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Demand, Control and Support at Work Among Sick-Listed Patients with Neck or Back Pain: A Prospective Study

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Abstract *Purpose* The main aim of this study was to assess changes in perceived demand, control and support at work of neck and back pain patients over 1 year. We also hypothesised that perceived changes in demand, control and support at work were associated with clinical improvement, reduced fear-avoidance beliefs and successful return to work. *Methods* Four hundred and five sick-listed patients referred to secondary care with neck or back pain were originally included in an interventional study. Of these, two hundred and twenty-six patients reported perceived psychosocial work factors at both baseline and 1-year follow-up, and they were later included in this prospective study. Changes in demand, control and support dimensions were measured by a total of nine variables. *Results* At the group level, no significant differences were found among the measured subscales. At the individual level, the regression analyses showed that decreases in fear-avoidance beliefs about work were consistently related to decreases in demand and increases in control, whereas decreases in disability, anxiety and depression were related to increases in support subscales. *Conclusions* The perception of demand, control and support appear to be stable over 1 year in patients with neck and back pain, despite marked improvement in pain and disability. Disability, anxiety, depression and fear-avoidance beliefs about work were significantly associated with the perception of the work environment, whereas neck and back pain were not.

Keywords Sick leave · Work · Musculoskeletal diseases · Social support · Psychology

Introduction

Neck and back pain are common ailments, and they are a major source of disability and work absences [1]. Disability from neck and low back pain is multi-factorial and not just related to medical factors [2, 3]. In particular, the importance of working conditions has been recognised [4]. Although the physical work environment is still important for ensuring safety and health at the workplace, the psychosocial work environment is considered to be the most important factor in disability prevention [5]. Several models have been developed to explain the relationship between the perceived psychosocial work environment and health problems [6]. One of the most used models is the job-demand-control-support model (JDCS) developed by Karasek and colleagues [7]. The JDCS is a three-dimensional model integrating job demand, decision latitude and social support at work. The model is based on research showing that workers with high-strain jobs and low social support have a higher risk of cardiovascular disease [8]. The influences of demand, control and support at work in occupational neck and back pain have attracted considerable interest over the years. Recent reviews suggest that high demand, low control and low supervisor support are probably associated with the presence of neck and back pain [9, 10].

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In a previous study, the model was applied to patients on sick leave referred to specialised care due to neck and back pain [11]. The patients perceived higher demands on their physical endurance compared to the reference population. Additionally, perceived demand, control and support were closely associated with fear-avoidance beliefs about work [11]. Although a recent study focusing on a Norwegian worker population reported quantitative demand and decision control to be rather stable over a 4-year period [12], we have no knowledge about the perception of demand, control and support over time in patient populations.

The view that a worker's health might influence the perceived psychosocial work environment has recently been proposed in a systematic review [13]. One of the most common mechanisms proposed to explain this "reversed effect" is the "perception" hypothesis. In this hypothesis, changes in worker well-being are suggested to cause an altered perception of the existing work environment, despite an actual unchanged work environment. Unhealthy workers might interpret their work environment more negatively over time due to reduced work capacity or by a selective recall of negative information or situations in individuals with poor affective health. Conversely, healthy workers are more likely to re-interpret their jobs positively over time [13]. In neck and back pain patients, a considerable reduction in pain and disability over the first year following a multidisciplinary intervention is expected [14, 15], as well as reduced emotional distress [14]. In addition, one of the priorities of multidisciplinary treatments is to reduce fear-avoidance beliefs, as high fear avoidance beliefs about work are found to be associated with prolonged sick leave and work loss [16]. Therefore, a reduction in fear-avoidance beliefs about work is anticipated [14]. Furthermore, the majority of sick-listed back pain patients generally return to their usual work within 1 year [17–19]. The extent to which the clinical recovery and return to work (RTW) actually influence the perception of demand, control and support over time in a patient population is not known.

The overall aim of this study was to assess changes in perceived demand, control and support at work in neck and back pain patients over 1 year. We also hypothesised that changes in demand, control or support at work were associated with clinical improvement, reduced fear avoidance beliefs and successful RTW.

Methods

Design

This study was part of a randomised controlled multicentre trial of patients on sick leave due to neck and back pain [17]. All variables were measured at baseline and at 1-year follow-up. This study was conducted in accordance with the Helsinki Declaration and was evaluated by the Regional Committees for Medical and Health Research Ethics in Southeast Norway (S09024b 2009/1000). It was authorised by the Data Protection for Research at Oslo University Hospital (1207-091208) according to Norwegian guidelines.

Participants

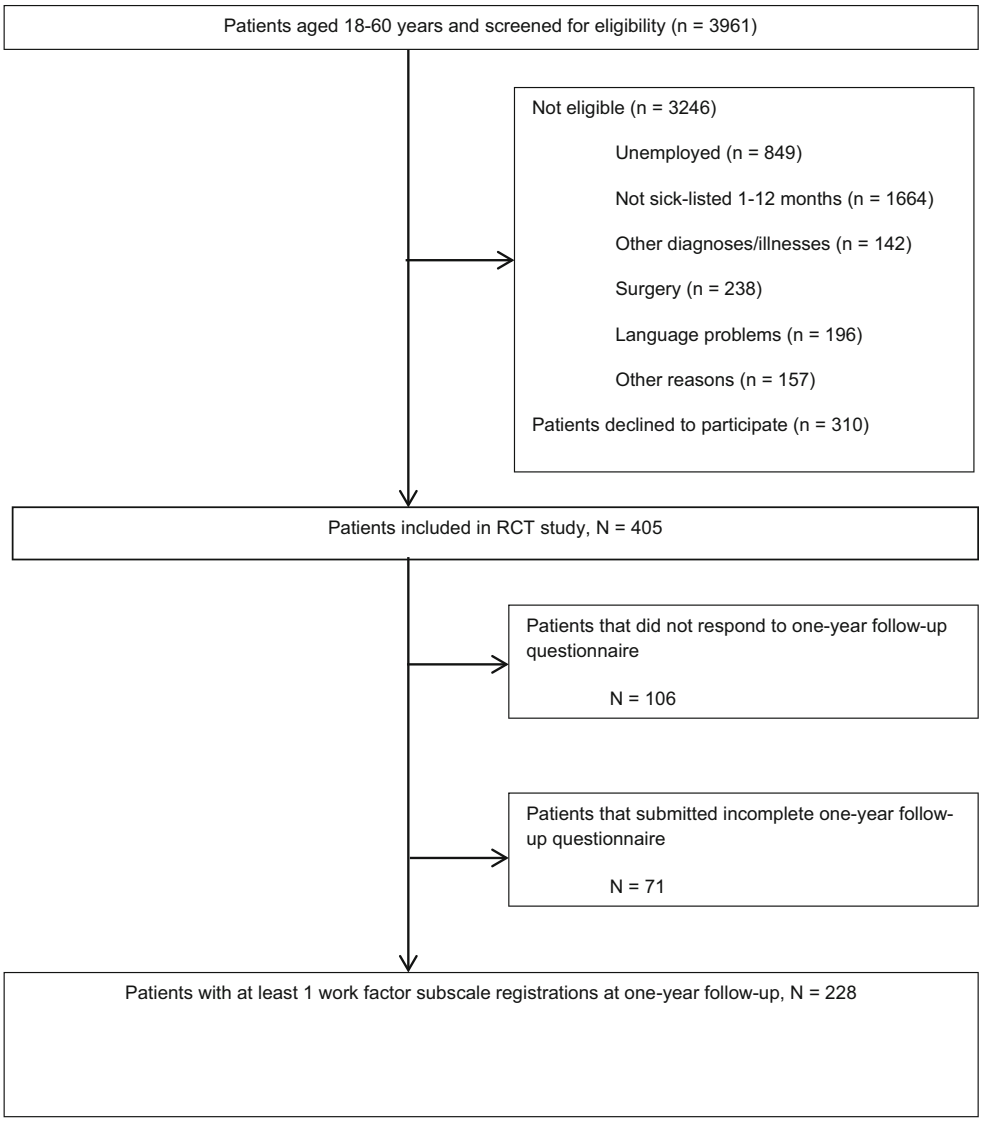
Patients referred to the neck and back outpatient clinic at Oslo University Hospital (OUS), Ulleval and St. Olavs University Hospital (SOH), Trondheim, Norway were recruited. All referred patients underwent a standardised medical examination to assess their eligibility for inclusion. To be included in the study, patients had to be between 18 and 60 years of age, employed and have sick leave duration between 1 and 12 months. The exclusion criteria were requiring surgical treatment, cauda equina syndrome, symptomatic spinal deformities, osteoporosis with fractures, inflammatory rheumatic diseases, pregnancy, legal labour disputes, insufficient Norwegian language skills, cardiac, pulmonary, or metabolic disease with functional restrictions, and DSM-IV-diagnosed mental disorders.

Between August 2009 and August 2011, a total of 3961 patients were screened for eligibility. The main reasons for ineligibility included not being sick-listed (50 %), unemployed (26 %), having a disorder suitable for surgical treatment (7 %) and a lack of Norwegian language skills (6 %). A total of 715 patients were eligible. Of these patients, 310 declined to participate. The remaining 405 patients were included in the intervention study (Fig. 1) and were randomised to either the work-focused multidisciplinary or clinical multidisciplinary intervention.

Assessments

We recorded age, gender, native language, marital status, smoking status, highest level of education and occupation at baseline. The level of education was categorised into the following four groups: primary school (7–10 years), vocational high school or general academic secondary school, college or university for <4 years and college or university ≥ 4 years [20]. Occupation was categorised based on the International Standard Classifications of Occupations, ISCO-88 [21]. Based on the ISCO-88 codes, we collapsed the occupations into four categories: low-skilled blue-collar workers (ISCO-codes 8 and 9), high-skilled blue-collar workers (ISCO-codes 6 and 7), low-skilled white-collar workers (ISCO-codes 4 and 5) and high-skilled white-collar workers (ISCO-codes 1, 2 and 3).

Fig. 1 Patient flow



Intensity of pain during activity over the past week was reported on an 11-point numeric rating scale (NRS), ranging from 0 (no pain) to 10 (worst possible pain) [22]. Both neck/arm and back/leg pain were reported, and the highest pain rating of the two was used in the analyses. A minimum important change (MIC) of 2.0–2.5 points or a 30 % improvement on the NRS was previously proposed [22, 23].

The Oswestry Disability Index (ODI) [24, 25] and Neck Disability Index (NDI) [26, 27] are composed of ten items ranging from 0 to 5. The summed score is presented as a percentage, where 0 represents no disability and 100 represents maximum disability. If more than five items were missing, no total ODI/NDI scores were calculated. A MIC of 30 % improvement or ten points for the ODI has been previously proposed [23]. For participants reporting disability due to both NP and LBP, the highest disability score was used in the analyses and was referred to as the Disability Index (DI) score.

Levels of anxiety and depression were measured by the Hospital Anxiety and Depression Scale (HADS) [28]. This has been found to perform well in screening for symptom severity and for case evaluation of anxiety disorders and depression in somatic, psychiatric and primary care patients, as well as in the general population. The anxiety and depression subscales consist of seven items each, scored on a four-point scale from 0 to 3. The items are added together, resulting in a subscale score from 0 to 21. One or two missing items in the HADS were substituted with the subject's mean value. If more items were missing, no HADS score was computed.

Fear-avoidance was measured using Waddell's Fear–Avoidance Belief Questionnaire (FABQ), where each item was scored on a 7-point Likert scale ranging from 0 (strongly

disagree) to 6 (strongly agree). The 7-item FABQ about work subscale (FABQ-W) was chosen in the analyses, as previous studies have shown an association between work-loss and disability [16]. The score ranges from 0 to 42 [16, 29], with high scores denoting strong fear-avoidance beliefs. No missing values were allowed when calculating the FABQ scores.

The General Nordic Questionnaire for Psychological and Social Factors at Work (QPS Nordic) [30] is a questionnaire used to identify psychosocial factors at work. The validity and reliability have been documented previously [31]. The questionnaire was constructed on the basis of common questionnaires on this subject. The total questionnaire comprises questions that are found to be important for health and well-being, independent of specific models. The QPS Nordic items covering the dimensions of demand, control and social support were used in this study. An overview of the subscales and items included in the present analyses is provided in Table 1. QPS Nordic subscale scores were calculated as the mean scores of completed items for those completing at least two-thirds of the corresponding items. In five subscale measures at baseline and 13 measures at the 1-year follow-up, this rule was not met, and the subscale scores were replaced by the average subscale scores of the patient group. In addition, to achieve similar N for the nine QPS Nordic subscales in the analyses, we replaced a complete missing subscale score with the average score in ten subjects. The average values were calculated and substituted in two subgroups, depending on whether the patient had returned to work or not. The number of imputed values varied between 3 and 11 for each subscale. We also replaced the missing values with extreme values and calculated the effect size of the difference between the two methods on each subscale by Cohen's d (Table 2).

In this prospective study of change in the work environment, patients were defined as 'RTW' if they had returned to their workplace, even if they still worked fewer hours per week than their employment entailed.

Data Analysis and Statistics

We used paired t tests to compare the average subscale values of the study population at baseline with 1-year follow-up. After Bonferroni adjustment for three comparisons within each of the three dimensions (demand, control and support), values of $p \leq 0.05/3 = 0.017$ were regarded as statistically significant. To assess the size of the differences, Cohen's d values [32] were calculated. Cohen's d is defined as the difference between two means divided by the pooled standard deviation. We used the definition of effect sizes as given by Cohen, including small (d = 0.2), medium (d = 0.5) and large (d = 0.8).

A hierarchical multiple regression analysis with each of the nine QPS Nordic subscale change-scores as dependent variables was performed. This was conducted to explore the relationship between the demographic characteristics, changes in clinical and mental health variables, the work-focused intervention, RTW-status, and the subscales' change-score. First, we divided possible independent variables into two blocks: *demographic* and *functioning* blocks. Within each block, a series of standard univariate regression analyses were performed, and variables with p values <0.2 were later included in the multiple regression analyses. In the *demographic* block the following variables were explored: age, gender, educational level, and occupation. In the *functioning* block, we explored RTW-status, occurrence of work-focused intervention, and the change-scores of pain intensity, DI, HADS-anxiety, HADS-depression, and FABQ-W. We controlled for age, gender, and the baseline value of the QPS Nordic subscale. All clinical variables were assessed with respect to the normal distribution. Low co-linearity was

Table 1 An overview of the subscales and items from the QPS Nordic used in the analysis

Composite subscale	Subscales	Number of items	Total range of scores
Demand	Quantitative demands	4	1–5[a]
	Control demands	3	1–5[a]
	Learning demands	3	1–5[a]
Control	Positive challenge at work	3	1–5[a]
	Control of decision	5	1–5[a]
	Control of work pacing	4	1–5[a]
Support	Support from superior	3	1–5[a]
	Support from co-workers	2	1–5[a]
	Support from friends and family	3	1–5[a]

[a] Responses were given along a five-point scale ranging from 1 (very seldom or never) to 5 (very often or always). For each subscale, we reported the sum of the item score divided by the number of items (range 1–5)

Table 2 The mean values of the QPS Nordic subscale scorings at baseline and 1-year, and the *t* test *p* values and effect size (Cohen's d) with mean and extreme value imputations

	Imputing with mean value (*t* test)				Imputing with extreme value (*t* test)			
	Baseline mean (SD)	1 year mean (SD)	*p* value	Cohen's d	Baseline mean (SD)	1 year mean (SD)	*p* value	Cohen's d
Quantitative demands	3.09 (0.82)	2.96 (0.91)	0.025[a]	0.15	3.09 (0.82)	2.95 (0.93)	0.009[b]	0.16
Decision demands	3.47 (0.78)	3.56 (0.90)	0.062	−0.11	3.48 (0.79)	3.58 (0.91)	0.038[a]	−0.12
Learning demands	2.48 (0.69)	2.42 (0.70)	0.128	0.09	2.48 (0.69)	2.40 (0.71)	0.080	0.11
Positive challenge at work	3.94 (0.83)	3.98 (0.87)	0.236	−0.05	3.94 (0.83)	4.01 (0.87)	0.154	−0.08
Control of decision	2.65 (0.85)	2.72 (0.81)	0.169	−0.08	2.64 (0.86)	2.81 (0.93)	0.005[b]	−0.19
Control of work pacing	2.67 (1.20)	2.69 (1.14)	0.724	−0.02	2.67 (1.20)	2.73 (1.17)	0.322	−0.05
Support from superior	3.54 (1.08)	3.61 (1.06)	0.246	−0.07	3.54 (1.08)	3.69 (1.08)	0.039[a]	−0.14
Support from co-workers	3.79 (0.96)	3.78 (0.98)	0.984	0.01	3.75 (1.01)	3.83 (0.99)	0.254	−0.08
Support from friends	4.00 (0.97)	3.92 (1.01)	0.227	0.08	3.99 (0.97)	3.84 (1.10)	0.022[a]	0.14

[a] Significant at 0.05-level

[b] Significant at 0.05/3 = 0.0167-level (Bonferroni correction)

found between the independent variables with tolerance >0.9. The final multiple regression analysis included variables with *p* values <0.2 from each block. The R^2 value was reported for each step. A statistical significance level of $p < 0.05$ was adopted. Statistical analyses were performed using PASW Statistics, version 18 (IBM SPSS, IBM Corporation, NY, USA).

Results

Response-Rate

Although we had a total response rate of 74 % at the 1-year follow-up, the QPS Nordic response rate was 56 % due to incomplete questionnaire responses. The characteristics of those patients who completed the QPS Nordic questionnaire are compared to those without a QPS Nordic response in Table 3. Women were overrepresented as respondents ($\chi^2 = 7.5$, $p = 0.006$). In addition, respondents were older (t = 2.0, $p = 0.049$) and reported lower levels of fear-avoidance beliefs about work (t = 2.8, $p = 0.005$) than non-responders. However, the magnitude of these differences was small (Cohen's d 0.20–0.29). In contrast, the tests indicated no significant association between response-status and educational level, occupation group, RTW status, intervention type, smoking, use of analgesic, physical activity level, BMI, pain-intensity, the Disability Index, and the HAD Anxiety or Depression scores.

Patient Characteristics

The clinical characteristics of the patients at baseline and 1 year are reported in Table 4.

Changes in Demand, Control and Support Subscales at the 1-year Follow-up

No significant differences were found among the measured subscales (Table 5).

Determinants for Individual-Level Changes in Demand, Control, and Support Subscales

The results from the univariate and multiple regression analyses for *Quantitative demands* are presented in Tables 6, 7 and 8 and are used to illustrate the procedure in the regression analyses. Table 9 shows the final step in the hierarchical multiple regression analyses for all nine subscales. A positive value in any change-score variable denotes an increased 1-year follow-up score compared with the baseline score.

In the univariate analyses, age was associated with *Quantitative demands*, *Control of decision* and *Control of work pacing*, while gender was associated with *Quantitative demands* and *Decision demands,* educational level was associated with *Quantitative demands*, *Decision demands* and *Support from co-workers*, and occupation was associated with *Quantitative demands*, *Decision demands*, and *Positive challenge at work*, ($p < 0.2$). Demographic variables remaining in the final model (Table 9) were those associated with a subscale ($p < 0.2$) after the demographic box multiple regression analyses (only shown for *Quantitative demands*). However, age and gender were controlled for in all multiple analyses. The RTW-status was not associated with any subscale, and the work-focused intervention was only significantly associated with increased *Decision demands*.

Table 3 The baseline description of participants; total N in the RCT versus those completing and not completing the QPS Nordic questionnaire subscale scores at the 1-year follow-up

	N (total) = 405				N (QPS Nordic responders) = 228				N (Non QPS Nordic responders) = 177			
	N	%	Mean	SD	N	%	Mean	SD	N	%	Mean	SD
Age, years			40.6	9.9			41.4	9.8			39.5	9.9
Gender												
Women	188	46			120	53			68	38		
Men	217	54			108	47			109	62		
Educational level												
Primary school	64	16			31	14			33	19		
Secondary school	228	57			126	56			102	58		
College <4 years	68	17			42	19			26	15		
College >4 years	42	10			27	12			15	8		
Occupation												
Low-skilled blue-collar	70	17			33	14			37	21		
High-skilled blue-collar	87	22			48	21			39	22		
Low-skilled white-collar	139	34			82	36			57	32		
High-skilled white-collar	109	27			65	29			44	25		
RTW status												
100 % RTW	294	73			169	74			125	71		
Partly RTW	29	7			20	9			9	5		
Unsuccessful RTW	82	20			39	17			43	24		
Work-focused intervention	203	50			118	52			85	48		
Smokers	118	30			62	28			56	32		
Use of analgesics	318	80			178	79			140	81		
Physical activity level, sedentary	49	12			29	13			20	12		
BMI			27	4.8			27	4.9			27	4.8
Pain, NRS (range 0–10)			6.2	2.2			6.1	2.2			6.3	2.3
DI (range 0–100)			38.3	13.3			37.5	13.1			39.3	13.5
FABQ-W (range 0–42)			27.7	10.0			26.4	9.9			29.3	9.9
HADS-A (range 0–21)			7.1	4.0			6.9	3.9			7.3	4.2
HADS-D (range 0–21)			5.3	3.9			5.1	3.8			5.6	3.9

BMI body mass index, *DI* Disability Index, maximum of Oswestry Disability Index or Neck Disability Index, *FABQ-W* fear avoidance beliefs about work, *HADS-A* Hospital Anxiety and Depression Scale, Anxiety, *HADS-D* Hospital Anxiety and Depression Scale, Depression, *NRS* numeric rating scale, *QPS Nordic* The General Nordic Questionnaire for Psychological and Social factors at Work, demand, control and social support subscales, *RTW* return to work

In the final multiple regression analyses, higher age was inversely associated with changes in the *Quantitative demands* and *Learning demands* subscales. No other demographic variable had associations in the final step. A decrease in the FABQ-W was significantly associated with a decrease in all *Demands* dimensions (*Quantitative, Decision, Learning*) and accounted for 3 % of the variability of the change. A decrease in DI (disability) was associated with an increase in *Positive challenge at work*, which accounted for 2 % of the variability. Decreases in the HADS-A (anxiety) score and the FABQ-W were significantly associated with a rise in *Control of work pacing*, and explained 8 % of the variability. No clinical variables were associated with *Control of decision*. In the support dimensions, decreases in DI and the HADS-A score were associated with increased *Support from superior* and explained 5 % of the variability. Additionally, a decrease in the HADS-D (depression) score was associated with an increase in *Support from friends and family*. None of the investigated variables were significantly associated with *Support from co-workers*.

Table 4 The clinical characteristics of the study population at baseline and the 1-year follow-up and differences between the two points in time and the *t* test *p* values (values for the QPS Nordic responders at both time points only)

	Baseline			12 MND			Baseline (t1)—1-year (t2)	
	N	Mean	SD	N	Mean	SD	Mean (t1 − t2)	*t* test *p* value
Pain (NRS)	227	6.1	2.2	227	4.8	2.7	1.3	<0.001[a]
ODI	206	34.8	13.0	206	25.6	15.1	9.2	<0.001[a]
NDI	85	37.9	14.2	85	32.6	16.8	5.3	0.001[a]
DI	222	37.5	13.2	222	28.4	16.3	9.1	<0.001[a]
FABQ-W	206	26.5	9.8	206	20.7	12.7	5.8	<0.001[a]
HADS-A	225	6.9	3.9	225	6.1	4.2	0.8	0.001[a]
HADS-D	225	5.1	3.8	225	4.2	4.4	0.9	<0.001[a]

DI Disability Index, maximum of Oswestry Disability Index or Neck Disability Index, *FABQ-W* fear avoidance beliefs about work, *HADS-A* Hospital Anxiety and Depression Scale, Anxiety, *HADS-D* Hospital Anxiety and Depression Scale, Depression, *NDI* Neck Disability Index, *NRS* numeric rating scale, *ODI* Oswestry Disability Index, *QPS Nordic* The General Nordic Questionnaire for Psychological and Social factors at Work, demand, control and social support subscales

[a] Significant at 0.05-level

Table 5 The mean values of the QPS Nordic subscale scorings at baseline and 1-year, and the differences between the two points in time and the *t* test *p* values (values for the QPS Nordic responders at both time-points only)

	Baseline			12 MND			Baseline (t1)—1-year (t2)	
	N	Mean	SD	N	Mean	SD	Mean (t1 − t2)	*t* test *p* value[a]
Job demands								
Quantitative demands	225	3.09	0.82	228	2.96	0.91	0.119	0.025
Decision demands	225	3.47	0.78	226	3.56	0.90	−0.085	0.062
Learning demands	225	2.48	0.69	226	2.42	0.70	0.074	0.128
Job control								
Positive challenge at work	225	3.94	0.83	225	3.98	0.87	−0.058	0.236
Control of decision	226	2.65	0.85	224	2.72	0.81	−0.065	0.169
Control of work pacing	226	2.67	1.20	224	2.69	1.14	−0.022	0.724
Job support								
Support from superior	225	3.54	1.08	219	3.61	1.06	−0.076	0.246
Support from co-workers	225	3.79	0.96	221	3.78	0.98	−0.001	0.984
Support from friends	225	4.00	0.97	222	3.92	1.01	0.069	0.227

QPS Nordic The General Nordic Questionnaire for Psychological and Social factors at Work, demand, control and social support subscales

[a] Significance level after Bonferroni adjustments: $p \leq 0.017$

Discussion

In this study, the population reported no changes in their perceived psychosocial work factors over the 1-year follow-up period. In contrast, they reported significant average improvements in subjective clinical variables such as pain, disability, fear-avoidance beliefs, anxiety and depression over the 1-year follow-up period. However, the regression analyses showed that individually, a reduction in fear avoidance beliefs was consistently related to a reduction in the demand subscales and an increase in the control subscales, while reductions in disability, anxiety, and depression were related to increases in the support subscales. Inclusion of these variables in the multivariate models explained only 2–8 % of the variability of the subscales' changes.

The psychosocial constructs of demand, control, and support each include several aspects. Job control, as measured by the QPS Nordic, refers to the individual's perceived ability to choose between alternatives in the work situation and decide about work pace, breaks, and flexitime.

In the same way, job demands refer to the time pressure and amount of work required by the position, demands for quick and complex decision-making and attention, and requirements for better education or continuous training. To display the heterogeneous aspects of the job environment, we found it necessary to examine each of the QPS Nordic subscales separately.

Table 6 Univariate and multivariate regression analyses with demographic factors as independent variables and *Change of Quantitative Demands* as the dependent variable at the 1-year follow-up for sick-listed patients with neck and back pain

Independent variables	Univariate analyses			Multiple analysis		
	β	95 % CI for β	*p* value	B	95 % CI for β	*p* value
Age	−0.107	−0.02 to 0.002	0.11[a]	−0.094	−0.02 to 0.00	0.17
Gender (men vs. women)	0.114	−0.03 to 0.39	0.09[a]	0.080	−0.11 to 0.36	0.29
Education level 2 (vs. level 1)	0.037	−0.15 to 0.27	0.59			
Education level 3 (vs. level 1)	−0.123	−0.52 to 0.02	0.07[a]	−0.121	−0.52 to 0.03	0.08[a]
Education level 4 (vs. level 1)	0.070	−0.15 to 0.49	0.30			
High-skilled blue-collar (vs. low-skilled blue-collar)	0.110	−0.04 to 0.47	0.10[a]	0.013	−0.28 to 0.33	0.87
Low-skilled white-collar (vs. low-skilled blue-collar)	−0.103	−0.39 to 0.05	0.12[a]	−0.072	−0.36 to 0.12	0.33
High-skilled white-collar (vs. low-skilled blue-collar)	0.006	−0.22 to 0.24	0.93			

[a] *p* value < 0.2

Table 7 Univariate and multivariate regression analyses with RTW status, intervention type, and changes in: pain, disability, the HADS Anxiety score, the HADS Depression score, and the FABQ-W as predictors and *Change of Quantitative Demand* as the dependent variable at the 1-year follow-up for sick-listed patients with neck and back pain, controlling for age and gender

Independent variables	Univariate analyses			Multiple analysis		
	β	95 % CI for β	*p* value	β	95 % CI for β	*p* value
Age				−0.179	−0.025 to −0.004	0.006[a]
Gender				0.123	−0.07 to 0.44	0.058[b]
Quantitative demands baseline	−0.394	−0.50 to −0.26	<0.001[a]	−0.367	−0.48 to −0.23	<0.001[a]
RTW status (at work vs. fully sick-listed)	−0.029	−0.34 to 0.21	0.66			
Intervention type (work-focused vs. control)	0.077	−0.09 to 0.33	0.25			
Change in pain	−0.048	−0.05 to 0.02	0.48			
Change in DI	0.077	−0.00 to 0.01	0.26			
Change in HADS-A	0.130	0.00 to 0.06	0.052[b]	0.073	−0.014 to 0.047	0.28
Change in HADS-D	0.031	−0.02 to 0.04	0.64			
Change in FABQ-W	0.189	0.004 to 0.03	0.007[a]	0.161	0.002 to 0.023	0.17[b]

DI Disability Index, maximum of Oswestry Disability Index or Neck Disability Index), *FABQ-W* Fear Avoidance Beliefs about Work, *HADS-A* Hospital Anxiety and Depression Scale, Anxiety, *HADS-D* Hospital Anxiety and Depression Scale, Depression, *RTW* return to work

[a] Significant with *p* value < 0.05

[b] *p* value < 0.2

Changes in Demand, Control and Support at the 1-year Follow-up

Our first finding revealed that none of the nine subscales changed at the 1-year follow-up. The QPS Nordic subscale *Quantitative demands*, which measures time pressure and the amount of work, is probably a valid measure regardless of occupation or profession in this patient population. In contrast, *Decision demands* (demand for quick and complex decision making and attention) and *Learning demands* (demand for better education and continuous training) might vary among occupations or professions, but probably do not vary over a limited time period at the same workplace. Consequently, we did not expect the average score of the decision or learning demands to change in a patient population with different occupations.

In previous studies, subjective job control has been found to be highly correlated with objective job control data (based upon expert ratings or average group assessments) among workers [33, 34]. As such, there is less reason to believe that job control will change significantly in the course of 1 year, even in a patient population. An exception might be with temporary work modifications.

In a previous study, we found that the demand, control, and support subscale scores at baseline were quite similar to the scores of the reference worker population [11].

Table 8 Stepwise multiple regression analyses with the FABQ-W score as predictor and *Change in Quantitative Demands* as the dependent variable at the 1-year follow-up for sick-listed patients with neck and back pain, controlling for age, gender, baseline values and educational level 3

Step	Independent variables	β	95 % CI for β	*p* value	R^2 (%)
1	Age	−0.109	−0.02 to −0.00	0.12	3
	Gender	0.084	0.09 to 0.36	0.23	
	Educational level 3	−0.097	−0.49 to 0.08	0.17	
2	Age	−0.159	−0.02 to −0.00	0.02[a]	16
	Gender	0.109	−0.03 to −0.38	0.10	
	Educational level 3	−0.039	−0.35 to 0.19	0.56	
	Quantitative demands baseline	−0.366	−0.48 to −0.23	<0.001[a]	
3	Age	−0.176	−0.03 to −0.00	0.007[a]	19
	Gender	0.127	−0.01 to 0.41	0.051	
	Educational level 3	−0.042	−0.35 to 0.18	0.52	
	Quantitative demands baseline	−0.364	−0.48 to −0.23	<0.001[a]	
	Change in FABQ-W	0.184	0.00 to 0.02	0.005[a]	

[a] Significant with p value < 0.05

Furthermore, the rather stable quantitative demand and decision control over time in a Norwegian worker population [12] suggests that we could not expect major changes. On the other hand, the "perception" hypothesis suggests that "changes in worker well-being may lead to an altered evaluation of existing job characteristics, even though the work environment itself may be unchanged" [13], and the study population showed a concurrent improvement in pain, disability and fear-avoidance beliefs (Table 4).

At the same time, feasible changes in the work environment might not necessarily be associated with changes in 'major' work environment factors like demand, control, and support. Unfortunately, we have no objective information indicating whether the work environment actually had been adapted. In previous prospective studies among workers, other work factors such as role conflict, social climate, empowering leadership, and fair leadership were closely associated with the level of neck and back pain intensity [35, 36]. Therefore, it is possible that the demand, control, and support concepts are not the only important work aspects to study among neck and back pain patients.

Determinants for Individual-Level Changes in the Demand, Control and Support Subscales

The second finding was the different associations between changes in the individual clinical factors and changes in demand, control, and support. A particularly interesting finding was a trend of association between reduced fear-avoidance beliefs about work and reduced perceptions of work demands. A reduced fear-avoidance belief about work was also associated with increased control of work pacing. More precisely, this means that if the subjective belief that work is harmful or might cause more pain decreases, this belief is associated with a concomitant decrease in subjective perceived job demands and an increase in control over work pace and breaks. Thus, opportunities for individual beneficial changes in these factors in the work place might seem important for an individual's perception of better coping and adjustment possibilities at work. However, a reduction in the fear-avoidance belief about work was not associated with changes in the perceived positive challenges at work, control of decisions, or social support. Control of decisions and the perception of the work as meaningful and positively challenging are probably more related to the occupation or the organisation's structure and do not change rapidly over time. Although changes in fear-avoidance beliefs about work only explained a small part of the variability in the demand and control change scores, these relationships are consistent with previously found cross-sectional associations between work environment and fear-avoidance beliefs about work [11].

We would argue that the most important work environment assessment is provided by the subject, even though we cannot exclude the fact that high levels of pain and disability influence the perception of work demand, which subsequently is misclassified [34, 37]. In that case, we would expect the pain and disability change scores to be associated with changes in the work factors. Such an influence was only observed for disability regarding positive challenges at work and support from superiors, whereas pain had no significant effect.

Although Airila et al. [38] did not find any association between the trajectory of musculoskeletal pain and job demands, they found close associations between high levels of job demands and poor interpersonal relations and depression. Additionally, in our study, improvements in anxiety and depression were more closely related to the

Table 9 The final step in the multiple regression analyses for each QPS subscale. Possible predictors were RTW status, intervention type, Change in: pain, disability, HADS Anxiety, HADS Depression, and FABQ-W and *Change of current QPS scale* was the dependent variable at 1-year follow up for sick-listed patients with neck and back pain, controlling for age, gender and baseline value

QPS subscale	Independent variables	β	95 % CI for β	*p* value	R^2 (%)
Quantitative demands	Age	−0.176	−0.025 to −0.004	0.007[a]	19
	Gender	0.127	−0.01 to 0.41	0.051	
	Educational level 3	−0.042	−0.35 to 0.18	0.52	
	Quantitative demands baseline	−0.364	−0.48 to −0.23	<0.001[a]	
	Change in FABQ-W	0.184	0.004 to 0.024	0.005[a]	
Decision demands	Age	−0.090	−0.15 to 0.00	0.18	12
	Gender	0.104	−0.04 to 0.32	0.13	
	Decision demands baseline	−0.271	−0.34 to −0.12	<0.001[a]	
	Intervention type	0.095	−0.05 to 0.30	0.16	
	Change in FABQ-W	0.154	0.00 to 0.02	0.024[a]	
Learning demands	Age	−0.137	−0.18 to −0.00	0.024[a]	30
	Gender	−0.041	−0.17 to 0.16	0.97	
	Learning demands baseline	−0.517	−0.64 to −0.40	<0.001[a]	
	Change in FABQ-W	0.162	0.00 to 0.02	0.007[a]	
Positive challenge at work	Age	0.04	−0.006 to 0.01	0.52	19
	Gender	−0.066	−0.28 to 0.09	0.30	
	Positive challenge at work baseline	−0.41	−0.47 to −0.25	<0.001[a]	
	Change in DI	−0.165	−0.01 to −0.002	0.008[a]	
Control of decision	Age	−0.034	−0.011 to 0.006	0.58	27
	Gender	−0.031	−0.22 to 0.13	0.61	
	Control of decision baseline	−0.455	−0.49 to −0.28	<0.001[a]	
	Change in DI	−0.124	−0.01 to −0.000	0.068	
	Change in FABQ-W	−0.131	−0.02 to 0.00	0.055	
Control of work pacing	Age	−0.070	−0.02 to 0.006	0.30	13
	Gender	−0.026	−0.29 to 0.20	0.69	
	Control of decision baseline	−0.160	−0.32 to −0.03	0.019[a]	
	Change in HADS-A	−0.163	−0.08 to −0.007	0.021[a]	
	Change in FABQ-W	−0.192	−0.03 to −0.005	0.006[a]	
Support from superior	Age	−0.015	−0.013 to 0.010	0.80	29
	Gender	−0.066	−0.35 to 0.09	0.26	
	Support from superior baseline	−0.495	−0.56 to −0.35	<0.001[a]	
	Change in DI	−0.146	−0.017 to −0.002	0.019[a]	
	Change in HADS-A	−0.129	−0.07 to −0.002	0.038[a]	
Support from co-workers	Age	0.041	−0.008 to 0.016	0.49	27
	Gender	−0.049	−0.32 to 0.13	0.42	
	Educational level 3	0.084	−0.08 to 0.50	0.16	
	Support from co-workers baseline	−0.507	−0.64 to −0.40	<0.001[a]	
	Change in DI	−0.099	−0.014 to −0.002	0.12	
	Change in HADS-A	−0.059	−0.05 to 0.018	0.36	
Support from friends/family	Age	−0.083	−0.018 to 0.003	0.18	23
	Gender	−0.094	−0.37 to 0.04	0.12	
	Support from friends/family baseline	−0.459	−0.51 to −0.30	<0.001[a]	
	Change in HADS-D	−0.175	−0.07 to −0.013	0.004[a]	

DI Disability Index, maximum of Oswestry Disability Index or Neck Disability Index, *FABQ-W* Fear Avoidance Beliefs about Work, *HADS-A* Hospital Anxiety and Depression Scale, Anxiety, *HADS-D* Hospital Anxiety and Depression Scale, Depression

[a] Significant with p value < 0.05

work factors (i.e., control and support) than to improvement in neck or back pain.

The current study showed that a successful RTW status had no relation to the development of the perceived work environment. Similarly, no additional effect of a work-focused intervention compared to a general multidisciplinary intervention regarding changes in the work environment was found. Indeed, the unchanged demand, control, and support for the entire study population suggests that none of the interventions influenced these factors. This finding suggests that development in demand, control, and support was partly associated with the individual's subjective clinical assessment but not with objective measureable factors such as RTW status or intervention type.

Strength and Limitations

The strength of the present study is its prospective design and rather large sample size. The inclusion of two regional neck and back clinics and participants with a wide variety of occupations, workplaces, and employers increases the external validity of this study. A further strength is the combination of demographic, clinical, and work-related information about the participants. The application of scales from the QPS Nordic, a validated comprehensive instrument designed for research on the association between work and health as well as documentation of work conditions [31], was also a strength. However, the responsiveness of this instrument has, to the best of our knowledge, not been tested in a neck or back pain population.

The limitations to the present study are the low response rate of 56 %, which may influence the external validity of the study. Although the analyses showed mainly similar demographic and clinical characteristics in the QPS Nordic responders versus the QPS Nordic non-responders, there was a predominance of women, older age individuals and lower fear-avoidance among responders, which suggests that we did not capture younger men and those with high FABQ-W. However, women and middle age individuals (45–54 years) have an increased risk of sick-leave [39]. Although high FABs are documented predictors of failure to RTW [40], in another study, we found that improvement in the FABQ-W scores after treatment predicted RTW within 12-months of follow-up, while the baseline values did not [41].

Missing data were replaced by the mean scores of the population. The number of imputed measures ranged from 0.9 to 4.8 % for the different subscales. In order to assess the effect of missing not at random, we also replaced the missing values with the worst case scenario values and performed *t* test analyses. As expected, the analyses showed that the extreme value imputation would cause statistically significant changes for several subscales; however, the effect-sizes of the differences would remain small (Cohen's $d < 0.19$). Additionally, after Bonferroni correction, only 'Quantitative demands' and 'Control of decision' would be statistically significant. Accordingly, we do not believe that the use of mean imputations to replace missing values is crucial for the clinical interpretation of the analyses.

Additionally, the prospective design of the study contributes new knowledge about the perceived psychosocial work environment among sick-listed neck and back pain patients. However, because we include score changes both as dependent and independent variables in the regression analyses, we no longer have a traditional prospective regression analysis. This analysis limits us to associations between the change score variables and prevents causal interpretations of the associations.

Conclusion

In conclusion, the perception of demand, control and support at work appeared to be stable over 1 year in patients with neck and back pain, despite marked improvement in pain and disability. Disability, anxiety, and depression were more closely associated with the perception of the work environment than pain. Decreased fear-avoidance beliefs about work were consistently associated with decreased demands and increased control of work pacing.

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References

1. Hoy D, March L, Brooks P, Blyth F, Woolf A, Bain C, et al. The global burden of low back pain: estimates from the Global Burden of Disease 2010 study. Ann Rheum Dis. 2014;73(6):968–74.
2. Pincus T, Burton AK, Vogel S, Field AP. A systematic review of psychological factors as predictors of chronicity/disability in prospective cohorts of low back pain. Spine. 2002;27(5):E109–20.
3. Foss L, Gravseth HM, Kristensen P, Claussen B, Mehlum IS, Knardahl S, et al. The impact of workplace risk factors on long-term musculoskeletal sickness absence: a registry-based 5-year follow-up from the Oslo health study. J Occup Environ Med. 2011;53(12):1478–82.
4. Pransky GS, Loisel P, Anema JR. Work disability prevention research: current and future prospects. J Occup Rehabil. 2011;21(3):287–92.
5. WHO Healthy Workplace Framework and Model Synthesis Report. World Health Organization 2010. http://www.who.int/occupational_health/activities/healthy_workplaces/en/index.html Accessed 2014 Sep 22.
6. Pransky G, Gatchel R, Linton SJ, Loisel P. Improving return to work research. J Occup Rehabil. 2005;15(4):453–7.
7. Karasek R, Theorell T. Healthy work. New York: Basic Books; 1990.

8. Karasek R, Baker D, Marxer F, Ahlbom A, Theorell T. Job decision latitude, job demands, and cardiovascular disease: a prospective study of Swedish men. Am J Public Health. 1981;71(7):694–705.
9. Macfarlane GJ, Pallewatte N, Paudyal P, Blyth FM, Coggon D, Crombez G, et al. Evaluation of work-related psychosocial factors and regional musculoskeletal pain: results from a EULAR Task Force. Ann Rheum Dis. 2009;68(6):885–91.
10. Lang J, Ochsmann E, Kraus T, Lang JW. Psychosocial work stressors as antecedents of musculoskeletal problems: a systematic review and meta-analysis of stability-adjusted longitudinal studies. Soc Sci Med. 2012;75(7):1163–74.
11. Myhre K, Roe C, Marchand GH, Keller A, Bautz-Holter E, Leivseth G, et al. Fear-avoidance beliefs associated with perceived psychological and social factors at work among patients with neck and back pain: a cross-sectional multicentre study. BMC Musculoskelet Disord. 2013;14:329.
12. Christensen JO, Knardahl S. Time-course of occupational psychological and social factors as predictors of new-onset and persistent neck pain: a three-wave prospective study over 4 years. Pain. 2014;155(7):1262–71.
13. Tang K. A reciprocal interplay between psychosocial job stressors and worker well-being? A systematic review of the "reversed" effect. Scand J Work Environ Health. 2014;40(5):441–56.
14. Brox JI, Sorensen R, Friis A, Nygaard O, Indahl A, Keller A, et al. Randomized clinical trial of lumbar instrumented fusion and cognitive intervention and exercises in patients with chronic low back pain and disc degenration. Spine. 2003;28(17):1913–21.
15. Keller A, Brox JI, Reikeras O. Predictors of change in trunk muscle strength for patients with chronic low back pain randomized to lumbar fusion or cognitive intervention and exercises. Pain Med. 2008;9(6):680–7.
16. Waddell G, Newton M, Henderson I, Somerville D, Main CJ. A Fear-Avoidance Beliefs Questionnaire (FABQ) and the role of fear-avoidance beliefs in chronic low back pain and disability. Pain. 1993;52(2):157–68.
17. Myhre K, Marchand GH, Leivseth G, Keller A, Bautz-Holter E, Sandvik L, et al. The effect of work-focused rehabilitation among patients with neck and back pain: a randomized controlled trial. Spine. 2014;39(24):1999–2006.
18. Indahl A, Velund L, Reikeraas O. Good prognosis for low back pain when left untampered. A randomized clinical trial. Spine. 1995;20(4):473–7.
19. Storheim K, Brox JI, Holm I, Bo K. Predictors of return to work in patients sick listed for sub-acute low back pain: a 12-month follow-up study. J Rehabil Med. 2005;37(6):365–71.
20. Statistisk sentralbyrå. Population's level of education. Statistics Norway 2014. http://www.ssb.no/utdanning/statistikker/utniv/aar Accessed 2015 Jan 6.
21. Statistisk sentralbyrå. Standard for yrkesklassifisering. Statistics Norway 2011. http://www.ssb.no/a/yrke/ Accessed 2011 Jul 6.
22. Farrar JT, Pritchett YL, Robinson M, Prakash A, Chappell A. The clinical importance of changes in the 0 to 10 numeric rating scale for worst, least, and average pain intensity: analyses of data from clinical trials of duloxetine in pain disorders. J Pain. 2010;11(2):109–18.
23. Ostelo RW, Deyo RA, Stratford P, Waddell G, Croft P, Von KM, et al. Interpreting change scores for pain and functional status in low back pain: towards international consensus regarding minimal important change. Spine. 2008;33(1):90–4.
24. Roland M, Fairbank J. The Roland-Morris Disability Questionnaire and the Oswestry Disability Questionnaire. Spine. 2000;25(24):3115–24.
25. Grotle M, Brox JI, Vollestad NK. Cross-cultural adaptation of the Norwegian versions of the Roland-Morris Disability Questionnaire and the Oswestry Disability Index. J Rehabil Med. 2003;35(5):241–7.
26. Vernon H, Mior S. The Neck Disability Index: a study of reliability and validity. J Manip Physiol Ther. 1991;14(7):409–15.
27. Johansen JB, Andelic N, Bakke E, Holter EB, Mengshoel AM, Roe C. Measurement properties of the norwegian version of the neck disability index in chronic neck pain. Spine. 2013;38(10):851–6.
28. Bjelland I, Dahl AA, Haug TT, Neckelmann D. The validity of the Hospital Anxiety and Depression Scale. An updated. J Psychosom Res. 2002;52(2):69–77.
29. Grotle M, Brox JI, Vollestad NK. Reliability, validity and responsiveness of the fear-avoidance beliefs questionnaire: methodological aspects of the Norwegian version. J Rehabil Med. 2006;38(6):346–53.
30. Lindstrøm K. User's guide for the QPSNordic: general Nordic questionnaire for psychological and social factors at work. 2000:603 ed. Copenhagen: Nordic Council of Ministers; 2000.
31. Dallner M, Elo AL, Gamberale F, Hottinen V, Knardahl S, Lindstrøm K, et al. Validation of the General Nordic Questionnaire (QPSNordic) for Psychological and Social Factors at Work. Copenhagen: Nordic Council of Ministers; 2000.
32. Cohen J. Statistical power analysis for the behvioral sciences. 2nd ed. Hillsdale, NJ: Lawrence Earlbaum Associates; 1988.
33. Theorell T, Hasselhorn HM. On cross-sectional questionnaire studies of relationships between psychosocial conditions at work and health–are they reliable? Int Arch Occup Environ Health. 2005;78(7):517–22.
34. Solovieva S, Pensola T, Kausto J, Shiri R, Heliovaara M, Burdorf A, et al. Evaluation of the validity of job exposure matrix for psychosocial factors at work. PLoS One. 2014;9(9):e108987.
35. Christensen JO, Knardahl S. Work and neck pain: a prospective study of psychological, social, and mechanical risk factors. Pain. 2010;151(1):162–73.
36. Christensen JO, Knardahl S. Work and back pain: a prospective study of psychological, social and mechanical predictors of back pain severity. Eur J Pain. 2012;16(6):921–33.
37. Blair A, Stewart P, Lubin JH, Forastiere F. Methodological issues regarding confounding and exposure misclassification in epidemiological studies of occupational exposures. Am J Ind Med. 2007;50(3):199–207.
38. Airila A, Hakanen JJ, Luukkonen R, Lusa S, Punakallio A, Leino-Arjas P. Developmental trajectories of multisite musculoskeletal pain and depressive symptoms: the effects of job demands and resources and individual factors. Psychol Health. 2014;29(12):1421–41.
39. Sickness absence, Q4 2014. Statistics Norway 2015 March 12. https://www.ssb.no/en/arbeid-og-lonn/statistikker/sykefratot/kvartal/2015-03-12#content Accessed 2015 Apr 23.
40. Iles RA, Davidson M, Taylor NF. Psychosocial predictors of failure to return to work in non-chronic non-specific low back pain: a systematic review. Occup Environ Med. 2008;65(8):507–17.
41. Marchand GH, Myhre K, Leivseth G, Sandvik L, Lau B, Bautz-Holter E, et al. Change in pain, disability and influence of fear-avoidance in a work-focused intervention on neck and back pain: a randomized controlled trial. BMC Musculoskelet Disord. 2015;16(1):94.