Screening, Targeting, Tailoring, and Implementation in Primary Health Care

An integrated physical therapy and behavioural medicine approach to persons with persistent musculoskeletal pain

MARIA SANDBORGH
Dissertation presented at Uppsala University to be publicly examined in Sal IX, Universitetshuset, Övre Slottsgatan 2, Uppsala, Friday, May 16, 2008 at 13:00 for the degree of Doctor of Philosophy (Faculty of Medicine). The examination will be conducted in Swedish.

Abstract

This thesis deals with a behavioural medicine approach to the management of patients with persistent musculoskeletal pain in primary health care physical therapy. The main aims of the thesis were; to develop, and evaluate the psychometric properties of, a screening instrument for risk of disability and; to evaluate the implementation and effects of a targeted and tailored treatment.

The studies comprise four samples of patients with musculoskeletal pain exceeding one month. All subjects were recruited when consulting physical therapists in Swedish primary health care settings. For development and evaluation of the Pain Belief Screening Instrument (PBSI) four samples were used; two samples (n1 = 215 and n2 = 93) in Study I, one sample (n = 168) in Study II, and one sample (n = 45) in Study III. For evaluation of implementation and effects of targeted and tailored treatment the 32 patients who completed treatment in Study III were used. In Study IV treatment documents of 18 patient cases from Study III were studied to evaluate treatment integrity.

The concurrent and predictive validity of the PBSI was good, and the instrument was therefore used to define subgroups with either a high or low risk for disability. A low treatment dosage of a tailored treatment for low risk patients was tried and found equally efficient as a longer treatment focusing physical exercise. Subjects who received a treatment tailored to individual patient characteristics perceived a better global outcome of treatment compared to subjects in the control group. However, no between-group differences in the disability measures were found. The evaluation of treatment integrity displayed low therapist adherence to the treatment rationale for the tailored treatment.

The studies demonstrate ways to systematically integrate a behavioural medicine approach and physical therapy. The results indicate efficiency in managing patients with persistent musculoskeletal pain in primary health care.

Keywords: physical therapy, behavioural medicine, screening, chronic pain, primary health care

Maria Sandborgh, Department of Public Health and Caring Sciences, Uppsala Science Park, Uppsala University, SE-75183 Uppsala, Sweden

© Maria Sandborgh 2008

ISSN 1651-6206
urn:nbn:se:uu:diva-8665 (http://urn.kb.se/resolve?urn=urn:nbn:se:uu:diva-8665)
To my family

“Go as far as you can see; when you get there you’ll be able to see farther”

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


Reprints of papers I and II were made with the permission of the publishers
## Contents

Introduction ................................................................................................... 11
  About the thesis ........................................................................................ 11
  Musculoskeletal pain ............................................................................... 12
  The development of pain-related disability ............................................. 12
  Assessment and treatment from a movement behaviour perspective ..... 14
  Screening .................................................................................................. 15
  Targeting and tailoring of treatment ....................................................... 15
  Self-management in persistent musculoskeletal pain .............................. 16
  Development of new treatments and treatment integrity ....................... 17
  Context and scope of the present thesis ................................................ 18

Aims .............................................................................................................. 20

Methods ........................................................................................................ 21
  Design ...................................................................................................... 21
  Setting, participants, study materials, and procedures ......................... 21
    Study I .................................................................................................. 21
    Study II ................................................................................................ 23
    Study III .............................................................................................. 23
    Study IV .............................................................................................. 24
  Targeted and tailored intervention, experimental condition ............... 26
    Targeted and tailored treatment ....................................................... 26
    Training of physical therapists .......................................................... 27
  Physical exercise intervention, control condition .................................. 29
  Treatment integrity in Study III ............................................................. 30

Measures ........................................................................................................ 31
  Pain-related disability ............................................................................ 31
  Fear-avoidance variables ....................................................................... 32
  Self-efficacy for everyday activities ..................................................... 32
  Screening of risk profiles for disability ................................................ 32
  Pain intensity .......................................................................................... 33
  Treatment integrity measure ................................................................. 33

Data management and analyses ................................................................. 33
  Study I .................................................................................................. 33
  Study II ................................................................................................ 35
  Study III ............................................................................................... 35
Abbreviations

CAT The Catatrophizing subscale of the Coping Strategies Questionnaire
CB Cognitive behavioural
FBA Functional behavioural analysis
M1, M2 First and second point of measurement
MSP Musculoskeletal pain
NRS Numerical rating scale
PBSI The Pain Belief Screening Instrument
PCA Principal Component Analysis
PDI The Pain Disability Index
PGPQ The Patient Goal Priority Questionnaire
PHC Primary health care
PT Physical therapy
SES The Self-Efficacy Scale
TSK The Tampa Scale of Kinesiophobia
Introduction

About the thesis

The present thesis comprises the screening of persons with persistent musculoskeletal pain in primary health care physical therapy, and the subsequent targeting of an individually tailored treatment. The thesis is based on four empirical studies. In two studies a screening instrument was developed and tested for its psychometric properties. The purpose of the instrument is screening of cognitive risk factors for sustained or increased disability, considered as subgroup indicators. This screening procedure would thereby identify persons with high- or low risk for sustained or increased pain related disability. The focus in the third study was the adaptation, i.e. targeting, of an individually tailored treatment to subgroup characteristics by adjustment of treatment dosage. In the fourth study, physical therapists’ adherence to the treatment manual for the targeted and tailored intervention was assessed.

Treatments of chronic pain patients in multidisciplinary pain centers have proven cost-effective (Turk and Okifuju, 1998; Turk, 2002), but these results appear to be valid only for a highly selected patient group, representing the more dysfunctional cases (Turk and Rudy, 1990a). The majority of patients with musculoskeletal pain are received and treated in the primary health care (PHC) institutions, in Sweden (Andersson et al., 1999), as well as internationally (Gureje et al., 1998). Many of these patients seek or are referred to physical therapy (Woólf et al., 2004). In the unselected and heterogeneous PHC patient population, patients differ largely with respect to the course of pain symptoms and the influence of pain on activity and participation in daily life (Parsons et al., 2007; Rohrbeck et al., 2007). However, subgroups can be defined, demonstrating different degrees of pain related risk factors for disability (Bergström et al., 2001; Johansson and Lindberg, 2000; Haldorsen et al., 2002; George et al., 2003; Woby et al., 2007a), indicating a need for targeting of treatment to subgroups with different risk levels for disability. Further, tailoring of treatment to the individual patient’s needs and goals appears to decrease disability (Evers et al., 2002; Åsenlöf et al., 2005b; Åsenlöf et al., 2006), decrease analgesic consumption (Buketorp et al., 2006), and reduce the number of health care visits over time (Lorig et al., 2004). Thus, it could be argued that treatment of musculoskeletal pain patients should be individualized. Consequently, the development of a screening instrument to identify subgroups of patients with either a high- or low
risk for disability, the adaptation of treatment strategies to subgroup characteristics, and the tailoring of treatment to the individual is needed in order to successfully and in a cost effective manner help musculoskeletal pain patients in primary health care.

In the following the research area is outlined and the four studies are summarised.

Musculoskeletal pain

Disability related to persistent musculoskeletal pain (MSP) is a common health problem throughout the world (Gureje et al., 1998; Gureje et al., 2001; Picavet and Schouten, 2003). Pain related disability often affects functional capacity, work capacity, and quality of life (Andersson, 1994; SBU, 2000; SBU, 2006), thereby causing suffering and economic loss to the individual. The costs for society are enormous and increasing, and in particular the indirect costs, i.e. the loss of potential productivity, (SBU, 2000; SBU, 2006; Lindgren, 1998).

Musculoskeletal pain may originate from specific pain sites such as the spine or shoulders (Mcbeth and Macfarlane, 2002) but more commonly, i.e. in two thirds of the cases, from multiple pain sites (Gureje et al., 1998; Urwin et al., 1998; Kamaleri et al., 2007). In the context of this thesis “musculoskeletal pain” refers to pain from one or several pain sites of the spine, pelvis, and the upper and lower extremities.

Persons with persistent pain are dealing with pain itself but also managing consequences of pain in terms of coping with individually specific stressors that impede physical and psychosocial wellbeing (Jensen et al., 1991b). A multitude of stressors related to pain or to chronic conditions in general may influence the person (Keefe et al., 1992). In chronic conditions several possible stressors like diagnostic uncertainties, disability, dependency on professional expertise, prejudices and social stigma, and illness-induced disruptions to valued activities and interests, constitute important psychosocial challenges (Devins and Binik, 1996). Hence, in persistent pain a number of stressors interact and threaten the normal role functioning of the individual.

The development of pain-related disability

Disability is the inability to perform activities of importance for normal role functioning, the equivalent of decreased participation (Leonardi et al., 2006). Body functions and personal factors such as cognitions, but also the interactions between the individual and the environment determine a person’s level of disability (WHO, 2002; Reed et al., 2006). Thus, the interaction between the individual, the environment and behaviour, all of which influences func-
tioning, is implied in the biopsychosocial model, outlined in the International Classification of Functioning, Disability and Health (Dunstan and Covic, 2006). Functioning at the activity and participation level can be seen as the individual’s capacity, and performance. Capacity is how activities are carried out in a “standardized environment”, such as the clinical environment. Performance is how activities are carried out in the varying day to day settings, such as at home, work, or school, and where situational variations influence the actual level of functioning (Reed et al., 2006). Therefore, it is the performance of activities which indicates a person’s degree of disability.

The process by which a pain condition develops into a disabling condition can not be sufficiently explained by the influence of biomedical or biomechanical factors (Sullivan et al., 2004; Den Boer et al., 2006). In the later decades a range of psychological factors, such as cognitions, attitudes, and beliefs have been put forward as important in the course of pain-related disability (SBU, 2000; Linton, 2000). However, only some of these factors are possible to influence in physical therapy. Self-efficacy, fear of movement/(re)injury and catastrophic thinking, appear to be more directly linked to movement behaviour (Lackner et al., 1996; Leeuw et al., 2006; Picavet et al., 2002), and thus warrant special attention in physical therapy.

Self-efficacy is defined as the individuals confidence in performing a specific behaviour in a specific situation and whether this behaviour will result in a specific outcome (Bandura, 1977; Bandura, 1997). Self-efficacy influences the adjustment to a pain condition and to pain-related disability (Jensen et al., 1991a), is related to lifting capacity (Estlander et al., 1994), and pain behaviour and avoidance (Asghari and Nicholas, 2001).

Catastrophizing is a negative pattern of thought concerning experiences and outcome, and is considered a potential precursor of fear-avoidance (Turner et al., 1999). Catastrophizing is related to pain intensity, disability, and psychological distress (Martin et al., 1996; Turner et al., 1999; Severijns et al., 2001). It is also related to greater limitations in social activities (Severijns et al., 2002), and higher levels of motor pain behaviours (Keefe et al., 2000).

Fear of movement/(re)injury is a generalized pain related fear where movements are expected to cause pain or injury and hence avoided (Kori et al., 1990; Vlaeyen et al., 1995). Fear and avoidance of activity or movement is strongly related to observable physical performance and self reported disability (Al-Oubadi et al., 2000; Buer and Linton, 2002; Woby et al., 2004a). Further, fear of movement is also suggested to be a mediator between pain and disability in chronic pain patients (Vlaeyen and Linton, 2000; Leeuw et al., 2006).

The relations between disability and fear of movement/(re)injury, self-efficacy, catastrophizing, and pain intensity were explored in a study on patients in PHC physical therapy (Denison et al., 2004). Self-efficacy, fear of movement/(re)injury and catastrophizing explained 61% of the variance in
disability scores. Conclusive evidence has not been presented for a uniform model of how these factors are related to each other. However, Woby and coworkers (2007b) propose a revised fear-avoidance model (Vlaeyen and Linton, 2000; Leeuw et al., 2006) incorporating a mediational role of self-efficacy for chronic low back patients. It is suggested that if pain related fear leads to a reduction in self-efficacy, then avoidance behaviour is likely to occur. This ultimately leads to greater disability, depression and disuse. The authors conclude that the assessment of both self-efficacy and fear-avoidance, including catastrophic thinking, and the targeting of both in treatment, appear important (Woby et al., 2007b).

Assessment and treatment from a movement behaviour perspective

A central concept in physical therapy is movement, i.e. therapy is directed at restoring normal movement capability, or preventing reductions of present movement capability (Cott et al., 1995; Broberg, 1997). Physical prerequisites for movements, i.e. muscle strength, endurance, coordination of movements, mobility, and joint stability are traditionally targeted in physical therapy.

However, cognitive factors such as the drive and motivation to move are as important as physical prerequisites for movement (Cott et al., 1995). Movement behaviour is how and why movements are actually employed in a specific task/situation (Schmidt, 1999). Internal and external factors, e.g. cognitions and the social context, influence movement behaviour. Notably, this definition of movement behaviour (or the synonym motor behaviour), differs from a more common definition, restricted to the coordination of movements, or the neurophysiologic chain of events affecting movements (Carr and Shepherd, 1998).

In the later decades physical therapy interventions targeting movement behaviour and disability have been developed and evaluated in clinical studies (Lindström et al., 1992a; Williams et al., 1993; Åsenlöf et al., 2005b). Lindström et al. (1992b) used an operant conditioning approach in a randomized controlled study on sick listed industrial blue-collar workers with low back pain. This treatment successfully reduced long-term sick leave and disability (Lindström et al., 1992a). Williams et al. (1993) and Harding & Williams (1998) developed a physical therapy treatment for patients with chronic pain which integrated cognitive-behavioural treatment principles. Åsenlöf et al. (2005a) further developed the behavioural medicine approach in physical therapy by individually tailoring the treatment to the patients’ prioritized activity goals and level of self-efficacy. Positive effects like reduced disability, pain intensity, fear-avoidance, as well as increased pain
control and perceived ability to handle future problem situations were shown for the intervention group as compared with a control group (Åsenlöf et al., 2005b; Åsenlöf et al., 2006).

Screening

Screening is the identification of individuals or groups of individuals at risk for decreased health, through the assessment of detectable risk factors (NSC, 2008). Screening methods have been developed to identify musculoskeletal pain patients at risk for longstanding disability in pain-clinic settings (Turk and Rudy, 1990b), in PHC settings (Boersma and Linton, 2005b), as well as in occupational settings (Schultz et al., 2004), but such screening has predominantly concerned low back pain patients. Screening methods for identifying risk for disability in the total group of MSP patients, including patients with other pain sites, e.g. neck and shoulder pain, remain to be investigated. Further, existing screening instruments for use in PHC (Linton and Halldén, 1998) cover a broad range of psychosocial factors of which only a few are possible to target in physical therapy treatment. Psychological factors of relevance for movement behaviour, i.e. fear of movement/(re)injury, catastrophizing, and self-efficacy, have been shown to play an important role in the disablement process for PHC-patients (Denison et al., 2004). Based on these cognitive risk factors, subgroups of PHC patients with persistent MSP have been defined, demonstrating different degrees of disability (Denison et al., 2007).

More importantly though, these factors are possible to influence by treatment, as has been shown for fear of movement (Boersma et al., 2004), catastrophizing (Woby et al., 2004b), and self-efficacy (Lorig et al., 2001).

In everyday clinical practice the assessment of psychological risk profiles for disability through the use of extensive questionnaires is probably too time consuming. A more feasible way would be to use a self-administered, short screening questionnaire based on well known and validated instruments. The objective of such a screening instrument would be to identify subjects with high or low risk for disability, but also to produce the individual risk profile of the patient. The ultimate purpose of the screening procedure would be to enable clinicians to allocate patients to the right type of treatment.

Targeting and tailoring of treatment

Targeting of treatment implies that an intervention approach is applied to a population subgroup defined by specified characteristics (Kreuter and Skinner, 2000). The adaptation of treatment to subgroups has shown
beneficial effects for patients with temporomandibular disorders (Dworkin et al., 2002), and patients with acute low back pain (Gatchel et al., 2003). For targeting of treatment to PHC patients with persistent musculoskeletal pain, the subgroups of interest would be those with high or low risk for disability. Subgroup characteristics would be the patients’ degree of self-efficacy, fear of movement and catastrophic thinking.

Tailoring is the adaptation of treatment to the individual’s characteristics (Kreuter and Skinner, 2000). Tailoring of a cognitive behavioural treatment to patients’ preferred training modules for patients with rheumatoid arthritis (Evers et al., 2002) had significant short- and long term benefits when compared to standard medical care.

In an integrated physical therapy-cognitive behavioural approach the tailoring of treatment is achieved by adapting the treatment to individual physical, cognitive, and behavioural factors of importance for the performance of prioritized activities. Goal activities for the treatment are selected based on their importance for the patient, the patient’s self-efficacy for the activity, and that the activity occurs frequently in the patient’s daily life. Further, the performance of these activities should be possible to influence by physical therapy, i.e. include movement behaviour (Åsenlöf et al., 2005b). The patient’s behavioural treatment goals, and assets and problems in relation to these, are assessed prospectively. Data are analyzed in terms of determinants and consequences, and summarized in a functional behavioural analysis (FBA) (Sturmey, 1996). A FBA should be seen as a hypothesis about the functional and potentially causal relationships between cognitive, physical and environmental factors influencing behavioural performance. The hypothesis is discussed with the patient, modified during the course of treatment, and justifies treatment tactics (Haynes et al., 1997). The objectives of the tailored treatment for patients with persistent MSP are resumed and/or increased physical activity, and self-management of frequent and recurring pain related problems (Åsenlöf et al., 2005a; Åsenlöf et al., 2005b).

Self-management in persistent musculoskeletal pain

From a societal perspective the large costs pertinent to persistent musculoskeletal pain (MSP) are mainly due to indirect costs, i.e. the loss of potential production because of sick leave (Lindgren, 1998). However, Mäntyselkä et al. (2002) concludes that costs for MSP patients in primary health care are also due to frequent referrals of patients and inefficient therapy. Further, recurrent pain episodes are common in this patient group (Picavet and Schouten, 2003), which leads to repeated periods of health care utilization. However, long term utilization of health care services for MSP patients in PHC is poorly studied (Mäntyselkä et al., 2002). In an Australian study on chronic pain in a general population (Blyth et al., 2005), it was concluded
that self-management strategies had a significant impact on degree of dis-
ability and use of formal health care. Consequently, an important aim in
MSP interventions would be to make the patient less dependent on health
care and to foster sustainable strategies for self-management.

Psychological and physical functioning is associated with the ability to
control pain and its effects on life (Jensen et al., 2003). Hence, the individual
patient would probably benefit from a self-management approach in treat-
ments (Kerns et al., 1997). In self-management the patient assumes the ma-
jor responsibility for activities that lead to positive change in symptoms
(Burckhardt, 2005). Therefore, the relationship between the patient and the
health care provider needs to become a collaborative partnership (Lorig and
Holman, 2003; Burckhardt, 2005). Self-management includes the learning of
self-management skills such as problem solving, decision making in re-
sponse to fluctuating signs and symptoms, and taking action, i.e. learning
how to change a behaviour (Lorig and Holman, 2003). As recurrent pain
episodes are common in MSP a broad repertoire of strategies are needed, and
the patient must learn to use these in a flexible way (Keefe et al., 1997). Vi-
tal for efficient self-management is the ability to use self-management skills
and knowledge and applying these to one self as appropriate (Lorig and
Holman, 2003). Of primary importance for self-management is the patient’s
own beliefs about her/his ability to perform specific behaviours or change
specific thinking patterns, i.e. self-efficacy (Burckhardt, 2005).

From an organisational perspective the integration of a self-management
approach in MSP-treatment is dependent on health care professionals’
knowledge and skills in self-management education. According to Lorig and
Holman (2003) the undergraduate training of those health care professionals
currently providing care in PHC has hitherto not emphasized self-
management approaches in treatment. The “diagnose and cure” approach
may still dominate health care systems where patients are allotted a passive
role in the treatment (Turk and Okifuju, 1998).

Development of new treatments and treatment integrity

When a new treatment or a modification of a treatment is tried in research,
the focus lies on how the independent variable, i.e. the intervention, is re-
lated to the dependent variable, i.e. the outcome (Gresham et al., 2000; Fuh-
rer, 2003). Therefore, the structure, logic and contents of the treatment need
to be specified, and the execution of the treatment should be monitored and
evaluated (Rounsaville et al., 2001; Davidson et al., 2003). This includes the
construction of a written treatment manual, the development of a training
program to impart the required skills to the treatment providers, and the de-
velopment of a treatment integrity measure to evaluate therapists’ adherence
to the treatment manual (Gresham et al., 2000; Rounsaville et al., 2001).
Further, modifications of a newly developed intervention, e.g. increasing or decreasing the intensity of treatment, should be tried in pilot studies (Fuhrer, 2003).

The tailored behavioural medicine approach for patients with persistent MSP, developed by Åsenlöf et al. (2005b) was effective for a sample of patients, which included patients with differing degrees of risk factors for disability. Modification of the tailored treatment by adaptation of treatment dosage to subgroups defined by risk profile therefore necessitates further study.

Treatment integrity refers to the degree to which treatment is implemented as intended, and includes three components: adherence, competence, and differentiation (Perepletchikova and Kazdin, 2005). Adherence is the degree to which the therapist conducted treatment in adherence with the treatment manual, globally and for each treatment component (Gresham et al., 2000; Perepletchikova and Kazdin, 2005). Competence refers to the therapist’s level of skill when delivering the treatment (Perepletchikova and Kazdin, 2005). The therapists degree of competence could account for a potentially large degree of variance not explained by the treatment itself and may vary from patient to patient and depend on many extraneous factors (Barber et al., 2007; Perepletchikova and Kazdin, 2005). Differentiation refers to whether treatments in a clinical trial differ from each other in the intended manner (Perepletchikova et al., 2007). For assessment of treatment differentiation both the experimental and the control conditions require attention, as the difference between those conditions affects the interpretation of results (Fuhrer, 2003).

Treatment integrity can be assessed using direct or indirect methods. Direct methods are observations of treatment sessions or videotaped sessions following an observation protocol. Indirect methods include therapist self-reports, subjects’ report of treatment content, and permanent products of treatment implementation, such as treatment records or written homework assignments (Gresham et al., 2000; Perepletchikova and Kazdin, 2005). Direct methods allow for assessment of treatment adherence but also therapist competence, whereas indirect methods preferably are used for assessment of treatment adherence. Of the indirect methods permanent products has the advantage of being less time consuming, more efficient, less reactive, and less likely to be influenced by social desirability than other methods (Gresham et al., 2000).

Context and scope of the present thesis

Among the unselected and heterogeneous patient group with persistent musculoskeletal pain in primary health care physical therapy, subgroups have been identified. These subgroups differ regarding degree of psycho-
logical risk factors for sustained or increased disability. Further, some of the psychological risk factors have high relevance for physical therapy as they are related to both movement behaviour and disability, and are also possible to influence by treatment. To date, a clinically manageable screening instrument for identifying the patient’s degree of these risk factors, and for deciding the patient’s risk group affiliation, does not exist in primary health care PT.

Treatment in PT based on cognitive behavioural (CB) principles appears promising. Further, tailoring of such a treatment to the individual patient’s needs and goals has been shown to decrease disability and to supply the patient with sustainable self-management strategies. However, targeting of a tailored treatment to identified subgroups by adaptation of treatment dosage has not been tried. Consequently, the development of a screening instrument to identify subgroups, and targeting of a tailored CB-based treatment will be investigated in this thesis.
Aims

This thesis concerns the management of patients with persistent musculoskeletal pain in primary health care physical therapy.

The main aims of the thesis were: to develop, and evaluate the psychometric properties of, an instrument for screening of risk factors for disability; and to evaluate possible effects and implementation of a targeted and tailored treatment.

Specific aims were:

- To develop a short and clinically applicable screening instrument, to investigate the concurrent validity of the instrument, and reliability of items in the instrument. (Study I)
- To evaluate the predictive validity of a screening instrument for disability status of patients with persistent musculoskeletal pain. (Study II)
- To investigate if the screening instrument could be used to reliably identify subgroups of patients with either high or low risk for disability, for targeting of treatment. (Study III)

- To evaluate the effects of targeted treatment for patients with low risk for disability. (Study III)
- To study the effects of tailored treatments for patients with either high- or low risk for disability. (Study III)
- To investigate treatment integrity of tailored treatment. (Study IV)
Methods

Design
The project was started in 2003 and completed in 2007. It comprises four samples and treatment documents from eighteen patient cases in Study III. All subjects in the studies were recruited when consulting physical therapists in Swedish PHC settings. The project was approved by the local ethics committee at the Faculty of Medicine, Uppsala University. An overview of the design of the studies in the thesis is presented in Figure 1.

Setting, participants, study materials, and procedures
Physical therapy departments in PHC, in six urban areas with surrounding communities in the middle of Sweden, provided the setting for Study I–III. The inclusion criteria for patients were: age 18 - 65, MSP (neck/shoulder, low back), no signs of trauma, no malignant, infectious or systemic disease, ability to understand written and spoken Swedish, and duration of MSP for at least 4 weeks. Demographic and background characteristics of the four samples in Study I, II and III are presented in Table 1.
For Study IV treatment documents, produced during the treatment period, regarding the 18 patients in the experimental group in Study III, were used.

Study I
An instrument for screening of risk factors leading to disability was developed, and its psychometric properties investigated. The study comprised two samples. The first sample, n=215 was used for the development of the screening instrument. Data from this sample were collected in connection with the patients’ first PT consultation by the use of self-report questionnaires. The response rate was 77%. For evaluation of concurrent validity and reliability of items in the screening instrument the second sample, n = 93, was used. The response rate for this sample was 68%. For demographic and background characteristics of the two samples in Study I see Table 1.
<table>
<thead>
<tr>
<th>Study I (2003-2004)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Focus:</strong> development and preliminary validation of a screening instrument for disabling persistent pain</td>
</tr>
<tr>
<td><strong>Design:</strong> correlational and comparative</td>
</tr>
<tr>
<td><strong>Setting and samples:</strong> Two samples ($n_1 = 215$; $n_2 = 93$) from 6 + 15 physical therapy departments in primary health care</td>
</tr>
<tr>
<td><strong>Subjects:</strong> Patients with musculoskeletal pain (&gt; 4 weeks)</td>
</tr>
<tr>
<td><strong>Point of measurement:</strong> at the first PT visit</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Study II (2004-2005)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Focus:</strong> predictive validity for disability status of the screening instrument</td>
</tr>
<tr>
<td><strong>Design:</strong> comparative</td>
</tr>
<tr>
<td><strong>Setting and samples:</strong> 168 patients from 15 physical therapy departments in primary health care</td>
</tr>
<tr>
<td><strong>Subjects:</strong> Patients with musculoskeletal pain (&gt; 4 weeks)</td>
</tr>
<tr>
<td><strong>Point of measurements:</strong> at the first PT visit and 8 months later</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Study III (2006-2007)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Focus:</strong> continued validation of the screening instrument. Development of new treatment strategies; evaluation of group and individual effects</td>
</tr>
<tr>
<td><strong>Design:</strong> experimental</td>
</tr>
<tr>
<td><strong>Setting and samples:</strong> 32 patients from 4 physical therapy departments in primary health care</td>
</tr>
<tr>
<td><strong>Subjects:</strong> Patients with musculoskeletal pain (&gt; 4 weeks)</td>
</tr>
<tr>
<td><strong>Point of measurements:</strong> pre-treatment and post-treatment</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Study IV (2006-2007)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Focus:</strong> implementation; assessment of treatment integrity</td>
</tr>
<tr>
<td><strong>Design:</strong> descriptive</td>
</tr>
<tr>
<td><strong>Materials:</strong> permanent products, i.e. treatment documents for 18 patient cases</td>
</tr>
<tr>
<td><strong>Point of measurement:</strong> post-treatment</td>
</tr>
</tbody>
</table>

*Figure 1. Overview of the studies included in the thesis*
Study II
The predictive validity of the screening instrument for disability status was investigated. At the first point of measurement (M1), data were collected as in Study I. The sample comprised 168 patients, and the response rate was 97%. At the second measurement (M2), after 8 months, questionnaires were sent by mail to participants. Completed questionnaires from 146 patients, i.e. 85% of the original sample, were returned by prepaid post.
For further details of the sample, see Table 1.

Study III
The validity of the screening instrument was further studied by comparing subgroups defined by screening, i.e. patients with high or low risk for disability, on variables of interest.
In this experimental clinical pilot study the effects of targeted treatment, i.e. treatment dosage adapted to subgroups, was evaluated. Subgroups were patients with a high- or low risk for disability, as defined by the screening instrument. The treatment was also tailored to individual patient characteristics. Participants, n = 32, were recruited consecutively when seeking care at four physical therapy departments in an urban area, between February 2006 and May 2007. In addition to the general inclusion and exclusion criteria for the project as a whole, patients were not eligible if they had received physical therapy or treatment by a chiropractor/similar treatments during the last three months, or had ongoing treatment for depression. Prior to inclusion all patients received written information about the study, an informed consent form to sign, and questionnaires for screening and baseline measures. Patients who agreed to participate returned the forms by mail to the researchers. Subjects were randomly allocated in matched pairs to the experimental or control conditions, with either a high- or a low risk-profile for disability as depicted in Figure 2. Randomization was performed separately for each of the PHC-clinics participating in the study. For the post treatment measurement, questionnaires were handed over to the patient by the physical therapist after the last session. Completed questionnaires were mailed to the researchers. Background and demographic characteristics of the sample are described in Table 1.
Study IV

Treatment documents from 18 completed patient cases in the experimental condition in Study III were included (see Figure 2). Treatment documents comprised working sheets used in the treatment, patients’ individual working sheets, patients’ home work assignments, and physical therapists’ documentation of treatment content session by session. In total eight types of treatment documents constituted the study material. All documents were collected in individual patient dossiers and mailed to the researchers after completion of treatment. For further details on treatment documents, see Table 2.

![Figure 2. Flow of participants in Study III.](image-url)
Table 1. Background characteristics of included samples in Study I, II, and III.

<table>
<thead>
<tr>
<th>Sample 1 (Study I)</th>
<th>Sample 2 (Study I)</th>
<th>Sample 3 (Study II)</th>
<th>Sample 4 (Study III)</th>
</tr>
</thead>
<tbody>
<tr>
<td>n = 215</td>
<td>n = 93</td>
<td>n = 168</td>
<td>n = 32</td>
</tr>
<tr>
<td>Mean age (SD)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>45 (13)</td>
<td>48 (11)</td>
<td>46 (11)</td>
<td>44 (12)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>female</td>
<td>162 (71%)</td>
<td>56 (60%)</td>
<td>114 (68%)</td>
</tr>
<tr>
<td>male</td>
<td>53 (29%)</td>
<td>37 (40%)</td>
<td>54 (32%)</td>
</tr>
<tr>
<td>Civic status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>158 (74%)</td>
<td>64 (69%)</td>
<td>126 (75%)</td>
</tr>
<tr>
<td>single</td>
<td>57 (26%)</td>
<td>28 (30%)</td>
<td>42 (25%)</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>compulsory school</td>
<td>82 (38%)</td>
<td>38 (41%)</td>
<td>46 (27%)</td>
</tr>
<tr>
<td>high-school</td>
<td>79 (37%)</td>
<td>34 (37%)</td>
<td>73 (43%)</td>
</tr>
<tr>
<td>university</td>
<td>52 (24%)</td>
<td>21 (23%)</td>
<td>49 (30%)</td>
</tr>
<tr>
<td>Working status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>working</td>
<td>85 (40%)</td>
<td>46 (49%)</td>
<td>108 (64%)</td>
</tr>
<tr>
<td>sicklisted</td>
<td>82 (38%)</td>
<td>35 (38%)</td>
<td>42 (25%)</td>
</tr>
<tr>
<td>unemployed</td>
<td>10 (5%)</td>
<td>4 (4%)</td>
<td>9 (5%)</td>
</tr>
<tr>
<td>retired</td>
<td>14 (7%)</td>
<td>6 (6%)</td>
<td>2 (1%)</td>
</tr>
<tr>
<td>student</td>
<td>16 (7%)</td>
<td>2 (2%)</td>
<td>7 (4%)</td>
</tr>
<tr>
<td>Pain location</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>low back</td>
<td>48 (22%)</td>
<td>17 (18%)</td>
<td>37 (22%)</td>
</tr>
<tr>
<td>neck</td>
<td>11 (5%)</td>
<td>5 (5%)</td>
<td>10 (6%)</td>
</tr>
<tr>
<td>shoulder</td>
<td>27 (13%)</td>
<td>3 (3%)</td>
<td>11 (7%)</td>
</tr>
<tr>
<td>multiple</td>
<td>102 (47%)</td>
<td>61 (66%)</td>
<td>90 (54%)</td>
</tr>
<tr>
<td>other (e.g. head, hip)</td>
<td>4 (2%)</td>
<td>7 (8%)</td>
<td>20 (12%)</td>
</tr>
<tr>
<td>Pain duration</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>subacute</td>
<td>38 (22%)</td>
<td>12 (13%)</td>
<td>37 (22%)</td>
</tr>
<tr>
<td>chronic</td>
<td>173 (78%)</td>
<td>79 (85%)</td>
<td>131 (78%)</td>
</tr>
<tr>
<td>Course of pain last 5 years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>first episode</td>
<td>70 (33%)</td>
<td>22 (24%)</td>
<td>46 (27%)</td>
</tr>
<tr>
<td>occasionally recurring</td>
<td>44 (20%)</td>
<td>23 (25%)</td>
<td>32 (19%)</td>
</tr>
<tr>
<td>frequently recurring</td>
<td>97 (45%)</td>
<td>48 (51%)</td>
<td>90 (54%)</td>
</tr>
<tr>
<td>Pain medication</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>yes</td>
<td>123 (57%)</td>
<td>58 (62%)</td>
<td>67 (40%)</td>
</tr>
<tr>
<td>no</td>
<td>92 (43%)</td>
<td>35 (38%)</td>
<td>100 (60%)</td>
</tr>
</tbody>
</table>

Note: When numbers in columns do not add up to n or 100%, there are missing values in the background-data. Decimals are rounded off.
Targeted and tailored intervention, experimental condition

Targeted and tailored treatment

Treatment aimed at resumed and/or increased physical activity and self-management of frequent and recurring pain related problems for patients with persistent musculoskeletal pain problems (Åsenlöf et al., 2005a; Åsenlöf et al., 2005b). Treatment content focused on self-selected, prioritized and frequently performed activities considered difficult to perform due to pain, thereby allowing tailoring of treatment to individual needs. Treatment sequencing and components are presented in Table 2.

The treatment components were:

1. Problem- and behavioural goal identification and assessment, i.e. selection of activities to target in treatment. The selected 3-4 goal activities are ranked by their importance for the patient, frequency, and the patient’s self-efficacy for the activity. The first goal activity to be targeted in treatment should be important, frequently occurring in daily life, and an activity for which the patient has a relatively high self-efficacy. The subsequent physical examination focuses on physical prerequisites for the performance of the first goal activity.

2. Self-monitoring, in the form of a diary, of activity performance related to the selected behavioural goal and of factors assumed to relate to activity performance, e.g. environmental factors, cognitions, motor behaviour, and performance responses. In the diary the patient makes notations on situation specific conditions, expectancies (e.g. self-efficacy), and fears, negative or positive thoughts, motor behaviours, evaluation of performance, internal or external responses, and immediate consequences of behaviour. Information in the diary contributes to the subsequent functional behavioural analysis, but can also help increase the patient’s awareness of behaviour, and increase a sense of control over the situation.

3. Individual functional behavioural analysis (FBA), i.e. the synthesizing of clinical information in a hypothesis about the functional and potentially causal relationships between cognitive, physical and environmental factors and the activity performance. The initial FBA concerns the first goal activity. On principle there are two phases in the analysis (Cone, 1997). In the first descriptive phase, the situation, the individual’s capabilities, the behavioural responses and the short and long term consequences are described. In the second, interpretative phase these are linked together in a functional and causal hypothesis. Subsequent to the FBA the behavioural treatment goals are operationalized and specified.

4. Basic skills acquisition, i.e. the training of basic skills of importance for behavioural performance, identified in the FBA. Basic skills could be motor skills such as coordination of movements or endurance, but also cog-
nitive skills, such as recognition of negative thoughts and the inclusion of positive self statements in self instructions.

5. Applied skills acquisition, i.e. the merging of basic skills trained in the preceding phase into more complex behaviours. This phase includes the application of motor and cognitive skills, and problem solving skills in contrived and real life situations.

6. Generalization of skills to other activities and situations. Generalization of skills to the next goals on the activity list is investigated, and also generalization to other activities, similar to the first goal activity. The functional behavioural analysis phase is repeated for the second goal activity, additional basic skills are practiced if needed, and applied in contrived and real life situations.

7. Maintenance and relapse prevention. The patient is given a document to fill in for the identification of high risk situations and problem-solving strategies for these, and also strategies for maintaining performance in relation to attained goals. The document is discussed, and possibly revised, together with the physical therapist, resulting in a personal relapse prevention and management document.

The intervention protocol was scheduled to 11-12 sessions for high-risk patients and 3-4 sessions for low-risk patients. Thus, targeting was mirrored in dosage, i.e. the number of treatment sessions. Patients in the low-risk group trained basic and applied skills on their own and were expected to independently use the activity training program developed during the initial sessions, as opposed to the high-risk group. For all patients the final session was scheduled one month after the second last, thus constituting a “booster” session.

Training of physical therapists

Four physical therapists, one per clinic, underwent a training period of seven 3½-hour seminars during six months. The physical therapists’ clinical experience ranged from 6 to 34 years. A clinical psychologist (assistant supervisor) and two physical therapists (main supervisor and author) carried out the training program which included all the treatment components in the tailored conditions (see Table 2). The objectives of the training program were to implement the adaptation of treatment contents to the individual patient’s physical, cognitive, and behavioural characteristics (i.e. tailoring) and to adapt treatment to the stipulated treatment dosage, as determined by the patient’s degree of risk for sustained/increased disability (i.e. targeting). Participants were given homework assignments, i.e. applied training of skills in clinical work, between sessions. Experiences from the therapists’ homework assignments in clinical work constituted the basis for all discussions.
The theoretical foundation for the treatment, treatment sequencing, and treatment components were introduced in connection with these discussions. Individual clinical supervision was provided in-between group sessions by the author. The physical therapists and patients were observed and feedback on clinical performance provided to each physical therapist.

During the intervention period supervision was provided individually and in 6 group-sessions by the author. Each physical therapist received a treatment manual covering treatment components, systematic strategies for individualization, and the didactic principles for the interventions.

Treatment sequencing, treatment components, and treatment documents produced in the tailored and targeted treatment are presented in Table 2.

### Table 2: Treatment components, objectives for components, and treatment documents produced in the tailored and targeted intervention.

<table>
<thead>
<tr>
<th>Treatment component and contents</th>
<th>Objective</th>
<th>Treatment document</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Behavioural goal identification and assessment including: activity list, priority list, frequency ranking of goals, self-efficacy ranking, selection of first activity to target in treatment</td>
<td>To select a first target-activity for the treatment which is prioritized by the patient, frequently occurring and for which the patient has comparatively high self-efficacy.</td>
<td>Document 1: List of activities ranked by priority, frequency and self-efficacy magnitude. Document 2: Specified first target activity in diary (see below)</td>
</tr>
<tr>
<td>2. Self-monitoring including a diary</td>
<td>To obtain information relating to activity performance as it occurs in the natural setting of the patient: situational variations, pain, cognitions, motor behaviour, behavioural responses and consequences of the behaviour.</td>
<td>Document 2: A diary tailored to the patient.</td>
</tr>
<tr>
<td>3. Individual functional behavioural analysis including specification of: activity, situation, physical and cognitive intra-personal factors, behavioural responses, long- and short term consequences. A hypothesis is formulated about relations between these variables. Finally goals are operationalized.</td>
<td>To synthesise clinical information in a hypothesis about the functional and potentially causal relationships between cognitive, physical and environmental factors and the behavioural performance. To specify behavioural goals.</td>
<td>Document 3: Document to be filled in by the physiotherapist, discussed and revised together with the patient. New target activities for the treatment each require a new FBA. Only the first FBA-document is evaluated in the current study. Document 4: Goal setting and treatment plan document</td>
</tr>
</tbody>
</table>
### 4. Basics skills acquisition
including physical and cognitive skills

To train physical and cognitive skills constituent to the first target activity.

**Document 5:**
Session plan. One session plan for each session; follow up of home-exercises and new home-exercises to be documented.

**Document 6:**
Home work assignments (could be several as number of exercises are increased or home work assignments are changed)

**Document 7:**
Exercise diary (could be several as number of exercises are increased or home work assignments are changed)

### 5. Applied skills acquisition
including physical, cognitive, and problem solving skills of importance for target activity

To merge basic skills and shape adequate behaviour by applying and training skills in target activities.

**Document 5, 6, 7**

### 6. Generalization
to other activities

To extend the application of skills to new activities and situations.

**Document 4 (Goal setting and treatment plan), 5 (Session plan)**

### 7. Maintenance and relapse prevention
including specified activities and/or situations, and strategies possible to apply to these

To identify future risk situations and/or activities and the individual’s management strategies for handling these.

**Document 8**
Maintenance document including two paragraphs: Future risk situations/activities and Management strategies. To be filled in by the patient and the physiotherapist and discussed.

---

### Physical exercise intervention, control condition

The treatment consisted of individually adapted and structured physical exercise (Johnson, 2000) and complied with evidence based “best possible standard physical therapy” (Airaksinen et al., 2006; SBU, 2006). The treatment was not to include components similar to those in the tailored treatments, e.g. specific activities to be targeted in treatment or a functional behavioural analysis. Manual or passive treatment methods, e.g. massage, vertebral manipulation, acupuncture, or ultrasound, were not allowed. Further, the patients were to receive a home exercise program and all sessions to be supervised by the physical therapist.
The intervention protocol was scheduled to 11-12 sessions, regardless of the patient’s risk-profile.

Four physical therapists underwent training prior to the start of the study. As the physical exercise therapy was well in concordance with their professional competence the training program consisted of only 2 sessions of 2 hours. These sessions focused on guidelines for physical exercise therapy in MSP. A treatment manual covering principles and strategies for the treatment was distributed to the physical therapists.

Treatment integrity in Study III

For evaluation of treatment integrity all treatment documents were collected in individual patient dossiers, and mailed to the researchers after completion of treatment. The documents included the physical therapy record for each patient, patients’ individual working sheets, and therapists’ documentation of treatment content session by session. Further, patients self-report of treatment content, i.e. a structured questionnaire about treatment components, were included in the post treatment measurement.

In the experimental group (tailored and targeted) all low risk patients were treated in 4 sessions. The median length of the treatment period was 9.5 weeks (range 7-12 weeks). In the control group (non-tailored physical exercise) the median number of sessions for low risk patients was 11 (range 9-12 sessions). Median length of the treatment period was 10 weeks (range 7-14 weeks). For all high risk patients, in both the experimental and the control group, the median number of sessions was 10 (range 7-12 sessions) and the median duration of treatment was 19 weeks (range 6-27 weeks).

For the experimental group examination of treatment documents revealed that all treatment components in the tailored treatment were included for only two of the high risk patients, and three of the low risk patients. For the remaining 13 patient cases the behavioural goal was documented in 12 cases, the functional behavioural analyses in 9 cases, the basic skills training in 12 cases, the applied skills training in 5 cases, the generalization in 7 cases, and the maintenance component in 11 cases. Regarding patients’ self-reports on treatment content, one patient reported not having formulated treatment goals together with the physical therapist. Three of the patients reported not having trained applied skills, and 5 patients reported not having discussed generalization of skills to other activities.

For the control group treatments included exercises to increase strength and muscular endurance for 7 patients, flexibility (6 patients), coordination, equilibrium and dynamic stability (6 patients), and aerobic capacity (3 patients). All 14 patients were supplied with a written exercise program and an exercise diary, and were encouraged to do home-exercises in between sessions. There was no documentation of treatment components specific for the
tailored interventions in treatment documents or patients’ self-reports on treatment content. As stipulated, all sessions were supervised. To sum, the number of treatment sessions was within the stipulated range in all groups. Several treatment components were missing in the experimental group, indicating low adherence to the treatment protocol. For the control condition the physical exercise treatment appears to have been delivered as planned.

Measures

The measures used in Study I, II, and III covered physical, cognitive, and behavioural dimensions. In Study IV a checklist for evaluation of treatment integrity was developed and used. The measures used in the studies and the measured variables are described in the following.

Pain-related disability

Pain interference in everyday life was measured with The Pain Disability Index (PDI) (Chibnall and Tait, 1994), which measures disruptions in seven dimensions of everyday life due to persistent pain: family/home responsibilities, recreation, social activity, occupation, sexual behaviour, self-care, and life-supporting activities. The response format is a numerical rating scale (NRS) where 0 = no disability and 10 = total disability. The total range is 0-70 points with higher scores indicating more perceived disability. Internal consistency of the Swedish version of PDI (Denison et al., 2004) was high in study I; Cronbach’s Alpha = 0.85 for both samples, and in Study II; Cronbach’s Alpha = 0.88. (Study I, II, and III)

Disability in relation to patients specific activity goals in treatment was measured with The Patient Goal Priority Questionnaire (PGPQ) (Ăsenløf et al., 2004). The questionnaire is a patient specific measure, i.e. a measure of functional ability, frequency, self-efficacy, fear of and satisfaction in relation to 1-3 goal activities prioritized by the patient. Only scores on functional ability, i.e. current activity levels, were used in Study III. An eleven grade NRS is used for scoring. (Study III)

In Study II patients’ global reports of changes in disability status concerned self-reported changes in overall daily function and work capacity. Patients were asked to compare their current state with their status 8 months earlier on a 5-graded scale (1=much worse, 2=worse, 3=the same, 4=better, 5=much better). (Study II)

In Study III patients’ global reports on treatment outcome concerned performance of daily activities, scored on a 7-grade scale (0 = very much worse – 6 = very much better), overall satisfaction with daily living, scored on a 4-grade scale (0 = less satisfied – 3 = much more satisfied), and confidence in
self-management of future risk situations, scored on a 5-grade scale (0 = very unsure – 4 = very sure) (Johansson, 1999; Åsenlöf, 2005). (Study III)

Fear-avoidance variables

The Tampa Scale of Kinesiophobia (TSK) (Kori et al., 1990; Vlaeyen et al., 1995), measures fear of movement/(re)injury in individuals with pain. The TSK consists of 17 items scored on a 4-grade scale where 1=strongly disagree and 4=strongly agree. The time frame is not defined. Internal consistency for the Swedish version of TSK used in this thesis, was fair to high; Cronbach’s Alpha = 0.74 – 0.80. (Study I, III)

The Catastrophizing subscale (CAT), of the Coping Strategies Questionnaire (CSQ) (Rosenstiel and Keefe, 1983), attempts to measure negative self-statements, catastrophizing thoughts and ideation in patients with chronic pain. The subscale consists of six items scored on a 6-grade scale where 0 = never and 5 = always. Internal consistency of the Swedish version of CSQ was fair/good in a study by Jensen and Linton (1993). In Study I the internal consistency of the CAT subscale was high; Cronbach’s Alpha = 0.80 – 0.85. (Study I, III)

Self-efficacy for everyday activities

The Self-Efficacy Scale (SES) (Altmaier et al., 1993) was initially designed to measure perceived self-efficacy in performing 20 common activities relevant to patients with chronic low back pain. In the Swedish version the introductory text was modified by substituting ”back pain” with ”pain”. The response format is an 11-grade NRS where 0 = not at all confident and 10 = very confident. The time frame is not defined. Internal consistency of SES was high in Study I; Cronbach’s Alpha = 0.90 – 0.94. (Study I, III)

Screening of risk profiles for disability

The Pain Belief Screening Instrument (PBSI) was developed in Study I and its psychometric properties evaluated in Study I and II, and further validated in Study III.

The response format for each of the 7 items in the PBSI is an eleven graded NRS where 0 defines no or a low amount of the variable and 10 a high amount of the variable. Variables are: pain intensity, functional ability, avoidance, fear, catastrophic thinking, self-efficacy (social activities), and self-efficacy (light household activities). (Study I, II, and III)
Pain intensity

Estimated average pain intensity last week was assessed in Study II at the second measurement with one question and scores rated on an 11 graded NRS where 0 = no pain and 10 = worst imaginable pain (Jensen and Karoly, 1992). This question is included in the PBSI used at the first measurement in study II and hence at the second measurement point substituted with a separate question. (Study II)

Treatment integrity measure

A check list for evaluation of physical therapists’ adherence to a treatment manual was developed and used in Study IV. The measure concerned permanent products, i.e. treatment documents produced in the experimental conditions in Study III (see Table 2). The treatment and its components were operationalized in accordance with the treatment manual. Criteria for the evaluation of treatment documents, and thereby adherence, were structured in a check list. The check list was tested on a similar material, revised and tested again. In the final check list documentation concerning treatment components and important parts of these were categorized as either present or not. Where applicable the accuracy of the documentation was evaluated by an either 2- or 3 graded quality-categorization. For further details on the treatment integrity checklist and criteria, see paper IV.

To estimate reliability of the checklist two of the researchers evaluated the treatment documents of 4 completed cases; 2 low risk patients and 2 high risk patients. The interrater reliability was assessed for each case separately and ranged for presence of documentation between $\text{Kappa} = 0.76$ and 1.0, and for accuracy of what was documented between $\text{Kendall’s tau-c} = 0.63$ and 0.89. (Study IV)

Data management and analyses

Study I

For development of the Pain Belief Screening Instrument principal component analyses (PCA) with varimax rotation, were performed on the data from PDI, TSK, SES and CAT in Sample 1. The purpose of a PCA is to extract a small number of components (hereafter named factors), from a large number of variables or items (Tabachnick and Fidell, 2001). Factors with statistical validity and face validity for a PHC population were chosen from each of the instruments. Further, items with loadings $> 0.5$ in these factors were selected as items in the PBSI. Finally, one item regarding pain intensity the last week was added. For testing of concurrent validity cluster analyses, based on the
K-means algorithm (Tabachnick and Fidell, 2001), were performed on Sample 2, on data from the screening instrument and the original instruments (PDI, TSK, CAT and SES). Subjects were classified into subsets containing similar characteristics, and subgroups were identified by minimizing within group distances and maximizing between group distances. Data were transformed into z-scores due to different response formats in the original instruments. Based on findings from an earlier study (Denison et al., 2006), a three-cluster solution was chosen for cluster analyses. Subsequently, the ability of the screening instrument to detect subgroups, consistent with those defined by the original instruments, was examined by cross tabulating the subgroups and calculating the kappa coefficients. The reliability of the items in the screening instrument was checked with Spearman Rank Correlation Coefficient by examining the correlations between each item in the screening instrument and the corresponding item in the original instruments. Data management and analyses in relation to the 2 samples in Study I are depicted in Figure 3.

Figure 3. Data management and analyses in relation to the 2 samples in Study I.
Study II

To evaluate the *predictive validity* of the PBSI discriminant analyses were used. Discriminant analysis is described as a backward MANOVA and reveals if predictors can be combined to predict group membership reliably (Tabachnick and Fidell, 2001). For this reason the sample was classified into groups in accordance with scores at M2 to obtain grouping variables for each of: Disability, Pain intensity, Self-reported changes in work capacity and Self-reported changes in overall daily function. Prior to analyses data were examined for fit between data distribution and the assumptions of multivariate analysis. Neither uni- nor multivariate outliers were found.

For Disability two groups were obtained from the PDI-scores at the second measurement. Cut-off between groups for PDI-scores was set at the third quartile upper limit (34 points) on PDI of the whole sample and subsequently the material was divided in two groups: *High Disability*, (35 points and above), and *Low Disability* (34 points and below). The decision for this particular cut-off point was based on the assumption that a PHC-sample would not be as disabled as a pain clinic sample (Tait et al., 1990).

For Pain intensity two groups were obtained by dividing the sample in subjects with pain scores ≥ 5 as *High pain intensity* and subjects with scores ≤ 4 as *Low pain intensity*. The mean value for pain intensity in a study on MSP-patients in primary health care (Denison et al., 2004) indicates that pain intensity levels ≥ 5 can be considered high in a PHC-sample.

For Self-reported changes in work capacity and Self-reported overall daily function respectively, subjects were categorized as *Improved* when scoring 4 (better) or 5 (much better), and *Not improved* when scoring 1 (much worse), 2 (worse), or 3 (the same).

The development over time for subjects with high or low disability was retrospectively examined at M2. Changes in disability and pain intensity was analysed by comparing scores on PDI at M1 and M2 for the two disability-groups with paired t-tests. Comparisons of self-reported changes in overall daily function and work capacity at M2 was analysed with *chi²*. For *chi²*-analyses the scores were split in two; worse (much worse and worse) or not worse (the same, better and much better).

Study III

For validation of the subgroups identified by the screening procedure, scores on PBSI were compared (Mann Whitney U-test) with scores on PDI, TSK, CAT, SES, and rankings of pain intensity on a numerical rating scale.
For analyses of treatment outcome on PDI the Mann Whitney U-test was used for assessments of between-groups differences and the Wilcoxon Signed Rank test for assessment of within-group difference over time.

The clinical significance of the individual behavioral performance outcomes, as measured by the PGPQ, was evaluated using the methodology proposed by Jacobson and Truax (Jacobson and Truax, 1991). Change from pre- to post treatment was assessed in three steps by the following idiographic analysis method:

1. reliable changes were identified using within-individual change scores from baseline to post-treatment;
2. a clinical cut-off point assumed to separate the dysfunctional sample from a functional sample was established and;
3. outcome was classified in four categories as non-disabled, improved, unchanged, and deteriorated. The treatment effectiveness was compared across conditions using \( \chi^2 \) exact-analyses. Prior to analyses these four outcome categories were collapsed into two, i.e. non-disabled/improved, and unchanged/deteriorated because of an expected frequency in some cells of less than five.

Relative proportions of participants’ ratings of global outcome, as measured with three rating scales, were analyzed using \( \chi^2 \) exact tests. Prior to analyses outcome scores were dichotomized in:

1) 0 = very much worse - no difference, and 1 = better-very much better for Performance of daily activities;
2) 0 = less satisfied - no difference, and 1 = more satisfied - much more satisfied for Overall satisfaction with daily living;
3) 0 = very uncertain - somewhat uncertain, and 1 = confident - very confident for Confidence in self-management of future risk situations.

Study IV

For analyses of physical therapists’ adherence to the treatment manual, treatment documents, described in Table 2, were reviewed and evaluated by a researcher who was neither involved in the pre-intervention training program, nor in the supervision of the physical therapists during the intervention period. All documents were evaluated per treatment component. The presence of treatment components in documents was assessed before the accuracy of the documented components’ contents was evaluated and scored. Additionally, the overall treatment adherence was evaluated, i.e. the logical sequencing of treatment, as described in the treatment manual (see Table 2).
Results

Development and psychometric properties of the PBSI

Study I

From the principal component analyses of the Pain Disability Index, the Tampa Scale of Kinesiophobia, the Catastrophizing subscale of the Coping Strategies Questionnaire, and the Self Efficacy Scale, in total eleven factors were identified and of these six factors were chosen. One item from each of these factors was selected as singular questions in the PBSI, and one item covering pain intensity was added. This brought the number of items in PBSI to seven, as can be seen in Table 3.

Cluster analysis of the PBSI identified three different cluster subgroup profiles. One subgroup, labelled Fear-avoidant, displayed high scores on fear-avoidance and catastrophizing items, low on degree of functional ability, and moderate on self-efficacy (31% of the sample). A second subgroup, labeled Low Self-efficacy, displayed low scores on self-efficacy items, low scores on degree of functional ability, and low on fear-avoidance and catastrophizing items (16% of the sample). A third subgroup, labeled High self-efficacy and Low Fear-avoidance, scored high on self-efficacy, high on degree of functional ability, and low on fear-avoidance and catastrophizing items (54% of the sample).

The PBSI cluster subgroups were cross tabulated with the original instruments cluster subgroups. This resulted in poor agreement. Therefore, the cluster subgroups Fear-avoidant and Low Self-efficacy were merged into one group for both the original instruments’ and the screening instrument’s cluster solutions. This resulted in two cluster subgroups instead of three; one group with high disability and high fear-avoidance/low self-efficacy; one group with low disability, low fear-avoidance and high self-efficacy, for both the PBSI and the original instruments. The subsequent cross tabulation showed moderate to substantial agreement, $Kappa = 0.61$, $p < 0.001$, between subgroups defined by the PBSI and those defined by the original instruments.

Reliability for items in the PBSI was acceptable with moderate to high correlations between items in the PBSI and the corresponding items in PDI, TSK, SES and subscale CAT in CSQ ($r_{s} 0.50 - 0.80$, $p < 0.01$).
Table 3. Items in the PBSI and the corresponding item in the original instruments.

<table>
<thead>
<tr>
<th>Item in the PBSI</th>
<th>Original item-list from PDI(^a), TSK(^b), CAT(^c), SES(^d)</th>
<th>Response format: endpoints 0 and 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Pain intensity, not in original instruments.</td>
<td>0 = no pain</td>
</tr>
<tr>
<td></td>
<td>2. PDI, item 1. This category refers to activities related to the home or family. It includes chores or duties performed around the house (e.g. yard work) and errands or favours for other family members (e.g. driving the children to school). Note: Scores are reversed in the PBSI</td>
<td>0 = not at all 10 = to a high degree</td>
</tr>
<tr>
<td></td>
<td>3. TSK, item 10. Simply being careful that I do not make any unnecessary movements is the safest thing I can do to prevent my pain from worsening</td>
<td>0 = do not agree at all 10 = fully agree</td>
</tr>
<tr>
<td></td>
<td>4. TSK, item 3. My body is telling me I have something dangerously wrong.</td>
<td>0 = do not agree at all 10 = fully agree</td>
</tr>
<tr>
<td></td>
<td>5. CAT, item 12 in CSQ. It is awful and I feel it overwhelms me.</td>
<td>0 = do not agree at all 10 = fully agree</td>
</tr>
<tr>
<td></td>
<td>6. SES 15. How confident are you about your ability to go to a movie?</td>
<td>0 = not at all confident 10 = very confident</td>
</tr>
<tr>
<td></td>
<td>7. SES 3. How confident are you in your ability to go shopping?</td>
<td>0 = not at all confident 10 = very confident</td>
</tr>
</tbody>
</table>

\(^a\)The Pain Disability Index, \(^b\)The Tampa Scale of Kinesiophobia, \(^c\)The Catastrophizing subscale of the Coping Strategies Questionnaire, \(^d\)The Self Efficacy Scale
Study II

A discriminant analysis was performed with disability category as the dependent variable. The sample was classified into two groups prior to analyses, dependent on PDI-scores at M2. These groups were called High Disability and Low Disability. For disability categories a single discriminant function was calculated. The value of this function was significantly different for High Disability and Low Disability-patients, \( \chi^2 (7, N = 146) = 22.66, \ p< 0.005 \). The seven predictor variables in the PBSI taken together, correctly classified 70.5 % (Wilks’ lambda = 0.848, \( p< 0.005 \)) of the subject into either of the two categories, High Disability (n=33) or Low Disability (n= 113) as measured with the PDI. More specifically, 70.8 % of the subjects in the Low Disability group were correctly classified into this group, and 69.7 % subjects in the High Disability group were correctly classified into this group.

The discriminant functions for pain-intensity, self-reported work capacity and overall daily function respectively were not significant, i.e. the PBSI did not predict any of these grouping variables better than chance.

For analyses of the development over time data were examined retrospectively. The High Disability group had increased disability and unchanged pain intensity after 8 months. Self-reported changes in overall daily function and work capacity were measured retrospectively at M2. A higher proportion of subjects in the High Disability group (33%) considered their overall daily function as worse, or much worse than in the Low Disability group ( 6.4 % ), \( \chi^2 (1, N = 146) = 16.13, \ p<0.001 \), corrected for continuity. The corresponding analysis of perceived changes in work-capacity included only subjects who where working. In the whole group 112 subjects were working at 8 months, in the High Disability group 19 subjects, and in the Low Disability group 93 subjects. Work capacity was rated as worse by 24.2% of the working patients in the High Disability subgroup and 6.4 % of the working patients in the Low Disability subgroup, \( \chi^2 (1, N = 112) =23.26, \ p<0.001 \), corrected for continuity.

To sum, PBSI data could reliably predict patients’ degree of disability after 8 months.

Study III

All patients included in the pilot study (n = 45) were screened by the PBSI prior to randomization. Dependent on PBSI scores patients were classified as either a high risk subgroup, n = 21, or a low risk subgroup, n = 24. There were no differences between high-and low risk groups in demographic characteristics, pain duration, and pain location, recurrence of pain or pain medi-
cation. Statistically significant differences were found between high- and low-risk subgroups for baseline-scores on Pain intensity, PDI, SES, TSK and CAT. High-risk patients scored higher on pain intensity, disability, fear of movement/(re)injury, and catastrophizing, and lower on self-efficacy than did low-risk patients (see Table 4). To sum, high- and low risk groups differed significantly on all variables the PBSI was presumed to assess, which supports the discriminative ability of the instruments.

Table 4. Differences between high- and low risk groups, as defined by screening with the Pain Belief Screening Instrument, in pain intensity, pain-related disability, self-efficacy, fear of movement/(re)injury and catastrophizing. MannWhitney U-test.

<table>
<thead>
<tr>
<th></th>
<th>High risk group, n = 23</th>
<th>Low risk group, n = 26</th>
<th>U</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain intensity last week, NRS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median (25th, 75th percentile)</td>
<td>7 (6, 8)</td>
<td>5 (3, 7)</td>
<td>143.5</td>
<td>&lt; 0.005</td>
</tr>
<tr>
<td>PDI a</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median (25th, 75th percentile)</td>
<td>34 (30, 50)</td>
<td>11 (8.75, 22.5)</td>
<td>69.5</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>SES b</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median (25th, 75th percentile)</td>
<td>120 (85,162)</td>
<td>169 (157.5, 188)</td>
<td>101.5</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>TSK c</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median (25th, 75th percentile)</td>
<td>42 (33, 50)</td>
<td>30 (24.75, 35)</td>
<td>112</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>CAT d</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median (25th, 75th percentile)</td>
<td>22 (15, 27)</td>
<td>7.5 (4, 17)</td>
<td>122.5</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

a The Pain Disability Index, b The Self-efficacy Scale, c The Tampa Scale of Kinesiophobia, d The Catastrophizing subscale of Coping Strategies Questionnaire
Implementation and effects of targeted and tailored treatment

Study III

There were no significant differences between low risk patients in targeted and non-targeted groups on PDI pre-treatment (U 28.5, N₁=9, N₂=10, n.s., two tailed), and post-treatment (U 34.5, N₁=9, N₂=10, n.s., two tailed). Proportions of reliably improved patients did not differ between low risk patients in targeted and non-targeted treatment groups neither for behavioural performance of prioritized activities as measured with PGPQ (see Table 5), nor for global improvement as rated with three questions. The number of sessions was within the stipulated range in both intervention and control conditions. To sum, treatment targeted by dosage for low risk patients (n = 10) was equally effective as a non-targeted treatment (n = 9) in relation to general disability as measured with PDI, activity specific disability as measured with the PGPQ, and ratings of global improvement as rated with three questions.

Table 5. Clinically significant changes in the non-targeted and targeted low-risk groups for behavioural performance of prioritized activities in ranking order, Prio 1, 2, and 3*, as measured with the PGPQ**. n = 19

<table>
<thead>
<tr>
<th>Prio 1 (behavioral performance)</th>
<th>Non-disabled/ Improved</th>
<th>Unchanged/ Deteriorated</th>
<th>Missing data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low risk Non-targeted treatment</td>
<td>4</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Low risk Targeted treatment</td>
<td>9</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Prio 2 (behavioral performance)</td>
<td>Low risk Non-targeted treatment</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Low risk Targeted treatment</td>
<td>6</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Prio 3 (behavioral performance)</td>
<td>Low risk Non-targeted treatment</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Low risk Targeted treatment</td>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

* The activity goals prioritized by the patient, by ranking order one to three in **the Patient Goal Priority Questionnaire
For tailored versus non-tailored treatments analyses of outcome showed no differences between the tailored (n = 18) and non-tailored treatment groups (n = 14) for outcome on general disability as measured with PDI. There were no significant differences between groups at M1 (U 92.5, N1=14, N2=18, n.s., two tailed) or at M2 (U 110.5, N1=14, N2=18, n.s., two tailed). Proportions of reliably improved patients did not differ between tailored and non-tailored treatment groups for behavioural performance of prioritized activities as measured with PGPQ. Compared to the participants in the non-tailored treatment groups a higher proportion of participants in the tailored treatment groups, i.e. all 18 participants, rated their performance of daily activities as better or much better, \( \chi^2 (1, N = 32) = 5.9 \), exact \( p = 0.028 \). There was no difference between groups in satisfaction with daily life. Participants confidence in handling future risk situations differed to the advantage of the tailored condition, \( \chi^2 (1, n = 32) = 5.7 \), exact \( p = 0.027 \).

To sum, there were no differences between the tailored and non-tailored treatment groups for outcome on general disability, as measured by the PDI, or activity specific disability, as measured by the PGPQ. A higher proportion of participants in the tailored treatment groups rated their performance of daily activities as better or much better, and their confidence in handling future risk situations as higher or very much higher.

Study IV

As the preliminary examination of treatment integrity in Study III indicated that treatment components were missing in the tailored treatments this problem was further studied in Study IV. Treatment documents for 18 patient cases in the tailored conditions of the pilot study were evaluated. A checklist was developed and used for evaluation of physical therapists’ adherence to the treatment manual. Adherence to the treatment manual was low concerning treatment components and their contents. In particular, intrapersonal physical and cognitive factors, and situational variations tied to the performance of target activities, were rarely specified in treatment documents. A hypothesis about functional and causal relationships between factors of importance for the individual’s performance of targeted activity performance was found in only one case. The skills acquisition phase of the treatment was mainly directed at physical skills, in none of the cases at cognitive skills and in only two of the cases at problem solving skills. Further, the overall adherence, i.e. the sequencing of the treatment, was compromised for the crucial component of the treatment, i.e. the individual functional behavioural analysis. The FBA is an important component in a tailored treatment because it contains the identification and specification of what is to be trained, and why, during the course of the treatment. For further details see Table 6.
Table 6. Treatment adherence as seen in treatment documents produced in a tailored and targeted physical therapy treatment for 18 patients with persistent musculoskeletal pain

<table>
<thead>
<tr>
<th>Components and their contents</th>
<th>Documented</th>
<th>Accuracy of content</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Behavioural goal identification and assessment</strong></td>
<td>Yes/No</td>
<td>Evaluation categories</td>
</tr>
<tr>
<td>a) Activity list</td>
<td>17/1</td>
<td>Unspecified activities</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Partly specified activities</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Specified activities</td>
</tr>
<tr>
<td>b) Priority list</td>
<td>15/3</td>
<td>Unspecified activities</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Partly specified activities</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Specified activities</td>
</tr>
<tr>
<td>c) Frequency-ranking of goals</td>
<td>9/9</td>
<td>---</td>
</tr>
<tr>
<td>d) Self-efficacy magnitude ranking of goals</td>
<td>11/7</td>
<td>---</td>
</tr>
<tr>
<td>e) Selection of first target activity</td>
<td>16/2</td>
<td>Unspecified activities</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Partly specified activities</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Specified activities</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Selection not based on ranking</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Selection based on ranking</td>
</tr>
</tbody>
</table>

| **2. Self-monitoring** | Yes/No | --- | --- |
| a) Diary | 17/1 | --- | --- |
| b) Activity related to target activity | 17/1 | --- | --- |

<p>| <strong>3. Individual functional behavioural analysis</strong> | Yes/No | --- | --- |
| a) Activity related to target activity | 14/4 | --- | --- |
| b) Situation | 4/14 | --- | --- |
| c) Interpersonal factors; physical | 14/4 | Unspecified | 10 |
| | | Partly specified | 4 |
| | | Specified | 0 |
| d) Interpersonal factors; cognitions | 14/4 | Unspecified | 10 |
| | | Partly specified | 3 |
| | | Specified | 1 |
| e) Behavioural responses | 14/4 | Not specific for the activity/situation | 5 |
| | | Specific for the activity/situation | 8 |
| | | Specific and including behaviours | 1 |
| f) Consequences short and long term | 15/3 | Not specific for the activity/situation | 7 |
| | | Partly specific for the activity/situation | 8 |
| | | Specific for the activity/situation | 0 |</p>
<table>
<thead>
<tr>
<th>Section</th>
<th>Percentage</th>
<th>Description</th>
<th>Specified</th>
<th>Specified and possible to influence by PT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>g) Hypothesis about relations</strong></td>
<td>1/17</td>
<td>Unspecified</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>between variables (i.e. a proposed causality)</td>
<td></td>
<td>Specified and possible to influence by PT</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td><strong>h) Goal setting</strong></td>
<td>12/6</td>
<td>Not specified, measurable, activity related</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Specified, measurable, activity related</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>4. <strong>Basics skills acquisition</strong></td>
<td>17/1</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>a) Physical skills</td>
<td>17/1</td>
<td>Unspecified (how, how much, when)</td>
<td>13</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Specified (how, how much, when)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>b) Cognitive skills</td>
<td>0/18</td>
<td>Unspecified (task, dose)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Specified (what, how, how much, when)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>5. <strong>Applied skills acquisition</strong></td>
<td>10/8</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>a) target activity</td>
<td>9/9</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>b) specified situation</td>
<td>5/13</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>c) physical skills</td>
<td>5/13</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>d) cognitive skills</td>
<td>0/18</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>e) problem solving skills</td>
<td>2/16</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>6. <strong>Generalization</strong></td>
<td>6/12</td>
<td>Not specified what is generalised into what specified activity/situations</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>to other activities</td>
<td></td>
<td>Specified</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>7. <strong>Maintenance and relapse prevention</strong></td>
<td>13/5</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>a) identified activities and/or situations</td>
<td>13/5</td>
<td>Unspecified</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Partly specified</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Specified</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>
Discussion

The results of this thesis imply that the PBSI is a valid and reliable instrument for screening of disability risk factors in patients with persistent musculoskeletal pain, a large and heterogeneous patient group in primary health care. The concurrent and predictive validity of the Pain Belief Screening Instrument was good and the instrument could therefore be used to define subgroups, with a high or low risk for disability, among patients with persistent musculoskeletal pain. Modifications of a new treatment approach i.e. targeting of a tailored treatment, was tried in a pilot study. Subsequent to determining the subgroup-affiliation of patients by screening, the adaptation of treatment dosage to subgroups, i.e. targeting, was evaluated. The results indicate that the large subgroup of patients with low risk for disability could be effectively treated with a brief physical therapy treatment. Tailoring of treatment to individual characteristics was successful in that patients post treatment rated their performance of daily activities as better, and their confidence in handling future risk situations as higher, than in the control conditions. However, disability status and clinically significant changes in the performance of prioritized activities did not differ between the tailored and non tailored conditions. Finally, the evaluation of treatment integrity displayed low treatment adherence for the tailored treatment.

Taken together, the results of this thesis, concerning the screening procedure and the treatment targeted to the low risk subgroup, point forward to an efficient way of managing patients with persistent musculoskeletal pain presenting for physical therapy in primary health care. The PBSI proved a reliable screening method that would enable the clinician to adequately target the individually tailored treatment.

Development and psychometric properties of the PBSI

In Study I a screening instrument, the PBSI, was developed. Factors included in the PBSI were chosen because of their importance for movement behaviour and disability (Lackner et al., 1996; Vlaeyen and Linton, 2000; Woby et al., 2004b), and thereby their relevance for physical therapy.

Two subgroups of patients with persistent MSP in primary health care, i.e. patients with a high- or low risk for pain-related disability, were identified. PBSI data could adequately replicate these two subgroups. Boersma
and Linton (2005b) also identified two main subgroups with high- or low-risk profiles in a group of PHC-patients with acute and sub acute neck- and back pain. Despite differences in objectives, patient characteristics, and duration of pain in the two studies, the corresponding results suggest that screening is a way to identify subgroups among patients with musculoskeletal pain in PHC.

In Study II the PBSI correctly predicted outcome in disability-status after 8 months for 70.5% of the patients. This is well in line with results on other screening instruments (Linton and Halldén, 1998; Hurley et al., 2000). The PBSI did not predict group affiliation for either of pain intensity, self-reported changes in work capacity or overall daily function better than chance. One possible explanation for the non-significant discriminant function for pain intensity could be the low correlation between pain intensity and self-efficacy, fear-avoidance and catastrophizing in PHC-patients, as reported in a previous correlational study (Denison et al., 2004). The failure of PBSI to predict self-reported changes in work capacity and overall daily function was unexpected. One explanation could be that many factors outside the scope of what the PBSI assesses could have influenced the work capacity and daily function of the patients, and hence their reports of change in work capacity and daily function. The total group of patients improved over time with diminished disability and pain intensity, and improved work capacity and overall daily function. However, initially disabled patients were more disabled and reported unchanged pain intensity after 8 months. Further, a large proportion of these patients perceived their work capacity and overall daily function as having changed for the worse. These results indicate a need to match treatment to subgroup characteristics, in order to increase treatment efficacy (Bergström et al., 2001; Skouen and Kvåle, 2006). Considering that the item measuring functional ability in the PBSI was the strongest predictor variable for disability after 8 months (see paper II), a simplified conclusion would be that “disability predicts disability”. However, patients show different “disability-profiles” where cognitive-behavioural factors influence the level of disability and also the course of the disablement process (Asghari and Nicholas, 2001; Boersma and Linton, 2005a). Hence, the PBSI could provide information about patients’ disability profiles.

In Study III the PBSI was employed to define high- and low risk patients prior to treatment. The high-and low risk subgroups were validated by comparing pre-treatment scores for the two groups. High-risk patients scored higher on pain intensity, disability, fear of movement/(re)injury, and catastrophizing, and lower on self-efficacy, results which are consistent with those of Study I and II.
Implementation and effects of targeted and tailored treatment

As a first step in the modification of a tailored treatment by targeting treatment dosage to subgroups, this was tried in an experimental clinical pilot study. The aim was to study the efficacy of the treatment, as well as to monitor the execution of the treatment, as recommended by (Rounsaville et al., 2001; Fuhrer, 2003).

For low-risk patients, targeting of treatment, i.e. a few number of treatment sessions, proved equally efficient in terms of reduced disability as a non-targeted, multi session intervention. Brief physical therapy (PT) treatments with an integrated cognitive behavioural approach, focusing on pain self-management, have been tried in PHC for patients with neck pain (Klaber Moffet et al., 2005) and back pain (Hay et al., 2005). The brief intervention for patients with neck pain produced marginally smaller effects than PT treatment “as usual” (Klaber Moffet et al., 2005), while for patients with back pain results were equivalent for the brief intervention and PT treatment including manual therapy and physical exercise (Hay et al., 2005). To our knowledge, brief treatments for a subgroup of patients, defined by screening, have not been tried earlier.

All patients in the tailored treatment groups rated their performance of daily activities as better, and confidence in handling future risk situations as higher, compared to patients in the non-tailored conditions. In patients with persistent pain treatment should be aimed at enhancing problem solving focused on activities despite pain (Aldrich et al., 2000). Ultimately, the goal is to foster sustainable strategies for self-management. As recurrent pain episodes are common in musculoskeletal pain (MSP) a broad repertoire of problem solving strategies, and the ability to apply these to oneself as appropriate, i.e. in a flexible way, are important self-management skills (Lorig and Holman, 2003; Keefe et al., 1997). The sustainability of the high confidence in handling risk situations, and the applicability of problem solving strategies to risk situations, reported by the patients, remains however to be investigated.

The targeted and tailored treatment in the experimental condition was compared with a non-tailored physical exercise treatment in the control condition. It should be noted that physical exercise is expected to be an effective treatment for reducing disability in persistent MSP (Hayden et al., 2005), and complies with evidence based “best possible standard physical therapy” (Airaksinen et al., 2006).

In Study III the treatment integrity was examined as a manipulation check, i.e. a methodological concern. In order to reliably evaluate treatment effects it is crucial to assert that treatment is carried out as intended (Fuhrer, 2003; Bellg et al., 2004), and that all treatment components are included in the treatment (Schlosser, 2002). Evaluation of treatment integrity is an es-
sential component in intervention studies but rarely performed other than in teacher delivered interventions for students with learning disability, or in psychotherapy treatments (Schlosser, 2002). The absence of treatment integrity assessments in interventions seriously threaten the internal, external and construct validity of studies with experimental designs (Gresham et al., 2000; Davidson et al., 2003; Fuhrer, 2003; Perepletchikova and Kazdin, 2005). The examination of treatment documents in Study III revealed that treatment components were missing for a majority of the tailored treatments, suggesting that treatment integrity was compromised. Therefore, a further evaluation of treatment integrity was undertaken in Study IV.

Results of Study IV indicated that treatment adherence was compromised for the crucial component of the treatment, i.e. the individual functional behavioural analysis. Tailoring of treatment implies that treatment and treatment tactics are adapted to individual characteristics (Kreuter and Skinner, 2000). In the treatment in question, such characteristics were factors of importance for the individual’s activity performance. If those factors are not identified, defined, and put in relation to activity performance, tailoring of treatment is not possible (Turk and Okifuju, 2001). In spite of the compromised overall treatment adherence in the early stages of the treatment, the analyses of treatment documents indicated that the physical therapists tried to adhere to subsequent treatment components. Documentation was however mostly unspecific concerning what was trained, how, and for what purpose. It appears that basic physical skills were easier to identify and put into context than cognitive and problem solving skills. This focus on basic physical skills corresponds with a more traditional perspective in physical therapy (Cott et al., 1995). The emphasis on physical exercise in the tailored conditions indicates a diffusion of the treatments compared in Study III. All physical therapists participating in the study had several years of clinical experience. Extensive work experience may have negatively influenced adherence to protocol by solidifying the working style well known to the physical therapists, and with which they felt professionally secure (Perepletchikova and Kazdin, 2005).

Even if adherence to the treatment manual is good, treatment integrity may be compromised by inadequate delivery of treatment (Barber et al., 2007). Evaluation of therapists’ competence is best done by observations of the actual delivery of treatment (Gresham et al., 2000), and is therefore difficult to evaluate by the indirect assessment methods used in Study IV. However, unspecific descriptions in documents concerning cognitive and behavioural factors of importance for activity performance indicated that the physical therapists could not stringently deliver the tailored treatment. As a consequence, the physical therapists were not able to logically link factors in hypotheses concerning functional and potentially causal relationships. Thereby, the move from the descriptive to the interpretative phase in a functional behavioural analysis was rendered problematic (Cone, 1997).
Therapist adherence is dependent on the therapist’s theoretical understanding of the treatment components and the logic and structure of the treatment (Gresham et al., 2000; Perepletchikova and Kazdin, 2005). The pre-intervention education program may have failed to present and thoroughly discuss the theoretical foundations for the tailored treatment, i.e. knowledge of basic learning principles and understanding of the logical rationale for identifying their interrelations in a FBA. Complemented with supervised training, those elements are probably necessary for therapist adherence to the treatment rationale. If pre-intervention training is carried out without the physical therapists reaching a sufficient understanding, the skills required for tailoring of treatment can not be obtained. Thus, a more thorough theoretical education is needed before the skills-training phase.

Supervision of therapists during the intervention is recommended to avoid drift from treatment protocol (Moncher and Prinz, 1991; Perepletchikova and Kazdin, 2005). In this study the supervision provided focused on the logical sequencing of the treatment, but may not have been sufficient to remediate inadequate comprehension of the rationale for the treatment.

Methodological considerations

The characteristics of the four samples used in Study I, II, and III were similar to those in other PHC studies (Gureje et al., 1998; Gureje et al., 2001; Parsons et al., 2007; Rohrbeck et al., 2007), and suggest that there are general patterns in the findings of the studies. Consistent with other studies in PHC (Johansson and Lindberg, 2000; Åsenlöf et al., 2005b), the samples did not score as high on pain interference and disability as pain clinic patients.

For the concurrent validation of the PBSI, cluster analysis was performed on the screening instrument. The resulting cluster subgroups were cross tabulated with subgroups resulting from cluster analysis of the original instruments, i.e. PDI, TSK, the CAT subscale of CSQ, and SES. As the PBSI cluster solution did not sufficiently well correlate with that of the original instruments, two cluster subgroups were merged. The validity of the cluster solutions needs to be considered. Cluster analytic methods are statistical methods to define, rather than to discover, subgroups in heterogeneous samples and cluster analysis invariably generates a classification solution (Klapow et al., 1993). The initial choice of a three-cluster solution in Study I was based on a previously performed cluster analysis on a PHC sample (Denison et al., 2007), and therefore considered valid for other PHC samples. The reliability of items in the PBSI was evaluated by examining the correlations between each item in the screening instrument and the corresponding item in the original instruments. Correlations between PBSI items and the similar items in the original instruments were significant but low for
some of the items ($r_s 0.50 - 0.80, p<0.01$). As all instruments, including the PBSI, were to be filled in at the same time inflated correlation coefficients were expected due to subjects’ memory bias (Carmines and Zeller, 1980). One reason for low correlations could be that the context of each item in the original instruments is different from the context in the PBSI. More specifically, the items in PBSI covering activity level and catastrophizing displayed low correlations, possibly explained by different time frames and slight differences in wording. (Study I)

To evaluate the predictive validity of the PBSI discriminant analyses were conducted. Regarding the prediction of disability status, the correct classification for 70.5% of the cases and around 70% into each grouping variable, is a result that must be evaluated carefully. The result is substantially better than the chance level for correct classification (50%), and well in line with results on other screening instruments (Linton and Hallåldén, 1998; Hurley et al., 2000). Further, a classification accuracy approaching 100% is a result that can not be expected for a short screening questionnaire. (Study II)

Outcome measures in Study III were the PDI, PGPQ and patients self-reports of global outcomes. The initial floor effect on PDI for low-risk patients left little room for improvement. It is possible that this global disability measure does not capture clinically relevant changes in disability for some PHC patients. Therefore, the use of an idiographic measure like the PGPQ, which represents the individual’s specific activity goals, appears necessary to assess relevant treatment effects. Logically, the subsequent outcome analyses should be of clinically significant changes to detect treatment effects in samples with large variances in global disability measures. Additionally, outcome measures in treatment studies should reflect the clinical problems and goals of treatment (Kazdin, 2001). However, in this pilot study there were no differences in clinically significant outcomes, possibly explained by the small sample size. Further, the sustainability of clinically significant outcomes over time, resulting from tailored treatments (Åsenlöf et al., 2006) was not possible to evaluate in Study III. Treatment integrity for the tailored treatments appeared compromised and was further studied in Study IV.

In Study IV treatment documents were used for the evaluation of physical therapists’ adherence to the treatment manual. The observational methods used in other studies of physical therapists’ adherence to cognitive behavioural treatment protocols (Klaber Moffet et al., 2005; Johnson et al., 2007), allowed for evaluations of only a sample of sessions or physical therapists. Hence, these researchers did not have access to the amount of information, representing all treatment cases and sessions, similar to that which were obtained and used in Study IV. In order to get an overview of the stepwise structure of the tailored treatment and to allow for a closer examination of treatment delivery, an evaluation of documents for all treatment components and all cases was needed (Perepletchikova and Kazdin, 2005). It is possible
however, that treatment documents did not reflect what was actually being said and done in the treatments (Gresham et al., 2000).

The interrater reliability of the check list used for integrity assessment was good. A further step in establishing the psychometric properties of the checklist used in Study IV would be to look at agreement across differing assessment methods, e.g. ratings of direct observations and treatment documents (Gresham et al., 2000). Preferably the person or persons assessing treatment integrity should be skilled in the delivery of the treatment in question (Perepletchikova et al., 2007). In the current study the evaluator had detailed knowledge of the contents and structure of a tailored treatment in physical therapy (Åsenlöf et al., 2005b) but had not been involved in the pre-intervention training of physical therapists. (Study IV)

Conclusions and future implications

The validity and reliability of the Pain Belief Screening Instrument (PBSI) was supported in this thesis. The concurrent and predictive validity of the PBSI was good and the instrument could therefore be used to define subgroups with either high or low risk for disability, among primary health care patients with persistent musculoskeletal pain. Further, the PBSI could be used when investigating the individual patient’s degree of risk factors for sustained or increased disability.

Targeting of a tailored treatment by treatment dosage was investigated. A low treatment dosage for low risk patients, as defined by the PBSI, was equally efficient as a treatment including multiple sessions and focusing on physical exercise. Thus, the results of the PBSI could serve as a guide for the clinician when choosing an appropriate amount of treatment sessions for low risk patients. Targeting of treatment by dosage for high risk patients remains to be investigated. Further, the targeting of treatment contents to PBSI defined subgroups, i.e. modifications of the structure and contents of a tailored treatment should be evaluated in future studies.

Tailoring of treatment to the individual patient’s needs and goals could not be shown to be superior to non-tailored treatment in decreasing disability, as measured with the Pain Disability Index and the Patient Goal Priority Questionnaire. However, patients in the tailored treatment groups rated their performance of daily activities as better, and their confidence in handling future risk situations as higher, than in the comparison group.

Physical therapists’ adherence to the tailored treatment rationale was evaluated in Study IV. Results showed that treatment adherence was compromised. It remains however to be investigated what constitutes a “good-enough” adherence in order to achieve effects of a tailored treatment. To
improve treatment integrity it is suggested that the pre-intervention training program of physical therapists should focus on their understanding of the theoretical rationale for the treatment, prior to the skills-training phase of the program. Educators in such a program need to be knowledgeable about both cognitive behavioural theory and its application in physical therapy.

The implementation of new or modified interventions is rarely systematically evaluated by e.g. investigating if treatment was delivered as intended. This thesis therefore contributes to the field of implementation research which is rarely investigated in behavioural medicine research, including physical therapy.

The studies in this thesis demonstrate ways to systematically integrate a behavioural medicine approach and physical therapy. The results indicate efficiency in managing patients with persistent musculoskeletal pain in primary health care.

För utveckling av screening-instrumentet (benämnt Pain Belief Screening Instrument, PBSI) skickades frågeformulär ut till 215 patienter i primärvårds sjukgymnastik. Från dessa frågeformulär, som innehöll frågor kring aktivitetsbegränsning, rädsla för rörelse, negativa tankemönster samt tilltro till den egna förmågan att utföra specifika aktiviteter, valdes frågor till PBSI ut med statistiska metoder. Därefter skickades PBSI och de ursprungliga frågeformulären ut till 93 nya patienter för att pröva om frågorna mätte det de var avsedda att mäta.

I den andra studien prövades om PBSI kunde förutsäga hur aktivitetsförmågan utvecklas över tid för patienter med hög eller låg grad av psykologiska riskfaktorer för aktivitetsbegränsning. PBSI och frågor kring aktivitetsförmåga och smärtintensitet delades ut till 168 patienter vid första besöket hos sjukgymnast. Efter 8 månader besvarade 146 av dessa patienter återigen frågor kring aktivitetsförmåga och smärtintensitet samt upplevd förändring av arbetsförmåga och aktivitetsförmåga.

I den tredje studien sorterades 32 patienter med hjälp av PBSI i undergrupper med hög- eller låg risk för aktivitetsbegränsning. Dessa undergrupper jämfördes för att se om de skiljde sig åt med avseende på aktivitetsbegränsning, smärta och psykologiska riskfaktorer.

Sammantaget visade de första tre studierna att PBSI mäter det instrumentet avser att mäta, kan förutsäga hur aktivitetsbegränsningen utvecklas över tid, samt att man med PBSI kan sortera patienter med långvarig muskuloskeletal smärta som söker sjukgymnastik.
letal smärta i två undergrupper med antingen hög eller låg risk för vidmakthållen eller ökad aktivitetsbegränsning.


När man i klinisk forskning genomför studier av nya eller modifierade behandlingar är det viktigt att systematiskt utvärdera om behandlingen genomförts som var avsett. Eftersom detta sällan görs inom beteendemedicinsk
forskning, inklusive sjukgymnastik, illustrerar avhandlingen även hur man kan gå tillväga med en sådan utvärdering av behandlingsgenomförande.

Studierna i denna avhandling visar hur man på ett systematiskt sätt kan integrera ett beteendemedicinskt angreppssätt med sjukgymnastiska metoder. Resultaten indikerar att detta är ett effektivt angreppssätt för att omhänderta och behandla primärvårdspatienter med långvarig muskuloskeletalsmärta.
Acknowledgements

The long and winding journey towards a dissertation is luckily made in the company of many nice and supportive persons. Here is the time and place to express my deepest gratitude to, and appreciation of all of you without whom I would not have produced this thesis. In particular I would like to thank the following:

First of all the **patients** who have participated in the studies: Thank you for sharing how you feel, think and manage!

The Department of Public Health and Caring Sciences, and especially the former section of **Caring Sciences** has constituted a stimulating and “fertile” research environment, a model for how to educate PhD-students and how to make them grow into skilled, curious and thorough researchers. It has been a privilege! In many ways the late professor **Per-Olow Sjödén** was responsible for creating this special research ambiance.

**Eva Denison**, for being such an excellent supervisor! From the initial “hand-holding” (especially when conducting statistical analyses), you have gradually and gently pushed me towards independence. Your patience with all my questions, huge and tiny ones equally, and your belief in my “research abilities” have been invaluable. If it hadn’t been for you I would not have started on this journey – and I certainly wouldn’t have continued!

**Per Lindberg**, my brilliant co supervisor, head of the research group and former study director for PhD students – where would I be without you! Always interested in my thoughts and ideas, and gently pushing me back on track when I am straying. Thank you for sharing your extensive research knowledge and know-how, no matter when I disturbed you.

**Pernilla Åsenlöf**, co writer, committed researcher and good friend. I am so grateful for your support, clear thinking and your stamina in both research and friendship. There are for sure no shortcuts…

**Marianne Carlsson**, head of the Department of Public Health and Caring Sciences for good leadership, for razor sharp feedback on papers and in seminars, for thoroughly scrutinizing my thesis, and for always providing me with constructive thoughts and ideas.

**Helena Lindstedt** for thorough reading and feedback on my thesis, and for your support and interest over the years of post graduate studies.

**The Behavioural Medicine Research group** – a bunch of Very Smart and Very Nice People. Our seminar discussions have been highlights during the last five years. I look forward to many more of those in the years to come.
This “think tank” consists of: Per Lindberg and Eva Denison who were in a sense the founders of the group, Anne Söderlund contributing with warmth and “to the point” comments in an unmistakable Finnish way, Pernilla Äsenlöff, provocateur of interesting discussions, Ingrid Demmelmaier who is, among many good things, a role model for giving and taking critique, Annika Nilsson - the sensitive provider of both intellectual and emotional support, Magnus Lindberg who thinks first and then deliver, clever Cecilia Rastad - a thoughtful commentator, Catharina Gustavsson, enviably abundant with research energy, Annika Bring, always interested and questioning, Birgitta Jönsson who without big talk produce formidable research, and Helena Igelström our newest member.

All present and former colleagues and staff at the section of Caring Sciences, for constructive discussions about research questions and life in general. Special thanks are due to: Afsaneh Roshanai, Annika Lundquist, Camilla Fröjd, Cecilia Arving, Claudia Lampic, Elisabet Mattson Eva Landström, Frida Anteson, Gunilla Burell, Helena Lindstedt, Ingrid Demmelmaier, Josefin Westerberg, Karin Nordin, Kerstin Kullberg, Kjerstin Larsson, Kristina Haglund, Louise von Essen, Maria Magnusson, Sören Jonasson, Susanne Lorenz, and Ulrika Pöder. For good laughs, and sometimes good cries, for good advice and for being there when things get ruff!

All Physical Therapy Departments in primary health care, in the counties of Uppsala, Gävleborg, and Dalarna, and also SCA-Hälsan, Ortviken, Timrâ who provided the setting, but also the staff time for data collection and administration. reAgera klinikerna for generously giving me the opportunity to try out new treatment methods in the clinic. I would also like to thank all physical therapists who participated and loyalty invested time and effort in the research project, but in particular Anna, Anette, Birgit and Kim.

The Faculty of Medical Sciences, The Swedish Research Council and the Olle Engkvist Building Foundation, Stockholm who gave their financial support to the research project.

All present and former colleagues and staff at the Physical Therapy Programme for your belief in me, interest in my research and for being very good old friends of mine!

In memory of my dear friend Carina Skoglund, from whom I learnt so much about fighting spirits, looking for what is important in life, and to find hope; all of which helped me complete this thesis in the midst of grief.

My friends who gilded my life during this period of hard work with dinners, walks, “fika”, theatre and movie going, tango dancing and enduring friendship: Gerd and Signe, “pasta club” members, Margareta, my old room mate, Kerstin and Åke early morning singers, Sanna my cultural chaperon, and Mats who gladly travels with me to Denmark, Michael who provides (and has done for a large part of my life) good dinners and friendship, and Helen my “language adviser”, even in the midst of house cleaning and de-
manding children, Björn, my patient tango partner, and Brynhild, without whom I simply would not be able to unravel the tangles of my life.

My mother Gun and father Sven, for unfailing belief in me, but most of all for your love. You are my rock!

My stepfather Gunnar, for always being there, for support and good advice.

My siblings, Gunilla, Henrik, and Kina, with whom I stand shoulder to shoulder in life. Also your partners Finn, Ingrid and Jovo, and your children who have become my family as well. Your solidarity and love gives me strength in life.

My beautiful son August who is the biggest love and the biggest challenge in my life (far exceeding that of a thesis). I love you and I am proud of you!

And Olivia, our dog, who helps me remember to enjoy life here and now.
References


A doctoral dissertation from the Faculty of Medicine, Uppsala University, is usually a summary of a number of papers. A few copies of the complete dissertation are kept at major Swedish research libraries, while the summary alone is distributed internationally through the series Digital Comprehensive Summaries of Uppsala Dissertations from the Faculty of Medicine. (Prior to January, 2005, the series was published under the title “Comprehensive Summaries of Uppsala Dissertations from the Faculty of Medicine”.)