2.50 | | |
| high school | 5.6 (8.5) | 3.0 | 0.03 | 0.39 | –0.82 to 0.87 | | |
| >high school | 5.7 (6.7) | 3.5 | ref | | | | |
| Occupational physical activity | | | | | | | |
| sitting | 4.4 (6.8) | 2.8 | | | | | |
| walking | 5.0 (6.4) | 3.0 | | | | | |
| light lifting | 6.9 (9.5) | 3.5 | | | | | |
| heavy lifting | 7.3 (10.4) | 4.7 | | | | | |
| Work status | | | | | | | |
| full-time | 5.2 (7.1) | 3.0 | | | | | |
| part-time | 6.3 (9.0) | 3.5 | | | | | |
| Sex | | | | | | | <.0001 |
| male | 6.5 (0.3) | | 2.07 | 0.33 | 1.36 to 2.79 | | |
| female | 4.5 (0.2) | | ref | | | | |
| Age | | | –0.01 | 0.01 | –0.03 to 0.01 | | .32 |
| Race | | | | | | | .02 |
| Mexican American | 4.4 (0.4) | | –0.45 | 0.94 | –2.46 to 1.56 | | |
| other Hispanic | 4.8 (0.4) | | –0.06 | 0.85 | –1.87 to 1.76 | | |
| White | 5.5 (0.3) | | 0.71 | 0.84 | –1.09 to 2.51 | | |
| Black | 7.0 (0.5) | | 2.18 | 1.21 | –0.41 to 4.76 | | |
| other/mixed | 4.8 (0.9) | | ref | | | | |

^a *P* value is from Wald F test.

LTPA than those reporting sitting at work ($\beta = 2.49$, 95% CI: 0.15–4.83). However, in gender-stratified models, the positive association between OPA and LTPA held among men ($P = .0009$) but not women ($P = .30$; Table 3).

Education-Stratified Analyses of LTPA Outcome

In analyses stratified by education, OPA was significantly associated with LTPA for those with less than a high school education ($P = .02$), those with a high school education ($P = .04$), and those with more than a high school education ($P = .0004$), though nearly all of the individual comparisons were nonsignificant (Table 5). Among those with a high school education or more than a high school education, the association was similar to the non-education stratified analyses: those who reported heavy lifting at work reported higher levels of LTPA than those who reported sitting at work. For example, in those with more than a high school education, participants who reported heavy lifting at work reported nearly 4 hours more LTPA per week than those who reported sitting at work ($\beta = 3.72$, 95% CI: –0.34 to 7.77). However, the nature of the association differed for those with less than a high school education. In participants with less than a high school education, despite the

Table 2B Associations of Occupational Physical Activity and Education With Leisure-Time Physical Activity, National Health and Nutrition Examination Survey, 1999–2000

| | Simple ^a | | | <i>P</i> ^b |
|--------------------------------|---------------------|------|---------------|-----------------------|
| | h/wk | SE | 95% CI | |
| Education | | | | |
| <high school | | | | |
| high school | | | | |
| >high school | | | | |
| Occupational physical activity | | | | |
| sitting | ref | | | <.0001 |
| walking | 0.95 | 0.33 | 0.23–1.67 | |
| light lifting | 2.86 | 0.49 | 1.81–3.91 | |
| heavy lifting | 3.18 | 0.91 | 1.23–5.13 | |
| Work status | | | | .27 |
| full-time | –0.59 | 0.52 | –1.71 to 0.52 | |
| part-time | ref | | | |
| Sex | | | | |
| male | | | | |
| female | | | | |
| Age | | | | |
| Race | | | | |
| Mexican American | | | | |
| other Hispanic | | | | |
| White | | | | |
| Black | | | | |
| other/mixed | | | | |

^a Adjusted for age, sex, and race.

^b *P* value is from Wald *F* test.

overall significant association between OPA and LTPA, none of the more intense OPA groups reported LTPA levels significantly different from sitting.

Because OPA was associated with LTPA across education levels, but gender differences in the association between OPA and LTPA existed, we conducted exploratory analyses of the association of OPA and LTPA in joint strata of gender and education. In age, race, and work-status adjusted models, OPA was positively associated with LTPA among men with both a high school education ($P = .01$) and above ($P = .0005$) but not among those with less than a high school education ($P = .39$; Table 6). Among men with a high school education and above, average LTPA increased with increasing intensity of OPA, but among men with less than a high school education, there was a trend, though not significant, of decreasing LTPA with increasing OPA. Compared with men who reported sitting, men with a high school education who reported heavy lifting at work reported over 7 h/wk more LTPA ($\beta = 7.51$, 95% CI: 2.29–12.72); men with more than a high school education reported nearly 5 h/wk more LTPA ($\beta = 4.78$, 95% CI: 0.49–9.07).

Among women, there was a significant association between LTPA and OPA only among women with a high school education ($P = .01$). However, when comparing sitting to the more intense OPA levels, none of the individual associations significantly differed. There was no association of OPA and LTPA either among

Table 2C Associations of Occupational Physical Activity and Education With Leisure-Time Physical Activity, National Health and Nutrition Examination Survey, 1999–2000

| | Multivariable ^a | | | |
|--------------------------------|----------------------------|------|---------------|----------------|
| | h/wk | SE | 95% CI | P ^b |
| Education | | | | .83 |
| <high school | 0.49 | 0.93 | -1.50 to 2.49 | |
| high school | 0.25 | 0.56 | -0.95 to 1.46 | |
| >high school | ref | | | |
| Occupational physical activity | | | | .0004 |
| sitting | ref | | | |
| walking | 0.90 | 0.36 | 0.13–1.67 | |
| light lifting | 2.50 | 0.47 | 1.50–3.50 | |
| heavy lifting | 2.49 | 1.09 | 0.15–4.83 | |
| Work status | | | | .12 |
| full-time | -0.86 | 0.52 | -1.97 to 0.24 | |
| part-time | ref | | | |
| Sex | | | | .0006 |
| male | 1.45 | 0.33 | 0.74–2.17 | |
| female | ref | | | |
| Age | -0.04 | 0.01 | -0.07 to 0.01 | .09 |
| Race | | | | .007 |
| Mexican American | -1.29 | 1.36 | -4.21 to 1.64 | |
| other Hispanic | -0.81 | 1.30 | -3.60 to 1.99 | |
| White | 0.16 | 1.20 | -2.41 to 2.74 | |
| Black | 1.53 | 1.66 | -2.04 to 5.10 | |
| other/mixed | ref | | | |

^a Adjusted for age, sex, race, work status, and each other.

^b P value is from Wald F test.

Table 3 Associations of Occupational Physical Activity and Leisure-Time Physical Activity by Gender, National Health and Nutrition Examination Survey, 1999–2000

| | Men | | | | Women | | | |
|--------------------------------|-------|------|---------------|----------------|-------|------|---------------|----------------|
| | h/wk | SE | 95% CI | P ^a | h/wk | SE | 95% CI | P ^a |
| Education | | | | .77 | | | | .45 |
| <high school | -0.67 | 1.09 | -3.02 to 1.67 | | 2.34 | 2.41 | -2.83 to 7.50 | |
| high school | 0.13 | 0.81 | -1.61 to 1.87 | | 0.14 | 0.57 | -1.08 to 1.35 | |
| >high school | ref | | | | ref | | | |
| Occupational physical activity | | | | .0009 | | | | .30 |
| sitting | ref | | | | ref | | | |
| walking | 1.58 | 0.45 | 0.61–2.56 | | 0.18 | 0.59 | -1.08 to 1.44 | |
| light lifting | 3.63 | 0.78 | 1.97–5.29 | | 0.99 | 0.57 | -0.24 to 2.21 | |
| heavy lifting | 3.19 | 1.11 | 0.81–5.58 | | 3.04 | 3.24 | -3.90 to 9.98 | |

^a Age, race, work-status, and each-other adjusted.

Table 4 Association of Education With Occupational Physical Activity^a, National Health and Nutrition Examination Survey, 1999–2000

| | Heavy lifting vs Sitting | | Light lifting vs Sitting | | Walking vs Sitting | | <i>P</i> ^b |
|--------------|--------------------------|------------|--------------------------|-----------|--------------------|-----------|-----------------------|
| | OR | 95% CI | OR | 95% CI | OR | 95% CI | |
| Education | | | | | | | <.0001 |
| <high school | 9.90 | 5.97–16.42 | 3.05 | 2.04–4.55 | 2.77 | 1.89–4.05 | |
| high school | 6.50 | 4.40–9.62 | 2.86 | 2.06–3.97 | 2.02 | 1.34–3.03 | |
| >high school | 1.00 | | 1.00 | | 1.00 | | |

^a Adjusted for work status.

^b *P* value from Wald F test.

women with less than a high school education or among those with a high school education or more.

Discussion

We found that OPA was positively associated with LTPA; however, we found this association held only among men. We predicted that the association between OPA and LTPA would be strongest among those with low SEP; however, this hypothesis was not supported. Although individuals with the lowest educational attainment displayed the highest OPA levels, we found that the positive relation of OPA with LTPA remained for men with a high school education or greater.

We found no association between education and LTPA, contradicting previous research in this area.^{5,21} Our findings suggest that occupational activity might be a stronger predictor of LTPA than is educational attainment. This finding has important implications for the implementation of PA promotion interventions and suggests that placing emphasis on groups with low education levels might be incomplete. Rather, directing attention to those with sedentary occupations might be particularly useful. Our findings both support and extend those of Kruger et al¹⁹ by examining LTPA in a continuous fashion and examining variation in the OPA–LTPA association by gender and SEP. Together, these studies provide additional support to calls for the assessment of OPA in observational, intervention, and population-surveillance research, particularly among individuals of low SEP.

There might be several possible explanations for the positive association between LTPA and OPA. Individuals who carry heavy loads at work might be more physically active during their leisure time to assist them in managing the demands (both physical and emotional) of their workday activities. As noted by Kruger et al, the increased physical fitness of those who are active at work might facilitate their ability to engage in active leisure pursuits.¹⁹ In addition, for some occupations requiring high OPA, strong social norms might exist regarding participation in group-based LTPA (eg, informal recreation, athletic leagues). Certainly, it is also possible that some degree of misclassification exists in the NHANES OPA measure; it perhaps differentially captures some job types. However, the fact that

Table 5 Associations of Occupational Physical Activity and Leisure-Time Physical Activity by Education, National Health and Nutrition Examination Survey, 1999–2000

| | <High school | | | High school | | | >High school | | | P ^a |
|--------------------------------|--------------|------|---------------|-------------|------|---------------|--------------|------|---------------|----------------|
| | h/wk | SE | 95% CI | h/wk | SE | 95% CI | h/wk | SE | 95% CI | |
| Occupational physical activity | | | | | | | | | | |
| sitting | ref | | | ref | | | ref | | | .0004 |
| walking | 2.51 | 2.28 | -2.38 to 7.40 | 0.62 | 1.04 | -1.60 to 2.85 | 0.70 | 0.43 | -0.23 to 1.63 | |
| light lifting | 1.77 | 1.93 | -2.37 to 5.90 | 2.66 | 1.44 | -0.43 to 5.75 | 2.74 | 0.50 | 1.66 to 3.81 | |
| heavy lifting | -0.09 | 1.87 | -4.11 to 3.92 | 4.56 | 2.44 | -0.68 to 9.80 | 3.72 | 1.89 | -0.34 to 7.77 | |

^a Age, sex, race, and work-status adjusted.

the positive relation between OPA and LTPA did not hold for those with less than a high school education suggests the importance of maintaining efforts to develop strategies to identify and address barriers to regular LTPA among those of low SEP. We are unable to determine whether, and it is perhaps unlikely that, those with less than a high school education in our sample were meeting national PA recommendations solely through OPA. If not, PA promotion intervention efforts directed to this segment of the population might need to contend with the physical and psychosocial implications of having a high OPA job—these might magnify the traditional set of LTPA barriers associated with low SEP. In addition, we should note that high educational attainment in this sample might not include only college-educated participants but those with technical or associate degrees who are employed in blue-collar occupations.

Our study is the first to look at whether the association of OPA and LTPA varied by gender. Although the association between education and LTPA did not vary by gender, the association between OPA and LTPA did. Thus, although OPA is an important correlate of LTPA in men, it does not appear to be an important determinant in women. We believe this finding is particularly compelling because, in contrast with women, few factors have been identified that might determine LTPA in men. Among women, a host of social and familial factors have been identified that might play important roles in determining PA levels. These factors, which include childcare responsibilities and neighborhood safety, were not assessed in NHANES. Future studies should consider examining the association of OPA and LTPA in the context of a broader set of potential covariates.

Although these findings are compelling, certain limitations should be considered in their interpretation. The NHANES OPA measure is limited; future studies should include more comprehensive measures of OPA, specifically those that allow for the determination of whether PA recommendations are met solely through occupational activities. However, the NHANES OPA measure is similar to that used in the previous study,¹⁹ which was based on the validated Behavioral Risk Factor Surveillance System (BRFSS) OPA question.^{22,23} Our study did not measure other domains of PA (ie, transport, domestic), which might also contribute to total PA differentially by SEP. Inclusion of these measures in future studies will provide a more comprehensive picture of the association between SEP and PA. NHANES also has several strengths including its national representation and rigorous methodology. Despite the large sample size of the NHANES study, our power to examine associations jointly stratified by gender and education might have been limited. As such, these findings should be considered exploratory. Our study employed a detailed measure of LTPA that accounted for frequency, duration, and intensity of the physical activities reported. We chose not to transform LTPA in our analyses so that our results would remain readily interpretable.

Together, our findings further highlight that traditional measures of SEP, such as educational attainment, might mask important occupation-associated differences in LTPA, identifying previously overlooked segments of the population at risk for sedentary-lifestyle associated adverse health outcomes. More specific, intervention attention is needed among those employed in occupations that primarily involve “sitting,” regardless of SEP. Measuring occupational factors might be a particularly important and potentially more sensitive indicator of SEP in studies of PA.

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