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Conflict of Interest

None.

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Abstract

Introduction: The proportion of workers with chronic health conditions (CHC) will increase over the years as pension reform is increasing the age of retirement in many European countries. This will increase the percentage of older adults with CHC performing highly demanding work. This study sought to examine the association between the most prevalent CHC (cardiovascular disease (CVD), diabetes, arthritis, respiratory and sleep disorders) and three domains of work stress in older Dutch workers.

Methods: This study used data from the first wave of the NIDI Pension Panel Study for working adults aged 60-65 years (n= 6,793). Logistic regression models examined the strength of association between CHC and 1) general work stress 2) emotional, and 3) physical demands.

Results: All 5 CHC were independently associated with one or more domains of stress. After including all CHC in the model CVD, sleep disorders, and arthritis were significantly associated with general stress. Respiratory disorders, sleep disorders, and arthritis were significantly associated with physical demands. Diabetes (1.25, 95%CI=1.01-1.53), sleep disorders (1.99, 95%CI=1.72-2.31), and arthritis (1.18, 95%CI=1.06-1.31) were significantly associated with emotional demands.

Conclusions: Our findings demonstrate that work stress is associated with prevalent chronic health conditions, and these conditions are differentially associated with several domains of work stress in adults approaching retirement. More research is needed to understand the causal relationship between CHC and work stress. Such research may provide insights for effective

workplace and public health interventions to ensure that older workers remain physically and mentally healthy, and productive through their working years.

Introduction

The prevalence of independent and comorbid chronic health conditions (CHC) increases with age (Koolhaas et al. 2013). Approximately 66% of the Dutch population aged 50-65 have at least one chronic condition, and common risk factors for CHC that include high BMI, smoking, and reduced physical activity have seen increasing trends in older Dutch adults over the years (Rezayatmand et al. 2015; Koopman et al. 2016). In addition to their association with disability and mortality, CHC such as cardiovascular disease (CVD), diabetes, sleep disorders, rheumatic diseases, and respiratory disorders can negatively impact work life (Graaf et al. 2012; Koolhaas et al. 2013). High prevalence of these conditions in older workers, coupled with extensions to the work life due to pension reform in many European countries, will result in larger proportions of workers with CHC, which can affect labour force participation and productivity (Koolhaas et al. 2013; Mutambudzi et al. 2019; Oude Mulders 2019). Approximately 20% of employees within the EU have a longstanding illness or health problem, and one in three mid-old age employees in the Netherlands report a CHC, with 30% experiencing job difficulties associated with their disease (Detaille et al. 2009; Koolhaas et al. 2012; European Foundation for the Improvement of Living and Working Conditions 2014).

Workers with CHC report greater exposure to work stress, and perceive their work as more mentally strenuous relative to their healthier colleagues (Koolhaas et al. 2012; European Foundation for the Improvement of Living and Working Conditions 2014). Approximately one quarter of employed adults in the EU report job strain, and annual costs of work-related stress factors are estimated to be around €4-€6 billion in the Netherlands, almost 3% of the country's GDP (European Agency for Safety and Health at Work 2014). Work stress is not only associated with subsequent poor health, but is known to adversely impact job satisfaction, productivity,

quality of life, and work-life balance, as well as increase incidence of sickness absence, and premature exit from the workforce through early retirement or disability pension (Ganster and Rosen 2013).

Research assessing work stress as an outcome of adverse health is lacking. Previous studies primarily reported that stressful work environments are explanatory factors for increased risk of onset, or exacerbation of CHC (Koolhaas et al. 2013; Mutambudzi and Javed 2016). Some scholars have postulated that this association is bidirectional, with several suggesting that work stress levels increase after onset of CVD, diabetes, and sleep disorders (Li et al. 2015; Van Laethem et al. 2015). Li and colleagues measured work stress before and after onset of CVD and reported that work stress increased after workers diagnosed with CVD returned to work (Li et al. 2015). Another study which examined the bidirectional relationship between sleep and stress found that poor sleep quality was associated with increased work stress the following year, while work stress was not associated with subsequent decreased sleep quality. In addition to studies that examined a bidirectional association, some studies have demonstrated that CHC such as rheumatic diseases and diabetes, can confound an employee's ability to optimally perform work duties, thereby increasing risk of experiencing poor mental and psychosocial outcomes due to concerns of how their compromised work ability may impact their financial or job security and quality of life (Graaf et al. 2012; Mutambudzi et al. 2019).

There are several mechanisms through which poor chronic health may increase risk of work stress. CVD, diabetes, rheumatoid diseases and respiratory disorders are associated with reduced health related work performance and poor quality of working life after disease onset (Graaf et al. 2012; Mutambudzi et al. 2019). Existing health problems, their treatment side effects, and poor disease management may result in chronic fatigue, poor concentration, impaired functioning,

increased presentism or absenteeism, and decreased productivity (Graaf et al. 2012; de Jong et al. 2015; Mutambudzi et al. 2019). These factors may induce stress through impacting promotion and salary increment opportunities, prompting changes to the work role, and potential demotions or job loss (de Jong et al. 2015). Similarly, lack of quality sleep can negatively impact work performance, attention to tasks and decision making factors that may increase workload and work-related stress (Van Laethem et al. 2015). In addition, discrimination and prejudice in the workplace which have been associated with emotional stress, disproportionally affect workers with chronic diseases (Okechukwu et al. 2014).

Research indicates that the manifestation of general "non-specific" work stress, physical demands, and qualitative demands including emotional stress may be differentially patterned by varying factors (Rivera-Torres et al. 2013), and influence different aspects of human functioning, making it imperative to assess these domains separately (de Jonge et al. 2010). Of note, muscle mass decreases with age, making tasks that require physical exertion challenging (Sundstrup et al. 2016), while chronic exposure to emotionally charged interactions or events, and work that involves catering to the emotional needs of patients or clients can result in chronic fatigue and burnout (Scheibe et al. 2015). As the structure of the population changes due to longer life expectancies and extended work lives, the proportion of older adults in jobs with high emotional and physical demands is increasing (Scheibe et al. 2015; Oude Mulders 2019). There is however limited knowledge of how CHCs highly prevalent in aging adults may be explanatory factors for these work demands.

Despite plausible pathways of the association between poor health and greater risk of work stress, most studies continue to treat work stress primarily as a predictor rather than an outcome of adverse health. Less is therefore known of the independent and comorbid effects of CHC on risk

of work-related stress in the aging workforce. Studies assessing how varied CHC may be differentially associated with different domains of stress in adults approaching retirement are scarce, but vital, given that CHC have a high prevalence in this sub-population (Koolhaas et al. 2013), and the increasing age of retirement. Further, contributing to the literature on work stress as an outcome of poor health will not only increase our understanding of the bidirectional relationship between these factors, but may also provide insights into appropriate workplace and public health interventions to inform optimal self and clinical management of older workers, to ensure they are healthy and able to remain productive. Given these gaps in literature, the goal of this study was to examine whether the most common CHC in older adults were associated with work related stress. Specifically, we assessed if independent or comorbid CVD, respiratory disorders, diabetes, sleep disorders and arthritis were associated with 1) general stress 2) emotional demands and 3) physical demands, while accounting for relevant factors.

Methodology

Dataset description: This study used data from the first wave of the NIDI Pension Panel Study collected in 2015 (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, working 12 or more hours per week were randomly sampled from the selected organizations. Questionnaires were mailed to 15,470 potential respondents' home, who also had the option to complete the questionnaire online. Of the participants invited to participate, 6,793 completed the questionnaire, representing a 44% response rate at baseline.

Variables of interest: The outcome of interest was work-related stress. Participants were asked whether they experienced 1) "stress" 2) emotional demands and 3) physical demands in their

work. The response options very, fairly, a little, or no were dummy coded (very, fairly=1) no (a little, no=0). The independent variables of interest were CHC which were ascertained from responses to a question asking respondents whether a doctor had diagnosed one or more of a list of long standing diseases. Each of the responses were dichotomized (yes/no). For the purposes of this study, we focused on the 5 most common chronic health conditions among older adults which included 1) CVD 2) diabetes 3) arthritis, 4) sleeping disorders, and 5) respiratory disorders.

Covariates: Additional variables of interest controlled for in the analyses included gender (male, female), partner/marital status (single, have a partner), age respondent entered the work force (<18 years, 18-25 years, >25 years), work hours per week, schedule and location flexibility (flexible, not flexible), International Socio-Economic Index (ISEI-08), occupational sector (government, education, construction, health care), occupational group (blue/while collar), current smoker (yes/no), alcohol use more than twice a week (yes/no), and satisfaction with body weight (yes/no).

Statistical Analysis: Approximately 85.5% of the cases had complete data, and item non-response ranged from approximately 0.01% to 5.1% for each question. The outcomes of interest contained 3-5% missing data. As performing complete-case analyses may result in biased estimates and inflated standard errors (SE), we conducted diagnostic tests that indicated that data were missing at random for the variables of interest. To account for the missing data, we used multiple imputation to estimate probable value ranges for incomplete observations. Multiple imputation generates a set of replacements for the missing values based on plausible models for the data which produces multiple completed datasets for analysis (Rubin 1987). We used multiple imputation by chained equations (MICE) which allows for each variable containing missing data to be regressed on all other variables (Hurtado et al. 2012). This method of accounting for missing

data has been demonstrated to produce asymptotically unbiased estimates and standard errors (Hurtado et al. 2012). Five imputed datasets were generated and thereafter assessed according to multiple imputation procedures described by Rubin (Rubin 1987).

Sample characteristics were summarized using frequencies and means. Logistic regression models for which odds ratios (OR) and 95% CIs were reported, examined the strength of association between CHC and 1) general work stress 2) emotional demands, and 3) physical demands. Two models were estimated; the first independently assessed the relationship between each health condition individually and each of the work stress outcomes. The second model included all 5 health conditions in the model, which in so doing, accounted for comorbid CHC. All relevant covariates were accounted for in both models.

Results

Table 1 presents the participant baseline characteristics. The average age at baseline was 62 (SD=1.6). Participants were predominantly male (53.9), 49% started working between the ages of 18-25, and the average hours worked per week were 31.8 (SD=8.96). Prevalence of CVD, respiratory disorders, diabetes, arthritis and sleep disorders were 12.5%, 8.4%, 6.4%, 45.5% and 15.7% respectively.

Table 2 presents the results of the independent associations between each CHC and work-related stress. CVD (1.28, 95%CI=1.10-1.47), respiratory disorders (1.29, 95%CI=1.06-1.56), sleep disorders (2.29, 95%CI=1.95-2.68) and arthritis (1.28, 95%CI=1.15-1.42) were independently associated with an increased risk of general stress. Respiratory disorders, sleep disorders and arthritis were also significantly associated with a 60-70% increased risk of reporting high physical demands. All 5 chronic conditions were independently associated emotional demands.

After including all chronic conditions in the fully adjusted model (Table 3), CVD, sleep disorders and arthritis remained significantly associated with general stress. The association between respiratory disorders and stress however was attenuated and lost statistical significance. Respiratory disorders, sleep disorders, and arthritis remained significantly associated with physical demands. Diabetes (1.25, 95%CI=1.01-1.53), sleep disorders (1.99, 95%CI=1.72-2.31), and arthritis (1.18, 95%CI=1.06-1.31) remained significantly associated with emotional demands.

Overall respiratory and sleep disorders, and arthritis were associated with all 3 stress variables, and the strongest associations were observed between sleep disorders and general stress.

Discussion

Our study sought to assess whether highly prevalent CHC were associated with general stress, physical demands, and emotional demands. Overall, our results indicated that sleep disorders, respiratory disorders, and arthritis were significantly associated with all 3 stress domains. Studies assessing associations between these conditions as explanatory factors and stress as an outcome are scarce, however, several studies have suggested a reciprocal and reverse association between sleep and work stress (Van Laethem et al. 2015; Johannessen and Sterud 2017). Compromised sleep may lead to mental and physical fatigue, which may impair performance and adherence to safety guidelines, and alter perceptions of the work environment (Van Laethem et al. 2015; Johannessen and Sterud 2017). Studies have also indicated that patients with rheumatoid arthritis face challenges in the work place due to fatigue, poor range of motion, and pain which negatively impact their work ability, results in fear, anxiety, feelings of guilt and inadequacy, and fear of financial strain in case of job loss (Lacaille et al. 2007). There is also evidence from the literature that respiratory conditions such as COPD become incapacitating with

progression and severity, and can decrease ability to carry out tasks or engage in strenuous activities (Carter et al. 1994).

While we found significant associations between CVD and general demands, and diabetes and emotional demands, both conditions were not associated with physical demands in the fully adjusted models. The reason for this lack of association is not clear, however, it is possible there was unaccounted selection bias in our data, due to the healthy worker survival effect (HWSE). The HWSE is characterized by self-selection out of jobs or the labour force market, by workers with poorer health, leaving workers who are generally healthier in the workplace (Pearce et al. 2007). These diseases have multiple daily self-management activities such as blood glucose monitoring and insulin administration (Ruston et al. 2013), which may be difficult to carry out in the work environment, particularly for workers with high occupational physical activity, prompting premature exit from the workforce.

Through our findings we demonstrate that work stress may be a consequence of prevalent health conditions, and that these conditions are differentially associated with several dimensions of work stress in adults approaching retirement. The average age of the workforce is steadily rising in industrialized countries and, thus, jobs with high emotional and physical demands are increasingly carried out by older employees (Scheibe et al. 2015). In addition to general work stress, assessing how CHCs affect physical demands is vital because physical capacity decreases as individuals age. Adults can observe annual muscle decrements of up to 2% starting at age 30, with approximately 30% of muscle strength lost by age 50 (Sundstrup et al. 2016). One study reported muscle strength decline of over 40% in adults over the age of 40, implying an increased rate of deceleration (Keller and Engelhardt 2013). The loss of muscle mass and strength, which is independently associated with chronic illness, makes physical work such as carrying heavy loads,

restricted standing, and severe bending challenging and, in some cases, unmanageable for older workers. Similarly, emotionally demanding work which involves direct client, customer, or patient contact, exposure to their behavioural characteristics, and potentially traumatic events (de Jonge et al. 2010) and can invoke strong feelings such as sorrow, anger, desperation and frustration. Chronic exposure to emotionally stressful work is associated with burnout, job dissatisfaction, absenteeism, disability pension, and presenteeism (Scheibe et al. 2015; Salvagioni et al. 2017). Our findings contribute to understanding how poor chronic health differentially impacts perceived general stress, physical and emotional demands in older workers, and may help inform conversations and decisions about appropriate allocation of resources to intervene and mitigate associated negative effects on general wellbeing and quality of life.

Our study has several limitations. First, use of cross-sectional data did not allow us to establish causality. Second, self-reported chronic health measures may underestimate the true incidence of disease, as these are impacted by disease awareness and recall bias, particularly among older participants. Third, due to the cross-sectional nature of the data, we were unable to control for time-related employment status, to assess HWSE. Our study however is strengthened by the use of a large dataset of Dutch adults approaching the age of retirement.

The proportion of older workers with CHC will continue to increase over the years. Understanding how their health may increase susceptibility to stress and subsequent health outcomes is therefore important. Continued research in this area is of great importance in order to gather evidence that will allow for effective workplace and public health interventions. Future research needs to take into account disease severity, longitudinal employment history to account for HWSE, and disease self-management, as these are likely to impact work ability and mediate the relationship between CHC and work stress.

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Table 1: Baseline Characteristics

Variable	%
Age [mean, SD]	62.0, 1.6
Gender	
Male	53.9
Female	46.1
Education	
Elementary school	3.6
Lower vocational education	17.3
Lower general secondary education	7.4
Intermediate vocational education	20.5
Upper general secondary education	5.1
Higher vocational education	36.0
University	10.1
Partner	
Partner	81.0
No Partner	19.1
Age Started Working	
<18 years	43.5
18-25 years	49.1
>25 Years	7.4
Work Hours per Week [mean, SD]	31.8, 9.0
Schedule Flexibility	
Yes	53.7
No	46.4
Location Flexibility	
Yes	22.2
No	77.8
Social Support Score [mean, SD]	2.7, 0.3
Blue/White Collar	
White Collar (Skilled Worker)	77.4
Blue Collar (Unskilled Worker)	22.6
Smoking	
Yes	15.8
No	84.3
Alcohol	
Yes	20.6
No	79.4
Satisfied with Body Weight	

Yes	83.6
No	16.4
Chronic Health Conditions Prevalence	
CVD	12.5
Respiratory	8.4
Diabetes	6.4
Arthritis	45.5
Sleep disorders	15.7

Table 2: Logistic Regression Results for the Independent Association between each Chronic Health Condition and Work-Related Stress

	General Stress			**Physical Demands**			**Emotional Demands**		
	OR	95% CI		OR	95% CI		OR	95% CI	
CVD	**1.28**	**1.10**	**1.49**	1.03	0.85	1.24	**1.20**	**1.03**	**1.39**
Respiratory Disorders	**1.29**	**1.06**	**1.56**	**1.60**	**1.29**	**1.99**	**1.23**	**1.02**	**1.48**
Diabetes	1.12	0.91	1.37	1.02	0.79	1.30	**1.34**	**1.10**	**1.65**
Sleep Disorders	**2.29**	**1.95**	**2.68**	**1.63**	**1.38**	**1.92**	**2.10**	**1.81**	**2.43**
Arthritis	**1.28**	**1.15**	**1.42**	**1.67**	**1.47**	**1.89**	**1.27**	**1.14**	**1.41**

*Fully adjusted for gender, partner, age started working, work hours per week, schedule flexibility, location flexibility, ISEI08, Occupational Sector blue/white collar occupation, smoking, alcohol, body weight

*The independent associations of each of the chronic health conditions were modeled separately, and controlled for the above-mentioned covariates

Table 3: Logistic Regression Results for the Association between All Chronic Health Conditions and Work-Related Stress

	General Stress			**Physical Demands**			**Emotional Demands**		
	OR	95% CI		OR	95% CI		OR	95% CI	
CVD	**1.19**	**1.02**	**1.40**	0.96	0.79	1.16	1.10	0.94	1.29
Respiratory Disorders	1.18	0.97	1.43	**1.47**	**1.18**	**1.84**	1.12	0.93	1.36
Diabetes	1.02	0.83	1.26	0.96	0.75	1.24	**1.25**	**1.01**	**1.53**
Sleep Disorders	**2.18**	**1.85**	**2.56**	**1.48**	**1.25**	**1.75**	**1.99**	**1.72**	**2.31**
Arthritis	**1.18**	**1.06**	**1.31**	**1.59**	**1.40**	**1.80**	**1.18**	**1.06**	**1.31**
Gender (ref: Male)	1.02	0.89	1.18	**1.34**	**1.12**	**1.60**	0.96	0.84	1.11
Partner (ref: Married/Partner)	0.96	0.83	1.10	0.92	0.78	1.09	0.93	0.81	1.07
ISEI08	**1.51**	**1.38**	**1.67**	**0.67**	**0.60**	**0.76**	**1.44**	**1.31**	**1.59**
SECTOR (ref: Government)									
Education	**1.35**	**1.14**	**1.59**	**2.82**	**2.26**	**3.51**	**2.16**	**1.83**	**2.54**
Construction	**1.45**	**1.22**	**1.72**	**2.04**	**1.65**	**2.52**	1.11	0.93	1.33
Healthcare	**1.29**	**1.07**	**1.56**	**4.43**	**3.51**	**5.58**	**2.72**	**2.25**	**3.29**
Welfare	**1.46**	**1.24**	**1.73**	**2.54**	**2.03**	**3.18**	**2.23**	**1.88**	**2.64**
Age Start Work (ref>25)									
<18 Years	**1.35**	**1.09**	**1.68**	**1.65**	**1.24**	**2.20**	**1.55**	**1.25**	**1.94**
18-25 Years	**1.34**	**1.10**	**1.65**	1.11	0.84	1.48	**1.32**	**1.08**	**1.63**
Work Hours per Week	**1.03**	**1.02**	**1.03**	1.00	0.99	1.01	**1.02**	**1.01**	**1.03**
Schedule Flexibility (ref: Yes)	**1.76**	**1.58**	**1.97**	**1.84**	**1.61**	**2.10**	**1.64**	**1.47**	**1.84**
Location Flexibility (ref: Yes)	0.93	0.81	1.06	**2.29**	**1.87**	**2.81**	1.15	1.00	1.32
Smoking (ref: No)	0.95	0.81	1.11	1.14	0.95	1.37	1.04	0.89	1.22
Alcohol (ref: No)	0.98	0.86	1.12	0.89	0.75	1.07	1.07	0.93	1.23
Satisfied with Body Weight (ref: No)	1.01	0.87	1.16	1.06	0.89	1.26	1.04	0.90	1.20
Blue/White Collar (ref: White Collar)	0.90	0.73	1.12	**4.47**	**3.49**	**5.74**	0.93	0.74	1.16

*Fully adjusted for gender, partner, age started working, work hours per week, schedule flexibility, location flexibility, ISEI08, Occupational Sector blue/white collar occupation, smoking, alcohol, body weight