

# Perceived psychosocial work environment and effects of a work-focused intervention among patients with neck and back pain

PhD Thesis

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March 2015

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*Series of dissertations submitted to the  
Faculty of Medicine, University of Oslo  
No. 2053*

ISBN 978-82-8333-069-4

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Cover: Hanne Baadsgaard Utigard.  
Printed in Norway: AIT Oslo AS.

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## Acknowledgements

This work is a part of a larger project which has been carried out at the Department of Physical Medicine and Rehabilitation, Oslo University Hospital, Ullevål (OUH) and the Department of Physical Medicine and Rehabilitation, St. Olav's Hospital, Trondheim (SOH) in the period from 2008 to 2014.

A large group of people have helped me complete this thesis, and I am deeply grateful to all of you. I especially want to express my sincere gratitude to my main supervisor, Professor Cecilie Røe, Head of Department for Physical Medicine and Rehabilitation. Her extensive knowledge and encouraging enthusiasm have been invaluable to me during these years. She has provided professional guidance and advice at all stages of my work and, as the head of the Department, she has made arrangements so that I could balance my work and research.

My sincerest gratitude to my closest collaborator and co-author in Trondheim, Dr. Gunn-Hege Marchand, for her effort in the accomplishment of this project. While she has worked on her thesis, and been responsible for the implementation of the study at the Department of Physical Medicine and Rehabilitation at SOH, we have collaborated on data collection, analysis and writing and shared first authorship in the RCT article.

I also wish to express special thanks to my co-supervisors and co-authors Dr. Anne Keller and Professor Bjørn Lau. Anne Keller was an important advisor in the start of my work and I am especially thankful for her patience and easy accessibility to discuss small and big issues. Even after she moved to Denmark, her constructive comments on my work have been highly appreciated. Bjørn Lau has provided me with excellent guidance and support in his field. His research experience and resources have made a significant contribution to the project.

To Dr. Erik Bautz-Holter, Professor Emeritus, another of my co-authors and the project manager for this multicentre project, thank you for giving me this opportunity and for your encouraging and supportive advice throughout the project.

I also want to thank co-author Professor Gunnar Leivseth for his collaboration and support.

Thank you to Leiv Sandvik, Department of Biostatistics and Epidemiology, for important statistical advice and interesting discussions.

I would also thank all my colleagues at the Department for Physical Medicine and Rehabilitation at OUH for their contribution and help in recruiting patients. Special thanks to Lise Kristin Holter, social worker, and Berit Johannessen and Nina Skorge, physiotherapists, who performed the treatments at OUH. I am also grateful to Kathrine Hope for practical assistance.

Special thanks to all the study patients for their time and willingness to participate in this research study.

This project has been made possible due to funding from the Research Council of Norway, Program for Sickness Absence, Work and Health.

Finally, I wish to express my dearest thanks to the most important people in my life, my three wonderful daughters, Katarina, Maiken and Ida and my husband Gunnar. A special thanks to, Gunnar, who, with his computer expertise, has provided me considerable assistance with organizing the data. To all of you, thank you for your patience, love, support and encourage.

Oslo, July 2015

Kjersti Myhre

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### Papers I-IV

## LIST OF INCLUDED PAPERS

### Paper I

Myhre K, Marchand GH, Leivseth G, Keller A, Bautz-Holter E, Sandvik L, Lau B, Røe C. The effect of work-focused rehabilitation among patients with neck and back pain: a randomized controlled trial. *Spine (Phila Pa 1976)* 2014 Nov 15;39(24):1999-2006.

### Paper II

Myhre K, Røe C, Marchand GH, Keller A, Bautz-Holter E, Leivseth G, Sandvik L, Lau B. 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.

### Paper III

Myhre K, Lau B, Marchand GH, Leivseth G, Bautz-Holter E, Røe C. Demand, control and support at work among sick-listed patients with neck or back pain. A prospective study. Submitted.

### Paper IV

Røe C, Myhre K, Marchand GH, Lau B, Leivseth G, Bautz-Holter E. Measurement properties of the Nordic Questionnaire for Psychological and Social Factors at Work - A Rasch analysis. Submitted.

## ABBREVIATIONS

AAP	Work-assessment allowance
BMI	Body mass index
DIF	Differential item functioning
ERI	Effort-reward imbalance
FAB	Fear-avoidance beliefs
FABQ	Fear-avoidance beliefs questionnaire
FABQ-W	Fear-avoidance beliefs questionnaire about work
HADS	Hospital Anxiety and Depression Scale
HR	Hazard ratio
LBP	Low back pain
MRI	Magnetic resonance imaging
MSD	Musculoskeletal disorder
NAV	The Norwegian Labour and Welfare Administration (includes the municipal social service, national insurance of employees and register)
NDI	Neck Disability Index
NRS	Numeric Rating Scale
ODI	Oswestry Disability Index
OUH	Oslo University Hospital
QPS Nordic	The General Nordic Questionnaire for Psychological and Social factors at Work
RCT	Randomised controlled trial
RTW	Return to work
SOH	St. Olav's Hospital, Trondheim University Hospital
YLD	Years lived with disability



## SUMMARY

A growing number of studies have focused on the return to work (RTW) processes associated with patients with back pain. Many studies have combined a workplace focus with multidisciplinary treatments; however, this focus has not been evaluated in Norway among patients with neck and back pain thus far. Several factors, including psychosocial factors at work as well as fear–avoidance beliefs (FAB), may influence the sick leave in these patients.

The main aim of this study was to evaluate the perceived psychosocial work environment among sick-listed patients with neck or back pain and the effect of interventions with respect to sickness absence.

The present multicentre randomised trial demonstrated that a work-focused intervention in secondary care added no supplementary effects compared to a control intervention with regard to the RTW rate or the proportion of patients who had achieved RTW during the first 12 months. In addition, the perceived psychosocial work factors were strongly associated with FAB about work in the current patient sample. However, the average perceived demand, control and support were quite similar to that of reference worker populations, except for a significantly increased demand for physical endurance. Furthermore, the overall perception of demand, control and support was fairly stable over one year, despite marked improvements in pain and disability. The evaluation of the measurement properties of the applied questionnaire, the Nordic Questionnaire for Psychological and Social Factors at Work (QPS Nordic), showed that the demand, control and support domains of the QPS Nordic comprised unidimensional constructs with good targeting to the present patients problems regarding work demands. The lower resolution of the scaling of the items may have implications for the responsiveness of the QPS Nordic.



## INTRODUCTION

### Background and epidemiology

Neck and back pain are common complaints worldwide and are frequently responsible for disability and sickness absence. The global one-year prevalence of low back pain is reported to vary from 0.8 – 82.5 %, with a mean value estimated at 38 % (1;2). In Norway, the one-year prevalence was estimated to be 40.5% among full time workers in 1999/2000 (3). Correspondingly, the global one-year prevalence of neck pain is estimated to vary from 30-50 % (4), and in a community in Norway, the one-year prevalence of neck pain was reported to be 48 % (5).

Acute neck and back pain are usually considered self-limiting, although recurrence is common (2;4;6). Since the 1950s, we have seen increasing back pain disability in the Western world (7;8). An estimated 10 % of acute back pain patients are not able to resume work after 3 months (9;10), and these account for as much as 80-90 % of the medical and compensation costs (6;9;11). In Norway, back pain was responsible for 11 % and neck pain for 4 % of the total sickness benefits in 2008 (12). In estimates from the Global Burden of Disease 2010 Study, low back pain (LBP) and neck pain were globally ranked first and fourth place, respectively, in terms of years lived with disability (YLD) (13;14).

In the search for an effective treatment for pain-related work disability, multidisciplinary rehabilitation programs that focus on diminishing the obstacles for return to work have been developed (15). In Canada (16) and the Netherlands (17), studies have demonstrated the effect of such programs compared to usual care among back pain patients. However, the effect these interventions will yield in countries with different financial compensation systems, health care systems and labour markets is unknown.

The development of chronic pain and disability does not merely depend on clinical or physical characteristics; the psychological and social factors of the individual are also regarded as important (11;18). In the research field of work disability prevention, the importance of working conditions has been emphasised (19). Although the physical work environment is important to ensure safety and health at the workplace, the psychosocial work environment is considered the most important factor in disability prevention (20). However, we do not know how patients who were sick-listed because of neck and back pain actually perceive their psychosocial work environments. Furthermore, we do not know

whether the perceived psychosocial work factors are subject to change in association with clinical improvement, completing treatment or resuming working life.

The current thesis presents a randomised controlled trial of patients who were listed sick because of neck and low back pain and were referred to specialist care with the main outcome as return to work (RTW). Further, it investigates the psychosocial work environment as perceived by the participant and any perceived changes at one-year follow-up.

## **Classification**

Neck and back pain may be classified in several ways.

Anatomically, spinal pain may be divided into neck pain, thoracic spine pain and low back pain. Neck pain is pain perceived in the region below the superior nuchal line and above the T1 spinous process (21). Thoracic spine pain is pain experienced in the area of the upper or middle back, between vertebrae T1-T12 (22), and low back pain is defined as pain or discomfort that is localised below the costal margin and above the inferior gluteal folds, with or without leg pain (6).

Clinically, low back pain (LBP) is commonly triaged into three groups: serious spinal pathology, nerve root pain and nonspecific low back pain (6;11). Serious spinal pathology should be suspected by the presence of “red flags” in the medical history (11), where fractures, neoplasm, cauda equine syndrome, myelopathy, inflammatory rheumatic disease, or infectious diseases are among the most important disorders. As many as 85 % of the patients who visit a physician because of back pain are classified with nonspecific LBP (23).

Similarly, a classification system for neck pain was proposed by the ‘The Neck Pain Task Force’ and advised that patients with neck pain be triaged into four groups according to severity (24). Grade IV is neck pain with signs of major pathology, suggesting the use of red flags, as for LBP. Grade III is neck pain with neurological signs of nerve compression. Grade II is non-specific neck pain that interferes with daily activity, whereas grade I is non-specific neck pain with no or little inference in daily activities (24).

Another usual division is to classify neck and back pain according to the duration of the condition. The following definitions are commonly used: acute pain is pain lasting 0-6

weeks, sub-acute pain is pain with a duration between 6 and 12 weeks, and chronic pain is persistent pain lasting for more than 12 weeks (6).

### **Mechanisms of neck and back pain**

The International Association of Pain has defined pain as ‘an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage’ by (25).

The origin of neck and back pain is often difficult to determine with certainty. Non-specific neck and back pain may arise from any structures in and around the spine, including the vertebrae, intervertebral disc, facet joints, muscles and ligaments. The degeneration of the discs has been considered a likely cause of the pain and is easily identified through MRI. However, evidence of disk bulging, annular tears, narrowing, degeneration, herniation and stenosis on a neck and back MRI also occurs in asymptomatic individuals, and the incidence of these abnormalities increases with age. Thus, the degenerative changes do not correlate with neck or back pain (4;7;11;26-28). Genetic predisposition is considered a risk factor for spinal disc degeneration although environmental factors are also assumed to influence this degeneration (29;30).

Modic changes in the vertebral endplates are another factor that has received much attention in recent years. Evidence exists for Modic changes to be associated with LBP (31-33), but how they influence the clinical course of back pain is not clear (34;35).

A high percentage of neck and back pain patients have tight and tender muscles. However, it is unknown whether this is a cause or consequence of the pain. It is suggested that an important cause of back pain is a disturbed function rather than structural damage (11).

Several factors are considered risk factors for developing neck and back pain. First, neck and back pain increases with age. The incidence of LBP has been found to increase until ages 60 to 65 years and then gradually declines (2), whereas the incidence of neck pain peaks at the middle age groups,  $\pm 40$  years (4). Neck pain is found to be more prevalent among women than men (4;36). Similarly, the overall prevalence of LBP has been reported to be higher among women in studies by Hoy et al. although others have found no significant gender differences (1;2). Low educational level is associated with a longer duration and poorer outcome of back pain and to a lesser degree with the increased onset of back pain (2;37).

Among general health risk factors, high BMI or obesity is assumed to be associated with back pain whereas the evidence varies regarding neck pain (7;36-40). Smoking is suggested to be related to both neck and back pain, although the evidence for a causal link is insufficient (4;37;41).

Mechanical factors such as a heavy workload, flexed, rotated, awkward positions, lifting, or body vibration are suggested to be associated with back pain, although they are not considered independent causes (7;42-45). Neck pain is proposed to be associated with working in a sedentary position for a long time, repetitive work and precision work, poor computer workstation design, and poor work posture (36;46). Evidence on the associations between physical or sport activities during leisure time and the risk for neck and back pain varies, although most studies have found no associations for neck pain (36) and possibly a U-shaped relationship for chronic low back pain (7).

Poor psychological health is regarded a risk factor for neck pain in the general population and likely also among workers (4;36). Waddell suggested that the association between psychological distress and LBP was weak, but patients with psychological distress were more likely to report back pain (11). However, comorbid psychiatric disorders appear to be associated with the development of chronic LBP (7).

The mechanisms leading to the development of chronic pain have been frequently studied in patients with LBP (11). However, the psychosocial factors that influence the development of chronic pain and work disability are assumed to apply to all musculoskeletal-related pain (18;19;47). Hence, the mechanisms of chronic LBP described below are believed to relate to both neck and back pain.

Acute non-specific LBP is assumed to recover within 4-6 weeks (48). Although pain may persist beyond 6 weeks, the majority of individuals who experience acute LBP will adjust and gradually return to their daily life activities including work (11;23). However, for the lesser proportion of patients who are not able to resume work within 3 months, the back pain has now been transformed into chronic pain. During the development of chronic back pain, psychosocial factors, or “yellow flags”, are regarded as important (18). The psychosocial factors may already be present in the acute stage of the pain. Examples of psychosocial factors are emotions, psychological distress, attitudes, beliefs, illness

behaviour, the social framework around the individual, behaviour and attitudes of healthcare providers and family members, the social culture, the social expectations of a sick role, the organisation of social benefits and compensations, the labour market, and workplace factors (11;18;49). Following this, acute pain has a biological meaning as a warning of tissue damage, whereas in chronic pain the original physical problem may no longer explain the major part of the pain or pain behaviour. Thus, acute and chronic pain are two different conditions.

### **Fear-avoidance belief**

Fear-avoidance belief (FAB) is assumed to be one of the most important psychological factors contributing to the development of chronic musculoskeletal pain and disability. FAB is suggested to be mediated by two behavioural responses: confrontation and avoidance (47). The term ‘fear-avoidance’ was first used by Lethem et al. (50); since then, the phenomenon has been extensively studied. According to Vlaeyen and Linton (47), there are several mechanisms of how the fear of experiencing pain may contribute to the disability. A potential precursor is catastrophising, which means negative appraisals about pain and the outcomes of pain. Further, pain-related fear leads to avoidance behaviour, which then implies that daily activities in which one expects pain are avoided. The avoidance behaviour occurs during the anticipation of pain and not as a response to pain. Because the possibilities for correction are then limited, this leads to a persistent behaviour. In addition, withdrawal may increase mood disturbances, and both depression and the ‘disuse syndrome’ may decrease pain tolerance. Misinformation or a lack of illness information may also contribute to FAB (51;52). FAB has been extensively investigated in patients with back pain and was found to be associated with disability, sickness absence and work loss (43;51;53-55). Elements from a fear-avoidance model have also been found to be important in the development of post-traumatic chronic neck pain (56).

### **Disability**

A comprehensive definition of disability is given by the World Health Organization (57): ‘Disability is any restriction or lack (resulting from impairment) of ability to perform an activity in the manner or within the range considered normal for a human being’.

In the International Classification of Functioning, Disability and Health (ICF), the focus has changed to activity limitations (58). Thus, activity limitation is defined as:

‘a difficulty in the performance, accomplishment, or completion of an activity. Difficulties in performing activities occur when there is qualitative or quantitative alteration in the way in which activities are carried out. Difficulty encompasses all the ways in which the doing of the activity may be affected.’

In both definitions, the main point is that disability is restricted activity. It may be difficult to determine the difference between loss of capacity or reduced performance. Disability is generally assessed by self-report questionnaires, which may not be equivalent to the actual performance or capacity (59). Disability is usually influenced by several psychosocial factors (18;60). Although a physical disorder may lead to both pain and disability, the relationship between these factors depends on many factors other than pain (11).

Work disability is an important aspect in neck and back pain patients. The Norwegian society is based on the Nordic welfare model and relies on a high labour force participation rate to be viable (61). Furthermore, for the individual, work and employment is a key source of good living in society. Recent Norwegian living condition surveys have shown clearly that economically active citizens have better living conditions than non-working citizens. This applies to both financial and immaterial benefits such as social relations, prestige, reputation, appreciation, trust and perceived respect (61).

In a review exploring the meaning of work among workers with work disability, work was perceived as a source of identity, feelings of normality, financial support and socialisation (62). Accordingly, work disability may cause economic uncertainties for the individual, and it is associated with poorer overall self-rated health, more depressive symptoms and a greater decline in health symptoms (63). For society, sickness absence leads to increased social costs in the form of compensation costs and medical expenses, a reduced workforce, and an economic and organisational burden for employers (11).

Work disability among patients with neck and back pain is found to be only weakly correlated with pain and disability (11;19). The causes of sickness absenteeism are the results of complex relationships between medical, psychological, social and occupational issues, which often are separate from associated health conditions and treatment (19;63;64).



In particular among back pain patients, much effort has been put forth in the search for potential contributors to work disability. Radiculopathy or radiating pain, along with back pain, is found to be a risk factor for a longer duration of sickness absence (65;66). Similarly, initially high self-reported disability and previous sickness absence are risk factors (65). Socioeconomic status and education have previously been linked to pain and disability (35;67). Among psychological factors, the evidence for depression as a predictor of work outcome is conflicting whereas anxiety is likely not a predictor (68-70). In the review by Iles et al. (68), depression was suggested to influence the development of chronic back pain but not to predict ongoing disability. Psychological factors such as catastrophising, negative illness beliefs, and fear-avoidance beliefs are prognostic of work outcome (65;68). In addition, consistent evidence suggests that own expectations of recovery are a predictor for work outcome (53;68-70). Factors associated with prognosis in workers with neck pain have been less studied (71).

The financial compensation system and health care system are among the social factors that are advocated to influence work disability (15;64). However, evidence for the social compensation system affecting work outcome is currently insufficient because of the different compensation systems worldwide (68). For example, in Norway, employees receive 100 % sick compensation for up to 12 months; it is possible that this influences the duration of the sick leave. However, in a study of a multinational worker LBP cohort, less strict criteria for long-term and/or partial disability benefits were found to be more effective in sustainable return to work (RTW) rates (72). Finally, work disability is also assumed to be related to the environmental factors at the workplace (15;19;64).

## **Work environment**

Occupational medicine is a field focusing on preventing and managing illness, injuries and disability related to the workplace. Although a focus on the physical work environment is important to ensure safety and health at the workplace, over the years an additional emphasis on the psychosocial work environment has evolved.

A definition of psychosocial work environment is given by WHO (20):

'The Psychosocial Work Environment includes the organization of work and the organizational culture; the attitudes, values, beliefs and practices that are demonstrated on a

daily basis in the enterprise, and which affect the mental and physical well-being of employees. These are sometimes generally referred to as workplace stressors, which may cause emotional or mental stress to workers.’

This suggests that the ‘psychosocial work environment’ relates to an interaction between the employee’s understanding of their situation at work, their feelings and behaviours on the one hand, and their actual working environment on the other.

### **Demand-control-support model**

One of the most used models in psychosocial work environment research is the demand-control model (73). This model advocates that the combination of high demands and a lack of control will cause stress, and workers in such high-strain jobs experience the lowest well-being (73;74). However, the effects of high demands depend on the possibilities for control. High demands combined with a high degree of work control might lead to positive coping. Social support is believed to moderate the effect of a high-strain job and hence is presently incorporated in the model (74).

There is conflicting evidence of psychosocial workplace factors as predictors for the onset of neck and back pain (2;75-78), although they are suggested as predictors for chronicity in patients with LBP (23;79). The different reviews’ conclusions may be because of the different criteria for inclusion and strength of evidence (78). The most consistent evidence appears to be an association between high job demands and LBP (78). The presence of neck pain has been found to be associated with a high level of job strain or both high and low work demands (36;78). In a Norwegian study of workers, one of the most consistent protective factors for the presence of neck pain was decision control (80). Moreover, a recent review concluded that most psychosocial stressors had small but significant lagged effects on the development of musculoskeletal problems (81).

The influence of psychosocial workplace factors on work disability is even less evident. In studies of workers with musculoskeletal disorders (MSD), a lack of work accommodations offered has been found to predict chronic work disability (65;82), whereas job satisfaction was not predictive (68;69). In fact, two reviews of LBP patients concluded that the evidence has not been sufficient to determine an association between psychosocial work factors and work outcome (69;77).

The current population comprises patients with neck or back pain who were sick-listed and referred to secondary care. In these patients, psychological distress and disability often accompanied the pain (83). The disability might be influenced by factors at work (18;19). Thus, exploring the workplace factors is regarded as essential in the search for obstacles and facilitators for RTW among sick-listed workers (15). In Norway, psychosocial work factors have been explored in worker populations (84) or in the general population (85). However, how the psychosocial work environment is actually perceived by sick-listed neck and back pain patients and possible influences on work disability have seldom been investigated. In addition, we have no knowledge of how the perception of demand, control and support change over time in patient populations.

### **Interventions for patients with chronic neck and back pain**

Numerous interventions for patients with neck and back pain have been developed and investigated. For patients with chronic LBP, cognitive behavioural therapy, supervised exercise therapy, brief educational interventions, and multidisciplinary rehabilitation programs are recommended by the European guidelines (23). For neck pain patients, evidence suggests that manual therapy, exercises and therapies including educational interventions addressing self-efficacy are more effective than other strategies (86).

Neck and back pain are commonly considered different conditions. However, in the search for effective treatment for work disability, several non-medical factors have emerged as important factors (15). This suggests that interventions targeting work disability among back pain patients are assumingly applicable to neck pain or musculoskeletal disorders in general (15;19).

### **Multidisciplinary interventions**

The efficacy of multidisciplinary interventions for chronic low back pain on disability and pain relief has been previously documented (87-92); additionally, moderate evidence supports the efficacy of multidisciplinary rehabilitation for sub-acute LBP (93). In a systematic review that investigated the effectiveness of multidisciplinary interventions for neck pain patients, the researchers concluded that although multidisciplinary rehabilitation is commonly used in the treatment of chronic neck pain, evidence on the treatment effects is scarce and highly sought (94). A multidisciplinary rehabilitation program typically includes

a combination of physical, psychological and social dimensions (90). The different elements aim at improving pain-related physical disability and addressing additional issues such as psychological, social or work-related behaviours. The multidisciplinary team includes a minimum two of different-skilled health caretakers; e.g., a physician, physiotherapist, social worker, psychologist, and case worker.

A few reviews have suggested an effect on RTW or work participation for back pain patients (90;95;96). Only a modest effect was revealed in a meta-analysis, although a better effect was found when only Scandinavian studies were included (95). A recent review by Kamper et al. reported positive influence of multidisciplinary rehabilitation on work outcome compared to physical treatment (90).

In Norway, a brief intervention was effective regarding RTW compared to usual care in patients with sub-acute LBP (10). The brief intervention was conducted by physicians and therapists, and as such, qualified as a brief multidisciplinary intervention. In another Norwegian study, light multidisciplinary treatment showed effects on full RTW for male patients with chronic LBP compared to usual care (97). This effect was not present for extensive multidisciplinary treatment. This absent additional efficiency from more intensive interventions has also been found by others (90;98).

### **Work-focused interventions**

The marked work disability displayed by a proportion of the patients with back pain has received much attention. In particular, the weak correlation between pain intensity, disability and work disability suggests that traditional clinical interventions do not capture work disability sufficiently (19). In 1997, Loisel et al. (16) showed that workers with sub-acute work-related back pain, who received both clinical and occupational interventions, had a hazard ratio (HR) of 2.41 to RTW compared to treatment as usual in primary care settings. The main effect was from the occupational intervention. This study has subsequently been considered the start of a paradigm shift in which occupational or workplace interventions have been regarded as essential in rehabilitation programs for the prevention of pain-related work disability.

Later, in a review of workplace-based RTW interventions, strong evidence was found demonstrating that work accommodation offers and contact between the healthcare provider and the workplace were effective in reducing the work disability duration. Effects were also suggested for early contact with the worker by the workplace, ergonomic workplace visits,

and the presence of a RTW coordinator (82). In a recent Cochrane review of workplace interventions (64), workplace intervention was defined by ‘changes to the workplace or equipment, changes in work design and organisation, changes in working conditions or work environment, and occupational (case) management with active stakeholder involvement of (at least) the worker and the employer’(64). This review suggested that workplace interventions were effective in reducing sickness absence for workers with musculoskeletal disorders.

Because of the location of the workplace interventions, most studies have included workers with acute or sub-acute pain conditions. Although we would argue that the sub-acute phase is likely the most appropriate time frame to prevent work disability, effective treatment options for patients with chronic pain conditions are necessary. In fact, Lambeek et al. (99) demonstrated the effect of a combined patient directed and workplace directed intervention for patients with chronic back pain compared to usual care. However, patients with persistent neck or back pain and prolonged sickness absence are often referred to secondary care. In this setting, a traditional workplace intervention might not be feasible. Nevertheless, case management, work accommodation recommendations, workplace visits, or involving the workplace by phone, may be applicable. In a Danish study of sub-acute LBP patients by Jensen et al. (100), a multidisciplinary intervention, including case management, was not found to be superior to a brief intervention. Both interventions occurred at the hospital, yet the patients were recruited from primary care.

The effectiveness of a RTW intervention is influenced by the compensation system, the health care system, the working conditions of the country and the characteristics of the patients (101;102). Currently, there are no randomised controlled studies that have compared the RTW efficacy of work-focused interventions with existing interventions for chronic neck and back patients in specialist health care in Norway.

## **AIMS OF THE THESIS**

The main aim of this study was to evaluate the perceived psychosocial work environment among sick-listed patients with neck or back pain and the effect of interventions with respect to sickness absence.

The specific aims of the study of sick-listed patients with neck and back pain were:

To compare the efficacy of a work-focused intervention versus a multidisciplinary intervention regarding return to work (RTW) and sickness absence over one year.

To assess how the patients perceived demand, control, and support at work compared to a general reference group of workers and to investigate possible influences between psychological and social factors at work and fear–avoidance beliefs about work.

To investigate changes in the perception of control, demand, and support over one year in patients with neck and back pain.

To evaluate the psychometric measurement properties of control, demand and support dimensions in the QPS Nordic questionnaire.

## PATIENTS

We recruited patients who were referred to the neck and back outpatient clinic at Oslo University Hospital (OUH) and St. Olavs University Hospital (SOH), Trondheim, Norway between August 2009 and August 2011. At OUH, the patients with both neck and back pain were included whereas at SOH, only back pain patients were eligible. All referred patients underwent a standardised medical examination to assess their eligibility for inclusion.

Table 1. Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
Neck or back pain <ul style="list-style-type: none"> <li>• with/without disc herniation</li> <li>• with/without radicular pain/radiculopathy</li> <li>• recommended conservative treatment</li> </ul>	Neck or back pain <ul style="list-style-type: none"> <li>• assessed for surgical treatment</li> </ul>
Age between 18-60 years	Cauda equine syndrome
Employed or self-employed	Symptomatic spinal deformities
Sick leave duration 4 weeks – 12 months	Osteoporosis with fractures
	Inflammatory rheumatic diseases
	Pregnancy
	Cardiac, pulmonary, or metabolic diseases with functional restrictions
	DSM-IV diagnosed mental disorder
	Legal labour dispute
	Insufficient Norwegian language skills

A flowchart of the eligible and enrolled patients in the study is shown in Figure 1.

A total of 723 patients were eligible; of these patients, 310 declined to participate, usually because of distance from the hospital or because they were receiving other treatments. The remaining 413 patients were included in the study. Seven patients were excluded shortly after randomisation as a result of not being sick-listed (n = 3), unemployment (n = 1), the need for surgical evaluation (n = 1), pregnancy (n = 1), or language issues (n = 1). One participant withdrew his consent, leaving 405 participants in **Paper 1** (Figure 1).

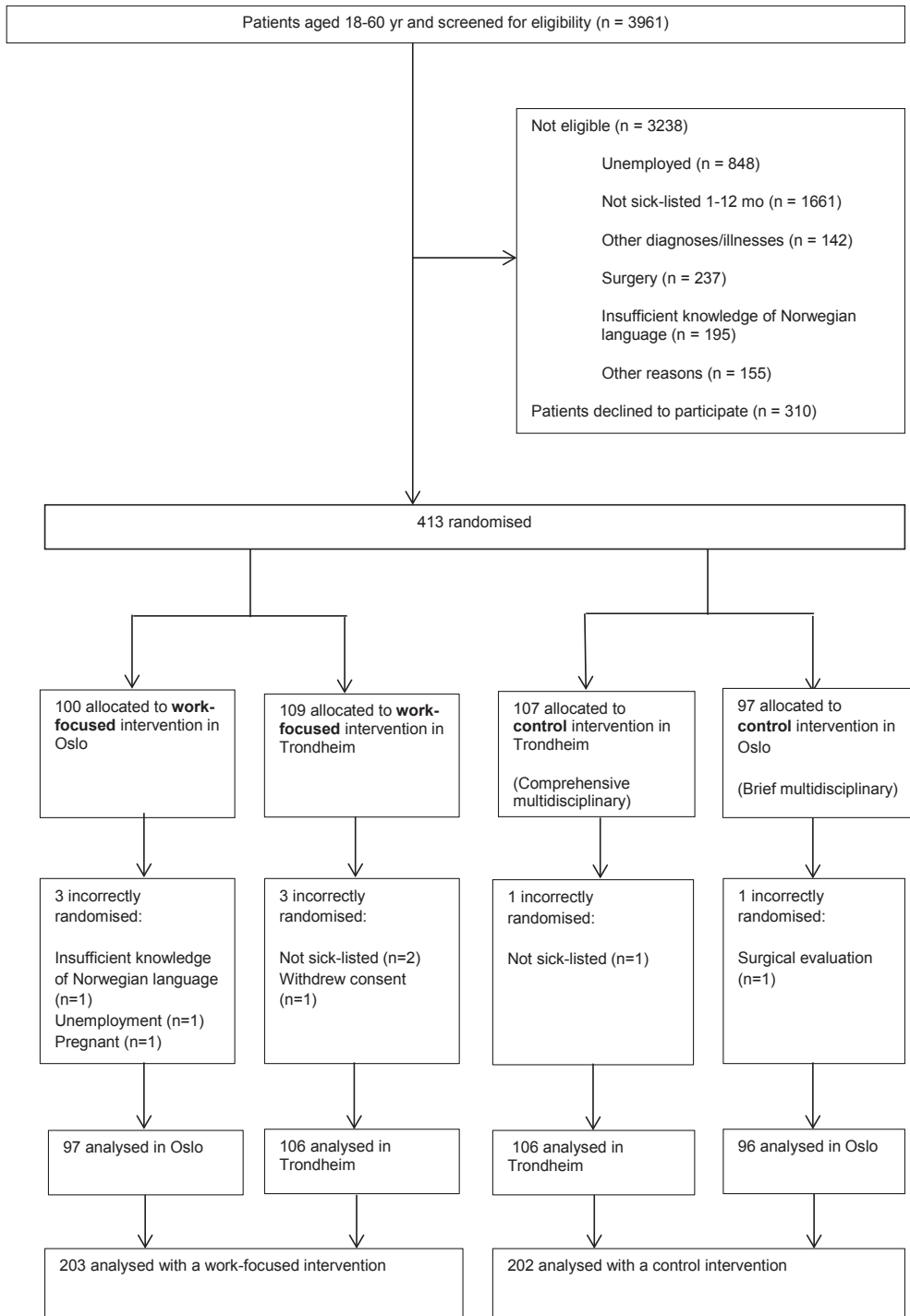
In **Paper 2**, these numbers deviate slightly because of a minor error in the counting of eligible (719) and declining patients (311), resulting in a total of 408 patients giving their consent. The discrepancy between the 408 patients in Paper 2 and the 405 patients in Paper 1 was because of scrutinising the data attained from national databases at one-year follow-up. This resulted in three participants being excluded in the intervention study because they were not sick-listed (n=1), unemployed (n=1) and pregnant (n=1).

In Paper 2, we analysed 373 participants. A total of 31 participants were removed because of missing or incomplete scores in the General Nordic Questionnaire for Psychological and Social Factors at Work (QPS Nordic) and the Effort-Reward Imbalance (ERI) questionnaire and another four because of missing responses in the Fear-avoidance beliefs questionnaire about work (FABQ-W).

In **Papers 3 and 4**, 106 patients (26 %) did not respond to the one-year follow-up questionnaire, and another 71 patients (18 %) submitted incomplete questionnaires. This resulted in 226 patients (56 %) who completed two-third or more of each subscale in the QPS Nordic at baseline and at 12 months follow-up.



Figure 1. Patient flow



## **METHODS**

### **Design**

The main study, **Paper 1**, was a multicentre prospective randomised controlled trial that compared work-focused treatment with multidisciplinary treatment with follow-up at one year.

**Paper 2** was a cross-sectional multicentre study. The assessed psychological and social work factors in the patient population were compared to workers, and possible associations between psychological and social work factors and FAB about work were investigated.

The prospective multicentre study in **Paper 3** examined the changes in demand, control and support dimensions at work over one year and the association between these changes and clinical improvement, reduced FAB and successful RTW.

In **Paper 4**, a Rasch analysis was performed to evaluate the measuring properties of the demand, control, and support dimensions in the QPS Nordic questionnaire.

### **Randomisation**

The patients were randomised by a website hosted by the Unit for Clinical Research, Faculty of Medicine, Norwegian University of Science and Technology in Trondheim. The randomisation was stratified by hospital. An independent statistician used a computer program to generate a random block size sequence that was concealed for all involved in the trial. The first clinical examination was double-blinded because this was performed before randomisation. After randomisation, it was not possible to blind either the treatment team or the participants. However, the investigators did not have access to the allocation code in the data files for each patient until the analyses were performed.

### **Intervention**

Both the work focused and control interventions occurred at the outpatient clinics at the respective hospitals. All the participants went through a standard neck or back pain examination by a physician at the neck and back clinic. Relevant imaging was evaluated, and the patients were informed about the findings and that the origin of the pain is often

difficult to visualise on imaging. They were reassured that daily activities, physical exercise or jobs would not hurt or damage their neck or back. Effort was placed on removing FAB, restoring activity levels, and enhancing self-care and coping.

### **Multidisciplinary intervention**

At the time of the study, the neck and back clinic at SOH offered a comprehensive multidisciplinary intervention for chronic LBP patients that was developed from a model described by Brox et al. (91). At the same time, the neck and back clinic at OUH offered a brief multidisciplinary intervention that was inspired by the study by Indahl et al. (10); these were used as the control interventions at each respective site.

At SOH, the intervention was mainly conducted in group sessions over three weeks, with a one week break in the middle. The treatment lasted approximately 6 hours each day and consisted of lectures, discussions and exercises. At OUH, the intervention was individually based, with one appointment with a physiotherapist and a specialist within three weeks. The contents of the two multidisciplinary interventions are given in Table 2.

### **Work-focused intervention**

The above procedures were also followed for the work-focused intervention, but here additional focus was put on the RTW process (Table 2). The patients received individual appointments with a case worker within the first days of treatment. Work histories, family lives, and obstacles to RTW were discussed. The case worker contacted the participants' employer by phone in most cases (unless the patient refused) to inform about the program and inquire about possible temporary modifications at work. The patients created a RTW schedule together with the case worker and the multidisciplinary team. The case worker and patient also discussed relevant issues for a meeting with the employer. The case worker offered assistance at this meeting, if requested. If sick-leave compensation was an issue, the case worker contacted municipal social services (NAV). The medical record and RTW schedule was sent to the participant and their general physician, who managed the patients' sick-leave certificates.

Table 2. The contents of the work-focused and control interventions

	Work-focused intervention		Control intervention	
	Oslo	Trondheim	Oslo	Trondheim
Team	Multidisciplinary healthcare professionals			
	Caseworker	Caseworker		
Total duration of intervention	3 weeks	3 weeks	3 weeks	3 weeks
Sessions with physiotherapist	7	7	1-2	17
Lectures	4	5	0	8
Group discussions	0	3	0	4
No. of appointments with a medical specialist	2	2	1	2
No. of appointments with a caseworker	2 (-3)	2	0	0

### Data collection

Registrations for Papers 1, 3 and 4 were collected at baseline and at one year, whereas Paper 2 included only baseline registrations. The registration and use of the different patient characteristics at baseline and one-year follow-up are given in Table 3. The baseline data were collected at the hospital after the patients gave their informed consent. At one year, sickness benefits data were attained from the national social insurance register (NAV) whereas other data were collected through a postal questionnaire.

Table 3. Data used in Papers 1, 2, 3 and 4 (I, II, III and IV)

	<b>Baseline</b>	<b>One-year follow-up</b>
<b>Demographic variables</b>		
Age	I,II,III,IV	
Gender	I,II,III,IV	
Educational level	I,II,III,IV	
Occupation	I,II,III,IV	
<b>Sickness absence variables</b>		
Days off work before inclusion, last episode	I	
RTW status		I,III,IV
Number of days until RTW		I
<b>Variables from questionnaire</b>		
Norwegian mother tongue	I	
Married or living with partner	I	
Have children	I	
Smokers	I,II,III	
Use of analgesics	III	
Physical activity level, No. of sedentary patients	I,III	
BMI	I,III	
<b>Self-report questionnaire:</b>		
Oswestry Disability Index	I,II,III	III,IV
Neck Disability Index	I,II,III	III,IV
FABQ-Physical Activity	I,II	
FABQ-Work	I,II,III	III

HSCL-10	I,II	
HADS	III	III
NRS pain at rest	II	
NRS pain in activity	I,II,III	III,IV
Number of pain regions	II	
Number of comorbid conditions	II	
QPS Nordic (demand, control, support)	II,III,IV	III,IV
ERI (effort, reward, overcommitment)	II	

BMI; body mass index, ERI; Effort-Reward Imbalance Questionnaire, FABQ; Fear-avoidance Beliefs Questionnaire, HADS; Hospital Anxiety and Depression Scale, NRS; Numeric Rating Scale, NDI; Neck Disability Index, ODI; Oswestry Disability Index, QPS Nordic; The General Nordic Questionnaire for Psychological and Social factors at Work, RTW; Return to work

## Measures

### Primary outcome measure

The primary outcome in the main study (Paper 1) was the number of days from inclusion until sustainable RTW. In this study, we defined sustainable RTW as the first five-week period after random assignment that the patient did not receive sickness benefit, a work-assessment allowance (AAP), or a disability pension from NAV. We deemed that the patients were RTW when they no longer received social benefits from NAV because all employees are entitled to financial assistance in case of illness in Norway. For patients receiving a partial disability pension prior to inclusion, RTW was designated when they returned to their partial disability status.

## **Other measures**

### **Work-status**

We also assessed work-status at one-year follow-up. Work-status was dichotomised into working versus sick-listed. Table 4 gives the definitions in the various papers. Those still partly sick-listed at one year were mainly defined as sick-listed because they had not achieved RTW. However, we chose a separate definition of work-status in Paper 3 because we wanted to distinguish between those who had not versus those who had been, at least partly at the workplace, when the one-year follow-up of psychosocial work factors was reported.

Table 4. Definitions of work-status at one-year follow-up in the corresponding papers

	<b>Working</b>	<b>Sick-listed</b>
<b>Papers 1 and 4</b>	100 % RTW	100 % or partly sick-listed
<b>Paper 3</b>	100 % and partly RTW	100 % sick-listed

### **Demand, control, and support**

When we use questionnaires to measure subjective symptoms or perceptions, we must know the quality of the questionnaire or the psychometric properties.

Validity is the term used to describe how well an instrument actually measures what it was proposed to measure. There are several types of validity that can be assessed. Construct validity addresses the validity of a questionnaire measuring an abstract construct for which there is no criterion (or “gold standard”) (103).

Reliability is another property of a questionnaire that refers to the degree of how stable and repeatable the measures are (103). Test-retest and internal consistency are the main types of measured reliability. Test-retest reliability assesses the stability of a test, meaning that the test response in the same individual at two time points should be similar, assuming the clinical conditions are similar across the time points (103). Internal consistency relates to the concern that all items are measuring the same construct. Cronbach’s alpha coefficient is a widely used measure of internal consistency. A coefficient above 0.7 or 0.85 is generally proposed (104).

The General Nordic Questionnaire for Psychological and Social factors at Work (QPS Nordic) was developed to improve the quality and comparability in studies relating to the psychological, social and organisational work environment (104). It was a joint Nordic project. The questionnaire is comprehensive and is based on several theories and models, including the demand-control model by Karasek (105). The items regarding demand, control and support at work were used in this study.

The QPS Nordic includes a total of 118 items (excluding 11 background items), with 80 of these items making up 26 scales. Among these scales, nine are related to the concepts of job demands, job control and social relations at work (106). In addition, we used the single item: 'Does your work require physical endurance?' Table 5 gives an overview of the scales and items used in this thesis. The scales are calculated as the mean response value of the included items, and each item is measured with a frequency scale in the form of a Likert five-point response scale.

The construction and validation of the QPS Nordic was based on two data sets that were collected from the four Nordic countries (104). A total of 2010 employees from production industries, private service companies, the health sector, and public administration were collected (106). These data constitute the reference data included in the QPS Nordic user's guide, which we used to compare with the scores of our study population. The reference group consisted of 64 % women, the mean age was 43.5 years, 5 % of the patients were >60 years, and 53 % had a college or higher level of education.

The validation and reliability of the QPS Nordic is documented in the development project (104). There are few studies that have evaluated the measurement properties of the QPS Nordic later on (107). However, how well the questionnaire measures demand, control and support among neck and back pain patients is unknown because its measurement properties have currently only been tested in worker populations. Furthermore, the psychometric properties of the QPS Nordic have not yet been examined with modern measurement theories such as the Rasch analysis, although these theories have been applied to clinical instruments including the Oswestry and Neck Disability Index (108-112).

Rasch analysis is based on the Item Response Theory and serves as a supplement to traditional statistical approaches, such as factor analysis, regarding the assessment of the underlying construct of a measurement (113). Unidimensionality of the construct is an assumption that must be met to provide a valid sum score from a measurement (114). In



addition, interval scaling of the items is also necessary for a valid sum score, which is not necessarily met in the ordinal scoring options of many clinical instruments. These features can be evaluated by the Rasch analysis approach. In addition, the responses of the subjects and the items can be evaluated along the same metric, and response differences according to individual factors such as gender or nationality may be evaluated (Differential Item Functioning (DIF)) (115).

Table 5. Overview of subscales and items from the QPS Nordic used in the analyses

Composite subscale	Subscales	Number of items	Total range of scores
Demand	Quantitative demands	4 items	1-5*
	Control demands	3 items	1-5*
	Learning demands	3 items	1-5*
Control	Positive challenge at work	3 items	1-5*
	Control of decision	5 items	1-5*
	Control of work pacing	4 items	1-5*
Support	Support from superior	3 items	1-5*
	Support from co-workers	2 items	1-5*
	Support from friends and family	3 items	1-5*
Single item	'Does your work require physical endurance'?	Single item	1-5*

\*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).

## Statistical analysis

A significance threshold of  $p < 0.05$  was adopted. The statistical analyses in Papers 1, 2, and 3 were performed using SPSS version 18 and version 21, IBM Corporation, NY, USA.

## Paper 1

The randomised trial was designed to detect a relative probability, HR, of 1.7 of returning to work. This number was based on previous studies (16;17). Given a power (1- $\beta$ ) of at least 0.8 and a significance level of  $\alpha = 0.05$ , we determined that at least 157 patients were required for the primary outcome. We also expected a 10 % attrition rate during the interventions and another 30 % to not respond to the questionnaires sent at four and 12 months; hence, a sample size of at least 224 patients was required at inclusion.

We used a survival analysis (Kaplan-Meier) to investigate the length of sickness absence and the Breslow test to compare the intervention group with the control group. The follow-up period was from enrolment until one-year after the inclusion of the final participant. First, we analysed each hospital separately. Because no significant differences between the interventions were found, we subsequently merged the data from the two hospitals into joint analyses. A Cox proportional hazard regression model was used to calculate the HRs for the RTW rates between the two treatment groups. Crude and adjusted HRs were calculated for all participants included in the study (adjusting for age, sex, and education).

## **Paper 2**

We used *t*-tests to compare the average demand, control and support subscale scores with the mean from the QPS Nordic reference data. *t*-tests were also used to compare differences between men and women regarding the QPS Nordic subscales. To assess the size of the differences, we calculated Cohen's *d* values (116). 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: small ( $d = 0.2$ ), medium ( $d = 0.5$ ) and large ( $d = 0.8$ ).

Hierarchical multiple regression analyses were performed to explore to what extent psychological and social work factors were related to the FABQ-W. In the regression analyses, composite QPS Nordic scores were created by adding the three respective subscales for each dimension: job demands, job control, and job support (Table 5).

## **Paper 3**

We used paired *t*-tests to compare the average subscale baseline values of the study population with the one-year follow-up value. Cohen's *d* was used to assess the size of the differences.

Hierarchical multiple regression analyses for each of the nine QPS Nordic demand, control and support subscale change-scores as dependent variables were performed. We explored

the relationship between the change-scores of the demand, control and support subscales and changes in clinical and mental health variables, a work-focused intervention, and work-status. The absolute values were controlled for the baseline value in the regression analysis. The influence of the baseline value will depend on which variable is investigated and should be considered as measurement error, such as the regression to the mean.

#### **Paper 4**

Rasch analysis (108), the partial credit model (117), was applied to evaluate the measurement properties of QPS Nordic demand, control, and support dimensions. All the dimensions with a total of nine subscales and a total of 30 items were included in the analysis to evaluate whether these items share a common underlying construct of psychosocial factors at work. Subsequently, the demand, control and support dimensions were evaluated separately.

More specifically, the demand, control and support dimensions were investigated with respect to its scaling properties, unidimensionality and targeting. Furthermore, the invariance of the measurement properties with respect to age, gender, occupation and sick leave status was evaluated in subjects with neck and back pain.

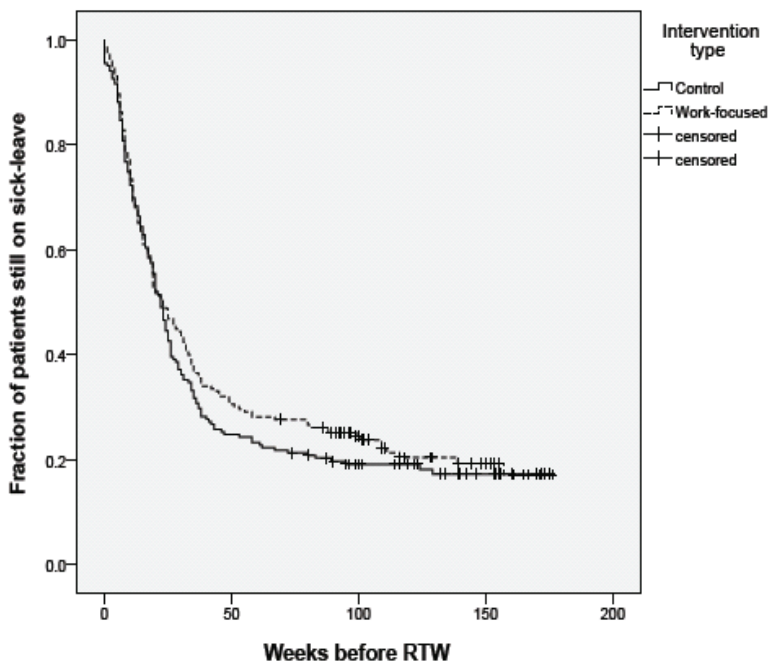
The Rasch analysis was performed in RUMM 2030 (RUMM laboratory, Perth, Australia). Other analyses were performed using SPSS for Windows version 21.0.

## RESULTS

### Paper 1

We compared the RTW rate among patients who were offered a work-focused intervention versus those with a multidisciplinary intervention. Of the total 3961 patients who were screened for eligibility, a total of 717 patients were found eligible, and of those, a total of 405 patients gave their consent and were randomised. The two participating hospitals had their own established treatments, which were used as the control interventions; these consisted of a comprehensive multidisciplinary intervention at SOH and a brief multidisciplinary intervention at OUS.

Figure 2 Survival plot from the Kaplan-Meier analysis showing the percentage of participants who returned to work during the follow-up period for both intervention groups



During the first 12 months after inclusion, 142 (70 %) participants in the work-focused rehabilitation group and 152 (75 %) participants in the control group had returned to work. The median RTW time was 161 days in the work-focused group and 158 days in the control

group (Figure 2). A comparison of the work-focused and control interventions revealed a relative RTW probability, HR, of 0.94 (95 % CI = 0.75 to 1.17) after adjusting for age, gender and education.

## **Paper 2**

Of the 405 patients included, 373 subjects had answered the baseline questionnaires adequately to perform a cross-sectional study in which we investigated their perceived demand, control and support at work. Although the patients' mean scores differed significantly from those of a reference worker group in several subscales, the magnitude of these differences was small. The greatest difference was found for the item; 'demand for physical endurance'. Female patients reported significantly higher scores on support, whereas male patients reported significantly higher demands for physical endurance and quantitative demands. In multiple regression analyses, we explored the associations between psychological and social factors at work and the FABQ-W. The analyses indicated that the demographic and clinical variables explained 19 % of the variability in the FABQ-W, and another 20 % was explained when the psychosocial work factors were added in the model. Perceived lower job control, higher job support, and a higher demand for physical endurance were strongly associated with a higher FABQ-W in sick-listed neck and back pain patients.

## **Paper 3**

In this prospective study, we investigated changes in perceived demand, control, and support at work among the 226 patients (56 %) who responded to the work factor questionnaire at the one-year follow-up. The quantitative demand score was the only work factor subscale showing a significant change, with the one-year score significantly lower than the baseline score ( $p=0.03$ ). Furthermore, we investigated whether the perceived changes in demand, control or support at work were associated with clinical improvement, reduced fear-avoidance beliefs or successful RTW. The multiple regression analyses showed that decreases in fear avoidance beliefs were consistently correlated with decreases in demand and increases in the control of work pace subscales, whereas decreases in disability, anxiety and depression were related to increases in support subscales. The inclusion of these variables in the multiple regression models explained 2-8 % of the variability of the subscales' changes.

## **Paper 4**

In this paper, the construct validity of the QPS Nordic and the underlying domains of demand, control and support regarding scaling properties, unidimensionality and targeting among patients with neck and back pain were assessed using Rasch modelling. Furthermore, the invariance of the measurement properties with respect to age, gender, white or blue collar work and sick-listed status was evaluated.

The Rasch analysis (RUMM 2030) was based on 226 subjects with neck and back pain who completed the QPS Nordic at one-year follow-up. The QPS Nordic (30 items) sections covering the dimensions of demand, control, and social support were used in the study. The scaling of the items and the overall fit of the QPS Nordic to the Rasch model with separate analyses for the demand, control and support domains were performed.

The Rasch analysis revealed disordered thresholds in a total of 25 of the 30 items and had to be rescored. The 30 item QPS Nordic did not fit the Rasch model, whereas the domains of demand, control, and support fit the Rasch model when analysed separately. The demand domain was well-targeted whereas the present neck and back pain patients had lower control and higher support than reflected by the questions. Two items revealed DIF by gender; otherwise, invariance to age, gender, occupation and sick-leave was documented.

## GENERAL DISCUSSION

### Patient population

The participants in this study were recruited from two neck and back outpatient hospital clinics. The patients were referred from primary care to the neck and back clinic, and no additional effort was used to increase the referrals because of the study. This suggests that the study population resembles the patients in a general outpatient clinic today.

The two current outpatient hospital clinics are situated in two areas of Norway that have regional differences. OUH receives the referrals from the counties Oslo and Akershus. These two counties have a predominantly urban population, and the labour market offers many service industry positions. At SOH in Trondheim, the outpatient clinic receives patients from the three counties of Møre and Romsdal, Sør-Trøndelag and Nord-Trøndelag. These counties are comprised of large areas with scattered settlements in addition to cities. Thus, we assume that this population may hold occupations not present in the Oslo area. We also believe that the number of private institutions offering treatment for neck and back patients is less in Trondheim, and as such SOH receives a greater proportion of the population for rehabilitation.

However, the external validity of a study population is influenced by the selection of patients into the randomised trial. Of the total of 3961 patients screened for eligibility, only 723 were deemed to be eligible. Among the patients who were not eligible, 75 % were not sick-listed or were unemployed, and 7 % were assigned for assessment by an orthopaedic surgeon. However, 6 % were not eligible because of poor Norwegian skills, which is a limitation to this population. A corresponding number of patients with poor language skills has not been shown in other studies (35;91;92;99). The small proportion of eligible patients is likely a result of the inclusion procedure; all patients visiting a specialist in physical medicine at the outpatient clinic were simultaneously screened for eligibility during the appointment.

Furthermore, 310 of the 723 eligible patients declined to participate. Few patients reported any reason for their decline. However, of the few reasons given, the long distance from the hospital, having just started treatment by other care-takers, or not wanting to return to their previous job because of a belief that the job was too demanding were the most frequently occurring reasons. It is possible that the patients who were most satisfied with their current

job were those who were willing to participate. The large number of patients who declined to participate likely indicates selection bias because the patients who are recruited normally differ from those not recruited in terms of age, sex, race, severity of disease, educational status, social class, and place of residence (118). We have no record of the socio-demographic variables of the patients who declined to participate, except for being of a similar gender and age. The large proportion who declined to participate might limit the external validity of our study. However, the number of eligible patients not invited to participate or who decline to participate in RCT's is generally estimated to be between 20-80 % (118).

The patients with neck and back pain who are referred to specialist care differ from patients in primary care. In the absence of severe symptoms, such as suspected red flag symptoms or paresis, these patients are usually referred because of slow improvement in pain or prolonged sickness absence. The time period from the onset of pain until referral varies between general practitioners. Although wide inclusion criteria have been used with a sick leave duration between 1 and 12 months, most patients will be classified with chronic pain. Except for the study by Lambeek et al. (119), most previous studies on workplace (64) or work-focused rehabilitation (100) have included patients with acute or sub-acute pain.

In addition to non-specific neck and back pain disorders, we also included patients with nerve root affection. Thus, patients with radicular pain or radiculopathy because of disc herniation would be included if conservative treatment was recommended. This is consistent with two recent work-focused LBP studies (99;100), whereas other studies have included non-specific LBP patients (17) or this has not been specified (16).

In the present study, neck pain patients were only included at OUS. This means that the patients with neck pain only constitute a minor part of the material. However, studies have shown that individuals with chronic musculoskeletal disorders often report complaints from three or more body parts (5;120). Accordingly, pain drawings among our study patients revealed that 17 % of the participants marked only one painful region whereas 64 % reported pain from three or more body parts. The proportions of patients who had indicated both neck and low back pain were similar at the two hospitals. Few other work-focused RCTs have included patients with neck pain, yet Loisel et al. included neck pain in their prospective study (15).



The gender, age, and educational level in our study population were in accordance with other studies of chronic back pain (91;92;99;121) and neck pain (120) patients in secondary care. The slightly older populations in (99;120) are most likely a result of differences in the inclusion criteria. A higher proportion of women (60 %) were reported in the Norwegian studies (91;92;120). The median time sick-listed prior to enrolment in the present study was 16 weeks in both groups, which is 4-7 weeks shorter than that reported by Lambeek et al. (99). In the study by Jensen et al. (100), patients with sick leave up to a 16 week duration were included, but the median time was not reported.

## **Design**

A randomised controlled trial, such as Paper 1, is reckoned as the gold standard in evaluating treatment interventions when appropriately designed, conducted, and reported (122). In other words, the study must be both internally and externally valid.

First, internal validity is the extent to which the results of the study are true. It is concerned with how the data collection, analysing and study reporting eliminates the possibility of biases (118). Randomisation is the best method to achieve similarity between comparison groups and to prevent any systematic bias from known and unknown confounders (123). Bias in randomisation can arise if the treatment provider or patient believes that they can predict when the chances of receiving a desired intervention increase; therefore, concealed randomisation is recommended. This was accomplished in our study by randomisation on a website; an independent statistician who did not take part in the study in any way used a data program to generate random block sizes. This also guaranteed equal-sized groups and reduced the probability to predict allocation before randomisation. The randomisation was stratified by centre, which is usual in multicentre studies (123). Although blinding is recommended to prevent bias, in this study it was not possible to blind the patients and treatment providers. However, the researchers were blinded for the allocation codes until the analyses were performed. The primary outcome was sustainable RTW, and data regarding this outcome were obtained from the NAV, which assured a 100 % follow-up. Hence, the all included patients were analysed as intention-to-treat regardless of drop-outs or non-compliance. No participants switched the allocated treatment group.

Second, external validity is to what extent the results can be generalised to subjects outside the study sample. However, to obtain external validity, the presence of internal validity is

fundamental. Clinical trials are often described as explanatory or pragmatic although they are a continuum. Explanatory trials measure the efficacy of an intervention under ideal conditions and are often used under the development of new interventions. However, they often have limited generalisability to clinical practice and limited external validity (124). Conversely, pragmatic trials measure the effectiveness of an intervention in clinical practice. Pragmatic trials take place in a clinical care setting, the participants may receive other healthcare, and the participants exhibit variations commonly observed between patients. The internal validity will be lower in the pragmatic trials than in explanatory trials. The follow-up in a pragmatic trial will be less intensive, and the participant may not adhere to the treatment regimen allocated. To minimise confounding, the analysis is based on intention-to-treat analyses (124). Based on the setting of this trial at the out-patient clinics of two university hospitals in Norway, the rather broad inclusion criteria (neck or back pain, sick-listed between 1-12 months) and the less intensive follow-up, we considered this trial to be a pragmatic trial.

Previous studies (16;17;99) have mostly recruited patients from primary care and thus, the work-focused interventions have been compared with usual care. However, because we recruited patients from secondary care, usual care in primary care had previously been attempted. The choice of control intervention in secondary care was based on the feasibility of the spine centres. Previous Norwegian studies have demonstrated the effects of brief multidisciplinary treatment in secondary care compared to usual care on RTW (10;125). However, the existing treatment modality at SOH was an extensive multidisciplinary treatment, and, in fact, many patients were originally referred to participate in this program. The use of two different multidisciplinary control interventions might increase the external validity of the study. Although separate site analyses revealed no significant differences (Paper 1), it was more complicated to interpret the results of this study. However, in a systematic review, the pooling of Scandinavian multidisciplinary interventions with different durations and content in a meta-analysis resulted in a clinically relevant effect on RTW (95).

The cross-sectional study in Paper 2 investigated the differences in participants' perceived demand, control and support at work compared to the QPS Nordic reference population (106). These worker reference scores were obtained during the construction and validation of the questionnaire, and data were collected from workers, not patient populations (104). Although the average and standard deviation of the reference population are provided in the

user guidelines, these data were not originally collected to constitute the general normal measurement.

We used the study population from the RCT in the cross-sectional (Paper 2) and prospective (Paper 3) study. This implies that the results may not be generalised into other patient populations such as primary care patients.

In Paper 2, we explored the associations between FAB about work and psychosocial work factors. A limitation to a cross-sectional study is that both the dependent and independent variables were measured at the same time, which prevents us from drawing causal conclusions based on associations found.

The results of the Rasch analysis (Paper 4) are also confined to the population studied. In particular, the targeting of the demand, control and support domains may differ from patient to worker populations and across occupations and work places. In addition, the Norwegian patient population did not provide the opportunity to evaluate differences across countries and cultures, which is an important aspect in the validation of measurements.

## **Statistics**

The time until sustainable RTW in Paper 1 was analysed with a survival analysis, which is the proper analysis used to analyse how much time passes before a given event occurs (123). We used a Cox regression analysis to compare the RTW rates between the intervention groups. The results of a Cox regression analysis are commonly presented by hazard ratios.

The power analysis was based on detecting the relative probability of returning to work, or an HR of 1.7. A web-based programme was used that was developed based on (126). We chose the HR value based on previous results in studies that compared combined work-place and multidisciplinary interventions with usual care (16;17). However, an HR of 1.7 might be too strict of a requirement compared to a multidisciplinary intervention. As far as we know, no general agreement on clinically important differences in RTW rates exists, although a 20-30 % difference in the RTW rate was previously assumed to be clinical relevant (95;127). Because we added 40 % more participants because of possible attrition yet the register data provided us 100 % of the outcome data, this implies that we should detect a lower HR. The time until RTW in the control group was five months (150 days). If we assume a 30 % reduction, this indicates 105 days. Thus, with the present 405 patients included in our study, an HR of 1.33 would have been detected with a 95 % probability.

A power analysis for the subgroup with half of the population corresponds to a detection of an HR of 1.5 with 95 % probability.

The comparison of the demand, control and support subscale scores in Paper 2 was performed using an independent *t*-test. This approach assumes that the dependent variable is measured on a continuous scale, that each observation is not influenced by the other observations, and that there is a normal distribution and equal variance (128). The distributions were investigated and found to adequately resemble normal distributions.

Hierarchical multiple regression analyses were performed in Paper 2. The regression model building was conducted according to a “purposeful selection strategy”. This procedure may result in over-fitting because it is based on *p*-values, although no obvious solutions exist to this problem (123;129).

In Paper 3, we used paired *t*-tests to compare the average subscale values of the study population at baseline with one-year follow-up. In addition, we explored the relationships between the demographic characteristics, changes in clinical and mental health variables, work-focused interventions, RTW-status, and the changes in demand, control, and support. However, because we included score changes as both 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 score change variables and not any causality based on the associations found.

## **Outcome measures and other measures**

In clinical studies on patients with LBP, the outcome assessments are multiple and complex. Thus, a set of standardised measurements for clinical outcomes in LBP research was suggested by Deyo et al. (130), including the assessment of symptoms, function, general well-being, work disability, and satisfaction with care. This thesis concentrates on work disability as a main outcome in the intervention study. The remaining issues will be investigated in further studies. Additionally, the demand, control and support at work and their influences among neck and back pain patients were investigated.

The use of register data from NAV in the intervention study provided us with a complete set of the primary outcome. However, register data only offer information about financial support from social insurance and not the true work-status, adaptations or altered job tasks. However, any discrepancies would be equally distributed in the two intervention arms.

The postal questionnaire at one-year follow-up yielded a 70 % response rate. It comprised a considerable amount of items. Although reminder letters and telephone contact was applied to enhance the response rate, the QPS Nordic demand, control, and support items were only completed by 56 % of the participants (131). This low response rate might influence the validity of the prospective study in Paper 3. Comparisons of baseline characteristics between patients who completed versus did not complete the QPS Nordic questionnaire were performed. Women were overrepresented as respondents ( $\chi^2= 7.5$ ,  $p=0.006$ ). In addition, the respondents were older ( $t=2.0$ ,  $p=0.049$ ) and reported higher levels of FAB about work ( $t=2.8$ ,  $p=0.005$ ) than the non-responders. However, the magnitude of these differences was small (Cohen's  $d$  0.20-0.29). Otherwise, the comparisons showed mainly similar demographic and clinical characteristics among the responders versus non-responders (Table 2, Paper 3).

### **Work-related outcomes**

The assessment of work-related outcomes is essential within research regarding work disability (19;132;133). The traditional work-related outcome measures are work-status and sickness absence. At a minimum, work-status should be measured both at the first visit and after the final care visit (132). In addition, information about the following is recommended: regular employment, employment with restricted work assignments, paid sick leave, unpaid leave, unemployed because of health problems, unemployed because of other causes, student, homemaker, retired, and disability pension (133). However, collecting this type of information requires self-report about the sickness absence. Although such categories were included in the one-year follow-up questionnaire, the response rate of 70 % forced us to apply the register data in the main analysis.

The length of sickness absence is normally measured in days and is a relevant measure for intervention studies. However, another common approach in intervention studies is how long it takes before the worker returns to work. RTW has been frequently used in LBP studies focusing on work disability (10;16;17;99;100;125).

Another desired ambition in an intervention study is to maintain work-status after RTW. When measuring the first RTW, it is important to remember that this may be one of several episodes of work disability because of neck or back pain (132;134). Accordingly, a time interval that is 'sustainable' RTW should be defined. Recent studies have used four weeks as sustainable RTW (99;100). However, because sick-listed patients in Norway are obliged

to be declared fit to take their holiday and the Norwegian holiday lasts 5 weeks, we chose 5 weeks.

A follow-up measure after RTW for at least for one year to measure the intervention's sustainability and reoccurrence of sick leave because of spinal disorders is also suggested (132). This will be included in future analyses. Furthermore, the distribution of sickness absence spells are skewed, with a large number of individuals having short term spells and a small number having long term spells. Accordingly, the median number of sickness days should be used instead of average values (135).

Sickness absence and work-status may often be easily obtained from administrative registers or may be collected by self-report. Sickness absence is registered for administrative and economic reasons, and registers are often valid in regard to numbers. However, the validity and reliability of the diagnoses recorded in medical certificates may vary (135). The level of agreement between register data and self-report data has been a concern. A Swedish study found good agreement between self-reported and employer's register data on sickness absence (136), and a Norwegian study demonstrated acceptable to good correlations between self-reported data on work-status and social benefits compared to register data from NAV (137). In Denmark, the Danish national register on sickness benefits offered valid measures compared to the workplace register when sick leave exceeded 15 days (138). In the same study, self-reported sick leave was more imprecise when sick leave days increased, but for up to one week, the specificity and sensitivity was acceptable. It has been suggested that the memory time period in self-reported data should be limited to two months because memory problems may lead to errors in estimating the duration of sick leave (132). In present study, only 70 % of the participants responded to the one-year questionnaire, and a substantial proportion did not remember the date when they returned to work.

### **Demand, control and support**

The QPS Nordic has been used in studies of the work environment in general worker populations (80;84;85;139;140). In Papers 2 and 3, we explored the QPS Nordic demand, control and support subscales, both at baseline and at one-year follow-up among our patients. The QPS Nordic has, to the best of our knowledge, not yet been evaluated in neck or back pain populations in Norway. In Paper 4, the measurement properties of the demand, control and support dimensions regarding unidimensionality, targeting and robustness to individual characteristics such as age and gender were found to be adequate.

The baseline work characteristics and the environment of the patients have been assessed in other intervention studies (99;100). Although the use of different instruments makes it difficult to compare between populations, our patient population showed small differences from the reference population, with the exception of increased perceived demand for physical endurance (Paper 2).

In Paper 3, we assessed the average changes in the demand, control and support dimension of the patient sample over one year. Although we do not have any objective information about actual changes to their work environment, this is not critical because we are concerned with the subjective perception of the work environment. Furthermore, the heterogeneous sample with a large number of work places might result in large variation in scores (141), which does not emerge in an average value. However, for several items within the control and support domain, the analyses in Paper 4 revealed that it was not possible to separate the five existing response levels, thus decreasing the potential to identify changes. To the best of our knowledge, the responsiveness of the QPS Nordic has not been tested in worker or patient populations (104;107).

All the participants were sick-listed at the time that they completed the QPS Nordic at baseline whereas the majority of patients had returned to work at one-year follow-up. No DIF was found for work status regarding responses to the QPS Nordic (Paper 4). However, we cannot rule out that improvements in individuals' pain, disability, fear, beliefs, anxiety, and depression and return to work influenced the responses of perceived demand, control, and support in opposite directions and contributed to the lack of changes found in Paper 3 (142).

## **Interventions and results**

### **Efficacy of the work-focused intervention versus the multidisciplinary intervention**

In Paper 1, we found no additional effects of the work-focused intervention compared to the multidisciplinary intervention regarding the RTW rate or the percentage of participants that had returned to work at one-year follow-up.

This result was in contrast to workplace intervention studies on musculoskeletal disorders (16;17;99) although recent reviews have suggested that the positive results were associated with uncertainty (64;143). However, it is difficult to compare workplace studies with the present study. First, we included patients who were originally referred to secondary care

because the initial usual care treatment had been inadequate. Thus, usual care was not an option as the control intervention. We compared the work-focused intervention with a multidisciplinary intervention. The effects of multidisciplinary interventions for LBP on RTW have been shown in a meta-analysis of Scandinavian studies in (95) and suggested in (143). A recent Cochrane systematic review for chronic LBP concluded that multidisciplinary treatment had positive but modest effects on work outcomes compared to physical treatment but not compared to usual care (90). In contrast to the present study, workplace interventions have been compared with usual care in workplace studies (64;99).

Second, we likely had as many employers as patients, and the distance from the hospital to the workplace might be substantial. Hence, a traditional 'workplace intervention' was not feasible within the hospital setting. To provide the work-focus in the new intervention, a case manager was added to the multidisciplinary team. The case manager's task was individual appointments with the patient. In these meetings, the self-reported work environment questionnaires were examined, obstacles for RTW were sought, and schedules for RTW were created. The case manager also contacted the employers by phone. As such, these tasks resembled a kind of coordinated care, which in literature is found to indicate probable positive but modest effects (143;144). A combination of both clinical and workplace interventions has been shown to be effective for RTW in sub-acute (16) and chronic (99) LBP although the evidence is not conclusive (17;145;146).

Currently, few work-focused studies have been performed in secondary care. A Danish study (100) compared a brief intervention with a multidisciplinary intervention in secondary care. The multidisciplinary intervention included a case manager with tasks similar to the present study's case manager. Consistent with our study, no significant difference in the RTW rate between intervention groups was revealed. Additionally, the percentage of patients who had returned to work over one year was quite similar to our results, and no significant difference between allocation groups was shown.

A Dutch study that recruited patients from hospital out-patient clinics demonstrated a substantially shorter time until RTW for the group that was treated with integrated care compared to usual care (99). However, except for the care manager's coordinating and communicating with the patients' care-takers, treatment was not performed at the hospitals. Treatment included workplace visits and graded activity programs delivered by regional



physiotherapists in addition to treatment as usual. Hence, this study must be considered a workplace study and very different from the present study.

In a prospective study of workers with chronic back or upper extremity disorders, the PREVICAP program (16) was deliberately chosen to be located in secondary care (15). This transfer of location was explained by 'more efforts are required for the few remaining off work, requiring the involvement of an interdisciplinary team'. The results showed that 75 % of those participating in the PREVICAP program returned to work, which was consistent with our results (15).

Previous Norwegian intervention studies that included patients with sub-acute LBP have shown equivalent proportions of patients with RTW over one year (125;147) although Indahl et al. (10) reported a slightly higher percentage.

The absent additional effect of the work-focused intervention might be caused by the work-focused and control interventions being too similar. First, the fact that all the participants received a thorough clinical examination in specialist care and that this might have been sufficiently reassuring for some patients, suggests the similarity. Second, following the 3-4 week intervention in secondary care, the sick leave was managed by their general physician according to Norwegian regulations. However, to what degree the RTW schedule was followed in primary care should be investigated in future work. Third, were the work-related tasks that were performed by the case-manager sufficient to have any effect on the RTW rate? E.g., did the telephone call to the employer manage to influence possible stakeholders and thus cause changes or increase the support climate at the workplace? This will have to be studied in further investigations.

The median number of weeks until RTW in the present study was 23 weeks in both intervention groups, which is a considerably longer duration than previous studies. However, the majority of previous studies have included patients with acute/sub-acute LBP (2-16 weeks) from primary or occupational care (16;17;100). By contrast, the median time off work prior to enrolment in the present study was nearly 16 weeks. This indicates that the majority of participants were classified with chronic conditions, thereby increasing the risk of long-term sick leave (9).

Few work-place studies have investigated RTW among patients with chronic conditions. In a prospective study, Loisel et al. (15) included workers with prolonged work disability and reported a mean time until RTW of 13.8 weeks. However, because 22 % of the study participants were discharged because RTW was not deemed attainable, this study is not comparable.

Lambeek et al. (99) included chronic LBP patients with the median number of days off work before inclusion amounting to 20 and 23 weeks in the two intervention groups. They achieved a superior effect of the integrated care intervention with a median time until RTW of 12.5 weeks versus 30 weeks in the treatment as usual group. However, this study should be considered a workplace study.

Previous Norwegian studies of sub-acute LBP patients have shown a mean time until RTW of 18.5-20 weeks (10;147), which must be considered comparable; since we included patients with chronic pain and not sub-acute pain.

The defined follow-up time among the studies varied. Studies typically have a short-term follow-up time of 3-6 months, a long-term follow-up time of one year, or a very long-term follow-up time of two years or longer. This makes comparisons difficult. Additionally, intervention benefits are often greater in the earlier stages of follow-up (3-6 months) compared to later stages (1-2 years) (98). In a 5 year follow-up study of sub-acute LBP patients, Indahl et al. (148) found that 81 % of the intervention group and 65 % of the control group had achieved RTW. This appears to be similar to the original study, which had an observational time of 13-19 months (10).

In a two-year follow-up study by Jensen et al. (149), a weak increase in the percentage with RTW for at least four weeks was displayed. They also found that the median total number of weeks on sick leave during the first year was significantly lower for the brief intervention group (14 weeks) compared to the multidisciplinary group (20 weeks). However, this difference was not maintained in the second year after the intervention.

The proportion of participants having RTW at one-year follow-up is one way to measure the effectiveness of an intervention. However, it is also important to measure whether this effect is maintained over the long-term (98;144). In present study, we used a follow-up time of one

year. Hence, a comparison of total sick-leave days at the two-year follow-up will be performed when the results are available.

The current study showed a median time until RTW of 23 weeks in both the work-focused and control groups, which makes one question the efficacy of both interventions in this population. The total median sick leave duration in the present population amounted to almost 10 months, which approaches the time (12 months) when sickness benefits from NAV are reduced to 67 %. Similar findings were also observed among men in another Norwegian study (97). In Denmark, sickness benefits are normally provided for a maximum of 22 weeks. With a sick leave duration of 4-16 weeks before enrolment and median RTW times of 14 and 18 weeks, the median total sick leave duration was considerable shorter in the Danish study (100). Thus, this might indicate how important the financial compensation system and health policies are when studying sickness absence and RTW. This is consistent with other researchers who claim that sickness absence and RTW are influenced by socioeconomic characteristics, economic incentives, health policy factors, work environments, financial compensation systems and health care systems (64;72;132;134), and in the research field of work disability prevention, pain-related work disability is no longer mainly considered a consequence of the disorder or intervention effect (19).

### **The psychosocial work environment**

In work interventions, one of the main focuses is to identify obstacles and facilitators for RTW among sick-listed workers (15). Although the current work-focused intervention took place at the hospital, we aimed at investigating non-medical explanations for the sickness absence of the patients. The psychosocial work environment is regarded as a possible non-medical concern in the field of work disability prevention (19). In this population, the psychosocial work environment is likely to be perceived differently by each individual. Thus, the investigation of the demand, control and support in this population, both at baseline and follow-up, might illuminate an aspect important for work absenteeism and hopefully bring new knowledge on the subject.

### **The perceived demand, control and support at work at baseline**

The study population reported significantly lower scores for perceived quantitative demand, learning demands, control of decision, control of work pacing, and support from co-workers compared to the reference population (Paper 2). However, the magnitudes of the differences were small. Although we might have expected that the patient sample would report a more unfavourable work environment, particularly higher demands, the variety of workplaces among the present patients might have influenced the results.

However, the study population reported significantly higher scores of 'demand for physical endurance' than the reference population, with a medium magnitude of difference. It is well known that physical work demands are associated with LBP prevalence in specific occupational populations (43;150;151) and in the general worker population (44). In this study, we have no information of the physical demands in our population. However, the study population consisted of a greater proportion of men and blue-collar workers than the reference population. In addition, male patients reported higher physical demand scores than women. Thus, the discrepancy in physical endurance may be partly explained by the difference of the demographic characteristics of the two populations. Still, we cannot exclude that a high level of pain and disability may influence the reporting of work demands (142;152).

Furthermore, the demand, control and support at baseline were found to be significantly and relatively strongly associated with FAB about work. Factors influencing FAB are important to investigate because increased FAB about work is associated with a poor prognosis in work outcome (51;53-55;68;147;153). The influence of the psychosocial work factors on FAB have, to the best of our knowledge, not been evaluated previously. It is well known that medical factors such as pain and disability, along with more personal factors such as depressive symptoms and anxiety, are associated with FAB (47;51;54;154). We also know that perceived psychosocial factors at work are closely associated with anxiety and depression (155;156). However, we found that emotional distress continued to make a unique contribution to FAB, in addition to psychosocial factors at work. Furthermore, consistent with other studies (54;121), disability, but not pain intensity, was associated with FAB in our population. In the analyses, gender, disability and psychological distress together accounted for 19 % of the variance in FAB, whereas the psychosocial work factors explained an additional 20 % of the variability in the FABQ-W.

### **Change in the perceived demand, control and support subscales from baseline to one-year follow-up**

The study population reported a decrease in perceived quantitative demands at one-year follow-up compared to baseline, but no other changes in the demand, control and support subscales were reported (Paper 3). The changes in the perceived demand, control and support over time in Norwegian worker populations have seldom been reported. However, in a recent study, a sample of Norwegian employees was followed for four years. The reporting of a rather stable quantitative demand and decision control in this population suggests that we could not expect major changes (140).

However, the reduced quantitative demands in our population might be explained by a corresponding substantial decrease in pain, disability and fear-avoidance beliefs. This may be supported by the “perception” hypothesis, which 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” (142). We do not know of other studies that have investigated the development of these factors in neck and back pain patient populations.

Moreover, the solitary decline in quantitative demand for the present population could be explained by the fact that quantitative demand is likely a generally valid measurement in this patient population because it measures time pressure and amount of work. In contrast, decision demands and learning demands might vary among occupations or professions but most likely do not vary over a limited time period at the same workplace. Additionally, 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) in workers (152;157). As such, there is less reason to believe that job control will change significantly in the course of one year, even in a patient population.

Furthermore, the regression analysis showed that a reduction in fear-avoidance beliefs about work was significantly associated with a reduction in the perceptions of work demands and the increased control of work pacing (Paper 3). Although changes in fear-avoidance beliefs about work only explained a small part of the variability in the demand change scores, it was consistent with previously reported cross-sectional associations between work environment and fear-avoidance beliefs about work in Paper 2. However, neither a

successful RTW-status nor a work-focused intervention had any association with the development of the individual's perceived work environment.

This suggests that the work-focused intervention using a case-manager did not manage to change this factor. Indeed, the unchanged demand, control, and support for the entire study population suggest that none of the interventions influenced these factors.

However, because RTW-status was not associated with changes in demand, control and support, these factors might not be the most important factors to measure in this population.

### **The psychometric properties of control, demand and support in the QPS Nordic**

The analysis in Paper 4 revealed that each of the demand, control and support dimensions fit the Rasch model when rescoring the items with disordered threshold and removing one item in the demand scale, the three items constituting challenges at work, and three items in the support scale. Thus, these results support the underlying constructs of demand, control and support in this population of sick-listed patients with a wide variety of occupations and employers. The results add to the previous evidence from the factor analysis in worker populations regarding the scales in the QPS Nordic (107). No uniform underlying construct was revealed. This supports the approach in Papers 2 and 3 that used the QPS Nordic subscales in the analysis.

A Rasch analysis may be used to evaluate whether the scaling of the measurement may be interpreted as interval scaling. This is strictly required when adding, subtracting or calculating average scores (103). For the demand dimension, the analyses revealed generally ordered thresholds. However, for several items within the control and support domain, disordered scoring thresholds were discovered. Generally, work pace control could only be experienced as present or absent. This result should be taken into account when changes in the scores are evaluated.

In the demand domain, the thresholds of the items covered the challenges reported by the subjects adequately. However, the present patients experienced less control than reflected by the items in the control domain and higher levels of support than reflected by the items in the support demand. Consequently, in this population, a floor effect and a ceiling effect

were indicated for the control and support domains, respectively. Ideally, additional items should be supplemented to optimise the discrimination between persons.

The DIF analysis revealed that females reported lower demands in obligation to work overtime compared to men; otherwise, the demand items appeared robust regarding invariance to gender, age, education and sick-leave status. After removing this item, the demand dimension fit the Rasch model. Females also experienced lower control over the length of breaks compared to men, although this item did not markedly influence the overall fit. The support items were invariant to age, gender, education and sick-leave differences.

Overall, the results of the Rasch analyses indicated that the demand, control and support dimensions of the QPS Nordic comprised good measurement properties in the current population. However, this conclusion is based on the rescaling of items with disordered thresholds and removing several items.

The lower resolutions of 25 of the 30 items revealed in this Rasch analysis are valid for the current population. We do not know how the item response resolutions would be if a Rasch analysis were performed in the reference worker population. However, several items in the QPS Nordic appear to be designed so that the responses are mostly categorical: present/not present.

The lower resolution of the scaling of several items in the control and support dimensions might indicate a lower responsiveness and sensitivity to change in this population and thus might explain the missing changes in the control and support subscales in Paper 3.

## CONCLUSIONS AND FUTURE PERSPECTIVES

The conclusions of the present thesis are as follows:

- A work-focused intervention in secondary care added no supplementary effects compared to a control intervention with regard to the RTW rate or the proportion of patients who had achieved RTW during the first 12 months.
- The perceived psychosocial work factors were strongly associated with FAB about work in the current patient sample, which may be important because FAB about work is an important predictor for work outcome. However, the average perceived demand, control and support were quite similar to that of reference worker populations, except for a significantly increased demand for physical endurance.
- The overall perception of demand, control and support was fairly stable over one year, despite marked improvements in pain and disability. The individual changes in demand, control and support were only weakly associated with the changes in FAB, disability, depression and anxiety (explained only 2-8 % of the variability of work factors).
- The demand, control and support dimensions in the QPS Nordic revealed unidimensional constructs in this population of sick-listed neck and back pain patients with a wide variety of occupations and employers. The demand dimension showed particularly good targeting to the present patients' challenges. However, the lower item scaling resolution of the control and support dimensions may explain the stability of the reported work factors over one year in this population.

Based on the results of the present study, a multidisciplinary work-focused treatment should probably not be implemented for all patients with neck or back pain in secondary care.

Sickness absence is influenced by numerous non-medical factors, such as financial compensation, the health care system and the labour market. A work-focused part of the intervention should most likely be performed by professionals with this type of expertise and who are closer to the labour market.

The association between psychosocial work factors and fear-avoidance beliefs about work is, to the best of our knowledge, a new important finding implicating that psychosocial work factors should be assessed when addressing the prognosis among sick-listed neck and back



pain patients. Whether these factors are actually predictors for RTW is unclear and should be investigated in further studies.

It appears that the demand, control and support dimensions of the QPS Nordic may be suitable to map the perceived work environment among neck and back pain patients.

However, the use of the QPS Nordic appears less appropriate when investigating changes after an intervention.

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