



Work limitations due to neck-shoulder pain and physical work demands in older workers: cross-sectional study

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Abstract

Purpose Many older workers are working despite having neck-shoulder pain (NSP), which may give rise to work limitations due to pain, especially among those with high physical work demands. This study investigated the joint association of neck-shoulder pain intensity and physical work demands with work limitations among older workers.

Methods In SeniorWorkingLife, workers ≥ 50 years ($n = 11,800$) replied to questions about NSP intensity, work limitations due to pain, and physical activity demands at work. The odds ratio for having a higher level of work limitations due to pain in relation to neck-shoulder pain intensity and physical work demands were modeled using logistic regression controlled for various confounders.

Results The results showed that the neck-shoulder pain intensity was associated with work limitations in a dose–response fashion ($p < 0.0001$). Importantly, a significant interaction existed between neck-shoulder pain intensity and physical activity at work ($p < 0.0001$), e.g., 77% of workers with high pain and high work demands experienced work limitations due to the pain.

Conclusion Higher neck-shoulder pain intensity and higher physical work demands—and particularly in combination—were associated with higher odds of work limitation due to pain among older workers. Thus, it seems especially important to accommodate work demands through a better work environment for these groups of workers.

Keywords Musculoskeletal pain · Neck · Shoulder · Work demands · Older worker · Work limitation · Labor market · Occupational health

Introduction

Many western societies are facing an aging population, putting pressure on economies and welfare systems (Andersen and Sundstrup 2019; Ilmarinen 2006). Therefore, most countries have implemented special labor market reforms aimed at extending working lives and maintaining labor force participation (Andersen et al. 2019; Edge et al. 2017). However, more than half of older workers leave the labor market

before the statutory retirement age (Edge et al. 2017), with one of the main reasons being work-related musculoskeletal disorders (MSD), e.g., neck-shoulder pain (NSP) (Lee et al. 2016). NSP is widespread in the working population, and especially among older workers, where the prevalence of the NSP is highest in the age range of 45–65 years (James et al. 2018; Östergren et al. 2005).

On the other hand, while many workers aged 55 or older are working despite having MSD like NSP (Richard and Durand 2019), the MSD may impact their ability to perform work tasks and lead to a variety of work limitations (Vos et al. 2015). Importantly, work limitation due to pain is associated with increased risk of long-term sickness absence (Andersen et al. 2018). Many studies have reported the adverse outcomes of NSP upon work participation and performance (Bayattork et al. 2019; Leijten et al. 2014). However, less is known about the impact of NSP on work limitations among older workers. Such knowledge has the potential to help societies find a

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fundamental strategy for sustainable employment in an aging society.

The intensity of NSP and physical work demands are two potentially important factors that may affect work-related factors such as work ability (Bayattork et al. 2019). A longitudinal study showed that severe persistent NSP was associated with increased sick leave due to pain and reduced work ability over 1 year among workers (Hallman et al. 2019). Andersen et al. found that moderate to severe pain from the neck-shoulder was a significant risk factor for long-term sickness absence among healthcare workers (Andersen et al. 2012). Moreover, workers with high levels of physical work demands, such as high muscular workload may have a higher risk of work-related disability and limitation compared to workers in less physically demanding jobs (van den Berg et al. 2008). Importantly, the association between physical work demands and work ability may be stronger among older than younger workers (Siu et al. 2013; Siukola et al. 2011). Oliv et al., in a cross-sectional study, found that a lower level of physically demanding work was associated with higher work ability among older workers with neck pain (Oliv et al. 2017). A cohort study among employees with neck-shoulder and low-back pain showed that heavy physical work (i.e., prolonged kneeling or squatting, pushing or pulling, carrying or lifting) was an essential prognostic factor for long-term sickness absence in the 2-year follow-up period (Holtermann et al. 2010). However, most of the previous studies did not directly investigate the work limitations due to pain, especially among older workers.

In accordance with the biopsychosocial model of pain (Engel 1977), individual factors as well as psychosocial and physical work factors influence the sensation of pain and should also be acknowledged in the treatment process (Magnavita et al. 2011). Consequently, factors such as NSP and high physical work demands may lead to reduced work ability and increased work-limitations. Moreover, these factors have been associated with reduced labor market participation by increasing the risk of sickness absence and disability pension. Whether and to what extent work limitations due to NSP are related to physical work demands is, however, still unclear.

The purpose of this study was to investigate the joint association (i.e., interaction) of neck-shoulder pain intensity and physical work characteristics with work limitations among older/senior workers. We hypothesized that the higher the neck-shoulder pain intensity and physical work demands, the higher the odds of work limitations due to pain.

Methods

Study design and setting

This cross-sectional study employs data from the 2018 round of the SeniorWorkingLife Study, which is registered

in ClinicalTrials.gov (Identifier: NCT03634410). The study protocol has previously been published (Andersen and Sundstrup 2019) and results on work limitations in relation to low-back pain have been published elsewhere (Nygaard et al. 2020). This article reports the findings from the first wave of the questionnaire survey. The specific questions are specified below. The reporting of this study conforms to the guideline ‘Strengthening the Reporting of Observational Studies in Epidemiology’ (STROBE) (Vandenbroucke et al. 2009).

Participants

For the questionnaire survey, Statistics Denmark drew a probability sample of 30,000 Danish residents ≥ 50 years: 18,000 employed, 7000 unemployed, 3000 on voluntary early retirement, 2000 on a disability pension. Invited participants received a personal questionnaire-link via e-Boks, which is an online digital mailbox linked to the Danish social security number. Only currently employed workers were included for the present analyses, and among these, the response-rate to the entire questionnaire was 56%. However, those who responded only partly (i.e., to the below questions) were also included, yielding a total sample size of 11,842 (~66% of 18,000) currently employed older workers.

Outcome variables

Work limitations due to neck-shoulder pain

We used a modified version of the Standardized Nordic Questionnaire for Musculoskeletal Symptoms to assess work-limiting musculoskeletal pain (Kuorinka et al. 1987): ‘To which degree did the pain limit you in your work during the last 3 months?’, with a response scale of ‘To a very high degree’, ‘To a high degree’, ‘To some degree’, ‘To a lesser degree and ‘Not at all’. To be able to perform the logistic regression, work-limiting pain was further dichotomized in to ‘Not at all to a lesser degree’ (the first two response options) and ‘To some degree to a very high degree’ (the last three response options together), respectively.

Neck-shoulder pain

Pain intensity in the neck-shoulder was assessed as average pain during the last 3 months on a scale from 0–10, where 0 is no pain, and 10 is the worst pain imaginable (Pincus et al. 2008). For further analyses, the pain was averaged and dichotomized into “No or little pain” (pain intensity 0–2/10), “Moderate pain” (pain intensity 3–4/10), “High pain” (pain intensity 5–6/10), “Very high pain” (pain intensity $\geq 7/10$).

Physical activity at work

Participants were divided into four groups based on their answers to the following question: “How would you generally describe your physical activity in your current work?” (Calatayud et al. 2015). The four response categories were: “Mostly sedentary work that is not physically demanding”, “Mostly standing and walking work that otherwise is not physically demanding”, “Standing or walking work with some lifting and carrying tasks”, or “Heavy or fast work that is physically demanding”.

Control variables

The analyses were controlled for the following potential confounders: age (continuous), gender (categorical), smoking status (categorical; “No, never”, “Ex-smoker”, “Yes, but not every day” and “Yes, every day”), body mass index (BMI, continuous (Organization 2000)), physical activity during leisure (categorical; “Mostly sedentary”, “Light exercise at least 4 h”, “Sports or heavy physical activity at least 4 h per week”, “Training and competing regularly and several times a week”), psychosocial work factors (continuous; recognition from colleagues at work and influence at work) from the second version of the COPSOQ questionnaire and the Danish Psychosocial Questionnaire (Andersen and Sundstrup 2019; Pejtersen et al. 2010), pain in the other body regions (low-back, arm/hands, and legs), and highest completed education.

Statistical analysis

All statistical analyses were performed using the SAS statistical software for Windows (SAS Institute, Cary, NC). Using logistic regression analyses, we estimated the association between work limitation due to pain with physical work characteristics and neck-shoulder pain intensity. The statistical analyses were controlled for potential confounders: model 1 was adjusted for age, gender and pain in other regions. Model 2 was additionally controlled for educational level, physical activity level during leisure, smoking, BMI, and psychosocial work factors. Model-assisted weights were used in all analyses to ensure representative estimates (including sex, age, education, income, industry, origin, and family type). An alpha level of < 0.05 was accepted as statistically significant. Results are reported as odds ratios (OR) and 95% confidence intervals (CI) unless otherwise stated.

Results

Table 1 shows the demographics, lifestyle, and work-related characteristics of the study population. The average age of participants was 56.6 years and 63% had no or mild pain,

whereas 37% had moderate to very high pain. Also, among the total population of workers, 47.4% were engaged in mostly sedentary work, while 52.6% had a physically demanding work.

Table 2 shows the association between physical work demands and work limitations among older workers with moderate to very high pain intensity. The results showed a dose–response association between neck-shoulder pain intensity and work limitations due to pain (trend test with neck pain intensity as a continuous variable: $p < 0.0001$). In model 1 (adjusted for age, gender and pain in other body regions) and model 2 (fully adjusted model), the same pattern was observed, i.e., the OR for higher work limitations due to pain progressively increased with increasing physical work demands among older workers with moderate to very high pain [e.g., among workers with very high pain in the mostly standing group [OR, 2.09 (95% CI 2.00–2.17)] comparing those in the heavy physical work group [OR, 4.83 (95% CI 4.56–5.11)]. Also, the OR for higher work limitations due to pain progressively increased with increasing NSP intensity [e.g., among workers in the heavy physical work group with moderate pain [OR, 2.99 (95% CI 2.80–3.18)] comparing those with very high pain [OR, 4.83 (95% CI 4.56–5.11)].

Model 1 and 2 reports significant associations between work limitation due to pain and NSP intensity among old workers with mostly sedentary to mainly physical work. Also, there are significant associations between work limitations due to pain and physical work characteristics, among old workers with moderate to very high pain. Therefore, the data show that the higher the NSP, the higher the odds of work limitations due to pain. Moreover, it depends on the physical work characteristics, i.e., the harder the work, the more limitations due to pain even when comparing the same pain intensities. Figure 1 illustrates visually the statistically significant interaction, i.e., the slope of the curves become steeper as the physical work demands increase (Fig. 1). Among the workers who were engaged in physical work and had very high NSP intensity, 76.8% mentioned some degree of work limitations.

Discussion

This cross-sectional study shows that the combination of neck-shoulder pain intensity and physical work demands was associated with work limitation due to pain among older workers. Specifically, neck-shoulder pain intensity was progressively associated with higher odds of work limitations due to pain, and physical activity at work aggravated this association, i.e., there was a significant interaction.

A dose–response association was observed between NSP intensity and work limitations due to pain. This finding

Table 1 Demographics and lifestyle characteristics

	<i>N</i>	Mean	SD	% (95% Confidence limit)
Age, years	11,842	56.6	5.4	
Gender				
Men	4762			53.4 (52.4–54.3)
Women	5665			46.6 (45.7–47.6)
BMI		26.4	5.1	
Smoking				
No, never	5714			48.3 (47.3–49.3)
Ex-smoker	4110			34.3 (33.3–35.2)
Yes, but not every day	373			3.3 (2.9–3.6)
Yes, every day	1729			14.2 (13.5–14.9)
Physical activity during leisure				
Mostly sedentary	1779			14.8 (14.0–15.5)
Light exercise at least 4 h per week	7202			60.9 (59.9–61.9)
Sports or heavy physical activity at least 4 h per week	2697			22.3 (21.5–23.1)
Training and competing regularly and several times a week	233			2.0 (1.7–2.3)
Physical activity at work				
Mostly sedentary work that is not physically demanding	5909			47.4 (46.3–48.4)
Mostly standing and walking work that otherwise is not physically demanding	2698			23.6 (22.7–24.4)
Standing or walking work with some lifting and carrying tasks	2779			22.9 (22.0–23.8)
Heavy or fast work that is physically demanding	787			6.2 (5.7–6.7)
Neck-shoulder pain intensity (0–10)	11,842	2.9	3.2	
Psychosocial work factors (0–100)				
Recognition from colleagues	12,111	77.0	22.5	
Influence at work	12,128	77.5	23.8	
Work-limitation due to pain				
To a very high degree	166			1.2 (1.0–1.5)
To a high degree	337			3.0 (2.7–3.4)
To some degree	1578			13.3 (12.5–14.0)
To a lesser degree	3420			29.5 (28.5–30.4)
Not at all	6285			53.0 (52.0–54.0)

supports the results from previous studies across age groups, reporting the negative impact of higher NSP intensity on work-related factors (e.g., sick leave and work ability) (Andersen et al. 2012; Hallman et al. 2019; Munir et al. 2005). We have previously found that moderate to high pain intensity in the neck and shoulder region was associated with lower work ability among older workers (Bayattork et al. 2019). In addition, Holtermann et al. demonstrated that pain intensity was one of the main prognostic factors for sickness absence during the 2-year follow-up among employees with NSP (Holtermann et al. 2010). Thus, it seems that NSP—and especially higher NSP intensity—can affect work-related factors in an intensity-dependent matter (e.g., performance, work ability, sick leave, etc.).

Furthermore, this study found that the association between neck-shoulder pain intensity and work limitations due to pain was aggravated by high physical work demands.

Besides the statistical interaction, this is visually very clear from the slope of the curves in Fig. 1, where increased pain intensity has much more impact on work-limitations among those with high physical work demands than those with seated work. Thus, the combination of high pain intensity and physically demanding work seems to be especially detrimental to work performance among older workers. Studies have previously shown that high physical work demands increases the risk of work-related disability and work limitations (Lund et al. 2006; van den Berg et al. 2008).

Older workers seem to be at a higher risk of overload from physically demanding work (Flower et al. 2019) and it has been shown that they are more affected by physical work demands than their younger colleagues (de Vries et al. 2013; Oliv et al. 2017). This may partly be explained by the age-related decline in physical capacity, which could make it harder to cope with the physical demands during work, consequently challenging

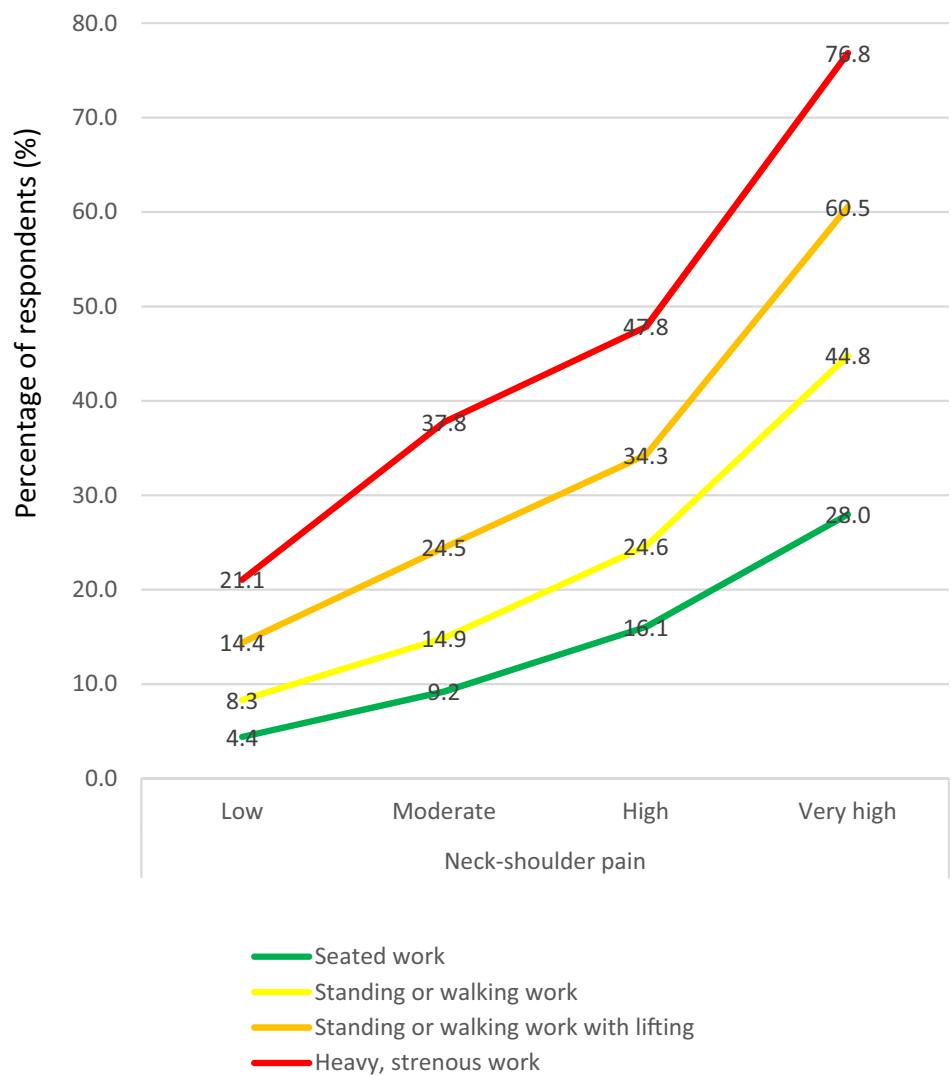
Table 2 Work limitations due to pain by physical work characteristics among workers with moderate to very high NSP intensity

Simple effect level	Physical activity at work	Model 1# OR (95% CI)	Model 2## OR (95% CI)
Moderate pain (3–4)	Mostly sedentary work that is not physically demanding	1	1
	Mostly standing and walking work that otherwise is not physically demanding	1.54 (1.47–1.61)	1.48 (1.41–1.55)
	Standing or walking work with some lifting and carrying tasks	2.22 (2.13–2.32)	2.07 (1.98–2.17)
	Heavy or fast work that is physically demanding	2.99 (2.80–3.18)	2.96 (2.77–3.16)
High pain (5–6)	Mostly sedentary work that is not physically demanding	1	1
	Mostly standing and walking work that otherwise is not physically demanding	1.62 (1.55–1.69)	1.57 (1.50–1.64)
	Standing or walking work with some lifting and carrying tasks	1.81 (1.74–1.88)	1.69 (1.62–1.76)
	Heavy or fast work that is physically demanding	2.80 (2.65–2.96)	2.54 (2.40–2.68)
Very high pain (7–10)	Mostly sedentary work that is not physically demanding	1	1
	Mostly standing and walking work that otherwise is not physically demanding	2.09 (2.00–2.17)	2.06 (1.97–2.15)
	Standing or walking work with some lifting and carrying tasks	2.93 (2.83–3.05)	2.69 (2.59–2.80)
	Heavy or fast work that is physically demanding	4.83 (4.56–5.11)	4.20 (3.96–4.45)

#Model 1 was controlled for age, gender and pain in other regions

##Model 2 was controlled for the same as Model 1, as well as for educational level, physical activity level during leisure, smoking, BMI, and psychosocial work factors

Fig. 1 Prevalence (percentage) of workers with work limitations due to low, moderate, high and very high neck-shoulder pain in the four groups with physical work demands ranging from seated to heavy, strenuous work



work ability and work participation (Kenny et al. 2008). A prospective cohort study found that low physical capability was associated with increased risk of disability pension and long-term sickness absence (Sundstrup et al. 2019). Moreover, hard physical work during working life is an important risk factor for labor market exit and sickness absence (Sundstrup et al. 2018). In support of this, research already demonstrated that increasing age might increase the susceptibility of tissues to physical loads, especially among workers with pain (Casou et al. 2002). Therefore, it seems that older workers with physically demanding work are more affected by their pain during work compared to workers with a similar pain-intensity in sedentary employment.

Weighted prevalence representative of older workers in Denmark, showed that 52.6% had a physically active work, i.e., either standing/walking or some type of lifting or more physically strenuous type of work. The results of our study may help to design interventional workplace strategies to promote the health of older workers (Poscia et al. 2016), taking into account that this type of intervention must overcome different barriers at the workplace level (Magnavita 2018). Moreover, such knowledge may help us to accommodate their work because it is important to reduce unnecessary physically demanding work already when people are entering the labor market to ensure a long and healthy working life. Hence older workers with pain symptoms should be able to do their job without being limited in their work if the necessary work accommodations are implemented. For example, it may be necessary to provide additional assistive devices to perform lifting tasks, provide additional rest-breaks, organize the heavy work in groups, etc. Additionally, it is important to focus on the worker's pain intensity granted that a decrease in intensity could reduce work limitations and thus the practical consequences of NSP (since we found a dose–response relation between pain intensity and work limitations). Such knowledge may help practitioners tailor workplace-based rehabilitation programs to prevent and reduce the intensity of NSP, which may reduce work limitations and hence potentially increase working capacity and working life among older workers. Importantly, improving health among older workers should not only be seen as an individual responsibility, but rather something that should be dealt with more systematically at the workplace and/or at the political level. Thus, the older workers who have already developed pain, should have opportunities for physical rehabilitation through the workplace and during working hours.

Strengths and limitations

There are strengths as well as weaknesses to the current study. The main strength is that Statistics Denmark drew a probability sample among all eligible Danish

residents ≥ 50 years, which ensured—together with the use of model-assisted weights—that the data were representative of senior workers in Denmark. In combination with the high response rate, this reduced the risk of selection bias influencing the current estimates (Burr et al. 2003). The main limitation is the cross-sectional study design that excludes the possibility to examine temporal relationships of the variables and hence to make causal inferences. On the other hand, the association between the present variables are best investigated at the same time point, i.e., pain intensity and work-limitations due to pain are expected to be intimately related. Thus, we did not investigate, e.g., whether high physical work demands were causally associated with later development of work-related pain limitations. Moreover, data from self-assessments are often criticized for lack of precision, commonly resulting in an increased risk of bias due to overestimation or underestimation of a given exposure levels (Lagersted-Olsen et al. 2014). A strength is, however, that data on the potential confounder educational level were obtained from a high quality Danish register. The adjustment for multiple potential confounders that could influence the association of pain intensity and physical work demands with work limitations is a strength of the study. Importantly, the adjustment for potential confounders only changed the odds-estimates to a very small degree, which may indicate that factors such as BMI, smoking, physical exercise, and psychosocial working environment (influence and recognition) play only a minor role in the association of NSP intensity and physical work characteristics with work limitations due to pain. Thus, the results are likely to remain robust in future studies assessing similar research questions with other methods.

Conclusion

The current study demonstrated that the combination of neck-shoulder pain intensity and physical work characteristics were associated with work limitation due to pain among older workers. Specifically, neck-shoulder pain intensity was progressively associated with higher odds of work limitations due to pain, and physical activity at work aggravated this association. Thus, it seems especially important to accommodate the work demands among older workers physically strenuous work and neck-shoulder pain, so that they can do their job without being limited. Thus, it seems especially important to accommodate work demands through a better work environment for these groups of workers. Physical rehabilitation at the workplace and during working hours should also be considered for workers who have already developed pain.

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Availability of data and material The authors encourage collaboration and use of the data by other researchers. Data are stored on the server of Statistics Denmark, and researchers interested in using the data for scientific purposes should contact the project leader Prof. Lars L. Andersen, lla@nfa.dk, who is responsible for the study design, questionnaire development, definition of population, and data collection.

Compliance with ethical standards

Conflict of interest The authors declare no conflicts of interest.

Ethical approval According to Danish law, questionnaire and register-based studies do not need approval by ethical and scientific committees, nor informed consent. All data were de-identified and analyzed anonymously.

Consent to participate Not applicable (see above).

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