Long-term perspectives on musculoskeletal pain

Health care utilization and integration of behavioral medicine treatment into physical therapy

CHRISTINA EMILSON
Abstract

There are currently no effective methods for treating and preventing chronic pain. The aim of this thesis was to study prognostic factors for health care utilization, and the long-term outcomes of tailored behavioral medicine treatment for patients with musculoskeletal pain. Another aim was to increase knowledge about physical therapists’ assessment and analysis of patients’ pain conditions and to investigate the potential of subgrouping patients based on prognostic factors.

Methods: In Study I, a prospective population-based cohort was followed over 21 years. Data from three measure points were analyzed: 1995 (n=2425), 2007 (n=1582) and 2016 (n=1184). Study II was a 10-year follow-up of randomized controlled trial (n=97), comparing tailored behavioral medicine treatment and exercise-based physical therapy. In Study III, a descriptive and explorative design was applied, using data from video-recordings of 12 physical therapists. In study IV, assignment to three subgroups based on the Örebro Musculoskeletal Pain Screening Questionnaire was validated against reference instruments, and the stability between two points of measurement was investigated in patients (n=40) who were seeking primary health care due to musculoskeletal pain.

Results: Chronic pain, female gender and high age predict high health care utilization over 21 years, and a trajectory of stable high health care utilization over the entire period. The differences between groups in favor for tailored behavioral medicine treatment reported at post-treatment and after two years, were not maintained at the 10-year follow-up. A majority of the physical therapists assessed factors for poor prognosis. The analyses were mainly based on biomedical assessments and none of the physical therapists included behavioral factors. Subgroup assignment according to the Örebro Musculoskeletal Pain Screening Questionnaire appears to be valid and stable over time.

Conclusion: Prognostic factors such as chronic pain and female gender need to be considered when allocating health care resources and planning treatment to improve long-term outcomes. The treatment should also be tailored based on individual functional behavioral analyses of key behaviors and on patient’s biomedical and psychosocial condition, including strategies for maintenance of behavioral changes. Evidence-based methods for integrating behavioral medicine treatment into physical therapy need to be further evaluated and improved.

Keywords: Chronic pain, health care utilization, behavioral medicine, stratified treatment, prognostic factors, physical therapy, primary care

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To Axel, Louise and Sofie
List of Papers

This thesis is based on the following papers, which are referred to in the text by their Roman numerals.


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<tr>
<td>IASP</td>
<td>International Association for the Study of Pain</td>
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<td>ICD</td>
<td>International Classification of Diseases</td>
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<td>WHO</td>
<td>World Health Organization</td>
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<td>CWP</td>
<td>Chronic widespread pain</td>
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<td>CRP</td>
<td>Chronic regional pain</td>
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<td>NCP</td>
<td>Non chronic pain</td>
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<td>CNS</td>
<td>Central nervous system</td>
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<td>SCT</td>
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<td>CBT</td>
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<td>ÖMPSQ</td>
<td>Örebro Musculoskeletal Pain Screening Questionnaire</td>
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<td>SBT</td>
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<td>Behavior change technique</td>
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<td>Randomized controlled trial</td>
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<td>Tailored behavioral medicine treatment</td>
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<td>EBT</td>
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<td>PDI</td>
<td>Pain Disability Index</td>
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<td>NRS</td>
<td>Numerical Rating Scale</td>
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<td>Pain Catastrophizing Scale</td>
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A majority of all individuals in the general population will be affected by musculoskeletal pain at some point during their lifetime. For some of them, the pain becomes chronic, affecting both physical and psychosocial aspects of life and leading to great suffering for the individual. Despite advances in pain research, within both the biomedical and psychological areas, there are currently no effective methods for treating and preventing chronic pain, which is a challenge for both health care and society. Chronic pain is complex, involving biological, psychosocial and behavioral factors. In recent decades, psychosocial aspects and active strategies for health behavioral change have increased in pain research and treatment, and are the main focus of this thesis.

In the four included studies, an integrated biopsychosocial perspective on pain was applied. The long-term perspective has been studied not only regarding the course of chronic pain associated with prognostic factors and health care utilization but also in relation to the long-term outcome of a behavioral medicine interventions. Another focus is the potential for the integration of behavioral medicine into physical therapy practice regarding the assessment, analysis and treatment of patients with musculoskeletal pain conditions.
Introduction

Definitions of pain

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.” 1 This definition is multidimensional and includes physical, psychological and social aspects related to pain. The definition of chronic pain according to the IASP is that pain must “persist past the normal time of healing.” 1

The definition of chronic pain is often described based on a duration of at least three months of persistent or recurrent pain 2. The new version of the International Classification of Diseases (ICD) of the World Health Organization (WHO) 3 includes diagnostic codes for chronic pain conditions and has been developed to suite different types of chronic pain.

The definition of acute and sub-acute pain is a duration of pain up to three months, but the differentiation of the duration between acute and subacute pain is inconsistently described in the literature 4,5. For the definition of recurrent pain, a criterion of minimum pain duration of 24 hours has been suggested to signify a new pain episode 6. Recovery has been defined as a pain-free period of at least one month 6.

Chronic pain can also be differentiated into chronic regional pain (CRP) or chronic widespread pain (CWP) according to the American College of Rheumatology criteria for the Classification of Fibromyalgia regarding the distribution of pain 7.

A prognostic approach to define chronic pain has also been described 8,9, focusing mainly on the psychological risk factors for future disabling pain.

In study I the definitions CRP and CWP were used to categorize the presence of chronic pain in the general population. If the criteria for CWP were not met the pain was defined as CRP. Study II, III and IV included patients with nonmalignant musculoskeletal pain, defined as sub-acute, recurrent or persistent. In study IV prognostic criteria for the classification of pain condition severity were also applied.
Epidemiology of pain

The prevalence of musculoskeletal pain is between 10% and 48% of the general population in Western countries, depending on the type of prevalence that has been investigated and the type of pain that is reported. The 12-month prevalence of chronic pain for at least 3 months has reported to be between 35% and 48%\(^{10,11}\), of CWP to be between 11% and 20%\(^{10,11}\), and of chronic pain for at least six months to be 19%\(^{12}\). The point prevalence of chronic musculoskeletal pain has been estimated to be between 23% and 28%\(^{13,14}\). A systematic review of the global prevalence of low back pain revealed that the point prevalence was estimated to be 12%, the 1-month prevalence was estimated to be 23%, and the 12-month prevalence was estimated to be 38%, with varied definitions of chronic pain\(^{15}\). The overall point prevalence of pain has been reported to be approximately 50%\(^{16}\), that of chronic widespread pain to be 5%\(^{17}\). A population study based on a U.S national health interview survey reported a prevalence of chronic pain of 19%\(^{18}\).

The prevalence of chronic pain is higher among women\(^{11,13,15-19}\), increase with age\(^{13,15-17,19}\), and has been associated with socioeconomic factors, i.e., low levels of education and income, sickness-related absence and immigrant status\(^{12,16,17,19,20}\). Psychological factors such as depression, anxiety, catastrophizing beliefs about pain and fear of movement have also been associated with the prevalence of chronic pain\(^{18-21}\).

Although the prognosis for musculoskeletal pain is uncertain, clinical guidelines indicate that most musculoskeletal pain conditions will recover within a few weeks\(^{22,23}\), but approximately 10% of those who experience a new episode of pain do not recover and develop into a recurrent or chronic pain condition. A process of recurring episodes of pain has been reported as one of the main characteristics of low back pain\(^{24,25}\). A cohort-study in Australia in patients in whom pain persisted for ≥3 months, approximately 40% were reported to be recovered within 12 months after onset\(^{26}\).

Pain physiology

In the transition from acute to chronic pain, a number of physiological changes occur in the central nervous system (CNS). In acute nociceptive pain, free nerve endings will respond to mechanical, chemical or thermal nociceptive stimulation in the periphery and conduct the nerve signal in the primary somatosensory neuron\(^27\). Two types of nerve fibers are involved in the transmission of the pain signal from the peripheral to the dorsal horn of the spinal cord, the rapid myelinated A\(\delta\)-fibers and the thin slower unmyelinated C-fibers. A\(\delta\)-fibers provides a sharp localization of pain, while C-fibers give a diffuse and dull pain sensation. In the dorsal horn, synaptic transmission from the primary neuron to the secondary neuron will occur, and an afferent projection to higher
centers in the CNS occurs; the somatosensory cortex involves the sensory experiences of pain, such as localization, duration and intensity, and the limbic structures are involved in the affective or emotional components of pain. The neurophysiological mechanisms of pain also involve endogenous pain modulation deriving from the brainstem and can be activated by higher central structures\(^ {27,28}\).

Central sensitization is a complex phenomenon that is associated with the development and maintenance of chronic pain. The IASP has defined the term central sensitization as “Increased responsiveness of nociceptive neurons in the central nervous system to their normal or subthreshold afferent input”\(^ {1}\). Changes in the CNS also include long term potentiation, dysfunction in the descending disinhibition system, increased temporal summation, and facilitation of cognitive-affective mechanisms, which has been associated with CWP, fatigue and sleep disturbance\(^ {29,30} \).

**Psychological factors in pain**

Psychological factors have been associated with pain experiences and the development of chronic pain, disability and poor outcome. The most important factors that describe and explain pain perceptions and the association with treatment outcome are targeted in this thesis.  

**Emotional factors** including depression, anxiety and fear, have been associated with long-term disability and pain, sickness absence and poor treatment outcome for pain\(^ {31-33} \).  

**Cognitive factors** include beliefs and expectations related to pain, negative thoughts, and catastrophizing. Negative thoughts and expectation regarding the pain condition and recovery have been described as unhelpful coping strategies\(^ {32} \). Pain catastrophizing is defined as a negative mental set during an actual or anticipated experience\(^ {34} \), including irrational expectations about future events, which is reported to have a significant impact on pain experiences, depression, disability\(^ {32,35,36} \), and delayed recovery from chronic pain\(^ {37} \). A high level of pain catastrophizing has also been associated with anxiety, fear and avoidance\(^ {38} \).  

**Pain behavior** is behavior associated with pain symptoms, such as avoidance of activity, and is influenced by emotions and cognitions and can be reinforced by contextual factors and consequences\(^ {32,39} \).  

The **fear-avoidance model of pain** explains how disability, depression and disuse develop as a consequence of prolonged avoidance with fear of pain as a regulation factor\(^ {40-42} \). Catastrophizing is one of the key components in the fear-avoidance model. The model also suggests that if the fear-avoidance beliefs related to pain decrease and the individual uses more active strategies and confronts the pain, this will lead to recovery. The fear-avoidance model has been extensively used in pain research\(^ {41,42} \). The role of pain-related fear as a
consequence rather than an antecedent of the development of pain severity has been suggested\textsuperscript{43}. Instead, pain intensity would be a predictor of pain-related fear and disability.

**Factors in poor prognosis**

Biomedical, psychological and socioeconomic factors have all been associated with chronic disabling pain, but there is no consensus about which one of these factors has the greatest impact on the development of chronic pain and treatment outcomes. A combination of these factors is suggested to explain the course of chronic pain and its consequences, and prognostic factors may also differ between pain conditions\textsuperscript{44}. Early identification of such factors is important to provide adequate assessment and treatment.

Biomedical factors such as high pain intensity, multiple pain sites, long pain duration and baseline disability, have been reported to be prognostic factors for chronic disabling pain conditions\textsuperscript{45,46}. Chronic regional pain has been found as a prognostic factor for the development of chronic widespread pain\textsuperscript{10,47}. Serious medical conditions and symptoms, i.e. malignancy, fractures and cauda equine syndrome, defined as “red flags”, are factors that need to be managed promptly based on their etiology\textsuperscript{48}.

Psychological factors, such as depression, anxiety, fear-avoidance beliefs and catastrophizing, low expectations for recovery are factors associated with chronic disabling pain and delayed recovery, also defined as “yellow flags”\textsuperscript{49}. Yellow flags are important factors for whether treatment will succeed and are recommended to be identified and targeted\textsuperscript{49}.

In addition to red and yellow flags, definitions of other prognostic factors associated with musculoskeletal pain have been described\textsuperscript{49}. Orange flags are psychiatric symptoms, e.g., clinical depression and personality disorder, blue flags are defined as perceptions about the relationship between work and health and black flags are related to systemic or contextual factors, e.g., insurance and health care systems. These additional flags are not targeted in this thesis.

Socioeconomic factors, i.e., female gender, high age, low education and employment status, and geographic and cultural aspects have also been reported as prognostic factors associated with poor treatment outcome, sickness-related absence and chronic pain\textsuperscript{19}. Being an immigrant has been reported to be a predictor of CWP and fibromyalgia\textsuperscript{50}.

The potential predictive factors included in study I were chronic pain and socioeconomic factors. The intervention that was followed up in study II, was targeting yellow flags, such as fear of movement and self-efficacy. Red and yellow flags were targeted in studies III and IV.
Consequences of pain

Disability

Chronic pain is associated with several negative consequences for the individual. Disability is defined as an umbrella term including impairments, activity limitations, and participation restrictions, according to the World Health Organization’s International Classification of Functioning, Disability and Health (ICF)\textsuperscript{51}. The term involves biomedical, psychological and environmental factors that affect the health condition in the individual. Pain-related disability is one of the main consequences of musculoskeletal pain both in the short and long perspectives, and it is important in the transition from acute to chronic pain\textsuperscript{4,45}.

Health care utilization and sickness-related absence

Musculoskeletal pain is a common reason why patients seek health care in the general population, but many different factors explain the large variation related to health care seeking. Major determinants of health care utilization are female gender, higher age\textsuperscript{13,52,53}, degree of disability\textsuperscript{53}, and fear-avoidance beliefs related to pain\textsuperscript{54}. Low education level is also associated with higher health care utilization, except for consultations to physiotherapists for which no such association has been found\textsuperscript{52}. Regarding chronic pain, the frequency and intensity of pain are associated with health care seeking\textsuperscript{16}. Individuals with CWP, chronic low back pain\textsuperscript{55}, and fibromyalgia\textsuperscript{56,57} are reported to have a high health care utilization compared to individuals with other musculoskeletal pain conditions, who use no or little health care\textsuperscript{52,53,57}.

It is also interesting to study patterns of health care utilization during the course of chronic pain over time. To describe changing patterns over time, a person-centred model for identifying different trajectories has been used\textsuperscript{58}. Trajectories for health care utilization due to pain may vary in the population over time, which is sparsely reported. Regarding chronic low back pain, different trajectories of persistent or fluctuating pain with different intensities and frequencies have been identified and described\textsuperscript{59}, which can have implications for health care utilization over time. A few longitudinal population studies have reported that both chronic\textsuperscript{13} and acute musculoskeletal pain (<2 weeks duration)\textsuperscript{60} could have a considerable impact on health care utilization in the longer term. Knowledge of the factors that predict specific trajectories for health care utilization associated with the course of pain can contribute to better understanding of individual conditions for managing pain. Such knowledge is also valuable when allocating health care resources and differentiating treatment methods.

Sickness-related absence is also a major consequence of musculoskeletal pain\textsuperscript{61}. In Sweden, musculoskeletal disorders were the second most common
cause, accounting for about 22% of all sickness-related absence (>14 days) in 2016\textsuperscript{62}.

**Pain and suffering**

Chronic pain is not only a condition explained by physiological and psychological mechanisms but also causes great suffering for the individual affecting many aspect of life\textsuperscript{63}. Suffering is a reaction to the consequences of pain and is associated with the person’s perception of the meaning and the impact of pain on his or her life, e.g., threats to one’s self-concept, self-esteem and integrity, helplessness, and psychological and economic distress. It is important to understand how these factors affect the individual and how they may influence the treatment outcome. Poor health-related quality of life has also been reported to be associated with the development and experiences of chronic pain\textsuperscript{50,64,65}.

**Theoretical perspectives**

In this thesis, a biopsychosocial approach is applied to investigate and explain the complexity of musculoskeletal pain and its impact on the individual in the longer perspective. The biopsychosocial model of health is multidimensional including an integration of biological, psychological and social factors\textsuperscript{66,67}. The model is widely used, become fundamental in pain research and treatment\textsuperscript{68}, and aims to explain how these factors influence the experience of pain for the individual. The biopsychosocial model has been criticized for being too general and not describing the relationship between the different factors in the model\textsuperscript{68,69}. To integrate the behavioral components related to pain responses, a bio-behavioral view has been suggested\textsuperscript{63}.

There are many behavioral change theories described in the literature aiming to explain behavioral learning and behavioral change\textsuperscript{70}. Some of the most important and frequently used theories in pain research are respondent and operant learning theories, social cognitive theory (SCT), and self-efficacy theory, which have informed the study designs, interventions and assessments in this thesis.

**Respondent and operant learning theory**

Respondent learning is described as learning by association\textsuperscript{63}. An unconditioned stimulus (i.e., pain) elict a biological reflex (i.e., fear), which is called an unconditioned response to indicate that no learning is involved in the process. If preceded by a neutral stimulus (e.g. heavy lifting), a learning process starts where the neutral stimulus becomes conditioned and associated with a
conditioned response (i.e. fear). Hence, the heavy lifting then acts as a conditioned stimulus that is associated with the conditioned response in terms of fear. In patients with musculoskeletal pain, the learning mechanism of fear and avoidance behavior can be explained by respondent conditioning but can also be driven and maintained by operant learning mechanisms. An example of pain treatment based on respondent conditioning is graded exposure, consisting of gradual exposure to fearful situations identified by the patient.

Operant learning theory describe the mechanisms of how behaviors can be learned and changed by their consequences. The frequency of the behavior can be modified both by positive and negative reinforcement or punishment. Reinforcing consequences increase the likelihood that a behavior will occur, while punishing consequences may cause the behavior to become less frequent in the future. During the last decades, the operant learning theory has more frequently been used to explain pain behaviors. Operant discrimination refers to a specific situation in which the reinforcement of a behavior is contingent on the presence of a certain stimulus and can be defined as an individual’s ability to differentiate between a learned voluntary response and an irrelevant non-learned response.

Maladaptive pain behaviors can be changed by reinforcement, to increase the frequency of a desired target behavior, or by punishment, to decrease the likelihood of an unwanted behavior to occur by using reducers. Attention to a specific activity goal instead of pain and using positive reinforcements when the desired behavior occurs can increase the probability of a behavioral change. Respondent and operant learning mechanisms often interact simultaneously in everyday activities, such as avoidance of a fearful situation. One example of how operant learning can be used in the management of musculoskeletal pain is graded activity, where operant conditioning is used to reinforce healthy behaviors, such as improving physical activity tolerance.

Social cognitive theory

SCT, which aims to provide a framework for the understanding of human thoughts and behavior, is derived from social cognitive learning. The central core in this theory is the causal model of triadic reciprocal determinism, describing how personal, behavioral and environmental factors interact as determinants of each other in the process of behavioral change. SCT describes functions of human behavior in a number of key concepts: 1) determinants of a behavior, such as outcome expectations; 2) observational learning by modeling others’ behavior; and 3) self-regulation, referring to the individuals’ ability to motivate or regulate a behavior on the basis on personal standards and to evaluate of their own behavior through self-monitoring, goal setting, feedback or self-reward. Perceived self-efficacy is also described as an important concept in the SCT that influence the behavior and behavioral change.
Several constructs in SCT correspond to behavioral change interventions and to several specific behavioral change techniques that are used in pain interventions, i.e., self-monitoring, modelling or demonstrating a behavior, planning social support, goal setting and learning to use prompts and cues to action \textsuperscript{76}.

**Self-efficacy theory**

Self-efficacy theory \textsuperscript{77} describes central psychological mechanisms in behavior change, and the individual’s beliefs about their ability to perform a particular activity or behavior in a specific situation. Self-efficacy is based on four sources of beliefs: personal experiences of success, vicarious experiences, verbal persuasion about capability, and emotional individual states. The perception of self-efficacy influence individuals’ intention to action, the effort they are willing to do, and the confidence with which they approach action. The self-efficacy concept is central in several theories of health behavior and behavioral change, and is described as a key factor for success in behavioral change interventions. In musculoskeletal pain self-efficacy is an important predictor of several behaviors and has been identified as a key determinant of physical activity \textsuperscript{78}. Self-efficacy has also been found to be a mediator between pain and pain-related disability \textsuperscript{79,80}, and it is an important factor to consider in pain management.

**Pain management**

**Clinical guidelines and practice**

The current management of musculoskeletal pain includes different treatments, such as medication, exercise and psychological therapies. In international guidelines for the management of musculoskeletal pain, a biopsychosocial model is recommended, and the overall goals are to reduce pain, disability and psychosocial suffering, and to increase the patient’s participation, workability and health-related quality of life \textsuperscript{23,81}. In chronic pain, and in CWP in particular, a more comprehensive pain management intervention is needed that focuses on the integration of the biomedical and psychosocial aspects of pain \textsuperscript{82}.

Treatment recommended for acute pain are as follows: 1) assessment of relevant red and yellow flags in initial consultations; 2) provision of adequate information about the pain condition and reassurance that rapid recovery is expected in most patients; 3) advice on being physically active (after having excluded red flags), returning to normal activities, and avoiding passive treatment strategies such as rest in bed; and 4) if necessary, prescription of medication for pain relief \textsuperscript{22,23}. Stay-active advice has been reported to be equally effective as more extensive physical therapy, including manual therapy and
exercise-based treatment. In patients seeking care for musculoskeletal pain, red flags are identified in less than 1%, and for a majority of patients, physical activity can be recommended.

Treatments recommended for chronic pain conditions are as follows: 1) supervised exercise-based therapy; 2) short-term use of medication or manual therapies; 3) cognitive behavioral therapy; and 4) multimodal rehabilitation.

Multimodal rehabilitation programs based on a biopsychosocial model and involving several health care professions are recommended to patients with complex chronic pain conditions, including more extensive integrated pain management with psychosocial and biomedical interventions. Multimodal rehabilitation has reported to improve the functional status, work ability, quality of life, and in psychological variables, i.e., distressed mood, and pain-related fear. The evidence is still limited regarding the effects of specific treatment components or what characterizes patients who benefit from such treatments.

Models for clinical analysis of pain conditions

In clinical practice, an analysis of a pain condition is the basis for all treatment and can be performed according to different models to understand and explain the probable relationship between different aspects of pain.

Historically, a biomedical model, based on biological factors, has dominated clinical practice. This model is derived from a reductionistic and dualistic principle to explain a health condition or phenomena, e.g., separation between biological and psychosocial factors. The definition of biomedical analysis used in this thesis is based mainly on physical assessment and physical impairments or limitations. To understand and explain the determinants of pain conditions, the biomedical model has proved to be insufficient, and a more broad model that includes psychosocial aspects is requested.

A biopsychosocial model of health, based on an integration of biological, psychological and social factors and has been used to understand and explain chronic pain (figure 1). In the biopsychosocial model, the functional relationship between the three components, and a specific behavior is not identified and described.

A functional behavioral analysis is based on the biopsychosocial model and has been defined as “identification of important, controllable, and causal functional relationship applicable to specific target behaviors for an individual”. The A-B-C format describes a hypothetical functional relationship between the main components of operant learning principles, including antecedent cues (A) that precede a behavior (B) and consequences of the behavior (C) (figure 2). The antecedents do not cause a behavior but set the context in which the behavior occurs. Reinforcing or punishing consequences increase or decrease the probability of the behavior being more or less frequent in the
Figure 1. Illustration of a biopsychosocial model of health, including biological, psychological and social aspects.

Figure 2. Illustration of a functional behavioral analysis in the A-B-C format, including the functional relationship between antecedents, behavior and consequences.
future, and they also influence the way the antecedents set the context for whether a behavior will occur. In this thesis, clinical analyses of pain conditions have been categorized based on these three models.

Exercise-based physical therapy

Physical therapists are often the first primary health care providers for patients seeking care for musculoskeletal pain and have an important role in the assessment, analysis, and treatment. According to clinical guidelines, a biopsychosocial model including psychosocial factors is recommended to be integrated into physical therapy clinical practice for patients with musculoskeletal pain.23,96,97.

Physical activity or exercise-based therapy is one of the most frequently used physical therapy treatments for chronic pain.81 Physical activity has been defined as bodily movement produced by skeletal muscles that results in energy expenditure.98 The definition of physical exercise is a planned, structured physical activity with the purpose of improving or maintaining physical fitness. Exercise-based therapy and physical activity, i.e., performing activities of daily living, are reported to be effective in chronic pain conditions regarding reduced pain severity and improved physical function compared to no intervention, minimal care or other manual therapies.81,97,99 Aerobic and resistance exercises are recommended, but evidence is lacking regarding the most effective type of exercise and dosage for chronic pain conditions.100 Motor control exercise for non-specific low back pain, commonly used in clinical practice, has been reported to be effective but not superior compared with other exercise-based treatments.101

There is consensus for individualized, supervised exercise, based on patient’s pain condition severity, goals and preferences.97

Psychological treatment

All patients with musculoskeletal pain are affected by psychological factors to some extent. Most health care providers can learn to use psychologically informed patient-centered communication, e.g., active listening, assessment of psychosocial factors, providing advice and assurance in pain management. Other patients need advanced psychological treatment that require more highly educated and trained health care providers, such as clinical psychologists.67

In pain management, cognitive-behavioral therapy (CBT) and operant treatments, are the most common psychological therapies.102 The CBT aims to identify harmful cognitions regarding pain and disability and involving a systematic application of psychological principles to support patients to change cognitions, negative emotions and behaviors.63 The operant treatment
involves the removal of positive reinforcement of pain behaviors and the promotion of healthy behaviors (e.g. physical activity)\textsuperscript{39}. When comparing operant and cognitive therapies for low back pain, little or no differences was reported regarding pain and depression, which had equally effects as exercise-based treatment\textsuperscript{102}.

Graded activity treatment, based on operant mechanisms, involves a gradual increase in exercise and activity tolerance based on a quota system\textsuperscript{103}. Graded activity has been successfully used in patients with pain-related disability to improve the function in daily activities\textsuperscript{104,105}, while other studies have reported equal improvements when comparing graded activity and exercise-based therapies\textsuperscript{106,107}.

Exposure treatment in vivo or graded exposure, based on the principle of respondent conditioning, has been developed for the treatment of pain-related fear\textsuperscript{71,108}. In graded exposure treatment, the patient is exposed to a specific situation identified as fearful and as a barrier for the rehabilitation and proceeds hierarchically as the patient’s fear in the specific situation decreases. Studies comparing graded activity and graded exposure treatment have reported equally effects regarding decrease in pain intensity and disability, and increase in activity level\textsuperscript{109-112} and were slightly more effective than a minimal intervention (e.g., stay-active advice and information)\textsuperscript{110}. Another review and meta-analysis\textsuperscript{113} reported insufficient evidence for the impact of graded activity on disability but the methods in many of the included studies were poorly described, which reduced the possibility of drawing valid conclusions.

Integration of behavioral medicine into physical therapy

Behavioral medicine is defined as an interdisciplinary field integrating behavioral, psychosocial, and biomedical science, and knowledge and techniques relevant to the understanding of health and illness, and is applied in health promotion, prevention, diagnosis, treatment, and rehabilitation\textsuperscript{114}. Integration of behavioral medicine, also defined as psychologically informed physical therapy\textsuperscript{96,115,116}, require education and skills-training for physical therapists to change their clinical behavior. Traditionally, physical therapists are educated and trained in accordance with a biomedical approach, based on physical assessments and treatments to reduce pain symptoms, such as manual and exercise-based therapies and have limited education in psychological treatment\textsuperscript{116}. However, in recent years the knowledge and understanding about the importance of psychosocial factors in pain management has increased among physical therapists. Studies have concluded that physical therapists can be successfully educated and trained to deliver behavioral medicine treatment and psychologically informed interventions, resulting in improved understanding, interpretation and skills, but comprehensive training and supervision may be crucial for success\textsuperscript{104,117-119}.
The evidence of positive treatment outcomes in patients or whom behavioral medicine treatment was implemented is still limited\(^{120,121}\). A structured model for tailored behavioral medicine treatment was developed in a randomized controlled trial in patients with musculoskeletal pain provided by physical therapists in primary health care\(^{122}\). A functional behavioral analysis was performed based on individual activity goals identified by the patient, followed by an individually tailored behavioral treatment protocol, and compared with exercise-based physical therapy in a previous RCT\(^{104}\). Individually behavioral treatment was reported to be more effective than exercise treatment regarding pain-related disability. The results were maintained two years after the intervention\(^{123}\). Supervised exercise-based physical therapy including a behavioral approach has been reported to decrease pain-related disability and pain catastrophizing in patients with chronic whiplash-associated disorders (WAD)\(^{124}\), and improve physical function in patients with knee osteoarthritis\(^{125}\).

The content of behavioral change interventions has traditionally been poorly defined and described in previous studies\(^{126,127}\). To address this problem, a hierarchically organized taxonomy of behavior change techniques (BCTs) has been developed\(^{128}\). The taxonomy includes 93 well defined BCTs grouped into 16 clusters\(^{129}\) and has been used in behavioral change research both in single and more complex interventions\(^{76}\). A BCT is an active component of an intervention that is used to support a specific health behavior change, e.g., increase physical activity, healthy eating or decrease sedentary behavior. Systematic reviews indicate that BCTs targeting self-regulation, e.g., goal-setting and self-monitoring of behavior, are the most salient for influencing and maintaining health behaviors\(^{130-133}\). The BCTs that were most frequently identified in chronic pain interventions are “Instruction on how to perform the behavior” and “demonstration of the behavior, behavior practice”, while BCTs associated with self-regulation were not as frequently used\(^{76}\). Limited treatment effects of specific BCTs on target behaviors have been reported\(^{133-135}\). In other studies, positive effects were found regarding BCTs promoting physical activity and healthy eating\(^{133,136,137}\). Combinations of BCTs have also been reported to be effective, e.g., “Provide information about behavior” and “Prompt intention formation”\(^{138}\).

There is still a challenge to integrate behavioral medicine treatment into clinical practice\(^{139-141}\). Physical therapists have been reported to be unprepared or uncomfortable in using psychological strategies in their clinical practice\(^{139,142,143}\). Another challenge may be the patient’s beliefs and expectations, particularly of physical examination, adequate biomedical diagnosis and manual treatment of the pain symptoms, which can have an impact on the clinical approach and selection of methods. A few studies on physical therapists’ experiences of using behavioral medicine strategies have reported enhanced knowledge and changes in attitudes and beliefs\(^{142,144}\). An important aspect is that interviews and self-report questionnaires have been used in most of these
studies, but observed clinical behaviors regarding what the physical therapists actually do have rarely been studied. In other studies the content of the assessment and intervention are not specifically described, which make the clinical behavior difficult to evaluate.

Screening for prognostic factors is another important assessment for physical therapists at the initial consultation. A previous study revealed that assessment of red flags was integrated into physical therapy, but the questioning for identification was suggested to be more specific, e.g., regarding previous malignancy and other serious conditions. Audio recording of brief telephone consultations in primary health care indicated that physical therapists can improve their assessment of yellow flags, but it is not fully integrated in a systematic way into clinical practice.

The purpose of an integrated physical therapy treatment in musculoskeletal pain, would be to provide individually tailored treatment based on biomedical, psychosocial and behavioral factors related to the pain condition and by targeting the prognostic factors for poor treatment outcome.

**Stratified treatment**

Different methods for differentiation of treatment according to the patients’ needs have been described in the literature. To provide adequate treatment and for optimizing the treatment effects in patients with musculoskeletal pain, stratified care has been suggested. Stratified care involves targeting treatments based on specific subgroups of patients. The subgroups can be based on 1) prognostic factors (e.g., psychosocial factors) for poor outcome, 2) diagnosis based on underlying pain mechanisms or pathoanatomical causes, and 3) the patients’ expected treatment responsiveness (e.g., exercise or manual therapy treatments).

In pain conditions, the treatment is suggested to target not only prognostic factors for poor outcome but also other factors that have a negative impact on treatment outcome, such as pain condition severity. Target treatment by matching patients to an intervention based on their psychological risk profile was performed by Bergbom et al. The definition of matching was described as targeted treatment based on psychological risk factors and individual determinants of outcome.

One screening instrument is the Örebro Musculoskeletal Pain Screening Questionnaire (ÖMPSQ), a multidimensional instrument assessing pain variables, disability, fear-avoidance beliefs, catastrophizing, and depressive symptoms. Risk profiles based on the ÖMPSQ have previously been validated using standard reference measures assessing fear-avoidance beliefs and depressive symptoms in patients with musculoskeletal pain and measures assessing disability, catastrophizing and fear-avoidance in patients with low back pain. However, the definitions of the risk profiles differed between
these studies, and the assignment to subgroups with three levels of pain condition severity needs to be further validated against reference instruments. To identify prognostic risk factors, a screening tool is useful in clinical practice.

Tailored behavioral treatment is based on individual functional behavioral analyses of key behaviors and health outcomes of interest\textsuperscript{32,35}. Another method for differentiating treatment based on the severity of the pain condition is the stepped-care design\textsuperscript{155,156}. This method provides treatment of differing intensity or extent, meaning that more intensive treatments are reserved only for those patients who do not benefit from the simpler first-step treatment, e.g., stay-active advice and adequate information about the pain condition. The clinical and economic advantages have the potential for deriving the greatest benefits from available health resources. The Stepped care design has rarely been used in pain research\textsuperscript{155}, but it was planned for future interventions based on studies III and IV in this thesis.

Rationale for this thesis

The prevalence of musculoskeletal pain is high in the population and is a common reason for poor health and extensive health care utilization. Biomedical, psychosocial and behavioral factors are important in pain management, but knowledge about methods for assessment and treatment and how to integrate a behavioral medicine treatment model into clinical practice is still unclear.

Several cross-sectional and short-term follow-up studies of prognostic factors for health care utilization have previously been reported, but the long-term perspective and trajectories for health care utilization among individuals with musculoskeletal pain in the general populations have not been investigated previously.

Increasing evidence is reported about the importance of integrating psychological factors into pain management to improve the treatment outcome. Positive effects of tailored behavioral medicine treatment, provided by physical therapists, have been reported regarding pain-related disability and pain intensity, but the long-term effects have not been investigated. Knowledge about the outcomes and consequences in the long run is needed to improve future pain interventions.

Physical therapists are one of the first health care providers who meet patients seeking primary health care for musculoskeletal pain and therefore have a significant role regarding the assessment, analysis and treatment of these patients. In recent years, awareness and knowledge about the importance of behavioral medicine into pain treatment has increased but has not fully been integrated in physical therapy and needs to be further investigated.

Assessment of prognostic factors for poor prognosis and recovery is recommended in clinical guidelines. To identify patients at risk not only for poor outcome but also for stratification of treatment based on prognostic factors,
screening instruments for assessing these characteristics are important. The method of subgroup assignment with different levels of pain condition based on the ÖMPSQ is promising for this purpose but needs to be further investigated.
Aims

The aim of this thesis was to study prognostic factors for health care utilization, and long-term outcomes of individual behavioral medicine treatment for patients with musculoskeletal pain. Another aim was to increase knowledge about physical therapists’ assessment and analysis of patients’ pain conditions and to investigate the potential of subgrouping patients based on prognostic factors for future outcomes.

Specific aims

I  To describe and predict health care utilization associated with musculoskeletal pain in a 21-year follow-up of a population cohort. The secondary aim was to describe trajectories of health care utilization over the entire period.

II To investigate whether the previously reported beneficial effects of tailored behavioral medicine treatment in a physical therapy context were sustained 10 years after completion of treatment. The primary outcome was pain-related disability.

III To explore variation and describe physical therapists’ observed behaviors regarding the assessment of red and yellow flags, analysis of a pain condition and use of BCTs when performing initial consultations in patients with musculoskeletal pain in primary health care.

IV To investigate the concurrent validity of subgroup assignment based on the ÖMPSQ and reference measures of pain-related disability, fear of movement and/or (re)-injury, and pain-catastrophizing. The secondary aim was to investigate the stability of the subgroups over time in patients seeking primary health care due to musculoskeletal pain.
Methods

Design

This thesis includes four studies (table 1). *Study I* was a population-based cohort (*n*= 2425 at the baseline) over 21 years including five measure points. *Study II* was a 10-year follow-up of a randomized controlled trial (RCT) that initially included 97 patients with musculoskeletal pain in primary health care. In *study III*, video recordings of initial consultations with 12 primary health care physical therapists were analyzed and described. In *study IV*, a cross-sectional and prospective design was used based on a sample of patients with musculoskeletal pain (*n*=40) in primary health care.

Table 1. Overview of design, participants, variables, data collection and analysis in the four studies.

<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>Participants</th>
<th>Variables</th>
<th>Data collection</th>
<th>Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study 1</td>
<td>Population cohort</td>
<td>Individuals, aged 20-74, from a general population</td>
<td>HCU, pain prevalence, quality of life</td>
<td>Self-reported questionnaire</td>
<td>Prediction of categorical outcome variables</td>
</tr>
<tr>
<td></td>
<td>study over 21</td>
<td>(n=1184 in 2016)</td>
<td>Pain-related disability, pain intensity, pain control, fear of movement, sickness-absence</td>
<td>Self-reported questionnaire, register data on sickness absence</td>
<td>Between-group comparisons</td>
</tr>
<tr>
<td>Study II</td>
<td>10-year follow-up of an RCT</td>
<td>Patients, aged 18-65, with MSP in primary care (n=43)</td>
<td>Analysis of red and yellow flags, analysis of a pain condition, and use of BCTs.</td>
<td>Video-recordings</td>
<td>Deductive and inductive analyses</td>
</tr>
<tr>
<td>Study III</td>
<td>Descriptive and explorative</td>
<td>PTs in primary health care (n=12)</td>
<td>Subgroup assessment based on the ÖMPSQ, pain-related disability, fear of movement, pain catastrophizing</td>
<td>Self-reported questionnaire</td>
<td>Analysis of concurrent validity and intra-rater agreement</td>
</tr>
<tr>
<td>Study IV</td>
<td>Cross-sectional and prospective</td>
<td>Patients aged 18-65, with MSP in primary care (n=40)</td>
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</tr>
</tbody>
</table>

*MSP= Musculoskeletal pain, PT= Physical therapist, HCU= Health care utilization, BCT= Behavior change technique taxonomy, RCT= Randomized controlled trial, ÖMPSQ= Örebro musculoskeletal pain screening questionnaire*
Ethical considerations

Ethical approval was obtained for all studies included in the thesis. Study I was approved by the Ethics Research Committee, Faculty of Medicine, University of Lund Sweden (Dnr:1995 (LU389-94). The computerized registration was approved by the Swedish Data Inspection Board. Study II was approved by the regional ethics review board in Uppsala, Sweden (Dnr: 01-34899 for the original study, Dnr: 2012/512 for the follow-up). Studies III and IV were approved by the regional ethic review board in Uppsala, Sweden (Dnr: 2012/448). Participants were given oral and written information about the respective study, and informed consent was obtained from each participant. In study III, personal data were coded so that participants’ names and workplaces could not be associated with a specific case.

Participants and procedures

Study I

A representative sample of 3928 subjects, every 18th man and woman age 20-74 years, from two municipalities in the south of Sweden was selected from the computerized Swedish national population register. Data were collected at five measure points over a 21-year period (figure 3) by self-reported questionnaires consisting of the prevalence of chronic pain during the last 12 months, health care utilization, demographic variables and general health. Participants who responded to the baseline measure in 1995 (n=2425) received follow-up surveys in 1998, 2003, 2007 and 2016. Respondents to the follow-up in 2016 was 1184. The questionnaire was sent out by regular mail, and at the last measure point in 2016, participants also had the option to answer by a web-based survey. Two reminders were sent out on each occasion.

Study II

The participants in the original RCT (n=122) were recruited from three physical therapy primary care centers from 2003 to 2004. The eligible patients, aged 18-65 years, were seeking care for sub-acute, recurrent, or persistent musculoskeletal pain. The RCT included two active treatments provided by physical therapists: 1) a tailored behavioral medicine treatment protocol (TBT) and 2) an exercise-based physical therapy protocol (EBT). The physical therapists were trained to deliver treatments according to the protocols before the study start. The TBT was tailored according to individual behavioral goals and functional behavioral analysis. The EBT was based on the best available evidence of physical exercise in chronic musculoskeletal pain.
Of the 97 participants who completed the RCT, 92 were eligible for the 10-year follow-up study. The participants were traced through contact information collected during the original study, which was updated against the Swedish population register. Two had died, and another three could not be found in the register. For the 10-year follow-up, presented in this thesis, data were collected either by a postal survey or a web-based survey, depending on the participants’ preferences. Two reminders were sent out after two and six weeks.

Figure 3. Flow diagram of the surveys in the study cohort (study I).
Study III and IV

Study III and IV are based on initial data from a planned RCT with a stepped care design, including behavioral medicine interventions based on both prognostic and individual factors in patients with musculoskeletal pain provided by physical therapists in primary health care. The RCT aimed to study methods for the identification of prognostic factors and subgroups with different pain condition severity, treatment effects on patients, and physical therapists’ clinical behaviors. In this thesis, investigations of physical therapists’ clinical behavior (study III), and methods for assessments of subgroup assignment (study IV) were studied.

In study III, 12 experienced physical therapists from six primary care centers in three different counties in Sweden participated. The participants were females, aged 39-57 years (mean: 50), recruited from five primary health care centers in different parts of Sweden. They had between 10 and 35 years in the profession (mean: 19), and half of the participants were further educated in behavioral medicine or cognitive behavioral therapy. Background data and study-specific questions about attitudes towards a behavioral medicine model for clinical reasoning were collected by self-reported questionnaires. Data on their clinical behavior during initial consultations with patients seeking care for musculoskeletal pain were collected by video recording.

In study IV, the participants were 40 patients, aged 19-64 years (mean: 42) seeking physical therapy for low back, neck or widespread pain in primary health care who were recruited from five primary care centers in three different counties in Sweden. The exclusion criteria were insufficient skills in Swedish language and red flags, i.e., identified serious spinal, malignant or systemic disorders or symptoms of severe depression. Data on background variables, pain intensity and duration, pain control, general health, pain-related disability, anxiety and depression, fear avoidance beliefs, and pain catastrophizing, were collected by self-reported questionnaires at two time points: 1) before the first consultation with the physiotherapists at the primary care center and 2) two to three weeks after the first consultation. The questionnaires were administered by a researcher and were answered by the participants by a web-based survey or a postal survey.

Data collection

An overview of the variables and questionnaires used in studies I-II and IV is presented in table 2. Data collection in study III was performed by video-recordings.
Table 2. Variables and instruments used in studies I-II and IV in this thesis.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Study I</th>
<th>Study II</th>
<th>Study IV</th>
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<tbody>
<tr>
<td>Pain prevalence</td>
<td>x</td>
<td>x</td>
<td></td>
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<tr>
<td>Health care utilization</td>
<td>x</td>
<td></td>
<td></td>
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<tr>
<td>Pain intensity and pain control (NRS)</td>
<td>x</td>
<td></td>
<td></td>
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<tr>
<td>Sickness-related absence</td>
<td>x</td>
<td></td>
<td></td>
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<tr>
<td>Self-reported benefit</td>
<td>x</td>
<td></td>
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</table>

**Instruments**

<table>
<thead>
<tr>
<th>Instruments</th>
<th>Study I</th>
<th>Study II</th>
<th>Study IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain Disability Index (PDI)</td>
<td>x</td>
<td>x</td>
<td></td>
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<tr>
<td>Short Form-36 Health Survey (SF 36)</td>
<td>x</td>
<td></td>
<td></td>
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<tr>
<td>Tampa Scale for Kinesiophobia (TSK)</td>
<td>x</td>
<td></td>
<td></td>
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<tr>
<td>Pain Catastrophizing Scale (PCS)</td>
<td>x</td>
<td></td>
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<tr>
<td>Örebro Musculoskeletal Pain Screening Questionnaire (ÖMPSQ)</td>
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</table>

NRS= Numerical rating scale

Pain-related Disability (studies II and IV)

The Pain Disability Index (PDI)\textsuperscript{158} is a questionnaire assessing pain-related disability and social role functioning regarding seven areas: family and home responsibilities, recreation, social role activities, occupation, sexual behavior, self-care and life support activity. Each item ranges from 0-10 (total score 0-70. The PDI is considered has acceptable validity and test-retest reliability\textsuperscript{159,160}. The Swedish version of the PDI\textsuperscript{79} was used in studies II and IV.

Pain prevalence and pain location (study I)

The prevalence of chronic pain (>3 months) during the last 12 months was assessed by specific items included in a self-reported questionnaire. Based on a pain drawing of the body with 18 predefined regions, pain was categorized into three categories: non-chronic pain (NCP), chronic widespread pain (CWP) according to the American College of Rheumatology 1090 criteria for fibromyalgia\textsuperscript{7}, or chronic regional pain (CRP) if the criteria for CWP were not met.

Pain intensity and pain control (studies II and IV)

The maximum pain intensity (study II) and the average pain intensity (study IV) experienced over the past two weeks were scored on a numerical rating scale (NRS)\textsuperscript{161} ranging from 0= no pain to 10= worst pain imaginable. The perceived pain control considering the participants´ strategies to manage pain during an average day was scored on the NRS ranging from 0= no control to 10= total control.
Health care utilization (study I)
Questions about health care utilization during the last 12 months (study I) were responded to in a multiple-choice format with four categories for each health care provider: 0 consultations, 1 consultation, 2-5 consultations and >5 consultations. The ordinal data on health care utilization included consultations with physiotherapists, general practitioners, rheumatologists, orthopaedic surgeons/general surgeons, pain physicians, emergency room physicians, occupational physicians and other physicians.

Health-related quality of life (study I)
The standard version of the Short Form-36 Health Survey (SF 36)\textsuperscript{162} (study I) measures health-related quality of life across eight generic health concepts, covering physical, psychosocial and health variables. It is considered generic and represents basic human functions and well-being. The questionnaire consists of 35 items grouped into the following eight categories: physical functioning, role function – physical aspects, bodily pain, general health perception, vitality, social functioning, role function – emotional aspects, and mental health. For each item, raw scores were coded, summed and transformed into a subscale according to a scoring algorithm\textsuperscript{162} ranging from 0-100, where a higher score indicates better health. The Swedish version of the SF-36 that was used in the current study has been reported to be reliable and valid in general adult and elderly populations\textsuperscript{163-165}.

Sickness-related absence (study II)
Data on sickness-related absence periods were gathered from the Swedish Social Insurance Agency Register during the entire period from three months prior to baseline to the 10-year follow-up. The register includes data on sickness-related compensation periods (i.e., days of sick leave and disability pension) exceeding 14 days, and different degrees of compensation from 25% to 100% of the full-time compensation are also available.

Self-reported benefit (study II)
Self-reported benefit from the intervention and confidence in solving future problems were measured by two study-specific ordered-category items. The first question was “To what degree have you had benefits from what you learned from treatment?” A four-point item ranging from 1 = “no benefit” to 4 = “very large benefit” was used. The second question was “How confident are you that you can cope with future problem situations?” A five-point item ranging from 1 = “very confident” to 5 = “very unconfident” was used.
Fear and avoidance (studies II and IV)
The Tampa Scale for Kinesiophobia (TSK)\textsuperscript{166} was used to assess fear of movement and/or re-injury. The scale consists of 17 items (total score 17-68), and a cut-off score of ≥37 indicates high levels of fear-avoidance beliefs. Responses are made on a 4-point Likert scale ranging from 1=strongly disagree to 4=strongly agree. Four of the items are reverse-scored. The Swedish version of the questionnaire (TSK-SV) was used in this study and has been reported to be valid and reliable\textsuperscript{167}.

Pain catastrophizing (study IV)
The Pain Catastrophizing Scale (PCS)\textsuperscript{168} was used to assess pain catastrophizing. The scale consists of 13 items (total score 0-52) describing thoughts and emotions related to pain, with a cut-off score of ≥30 for clinically relevant catastrophizing\textsuperscript{169}. The PCS comprises three components of catastrophizing: 1) rumination, reflecting ruminative thoughts and worry; 2) magnification, reflecting magnification of negative experiences of pain; and 3) helplessness, reflecting inability to cope with painful situations. Responders are instructed to rate their thoughts and feelings related to pain using a 5-point Likert scale ranging from 0=not at all to 4=all the time, where a high score indicates a high degree of catastrophizing. The PCS has been used in physical therapy settings and has good psychometric properties, including internal reliability and construct validity\textsuperscript{170}.

Prognostic factors for poor outcome (study IV)
The Örebro Musculoskeletal Pain Screening Questionnaire (ÖMPSQ)\textsuperscript{171} was developed and used to screen for psychological risk factors for long-term pain-related disability\textsuperscript{153}. The ÖMPSQ consists of 25 items, of which 21 are scored (total score 3-210). The questionnaire has good reliability and predictive validity for musculoskeletal pain\textsuperscript{153,172,173}. Different high-risk cut-off scores have been reported in different pain conditions and settings\textsuperscript{149,174,175}. A higher cut-off score, i.e., ≥112, is considered to have high specificity to identify patients at high risk for poor outcome, but with lower sensitivity\textsuperscript{175}. A cut-off of ≥90 has been reported to have lower specificity but higher sensitivity, which increases the ability to identify a majority of patients at high risk of developing long-term disability\textsuperscript{153}. Another purpose of the ÖMPSQ may be to identify potentially modifiable prognostic factors in patients with musculoskeletal pain as a basis for stratified treatment. A few studies have reported psychometric properties of subgroup assignment based on the ÖMPSQ\textsuperscript{151,154,176} but used different methods for categorizing the subgroups.
Observable clinical behavior (study III)

Data on the physical therapists’ clinical behaviors were collected by video recordings during initial consultations with patients seeking care for musculoskeletal pain; the patients were scheduled according to the usual routines. The video recordings were performed at the primary care center where the participants were working. The video camera was placed in a fixed position using a single viewpoint with focus on the physical therapist during the consultation, and the researcher was an observer. Before the video recordings began, the researcher ensured that patients were comfortable with the camera’s presence, and oral informed consent was obtained from every patient. The video recordings lasted 19-69 minutes (mean 39 minutes) and occurred between June 2013 and January 2014.

Observation protocols

Four domains were targeted for the observation. An observation protocol was developed to identify the participants’ specific behaviors regarding the assessment of red and yellow flags and analyzing clinical problems.

**Red flags:** To be defined as having assessed red flags, the physical therapists had to ask at least one question specifically about severe symptoms and other severe diagnoses, traumas or spinal pathology in combination with a question about general health.

**Yellow flags:** The yellow flags were categorized into three domains: 1) beliefs, appraisals, and judgments; 2) emotional responses; and 3) pain behavior, including pain coping strategies. To be defined as having assessed yellow flags, physical therapists had to ask at least one question about specific factors according to the protocol to make it possible to identify or exclude the presence of yellow flags.

**Analysis of the clinical problem** was categorized as one of three models: a) functional behavioral, b) bio-psychosocial, or c) biomedical. For an analysis to be categorized as functional and behavioral, the pain problem had to be defined in behavioral terms, and functional relationships between individual and contextual factors had to be identified and discussed with the patient, for instance, how a patient’s fear of increased pain resulted in avoidance behaviors that were negatively reinforced by subsequent reductions in fear, which in turn impeded participation in important activities. For an analysis to be categorized as bio-psychosocial, both biomedical and psychosocial factors had to be integrated. A biomedical analysis had to be based on solely physical assessments, physical impairments or limitations and the physical environment.

**The assessment of BCTs** was measured using the BCT taxonomy. The BCTs that were observed in the video observations were identified and labeled according to the definitions in the taxonomy. The overall inter-coder reliability
and test-retest reliability has been reported to be good, and the taxonomy provides a reliable method for coding behavior change techniques in intervention studies\textsuperscript{177,178}.

Data management and analysis
Statistical analyses were performed using the IBM, Statistical Package for the Social Science (SPSS) software version 24.0 (SPSS Inc., Chicago, IL, USA). The statistical methods used in studies I-IV are presented in table 3.

Table 3. Statistical methods used in studies I-IV.

<table>
<thead>
<tr>
<th>Methods</th>
<th>Study I</th>
<th>Study II</th>
<th>Study III</th>
<th>Study IV</th>
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<tbody>
<tr>
<td>Mean and standard deviation (SD)</td>
<td>x</td>
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<tr>
<td>Mean and range</td>
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<tr>
<td>Frequencies and percentage</td>
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<td>x</td>
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<tr>
<td>Median and interquartile range (IQR)</td>
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<tr>
<td>Pearson’s chi-squared test</td>
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<td>Fisher’s exact test</td>
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<td>McNemar’s test</td>
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<td>Independent-sample (t)-test</td>
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<td>Mann-Whitney (U)-test</td>
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<td>Binary logistic regression analysis</td>
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<tr>
<td>Weighted kappa analysis</td>
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<tr>
<td>Deductive and inductive video analysis</td>
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Study I
Data on health care utilization were dichotomized at each time point to either high or low health care utilization. High utilization was based on >5 consultations with at least one health care provider, or on ≥1 consultation with at least 3 different health care providers. All other combinations were considered to be low health care utilization. Data on health care utilization for physical therapists and for general practitioners were selected for separate analyses. A binary logistic regression analysis was used to calculate odds ratios and 95% confidence intervals for the association between potential predictive baseline variables and health care utilization in 2016.

Trajectories for health care utilization were identified based on low or high total health care utilization at each point of measurement. Three points of measurements were included in the analyses: 1995, 2007 and 2016. In case of missing data in 2007, data from 2003 were imputed to represent 2007 data in
the analyses. Comparisons between different trajectories were performed using a chi-square test or Fisher’s exact test for categorical data and with independent-sample t-tests for numerical data. Comparisons of pain prevalence, i.e., NCP, CRP, and CWP, and health care utilizations in 1995, 2007 and 2016 were performed with McNemar’s test.

Study II

Between-group analyses of the change scores for the differences between the scores from each variable at post-treatment and at the 10-year follow-up data, were analyzed by Mann-Whitney U-tests.

Regarding the total days of sickness-related absence from the register data, three periods were analyzed: from three months prior to baseline until baseline, from baseline until post-treatment, and post-treatment until the 10-year follow-up. The data on sickness absence were dichotomized into two categories (i.e., absence/ no absence) and were analyzed with Fisher’s exact test. The follow-up questions about self-reported benefit were analyzed with Fisher’s exact test.

Study III

The video recordings were analyzed using a combined deductive and inductive approach (figure 4). An initial deductive analysis was performed based on a protocol with predefined criteria for physical therapists’ assessment of red and yellow flags, definitions of three different models of analysis and a taxonomy of BCTs\textsuperscript{129}. Sequences demonstrating assessment, analyses and use of BCTs in all 12 video recordings were identified and transcribed. The content of the transcriptions was analyzed and organized into subgroups based on the predefined criteria and coding of specific BCTs.

To describe the variation in the physical therapists’ clinical practice, all the selected video sequences were repeatedly reviewed to a) identify the physical therapists’ different ways of assessing, analyzing and using BCTs and b) identify physical therapists’ different ways of interact with their patients during the consultations. Four of the 12 cases were deemed to illustrate the most clinically relevant variations according to the clinical behavior that were targeted in the video-sequences and are presented with brief descriptions of each one’s background, narratives and quotations.
Study IV

Data on the total scores of the measurements included in the concurrent validity analyses against the reference instruments were dichotomized as high or low based on previously established cut-off scores for each instrument: for the ÖMPSQ, ≥90; for the TSK, ≥37; and for the PSC, ≥30. No standardized cut-off score for the PDI was found in previous research. A cut-off score of ≥25 for high pain-related disability was therefore used based on the pooled mean scores on the PDI reported in previous studies on three primary health care samples of patients with musculoskeletal pain79,104.

The concurrent validity of the subgroups based on the ÖMPSQ in comparison to the reference measurements (PDI, TSK and PCS), including data from the first measurement point (baseline), were analyzed with Fisher’s exact test.

The test-retest reliability of the subgroup assignment was performed with quadratic weighted kappa analyses based on the assumption that the three pre-defined groups differed in pain severity according to their graded level (from low to high)179. The weighted kappa analysis was calculated using Vassar Stats180. The values of the weighted $K$-coefficient ($K_w$) were interpreted as follows: below 0.20 as poor agreement, 0.21-0.40 as fair, 0.41-0.60 as moderate, 0.61-0.80 as good, and >0.80 as very good179.
Results

Follow-up of a population-based cohort

Of the 1882 eligible participants, the total number of respondents to the follow-up questionnaire in 2016 was 1184 (63%). Attrition was due to actively declining participation (13%), not responding to the questionnaire (85%), and death of the participant (2%). The study sample consisted of 675 (57%) women and 509 (43%) men, and these rates did not differ significantly compared to the baseline data from 1995, which included 1285 (53%) women and 1140 (47%) men.

Significant differences were found between those who responded and those who did not respond to the follow-up in 2016. Among those who responded, there were more females in the 1st and 2nd age quartiles and more individuals who reported either NCP or CWP at baseline. Immigrants were more likely to be non-responding. Regarding the trajectory analysis, 44% (n=1064) of all participants in 1995 (n=2425) responded to all of the three measures (1995, 2007 and 2016).

The prevalence of chronic pain (CRP and CWP) increased from 1995 to 2007 and from 1995 to 2016, and the NCP group decreased. No differences were found regarding data on total health care utilization between the points of measurements. Regarding consultations to physiotherapists, differences were found between 1995 and 2007, during which high health care utilization decreased, whereas low utilization increased. Increased frequencies of consultations with general practitioners were found from 1995 to 2016 and from 2007 to 2016.

Prediction of high health care utilization in 2016

Significant associations were found between baseline variables and high or low health care utilization in 2016 regarding gender, age, pain prevalence, health-related quality of life, and levels of health care utilization. Further binary logistic regression analyses of the predictors of high health care utilization in 2016 were performed (table 4). Female gender was a predictor of high total health care utilization based on physiotherapist consultations but not on general practitioner consultations. High age was a predictor of high health care utilization based on general practitioner consultations. Both CRP and CWP predicted high health care utilization 21 years after baseline according to total
health care utilization and consultations with physiotherapists and general practitioners, respectively. Being an immigrant did not predict high health care utilization in 2016. Low scores on health-related quality of life (SF36) at baseline regarding all domains were associated with high total health care utilization and with consultations with general practitioners. Low scores in the four domains of bodily pain, general health, vitality and mental health were associated with high health care utilization based on physiotherapist consultations. The results of the logistic regression analysis are presented with ORs and 95% confidence intervals (table 4).

Table 4. Predictive variables at baseline 1995 for high total health care utilization, for physical therapists, and for general practitioners at the 21-year follow-up.

<table>
<thead>
<tr>
<th>Variables 1995</th>
<th>Total health care utilization</th>
<th>Physical therapist</th>
<th>General practitioner</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n=1130</td>
<td>n=1070</td>
<td>n=1107</td>
</tr>
<tr>
<td></td>
<td>OR (95% CI) p</td>
<td>OR (95% CI) p</td>
<td>OR (95% CI) p</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Female</td>
<td>2.0 (1.4-3.0) &lt;0.01</td>
<td>1.9 (1.2-3.1) 0.01</td>
<td>1.3 (0.7-2.3) 0.36</td>
</tr>
<tr>
<td>Immigrant</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Yes</td>
<td>1.6 (1.0-2.7) 0.07</td>
<td>0.9 (0.5-2.0) 0.87</td>
<td>1.6 (0.8-3.4) 0.21</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20-30</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>32-47</td>
<td>1.0 (0.6-1.7) 0.87</td>
<td>1.2 (0.7-2.1) 0.54</td>
<td>0.5 (0.2-1.2) 0.12</td>
</tr>
<tr>
<td>48-59</td>
<td>1.2 (0.7-1.8) 0.69</td>
<td>0.8 (0.4-1.5) 0.50</td>
<td>0.7 (0.4-1.6) 0.43</td>
</tr>
<tr>
<td>60-75</td>
<td>1.6 (0.9-2.9) 0.12</td>
<td>0.4 (0.2-1.2) 0.12</td>
<td>2.2 (1.0-4.8) 0.04</td>
</tr>
<tr>
<td>Pain-group</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NCP</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CRP</td>
<td>1.8 (1.2-2.6) &lt;0.01</td>
<td>1.9 (1.1-3.1) 0.02</td>
<td>2.0 (1.1-3.8) 0.03</td>
</tr>
<tr>
<td>CWP</td>
<td>3.2 (1.9-5.1) &lt;0.01</td>
<td>3.9 (2.1-7.1) &lt;0.01</td>
<td>4.8 (2.4-9.5) &lt;0.01</td>
</tr>
</tbody>
</table>

NCP= Non chronic pain, CRP= Chronic regional pain, CWP= Chronic widespread pain

Trajectories of health care utilization

The trajectories illustrate different patterns of total health care utilization from baseline to the 21-year follow-up. Four distinct trajectories were identified based on visual analyses of the descriptive data: stable high (n=23), stable low (n=744), increasing (n=108), and decreasing (n=107) trajectories. One group fluctuated between high and low levels of health care utilization without a specific direction of trajectory (n=88) and was not included in the analyses.

The stable low group was characterized by low health care utilization at all three points of measurement. A majority of the subjects in the low group reported NCP at baseline (80%), and there was an equal distribution between genders.
The stable high group was characterized by high levels of health care utilization at all measurement time points. This group consisted of significantly more women (74%) compared to the stable low and the increasing groups. A majority of participants in the stable high group reported CWP at baseline (61%).

The increasing group was characterized by low levels of health care utilization at baseline followed by an increasing trend. A majority of the subjects were women in the increasing group (72%). Approximately half of the participants in the increasing group reported CRP or CWP at baseline.

The decreasing group was characterized by high levels at baseline followed by a decreasing trend. Nearly 80% of all the participants reported CRP or CWP at baseline in the decreasing group.

Associations between baseline characteristics and trajectories of health care utilization are presented in table 5.
<table>
<thead>
<tr>
<th>Baseline variables</th>
<th>1. Stable low n (%)</th>
<th>2. Stable high n (%)</th>
<th>Group 1 vs 2 p-value</th>
<th>3. Increasing n (%)</th>
<th>Group 1 vs 3 p-value</th>
<th>4. Decreasing n (%)</th>
<th>Group 1 vs 4 p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>744</td>
<td>23</td>
<td></td>
<td>108</td>
<td></td>
<td>107</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td>0.05</td>
<td>&lt;0.01</td>
<td></td>
<td>0.13</td>
<td></td>
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<tr>
<td>Women</td>
<td>399 (54)</td>
<td>17 (74)</td>
<td></td>
<td>78 (72)</td>
<td></td>
<td>71 (66)</td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>345 (46)</td>
<td>6 (26)</td>
<td></td>
<td>30 (28)</td>
<td></td>
<td>36 (34)</td>
<td></td>
</tr>
<tr>
<td>Immigrant</td>
<td></td>
<td></td>
<td>0.41</td>
<td>0.11</td>
<td>0.09</td>
<td></td>
<td></td>
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<tr>
<td>Yes</td>
<td>56 (8)</td>
<td>3 (13)</td>
<td></td>
<td>13 (12)</td>
<td></td>
<td>13 (12)</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>684 (92)</td>
<td>20 (87)</td>
<td></td>
<td>95 (88)</td>
<td></td>
<td>94 (99)</td>
<td></td>
</tr>
<tr>
<td>Age-group</td>
<td></td>
<td></td>
<td>0.47</td>
<td>0.02</td>
<td>0.15</td>
<td></td>
<td></td>
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<tr>
<td>20-33</td>
<td>203 (27)</td>
<td>3 (13)</td>
<td></td>
<td>22 (20.5)</td>
<td></td>
<td>24 (22)</td>
<td></td>
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<tr>
<td>34-47</td>
<td>243 (33)</td>
<td>10 (43)</td>
<td></td>
<td>29 (27)</td>
<td></td>
<td>34 (32)</td>
<td></td>
</tr>
<tr>
<td>48-59</td>
<td>236 (32)</td>
<td>8 (35)</td>
<td></td>
<td>36 (33)</td>
<td></td>
<td>33 (31)</td>
<td></td>
</tr>
<tr>
<td>60-75</td>
<td>62 (8)</td>
<td>2 (9)</td>
<td></td>
<td>21 (19.5)</td>
<td></td>
<td>16 (15)</td>
<td></td>
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<tr>
<td>Pain-group</td>
<td></td>
<td></td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non chronic pain</td>
<td>594 (80)</td>
<td>1 (4)</td>
<td></td>
<td>61 (56)</td>
<td></td>
<td>23 (22)</td>
<td></td>
</tr>
<tr>
<td>Chronic regional pain</td>
<td>116 (15)</td>
<td>8 (35)</td>
<td></td>
<td>29 (27)</td>
<td></td>
<td>55 (51)</td>
<td></td>
</tr>
<tr>
<td>Chronic widespread pain</td>
<td>34 (5)</td>
<td>14 (61)</td>
<td></td>
<td>18 (17)</td>
<td></td>
<td>29 (27)</td>
<td></td>
</tr>
<tr>
<td>SF 36 Mean (SD)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>PF</td>
<td>94.2 (9.9)</td>
<td>66.0 (17.9)</td>
<td>&lt;0.01</td>
<td>88.2 (17.1)</td>
<td>&lt;0.01</td>
<td>76.9 (20.3)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>RP</td>
<td>91.6 (22.6)</td>
<td>40.5 (38.3)</td>
<td>&lt;0.01</td>
<td>82.6 (32.7)</td>
<td>&lt;0.01</td>
<td>54.3 (41.3)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>BP</td>
<td>81.3 (21.5)</td>
<td>37.1 (14.6)</td>
<td>&lt;0.01</td>
<td>70.5 (26.9)</td>
<td>&lt;0.01</td>
<td>50.3 (24.4)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>GH</td>
<td>83.3 (16.6)</td>
<td>47.4 (18.6)</td>
<td>&lt;0.01</td>
<td>74.6 (21.0)</td>
<td>&lt;0.01</td>
<td>58.4 (23.3)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>VT</td>
<td>75.0 (19.1)</td>
<td>42.3 (21.2)</td>
<td>&lt;0.01</td>
<td>65.4 (22.7)</td>
<td>&lt;0.01</td>
<td>49.6 (23.8)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>SF</td>
<td>93.4 (14.7)</td>
<td>73.6 (22.5)</td>
<td>&lt;0.01</td>
<td>88.2 (20.4)</td>
<td>0.01</td>
<td>77.8 (25.0)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>RE</td>
<td>91.7 (21.9)</td>
<td>60.3 (40.4)</td>
<td>&lt;0.01</td>
<td>81.3 (34.6)</td>
<td>&lt;0.01</td>
<td>74.5 (37.0)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>MH</td>
<td>85.8 (14.9)</td>
<td>67.4 (16.4)</td>
<td>&lt;0.01</td>
<td>77.4 (20.8)</td>
<td>&lt;0.01</td>
<td>71.9 (20.0)</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

Low = ≤ 5 consultations to 1 health care provider, High = >5 consultations with at least 1 health care provider or ≥ 1 consultation to at least 3 different health care providers.

Stable low = low at three measurements, stable high = high at three measurements, increasing = go from low to high, decreasing = go from high to low. SF 36: PF = Physical functioning, RP = Role function -physical, BP = Bodily pain, GH = general health, V = Vitality, SF = Social functioning, RE = Role function - emotional, MH = mental health
Follow-up of tailored behavioral medicine treatment

Data from a total of 43 (44%) participants in the original study group (\textit{n}=97), 20 in the TBT group and 23 in the EBT group were collected at the 10-year follow-up. Thirty-three (77%) of the participants were women, and the mean age was 42.8 years. There were no evident differences in pain-related disability, pain intensity, pain control, fear of movement/(re)injury or baseline variables immediately post-treatment between those who completed the 10-year follow-up and those who did not.

Pain-related disability

No significant differences between the groups were found regarding the change in pain-related disability scores (PDI) from immediately post-treatment to 10 years after treatment (table 6). The differences reported at the two-year follow-up\textsuperscript{123} were levelled out at the 10-year follow-up (figure 5).

Secondary outcomes

\textit{Pain intensity and pain control}: A significant difference in the change-scores from immediately post-treatment to 10 years after treatment was found for the maximum pain intensity (table 6). The TBT group reported increased levels of pain, whereas the EBT group reported decreased levels (figure 6). In total, 24 (56\%) of the participants in the 10-year follow-up reported a score of five or higher for the pain intensity on the NRS. No differences were found between the two groups regarding pain control or fear (table 6).

\textit{Fear and avoidance}: No differences were found between the two groups regarding fear of movement and/or re-injury (table 6).

\textit{Sickness-related absence}: The presence of sickness-related absence at three months prior to baseline, at baseline, post-treatment, and at the 10-year follow-up did not differ between the groups, except for three months prior to the intervention (\(p=0.05\)). In terms of the total days of sickness-related absence (>14 days), there were significant more days of absence in the exercise-based physical therapy group both three months prior to the intervention (\(p=0.02\)) and at the 10-year follow-up (\(p=0.03\)).

\textit{Self-reported benefit}: Regarding the two questions about “perceived benefit of the former treatment”, and “confidence in coping with future problem situations”, no significant differences were found between the groups (\(p=0.63\)).
Figure 5. Pain-related disability at baseline, post treatment, at the 2-year follow-up, and at the 10-year follow-up, measured with the Pain Disability Index (PDI).

Figure 6. The maximum pain intensity at baseline, post treatment, at the 2-year follow-up, and at the 10-year follow-up, measured with the Numerical Rating Scale (NRS).
Table 6. Differences in change scores from between group-analyses of pain-related disability, maximum pain intensity, pain control, and fear of movement/(re)injury immediately at post-treatment and at the 10-year follow-up.

<table>
<thead>
<tr>
<th>Outcome Measurement</th>
<th>Post-treatment Mdn (IQR)</th>
<th>10-year follow-up Mdn (IQR)</th>
<th>Change score Mdn (IQR)</th>
<th>Between-group p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disability (PDI)</td>
<td></td>
<td></td>
<td></td>
<td>0.17</td>
</tr>
<tr>
<td>TBT</td>
<td>4.5 (11.7)</td>
<td>10.0 (16.5)</td>
<td>2.5 (16.8)</td>
<td></td>
</tr>
<tr>
<td>EBT</td>
<td>15.0 (25.0)</td>
<td>15.0 (22.0)</td>
<td>0.0 (11.0)</td>
<td></td>
</tr>
<tr>
<td>Max pain intensity (NRS)</td>
<td></td>
<td></td>
<td></td>
<td>0.03</td>
</tr>
<tr>
<td>TBT</td>
<td>3.0 (4.0)</td>
<td>6.0 (5.7)</td>
<td>1.0 (5.0)</td>
<td></td>
</tr>
<tr>
<td>EBT</td>
<td>8.0 (5.0)</td>
<td>6.0 (7.0)</td>
<td>0.0 (5.3)</td>
<td></td>
</tr>
<tr>
<td>Pain control (NRS)</td>
<td></td>
<td></td>
<td></td>
<td>0.49</td>
</tr>
<tr>
<td>TBT</td>
<td>8.0 (4.5)</td>
<td>7.5 (3.8)</td>
<td>0.0 (6.0)</td>
<td></td>
</tr>
<tr>
<td>EBT</td>
<td>7.0 (3.0)</td>
<td>7.0 (4.0)</td>
<td>0.0 (4.3)</td>
<td></td>
</tr>
<tr>
<td>Fear of movement (TSK)</td>
<td></td>
<td></td>
<td></td>
<td>0.25</td>
</tr>
<tr>
<td>TBT</td>
<td>25.0 (9.8)</td>
<td>28.5 (10.0)</td>
<td>2.3 (10.6)</td>
<td></td>
</tr>
<tr>
<td>EBT</td>
<td>28.0 (12.0)</td>
<td>29.0 (12.0)</td>
<td>2.0 (11.0)</td>
<td></td>
</tr>
</tbody>
</table>

TBT= Tailored behavioral treatment. EBT= Exercise-based physical therapy. PDI= Pain Disability Index (0-70), low scores indicate low disability. NRS= Numerical Rating Scale (0-10); low scores indicate low pain intensity/pain control. TSK= Tampa Scale for Kinesiophobia (17-68); low scores indicate low fear.

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Observation of physical therapists in primary health care

Description of clinical behavior

The results of the deductive analysis of the observed clinical behavior during the initial consultations with the physical therapists are described with frequencies and content according to the observation protocols (table 7). Red flags were assessed in nine out of 12 observations but were not identified in any of them. Yellow flags were assessed in eight out of 12 observations. In four of the consultations yellow flags regarding pain behaviors, coping strategies and emotional responses were identified.

Model for analysis: Biomedical analyses were performed in ten out of 12 observations. A bio-psychosocial analysis was performed by one of the physical therapists. None of the analyses met the criteria for a functional behavioral analysis. In one case, no analysis was performed at all.

Use of behavior change techniques: BCTs were used by all of the physical therapists, mainly to facilitate physical activity. The most frequently used BCTs concerned information about health consequences, instruction on how
to perform the behavior, i.e., physical exercise, and feedback on behavior. BCTs concerning goals and planning were observed in two of the 12 consultations.

Table 7. Description of the 12 physical therapists’ observed clinical behaviors.

<table>
<thead>
<tr>
<th>Clinical behaviors</th>
<th>Frequency n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total n=12</td>
<td></td>
</tr>
<tr>
<td>Assessment of red flags</td>
<td>9</td>
</tr>
<tr>
<td>Assessment of yellow flags</td>
<td>8</td>
</tr>
<tr>
<td>Functional behavioral analysis</td>
<td>0</td>
</tr>
<tr>
<td>Biopsychosocial analysis</td>
<td>1</td>
</tr>
<tr>
<td>Biomedical analysis</td>
<td>10</td>
</tr>
<tr>
<td>No analysis performed</td>
<td>1</td>
</tr>
<tr>
<td>Use of BCTs</td>
<td>12</td>
</tr>
</tbody>
</table>

BCT= Behavior change techniques

Variation in clinical behavior

The result of the inductive analysis of the video-observations revealed great variation in the physical therapists’ clinical practice regarding their assessments, model used for analysis, use of BCTs, and how they interacted with their patients. Four of the cases were selected to illustrate these variations, and there were various degrees of patient involvement regarding their clinical problem and treatment discussion. In case 1, the patient was involved in communication to a great extent in the combination of biopsychosocial analysis. In case 2, the patient was involved in the assessments, but the psychosocial factors were not integrated into the analysis or treatment. In cases 3 and 4, the physical therapists used closed questions and were more focused on the biomedical symptoms to various degree. Quotes from the selected cases and a detailed description of all 12 cases are presented in study III.

Case 1: High degree of patient involvement and a biopsychosocial analysis

This case was selected to demonstrate a physical therapist who performed a bio-psychosocial analysis and guided her patient, who was seeking care for headache, in a behavioral goal setting. The physical therapist was experienced in her profession and educated in both motivational interviews and manual treatments. She assessed red and yellow flags and identified passive coping strategies and worries related to a stressful family situation. A bio-psychosocial analysis was performed based on the physical examination and the identified yellow flags. The patient was involved in the communication regarding sharing information, making decisions, and responsibility for assessment and
treatment. This was the only case that included a BCT regarding behavioral goal setting.

Case 2: Some patient involvement and a biomedical analysis
This case was selected to demonstrate the assessment and identification of yellow flags that were not included in the analysis of the patients’ clinical problem or related to the use of BCTs. The physical therapist had many years of experience in the profession, was further educated in physical activity and in motivations interviews on a basic level. The patient, seeking care for shoulder pain, was assessed for red and yellow flags, and negative thoughts about recovery and treatment outcome, avoiding behavior related to physical activity was identified by the physical therapist. She performed a biomedical analysis based only on the physical examination, despite the identified yellow flags.

Case 3: Minor patient involvement and a biomedical analysis
This case was selected to demonstrate how a few BCTs can be used in a pedagogical and structural way to promote home-based exercise. The physical therapist had many years in the profession and was educated in the manual treatment of pain. The analysis of the patient, seeking care for rehabilitation after a hip replacement surgery, was based solely on findings from the physical examination. The communication was directed by the physical therapist and focused on biomedical factors. The patient was involved in the discussion about the home-exercises.

Case 4: Very low degree of patient involvement and no analysis
This case was selected to demonstrate a traditional biomedical model of clinical reasoning in which the physical therapist was active and the patient, seeking care for pain of the elbow and shoulder, played a passive role. The communication was strictly directed by the physical therapist and consisted mainly of closed questions. The physical therapist had many years in the profession and was well educated in manual treatment and cognitive behavioral therapy for physical therapists. Red flags, but not yellow flags, were assessed. A general biomedical hypothesis regarding the relationship between pain and work was performed, but it was not specifically based on the patient’s clinical problem or assessments. A few BCTs were used, mainly to promote physical exercise.

Subgroup assignment based on the ÖMPSQ
A total of 40 participants from five primary health care centers completed the first questionnaire at baseline (table 8). The second questionnaire after two to three weeks was completed by 32 participants. Reasons for dropping out were red flags \((n=2)\), not interested in participating in the study, or refraining from consultation due to reduced pain or other reasons \((n=6)\).
Concurrent validity of subgroup assignment

The subgroup assignment based on the ÖMPSQ was associated with scores on the PDI and the TSK (table 9). Being in the low-severity subgroup was associated with low scores on the PDI and the TSK, 2) being in the moderate-severity subgroup was associated with high scores on the PDI and low scores on the TSK, and 3) being in the high-severity subgroup was associated with high scores on both the PDI and the TSK. No association was found between the subgroup assignment and scores on the PCS (table 9).

Table 8. Baseline characteristics of the participants (n=40)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (year), mean (SD)</td>
<td>42 (10)</td>
</tr>
<tr>
<td>Female n (%)</td>
<td>25 (63)</td>
</tr>
<tr>
<td>Nationality (born in Sweden), n (%)</td>
<td>34 (85)</td>
</tr>
<tr>
<td>Duration of pain, n (%)</td>
<td></td>
</tr>
<tr>
<td>&lt;3 months</td>
<td>12 (30)</td>
</tr>
<tr>
<td>≥3 months</td>
<td>28 (70)</td>
</tr>
<tr>
<td>Presence of pain, n (%)</td>
<td></td>
</tr>
<tr>
<td>Persistent</td>
<td>26 (65)</td>
</tr>
<tr>
<td>Intermittent</td>
<td>14 (35)</td>
</tr>
<tr>
<td>Location of pain, n (%)</td>
<td></td>
</tr>
<tr>
<td>Neck</td>
<td>3 (7.5)</td>
</tr>
<tr>
<td>Low back</td>
<td>18 (45)</td>
</tr>
<tr>
<td>Widespread pain</td>
<td>18 (45)</td>
</tr>
<tr>
<td>Shoulder</td>
<td>1 (2.5)</td>
</tr>
<tr>
<td>Pain intensity (average) NRS 0-10, mean (SD)</td>
<td>7 (2)</td>
</tr>
<tr>
<td>Occupation, n (%)</td>
<td></td>
</tr>
<tr>
<td>Working</td>
<td>26 (65)</td>
</tr>
<tr>
<td>Sick leave</td>
<td>6 (15)</td>
</tr>
<tr>
<td>Unemployed</td>
<td>4 (10)</td>
</tr>
<tr>
<td>Maternity leave</td>
<td>3 (7.5)</td>
</tr>
<tr>
<td>Student</td>
<td>1 (2.5)</td>
</tr>
<tr>
<td>ÖMPSQ scale 3-210, mean (SD)</td>
<td>114 (31)</td>
</tr>
<tr>
<td>PDI scale 0-70, mean (SD)</td>
<td>35 (16)</td>
</tr>
<tr>
<td>TSK scale 17-68, mean (SD)</td>
<td>40 (8)</td>
</tr>
<tr>
<td>PCS scale 0-52, mean (SD)</td>
<td>30 (12)</td>
</tr>
</tbody>
</table>

NRS= Numerical Rating Scale, ÖMPSQ= Örebro Musculoskeletal Pain Screening Questionnaire, PDI= Pain Disability Index, TSK= Tampa Scale for Kinesiophobia, PCS= Pain Catastrophizing Scale
Table 9. Concurrent validity of subgroup assignment based on the Örebro Musculo-skeletal Screening Questionnaire (ÖMPSQ), and measures of the Pain Disability Index (PDI), the Tampa Scale for Kinesiophobia (TSK) and the Pain Catastrophizing Scale (PCS) (n=40).

<table>
<thead>
<tr>
<th>Measure</th>
<th>Low severity subgroup n (%)</th>
<th>Moderate severity subgroup n (%)</th>
<th>High severity subgroup n (%)</th>
<th>df</th>
<th>Fisher’s exact test</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PDI (0-70)</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>13.3</td>
<td>0.001</td>
</tr>
<tr>
<td>Low &lt;25</td>
<td>7 (78)</td>
<td>2 (20)</td>
<td>2 (9.5)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High ≥25</td>
<td>2 (22)</td>
<td>8 (80)</td>
<td>19 (90.5)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TSK (17-68)</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>12.1</td>
<td>0.002</td>
</tr>
<tr>
<td>Low &lt;37</td>
<td>5 (56)</td>
<td>7 (70)</td>
<td>3 (14)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High ≥37</td>
<td>4 (44)</td>
<td>3 (30)</td>
<td>18 (86)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PCS (0-52)</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>3.6</td>
<td>0.20</td>
</tr>
<tr>
<td>Low &lt;30</td>
<td>6 (67)</td>
<td>7 (70)</td>
<td>8 (38)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High ≥30</td>
<td>3 (33)</td>
<td>3 (30)</td>
<td>13 (62)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Stability of subgroup assignment
The stability of the subgroup assignment between the two points of measurement for the subgroup assignment, as calculated with the weighted kappa-coefficient, was 0.51 (95% CI: 0.22-0.81), which was considered moderate (Kw0.41-0.60).
General discussion

This thesis includes various aspects of the management of musculoskeletal pain conditions, which are important for further development of the field. In studies I and II the long term perspective was considered: a 21-years follow-up of a cohort study regarding chronic pain and health care utilization which adds new information about the long-term impact of chronic pain on health care utilization, and a 10-years follow-up of an RCT including tailored behavioral treatment and exercise-based treatment in primary health care, contributing valuable knowledge about the development of pain and disability in a primary health care sample. In study III, the potential and challenges for the integration of behavioral medicine treatment into physical therapy were explored and described. In study IV, an instrument for subgrouping patients based on psychological prognostic factors was evaluated for use in stratified treatment.

Chronic pain is a major problem in the general population, but for some subgroups, it is a problem that extends over a 21-year period and is associated with high healthcare utilization. Even individuals with musculoskeletal pain who participated in an RCT comparing TBT and EBT still reported moderate pain intensity 10 years after the intervention. Although our findings did not correspond with high levels of disability, chronic pain has been reported to be associated with great physical and psychosocial suffering for the individual. The results from the long-term follow-ups indicate that the treatment of musculoskeletal pain for specific subgroups has not been sufficiently effective in the long run, and further efforts are needed to improve the long-term outcomes.

Most patients with musculoskeletal pain seek primary care initially, where physical therapists are often the first health care providers. In study III, a majority of the physical therapists assessed red and yellow flags, in line with clinical guidelines, but they did not integrate the psychosocial findings into the analysis and treatment, indicating a need for further efforts to integrate behavioral medicine into physical therapy.

Psychological prognostic factors for a poor prognosis have been reported as significant for targeting treatment and can be identified with screening tools developed for this purpose. Our results indicate that the ÖMPSQ can be used to target treatment to different subgroups based on psychological factors, but
it needs to be complemented with an assessment of the pain condition, including pain catastrophizing and individual characteristics.

Prognostic factors for health care utilization

Health care utilization has been associated with several pain conditions, and with chronic pain in particular. Our findings that chronic pain predicted high health care utilization 21 years later, indicated that a specific vulnerable group, characterized by CWP, female gender and high age, is more likely to utilize health care resources in the long run. This result may also indicate that treatment has not been successful for individuals who still experience chronic pain for such a long period of time. The results from previous research have been inconsistent regarding predictors of high health care utilization. Similar to our findings, several studies have reported that chronic pain\textsuperscript{13,14,16,55,181,182} and female gender\textsuperscript{13,52,53,181} predicted high health care utilization. In contrast, no differences regarding gender were found in a Swedish population-based study by Andersson et.al.\textsuperscript{182}. Old age has also been found to predict high health care utilization\textsuperscript{16,52,181}, which is in line with our findings, while no association between age and health care utilization was found in a study by Ferreira et.al.\textsuperscript{53}. Regional musculoskeletal pain in the acute stage (\textless{}4 weeks duration) has also been associated as a predictor of health care utilization after 18 months\textsuperscript{183}, and after 20-years\textsuperscript{60}. Health care utilization may vary between different pain populations and the prevalence has been investigated and analyzed using different methods, which can explain the different results. However, the long follow-up period and the identification of trajectories of health care utilization over the entire period is unique to our study.

Individuals with chronic pain are expected to have an increased health care utilization compared to those without pain, but our findings emphasize the importance of identification of predictors for health care utilization early in the course of pain to target the treatment against these variables. Psychological predictors for high health care utilization, i.e. fear and avoidance, anxiety, and negative beliefs regarding consequences and outcome have been reported\textsuperscript{54,183}, as well as level of disability\textsuperscript{53}. These factors are also important variables to consider in the management of musculoskeletal pain, but were not targeted in study I.

The prevalence of chronic pain increased over a 21-year follow-up period in the general population, which was also expected, considering the aging study population. Interestingly, despite the increased prevalence of pain, no corresponding increase was seen in health care utilization during the same period. Among individuals with low back pain, less than 60\% were seeking care for their pain condition\textsuperscript{53}, and in an elderly population (\textgeq{}62 years) there were less than 50\%\textsuperscript{184}, similar to our results. Individuals with chronic pain may have adapted to their pain condition over time, resulting in a decreased impact on
function in daily activities and on health care utilization. In a study on patients with fibromyalgia, increased health care utilization was reported the first six months after the diagnosis, followed by stabilization over a three-year period\textsuperscript{56}, which supports the explanation of our findings.

Behavioral medicine and physical therapy

In recent years a paradigm shift in physical therapy has been discussed regarding the management of chronic pain toward an integrated model including biomedical, psychosocial and behavioral factors\textsuperscript{116}. One example of an integrated intervention is the tailored behavioral medicine treatment intervention evaluated in study II, which was based on a treatment protocol including graded activity. Significant improvements were found in the TBT group regarding pain-related disability, pain intensity and pain control\textsuperscript{104}. Positive treatment effects of graded activity regarding disability and pain variables in musculoskeletal pain have also been reported in other studies\textsuperscript{106,185}, and improved adherence to exercise and a higher level of physical activity have been reported in patients with osteoarthritis\textsuperscript{105}. Other studies have reported equally effects of graded activity treatment compared with exercise-based treatment\textsuperscript{106,107,186}, in contrast to the findings at post-treatment and at the two-year follow-up in our sample. Treatment effects of behavioral medicine interventions in patients with musculoskeletal pain are still sparsely reported, and there is no consensus about the beneficial effects of behavioral medicine treatments versus more traditional treatments, i.e., exercise-based therapy and manual therapy treatments. There is also limited evidence regarding which patients would benefit from which type of treatment. When applied in a physical therapy context, it is important that physical therapists have the knowledge and skills regarding assessments of physical and psychosocial factors, identification of patients at risk for poor prognosis, and what impact those factors have on behaviors that are important to the patient. This information is crucial for the analysis of the patient's clinical problem and as a basis for the choice of treatment. Identification of psychological variables such as a high level of fear and avoidance beliefs and catastrophizing behavior has reported to be important when allocating a specific treatment, e.g., graded exposure; otherwise, the effect may fail, or at worst, lead to a deterioration of the treatment outcome\textsuperscript{187}. To succeed, the treatment has to be tailored based on individual functional behavioral analyses of key behaviors and to the patient's biomedical and psychosocial condition, but it must also be targeted based on prognostic factors.
Long-term outcome

Few studies on behavioral medicine interventions applied in physical therapy have reported treatment effects longer than 12 months after the intervention. The purpose of behavioral change interventions in chronic pain is to improve the physical and psychosocial function of the individual through learning new strategies, i.e., coping with barriers to recovering. Another goal is to acquire strategies for maintaining of behavioral change, and preventing a relapse to maladaptive behaviors with pain-related disability as a consequence. That is, an important reason why the long-term effect of such interventions has to be investigated to provide valuable information when designing future research on pain interventions.

Previous studies have been reported that positive effects of behavioral medicine treatment regarding disability, pain intensity and pain control were maintained two years\(^{123}\) and five years\(^{188}\) after the intervention. In study II, no between-group differences remained at the 10-year follow-up. The total number of sickness-related days of absence, included as an outcome variable in the 10-year follow-up, was found to be low in both groups. A limitation regarding the register data on sickness-related absence was that we did not have information about short-term absence (<14 days). There may be several explanations for our findings. We had no data on co-morbidities, important life events or received pain treatments that may have affected participants' experience of their pain condition after such a long time.

The main outcome in study II was pain-related disability, which is one of the most important consequences related to chronic pain. Although no differences between the groups could be detected in the follow-up of the previous RCT, the participants in both groups still reported a moderate level of pain-related disability 10 years after the intervention (figure 5). The median scores on the PDI were 10.0 for the TBT group and 15.0 for the EBT group. The scores were below the cut-off score of ≥25 for high disability used in this thesis but above the scores for recovery of ≤4\(^{189}\). The moderate levels of pain-related disability at the 10-year follow-up did not correspond to high levels of pain intensity, which were reported to be moderate to high in both groups. The results indicate that the participants were still affected by their pain but did not experience such a great impact on the function in daily activities. As previously discussed, adaption to the pain condition may have occurred over time, resulting in a decreased level of self-reported disability.

Assessment of prognostic factors

To improve the assessments of psychological prognostic factors in a systematic way, the use of screening tool in physical therapy is suggested. Assessment of prognostic factors for long-term disability and poor outcome is recommended in clinical guidelines\(^{22,23}\). In study IV, assignment to subgroups
with low, moderate and high pain condition severity based on the ÖMPSQ was found to have acceptable concurrent validity and stability, considering the small study sample. In line with our findings, assignment to prognostic subgroups based on the ÖMPSQ has been used in previous studies\textsuperscript{149,151,154} and has been found to be a valid and reliable screening tool for this purpose. However, the definitions of the subgroups in these studies differed somewhat from our classification. The assignment to the three subgroups used a cut-off score of \( \geq 90 \) for the high subgroup, which has not been previously validated against the PDI, TSK and PCS. However, if the ÖMPSQ is to be used to stratify treatment based on the different prognostic subgroups, further studies are required to investigate the effect of treatment targeted against these subgroups in patients with musculoskeletal pain.

A similar screening tool is the STarT Back Tool (SBT), which was developed to identify prognostic subgroups of patients with back pain in primary health care\textsuperscript{190}. The purpose of the SBT is to categorize patients with modifiable prognostic factors into low-, medium- and high-risk subgroups for use as basis for treatment. Comparisons between the ÖMPSQ and the SBT have reported equally good concurrent validity\textsuperscript{154,176} and similar ability to discriminate patients according to standard reference instruments\textsuperscript{154,191}. The correlation between the ÖMPSQ and the SBT regarding assignment to low-, moderate- and high-risk subgroups has been reported to have moderate agreement\textsuperscript{154,176}. Although both instruments are suggested to be used for assignment to different subgroups in clinical practice, there are differences to consider. The SBT is short and easy to use, comprising only modifiable prognostic factors and was developed for patients with back pain, while the ÖMPSQ provides more information about pain characteristics and background variables, and has also been used for other musculoskeletal pain conditions and was therefore considered to be best suited for our purpose. Valid and reliable screening tools are important to identify which patients will benefit from a specific type of treatment, i.e., minimal interventions, exercise-based therapy, graded activity or graded exposure, according to prognostic factors.

Stratified treatment by target prognostic factors based on the subgroup level has been reported\textsuperscript{150}, and a few studies have reported the effects of stratified treatment for back pain provided in primary health care. Promising results of stratified treatment based on prognostic subgroups, compared with non-stratified treatment, e.g., exercise-based physical therapy or manual treatment, have been reported in patients with low back pain regarding disability, psychological and pain variables\textsuperscript{192-194}. In contrast, another study on patients with back and/or neck pain did not find that the received stratified treatment corresponded to the different risk subgroups, and a majority of the patients received “moderate-risk” treatment regardless of risk profile\textsuperscript{195}. Matched treatment based on psychological risk profiles did not have a better outcome than unmatched treatment\textsuperscript{196}. Based on the findings of \textit{study IV}, the ÖMPSQ can
be used for stratified treatment but has to be validated in patients with different levels of pain condition severity.

A mean score of 35 on the PDI was reported in study IV, indicating a high level of pain-related disability. The scores was higher than the baseline score for the participants in study II despite the similar clinical setting and the inclusion criteria104. Similar with our results, a study consisting of patients in multidisciplinary pain rehabilitation programs with a variety of musculoskeletal pain conditions, a mean PDI score of 37.7 has been reported 197, indicating that our sample was not representative of patients seeking primary health for pain conditions.

Strategies for integration

To integrate behavioral medicine treatment into physical therapy, it is urgent to investigate the current opportunities and challenges in clinical practice, which have been reported in previous studies. In study III, new knowledge about experiences with physical therapists’ observed behavior was added, confirming previous studies reports of increasing awareness about the importance of integrating psychosocial factors into clinical practice139,140,143,147,148. A finding observed in our study was that the majority of the participants assessed red and yellow flags, although they did not integrate their findings into the analysis and treatment. In contrast, an observational study of physical therapists’ use of cognitive behavioral principles in pain treatment142 reported that most of the physical therapists did not assess psychosocial factors. Another finding, similar to our results, was that the use of goal-setting was under-utilized by a majority of the physical therapists.

Another finding of our study was the frequent use of BCTs by all participants. Not surprisingly, BCTs targeting activity behaviors, such as “instructions on how to perform a behavior”, “demonstration of the behavior”, and “informing about health consequences” of a specific behavior, were most commonly used, which was similar to previous results76. Techniques associated with self-regulation, e.g., goal setting and self-monitoring of a target behavior, were not used by the majority of the participants, in line with previous results76,142, while other studies have reported that physical therapists used goal-setting in their clinical practice104,147. The taxonomy of behavior change techniques129 was used only to identify, organize and describe the observed behaviors in the video-observation in study III, regardless of whether they were based on biomedical or psychosocial findings. The intention of the observed BCTs and their relation to the findings from the assessments were not investigated. When integrating behavioral medicine treatment into physical therapy, the BCTs could also be used in the design and planning of behavioral change interventions by the selection of BCTs that have been reported to have the best effects on specific behaviors133,136-138 and applied within a theoretical
framework, e.g., SCT or the Transtheoretical Model of Behavior Change (TTM)\textsuperscript{198}, to improve the treatment outcomes\textsuperscript{76}.

Several aspects need to be considered when behavioral medicine is to be integrated into physical therapy: understanding of the impact of psychological factors on the consequences of pain and recovery, adequate skills training (i.e., assessments, analysis, patient-centered communication and treatments), and supervision and support during the process\textsuperscript{116-118}. Increased understanding and knowledge about psychosocial factors as well as improved competence and confidence regarding the assessment and delivery of treatment have been reported after education and training in cognitive behavioral therapy and behavioral medicine of physical therapists\textsuperscript{117-119,144,199}. Important factors to consider in those studies in which the integration of such treatment has been successfully reported are that substantial time has been allocated for education, continuous supervision and follow-up throughout the study. These strategies are considered costly and time consuming and could be difficult to implement in clinical practice. Although a paradigm shift regarding pain management among physiotherapists has been highlighted\textsuperscript{116}, the more traditional biomedical approach still dominates, and changes in attitudes, beliefs and expectations of the physical therapists’ role as a professional are needed in health care.

If behavioral medicine treatment is to be integrated into physical therapy, it is important to implement change strategies on different levels; the individual level, e.g., clinical behavior; the environmental level, e.g., attitudes on the workplace and patients’ expectations; and on policy level, e.g., health economic costs and priorities.

To successfully change clinical behavior, an integration of behavioral medicine into academic physical therapy education has been requested\textsuperscript{116}. At the undergraduate level, such integration has begun but has to be further developed, even in continuing education in physical therapy.

Methodological considerations

Longitudinal studies

Long term follow-ups have both strengths and weaknesses to be considered\textsuperscript{200}. The most important strengths in the population cohort, \textit{study I}, is the time line between the predictive baseline variables and the health care utilization at repeated measures over a 21-year follow-up period, which provided useful information about health care utilization in relation to the prevalence of chronic pain. Long-term follow-ups of rehabilitation interventions are often requested, but are difficult to perform and sparsely reported. In \textit{study II}, the effects of treatment aimed at changing target behaviors in chronic pain conditions were studied, and it was of great interest to investigate the adoption and mainte-
nance of these changes in the longer perspective and to describe the pain condition severity in the remaining participants after such a long time. Pain-related disability was the main outcome, and a few secondary variables for which a significant difference was reported at post-treatment and at the 2-year follow-up were selected to be included in the 10-year follow-up. Sickness-related absence was included as a new variable to contribute additional information about the long-term outcome. A limitation was that the data on sickness-related absence were based only on register data, and no information about short periods of absence was available.

A weakness of both follow-ups was the rate of attrition. In study I, it was a plausible threat to the external validity, with an increased risk of selection bias in the remaining sample with a higher response rate for females, individuals with NCP or CWP and high age, which limits the possibility of generalizing the results to the general population. In study II, the attrition rate raised important issues regarding the validity of the data at the 10-year follow-up. The study was not sufficiently powered to detect meaningful differences after such a long time. There was also a plausible threat to the external validity considering the attrition. However, no differences were reported regarding the drop-outs, baseline characteristics or outcome measures between the two treatment groups, and no evident differences in the baseline characteristics were identified between those who responded to the follow-up and those who did not. Considering the long time span, the response rate of 63% in study I was good, and the response rate of nearly 50% in study II was acceptable. The criteria for acceptable loss to follow-up in RCTs and cohort studies vary between 20% and 50% in the literature.

The data on health care utilization in study I were self-reported from the last 12 months and were dichotomized into either low or high, based on the number of consultation to physicians and physical therapists. Higher rates of consultations regarding self-reported data compared to register data has been found, which may has influenced the results. A combination of self-reported data and register data may provide the most valid data on health care utilization.

**Video analysis**

In study III, a combination of deductive and inductive analyses was used. The strengths were that the content in the consultation could be investigated with both quantitative and qualitative methods, which provided important information about the clinical practice during an initial consultation. Video observation provides both audio and visual information about a specific situation, which is a strength, but it does not allow a further extended investigation of thoughts and intentions. The variation in the physical therapists’ clinical practice regarding assessment, analysis, use of BCTs and the communication with their patients was illustrated in four selected cases. A weakness of this method
was that the data collected from 12 video observations were not completely and deeply analyzed. Thematic analysis has been used in previous interview studies of physical therapists’ clinical practice\textsuperscript{143,148,199,203} and would have been an alternative qualitative method to identify and describe the variation in the physical therapists’ clinical practice. However, in video-based research on health care providers quantitative coding and frequencies of coding behaviors are included in the analysis method\textsuperscript{204}. A combination of video-observation and interview may provide valuable information about both overt and covert behaviors in a specific situation. We complemented our video-data with brief interviews with the physical therapists, which validated the findings from the video-recording.

Validity of subgroup assignment

The associations between the assignment to subgroup with low, moderate and high pain condition severity and the dichotomized scores on three reference instruments were analyzed with Fischer’s exact test. Based on the results of these analyses, two instruments (PDI and TSK) were demonstrated to be associated with assignment of the subgroups, but not the PCS. A limitation of the study was the small study sample, which did not make it feasible to perform univariate comparisons between the subgroups or to use cluster analysis to identify different subgroups. Considering that the current method of subgroup assignment based on the ÖMPSQ has not been reported previously, the results can be used as a first indication that the psychometric properties are acceptable. Further investigation of the predictive and discriminative validity and the stability of the subgroup assignment is needed in different pain populations and with a larger sample size, with the purpose of being used for stratified treatment.
Conclusions

- Chronic pain, particularly CWP, has implications for health care utilization over 21-years. A trajectory of high health care utilization was identified in a small group in the general population, characterized by CWP and female gender, which indicates that the treatment of chronic pain in this group has not been successful and remains a challenge for health care and society.

- The between-group differences in favor of tailored behavioral medicine treatment regarding pain-related disability, pain intensity and pain control and fear of movement/(re) injury, which were previously observed post-treatment and at the two-year follow-up, were not maintained 10 years after treatment. The study highlights the challenges associated with the control of threats to internal validity in the long-term perspective.

- Our results suggest that physical therapists, although well-educated and motivated to integrate behavioral medicine into physical therapy, mainly perform their analyses of patients’ pain conditions based on biomedical findings, indicating a need for innovative and evidence-based implementation strategies.

- Subgroup assignment according to the ÖMPSQ appears to be valid and stable over time. It could be used as a basis for stratified treatment in patients with musculoskeletal pain in primary health care but needs to be complemented with assessments of individual characteristics and behaviors related to the outcomes of interest.

Clinical implications

Prognostic factors such as chronic pain (particularly CWP) and female gender need to be considered when allocating health care resources and planning treatment to improve the long-term treatment outcomes.

Physical therapists are recommended to use early assessment of prognostic factors, and subgroup assignment based on the ÖMPSQ can be recommended to target treatment to different subgroups. Given the positive outcomes over
the first two years after the TBT intervention, treatment should also be tailored based on individual functional behavioral analyses of key behaviors and to the patient’s biomedical and psychosocial condition. To improve long-term outcomes, strategies for the maintenance of health behavioral changes are suggested to be included.

Methods for integrating behavioral medicine treatment into physical therapy need to be evaluated and improved. Integrating into physical therapy education (both undergraduate and beyond), supervised skills-training, follow-ups of physical therapists’ clinical behavior, and health economic incentives to facilitate a change in clinical practice are suggested to succeed.

Future research

Assignment to subgroups with low, moderate and high pain condition severity based on the ÖMPSQ should be further validated in different pain populations and in larger samples. Future studies are needed to evaluate the effects of stratified treatment by targeting prognostic factors based on the ÖMPSQ in combination with individual functional behavioral analyses of key behaviors and health outcomes. Strategies for the maintenance of behavioral change in individuals with musculoskeletal pain should be explored in qualitative studies and subsequently evaluated in intervention studies.

A stepped care design would be used in future studies to differentiate treatments according to the patient’s need and pain condition severity to evaluate both treatment effects and the health-related cost-effectiveness.

To facilitate changes in physical therapists’ clinical reasoning and to integrate behavioral medicine into clinical practice, more extensive interviews in combination with video-observations are suggested. When a clinical behavioral change is integrated, the effect on treatment outcomes needs to be evaluated.
Svensk sammanfattning

Muskuloskeletal smärta är vanligt förekommande och drabbar de flesta individer någon gång under livet. För de flesta klingar smärtan av inom några veckor, men ca: 10 % utvecklar kronisk smärta (>3 månader) vilket ofta medför ett stort lidande för individen med fysiska och psykosociala konsekvenser samt en ökad samhällskostnad i form av sjukskrivning och vårdkonsumtion. Trots framsteg inom smärtforskning, både inom biomedicinska och psykosociala områden, finns det inga effektiva metoder för att behandla och förebygga kronisk smärta vilket är en utmaning både för sjukvården och samhället. Kronisk smärta är ett komplext tillstånd som involverar biologiska, psykosociala och beteendefaktorer. Under de senaste decennierna har intresset och kunskapen om psykosociala faktorer och strategier för hälsofrämjande beteendeförändring ökat inom smärtforskning och är också huvudfokus i denna avhandling.

Syftet med avhandlingen var att studera prognostiska faktorer för vårdkonsumtion relaterat till smärta i befolkningen, samt att undersöka långtidseffekter av individuell beteendemedicinsk behandling för patienter med muskuloskeletal smärta i primärvården. Ett annat syfte var att öka kunskapen om beteendemedicinsk kompetens hos fysioterapeuter avseende kliniskt resonerande vid muskuloskeletala smärttillstånd, samt att identifiera förutsättningar och utmaningar för att integrera beteendemedicin i fysioterapi.


**Studie II** var en 10-årsuppföljning av en randomiserad kontrollerad studie på patienter med muskuloskeletal smärta, där skräddarsydd beteendemedicinsk behandling jämfördes med fysisk träning. Båda behandlingsprotokollen utfördes av fysioterapeuter i primärvården. Det var ingen signifikant skillnad avseende funktionsnivå, smärta, smärtkontroll eller rörelserädsla mellan grupperna vid 10-årsuppföljningen. Den statistiskt säkerställda skillnaden mellan grupperna, med större effekt för skräddarsydd beteendemedicinsk behandling
som rapporterades direkt efter avslutad behandling och efter 2-år, kvarstod därmed inte vid 10-årsuppföljningen.


I *studie IV* undersöktes samtidig validitet av indelning till tre subgrupper med olika svårighetsgrad av smärta baserat på Örebro Pain Screening Questionnaire (ÖMPSQ), vilka jämfördes med referensinstrumenten Pain Disability Index (PDI), Tampa Scale for Kinesiophobia (TSK) och Pain Catastrophizing Scale (PCS). Stabilitet över tid av subgruppsindelningen undersöcktes också vid två tillfällen med två till tre veckor mellan mätningarna.

Konklusionerna i denna avhandling är: 1) Man bör tidigt uppmärksamma individer med kronisk smärta, kvinnligt kön och hög ålder för att kunna erbjuda en riktad behandling och minska vårdkonsumtionen på lång sikt; 2) Fysioterapeuter bör systematiskt undersöka riskfaktorer för sämre prognos. ÖMPSQ kan rekommenderas för indelning till subgrupper med olika svårighetsgrad av smärttillstånd, men behöver kompletteras med andra undersökningar utifrån patientens behov; 3) Smärtbehandling bör vara riktad mot prognostiska subgrupper, men även utifrån individuellt funktionell beteendeanalyt av nyckelbeteenden och undersökningsfynd för att kunna optimera behandlingsseffekterna. Strategier för bibehållande och återfallsprevention bör vara inkluderade i behandlingen; 4) Metoder för att integrera beteendemedicin i fysioterapi behöver utvärderas och förbättras. Förslag på åtgärder är implementering i grundutbildning och vidareutbildning för fysioterapeuter samt klinisk träning och handledning.
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