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Article

Physical Work Exposures of Older Workers: Does Measurement Make a Difference?

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ABSTRACT

Physically demanding work at later ages, which is especially prevalent among disadvantaged groups, is associated with long-term health outcomes and may contribute to health inequality over the life course. Past studies of these issues have relied on occupational characteristics from the Occupational Information Network (O*NET), but few have assessed how O*NET compares to survey reports when measuring occupational exposures in analyses of socioeconomic status, work conditions, and health. We compare Health and Retirement Study (HRS, $N = 16{,}683$ working respondents) and O*NET measurements of general physical activity, frequency of lifting/handling objects, and frequency of stooping-related postures required at work. Pearson correlations between the HRS items and corresponding O*NET items vary from weak to moderate for lifting/handling and stooping-related postures to relatively large for general physical activity. Though they are measured on different scales, both the HRS and O*NET measures of physical demands reveal similar sex, racial/ethnic, and educational differentials in exposure to physically strenuous work. We fit random effects Poisson models to assess how these measures predict accumulation of functional limitations, a potential long-term consequence of strenuous working conditions. Comparable HRS and O*NET measures have similar associations with functional limitations. We also consider an average of physical demand items available in O*NET, finding that this measure has similar associations with functional limitations as the O*NET measure of general physical activity. These results suggest that O*NET characteristics and HRS respondent reports produce comparable disparities in physical work exposures (PWEs) and associations between physically demanding work and declines in physical functioning.

Occupational characteristics are important determinants of health in the general population and may contribute to unexplained health disparities (Ahonen, Fujishiro, Cunningham, & Flynn, 2018; Burgard & Lin, 2013; Landsbergis, 2010; Landsbergis, Grzywacz, & LaMontagne, 2014; Lipscomb, Loomis, McDonald, Argue, & Wing, 2006; Lundberg, 2021; Pebley, Goldman, Andrasfay, & Pratt, 2021). Physical demands at work, including heavy lifting, working in awkward postures, and repetitive motions, are associated with a broad range of health outcomes, including pain, injuries, and declines in physical functioning (da Costa & Vieira, 2010; Dembe, Yao, Wickizer, Shoben, & Dong, 2014; Dong, Wang, Daw, & Ringen, 2011; Fraade-Blanar et al., 2017; McCarthy, Perry, & Greiner, 2013; Ngabirano et al., 2020; Oakman, de Wind, van den Heuvel, & van der Beek, 2017; Solovieva et al., 2012).

Though potentially hazardous for all workers, the health consequences of these PWEs are generally more severe for older workers (Fletcher, Sindelar, & Yamaguchi, 2011; Oakman et al., 2017; Rogers & Wiatrowksi, 2005; Steege, Baron, Marsh, Menéndez, & Myers, 2014). Physically demanding work is also associated with older workers' exit from the labor force: Individuals in strenuous jobs are more likely to retire, transition into part-time work, or receive disability benefits than individuals in less-demanding jobs (Angrisani, Kapteyn, & Meijer, 2016; Cadiz, Brady, Rineer, & Truxillo, 2019; Ervasti et al., 2019; Glickman & Hermes, 2015; Poterba, Venti, & Wise, 2017; Sonnega, Helppie-McFall, Hudomiet, Willis, & Fisher, 2018). Although some workers transition out of strenuous jobs at older ages (Sonnega, Helppie-McFall, & Willis, 2016), PWEs remain common among older workers. About 40% of workers in their late 50s and early 60s report that their jobs require a high degree of physical activity or include hazardous and physically uncomfortable working conditions (Bucknor & Baker, 2016; Pebley et al., 2021). Research on the effects of physically demanding work at older ages and its long-term consequences is especially important given population aging and policies incentivizing later retirement (Fideler, 2020).

Unfortunately, there are few individual-level data sources that include information on working conditions, demographic

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characteristics, socioeconomic status, and subsequent health outcomes, all of which are necessary to study the long-term consequences of physically strenuous work and its contribution to health disparities. A few surveys, including the HRS and Midlife in the United States (MIDUS), ask respondents about occupational exposures. In these cases, the data collected are generally limited to a small number of exposures at one's current job, as collecting retrospective data on past job exposures in surveys depends on respondent recollection and requires additional burden on respondents. Most other representative health surveys collect no information on work conditions even for current jobs and are limited to collecting employment status and occupation.

Given the limited information on occupation within surveys, many studies have used an external source of data, the Occupational Information Network (O*NET), which is maintained by the US Department of Labor to provide information on the characteristics of occupations, including their content (activities, work requirements, etc.). Over the past two decades, O*NET has regularly collected and released data drawn from repeated cross-sectional, employer-based surveys of incumbents. Studies have linked these O*NET characteristics to survey data, for example, the HRS, National Health Interview Study (NHIS), and National Health and Nutrition Examination Study (NHANES), to assess the effects of physical work characteristics on health and labor force participation (Alterman et al., 2008; Cifuentes, Boyer, Lombardi, & Punnett, 2010; Dale et al., 2015; Nicholas, Done, & Baum, 2020; Yung et al., 2020).

Understanding whether these two sources—survey self-reports and O*NET—are comparable in a survey when both are available is important to inform other cases in which only one source is available. As noted earlier, this is often the case in surveys or retrospective job histories that ask only about occupation and may also occur in surveys that ask about working conditions but do not record occupation with sufficient detail to link to O*NET. Researchers would have more confidence relying on either of these sources of occupational exposure information if they yielded similar analytical results. Moreover, survey designers are often striving to reduce the number of questions asked of respondents, to reduce both costs and respondent burden (Rolstad, Adler, & Rydén, 2011). Finding that O*NET questions and survey self-reports are comparable would help survey designers considering the necessity of collecting work condition data in the survey itself.

Both O*NET and self-reported job characteristics in the HRS have their advantages and disadvantages and neither is necessarily an accurate measure of the occupational characteristics actually faced by workers. O*NET includes over 50 detailed questions about job context in addition to dozens of questions about the education, training, abilities, skills, and knowledge required for the job (O*NET OnLine, n.d.), allowing researchers to choose the demands or exposures most directly related to the outcomes being studied. However, O*NET was not designed with research in mind and some of the questions asked may be poor proxies for the risk factors researchers intend to measure (Dale et al., 2018; Handel, 2016). Because O*NET provides only occupation-level data rather than individual-level questionnaire responses, researchers can neither examine whether working conditions within occupations are associated with demographic characteristics such as age, race, ethnicity, or gender, nor can they examine measures for a population subgroup (Handel, 2016; Loomis & Kromhout, 2004). This concern may be especially salient in studies of older populations. Older workers may receive accommodations or have greater experience or seniority in their jobs that allow them to reduce exposures and demands in their job relative to those of the typical worker. Although workers are supposed to be selected randomly by their employers to participate in the O*NET questionnaire, we do not know how representative these respondents are of all workers in each occupation because worker characteristics associated with nonresponse are not provided, and, as an employer-based sample, casual and informal workers are not included in the O*NET surveys (Handel, 2016). In contrast to O*NET, self-reports in the HRS have the benefit of pertaining to an individual's own experiences on the job, taking into account any modifications based on age, physical ability, or the worker's own efforts to reduce physical strains on the job. A drawback is that respondents' reports of job characteristics may be influenced by their own frustrations with their jobs, health problems, or even outlook on life (Alterman et al., 2008; Köster, Alfredsson, Michélsen, Vingård, & Kilbom, 1999; Madsen et al., 2018; Theorell & Karasek, 1996; Viikari-Juntura et al., 1996), which can lead to biased associations (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003).

A few previous studies have assessed the comparability between O*NET and HRS measures of PWE with the goal of predicting retirement transitions and workplace injuries. Angrisani and colleagues (2016) assessed how HRS and O*NET measures of PWE, among several other non-monetary occupational characteristics, predicted retirement decisions. They found that both types of measures were associated with intentions to retire, but only O*NET measures were significantly associated with retirement from full-time work, whereas only HRS measures were associated with transitions to part-time work (Angrisani et al., 2016). Sonnega and colleagues (2018) also studied retirement timing with an emphasis on the mismatch between worker physical ability and his/her physical job requirements. Mismatch defined by HRS and O*NET measures of PWE were both significantly associated with retirement timing, though the HRS-based model fit better than the one based on O*NET (Sonnega et al., 2018). Fraade-Blanar and colleagues (2017) assessed how PWE and its mismatch with worker abilities relate to the risk of workplace injuries. They found that both HRS and O*NET measures of PWE were significant predictors of workplace injuries, but models using the O*NET measures yielded a better fit to the data (Fraade-Blanar et al., 2017). These prior studies provide evidence that both HRS and O*NET measures capture the underlying physical work environment faced by older workers, but to our knowledge, no studies have assessed whether estimates of sociodemographic differences in PWE vary by measurement type. The previous literature also indicates that comparability between survey-based and O*NET measures depends on the outcome being predicted, underscoring the need to examine other outcomes related to physically strenuous work.

In the present study, we focus on the use of self-reported survey versus O*NET data for studies of physical functioning. Our goals are to (1) assess whether sociodemographic differences in PWE vary by method of measurement and (2) compare the strength of associations between a long-term health outcome and each of these two sources. Because O*NET provides a broad array of PWE-related measures that extend well beyond the items included in HRS questions, we also examine whether using a wider range of these characteristics improves our ability to predict functional limitations.

DATA AND METHODS

Data

Our data are drawn from the HRS and O*NET. The HRS is a nationally representative, longitudinal study of Americans over the age of 50 that was established to collect health and economic information on the growing population of older adults (Sonnega et al., 2014). The HRS began in 1992 as a sample of individuals born between 1931 and 1941 (aged 51–61) and their spouses of any age; samples from additional birth cohorts were added in later waves (Sonnega et al., 2014). The HRS is sponsored by the National Institute on Aging (grant number NIA U01AG009740) and is conducted by the University of Michigan. We use data from the HRS 2014 tracker file (Health and Retirement Study 2017b), RAND HRS 2014 file (version 2) (RAND 2018), and the restricted Cross-Wave Industry and Occupation file (version 4.0.1) (Health and Retirement Study 2017a).

O*NET is a database of employment characteristics sponsored by the U.S. Department of Labor Employment and Training Administration and developed by the National Center for O*NET Development (O*NET OnLine, n.d.). O*NET fields questionnaires for individual occupations about specific tasks; knowledge, education and training; work styles; work activities; and work context. Each sampled incumbent (worker in the occupation) completes the task questionnaire and a randomly assigned subset of the remaining questionnaires. The measures are updated on a rolling basis as O*NET surveys new samples of incumbents. O*NET aggregates incumbent responses at the occupation level and releases summary scores and *SE* estimates for each questionnaire item.

Sample Restrictions

For our analyses, we use data from the 1998–2014 waves of the HRS. We exclude observations in which the respondent is under the age of 50 (i.e., younger spouses of age-eligible responses) and respondents whose race/ethnicity is not Black, Latino, or white. Respondents who are in the sample because they married a respondent after his/her initial interview are also excluded.

Since we compare HRS to O*NET ratings of job characteristics for the same job, individuals must report on job demands and have a recorded detailed occupation code during the same wave in order to be included in the sample. Most (93.2%) individuals who do not meet these inclusion criteria are not employed at any point during these years, 4.4% are missing at least one of the HRS reports of job characteristics, and 2.4% are missing a valid occupation code in the same wave in which they initially report on job characteristics. Valid occupational codes refer to three-digit (1980 or 2000 Census versions) or four-digit codes (2010 Census version) that are present in the Census occupational classification. Respondents are considered to have an invalid code if their occupation is coded as a missing value (e.g., 999 or 9999), if their occupation code does not appear in the Census classification list (i.e., typos), or if their occupation code was recorded during an AHEAD HRS wave that recorded only masked two-digit codes. An additional 19 individuals are excluded because they were employed in occupations not assessed by O*NET, primarily military and legislative occupations.

Observations missing time-varying health and demographic characteristics (see below) are excluded, but we include observations in which the interview was completed by a proxy (4%). After these exclusions, the analytic sample comprises 90,778 observations of 16,683 individual respondents.

Combining HRS and O*NET data

O*NET classifies occupations with O*NET-SOC codes, a more detailed version of the Standard Occupational Classification (SOC) codes, whereas HRS uses Census occupational classifications to code job titles reported by respondents. Because HRS and O*NET use different coding schema for occupations, we merged the two data sources using a series of crosswalks, details of which are available in Supplementary Material.

Measures

Physical work exposures

A set of time-invariant PWE is derived from a focal job held at or near the respondent's first interview wave between 1998 and 2014. For HRS individuals who reported both an occupation and physical work demands in 1998 or their first interview, we take that job as the focal job. For respondents who did not report this information in 1998 or their first interview, we take this information from either the closest wave after 1998 or the closest wave prior to 1998.

We consider three domains of PWE: general physical activity, heavy lifting/handling objects, and stooping-related postures. The HRS asked employed respondents how frequently (ranging from all or almost all the time to none or almost none of the time) their job required lots of physical effort; lifting heavy loads; and stooping, kneeling or crouching. We include three O*NET measures of PWE that most closely correspond to the HRS items. The *importance* of performing general physical activities (ranging from not important to extremely important) was chosen to correspond to the HRS question on lots of physical effort; O*NET does not include a question on *frequency* of general physical activity. Unfortunately, O*NET does not directly ask incumbents a question on the frequency of heavy lifting, but within the section on physical work conditions, O*NET asks about time spent using one's hands to handle, control, or feel objects, tools, or controls (ranging from never to continually or almost continually). Occupations commonly known to require heavy lifting, such as construction, forestry, and hospital orderly occupations, had high scores on this handling measure, suggesting that it partially captures lifting tasks in addition to fine motor tasks. This question on frequency of handling was chosen to correspond to the HRS report of the frequency of lifting heavy loads. Time spent kneeling, crouching, stooping, or crawling (ranging from never to continually or almost continually) was chosen to correspond to the HRS report of the frequency of stooping, kneeling, or crouching. Because the HRS and O*NET items were measured on different scales, we scaled both to range from 0 to 100, where 0 represents the lowest and 100 the highest level of exposure.

To assess whether the additional information provided by O*NET incumbents would improve our prediction of functional limitations, in the final part of the analysis we use a set of 12 physical demand items, including the three mentioned above as well as nine other characteristics we identified from the literature as relevant to the development of musculoskeletal conditions and, ultimately, functional limitations (Bernard et al., 1997; da Costa & Vieira, 2010). These additional physical demand variables comprise time spent standing; time spent climbing ladders, scaffolds or poles; time spent walking or running;

time spent keeping or regaining balance; time spent bending and twisting; time spent making repetitive motions; the importance of keeping up with the pace of equipment; the importance of handling, installing, positioning, and moving materials; and the importance of operating vehicles, mechanized devices, or equipment.

Functional limitations

Our primary outcome variable is the count of functional limitations reported in HRS. In each wave, respondents were asked whether they had difficulty performing several everyday activities, excluding temporary difficulties expected to last less than 3 months. We classify reports of difficulty as well as responses of "can't do" and "don't do" as having difficulty with the activity. We sum the number of difficulties reported by the respondent for the following 11 activities: walking several blocks; walking one block; sitting 2 hr; getting up from a chair; climbing several flights of stairs; climbing one flight of stairs; stooping, kneeling, or crouching; reaching or extending arms above the shoulder; pulling or pushing large objects; lifting or carrying weights over 10 pounds; and picking up a dime. This results in a count of functional limitations ranging from 0 to 11, a common way of operationalizing functional limitations in the literature on disability and physical functioning (Long & Pavalko, 2004).

Covariates

Our analyses include a set of basic demographic controls, including linear and quadratic terms for age (in years, centered on 50), race/ethnicity (categorized as non-Latino white, non-Latino Black, and Latino), whether the respondent is foreign born, a time-varying indicator for whether the respondent is married, and an indicator for the survey wave. To allow for different trajectories of functional limitations by race/ethnicity and foreign-born status, we include interactions between these two variables and a three-way interaction with age. In supplementary analyses, we consider a more extensive set of health, socioeconomic, and early life characteristics in a fully adjusted model.

Statistical Analyses

First, to determine whether socioeconomic and racial/ethnic differences in PWE vary by the source of occupational characteristics, we assess sex, racial/ethnic, and educational differences in average exposure to these occupational demands using both the HRS reports and the external O*NET scores.

The second part of our analysis consists of a set of multivariate analyses predicting the count of functional limitations from occupational exposures. We estimate trajectories of functional limitations using mixed effects Poisson models with person-level random intercepts to account for multiple observations of the same respondent. In these Poisson models, individuals contribute observations beginning with their first interview in the analytic sample and continuing until death or censoring (i.e., until they have reached the final wave in our sample or until loss-to-follow-up). These models are fit separately for males and females because trajectories of functional limitations and exposure to physically demanding work differ substantially by sex.

We estimate these trajectories with five different sets of models. To determine whether the comparable items have similar associations with functional limitations, Models 1–4 estimate the associations between the three specific domains of exposure and functional limitations. Model 1 includes general physical activity, Model 2 includes heavy lifting/handling objects, Model 3 includes stooping-related postures, and Model 4 includes all three of these work exposures. These models are estimated separately for the HRS and O*NET PWE variables. To assess the relationship between a broad set of physical demands and physical functioning, Model 5 predicts functional limitations from the average of the 12 physical demand items. In these models, all measures of PWE have been standardized as *z*-scores, so that the coefficients can be compared across models.

We use multiple imputation to impute missing values for time-invariant covariates, creating 10 replicate data sets from the procedure. Nonresponse for the covariates in the main analyses is rare (less than 1%), but we create these data sets to facilitate comparison with supplemental analyses in which we include additional covariates that are missing for up to 14% of respondents. These Poisson models were run on each of the imputed data sets, and we present results pooled across 10 models. Additional details on the imputation strategy are available in Supplementary Material.

All analyses are unweighted. Our purpose in these analyses is not to produce nationally representative estimates but rather to compare these two sources—HRS and O*NET—within a given sample. In the regression analyses, we control for a set of characteristics related to selection of respondents, an approach that produces unbiased and efficient estimates (Solon, Haider, & Wooldridge, 2015; Winship & Radbill, 1994). Poisson regressions are fit using the "xtpoisson" command in Stata version 16 (StataCorp, 2019).

RESULTS

Characteristics of the analytic sample at first observation are displayed in Table 1. The average level of PWE varies by domain (i.e., physical effort, lifting/handling, etc.) and source of occupational exposure (i.e., HRS vs. O*NET). Average occupational physical activity is similar between HRS reports (42.4) and O*NET (45.1). The average level of handling objects with O*NET (55.3) is twice as high as the average HRS level of lifting heavy loads (27.5). In contrast, the average level of stooping-related postures is higher in the HRS (38.5) than in O*NET (22.4).

Pearson correlations between these PWE variables are displayed in Table 2. In general, measures from the same data source are more highly correlated than measures of the same type of PWE across data sources. The correlations between HRS and O*NET are 0.50 for physical activity, 0.26 for lifting/handling, and 0.36 for stooping-related postures. Although the correlation for physical activity is relatively large, the other correlation coefficients are considered weak to moderate (Akoglu, 2018; Cohen, 1988).

Average levels of PWE by data source and demographic characteristics are displayed in Table 3. Although the HRS and O*NET measures have different distributions, they show similar differentials. In each domain, in both sources, males have higher PWE than females, and Latino workers have the highest PWE, followed by Black workers, whereas white workers have the lowest PWE. The expected educational gradient is present using both measures: PWE is highest among individuals with less than high school education and declines progressively with increases in education.

Results from the Poisson models for the three individual PWE variables in the HRS and their corresponding O*NET items are displayed

in Figure 1. These models include all control variables described above. This figure presents the incidence rate ratio (IRR), equivalent to the exponentiated coefficient, associated with a 1 *SD* increase in the scaled PWE. IRRs have a straightforward multiplicative interpretation, in contrast to the coefficients themselves. The first three rows present results for models including only one PWE variable at a time (Models 1–3).

The HRS and O*NET-derived PWE items have remarkably similar associations (i.e., IRRs) with functional limitations and overlapping confidence intervals. For example, in the male sample, a 1-*SD* higher score on either the HRS or O*NET measure of physical activity is associated with 16% more (IRR = 1.16) functional limitations and in the female sample with 12%–13% more functional limitations.

The fourth row shows the results with all three items included in the model (Model 4). In contrast to Model 1, in Model 4 for both males and females, the IRR associated with the O*NET measure of physical activity is noticeably smaller than the corresponding HRS measure of physical activity, though the confidence intervals remain overlapping. Additionally, the IRR for each of these items is attenuated relative to the models that contained each item individually, which is expected given the positive correlations between these items within each data source.

Finally, in the fifth row, we investigate whether information from a broader range of O*NET PWE variables has a stronger association with functional limitations (Model 5). A 1-*SD* increase in the average of O*NET physical demands is associated with 18% more functional limitations for males and 14% more functional limitations for females. The Akaike information criterion, a measure of model fit that can be used to compare non-nested models, suggests a better fit to the data with this summary O*NET measure than the models using the general physical activity measure (see Supplementary Table A5 for these statistics for all models). Nevertheless, these associations are only slightly larger in magnitude than those for the individual-item measures of general physical activity.

Table 1. Summary Statistics of Analytic Sample at First Observation in Study Period

	Mean (*SD*) or Percent
Age (years)	58.3 (6.6)
Female	52.3
Ethnicity	
White	69.9
Latino	11.9
Black	18.2
Foreign born	11.3
Married	69.2
Educational attainment	
Less than high school	18.5
High school or equivalent	31.5
Some college	24.5
College or more	25.4
Job characteristics	
Reported in HRS (Scaled from 0 to 100)	
Physical effort	42.4 (37.9)
Lifting heavy loads	27.5 (35.3)
Stooping/kneeling/crouching	38.5 (37.0)
O*NET ratings (scaled from 0 to 100)	
Importance of physical activity	45.1 (20.8)
Time spent handling objects	55.3 (21.9)
Time spent kneeling/crouching/stooping/crawling	22.4 (15.7)
Average of all physical activity items	35.5 (14.8)
Number of respondents	16,683
Number of person-waves	90,778

Note. Means and percentages are defined only for individuals with non-missing responses on each item at first observation (person-wave) and are unweighted. Both HRS and O*NET measures of work characteristics have been scaled from 0 to 100 in which 0 is the lowest amount of exposure and 100 the highest.

Supplemental Analyses

We conducted a series of supplemental analyses to examine whether our findings are sensitive to the specification of the work exposures, such as dichotomizing the three work exposure items, including a more extensive set of covariates in the multivariate models, and modeling the 12 O*NET physical demand variables using the first principal component rather than a simple average. The conclusions from these analyses, presented in Supplementary Material, largely mirror those from the main analyses.

Table 2. Pearson Correlation Coefficients between Work Exposure Variables

	HRS Physical Activity	HRS Lifting/Handling	HRS Stooping-Related Postures	O*NET Physical Activity	O*NET Lifting/Handling	O*NET Stooping-Related Postures
HRS physical activity	1.00	.49	.50	.50	.37	.43
HRS lifting/handling		1.00	.64	.33	.26	.28
HRS stooping-related postures			1.00	.36	.27	.36
O*NET physical activity				1.00	.65	.74
O*NET lifting/handling					1.00	.51
O*NET stooping-related postures						1.00

Note. Pearson correlation coefficients between work exposure variables. Both HRS and O*NET measures of work characteristics have been scaled from 0 to 100 in which 0 is the lowest amount of exposure and 100 the highest. N = 16,683 respondents.

Table 3. Average Work Characteristics by Demographic Characteristics

	Physical Activity			Lifting/Handling Objects		Stooping-Related Postures	
	N	HRS	O*NET	HRS	O*NET	HRS	O*NET
Total sample	16,683	42.4	45.1	27.5	55.3	38.5	22.4
Respondent sex							
Male	7,957	44.1	49.2	30.9	59.6	40.1	23.7
Female	8,726	40.8	41.3	24.5	51.4	37.1	21.3
Test of sex difference (*p*-value)[1]		<.001	<.001	<.001	<.001	<.001	<.001
Race/ethnicity							
Latino	1,987	52.6	53.6	33.4	62.0	47.4	28.9
Black	3,032	51.7	51.0	28.2	58.9	41.3	26.5
White	11,664	38.2	42.1	26.4	53.3	36.2	20.3
Test of race/ethnicity differences (*p*-value)[1]		<.001	<.001	<.001	<.001	<.001	<.001
Educational attainment[2]							
Less than high school	3,077	60.1	57.7	38.3	67.9	49.5	31.3
High school or equivalent	5,237	48.1	48.4	32.2	60.5	43.1	25.0
Some college	4,076	38.9	42.4	25.5	53.1	37.6	20.2
College or more	4,224	25.7	34.4	15.9	42.0	25.8	15.0
Test of educational differences (*p*-value)[1]		<.001	<.001	<.001	<.001	<.001	<.001

Note. Both HRS and O*NET measures of work characteristics have been scaled from 0 to 100 in which 0 is the lowest amount of exposure and 100 the highest. *N* = 16,683 respondents. Means are unweighted.
[1]*p*-value from ANOVA.
[2]Sixty-nine individuals are missing education information and are therefore not included in these tabulations.

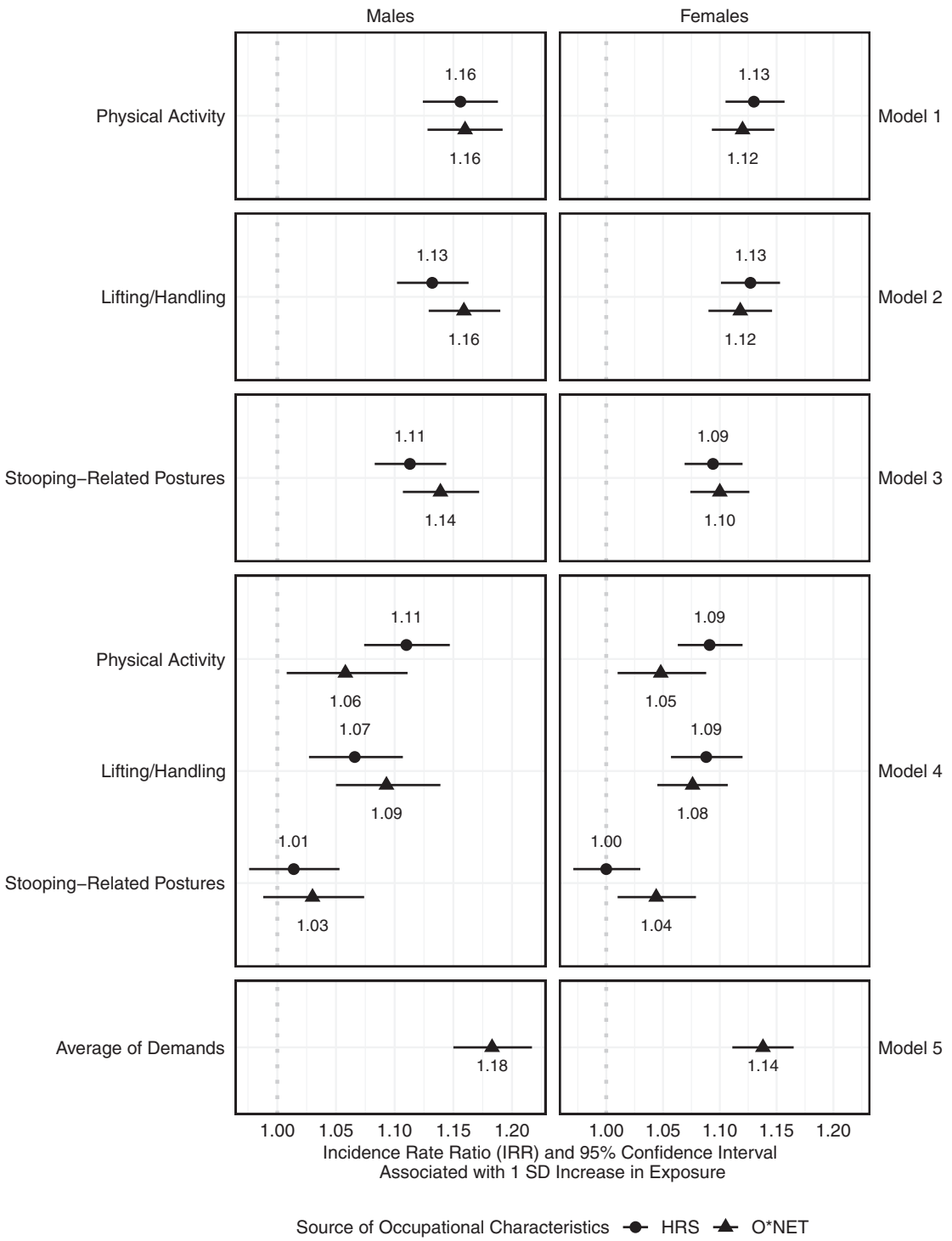

Figure 1. Incidence rate ratios (IRRs) and 95% confidence intervals from models predicting the count of functional limitations from physical work exposures. The physical work exposures have all been standardized, so that the IRR refers to the effect associated with a 1 *SD* increase in the work exposure measure. All models include linear and quadratic terms for age (in years, centered on age 50); race/ethnicity (categorized as non-Latino white, non-Latino Black, and Latino); whether the respondent is foreign born; interactions between race/ethnicity and foreign-born status; three-way interactions between race/ethnicity, foreign-born status, and age; a time-varying indicator for whether the respondent is married; and an indicator for the survey wave.

DISCUSSION

Research on PWEs and their health consequences has frequently relied on O*NET as the source of occupational characteristics. In this study, we compare two sources of PWE data, those reported in the Health and Retirement Study and in O*NET, and we assess the consistency of estimates obtained between sources.

The correlations between the HRS and O*NET measures are weak to moderate for the domains of stooping and lifting/handling and relatively large for the domain of general physical activity. These correlations are stronger than those observed between survey self-reports and O*NET measures of psychosocial aspects of work (Liu, Spector, & Jex, 2005; Schmitz, McCluney, Sonnega, & Hicken, 2019), which may be due to the inherent subjectivity of questions about experienced stress and the complex wording of those questions compared to the seemingly more straightforward questions about physical tasks (Handel, 2016). Prior research comparing measures of work exposures from different sources has found that the correlations or agreements between measures are highest when the constructs being measured and the wording of the questions were similar in both sources (Barrero, Katz, & Dennerlein, 2009). Previous work has also suggested that workers rate tasks differently on frequency scales and importance scales and that these two scales have different associations with measures of job satisfaction (Conte et al., 2005).

Our findings across the three domains included in this study (general physical activity, heavy lifting/handling objects, and stooping-related postures) partly follow this pattern. Though HRS asked about frequency, whereas O*NET asked about importance of general physical activity, general physical activity is the domain with the strongest correlation between the HRS and O*NET and the most similar average exposure levels between these two sources.

As expected from the lack of a comparable measure of heavy lifting in O*NET, the correlation is weaker and there is disagreement in average exposure in the domain of heavy lifting/handling objects. The average level of exposure suggested by O*NET's measure of handling objects is twice as high as the frequency of lifting reported by HRS respondents, likely because the O*NET measure of handling captures many more work activities than does the narrow lifting measure asked in the HRS. This disagreement could also partly reflect accommodations that the older HRS respondents have received, which would reduce the amount of lifting and handling of objects they are required to do.

The relatively weak correlation and large difference in average exposure between the two measures of stooping-related postures is unexpected. Though the O*NET question included crawling in addition to stooping, kneeling, and crouching, the wording between the two sources was similar, and both were asked relative to time spent on this activity. It is possible that HRS respondents, being older than the average O*NET incumbents and likely having more pain and difficulty completing these motions, may perceive the same amount of stooping-related postures at work as more frequent than the average incumbent. Another possibility is that, even though the two sources were worded similarly, O*NET incumbents may have interpreted the response category of "continually or almost continually" more literally than did HRS respondents using the category of "all the time or almost all of the time." This supposition is supported by the fact that occupations rarely score near the maximum in O*NET and those that score very high are occupations in which the primary task requires these positions, like tile setting or carpet installation.

Despite these disagreements in average levels of exposure, HRS and O*NET are remarkably similar at characterizing differential patterns of PWEs. In both sources across all three domains, exposures are highest for Latino workers, slightly lower for Black workers, and lowest for white workers. In both sources, men have more strenuous work than women on average, as expected. And, both sources identify the same educational gradient such that PWEs are highest among individuals with less than high school education and decline progressively with each higher educational category.

In our analysis relating work exposures to physical functioning, the HRS and O*NET measures show strikingly similar significant associations with trajectories of functional limitations. Another recent study (Fraade-Blanar et al., 2017) examined a different health outcome, workplace injury, finding that associations were similar in magnitude when comparing HRS and O*NET measures of PWEs. Taken together, our findings and those of Fraade-Blanar and colleagues (2017) provide evidence that physically demanding work at older ages is associated with adverse physical health outcomes and both self-reported and O*NET measures of occupational characteristics can be utilized to examine these associations.

Another contribution of this study is an assessment of the benefits of including a broad set of characteristics by considering an index based on 12 O*NET questions about physical demands. A potential benefit of O*NET is its questions about many physical aspects of jobs that go beyond what is included in the HRS or other surveys, for example, questions about time spent standing or climbing ladders. These tasks may also be relevant to long-term physical health outcomes. We find that the average of these 12 demands has a slightly stronger association with functional limitations and better fit to the data compared to the question on general physical activity. This suggests that although neither the HRS nor O*NET measure is clearly a superior measure of the individual physical demands, there may be some benefit to using the wide range of relevant items available in O*NET, although the choice of items may depend on the health outcome of interest.

LIMITATIONS

The findings from this study apply only to older adults still working at the time of interview. The individuals who were not in our analytic sample may have stopped working in response to the physical demands of their jobs, and those remaining may have had access to more workplace accommodations. HRS measures of PWE are not available for these individuals before they exited the labor force. An examination of the O*NET characteristics associated with previously held occupations reported by HRS respondents suggests that, on average, the excluded respondents held more strenuous jobs in the past than did those in our sample.

O*NET measures are available only at the occupation level, and we had to aggregate multiple O*NET occupations up to the less detailed code used by the HRS. As a result, some loss of precision in assigning exposures may have occurred. Though we have attempted to use the O*NET measures of PWE temporally closest in time to when HRS respondents provided their self-reports, it is still possible that job characteristics may have changed between when respondents reported on their jobs and when these jobs were measured in O*NET. However, in recent years, within-occupation changes have been modest (Freeman,

Ganguli, & Handel, 2020), and in preliminary analyses, we found that the distributions of these PWE did not substantially change between O*NET versions. Thus, it is unlikely that changes in job requirements over time account for the discrepancies between the two measurement sources.

CONCLUSIONS

The experience of physically demanding work, particularly at older ages, is associated with several adverse health outcomes and warrants continued attention in health research. Many major population-based surveys ask respondents about their occupations, but far fewer surveys ask respondents to report on their physical work conditions (Ahonen et al., 2018). As survey researchers continue to look for ways to reduce costs and respondent burden, and as new technologies facilitate automating the process of occupation coding (Schierholz, Gensicke, Tschersich, & Kreuter, 2018; Thompson, Kornbau, & Vesely, 2012), survey self-reports of occupational characteristics may become increasingly rare. If respondents are not asked about working conditions, O*NET or other external sources are the only option. It is important to understand whether findings between studies using O*NET and those using survey questions would yield comparable results, ceteris paribus. Our findings of disagreements in average levels between O*NET measures and those reported by HRS respondents indicate that these two sources are not direct substitutes for absolute levels of PWEs. However, the consistency of our findings regarding differentials in PWEs and their associations with functional limitations may assuage concerns about using physical work characteristics collected in a demographically different sample and suggest that O*NET measures can be useful in cases where self-reports are not available in surveys.

SUPPLEMENTARY MATERIAL

Supplementary data are available at *Work, Aging, and Retirement* online.

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