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ORIGINAL RESEARCH

Physical and psychosocial work exposures as risk factors for disability retirement due to a shoulder lesion

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ABSTRACT

Objective To assess the longitudinal associations of physical and psychosocial exposures with disability retirement due to a shoulder lesion.

Methods In a nationwide register-based study, we followed 1 135 654 wage earners aged 30–59 years for the occurrence of disability retirement due to a shoulder lesion. The occupational exposures were assessed with job exposure matrices. We used a competing risk regression model to estimate HRs and their 95% CIs and to test for the association between the exposures and the outcome. We also calculated the attributable fraction of disability retirement due to occupational exposures.

Results A total of 2472 persons had full disability retirement due to a shoulder lesion during the follow-up. Physically heavy work showed the strongest association with the outcome in both genders, in men with an HR of 2.90 (95% CI 2.37 to 3.55) and in women with an HR of 3.21 (95% CI 2.80 to 3.90). Of the specific physical exposures, working with hands above shoulder level was statistically significantly associated with disability retirement in men. When all physical exposures were taken into consideration, 46% and 41% of disability retirement due to a shoulder lesion were attributed to physical work load factors in men and women, respectively. In addition, 49% (men) and 35% (women) of disability retirement were attributed to psychosocial work-related factors.

Conclusions Our findings suggest that a considerable proportion of disability retirement due to a shoulder lesion could be prevented by reducing physical and psychosocial exposures at work to a low level.

Key messages

What is already known about this subject?

► There is some evidence on the associations of workplace physical and psychosocial exposures with shoulder diseases. Knowledge on the role of work-related factors in the aetiology of disabling shoulder diseases is needed to plan workplace interventions.

What are the new findings?

► In our nationally representative study, we found that physical and psychosocial work-related factors showed a strong association with disability retirement due to a shoulder lesion. Among men, 46% and 49% of disability retirement due to a shoulder lesion were attributed to physical and psychosocial exposures, respectively. Among women, the corresponding values were 41% and 35%.

How might this impact on policy or clinical practice in the foreseeable future?

► The take-home message to general practitioners and occupational health physicians is that reducing physical and psychosocial work-related exposures has a substantial potential to prolong working careers.

INTRODUCTION

Rotator cuff syndrome is common in working populations, with prevalence rates varying between 2.0% and 8.5.[1–3] In Finland, shoulder lesion is the second leading cause for a new sickness absence (SA) episode within musculoskeletal diseases in both men and women, the risk being remarkably higher among manual workers than non-manual workers.[4]

Researchers have suggested several workplace physical exposures to be associated with specific shoulder diseases, while the role of the psychosocial risk factors has remained unclear. According to a systematic review, there is moderate quality evidence that arm elevation and shoulder load increase the incidence of subacromial pain. Hand force exertion, hand-arm vibration and psychosocial demands possibly increase the incidence too, but the evidence is of low quality.[5] In both genders, manual workers have an almost twofold risk of rotator cuff syndrome compared with non-manual workers.[6] The higher risk is largely explained by physical work exposures.

Long-term exposure to high physical workload is associated with disability retirement due to musculoskeletal disorders in middle-aged men and women.[7 8] Higher job strain has been reported to increase the risk of disability retirement due to musculoskeletal diseases in manual workers.[9] However, the associations of work exposures with disability retirement due to specific musculoskeletal disorders have been little studied and focused mainly on back diseases and osteoarthritis.[10–12]

In our previous work, we followed persons with a prolonged SA due to a shoulder lesion for 9 years. During follow-up, 15.8% of the study population were granted a disability pension for any cause and by the end of the follow-up only less than half of the time was spent at work.[13] The aim of this

study was to assess the longitudinal associations of physical and psychosocial work exposures with disability retirement due to a shoulder lesion. Furthermore, we explored whether the associations would differ according to employment sector or industry.

MATERIALS AND METHODS

Setting and data sources

We carried out a population-based study, using register data from a 70% random sample of the Finnish population aged 18–70 years living in Finland on 31 December 2004 (~2.5 million). Persons aged 30–59 years (as of December 2004) who had gainful job on 1 January 2005 were eligible to the study. We excluded persons who did not have an occupational title and those who started to receive any retirement-related benefit (full disability retirement, partial or full old-age retirement or unemployment retirement) before 1 January 2005. Our cohort consisted of 1 135 654 persons (574 617 men and 561 037 women), who were followed from 1 January 2005 till the occurrence of full disability retirement, or other pension, death or end of study period (31 October 2014), whichever came first.

The Finnish disability retirement scheme

All Finnish residents with considerable and long-lasting decreased work ability caused by a physician verified chronic illness, disability or injury are entitled to a disability pension. Before that, sickness allowance is usually paid for a maximum of 300 working days. At the time of the study, full disability pension could be granted to Finnish residents aged 18–62 years. If there is a possibility to restore the employee's work ability through rehabilitation or treatment, a temporary pension for a fixed period can be granted. The work disability pension schemes have been described in more detail elsewhere.[14 15]

Disability retirement due to a shoulder lesion

Information on employee pensions and earning periods was obtained from the register held by the Finnish Centre for Pensions. This register provides information on all disability retirement events with their primary and secondary diagnoses, which are classified according to The International Statistical Classification of Diseases and Related Health Problems, Tenth Revision (ICD-10, Finnish version of ICD-classification 1996). The outcome of this study was full-time disability retirement (either temporary or permanent) due to a shoulder lesion (ICD-10 code: M75) as the primary diagnosis in the period from 1 January 2005 to 31 October 2014.

Occupation

Information on persons' occupation held on 31 December 2004 was obtained from the Finnish Longitudinal Employer–Employee Data (FLEED) of Statistics Finland.

Physical work load factors

Heavy physical work (involving, eg, lifting and carrying heavy loads, excavating, shovelling or hammering), manual handling of heavy loads (lifting, carrying or pushing items heavier than 20 kg at least 10 times every day), working with hands above shoulder level (on average at least 1 hour per day), working in forward bent posture (on average at least 1 hour per day) and forceful hand movements (involving squeezing, twisting, holding burdens or tools on an average at least 1 hour per day) were estimated with a gender-specific job exposure matrix (JEM).[16] The JEM provided the estimates for the likelihood of being exposed. For the analyses, continuous JEM values were dichotomised as 0–0.39 (non-exposed) and 0.40–1.00 (exposed).

Psychosocial work-related factors

High job demands, low job control and monotonousness of work were also estimated with a gender-specific JEM.[17] Job strain was operationalised using the quadrant approach proposed by Karasek and Theorell.[18] It defines workers who are above the median on job demands and below the median on job control as having a high strain job. Other categories are: low strain (low demands and high control), passive (low demands and low control) and active (high demands and high control). Low strain job was used as the reference category in the analyses.

Potential confounders

Information on the persons' education achieved by 31 December 2004, employment sector and industrial sector was obtained from FLEED. Education was categorised as (1) primary (no education after 9 years of compulsory school and sometimes a voluntary 10th year), (2) secondary (11–12 years) and (3) tertiary (13+years). Employment sector was classified as (1) private, (2) public and (3) other, including self-employment. The classification of the industrial sector was based on a standard industrial classification.[19] For the analyses, we selected three most common industries: (1) manufacturing (manufacturing, mining and quarrying), (2) transportation and storage and (3) human health and social work activities.

Statistical analysis

We used a competing risk regression model (stcrreg, STATA V.14) to estimate HRs and their 95% CIs and to test for the association of physical and psychosocial work load factors with disability retirement due to a shoulder lesion. The reference category for each work-related factor consisted of the non-exposed. We accounted for the effect on the outcome of the following competing risks: full disability retirement due to other causes than shoulder lesion, old-age retirement and death. First, age was adjusted for in all analyses (model 1). After this, we included all work-related exposures within the group (either physical or psychosocial) simultaneously into the age-adjusted model (model 2). Finally, we included education into the model (model 3). The analyses were repeated according to age group (30–39, 40–44, 45–49, 50–54, 55–59 years), education, employment sector and selected industries.

We calculated the attributable fraction (AF) to estimate the proportion of disability retirement cases that could be attributed to physical and psychosocial exposures using the following formula: $AF = p(RR-1)/(p(RR-1)+1)$, where p denotes the prevalence of exposure in the population and RR denotes relative risk of disability retirement associated with the exposure. AF refers to the hypothetical effects of reduction in an outcome due to reduction in specific exposures in the population. In this paper, AF is the proportional reduction in disability retirement that would occur if exposure to a risk factor would be reduced to an alternative ideal exposure scenario (eg, likelihood of being exposed is below 0.40) or eliminated. AF close to 1 indicates that the removal of exposure will greatly reduce the number of the disability retirement events in the population. The values of AF close to 0 indicate that removal of exposure from the population will have little effect. The value of AF depends on the prevalence of the specific exposure in the population and the strength of the association between the exposure and the outcome. Therefore, a highly prevalent exposure with a modest effect and a less

prevalent exposure with a strong effect may result in similar values of AF.

After the calculation of AF to each exposure, we calculated the overall AF for physical and psychosocial exposures using the sum formula[20]: $AF_{overall}=1-(1-AF_1)(1-AF_2)\ldots.(1-AF_n)$. The use of the formula is based on the assumption that the exposures are not statistically significantly correlated. Due to this assumption, the overall AFs were calculated for model 2 and model 3 only.

Sensitivity analyses

The use of 50% cut-off point (0.50) to define the exposed and the non-exposed is a common practice for constructing binary JEM measures.[21] Earlier, we showed that lowering the cut-off point to 40% (0.40) resulted in a noticeable gain in the JEM performance, especially for less prevalent exposures.[16] For this study, we explored whether the observed associations are sensitive towards exposure dichotomisation. For that, we looked at the associations between physical work load factors and disability retirement using additional cut-off points of 0.50 and 0.60.

All analyses were made for men and women separately.

RESULTS

The mean age of the study population was 44.63 for men and 45.26 for women. Overall, women had a higher education level than men (table 1). Men worked more often as managers, agricultural workers and skilled manual workers, while women were more often employed in lower level non-manual occupations. Men predominantly worked in the private sector, while women equally often worked in the private and public sector. Men were more frequently exposed than women to physical work load factors, especially heavy lifting, working with hands above shoulder level and high handgrip forces. There were no major gender differences in the prevalence of psychosocial work load factors.

The 9-year incidence rate per 100 000 person years was 36 (95% CI 32 to 39) in men and 28 (25 to 31) in women. During the follow-up, a total of 2472 persons (1415 men and 1057 women) were granted full disability retirement due to a shoulder lesion as the primary diagnosis. A secondary diagnosis was made to 1521 (61.5%) persons. The most common secondary diagnostic group was musculoskeletal diseases (71.2%) followed by mental disorders (5.7%). Compared with the general population, the receivers of disability retirement were older, less educated, held more frequently a manual occupation and were more frequently exposed to physical and psychosocial work-related factors (online supplementary table 1).

Controlling for age, all physical and psychosocial exposures showed a statistically significant association with disability retirement due to a shoulder lesion in both genders (table 2, model 1). Among men, when all physical exposures were included into the model simultaneously, physically heavy work showed a 2.90 fold (95% CI 2.37 to 3.55) and working with hands above shoulder level a 1.57-fold (95% CI 1.35 to 1.81) risk of disability retirement (table 2, model 2). In women, physically heavy work showed the strongest association with the outcome (HR 3.21, 95% CI 2.80 to 3.90). Working in a forward bent posture and work demanding high handgrip forces also marginally increased the risk, while heavy lifting decreased it.

When all psychosocial factors were included into the model, low job control in men and monotonous work in women showed the strongest association with disability retirement (table 2, model 2). Among men, having active job, passive job or high strain job were strongly associated with disability retirement, whereas among women an association was seen only for high strain job. Further adjustment for education attenuated the observed associations (table 2, model 3).

Physically heavy work (men) and working with hands above shoulder level (both genders) showed similar associations with disability retirement due to a shoulder lesion across the age groups (table 3). Among women, the association between heavy physical work and disability retirement decreased with age. There were no marked differences in the psychosocial factors across age groups in either gender.

Table 1 Background characteristics of the study population

	Men (n=574 617)		Women (561 037)	
	N	%	N	%
Age at baseline				
30–34	84 505	14.7	70 793	12.6
35–39	98 333	17.1	89 474	15.9
40–44	103 426	18.0	100 594	17.9
45–49	100 661	17.5	102 908	18.3
50–54	97 177	16.9	102 183	18.2
55–59	90 515	15.8	95 085	16.9
Education				
Tertiary	198 936	34.7	252 068	45.0
Secondary	251 862	43.8	217 190	38.7
Primary	123 819	21.5	91 779	16.3
Major occupational group				
Managers	33 383	5.8	15 887	2.8
Professionals	100 418	17.5	104 007	18.5
Technicians	103 465	18.0	124 689	22.2
Office and customer workers	19 867	3.5	77 626	13.8
Shop, sales and service workers	35 800	6.2	133 400	23.8
Agricultural workers	34 425	6.0	18 183	3.2
Construction, metal and wood workers	120 951	21.0	11 820	2.1
Machine operators and assemblers	91 159	15.9	24 861	4.4
Unskilled manual workers	35 149	6.1	50 564	9.0
Employment sector				
Private	382 138	66.5	251 858	44.9
Public	98 111	17.1	258 930	46.2
Other, including self-employed	94 368	16.4	50 249	9.0
Selected industrial sectors				
Manufacturing	156 548	27.2	63 507	11.3
Transportation and storage	62 083	10.8	22 362	4.0
Human health and social work activities	19 763	3.4	161 253	28.7
Physical work load factors				
Physically heavy work	207 977	36.2	147 485	26.3
Heavy lifting	121 886	21.2	46 773	8.3
Working in a forward bent posture	199 282	34.7	177 791	31.7
Working with hands above shoulder level	105 962	18.4	51 840	9.2
Work demanding high handgrip forces	196 191	34.1	39 513	7.0
Psychosocial work-related factors				
High job demands	214 826	37.4	196 627	35.1
Low job control	331 106	57.6	300 553	53.6
Monotonous work	118 513	20.6	82 296	14.7

Table 2 Associations of physical and psychosocial work-related factors with disability retirement due to a shoulder lesion among men and women

	Model 1*		Model 2†		Model 3‡	
	HR	95% CI	HR	95% CI	HR	95% CI
Men						
Physical work load factors						
Physically heavy work	**3.88**	**3.46 to 4.34**	**2.90**	**2.37 to 3.55**	**1.88**	**1.56 to 2.26**
Heavy lifting	**2.47**	**2.22 to 2.75**	1.09	0.93 to 1.27	1.14	0.98 to 1.34
Working in a forward bent posture	**3.00**	**2.69 to 3.33**	1.06	0.86 to 1.31	1.10	0.90 to 1.34
Working with hands above shoulder level	**2.95**	**2.65 to 3.28**	**1.57**	**1.35 to 1.81**	**1.60**	**1.39 to 1.84**
Work demanding high handgrip forces	**3.04**	**2.73 to 3.38**	0.99	0.78 to 1.25	0.82	0.66 to 1.02
Psychosocial work-related factors						
High job demands	**1.36**	**1.23 to 1.51**	**1.34**	**1.21 to 1.49**	**1.30**	**1.17 to 1.44**
Low job control	**2.28**	**2.02 to 2.58**	**2.09**	**1.84 to 2.38**	**1.22**	**1.07 to 1.39**
Monotonous work	**1.79**	**1.59 to 2.00**	**1.31**	**1.17 to 1.48**	1.08	0.96 to 1.22
Job strain§						
Low strain job	1.00				1.00	
Active job	**3.45**	**2.75 to 4.34**			**2.54**	**2.02 to 3.19**
Passive job	**4.40**	**3.59 to 5.39**			**2.05**	**1.87 to 2.52**
High strain job	**4.50**	**3.64 to 5.57**			**2.18**	**1.76 to 2.71**
Women						
Physical work load factors						
Physically heavy work	**3.65**	**3.23 to 4.13**	**3.21**	**2.80 to 3.90**	**2.04**	**1.71 to 2.43**
Heavy lifting	**1.62**	**1.36 to 1.93**	**0.70**	**0.57 to 0.86**	**0.79**	**0.64 to 0.97**
Working in a forward bent posture	**2.35**	**2.08 to 2.65**	**1.21**	**1.03 to 1.42**	**1.22**	**1.03 to 1.45**
Working with hands above shoulder level	**2.18**	**1.87 to 2.53**	1.04	0.81 to 1.28	1.12	0.89 to 1.41
Work demanding high handgrip forces	**2.90**	**2.50 to 3.38**	**1.22**	**1.05 to 1.65**	1.17	0.93 to 1.49
Psychosocial work-related factors						
High job demands	**1.23**	**1.09 to 1.39**	0.91	0.80 to 1.04	0.99	0.87 to 1.14
Low job control	**2.05**	**1.79 to 2.35**	**1.43**	**1.23 to 1.67**	0.92	0.79 to 1.08
Monotonous work	**3.07**	**2.71 to 3.48**	**2.71**	**2.34 to 3.15**	**2.04**	**1.75 to 2.37**
Job strain§						
Low strain job	1.00				1.00	
Active job	**0.49**	**0.37 to 0.66**			**0.73**	**0.55 to 0.98**
Passive job	**1.39**	**1.18 to 1.64**			0.97	0.82 to 1.14
High strain job	**2.26**	**1.91 to 2.68**			**1.39**	**1.17 to 1.65**

Bold values are statistically significant.
*Adjusted for age.
†Adjusted for age and other risk factors within the group (either physical or psychosocial).
‡Adjusted for age, education and other risk factors within the group (either physical or psychosocial).
§For job strain, the HRs and their 95% CIs in model 1 are adjusted for age and in model 3 for age and education. The reference category for each work-related factor consists of the non-exposed.

The associations of physical and psychosocial work-related factors with the outcome were similar across educational strata (online supplementary table 2). Physically, heavy work was associated with disability retirement in both private and public sector among both men and women (online supplementary table 3). Working with hands above shoulder level was associated with disability retirement among men working in the private sector or as self-employed but not in the public sector. No major differences in associations between the employment sectors were seen for the other exposures.

When the analyses were repeated in the three most common industries, the associations between the exposures and disability retirement were similar to the entire population for the manufacturing and health and social work industries (table 4). Among men working in the transportation and storage industry, a strong statistically significant association was seen for heavy lifting and working with hands above shoulder level.

A total of 24%–51% of disability retirement in men and 5%–41% in women were attributed to physical exposures (table 5, model 1). For both genders, the AF for physically heavy work was the highest. The impact of psychosocial factors was smaller.

When all physical exposures were taken into consideration, 46% and 41% of disability retirement due to a shoulder lesion were attributed to physical work load factors in men and women, respectively. In addition, 49% and 35% of disability retirement were attributed to psychosocial work-related factors in men and women, respectively. Low job control had the strongest impact on disability retirement in men (39%). Controlling for education, AFs for physical work load factors were still 32% and 27% for men and women, respectively.

Using cut-off points of 0.50 and 0.60 resulted in a substantial reduction in the prevalence of physical work load factors, especially among women (online supplementary table 4). Nevertheless, there were negligible differences in the observed associations between the exposures and outcome (online supplementary table 5).

Table 3 Associations of physical and psychosocial work-related factors with disability retirement due to shoulder lesion among men and women by age group

	30–39 years		40–44 years		45–49 years		50–54 years		55–59 years	
	HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI
Men										
Physical work load factors										
Physically heavy work	**1.62**	**1.36 to 1.94**	**1.66**	**1.39 to 1.99**	**1.87**	**1.54 to 2.16**	**1.97**	**1.71 to 2.27**	**1.32**	**1.14 to 1.53**
Heavy lifting	1.09	0.95 to 1.27	1.06	0.91 to 1.20	1.07	0.93 to 1.23	**0.86**	**0.75 to 0.98**	0.97	0.85 to 1.10
Working in a forward bent posture	0.94	0.81 to 1.09	0.98	0.84 to 1.14	1.13	0.96 to 1.32	**1.25**	**1.09 to 1.45**	**1.32**	**1.14 to 1.53**
Working with hands above shoulder level	**1.57**	**1.37 to 1.80**	**1.56**	**1.36 to 1.79**	**1.50**	**1.31 to 1.71**	**1.36**	**1.20 to 1.54**	**1.45**	**1.28 to 1.65**
Work demanding high handgrip forces	**1.37**	**1.17 to 1.62**	**1.27**	**1.07 to 1.59**	1.00	0.85 to 1.18	**0.79**	**0.68 to 0.92**	**0.71**	**0.61 to 0.83**
Psychosocial work-related factors										
High job demands	**1.30**	**1.17 to 1.44**	**1.29**	**1.16 to 1.43**	**1.30**	**1.17 to 1.44**	**1.17**	**1.07 to 1.28**	**1.22**	**1.11 to 1.34**
Low job control	**1.33**	**1.17 to 1.52**	**1.27**	**1.12 to 1.44**	**1.29**	**1.14 to 1.47**	**1.14**	**1.03 to 1.28**	**1.15**	**1.03 to 1.29**
Monotonous work	0.91	0.81 to 1.03	0.95	0.84 to 1.07	0.98	0.87 to 1.10	1.07	0.97 to 1.19	1.06	0.96 to 1.18
Women										
Physical work load factors										
Physically heavy work	**2.53**	**2.16 to 2.97**	**2.40**	**2.05 to 2.82**	**2.29**	**1.97 to 2.66**	**1.81**	**1.57 to 2.08**	**1.77**	**1.54 to 2.05**
Heavy lifting	**0.51**	**0.42 to 0.62**	**0.58**	**0.48 to 0.70**	**0.73**	**0.62 to 0.87**	**1.18**	**1.03 to 1.35**	1.07	0.93 to 1.24
Working in a forward bent posture	**1.32**	**1.14 to 1.55**	**1.28**	**1.10 to 1.50**	**1.16**	**1.01 to 1.35**	1.03	0.90 to 1.18	1.06	0.93 to 1.22
Working with hands above shoulder level	**1.22**	**1.00 to 1.49**	1.21	0.99 to 1.47	1.19	1.00 to 1.43	**1.38**	**1.19 to 1.59**	**1.36**	**1.17 to 1.57**
Work demanding high handgrip forces	**0.59**	**0.48 to 0.72**	**0.71**	**0.58 to 0.86**	0.92	0.78 to 1.10	**1.53**	**1.34 to 1.75**	**1.53**	**1.33 to 1.75**
Psychosocial work-related factors										
High job demands	0.99	0.88 to 1.12	0.99	0.87 to 1.13	1.05	0.93 to 1.18	**1.17**	**1.05 to 1.30**	**1.16**	**1.04 to 1.29**
Low job control	1.05	0.91 to 1.22	1.03	0.89 to 1.20	1.03	0.90 to 1.19	1.11	0.99 to 1.25	**1.17**	**1.04 to 1.33**
Monotonous work	**1.60**	**1.39 to 1.84**	**1.66**	**1.44 to 1.81**	**1.57**	**1.37 to 1.78**	**1.46**	**1.30 to 1.64**	**1.39**	**1.23 to 1.57**

HRs and their 95% CIs. HRs are adjusted for education and each work-related factor within the group (either physical or psychosocial). The reference category for each work-related factor consists of the non-exposed.
Bold values are statistically significant.

DISCUSSION

This nationwide register-based study showed a considerable contribution of physical and psychosocial work-related exposures to disability retirement due to a shoulder lesion in both genders. When all physical exposures were taken into consideration, 46% and 41% of disability retirement were attributed to physical work load factors in men and women, respectively. Moreover, 49% (men) and 35% (women) of disability retirement were attributed to psychosocial work-related factors. Of the specific physical exposures, working with hands above shoulder level was statistically significantly associated with disability retirement in men; however, the AF was only 9%, when the other physical work load factors were controlled for. The associations of physically heavy work (both genders) and working with hands above shoulder level (men) with the outcome were seen in all age groups. The associations of both physical and psychosocial exposures with disability retirement were in general similar in the different educational strata, in the private and public sector and in the three most common industries. However, working with hands above shoulder level increased the risk of disability retirement in men working in the private sector and especially in the transportation and storage industry.

The current study is to our knowledge the first one to explore the contribution of physical and psychosocial factors on disability retirement due to a shoulder lesion; therefore, the results are not directly comparable with other studies. Nevertheless, our findings are in line with the results of systematic reviews[5 22 23] that reported an association between specific shoulder diseases and arm elevation, shoulder load including lifting, and highly repetitive work. In this study, we included additionally physically heavy work as a composite exposure. In univariable models, this exposure showed the strongest association with disability retirement. With all physical exposures in the model, only physically heavy work (both genders), working with hands above shoulder level (men) and working in a forward bent posture (women), remained statistically significant. In contrast with previous studies, we found job control to be more strongly associated with disability retirement than job demands.

In our population-based study, we quantified the burden of disability retirement attributable to physical and psychosocial exposures. For both physical and psychosocial exposures, the disability retirement attributable to these factors was higher for men than women (46 vs 41% and 49 vs 35% for physical and psychosocial factors, respectively). In contrast, a Danish study reported 21% and 34% of all-cause disability pensions in men and women, respectively, to be attributable to physical work exposures.[24] Our results indicate that reducing physical exposures will decrease disability retirement due to a shoulder lesion by more than 40% in both genders. In agreement with our findings, a German population-based study reported that early retirement due to musculoskeletal diseases was notably attributed to low job control, especially in men.[25]

This study shows some gender differences in the contribution of physical and psychosocial exposures to disability retirement due to a shoulder lesion. The overall 9-year incidence rate of disability retirement was higher in men than women, even though several studies have reported that degenerative rotator cuff disorders are approximately as common between the genders.[1 2 26]

Table 4 Associations of physical and psychosocial work-related factors with disability retirement due to shoulder lesion among men and women in selected industrial sectors

	Manufacturing		Transportation and storage		Health and social work	
	HR*	95% CI	HR	95% CI	HR	95% CI
Men						
Physical work load factors						
Physically heavy work	**2.06**	**1.55 to 2.74**	0.71	0.31 to 1.61		
Heavy lifting	0.96	0.72 to 1.28	**2.91**	**1.09 to 7.75**		
Working in a forward bent posture	1.07	0.82 to 1.41	0.97	0.48 to 1.96		
Working with hands above shoulder level	1.08	0.82 to 1.43	**3.25**	**1.44 to 7.34**		
Work demanding high handgrip forces	0.99	0.72 to 1.34	0.60	0.31 to 1.16		
Psychosocial work-related factors						
High job demands	**1.26**	**1.03 to 1.55**	1.07	0.76 to 1.51		
Low job control	**2.75**	**1.91 to 3.97**	1.19	0.56 to 2.54		
Monotonous work	1.22	0.99 to 1.49	1.36	0.82 to 2.27		
Women						
Physical work load factors						
Physically heavy work	**1.60**	**1.06 to 2.41**			**1.42**	**1.09 to 1.85**
Heavy lifting	1.31	0.78 to 2.19			0.71	0.50 to 1.03
Working in a forward bent posture	1.38	0.94 to 2.02			0.94	0.73 to 1.22
Working with hands above shoulder level	1.00	0.54 to 1.85			1.19	0.67 to 2.11
Work demanding high handgrip forces	1.02	0.65 to 1.60			1.25	0.68 to 2.30
Psychosocial work-related factors						
High job demands	1.09	0.80 to 1.49			**0.67**	**0.47 to 0.96**
Low job control	1.29	0.72 to 2.29			0.89	0.70 to 1.14
Monotonous work	**1.52**	**1.06 to 2.17**			**1.66**	**1.13 to 2.44**

HRs[19] and their 95% CIs.
Bold values are statistically significant.
*HRs are adjusted for age, education and each work-related factor within the group (either physical or psychosocial). The reference category for each work-related factor consists of the non-exposed.
†Including self-employed.

The gender difference in disability retirement could be due to men being more frequently than women exposed to heavy physical loads. Men also have a lower education level than women which may reduce the possibilities for job change or re-education in case of work disability. In men, working with hands above shoulder level increased the risk of disability retirement, while in women it did not. Occupations with tasks demanding arm elevation, like electricians, painters, construction workers and truck drivers, are strongly male dominated.

The results of the current study are biologically plausible, as there is evidence for an association between biomechanical shoulder load and rotator cuff tendinopathy.[27 28] Jobs involving physically demanding tasks are often marked by low job control.[29] In our study, low job control remained a risk factor

Table 5 Attributable fractions of work-related factors for disability retirement due to a shoulder lesion

	Model 1*		Model 2†		Model 3‡	
	Men	Women	Men	Women	Men	Women
Physical work load factors						
Physically heavy work	0.51	0.41	0.41	0.37	0.24	0.21
Heavy lifting	0.24	0.05	NA§	NA	NA	NA
Working in a forward bent posture	0.41	0.30	NA	0.06	NA	0.07
Working with hands above shoulder level	0.26	0.10	0.09	NA	0.10	NA
Work demanding high handgrip forces	0.41	0.12	NA	NA	NA	
Overall			0.46	0.41	0.32	0.27
Psychosocial work-related factors						
High job demands	0.13	NA	0.11	NA	0.10	NA
Low job control	0.43	0.17	0.39	0.19	0.11	NA
Monotonous work	0.14	0.16	0.06	0.20	NA	0.13
Overall			0.49	0.35	0.20	0.13

*Adjusted for age.
†Adjusted for age and other risk factors within the group (either physical or psychosocial).
‡Adjusted for age, education and other risk factors within the group (either physical or psychosocial).
§NA, not applicable.

for disability retirement in men when the model was adjusted for the other work exposures. Having high job control may enable a person to regulate the intensity and timing of loads imposed on the shoulder. Moreover, it has been suggested that if a person cannot control and organise his own work, the job might be experienced less attractive and retirement more appealing.[30]

During the time period of the study, Finland underwent an economic recession and stagnation which induced structural changes in the labour force, reducing proportionally the labour force in some industries.[31] It is, however, unlikely that these changes would have affected the associations between the exposures and the outcome. In addition, the rejection rate of disability retirement applications has increased during the latest years which is likely to strengthen the associations observed in the current study. Our findings can be generalised to societies with similar level of industrial development and a relatively generous social security system.

Strengths and limitations

This study has several strengths, including large nationwide representative register data, a relatively long follow-up time and the utilisation of physical and psychosocial exposures based on a gender-specific JEM. Moreover, due to a large sample size, we were able to analyse both genders separately. As our study was population based, we were able to calculate AFs of disability retirement due to work-related exposures.

A limitation typical register-based studies is that we lacked information on some possible confounders. We did not have data on lifestyle factors, such as obesity and smoking. However, we took educational factors into account, which has been shown to partly cover this weakness.[32] Additionally, economic circumstances may have had an impact on the willingness to retire. For example, a person with a low income can conceivably not afford to retire before the statutory retirement age, whereas for a person with long-term high-income level retiring will not present an economic problem. We did not have information on accidental injuries of the shoulder, which may lead to disability retirement regardless of occupational exposures.

The use of JEM can be seen as both a strength and limitation. Exposures estimated with JEM are not prone to recall bias or other types of information bias. However, such method of exposure assessment induces non-differential misclassification bias due to neglection both within worker (over time variation) and between worker (variation in tasks, activities and work processes) variation in a job.[33] A non-differential misclassification bias induced by JEM will attenuate the observed associations towards null.[33 34] As a result, we may have underestimated the association between the exposures and disability retirement due to a shoulder lesion as well as the AFs. Even though the JEM measures may guarantee some degree of objectivity compared with self-reported ones, they cannot be seen as a gold standard in the context of psychosocial work-related factors.[35] The interpretation of the observed associations between psychosocial factors at work and health outcome mainly depends on the validity of the JEM. The JEM used in the current study has a good accuracy in the identification of individuals exposed to low job control, high job strain and monotonous work. Although the validity of the JEM for job demands (especially among men) is relatively low, it is comparable with that for some of the physical exposures (eg, heavy lifting).

CONCLUSIONS

Our findings suggest that a considerable proportion of disability retirement due to a shoulder lesion could be prevented by reducing physical and psychosocial exposures at work to a low level.

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Patient consent for publication Not required.

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