

Indicators for Behavioral Pain Rehabilitation

Impact and predictive value on assessment,
patient-selection, treatment and outcome

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"*What* treatment, by *whom*, is most effective for *this* individual with *that* specific problem, and under *which* set of circumstances, and how does that come about? (1, p. 111)

To Stefan, my life's love, my children Alexis & Erika, my life's meaning and my grandma '*Maña*', my loving and powerful life guide.

I have all to thank my wonderful patients; I love to work with you!
Thanks for opening your hearts and allowing me to share mine with you,
without you, this work would have no meaning to exist.

... with the hope to contribute to decrease "the tyranny of the discontinuous mind" (2) and its "false clarity" (3).

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ABSTRACT

Chronic musculoskeletal ‘non-specific’ pain is still highly prevalent, despite advances of the biopsychosocial model in pain care and interprofessional rehabilitation. According to national and international reports, one of the areas in need of empirical evidence and development is the selection of patients to appropriate rehabilitation programs. Pain assessment instruments are often packaged without consideration of underlying models, and this mixture can create further confusion in the field. Furthermore, the instruments used do not indicate to *potentially modifiable variables*, and thus clinicians are still left guessing when assessing and planning rehabilitation for patients with chronic pain.

In order to improve the selection of patients to the appropriated rehabilitation program, this thesis investigates which widely used pain instruments are pragmatic and useful to identifying rehabilitation needs, provide clear guide for therapeutic **actions** to take in the rehabilitation program. To be clinically relevant, indicators may be also sensitive to capture differential response to treatment and have a good predictive value.

The thesis describes four studies that used existing data, gathered in clinical practice, by the Swedish Quality Registry for Pain Rehabilitation (SQRP) as routine monitoring of assessment and outcome in pain rehabilitation settings. The SQRP data from one big rehabilitation clinic was analyzed using a variety of statistical techniques, including cluster analysis and general linear models. Since the SQRP made changes in the package of instruments, of packages were used, the old one (for Study I) and the new for Studies II to IV.

Results based on the older data (instruments from the 1980’s and 1990’s), results showed that signs and symptoms such as pain intensity, anxiety and

depression, emerged as variables that correlated with quality of life and functioning. These results were consistent with the pain models in force at that time. Signs and symptoms express a topography that is clinically linked to diagnostic considerations, and further expected to be indicators that will lead to effective treatment. These topographical (formistic) variables indicated a certain level of utility at the primary care to identify patients in need for referral. However at the rehabilitation clinic, signs, symptoms or diagnoses were not useful to find distinct groups that indicate their needs or predicted of response to rehabilitation.

On the other hand, clustering the patients according to the core therapeutic processes of Pain Acceptance, from the Acceptance and Commitment Therapy (ACT) emerged as the most useful indicator for rehabilitation when investigating the new package of instruments of the SQRP. Combining the two behaviors and therapeutic processes of pain acceptance (Pain Willingness and Activity Engagement) effectively differentiated four groups with differential pattern of psychosocial status and needs and response to rehabilitation. Pain acceptance could also distinguish differences between the sexes before rehabilitation, suggesting clinical utility in terms of treatment matching and potentially developing alternative treatment modalities for each group and each sex.

Finally, given the number of items in the SQRP and its burden for the individual and the organization, this study also investigated the properties of a shortened version of the Chronic Pain Acceptance Questionnaire (CPAQ) as a step towards a scientific approach to streamlining assessment procedures. The data showed that the CPAQ-8, with less than half the length of the full version, carried similar information, demonstrating good predictive value and sensitivity to track rehabilitation changes.

In conclusion, this thesis presents several methods for investigating indicators that could be used to identify clinically relevant and distinct groups. The usefulness of these indicators depends upon their function and setting. The overall aim was to bring a scientific focus to assessment and triage. Although primarily pragmatic in its focus, the thesis inevitably touches upon the 'usefulness' of different forms of knowing and understanding in the assessment and treatment of pain. These are discussed in relation to psychological theories and their philosophical roots.

Keywords: Chronic Pain, Rehabilitation Medicine. Behavioral Medicine, Pain Assessment, Pain Management, Acceptance Processes, Behavioral Disciplines and Activities; Clinics; Sex distribution & differences

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This thesis is based on the studies referred to in the text by their Roman numerals.

- I. Bromley Milton, M.; Börsbo, B; **Rovner, G.**; Lundgren-
Nilsson, A.; Stibrant-Sunnerhagen, K.; Gerdle, B. (2013)
Is pain intensity really that important to assess in
chronic pain patients? A study based on the Swedish
Quality Registry for Pain Rehabilitation (SQRP). *PlosOne*.
Jun 21;8(6), e65483.

- II. **Rovner, GS.**; Årestedt, K.; Gerdle, B.; Börsbo, B. &
McCracken, LM., (2014) Psychometric properties of the
8-item Chronic Pain Acceptance Questionnaire (CPAQ -
8) in a Swedish Chronic Pain Cohort. *Journal of*
Rehabilitation Medicine; 46(1), 73–80

- III. **Rovner, GS.**; Gerdle, B.; Biguet, G.; Björkdahl, A.;
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according to pain acceptance, diagnosis or patient
perception differentially predicts response to
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- IV. **Rovner, GS.**; Björkdahl, A.; Sunnerhagen, KS.; Gerdle, B.;
Gillanders, D. Capturing sex-differences relevant to
rehabilitation with the instruments included in the
Swedish National Registry for pain rehabilitation (in
manuscript).

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ABBREVIATIONS

ACT	Acceptance & Commitment Therapy
AE	Activity Engagement, a behavior and a subscale of the CPAQ
CBT	Cognitive and Behavioral Therapy
CPAQ	Chronic Pain Acceptance Questionnaire (20 items) CPAQ-8: Chronic Pain Acceptance Questionnaire -8 items
DSM	Diagnostic and Statistical Manual of Mental Disorders
HAD	Hospital Anxiety and Depression Scale
IASP	International Association for the Study of Pain
PF	Psychological Flexibility
PW	Pain Willingness, a behavior and a subscale of the CPAQ
QoL	Quality of Life
Rehab	Rehabilitation
SF-36	Medical Outcome Study Short Form 36 <i>Subscales: PF: Physical Function; RP: Role Physical; BP: Bodily Pain; GH: General Health; VT: Vitality; SF: Social Function; RE: Role Emotional; MH: Mental Health; PCS: Physical Component Summary; MCS: Mental Component Summary.</i>
SQRP	Swedish Quality Registry for Pain Rehabilitation
TSK	Tampa Scale for Kinesiophobia
WHO	World Health Organization

DEFINITIONS AND CONCEPTS

Acceptance & Commitment Therapy (ACT)	<p>ACT is a behavioral therapy that addresses functioning rather than symptoms. Psychological Flexibility is the underlying therapeutic model that explains the empirically developed and tested processes and agents of change of ACT.</p> <p>The goal of ACT is to increase the capacity to be willing to experience a full range of private events (e.g., emotions, thoughts, memories, bodily sensations) including those that are negatively evaluated, without necessarily having to change them, escape from them, do what they say, or avoid them and still engage in what is valued or important in our lives.</p>
Chronic Pain	<p>Pain is chronic when it lasts more than three months for clinical purposes while six months is commonly used for research aims (4, 5).</p>
Indicator for rehabilitation	<p>While sign and symptoms are indicators for the biomedical model, in behavioral approaches an <i>'indicator for rehabilitation'</i> has to be a modifiable behavior. In this thesis a pragmatic indicator refers to aspects assessed by the questionnaires that can provide behavioral (ideographic) understanding of the individual and its needs for behavioral changes under rehabilitation. It has to offer clear information of the direction to take in rehabilitation and how to plan it. It can point to aspects that can 'attract attention' of the clinician and that is linked with behavioral approaches that empirically showed effect on changing these same indicators, so that this indicator is clinically relevant and useful in the assessment. Indicators are also instruments that display certain operating capacity (as a mechanism of action in therapy) and a blinker indicating that the 'vehicle' the therapy needs also to 'turn or to the right or to the left' meaning that this indicator will pragmatically prompt a certain treatment program or protocol. So the indicator will be 'indication' for a certain rehabilitation program and as such also have predictive value.</p>
Behavioral Pain Rehabilitation	<p><i>Behavioral Pain Rehabilitation</i> consists of programs for groups of patients that run a certain amount of time (typically 6 to 12 weeks), and is delivered by a well-coordinated interprofessional team with basic training in Behavioral Medicine. The programs target behavioral changes with the aim to increase physical and mental functioning and quality of life of the patients with chronic pain. <i>Behavioral interventions</i> should address behavioral phenomena that can be predicted and influenced as a unified goal, and do not target signs or symptoms (i.e. the form or topography of the condition or patient). <i>Behavioral Pain Rehabilitation</i> is not the same as <i>Multidisciplinary Pain Management</i>, where typically there</p>

is no defined program or coordinated protocol and typically much of the focus is still in decreasing signs or symptoms (pain, sleep problems, depression, etc.).

Context	Context includes, besides the physical aspect, also the psychological as history and situations (stimulus) as they relate to behavior (6). Behavior and context define each other, a response is dependent of a stimulus (context) and a context is not a context if there is no response or behavior. .
Functional Contextualism	A philosophy of sciences that recognizes 'effective action' to be the goal of science. Effective action in therapy is when it can predict and influence behavior with precision, scope and depth i (where behavioral prediction and influence are treated as two aspects of a unified goal).
Inter-professional	<i>Interprofessional rehabilitation</i> refers to a coordinated program offered by several professions working as a team. This program can be from 4 to 12 weeks long. It may include at least a physical therapist and a CBT/ACT-psychologist and a medical doctor but also a nurse, a social worker and an occupational therapist. A term being used in Sweden is ' <i>multi-modal</i> ' rehabilitation which is used in the article I in this thesis, probably this term is a passing fad since per definition it refers to several treatment modalities. <i>Multi-disciplinary</i> , refers to the inclusion of medical specializations or disciplines in a Pain Unit. It does not mean that these medical specialties offer a coordinated treatment program together. Only that there is access to all these specialties. Not the same as <i>inter-professional</i> .
Therapeutic process	<i>Therapeutic processes</i> are the theoretically based mechanisms of action, psychological and or physical agents deemed to affect improvements in treatment outcome variables.
Rehabilitation Medicine	Rehabilitation is defined by the WHO as " <i>a process aimed at enabling the individual to reach and maintain his or hers optimal physical, sensory, intellectual, psychological and social functional levels.</i> "
Sex & gender	<i>Sex</i> refers to biologically based differences, while the term <i>gender</i> refers to socially based phenomena and it is a psychological construct, not equivalent nor interchangeable terms
Widespread Pain	Pain is considered <i>widespread</i> when it is present in two separate section of a body quadrant (left/right sides of the body and above/below the waist) (7) and this criteria is also valid for diagnosis of fibromyalgia

PREFACE

After my first pilot study in 2003 as I was about to submit my first application into the doctoral program in Medicine, another dream was about to become reality: moving to the US, where I spent two highly enriching years at the University of North Carolina at Chapel Hill.

Back in Sweden while working in a pain specialty clinic as pain specialist physiotherapist, I received European Union funding to build an inter-professional and ACT-based rehabilitation clinic for patients with widespread pain. I visited the primary care clinics in the area in order to inform them about this project and which patients to refer. More than often, I got the 'wrong referrals'. The GPs asserted that they did not have patients with widespread pain, while the Social Security Office was overwhelmed with these patients not being helped by the health care system.

I suspected that we (primary care and pain specialty care) did not view pain through the same lenses, and that our assessment differed – probably dependent upon traditions or the way of conceptualization or our models of pain. At that point I realized that rather than developing interventions, we should focus on improving assessment procedures so the 'right' patient would get appropriate and timely intervention. These primary care patients were not referred to an intervention that was able to help them! I also realized that assessments have different functions at the Primary Care and for the Specialty care. The first focused more on prevention and identified indicators for referral, and the second focused on rehabilitation, improving physical and mental functioning and indicators to systematically select, predict and plan rehabilitation programs.

My deep interest in interprofessional work and its dynamics is reflected by my training and studies. Possessing a masters in psychology, physiotherapy and clinical medical sciences, I found this thesis the perfect forum to integrate these fields and hopefully contribute some new thoughts and insights, ultimately being able to develop the pain care system and the life of my wonderful patients.

I hope that interprofessional teams working in pain rehabilitation may find this work nourishing and will enjoy reading it as much as I enjoyed writing it.

Graciela
Gothenburg, April 2014

THE CHRONICITY OF PAIN

Pain definition

Pain has been defined as “*an unpleasant sensory and emotional experience, which we primarily associate with tissue damage or describe in terms of tissue damage, or both*”. Pain is chronic when there is no “*apparent biological value and has persisted beyond the normal tissue healing time (usually taken to be 3 months)*” (8). Chronic pain is persistent, either continuous or recurrent and is more than a biological process affecting functioning, role participation, wellbeing and quality of life (9).

Pain epidemiology

The prevalence of chronic pain in developed countries is estimated in the range of 10% to 65% (10-16) a fluctuation depending how it was defined and the methods chosen by the epidemiological studies (17). In European countries, chronic pain accounts for over 80% of all physicians’ visits and 70% are managed in primary care (18). In the US it affects more than 100 million adults bringing the annual costs to over \$600 billion (19). Biomedical treatments leave more than 40% without achieving results (20, 21). Around 40 % of the Swedish Social Security disability is associated to back pain (22-24) and together with widespread pain they account for the highest costs in several countries (25-28).

History and views of pain

*Physical pain has no voice, but when it at last finds a voice,
it begins to tell a story... (29)*

Pain was a natural feature of the human condition (30) until the Cartesian science developed the Theory of Dualism in the 1600s that separated body and spirit as two entities (31). This theory laid the basis for positivism, an analytic method of breaking problems in parts, studying them and rearranging them in a logical sequence. The exact sciences and medical technology could then successfully flourish and the scientific method became the only legitimate path to knowledge.

The biomedical model studies the human being as a biological organism (mechanistic approach), understands it by examining the constituent parts of pain (reductionistic approach) and develops treatments/medicines that target the mechanisms that are disturbing the homeostasis or the state of health (32).

This view was challenged in 1946 by Dr. Beecher, anesthesiologist from Harvard, when he was serving in World War II. He observed that many factors other than the size of the wounds could influence the effect and dosage of the analgesics. He introduced the concept of psychological and emotional dimensions as influencing the experience of pain (33, 34). Later on, the Gate Theory (35) attempted to explain how the nervous system could be influenced by psychosocial aspects modulating the pain sensation.

Criticisms of the dualistic, Cartesian nature of the biomedical approach (36) led to the origin of the biopsychosocial framework (37). By including the psychological and social aspects with the biological view, cognitive behavioral therapy (CBT) is today recognized as the dominant psychological approach in the area of pain (38-40). CBT as integrated into behavioral medicine, serve as platform for the interprofessional pain rehabilitation programs (41, 42); currently, the 'state of the art' in the area of chronic pain (43). Originally CBT target behavioral changes by means of influencing the environment (stressors) and by controlling 'maladaptive' behaviors, thoughts, and beliefs related to pain (44). A more specific and well disseminated CBT- approach is the 'fear-avoidance' model, which focuses on decreasing catastrophic thinking and pain-related fear (fear of movement or kinesiophobia) (45) by exposure-based therapies (46).

One of the most recent developments in behavioral therapies, focuses on experientially creating openness to feelings of discomfort, is Acceptance and Commitment Therapy (ACT) (47). ACT is less focused on pathologies and more on healthy resources and proposes a model of psychological flexibility that integrates empirical findings with clear clinical implementations of therapeutic processes. ACT is listed as having strong evidence for chronic pain and the body of literature includes books for the clinician, the patient, as well as basic and clinical research (48-60). Appendix 1 includes two graphs depicting the differences in treatment approaches.

Pain guidelines and recommendations

The biopsychosocial framework has produced many outcome studies in the area of psychological treatments for pain and a myriad of outcome instruments have been and are still being developed. Unfortunately these research findings and instruments are not adapted to be integrated with clinical needs and assessment procedures. There are many protocols with no consistent analysis of the intrinsic mechanism of action not providing clear principles for treatment or for selecting the 'right' treatment for the 'right' patient, which leaves a concerning gap in the field of chronic pain (61, 62).

Pain guidelines unanimously recommend interprofessional rehabilitation and multi-dimensional assessment (63-71). These guidelines together with the epidemiological figures of chronic pain have prompted a nation-wide program in Sweden. This so-called 'Rehabilitation Guarantee' (RG)(Swe: *Rehabiliteringsgarantin*) is an investment of around \$100 million per year since 2009 to generate and support interprofessional, behavioral-based rehabilitation teams for patients with chronic musculoskeletal pain diagnoses (shoulder, neck, low back and widespread pain) (72, 73). The evaluation of rehabilitation demonstrates relatively good outcomes, though according to these reports the remaining problem is the non-specific assessment procedure for selecting and identifying which patients benefit from these rehabilitation programs (74, 75). This was almost expected, since the only condition stated in the regulation of the RG regarding assessment is a 'description' of (apart of the pain localization of the patients) the expected knowledge of the professional team: they have to have 'relevant' knowledge to assess in a systematic manner (76).

The rehabilitation supported by the RG has as condition that 1) only individuals with certain diagnoses or pain localizations can benefit from this program and 2) the rehabilitation 'must' be based on the biopsychosocial model, even though it is also stated that it is not exactly known what these programs have to offer (73, 77). These two conditions are contradictory in the medical philosophy and models: the first refers to a biomedical way of conceptualizing the problem, the second appeals to the biopsychosocial model of pain.

The Pain Care levels and contexts

International pain guidelines stress the importance of preventing long-lasting disability (64, 78, 79) with a heuristic view, suggesting giving up the uni-dimensional biomedical reductionism that seems to amplify the problem (80-82). The prevention and treatment stages in the Health Care chain as declared in the WHO Constitution (83) are: the **Primary Care**, that focuses on the prevention of chronicity of pain by promoting healthier lifestyles and behaviors (84, 85, 86, p 2) and perform differential diagnostic for referrals. **Secondary Care** treats disorder in early stages, to reduce the incidence of chronic incapacity or recurrences among those with pain (87). The most developed level is the **Specialty Care** or Pain Rehabilitation Clinics offers interprofessional assessments supporting the other two levels and also offers rehabilitation programs with its main focus on minimizing the consequences of decrease function for patients with chronic pain (86, 88).

PAIN CLASSIFICATION & ASSESSMENT

Pain can be perceived and understood from different perspectives (89). The temporal aspect has been the primary aspect demarcating chronic pain from acute pain (11, 80, 90). The second most important aspect has been the identification of etiology and pathophysiology (as nociceptive or neuropathic) (80, 91-93) to support the appropriate choice of pharmacotherapeutic treatment (94-97) or the appropriate physical therapy treatment (98, 99). One of the most difficult pain conditions is pain with no medical findings or evidence of tissue damage. The impossibility of fully explaining the reported severity of pain or disability challenges the current understanding of pain. This phenomenon is known as pain with 'unknown etiology,' also called 'idiopathic pain' 'non-specific,' 'intractable pain' or as 'poorly defined diagnoses,' 'refractory chronic pain' and 'problematic pain' (92, 100-102).

Diagnoses

Based on signs, symptoms and tests, the diagnoses support the clinical decision making and choice of treatment (103, 104). Classification of diagnoses were developed according to the biomedical model from the mid-1800s when new diagnostic instruments (e.g., the stethoscope, X-rays) generated more reliable data on patient's physiological status (105). These diagnoses were compiled into complete manuals of diseases. The most used classifications are the International Classification of Diseases (ICD) for medical conditions and the Diagnostic and Statistical Manual of Mental Disorders (DSM) for psychological and psychiatric conditions. These manuals present an a-theoretical strategy for diagnoses based on the topography (form) of the condition using a checklist of signs and symptoms.

Diagnoses are well established among clinicians and stakeholders and are successful in many medical areas, such as infection or diabetes, prompting effective and appropriate treatment. However, when it comes to chronic pain conditions with low symptom certainty and medical evidence, clinical judgments become more ambiguous, since in conditions as widespread pain, diagnoses are insufficient to delineate comprehensive and reliable case conceptualization that can prompt effective treatment (106). These 'non-specific' pain conditions have non-specific names such as those listed above, or the most often used 'comorbid or complex pain.' There are also several diagnostic terms, such as *somatoform pain syndrome* (ICD-10) and *somatic symptom disorder* (DSM-5). The problem with these diagnoses is

that they do not elicit any specific treatment or prognosis, which is one the primary and core functions of a diagnosis.

Psychosocial dimensions

One issue underlying the rapid increase in assignment of disability to nonspecific low back pain (...) is that the healthcare system relies too exclusively on a biomedical perspective on pain and illness while failing to consider adequately environmental influences on symptom behavior and care seeking (107).

The introduction of the biopsychosocial model in the pain field (26, 33-35, 107, 108) highlighted the multi-dimensionality of chronic pain and contributed to the creation of 'multidisciplinary pain management.' Most of the assessments have focused on the quantitative experience of pain, such as the intensity, the threshold, the tolerance (100, 109), as well as the quality of pain (i.e. throbbing, aching, and burning, among other qualities) (110, 111). In order to assess the broad spectra and the several dimensions of chronic pain, an array of instruments have been developed. The dimensions most often assessed are pain intensity, frequency, functional limitations, and quality of life among many others (109, 112); there are some instruments that can assess many of these dimensions (e.g., the Multidimensional Pain Inventory included in this thesis). There are other more specific that just assess anxiety and depression (e.g., the Hospital Anxiety and Depression Scale, also included), pain specific health related quality of life (e.g., The Short Form 36 survey questionnaire and the EuroQol, quality of life measure) as well as mental and physical functioning. The goal has been to offer a wider framework to understand the patient's needs and to predict outcomes (113-119). Typically these instruments are used together as a *package*, both by clinicians and researchers. In Sweden, most of the specialty pain clinics implement the packaged offered by the Swedish Quality Registry for Pain Rehabilitation.

Quality registries are important tools to support and generate improvement in the health care system(120). The Swedish National Quality Register of Pain Rehabilitation (SQRP) gathers data and then supplies the rehabilitation clinics with reports for quality control, and as base for research and development of evidence based interventions. The SQRP include *patient related outcome measurement*, mainly bio-psychosocial based instruments considered to be relevant for the needs of the patients with chronic pain. This thesis is an example of the research that can be done with this data gathered by the SQRP.

Subgrouping as a strategy

Patients with chronic musculoskeletal pain have been studied as if they were a homogeneous group, according to physical or psychiatric uni-dimensional diagnosis criteria (121). In studies they have been clumped together as 'consecutively referred patients' or patients with 'musculoskeletal/non-malignant pain' (122-124), today called patients with 'non-specific' pain. In order to identify differences and variation among the patients with 'non-specific' pain, psychosocial variables have been used to group them (125, 126).

The importance of identifying indicators that help to select patients that can benefit from a given rehabilitation technique has been stressed (25, 43, 127). Many attempts have been made to match patients according to a variety of dimensions, such as sensitivity to pain (128, 129) quality of life (130), coping strategies (131-133) and depression severity (134).

Group disparities have been reported across different cultures (135), ethnical/minority groups (136) and ages (137). Sex differences in characteristics and experiences of pain were firstly recognized in the late 1990's pointing out the compelling need to better characterize and assess these differences, since they seem to affect response to treatment (138-140). These differences can potentially be considered when planning rehabilitation programs and selecting patients into them.

Women report pain in more areas and higher pain intensity (141) and respond differently to the effects of therapies and analgesics (142, 143) being more sensitive to both dosage and type of medication (144). Women report higher levels of anxiety (145), which in turn is linearly related to disability, indicating that sex differences are predictive of pain rehabilitation's outcomes (140). Women use more distraction-directed coping strategies (146, 147), have different expectations (148) and involve more emotional based problem-solution techniques than men (149). Women seem to score lower kinesiophobia levels than men (150-152).

Experimental research has demonstrated that the reactions to pain between sexes are substantially different in threshold and tolerance level (153, 154) whereas other research groups believe that even if there are differences, they are not clinical relevant (155).

The unrestrained proliferation of constructs

The efforts to understand the multi-dimensionality of pain have generated a proliferation of instruments combined in different packages. There is widespread agreement that when multiple instruments are included in a package we then have a “more thorough understanding of the patient –and where to intervene to have the most positive effects” (156, p. 722). The equation is probably not that straightforward. The results after 30 years of the biopsychosocial approach, and the development of more than 200 instruments to assess a range of constructs, and the production of innumerable quantity of research have not yield rationale in how all these instruments are put together nor how to use them in the assessment and selection routine.

The majority of the biopsychosocial pain instruments assess treatment *efficacy* and *outcomes*, or what the treatment is intended to have an impact on (improve functioning and quality of life). Other instruments assess *risk factors* that may hamper the efficacy of the treatment or they may *predict* outcomes. Demographic data or patient characteristics can be seen as factors that *moderate* treatment (sex, age, income, etc.) and *mediators* assess and explain the intervening variables, process or *mechanism of action* that may account for the effect of treatment and *how* these changes or outcomes come about (e.g., pain acceptance) (157). Different models or researchers of pain may consider some domains to be mediators, while others consider them to be outcomes (158).

Few packages contain instruments that evaluate mechanisms of therapeutic change (156, 159). In the package offered by the Swedish National Registry, for example, there is only one instrument with the empirical tested capacity to evaluate therapeutic process: the Chronic Pain Acceptance Questionnaire. It is included as optional. The compulsory instruments pertain to different models and époques. It is important to better understand the use of each instrument and which pain model they fit in order to create systematization and parsimony within the current practice of multiple assessments (160). Furthermore, there are relatively few resources to systematically assist the clinician and the researcher in integrating all this information based on evidence, and the risk is that in the end the assessment and triage will be done by ‘pure opinion’ (161). Therefore, the mere assertion that “*selecting according to socio-demographic and clinical differences shows a conscientious selection process that imply that the patients benefit of rehabilitation*” (see 162, p. 37) is an insufficient response to the criticism and requests from national (75) and international research (62, 163); more evidence of consistency and systematization is needed.

THEORIES, MODELS & PROCESSES

Theories, frameworks and models influence the way pain is assessed, treated and studied. Models can be derived from common sense and/or have more or less empiric evidence. There is a difference between models based on frameworks or assumptions, on the one hand, and those based on tested theories, on the other.

A *framework* in this thesis is considered the one derived from observations (and it will be used instead of using *paradigm*). A framework is a set of assumptions and values that in turn create 'models' that try to explain the world and why we do what we do. Many of the frameworks in behavioral sciences are based on 'commonsense' (164) or on the therapist's beliefs (165). For example, the common belief that positive thinking increases self-esteem can be questioned since there are indications that, when studied, that this assumption was effective only for those that already had good self-esteem, as those that had low self-esteem, felt worse after positive reaffirmations (166). Frameworks that are not supported by a testable theory, a *top-down* framework, can keep on creating models and concepts in attempts to find the best explanation and solution of a problem, at the end creating confusion rather than clarity. These models are, in this thesis, not considered to be *theory-based*.

A theory is an organized and interrelated set of statements relating to reality that explains phenomena and is the base to formulate testable hypotheses, and from there therapies with empirical tested mechanism that can be both modifiable and assessed with precision (167, 168).

In this thesis, *theory-based models* of behavioral sciences refer to those that (a) are integrative and translational, meaning that they carry the capacity to condense basic research findings in few core principles that can be clear and useful in the clinical work and that (b) have well-defined philosophical postulates and pragmatic goals that delineate both the future research as well as the path of treatment (169). A theory has to have the ability to organize observation, produce clear hypotheses and being testable. Then the assessments and triage derived from such theory will be linked to a precise selection, prediction and development of treatment programs in a *bottom-up* manner (170).

The biopsychosocial model

During the 1960's the Gate Theory (35) opened up for the inclusion of the psychosocial dimensions into pain field. Pain management expanded from being a field of anesthesiology aiming to reduce pain via blocking biochemical mechanisms into addressing pain regulation via skill training. The *bio*-aspect and the *psychosocial* became integrated. Since then, persistent pain has been referred to as a multi-dimensional and 'complex' condition defined as a subjective and dynamic process overarching from the peripheral nociceptor, the genome of cells all the way to the patient's psychosocial milieu (171). Several authors contributed to the introduction of the bio-psychosocial framework in the pain field (26, 33-35, 107, 108, 172) in turn generating the development of several models and treatment based on cognitive behavioral therapies (40, 173). The emerging knowledge showed that when pain becomes chronic, nociception becomes less a determinant of functioning than psychological and social attributes (174).



Figure 1 Waddell's model (adapted from 171).

Another well-known model of disability is Loeser's clinical model of pain (176). It includes the 'bio' aspect where pain originates from the nociceptive machinery, triggers suffering and it expresses as pain behaviors (Figure 2, the text at the left).

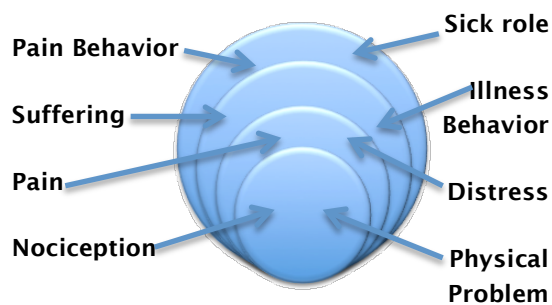


Figure 2 The Loeser's model (the text at the left of the figure) and the Glasgow Illness Model (text at the right of the figure).

The Glasgow Illness Model (adapted from 177) attempted to disentangle physical and psychological factors that could be used to explain to the patients why some of them became more disabled than others (Figure 2,

the text at the right). These models were effective in moving the pain field from anesthesiology into rehabilitation (178, 179). These models are useful in the clinical setting as didactic tools to explain to professionals and clients the multi-dimensionality of chronic pain.

These many and different models use the same visualization generating confusion, however the most serious shortcoming may be that none of these models have been tested empirically or supported by an underlying empirical theory (180-182). In conclusion, these descriptive models include the **biological**, the **psychological** and the **social** factors without explaining how they interact. Other more developed descriptive models explain the interactions of the biopsychosocial framework clearly showing how complex this model is. The **Figure 3** (Adapted with permission of Michael K. Nicholas (118)) explains how persisting pain evolves from being a chronic pain into 'excessive suffering.' Other models (and a huge amount of current research) are going back to include biological findings into the biopsychosocial model as a way to understand the world of pain (156, 183).

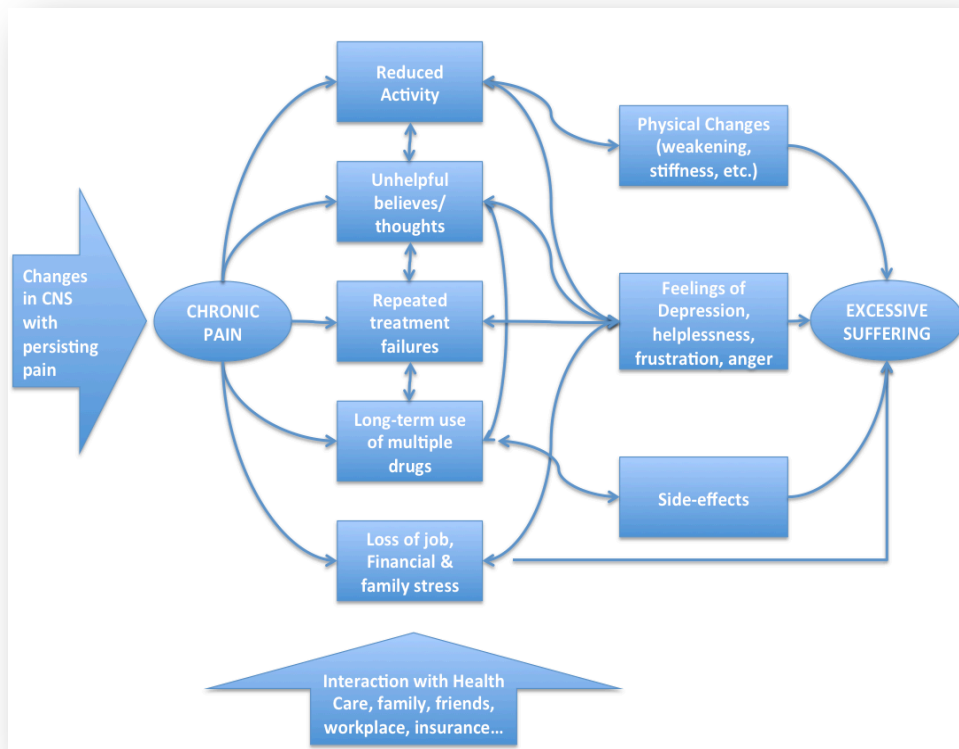


Figure 3 How chronic pain can become a complex problem. Adapted with permission of M. Nicholas.

Cognitive Behavioral Therapy

Since the disability caused by chronic pain was not explained by the extent of damage or disease (184, 185) the distinctive feature and focus for research became the 'way' the patient managed the pain (186). This 'management style' has been called '*pain coping*' (187). If the pain coping strategies are 'maladaptive,' they can contribute to disability and are considered to be risk-factors (188). In this model, coping can be defined as "an active effort to manage or control a perceived stressor" in other words, a strategy to avoid stressors (189, 190).

According to cognitive behavioral therapies (CBT), assumptions, thoughts and emotions control behaviors, and when reducing their intensity or frequency, it is possible to modify 'pain behaviors' (108). CBT uses tools such as education (e.g., back schools), distraction, exposure, goal setting, problem solving, relaxation and activity pacing in order to "control thoughts, feelings, behaviors and physiologic responses" (191) by means of self-monitoring skills. The techniques most used by CBT therapists are often education, cognitive restructuring (controlling content, frequency and intensity of cognitions or emotions) and relaxation (192). This is a different approach compared to the 'coping' model that attempts to control 'external stressors' to get rid of their pain (193). Being on sick leave, distraction and pacing are strategies inspired in the early stress theory; however, it has not been demonstrated that these coping strategies influence quality of life (194, 195).

In CBT there is a strong focus on the training of adaptive skills and as such physical exercise is seen as an "intervention for enhancing the self-management" (191). However, this 'adaptive' coping has failed to show that multi-professional programs targeting increasing activity and exercise, distraction or relaxation were really 'adaptive' since they are not strongly correlated (if at all) to functioning (196).



Figure 4
The unrestrained proliferation of constructs. Inspired by McCracken's a presentation at the WAD conference in Lund, 2011. Adapted with his permission.

CBT has been conceptualized with many models, terms, constructs, variables and psychopathologies some of them seen as 'disabilities' or 'maladaptive beliefs' to be controlled or reduced **Figure 4**.

There are more than 200 pain related questionnaires in the CBT model (each with many variables and subscales) and an impressive body of literature and research primarily based on correlational data and these effectiveness studies show good outcomes. The problem is that correlational data is not enough to empirically demonstrate the models and elucidate the underlying theories and assumptions of such models, treatments or assessment instruments (197) and the few studies investigating CBT *process* fail in showing results consistent with the assumptions of CBT (166, 198). For example, there is not enough and persuasive evidence that confronting negative thoughts or changing their content or frequency mediates when treating anxiety or depression (199). In conclusion, this inclusiveness of the increasing amount of concepts and variables further difficult the empirical investigation and identification of the potential therapeutic processes or mechanisms, bringing more confusion at the time of choice of appropriated technique. These many models of pain may provide predictive verification, but do not point to *potentially modifiable environmental variables*, and thus clinicians are still left with using guesswork.

Acceptance and Commitment Therapy

*Moving from "seeking to understand the reality of the world to seeking ways to **act** successfully in the world" (200, p. 185)*

Within the behavioral sciences, the Functional and Contextual Behavioral Sciences (known as CBS) suggests a different approach to 'coping' characterized as attempts and strategies to overcome pain by controlling their negative content, reducing their frequency, or avoiding it (201). The CBS model is based on *healthy* functioning rather than pathologies and proposes a different agenda to archive improvement in function and vitality when constant and long lasting attempts to avoid, reduce or control symptoms (pain) are ineffective. The strategy is to notice and understand how the pain (or other discomfort such as difficult thoughts, emotions, etc.) influences our behavior, with an open attitude and without trying to change the frequency or intensity of discomfort. This psychological process stimulates the healthy resources of the individual and the capacity to open up, create 'space' and a willingness to *accept* negative feelings, sensations or thoughts. The theoretical model developed by the CBS has been referred to as Psychological Flexibility (PF) (159, 169, 202) and the psychotherapy within this model is *Acceptance and Commitment Therapy (ACT)*(47).

The PF model is a set of six integrated component processes that apply with precision to a wide range of clinically relevant problems and to issues of human functioning and adaptability (47). The theory supporting ACT is the Relational Frame Theory, a behavioral account of human language and cognition (203, 204). Each of the component processes in the **Figure 5** (adapted from 205, p. 16), have been examined

individually and also as a comprehensive treatment and sound model for treatment in the area of chronic pain (206) and the components has validated instruments in several languages (available at www.contextualscience.org).

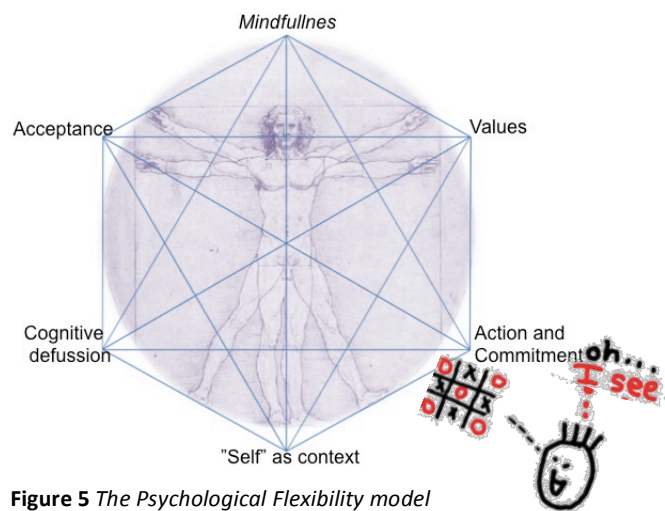


Figure 5 The Psychological Flexibility model

Briefly, the component processes in the PF model and ACT are: *Acceptance* (a chosen willingness to have pain or discomfort while committed in valued actions), *Cognitive Defusion* (an awareness and management of the dominance of the content of thoughts that narrow our possibility to choose flexible and functional actions), *Mindfulness* or also called *Flexible Awareness of the Present* (a purposeful, nonjudgmental, and fluid attending to present experiences), *Self-as-Context* (the difference between being a thought and 'having' a thought, realizing that thoughts change and the capacity to notice those changes offers more stability to the individual than otherwise when blindly following or acting after shifting thoughts), *Values* (freely chosen orientation for activity that bring meaning, importance, or vitality to living) and *Committed Action* (behaviors chosen that encompasses a flexible persistence oriented towards valued living) (6).

In this thesis the focus is on Pain Acceptance, since it is the only ACT-consistent instrument included in the Registry. *Acceptance* is defined as a psychological willingness to experience internal events (thoughts, feelings, body sensations) without getting stuck in unsuccessfully attempting to control or to avoid them instead for doing what is meaningful in life (47). Despite functional limitations and adversities ACT helps patients to find a new way to relate to the pain and a flexible way to actively engage (207), and adaptively adjust to personal values and goals (208) continuing living life as normal as possible .

Acceptance changes strategies for pain management in a somewhat counterintuitive way; however, it has been empirically tested and shown effective as core component therapeutic process (e.g., 49, 209, 210). Addressing pain acceptance promotes less avoidance, anxiety, depression and medical consumption and increased work capacity (209, 211). It has been demonstrated effective to lower levels of psychological and physical disability, improve health, functioning (207, 212) and quality of life (58, 213, 214).

In this thesis Pain Acceptance is the only ACT process studied. There were at least four important reasons for that choice: a) the theory behind the therapy and instrument that measures a modifiable variable (pain acceptance) targeted in rehabilitation; and b) the groupings according to the CPAQ has been previously done by Vowles et al. (215) and this thesis could potentially replicate their results, c) acceptance is an adaptive and *normal* behavior and last but not least, d) the CPAQ was the only ACT consistent instrument included in the SQRP.

In the CBS research and clinical program (170) applied for chronic pain (200) it is highlighted the importance of keeping the model flexible and progressive delineating three basic steps to follow: 1) to let go of variables and processes that have ceased to be useful for the development of research and treatments, 2) to firstly choose scientific goals and be clear about the underlying philosophical assumptions and 3) develop treatment guided by tested theories and basic processes that can with precision generate change .

To assess pain acceptance

Pain acceptance is most often assessed with the Chronic Pain Acceptance Questionnaire (CPAQ; 216, 217) and the one from the PF model that is included in the package of the Swedish Quality Registry for Pain Rehabilitation. It has 20 items and yields two subscales: Activity Engagement (AE), the degree to which the person engages in activities with pain present, and Pain Willingness (PW), the degree to which the person refrains from attempts to avoid or control painful experiences. Evidence shows that the CPAQ is coherent with ACT processes and concepts, useful in clinical practice (215) and psychometrically robust (218).

Treatment providers and researchers often seek shorter and more efficient means for obtaining data from patient reports. Hence, a shorter version of the CPAQ was recently developed (219). The result is an eight-item version of the instrument (CPAQ-8) that appears to have good psychometric properties and kept the two-factor structure as the original. As yet

unknown property of the instrument has been the sensitivity of the CPAQ to treatment effects.

The models and their impact on assessment

The CBT model with its inclusiveness of the increasing amount of concepts and instruments can further complicate the choice of appropriated assessment instruments and the understanding of their results when analyzed. These many variables and models of pain may provide predictive verification, many correlations, some statistical moderators but do not point to *potentially modifiable environmental variables*, and thus clinicians are still left with using guesswork. One possibility to support the assessment process and thus increase quality of the pain rehabilitation is to implement the widely used instruments included in the National Quality Registry for Pain Rehabilitation (SQRP) since already is used the majority of the clinics.

Apart for the differences in therapeutic approach between models (included in Appendix 1) the Psychological Flexibility model for chronic pain have developed process instruments capable to measure the ACT mechanisms of action and the therapy progress over time (170, 220, 221). They show reasonable coherence between the assessment data, the model, and the model's relations with key aspects of rehabilitation for patients with chronic pain (206).

A front-line strategy towards a clear and evidence-based triage that interact in a sound theoretical manner, including indicators for referral and selection of patients to the appropriate rehabilitation program and prediction of their outcome, guarantee further investigation (25, 43, 73, page 1, 222, 223).

AIMS

Overall, this thesis investigates which of the widely used pain instruments are relevant and useful indicators for identifying rehabilitation needs and predicting outcomes among patients with chronic pain.

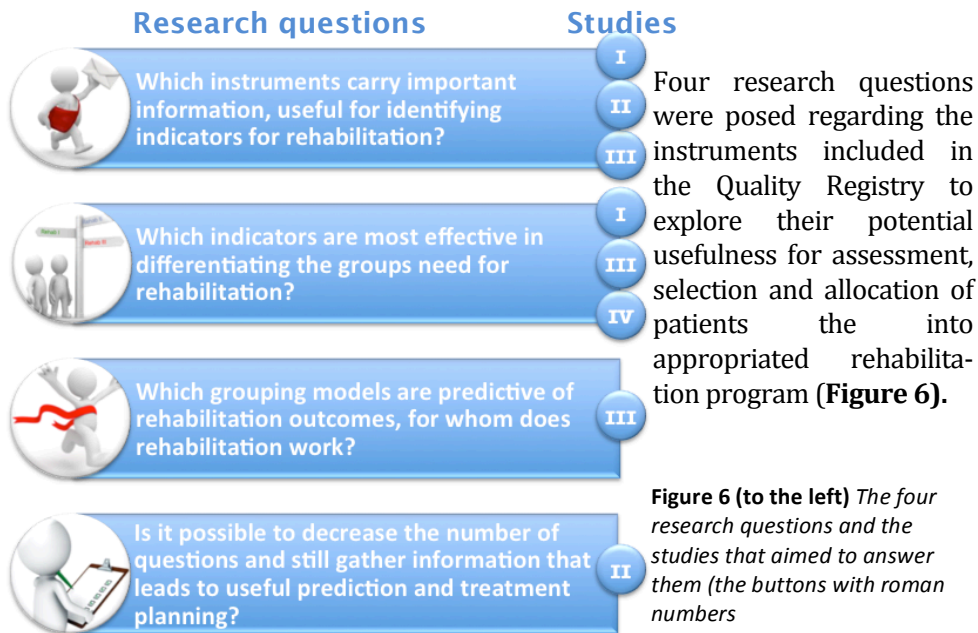


Figure 6 (to the left) The four research questions and the studies that aimed to answer them (the buttons with roman numbers

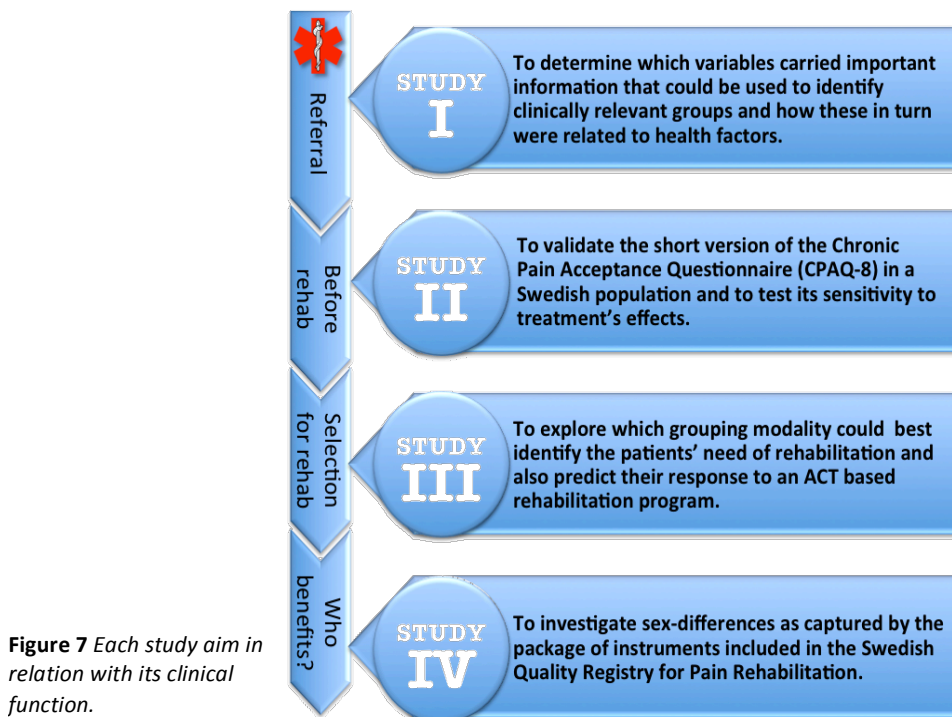


Figure 7 Each study aim in relation with its clinical function.

PATIENTS AND METHODS

Sample and Setting

The participants of the studies were those referred to the Multidisciplinary Pain Specialty Clinic at the University Hospital, Linköping in the southeastern region of Sweden. The clinic has a behavioral-medicine approach and one of the first in the country to incorporate ACT elements to the rehabilitation. The clinic specializes in vocational interprofessional pain assessments and rehabilitation for patients with heterogeneous and non-malignant chronic pain conditions. The patients are referred from several sources, mainly from the primary care. The referral may require rehabilitation or just a comprehensive assessment to support the primary care decisions of medication, tests or sick leave certifications. Some patients enter rehabilitation programs, but not all. Those who have other primary problems than pain, such as other somatic or psychological conditions just looking for new medicine or a cure of a more invasive nature, are assessed and referred back to their doctor.

Study I included data from 4069 patients referred to the Pain and Rehabilitation Center between 2005 and 2008. Studies II, III and IV are based on 1371 patients registered in the clinic between May 2009 and April 2011. Study II included the subset of 891 patients that had no missing data in order to validate the short pain acceptance instrument (CPAQ-8). To test the CPAQ-8 sensitivity to change, an even smaller subset that had finished the acceptance-based rehabilitation program and had complete CPAQ post-rehab data ($n=91$) was included. This same subgroup was included in study III, while study IV included the original group of 1371. The included patients' demographic data and pain characteristics are summarized in **(Table 2)**.

Ethical approval

The patients give informed consent to be included at the Swedish National Registry for Pain Rehabilitation (SQRP) when attending the clinic for the first time. Permission to conduct all the studies was obtained from the Regional Ethics Board in Gothenburg (Dnr. 815-12) and the study I had clearance by the Linköping University Ethics Committee (Dnr. 97139).

Assessments

The questionnaires used in this thesis were those included in the Swedish National Quality Register of Pain Rehabilitation (SQRP). The questionnaires are self-reported instruments widely used internationally and also validated in Swedish populations. The SQRP included new instrument in 2009 and excluded others. In **Table 1** are presented the instruments included in each package (the older and the newer, before and after 2009) and in each study. In this thesis both packages were analyzed: Study I includes participants before 2009 and the oldest package is analyzed while in Studies II to IV the new package is used. No tests of physical capacity or functioning are included; the doctors answer some questions about the kind of pain, diagnoses and recommendations at discharge. All the instruments are compulsory to use, but the CPAQ and TSK are elective instruments.

Table 1 Overview of the assessments and validation year of the instruments included in Study I-IV

ASSESSMENTS (Acronym, year of first validation)	STUDIES			
	I	II	III	IV
Demographics & Pain variables	X	X	X	X
Fatigue visual analogue scale 0-100	X			
Diagnoses			X	
Hospital Anxiety and Depression Scale (HAD, 1983)	X	X	X	X
Short Form SF-36 (SF-36, 1992)	X	X	X	X
Life Satisfaction Questionnaire (LiSat-11, 1991)	X			X
Multidimensional Pain Inventory (MPI, 1987)	X			X
Modified Somatic Perception Questionnaire (MSPQ, 1983)*	X			
Disability Rating Index (DRI, 1994)*	X			
Quality Of Life Measure EuroQol (EQ-5D, 1996)**		X	X	X
Tampa Scale for Kinesiophobia (TSK)**		X	X	X
Chronic Pain Acceptance Questionnaire (CPAQ, 2004)** ²		X	X	X

¹Instruments included in the Swedish Quality Registry for Pain Rehabilitation.

*Instruments excluded 2009. **Instruments added 2009

² In Study II a short version of the CPAQ was validated and used Studies III and IV. The Swedish version of the CPAQ-8 is included in Appendix 3

Demographic data

The registry includes also questions regarding pain intensity and localizations, work status, sick leave or insurance situation as well as outcome and work expectations. In **Table 2** the patients' demographic information used in each study is presented.

Table 2. Demographic and pain characteristics of the patients in each study.

	STUDIES			
	I	II	III	IV
Subjects, N	4069	891	91	1371
Age M (SD)	46 (14)	47.5 (14)	47.5 (14)	47 (15)
Females, %	70	66	69	68
Born in Sweden, %	77	83	79	80
Elementary school, %		26	26	
High school, %		47	39	
University, %	16	18	25	17
Years without working, M (SD)	5.4 (6.4)	5.6 (8.9)	6 (6.8)	6.4 (8.8)
Pain duration in years M (SD)	8 (8.3)	8.3 (9.4)	9.8 (11.2)	8 (9)
Days with persistent pain	6 (6.7)	6.8 (8.7)	6.6 (8)	6.6 (8.4)
Pain severity (range 0-6) M (SD)	4.43 (1.0)	4.5 (1.0)	4.2 (1.1)	4.5(1.04)
Pain localizations (1-36) M (SD)	14 (18)	12.5 (8.2)	13.2 (8.6)	13 (8)
Headache or pain in the face %		5.7	5.6	
Neck, shoulder, arm pain %		28.5	17.8	
Chest pain %		4.2	4.5	
Low back pain %		15.9	13.5	
Pelvis, hip, leg pain %		13.8	10.1	
Stomach or belly pain %		4.1	5.6	
Widespread pain %		27.9	34.9	31

Validated questionnaires¹

Multidimensional Pain Inventory (MPI) (224, 225). The Swedish version MPI-S (226, 227) has good internal consistency, with a Cronbach's alpha coefficient reported of within the 0.6 and 0.9. The MPI-S has 61 items² with several scales and yield three clusters according to patients' coping styles: *dysfunctional copers* (DYS), *interpersonally distressed* (ID), and *adaptive copers* (AC) (225). The MPI requires the whole completion (no missing values) in order to calculate it (228).

¹ More information about the instruments can be found in the method section in each study

² There is a shorter version of the MPI-S with 34 items, but the Quality Registry for Pain Rehabilitation still uses the long version that is no longer supported by the original authors.

The Chronic Pain Acceptance Questionnaire 20-Items (CPAQ; 217) is a 20-item scale with two subscales: 'Activity Engagement' (the degree to which the person is engaged in life activities regardless of pain) and 'Pain Willingness' (the degree to which the person feels little need to avoid or control painful experiences) shown to be useful in theory and in practice (215). All items are rated on a scale from 0 (never true) to 6 (always true). The scale has shown to be reliable and valid both in English and in Swedish (217, 229). The CPAQ assesses acceptance from a functional and contextual perspective focusing on the behavioral facet of acceptance of pain and is founded within a coherent theoretical framework (54, 55). It has been shown that pain acceptance is negatively correlated with avoidance and emotional distress and positively correlated with functioning (217). Acceptance of chronic pain can effectively predict lower pain intensity, depression and anxiety, as well as higher functional and activity levels (49).

Evidence shows that the CPAQ is coherent with ACT processes and concepts, useful in clinical practice (215) and psychometrically robust (218) and translated into German (230), in Spanish (231, 232), Chinese (233), Finnish (234) Italian (235), Swedish (236), Persian (237) and Korean (238), with each of these studies supporting the validity and reliability of the CPAQ-20. Appendix 2 includes the scale in Swedish.

The Chronic Pain Acceptance Questionnaire 8-Items (CPAQ-8) is the short form of the CPAQ derived from the original 20-items. The CPAQ-8 has demonstrated good reliability and validity both in English (219, 239, 240) and in Swedish (241). Pain acceptance is operationalized with two main classes of behaviours (calculated as subscales): 1) 'Activity Engagement' ('AE', score range: 0-24), which is the openness to experience pain while being engaged in a valuable activity and 2) 'Pain Willingness' ('PW', score range: 0-24), the capacity to be open to the pain without struggling with while engaging in meaningful activities in life. This willingness and openness to discomfort is functional when it is in the service of living a valued life. All items are rated on a scale from 0 (never true) to 6 (always true). The CPA-8 in Swedish is included in Appendix 3.

Hospital Anxiety and Depression Scale (HAD; 242) yields two subscales of depression and anxiety symptoms with 7-items each. Each item has four response categories in the 0 (no problem) to 3 and the sum for each component. The scale covers a period of the past few days and takes 5-10 minutes to answer. A score of <7 in a subscale is taken as a non-symptomatic; a score of 8-10 indicates mild/moderate symptoms; and >10 or more indicates severe symptoms. The scores for the two subscales can

also be added together to give a composite anxiety–depression score. The Swedish translation has shown acceptable psychometric properties (243).

The Modified Somatic Perception Questionnaire (MSPQ) (244) identifies psychological distress in patients with persistent back pain. It has 13-items in a Likert 4-graded scale. It has shown good psychometric properties (245) and it is easy to administer (246). In Study I the total index (with a maximum score of 39) is analyzed.

Disability Rating Index (DRI) used to assess physical functioning (247). The DRI includes 12 activities grouped in three categories: basic daily life activities (items 1-4), physical activities (items 5-8) and work-related/vigorous activities (items 9–12). It is rated on a continuous scale (0-100) where the patients marks a point on the line. In study I, the total score is calculated as the sum of the 12 items in mm (between 0-1200 mm; a high value denotes low physical functioning). The DRI is a very quick self-administered questionnaire, and can be scored in less than 2 min.

Quality of life (QoL) has been defined as ‘an individual’s perception of their position in life, in relation to their goals, expectations, standards and concerns’ (248). Quality of life is increasingly used as end-points for medical interventions and rehabilitation programs and the following three QoL instruments are included in the SQRP.

The Short Form 36 survey questionnaire (SF-36; 249) (250) is used worldwide and available in many languages. It has only 36 questions that yield an 8-scale profile of functioning, health and well-being scores as well as two physical and mental health summary scores (PCS and MCS). The SF-36 reports the patients' perception of quality of life by means of scores ranging from zero to 100, with 100 being the ideal score. The internal consistency of these scales in the Swedish norm is between .79 to .93, a range quite near the US and UK’s reliability (251). In the current study, the Cronbach’s alpha coefficient was .89.

EuroQol, quality of life scale (EQ-5D; 252, 253, 254) is a non-disease-specific instrument describing health-related quality of life and complements other scores with a cardinal index of health, used in health economic evaluation. The EQ-5D captures physical, mental, and social functioning and it takes approximately 5 minutes to complete.

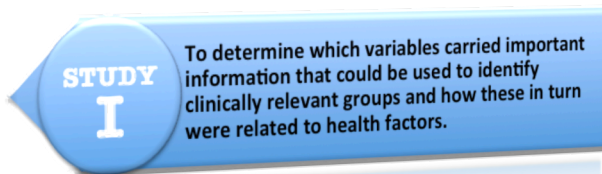
Life Satisfaction questionnaire (LiSat-11) consists of one item about satisfaction with life as a whole and 10 items about different domains of life. The levels of satisfaction are graded along a 6-point response scale (255, 256). The scale is gender-independent and shows acceptable psychometric qualities (255, 257).

Rehabilitation program

This clinic that participated in these studies, is one of the first in Sweden to implement ACT-based interprofessional rehabilitation. Since this thesis does not evaluate the effectiveness of such rehabilitation, a detailed description is out of the scope of this thesis. The post-rehabilitation data included in Study I test the short pain acceptance instrument's capacity to track changes of rehabilitation (its sensitivity to change). In Study III, it is included in order to compare different groupings' capacity to predict outcomes.

The psychotherapeutic approach has been thoroughly presented elsewhere (see 52, 60). ACT can be adapted and implemented by the interprofessional team (physicians, physical therapists (PT) and occupational therapists). ACT's basic concepts are interwoven in the interprofessional program and in other situations than verbal therapy, such as during physical activity and activities of daily living. More about this kind of adaptation and ACT-based rehab program can be read elsewhere (258, 259).

Statistical methods³



In order to be able to extract and display systematic variation among all the variables the

Principal Component Analysis, PCA/PLS was used (SIMCA-P+ by Umetrics, Umeå, Sweden).

The results in the PCA can generate one or two *components* placed along vectors (X and Y) with *loadings* between -1 to 1. The higher the number of the loading (independent of sign) the more inter-correlated and important these variables are in the model. Those variables are called *principal component* and visualized by so-called score plots (relation between different samples) or loading plots (relation between the sensors) and they are used to esteem the dimensionality of the data collected on each patient. Superposing these two plots it would be possible to see the relation between each participant and the variables.

³ For a detailed explanation, see Method of the corresponding study at the back of this thesis.

**STUDY
II**

To validate the short version of the Chronic Pain Acceptance Questionnaire (CPAQ-8) in a Swedish population and to test its sensitivity to treatment's effects.

The psychometric properties of the CPAQ were explored by firstly the investigation of data quality (260), evaluation of the scale-

scores distribution and endorsement of item responses and missing data.

The homogeneity was tested with item-total correlations. Internal consistency was assessed using Cronbach's alpha (261). Confirmatory factor analyses (CFA) performed with a one and two factor model were analyzed for each version of the scale to evaluate the dimensionality (262). Different measures were used to evaluate model fit in terms of absolute fit (262-266). To evaluate construct validity (convergent validity), the CPAQ scores were correlated with SF-36, HADS and TSK.

The short version's ability to detect change (sensitivity) was evaluated by comparing its pre- and post-rehabilitation scores as well as tracking the changes in the other included instruments in order to see if the CPAQ-8 could reflect changes in accordance with those registered by the other instruments analyzed with t-test and Cohen's effect size (267) as well as exploring how much of the variance from the long version was still explained by the short one.

The statistical analyses were conducted with SPSS Statistics 19 and SPSS AMOS 19 (IBM Corporation, Somers, NY, USA) as well as STATA 12.1 (StataCorp, College Station, TX, USA).

**STUDY
III**

To explore which grouping modality could best identify the patients' need of rehabilitation and also predict their response to an ACT based rehabilitation program.

Three models of grouping were tested, the patients were grouped by their diagnoses, their perception of the worse pain and their pain

acceptance. The first two models of grouping were divided in three groups: a) Localized pain, b) neck or shoulder pain and c) widespread pain. The third grouping modality was statistically created by clustering the patient acceptance level. Methods and the models of grouping are described in the Study III.

In the mixed between-within subjects ANOVA, the interaction term between groups was considered as including information about an overall pattern of differences across the groups. The interpretation of the interaction term and the groupings' differentiation capacity can be seen by 1) identify which groups respond best to the rehabilitation and 2) if there

were a systematic and consistent pattern of change in these groups (see **Study II**, Table VII).

The change in rehabilitation was graphically illustrated on the ANOVA charts (**Study III**, Figure 2). In these graphs the pre and post mean scores for each group are on the x-axis and the variable's scores in the y-axis. The interpretation was done with the Profile Analysis Approach by the height of the lines (each line representing a group). If these lines are at the same height, this implies no difference, and if they are at different heights then there may be enough difference for a statistically significant main effect (**Study III**, Table III for significances and Effect Sizes). While the slope of the lines show main effects of the rehabilitation, their parallelism indicates no interaction between groups. If the lines are not parallel, then there may be a statistically significant interaction effect. This means that the groups were changing at different rates and the overall average line may not represent the real patterns in the data. When looking at the graphs for all variables in each model of grouping, a pattern of response may or may not be visually identified.



Descriptive statistics of the socio-demographics as well as for the predictors and outcomes variables (gathered pre-rehabilitation) were

computed for the sample and by sex. Comparisons between groups for each instrument were done with Chi2 and t-tests. In this study, results that were significant at the $p \leq .01$ were considered significant and at the $p \leq .001$ 'highly' significant and between .05 and .01 were seen as 'tendencies' or a trend. Means and SDs are calculated in order to make comparisons with other studies possible. The missing data excluded cases on a pairwise (a.k.a. analysis-by-analysis or test-by-test) basis and the n 's of each variable are stated in the results.

Statistical methods: a summary

Table 3 Overview of statistical methods used in Studies I-IV

Study I	Study II	Study III	Study IV
Principal component analysis (PCA)	Confirmatory factor analyses (CFA)	One-way ANOVA	Chi2 t-tests
Partial least squares (PLS) (SIMCA-P+)	Item-total correlations (ITC)	Mixed between-within-subjects ANOVA	Unpaired t-tests
	Pearson correlations coefficient (.3-.9)	k-means cluster analysis	
	Paired t-test & Cohen EF		

RESULTS

STUDY I

To determine which variables carried important information that could be used to identify clinically relevant groups and how these in turn were related to health factors.

At the time of referral, the answers of the patients that showed greater variations were firstly those related to pain symptoms and mood, which were negatively correlated with quality of life, control and general activity level. The variables related with social dimensions carried also information about the patients' pain intensity, life satisfaction and participation (**Study I**, Table 1).

Based on these results, regressions were performed and the most important regressors in relation to participation and ill-health, were pain intensity and psychological functioning. Depression was stronger regressor than Anxiety.

These three variables, pain intensity (last week), depression and anxiety carrying with great variability were selected to perform groupings. These variables were dichotomized in high respectively low scores and combined in 8 groups (one group scored high in all 3 variables, the other had high in 2 and low in 1, the third 1 high and two low, and so on). The two groups probably most useful and clinically relevant, were those with high respective low scores in all three variables (**Study I**, Table 5).

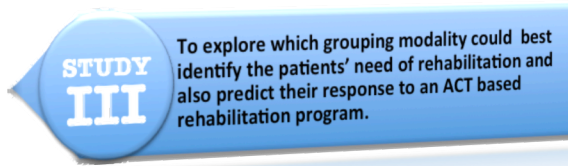
STUDY II

To validate the short version of the Chronic Pain Acceptance Questionnaire (CPAQ-8) in a Swedish population and to test its sensitivity to treatment's effects.

The CPAQ-8 demonstrated good psychometric properties, a satisfactory internal consistency, no tendency of floor or ceiling effects, and kept the multidimensionality and the good fit of the two factors model of the 20-Items CPAQ (**Study II**, Table III). Regarding the convergent validity, the CPAQ-8 total scores correlated with quality of life (SF-36), anxiety and depression (HAD), and pain-related fear (TSK) while the PW subscale, showed a weak correlation to some of the SF-36 scales and to the depression scale from the HAD. However, the correlation pattern and the significance level was the same for the CPAQ-8 and CPAQ-20, as well as the correlation between versions.

Both CPAQ-8 and CPAQ-20 showed good capacity to track rehabilitation changes, an attribute not tested before. Both CPAQ-20 and the CPAQ-8 were sensitive to changes but the CPAQ-20 yield larger effect size ($d=.70$) than the one derived from the CPAQ-8 ($d=.55$). The AE subscales reflected

medium effect size; the PW subscales showed small effects. Improvements were also demonstrated for all SF-36 scales, HAD and TSK, although not all were statistically significant. The CPAQ original and the CPAQ-8 in Swedish are found in Appendix 2 and 3 respectively.



As Shown in Study II the 91 participants' in this study underwent an ACT-based pain rehabilitation. They had improved significantly in acceptance behaviors as seen in

the Study II (**Study II**, Table 1). The magnitude of the effect sizes in relation to their significance reflected the great variation (heterogeneity) among patients before rehabilitation and their potentially different benefits of it.

To investigate who benefited, three grouping models were performed: (1) according to their diagnoses as reported by the doctors (**Figure 8**), (2) grouping patient's their self-reported perception of their worst pain location (**Figure 9**) and (3) clustering them according to their pain acceptance. The two first grouping models were then sub-grouped in three: (a) Widespread pain, (b) localized pain and (c) neck pain, while clustering by levels of pain acceptance yield in four subgroups (**Figure C**). The distributions are shown in the **Figures A, B** and **C**.

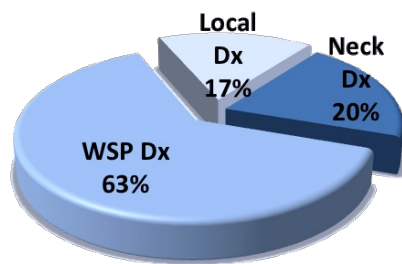


Figure 8 Model of grouping by diagnoses (Dx)

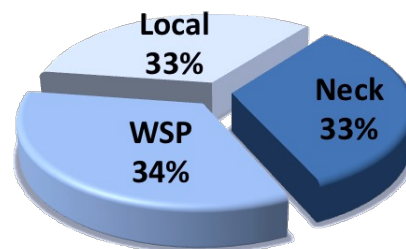


Figure 9 Model of grouping by the patient 's worst symptoms

Among the sub-groups by diagnoses, the patients with widespread pain showed significantly more interference in mood, QoL and in behavioral variables compared with the other two subgroups. This was also the only group that showed a non-significant but consistent pattern of amelioration in the graphical output (**Study III**, Table 2 and 3 and Figure II).

Similarly for the subgroups according with the patients' own rating of their worst pain, there were distinctions between the subgroup of patients with widespread pain and the two other sub-groups regarding anxiety,

depression and some aspects of QoL (**Study III**, Table 4). However, these groups did not respond differently to rehabilitation or showed a consistent pattern of change (**Study III**, Table 3) a lack of consistent pattern of change indicates that these models of grouping and sub-grouping have poor predictive value.

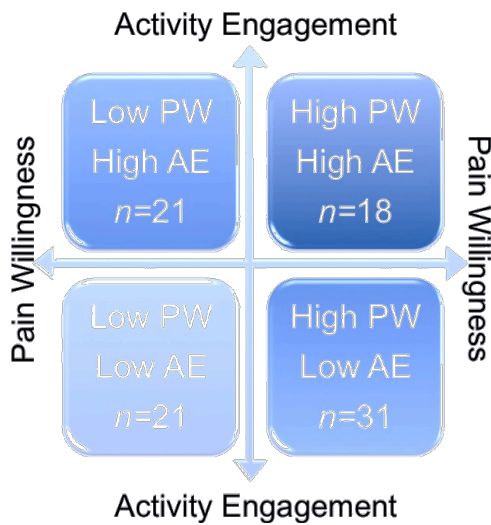


Figure 10 Model of grouping by pain acceptance's two subscales: PW: Pain Willingness and AE: Activity Engagement

Grouping by clusters based on patients' scores of pain acceptance yielded four solutions; two groups with high respectively low acceptance behaviors (PW & AE) and two groups with an uneven combination of these behaviors (**Figure 10**). These sub-groups had significant and distinct differences in their anxiety, depression, quality of life and kinesiophobia scores before entering the rehabilitation program (**Study III**; Table 5). The impact of rehabilitation was also different for these groups and specific patterns of response were found (**Study III**, Table 3, Table 6 & Figure 2). All but the group with high pain acceptance improved in all the other variables after rehabilitation. The group with high acceptance showed no significant changes.



Among the 1371 patients participating in this study 68.4% were women and 35% of them suffered from widespread pain while a 78% of the men suffered from localized pain (**Study IV**, Table 1). While most of the men were working full time the women were not working or working part time. All the patients reported high pain severity with a duration up to 15 years.

The entire group reported a considerable variation in anxiety and depression symptoms and a high level of pain interference, but women reported being more active than men (**Study IV**, Table 3). Men reported feeling mentally worse than women (anxiety and depression). Women experienced higher satisfaction with life than men (**Study IV**, Table 4). They scored being more satisfied with their social and family life as well as

with and their sexual life. The instrument assessing life satisfaction (LiSat-11) showed more distinct and significant differences between sexes compared with other instruments of quality of life. The EQ-5D could not identify differences at all.

Regarding pain acceptance (**Study IV**, Table 4) as assessed with the CPAQ-8, the women scored higher values in both Activity Engagement and Pain Willingness. The overall mean of kinesiophobia was high and men scored higher level of avoidance than women. Both instruments (CPAQ and TSK) were sensitive to sex differences.

Summary of results

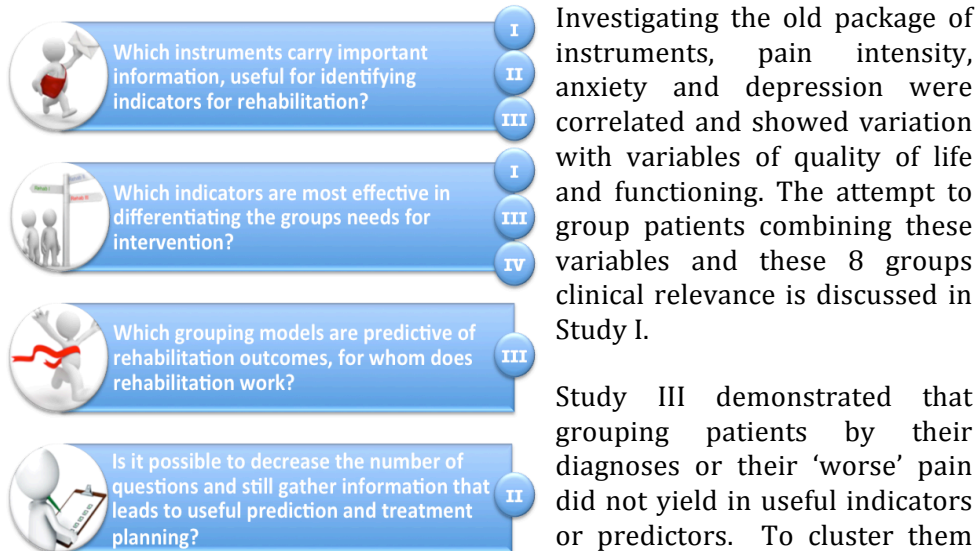


Figure 11 The research question of this thesis (the same figure as **Figure 6**).

Investigating the old package of instruments, pain intensity, anxiety and depression were correlated and showed variation with variables of quality of life and functioning. The attempt to group patients combining these variables and these 8 groups clinical relevance is discussed in Study I.


Study III demonstrated that grouping patients by their diagnoses or their 'worse' pain did not yield in useful indicators or predictors. To cluster them according to their pain acceptance scores allowed distinct identification subgroups with different levels of psychological functioning and quality of life and also could predict response of rehabilitation. The group with high level of pain acceptance did not benefit of such program while the other three clusters did. In Study IV, the sexes demonstrated being significant different in pain acceptance and kinesiophobia before rehabilitation. Furthermore, it was also possible to decrease the amount of questions in the pain acceptance instrument keeping good psychometric properties and the capacity to track rehabilitation changes, according to Study II (see Appendix 3 for the Swedish version).

Overall these results show that part of the data gathered by the Swedish Quality Registry for Pain Rehabilitation, have potential capacity to assist the assessment, triage and prediction of pain rehabilitation.

DISCUSSION


Main findings

Relevant indicators for identifying rehabilitation needs and predicting outcomes emerged from the two different packages (old vs. new) of instruments from the SQRP. The old and new packages generated different indicators. The indicators identified for the old package were consistent with the theories of pain existing at that time, while the indicators from the new package emerged from a newer and shorter instrument designed to track therapeutic processes that are currently implemented in ACT-based pain rehabilitation. However, it is possible that these different indicators may have different functions and utility in different settings.



Which instruments carry important information, useful for identifying indicators for rehabilitation?

I Symptoms, such as pain intensity,
II depression and anxiety
III appeared as indicators among the instruments included in the older SQRP package included in Study I. However, findings from Study II (which investigated the new package of instruments) indicated that the shortened version of CPAQ could track significant behavioral changes of rehabilitation indicating the potential usefulness of this instrument, which is consistent with earlier investigation (54, 57). Indeed, in Study III it was demonstrated that pain acceptance (as assessed with the CPAQ-8) was most useful as indicator for selecting and allocating patients to rehabilitation.



Which indicators are most effective in differentiating the groups need for rehabilitation?

I When combining
III pain intensity,
IV anxiety and
depression, eight groups were generated with statistical methods (Study I). Hypothetically, these eight groups were different; however, the clinical utility of these 8 groups was not without question. Therefore, Study III investigates different possibilities to generate fewer and clinically identifiable groups. To cluster the patients combining the two behaviors and therapeutic processes of pain acceptance (Pain Willingness and Activity Engagement) effectively differentiated four groups, not only regarding their pain acceptance and their need of acceptance-based rehabilitation (which was expected since the clustering was performed on the CPAQ scores, maximizing their

differences), but also regarding their quality of life, anxiety, depression and kinesiophobia. Finally, the results of Study IV indicated that pain acceptance as assessed with the CPAQ-8 could distinguish differences between the sexes before rehabilitation, suggesting alternative treatment target for each sex.



Which grouping models are predictive of rehabilitation outcomes, for whom does rehabilitation work?

III

Grouping patients according to indicators that explain behaviors and

therapeutic processes, rather than by symptoms, showed the best capacity to identify and predict who benefited from an ACT-based rehabilitation. The four clusters combining pain acceptance processes and behaviors were a combination of Pain Willingness and Activity Engagement. The group with high scores in both had a distinctly different response to rehabilitation compared with the other three groups (i.e. those with low scores in both and the two with uneven combination high and low in each). This group did not improve in any other assessed aspect during the program while the three others did, which may suggest alternative configuration, content and pace of the program. The distinctive predictive capacity was therefore clearly visualized (**Study III, Figure 2**) by the consistent patterns of changes of each pain acceptance based groups in all the variables, demonstrating the capacity of this clustering or groups to track differential response to rehabilitation.



Is it possible to decrease the number of questions and still gather information that leads to useful prediction and treatment planning?

II

The short version of the CPAQ (the CPAQ-8) showed good psychometric

properties as well as sensitivity to track rehabilitation changes over time. The CPAQ-8 may prove easier to implement in clinical practice compared with the 20-item version. The CPAQ-8 also showed the capacity to differentiate patient groups, a characteristic that needs further investigation.

The function of the results in context



The four studies in this thesis investigated which of the widely used and included pain instruments in the SQRP were indicators for identifying group of patients' with similar needs of rehabilitation, could point out modifiable aspects and therapeutic processes to use, had sensitivity to track these changes and predict outcome for an ACT-based interprofessional rehabilitation program for groups. The results are better understood if situated in the appropriate context and when considering their potential function. Study I offers useful information for primary care services at the time of referral, while studies II, III and IV contribute with information relevant to the pain rehabilitation clinic, which is the most novel contribution of this thesis.



Not only the assessment after referral requires attention, there is also a need to improve assessment prior to referral. The primary care service demonstrates insufficient knowledge about *who*, *when* and *where* to refer the patient. There is an imperative need of a clear protocol or triage system supporting decision making (268) to insure timely and appropriate referral.

The results of Study I revealed that among the patients referred, and analyzing the old data from the SQRP, pain intensity, depression and anxiety appeared as carrying most information about the patients' QoL and other aspects of their functioning. These aspects are well known risk factors for long-lasting dysfunction, and are important to take in consideration and incorporate in the primary care while assessing a patient with pain in an early stage (269).

Anxiety is strongly related to catastrophizing thoughts, and depression is known to have an adverse effect and predict chronicity of pain and disability (117, 270). From Study I, it can be deduced that screening for depression and anxiety at the primary care are potentially useful indicators for need of referrals to specialists (117). These aspects are easy to recognize timely and most of the primary care services have psychologists that soon could assess the severity of these problems.

The same may apply to pain intensity. The patients in Study I have had pain for many years (mean >8 years, with a *SD* >8, see **Table 2**) and scored to still have severe pain (4.43 of 6, see **Table 2**) after all these years at the primary care level. The pain severity may also be associated with increased depression (271). Pain intensity or severity as verbal rating is an interesting phenomenon, while some researchers and correlation studies demonstrate it to be very related (and sometimes even they found it as cause of) low function on the one hand; on the other anecdotically we know that many people can successfully work or perform at higher levels (sports, dance) even with enormous amount of pain. Pain is more than simple nociception and definitely not the same as suffering. And suffering is not about pain; it is much more than that. Pain and losses are sometimes irreparable, but the suffering associated with them is modifiable and more likely to be treatable (272).

Pain intensity, anxiety and depression are easy to recognize by the clinician, however, the 8-groups solution offered by combining them became too complicated to implement in a clinical setting (see Study I). The two extreme groups (the high and low groups in the three aspects, respectively) may need different approaches and treatment and may be easier to recognize but what is not evident, based on this information, is what kind of treatment is optimal to implement for all these 8 groups. Another potentially more serious problem is that this subgrouping approach is primarily based on statistical models rather than on theories, which leaves this model with a dubious translational value (**Study I**, see Discussion).



The patients included in the studies in this thesis were referred to a clinic that offers an ACT-based rehabilitation. The patients get the package of instruments by mail before their first appointment with a postage-paid return envelope. In the newer package of instruments, the Chronic Pain Acceptance Questionnaire 20-items (CPAQ) is included as optative for the clinic to include in their package. All together the package has more than 250 questions (to be answered 3 times), a high burden both for the patient and for the clinic.

For the aims of simplifying the gathering process and improving the assessment procedure, a shorter version of CPAQ was validated for the Swedish cohort. Along with the validation procedure of the CPAQ-8, Study II demonstrated its sensitivity to capture processes and changes over time during rehabilitation. To the best of our knowledge, this is the first thesis/study demonstrating sensitivity of a pain instrument to assess a

component therapeutic process and prove its capacity and precision to show how these changes for groups of patients.

The CPAQ-8 confirmed the two-factor structure with good scale reliability and validity for a large sample clinical population of patients with chronic pain in Sweden. The content of CPAQ-20 was reduced and still kept the two subscales 'Activity Engagement' and 'Pain Willingness' in accordance with previous studies (218) and the complete version of it in Swedish is included in Appendix 3.

Regarding the criterion measures, CPAQ-8 correlations supported previous findings where both subscales demonstrated associations with depression, pain-related anxiety and psychosocial aspects (219). Given that acceptance is an adaptive behavior, it was expected that a construct such as kinesiophobia or other scores of low functioning would be negatively correlated with acceptance, which was demonstrated for this short version.

The CPAQ is one of the many instruments in the SQRP package (and in other packages). If it is possible to reduce one instrument from 20 to 8 items and still capture useful information, it could be hypothesized that the procedure could also apply to the total package. How far can we streamline the packages and the scales (that are still relevant to the modern rehab) and still capture the information needed for further develop and increase the quality of the pain care services?



Study II had shown a significant positive outcome for the total group of patients. The relatively modest effect size found was due to pain populations being heterogeneous (18). This raised several questions: Who or which group of patients benefited the most? Which indicators best differentiate these groups? Could these indicators predict outcomes? Study III could identify a group that did not benefit at all, and probably lowered the effect sizes for the total group. Together, Studies III and IV present several ways to approach the issue of revealing different indicators for grouping and matching patients useful to select and allocate them to the appropriated rehabilitation program. This can be contrasted with Study I, which did not reach any level of pragmatism and usefulness at a rehab setting.

Diagnoses as a grouping strategy

To group by diagnosis was chosen since this is the most established way to classify the patient concerns in the Health Care system. To group according with diagnosis (**Figure 8**) resulted in relatively poor differentiation

between the sub-groups in many aspects and was not sensitive to differential responses to rehabilitation either. Furthermore, no treatment effect could be confirmed when analyzing outcomes per group. This was intriguing, since it is known that the total group benefited from the rehab (see Study II, table VI). One big concern is that in clinical practice, diagnoses are still used to group patients: national guidelines (see 70), policy documents such as the one for Rehabilitation Guarantee (i.e. the77), reports of evaluations of pain rehabilitation (61, 74, 75) and research studies use diagnoses as the main indicator to evaluate, select and give treatment or sick leave to patients with pain (i.e. 73).

From a theoretical perspective, it also suggests that diagnostic considerations do not clearly lead to treatment choice and planning or predict outcomes. The diagnoses according to ICD10 within the field of pain are mainly based on anatomical localization, duration and in some instances on an assumed aetiology but not based in basic science or pain mechanisms (273-275). The reliability of the diagnostic procedure in conditions with low medical evidence is not studied. We do not know if these patients would receive the same diagnosis from different physicians, at different time points and so the meaningfulness of this grouping done in Study III is not without question.

The patient's experience of pain as a grouping strategy

The rationale behind grouping by the patients' own 'classification' was to present the patient-centered approach and also to investigate whether their view was more indicative for prognosis. In this case the 'anatomy' of the worst pain and the symptom were reported by the patient and not by the doctor as in the case of the diagnoses. The group that reported the widespread pain as being the most difficult, clearly differentiated themselves from the other two groups in terms of initial psychosocial profiles, which was not the case among those that were diagnosed with widespread pain. In this sub-grouping modality there moderate to large correlations were found among the sub-groups and the other variables. However, their patterns of changes after rehabilitation were not consistent, in some variables they ameliorated in others they worsened. Even if these were consistent, this anatomical information of the worse pain do not give a clear guidance for what is the therapeutic process to apply in the rehabilitation nor does it provide sufficient and precise information to know how to select the patient into behavioral based rehabilitation programs. Which behaviors do they need to change?

Pain acceptance as grouping strategy

Several studies have shown that this 'functional coping' (acceptance) is associated with decrease in disability, pain intensity and interference (276). Coping has been shown to be associated with emotional distress but is not demonstrated to be associated with pain acceptance (201, 277). This may be due to the fact that the attempt to control the uncontrollable has a paradoxical impact on adjustment to chronic health problems (278, 279). High acceptance predicts better mental well being (50, 280) and adjustment in functioning and pain intensity (49). Acceptance is a very strong predictor for future disability and a good predictor for pain-coping styles (53, 201, 211). There were some 'correlational' reasons why acceptance was chosen as grouping modality. However, there were four more important reasons for that choice: a) the theory behind the therapy and instrument is empirically tested as well as supported as an effective mechanism of action used in ACT; and b) the clustering according to the CPAQ has been previously done by Vowles et al. (215) and this study could potentially replicate their results using the short version of the CPAQ for clustering the patients, c) acceptance is an adaptive and *normal* behavior and it is well studied that it is more effective to learn how to increase a normal behavior than to decrease behaviors. Furthermore, Acceptance has positive connotations and is less pathologizing than other behaviors such as kinesiphobia. Last but not least: d) the CPAQ was the only included in the SQRP.

Clustering by pain acceptance could better distinguish the specific profile of the groups prior to treatment, showing the ability to predict differential response to inter-disciplinary rehabilitation for each group. In study IV, pain acceptance could also identify relevant differences between sexes. The clustering combined the two behaviors, Pain Willingness and Activity Engagement, yielded four sub-groups or clusters with distinct psychosocial characteristics (**Figure 10**). The clusters were also the most sensitive subgrouping modality in terms of showing differential responses to rehabilitation. Both sex and pain acceptance demonstrated to be good indicators for selection and allocation of patients in rehabilitation programs. Furthermore, pain acceptance behaviors and sex differences could potentially identify the patients' rehabilitation needs.

Vowles et al. (215) found expected differences between the high and the low acceptance groups, but relatively few differences between these and their mixed group (Low PW, High AE). In Study III of this thesis, the mixed groups demonstrated statistically significant differences in eight of fifteen of the mental, emotional and social aspects but not at the physical ones. Conversely, the group with high AE and low PW in this study showed more disturbances than those with high PW and low AE in ten of the fifteen

variables scoring more disturbances in the physical aspects. One possible interpretation would be that having only a willingness or openness to experience discomfort (Pain willingness) but not being engaged in valued activities, might imply having more limitations. Therefore this could imply the need to increase physical and occupational therapy interventions in the program for this group with low AE.

To subgroup patients according to pain acceptance generates clearer links between theory, model and the specific intervention, which in turn generates an integrity in the process of subgrouping and predicting outcome for a specific treatment and the outcomes expected (163).



Even though Study III presents outcome scores and the effectiveness of the ACT-based rehab, the intention was not to investigate the effectiveness of a rehabilitation program, but to determine which sub-group alternatives could identify patterns of differential responses to rehabilitation benefits. The exploration of which grouping modality best differentiate patients and their capacity to benefit from a rehabilitation program has been an almost ignored line of research (43).

In the last report from the SQRP (162), in face of the critics regarding the lack and the imperative need of systematization in the selection process (73, 75), it is emphasized that the clinics seem to have an “aware/informed selection process” since they seem to “offer rehabilitation to those that benefit of it” (162, p. 16). However, the report does also acknowledge much variation among the patients and admits that selection procedures may differ among the clinics. According to Study II, it was a statistically significant amelioration for the total group of patients that underwent the ACT-based rehabilitation, which is what the report can confirm; nonetheless the effect sizes were moderated to low implying not only variation among patient but also the possibility that some patients did not benefit. Indeed, in Study III it was shown that some patients did not benefit at all. So, the question still remains: who benefits?

There have been several endeavors to sub-group patients according to their depression (281) or their coping strategies (282). However, these together with the results of Study I have yielded groupings that have low clinical applicability. These grouping models and classifications can at best give a hint about which symptoms or behaviors are ‘maladaptive’ and need to decrease. Popular and frequently used constructs such as coping styles (e.g., measured with MPI), or self-efficacy or dysfunctional behaviors (pain

behaviors) cannot guide the practitioner to a specific mechanism of action, or distinguish a treatment process to implement and therefore can hardly be predictive for such a non-specific intervention. It is not known exactly which intervention among all in the CBS model would be most effective given this information. An integrative model on how to use these groupings in order to select patients, inform decisions about targeted rehabilitation program and predict outcome has not been investigated among the CBT therapies (62, 283). In ACT for chronic pain, pain acceptance has demonstrated to be a behavior with specific therapeutic tools to address it (60, 212) and as such adapted to be studied as a predictive indicator for rehabilitation outcomes, and indeed it was the pain acceptance clusters that could best predict outcomes.

Study III continues the exploration of the four pain acceptance clusters begun by Vowles et al (2008) with the difference that their analyses yield three clusters and ours, four. From these four clusters, one group scored 'low' in both subscales and another 'high' in both, followed by two uneven groups. These four groups provide the clearest differentiation of the others psychosocial variables (mood and QoL) and prediction of rehabilitation outcomes. This indicates the theoretical importance of both aspects of the pain acceptance construct: activity *and* willingness. When only one of these facets is present we do not see benefits in terms of being associated with less depression, anxiety, better QoL etc. Furthermore, the CPAQ-8 has demonstrated to be sensitive to treatment changes and measures with parsimony and clear theoretical plausibility (see Study II) the two facets of pain acceptance: Activity engagement and Pain Willingness. It is demonstrated that these two behaviors are highly correlated with psychological inflexibility in pain, pain self-efficacy, catastrophizing and fear of movement/kinesiophobia, terms that direct our focus on the *what* and *why* but there is more to do in pain rehabilitation. Pain Acceptance fully mediate the relationship between pain severity, emotional health and partially mediate the relationship between pain severity and pain interference (239).

The other advantage of this method of patient clustering is that it bases assessment for rehabilitation on exactly the kind of behavioral measures that the treatment is attempting to change. It is notable that those low in acceptance and mixed in terms of acceptance responded to treatment significantly better across many domains, than those high in acceptance initially. Targeting treatment on the basis of assessment in this way would be likely to lead to greater efficiency of treatment programs, better use of healthcare resources and less frustrating experiences for patients and healthcare professionals.

Implications

“We cannot ethically treat what we do not measure” (284)

In the research context this thesis may serve as an example that the answers we get to our questions are very much dependent on a) how we measure, b) the instruments' underlying model and theory and c) the harmony between this theory and our research questions. The contrast is visible between Study I, performed with instruments pertaining to the older biopsychosocial models (the older package of the SQRP), and Study II with modern instruments (the current SQRP's package). Study I is a good example of studies that can add more confusion in the already existing one, if it is not interpreted with caution and in the appropriate context, which requires good theoretical knowledge from the researcher and statistician.

Meta-analyses and guidelines are based on randomized controlled trials of good quality, but also based on the CBT model (as depicted in **Figure 4**). The result of such a mixture of studies contributes to the confusion reflected in the non-specificity of guidelines when it comes to specify assessment and selection criteria on the one hand and what exactly has to be delivered in the rehabilitation program on the other. The Catch 22 in the area of pain.

Along the same lines, the implementation of evidence-based rehabilitation programs can be seriously hampered by the use of inaccurate assessment procedures that are inconsistent with the underlying theories of rehabilitation. In order to ensure evidence-based assessment and management it is imperative to offer clinicians a pragmatic framework to facilitate the operationalization of results from clinical research into routine healthcare settings. This thesis shows an example, when subgrouping patients according to pain acceptance generates clearer links between theory, model and the specific intervention. This integrity in the process of subgrouping and predicting outcome for a specific treatment and the outcomes expected is what is needed to ensure quality both in the health care and in the science of chronic pain (163).

In the biomedical and even some alternative or complementary medicine models it is enough to find some 'signs or symptoms' to know which medicine or compound to give the patient. Rehabilitation is not as straightforward as these models. There is more than signs and symptoms, there are functions that matter for the patient that are missing. To view the patient as a set of signs and symptoms is not only reductionistic but also 'formistic' (to assume that what we see is the reality or the truth). A sign and symptom is the form, the topography of a condition. Rehabilitation does

not deal with the form or topology of the condition; it deals with functioning and treats the patient and his or her conditions in a pragmatic manner (285).

As seen in the studies included in this thesis, the interpretation of patient needs are very much depending upon the assessment modality, which in turn is a combination of the clinician's way to conceptualize pain and which assessment instruments are used. Different instruments bring to light different aspects. And what are the 'individual needs'? Based on common sense the answer is "to reduce pain and suffering" as many patients, and pain experts express it (286, 287). Or decrease depression, or anxiety or all other variables that are gathered by these instruments.

The differences between the models are several, apart from their treatment approaches (see Appendix 1 for a visual explanation). The most important difference is that the biopsychosocial and CBT models are top-down-developed. A top-down process firstly observes the problem and designs interventions and protocols for specific populations and then evaluates the outcomes. Then, if effective, the last step is to try to find a model to explain what has been done (see The biopsychosocial model in this thesis). On the contrary, those developed in the CBS program, such as the Psychological Flexibility model with the ACT as therapeutic intervention, have a bottom-up inductive approach. A bottom-up firstly observes the situation and develops understanding of the processes involved in this problem through basic sciences. From there to applied sciences generating feasible theoretical models and processes in an early stage, creating a strategy for implementation and progress from the very beginning (170, 220, 221).

A higher quality and front-line strategy towards a clear and evidence-based assessment is to further study and identify sound theoretical instruments that can be used as mediational indicators to assess group and allocate patients to the appropriate rehabilitation program and predict their outcome (25, 73, p. 1, 222, 223, 288).

The choice of instruments and its impact on assessment

As seen in the method chapter and in **Table 1**, there are many instruments from the 1980's and 1990's in the packages included in this thesis. The age of the instrument is not a problem per se as long as their theory is shared and consistent, otherwise a combination in an attempt to be comprehensive creates its own and bigger problems. On the contrary, a well-constructed instrument that can hold over time and that many others

have implemented is to be preferred, both in the clinic and in research. These well-established instruments facilitate comparisons and meta-analyses, especially if it is theoretically sound and integrates current findings into the principle of assessment and current treatment (170). Most of the instruments are based on more or less developed models and no one model seems to explain how to assess, select and best treat the patient with chronic pain (156), yielding in a disorganized and incoherent number of variables and data impossible to practically integrate in clear principles.

There are many possible influences on choices made for including instruments in these packages of assessments and keeping them even if they have outlived their usefulness and may probably offer little potential for development. Habits are not easy to change, not only for our patients, but also for clinicians (289). We still use many of the still prevailing pivotal but old concepts such as pain coping (as measured by the MPI) or self-efficacy and still use the pain diagnoses that today are more based on common sense than on a theoretical models tested with basic research. They are not linked today to advances in the rehabilitation programs or helping in developing better programs or in selecting the patients that can benefit from these programs. Still they are included in the registry's package to evaluate rehabilitation programs that no longer address these concepts; or if they do, they are probably delivering programs with only efficacy evidence (if any) but not supported with basic research on integrated therapeutic processes; which currently, only the PF model offers. Many of these concepts try to show *what* is the pain situation like and explain *why* but there is more to do than get trapped in this questions.

One of the component processes of the PF model, the Pain Acceptance, is assessed by the Chronic Pain Acceptance Questionnaire. Pain Acceptance as behavior and independent variable, is effectively influenced by well-described therapeutic procedures and techniques developed from basic research. The research and underlying theory (Relational Frame Theory) have ad hoc organized a set of assumptions that offers a comprehensive scientific account of behaviors, how they can be influenced and predicted (290). At a first sight or according with 'common sense' many of these concepts -e.g., to accept the pain- seem counterintuitive, but empirical tests show support for the clinical relevance of these constructs (200, 217). The core processes of PF are organized under well-delineated philosophical assumptions, developed under established CBS programs of basic and applied research (221) and to include these concepts and their assessment instruments in the Registry would be an asset for the development of pain field in general and the Registry in particular.

The CPAQ-8 demonstrated sensitivity to changes in pain acceptance over time from treatments designed to increase acceptance. At this point it is important to acknowledge that pain acceptance and its assessment should be seen as a potentially useful method for unfolding the treatment processes needed, and possibly as a means for enhancing the benefits of an interprofessional ACT-based rehabilitation.

It is not in the scope of this thesis to develop or deeply discuss the philosophy of science behind the PT and ACT, but it is important to know that the philosophy and its theory have been systematically developed in parallel with the creation of therapeutic techniques or concepts (291). To ensure progress in the area of chronic pain three steps have been suggested by McCracken and Vowles' (200) (a) to let go of variables and processes that have ceased to be useful for the development of research and treatments, (b) to firstly choose scientific goals and be clear about the underlying philosophical assumptions and (c) develop treatment guided by tested theories and basic processes that can with precision generate change. Their formulation is clear, they assert that the difference may be subtle, but the shift can move the science from "seeking to *understand the reality of the world* to seeking ways to *act successfully in the world*" (p. 185). In other words, a bottom up strategy with more focus on process as well as much on outcomes, which also will influence in the choice of appropriated instruments for assessment (170).

The choice of instruments to an adequate package of instruments could serve as a versatile tool to further investigate novel hypotheses using existing data and help to increase our knowledge about behavioral factors to target in rehabilitation. The problem with the package today is that the instruments appertain to different époques and theories more or less tested empirically. Furthermore, not all the aspects measured, such as pain intensity, are today the focus or even targeted in rehabilitation.

Limitations

The limitations of the studies were several. In Study III the main limitation was the arbitrary choice of groupings. For example, regarding grouping by diagnoses, there were many doubts since it was no clear how the doctors chose these diagnoses when it comes to non-specific pain conditions. Some doctors chose a psychiatric diagnosis as first diagnosis for the patients that had pain in several areas of the body. The diagnosis could first be seen as related to depression or mental trauma rather than with pain. Other doctors had as first diagnosis a pain diagnosis (as widespread pain, fibromyalgia, myofascial pain syndrome, etc.) and then as second diagnosis a psychiatric one. This 'diagnostic patterns' portrayed best the way each

doctor conceptualized 'non-specific pain' rather than offering a useful and reliable diagnosis. However, the diagnoses were still included since diagnosis classification is the most used classification in the health care system and also in the pain field (and the one used by the Rehabilitation Guarantee to define who will benefit of these programs).

It can be argued that to include the same set or sub-set of patients in several studies is a scientific shortcoming. In this thesis, however, this is considered to be an advantage since the thesis shows how different ways to analyze the same data can yield different results, that in turn can be interpreted differently depending of their content and context. This insight is important when disseminating 'knowledge'. In the Contextual Behavioral Sciences community it is expressed as "hold the truth lightly" and this thesis can demonstrate that if many 'truths' can arise from the same data, they need to be hold very lightly.

To use the same data and the data from the SQRP was a choice, but the instruments were not chosen, since the SQRP offers a given package of instruments. This is a serious limitation because the novel questions and methodology implemented in this thesis probably would have been enriched with the choice of up-to date and more function-related instruments, such as measures of physical capacity which is known to be related to pain, quality of life and overall health. Furthermore, to analyze data gathered by 'legacy' and outdated instruments, is not progressive and not consistent with current rehabilitation programs. ACT-consistent instruments assessing values or also valued directed activity engagement would have been of greater utility to answer many of the questions of this thesis.

Is important to highlight that *pain acceptance* is only *one* of the core processes of ACT even if it is the aspect that is most known. However there is a risk that the isolated use of acceptance in this thesis (and the in the SQRP package) may lead researchers and clinicians to miss parallel and broader aspects and instruments in the wider process of psychological flexibility. The other therapeutic processes and mechanisms (Cognitive Defusion, Flexible Awareness of the Present, Self-as-Context, Values, and Committed Action) also need to be taken into consideration and assessed (206).

It is almost inevitable to highlight one of the common shortcomings of studies that only relay on self-report data. Besides the known limitations, most of the data in this thesis is gathered when the patient has (finally) been referred to the pain specialty clinic, the patients 'last' hope to get help. This contextual factor per se can be a source of bias to take in

consideration. One way to restrain this limitation would be to combine patient reports and objective measures would allow greater insight into the dynamics of physical, psychological and social mechanisms and their relation to the functional observable changes in rehabilitation.

To use data gathered for the SQRP is opportunistic since the data was not gathered with the purpose of this thesis. Databases as the one in the SQRP may have a useful role in developing the science and practice when the data is approached with novel hypotheses, however a significant limitation is that the hypotheses need to be operationalized with the data that has been collected, which is an awkward procedure. From a scientific perspective, we might have wished to operationalize some of the research questions in a variety of different ways. Exploring data that already exists is on the one hand very effective but have additional limitations, such as sampling biases, missing data, participants not completing follow up, attrition from treatment, and those participants with complete data perhaps being distinct in some ways to the rest of the population. The other limitation is the arbitrary conditions that the SQRP imposes at time to access the data in order to get timely delivery of it. Last but not least, a warning is guaranteed when having access to the 'Big Data' (many patients and variables) that combined with advanced statistical methods (e.g., Principal Component Analysis), can generate the illusion that the results will tell us 'the truth.' The problem is that these procedures do not take in account the variables underlying theories and their coherence with the clinical practice.

Ethical reflections

Even though the studies included in this thesis have ethical approval for this study, there may be important ethical issues still to be considered. Firstly there are many intimate questions in the SPRP package that may not be relevant for pain research or rehabilitation, such as "are you satisfied with your sexual life?" Many patients have negatively reacted to such questions and felt offended. It is known that pain can influence the sexual life of a person and when is related to pain can also be treated. However, a negative answer to the above question does not imply that this dissatisfaction is related to pain. These non-relevant and intrusive questions should be re-considered by the SQRP authorities.

The questionnaires included assess, apart from pain variables many others psychological dimensions such as the level of depression and anxiety of the patient, parameters that also have been seen as risk for development of chronicity, which in turn may have prompted the myth that the patients or the conditions are 'complex'. This view of the situation risks stigmatizing

this patient population when interpreting data from the registry or studies done with it. If so is the case one may wonder: is the data being used to improve the pain care system? Moreover: how is this data helping our patients? What are their benefits?

Stigma can be defined as the process by which the reaction of a group reduces a person's identity from being a whole and usual person to a tainted, discounted, one. More than a third part of the patients registered at the SQRP have widespread pain and many of them have fibromyalgia. Issues of legitimation are important for patients with chronic conditions that cannot be seen or affirmed by 'objective signs' risking the threat of stigma and the shame of being wrong about 'really' being sick, which in turn can moderate the psychological consequences of chronic pain (292). Today these patients are often referred as "complex" and "co-morbid" (see for example 293). Carefulness and awareness on how we interpret the data and how the discursive communicate our studies with therefore be imperative.

A final ethical reflection is the imperative need to find regulation to allow a good access to the Registry data, minimizing risks for decision-making by the authorities of the registry based on 'pure opinion. It is important to offer efficient, systematic and timely delivery of data for the researches with approved ethical permits. The patient safety is already established and regulated by the Swedish laws.

CONCLUSIONS

- Among all instruments included at the National Registry for Pain Rehabilitation, Pain Acceptance, a component therapeutic process of Acceptance and Commitment Therapy (ACT) emerged as the most useful indicator for rehabilitation. Pain acceptance showed coherence between the data, the underlying principles of Psychological Flexibility and the key aspects of functioning in those with chronic pain. Pain Acceptance should be routinely assessed in the triage of patients into ACT-based rehabilitation programs.
- This thesis suggests Pain Acceptance as a useful indicator for ACT-based rehabilitation. Its two subscales and behaviors, Pain Willingness and Activity Engagement, effectively differentiated four groups with distinct needs of rehabilitation and discriminate the groups' variability in the other psychosocial aspects before and after rehabilitation. Pain Acceptance could distinguish differences between the sexes before rehabilitation, suggesting alternative treatment target for men and women.
- The Chronic Pain Acceptance Questionnaire in its short form (less than half the original items) showed good psychometric proprieties and demonstrated capacity to cluster patients by pain acceptance and it was also sensitive to these clusters differential responses to rehabilitation.
- Together, the four studies show that research results and their utility may vary between the chosen instruments and their underpinning conceptualization of model of pain. When investigating the a package with 'legacy' instruments, signs and symptoms such as pain intensity, anxiety and depression, emerged as variables that showed a certain level of utility for clinicians in primary care, as topographical (formistic) indicators to identify who needs referral to a behavioral approach to pain. However these indicators gave little additional information about psychosocial needs and were poor predictors of response to treatment.

FUTURE CONSIDERATIONS

"Accept, Choose, and Take action"(47)

ACT!

- Pain acceptance may be the best-known process of ACT, appropriated for the study and treatment of chronic pain (48, 206) and can identify and differentiated rehabilitation needs (Study III). However, it remains only one part of the PF model, and therefore incomplete. Further investigation of the other ACT component processes is encouraged, including Cognitive Defusion, Flexible Awareness of the Present, Self-as-Context, Values, and Committed Action.
- The clusters performed by the CPAQ-8 yield different results than the original clusters performed by Vowles et al. (215). More research is required to confirm results and to further develop an algorithm that is pragmatic for the clinical usefulness of each cluster's and as basics for planning rehabilitation programs that meet these groups/clusters's needs.
- The biopsychosocial model of pain assessment has developed many questionnaires in order to study and explain the multi-dimensionality of pain. Scale construction models and validation methods for outcome measures has been developed and implemented, while advances in constructing process/mediation instruments with sound theoretical consistency with the therapeutic mechanisms and useful in the clinical process need more attention.
- Regarding the length of the pain questionnaires, this thesis demonstrated that a reduction from a 20-item questionnaire to 8-items (the CPAQ) still keep its properties. Very long instruments in the registry (e.g., MPI with 61 items and dubious current validity) remain. This suggest that future research is needed to determine how far we could streamline all the scales in the packages and in the registry, still with capacity to capture important information. What would be the minimum data set required?
- There are several advantages of conceptualizing chronic pain patients in terms of pain acceptance capacity: 1) it recognizes healthy and natural resources that the patient already has and positively reinforce these, 2) it is not as stigmatizing as keep finding co-morbidities or other psychopathologies (early trauma, depression, etc.) and 3) it is effectively being targeted and changed in behavioral based treatment. Further

studies are needed to explore if an appropriate assessment of pain acceptance at an early or acute stage may be predictive for the development of chronicity.

- A line of investigation holds promise in further increase understanding of processes and adaptive mechanism of change as rehabilitation progresses. Hopefully this thesis can contribute to illuminating this path and also help the decision makers in clinics and registries to include such instruments in their packages and exclude the outlived ones. As suggested by McCracken and Vowels (200) this thesis points out the need of a systematic three-step process of development, in order to improve the identification of useful indicators: 1) to let go of variables and concepts that are not useful as indicators for selection, prediction or treatment development, 2) to adopt a clear scientific philosophy and choose instrument based on well delineated scientific goals related to those philosophical assumptions and 3) develop assessment methods linked to treatment processes and a unified theoretical model harmonic with such scientific program.
- The assessment procedure is the most critical process along the health care in general and in pain rehabilitation in particular, since there is no other medical technology that can give useful information for rehabilitation. The SQRP should strongly consider offering a good balance of outcome, risk factors, moderation and mediation instruments for assessment in order to ensure research progression, quality and safety in the pain care chain from the farm to table.
- The results of all the studies apply to adult patients between 18-65 at a pain rehabilitation specialty care clinic, and cannot be generalized to other pain populations, such as pediatric, geriatric, oncologic or patients that undergo rehabilitation at the primary care lever. More research for these populations will be needed.

SAMMANFATTNING PÅ SVENSKA

Denna avhandling undersöker kliniskt användbara indikatorer för att gruppera patienter utifrån deras rehabiliterings-behov, och på så sätt säkra urvalsprocessen till rätt rehabiliteringsprogram samt för att kunna predicera utfall. Avhandlingen visar att det finns ett vetenskapligt grundat och pragmatiskt sätt att utföra en säker och effektiv 'triage' inför smärtrehabilitering med stöd av registerdata och att indikatorer kan potentiellt användas för att planera rehabiliteringsprogram för dessa distinkta grupper.

Långvarig smärta är ett av de största hälsoproblemen nationellt och internationellt, såväl för individen som för vården och samhället. Utveckling och uppbyggnad av smärtvården är därför prioriterat. Ett exempel är Rehabiliteringsgarantin, en insats i miljardklass som syftar till att öka tillgängligheten till så kallad 'multimodal smärtrehabilitering'. Denna har visats ge goda resultat för somliga patienter, dock inte för alla. Utvärderingar visar att man framöver måste bli bättre på att selektera vilka patienter som kan bli hjälpta av de specificerade insatserna⁴. Empirisk evidens och systematik i hur man bedömer och väljer patienter till olika rehabiliteringsprogram är i princip obefintlig.

Smärtforskning utifrån den biopsykosociala modellen och med en beteendeterapeutisk inriktning har under de senaste 30 åren varit omfattande och har visat goda effekter av kognitiv beteendeterapi (KBT). För att förklara och förstå den multidimensionella vidden av långvarig smärta har KBT forskare ständigt utvecklat nya begrepp och det finns mer än 200 frågeformulär som skattar dessa begrepp. Traditionellt används ett batteri med flera instrument i tron att ju fler variabler som bedöms desto bättre kan patienten förstås och behandlas. Det Nationella kvalitetsregister över Smärtrehabilitering (NRS) inkluderar ett gediget batteri av frågeformulär som omfattar mer än 250 variabler som patienten fyller in före- och efter rehabilitering samt ett år efter avslutad rehabilitering. Syftet med NRS är att erbjuda ett underlag för kvalitetsförbättring och stimulera till forskning för de deltagande rehabiliteringsklinikerna.

Frågeformulären kombineras av kliniker eller forskare, ofta utan större hänsyn till vilka teorier som ligger till grund för de frågor som ställs. Blandning av olika instrument som inte stämmer överens med de terapeutiska processerna i rehabiliteringen kan skapa förvirring i det

⁴ Se ref. 74 och 75

kliniska sammanhanget. I beteendeorikterad rehabilitering är det först och främst individens funktion som ska bedömas och som sedan ska rehabiliteras genom beteendeförändring. Det är då inte symptom och symptomlindring som står i fokus. Indikatorer ska inte enbart identifiera en funktionsnedsättning, utan de ska även tydligt identifiera ett beteende som ska ändras, och helst också synliggöra den relaterade terapeutiska processen under rehabiliteringen. Detta är högt ställda krav och därför brukar alla i rehabteamet göra egna professionella bedömningar som därefter diskuteras i teamet. Genom att det saknas underlag för en systematisk beslutsprocess selekteras patienter med stöd av 'kvalificerade gissningar' hos personalen (som i och för sig ofta har goda kunskaper).

I syfte att säkra och systematisera bedömnings- och urvalsprocessen, utforskar denna avhandling registerdata. Två batterier av instrument från NRS används, ett äldre som användes före 2009 dels ett nyare som används sedan dess. I avhandlingen utforskas instrumentens förmåga att användas som pragmatiska och kliniskt relevanta indikatorer för smärtrehabilitering. Med hjälp av linjära statistiska modeller och klusteranalys grupperades patienter efter olika potentiella indikatorer för att testa de olika grupperingsalternativ förmågan att identifiera rehabiliteringsbehov hos patienterna i varje grupp samt gruppens respons på rehabilitering.

Det äldre batteriet av instrument analyserades med *Principal Component Analysis* som visar att när det används variabler som tillhör äldre smärtmodeller, erhålls resultat i enlighet med dessa modeller. Resultat i Studie I framhäver att smärtintensitet, ångest och depression är viktiga variabler att använda som indikatorer och grupperingsalternativ. Dessa är redan kända riskfaktorer för "kronifiering" av smärta och potentiellt användbara i primärvården för att identifiera patienter som är i behov av vidare remittering till andra instanser. Smärtintensitet, ångest och depression beskriver dock inte vad patienter gör eller inte gör, det vill säga deras beteende. Rehabilitering påverkar beteende och de tre variablerna är därför otillräckliga som indikatorer till rehabilitering. Att gruppera patienterna i 8 grupper genom en kombination av dessa variabler är tveksam ur kliniskt perspektiv.

När det nyare batteriet av instrument undersöks förändras bilden. Smärtacceptans framträder som en pragmatisk indikator, som visar på ett beteende som kan förändras genom en tydlig och empiriskt testad terapeutisk strategi, en av processerna som ingår i Acceptance & Commitment Therapy, känd som ACT. I Studie II visas att instrumentet som skattar smärtacceptans, *The Chronic Pain Acceptance Questionnaire* kan kortas från 20 till 8 frågor med fortsatt bibehållna goda egenskaper för att

användas både som bedömning och processinstrument för en ACT-baserad rehabilitering.

Studie III påvisar hur smärtacceptansens två underliggande beteende- och terapeutiska processer; 'Öppenhet för smärta' och 'Engagemang i aktiviteter' kan generera fyra distinkta kluster, en grupp med höga värden i båda, en grupp med låga värden i båda och de andra två grupper med ojämnt fördelade kombinationer. Dessa grupper samvarierar i sin tur med andra variabler såsom smärta, ångest, depression, livskvalitet och funktionsmått. I studie IV, kunde även smärtacceptans identifiera kliniskt relevanta skillnader mellan könen. Tillsammans visar dessa resultat att smärtacceptans tydligt kan differentiera behov hos olika patientgrupper och kön och kan därmed stödja selektering av patienter till rätt vård och rehabilitering. Detta kan i framtiden leda till bättre utformning av anpassade och acceptansbaserade rehabiliteringsprogram utifrån varje patientgrupps behov.

Avhandlingen visar att olika resultat kan erhållas, beroende på vilka instrument som inkluderas i studien och tolkningen är också beroende av instrumentets underliggande smärtmodell och kunskaper hos den som tolkar resultaten. Dessutom, indikatorernas användbarhet kan vara beroende av dess funktion, bland annat var och hur de ska användas. Denna avhandling omfattar främst klinisk forskning och implementering, men diskuterar också hur olika förståelse av smärta kan påverka klinisk och vetenskaplig praxis. Resultatet ramar in och relateras till olika psykologiska modeller utifrån filosofiska teorier.

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Inst. of Neurosciences and Physiology, Sahlgrenska Academy at Gothenburg University, my home university for most of my education from undergraduate to this graduation (ok I need to admit that have been cheating a little with Karolinska Institutet, Linköping University and North Carolina University at Chapel Hill), but believe me, I still love you ;-) Then, this university is made by human beings, without whom all this work wouldn't be possible. To start with the rector of studies, **Mia Ericson**, a young, talented, open minded and just amazing to deal with. I hope to be able to come by and drink some coffee or lunch even if I am not a grad-student! **Lars Rönnbäck**, the head of the Dept. of Neurosciences and Rehabilitation, the most wonderful professor, my former teacher, tango and party dance partner, you are fun and so nice. I admire you and your humanity, thanks Lasse. **Our administratives at the first floor**, I thank you too and admire your capacity to handle all these papers that make me crazy... but you guys make everything smooth. **Inger Almgren**, the registry of doctoral studies, a prompt and nice helper and the Academy Office at Sahlgrenska, specially **Tanja Johansson**, **Annika Sandequist** and **Lena Eriksson Tanemar**, so service minded and wonderful to deal with, thanks for you flexibility and understanding.

To my friends, Michaela Moonen, you are my most close friend and always there. I am looking forward for this future you imagine for us, sitting and talking about our future grandchildren on our rocking chairs, **Linda Kjellsson & family**, my youngest sister and loving friend and colleague, I really enjoy being with you, feel always at home, love your family interactions, everything and all of you. ...and I am waiting to be you 'supervisor' soon. **Susanne Didricksson**, the opponent of my master thesis in psychology and since then, such a fantastic friend. Also similar paths in life. **Vilma Martínez**, por tu eterno apoyo y amistad y por preocuparte y ayudarme también con mi salud en todo momento. Gracias por tu confianza y cariño y por muchos mas años de amistad. ¡Te quiero mucho!

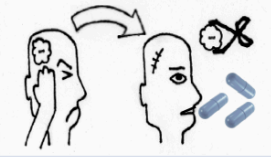
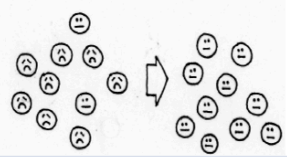
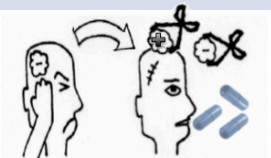
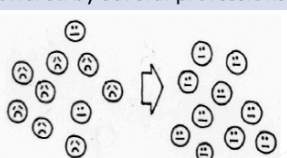
To my grandmother, Maña, your were the one and only out there for me when I was a little child, the one that really saw me and connected deeply with me. You gave me the power and energy I have. You died in my house and I miss you since then, the day Armstrong put his foot on the moon. You and grandpa showed me what love can look like, how to live with love and how to die for love. He just died 5 minutes after you died, he lied at your side, embraced you and said "Please, grave us together, my life without her has no meaning, tell all the grandchildren that I love them" the two doctors there could not understand how that could happen, nor could I. But now I can, thanks for showing me the path of love!

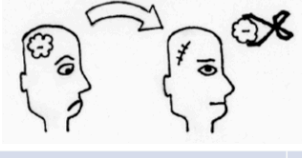
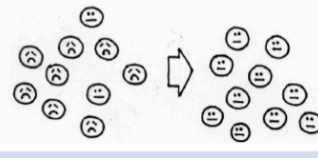
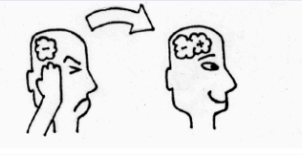
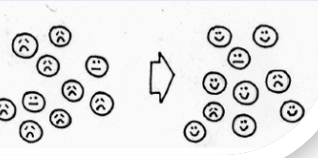
To my mother and her husband, Jorge teacher of love and non-judgmental living. You don't like when I say that you are like a father for me, and you are right, you are much more than that! Your second name: Angel describes you so well. I love you Jorge for what you gave me when I was young and was suffering and for what you always give to my mother, your love, your wonderful 'eutonic' hands, your caring, your softness. But you are also a warrior, you do not give up, I love you and admire you. And *Mamita querida*, your heart is of sugar, you are funny and you suffer, you are happy for me and you cry for me. You were the one calling me every week since I moved to Sweden until I start calling you. I know you would like to be here, AND you are here in my heart. Thanks mom for your lovely support and for you always believed on me! I miss you!!

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APPENDIX 1: DIFFERENCES IN TREATMENT APPROACHES

	Case conceptualization	Desired outcome
BIOMEDICAL MODEL	Illness, presence of symptom, disruption of homeostasis	Symptom elimination or relief.
		
BIOPSYCHOSOCIAL MODEL	Illness, interaction between psychological, social and pathophysiological 'variables.'	Symptoms relief with pharmacological and non-pharmacological interventions offered by several professions.
		

	Case conceptualization	Desired outcome
CBT	Evaluates thoughts, feeling and negative ("maladaptive") behaviors.	Eliminate behaviors with exposure or to transform their content into something positive. Be happy!
		
ACT	Identification of avoidance behaviors or symptom-controlling activities (rest, staying home from work, friends meetings, spare time activities, etc.).	Support the patient to clarify his or her values and help them to take the necessary steps/behaviors towards living a meaningful life despite pain of discomfort.
		

Adapted with permission of Wakiza Gámez (at http://contextualscience.org/act_related_illustrations)

APPENDIX 2: CPAQ- 20 IN SWEDISH

CPAQ

Nedan finner du ett antal påståenden. Skatta hur sant varje påstående är för dig genom att ringa in en siffra. Använd skalan nedan för att göra dina val. Exempel: Om du anser att ett påstående är "alltid sant" ringar du in siffran sex.


0	1	2	3	4	5	6
Aldrig sant	Mycket sällan sant	Sällan sant	Sant ibland	Ofta sant	Nästan alltid sant	Alltid sant

1.	Jag fortsätter att leva som vanligt oavsett hur mycket smärta jag har.	0	1	2	3	4	5	6
2.	Mitt liv fungerar bra även fast jag har kronisk smärta.	0	1	2	3	4	5	6
3.	Det är OK att uppleva smärta.	0	1	2	3	4	5	6
4.	Jag skulle gärna avstå från viktiga saker i mitt liv för att kunna kontrollera min smärta bättre.	0	1	2	3	4	5	6
5.	Det är inte nödvändigt för mig att kontrollera min smärta för att kunna hantera mitt liv bra.	0	1	2	3	4	5	6
6.	Även om saker har förändrats lever jag ett normalt liv trots min kroniska smärta.	0	1	2	3	4	5	6
7.	Jag måste fokusera på att bli av med min smärta.	0	1	2	3	4	5	6
8.	Det finns många aktiviteter som jag gör när jag känner smärta.	0	1	2	3	4	5	6
9.	Jag lever ett fullvärdigt liv trots att jag har kronisk smärta.	0	1	2	3	4	5	6
10.	Att kontrollera smärtan är mindre viktigt än andra mål i mitt liv.	0	1	2	3	4	5	6
11.	Mina tankar och känslor om smärtan måste förändras innan jag kan gå vidare med mitt liv.	0	1	2	3	4	5	6
12.	Trots smärtan lever jag mitt liv som planerat.	0	1	2	3	4	5	6
13.	Att hålla min smärta under kontroll har högsta prioritet när jag gör något.	0	1	2	3	4	5	6
14.	Innan jag kan göra upp några bestämda planer måste jag få viss kontroll över min smärta.	0	1	2	3	4	5	6
15.	När min smärta ökar kan jag fortfarande sköta det jag har ansvar för.	0	1	2	3	4	5	6
16.	Om jag kan kontrollera mina negativa tankar kring smärtan får jag bättre kontroll över mitt liv.	0	1	2	3	4	5	6
17.	Jag undviker att sätta mig i situationer där smärtan skulle kunna öka.	0	1	2	3	4	5	6
18.	Min oro och rädsla över vad smärtan kan göra mig är sann.	0	1	2	3	4	5	6
19.	Det är en lättnad att inse att jag inte behöver förändra min smärta för att gå vidare med mitt liv.	0	1	2	3	4	5	6
20.	Jag måste kämpa för att göra saker när jag har smärta.	0	1	2	3	4	5	6

Swedish translation: Kristoffer Lundmark, Ned Carter, Lennart Melin och Richard Wicksell (229).



APPENDIX 3: CPAQ- 8 IN SWEDISH



GÖTEBORGS UNIVERSITET

Rehabiliteringsmedicin vid
Sahlgrenska Akademin

Datum: Kod:

CPAQ-8

Nedan finner du ett antal påståenden. Skatta hur sant varje påstående är för dig genom att ringa in en siffra. Använd skalan nedan för att göra dina val.
Exempel: Om du anser att ett påstående är "alltid sant" ringar du in siffran sex.

	0 Aldrig sant	1 Mycket sällan sant	2 Sällan sant	3 Sant ibland	4 Ofta sant	5 Nästan alltid sant	6 Alltid sant						
1	Jag fortsätter att leva som vanligt oavsett hur mycket smärta jag har.						0	1	2	3	4	5	6
2	Även om saker har förändrats lever jag ett normalt liv trots min kroniska smärta.						0	1	2	3	4	5	6
3	Jag lever ett fullvärdigt liv trots att jag har kronisk smärta.						0	1	2	3	4	5	6
4	Att hålla min smärta under kontroll har högsta prioritet när jag gör något.						0	1	2	3	4	5	6
5	Innan jag kan göra upp några bestämda planer måste jag få viss kontroll över min smärta.						0	1	2	3	4	5	6
6	När min smärta ökar kan jag fortfarande sköta det jag har ansvar för.						0	1	2	3	4	5	6
7	Jag undviker att sätta mig i situationer där smärtan skulle kunna öka.						0	1	2	3	4	5	6
8	Min oro och rädsla över vad smärtan kan göra mig är sann.						0	1	2	3	4	5	6

GÖTEBORGS UNIVERSITET

Rovner, GS.; Årestedt, K.; Gerdle, B.; Börsbo, B. & McCracken, LM. (2014) Psychometric properties of the 8-item Chronic Pain Acceptance Questionnaire (CPAQ - 8) in a Swedish Chronic Pain Cohort. *Journal of Rehabilitation Medicine*; 46(1), 73–80

The CPAQ-8 is free to use, but please require an original copy and the calculation sheet from Graciela: graciela.rovner@neuro.gu.se

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