Musculoskeletal Pain and Depressive Symptoms as Predictors of Trajectories in Work Ability Among Finnish Firefighters at 13-Year Follow-Up

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Objective: To identify work ability trajectories among Finnish firefighters during a 13-year follow-up. We examined whether baseline musculoskeletal pain and depressive symptoms (DPS) predicted membership of the trajectories. **Methods:** We studied 411 male firefighters who responded to a questionnaire at both baseline and at least one of two follow-ups. The outcome variable was perceived work ability (0 to 10). The predictors were musculoskeletal and depressive symptoms. Covariates included age, diseases, lifestyle habits, and work-related factors. **Results:** One fourth of the firefighters belonged to the Diminished work ability trajectory. Musculoskeletal and depressive symptoms, lifestyle risks and diseases, and, in separate analyses, low back pain, were strong predictors of this. **Conclusions:** When planning preventive actions and workplace health promotion among firefighters, even one site musculoskeletal pain and mild signs of depression should be taken into account. Prevention of adverse lifestyle habits is also essential.

Firefighters are multiskilled rescuers who are trained to carry out a wide range of tasks from firefighting and rescue operations to patient transportation and medical first aid. They work with heavy tools and rescue and carry victims in unpredictable environments. They need to deal with fatalities, injured people, and their families. Firefighters have long working hours and may encounter violence at work. Many work tasks have to be carried out under severe time pressure. The tasks described previously require especially good musculoskeletal and mental health and work ability. Sufficient work ability for the high demands of their work is essential for firefighters to cope with all fire and rescue tasks in diverse work conditions.[1–3] It is essential to monitor work ability over time in high-demand occupations.[4]

Several factors, such as suitable physical workload, good task resources, low job demands, good leadership, and relationships between workers and supervisors,[5,6] have been associated with the good work ability of firefighters in both cross-sectional and longitudinal designs. Other studies have found that poor musculoskeletal capacity, motor coordination and balance, work accidents, and poor working postures can be risk factors for decreased work ability among firefighters.[6–8] High perceived mental stress and poor stress tolerance also seemed to be powerful risk factors for decreased work ability in a 13-year follow-up study.[6] In addition, affective factors, such as high levels of vigor and low levels of fatigue, have shown to predict firefighters' work ability.[9]

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The study was approved by the Ethics Committee of the HUS Hospital District and was carried out in accordance with the Helsinki Declaration.

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In a cross-sectional design, work engagement, good lifestyle habits (frequent exercise, nonsmoking), and good sleep were associated with good work ability among fire and rescue personnel.[5] Recently, Plat et al[4] reported that having chronic diseases was not associated with significantly lower current work ability among Dutch firefighters. Nevertheless, Dutch firefighters who suffered from musculoskeletal complaints, especially in the low back, shoulders, or knees, reported that these complaints disabled them in their job performance.[2] To our knowledge, no previous longitudinal studies have explored musculoskeletal disorders as predictors of work ability among firefighters.

Musculoskeletal pain (MSP) in different sites of the body is common among firefighters, and it further increases with age. A prevalence of 14% to 40% of local and radiating low back, shoulder, and knee pain has been reported.[2,10,11] More importantly, in Finland, musculoskeletal (43%) disorders are the most common reason for early retirement among firefighters. The next most common reasons are mental (14%) and cardiovascular disorders (14%) (A. Koski-Pirilä, The Local Government Pensions Institution, written personal communication, 2011).

The prevalence of depressive symptoms (DPS) among firefighters varies between 4% and 22% according to different studies.[11–14] Firefighters aged 45 to 49 years in particular often reported depression.[11] Critical fire and rescue duties may be compromised if firefighters suffer from depression, sleep problems, and/or hazardous drinking.[12] Furthermore, high workload predicted depressive symptoms among Japanese firefighters.[15] Nevertheless, there is a lack of research exploring the associations between depressive symptoms and work ability among fire and rescue personnel.

Over the last decade, the co-occurrence of MSP and depressive symptoms has been increasingly reported (eg, Demyttenaere et al,[16] Patten et al[17]). The risk of depression was found to be 4-fold among those with multisite pain.[18] In studies among the general population, up to every fourth person who reports pain also reports symptoms of depression.[19] The risk of disability seems to be significantly greater for those with both mental disorder and neck or back pain than those with only pain or mental disorder.[20] Nevertheless, the work ability of workers with both pain and depressive symptoms is understudied. The overlap of pain and depression among firefighters has not been previously studied.

For the early prevention of decreased work ability among Finnish firefighters, it is important to know the prevalence of MSP and depressive symptoms as well as their co-occurrence, and more importantly if they predict diminished work ability. This knowledge may enable occupational health care personnel to better prevent and treat pain and depression. It may also be useful for effective interventions at the workplace: to help workers with symptoms of pain and depression and hence enable them to continue working.

The aim of this study was (1) to identify possible distinct trajectories of perceived work ability among Finnish firefighters during a 13-year follow-up, (2) to investigate the prevalence of baseline MSP and depressive symptoms and their co-occurrence, and (3) to examine whether baseline MSP and depressive symptoms and their interaction predicted membership of the perceived work ability trajectories. We also studied the factors predicting disability retirement.

METHODS

Study Design

The data of this study are based on a repeated, self-administered, nationwide questionnaire study, which is part of extensive 3- and 13-year follow-up studies of the health and physical and mental capacity of Finnish professional firefighters.[3,21]

At baseline in 1996, 1124 participants were selected out of 3512 (trade unions' membership register) professional operative male firefighters nationwide through stratified sampling.[22] The sampling was stratified according to the amount of firefighters in the area and their age. The questionnaire study was repeated in 1999 and 2009. The questionnaire was sent in every cross section to all those eligible to participate in the study. The participants of this study consisted of 411 actively working firefighters who responded at baseline and to least one repeated questionnaire (Fig. 1). The analysis also covered 54 participants who were retired on disability pension at follow-up.

Outcome Variables

Perceived current work ability was elicited by the 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? (0 means that you cannot currently work at all)." The question is taken from the Work Ability Index, which is a reliable, validated tool for measuring self-assessed work ability.[23–25]

The variable was then classified as 0 to 7 = diminished and as 8 to 10 = good work ability.[26] Next we established distinct trajectories (models of two and three trajectories) of perceived work ability according to repeated measures in 1996, 1999, and 2009.

Another outcome variable was retiring on disability pension during follow-up.

Predictors and Covariates

Predictors

The predictors and covariates included were chosen on the basis of the literature, the correlation and factor analysis of the predictors and covariates, and the outcome variables of these data. The main predictors of interest were MSP and DPS and their possible co-occurrence. Musculoskeletal pain in the neck, shoulders, forearms/hands, hips, knees, and radiating and local pain in the low back, all at the baseline, was elicited by a separate question on the basis of the validated Nordic questionnaire, which has high repeatability and sensitivity.[27] The question was: "Estimate how many days altogether you have had neck etc. pain during the last 12 months?" The answers were categorized into two categories: 0 = "no pain" (pain on 0 to 7 days) and 1 = "pain" (including pain on 8 to 30 days, pain > 30 days but not daily, or daily). The 12-month time period for the follow-up and a cutoff point of over 7 days of pain are commonly used criteria in MSP studies.[28] Then the sum score of MSP at all sites was calculated (0 = no pain to 7 = pain in seven sites). Finally,

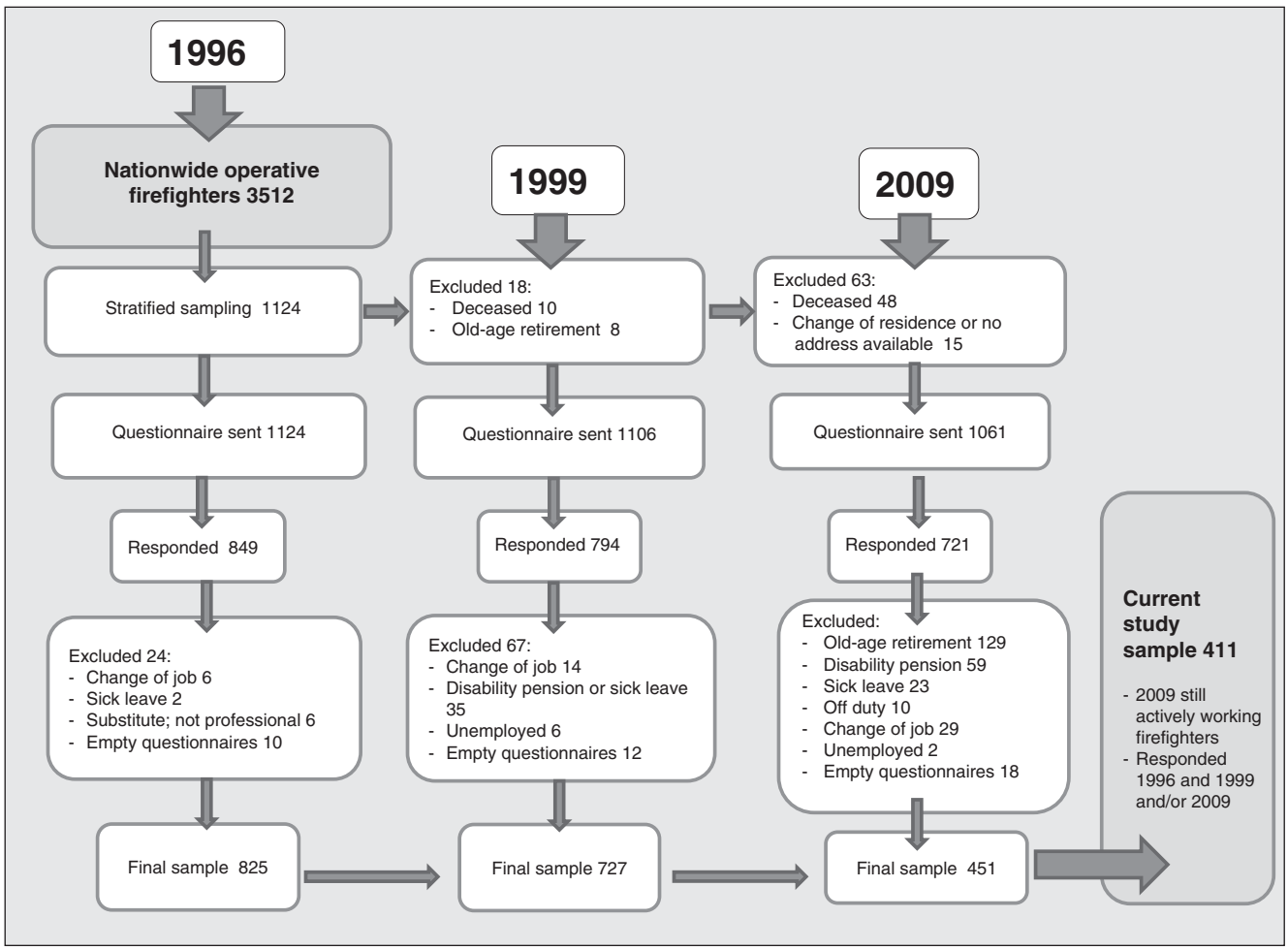

FIGURE 1. Study design, sampling, the number of participants, and reasons for dropping out during 13-year follow-up.

the sum score was classified as follows: 0 = "no pain" (pain in 0 sites), 1 = "pain in one site," and 2 = "pain in 2 to 7 sites."

The DPS (seven items) at baseline were assessed by the Finnish version[29] of the Profile of Mood States (POMS) questionnaire.[30] The short version of POMS includes 38 adjectives that reflect both positive and negative affective states. Respondents were requested to indicate how the specific items describe their state during the last week rated on a five-point frequency scale (0 = not at all, 4 = very much). The construct validity of the scale is satisfactory.[31] The depression subscale consists of seven items, which are miserable, sad, depressed, hopeless, blue, lonely, and distressed. Cronbach α was 0.88. Then the sum score of the depression subscale was calculated (0 = no depressive symptoms; 28 = very much DPS in all seven items). The sum score was further categorized as 0 = "no DPS" (symptoms in 0 items), 1 = "little DPS" (symptoms in one item), 2 = "some DPS" (some to very much symptoms in one to seven items).

Covariates

The variables included in the models as covariates were age, lifestyle factors, current diseases, sleep disturbances, work accidents, physical workload, job demands, task resources, and supervisory relations.

The lifestyle risk variable involved the following: regularity of physical exercise: yes = 0 (no risk), occasional or no regular exercise = 1 (risk); regular smoking ever: no = 0 (no risk), yes = 1 (risk) and units of alcohol per week: $<16 = 0$ (no risk), ≥ 16 units = 1 (risk). The sum variable ranged from 0 (no risk) to 3 (three risks) and was categorized as 0 = "no risks," 1 = "one risk," and 2 = "2 or more risks."[21]

The number of current diseases diagnosed by a physician was elicited using the Work Ability Index.[23] The Index includes a list of the following: musculoskeletal (MSD), cardiovascular, respiratory, mental, neurological and sensory, digestive, genitourinary, skin, endocrine, metabolic, and blood diseases; tumors; and injuries from accidents. The sum score of all diseases was calculated and classified as 0 = "no diseases," 1 = "one disease," and 2 = "2 or more diseases."

Sleep disturbances were elicited using the Basic Nordic sleep Questionnaire.[32] Sleep problems were considered mild if firefighters reported either not sleeping well during the preceding 3 months or having felt extremely tired during the day time on at least 3 to 5 days in 1 week, and to be severe if they reported both. Sleep disorders were then dichotomized as 0 = "no problems," 1 = "sleep problems."

Work accidents were examined by asking "Over the last three years, have you had accidents or minor injuries at work? How many?" Answers were categorized as 0, 1, 2, or >2.

Physical workload was measured with four items adapted from Viikari-Juntura et al.[33] The questions were as follows: "How many hours on average per shift do you work on your knees, sitting on yours hunches, squatting or crawling?" (1 = not at all, 2 = <1/2 hour, 3 = 1/2 to 1 hour, 4 = >1 hour), "How many hours on average per shift do you work in a bent forward position?" (1 = <1/2 hour, 2 = 1/2 to 1 hour, 3 = 1 to 2 hours, 4 = >2 hours), "Estimate the extent to which you work with your back twisted during a regular shift" (1 = not at all, 2 = a little, 3 = moderately, 4 = a lot), and "Estimate how long you work with your hand or hands above the neck-shoulder level during a regular shift?" (1 = <1/2 hour, 2 = 1/2 to 1 hour, 3 = 1 to 2 hours, 4 = >2 hours). Cronbach α was 0.726. We formed sum variables (4 to 16) for the items and categorized them into three classes: low, average, and high workload.[5]

Job demands consisted of three items: responsibility of job, fear of failure at work, and excessive demands of work.[5,34] Answers to the question "Do these factors disturb (your enjoyment of) your work?" were rated on a five-point scale (0 = not at all, 1 = a little, 2 = somewhat, 3 = quite a lot, 4 = a great deal). Cronbach α was 0.754. We formed sum variables of the items (range, 0 to 12) and categorized them into two classes (low–high demands), using the median.

Task resources and supervisory relations were adapted from the Occupational Stress Questionnaire.[35] Task resources included three items: decision making on issues concerning one's tasks, opportunities to use one's knowledge and skills at work, and feedback on success in work tasks. Supervisory relations included five items covering supervisory support, supervisory control, and relationships between employees and supervisors. Task resources were rated on a five-point scale (1 = not at all; low resources, to 5 = very much; high resources). Supervisory relations were rated on a five-point scale (1 = very much; high support, to 5 = not at all; low support).

Cronbach α values were 0.66 for task resources and 0.80 for supervisory relations. We formed sum variables for both of the items (range, 1 to 20) and categorized them into two classes (low–high task resources, low–high support), using the median.

We also enquired about work experience in the fire and rescue sector.

Statistical Analysis

The work ability trajectories were identified using a semiparametric group-based modeling strategy by PROC TRAJ, available in SAS version 9.2.[36,37] This method identifies different latent trajectory groups that tend to have a similar profile over time. All available data points during a given period are used. Trajectory analysis accommodates missing data, but for individuals with very incomplete histories, exclusion from analysis is a practical necessity. One criterion for inclusion was that data from at least two time points of the three had to be available, that is, baseline and at least one follow-up measurement. All our observations fulfilled this criterion. To identify the proper amount of the trajectories, we applied the Bayesian Information Criterion (BIC). On the basis of posterior membership probability (ideally 1, at least 0.70), the participants are assigned to the trajectory that best matches their behavior.[37] When establishing trajectories, the outcome variable was coded as 0 = diminished and 1 = good work ability. The link function was logit.

First, we studied associations between trajectory groups and predictors and covariates by applying cross-tabulations. After these preliminary calculations, we applied logistic regression analysis for defining potential explanatory variables for the final model. The models were estimated with one predictor or covariate at a time. Then the age was entered into the models. To evaluate the association of MSP and DPS co-occurrence with work ability trajectories, we also tested the interaction of MSP and DPS.

We used backward stepwise logistic regression analysis to examine the associations between potential risk factors and membership of the Diminished work ability trajectory. To determine the final model, we applied so-called backward model elimination. First, MSP and DPS with all significant covariates were entered into the same model. Then we started by fitting a model with all potential explanatory variables. We continued by eliminating variables one at a time until all remaining variables were significant at the critical level of 0.05. Next we calculated the odds ratios (ORs) and their 95% confidence intervals (95% CI). A $P < 0.05$ was considered statistically significant. We also analyzed the crude and age-adjusted associations of individual MSP areas (neck, shoulders, forearms/hands, hips, knees, low back) with work ability trajectories. Logistic regression analyses were also applied when examining the associations between potential risk factors for retiring on disability pension. The reference group ($n = 771$) comprised study participants and other nonrespondents than subjects who were retired on disability pension. The ORs and their 95% confidence intervals (95% CI) were then computed. All statistical analyses were carried out using the Statistical Analysis System 9.2 program.[38]

RESULTS

Descriptive Characteristics

Altogether 849 (76%), 794 (72%), and 721 (68%) firefighters answered in 1996, 1999, and 2009, respectively. At baseline, 825 participants' questionnaires were included in the analysis. Twenty-four questionnaires were excluded because the respondents either did not work actively in the fire and rescue sector or returned empty questionnaires (Fig. 1). From the 2009 sample, 63% ($n = 451$) were still working in the fire and rescue sector. The most prominent reasons for dropping out were old-age retirement and disability pension.

There were 411 male firefighters who responded to the questionnaire at baseline in 1996 and at least one follow-up (1999; 2009) and worked actively in firefighting and rescue tasks. Their mean age at baseline was 35.4 ± 5.5 years, and they had 12.0 ± 5.4 years of work experience. The current work ability of over two-thirds of the study sample was classified as good at baseline. The subpopulation of this study was 54 firefighters who had retired on disability pension at 13-year follow-up (Table 1; Fig. 1).

The number of nonrespondents (who did not respond in either 1999 or 2009) after 1996 was 414. The nonparticipants were older than the study sample and had longer work experience and their current work ability was more often diminished (Table 1). They reported slightly more MSP, DPS, and diseases than the study participants. In addition, dropouts more often had two or more lifestyle risks and sleep problems, and job demands were more often high at baseline. No or minor differences were found in the number of work accidents, task resources, and supervisory relations compared with the follow-up cohort.

Work Ability Trajectories

In trajectory analysis, a model of two trajectories had the best fit (Fig. 2). The larger work ability trajectory, labeled "Good," comprised participants ($n = 314$; 76.4%) whose perceived work ability at baseline and at 3- and 13-year follow-ups was on average (SD) 8.8 (0.9), 8.4 (0.9), and 7.6 (1.5), respectively. A total of 23.6% of participants ($n = 97$) belonged to the trajectory group labeled "Diminished" work ability with average values (SD) of 7.1 (1.5) at baseline, 6.8 (1.3) in 1999, and 5.6 (1.8) in 2009. The mean (SD) assignment probabilities were 0.83 (0.12) for the Good and 0.95 (0.08) for the Diminished trajectory group.

Prevalence of MSP and DPS

Musculoskeletal pain was common, with 67% of the study sample experiencing pain in one or several sites. The subjects reported pain in the individual areas as follows: neck, 29.0%; shoulders, 21.9%; forearms/hands, 16.6%; hips, 2.9%; knees, 21.9%; and radiating and local pain in the low back, 14.4% and 25.3%, respectively. More than half (56%) of the participants reported DPS. Almost 40% reported both MSP and DPS (Table 1). Furthermore, nearly half (46%) of the participants had at least one disease, 46% ($n = 87$) of them reported an MSD, and 1% ($n = 2$) reported a mental disease. More than half (58%) expressed having at least one lifestyle risk factor. Of the study sample, 41% reported sleep disturbances and 79% of them had had at least one work-related accident. The physical workload of about one third of the participants was classified as high. Furthermore, the job demands of 39% of the participants were high, 64% had low task resources, and about half (52%) reported poor relationships between supervisors and employees (Table 1).

Factors Associated With Work Ability Trajectories

The distributions of MSP and DPS and the covariates according to the two work ability trajectories are shown in Table 2. As both crude and adjusted for age, MSP and DPS were strong independent predictors for belonging to work ability trajectories. In the age-adjusted analysis, the respondents with MSP in one and more than one sites were at 3.4- and 3.2-fold risks (95% CIs: 1.7 to 6.8 and 1.7 to 6.2), respectively, of belonging to the Diminished work ability trajectory, compared with the participants with no MSP at baseline. Participants who expressed some DPS were at a 2.5-fold risk (95% CIs: 1.5 to 4.3). Nevertheless, the interaction of MSP and DPS was not significant. In addition, two or more lifestyle risks, diseases, work accidents, and high job demands and poor supervisory

TABLE 1. Baseline Characteristics of Respondents ($n = 411$) and Nonrespondents ($n = 414$)

Characteristics in 1996	Participants ($n = 411$)	Nonparticipants ($n = 414$)
Age, mean (SD), yrs	35.4 (5.5)	42.7 (8.9)
Work experience, mean (SD), yrs	12.0 (5.4)	18.2 (8.7)
Current work ability, (%) *n*		
Good (8–10)	341 (83.0)	224 (54.2)
Diminished (0–7)	70 (17.0)	189 (45.8)
Number of pain sites, (%) *n*		
0	135 (32.9)	142 (34.3)
1	122 (29.7)	108 (26.1)
≥2	154 (37.4)	164 (39.6)
Depressive symptoms, (%) *n*		
No	178 (44.4)	144 (35.8)
Little (1)	59 (14.7)	55 (13.7)
Some (≥2)	164 (40.9)	203 (50.5)
Both MSP and DPS, (%), *n*		
No	243 (60.6)	215 (53.5)
Yes	158 (39.4)	187 (46.5)
Number of diseases, (%) *n*		
0	223 (54.3)	144 (34.8)
1	113 (27.5)	119 (28.7)
≥2	75 (18.3)	151 (36.5)
Number of lifestyle risks, (%) *n*		
0	154 (41.6)	102 (28.5)
1	161 (43.5)	137 (38.3)
≥2	55 (14.9)	119 (33.2)
Sleep disturbances, (%) *n*		
No	240 (58.7)	203 (49.3)
Yes	169 (41.4)	209 (50.7)
Number of work accidents, (%) *n*		
0	48 (20.3)	42 (18.1)
1	69 (29.2)	66 (28.5)
2	53 (22.5)	59 (25.4)
>2	66 (28.0)	65 (28.0)
Physical workload, (%) *n*		
Low	129 (31.9)	106 (27.0)
Average	157 (38.8)	150 (38.2)
High	119 (29.4)	137 (34.9)
Job demands, (%) *n*		
Low	252 (61.5)	204 (49.6)
High	158 (38.5)	207 (50.4)
Task resources, (%) *n*		
Low	260 (63.7)	262 (63.6)
High	148 (36.3)	150 (36.4)
Supervisory relations, (%) *n*		
High support	210 (51.5)	193 (47.8)
Low support	194 (48.5)	211 (52.2)

DPS, depressive symptoms; MSP, musculoskeletal pain.

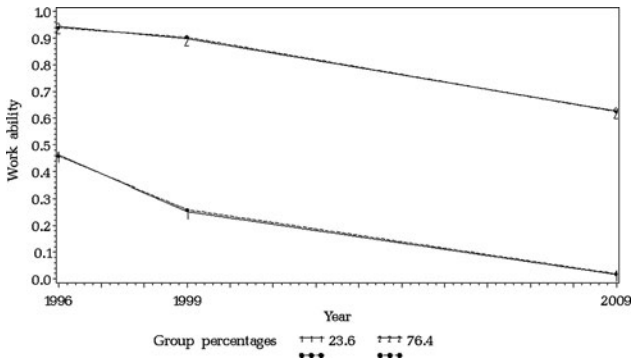

FIGURE 2. Two perceived current work ability trajectories among Finnish firefighters based on follow-up study. The trajectories were labeled as 2 = "Good," 1 = "Diminished." The work ability was coded as 0 = diminished, 1 = good. (Logit function.)

relations standardized by age were significant predictors of belonging to the Diminished group, whereas good task resources were a protective factor (OR = 0.57; 95% CIs 0.34 to 0.96) (Table 2).

MSP and DPS Predict Work Ability Trajectories

To determine the final model, MSP and DPS with all significant covariates were analyzed in the same model. The independent effects of MSP and DPS remained after adjustment for several covariates (MSP and DPS with each other, lifestyle factors, diseases, and age). The ORs and CIs of MSP were 3.8 (1.7 to 8.4) for one pain site and 2.8 (1.3 to 6.1) for equal or more than two sites. The OR (CI) for some amount of DPS was 2.1 (1.1 to 3.9) (Table 3).

Age, lifestyle risks, and diseases also remained in the final model. Two or more lifestyle risks and diseases predicted membership of the diminished trajectory. In the age-adjusted model, the risks were 3.9-fold (95% CIs: 1.8 to 8.4) and 2.5-fold (95% CIs: 1.2 to 5.2), respectively (Table 3).

In the analysis of the individual pain areas, local low back pain (crude OR = 1.9; 95% CI 1.1 to 3.1) and pain in the forearms and hands (1.9; 1.1 to 3.3) predicted belonging to the Diminished work ability trajectory. Neither MSP in the neck region (OR = 1.4; CIs 0.9 to 2.4) nor the other pain areas were predictive of trajectory membership. When adjusted for age, local low back pain retained its effect, with an OR of 2.4 (95% CI: 1.4 to 4.1).

Factors Related to Disability Pension

Participants who were retired on disability pension were older, more often had poor work ability, and had slightly more MSP and more DPS at baseline than the participants who were not retired on disability pension. In the reference group of 771 participants, two or more diseases at baseline and average to high physical workload seemed to be significant risk factors for retiring on disability pension during the 13-year follow-up, with ORs (CIs) of 2.5 (1.2 to 5.3), 3.1 (1.2 to 8.3), and 5.3 (2.1 to 13.4), respectively (Table 4).

DISCUSSION

This study among actively working Finnish firefighters identified two distinct declining trajectories of perceived work ability: Good and Diminished. Our results confirmed that MSP is a common health problem among firefighters, and a considerable proportion of firefighters also reported at least a little DPS. Forty per cent of respondents had both MSP and DPS. After standardization of diseases, lifestyle factors, age, and with each other, MSP and DPS were still strong risk factors of belonging to the Diminished work ability trajectory during follow-up. Nevertheless, the co-occurrence of MSP and DPS was not a significant predictor of diminished work ability. Of the separate pain areas, local low back pain was the strongest predictor of belonging to the Diminished trajectory. As well as MSP and DPS, lifestyle risks and diseases also proved to be independent risk factors. Musculoskeletal pain and DPS were, however, more powerful predictors than factors related to physical and psychosocial work demands. Diseases and high physical workload also seemed to be risk factors for retiring on disability pension.

During the 13-year follow-up, the majority of the firefighters belonged to the Good slightly declining trajectory group, whereas about one fourth belonged to the Diminished declining group. This is in line with studies of municipal workers and managers, which found that despite the overall trend toward decline, the majority of the respondents were located within the favorable work ability trajectory.[39,40] The high, diverse work demands of the fire and rescue sector require good work ability of firefighters. Intensive interventions need to be allocated, especially for those firefighters whose work ability remained diminished during the 13 years.

The results confirmed that MSP is a common health problem among firefighters. Despite possible differences in methodologies, just as Bos et al[2] found among Dutch firefighters (up to 32%) and Miranda et al[41] among general workers (33%), one-third (30%) of the respondents had pain in one body site. Furthermore, 37% of the firefighters in this study reported multisite MSP, which is less than, for example, that of male workers in the food industry (53%) (women 55%),[42] and postal clerks (66%, some women also).[43] This level is, however, about the same as that of the general working population in Finland (34%).[41]

Half of the participants reported at least a little DPS during the last week, but few reported much DPS. Comparison with the results of previous studies is difficult because of differences in study designs, methodology, definitions, and the criterions of DPS, MSP, and their co-occurrence. In this study, DPS included the following mood states: miserable, sad, depressed, hopeless, blue, lonely, and distressed, which are items of the POMS depression subscale.[30] The reported symptoms in this study were relatively mild. Earlier reported prevalence of DPS among firefighters has been considerably lower.[11–14] Furthermore, almost 40% of participants reported both MSP and DPS. Nevertheless, in this study, the interaction that is, co-occurrence of MSP and DPS in relation to work ability trajectories, was not significant. Both MSP and DPS were very independent predictors of work ability, as seen in the final model predicting membership of the trajectories.

Musculoskeletal pain in one site was the strongest predictor of belonging to the Diminished work ability trajectory. The risk was 3.4-fold (1.7 to 6.8) when adjusted for age and almost 4-fold (3.8, 1.7 to 8.4) when the effect of DPS, diseases, and lifestyle were also taken into account. In contrast to previous studies among other working populations (eg, Neupane et al,[44] Miranda et al[41]), multisite pain did not increase the risk for decreased work ability among firefighters. One explanation can be that even single-site pain, usually in the low back, knee, or shoulder, causes a great deal of difficulty for firefighters to cope with all their physically highly demanding tasks. More than one-third of the firefighters in this study reported pain in several sites, but it is possible that the sensation of pain in the other sites was not intense enough to influence perceived work ability. Firefighters with strong multisite pain are unlikely to be able to participate in operative tasks and therefore exit working life, thus also dropping out of these data.

Among the different pain areas, local low back pain was the strongest predictor of belonging to the Diminished work ability trajectory. The result is supported by the fact that the most common reasons (16% of all diagnoses) for early retirement of firefighters are related to low back pain (eg, lumbar disc degeneration) (A. Koski-Pirilä, The Local Government Pensions Institution, personal communication, 2011). Firefighters' low back pain is not only common

TABLE 2. Odds Ratios and 95% Confidence Intervals for the Predictors and Covariates Adjusted for Age Predicting Membership of Diminished Trajectory of Current Work Ability (Logistic Regression Analysis)

	Work Ability Trajectory Group			
Predictors and Covariates in 1996	**Good 8–10 ($n = 314$)**	**Diminished 0–7 ($n = 97$)**	**OR**	**95% CI**
Age, mean (SD), yrs	34.5 (5.5)	38.3 (4.6)	1.15	1.09–1.20
Work experience, mean (SD), yrs	11.4 (5.5)	14.1 (4.7)	1.04	1.06–1.16
Number of pain sites, (%) *n*				
0	120 (38.2)	15 (15.5)	1	Reference
1	85 (27.1)	37 (38.1)	3.42	1.72–6.80
≥2	109 (34.7)	45 (46.4)	3.22	1.66–6.24
Depressive symptoms, (%) *n*				
No	148 (48.5)	30 (31.3)	1	Reference
Little (1)	46 (15.1)	13 (13.5)	1.36	0.63–2.95
Some (≥2)	111 (36.4)	53 (55.2)	2.50	1.46–4.28
Number of diseases, (%) *n*				
0	184 (58.6)	39 (40.2)	1	Reference
1	84 (26.8)	29 (29.9)	1.41	0.80–2.49
≥2	46 (14.7)	29 (29.9)	2.47	1.34–4.52
Number of lifestyle risks, (%) *n*				
0	132 (46.5)	22 (25.6)	1	Reference
1	123 (43.3)	38 (44.2)	1.54	0.83–2.79
≥2	29 (10.2)	26 (30.3)	3.86	1.87–7.94
Sleep disturbances, (%) *n*				
No	192 (61.5)	48 (49.5)	1	Reference
Yes	120 (38.5)	49 (50.5)	1.60	0.99–2.59
Number of work accidents, (%) *n*				
0	41 (22.9)	7 (12.3)	1	Reference
1	54 (30.2)	15 (26.3)	1.57	0.56–4.40
2	36 (20.1)	17 (29.8)	3.18	1.12–9.03
>2	48 (26.8)	18 (31.6)	2.56	0.92–7.14
Physical workload, (%) *n*				
Low	104 (33.7)	25 (26.1)	1	Reference
Average	113 (36.6)	44 (45.8)	1.70	0.95–3.06
High	92 (29.8)	27 (28.1)	1.24	0.65–2.34
Job demands, (%) *n*				
Low	202 (64.5)	50 (51.6)	1	Reference
High	111 (35.5)	47 (48.5)	1.63	1.00–2.63
Task resources, (%) *n*				
Low	193 (61.9)	67 (69.8)	1	Reference
High	119 (38.1)	29 (30.2)	0.57	0.34–0.96
Supervisory relations, (%) *n*				
High support	172 (55.3)	38 (39.2)	1	Reference
Low support	139 (44.7)	58 (60.8)	1.75	1.08–2.85

CI, confidence interval; OR, odds ratio.

but also persistent and can have different pathways in the course of time; that is, it can recover, worsen, fluctuate, and become chronic (S. Lusa et al, Sleep disturbances predict long-term changes in low back among Finnish firefighters: 13-year follow-up study, submitted).

As discussed earlier, the prevalence of DPS was quite high, but reported symptoms were mild. This is in line with the number of diseases. Only 0.5% of participants had a diagnosed mental disease at baseline. It is noteworthy that DPS was, however, a powerful independent predictor (risk over 2-fold) of belonging to the Diminished work ability trajectory. Mental disorders are the second most common reason for early retirement among firefighters in Finland. A little less than 70% of operative Finnish firefighters are able to work until their normal retirement age (A. Koski-Pirilä, The Local Government Pensions Institution, personal communication, 2011). It is important as a preventive measure to include the evaluation and possible treatment of DPS in health examinations early enough, before they cause adverse effects on work ability.

In addition to MSP and DPS, the number of diseases was a significant predictor, with a 2.5-fold risk of belonging to the Diminished work ability group. The results do not support recent cross-sectional

TABLE 3. Odds Ratios and 95% Confidence Intervals for Final Model Predicting Membership in Trajectories of Current Work Ability ($n = 411$), Backward Stepwise Logistic Regression Analysis, Variables Adjusted for All Other Variables in Model

	Work Ability Trajectory Group (Diminished vs Good)	
Final Model	**OR**	**95% CI**
Number of pain sites		
1 vs 0	3.81	1.73–8.41
≥2 vs 0	2.80	1.28–6.10
Depressive symptoms		
Little vs no	1.01	0.42–2.42
Some vs no	2.10	1.14–3.87
Number of lifestyle risks		
1 vs 0	1.16	0.60–2.22
≥2 vs 0	3.85	1.77–8.36
Number of diseases		
1 vs 0	1.52	0.79–2.92
≥2 vs 0	2.53	1.22–5.24
Age, yrs	1.13	1.07–1.20

CI, confidence interval; OR, odds ratio.

findings of chronic diseases not being associated with significantly lower work ability among firefighters.[4] Earlier findings also show that firefighters with pain in the low back, shoulders, and knees reported disabilities during work.[2,11] In our data, MSP was, however, a more powerful predictor of diminished work ability compared with diseases, with a 4-fold risk. Almost half of the participants in this study reported having a diagnosed disease, and 46% of them had an MSD. Chronic MSD did not necessarily influence perceived work ability as detrimentally as MSP. It is of primary importance after musculoskeletal accidents or stress injuries, for example, to carefully rehabilitate and treat pain before the firefighter returns to the most physically demanding tasks.

Having two or more lifestyle risks at baseline meant an almost 4-fold risk of belonging to the Diminished work ability trajectory, even when adjusted for MSP, DPS, diseases, and age. This finding is in line with a previous study[21] in which lifestyle factors, such as nonfrequent exercise, regular smoking, and more than 15 units of alcohol a week, were also risk factors for a decline in aerobic capacity, which has to be good among rescue divers.[45–47] Rescue diving is an essential part of operative work in the fire and rescue sector and presumably affected the participants' work ability estimations.

Our results also confirm earlier, mostly cross-sectional findings that, in addition to good lifestyle habits, low job demands and good task resources, relationships between workers and supervisors were protective factors against the diminished work ability of firefighters.[5,6] Musculoskeletal pain and DPS in this study were, however, more powerful factors than the aforementioned psychosocial factors for predicting membership of the Diminished trajectory. It might be that the aforementioned factors are causes of MSP and DPS, which may explain their more significant association with work ability in physically and mentally highly demanding fire and rescue work.

Among the firefighters who retired on disability pension during the 13-year follow-up, having more than one disease was a significant predictor, with a 2.3-fold risk of retirement compared with participants with no diseases. Musculoskeletal disorder was the most common disease in our data, as it is the most common reason for early retirement among Finnish firefighters (A. Koski-Pirilä, The Local Government Pensions Institution, personal communication, 2011). The retired participants in our data also had slightly more MSP and DPS (although not statistically significant) than the firefighters who had not retired because of disabilities. Recently, MSP impairing work ability in one or several sites has shown to be an early and direct predictor of disability pension due to MSD diagnoses.[48,49]

Average to high physical workload at baseline also seemed to be a risk factor, with ORs of 3.1 and 5.3, for work disability after 13 years. Work-related strain may have long-term negative effects on work ability and can still affect functioning several decades later.[40,50]

Study Strengths and Considerations

The major strengths of this study are the use of a long follow-up time of 13 years, allowing claim for causality, carefully stratified sampled data, and the use of validated questionnaires. The response rates at baseline and follow-ups were good. At baseline, the participants represented Finnish firefighters well. The number of dropouts over 13 years was high, however. In this study, we included participants who were still actively working after follow-up and responded at baseline and to least one of the follow-up surveys. The dropouts were mostly older than the participants, because one third (30%) of them retired normally because of old-age pension during the follow-up. Dropouts due to disability pension were also older than the study sample. About 30% of the dropouts were out of the workforce for health-based reasons. Almost without exception, the dropouts reported more MSP, DPS, diseases, and lifestyle risks than the study participants. Therefore, our results are affected by the healthy worker effect, which means that the predictive value of MSP and DPS for belonging to the Diminished work ability group may be even higher.

The results of the disability pension subanalysis can be considered preliminary. The small number of participants (54) may have influenced the results. In addition, because of the long follow-up time—10 years between the second and third surveys—some of the participants may have started retirement on disability pension, and in accordance with the Finnish system, moved on to old age pension some years later.

Self-reporting may be subject to misclassification and cause systematic measurement errors. Nevertheless, the longitudinal design used in this study diminishes the risk of common method bias.[51] Furthermore, our data were collected through widely used, valid, and reliable questionnaires.[23–25,27,28,31]

It would be important in future studies to focus on early interventions to prevent MSP and DPS and thus diminished work ability. In planning these intervention studies, as well as workplace interventions, it would be useful to investigate factors predicting MSP and DPS among firefighters.

CONCLUSIONS

One fourth of the Finnish firefighters in this study belonged to the Diminished declining work ability trajectory group during follow-up. This is a high figure, especially as firefighters face heavy job demands. Musculoskeletal pain is common and a considerable proportion of firefighters also reported DPS. MSP and DPS, as well as lifestyle risks and diseases, were strong independent predictors of belonging to the Diminished work ability trajectory. Diseases and high physical workload also seemed to be significant risk factors for retirement on disability pension among firefighters. The results imply that even single-site MSP, especially in the low back, and some amount of DPS are important to consider when occupational health and safety providers and workplaces are planning interventions to prevent firefighters' work ability diminishing. Attention should be paid to healthy lifestyle habits and the efficient prevention and treatment of diseases, suitable job demands, good task resources, and relations between supervisors and subordinates. Lifestyle might

TABLE 4. Factors Predicting Retirement on Disability Pension During Follow-up: Age Standardized Odds Ratios and 95% Confidence Intervals, ($n = 54$) (Logistic Regression Analysis)

	Disability Pension			
Predictors and Covariates in 1996	**No ($n = 771$)**	**Yes ($n = 54$)**	**OR**	**95% CI**
Age, mean (SD), yrs	38.6 (8.2)	45.7 (5.4)	1.12	1.08–1.16
Work experience, mean (SD), yrs	14.7 (7.9)	20.1 (5.8)	1.09	1.05–1.13
Work ability				
Good (8–10)	543 (70.5)	22 (40.7)	1	Reference
Diminished (0–7)	227 (29.5)	32 (59.3)	1.59	0.84–3.03
Number of pain sites, (%) *n*				
0	261 (33.9)	16 (29.6)	1	Reference
1	215 (27.9)	35 (27.8)	1.14	0.54–2.40
≥2	295 (38.3)	23 (42.6)	0.97	0.49–1.93
Depressive symptoms, (%) *n*				
No	306 (40.9)	16 (29.6)	1	Reference
Little (1)	107 (14.3)	7 (13.0)	1.00	0.39–2.56
Some (≥2)	336 (44.9)	31 (57.4)	1.12	0.73–2.63
Number of diseases, (%) *n*				
0	356 (46.2)	11 (20.4)	1	Reference
1	217 (28.1)	15 (27.8)	1.71	0.76–3.85
≥2	198 (25.7)	28 (51.8)	2.45	1.15–5.26
Number of lifestyle risks, (%) *n*				
0	244 (35.9)	12 (25.0)	1	Reference
1	282 (41.5)	16 (33.3)	0.87	0.40–1.92
≥2	154 (22.7)	20 (22.7)	1.54	0.71–3.36
Sleep disturbances, (%) *n*				
No	421 (54.9)	22 (40.7)	1	Reference
Yes	346 (45.1)	32 (59.3)	1.49	0.84–2.65
Number of work accidents, (%) *n*				
0	85 (19.7)	5 (13.5)	1	Reference
1	125 (29.0)	10 (27.0)	1.29	0.41–4.02
2	100 (23.2)	12 (32.4)	2.05	0.67–6.26
>2	121 (28.1)	10 (27.0)	1.37	0.44–4.28
Physical workload, (%) *n*				
Low	229 (30.6)	6 (12.2)	1	Reference
Average	290 (38.7)	17 (34.7)	3.14	1.19–8.31
High	230 (30.7)	26 (53.1)	5.27	2.08–13.4
Job demands, (%) *n*				
Low	436 (56.8)	20 (37.0)	1	Reference
High	331 (43.2)	34 (63.0)	1.72	0.95–3.09
Task resources, (%) *n*				
Low	486 (63.5)	36 (66.7)	1	Reference
High	280 (36.5)	18 (33.3)	0.82	0.45–1.50
Supervisory relations, (%) *n*				
High support	379 (49.9)	24 (47.1)	1	Reference
Low support	382 (50.2)	27 (52.9)	0.89	0.50–1.60

CI, confidence interval; OR, odds ratio.

be even more important in the future because of the increasingly sedentary lifestyle of younger people.

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