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Diagnosed Arthritis on Changes in
Perceived Physical Demands and
Work Stress Among Older Workers
Results From a 3-Year Panel Study

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Journal of Aging and Health
2022, Vol. 34(4-5) 508–518
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DOI: 10.1177/08982643211046427
journals.sagepub.com/home/jah


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Abstract

Objectives: Examine the effects of prevalent and newly diagnosed arthritis on changes in perceived physical demands and general work stress.

Methods: Conditional change logistic regression models examined the strength of association between arthritis and perceived (1) work stress and (2) physical demands, using data from the NIDI Pension Panel Study ($n = 2099$).

Results: Prevalent and newly diagnosed arthritis were associated with increased odds of perceived work stress and high physical demands. Manual workers with newly diagnosed arthritis exhibited a 6.73-fold (95% CI = 2.87–15.77) increased odds of physical demands. Arthritis in three body extremities was differentially associated with increased odds of work stress and physical demands in manual and non-manual workers.

Discussion: Prevalent and incident arthritis were associated with changes in work stress and physical demands in older workers. Policies and workplace interventions to reduce stress and physical demands and improve workability in older workers with arthritis are needed.

Keywords

aging workforce, work demands, work-related stress, impact of health on work, manual and non-manual workers

Introduction

Arthritis, both inflammatory and degenerative, primarily affects the joints and is highly prevalent in older adults (Dominick et al., 2004; Zyrianova et al., 2011). According to the World Health Organization (WHO), approximately 10–15% of global adults 60 years and older are estimated to have osteoarthritis and up to 1% have rheumatoid arthritis (World Health Organization, n.d.). Findings from epidemiological studies in Brazil and America have reported rheumatoid arthritis prevalence rates between 5 and 8.5% and evidence that one-third of diagnosed adults develop the disease after the age of 60 years (World Health Organization, 2013; Yazici & Paget, 2000). A Dutch study examining changes in prevalence of chronic disease and associations with disability reported that arthritis prevalence declined in the country between 1987 and 2001 (Puts et al., 2008). A subsequent study in 2003 found that 10.1% of Dutch men and 13.6% of women self-reported knee osteoarthritis, while 1.6% of men and 4.6% of women self-reported rheumatoid arthritis (Picavet & Hazes, 2003). This study will focus on the impact of prevalent and newly diagnosed arthritis on changes in

work stress and physical demands in older Dutch adults participating in the workforce.

Arthritis is one of the most common physical disorders in late life (Regier & Parmelee, 2015), the most common cause of disability, and the most frequent to co-occur with other chronic health conditions (Hootman et al., 2012). It is associated with severe pain, reduced physical functioning, impaired quality of life, disability, accelerated development of comorbidities, and premature mortality (Verstappen et al.,

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2005; Zyrianova et al., 2011). Older adults with arthritis are reported to have higher levels of depression and healthcare utilization, poorer physical and mental health, and sleep disorders, relative to those without arthritis (Dominick et al., 2004). In addition, arthritis is also associated with subsequent poor health and disability among workers in highly physically demanding jobs and those experiencing general work stress (Allaire, 2001; Mau et al., 1996).

There are physiological, psychological, and social/physical environmental mechanisms through which arthritis may result in high physical demands or general work stress. Arthritis symptoms such as inflammation, aching joints, pain with movement, fatigue, stiffness, and restricted range of motion negatively impact workability by making physical demands burdensome, resulting in anxiety, feelings of guilt and inadequacy, fear of future job loss, and subsequent psychosocial stress (Gignac et al., 2007; Lacaille et al., 2007). These symptoms may also result in work stress as they can be uncertain and unpredictable, and obscure to colleagues who may not fully comprehend the debilitating effects of the disease (Lacaille et al., 2007). The stress endured by workers with arthritis can in turn exacerbate the disease by increasing inflammation and pain (Straub & Kalden, 2009) which further decreases workability and subsequently leads to more stress and high physical demands in a vicious cycle.

Most workplace studies assessing arthritis have focused on maintaining workforce participation, productivity, and reducing disability and sickness absence (Lenssinck et al., 2013). Though alluded to as a mechanism through which arthritis impacts work (De Croon et al., 2005), few studies have actually examined the association of arthritis with work-related stress and physical demands (Fifield et al., 2004; Gignac et al., 2007; Richter et al., 2018), and even fewer have explored this relationship with arthritis as an independent variable of work stress and physical demands (Gignac et al., 2007). Gignac and colleagues in a study of arthritis patients reported that inflamed arthritis was associated with job strain (Gignac et al., 2007) and a non-causal association between arthritis and physical demands was also reported in a study of 5193 adults aged 35–75 years participating in the first National Health and Nutrition Examination Survey (Anderson & Felson, 1988).

These prior studies primarily focused on prevalent arthritis, despite research indicating that functioning is greatly impacted in newly diagnosed adults (Björk et al., 2006). For example, a study of arthritis patients reported a 70% reduction in hand function in women with early-stage arthritis (Björk et al., 2006). Newly diagnosed arthritis may result in incongruity between job demands and ability to carry out daily duties (Gilworth et al., 2003) due to the capricious nature of the symptoms, side effects of new medications, or poor self-efficacy in disease self-management (Lacaille et al., 2007). Disease progression in those with prevalent arthritis is associated with more pronounced symptoms,

activity limitations, physical impairments, decreased functioning, and increased disability (McDonough & Jette, 2010), all of which can affect the capacity to carry out physically demanding tasks and increase risk of stress experienced in the workplace.

Structural changes to disability pension are reducing the possibility of early ill-health retirement (Pedersen et al., 2020) and reforms to pension policy are increasing the occupational life course (Oude Mulders, 2019), resulting in higher prevalence of older adults with health challenges who have to continue working. According to the literature, workers with early stage arthritis are more eager to continue working (Holland & Collins, 2018), while those with prevalent disease are intent on exiting the workforce (Barrett, 2000; Verstappen et al., 2005). Knowledge of how newly diagnosed and prevalent arthritis may differentially impact work factors can inform interventions and workplace accommodations tailored to improve quality of work life for older workers who want to continue working, and those who are unable to exit the workforce prematurely due to pension reform. To the best of our knowledge, there are currently no studies examining the differential association of prevalent and newly diagnosed arthritis on physical demands and work stress in older workers whose occupational life course has been extended due to pension reform.

Physical demands and work stress in workers with arthritis may be determined by the nature of work activities and the joints impacted, and are therefore likely to differ across occupations (De Croon et al., 2005; Goedhard & Goedhard, 2005; Skovlund et al., 2020). Manual and non-manual occupational activities are differentially associated with arthritis risk and arthritis development in select joints. Manual work involves substantial physical exertion and is associated with risk of arthritis in the lower and upper extremities (Allen et al., 2010; Melchior et al., 2006). For example, arthritis and symptoms such as musculoskeletal disintegration, chronic hip and knee injuries, low back pain, and neck and upper limb complaints have been reported in agricultural workers whose jobs involve high physical exertion (Holmberg et al., 2004; Taylor-Gjevrev et al., 2015). Non-manual work, on the other hand, is reportedly associated with more upper extremity symptoms such as in the neck and shoulders, with one study reporting limited evidence of arthritis in lower extremity joints in non-manual workers (Baker et al., 2009; Kwon et al., 2019). Manifestation of arthritis in different body extremities may therefore have different implications for manual and non-manual occupations which involve different levels of exertion, work postures, controlled movements, and use/overuse of specific joints or muscle groups (Fraade-Blanar et al., 2017; Karlqvist et al., 2003). Knowledge of the impact of arthritis in the different body extremities on stress and physical demands may help inform appropriate workplace interventions that can allow older workers to continue to successfully engage in the labor force until they retire. To

date, however, no studies have assessed the differential associations of both prevalent and newly diagnosed arthritis on physical demands and general work stress in older manual and non-manual workers.

The objectives of this study were therefore to examine the effect of (a) prevalent and (b) newly diagnosed arthritis on changes in perceived physical demands and general work stress in older workers approaching retirement using two waves of data spanning a 3-year period. We compared participants who did not have an arthritis diagnoses over the study period, with those who had prevalent arthritis at baseline in 2015, and those with newly diagnosed arthritis self-reported at wave 2 in 2018. A second objective was to assess whether there were differences in the association of arthritis in different body extremities with our outcomes of interest. Specifically, we examined whether prevalent and newly diagnosed (a) hand/arm, (b) hip/leg/foot, and (c) neck and back arthritis were differentially associated with physical demands and general work stress. Finally, we assessed how these associations differ in manual and non-manual workers.

This study makes four distinct contributions to the literature. First, while previous research focused on prevalent arthritis only, our study further contributes to the literature through examining how both prevalent and newly diagnosed arthritis impact changes in stress and physical demands. This allows us to postulate whether complications in prevalent cases or aspects of disease management in newly diagnosed cases impact workability. Second, our use of panel data allows us to account for changes in stress and physical demands over the study period, thereby reducing potential bias of using a onetime only measure of the outcomes. A third valuable contribution of this study is the focus on the heterogeneity of the effects of prevalent and newly diagnosed arthritis through assessment of arthritis that has manifested in different body extremities in both manual and non-manual workers. Finally, the current study provides an in-depth assessment of arthritis in older workers who due to pension reform, will remain in the workforce much longer.

Methods

Dataset Description

This study used data from the first two waves of the (NIDI Pension Panel Study) spanning a 3-year period (2015–2018) (Henkens et al, 2017). Using a stratified design, a sample of organizations was selected from three large Dutch pension funds, after which workers aged 60–65 years working 12 or more hours per week were randomly sampled from the selected organizations. Questionnaires with an online response option were mailed to 15,470 potential respondents' home, and 6793 participated in the baseline wave, representing a 44% response rate at baseline, and a follow-up response rate over 79%.

Inclusion and Exclusion Criteria

Older workers who participated in the two waves of the NIDI Pension Panel Study ($n = 5311$) and were working for pay at wave 2 were eligible for the study ($n = 2636$). Participants were included if at wave 2 they were below the mandatory age of retirement ($n = 2528$). They were excluded if they did not provide a response regarding doctor diagnosed arthritis at wave 2 ($n = 147$) or reported an arthritis diagnoses in wave 1 but indicated that they did not have the diagnoses in wave 2 ($n = 282$). This resulted in a sample size of 2099. We excluded 136 participants from the physical demands models who did not have a physical demands measure. Similarly, 96 participants were excluded from the general work stress models as they did not have a general work stress measure. The final analytic models, therefore, had a sample size of 1963 and 2003 for physical demands and work general stress models, respectively. As individuals can self-select out of work for several factors, we conducted sensitivity analysis using Heckman selection models to assess whether our sample was vulnerable to selection bias. The results indicate that there was no selection bias associated with working in wave 2 (Supplemental Table 1).

Dependent Variables

The outcomes of interest were high physical demands and general work stress. Participants were asked whether they experienced (1) "stress" (2) and physical demands in their work. The response options very, fairly, a little, or no were dummy coded yes (very, fairly = 1) and no (a little, no = 0). These measures were adopted from the Study on Transitions in Employment, Ability, and Motivation survey (Van Vegchel et al., 2004). The term "stress" in the Dutch context refers to psychosocial demands. Physical work demands refer to work that involves work substantial physical exertion (Biering et al., 2015). These two variables are not empirically correlated in our study ($r = .21$).

Independent Variable

Self-reported arthritis diagnosis was the primary independent variable of interest. This was ascertained by a confirmatory response to a question asking participants about doctor diagnosed long-standing conditions, including arthritis of the (i) hand and arm; (ii) hip, leg, and foot; and (iii) neck and back. Responses to this question at both wave 1 and 2 were used to create an arthritis variable with three discrete categories (no arthritis, prevalent arthritis, and newly diagnosed arthritis). Prevalent arthritis was defined as an arthritis diagnosis in wave 1; newly diagnosed arthritis was defined as onset of arthritis after wave 1, as reported in wave 2; and no arthritis category represented those who had not been diagnosed with the disease at both waves. Arthritis variables for the body extremities included a fourth category "other

arthritis” which was indicative of those who did not have arthritis in a specified extremity, but had it in other different extremities. To assess our objectives, participants with arthritis in one or more of these body extremities were coded as having arthritis (yes/no). An additional independent variable of interest was occupational category (manual/non-manual work).

Covariates

Based on previous literature demonstrating effects on work stress and physical demands, additional variables of interest controlled for in the analyses included age, other chronic health conditions (diabetes, cardiovascular disease, and respiratory disorders), industrial sector (government, education, construction, and health & welfare), International Socioeconomic Index of Occupational Status (ISEI-08), work hours, and current smoker (yes, no). The ISEI-08 is an internationally comparable measure of occupational status which was developed by Ganzeboom (2010) and treats occupation as a mediating variable in the direct and indirect effects of education on income (Ganzeboom, 2010; Ganzeboom et al., 1992). It is a continuous variable with higher standardized scores reflecting higher occupational status. The ISEI-08 is a validated measure and has been widely used in work and health research (Jacobs et al., 2015; Kuntz et al., 2018; Qi et al., 2019).

Missing Data

Approximately 86.8% of the cases had complete data, and item non-response for relevant survey questions ranged from approximately .01% to 4.4%. We used multiple imputation by chained equations to generate 20 imputed datasets per Rubin’s procedures (Rubin, 1987). We ran analyses before and after imputation, and found that the direction, magnitude, and significance of the parameter estimates do not change. The results presented below are with imputed data.

Statistical Analyses

Sample characteristics were summarized using frequencies and means. Bivariate analysis between arthritis, occupational category, and the outcomes of interest was also conducted. Conditional change logistic regression models, fully adjusted for the above-mentioned covariates, examined the effect of all arthritis (model 1) and arthritis in the three different body extremities (models 2–4) on change in perceived (1) physical demands and (2) general work stress. Conditional change modeling allows for the dependent variable measured at time 2 to be regressed on the dependent variable measured at time 1, along with the primary independent variables and relevant covariates. Not only does this control for possible ceiling effects but it also models change between two timepoints (Aickin, 2009; Ferrarini et al., 2014; Patte et al., 2020). This

methodology reduces concerns of confounding effects and provides more sound results (Aickin, 2009; Ferrarini et al., 2014; Patte et al., 2020). To assess whether there were any differences between manual and non-manual workers, we ran an additional model that included an interaction between occupational category and arthritis. We observed significant interactions in the analysis for physical demands between manual work and newly diagnosed arthritis ($p = .01$) only, and in the analysis for work stress between manual work and prevalent back and neck arthritis ($p = .04$) only. We further stratified analysis by manual and non-manual work. All analyses were performed using Stata16 MP software (Stata, College Station, TX).

Results

Table 1 presents the participant characteristics as a function of arthritis diagnosis. The average age at wave 2 was 64 years (SD 1.0). Manual workers also had higher rates of both prevalent and newly diagnosed arthritis than non-manual workers. Rates of prevalent and newly diagnosed arthritis among participants reporting perceived physical demands between wave 1 and 2 are from 39.0% and 29.2% to 44.8% and 41.8%, respectively. Similarly, participants reporting perceived general work stress at waves 1 and 2 had prevalent arthritis rates of 64% and 69.5%, respectively, and newly diagnosed rates of 60.6% and 69.6%, respectively.

Table 2 presents the bivariate analysis of physical demands and work stress at wave 2 with arthritis and manual work, respectively. Approximately 59.7%, 69.5%, and 69.6% of participants with no, newly diagnosed, and prevalent arthritis, respectively, reported general work stress ($p < .01$). Physical demands were reported by 24.0%, 44.8%, and 41.8% participants with no, newly diagnosed, and prevalent arthritis, respectively ($p < .01$). More non-manual workers reported general work stress (66.8%) than high physical demands (23.5%), while among manual workers, rates of high physical demands (68.6%) were higher than those of general work stress (55.4%).

Table 3 presents the results of the conditional change models analyzing the impact of arthritis on changes in general work stress. In the pooled analyses, relative to those with no arthritis over the study period, prevalent arthritis at baseline was associated with a 52% (95% CI = 1.20–1.92) increased odds of stress in wave 2. Newly diagnosed arthritis was associated with a 57% (95% CI = 1.15–2.13) increased odds of stress. Prevalent (OR = 1.75, 96% CI = 1.27–2.41) and newly diagnosed (OR = 2.01, 96% CI = 1.38–2.93) hand and arm arthritis were associated with increased odds of stress. Relative to no arthritis, those with prevalent hip, leg, foot, or other arthritis had higher odds of general work stress, while the same was not observed for newly diagnosed cases. There were evident associations of both prevalent (OR = 1.57, 96% CI = 1.18–2.10) and newly diagnosed (OR = 1.71, 96% CI = 1.20–2.44) back and neck arthritis with general stress. We

Table 1. Cohort Characteristics at Wave 2 by Arthritis Diagnosis.

	No arthritis (n = 1052)	Prevalent (n = 713)	Newly diagnosed (n = 334)	p value
	%	%	%	
Age at wave 2 (mean, SD)	64.14 (1.01)	64.18 (.99)	64.13 (1.00)	.82
Gender				.01
Female	43.30	50.80	45.80	
Male	56.70	49.20	54.20	
Chronic conditions				.01
None	77.90	71.00	75.10	
At least one	22.10	29.00	24.90	
Smoke				.08
No	89.00	88.00	92.60	
Yes	11.00	12.00	7.40	
Occupational status (mean, SD)	.15 (.91)	-.10 (.92)	-.1 (.98)	.27
Work sector				<.01
Government	29.80	24.70	21.60	
Education	27.00	21.20	23.40	
Construction	15.20	19.60	20.70	
Healthcare/Welfare	28.00	34.50	34.40	
Manual and non-manual work				<.01
Non-manual	17.70	24.80	26.40	
Manual	82.30	75.20	73.60	
Work hours (mean, SD)	30.11 (9.03)	29.08 (9.57)	30.82 (8.92)	.17
Wave 1 physical demands				
No	78.30	61.00	70.80	
Yes	21.70	39.00	29.20	
Wave 2 physical demands				<.01
No	76.00	55.20	58.20	
Yes	24.00	44.80	41.80	
Wave 1 general work stress				<.01
No	44.10	36.00	39.40	
Yes	55.90	64.00	60.60	
Wave 2 general work stress				<.01
No	40.30	30.50	30.40	
Yes	59.70	69.50	69.60	

observed a significant interaction between manual work and back and neck arthritis ($p = .05$) only, implying that there was statistically significant difference in general work stress between the two occupational groups.

Stratification by occupational group indicated a 47% (95% CI = 1.03–2.11) increased odds of stress among non-manual workers with prevalent and newly diagnosed arthritis, respectively. Prevalent (OR = 1.59, 95% CI = 1.11–2.27) and newly diagnosed (OR = 1.95, 95% CI = 1.23–3.08) arthritis in the hand and arm were associated with increased odds of stress in non-manual workers. Among manual workers both prevalent and newly diagnosed arthritis in the hand and arm as well as back and neck arthritis were associated with an approximately two-fold increased odds of general work stress (Table 3).

Table 4 presents the results of the association between arthritis and physical demands. In the pooled analyses,

relative to those with no arthritis over the study period, prevalent (OR = 1.91, 95% CI = 1.41–2.58) and newly diagnosed (OR = 2.31, 95% CI = 1.59–3.34) arthritis were associated with an increase in physical demands in wave 2. Prevalent and newly diagnosed hand and arm, hip, leg, foot, and back and neck arthritis were associated with increased odds of physical demands in wave 2 (Table 4).

Stratification by occupational group indicated a two-fold (95% CI = 1.42–2.84) and 73% (95% CI = 1.11–2.72) increased odds of physical demands in non-manual workers with prevalent and newly diagnosed arthritis, respectively. There was a stronger association between prevalent arthritis and physical demands for non-manual workers; however among manual workers, we observed robust associations with newly diagnosed arthritis, and no significant associations with prevalent arthritis (Table 4). Manual workers with newly diagnosed arthritis exhibited a 6.73-

Table 2. Bivariate Association of General Work Stress and Physical Demands with the Primary Independent Variables.

	General work stress (n = 2003)				Physical demands (n = 1963)			
	No	Yes	χ^2	p	No	Yes	χ^2	p
	%	%			%	%		
All arthritis								
No disease	40.28	59.72	21.09	<.01	75.98	24.02	86.87	<.01
Prevalent arthritis	30.48	69.52			55.2	44.8		
Newly diagnosed arthritis	30.41	69.59			58.18	41.82		
Hand & arm arthritis								
No disease	40.28	59.72	26.98	<.01	75.98	24.02	98.23	<.01
Other arthritis	34.35	65.65			61.61	38.39		
Prevalent arthritis	26.40	73.60			50.31	49.69		
Newly diagnosed arthritis	28.00	72.00			53.00	47.00		
Hip, leg & foot arthritis								
No disease	40.28	59.72	21.92	.01	75.98	24.02	89.98	
Other arthritis	30.21	69.79			59.52	40.48		<.01
Prevalent arthritis	29.32	70.68			52.78	47.22		
Newly diagnosed arthritis	32.51	67.49			56.96	43.04		
Back & neck arthritis								
No disease	40.28	59.72	22.43	<.01	75.98	24.02	95.16	<.01
Other arthritis	32.51	67.49			61.75	38.25		
Prevalent arthritis	30.03	69.97			52.97	47.03		
Newly diagnosed arthritis	27.97	72.03			52.14	47.86		
Manual versus non-manual								
Manual	44.56	55.44	17.71	<.01	31.37	68.63	302.53	<.01
Non-manual	33.23	66.77			76.46	23.54		

Table 3. Impact of Arthritis on Changes in Perceived General Work Stress^{a,b}.

		Pooled analyses (n = 2003)		Stratified analysis			
		OR	95% CI	Non-manual (n = 1594)		Manual (n = 409)	
				OR	95% CI	OR	95% CI
<i>Model 1</i>	Arthritis (ref: no arthritis)						
	Prevalent arthritis	1.52	(1.20–1.92)**	1.39	(1.06–1.82)*	2.11	(1.26–3.53)**
	Newly diagnosed arthritis	1.57	(1.15–2.13)**	1.47	(1.03–2.11)*	2.17	(1.17–4.01)*
<i>Model 2</i>	Hand & arm arthritis (ref: no arthritis)						
	Other arthritis	1.27	(.98–1.65)	1.18	(.87–1.59)	1.81	(1.03–3.18)*
	Prevalent arthritis	1.75	(1.27–2.41)**	1.59	(1.11–2.27)**	2.65	(1.31–5.37)**
	Newly diagnosed arthritis	2.01	(1.38–2.93)**	1.95	(1.23–3.08)**	2.32	(1.16–4.62)*
<i>Model 3</i>	Hip, leg, foot arthritis (ref: no arthritis)						
	Other arthritis	1.57	(1.17–2.12)**	1.43	(1.01–2.01)*	2.10	(1.12–3.92)*
	Prevalent arthritis	1.61	(1.21–2.13)**	1.49	(1.08–2.05)**	2.30	(1.26–4.21)**
	Newly diagnosed arthritis	1.37	(.98–1.92)	1.30	(.88–1.93)	1.94	(.97–3.88)
<i>Model 4</i>	Back & neck (ref: no arthritis)						
	Other arthritis	1.40	(1.05–1.86)*	1.39	(1.00–1.93)*	1.69	(.89–3.22)
	Prevalent arthritis	1.57	(1.18–2.10)**	1.35	(.97–1.88)	2.43	(1.35–4.36)**
	Newly diagnosed arthritis	1.71	(1.20–2.44)**	1.59	(1.05–2.40)**	2.30	(1.14–4.62)*

Note. OR = odds ratio; CI = confidence interval; * <.05 **<.01.

^aModel was fully adjusted for wave 1 perceived general work stress, age, gender, other health conditions, occupational sector, occupational status, work hours, occupational category, current smoker.

^bResults showing covariates are available in Supplemental Tables 1 to 5.

Table 4. Impact of Arthritis on Changes in Perceived Physical Demands^{a,b}.

		Pooled analyses (<i>n</i> = 1963)		Stratified analysis			
		OR	95% CI	Manual (<i>n</i> = 438)		Manual (<i>n</i> = 438)	
				OR	95% CI	OR	95% CI
<i>Model 1</i>	Arthritis (ref: no arthritis)						
	Prevalent arthritis	1.91	(1.41–2.58)**	2.01	(1.42–2.84)**	1.58	(.84–2.96)
	Newly diagnosed arthritis	2.31	(1.59–3.34)**	1.73	(1.11–2.72)*	6.73	(2.87–15.77)**
<i>Model 2</i>	Hand & arm arthritis (ref: no arthritis)						
	Other arthritis	2.02	(1.44–2.82)**	1.91	(1.29–2.82)**	2.56	(1.29–5.07)**
	Prevalent arthritis	1.96	(1.34–2.84)**	2.01	(1.32–3.07)**	1.72	(.75–3.93)
	Newly diagnosed arthritis	2.23	(1.42–3.51)**	1.77	(1.03–3.05)*	5.14	(1.86–14.20)**
<i>Model 3</i>	Hip, leg, foot arthritis (ref: no arthritis)						
	Other arthritis	1.84	(1.27–2.67)**	1.56	(1.00–2.43)*	3.03	(1.40–6.58)**
	Prevalent arthritis	2.18	(1.54–3.08)**	2.36	(1.59–3.51)**	1.77	(.85–3.70)
	Newly diagnosed arthritis	2.09	(1.39–3.16)**	1.76	(1.08–2.86)*	3.83	(1.57–9.34)**
<i>Model 4</i>	Back & neck (ref: no arthritis)						
	Other arthritis	2.01	(1.41–2.87)**	1.80	(1.20–2.72)**	3.61	(1.62–8.06)**
	Prevalent arthritis	1.88	(1.31–2.70)**	1.99	(1.31–3.04)**	1.51	(.75–3.01)
	Newly diagnosed arthritis	2.34	(1.54–3.57)**	2.00	(1.23–3.26)**	5.36	(1.92–14.98)**

Note. OR = odds ratio; CI = confidence interval; * <.05 **<.01.

^aModel was fully adjusted for wave 1 perceived physical demands, age, gender, other health conditions, occupational sector, occupational status, work hours, occupational category, current smoker.

^bResults showing covariates are available in Supplemental Tables 1 to 5.

fold (95% CI = 2.87–15.77) increased odds of physical demands relative to those without arthritis. The non-overlapping confidence intervals and a significant arthritis and occupational category interaction ($p = .01$) indicate that this finding was statistically different from non-manual workers. The increased odds of perceived physical demands were also evident in manual workers with newly diagnosed arthritis in the hand and arm (OR = 5.14, 95% CI = 1.86–14.20), hip, leg, foot (OR = 3.83, 96% CI = 1.57–9.34), and back and neck (OR = 5.36, 96% CI = 1.92–14.98). The effect of newly diagnosed hand and arm and back and neck arthritis was greater than that of arthritis reported in other extremities (Tables 3 and 4).

Increasing age was modestly associated with decreased odds of general work stress and physical demands in non-manual workers. Similarly relative to female non-manual workers, male workers had decreased odds of physical demands. There was increased odds of general work stress in the education sector among non-manual workers, and in the healthcare/welfare sector in pooled analyses (Supplemental Tables 2 and 3). Relative to the government sector, the healthcare/welfare sector was associated in an over five-fold increased odds of high perceived physical demands, in all the body extremities (Supplemental Tables 4 and 5). The education and construction sectors were also associated with increased odds of high physical demands (Supplemental Tables 4 and 5). The strength of the association between work hours and

general stress was weak, and no association was observed with physical demands.

Discussion

Our study sought to examine the association of newly diagnosed and prevalent arthritis with general work stress and high physical demands among older workers using panel data. We found an increased odds of both work stress and physical demands at wave 2 in workers with newly diagnosed and prevalent disease, and in all body extremities examined. This study is of great relevance and importance in aging societies, in particular as pension reform is increasing retirement age across the globe (Amaglobeli et al., 2020). As incidence and prevalence of arthritis increases with age, there will be more older adults with arthritis in the workforce whose ability to remain productive in the latter years of their work lives may be compromised. While the impact of prevalent arthritis on work demands has been previously reported, ours is the first study to demonstrate that newly diagnosed arthritis is likely to have an even greater impact on work stress and demands particularly when occupational category and body extremity are taken into account. Of interest, we found a near seven-fold increased odds of physical demands for manual workers, compared to 73% increased odds among non-manual workers. The high odds of increased physical demands in manual workers which was not attenuated by control variables, provides support for the notion

that newly diagnosed arthritis has greater negative effects on workers whose jobs involve physical exertion. These workers may represent individuals with an accelerated decline in workability, with increased odds of prematurely exiting the workforce.

While our findings are partially supported by previous studies that have reported an association of prevalent arthritis with work stress and physical demands (Anderson & Felson, 1988; Fifield et al., 2004; Gignac et al., 2007; Richter et al., 2018), no prior studies had assessed these associations with newly diagnosed arthritis. To our knowledge, ours is the first study to show not only how newly diagnosed and prevalent arthritis may have different effects on risk of general and physical stress in the workplace, but also the differences in the magnitude of these associations for manual and non-manual workers.

We observed that the odds of general work stress and physical demands increased at wave 2 for those with prevalent arthritis, implying that health (and by extension workability) may have deteriorated due to disease progression, or older workers experienced challenges in disease management. While disease management and life adjustments are integral to living and working with arthritis, these may not be sufficient to address the complex challenges arthritis presents as an incurable condition in older workers. Workforce interventions are, therefore, paramount to deal with arthritis in the workplace.

General work stress among non-manual workers with new onset of the disease may be linked to adapting to life with unpredictable symptoms, effects of new medications, or challenges in disease self-management (Lacaille et al., 2007). On the other hand, the increased odds of perceived physical demands in those with prevalent arthritis may be the result of pain and continuously decreasing functioning (Regier & Parmelee, 2015). The literature has indicated that pain is one of the most distressing symptoms of arthritis due to progressive joint failure (Regier & Parmelee, 2015) which can make work increasingly difficult for those with prevalent disease, thereby increasing the level of stress experienced.

Among manual workers, we found that newly diagnosed, but not prevalent arthritis, was associated with high physical demands. The 6.7-fold increased odds of physical demands with newly diagnosed arthritis we observed may be due new arthritis symptoms such as inflammation, aching joints, fatigue, stiffness, and restricted range of motion which can prohibit ability to carry out tasks such as lifting heavy loads, standing for long periods of time, and repetitive movements with hands or arms (Barrett, 2000; Lacaille et al., 2007). Another possible explanation for these findings is that workers with prevalent disease may already have had relevant work adjustments after experiencing adverse effects of arthritis (McDonough & Jette, 2010), while those with new disease have not yet had relevant accommodations and support needs incorporated into their work. Arthritis is chronically painful and incurable, and studies have reported

that effective coping and self-management strategies are critical in its relationship with physical and psychological factors, and in mediating its impact on quality of life (Regier & Parmelee, 2015; Zyrianova et al., 2011). Individuals with newly diagnosed chronic conditions often lack disease management self-efficacy which may result in more adverse outcomes (Farrell et al., 2004). In addition, the adverse effects of arthritis on work stress and physical demands may be higher among workers with poor cognitive, emotional, and behavioral coping mechanisms, as well as those who lack effective self-management skills.

There were no significant associations between older workers in the construction sector and general work stress in our study; however, the construction sector was strongly associated with high physical demands. We found robust associations between the healthcare/welfare sector and general work stress in pooled analysis only. Similar to the construction sector, the association was greater for high physical demands. These findings of higher perceived physical demands in older workers in the construction and healthcare/welfare sector are corroborated by previous literature (Merkus et al., 2019). Older adults face increasing health challenges and deteriorations in their stamina, muscle mass, and physical capacity, which may increase the burden of work that requires physical exertion (Fraade-Blanar et al., 2017; Karlqvist et al., 2003). We further observed an increased odds of both general work stress and physical demands in the education sector. Stress in educators has been attributed to high expectancies of meeting the needs and demands of children and their parents (Viotti et al., 2017). Physical demands are understudied in educators; however, a few studies have reported that adults working with small children often have to bend to reach or carry children, as well as sit on the floor or small furniture often during interactions with children (Viotti et al., 2017). Meeting the needs and demands, as well as the physical exertion educators experience on a daily basis, may become burdensome with age in particular when managing arthritis which can have unpredictable flare ups.

Despite a small age range, increasing age was protective of stress and physical demands. This may be partially due to healthy worker survival effect and disengagement (Afrahi et al., 2021; Chowdhury et al., 2017; Damman et al., 2013; Johnson et al., 2011). Older workers are more likely to transition into less demanding positions or have less rigorous physical requirements before completely withdrawing from the labor force and are more likely to disengage, that is, emotionally, cognitively, or physically distance themselves from work as they approach retirement (Afrahi et al., 2021; Chowdhury et al., 2017; Damman et al., 2013; Johnson et al., 2011). In addition, working adults without arthritis account for 50.1% of our study population, 34% had prevalent and 15.9% had newly diagnosed arthritis, which is in contrast to 39.4%, 48.2%, and 12.4%, respectively, among those who exited the workforce before wave 2. The differences in these

rates imply that we cannot rule out selection bias due to healthy worker survivor effect as workers with poorer health are more likely to exit the workforce earlier (Mutambudzi et al., 2019; Vanajan et al., 2020).

Our findings should be considered in light of several limitations. First, our study collected single item responses for general work stress and physical demands in lieu of previously validated stress measures that capture different aspects of the work environment. Second, health is not stagnant, and we were unable to account for differences in pace of arthritis-related health declines, which may have differential impact on stress. Third, our study did not assess the role of coping, and disease self-efficacy which is reported to reduce pain and disability, and to positively impact symptom management without burdening the healthcare system (Osborne et al., 2007). Fourth, the effects of arthritis on health and well-being including perceived physical demands and stress are likely to differ based on differences in treatment, disease severity, side effects of new medications, or poor self-efficacy in disease self-management. Measures assessing these factors were not available to be adjusted for in our analysis. Finally, the baseline response rate of 44% was low and may have introduced non-response bias to our study, as individuals with poor health, health behaviors, and life experiences are less likely to participate in surveys (Cheung et al., 2017). This may potentially contribute to underestimation of the associations examined. The follow-up rate was over 79% which lends weight to our findings. Our study is also strengthened by the use of a dataset of working older adults approaching the age of retirement.

Our study findings confirm the need to address not only prevalent but also incident arthritis in older workers, especially as the retirement age is increasing. These findings suggest that there is a need for policies and workplace interventions to reduce work stress and physical demands. In addition to adjustments and reassignment of work, interventions should focus on arthritis self-management and coping mechanisms within the work setting. Future research should account for organizational practices, disease severity, personal coping methods, and disease self-management, as these are likely to impact workability and mediate the relationship between arthritis and working conditions. The proportion of older workers with arthritis will continue to increase over the years. Understanding how arthritis may increase susceptibility to work demands and subsequent health outcomes is, therefore, important. Continued research in this area to inform effective workplace and public health interventions is warranted.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This work

was supported by the Network for Studies on Pension, Aging, and Retirement (Netspar); and the Netherlands Organization for Scientific Research (NWO, grant number 453-14-001).

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Supplementary Material

Supplementary material for this article is available online.

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