Musculoskeletal disorders and disability among forest industry workers in lower and higher sickness absence groups: a case-control study

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ABSTRACT Background: Musculoskeletal wellbeing and disorders and explanatory factors were investigated among forest industry employees.

Methods: A new positive approach to maintenance of working ability focuses on being present at work. 140 individuals with low sickness absence (≤1.5% in hours during the past 6.5 years) and 140 controls with higher sickness absence (>1.5%), randomly selected from the source population (n = 636) in workplace clusters (n = 5), were studied. Questionnaire data on functioning, musculoskeletal disorders (MSD) and disability, work ability and wellbeing were collected (response rate 65%) during December 2012–January 2013. 183 employees (mean age 48.5; females 32%) participated. Differences between cases and controls were studied with t- and Mann–Whitney tests and between age groups with Kruskal–Wallis tests. Associations between dependent and independent variables were studied using linear and logistic regression.

Results: The sickness absence groups showed no statistically significant difference in MSD prevalence, although the lower sickness absence group reported less musculoskeletal disability than controls (p<.001). Across all participants, a low prevalence of MSD was explained by good work ability (p<.001) and high maximal oxygen consumption (p = .045). Lower musculoskeletal disability in the lower sickness absence group was explained by high psychological resources (OR =0.58) and in controls by good work ability (OR =0.03) and sedentary work (OR =0.08)

Conclusion: Employee heterogeneity is important issue when seeking to minimise prevalence of musculoskeletal disability or sickness absence or their interaction.

KEYWORDS musculoskeletal disorders; musculoskeletal disability; forest industry; sickness absence; working aged

Introduction

In Finland, musculoskeletal diseases are the main cause of sickness absence from work [1]. The direct annual costs of musculoskeletal diseases are around 580 million euros (11% of the costs of all diseases) and the annual cost of lost working time is around two billion euros [2]. The number of working days lost to employers, ranges between 5 and 15 per employee, with a cost to employers of around e1500 per employee [3].

It is commonly known that physical risk factors for musculoskeletal disorders (MSD) are overweight, smoking, injuries and excessively heavy, frequent or one-sided loading of musculoskeletal structures [4–11] and that psychosocial factors increase the risk for neck pain [12–14]. However, no clear consensus exists on the psychosocial risk factors for MSD [8,11,15–17]. Low social support seems to be a risk factor for low back pain [16,17], while symptoms of anxiety and depression in early adolescence were associated with recurrent headache [15], and mental distress, interpersonal stress at work, and dissatisfactory relationships with work colleagues were associated with incident low back pain [11]. Psychosocial factors may also have some effect on the experience of pain and risk for disability [8]. Previous studies have shown less interest in industrial workers or risk factors among industrial workers; however, some evidence exists that risk factors for MSD include painful or strenuous working postures [18], loaded working positions [4] and being a new employee, such as a first year workers [19], whereas satisfaction with one's work and a safe working environment protect against MSD [20,21].

Although the risk factors for MSD are relatively well known, the connections between MSD and sickness absence have been much less studied, and the results are less consistent. Previous studies have found that a lower level of physical functioning [22,23], low muscle power [22,24], sleeping problems [25,26], high job demands [27], low satisfaction with work [28] and low social support [27–29] are associated with a higher rate of sickness absence for MSD or are predictors of sickness absence for MSD. However, no association between low social support and MSD sickness absence has also been reported [12]. Moreover, among industrial employees, evidence of an association between MSD and sickness absence remains insufficient. Among laundry, dry-cleaning [30] and shipyard employees [31], chronic low back pain seems to increase the risk for sickness absence [30,31]. In the food industry, multi-site pain predicted absence, but one-site pain did not [32]. Hartman et al. [33] reported that low back pain and smoking, BMI >27 or high pace of work and workload were associated with higher levels of sickness absence due to low back pain, as also were neck-shoulder and/or upper extremity pain and smoking or previously reported pain. The evidence on the effect of gender on sickness absence among industrial employees is conflicting. In one study, upper extremity disorder among females and low back pain among males were associated with higher risk for sickness absence [30] while in another low back pain was a risk factor for sickness absence among both females and males [31].

Sjögren at al. [34] found that employees in the forest industry who had less sickness absence also reported fewer MSD, a better overall subjective state of health and a better relationship with their supervisor. Since MSD showed the biggest impact on sickness absence, the aim of the present study was to investigate the associations between the amount of MSD, disability due to MSD and sickness absence among the same population of forest industry employees. In Sjögren et al. [34], the case-control design adopted a novel positive approach to the study of work ability, based on being present at work, and hence the cases of interest were employees with a low rate sickness absence and controls with a higher rate of sickness absence.

Methods and material

Participants

This article utilises the research material in [34] and [35]. This study investigated a group of forest industry workers at two locations in Finland. The study was a case-control study. The source population comprised of 636 forest industry employees [timber and wood products employees (n = 600) and office workers (n = 36)] from five work departments. The project team, which included the two personnel managers in the two forest industry locations studied, four researchers and one occupational health specialist determined the definition of a low level of sickness absence (in hours) prior to the data collection. A low level of sickness absence, 1.5% of total working hours over a period of 6.5 years, the period between January 2006 and June 2012, were the eligibility criteria. The sickness absence hours were collected from the forest industry factories sickness absence register. Employees meeting the low sickness absence criterion (n = 140; 22% of the source population) were then selected for the analysis as cases (Lower sickness absence group). Controls (n = 140), randomly selected from the source population in clusters (n = 5), were employees with sickness absence hours above the low level, i.e. >1.5%, during study period (Higher sickness absence group).

Randomisation was done within the clusters, so that the different departments, two industry locations and three different work tasks, were taken account. The whole study group comprised 280 employees, of whom 189 were males (67%) and 90 females (32%). [34,35.]

The data were collected by a questionnaire which was sent between December 2012 and January 2013 to the 280 employees selected for the study. The overall response rate was 65.4% and mean respondents age 48.45 (SD 8.1). In the lower sickness absence group (case group; mean sickness absence hours 66 (SD 50)) 100 employees and in the higher sickness absence group (control group; mean sickness absence hours 657 (SD 840)) 83 employees answered the question on MSD. These 183 employees were included in the analysis. Females were over-represented in the control group (Pearson Chi-square p = .001) but the two study groups did not differ significantly in age. In line with the questionnaire by Mälkiä [36], respondents' subjective occupational physical activity was distributed as follows; 7% "light sedentary work" [1.75 MET (metabolic equivalent)], 26% "sedentary work" (2.5 MET), 21% "physically light standing work or light work involving movement" (3.5 MET), 37% "medium heavy work" (5.0 MET) and 8% "heavy manual work" (7.25 MET). In the lower sickness absence group, 59 participants (59%) and in the higher sickness absence group 44 participants (53%) were overweight (BMI >25). Statistically significance differences were observed between the two sickness absence groups, with employees in the lower sickness absence group showing higher maximum oxygen uptake (VO2max), work ability and state of health. More detailed individual-level information on the physical and psychological functioning, work ability and well-being of the whole study population and between the study groups is given in Table 1. The study was approved by the ethical committee of the University of Jyväskylä, Finland (12 November 2012). [34,35.]

Measurements

The Standardised Nordic questionnaire was used to measure the prevalence of musculoskeletal ache, pain, discomfort and self-reported restriction on participation in daily activities at work (yes/no) during the past 12 months owing to musculoskeletal symptoms in nine anatomical areas of interest. These areas were neck/back of the head (=neck), shoulders, elbows, wrists/hands, upper back, low back, hips, knees and ankles/ feet [37,38] with headache included as a symptom [39]. In this study, these anatomical areas were combined as follows: neck/back of the head, shoulders and upper back were labelled neck/shoulders and/or upper back; low back remained unchanged; hips, knees and ankles/feet were labelled lower limb; elbow and wrist/hand were labelled hand, and headache remained unchanged. A sum index of self-reported pain, ache and discomfort (scale 0–10), labelled MSD was then calculated. Binary indices, “0” = no disorder and “1” = disorder, were also separately calculated for each anatomical category of and labelled, e.g. hand disorder. A sum index of self-reported restriction on participation in daily activities at work (scale 0–10), labelled musculoskeletal disability (MSD disability) was also calculated. Binary indices “0” = no disability and “1” = disability was also separately calculated for each anatomical category and labelled, e.g. disability due to hand disorder. A further binary category, “disability due to any disorder”, was formed from the sum index of self-reported disability due to MSD such that “0” = no disability and “1” = disability due to any disorder.

Application of the test/retest method revealed 0–23% of non-identical answers in the whole Standardised Nordic Questionnaire and the validity test for self-report vs. clinical history 0–20% of non-identical answers [37]. The test for the consistency of the musculoskeletal disability part of the Standardised Nordic Questionnaire revealed 73–93% of identical answers [40]. The reliability and validity of the Standardised Nordic Questionnaire are thus acceptable [37,40].

Overweight was calculated from participants’ self-reported weight and height BMI (kg/m^2). BMI >25 was considered overweight [41]. Age was asked in years and participants were assigned to the following age quartiles, 29–42, 43–48, 49–54 and 55–64 years.

Other measurements used in this study were the Sense on Coherence with SOC-13, work ability in five different components of the Work Ability Index (subjective estimation of present work ability compared with lifetime best, subjective work ability in relation to the physical and mental demands of the work, subjective estimation of work impairment due to diseases and own prognosis of work ability after the next two years) and psychological resources measured by three work ability index items, daily tasks, activity and life spirit and optimism about the future. Moreover, participants’ physical activity at work was assessed on a five-point scale; maximal oxygen uptake was assessed based on information given in a questionnaire, i.e. not measured with an exercise test (N-Ex.); work engagement was assessed with the Utrech Work Engagement Scale (UWES); and relationship with supervisor was self-rated by the participants, using two items (Scale 1 = never, 7 = daily), “Talk with supervisor” and “Assistance from supervisor. These measurements are described in greater detail in Haapakoski et al. [35] and Sjögren et al. [34].

Statistical analysis

The t-test was used to study MSD between cases and controls, the Mann–Whitney test to study MSD disability between cases and controls, the Kruskal–Wallis test to study MSD between age groups, and linear and logistic regression to study the associations between dependent and independent variables. In the linear regression, the dependent variable was MSD and in the logistic regression MSD disability. The independent variables were: work ability, psychological functioning, self-estimated subjective health, work engagement, relationship with supervisor, sense of coherence, physical activity at work, maximum oxygen uptake, self-reported physical activity and overweight. In the two final models age and gender were included in the adjustment analysis as independent variables. In the linear regression and logistic regression analyses non-significant independent variables were discarded until all the variables were statistically significant. The significance level was $p \leq .05$. All the analyses were performed with the statistical package SPSS version 22.0.

Results

Musculoskeletal disorders - differences between sickness absence, gender and age

No statistically significant difference in MSD was observed between the lower and higher sickness absence groups ($t = 1.660$, $df = 181$, $p=.099$). Mean MSD was 2.56 (SD 1.87) in the lower sickness absence group and 3.04 (SD 2.00) in the higher sickness absence group. For this reason, the whole study population was used in the subsequent analysis. A statistically significant gender difference was found across the whole study population ($t = 3.09$, $df = 181$, $p=.002$). Females reported more MSD than males: mean MSD was 3.4 (SD 1.9) for females and 2.5 (SD 1.9) for males. When MSD was compared across the age quartiles, significant differences were found between the quartiles 29–42 and 43–48 years: the younger quartiles reported more MSD (mean 3.31, SD 1.86, 95% CI [2.75, 3.87]) than the older quartiles (mean 2.19, SD 1.62, 95% CI [1.69, 2.69]) ($F = 2.72$, $df = 3$, $p=.046$, Bonferroni correction $p=.039$).

Explanatory factors for musculoskeletal disorders

A positive association was observed across the whole study population ($n = 183$) between a higher score for subjective work ability and VO2max and a low level of MSD. The linear regression model was significant [$F(2, 179)=15.126$ $p< .001$], indicating that the variation in MSD was explained by VO2max and work ability. The explanation rate was 13.5%. (Table 2).

In the whole study group, participants reported MSD in different anatomical areas: lower back 94 (51%), neck/shoulder and/or upper back 118 (65%), headache 58 (32%), hand 47 (26%), and lower limb 83 (45%). In the logistic regression analysis, higher scores for work ability, VO2max, work engagement and normal weight explained the lower MSD in the different anatomical areas. Higher scores in work ability (OR=0.39) explained lower MSD in neck-shoulder and/or upper back and also higher scores in work ability (OR=0.27) explained lower MSD in lower limb. Better VO2max (OR=0.95) explained lower MSD in neck-shoulder and/or upper back and also better VO2max (OR=0.95) protected against MSD in hand. Overweight (OR=3.32) increased the risk for MSD in lower limb. Higher scores in work engagement (OR=0.97) protected from MSD in low back. More details are given in Table 4. In the adjustment analysis, when age and gender were added into the final model as independent variables, gender proved non-significant while higher age protected against MSD in the areas low back, neck/shoulder and/or upper back and in headache (Table 5).

Differences in musculoskeletal disability between the sickness absence groups and by gender and age

A statistically significance difference in MSD disability ($U=5320.0$, $p<.001$) was observed between the two groups, the lower sickness absence group reporting less disability than the higher group (Figure 1.). For this reason, the groups were analysed separately in the subsequent analyses. No MSD disability was reported by 76 (76 %) of the participants in the lower and by 41 (49 %) in the higher sickness absence group. No statistically significant difference in MSD disability was observed for gender in the lower ($U=822.5$, $p=.937$) or higher ($U=771.0$, $p=.454$) sickness absence groups, or for age (quartiles) in the lower ($H=3.62$, $df=3$ $p=.306$) or higher ($H=1.61$, $df=3$, $p=.658$) sickness absence groups.

Explanatory factors for musculoskeletal disability

In the lower sickness absence group, better psychological resources (sum index) (OR=0.58) and in the higher sickness absence group better work ability (scaled sum index) (OR=0.03) and sedentary work (OR=0.08) compared to heavy manual work explained MSD disability due to any MSD. From 1 to 10 employees in the lower sickness absence group and 6 to 19 employees in the higher sickness absence group perceived MSD disability in different anatomical areas (Table 3). In the lower sickness absence group, better psychological resources (OR=0.51) protected from low back MSD disability and also better psychological resources (OR=0.50) from lower limb MSD disability. Better work ability (scaled sum index; OR=0.21) protected from neck/shoulder and/or upper back MSD disability.

In the higher sickness absence group, better work ability (scaled sum index; OR =0.20) and higher scores in sense of coherence (sum index; OR =0.90) protected from neck/shoulder and/or upper back MSD disability, and better work ability (scaled sum index; OR=0.35) protected from lower limb MSD disability. Better VO2max (OR=1.09) was associated with greater risk for low back pain MSD disability but better VO2max (OR=0.93) protected from lower limb MSD disability. Table 6 presents the explanatory factors for musculoskeletal disability in the different anatomical areas in more detail. In the adjustment analysis, age and gender, when added into the final model as independent variables, were not significant.

Discussion

No difference was found in the amount of MSD between the workers in the lower sickness absence group (1.5% of working time) and those in the higher sickness absence group (>1.5% of working time). However, participants in the lower sickness absence group reported less musculoskeletal disability than those in the higher sickness absence group. In both groups combined, females and younger employees reported more MSD than males and older employees. Our analysis was conducted in the following order. First, we analysed MSD. Since the results showed no difference between the groups, we studied MSD across the whole study population. We then analysed MSD disability, and because a difference between the groups was detected, we studied MSD disability in each group separately.

In the higher sickness absence group, lower MSD disability was explained by better work ability. In contrast, in the lower sickness absence group, a low level of MSD disability was explained by better psychological resources. These results, especially for the lower sickness absence group, support the findings of de Vries et al. [42], who found that factors supporting remaining at work, despite chronic musculoskeletal pain, were lower pain intensity, longer duration of pain, better pain acceptance, lower perceived physical workload, better mental health, and more psychological distress, whereas no association was found for level of activity, coping strategy or satisfaction with one's work.

We also found that across the whole study group the amount of MSD was associated with work ability and VO2max: a lower prevalence of MSD was explained by good work ability and higher VO2max. However, previous studies have reported inconsistent results for chronic low back pain and physical activity [43,44]. Van Weering et al. [43] found that chronic low back pain patients were less physically active than controls whereas Verbunt et al. [44] found no difference in physical activity between chronic low back pain patients and their counterparts. Hagen et al. [45] suggested that, in the forest industry context, attention should be paid to psychosocial work factors. They found that an increasing level of psychological demands was significantly associated with an increase in the prevalence of low-back and neck/shoulder disorders. Eatough et al. [46] also found that psychosocial work stressors were related to higher levels of work-related MSD symptoms (wrist/hand, shoulders, and lower back). These results are supported by our results for the lower sickness absence group, where psychological resources seemed to protect against MSD disability, especially disability caused by low back pain and lower limb disorder.

Our results support previous findings in industrial settings, where female gender was identified as a risk factor for upper extremity disorder and sickness absence [30]. It has also been reported that in the same working postures females displayed greater relative muscle activity than males in the shoulder and upper arm muscles [47]. In industrial occupations, however, the connection between age and MSD is less straightforward. In the present study, younger workers (aged 29–42) reported more MSD than older workers (aged 43–48). Other studies have found that, older workers seem to have more neck/shoulder pain [12–14] or were at greater risk for low back pain and neck/shoulder pain than younger counterparts [31]. However, Cheng et al. [48] found that childcare employees over age 40 had a lower incidence of workrelated low back and neck pain. Our results support those of, for example, Oakman & Chan [49] on the importance of taking multidisciplinary and multi-professional factors, into account in the management of work ability and sick leave. Oakman & Chan [49], found that age, psychosocial hazards, physical demands, job satisfaction and work-life balance were risk factors for work related MSD. Our results indicate that musculoskeletal disability should be examined in larger populations with the focus on the possible interactions between sickness absence and age, gender, work content and biopsychosocial resources.

Strength and limitations of the study

The main strengths of this study are the long retrospective follow-up time (6.5 years) in sickness absence rates and relatively high response rate (65.4%). Further, because there were no statistically significant differences in the sickness absence ratio between those who returned the questionnaires and those who did not, there was no selection bias. A further strength concerns the population of interest, i.e. forest industry employees, who have not been widely studied. The limitations of this study are the relatively small size of the study population (n = 280) and the fact that we did not collect or categorise register data on the reasons for or length of sickness absence (short- vs. long-term). For these reasons, the results should be considered tentative. The study was supported by Metsä Group.

In future

In the future, it would be important to investigate the phenomenon of musculoskeletal disability and its explanatory factors in more detail among different groups of employees. An important addition to the subjective measurements, used in this study would be objective measurements of, for example, physical activity by using new technologies. It would also be important to study the effectiveness of different multidisciplinary workplace interventions. Employee heterogeneity is a further important factor to consider when seeking to prevent or reduce the prevalence of MSD disability or sickness absence or their interaction.

Conclusion

In this case-control study of forest industry employees, no difference in the prevalence of MSD was found between the participants in the lower and higher sickness absence groups, although less musculoskeletal disability was reported in the lower than higher sickness absence group. In the lower sickness absence group, subjective musculoskeletal disability was explained by low psychological resources, and in the higher sickness absence group the explanatory factors were better work ability and sedentary work. In both groups combined, better work ability and VO2max explained the lower prevalence of MSD, females reported more MSD than males and younger employees reported more MSD than their older counterparts. The needs and resources of different subgroups and heterogeneity of employees should be considered when planning workplace interventions to promote work ability and reduce sickness absence.

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Disclosure statement

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Tables

Table 1. Descriptive factors of participants (means and standard deviations (SD) and difference between the lower and the higher sickness absence groups)

Variable	**Lower sickness absence group (n=100)** mean (SD)	**Higher sickness absence group (n=83)** mean (SD)	**All (n=183)** mean (SD)	**Difference between groups** p-value of t-test
Age (years)	48.7 (8.3)	48.2 (8.0)	48.0 (8.1)	.66
Body mass index (kg/m^2)**	26.3 (3.7)	26.2 (4.3)	26.2 (4.0)	.93
Maximum oxygen uptake (ml x kg -1 x min -1)**	35.3 (8.0)	32.6 (9.2)	34.1 (8.6)	.03
Psychological resources (sum index 5 - 15)	11.7 (1.7)	12.0 (1.9)	11.8 (1.8)	.30
Work ability (scaled sum index 0.9 - 5)	4.4 (0.47)	4.2 (0.6)	4.3 (0.6)	.05*
Work engagement (sum index 7 - 49)	36.4 (10.4)	37.5 (10.2)	36.9 (10.3)	.46
Sense of coherence (sum index 13 - 91)	68.7(9.0)	69.3 (8.7)	69.0 (8.9)	.62
State of health (0 - 10)	8.3 (1.1)	7.9 (1.6)	8.1 (1.4)	.06*

*Tested also with Mann-Whitney's test, p-values were parallel, p-value of t-test reported

** n=99 in the low sickness absence group and n=182 in all participants, owing to missing information on one participant's body weight

Table 2. Factors explaining MSD (linear regression model, n=183)

Linear regression	**b**	**95 % CI**	**T**	**p-value**	**beta**
Work ability (scaled sum index)	-1.10	(-1.60; -.59)	-4.31	<.001	-.311
VO2max*	-.03	(-.065, -.001)	-2.02	.045	-.146

*n=182, owing to missing information on one participant's body weight

Table 3. Number of participants and percentage reporting musculoskeletal disability in different anatomical areas in the lower sickness absence group and in higher sickness absence group.

	Lower sickness absence group (n=100)	**Higher sickness absence group (n=83)**
Anatomical areas	Number of participants (percentage)	Number of participants (percentage)
No disability	76 (76)	41 (49)
Any anatomical area	24 (24)	42 (51)
Low back	7 (7)	19 (23)
Neck/shoulder and/or upper back	8 (8)	13 (16)
Headache	4 (4)	6 (7)
Hand	1 (1)	8 (10)
Lower limb	10 (10)	15 (18)

Table 4. Factors explaining musculoskeletal disorders in different anatomical areas in the whole study population, odds ratios (OR), 95% confidence intervals and p-values

n=183	**OR**	**95% CI**	**p-value**	**χ^2 ****
Low back				
Work engagement (sum index)	0.97	0.94, 1.0	.028	$\chi^2(1)=4.9$, $p=.028$
Neck-shoulder and/or upper back				
Work ability (scaled sum index)	0.39	0.19, 0.81	.012	$\chi^2(2)=17.2$, $p<.001$
VO2max*	0.95	0.92, 0.99	.021	
Hand				
VO2max*	0.95	0.89, 0.97	<.001	$\chi^2(1)=14.6$, $p<.001$
Lower limb				
Work ability (scaled sum index)	0.27	0.13, 0.53	<.001	$\chi^2(2)=30.4$, $p<.001$
Overweight (BMI >25)*	3.32	1.73, 6.38	<.001	

*n=182, owing to missing information on one participant's body weight

**Logistic regression analysis

Table 5. Adjustment analysis of musculoskeletal disorders in different anatomical areas in the whole study population, odds ratios (OR), 95% confidence intervals (CI) and p-values.

n=183	OR	95 % CI	p-value	χ^2*****
Low back				
Age quartiles 1 (29 - 42)	1.0			$\chi^2(5)=11.7$, p=.039
2 (43 - 48)	0.35	0.14, 0.84	.019*	
3 (49 - 54)	0.45	0.19, 1.10	.073	
4 (55 - 64)	0.41	0.17, 0.97	.042*	
Gender: Female	1.0			
Male	0.97	0.50, 1.85	.915	
Work engagement (sum index)	0.97	0.94, 1.00	.051	
Neck-shoulder and/or upper back				
Age quartiles 1 (29 - 42)	1.0			$\chi^2(6)=34.9$, p<.001
2 (43 - 48)	0.23	0.8, 0.65	.006**	
3 (49 - 54)	0.17	0.06, 0.53	.002**	
4 (55 - 64)	0.13	0.04, 0.42	.001**	
Gender: Female	1.0			
Male	0.84	0.27, 2.63	.768	
Work ability (scaled sum index)	0.33	0.15, 0.72	.005**	
VO2max****	0.92	0.86, 0.99	.019*	
Headache				
Age quartiles 1 (29 - 42)	1.0		.048*	$\chi^2(4)=14.6$, p=.006
2 (43 - 48)	0.41	0.17, 0.99	.017*	
3 (49 - 54)	0.34	0.14, 0.83	.001**	
4 (55 - 64)	0.20	0.08, 0.52		
Gender: Female	1.0		.091	
Male	0.55	0.27, 1.10		
Hand				
Age quartiles 1 (29 - 42)	1.0			$\chi^2(5)=18.7$, p=.002
2 (43 - 48)	0.76	0.25, 2.32	.629	
3 (49 - 54)	1.08	0.36, 3.30	.889	
4 (55 - 64)	0.58	0.17, 1.95	.375	
Gender: Female	1.0			
Male	0.24	0.18, 1.54	.239	
VO2max****	0.94	0.88, 1.01	.109	
Lower limb				
Age quartiles 1 (29 - 42)	1.0			$\chi^2(6)=35.5$, p<.001
2 (43 - 48)	0.66	0.26, 1.69	.660	
3 (49 - 54)	1.67	0.68, 4.07	.263	
4 (55 - 64)	1.52	0.62, 3.74	.366	
Gender: Female	1.0			
Male	0.87	0.43, 1.75	.688	
Work ability (scaled sum index)	0.29	0.14, 0.59	.001**	
Overweight (BMI>25)****	3.29	1.69, 6.41	<.001***	

*p<.05, **p<.01, ***p<.001, ****n=182, owing to missing information on one participant 's body weight;
***** age and gender added as independent variables in the final logistic regression model

Table 6. Factors explaining musculoskeletal disability in different anatomical areas in the lower (n=100) and higher (n=83) sickness absence groups, odds ratios (OR), 95% confidence intervals (CI) and p-values

Disability due to	OR	95% CI	p-value	χ^2*
Any disorder				
Lower				
Psychological resources (sum index)	0.58	0.43, 0.78	<.001	$\chi^2(1)=14.8$, p<.001
Higher				
Work ability (scaled sum index)	0.03	0.01, 0.17	<.001	$\chi^2(5)=40.0$, p<.001
Occupational physical activity				
heavy manual work	1.0			
light sedentary work	0.10	0.01, 1.65	.106	
sedentary work	0.08	0.01, 0.87	.038	
physically light standing work or light work	1.24	0.15, 9.91	.842	
medium heavy work	0.55	0.08, 3.85	.546	
Low back pain				
Lower				
Psychological resources (sum index)	0.51	0.32, 0.84	.007	$\chi^2(1)=8.4$ p=.004
Higher				
VO2max	1.09	1.02, 1.17	.018	$\chi^2(1)=6.8$, p=.009
Neck/shoulder and/or upper back disorder				
Lower				
Work ability (scaled sum index)	0.21	0.05, 0.83	.026	$\chi^2(1)=4.9$, p=.028
Higher				
Work ability (scaled sum index)	0.20	0.06, 0.60	.004	$\chi^2(2)=20.8$, p<.001
Sense of coherence (sum index)	0.90	0.83, 0.98	.013	
Lower limb				
Lower				
Psychological resources (sum index)	0.50	0.33, 0.77	.002	$\chi^2(1)=12.0$, p=.001
Higher				
Work ability (scaled sum index)	0.35	0.13, 0.91	.031	$\chi^2(2)=13.4$, p=.001
VO2max	0.93	0.87, 1.00	.042	

*Logistic regression analysis

Figures

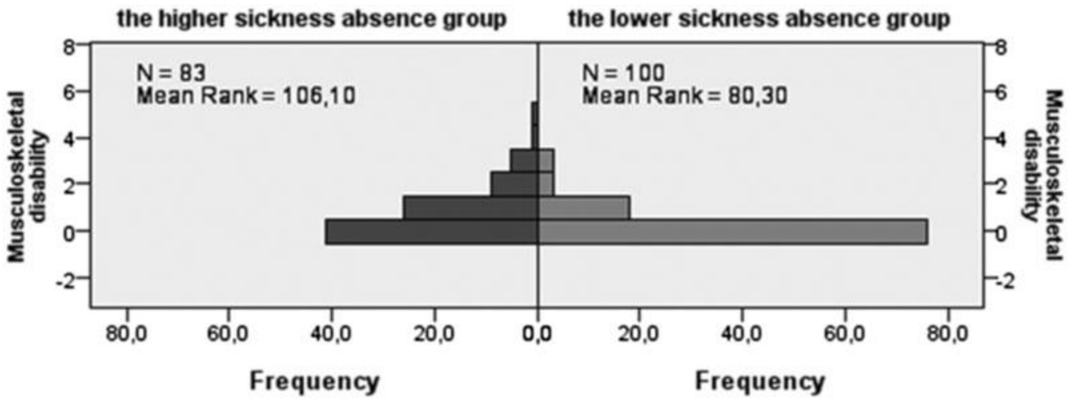

Figure 1. Musculoskeletal disability in the lower and higher sickness absence groups (Mann-Whitney test) (U=5320.0, p<.001)