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Original Article

A Lower Level of Physically Demanding Work Is Associated with Excellent Work Ability in Men and Women with Neck Pain in Different Age Groups



Stefan Oliv*, Adnan Noor, Ewa Gustafsson, Mats Hagberg

Department of Occupational and Environmental Medicine, University of Gothenburg and Sahlgrenska University Hospital, Gothenburg, Sweden

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ABSTRACT

Background: The aim of this study was to investigate which physical and psychosocial work demands were associated with excellent work ability in individuals with neck pain, and to investigate age and sex differences in these associations.

Methods: The study sample was obtained from the Statistics Sweden cross-sectional Work Environment survey and consisted of workers who reported neck pain after work ($N = 3,212$).

Results: The findings showed an association between excellent work ability and self-reported low exposure to lifting, twisted work posture, working with hands in shoulder level or higher, and leaning forward without support and combination of exposures containing these work demands. Low exposure to seated work and high demands showed a reversed association. The associations were present mainly among older workers and were generally stronger for men than for women.

Conclusion: This study indicates that a lower level of physically demanding work is an important element to maintain excellent work ability, especially for the older worker with neck pain.

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1. Introduction

Musculoskeletal disorders, such as neck pain, are one of the most common disorders causing sick leave and early retirement [1–4]. The prevalence of neck pain is high among workers in industrial countries [1,4], and it has been shown that having neck pain is one risk factor for developing long-term sick leave [5]. These disorders are one of the main causes of sick leave and disability pensions, leading to high costs for both the individual and society [4,6–8]. Regardless of the cause, musculoskeletal disorders can lead to reduced work ability, reduced productivity, work disability, and early retirement [9–12]. It has been shown that workers with a high level of physical work demands have a higher risk of work-related disability compared with workers in less physically demanding jobs [13,14]. Manual handling, awkward postures, and repetitive work are commonly reported as causes for work-related neck disorders. Psychosocial factors such as high job demands, low support from supervisors and coworkers, and low job control have also been reported as important contributors to musculoskeletal problems [15–19]. Recent studies have shown

that workers with pain report lower work ability and also lower work performance and productivity [20,21] compared with workers without pain. The Work Ability Index (WAI) was constructed as a method to measure work ability in an occupational setting [22]. It combines the individual's subjective assessment of his/her own ability to handle physical and mental work demands with information on diseases and consequent functional limitations. The index is sensitive to changes in work conditions, health status, and physical fitness [23]. The first question in the WAI has been used in epidemiological studies to investigate work ability. This question, also called the “work ability score,” has been compared with the total WAI and has shown a strong association and an equally good predictive value with regard to sick leave, health, age, job content, and reported pain [24,25]. Both sex and age have been shown to affect the prevalence of neck pain. It has been reported that women have higher prevalence of neck pain compared with men, which is partly explained by differences in work exposure between men and women [26–29]. Neck pain has also been reported as being more prevalent among older workers [27].

* Corresponding author. Department of Occupational and Environmental Medicine, University of Gothenburg and Sahlgrenska University Hospital, Arbets och miljömedicin, Box 414, 405 30 Göteborg, Sweden.

E-mail address: stefan.oliv@amm.gu.se (S. Oliv).

Many Western countries face an aging workforce, which places demands on the workplace to accommodate problems associated with aging, such as decreased muscle strength and decreased physical fitness [30–32]. Studies have shown that there is an association between older age and self-reported lower work ability; also, the association between physical work demands and work ability is stronger in workers closer to retirement than in younger workers [14,33].

Several studies report the effects of work-related physical and psychosocial factors and individual characteristics on work ability [34,35]. However, these studies have not addressed the effects of different work demands on the work ability of individuals with neck pain. When prioritizing interventions in the workplace, it is of value to know which work demands are associated with lower or higher levels of work ability. Most studies on work ability have focused on factors associated with poor work ability, and very few on which factors are associated excellent work ability [36].

The aim of this study was to investigate which physical and psychosocial exposures and combinations of these exposures were associated with excellent work ability, defined as self-reported work ability score of 10, among men and women with neck pain, and to investigate age and sex differences in this association.

2. Materials and methods

2.1. Source population

This was a cross-sectional study using material obtained from the National Work Environment survey conducted by Statistics Sweden (SCB) from 2007 and 2009. The Work Environment survey is part of the larger Swedish Labour Force survey. The Swedish Labour Force survey is conducted by a telephone-based interview with a representative sample of the general Swedish population between 16 years and 74 years old. Those who answered the survey and were between 16 years and 64 years old, employed, and not on long-term sick or maternity leave were asked 25 extra questions with regard to their work environment. They also received an additional questionnaire sent by mail. A total of 19,839 individuals from the Labour Force survey answered the telephone interview (86% of the source population), and were sent the Work Environment survey questionnaire. Of this total, 14,082 answered the questionnaire (72% response rate; Fig. 1).

2.2. Study sample

The study sample for the present study was selected by including those reporting pain in the “upper back or neck” (neck pain) after work at least 2 days per week during the past 3 months (Fig. 1). Those who reported no pain in “upper back or neck” (no neck pain) were used as a reference group.

2.3. Neck pain

Neck pain were measured using self-reported questions from the SCB Work Environment survey asking about pain in the “upper back or neck” after work during the past 3 months. The categories were as follows: “every day,” “a few days per week (1 day out of 2),” “one day a week (1 day out of 5),” “a couple of days a month (1 day out of 10),” and “not at all or seldom.” For this study, “neck pain” was defined as self-reported pain in the neck or upper back “a few days per week (1 day out of 2 days)” or more often. The workers who reported pain in neck or upper back “not at all or seldom” and “a couple of days a month (1 day out of 10 days)” were categorized as having “no neck pain.”

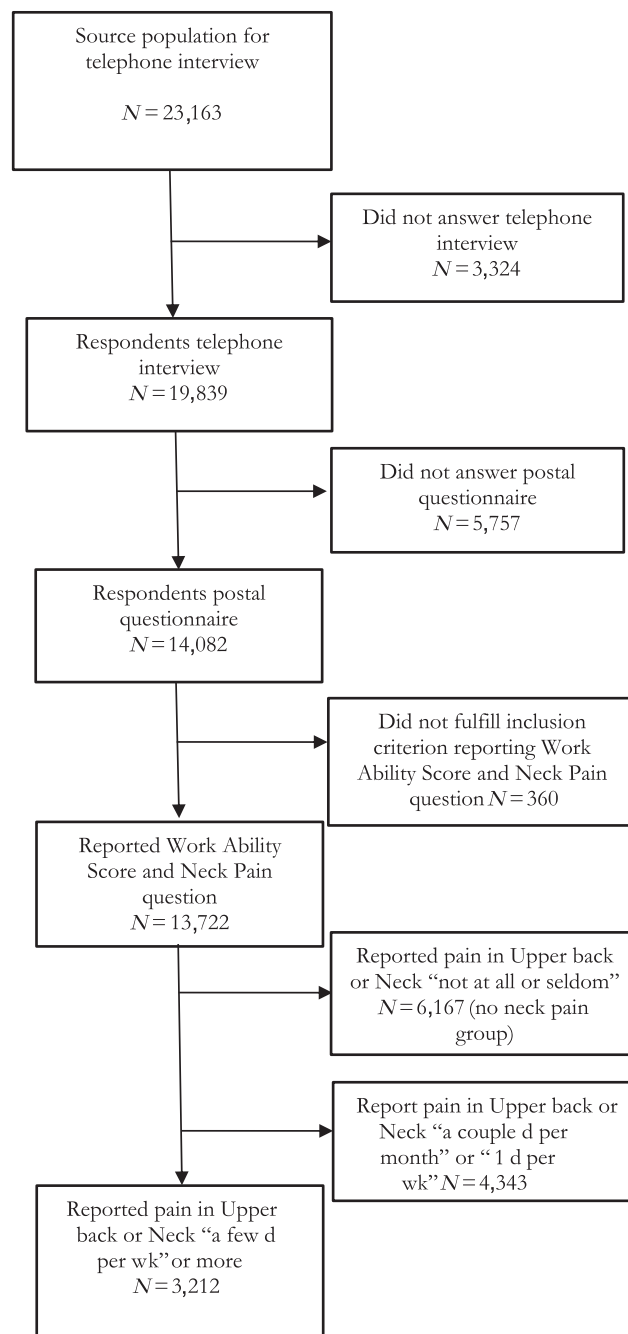


Fig. 1. Flowchart of inclusion in and dropout from the study (Swedish Workforce Survey 2007 and 2009; N = number of workers).

2.4. Work ability

Work ability was measured with the work ability score question: “Assume that your work ability at its best has a value of 10 points. How many points would you give your current work ability?,” with a score range of 1–10. This question was asked during the telephone interview conducted by the SCB. Studies [24,25] have shown that the work ability score question has good validity and reliability when compared with the total WAI. In this study, the work ability score was categorized into three levels: 1–7 (poor/moderate), 8–9 (good), and 10 (excellent). In the statistical analysis, excellent work ability was compared with poor work ability.

2.5. Physical exposure

In the Work Environment survey questionnaire, participants were asked to answer whether their jobs involved physical exposure, using a six-category scale: “no, not at all,” “some (approximately 1/10 of the time),” “roughly one-quarter of the time,” “half of the time,” “roughly three-quarters of the time,” and “nearly all the time.” In this study, those who reported exposure “half of the time” or more were classified as having *high exposure*, and those who reported exposure less than half of the time or no exposure were classified as having *low exposure*. This exposure level has previously been used in a similar study [37]. The questions used in this study were the regular questions used in the SCB survey and were not formulated specifically for this study.

The questions regarding physical exposures were: “Vibrations that make your whole body shake and vibrate”; “Vibrations from hand-held machines or tools”; “Does it happen at work that you bend or turn in the same way many times per hour for several hours in 1 day?”; “Do you have to lift at least 15 kg several times a day?”; “Do you sometimes work bending forward without supporting yourself with your hands and arms?”; “Do you sometimes work in a twisted posture?”; “Do you sometimes work with hands raised to the level of your shoulders or higher?”; “Does your work require you to perform only repetitive work movements at least twice every minute?”; “Do you sometimes work in a sitting position?”.

2.6. Psychosocial exposure

The variables for psychosocial exposure were demand, control, and support. These variables were created by SCB by indexing the answers for several questions into *high* or *low*. The index for demand was calculated based on following four questions. “Is your work, *half of the time* or more, so stressful that you do not have time to talk or even think of anything other than work?”; “Does your work require your undivided attention and concentration *nearly all of the time*?”; “Do you, *every week or more often*, have so much work to do that you have to skip lunch, work late, or take work home with you?”; “Do you *agree completely or agree to a certain extent* that you have far too much to do at work?”. Replying at most one of the questions with the answer alternative given in *italic* text categorized a worker as having *low demands*, and two or more of the answer alternative given in *italic* text categorized a worker as having *high demands*.

The index for control was calculated by using the following four questions. “Is it possible for you to set your own work tempo *half of the time or less*?”; “Is it, *mostly not or never*, possible for you to decide on your own when various tasks are to be done?”; “Are you, *mostly not or never*, involved in planning your own work?”; “Do you *agree completely or agree to a certain extent* that you have too little influence?”. Replying at most two of the question with the answer alternatives given in *italic* text categorized a worker having *high control*, and replying at least three of the question with the answer alternatives given in *italic* text categorized a worker having *low control*.

The support index was calculated using the following two questions. “Can you receive support and encouragement from your superiors when your work becomes troublesome?”; “Can you receive support and encouragement from your fellow workers when your work becomes troublesome?”. Workers answering having support and encouragement from both superiors and fellow workers “mostly” or “always” were considered workers with *high support*, and workers answering having support and encouragement from either superiors or fellow workers “mostly not” or “never” were considered workers with *low support*.

2.7. Statistical analysis

For all analyses in this study, SAS version 9.3 (SAS Institute, Cary, NC, USA) was used. Descriptive data on the neck pain and no neck pain group were derived through frequency analyses. Spearman’s rank correlation was calculated between all relevant exposure categories to check for collinearity. All analyses were stratified by age group and sex. The exposure category *high exposure* was used as reference category for physical exposures as it was hypothesized that *high exposure* would have a negative effect on work ability. The work ability score, 10 (excellent) versus 1–7 (poor), was used as the outcome variable. Bivariable logistic regression was used to investigate the relationship between the outcome, work ability score 10, and an explanatory variable, physical or psychosocial work exposure. Prevalence ratios (PRs) were calculated based on the result of the bivariable logistic regression [38]. An association was considered significant when the PR and the corresponding 95% confidence intervals (CIs) were above 1. By a reversed significant association, we mean to have a PR and corresponding CI below 1.

To investigate whether there was a different level of association if workers are exposed to several exposures as opposed to one, a second set of bivariable logistic regression was performed. Combinations of physical and psychosocial exposures were made according to author’s (SO, EG, MH) ergonomic experience to reflect exposure combinations seen in different occupations. Workers reporting *low exposure* to these combinations were compared to workers reporting *high exposure* to these combinations.

The study received approval from the Regional Ethics Review Board in Gothenburg, Sweden.

3. Results

Of the 14,082 persons who answered the Work Environment survey questionnaire, a total of 3,212 reported neck pain (23%). The mean age in the study sample was 44 years. There was a larger proportion of women (65%) than men (35%) among workers reporting neck pain. In the female group, 43% reported neck pain, and in the male group 25% reported neck pain (Table 1).

The most common occupational group among women was service, care, and shop sales workers for both those who reported neck pain (30%) and those who reported no neck pain (27%). Among men, craft and related, trade workers, miners, and construction workers (24%) were the most common occupation group for those who reported neck pain, and among those who reported no neck pain the most common occupation were technicians, associated professionals, and nurses (22%; Table 2).

The most frequently reported physical work demand for men with neck pain was “frequent trunk rotations,” and for men reporting no neck pain this was “seated work.” For women the most frequent physical exposure was “seated work” for both those reporting neck pain and those reporting no neck pain. The most frequent psychosocial exposure was reporting “high work demands” (Table 3) for both men and women with and without reported neck pain.

There was an association found between self-reported *low exposure* to most physical work demands and self-reported excellent work ability for both men and women reporting neck pain in the 50–64 years age group except for seated work (Table 4).

The strongest associations for self-reported excellent work ability and work demand exposure among men and women with neck pain were found in the 50–54 years age group (Table 5). For men, the strongest association was self-reported *low exposure* to “handheld vibration tools” (PR = 1.77; 95% CI: 1.26–2.89). For women, the strongest association (with excellent work ability) was

Table 1
Characteristics of the study population

	Men				Women				Total			
	No neck pain		Neck pain		No neck pain		Neck pain		No neck pain		Neck pain	
	%	N	%	N	%	N	%	N	%	N	%	N
	75	3,462	25	1,136	57	2,705	43	2,076	66	6,167	34	3,212
Age category												
16–29 y	14	493	11	123	14	379	14	282	14	872	13	405
30–49 y	48	1,649	44	503	47	1,278	46	948	47	2,927	45	1,451
50–64 y	38	1,320	45	510	39	1,048	41	846	38	2,368	42	1,356
Work ability score												
1–7 (Moderate, poor)	11	386	24	270	10	281	23	470	11	667	23	740
8–9 (Good)	32	1,098	36	409	27	727	31	652	30	1,825	33	1,061
10 (Excellent)	57	1,978	40	457	63	1,697	46	954	60	3,675	44	1,411

N, number of workers; work ability score range = 1–10.

Table 2
Distribution of the study population by occupation

Occupation	Men %		Women %		Total %	
	No neck pain	Neck pain	No neck pain	Neck pain	No neck pain	Neck pain
Service, care, and shop sales workers	8	8	27	30	16	22
Technicians and associated professionals, nurses	22	17	24	22	23	21
Professionals (e.g., teachers, computer technicians)	21	15	25	20	23	18
Clerks, office, warehouses workers	4	6	12	15	8	12
Plant and machine operators	14	20	3	5	9	9
Craft and related, trade workers, miners, construction workers	15	24	1	1	9	9
Managers, legislators, senior officials	9	5	4	3	7	3
Elementary occupations, janitors, cleaners, etc.	3	4	4	3	3	5
Skilled agricultural, forestry, and fishery workers	2	2	1	1	1	2

N, 3212; classification of occupations was made according to the International Standard Classification of Occupations.

self-reported *low exposure* to “working with hands in shoulder level or higher” (PR = 1.41; 95% CI: 1.09–1.99). There were no significant associations found in the youngest age group, 16–29 years, with any of the measured physical exposures and excellent work ability for neither men nor women reporting neck pain. Physical exposure

was the most common factor to be associated with excellent work ability for workers reporting neck pain, especially in the highest age group. The associations were mainly found in the 50–64 years age group, and the associations were generally stronger among men than among women. The only exposure found with excellent work

Table 3
Reported work demand exposure

Exposed to	Men				Women				Total			
	No neck pain		Neck pain		No neck pain		Neck pain		No neck pain		Neck pain	
	%	N	%	N	%	N	%	N	%	N	%	N
Physical work demands												
Whole body vibrations	5	162	13	149	1	14	1	23	3	176	5	172
Handheld vibrating tools	5	164	16	180	1	29	3	54	3	193	7	234
Frequent trunk rotations	22	749	56	629	25	673	52	1,076	23	1,422	53	1,705
Lifting ≥15 kg	25	852	48	544	15	400	27	566	20	1,252	35	1,110
Leaning forward without support	9	292	31	351	10	266	24	503	9	558	27	854
Twisted work posture	7	252	31	346	9	232	24	484	8	484	26	830
Hands at shoulder level or higher	6	210	22	252	5	130	13	266	6	340	16	518
Repetitive movements	17	582	41	465	16	435	35	725	17	1,017	37	1,190
Seated work	60	2,051	55	618	53	1,416	57	1,165	57	3,467	56	1,783
Psychosocial work demands												
High demands	44	1,516	62	701	51	1,372	66	1,375	47	2,888	65	2,076
Low control	35	1,209	46	628	49	1,331	59	1,236	41	2,539	55	1,764
Low support	39	1,341	52	594	31	843	42	873	35	2,184	46	1,467

N, number of workers.

Table 4
Univariate associations between work exposure (*low exposure vs. high exposure*) and self-reported excellent work ability (i.e., work ability score 10) for workers with pain in upper back and neck

Physical work demands		Age 16–29 y		Age 30–49 y		Age 50–64 y	
		N	PR (95% CI)	N	PR (95% CI)	N	PR (95% CI)
Low exposure to							
Whole body vibrations	Men	54	1.14 (0.76, 1.96)	211	1.30 (0.97, 1.82)	137	1.08 (0.78, 1.55)
	Women	168	1.05 (0.69, 2.74)	456	1.30 (0.77, 2.80)	315	1.15 (0.53, 4.26)
Low exposure to							
Handheld vibrating tools	Men	51	1.00 (0.73, 1.55)	199	1.17 (0.95, 1.53)	143	1.77 (1.26, 2.89)
	Women	166	1.05 (0.70, 2.15)	488	1.07 (0.76, 1.80)	309	1.06 (0.70, 2.23)
Low exposure to							
Frequent trunk rotations	Men	22	1.12 (0.91, 1.43)	126	1.31 (1.14, 1.54)	79	1.36 (1.13, 1.67)
	Women	50	1.03 (0.93, 1.16)	259	1.09 (0.99, 1.20)	160	1.15 (1.02, 1.31)
Low exposure to							
Lifting ≥15 kg	Men	28	1.00 (0.82, 1.29)	128	1.14 (1.00, 1.33)	108	1.71 (1.37, 2.22)
	Women	111	1.15 (0.98, 1.37)	347	1.06 (0.94, 1.21)	251	1.29 (1.08, 1.58)
Low exposure to							
Leaning forward without support	Men	35	0.97 (0.78, 1.28)	178	1.36 (1.13, 1.69)	126	1.57 (1.23, 2.12)
	Women	116	1.16 (0.99, 1.41)	367	1.13 (0.99, 1.31)	255	1.31 (1.09, 1.64)
Low exposure to							
Twisted work posture	Men	35	0.93 (0.74, 1.23)	178	1.26 (1.05, 1.56)	116	1.30 (1.05, 1.71)
	Women	109	1.09 (0.94, 1.30)	372	1.13 (0.98, 1.32)	249	1.13 (0.95, 1.38)
Low exposure to							
Hands at shoulder level or higher	Men	45	0.94 (0.72, 1.33)	189	1.15 (0.94, 1.45)	131	1.45 (1.12, 2.02)
	Women	139	1.05 (0.86, 1.34)	405	1.13 (0.95, 1.39)	290	1.41 (1.09, 1.99)
Low exposure to							
Repetitive movements	Men	33	0.97 (0.79, 1.27)	148	1.15 (1.00, 1.35)	107	1.20 (0.99, 1.50)
	Women	89	0.92 (0.82, 1.06)	316	1.11 (0.99, 1.26)	210	1.15 (1.00, 1.35)
Low exposure to							
Seated work	Men	37	1.29 (0.99, 1.81)	96	0.86 (0.77, 0.98)	47	0.55 (0.43, 0.69)
	Women	85	1.02 (0.90, 1.18)	178	0.87 (0.81, 0.95)	110	0.71 (0.63, 0.81)

N, number of workers (reporting *physical exposure* and work ability score 10). Bold values indicate a statistically significant association. CI, confidence interval; PR, prevalence ratio.

ability in the no neck pain group, but not in the neck pain group, was *low exposure to* “whole body vibrations.”

“Seated work” was the only physical exposure showing a reversed association between self-reported *low exposure* and excellent work ability for workers reporting neck pain. This association was found for both men and women in the age group 50–64 years and 30–49 years.

Regarding psychosocial exposure, an association was seen for both men and women reporting neck pain in the 30–49 years group between self-reported “high support” and self-reported excellent work ability, but this was not seen in any of the other age groups. Self-reported “low demands” was reverse associated with excellent work ability among men and women in the 50–64 years group. In the 16–29 years age group, an association was found, among women, between self-reported “low demands” and excellent work ability; however, this was not found in any other group.

In the analysis performed by combining different exposures (Table 6), associations were found for self-reported *low exposure* to

all combinations that included physical exposures. The combination including *low exposure* to seated work showed a reversed association for both men and women reporting neck pain, especially in the 50–64 years age group.

When introducing exposure to “low demands” with the physical exposure combinations, the association with excellent work ability did not increase. The combination containing *low exposure to* “seated work” and the combination containing only psychosocial exposures showed a reversed association with excellent work ability for both men and women reporting neck pain in the 50–64 years age group.

4. Discussion

4.1. Major findings

This study shows an association between self-reported excellent work ability and self-reported *low exposure* to most measured

Table 5
Univariate associations between work exposure (*psychosocial work demands*) and self-reported excellent work ability (work ability score 10) for workers with pain in upper back and neck

Psychosocial work demands		Age 16–29 y		Age 30–49 y		Age 50–64 y	
		N	PR (95% CI)	N	PR (95% CI)	N	PR (95% CI)
Low demands	Men	23	0.94 (0.78, 1.19)	78	0.93 (0.83, 1.04)	44	0.61 (0.49, 0.75)
	Women	69	1.27 (1.09, 1.48)	167	1.05 (0.97, 1.15)	94	0.88 (0.80, 0.98)
High control	Men	34	1.26 (0.98, 1.72)	122	1.00 (0.88, 1.14)	92	1.14 (0.96, 1.41)
	Women	50	1.03 (0.93, 1.16)	226	1.12 (1.03, 1.24)	123	1.04 (0.94, 1.17)
High support	Men	41	1.29 (0.98, 1.83)	124	1.24 (1.08, 1.45)	73	1.03 (0.88, 1.23)
	Women	110	0.96 (0.83, 1.13)	288	1.11 (1.01, 1.25)	173	1.08 (0.96, 1.24)

N, number of workers (reporting *psychosocial exposure* and work ability score 10). Bold values indicate a statistical significant association. CI, confidence interval; PR, prevalence ratio.

Table 6

Univariate associations between combinations of different work exposures (*low exposure*, to physical demands, vs. *high exposure*) and self-reported excellent work ability (i.e., work ability score 10) for workers with pain in upper back and neck

Work demands		Age 16–29 y		Age 30–49 y		Age 50–64 y	
		N	PR (95% CI)	N	PR (95% CI)	N	PR (95% CI)
Low exposure to “Leaning forward without support,” “Twisted work posture,” “Lifting ≥ 15 kg”	Men	15	0.96 (0.70, 1.51)	116	1.41 (1.41, 1.88)	94	1.56 (1.18, 2.22)
	Women	80	1.25 (0.99, 1.67)	298	1.01 (1.01, 1.54)	201	1.45 (1.08, 2.15)
Low exposure to “Leaning forward without support,” “Twisted work posture,” “Lifting ≥ 15 kg” and “Low demands”	Men	5	0.79 (0.50, 1.36)	45	1.23 (0.97, 1.65)	32	0.99 (0.75, 1.45)
	Women	39	1.51 (1.09, 2.22)	11	1.38 (1.08, 1.88)	64	1.28 (0.93, 2.02)
Low exposure to “Leaning forward without support,” “Twisted work posture,” “Lifting ≥ 15 kg,” “Hands at shoulder level or higher”	Men	15	0.99 (0.67, 1.11)	112	1.48 (1.11, 2.18)	93	1.49 (1.97, 2.01)
	Women	17	1.15 (0.88, 1.65)	291	1.36 (1.03, 1.99)	198	2.16 (1.38, 4.65)
Low exposure to “Leaning forward without support,” “Twisted work posture,” “Lifting ≥ 15 kg,” “Hands at shoulder level or higher,” and “Low demands”	Men	5	0.85 (0.54, 1.79)	43	1.29 (0.96, 1.92)	31	0.93 (0.68, 1.49)
	Women	39	1.48 (1.01, 2.50)	110	1.40 (1.02, 2.19)	64	1.87 (1.13, 4.64)
Low exposure to “Hands at shoulder level or higher,” “Repetitive movements”	Men	28	0.98 (0.72, 1.52)	136	1.23 (0.99, 1.63)	100	1.41 (1.05, 2.08)
	Women	82	1.03 (0.82, 1.37)	298	1.18 (0.96, 1.53)	197	1.83 (1.30, 3.01)
Low exposure to “Hands at shoulder level or higher,” “Repetitive movements,” and “Low demands”	Men	12	0.97 (0.70, 1.54)	54	1.10 (0.87, 1.51)	32	0.96 (0.69, 1.55)
	Women	32	1.38 (0.98, 2.14)	113	1.17 (0.93, 1.57)	60	1.47 (1.00, 2.63)
Low exposure to “Hands at shoulder level or higher,” “Repetitive movements,” “Frequent trunk rotations”	Men	16	1.06 (0.78, 1.62)	101	1.37 (1.08, 1.85)	64	1.48 (1.07, 2.32)
	Women	35	1.02 (0.81, 1.38)	209	1.24 (1.00, 1.63)	126	1.94 (1.34, 3.34)
Low exposure to “Hands at shoulder level or higher,” “Repetitive movements,” “Frequent trunk rotations,” and “Low demands”	Men	4	1.25 (0.70, 4.56)	36	0.78 (0.61, 1.03)	23	1.07 (0.81, 1.58)
	Women	15	0.70 (0.45, 1.08)	81	0.85 (0.73, 1.02)	43	0.62 (0.40, 0.90)
Exposure to “Seated work,” “Low demands,” “High control”	Men	10	1.36 (0.87, 2.29)	21	0.86 (0.70, 1.11)	8	0.38 (0.14, 0.69)
	Women	12	1.37 (0.96, 1.95)	33	0.98 (0.86, 1.15)	11	0.55 (0.34, 0.78)
“Low demands,” “High control,” “High support”	Men	13	1.36 (0.87, 2.29)	34	0.86 (0.70, 1.11)	16	0.38 (0.14, 0.69)
	Women	15	1.37 (0.96, 1.95)	75	0.98 (0.86, 1.15)	35	0.55 (0.34, 0.78)

N, number of workers (reporting *low exposure* and work ability score 10). Bold values indicate a statistically significant association. CI, confidence interval; PR, prevalence ratio.

physical and psychosocial work demands, with the strongest associations in the 55–64 years age group. This is in agreement with previous studies showing that older workers are more affected by physical work demands compared with younger workers [14]. Furthermore, some studies have shown that older workers who rate their work ability lower in relation to their work demands also have a higher risk of being on sick leave in the future [34].

The physical factors that showed the strongest association with excellent work ability for men with neck pain were self-reported *low exposure* to “handheld vibrating tools,” “lifting ≥ 15 kg,” and “leaning forward without support.” For women, they were self-reported *low exposure* to working with the “hands at shoulder level or higher,” “leaning forward without support,” and “lifting ≥ 15 kg.” These work demands have been reported as risk factors for developing work-related neck pain [18,27,39].

The analysis made using combination exposures did not substantially increase associations compared to the single exposure analysis. When creating the classifications for the single exposure categories, all workers reporting low exposure to one work demand were compared to those reporting high exposure to the same work demands. This means that, in both groups, there are workers both reporting high and low exposures to other work demands. It was not possible to include only workers reporting high or low exposure to only one work demand and no other work demands.

Self-reported *low exposure* to “seated work” showed a reversed association with excellent work ability in the middle and older age categories. This can be interpreted to mean that seated work is generally less physically demanding, which could be a positive factor for having excellent work ability with increasing age for workers with neck pain. It has been reported that standing,

walking, lifting, and other physically demanding exposures put stress on the cardiovascular and musculoskeletal systems, which generally become weaker with age [31]. This could be one explanation as to why work ability and physical exposure are associated with age. Prolonged seating has recently been suggested as a risk factor for several health factors [40]. Most of the studies in this review have measured TV time or total time spent sitting and not specifically seated work. However, from these results, it cannot be recommended to encourage workers to spend most of their time sitting.

In this study, women had a lower prevalence of exposure to most physical work demands compared with men. Women had a higher prevalence of exposure to low control, and men had a higher prevalence of high demands and low support. These results somewhat support previous findings in a study [41] that showed a significant association between neck and shoulder symptoms and physical exposure for men, and neck and shoulder symptoms and psychosocial exposure for women. In a Norwegian longitudinal study [42], it was found that older workers, women, and those who reported musculoskeletal symptoms reported a higher degree of disability. The same study also found that several physical work factors were associated with disability. Both of these studies suggest that interventions aimed to increase work ability in workers with neck pain might need to adopt a different approach for men and women.

In this study, 44% of included workers reported excellent work ability despite having neck pain (Table 1). Others who have investigated the relationship between pain and work ability have found much lower work ability scores. This may be explained by the study population and how pain was reported. In another study,

individuals with pain were actively invited to participate, which could mean that the severity of symptoms was higher in that study population [20]. In one review of factors for staying at work despite chronic pain [43], it was found that both individual factors and factors at the workplace were important determinants. Qualitative studies have shown that the ability to make adjustments in the workplace was one factor that seems important for staying at work despite having pain [44].

4.2. Limitations

The design of the study was cross-sectional, and this limits the possibility to draw conclusions about what affects the work ability score. It is not known, for instance, if the exposure to the work demands is a result of neck pain, i.e., whether individuals with neck pain change their exposure to certain work demands.

This study investigated whether excellent work ability is associated with low exposure to physical and psychosocial work demands in workers with neck pain. Both the work ability score and the work demand exposures were self-reported; therefore, the study population's true exposure level is not known. In a review [45], it was found that some items (including time working with the hands above shoulder level and exposure to whole-body vibrations) showed good validity, but other items (including trunk position and handheld vibrating tools) showed a lower level of validity. The method for asking questions about exposure in this study has previously been validated by the SCB [46,47], and good validity has been demonstrated.

This main study group consisted of workers with pain in the upper back and neck. Previous research has shown that some workers with pain rate their exposure higher or worse than those without pain, although their measured exposure was similar or lower [48,49]. In the present study, this may be a cause for misclassification, as exposure was divided into high and low exposure according to self-reports.

We did not perform any mutually adjusted analysis. Stratified analyses based on age and sex were performed as stratified analyses are easier to perform, comprehend, interpret, and communicate than PRs in complex models. Even though there were a high number of participants in this study, the distribution in different exposure categories did not allow for further stratification.

5. Conclusion

Excellent work ability was associated with self-reported low exposure to most measured physical work demands for the included workers with neck pain. This association was stronger among older workers. This study indicates that a lower level of physically demanding work is an important element to maintain excellent work ability, especially for the older worker with neck pain.

Conflicts of interests

The authors declare that they have no competing interests.

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