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IMPACT OF PSYCHOSOCIAL CHARACTERISTICS IN NECK AND LOW BACK PAIN

LONG-TERM OUTCOME AND PROGNOSIS CONCERNING SICK LEAVE

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IN LOVING MEMORY OF MY FATHER

PÄR BERGSTRÖM

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Human beings are members of a whole,
In creation of one essence and a soul,
If one member is afflicted with pain,
Other members uneasy will remain,
If you've no sympathy for human pain,
The name of human you cannot retain.

(Saadi 1184 – 1283)

ABSTRACT

Background: Neck pain (NP) and low back pain (LBP) are common, disabling and extremely costly health issues in the industrial world, and the problem does not seem to be declining. Previously, it was thought that NP/LBP would resolve within three months; however, it is now well established that NP and LBP are both recurrent and episodic in nature. Of even greater concern, back pain seems to first appear in early adolescence to reach the same levels as the adult population already at the age of 18. Psychosocial factors seem to influence the onset of pain. There is also increasing evidence that psychosocial factors may play a crucial role in the transition from acute and sub-acute pain to chronicity. Relevant clinical subgrouping, early identification of individuals suffering from NP/LBP and prevention of chronicity has thus become a principal objective in today's NP/LBP research.

Aims: The overall aim of this thesis was to evaluate two classification methods for individuals with NP and/or LBP. One based on psychosocial factors and one based on pain and pain related sick leave regarding their ability to predict future sickness absence and disability pension among individuals with NP and/or LBP.

The primary aim of study I was to evaluate the ability of a classification method based on the Swedish version of the Multidimensional Pain Inventory (MPI-S) to predict rehabilitation outcome (sick leave) among chronic neck and back pain patients for a period of seven years after multidisciplinary rehabilitation. A secondary aim was to use the MPI-subgroup information in conjunction with other clinical data, in this case sickness absence prior to rehabilitation, in order to investigate future sickness absence and disability pension. The third aim was to evaluate the economic outcome of rehabilitation across the defined patient groups.

In study II, the overall objective was to evaluate the predictive validity of a subgroup classification based the MPI-S among gainfully employed workers with NP and LBP during follow-up periods of 18 and 36-months.

The overall aim in study III was to evaluate the potential interaction between treatment content and MPI-S patient characteristic in the prediction of sickness absence during a 10-year follow-up.

The primary aim of study IV was to evaluate a mass screening method to identify individuals with NP/LBP regarded 'at-risk' of future long-term sickness absence and disability pension.

Results: Individuals with pronounced psychosocial difficulties have more sickness absence compared to patients with less pronounced psychosocial difficulties and better pain coping abilities. Further, subgroups based on psychosocial characteristics had different prognoses with regard to sickness absence during the follow-up periods. Patients with chronic NP/LBP appear to respond better to multidisciplinary rehabilitation compared to its single components and patients with less psychosocial difficulties appear to respond most favourably. Moreover, a classification method based

on basic pain characteristics is effective in identifying individuals with an increased risk of future long-term sickness absence and disability pension.

Conclusion: Altogether, these studies contribute to research in this area as they add to a better understanding of relevant subgroups. Multidisciplinary rehabilitation appears to be more advantageous compared to its single components in patients with chronic back pain with regard to future sickness absence. Furthermore, early targeting of individuals considered 'at-risk' for future sickness absence and in need of further investigation/interventions for their NP/LBP is valuable as it may significantly reduce individual suffering as well as health care costs, which are important objectives for the Swedish health care system.

Keywords: low back pain, neck pain, psychosocial characteristics, sickness absence, disability pension, rehabilitation economics, multidisciplinary intervention, mass screening.

SAMMANFATTNING

Bakgrund: Nack- och ländryggsmärta är mycket vanligt förekommande hos normalbefolkningen och orsakar ofta funktionsnedsättning och långvarig sjukskrivning. De samhällsekonomiska utgifterna för dessa besvär är stora och problemet verkar inte heller minska. Tidigare hävdades att både nack- och ryggsmärta ofta går över inom tre månader men det är numera väletablerad kunskap att både nack- och ländryggsmärta är både återkommande och episodisk. Forskningen visar också att förekomsten av nack- och ländryggsmärta inte minskar med åldern, även om smärtan hos äldre individer tycks vara mer långvarig. Än mer oroande är att ryggproblem verkar börja redan i de tidiga tonåren för att senare nå samma nivå som i den vuxna befolkningen redan vid 18 års ålder. Psykosociala faktorer förefaller ha ett stort inflytande vid smärtdebuten. Det finns idag väl underbyggda vetenskapliga belägg för att psykosociala faktorer spelar en avgörande roll framförallt när det gäller övergången från akut och subakut smärta till kronisitet. Kliniskt relevanta subgrupper, prevention av kronisitet och tidig identifiering av individer med nack- och ländryggsmärta har idag blivit en av de viktigaste huvudinriktningarna i forskningen om nack- och ländryggsmärta.

Syfte: Det övergripande syftet för avhandlingen var att utvärdera två klassificeringsmetoder för individer med nack- och ländryggsmärta. En baserad på psykosociala faktorer och en baserad på smärta och smärtrelaterad sjukskrivning med fokus på framtida sjukskrivning och förtidspensionering bland individer med nack- och ländryggsmärta.

Det primära syftet för studie I var att utvärdera hur väl en klassificeringsmetod baserad på den svenska versionen av the Multidimensional Pain Inventory (MPI-S) predicerar rehabiliteringsutfall (sjukskrivning) bland patienter med kronisk smärtproblematik i nacke och rygg under en sjuårig uppföljningsperiod efter multidisciplinär rehabilitering. Det andra syftet var att genom information om MPI-subgrupperna och tillsammans med andra kliniska uppgifter, i detta fall sjukskrivning före rehabilitering, undersöka de olika gruppernas framtida sjukskrivning och förtidspension. Det tredje syftet var att utvärdera det ekonomiska utfallet efter rehabilitering bland de definierade subgrupperna.

Studie II hade som syfte att utvärdera den prediktiva validiteten av klassificeringen av olika subgrupper baserad på MPI-S bland yrkesverksamma individer med nack- och ländryggsmärta under en uppföljningsperiod på 18 och 36 månader.

Syftet i studie III var att utvärdera den potentiella interaktionen mellan behandlingsinnehåll och de olika MPI-S subgruppernas karaktäristika för att kunna predicera sjukskrivning under en uppföljningsperiod på tio år.

Syftet för studie IV var att utvärdera en metod för mass-screening som används för att identifiera individer med nack- och ländryggsmärta som bedöms ligga i riskzonen för framtida långtidssjukskrivning och förtidspension.

Resultat: Individer med mer uttalade psykosociala besvär är mer sjukskrivna i jämförelse med patienter som har mindre uttalade psykosociala besvär och bättre smärthantering. Vidare visar resultaten att skilda subgrupper, baserade på psykosociala karaktäristika, har olika prognos när det gäller sjukskrivning under uppföljningstiderna. Patienter med kronisk nack- och ländryggsmärta svarar bättre på en multidisciplinär

rehabilitering i jämförelse med dess utvalda delar (beteendeinriktad sjukgymnastik och kognitiv beteende terapi) och patienter med mindre uttalade psykosociala problem tycks svara allra bäst. Klassificeringsmetoden baserad på grundläggande smärta och smärtrelaterad sjukskrivning har visat sig effektiv i identifieringen av individer som bedöms ligga i riskzonen för framtida långtidssjukskrivning och förtidspension.

Slutsats: Sammantaget utgör dessa studier ett bidrag till forskningen inom nack- och ländryggsmärta eftersom de bidrar till en bättre förståelse av kliniskt relevanta subgrupper. Multidisciplinär behandling förefaller vara mer fördelaktig i jämförelse med dess utvalda delar (beteendeinriktad sjukgymnastik och kognitiv beteende terapi) hos patienter med kroniska nack- och ryggsmärtor när det gäller framtida sjukskrivning. Tidig identifiering av individer som bedöms ligga i riskzonen för framtida sjukskrivning och därmed i behov av vidare utredning/intervention för deras nack- och ländryggsmärta, anses vara värdefull eftersom det kan minska både det personliga lidandet men även minska samhällskostnaderna, vilket är två viktiga mål för den svenska hälso- och sjukvården.

LIST OF PUBLICATIONS

I. Bergström, G, Bergström C, Hagberg J, Bodin L, Jensen I. A 7-year follow-up of multidisciplinary rehabilitation among chronic neck and back pain patients. Is sick leave outcome dependent on psychologically derived patient groups? Eur J Pain 2010 Apr 14(4): 426-433.

II. Bergström, C, Hagberg J, Bodin L, Jensen I, Bergström G. Using a psychosocial subgroup assignment to predict sickness absence in a working population with neck and back pain. BMC Musculoskelet Disord 2011 12: 81.

III. Bergström, C, Jensen I, Hagberg J, Busch H, Bergström G. Effectiveness of different interventions using a psychosocial subgroup assignment in chronic neck and back pain patients – a 10-year follow-up. Disability & Rehabilitation (in press).

IV. Bergström, C, Hagberg J, Jensen I, Bergström G. Evaluation of a simple mass screening method for identification of individuals with neck and/or low back pain considered 'at-risk' for future sickness absence. Submitted.

CONTENTS

LIST OF ABBREVIATIONS

AC	Adaptive coper patient group
AHA	Swedish abbreviation for Work and Health in the Process and Engineering Industries (*Arbete och Hälsa*)
AIC	Akaike information criterion
ANCOVA	Analysis of covariance
ANOVA	Analysis of variance
BDI	Beck Depression Inventory
BIC	Bayesian information criterion
BM	Behavioral Medicine Rehabilitation
BMI	Body Mass Index
CBT	Cognitive Behavioral Therapy
CG	Control group
CI	Confidence interval
CLBP	Chronic Low Back Pain
CNSLBP	Chronic Non-specific Low Back Pain
CWP	Chronic Widespread Pain
DYS	Dysfunctional patient group
GNP	Gross National Product
HRQoL	Health-Related Quality of Life
HUR	Swedish abbreviation for Health-economic Evaluation and Rehabilitation (*Hälsoekonomisk Utvärdering av Rehabilitering*)
IASP	International Association for the Study of Pain
ID	Interpersonally distressed patient group
IMPaCT	IMplementation study to improve Patient Care through Targeted treatment for Back pain
LBP	Low back pain
MDP	Multidisciplinary rehabilitation programme
MMPI	Minnesota Multiphasic Personality Inventory
MPI	Multidimensional Pain Inventory
MPI-S	Multidimensional Pain Inventory – Swedish language version
MPQ	McGill Pain Questionnaire
NP	Neck pain
NSLBP	Non-specific Low Back Pain
OHS	Occupational Health Services
OR	Odds ratio
PT	Behavioral-oriented physical therapy
QTF	The Quebec Task Force
RCT	Randomised Controlled Trial
RR	Risk ratio
SBU	The Swedish Council of Health Technology Assessment
SCL-90	Symptom Checklist-90
SD	Standard deviation

SEK	Swedish crown
SF-12	Short Form 12; Questionnaire for measuring HRQoL
SSIA	Swedish Social Insurance Agency
STAI	Spielberger State-Trait Anxiety Inventory
STarT	Subgroups for Targeted Treatment Back Screening Tool
ÖMPSQ	Örebro Musculoskeletal Pain Screening Questionnaire

1 INTRODUCTION

In the past, common opinion was that non-specific neck pain (NP) and low back pain (LBP) would resolve within three months (1-3). However, recent research has challenged this view and it is now well established that both NP and LBP are recurrent and episodic in nature (4-7). The life time prevalence for LBP has been estimated at 80 percent and the one-year prevalence at 22 to 65 percent (8). Neck pain is the second most common musculoskeletal disorder, preceded only by LBP (9). The one-year prevalence for NP has been estimated at 30 to 50 percent and lifetime prevalence at 50 percent (10, 11). It has been suggested that recurrent and persistent symptoms of NP and LBP may be more related to psychosocial factors than medical aspects (12, 13), therefore, psychosocial risk factors have been suggested to be of particular importance in the development as well as the transition into chronic pain (14, 15).

If a current LBP episode becomes long-lasting it is often defined as chronic non-specific low back pain (CNSLBP). The problem with such a vague diagnosis is that it gives no particular information on the kind of treatment that could be helpful to a specific patient, and thus contributes to the impression that all patients share the same characteristics, the so-called 'patient uniformity myth' (16). Consequently, these patients are offered a wide array of more or less evaluated and effective treatments (12, 17). Furthermore, the clinical judgment of the need of these patients for rehabilitation appears to be unreliable (18). As a result, an unsystematic mismatch of patients and treatment is probably taking place. Moreover, NP and LBP are common causes for long-term sickness absence as well as exclusion from the labour market, both in Sweden and internationally (19). This makes these two conditions associated with considerable societal and health care costs.

This thesis attempt to shed light on some of the challenges encountered in the field of back pain research by classifying patients with non-specific NP and/or LBP into more manageable homogenous groups. One method is based on psychosocial factors and the other is a screening method based on pain and pain-related sickness absence and is used to distinguish individuals in need of extended investigation and/or intervention, possibly adding to the knowledge that will result in interventions to reduce the risk for future long-term sickness absence and disability pension in patients with NP and/or LBP.

1.1 LOW BACK PAIN

In contrast to most guidelines (20), more recent research has shown that LBP is not a self-limiting condition (4-7). Instead, a large proportion (42-75%) still experience pain after 12 months, and a majority (44-78%) experience relapses of pain (4). Furthermore, back pain is not confined to the adult population; rather, it has been shown to start early in life and the prevalence appear to increase with age to reach adult levels already at the age of 18 (21-23). In addition, recurrence of LBP is strongly correlated with previous episodes of LBP (3, 4, 24-26) and there appears to be an increase in the duration of pain with age (27). Further, an increase in duration of an episode of LBP and/or persistence is a strong predictor of poor outcome (28, 29). Bothersomeness and psychosocial measures have also been found to be a valid measure of severity in LBP (30) and there appears to be an accumulation of risk over time for pain itself (31).

LBP is not a diagnosis. Only 10 to 20 percent of patients seeking help for back pain receive a clear (patho-anatomical) diagnosis (32, 33), which means that the majority of other complaints are often being vaguely labelled with terms such as "non-specific" or "non-malignant". Predictors of poor outcome are, but not limited to, high pain intensity, long duration, distress, low self-efficacy and previous LBP (5, 34) and appear consistently as important predictors of poor outcome regardless of the type of treatment. Reduced self-rated health and low levels of physical activity may also be influential in LBP (35). Furthermore, individuals with high pain intensity and disability, low education levels, increased perceived risk of persistence of pain, and previous sick-leave due to LBP have been shown to have a delayed rate of recovery and thus a less favourable prognosis (36). Other factors that have been associated with influencing the development of chronic LBP are smoking and a high BMI (37). However, there are two sets of risk factors that have been suggested to be of particular importance in the course of LBP: previous episodes and psychological risk factors such as fear-avoidance beliefs and depression (14, 15, 38, 39).

1.2 NECK PAIN

NP is seldom localised, instead NP is often part of either regional or widespread pain (40). As for LBP, most cases of NP lack the characteristics that point to a specific pathology (9). Risk factors associated with the unfavourable development of NP are psychological distress, smoking, work ergonomics, previous history of pain and poor self-perceived general health, which are similar to the risk factors for the development of persistent LBP (11, 41). Furthermore, a history of neck injury has been shown to be a distinct and independent risk factor for future episodic NP (41). Emerging evidence also shows that individuals with regional spinal pain, especially women, have a greater tendency to develop chronic widespread pain (CWP) compared to patients with regional peripheral pain (42). There are also indications that patients seeking help for their NP may also experience pain from several other sites as well (40).

1.3 SICKNESS ABSENCE AND DISABILITY PENSION

The prevention of chronicity has become the principal objective in the Western world in order to lessen the suffering placed on individuals with chronic low back pain, and their families but also to reduce the economic burden on society (43). From a clinical point of view, it is important to appreciate the complexity in which individuals cope with pain and how existing coping strategies may influence symptomatology, recovery, future long-term sickness absence and disability pension.

The Swedish Social Insurance Agency (SSIA) is the authority that keeps records of all cases of sickness absence that exceed 14 consecutive days. All Swedish citizens from the age of 16 to the age of 64 are covered by this national health insurance, and it offers economic compensation in the event of reduced work ability due to disease or injury. This also applies to unemployed individuals.

Musculoskeletal disorders are among the most important reasons for activity limitation as well as short- and long-term disabilities both in Sweden and internationally (19, 44). In total, musculoskeletal-related problems and psychiatric disorders constitute up to 59 percent of the costs of sickness absence compensation and 47 percent of all

registered sickness absence in Sweden (44). Musculoskeletal and mental disorders constituted the majority of newly granted disability pensions in Sweden in 2006 (45).

The Swedish Council on Health Technology Assessment (SBU) estimated in 2003 the societal cost due to chronic pain at SEK 87.5 billion (46), where SEK 7.5 billion was associated with direct costs such as medical care and 80 billion were associated with indirect costs due to sickness absence and disability pension (46). The expenditure for society due to musculoskeletal disorders has been estimated at 1.3 percent of GNP (47). International studies have also reported higher utilisation of resources with regard to chronic pain and disability pension (48, 49). The largest potential for cost savings appear to be a faster return to work and early and more effective management of patients (50). However, a multidisciplinary rehabilitation programme may reduce these costs (51).

Even though only a small proportion of individuals with NP/LBP transition into a more chronic state, these individuals have been shown to take up the majority of the allocated resources (7). A survey by Martin et al. (52), suggests that spine-related problems are not only very common but amount to large costs per person, and the problem appears to be worsening. In addition, pain and disability have been associated with recurrence or continual pain and an increase in health care consumption (53). Only a small part of the costs involved is directly attributable to therapy. The major societal costs are made up of indirect costs such as impairment, production loss, and work absenteeism, where the latter two are most often due to sickness absence, disability pension and impairment (50). It has also been shown that there is a higher cost for patients taking analgesic drugs (50). This could indicate that the consequences of pain are of major importance in the management of these patients as well as for society.

1.4 PSYCHOSOCIAL FACTORS

Psychological factors have long been associated with chronic pain. The pain gate control theory, which was initially developed by Melzack and Wall, is one of the most remarkable discoveries in pain research and is being continually updated and revised (54). The main argument is that pain results from interconnections between nociception and non-nociceptive afferent pathways which are initially modulated in the spinal cord and therefore controls the transmission of nociceptive information to higher brain centres. The pain gate control theory also takes into account several diverse factors associated with the perception of pain, i.e. sensory, emotional and motivational components. As a result, it has had a great influence on the importance of the interaction between physiological and psychological aspects of pain, as it views pain as a complex set of phenomena. Furthermore, Fordyce and Steger presented the operant perspective of pain that focuses on the behavioural expression of pain (pain behaviours) such as moaning, limping, bracing, guarded movement, pain statements, etc. Fordyce argued that it was not enough to evaluate only the individual's subjective experience of pain. Rather, it was necessary to evaluate the pain behaviour, involving both the patient's verbalisation of pain and the observable functioning of the patient (55).

In the past, the term psychogenic pain suggested that the pain was only due to psychological causes, that is, it was all in the patients head, thus not "real" (56). However, today it is widely accepted that organic and psychogenic pain can hurt equally as much. The International Association for the Study of Pain (IASP) has defined pain as "An unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage." Moreover,

symptoms of stress and depression have been shown to be present as early as six weeks after the initial onset of NP/LBP. It is therefore likely that stress and depression contribute to the development of persistent disability in neck and low back pain patients (57).

The biopsychosocial model paved the way towards a better understanding regarding the complexity of pain as it suggests that psychological, biological and social factors play a crucial role in pain. Consequently, pain can no longer be considered in purely physiological terms (56). The psychological component in the biopsychosocial model focuses on potential psychological risk factors such as fear-avoidance, poor coping ability and depression, while the social part examines, for example how socioeconomic status affects the perception of pain.

There is increasing evidence that psychosocial factors may play a crucial role in the transition from acute and sub-acute pain to chronicity, and that aetiology factors may also contribute (58-62). In fact, psychosocial factors have not only shown to be pivotal in the transition from acute neck and low back pain to chronicity but also seem to act as a strong influence in the onset of pain (14, 63, 64). For instance, cognitive factors such as fear-avoidance beliefs were found to be related to both pain and disability in the review article by Linton (14). As with all musculoskeletal pain, psychosocial factors appear to exacerbate the clinical component of pain (14, 15). In a recent study by Hall et al. (57), it was shown that psychological distress explains approximately 30 percent of the relationship between the initial pain and future disability. Individual coping strategies are considered to be important contributors to disability associated with CNSLBP. Active coping strategies are characterised by efforts to function regardless of pain or to distract oneself from the pain. In addition, it is well established that the thoughts, feelings and beliefs of an individual have a significant impact on the problem (14).

While LBP appears to be common, chronic and a recurrent condition, and mostly benign in nature (65), the presence of an episode of low disability-low intensity LBP has been shown to double the risk of the development of depression within 6-12 months (66). In addition, depression seems to be under-diagnosed, and thus under-treated, in individuals with musculoskeletal symptoms (29). The findings in the study by Sullivan et al. (29) show that depressive symptoms become more resilient to treatment over time, thus highlighting the importance of early screening and detection of individuals 'at-risk' of future long-term sickness absence, and consequently the possible development of depressive symptoms.

1.5 SUBGROUPS IN NP/LBP

The NP and LBP population appears to be a heterogeneous group. In a Cochrane Review by Bouter et al. (67), subgrouping has been referred to as the 'Holy Grail' in back research. Further, several researchers have realised the need to describe chronic pain more precisely using various sources and methods to discern subgroups of patients (68-70). About 9 out of 10 clinicians do not think that non-specific LBP (NSLBP) is 'one condition' and many clinicians believe that it is possible to distinguish subgroups of patients in the NSLBP population based on signs and symptoms (71, 72). However, to date, there is little empirical evidence that supports this view (71). Nevertheless, relevant clinical subgrouping, prevention of chronicity and early identification of individuals suffering from NP/LBP has become a principal objective in today's

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NP/LBP research area. A long-standing top priority in the field of NP/LBP research has been to establish valid and more homogeneous subgroups of patients (73). Furthermore, outcome prognosis is dependent on multiple variables beside factors such as pain intensity and duration (74).

Subgrouping could have an effect on outcome and treatment response, thus the heterogeneity of the LBP population could dilute the effects on treatment (72). It is thought that different subgroups of patients with CNSLBP require different and more specific interventions and that the identifications of these subgroups could assist in the prognosis and further allows refinement of interventions (75, 76). The underlying belief is that treatment would be more effective when treatment is matched to a specific subgroup of patients (77). Attempts have been made, to try to match patients' needs to a specific treatment (75), thus attempting to predict the relationship between treatment efficacy and customised patient treatment regime. Therefore, if matching treatment to a specific subgroup is possible, it would demarcate an important advancement in the NP/LBP research field.

Considering the prevalence of NP/LBP and the associated socioeconomic costs, there are compelling arguments for longitudinal studies that examine the relationship between distinct subgroups and treatment outcome (71). As a consequence, different classification systems have been developed over the years and the different classifications systems have been used either for diagnostic or treatment purposes.

There are different approaches to the classification of patients. Von Korff et al. developed and validated a simple classification instrument, which is now widely used and assigns patients in different stages of chronicity into four different groups (78). It is based on pain severity and patients are classified into one of four grades of pain severity: 1) low disability – low intensity, 2) low disability – high intensity, 3) high disability – moderately limiting, and 4) high disability – severely limiting (78). Other biomedical-based classification system are McKenzie's system that consists of analysing symptomatic and mechanical responses to mechanical loading by repeated movements and sustained positions and where patients are classified into three main syndromes (postural, dysfunction and derangement) (79). The Quebec Task Force (QTF) classification system is composed of data from different sources, such as signs and symptoms, radiological data, response to treatment, work status and symptom duration (80). Another classification system by Delitto is a treatment based classification system for patients with acute LBP where acuity of LBP is determined by severity of disability (81). However, the McKenzie, QTF and the Delitto classifications systems do not have a good inter-tester reliability (75).

The Minnesota Multiphasic Personality Inventory (MMPI) was originally developed and standardised in psychiatric patients and is the most frequently used personality test in mental health. Three subgroups of male and four subgroups of females were identified in a population with LBP (82, 83). It is also lengthy with over 500 items divided into 10 scales. The Symptom Checklist-90 (SCL-90) was developed to evaluate a broad range of psychological disorders but has also been widely used to assess psychosocial distress in patients with chronic LBP (CLBP) (15, 84, 85). Three subgroups have been identified: 1) Psychological denial, 2) Psychologically overwhelmed, and 3) Psychologically adjusted. However, these two instruments were not developed for a pain population.

There are several tools developed to assess patients with chronic pain. The McGill Pain Questionnaire (86), the Beck Depression Inventory (BDI) questionnaire (87) and the Spielberger State-Trait Anxiety Inventory (STAI) (88). The self-administered 'yellow-flag' Örebro Musculoskeletal Pain Screening Questionnaire (ÖMPSQ) was developed to complement the medical examination of patients with musculoskeletal pain (89). It has been shown to be a clinically reliable and valid assessment tool that may be able to identify subgroups of patients considered at risk of developing persistent pain (89). The Subgroups for Targeted Treatment (STarT) Back Screening Tool is a recently developed tool for the identification of subgroups of patients with back pain in a primary care setting (90) and allocates patients into low-, medium- and high-risk subgroups. The tool is to be seen as a guide to decision making about potential referral and treatment. It has been compared to the ÖMPSQ in patients with LBP and it was found to be similar in respect to subgroup patient characteristics (91). However, STarT has been found to be quicker for the patient to complete and easier for the clinician to score as it consists of only nine items (91). The IMplementation study to improve Patient Care through Targeted treatment for Back pain (IMPaCT Back study) is designed to introduce and support the STaRT subgrouping system in a primary setting (92).

1.5.1   The Multidimensional Pain Inventory (MPI)

The West Haven Yale Multidimensional Pain Inventory (MPI) is a psychological assessment tool originally developed for chronic pain patients and used to derive more homogenous subgroups of patients (93, 94). MPI measures both the psychosocial and behavioural consequences of pain, thus capturing the multidimensionality of chronic pain. Theoretically, it is linked to the cognitive behavioural perspective of pain. The MPI self-report questionnaire consists of 61 items and is divided into three parts: one psychosocial, one behavioural and one concerning the everyday activity level.

Three different patient groups derived empirically from the MPI have been labelled: dysfunctional (DYS) patients, interpersonally distressed (ID) patients and adaptive copers (AC) (94).

- DYS patients are characterised by high pain, disability and affective distress. DYS patients are also found to be more depressed, have more catastrophizing thoughts, low physical functioning, poor sleep quality and poor lifting capacity.

- ID patients are characterised by inadequate social support, lower solicitous response from a significant other and lower distracting response compared to DYS patients.

- AC patients reported a more successful adjustment to chronic pain compared to the other two patient groups and had generally low pain severity, low emotional distress and less catastrophizing thoughts. They also experience better quality of sleep and physical functioning.

This classification strategy has been replicated in several studies (for a review see Turk (95)) and the Swedish version of the MPI (MPI-S) has been shown to have good reliability and validity across gender (96). Furthermore, the MPI subgroups were independent of age, duration of pain and were the same even when controlling for physical pathology.

The MPI has been externally validated to the McGill Pain Questionnaire (MPQ), Pain Behaviour Checklist, Beck Depression Inventory, medical status and demographic variables. The predictive validity of the subgroups derived from the MPI concerning treatment outcome has also been evaluated in a few studies for a review, see Turk (95). However, it has been recommended that MPI-subgroup assignment should be used in conjunction with other clinical data when attempting to match treatment to patient needs (97). The MPI has been translated into several languages (e.g. Swedish, German, Dutch and Finish) and the reliability and validity of the MPI-S has been shown to be acceptable (98). Similar subgroups for the MPI have been derived and validated for the MPI-S.

1.6 SCREENING OF BASIC PAIN CHARACTERISTICS

Failure to identify effective primary or tertiary prevention strategies has led to a focus on prevention of prolonged disability following the onset of an acute episode of LBP (i.e. secondary prevention). Several recommendations have been put forward regarding the examination and rehabilitation of patients with acute back pain (99, 100). However, today's health care structure requires that patients actively seek health care for their NP and/or LBP at the right time to be referred to an appropriate intervention. It has been shown that only 25 percent of all acute NP patients actively seek health care (101).

One way to identify individuals with NP/LBP in need of preventative measures might be to use a mass screening instrument, such as a questionnaire, to collect information which can identify individuals 'at-risk' of future long-term sickness absence and disability pension. Thus, targeting individuals in need of further investigations and/or early interventions but who have not yet sought health care for their NP/LBP. Furthermore, detecting individuals 'at-risk' of future long-term sickness absence due to NP/LBP would be valuable not only to patients but also to organisations and society. A worksite could thus constitute an excellent venue for such secondary preventive efforts.

By enabling early detection of individuals who are considered 'at-risk' of a future, more intense and disabling form of NP and/or LBP and thus potential chronicity, one could expect that a prompt and a more individualised management of episodes of bothersome NP/LBP could result in better outcomes for these individuals (31, 65). It has been suggested that early preventative interventions may be helpful by reducing future problems but that the time point for intervention as well as selection criteria is of outmost importance for the outcome (102).

This fairly simple mass screening method should be seen as a first step to identifying individuals with NP/LBP considered 'at-risk' of future long-term sickness absence and full-time disability pension. A more in depth investigation, including screening of both red and yellow flags (12, 14, 15, 103), of those individuals considered 'at-risk' should instead take place at, for example, the OHS.

Different screening procedures are associated with various challenges as they may infer negative consequences for participants, such as unnecessary worrying, false-negative test results or simply being eased into a false sense of security (104, 105). Screening for individuals with a potentially higher risk of adverse outcomes, such as disability or long-term sickness absence, may be problematic. For instance, guidelines usually recommend that individuals with common NP/LBP should continue as far as possible with their normal everyday activities, including work (20). It could be argued that the result from a screening procedure may evoke fear and worrying among employees,

which could be counterproductive to this 'activity' recommendation. However, despite these reservations it is important to evaluate the accuracy of screening procedures applied at workplaces.

1.7 INTERVENTIONS

There are many theories behind the underlying cause of non-specific back pain. This has resulted in an array of different approaches to treatment, i.e. manual therapy, exercise therapy, back schools, psychotherapy and behavioural treatment.

Clinically, all of these approaches may seem to work but few show strong or moderate quality evidence with regard to effectiveness when further examined (106). In this thesis, the outcome from a few evidence-based interventions has been considered in relation to psychosocially-derived subgroups among individuals with NP/LBP.

1.7.1   Physical Therapy

Physical therapy is one of the most common modalities in the treatment of back pain and is concerned with maximising quality of life and motion potential. It encompasses rehabilitation (treatment/intervention), prevention, habilitation and health promotion. Furthermore, exercise has been shown to have a secondary preventive effect on future LBP (107-109). In fact, there is strong evidence for physical exercise with regard to prevention, prevention of recurrence and prevention of sick leave due to LBP (107). However, in a recent systematic review, it has been concluded that exercise therapy was ineffective (low quality evidence) or no better than usual care/advice to stay active, back school/education, behavioural treatment, TENS/laser therapy/ultrasound/massage, manual therapy/manipulation and psychotherapy (106).

1.7.2   Cognitive Behavioural Therapy

Cognitive behavioural therapy (CBT) is a psychotherapeutic approach, primarily developed through the merging of behavioural therapy and cognitive therapy. The objective in CBT is to resolve problems concerning painful emotions and dysfunctional behaviours and cognitions through a goal-oriented and systematic procedure. The goal of CBT in the management of persistent pain is to provide the individual with tools enabling the patient to better manage pain and to resume a normal level of activity, as CBT addresses symptoms of depression such as inactivity, negative effect and view of self (110). However, therapeutic techniques may vary according to the particular kind of problem that an individual is experiencing. CBT can be administered individually or in groups.

For instance, considering that LBP is shown to double the risk of the development of depression (65), the logical corollary is to assume that CBT would be helpful in individuals with chronic non-specific NP/LBP. CBT has also been shown to be effective in the management of sub-acute and chronic LBP in a primary care setting and this effect was maintained for up to 12 month after treatment (111).

1.7.3   Multidisciplinary intervention

A multidisciplinary intervention programme includes a biopsychosocial rehabilitation approach with at least one physical and either a psychological, social or occupational dimension. Commonly, an extensive multidisciplinary programme has been found to be more advantageous for patients with a poor prognosis (112), and there is moderate quality evidence for the effectiveness of such a programme (106). An eight-year follow-up study by Suoyrjo et al. (113) found a declining trend for sickness absence among employees with chronic back or neck pain participating in a multidisciplinary programme compared to the control group. Furthermore, a recent systematic review by van Middelkoop et al. (106) found that multidisciplinary treatment was more effective in reducing pain intensity and sick leave compared to no treatment/waiting list and active treatment (i.e. physical therapy, usual care) for patients with CLBP. The choice of treatment seems vital for patients with chronic NP/LBP and a poor prognosis (112), and with today's evidence, an extensive multidisciplinary treatment programme seems to be superior to other treatment alternatives.

Multidisciplinary treatment has been accused of being an extremely expensive form of rehabilitation both in terms of finance and time. Economic decision-making is often based on an evaluation of cost and effect. For an intervention to be cost-effective the individual has to return to work and the total cost of rehabilitation, sickness absence and disability pension has to be lower than if the person would have been on sick leave or had been granted full-time disability pension. It is therefore important to consider that a decrease in sickness absence and disability pension may counterbalance the expense incurred by an intensive multidisciplinary intervention (74, 114-116).

2 AIMS

2.1 GENERAL AIM

The overall aim of the thesis was to evaluate two classification methods, one based on psychosocial factors and one based on pain and pain-related sick leave regarding their ability to predict future sickness absence and disability pension among individuals with NP and/or LBP. This aim also included evaluating whether the treatment outcome may differ between psychosocially derived subgroups of individuals.

2.2 SPECIFIC AIMS

2.2.1 Study I

The primary aim of this study was to evaluate the ability of a classification method based on the MPI-S to predict rehabilitation outcome (sick leave) among chronic neck and back pain patients for a period of seven years after multidisciplinary rehabilitation. The hypothesis was that DYS patients would have more instances of sick leave and a higher risk of receiving full-time disability pension during the follow-up period, compared to AC patients.

A secondary aim was to use the MPI-subgroup information in conjunction with other clinical data, in this case sickness absence prior to rehabilitation. The hypothesis was that DYS patients would show a higher rate of sick leave and a higher risk of being granted full-time disability pension, compared to AC patients, within two predefined strata of patients based on the duration of sickness absence prior to rehabilitation.

A third aim was to evaluate the economic outcome of rehabilitation across the defined patient groups.

2.2.2 Study II

The overall objective of the study was to evaluate the predictive validity of a subgroup classification based on the MPI-S among gainfully employed workers with NP and LBP during a follow-up period of 18- and 36-months.

Due to poorer coping ability and higher pain severity in both ID and DYS individuals, compared to AC individuals, it is hypothesised that DYS and ID subgroups would have more sickness absence than the AC subgroup. It was also hypothesised that DYS and ID individuals would score worse with regard to bodily pain, mental and physical health compared to the AC subgroup at the 18- and 36-month follow-ups.

2.2.3 Study III

The overall aim of this study was to evaluate the potential interaction between treatment content and MPI-S patient characteristics on sickness absence during a 10-year follow-up. The hypothesis was that multidisciplinary rehabilitation would be more advantageous compared to its single components or 'treatment-as-usual' (control group) for ID and DYS patients, and would thus be linked to lower sickness absenteeism. Further, we hypothesised that all three treatment interventions would

lower sickness absenteeism in the AC patient group compared to AC patients in the control group.

2.2.4 Study IV

The primary aim of this study was to evaluate a mass screening method to identify individuals with NP/LBP regarded 'at-risk' of future long-term sickness absence and disability pension. The hypothesis was that individuals identified as 'at-risk' at the baseline measurement would have more sickness absence and disability pension compared to individuals in the control group (CG) at the five-year follow-up.

3 MATERIAL AND METHODS

The materials used in this thesis were obtained from different studies, which are outlined below.

3.1 THE HUR STUDY

The HUR-study (HUR is an abbreviation in Swedish for Health-economic Evaluation and Rehabilitation) commenced in 1994 and comprised three diagnostic areas: NP/LBP, cardio-vascular disease and asthma. The participants were offered two different rehabilitation interventions. The part of the HUR study that focused on NP/LBP consisted of two separate and prospective studies, one controlled observational study and one randomised controlled trial (RCT). The overall purpose in both of these studies was to evaluate the included interventions concerning their effects on sick leave, cost-effectiveness and Health-Related Quality of Life (HRQoL) (117). The material for studies I and III are based on these two studies.

3.2 THE AHA STUDY

The large intervention study called the AHA-study (which is an abbreviation in Swedish for Work and Health in Process and Engineering industries) was conducted at four companies in Sweden between 2000 and 2003 and included over 4,000 employees (118). Two companies were paper mills, one was a steelwork company and one was a truck manufacturer. The overall purpose of the AHA study was to evaluate an extensive risk assessment tool and evidence based work place intervention with regard to its effect on the health of the employees and the work environment as well as the company's productivity. Material for study II is gathered from this study.

3.3 THE AFA INSURANCE PROJECT

The AFA Insurance cohort environment prevention programme was initiated by AFA Insurance (119). The programme is based on the methods developed in the AHA-study and is directed towards improving the working environment and to promote a health and lifestyle among employees in municipalities, county councils and the private sector. The program employed the same questionnaires and risk assessment as developed in the AHA-study.

The programme started in 2002 and is still ongoing. Nearly 200,000 employees in municipalities, county councils and the private sector across Sweden have been included in the programme. During the first year of the programme information was gathered, making it possible to follow individuals over time. Material for study IV was obtained from this group of individuals.

3.4 MATERIALS

3.4.1 Study I

The participants consisted of 146 patients referred consecutively to one of the intervention programmes that were evaluated in the HUR study (the controlled observational study). Data were gathered from December 1994 to December 2005. The inclusion criteria were pain located in the neck or back and fluency in Swedish. Patients who had previously undergone rehabilitation at the clinic or with a confirmed

pregnancy were excluded. There were no exclusion criteria for the duration of pain. However, all patients had to be examined and treated before referral to the intervention programme. Thus, the referred patients were clearly chronic in nature.

The mean age of the patients was 42.5 years (SD=9.5); 48 percent were females, 90 percent were married or cohabiting, 79 percent were employed, 56 percent had at least a high school education, 25 percent had pending litigation, 75 percent reported the lumbar region as the primary pain site, the mean pain duration was 38 months (SD=63.4; median=14) and the mean sick leave period in the quarter before rehabilitation was 51.2 days (SD=38.4; median=57).

3.4.2 Study II

The subjects were gathered from the AHA study. At baseline, all employees at the participating companies were invited to fill in a comprehensive health survey. In all, 2,894 individuals responded and 273 (9.4%) were considered at risk of future disabling NP/LBP (the criteria are the same as those described in study IV). These 273 subjects were sent the MPI-S and 126 questionnaires with complete information were gathered. This study group consisted of almost 90 percent males, the mean age was 42 years (SD=9.4), 94 percent had blue-collar jobs and 95 percent had at least a high school education. Almost one quarter of the study group were involved in heavy lifting >10 times each working day. The majority of individuals had mixed pain sites (66%) and had experienced NP and LBP once or several times during the previous year (72% and 94%, respectively).

3.4.3 Study III

The subjects consisted of participants in the mentioned RCT included in the HUR study. All subjects sick-listed for neck and/or back pain in the AFA insurance register were invited to participate in the study. The registry covers about 3,000,000 employees, i.e. more than half of the total working population in Sweden and includes employees in the private sector, county councils and municipalities. Inclusion criteria were continuous sickness absence for on to six months due to non-specific spinal pain, 18-60 years of age and fluency in Swedish. Exclusion criteria included serious spinal pathology, exposure to physical trauma within six months of examination, objective neurological signs indicating a need for surgery, serious co-morbidities, on-going rehabilitation and verified pregnancy. Participants were recruited consecutively and rehabilitation took place from May 1995 to March 1998. The 10-year follow-up was completed in March 2008.

The study group consisted of 194 individuals, 55 percent were females and the mean age was 43.0 years (SD=10.4). The majority of the participants were gainfully employed 83.9 percent), over 70 percent were married or cohabiting and 91 percent had at most a high school education. The mean pain duration was 32 months (SD=58.2; median=9 months), 45 percent reported the lumbar region as the primary pain site, 43 percent the cervical/thoracic region and 12 percent reported mixed pain sites.

3.4.4 Subjects Study IV

The participants in the study were invited to answer the AHA survey and consisted of employees working for the municipalities and the county council of the county of Västernorrland. This screening instrument has been described in detail elsewhere (118).

It also included the identification of subjects with a potential risk of future long-term sickness absence due to NP/LBP. The average response rate was 78 percent.

Individuals who had sufficient information on the questions concerning NP and LBP in the questionnaire and who reported NP/LBP were included. In total, 7,231 employees from the municipalities and county councils responded to the questionnaire, 155 were non-classifiable due to insufficient information on the questions regarding NP and LBP and 1,748 individuals reported no NP and/or LBP. Please refer to Figure 1.

3.4.4.1   Figure 1.
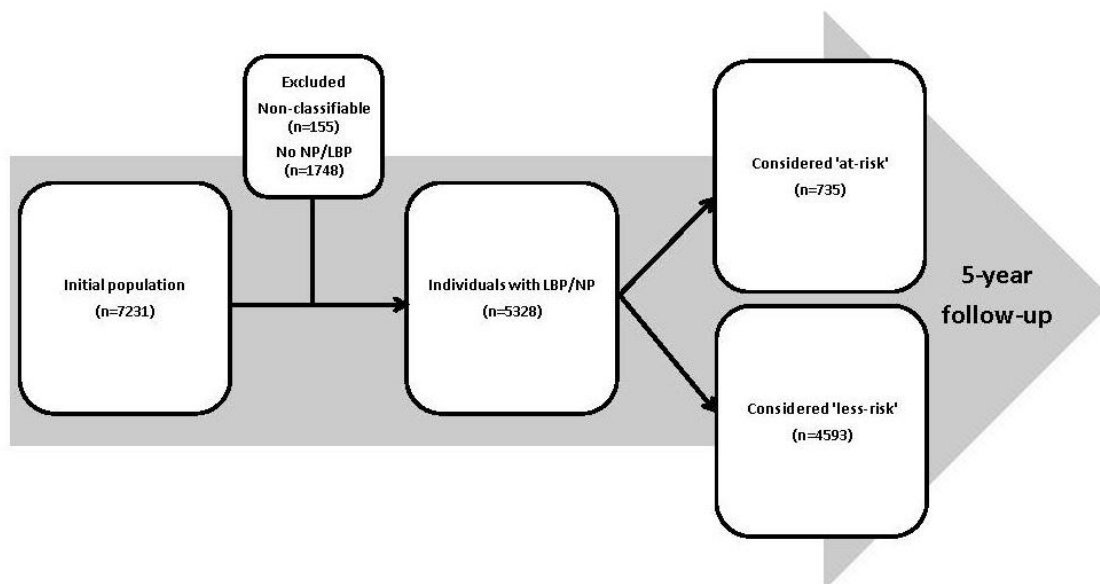
Overall, 5,328 employees with NP and/or LBP were included in the study. The study group consisted of 82 percent women and the mean age was 45.6 years (SD=10.5). The majority were non-smokers 80 percent), 66 percent had at most a high school education and more than 80 percent were married or co-habiting with or without children. Overall, 81 percent had suffered from back pain during the last year and 77 percent have had NP during the same period.

3.5 PROCEDURES AND METHODS OF MEASUREMENT

3.5.1   The Swedish version of the MPI (MPI-S)

In studies I and III, the MPI-S questionnaire was completed as part of the baseline measurement at the clinics. The personnel at the clinics were not aware of the subgroup assignment. In study II, both the MPI-S questionnaire and the follow-up measurement instruments were mailed (by post) to the participants home address.

The development of the MPI-S has been described earlier (96, 98). The reliability and validity of the MPI-S has been shown to be acceptable. It comprises 34 items and includes: 1) one psychosocial and 2) one behavioural section. Part 1 consists of five scales: Pain Severity (PS), pain-related Interference in everyday life (I), perceived Life Control (LC), Affective Distress (AD), and perceived Support from significant others (S). Part 2 encompasses three scales which measure the patient's perception of responses of significant others to displays of pain and suffering. The three scales are

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Punishing Responses (PR), Solicitous Responses (SR) and Distracting Responses (DR). All scales included range from 0 to 6 where a high score indicates more of the characteristics in question.

3.5.2 The short form-12 (SF-12)

In study II, bodily pain, physical and mental health was estimated by using scales from the Short Form-12 (SF-12) (120). SF-12 was developed as a shorter alternative to the SF-36. It can be administered in two minutes or less, thus making it easy to use in large-scale studies (120, 121). The scale is scored positively so that a higher score indicates better physical and mental functioning and less bodily pain.

3.5.3 Pain and pain-related sickness absence

Five questions were used in study IV to distinguish individuals considered 'at-risk' from those considered 'less-risk' of future long-term sickness absence and disability due to NP/LBP and included: 1. 'Have you had LBP in the past year?' 2. 'Have you had NP in the past year?' 3. 'Have you been on sick leave this past year due to LBP and/or NP?' 4. 'Do you currently experience NP/LBP?' 5. 'Are you currently on sick leave due to NP/LBP?' Response alternatives for question 1-3 were; 'Yes, once'; 'Yes, several times'; 'No'. Response alternatives for questions 4-5 were either 'yes' or 'no'.

3.5.4 Sickness absence and disability pension

3.5.4.1 Studies I, III and IV

Information on sickness absence and disability pension were obtained from the Swedish Social Insurance Agency (SSIA) 18-24 months prior to the commencement of the studies as well during the entire follow-up period.

During the follow-up period in these studies, it was necessary for the employee to notify the SSIA if he/she had been sick for more than 14 days, so that the employee could receive sick leave compensation from the SSIA. As a result, virtually all periods of sickness absence longer than two weeks are on record.

Disability pension is granted if work capacity is permanently reduced by at least 25 percent. Before sickness compensation is granted, all possibilities to perform work must be evaluated. Disability compensation is income-related and/or in the form of a guarantee benefit if the person has a permanent or long-term work capacity limitation as assessed by the SSIA. All granted disability pensions are thus on record.

3.5.4.2 Study II

Information about sick leave was gathered from the companies' payrolls. Thus, all sickness absence should be on record except for those whose employment was terminated during the study period.

3.5.5 Rehabilitation economics

In study I, the economic analyses are based on the costs of sickness absence and disability pension (number of days) in the three different MPI-S groups, calculated in terms of loss of production in accordance with the human capital approach (122).

Further, both the costs of rehabilitation (direct costs) and the costs for production loss (indirect costs) were incorporated in the total cost.

The economic analysis was based on the following assumptions:

- The cost of one year's sickness absence, in term of production loss, is calculated as amounting to €25,032, based on a one-year average salary for blue-collar workers (123).

- All individuals work full-time, which amounts to 220 working days a year.

- All individuals had an expected life span of at least 65 years.

- All individuals who received disability pension would otherwise be working to the age of 65 and no individuals receiving full-time disability pension were expected to return to the labour market. This last assumption is based on statistics from SSIA, which show that less than 1 percent of individuals who receive full-time disability pension return to the labour market (124).

All costs were stated in euro (€) at the exchange rate of 1 eur = 9.58 Swedish krona (SEK). The annual costs have been discounted by 3 percent to make the costs comparable over time.

3.5.6   Explanatory variables

In studies I, II and III the MPI-S subgroup classification was used as the explanatory variable.

The participants in study II were classified into one of the three MPI-S subgroups using a software programme (125).

In studies I and III, all participants were classified into one of the three MPI-S subgroups, using a non-hierarchical cluster procedure that was performed on the 8 MPI-S scales using the centroid vectors from an independent sample (126).

In study IV, employees considered 'at-risk' were currently sick-listed due to NP/LBP or were experiencing current NP/LBP, had been on sick leave on at least one occasion in the past year due to NP/LBP and had several earlier episodes of NP/LBP during the past year. The 'less-risk' group consisted of individuals who had reported NP/LBP and/or had been on sick leave once or several times in the past year. Individuals could also be considered at 'less-risk' with current NP/LBP but without current sickness absence due to NP/LBP (Figure 1).

3.5.7   Outcomes

Sick leave was used as the primary outcome in all four studies. In studies I, III and IV, disability pension was also used as an outcome. Furthermore, in study I, economic analyses were calculated, and in study II, bodily pain, physical and mental health assessed by the SF-12 were secondary outcomes.

3.6 CONTENT OF REHABILITATION PROGRAMMES

3.6.1 Multidisciplinary Rehabilitation Programme (MDP)

3.6.1.1 Study I

The multidisciplinary rehabilitation programme (MDP) lasted for four weeks and was a full-time, inpatient programme with a focus on increasing function and developing coping strategies in accordance with behavioural approaches. The programme was group-based, with a group size of about 14 persons. These four weeks were followed by a period of about five months during which activities took place outside the clinic in the form of work, exercise or vocational training. Support contacts and input during this period took place as required. The period was concluded by two days of monitoring at the clinic where the plans were checked. The rehabilitation included individual functional training and treatment, work technique and ergonomics, body awareness training, exercise, back school, pain management and self-efficacy training including relaxation. The staff delivering the treatment consisted of physical therapists, ergonomists and fitness trainers. A physician and a psychologist were available for consultations.

3.6.2 Behavioural-oriented Physical Therapy (PT)

3.6.2.1 Study III

The aim of the PT intervention was to enhance physical functioning and promote sustainable behavioural change. Each participant was assigned to an individually tailored training programme, which was carried out on a part-time basis (approximately 20 scheduled hours per week). The programme included individual goal setting, gradually increased exercises to improve muscular endurance, aerobic training, pool training, relaxation techniques and body awareness therapy. Homework assignments for physical activities were given according to the individual's interests and problem areas. The intervention was group based consisting of about 8 patients per group.

3.6.3 Cognitive Behavioural Therapy (CBT)

3.6.3.1 Study III

The goal of the CBT intervention was to improve the subjects' ability to manage pain and to resume a normal level of activity. In this intervention, individuals were required to participate in scheduled activities for approximately 13-14 hours per week. Basic elements of the CBT included activity planning including work, goal setting, problem solving, applied relaxation, cognitive coping techniques, activity pacing, training in how to break vicious circles, assertion training and the role of significant others. Individually tailored homework assignments were given at the end of each session. The intervention was group based consisting of about 8 patients per group.

3.6.4 Behavioural Medicine Rehabilitation (BM)

3.6.4.1 Study III

BM was a group-based multidisciplinary programme in which all parts of the PT and CBT programmes were included. BM was given on a full-time basis (40 scheduled hours per week). The intervention was group based consisting of about 8 patients per group.

3.7 STATISTICAL METHODS

Statistical significance was set to $p<0.05$ in all analyses.

3.7.1 Study I

To facilitate a comparison with the previous follow-up of this material (127), the same analyses were initially repeated, this time using the SPSS 16.0 software package. Analysis of covariance (ANCOVA) was used to evaluate total sick leave (sickness absence and partial disability pension) during the entire follow-up period, controlling for sickness absence the quarter before rehabilitation. Complementary analyses without adjusting for sickness absence the quarter before rehabilitation was also carried out. The independent variable for days of sickness absence prior to intervention was stratified into ≤60 days and >60 days, as this had previously been found to be an intersection point found to distinguish patients' treatment outcome for this specific rehabilitation (128). Logistic regression was used to estimate the odds ratio (OR) of being granted full-time disability pension. The AC subgroup was used as a predefined reference category in all analyses concerning sick leave.

3.7.2 Study II

Due to violation of the normality assumption, all statistical analyses regarding sickness absence, physical and mental health as well as bodily pain were conducted by Kruskal-Wallis 1-way ANOVA on ranks. Non-parametric tests are a suitable alternative for comparisons of three or more groups when data is not normally distributed (129). The Mann-Whitney U test applied with the Holm-Bonferroni correction for multiple tests was chosen for group-wise posthoc analyses. The AC subgroup was used as the predefined reference group in all analyses. To assess the risk ratio for long-term sickness absence during the follow-up period a modified Poisson regression was used (130). Long-term sickness absence was defined as >30 days and was supported by figures based on goodness of fit, where the 30-day cut-off had the lowest AIC and BIC values (131). In all of the analyses, the PASW 17.0 software package was used.

3.7.3 Study III

Total sickness absence during the follow-up period (partial sick days and partial disability pension were transformed and standardised into whole sick days) was analysed by linear regression. The variables of gender and education did not add any additional information to the analysis of variance and were thus removed from the final model. In addition, a bootstrapping re-sampling technique was used to obtain estimates of parameters and intervals. These estimates were almost identical to the results from the ordinary linear regression. The 'treatment-as-usual' control group was used as the reference category. In all of the analyses, the PASW 18.0 software package was used.

3.7.4 Study IV

Differences in total sickness absence between those 'at-risk' and those at 'less-risk' during the five-year follow-up period were analysed by analysis of variance. A modified Poisson regression (130) was performed to predict the annual relative risk (RR) for long-term sickness absence during the follow-up period. Long-term sickness absence was defined as ≥30 days. The RR to obtain full-time disability pension during the five-year follow-period was analysed with modified Poisson regression (130). In all of the analyses, the IBM SPSS 19.0 software package was used.

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3.7.5   Confounders

Sickness absence in the quarter before intervention and age were considered as confounders in the analysis in study I. In study III, confounders were age and days of sickness absence prior to intervention. Gender, age and level of education were considered confounders in study IV.

3.8 ATTRITION

During the follow-up period in study I, three patients received retirement pension and one patient died.

In study II, a total of 17 individuals stopped their employment during the follow-up period. Information about sickness absence was available for 113 individuals at the 0-18 month follow-up, and 109 individuals at the 19-36 month follow-up. The response rate on the SF-12 was at 18 months 76.2 percent and at 36 months 73 percent.

In study III, a total of seven individuals (AC=3, ID=2 and DYS=2) died during the follow-up period and were thus not included in the follow-up analyses.

In study IV, 84 (1.6%) individuals died during the follow-up period, where n=14 (1.9%) belonged to the 'at-risk' group and n=70 (1.5%) belonged to the 'less-risk' group.

3.9 ETHICAL APPROVAL AND INFORMED CONSENT

Approval of all ethical considerations regarding the studies was obtained from the Committee on Ethics at the Karolinska Institutet, Stockholm. Written consent was obtained from all participants.

- Study I - HUR; Dnr 94-340
- Study II - AHA; Dnr 00-012
- Study III - HUR; Dnr 94-340
- Study IV - AHA; Dnr 00-012 with complement 2010/1516-32

4 RESULTS

The results from the four studies are briefly summarised in this section.

4.1 STUDY I

Figure 2 illustrates that sick leave is reduced after rehabilitation regardless of subgroup affiliation, but it also shows that the DYS group consistently shows more sick leave both prior to rehabilitation and during the seven-year follow-up period. It appears that the amount of sick leave reaches its lowest value at one to two years after rehabilitation. An increase in sick leave is noted after the first two to three years, regardless of subgroup affiliation.

4.1.1.1   Figure 2.
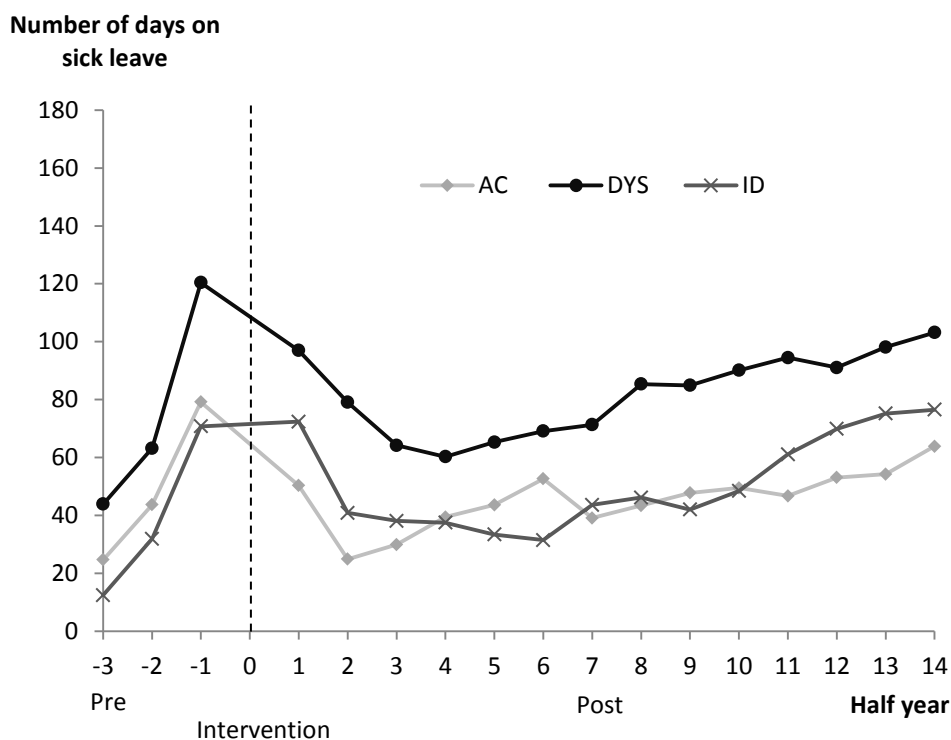
Analysis of variance showed that the DYS group had a statistically higher amount of sick leave during the follow-up period compared to the AC patients, even after adjusting for sickness absence prior to rehabilitation (355.8 (CI 95% 71.7; 639.9)). No statistically significant results were found between ID and AC patients.

In addition, separate analyses were performed for groups with different duration of sickness absence prior to the intervention (≤60 or >60 days). A significant difference was seen in the DYS versus the AC group with regard to sickness absence >60 days in the quarter before rehabilitation (473.4 (CI 95% 8.3; 938.6)), while there was no significant difference between ID and AC patients. In the group with ≤60 days of sickness absence, no significant differences were revealed between groups.

In summary, the analyses showed that the DYS patients had more total days of sick leave during the seven-year follow-up period than the AC patients.

The DYS patient group showed a higher risk of receiving full-time disability pension during the follow-up period compared the AC patient group (OR 2.43 (CI 95% 1.11; 5.30), but this statistically significant difference disappeared when adjusting for sickness absence prior to rehabilitation.

On average, patients in the DYS patient group lost 9.19 years in full production during the seven-year follow-up compared to 6.13 years in the AC patient group. Calculation of changes in costs per year (post-rehab minus pre-rehab) for each of the MPI subgroups reveals a change of € -6,379 for the AC group, € -5,636 for the DYS group, and € -2,194 for the ID group.

There was an increase in costs of € 81,855 (€ 60,447 discounted) per individual in the DYS group compared to the AC group. There was a decrease in costs of € -34,205 (-28,013 discounted) for individuals in the ID group compared to the AC group. Costs due to production loss are highest for the DYS patients and lowest for the ID patients.

4.2 STUDY II

The results show that the AC group has less sickness absence compared to the other two MPI-S groups. Furthermore, it is evident that all three MPI-S subgroups follow a distinctive course of sickness absence during the follow-up period (Figure 3).

The Kruskal-Wallis one-way ANOVA rank test and Mann-Whitney *U* test revealed a statistically significant difference in the overall sickness absence between the MPI-S groups (p=0.013), as well as between ID/AC and DYS/AC at 36 months follow-up (ID/AC: median 22.56 (IR=60.78) p=0.024 and DYS/AC: median 30.32 (IR=125.54) p=0.014). The same analyses were performed at the 18 months follow-up: however, the analysis did not show a statistically significant effect on the overall sickness absence between the MPI-S groups.

The relative risk of future sickness absence of more than >30 days at the 18 months follow-up was analysed with a modified Poisson regression analysis. All individuals were analysed in the full model and it revealed a statistically significant increase in the risk ratio (RR) for the ID and DYS subgroups (RR=2.086, p=0.032 (CI: 1.065 to 4.085 and RR=3.278, p<0.001 (CI: 1.715 to 6.266), respectively) in comparison to the AC group at the 18 months follow-up. At the 36 months follow-up, there was an increased RR of 1.900, p=0.055 (CI: 0.987 to 3.657) for the DYS group compared to the AC group.

The SF-12 was used to measure bodily pain, mental and physical health and revealed that both ID and DYS patients statistically differed (scored lower) from AC patients in all three scales at both the 18 and 36 months follow-ups.
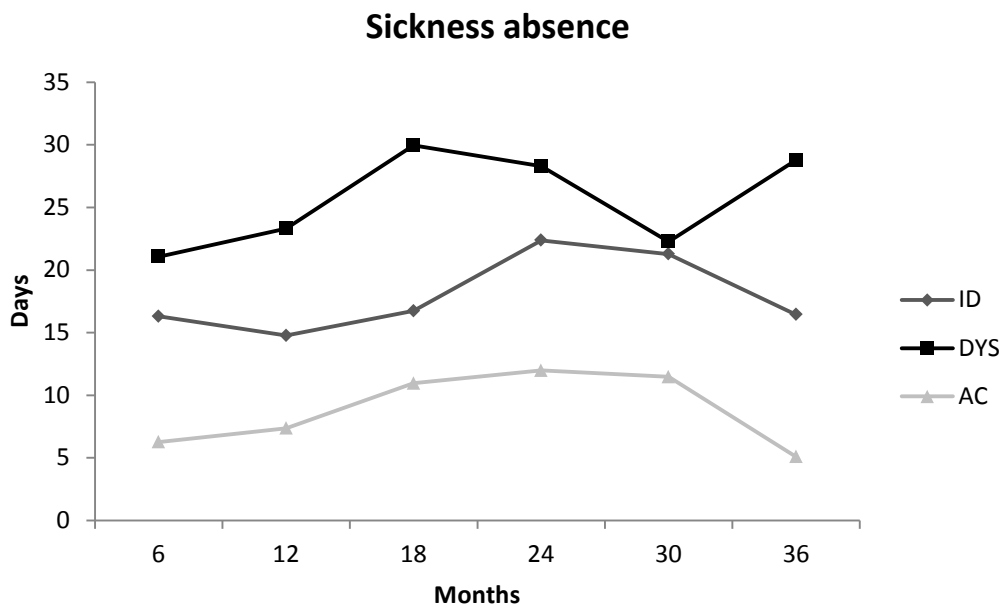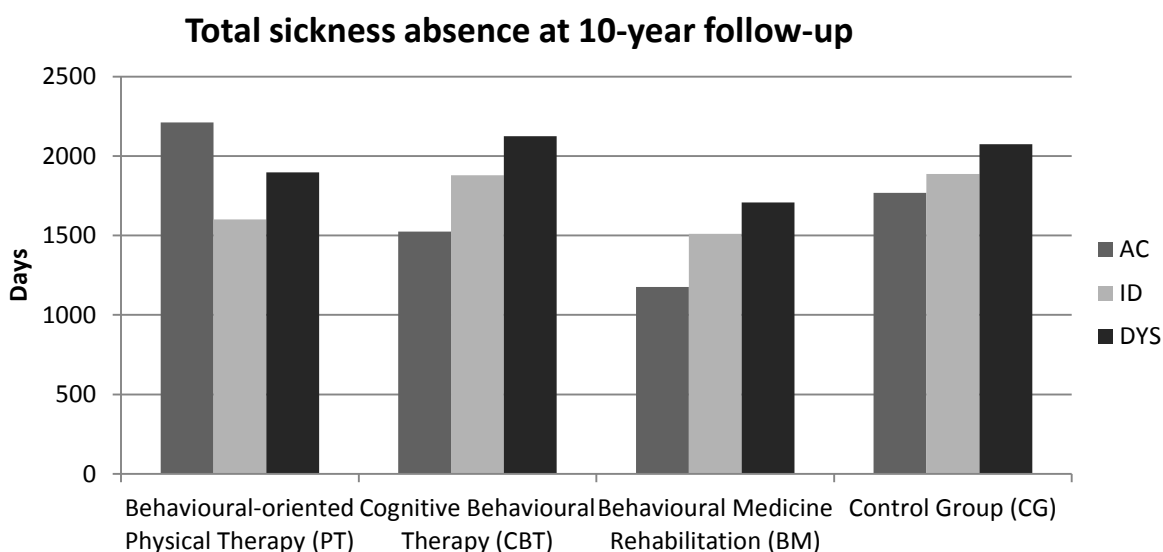
Sickness absence

4.3 STUDY III

Neither the unadjusted nor the adjusted model (adjusted for age and sickness absence prior to intervention) reached statistical significance differences with regard to the development of sickness absence during the 10-year follow-up. For the ID and DYS subgroups the development of sickness absence after rehabilitation was similar in all three treatment alternatives as well as the CG. However, Figure 4 indicates that patients who participated in the BM programme had less sickness absence during the 10-year follow-up compared to the CG, regardless of MPI-S affiliation. The BM rehabilitation programme was also related to a reduction in the average sickness absence per quarter after rehabilitation compared to 'treatment-as-usual' CG (with point estimate and 95% CI in parenthesis) $p=0.021$ (-12.9, CI: -23.9 to -2.0), adjusting for the interaction between MPI-S group and sickness absence prior to intervention. However, the trend in this study show that the AC patients responded favourably to all interventions, particularly the BM programme, in comparison to AC patients in the CG, with the exception of the PT rehabilitation alternative.

No statistical significant differences were reached when comparing all treatment alternatives to the CG for each of the MPI-S subgroups (with point estimate and 95% CI in parenthesis) AC (-3.6, CI: -22.9 to 15.7), ID (-6.8, CI: -28.5 to 14.9) and DYS (-4.6, CI: -20.6 to 11.5).

Total sickness absence at 10-year follow-up

Total sickness absence for each of the MPI-S subgroups in relation to treatment content at 10-year follow-up.

4.4 STUDY IV

The results from this study reveal that the 'at-risk' group has more sickness absence over time compared to the 'less-risk' group, even though sickness absence appear to decrease somewhat for women in the 'at-risk' group, please refer to Figures 5 and 6. Gender was found to have an interaction effect in the performed analyses; consequently the final analyses were gender-differentiated. The analysis of variance for total sickness absence during the five-year follow-up was adjusted for age and education. The mean total amount of sickness absence during the five-year follow-up period showed that both men and women in the 'at-risk' group had statistically significant more sickness absence compared to men and women in the 'less-risk' group. In addition, the modified Poisson regression consistently revealed that both men and women in the 'at-risk' group had a statistically significant increase in the RR with regard to annual long-term sickness absence (≥ 30 days), compared to men and women in the 'less-risk group during the five-year follow-up period.

All in all, 233 women out of 627 and 19 out of 91 men in the 'at-risk' group were granted full-time disability pension. In the 'less-risk group, 328 out of 3,667 women and 33 out of 874 men were granted full-time disability pension. The modified Poisson regression model was adjusted for age and education and stratified by gender. Women in the 'at-risk' group had an RR of 3.8, $p<0.001$ (CI: 3.31 to 4.40) to be granted disability pension and men had an RR of 5.2, $p<0.001$ (CI: 3.01 to 9.12) compared to the 'less-risk' group.

4.4.1.1   Figure 5.

Sickness absence women

4.4.1.2   Figure 6.

Sickness absence men
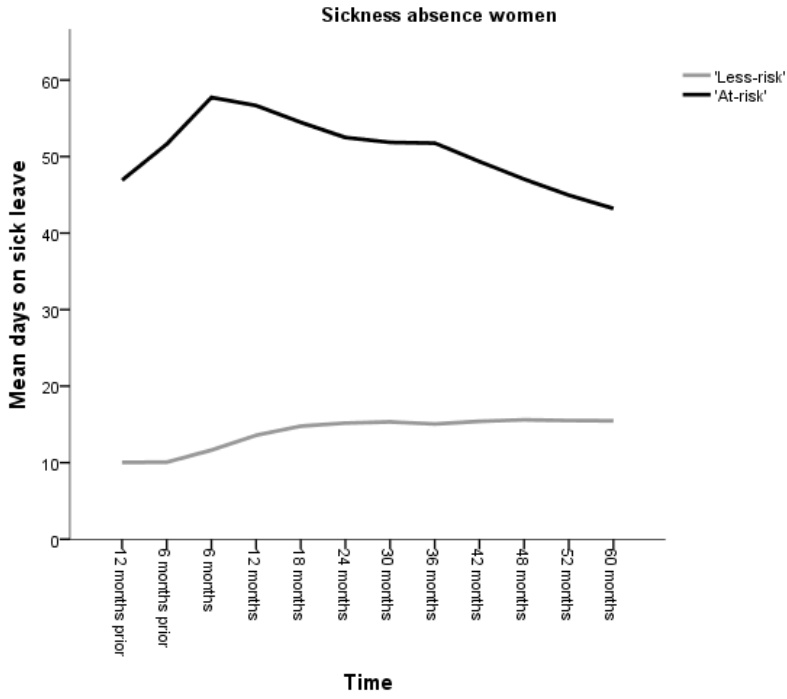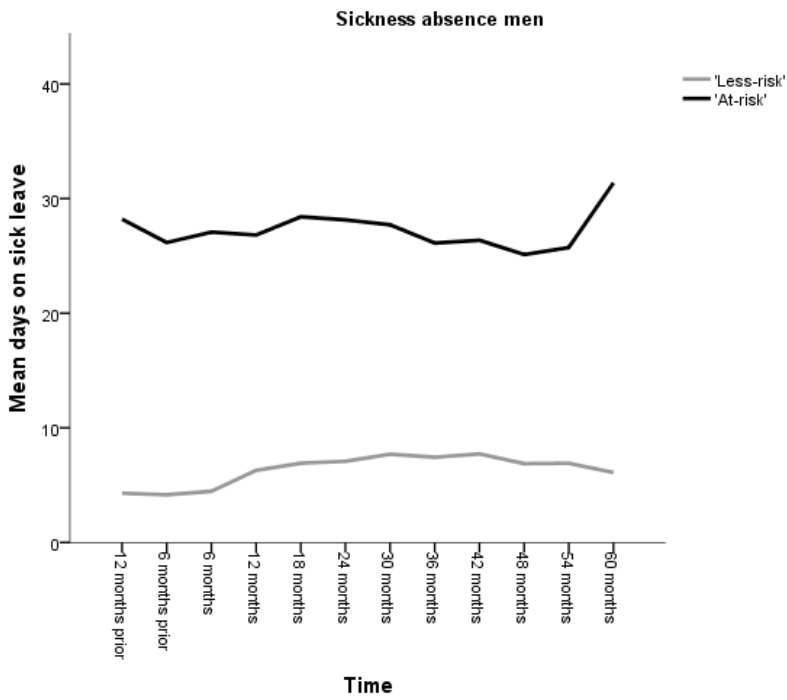
4.5   SUMMARY OF THE STUDIES

4.5.1.1   Table 1. Descriptive statistics of the included studies.

	Study I	Study II	Study III	Study IV
Title	A 7-year follow-up of multidisciplinary rehabilitation among chronic neck and back pain patients. Is sick leave outcome dependent on psychologically derived patient groups?	Using a psychosocial subgroup assignment to predict sickness absence in a working population with neck and back pain.	Effectiveness of different interventions using a psychosocial subgroup assignment in chronic neck and back pain patients – a 10-year follow-up	Evaluation of a simple mass screening method for identification of individuals with neck and/or low back pain considered 'at-risk' for future sickness absence
Aim of the study	• To evaluate the ability of a classification method based on the MPI-S to predict rehabilitation outcome (sick leave) among chronic neck and back pain patients for a period of seven years after multidisciplinary rehabilitation. • To use the MPI-subgroup information in conjunction with other clinical data, in this case sickness absence prior to rehabilitation. • To evaluate the economic outcome of rehabilitation across the defined patient groups.	• To evaluate the predictive validity of a subgroup classification based on the Swedish version of the MPI (the MPI-S) among gainfully employed workers with NP and LBP during a follow-up period of 18 and 36 months.	• To evaluate the potential interaction between treatment content and MPI-S patient characteristics on sickness absence during a 10-year follow-up.	• To evaluate a mass screening method to identify individuals with NP/LBP regarded 'at-risk' of future long-term sickness absence and disability pension.
Sample	The HUR-study	The AHA-study	The HUR-study	The AFA Insurance cohort
No of participants	146	126	194	5328
Data collection	Questionnaire, register data	Questionnaire, register data	Questionnaire, register data	Questionnaire, register data
Study design	Prospective, controlled observational study	Prospective multicentre study	Randomised controlled multicentre trial	Prospective cohort study
Method of analysis	ANCOVA, Logistic regression	Kruskal-Wallis 1-way ANOVA, Mann-Whitney U test, Modified Poisson Regression	ANOVA, Linear regression, bootstrapping	ANOVA, modified Poisson regression
Explanatory variables	MPI-S subgroup classification	MPI-S subgroups classification	MPI-S subgroup classification	'At-risk' and 'less-risk'

Outcome	Sickness absence, disability pension, total cost	Sickness absence, bodily pain, physical and mental health	Sickness absence	Sickness absence, disability pension
Main results	Patients with more pronounced psychosocial difficulties (DYS) have more sickness absence compared to patients with less pronounced psychosocial difficulties and better coping abilities (AC).	Subgroups based on psychosocial characteristics showed different prognosis with regard to sickness absence during the 36 months follow-up period.	Multidisciplinary rehabilitation is more advantageous compared to its single components for all MPI-S groups with regard to future sickness absence. However, the statistical power was low and the results did not reach statistical significance.	A classification method based on basic pain characteristics is effective in identifying individuals with an increased risk of future long-term sickness absence and disability pension.
Key points	• Failure to adapt treatment content to patients needs may lead to less cost-effective rehabilitation for certain subgroups of patients.	• This classification method based on psychosocial characteristics can be used to find employees with an increased risk of future sickness absence.	• There may be subgroups of patients with neck/back pain that benefit differently from different treatments. • Additional studies with larger study groups are needed to investigate further these findings.	• Mass screening using five simple questions is effective in identifying individuals at risk for future sickness absence.

5   DISCUSSION

5.1 OVERALL SUMMARY

The overall purpose of this thesis was to investigate the clinical relevance and predictive ability of psychosocial subgrouping and identification of individuals with NP/LBP considered 'at-risk' for future sickness absence and full-time disability pension. This was accomplished by subgrouping individuals using two classification methods: one based on psychosocial factors and one based on pain and pain-related sickness absence.

The predictive ability of psychosocial derived subgroups was demonstrated in three different populations (studies I to III) and in the fourth study a simple mass screening method showed some predictive ability. All studies used long-term follow-ups. Consequently, the methods presented in this thesis may be considered clinically useful, valid and reliable classification tools and could be part of any rehabilitation programme as well as in the initial assessment of individuals with NP/LBP.

5.1.1   Studies I to III

The results from these three studies reveal that individuals with more pronounced psychosocial difficulties (DYS patient subgroup) consistently has more sickness absence compared to individuals with less pronounced psychosocial difficulties (AC patients) during all three long-term follow-ups. ID patients also have more sickness absence compare to the AC subgroup, even though the psychosocial differences between ID and AC are not as evident as between DYS and AC patients. These results somewhat contradict one earlier study on these subgroups where DYS patients benefitted more from rehabilitation compared to AC patients (132). However, outcome variables and follow-up periods differed between the studies included in this thesis and the one by Riipinen et al. (132), which could explain some of the differences.

With regard to disability pension, study I revealed that DYS patients did have a higher OR of receiving disability pension compared to AC patients and the results reached significant levels when not adjusting for sickness absence prior to intervention. However, there was no statistically significant difference when stratifying individuals into groups that had been on sickness absence ≤ 60 days versus > 60 days.

In study I, the economic analysis demonstrated that the production losses among DYS patients were considerable when compared to AC patients after intervention. However, this does not necessarily mean that it is not cost-effective to refer DYS patients to a vocational rehabilitation programme, since a control group would have been needed in order to answer this question. In other words, the progression of patients belonging to the DYS subgroup that goes untreated or receives another type of rehabilitation is unknown.

In study II, DYS and ID patients demonstrated more total sickness absence at the 36 months follow-up and more long-term sickness absence at the 18 months follow-up. Furthermore, the AC group reported less bodily pain and better physical and mental health at both follow-ups. Since some of the employees received rehabilitation during the study period (17 employees), this could have affected the results. However, adjusting for rehabilitation did not substantially change the results.

In study III, the main results did not reach statistical significance for the outcome sickness absence during the 10-year follow-up period. However, it appears that the AC patients benefits most from the interventions, except for PT. There were also some indications that the BM intervention was most effective also for the DYS and ID groups.

5.1.2   Study IV

The results from study IV revealed that individuals classified as 'at-risk' had more annual and total sickness absence during the five-year follow-up compared to individuals at 'less-risk'. The results from study IV show that prior sickness absence has a profound impact not only on future sickness absence but also on future full-time disability pension.

The findings in study IV highlight the importance of early screening as well as early detection of individuals considered 'at-risk' is of outmost importance as musculoskeletal-related problems may become more resistant to treatment over time (29). Thus, preventive efforts with regard to the risk of development of chronicity should be the primary focus for this group of patients.

The mass screening tool tested in study IV could be considered fairly simple. However, it was developed for use in large worksite surveys and the questions were intended to have a good face validity to increase response frequency among employees. Consequently, it should be seen as a first step in identifying individuals with NP/LBP considered 'at-risk' of future long-term sickness absence and full-time disability pension. A more in depth investigation, including screening of both red and yellow flags (12, 14, 15, 103), of those individuals considered 'at-risk' should instead take place, for example, at the OHS. However, screening procedures may infer negative consequences for participating individuals (104, 105). It is therefore important to offer help and support from the OHS in conjunction to such screening. This needs to be considered before administrating screening surveys, as potential consequences should not outweigh the possible positive benefits of such a screening.

5.2 RESPONSE TO TREATMENT

5.3 STUDIES I AND III

In studies I and III, there is a pronounced decrease in sickness absence for all three MPI-S subgroups during the first two to three years following rehabilitation. Thereafter, the number of days of sickness absence increase again to reach almost the same levels as before the intervention. Nevertheless, there is a visible difference in the amount of sickness absence for the different subgroups during the entire follow-up period.

In study I, the three derived patient subgroups were given the same multidisciplinary rehabilitation. The results show that it is evident that individuals with less pronounced psychosocial difficulties (AC) respond better to treatment. Furthermore, individuals that belong to the AC subgroup consistently have less sickness absence and disability pension compared to both DYS and ID individuals. The differences in days of sickness absence could not be explained by differences between AC and DYS patients in sickness absence prior to rehabilitation.

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In study III, the potential interaction between interventions and the derived subgroups was investigated. The design of this study made it possible to compare how individuals within the same subgroup (e.g. the DYS group) benefitted from different interventions (treatment or control). Consequently, it was expected that for the DYS and ID subgroups a behavioural medicine full-time programme should be more effective than its single components, whereas all the three treatment conditions should be advantageous for the AC group. Even though the results were non-significant they consistently indicated that, similar to study I, the AC subgroup has less days of sickness absence during the follow-up period compared to both DYS and ID patients, except for the PT intervention.

AC patients seem to respond best of all MPI-S subgroups to the BM rehabilitation, even though there is a reduction in sickness absence for both DYS and ID patients participating in the BM rehabilitation programme compared to patients in the CG. Concerning the CBT and PT interventions, there appear to be no substantial long-term effects on sickness absence for any of the MPI-S subgroups. The difference in outcome between the three subgroups might be due to important determinants for claiming sick leave due to NP/LBP, such as negative beliefs of LBP, lack of coping and poor mental health (133). For example, DYS patients often rely on fear-avoidance coping strategies while AC individuals are characterised by better coping abilities, less pain and co-morbidities and report a more positive outlook with regard to LBP (134-136). Furthermore, even though similar to DYS patients, ID patients cope differently than DYS patients. Thus, some adjustments may need to be made when considering the different needs of the three different subgroups. Subgroups with more pronounced psychosocial difficulties, such as DYS and ID patients, might need a more extensive vocational rehabilitation programme and counselling focusing on different coping strategies with regard to pain management. Also, ID patients may benefit from interventions related to improved interpersonal relationships. It is noteworthy that the predictive validity of the defined subgroups was also confirmed in a gainfully employed working population (study II) which indicates their clinical meaningfulness also in a more acute/subacute phase.

These results coincide with earlier Swedish studies where DYS patients had significantly more days of sick leave and reported more utilisation of health care resources after vocational rehabilitation, compared to AC patients during the 18 months follow-up period (127). Furthermore, the differences in days of sickness absence could not be explained by differences between AC and DYS patients in sickness absence prior to rehabilitation (127). This further supports the theory that DYS patients are more prone to more sickness absence compared to individuals belonging to the AC subgroup.

5.4 GENERAL DISCUSSION

Studies I to III were accomplished under different circumstances and in different populations. Study I can be characterised as an effectiveness study since it used consecutively referred patients, study II used a gainfully employed population and study III was primarily an efficacy study where the participants were included for the sole purpose of the original treatment outcome study. Despite these different conditions

under which the studies were carried out the results were relatively similar in that individuals in the AC group consistently came out with the most favourable outcomes. Therefore the results may be generalizable both to working and clinical populations. However, it should be admitted that the working population in study II came from male-dominated manufacture industries which makes it uncertain how the results are transferable to other types of workplaces and female dominated populations. In study IV the study population was almost reversed compared to study II concerning the gender distribution and the study population came from municipalities and county councils. Subsequently, the results appear to be generalizable to similar populations.

There is some consensus in the scientific community that psychosocial variables are stronger predictors of persistent disability than biomedical factors (12, 13). In fact, there is evidence that structural changes, as seen on imaging, within the spine has little impact with regard to CNSLBP (137). The findings in this thesis highlight the importance of psychosocial risk factors as well as early screening with regard to both sickness absence and full-time disability pension. The findings are also in agreement with research in which previous episodes and psychological risk factors, have been suggested to be of particular importance in the course of LBP (3, 14, 15, 38, 39).

Prevention of NP/LBP has become a public health priority. Individuals with NP/LBP do not always actively seek health care for their problems, not even when they may experience flare-ups, recurrences or when they experience continual pain. Enthoven et al. (53) found that about half of the respondents in their study reported pain and disability at the five-year follow-up but only 32 percent reported health care consumption. This was similar to the reported pain and disability at the one-year follow-up of the same population. In addition, recurrences and/or continual pain were reported during the past six months at the five-year follow-up. Moreover, recurrences and/or continual pain at the one-year follow-up were associated with worse outcomes at the five-year follow-up (53). This non-seeking health care behaviour could become problematic as some patients may fall into chronicity with associated complex manifestation of chronic pain and a subsequent decrease in activity levels, future long-term sickness absence and full-time disability pension. However, non-seekers could also be considered better copers.

At present, there are few prospective studies on differential treatment outcomes among subgroups of patients with NP/LBP. However, there is evidence that tailored intervention reduces medical costs and is more effective in an early full-time return to work (138). Fritz et al. (138) also demonstrated that tailored interventions showed a reduction in medical costs. There are randomised controlled trials demonstrating a higher therapeutic effect when matching treatment to a specific subgroup (81, 139), while others show that matching treatment to patients needs does not enhance outcomes (140). Study III demonstrated that certain subgroups of patients (AC) show greater improvement after receiving multidisciplinary intervention compared to others (DYS and ID). However, more research with larger study groups is needed in this area as it is still to be demonstrated that distinctive subgroups of individuals with chronic musculoskeletal pain respond differently to different interventions.

Heitz et al. (141) have suggested that a psychosocial intervention may be more effective in a subacute phase but that an interdisciplinary approach is justified for

patients in both subacute and chronic stages of LBP. Cognitive behavioural intervention has been found to have a sustained positive effect on subacute and chronic LBP in a primary care setting (111). However, the short term effect of CBT ($\leq$ 4 months) has been found to be similar to manipulation, exercise, postural approach and acupuncture (111). There are some indications that the addition of behavioural components to a treatment regimen can reduce sickness absence when applied to patients with CNSLBP (142). Slater et al. (143) suggest that patients receiving a behavioural rehabilitation intervention at the subacute phase recovered to a higher degree with regard to pain and disability compared to the control group. Moreover, there appears to be a dose/response effect as the effect of the treatment was three times higher for individuals with subacute LBP who completed all four behavioural medicine sessions and attended the booster session compared to individuals who did not receive the maximum therapeutic dose (143). A simple screening questionnaire, like the one presented in study IV, could be a helpful tool in the identification of individuals considered 'at-risk' of future long-term sickness absence due to NP/LBP and who have not yet sought health care for their symptoms. A prompt identification and intervention could be essential in the prevention on long-term disability among individuals with NP/LBP, thus reducing societal costs due to chronic pain.

A single treatment may only offer a limited solution to the problem for patients with CNSLBP. This could be due to the fact that a single intervention only target parts of what makes up the complexity of chronic pain. Rather, the treatment of choice seems to be a multidisciplinary intervention comprised of physical exercises and biopsychosocial and behavioural interventions that is similar to the behavioural medicine programme in study I and III. Furthermore, systematic reviews have demonstrated that multidisciplinary treatment has a higher success rate in chronic patients with regard to functional improvement and pain reduction compared to a pure biomedical intervention (103, 144). Multidisciplinary treatment also produces good long-term outcomes (145, 146), which is further supported through study I and III included in this thesis. Moreover, a multidisciplinary intervention appears to be the best choice of treatment regardless of MPI-S subgroup classification compared to 'treatment-as-usual' control group.

Multidisciplinary treatment appears to be beneficial for patients with NSLBP in all stages of chronicity and subgroups (74). However, the choice of treatment seems vital for patients with a poor prognosis (112). Considering the different patient profiles in these studies, it appears that multidisciplinary treatment is the best intervention to address effectively the multidimensional aspects of chronic pain. Studies I and III in this thesis support current clinical guidelines recommending intensive multidisciplinary rehabilitation for patients with chronic or subacute LBP who do not improve with self-care education (147). Furthermore, multidisciplinary treatment has been proposed to be the most effective way to help the patient to a faster return-to-work, lessens subjective disability and reduces the number of days on sick leave (148).

All the studies described here employ long-term follow-ups. The major reason for applying a long follow-up is to test the accuracy of a prediction model as it often appears to decline over time (68). That is, its clinical or scientific usefulness may be acceptable in the short-term but less accurate for longer periods of time. Reliable long-term prognoses are important as they can be used to modify prognostic factors by

adjusting or further individualise interventions. The findings in this thesis are in line with findings demonstrating a less visible effect with regard to treatment when a longer follow-up time is applied (145, 149). Long-term follow-ups can also help clinicians educate patients about their condition (150).

5.5 METHODOLOGICAL CONSIDERATIONS

5.5.1 Strengths

Highly dependable registry data from the SSIA regarding disability pension and sickness absence lasting more than two weeks were available for all subjects in study I, III and IV for the entire follow-up periods. Consequently, all sickness absence is on record. In study II, information about sickness absence was gathered from the companies' payrolls and was thus available from day one. As a result, all sickness absence is on record except for those whose employment was terminated during the study period in study II.

5.5.2 Limitations

There are some methodological limitations that need to be acknowledged. The reason for both sickness absence and disability pension was not known (47, 151), as this information was not provided by either the SSIA or the companies' payroll. Consequently, data on sickness absence or disability pension may mirror other possible health complaints of the participating individuals. However, it seems reasonable to assume that the primary reason for sickness absence and disability pension among these individuals was in fact related to musculoskeletal complaints, as patients received rehabilitation for this specific health problem or were seeking help for NP/LBP. This is further supported by Enthoven et al. (53) as they found that about half of the respondents in the same study population reported NP/LBP pain and disability at both the one-year and five-year follow-ups.

Participants in long-term follow-up studies such as these could be influenced by several factors that are unrelated to a certain treatment or predictive model, such as a person's social support system, co-morbidities, unemployment and other work-related factors, etc. (47). With longer follow-up periods, the higher this risk may be. On the other hand, if such unrelated factors are evenly distributed across the subgroups evaluated here, they may not substantially affect the result. However, since sick leave is a multifactorial phenomenon this is a possible limitation of the studies.

Since both study I and III used data gathered in studies that were not originally powered for subgroup analyses the subgroups became small and this was especially the case in study III. However, despite this low statistical power in the study it was considered as meaningful to do this evaluation since it enabled some preliminary information about how these different interventions might interact with the described subgroups.

In an earlier study it was shown that approximately one third of patients classified into one of the MPI groups may change groups within one month (97). However, the majority of patients who change classification group show a response pattern that represents aspects from more than one of the three MPI-S profiles (also known as Hybrid) (97). Nevertheless, it has not been possible to predict patient group instability using demographic and clinical variables except for unemployment, which increase the risk of instability (97).

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Individuals who had missing data in section two of the MPI-S, which requires a significant other, were excluded since their patient profile is unclassifiable. In addition, in study II several individuals classified as Hybrid were excluded, as it has been argued that they do not render any valid clinical information (152). This contributed to small subgroups, thus further decreasing the statistical power and increasing the risk of Type II errors failing to reject the null hypothesis when in fact it is wrong. These shortcomings could potentially have been avoided by clarifying the meaning of significant other in section two of the MPI-S questionnaire (153). In the future development of the MPI-S, this should be considered.

Non-responsiveness in study II with regard to mental and physical health as well as bodily pain at 18 and 36 months follow-ups may have introduced some bias. However, this non-response was proportionally similar between the MPI-S groups.

Generally, sickness absence has a tendency to have a positively skewed distribution which violates the normality assumption. However, several steps were taken to reduce this. For instance, the non-parametric Kruskal-Wallis 1-way ANOVA on ranks and bootstrapping were used in study II and III, respectively. Bootstrapping provides a way of accounting for distortions in a sample that may not be fully representative of a population by obtaining estimates of parameters and confidence intervals. This method is often used as an alternative to interference-based on parametric assumptions (154).

5.6 IMPLICATIONS FOR THE FUTURE

The classification of subgroups of individuals needs to be evidence-based. This thesis confirms that the chronic non-specific back pain population does consist of distinct subgroups of patients. The three subgroups described here also seem to have a long-term predictive validity. Subgrouping can also be useful to improve further the understanding of prognosis of patients with chronic non-specific back pain. Furthermore, recognising the response to an intervention as well as understanding the natural history of LBP may be helpful in the prognosis of patients with NP/LBP (72). However, it is vital to take into consideration the complexity of chronic non-specific back pain as patient symptomatology and response to treatment may vary and will thus require personalisation of care.

Clinically, it would be valuable to be able to identify individuals/patients with a good prognosis as this could be used to reassure patients and could possibly limit the increase in resources of unnecessary, expensive or invasive interventions. Furthermore, it is possible that early and effective treatment should be the main focus of future research in this area with regard to patients with acute/subacute non-specific back pain. Treatment selection may be based on subgrouping, patient preferences, treatment availability, costs and possible side effects. Furthermore, care should be oriented towards the identification and management of individuals and environmental barriers preventing the return to usual activities and on decreasing symptom-based management (155). When classifying individuals with LBP into subgroups, it is recommended that a biopsychosocial approach should be used (156, 157). In addition, one should keep in mind that individual variations will always be present, thus clinical assessment and design of an intervention should also be carried out on an individual level.

The results from these studies suggest that psychosocial subgrouping and intervention using a multidisciplinary approach may be helpful in the rehabilitation of patients with chronic back pain (158). Furthermore, the sub-acute phase has been suggested to

be the optimal intervention window (159). Especially considering the possibility that when chronic pain becomes more longstanding rehabilitation also becomes more difficult (158). However, one should not exclude patients already considered chronic from treatment as they seem to respond quite well to multidisciplinary intervention.

In summary, health care professionals should rely on their clinical judgment and expertise (77) and a valid classification of patients into psychosocially derived subgroups could add meaningful information for the clinician concerning, for example, treatment planning and as an independent standard that can be compared with the clinicians view of the patient.

6 CONCLUSIONS

Based on the findings in this thesis, the following conclusions have been drawn:

- Patients with more psychosocial difficulties have more days of total sickness absence during the seven years following multidisciplinary vocational rehabilitation compared to patients with fewer psychosocial. This difference appears to be more pronounced among individuals with longer sickness absence (>60 days) prior to rehabilitation.

- Economic analyses demonstrated that the production losses among DYS patients after rehabilitation were considerable when compared to AC patients.

- Failure to adapt treatment content to patients' needs may lead to less cost-effective rehabilitation for certain subgroups of patients.

- There is a difference in the development over time between the three MPI-S subgroups among gainfully employed workers with NP/LBP. The ID and DYS groups showed more sickness absence during the 36 months follow-up period. The ID and DYS groups also reported more bodily pain and poorer mental and physical health during the same period.

- Multidisciplinary rehabilitation is more advantageous compared to its single components for all MPI-S groups with regard to future sickness absence.

- Patients belonging to the AC subgroup respond more favourably to a multidisciplinary intervention compared to ID and DYS patients.

- A simple mass screening method based on pain and pain-related sick leave is effective in identifying individuals with an increased risk of long-term sickness absence and disability pension in the future.

- A mass screening of individuals with NP/LBP may be helpful in the management of these individuals.

7 FUTURE RESEARCH

The psychosocial classification model evaluated in this thesis needs further evaluation. Firstly, from a more general perspective, studies need to be primarily designed for subgroup analyses. This necessitates larger study groups and study designs using control groups. When these demands are met, it would be possible to evaluate interventions that more specifically target the potential needs of the described patient profiles. It might also be beneficial to combine information on patient profiles with other clinical data, such as pain duration, recurrence of pain, psychological or social variables in these evaluations. Concerning the mass screening of employees at risk of future work disability due to NP/LBP, it would be valuable to use controlled designs where the screening model used here, or similar simple models, in combination with measures at the OHS were evaluated.

8 ACKNOWLEDGEMENTS

Orden räcker inte till,
i mitt huve står det nästan still
Ute där det blåser kallt,
jag andas djupt så kan jag stå emot allt
Och ser jag bara nån sorts moln,
kan solen inte va långt bort
Så därför vill jag passa på,
att visa tacksamhet för allt jag får

(Timbuktu "Oavsett Vad")

9 REFERENCES

1.   Dixon ASJ. Progress and Problems in Back Pain Research. Rheumatology and Rehabilitation. 1973;12(4):165-75.
2.   Waddell G. 1987 Volvo award in clinical sciences. A new clinical model for the treatment of low-back pain. Spine. 1987 Sep;12(7):632-44.
3.   Pengel LH, Herbert RD, Maher CG, Refshauge KM. Acute low back pain: systematic review of its prognosis. BMJ (Clinical research ed. 2003 Aug 9;327(7410):323.
4.   Hestbaek L, Leboeuf-Yde C, Manniche C. Low back pain: what is the long-term course? A review of studies of general patient populations. Eur Spine J. 2003 Apr;12(2):149-65.
5.   Henschke N, Maher CG, Refshauge KM, Herbert RD, Cumming RG, Bleasel J, et al. Prognosis in patients with recent onset low back pain in Australian primary care: inception cohort study. BMJ (Clinical research ed. 2008;337:a171.
6.   Ferguson SA, Marras WS, Gupta P. Longitudinal quantitative measures of the natural course of low back pain recovery. Spine (Phila Pa 1976). 2000 Aug 1;25(15):1950-6.
7.   Kent PM, Keating JL. The epidemiology of low back pain in primary care. Chiropr Osteopat. 2005 Jul 26;13:13.
8.   Walker BF. The prevalence of low back pain: a systematic review of the literature from 1966 to 1998. Journal of spinal disorders. 2000 Jun;13(3):205-17.
9.   Ferrari R, Russell AS. Regional musculoskeletal conditions: neck pain. Best practice & research. 2003 Feb;17(1):57-70.
10.   Fejer R, Kyvik KO, Hartvigsen J. The prevalence of neck pain in the world population: a systematic critical review of the literature. Eur Spine J. 2006 Jun;15(6):834-48.
11.   Haldeman S, Carroll L, Cassidy JD. Findings from the bone and joint decade 2000 to 2010 task force on neck pain and its associated disorders. Journal of occupational and environmental medicine / American College of Occupational and Environmental Medicine. 2010 Apr;52(4):424-7.
12.   Airaksinen O, Brox JI, Cedraschi C, Hildebrandt J, Klaber-Moffett J, Kovacs F, et al. Chapter 4. European guidelines for the management of chronic nonspecific low back pain. Eur Spine J. 2006 Mar;15 Suppl 2:S192-300.
13.   Hestbaek L, Leboeuf-Yde C, Kyvik KO, Vach W, Russell MB, Skadhauge L, et al. Comorbidity with low back pain: a cross-sectional population-based survey of 12- to 22-year-olds. Spine. 2004 Jul 1;29(13):1483-91; discussion 92.
14.   Linton SJ. A review of psychological risk factors in back and neck pain. Spine. 2000 May 1;25(9):1148-56.
15.   Pincus T, Burton AK, Vogel S, Field AP. A systematic review of psychological factors as predictors of chronicity/disability in prospective cohorts of low back pain. Spine. 2002 Mar 1;27(5):E109-20.
16.   Turk DC. Customizing Treatment for Chronic Pain Patients: Who, What, and Why. The Clinical journal of pain. 1990;6:255-70.
17.   Jonsson E, Nachemson A. [Collected knowledge about back pain and neck pain. What we know--and what we don't know]. Läkartidningen. 2000 Nov 1;97(44):4974-80.
18.   Jensen IB, Bodin L, Ljungqvist T, Gunnar Bergstrom K, Nygren A. Assessing the needs of patients in pain: a matter of opinion? Spine. 2000 Nov 1;25(21):2816-23.

19.   Hansson EK, Hansson TH. The costs for persons sick-listed more than one month because of low back or neck problems. A two-year prospective study of Swedish patients. Eur Spine J. 2005 May;14(4):337-45.

20.   Koes BW, van Tulder MW, Ostelo R, Kim Burton A, Waddell G. Clinical guidelines for the management of low back pain in primary care: an international comparison. Spine (Phila Pa 1976). 2001 Nov 15;26(22):2504-13; discussion 13-4.

21.   Jeffries LJ, Milanese SF, Grimmer-Somers KA. Epidemiology of adolescent spinal pain: a systematic overview of the research literature. Spine (Phila Pa 1976). 2007 Nov 1;32(23):2630-7.

22.   Kjaer P, Wedderkopp N, Korsholm L, Leboeuf-Yde C. Prevalence and tracking of back pain from childhood to adolescence. BMC Musculoskelet Disord. 2011;12:98.

23.   Leboeuf-Yde C, Kyvik KO. At what age does low back pain become a common problem? A study of 29,424 individuals aged 12-41 years. Spine (Phila Pa 1976). 1998 Jan 15;23(2):228-34.

24.   Leboeuf-Yde C, Gronstvedt A, Borge JA, Lothe J, Magnesen E, Nilsson O, et al. The nordic back pain subpopulation program: demographic and clinical predictors for outcome in patients receiving chiropractic treatment for persistent low back pain. J Manipulative Physiol Ther. 2004 Oct;27(8):493-502.

25.   Skargren EI, Carlsson PG, Oberg BE. One-year follow-up comparison of the cost and effectiveness of chiropractic and physiotherapy as primary management for back pain. Subgroup analysis, recurrence, and additional health care utilization. Spine. 1998 Sep 1;23(17):1875-83; discussion 84.

26.   van der Hulst M, Vollenbroek-Hutten MM, Ijzerman MJ. A systematic review of sociodemographic, physical, and psychological predictors of multidisciplinary rehabilitation-or, back school treatment outcome in patients with chronic low back pain. Spine. 2005 Apr 1;30(7):813-25.

27.   Leboeuf-Yde C, Nielsen J, Kyvik KO, Fejer R, Hartvigsen J. Pain in the lumbar, thoracic or cervical regions: do age and gender matter? A population-based study of 34,902 Danish twins 20-71 years of age. BMC Musculoskelet Disord. 2009;10:39.

28.   Dunn KM, Croft PR. The importance of symptom duration in determining prognosis. Pain. 2006 Mar;121(1-2):126-32.

29.   Sullivan MJ, Adams H, Tripp D, Stanish WD. Stage of chronicity and treatment response in patients with musculoskeletal injuries and concurrent symptoms of depression. Pain. 2008 Mar;135(1-2):151-9.

30.   Dunn KM, Croft PR. Classification of low back pain in primary care: using "bothersomeness" to identify the most severe cases. Spine (Phila Pa 1976). 2005 Aug 15;30(16):1887-92.

31.   Dunn KM. Extending conceptual frameworks: life course epidemiology for the study of back pain. BMC Musculoskelet Disord. 2010;11:23.

32.   Nachemson AL. Advances in low-back pain. Clin Orthop Relat Res. 1985 Nov(200):266-78.

33.   Woolf AD, Pfleger B. Burden of major musculoskeletal conditions. Bull World Health Organ. 2003;81(9):646-56.

34.   George SZ, Delitto A. Clinical examination variables discriminate among treatment-based classification groups: a study of construct validity in patients with acute low back pain. Physical therapy. 2005 Apr;85(4):306-14.

35.   Thomas E, Silman AJ, Croft PR, Papageorgiou AC, Jayson MI, Macfarlane GJ. Predicting who develops chronic low back pain in primary care: a prospective study. BMJ (Clinical research ed. 1999 Jun 19;318(7199):1662-7.

36.	Costa Lda C, Maher CG, McAuley JH, Hancock MJ, Herbert RD, Refshauge KM, et al. Prognosis for patients with chronic low back pain: inception cohort study. BMJ (Clinical research ed. 2009;339:b3829.

37.	Goode A, Cook C, Brown C, Isaacs R, Roman M, Richardson W. Differences in comorbidities on low back pain and low back related leg pain. Pain Pract. 2011 Jan-Feb;11(1):42-7.

38.	George C. The six-month incidence of clinically significant low back pain in the Saskatchewan adult population. Spine (Phila Pa 1976). 2002 Aug 15;27(16):1778-82.

39.	Jones GT, Johnson RE, Wiles NJ, Chaddock C, Potter RG, Roberts C, et al. Predicting persistent disabling low back pain in general practice: a prospective cohort study. Br J Gen Pract. 2006 May;56(526):334-41.

40.	Natvig B, Ihlebaek C, Grotle M, Brage S, Bruusgaard D. Neck pain is often a part of widespread pain and is associated with reduced functioning. Spine (Phila Pa 1976). 2010 Nov 1;35(23):E1285-9.

41.	Croft PR, Lewis M, Papageorgiou AC, Thomas E, Jayson MI, Macfarlane GJ, et al. Risk factors for neck pain: a longitudinal study in the general population. Pain. 2001 Sep;93(3):317-25.

42.	Kindler LL, Jones KD, Perrin N, Bennett RM. Risk factors predicting the development of widespread pain from chronic back or neck pain. J Pain. 2010 Dec;11(12):1320-8.

43.	Kendall NA. Psychosocial approaches to the prevention of chronic pain: the low back paradigm. Bailliere's best practice & research. 1999 Sep;13(3):545-54.

44.	Statistik (In Swedish) [database on the Internet]. Försäkringskassan. 2005. Available from: http://www.forsakringskassan.se/omfk/analys/

45.	Försäkringskassan. Newly awarded disability pensions. Distribution between counties and diagnosis, 2006 (In Swedish; Nybeviljade sjukersättningar/aktivetsersättningar. Fördelning på län och diagnos, 2006). Försäkringskassan; 2006.

46.	utvärdering Sbfm. Metoder för behandling av långvarig smärta2006.

47.	Hansson T, Jensen I. Swedish Council on Technology Assessment in Health Care (SBU). Chapter 6. Sickness absence due to back and neck disorders. Scandinavian journal of public health. 2004;63:109-51.

48.	Eriksen J, Sjogren P, Ekholm O, Rasmussen NK. Health care utilisation among individuals reporting long-term pain: an epidemiological study based on Danish National Health Surveys. European journal of pain (London, England). 2004 Dec;8(6):517-23.

49.	Hojsted J, Alban A, Hagild K, Eriksen J. Utilisation of health care system by chronic pain patients who applied for disability pensions. Pain. 1999 Sep;82(3):275-82.

50.	Gustavsson A, Bjorkman J, Ljungcrantz C, Rhodin A, Rivano-Fischer M, Sjolund KF, et al. Socio-economic burden of patients with a diagnosis related to chronic pain - Register data of 840,000 Swedish patients. European journal of pain (London, England). 2011 Aug 18.

51.	Thomsen AB, Sorensen J, Sjogren P, Eriksen J. Chronic non-malignant pain patients and health economic consequences. European journal of pain (London, England). 2002;6(5):341-52.

52.	Martin BI, Deyo RA, Mirza SK, Turner JA, Comstock BA, Hollingworth W, et al. Expenditures and health status among adults with back and neck problems. JAMA. 2008 Feb 13;299(6):656-64.

53.	Enthoven P, Skargren E, Oberg B. Clinical course in patients seeking primary care for back or neck pain: a prospective 5-year follow-up of outcome and

health care consumption with subgroup analysis. Spine (Phila Pa 1976). 2004 Nov 1;29(21):2458-65.

54.	Melzack R, Wall PD. Pain mechanisms: a new theory. Science. 1965 Nov 19;150(699):971-9.

55.	Fordyce WE. Behavior Methods for Chronic Pain and Illness. Saint Louis: The C.V. Mosby Company; 1976.

56.	Gatchel RJ, Turk DC. Psychosocial factors in pain : critical perspectives. New York: Guilford Press; 1999.

57.	Hall AM, Kamper SJ, Maher CG, Latimer J, Ferreira ML, Nicholas MK. Symptoms of depression and stress mediate the effect of pain on disability. Pain. 2011 May;152(5):1044-51.

58.	Hoogendoorn WE, van Poppel MN, Bongers PM, Koes BW, Bouter LM. Systematic review of psychosocial factors at work and private life as risk factors for back pain. Spine. 2000 Aug 15;25(16):2114-25.

59.	Macfarlane GJ, Thomas E, Croft PR, Papageorgiou AC, Jayson MI, Silman AJ. Predictors of early improvement in low back pain amongst consulters to general practice: the influence of pre-morbid and episode-related factors. Pain. 1999 Mar;80(1-2):113-9.

60.	Burton AK, Tillotson KM, Main CJ, Hollis S. Psychosocial predictors of outcome in acute and subchronic low back trouble. Spine. 1995 Mar 15;20(6):722-8.

61.	Croft PR, Rigby AS. Socioeconomic influences on back problems in the community in Britain. Journal of epidemiology and community health. 1994 Apr;48(2):166-70.

62.	Linton SJ, Hallden K. Can we screen for problematic back pain? A screening questionnaire for predicting outcome in acute and subacute back pain. The Clinical journal of pain. 1998 Sep;14(3):209-15.

63.	Burton AK, Waddell G, Tillotson KM, Summerton N. Information and advice to patients with back pain can have a positive effect. A randomized controlled trial of a novel educational booklet in primary care. Spine. 1999 Dec 1;24(23):2484-91.

64.	Turk DC. The role of psychological factors in chronic pain. Acta anaesthesiologica Scandinavica. 1999 Oct;43(9):885-8.

65.	Cassidy JD, Cote P, Carroll LJ, Kristman V. Incidence and course of low back pain episodes in the general population. Spine (Phila Pa 1976). 2005 Dec 15;30(24):2817-23.

66.	Carroll LJ, Cassidy JD, Cote P. Factors associated with the onset of an episode of depressive symptoms in the general population. Journal of clinical epidemiology. 2003 Jul;56(7):651-8.

67.	Bouter LM, Pennick V, Bombardier C. Cochrane back review group. Spine (Phila Pa 1976). 2003 Jun 15;28(12):1215-8.

68.	Von Korff M, Miglioretti DL. A prognostic approach to defining chronic pain. Pain. 2005 Oct;117(3):304-13.

69.	Tait RC, Chibnall JT. Attitude profiles and clinical status in patients with chronic pain. Pain. 1998 Oct;78(1):49-57.

70.	Klapow JC, Slater MA, Patterson TL, Doctor JN, Atkinson JH, Garfin SR. An empirical evaluation of multidimensional clinical outcome in chronic low back pain patients. Pain. 1993 Oct;55(1):107-18.

71.	Kent P, Keating JL. Classification in nonspecific low back pain: what methods do primary care clinicians currently use? Spine (Phila Pa 1976). 2005 Jun 15;30(12):1433-40.

72.	Kent P, Keating J. Do primary-care clinicians think that nonspecific low back pain is one condition? Spine (Phila Pa 1976). 2004 May 1;29(9):1022-31.

73.   Borkan JM, Koes B, Reis S, Cherkin DC. A report from the Second International Forum for Primary Care Research on Low Back Pain. Reexamining priorities. Spine (Phila Pa 1976). 1998 Sep 15;23(18):1992-6.

74.   Buchner M, Neubauer E, Zahlten-Hinguranage A, Schiltenwolf M. The influence of the grade of chronicity on the outcome of multidisciplinary therapy for chronic low back pain. Spine (Phila Pa 1976). 2007 Dec 15;32(26):3060-6.

75.   Billis EV, McCarthy CJ, Oldham JA. Subclassification of low back pain: a cross-country comparison. Eur Spine J. 2007 Jul;16(7):865-79.

76.   Delitto A. Research in low back pain: time to stop seeking the elusive "magic bullet". Physical therapy. 2005 Mar;85(3):206-8.

77.   Kamper SJ, Maher CG, Hancock MJ, Koes BW, Croft PR, Hay E. Treatment-based subgroups of low back pain: a guide to appraisal of research studies and a summary of current evidence. Best practice & research. 2010 Apr;24(2):181-91.

78.   Von Korff M, Ormel J, Keefe FJ, Dworkin SF. Grading the severity of chronic pain. Pain. 1992 Aug;50(2):133-49.

79.   Werneke M, Hart DL. Discriminant validity and relative precision for classifying patients with nonspecific neck and back pain by anatomic pain patterns. Spine (Phila Pa 1976). 2003 Jan 15;28(2):161-6.

80.   Marras WS, Parnianpour M, Ferguson SA, Kim JY, Crowell RR, Bose S, et al. The classification of anatomic- and symptom-based low back disorders using motion measure models. Spine (Phila Pa 1976). 1995 Dec 1;20(23):2531-46.

81.   Delitto A, Erhard RE, Bowling RW. A treatment-based classification approach to low back syndrome: identifying and staging patients for conservative treatment. Physical therapy. 1995 Jun;75(6):470-85; discussion 85-9.

82.   Armentrout DP, Moore JE, Parker JC, Hewett JE, Feltz C. Pain-patient MMPI subgroups: the psychological dimensions of pain. Journal of behavioral medicine. 1982 Jun;5(2):201-11.

83.   Bradley LA, Prokop CK, Margolis R, Gentry WD. Multivariate analyses of the MMPI profiles of low back pain patients. Journal of behavioral medicine. 1978 Sep;1(3):253-72.

84.   Bech P. Health-related quality of life measurements in the assessment of pain clinic results. Acta anaesthesiologica Scandinavica. 1999 Oct;43(9):893-6.

85.   Hardt J, Gerbershagen HU, Franke P. The symptom check-list, SCL-90-R: its use and characteristics in chronic pain patients. European journal of pain (London, England). 2000;4(2):137-48.

86.   Melzack R. The McGill Pain Questionnaire: major properties and scoring methods. Pain. 1975 Sep;1(3):277-99.

87.   Turner JA, Romano JM. Self-report screening measures for depression in chronic pain patients. Journal of clinical psychology. 1984 Jul;40(4):909-13.

88.   Lebovits AH. The psychological assessment of patients with chronic pain. Curr Rev Pain. 2000;4(2):122-6.

89.   Linton SJ, Boersma K. Early identification of patients at risk of developing a persistent back problem: the predictive validity of the Orebro Musculoskeletal Pain Questionnaire. The Clinical journal of pain. 2003 Mar-Apr;19(2):80-6.

90.   Hill JC, Dunn KM, Lewis M, Mullis R, Main CJ, Foster NE, et al. A primary care back pain screening tool: identifying patient subgroups for initial treatment. Arthritis and rheumatism. 2008 May 15;59(5):632-41.

91.   Hill JC, Dunn KM, Main CJ, Hay EM. Subgrouping low back pain: a comparison of the STarT Back Tool with the Orebro Musculoskeletal Pain Screening Questionnaire. European journal of pain (London, England). 2010 Jan;14(1):83-9.

92.		Sowden G, Hill JC, Konstantinou K, Khanna M, Main CJ, Salmon P, et al. Subgrouping for targeted treatment in primary care for low back pain: the treatment system and clinical training programmes used in the IMPaCT Back study (ISRCTN 55174281). Family practice. 2011 Jun 27.

93.		Kerns RD, Turk DC, Rudy TE. The West Haven-Yale Multidimensional Pain Inventory (WHYMPI). Pain. 1985 Dec;23(4):345-56.

94.		Turk DC, Rudy TE. Toward an empirically derived taxonomy of chronic pain patients: integration of psychological assessment data. Journal of consulting and clinical psychology. 1988 Apr;56(2):233-8.

95.		Turk DC. The potential of treatment matching for subgroups of patients with chronic pain: lumping versus splitting. The Clinical journal of pain. 2005 Jan-Feb;21(1):44-55; discussion 69-72.

96.		Bergstrom KG, Jensen IB, Linton SJ, Nygren AL. A psychometric evaluation of the Swedish version of the Multidimensional Pain Inventory (MPI-S): a gender differentiated evaluation. European journal of pain (London, England). 1999 Jun;3(3):261-73.

97.		Broderick JE, Junghaenel DU, Turk DC. Stability of patient adaptation classifications on the multidimensional pain inventory. Pain. 2004 May;109(1-2):94-102.

98.		Bergstrom G, Jensen IB, Bodin L, Linton SJ, Nygren AL, Carlsson SG. Reliability and factor structure of the Multidimensional Pain Inventory--Swedish Language Version (MPI-S). Pain. 1998 Mar;75(1):101-10.

99.		Main CJ, Williams AC. Musculoskeletal pain. BMJ (Clinical research ed. 2002 Sep 7;325(7363):534-7.

100.		Nachemson AL, Vingard E. Assessment of Patients with Neck and Back Pain: A Best-Evidence Synthesis. Neck and back pain : the scientific evidence of causes, diagnosis and treatment. Philadelphia: Lippincott Williams & Wilkins; 2000. p. 189-235.

101.		Cote P, Cassidy JD, Carroll L. The Saskatchewan Health and Back Pain Survey. The prevalence of neck pain and related disability in Saskatchewan adults. Spine. 1998 Aug 1;23(15):1689-98.

102.		Linton SJ, Ryberg M. A cognitive-behavioral group intervention as prevention for persistent neck and back pain in a non-patient population: a randomized controlled trial. Pain. 2001 Feb 1;90(1-2):83-90.

103.		Guzman J, Esmail R, Karjalainen K, Malmivaara A, Irvin E, Bombardier C. Multidisciplinary bio-psycho-social rehabilitation for chronic low back pain. Cochrane database of systematic reviews (Online). 2002(1):CD000963.

104.		Doust J MP, Bastian H, Edwards A. Interventions for improving understanding and minimising the psychological impact of screening. Cochrane Database of Systematic Reviews: Protocols 2007 Issue 4 John Wiley & Sons, Ltd Chichester, UK 2007(DOI: 10.1002/14651858.CD001212.pub2.).

105.		Thoolen BJ, de Ridder DT, Bensing JM, Gorter KJ, Rutten GE. Psychological outcomes of patients with screen-detected type 2 diabetes: the influence of time since diagnosis and treatment intensity. Diabetes Care. 2006 Oct;29(10):2257-62.

106.		van Middelkoop M, Rubinstein SM, Kuijpers T, Verhagen AP, Ostelo R, Koes BW, et al. A systematic review on the effectiveness of physical and rehabilitation interventions for chronic non-specific low back pain. Eur Spine J. 2011 Jan;20(1):19-39.

107.		Burton AK, Balague F, Cardon G, Eriksen HR, Henrotin Y, Lahad A, et al. Chapter 2. European guidelines for prevention in low back pain : November 2004. Eur Spine J. 2006 Mar;15 Suppl 2:S136-68.

108.	Choi BK, Verbeek JH, Tam WW, Jiang JY. Exercises for prevention of recurrences of low-back pain. Cochrane database of systematic reviews (Online). 2010(1):CD006555.

109.	Henchoz Y, Kai-Lik So A. Exercise and nonspecific low back pain: a literature review. Joint Bone Spine. 2008 Oct;75(5):533-9.

110.	Glombiewski JA, Hartwich-Tersek J, Rief W. Depression in chronic back pain patients: prediction of pain intensity and pain disability in cognitive-behavioral treatment. Psychosomatics. Mar;51(2):130-6.

111.	Lamb SE, Hansen Z, Lall R, Castelnuovo E, Withers EJ, Nichols V, et al. Group cognitive behavioural treatment for low-back pain in primary care: a randomised controlled trial and cost-effectiveness analysis. Lancet. 2010 Mar 13;375(9718):916-23.

112.	Haldorsen EM, Grasdal AL, Skouen JS, Risa AE, Kronholm K, Ursin H. Is there a right treatment for a particular patient group? Comparison of ordinary treatment, light multidisciplinary treatment, and extensive multidisciplinary treatment for long-term sick-listed employees with musculoskeletal pain. Pain. 2002 Jan;95(1-2):49-63.

113.	Suoyrjo H, Hinkka K, Oksanen T, Kivimaki M, Klaukka T, Pentti J, et al. Effects of multidisciplinary inpatient rehabilitation for chronic back or neck pain: a register-linkage study of sickness absences and analgesic purchases in an occupational cohort. Occup Environ Med. 2008 Mar;65(3):179-84.

114.	Busch H, Bodin L, Bergstrom G, Jensen IB. Patterns of sickness absence a decade after pain-related multidisciplinary rehabilitation. Pain. 2011 Aug;152(8):1727-33.

115.	utvärdering Sbfm. Rehabilitering vid långvarig smärta. Stockholm2010. Report No.: 198.

116.	van Oostrom SH, Driessen MT, de Vet HC, Franche RL, Schonstein E, Loisel P, et al. Workplace interventions for preventing work disability. Cochrane database of systematic reviews (Online). 2009(2):CD006955.

117.	Jensen I, Bergstrom G, Bodin L, Ljungquist T, Nygren A. [Effects of rehabilitation after seven years. Evaluation of two rehabilitation programs in Sweden]. Läkartidningen. 2006 Jun 8-13;103(23):1829-30, 33-4, 37-9.

118.	Bergstrom G, Bjorklund C, Fried I, Lisspers J, Nathell L, Hermansson U, et al. A comprehensive workplace intervention and its outcome with regard to lifestyle, health and sick leave: the AHA study. Work. 2008;31(2):167-80.

119.	Järvholm B, Reuterwall, C, Waling, K. Utvärdering av AFA:s metodstöd till kommuner och landsting. Stockholm2008.

120.	Gandek B, Ware JE, Aaronson NK, Apolone G, Bjorner JB, Brazier JE, et al. Cross-validation of item selection and scoring for the SF-12 Health Survey in nine countries: results from the IQOLA Project. International Quality of Life Assessment. Journal of clinical epidemiology. 1998 Nov;51(11):1171-8.

121.	Ware J, Jr., Kosinski M, Keller SD. A 12-Item Short-Form Health Survey: construction of scales and preliminary tests of reliability and validity. Medical care. 1996 Mar;34(3):220-33.

122.	Drummond MF, McGuire A. Economic evaluation in health care : merging theory with practice. Oxford ; New York: Oxford University Press; 2001.

123.	Aronsson T, Malmquist C. Rehabilitation economics (In Swedish). [3., rev. uppl.] ed. Stockholm: Bilda; 2002.

124.	Riksförsäkringsverket. Newly granted disability pensions and mental illness. (In Swedish; Nybeviljade förtidspensioner och psykisk ohälsa – ålder, kön och diagnos.). Stockholm: Riksförsäkringsverket2003. Report No.: 2003:1.

125.   Bergstrom G, Bodin L, Jensen IB, Linton SJ, Nygren AL. Long-term, non-specific spinal pain: reliable and valid subgroups of patients. Behaviour research and therapy. 2001 Jan;39(1):75-87.

126.   Blashfield RK. Propositions regarding the use of cluster analysis in clinical research. Journal of consulting and clinical psychology. 1980 Aug;48(4):456-9.

127.   Bergstrom G, Jensen IB, Bodin L, Linton SJ, Nygren AL. The impact of psychologically different patient groups on outcome after a vocational rehabilitation program for long-term spinal pain patients. Pain. 2001 Sep;93(3):229-37.

128.   Jensen IB, Busch H, Bodin L, Hagberg J, Nygren A, Bergstrom G. Cost effectiveness of two rehabilitation programmes for neck and back pain patients: A seven year follow-up. Pain. 2009 Apr;142(3):202-8.

129.   Chan Y, Walmsley RP. Learning and understanding the Kruskal-Wallis one-way analysis-of-variance-by-ranks test for differences among three or more independent groups. Physical therapy. 1997 Dec;77(12):1755-62.

130.   Zou G. A modified poisson regression approach to prospective studies with binary data. American journal of epidemiology. 2004 Apr 1;159(7):702-6.

131.   Weiss R. Modeling Longitudinal Data. New York: Springer; 2005. p. 429.

132.   Riipinen M, Niemisto L, Lindgren KA, Hurri H. Psychosocial differences as predictors for recovery from chronic low back pain following manipulation, stabilizing exercises and physician consultation or physician consultation alone. J Rehabil Med. 2005 May;37(3):152-8.

133.   Werner EL, Cote P. Low back pain and determinants of sickness absence. The European journal of general practice. 2009;15(2):74-9.

134.   Asmundson GJ, Norton GR, Allerdings MD. Fear and avoidance in dysfunctional chronic back pain patients. Pain. 1997 Feb;69(3):231-6.

135.   Carmody T. Psychosocial Subgroups, Coping, and Chronic Low-Back Pain Journal of Clinical Psychology in Medical Settings 2001;8(3):137-48.

136.   Geisser ME, Robinson ME, Henson CD. The Coping Strategies Questionnaire and chronic pain adjustment: a conceptual and empirical reanalysis. The Clinical journal of pain. 1994 Jun;10(2):98-106.

137.   Koes BW, van Tulder MW, Thomas S. Diagnosis and treatment of low back pain. BMJ (Clinical research ed. 2006 Jun 17;332(7555):1430-4.

138.   Fritz JM, Delitto A, Erhard RE. Comparison of classification-based physical therapy with therapy based on clinical practice guidelines for patients with acute low back pain: a randomized clinical trial. Spine (Phila Pa 1976). 2003 Jul 1;28(13):1363-71; discussion 72.

139.   Fritz JM, Cleland JA, Childs JD. Subgrouping patients with low back pain: evolution of a classification approach to physical therapy. J Orthop Sports Phys Ther. 2007 Jun;37(6):290-302.

140.   Wand BM, O'Connell NE. Chronic non-specific low back pain - sub-groups or a single mechanism? BMC Musculoskelet Disord. 2008;9:11.

141.   Heitz CA, Hilfiker R, Bachmann LM, Joronen H, Lorenz T, Uebelhart D, et al. Comparison of risk factors predicting return to work between patients with subacute and chronic non-specific low back pain: systematic review. Eur Spine J. 2009 Dec;18(12):1829-35.

142.   van Middelkoop M, Rubinstein SM, Kuijpers T, Verhagen AP, Ostelo R, Koes BW, et al. A systematic review on the effectiveness of physical and rehabilitation interventions for chronic non-specific low back pain. Eur Spine J. DOI: 10.1007/s00586-010-1518-3 Jul 18.

143.		Slater MA, Weickgenant AL, Greenberg MA, Wahlgren DR, Williams RA, Carter C, et al. Preventing progression to chronicity in first onset, subacute low back pain: an exploratory study. Arch Phys Med Rehabil. 2009 Apr;90(4):545-52.
144.		van Tulder MW, Koes B, Malmivaara A. Outcome of non-invasive treatment modalities on back pain: an evidence-based review. Eur Spine J. 2006 Jan;15 Suppl 1:S64-81.
145.		Jensen IB, Bergstrom G, Ljungquist T, Bodin L. A 3-year follow-up of a multidisciplinary rehabilitation programme for back and neck pain. Pain. 2005 Jun;115(3):273-83.
146.		Patrick LE, Altmaier EM, Found EM. Long-term outcomes in multidisciplinary treatment of chronic low back pain: results of a 13-year follow-up. Spine (Phila Pa 1976). 2004 Apr 15;29(8):850-5.
147.		Chou R, Qaseem A, Snow V, Casey D, Cross JT, Jr., Shekelle P, et al. Diagnosis and treatment of low back pain: a joint clinical practice guideline from the American College of Physicians and the American Pain Society. Annals of internal medicine. 2007 Oct 2;147(7):478-91.
148.		Karjalainen K, Malmivaara A, van Tulder M, Roine R, Jauhiainen M, Hurri H, et al. Multidisciplinary biopsychosocial rehabilitation for subacute low back pain among working age adults. Cochrane database of systematic reviews (Online). 2003(2):CD002193.
149.		Molde Hagen E, Grasdal A, Eriksen HR. Does early intervention with a light mobilization program reduce long-term sick leave for low back pain: a 3-year follow-up study. Spine. 2003 Oct 15;28(20):2309-15; discussion 16.
150.		Hayden JA, Chou R, Hogg-Johnson S, Bombardier C. Systematic reviews of low back pain prognosis had variable methods and results: guidance for future prognosis reviews. Journal of clinical epidemiology. 2009 Aug;62(8):781-96 e1.
151.		Nathell L, Larsson K, Jensen I. Determinants of undiagnosed asthma. Allergy. 2002 Aug;57(8):687-93.
152.		Davis PJ, Reeves JL, 2nd, Graff-Radford SB, Hastie BA, Naliboff BD. Multidimensional subgroups in migraine: differential treatment outcome to a pain medicine program. Pain medicine (Malden, Mass. 2003 Sep;4(3):215-22.
153.		Okifuji A, Turk DC, Eveleigh DJ. Improving the rate of classification of patients with the multidimensional pain inventory (MPI): clarifying the meaning of "significant other". The Clinical journal of pain. 1999 Dec;15(4):290-6.
154.		Hesterberg T, Moore, D, Monaghan, S, ClipSon, A, & Epstein, R. Bootstrap Methods and Permutation Tests. Bootstrap Methods and Permutation Tests: W. H. Freeman; 2005. p. 1-70.
155.		Poitras S, Rossignol M, Dionne C, Tousignant M, Truchon M, Arsenault B, et al. An interdisciplinary clinical practice model for the management of low-back pain in primary care: the CLIP project. BMC Musculoskelet Disord. 2008;9:54.
156.		Borkan J, Van Tulder M, Reis S, Schoene ML, Croft P, Hermoni D. Advances in the field of low back pain in primary care: a report from the fourth international forum. Spine (Phila Pa 1976). 2002 Mar 1;27(5):E128-32.
157.		McCarthy CJ, Arnall FA, Strimpakos N, Freemont A, Oldham JA. The Biopsychosocial Classification of Non-Specific Low Back Pain: A Systematic Review Physical Therapy Reviews. 2004;9(1):17-30.
158.		Deardoff WW, Rubin HS, Scott DW. Comprehensive multidisciplinary treatment of chronic pain: a follow-up study of treated and non-treated groups. Pain. 1991;45(1):35-43.
159.		Frank JW, Brooker AS, DeMaio SE, Kerr MS, Maetzel A, Shannon HS, et al. Disability resulting from occupational low back pain. Part II: What do we know

about secondary prevention? A review of the scientific evidence on prevention after disability begins. Spine (Phila Pa 1976). 1996 Dec 15;21(24):2918-29.