Physiotherapy Management, Coping and Outcome Prediction in Whiplash Associated Disorders (WAD)

BY

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The aims of the present thesis were to evaluate the management of acute WAD and to develop, describe and evaluate a cognitive behavioural approach for the physiotherapy management of long-term WAD as well as to study the predictors and mediating factors for long-term disability and pain after a whiplash injury.

Two approaches for acute and chronic WAD were evaluated in experimental studies. Fifty-nine patients with acute whiplash injury (study I) and 33 patients with chronic WAD (study V), were randomised into experimental and control groups. In addition, three chronic WAD patients participated in an experimental single case study (study IV). Home exercise programmes for patients with acute WAD were used in study I. In study IV a physiotherapy management with integrated components of cognitive-behavioural origin was tried for chronic WAD patients. In study V physiotherapy treatment in primary care units and a physiotherapy management with integrated components of cognitive-behavioural origin was tried for chronic WAD patients. Study I showed that a home exercise programme including training of neck and shoulder range of motion (ROM), relaxation and general advice, appears to be a sufficient treatment for most acute WAD patients. Further, the results of study IV and V suggest that cognitive behavioural components can be useful in physiotherapy treatment for patients with chronic WAD, but its contribution is not yet fully understood.

Study III showed that the significance of coping as an explanatory factor for disability increased during the one-year period after a whiplash injury. In study V it was concluded that self-efficacy is related to patients’ use of different coping styles. A model to study coping as a mediator between self-efficacy and disability was therefore introduced. In a path-analytic framework, data from subjects in study I were re-analysed to illustrate a theoretical standpoint that emphasises the process of coping. With regard to disability, the proportion of explained variance increased from 39% at three weeks after the accident, to 79% at one-year follow-up. These results also show that coping has a crucial and mediating role between self-efficacy and disability. Positive long-term outcomes in WAD-patients would therefore be improved by, shortly after an accident, boosting self-efficacy and teaching patients to use active, adaptive coping strategies to manage their problems.

Key words: Whiplash associated disorders, physiotherapy, cognitive behavioural, coping, self-efficacy, mediating factor.

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## CONTENTS

### INTRODUCTION
- Prognostic factors 8
- Medical interventions 8
- Physiotherapy treatment of WAD 9
- Chronic pain 11
- Self-efficacy 13
  - *Self-efficacy in rehabilitation* 13
- Coping with pain 14
- Functional behaviour analysis 16
  - *Psychological functional behaviour analysis for chronic WAD patients* 16
  - *Physical functional analysis for chronic WAD patients* 17
- Physiotherapy management of chronic WAD integrated with
  - cognitive components and maintenance of treatment effects 18

### THE AIMS

### METHODS
- Subjects and procedures in study I and III 22
- Subjects and procedures in study II 22
- Subjects in study IV 23
- Subjects and procedures in study V 23
- Measures 23
- Intervention and control treatment in study I 27
- Intervention and control treatment in study IV and V 28
- Data analyses, statistical procedures and special considerations 29
INTRODUCTION

Whiplash Associated Disorders (WAD) has rapidly developed into a large problem for health care providers and in terms of patient suffering (1). In the literature, whiplash is widely used as a diagnostic term, but until recently there has been no agreement on its definition. The definition of whiplash and WAD used in this thesis conforms with the proposal from the Quebec Task Force (2). "Whiplash is an acceleration-deceleration mechanism of energy transferred to the neck. It may result from rear end or side-impact motor vehicle collisions, but can also occur during diving or other mishaps. The impact may result in bony or soft tissue injuries (whiplash injury) which in turn may lead to a variety of clinical manifestations (Whiplash-Associated Disorders, WAD)." The Quebec Task Force (2) also proposed a five-grade classification of WAD based on the clinical-anatomical condition right after the accident. These are: WAD 0; No complaint about the neck, no physical signs, WAD 1; Neck complaint of pain, stiffness, or tenderness only, no physical signs, WAD 2; Neck complaint and musculoskeletal signs, WAD 3; Neck complaint and neurological signs, WAD 4; Neck complaint and fracture or dislocation. According to the Quebec Task Force the latter group of patients should be dealt with separately, and is therefore not included in this thesis.

Neck injuries after traffic accidents have increased dramatically during the last decades while other injuries have decreased. Neck injuries resulting at least 10% disability accounted for 67% of all injuries causing disability in motor vehicle accidents (3). According to the report of the Quebec Task Force (2) there are approximately 5000 whiplash injuries annually in Quebec. Barnsley et al (1) estimates the incidence of whiplash injuries to 1/1000 per year in the Western world. Björnstig and colleagues (4) reported the same incidence in a Swedish study.

Several studies have described the physical features of the acute whiplash syndrome (1, 5, 6). Symptoms like neck pain, neck stiffness, headache, shoulder pain, pain and numbness in the arms are common (2). According to Pearce (7), chronic WAD is present if the symptoms remain 6 months after the accident. Several authors (8-11) have shown that up to 35% of patients fulfil this criterion. There is a variety of manifestations of chronic WAD. Headache and neck pain are the most common, but symptoms like vertigo, unsteadiness of gait, visual disturbances and tinnitus occur frequently (12, 13). There is also some evidence of minor cognitive disturbances related to memory and concentration (14-16).
Prognostic factors

There are contradictory reports of the long-term predictive value of initial roentgenographic findings and clinical symptoms. In a study of predictive factors in chronic neck pain patients with and without neck injury, Gore and colleagues (17) concluded that clinical and roentgenographic data had minor explanatory value for long-term pain. The severity of initial neck pain was the only clinical symptom that significantly predicted the final outcome. Watkinson and associates (18) as well as Radanov et al (19) concluded that whiplash patients with a severe initial neck pain reported higher rates of late disability than others. Radanov and colleagues (11) also concluded that increasing age, injury-related cognitive impairment and the severity of initial neck pain predicted persistent symptoms at a six month follow-up, while Gargan and colleagues (20) found that the neck range of motion and psychological response were equally strong predictive factors for chronic disability. However, results in other studies (e.g. 12, 21) have not shown any predictive effects of initial neck pain.

Few sociodemographic factors have been shown to influence the prognosis of WAD. In a recent study, Harder and colleagues (22) reported that female gender, higher age, and not having full-time employment were independently associated with a slower recovery. According to Spitzer (2), women are overrepresented among those who complain about neck pain after a car accident. It has been shown that women has a 56% higher risk than men in sustaining initial symptoms (3). On the basis of clinical experience it has been suggested that women are more apt than men to report pain and disability caused by the injury, but no scientific evidence has been presented. On the other hand Radanov and colleagues (11) did not report gender as a prognostic factor for being symptomatic at a six month follow-up. Psychological factors, i.e. psychosocial stress, personality characteristics, and depressive symptoms were also examined in the latter study. The authors found no associations between these factors and the persistence of symptoms.

Medical interventions

Analgesics and anti-inflammatory drugs combined with other treatments have been associated with short-term benefits in the acute phase (23-26). In a recent study, 20 patients with acute whiplash injury treated with high-dose methylprednisone
were compared to patients on placebo treatment. At a six month follow-up there was a significant difference in disabling symptoms and total number of sick days benefiting the experimental group (27). Byrn and colleagues (28) treated 40 chronic WAD patients with subcutaneous sterile water injections or saline in a randomised trial. After an eight month follow-up there was still a significant difference compared to sterile water in minimum pain score and neck range of motion but not in the maximum pain or self-assessment of improvement. However, these treatment modalities have not become a part of the clinical management of WAD.

Physiotherapy treatment of WAD

Several studies have shown that early mobilisation is more effective than the traditional, clinical management of whiplash associated disorders (WAD), i.e. immobilisation with a cervical collar and analgesics (24-26, 29, 30). In a study by Rosenfeld and colleagues (30), the treatment and time factors were separated, i.e. the authors’ had four randomised groups, two groups with an active and regular (immobilisation with a cervical collar and analgesics) treatment immediately after the accident and two groups the same treatments 14 days after the injury. The conclusion was that active treatment provided early was significantly better in pain reduction compared to other conditions.

In other studies, where treatment with a cervical collar was compared to a group which was instructed to rest and take analgesics (31), and where a collar group was compared to treatment including traction of the neck and home exercises (32), no significant differences between groups were found.

Even though these results are inconclusive, the review of the Quebec Task Force (2) suggested that prolonged immobilisation may increase scar tissue in the neck and reduce cervical mobility, and that patients should return to normal activities after the injury without any delay.

Studies showing that activity provides better results than immobilisation have mainly used gentle neck and head movements, but so far the purpose of the movements has been to increase the neck range of motion, and questions regarding other purposes of the exercises have not been addressed. However, studies have shown that active head repositioning, i.e. kinaesthetic sensibility of neck muscles, was significantly less precise for patients with whiplash injury as compared to healthy controls (33, 34). Thus, individuals with whiplash injury may have acquired
proprioceptive deficits in their neck muscles. This can cause impairments in co-
coordination of the natural head movement patterns (34) and such deficits can be a
maintaining factor in neck pain (35). However, it is unclear if exercises aimed to
normalise kinaesthetic sensibility and co-ordination of the neck muscles should be
included in regular treatment.

Another treatment, including acute and subacute (36) WAD patients, i.e.
patients with symptom from one week to eight weeks, was presented by Provinciali
and colleagues (37). The authors compared relaxation, massage, psychological
support and postural training with a control treatment that included application of
physical agents, i.e. electrical and sonic modalities aiming to reduce neck pain. At a
six month follow-up, patients in the active treatment group reported less pain and
had returned to their usual occupations sooner than controls. However, treating acute
patients the same way as patients in the subacute phase may have biased these
results.

Typically, physiotherapy approaches to chronic WAD are concerned with
increasing movement and attempts to reduce pain. Reports of treatments such as
manipulation and mobilisation (38, 39), cervical traction (40), acupuncture (41, 42),
transcutaneous nervous stimulation (43) and myofascial trigger points treatment
(44), are examples in line with this tradition. However, a large proportion of studies
suffers from methodological deficiencies. For example, follow-up assessment varies
between “none” (42), “immediate” (39), five minutes after treatment (38), two
weeks (41), one month (40) and six months (43, 44). The clinical significance of
some of the results may therefore be questioned due to a short follow-up period.
Other methodological problems are illustrated in Fattori and colleagues (41) who did
not randomly allocate patients to physiotherapy and acupuncture groups. Another
study was retrospective using telephone interviews for data collection (39).
Interviewers expected the patient to recall symptoms they had had both before and
after the treatment. These examples raise serious questions of the internal validity of
the studies. The failure to report compliance with exercises (43, 44) used as home
assignments is another threat to internal validity. Vendrig and colleagues (45)
treated 26 chronic WAD patients with a multimodal approach. The program was
designed to restore normal daily functioning, including complete return to work.
Graded activity, discussions of beliefs regarding symptoms and disability as well as
sport activities were included. There was a significant decrease in patients’
symptoms at the end of the treatment, and at a six month follow-up more than half
of the patients were back to work and did not use any analgesics. The major limitation in this study was the lack of control group. To sum up, it is important that new treatment approaches to problems like WAD are developed and evaluated in reasonably well controlled studies before any conclusions are drawn.

Most of the treatment studies, medical as well as physiotherapeutic have employed outcome measures like neck range of motion, pain intensity, use of analgesics, days on sick leave and/or return to work. Other types of outcome measures, i.e. measures of disability, coping with pain, depression or cognitive complaints are seldom reported. Further, most of the interventions for acute or chronic WAD are directed towards correcting the organic dysfunction or pathology. This leads to the conclusion that whiplash associated disorders are mostly evaluated and treated according to the biomedical model of pain with less consideration of social and psychological factors. The biomedical model has been criticised for failing to take into account the dynamic interaction of psychological and psychosocial factors with pathophysiological variables in health and disease (46, 47). There is also a general agreement that reported physical symptoms cannot completely be due to physical factors (47). In general, chronic pain is a multi-component phenomenon with associations between injury, pain experience, impairment, physical maintaining factors, emotional and cognitive factors, as well as environmental and socio-economic influences (48, 49). Turk’s (47) biopsychosocial framework includes “biological factors that may initiate, maintain, and modulate physical perturbations.” It also includes psychological factors that “influence the appraisal and perception of internal physiological signs” while “social factors shape the behavioural responses of patients to the perceptions of their physical perturbations” (pp. 6). Thus, a broad perspective model, like the biopsychosocial model of pain that include the factors above, is needed to evaluate and manage symptoms after a whiplash injury, especially the chronic conditions.

**Chronic pain**

In other chronic pain conditions, it is known that the central part of the pain problem are the beliefs of the patient, as well as learned patterns of pain behaviour (50). Empirical research findings have thus pointed to the importance of several psychological influences on pain perception, including for example anxiety, depression, direction of attention, expectations, pain control and pain-related
beliefs. Some individuals adjust relatively well to prolonged pain, whereas others develop various degrees of dysfunction, disability and/or depression. These differences in adaptation are frequently explained by the individual use of coping strategies (51). Others (52, 53) have demonstrated positive relations between active coping strategies (such as exercise) requiring self-regulated participation by the patient, and psychological and physical functioning. Further, Jensen and Karoly (54) found that patients' confidence in self-control over pain and the strategies used to manage pain were related to well-being and activity level. In their review, Jensen and colleagues (51) showed that chronic pain patients’ disability levels were more strongly related to maladaptive cognitions, self-efficacy beliefs, coping style and perceived control than to either pain intensity, chronicity or degree of pathology.

So-far attention has been focused on the predictive value of psychological factors as an alternative to physiological factors. Cognitive-behavioural factors have been shown to predict changes in psychosocial functioning, affective distress, reported pain (55, 56), and functional ability (57). Limited attention has been devoted to the variability of psychological factors in relation to disability.

Chronic pain interferes with all aspects of daily life. Pain demands attention, affects concentration and reduces the energy individuals need for other things in daily living. Daily life can be changed to a relentless search for relief. According to Katz and colleagues (58), coping with chronic pain may be defined as actions and thoughts that engage people to manage pain. The individual’s reaction to perceived disability may include changes in behaviour and physical functioning. These changes can maintain the problem itself or even increase the degree of disability (59). The variability in links between specific behaviour and pain makes it difficult for patients to determine the relations between their actions and pain. This can lead to development of widespread avoidance behaviour and a sense of helplessness (58). Pain can persist in the absence of physical findings and pathology and outdated but persisting notions imply that this kind of pain is evidence of psychopathology, malingering or secondary gain (60). Thus, not only must patients cope with pain, but also with doubts about the authenticity of the pain displayed by family, friends and helping professionals (58).

Among the persisting effects of impairment and disability due to pain are loss of income, mood disturbances, changes in family dynamics and reductions of social and leisure activities (61). These facts can for example lead to a lower usefulness of social support. Perceived social support, supportive relationships and supportive
networks can act as buffering factors. When regarded as a coping resource, social support refers to supportive behaviour from others in stressful situations. On the other hand, such behaviours may be less desirable for the person receiving the aid. Thus, social support may have both costs and benefits and may influence the individual’s coping strategies as well as outcome of these coping efforts (62).

**Self-efficacy**

Theoretically, self-efficacy expectancies are defined as a personal belief of how successfully one can cope with difficult situations (63). Individuals with high self-efficacy expectancies should thus be more persistent in difficult situations than people with low expectancies (63, 64). Efficacy beliefs vary across domains of activities, within the same activity at different levels of difficulty, and under different circumstances (65). Self-efficacy theory is built on cognitive and behavioural concepts. The basic principle is that cognitive processes can mediate behavioural changes, and that cognitive events are induced and altered by the experience of mastery arising from effective performance. Interventions based on altering cognitions can provide individuals with the knowledge and awareness of skills and abilities underlying the performance of the behaviour, but if individuals do not believe that they can carry out the behaviour effectively, the behaviour will not occur (63, 64).

**Self-efficacy in rehabilitation**

Individuals who have difficulties in adjusting to disabilities may appear unmotivated to participate in rehabilitation. Lack of motivation can be reconceptualised in terms of a self-efficacy model (66). Those who experience low self-efficacy might be reluctant to begin rehabilitation due to fear of failure and uncertainty regarding their abilities (67). Self-efficacy should be an explicit goal of rehabilitation (68). If individuals attribute success to their skills instead of other factors, such as effort expended and task difficulty, self-efficacy is more likely to increase (66).

Dolce and colleagues (69) showed a strong positive relation between experimental acute pain tolerance and self-efficacy ratings. They concluded that self-efficacy expectancies were a better predictor of pain tolerance than were pain intensity ratings. In an other study, Dolce and colleagues found that higher self-
efficacy expectations were related to increases in exercise levels and reductions in patients’ need for pain medication (70).

Chronic pain patients’ higher self-efficacy scores after treatment have also been related to increased sitting and standing tolerance and to higher ratings of self-reported improvement in general areas (71), as well as improvements in work status after a physical reactivation programme (72). In a recent study, Anderson and associates (73) concluded that chronic pain patients with high levels of self-efficacy reported less intense pain, less daily interference due to pain, greater perceived life control, and higher activity levels. Further, several studies (68, 69, 71, 74) emphasise the importance of self-efficacy in chronic as well as in acute pain patients. Altmaier and colleagues (68) found that after receiving counselling aimed to increase self-efficacy related to coping skills, patients reported lower back pain at a six month follow-up. These authors also found that changes in self-efficacy during treatment were predictive of an individual’s level of functioning. According to this concept, pain patients with low self-efficacy might show more non-compliance with treatment recommendations.

Coping with pain

Understanding of coping and other psychosocial factors in relation to the development of chronic Whiplash Associated Disorders (WAD) is yet limited. Lazarus (75) defines coping as “ongoing cognitive and behavioural efforts to manage specific external and/or internal demands that are appraised as taxing or exceeding the resources of the person” (pp. 237). Coping must be studied and understood as a complex process and a multivariate construct with a number of different dimensions (76). This is reflected in several studies (51, 54, 77) indicating that disability due to pain is strongly related to coping with pain.

Individuals normally try to reduce the impact of pain by using cognitive and behavioural responses i.e. coping strategies. The identification of these strategies in the acute course of WAD may provide a basis for the prevention of chronicity.

There are several coping styles used in attempts to cope with pain. Problem-focused and emotion-focused coping can be distinguished from each other (75). Individuals using problem-focused coping strategies might try to reduce or eliminate the pain itself. In contrast, individuals using emotion-focused coping would try to manage the stress and negative emotions that co-occur with chronic pain. The
distinction between these two types is not clear-cut because a successful use of problem-focused strategies may also reduce associated emotional distress (58).

Cognitive and behavioural coping are two other strategies. Distraction and imagery-techniques are often included in cognitive strategies for managing pain. Taking medication, seeking social support and resting in bed are considered as behavioural strategies (53). However, these two categories are not entirely clear cut and this fact has led to controversy over what one investigator considers a behavioural strategy and another as an outcome of the attempt to cope with the pain.

Further, coping strategies may be regarded as either passive or active. Passive coping strategies involve a restriction of one’s functioning due to pain and a tendency to depend on others for help, whereas active coping involves efforts to deal with pain and carry on in spite of it (78).

Coping strategies can also be predominantly attentional or avoidant. Attentional strategies focus directly on the source of pain in attempts to manage it, while avoidant strategies includes denial of pain sensation, distraction and attention-diversion (79). In a study of effects of coping strategies on adaptation to chronic and recent-onset pain, Holmes and Stevenson (80) concluded that patients with recent-onset pain were positively adapted when they employed avoidant-type strategies. In contrast, chronic pain patients who employed attentional-type strategies were more positively adapted. In a review of chronic low back pain prevention strategies, Weiser and Cedraschi (81) concluded that preparedness to use cognitive coping exists before the pain begins but will be modified at the onset of pain. Thus, successful coping strategies in later stages of the acute - chronic process may be quite different from those early on.

The question whether a coping strategy is adaptive or maladaptive has puzzled many researches. The adaptiveness of a certain strategy depends on individual factors, the nature of the pain problem, and specific situational factors. In addition it varies over time (76). Thus, the success of coping, which in this context refers to the effectiveness of coping with pain in improving outcome (75), i.e. disability, must be viewed in relation to interactions between the individual and the situation (76, 82) as well as through the different dimensions of coping, i.e. cognitive – behavioural, passive – active, avoidant - attentional and adaptive - maladaptive. The prevention of chronicity may depend on early identification of these individual factors in coping.
Functional behaviour analysis

Haynes and O’Brien (83) define functional behaviour analysis as; ”The identification of important, controllable, causal functional relationships applicable to a specific set of target behaviours for an individual client (p.654)” . A functional behaviour analysis is thus concerned with finding out which variables affect a phenomenon and the way in which they do so. It aims to detect which of the relevant variables are antecedents and which ones are the consequences of the behaviour in order to modify those chains of events. The aim is also to detect individual problem behaviours and the change of these behaviours is then established as goals of treatment (84).

The provision of positive consequences for new behaviours is likely to increase the behaviour. Factors that reinforce behaviour should be identified at an early stage (85, 86). A key in successful treatment programmes is selecting individualised and relevant everyday activities in which the patients can practise their exercises. Such home assignments in-between sessions boost the patient’s motivation (87) and are also of importance for generalising treatment effects.

Psychological functional behaviour analysis for chronic WAD patients

Pain behaviours including maladaptive movement patterns can result from avoidance learning (88). Philips (89) concluded that chronic pain patients spend a lot of time trying to control pain intensity by limiting their behaviour and avoiding contact with any situation that might increase pain. In their review, Asmundson and associates (90) argued that avoidance behaviour is often related to poor treatment performance, contributes to disability and that the fear of pain may influence the way one copes with pain. Avoidance is regarded as a counterproductive coping behaviour by these authors. Thus, it is closely linked to passive, maladaptive coping strategies.

Altmaier and colleagues (68) reported that gains in self-efficacy were associated with improved patient functioning. The results also suggested that increased self-efficacy beliefs may enhance the long-term effects of rehabilitation. According to Harding and Williams (85) patients should be taught to “self-reinforce” and to attribute success to themselves. This increases their independence and control. Patients may also learn to provide themselves with cues and reminders of when to apply new behavioural skills instead of relying on others. Similar
Several studies (52, 53) have shown positive relationships between the use of active coping strategies, and psychological and physical functioning. Analysis of individual coping strategies, and identification of responses in risk situations for increased pain, are important components in treatment planning (91). Further, Turk and Salovey (91) argue that problem solving skills is an integral part of treatment for patients with chronic pain.

Perceived responsibility for the treatment program, realistic exercise situations, skills in problem solving, active coping strategies and evaluation of risk situations for relapse, are factors that increase the possibility for patients’ to continue to engage in the prescribed adaptive behaviours once discharged from the treatment program (86, 91). Learning to try different behaviours to establish sound and economic patterns of movement as well as behaviour patterns in daily living are crucial. Thus, the patient is taught to develop plans for adaptive responding, and adjust behaviour accordingly, when meeting difficulties in various activities (91). Since patients do not necessarily use learned behaviour and movement patterns in their everyday activities, the result of treatment might be disappointing. The solution would be to systematically use everyday activities as training opportunities, in order to maintain the new behaviours.

Physical functional analysis for chronic WAD patients

The focus of physical functional analysis is on chronic WAD patients’ muscular imbalance, posture and co-ordination of movements. Sahrmann (92) claimed that the focus of physiotherapy should not only concern the impairments that affect movement, but we must also identify the movements that cause impairments. An altered muscular balance, body posture and co-ordination are factors likely to be associated with pain (34, 93, 94).

There are several studies which provide a tentative indication that postural characteristics of the head, cervical spine, and shoulders may be associated with pain (93-98). Several studies have also shown that active head repositioning, i.e. kinaesthetic sensibility/co-ordination, was significantly less precise for a group of patients with whiplash injury (33, 34) and patients with chronic neck pain (99), compared to healthy controls. The ability to reproduce head position requires integration of proprioceptive information. Patients with whiplash injury may have
proprioceptive deficits that do not allow them to reliably identify their head position. This is likely to cause problems in everyday function (34). In a review, Edwards (100) suggested that the primary cause of occupational muscle pain might be sought in altered central motor control resulting in imbalance between motor unit recruitment and relaxation of muscles not directly involved in the activity. Unconscious learning of altered recruitment patterns might contribute to the functional defect. The planning of treatment programmes for patients with chronic WAD presupposes the recognition of factors that perpetuate dysfunction.

**Physiotherapy management of chronic WAD integrated with cognitive components and maintenance of treatment effects**

It has been suggested that patients with WAD should be viewed in the same way as patients with physical illness in general (101). Thus, rehabilitation programmes for these patients should include the same components as chronic pain management programmes for other diagnoses. These programmes should address and deal with behaviours, like avoidance of activities, rather than trying to diagnose and look for the pathology behind pain (85). General principles of learning can be applied to the physical, psychological and practical habits associated with chronic conditions like pain and their accompanying fears (86). Harding (86) also claim that the main aims of rehabilitation with regard to behavioural change are reducing undesired behaviours, initiating or increasing, as well as maintaining, desired behaviours. The individual’s lifestyle, available training time, and occupation are possible targets for intervention when making the most of a rehabilitation program. Thus, rehabilitation of chronic pain patients requires a wider approach to be successful, and any program must include active patient participation (102), attempts to increase the patient’s self-efficacy beliefs (67), analysis of coping strategies (91) and application of active coping strategies (52, 103).

Pain definitions that involve physiological, psychological and environmental components also need evaluation methods which reflect all three of these factors, taking into account pain characteristics, for example if pain is acute or chronic. As a consequence, three measurement domains – the physiological, the behavioural and the cognitive-affective components - are distinguished besides the measurement of pain intensity (48) in this thesis.

One of the largest problems faced in health behaviour modification programmes as well as in adherence to pain regimes, is the tendency of subjects to
relapse into earlier behaviour. The incidence of relapse following successful treatment of persistent pain ranges from 30 to 70%. For some pain conditions, relapse is directly related to nonadherence to treatment. Consequently, the factors that reduce relapse and increase adherence provide valuable assistance in the maintenance of post-treatment pain reduction (104). Among the first tasks in understanding the mechanisms involved in relapse is to try to predict its occurrence (105). The knowledge of factors determining relapse is limited, but some internal and external factors have been identified. Among those, self-efficacy has been considered to be an important component for maintaining behavioural change (106). High self-efficacy scores at post-treatment for chronic pain patients have been reported to relate to more improvement, less medication, and less downtime at follow-up (71). Dolce (107) proposed that patients who do not strengthen their self-efficacy but do improve otherwise during treatment, may be more likely to relapse after completed treatment. Adaptive coping responses in high risk situations for relapse can promote feelings of self-efficacy and thus reduce the likelihood of relapse (106).

In treatment programmes which integrate cognitive components, the problem of relapse is addressed through regular homework assignments from the start (58). The generalisation of treatment gains and skills to the patient’s home environment may be restrained by the nature of the treatment environment. Treatments conducted in natural settings, i.e. the patient’s home and workplace increase generalisation and maintenance of treatment results (104). Further, treatment programmes should include specific strategies, like coping skills, problem solving, self-control and relaxation, which are designed to deal with pain flare-ups and other risk situations for relapse (58, 104). Patients should be educated to see flare-ups as temporary conditions instead of personal failures of compliance with the programme or precursors of return to pre-treatment levels of pain and disability (104, 108).

Integration of psychological techniques and physical therapy provides a multimodal approach in the analysis, treatment and measurement of patients with chronic pain. Combining these aspects is an important strategy towards maximising treatment effects (86, 109). This angle will be applied in the present thesis to develop the treatment of chronic WAD patients, and to study treatment effects in acute and chronic phases and in outcome prediction.
THE AIMS

The general aim of this thesis was to evaluate the clinical management of acute WAD and to develop, describe and evaluate a cognitive behavioural approach in physiotherapy management of long-term WAD. Another aim was to study the predictors and mediating factors for long-term disability and pain after a whiplash injury. The specific aims were:

1. To study the effects of two home exercise programmes on acute WAD patients (Study I).
2. To describe a model for an integrated physiotherapy/cognitive-behavioural approach in the analysis and treatment of chronic WAD patients (Study IV).
3. To evaluate differences between physiotherapy treatment in primary care units and a physiotherapy management approach with integrated components of cognitive-behavioural origin (Study V).
4. To clarify the role of outcome predictors, i.e.;
   a. to describe differences in initial physical, psychological and behavioural factors for symptomatic and nonsymptomatic patients (Study I),
   b. to study the relations between the two predictor variables self-efficacy and optimism, and the outcome variables pain related dysfunction, disability, anxiety, depression, and pain intensity (Study II),
   c. to identify long-term prognostic factors for disability and pain intensity at a 12 month follow-up (Study III),
   d. to study if patients with high self-efficacy differ from those with low self-efficacy in disability and pain intensity (Study V).
5. To study;
   a. the coping process over time (Study III),
   b. if highly efficacious patients differ from those with low self-efficacy in reported use of coping strategies (Study V).
6. To study a possible mediating function of coping between self-efficacy and disability as well as changes in this model over time.

All studies were approved by the Research Ethics Committee of the Faculty of Medicine at Uppsala University.
METHODS

In the course of the project patients were included into the studies at different points, in the development from whiplash injury as a result of an accident, to various degrees of chronicity. Figure 1 presents a schematic picture of this time axis as well as demographic data for all studies.

Figure 1. The time axis and demographic data for the studies in this thesis.
Subjects and procedures in study I and III

Sixty-six patients visiting the orthopaedic clinic at the University hospital, Uppsala took part in the studies. Inclusion criteria were acute whiplash injury and report of acceleration – deceleration movement of head but without direct head trauma. Further criteria were age between 18 and 60 years and good ability to understand written Swedish. Patients claiming a history of neck injury due to accident before the actual whiplash accident were excluded. Typically, patients had been involved in road traffic accidents, mostly rear-end but also some side-impact collisions. Subjects were rated according WAD grade 0-3 (2). The study was performed during a 2.5-year period. On average patients were included 20 days after the accident. Study I includes an initial assessment, and three and six month follow-ups after inclusion.

Study III was conducted by studying the same patients as above prospectively on five occasions, one week after the inclusion, six weeks after the first appointment, at three-, six-, and 12 month follow-ups with regard to the use of different coping strategies and long-term predictors for disability. Questionnaires were collected at every follow-up and self-registrations of pain intensity were made three times a day during the first six weeks and four times daily during one-week periods at each follow-up (Study III).

Demographic data for these studies are presented in Figure 1.

Subjects and procedures in study II

A total of 104 subjects were recruited from all 130 chronic WAD patients participating in an inpatient four-week multidisciplinary pain programme at a rehabilitation centre. The patients were referred to the centre by regional social insurance offices in different parts of central Sweden. After giving their informed consent, patients willing to participate were asked to complete one questionnaire. The single questionnaire was complemented by five others and a pain intensity diary during the latter part of the study. This aimed at getting a more complete picture of the patients' physical and psychosocial functioning. Fifty-six patients were included in this part of the study. These patients were included in the study at a median of 2-5 years after the injury. Six patients were included between 6 –12
months, 20 between 1-2 years, 19 between 2-5 years and 11 more than 5 years after the injury. Demographic data are presented in Figure 1.

**Subjects in study IV**

This study was made with a single case design format including three cases. **Subject 1** was a 54-year old female, working part time as a teacher. She had been involved in a car accident approximately 10 months before referral to the clinic. **Subject 2** was a 48-year old female. She had had a car accident six months before referral to the clinic. **Subject 3** was a 20-year old female student. The patient was referred to the clinic four months after her accident. All three patients recorded pain intensity in various troubling daily life situations prior to functional analyses. The reports of pain intensity were used to rank situations according to how impaired the patient was in those situations and consequently classified as low, medium and high “expected disability situations”. A more detailed description of these situations is presented in paper IV. Demographic data are presented in Figure 1.

**Subjects and procedures in study V**

The study was conducted in an orthopaedic clinic where patients were targeted who came for their three-month follow-up appointment after a whiplash injury and who still had significant symptoms like neck and shoulder pain (1, 2). Further inclusion criteria were age between 18 and 60 years and good ability to understand written Swedish. Typically, patients had been involved in car-crashes (91%), mostly rear-end impacts (63%). There were 59 patients who fulfilled the inclusion criteria and among these, 26 declined further participation in the study. Thirty-three patients were randomised in two different intervention groups, i.e. an experimental and a control group. Demographic data are presented in Figure 1.

**Measures**

Twelve psychological and physiological measures with sound psychometric characteristic were used in various constellations in the five studies. The measures are summarised in Table 1.
**Table 1. The measures used in the studies of this thesis.**

The **Self-Efficacy Scale (SES)** (68) is a 20 item-scale where patients are asked to rate how confident they are regarding their ability to successfully complete activities of daily living despite their pain. The maximum score is 200, higher scores reflecting higher confidence. The reliability of the SES in our material (study I and III) was good ($\alpha = 0.91$).

The **Multidimensional Pain Inventory (MPI)** (111) is a measure of the psychosocial, cognitive and behavioural effects of chronic pain. The MPI describes different areas in daily life and the ways that life is affected by pain. It is a 60-item...

The Life Orientation Test (LOT) (110) is used as a measure of optimism, conceptualised as a stable personality characteristic. Optimism is defined as a person's generalised outcome expectancy. LOT contains 12 items, four of which are phrased in a positive way, four in a negative way and four filler items (excluded from final scores). The maximum score is 32, with higher scores indicating a general tendency to have positive outcome expectancies.

The Coping Strategies Questionnaire (CSQ) (53, 112) is a 48-item checklist where patients are asked to indicate the extent to which they use certain cognitive ['Reinterpreting pain sensations’ (RPS), ‘Coping self-statements’ (CSS), ‘Ignoring sensations’ (IS), ‘Diverting attention’ (DA), ‘Praying/hoping’ (PH) and ‘Catastrophising’ (Ca)] or behavioural [‘Increased behavioural activity’ (IBA) and ‘Pain behaviours’ (PB)] coping strategies. Items are summarised into eight subscales. The scores range from 0 to 6 for each item and the maximal score in each sub-scale is 36. Higher scores indicate that a person uses the particular coping strategy more extensively. The CSQ includes two additional items, i.e. ‘Control over pain’ and ‘Ability to decrease pain’ that were analysed separately.

The cognitive subscales were divided in two groups, i.e. conscious cognitive coping and pain avoidance (118). Conscious cognitive strategies are characterised by positive and constructive thinking as well as ignoring pain. These include the CSQ subscales ‘Reinterpreting pain sensations’, ‘Coping self-statements’ and ‘Ignoring sensations’. Pain avoidance strategies are characterised by focusing attention on non-pain-related mental activity such as mental games, the future and religious faith. The sub-scales ‘Diverting attention’ and ‘Praying/hoping’ form this factor.

The Pain Disability Index (PDI) (113) is a self-report inventory designed to measure both general and domain-specific disability related to chronic pain (119, 120). The maximum score is 70 which corresponds to a high degree of disability. The reliability of the PDI in our material (study I and III) was good (\(\alpha= 0.86\)).
The Sickness Impact Profile (SIP) (114) contains 136 items divided in 12 subscales; 'Sleep and rest', 'Emotional behaviour', 'Body care and movement', 'Home management', 'Mobility', 'Social interaction', 'Ambulation', 'Alertness behaviour', 'Communication', 'Work', 'Recreation and pastimes' and 'Eating'. The subscales are combined into one Physical dimension and one Psychosocial dimension. An Overall SIP score is computed on the basis of the Physical and Psychosocial dimensions and five independent subscales.

The Hospital Anxiety and Depression Scale (HADS) (115) is designed to assess states of depression and anxiety in non-psychiatric, general medical outpatients. It consist of 14 items, seven in each of the subscales Anxiety and Depression. The maximum score in each is 21. Silverstone (121) and Zigmond and Snaith (115) recommended cut-off score of 8 in both subscales indicating a clinically significant degree of anxiety or depression.

Pain intensity was reported with a visual analogue scale or a numerical rating scale (0-10) in a diary format. Individual means were calculated from the self-registrations made three to four times a day.

The physical measures included; cervicothoracic posture assessed with a goniometer in standing position (116, 117), where a certain grade, individual for each person represents the neutral cervicothoracic posture. Interrater reliability was 0.95 with a measurement error of 1.6° (116). Neck range of motion (ROM) in right and left rotation was measured with a goniometer, which measures joint movement by means of compass and inclination needle. The kinaesthetic sensibility of neck muscles (99) was also assessed.

Expectations and motivation toward the treatment (study V) as well as assessment of compliance and treatment integrity (study I, IV and V). To cover motivational aspects, five questions were used in a self-report form (122). Subjects were asked to consider; (a) whether they expected total or partial recovery or no difference at all, (b) how important it was to be pain free, (c) whether they thought they would experience any difference in their ability to perform daily chores, (d) how prepared they were to engage in their treatment (e.g. follow advice, change habits), and (e) how much time they were prepared to spend on exercising.
In study I daily exercise diaries were used to determine the extend to which subjects in both groups complied with instructions during the first six weeks, i.e. number of exercise occasions per day was registered.

Subjects in study IV completed a self-report exercise diary to register their compliance with exercises during the treatment.

Three means of measuring treatment integrity were used in study V. An exercise diary was used to report all exercises the patients did at home. Each patient’s treatment, duration, number of visits and what was included in treatment were reported by the treating physiotherapists. Patients were also asked what kind of treatment they had had and if they understood the purpose and principles of the treatment.

Pain intensity in activities (study IV). All three subjects in study IV completed a one-week, baseline diary where they reported daily living situations, which caused more pain. This one-week diary was also used during the treatment and follow-up periods.

Global ratings of treatment results (study V). At post-treatment patients were asked four global questions regarding treatment results (122), i.e. if patients; (a) perceived themselves recovered or had more pain, (b) had the ability to perform daily activities, (c) were satisfied with the overall treatment results, and (d) took any medication.

At the three month follow-up, patients answered seven questions regarding treatment results, covering (a) ability to perform daily activities, (b) interference due to pain in daily life, (c) if and, (d) how learned skills were used, (e) supplementary treatment, and (f) medication, as well as (g) working status.

Intervention and control treatment in study I

The control treatment for patients with acute WAD in study I included instructions for alternating rest with activities, keeping the neck from getting cold, walking a fair distance every day, and keeping an upright body posture intact while sitting, standing or walking. Patients were instructed not to lift or carry heavy items, and not to remain seated with their head bent forward during the first weeks after the injury.
The patients were also instructed to restore their normal neck movements as soon as possible by using the following three exercises;

- Looking over each shoulder in turn, 3-5 times.
- Moving the arms up and down anteriorly, 2-3 times.
- Taking a deep breath and lifting the shoulders upwards exhaling and relaxing the shoulders.

All the exercises were to be done cautiously until subjects reached their pain limit, and should be done at least three times a day. Patients were advised not to use a cervical collar.

The experimental treatment was the same as above complemented with an exercise, aiming to improve kinaesthetic sensibility and co-ordination of the neck muscles. This exercise was taught by having the patient lie down on the floor and by providing instructions to imagine a “quadrangle” under the head. The patient was instructed to gently press each angle of the “quadrangle”, one at a time, against the floor. This cycle was repeated three times. Thus, patients were instructed to press the two diagonal angles towards the surface at the same time, with three repetitions. This exercise should be made at least three times a day.

**Intervention and control treatment in study IV and V**

The physiotherapy management of chronic WAD integrated with cognitive components was developed in study IV, and compared to physiotherapy treatment in primary care in study V using an experimental design.

The general frame of the treatment included four phases that comprised basic skills, applied skills, generalisation, and maintenance. The functional behaviour analysis that was used to analyse the problem behaviours and to establish treatment goals, also served as basis for each treatment phase.

During the basic skills phase, the aims of the programme were discussed with the patients. Their ways of coping with increased pain, and self-efficacy, were also discussed. The basic skills phase also included relaxation training and re-education of a balanced cervicothoracic posture in lying, sitting, and standing based on cervicothoracic muscular stabilisation techniques suggested by Sweeney (123). Further, exercises aimed to increase neck range of motion, co-ordination and endurance of neck muscles as well as re-education of normal humeroscapular rhythm were included.
The following two phases included application and generalisation of basic skills. During these phases, the basic skills were integrated with everyday activities derived from the functional behavioural analysis, i.e. groups of situations where the patient expected low, medium and high disability because of pain. The patients were taught to use different active strategies to manage to do activities that cause pain in daily life.

The final part deals with maintenance. Repetition of key didactic components in booster sessions and a written summary of the program (108) were used to increase the probability that the treatment results would last. Patients’ responsibility to continue on their own to change behaviours was emphasised.

Before the start of study V, primary care physiotherapists in the Uppsala area were contacted to explore what type of treatments they introduced to patients with WAD. A uniform approach of treatment for the control group was then decided upon together with these physiotherapists. It included exercises designed to enhance muscular stabilisation of neck, neck and shoulder mobility with stretching and co-ordination of head movements, as well as exercises to maintain body posture and arm muscle strength. Patients were expected to practice exercises at home and / or in the physiotherapy departments’ gym. The treatment could also include pain-relieving methods like relaxation, Transcutaneous Electric Nerve Stimulation (TENS), acupuncture and heat, which were given in the physiotherapy department.

**Data analyses, statistical procedures and special considerations**

The statistical methods used in the different studies are presented in Table 2.

<table>
<thead>
<tr>
<th>Study</th>
<th>Statistical methods</th>
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<tbody>
<tr>
<td>I</td>
<td>2-way (treatment x time) ANOVAs with subsequent Tukey HSD post hocs, MANOVAs, t-tests, chi²-tests</td>
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<tr>
<td>II</td>
<td>ANOVAs with subsequent Sheffe’s post hocs, MANOVAs, t-tests, Pearson’s product correlation coefficient, linear multiple regression</td>
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<tr>
<td>III</td>
<td>Pearson’s product correlation coefficient, linear multiple regression</td>
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<tr>
<td>IV</td>
<td>Effect sizes</td>
</tr>
<tr>
<td>V</td>
<td>2-way (treatment x time) ANOVAs, ANCOVAs and MANOVAs t-tests, chi²-tests</td>
</tr>
</tbody>
</table>

Table 2. Statistical methods in studies I, II, III, IV, V.
Patients in study I were classified as symptomatic or nonsymptomatic at the six month follow-up using their self-reported pain intensity score. The cut-off point between symptomatic and nonsymptomatic was chosen as one half standard deviation below the group mean score (i.e.0.97). The rationale for this choice of cut-off point is partly that an average pain below one on the VAS scale is not considered a clinical problem. Further, the standard deviation in this material was 1.88 suggesting that small changes may be at least partly due to methodological artefacts.

In study III correlation matrixes for background variables; (age, gender, type of home exercise programme, WAD grade and previous neck pain), physical and psychosocial measures at entry as well as the two dependent variables (PDI, NRS) were screened for significant correlations before multiple regression analyses. This procedure was also used to rule out independent variables that were highly correlated to each other (124). In this study the sample size was somewhat small and consequently the regression analyses may lack in power. The magnitude of chance fluctuations is larger and therefore, the $R^2$ tends to be overestimated. However, with a low number of independent variables and by using the adjusted $R^2$ as recommended by Tabachnick and Fidell (124), the bias towards a low statistical power is reasonably compensated for.

In study V patients were assigned a posteriori into two different groups based on their initial self-efficacy scores. Patients with high self-efficacy scored above the group SES mean while those at the group mean or below were assigned to the low self-efficacy group. The scores of the new groups were then analysed for differences over time.
RESULTS

Physiotherapy treatment in the acute phase (study I)

Repeated measures ANOVAs showed no significant interaction effects (treatment x time) or group differences in the self-rated variables, i.e. PDI, SES, NRS. No significant interaction effects or group differences were found in the physical measures.

However, the merged (additional and regular treatment) group improved over time regarding self-efficacy (SES) ($p<0.001$), disability (PDI) ($p<0.001$) and in pain intensity ($p<0.001$). Further, this group showed improvements ($p<0.001$) in physical measures over time. An increase in right and left cervical rotation ROM, improvement in kinaesthetic sensibility in left rotation of the neck as well as in head posture were found.

The MANOVAs and two-way ANOVAs were conducted in order to study any differences in coping patterns as well as control over pain and ability to decrease pain between regular treatment and additional treatment groups. The results showed one significant interaction effect (i.e. treatment x time) in patients’ perceived ‘Ability to decrease pain’ ($p<0.01$). Post-hoc tests revealed that this independent CSQ item improved between three and six-month follow-ups for the additional treatment group ($p<0.05$) while no such change was seen in the regular treatment group. There were no other significant interactions or group differences. However, the coping process varied in conscious cognitive ($p<0.05$) and pain avoidance strategies ($p<0.05$) for the whole group between points in time.

Compliance with the treatment regime was examined both for differences in daily training (at least three times a day was requested) and for number of days per week when training was implemented. The analyses of “daily” and “days per week” training showed no significant differences between regular treatment and additional treatment groups. In all 41% of the subjects completed their exercises more often than five days a week.
An integrated physiotherapy / cognitive behavioural approach for treatment of long-term WAD (Study IV and V)

Study IV

The primary aim of this study was to describe a model for physiotherapy treatment of chronic WAD patients. The general trend in the results for all three patients showed the same pattern of improvement. The patients reported a decrease of pain intensity in the low, medium and high disability situations. The combined effect sizes (125) for low, medium and high disability varied from 1.5 to 35.4 when baseline means were compared to the last follow-up.

Study V

The main results of study V based on repeated measures ANCOVAs (SES as covariate) and MANOVAs, showed no significant interactions or differences between experimental and control groups over time in disability, pain intensity or in any of the physical measures.

Among the 33 patients, all but two initially expected to recover partly or totally. Thirty patients considered it to be very important or important to become pain free, while only two patients expected no change at all regarding ability to manage daily activities. All patients were prepared to engage in treatment, i.e. to follow advice and to change their habits. They were also prepared to conduct prescribed exercises on a regular basis.

Self-experienced benefits of the treatment were analysed at post-treatment and follow-up. The results showed that the patients in the experimental group perceived themselves as having less ($p<0.05$) pain than the control group at post-treatment. At the three month follow-up, patients’ perceived ability to perform daily activities differed ($p<0.05$) between groups in favour of the experimental group. The results also showed a better ($p<0.05$) long-term compliance for the experimental group.

There were improvements for the merged experimental and control groups over time regarding disability (PDI) ($p<0.01$), pain intensity (NRS) ($p<0.05$), and two physical measures i.e. head posture ($p<0.001$) and neck range of motion in flexion / extension ($p<0.01$).
Prediction of long-term WAD

Compliance

In study I there were no differences between nonsymptomatic and symptomatic groups in terms of “daily” compliance with the treatment regime, while the nonsymptomatic group exercised more regularly \( p<0.05 \) in terms of “days per week” compliance. Thus, in the treatment of acute WAD, the extend of compliance with the regime seems to be a predictor for outcome at six months.

Optimism (LOT)

No significant correlations were found between optimism (LOT) and the outcome measures (SIP, PDI, VAS). However, there were significant negative correlations between optimism and anxiety \( r=-0.55 \) as well as with depression \( r=-0.50 \) (HADS) (study II).

Self-efficacy (SES) and effects of pain (MPI)

In study I, the SES scores differed significantly \( p<0.05 \) between symptomatic and nonsymptomatic groups. The initial SES-scores were higher among the nonsymptomatic patients at the six month follow-up. Thus, high initial self-efficacy may predict a better long-term outcome.

The results in study II showed a significant negative correlation between self-efficacy (SES) and disability (PDI) \( r=0.62 \). Low self-efficacious patients reported more disability. Self-efficacy was also significantly related to the SIP 'Psychosocial' dimension \( r=-0.36 \), as well as to the SIP overall scores \( r=-0.38 \). Further, self-efficacy was negatively related to the HADS depression score \( r=-0.35 \).

In study V, the high and low self-efficient groups were included in two-factor repeated measures ANOVAs to check for any interaction effects (group x time) in disability (PDI) or pain intensity (NRS). No such effect was found for disability (PDI). However, there was an interaction effect (group x time) \( p<0.05 \) in pain intensity (NRS). Post hoc tests showed that the low self-efficacy group reported higher pain intensity at each point in time \( p < 0.05 \). Pain intensity decreased \( p< 0.05 \) in the low self-efficacy group at post-treatment while at the
three-month follow-up, this group had reverted to their original pain intensity level. Thus, low self-efficacious patients did not maintain their gains from treatment while no such negative effect was seen in the high self-efficacy group.

To identify possible relations between personal characteristics and disability at the one-year follow-up in study III, four independent variables (initial Multidimensional Pain Inventory sub-scales ‘Life control’, ‘Affective distress’, ‘Support’, and the Self-Efficacy Scale) were used as predictors in a standard multiple regression analysis. The analysis showed that the adjusted \( R^2 \) for the model was 0.36 (\( p<0.001 \)), i.e. 36% of the variation in disability was explained by these independent variables. Thus, quite a considerable proportion of disability can be explained by personal characteristics and psychosocial support.

Self-efficacy was the strongest predictor in this thesis. The associations between self-efficacy and disability suggest that self-efficacy is an important factor that should be taken to account in planning treatments for patients with WAD.

**Coping (CSQ)**

The results in study I revealed changes in coping over time. The pattern of conscious cognitive and pain avoidance strategies differed between inclusion, three and six month follow-ups. To study this process further and to predict disability at different point in time, five regression analyses were conducted of data collected at the time of inclusion, and at six weeks, three, six and twelve month follow-ups (study III).

Data from the first analysis revealed one subscale from the Coping Strategies Questionnaire i.e. ‘Pain behaviours’ as having a positive, significant correlation with the Pain Disability Index score. Additional results of the regression analysis showed that ‘Pain behaviours’ explained 12% of the variation in disability.

In the second analysis two Coping Strategies Questionnaire subscales, i.e. ‘Catastrophising’ and ‘Pain behaviours’ correlated significantly (positively) with disability. In the multiple regression analysis, these two subscales explained 24% of the variation in disability.

In the third analysis 16% of the variation in disability was explained by a regression model including two of the CSQ subscales, i.e. ‘Diverting attention’ and ‘Catastrophising’.
Four subscales from the Coping Strategies Questionnaire i.e. ‘Diverting attention’, ‘Catastrophising’, ‘Increased behavioural activity’, and ‘Pain behaviours’ correlated significantly (positively) with the six month Pain Disability Index score in the fourth analysis. The fourth multiple regression analysis showed that these subscales explained 30% of the variation in disability.

In the last analysis there were five CSQ subscales, i.e. ‘Diverting attention’, ‘Reinterpreting pain sensations’, ‘Catastrophising’, ‘Increased behavioural activity’, and ‘Pain behaviours’ that correlated significantly (positively) with the one year Pain Disability Index score. This regression model explained 54% of the variation in disability.

In sum, these analyses show a steady increase of the influence of coping as a mediating factor for disability. Interestingly, ‘Catastrophising’ was the most pronounced predictor already at the six-week follow-up, i.e. only two months after the injury, and throughout the course of the study.

In study V differences in the coping process over time between high and low self-efficient patients were addressed. At pre-treatment, patients with high self-efficacy scored higher in 'Ignoring Pain Sensations' ($p<0.05$). At post-treatment, patients with high self-efficacy scored lower in four subscales, 'Reinterpreting Pain Sensations' ($p<0.05$), 'Praying and Hoping' ($p<0.05$), 'Catastrophizing' ($p<0.01$), and 'Pain Behaviours' ($p<0.05$). At the three month follow-up, patients with high self-efficacy scored lower in 'Diverting Attention' ($p<0.05$), 'Reinterpreting Pain Sensations' ($p<0.05$), 'Praying and Hoping' ($p<0.01$), 'Catastrophizing' ($p<0.01$), and 'Pain Behaviours' ($p<0.05$). To sum, low self-efficient patients used more of those coping strategies that are characterised as avoidant and passive (118).

From a theoretical point of view, these results are compatible with a process oriented standpoint of coping (126).

**Coping as a mediating factor between self-efficacy and disability**

Study III showed an increasing influence of coping on disability with the passage of time. The results of comparisons between low and high self-efficacy groups in study V showed a similar development in coping strategies over time, i.e. only one subscale separating groups early on, to five subscales at the three month follow-up. Data from study III and V suggest that coping could be seen as a process and possibly a mediating factor for disability from WAD. To further develop the analyses of mediating effects of coping between self-efficacy and disability, data
from subjects (n=53) in study I were used to validate the process oriented path model presented in Figure 2.

Two Pearson product moment correlation matrixes including self-efficacy (SES), coping (CSQ) sub-scales and disability (PDI) were analysed. The first included data collected three weeks after the accident (acute phase) while the other contained data for the same WAD patients at the one-year follow-up (chronic phase). All correlations were then examined to ensure that multicollinearity (high intercorrelations among predictor variables) would not be a confounder (124). Subsequently, a series of regression analyses were conducted to test for mediation effects in the proposed model. The regression equations were calculated as follows: first self-efficacy was regressed (simple linear regression) separately on each of the eight coping sub-scales; secondly pain disability was regressed (multiple regression) on all coping sub-scales and on self-efficacy. The standardised coefficients (\(Beta\)) are reported for each path in the model along with the single coefficients critical \(p\)-level. The assumption of homoscedasticity (data evenly dispersed above and below the regression line) was checked by plotting the predicted values against the residuals. Results showed that homoscedasticity would not confound the interpretation of the results.
Figure 2. The path model for mediating effects of coping between self-efficacy (SES) and disability (PDI). (Coping sub-scales: Reinterpreting pain sensations’ (RPS), ‘Coping self-statements’ (CSS), ‘Ignoring sensations’ (IS), ‘Diverting attention’ (DA), ‘Praying/hoping’ (PH), ‘Catastrophising’ (Ca), ‘Increased behavioural activity’ (IBA) and ‘Pain behaviours’ (PB))
The results of simple linear regression analyses [self-efficacy (SES) – each coping (CSQ) subscale] at three weeks after the accident are presented in Table 3. The multiple regression analysis including self-efficacy (SES) and coping (CSQ-subscals) as independent variables and disability (PDI) as the dependent variable showed that the model explained 39% of the variance (adj R-sqr= 0.39, R-sqr=0.50, F=4.73, df=9, 43, p<0.001). The standardised coefficients (Beta) are reported for each path of the model in Figure 3. Three of the path coefficients were significant (p<0.05), i.e. ‘Diverting attention’ (beta=-0.32), ‘Increased behavioural activity’ (beta=-0.39) and ‘Pain behaviours’ (beta=-0.32) indicating that self-efficacy did explain 32 – 39% of the variation in these three coping subscales. Further analyses showed that there was only one significant path coefficient between the coping subscales and disability, i.e. ‘Pain behaviours’ (beta=0.30) indicating the unique contribution of this CSQ-subscale to disability.

The results of eight simple linear regression analyses [self-efficacy (SES) – each coping (CSQ) subscale] of one year follow-up data are presented in Table 4. The multiple regression analysis including self-efficacy (SES) and coping (CSQ) as independent variables and disability (PDI) as the dependent variable showed that the model explained 79% of the variance (adj R-sqr= 0.79, R-sqr=0.83, F=21.71, df=9, 41, p<0.001). The standardised coefficients (Beta) are reported for each path in the model in Figure 4. Four of the path coefficients were significant (p<0.05) in this model, i.e. ‘Diverting attention’ (beta=-0.29), ‘Catastrophising’ (beta=-0.61), ‘Increased behavioural activity’ (beta=-0.40) and ‘Pain behaviours’ (beta=-0.42) indicating an explained variation of self-efficacy from 29 – 61% in these four coping subscales. In the analysis at one year, similar to previous analysis, there was only one significant path coefficient between coping subscales and disability, i.e. ‘Catastrophising’ (beta=0.34) indicating the unique contribution of this CSQ-subscale to disability.
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Table 3. Linear simple regression analyses for SES – CSQ-sub scales three weeks after the accident.

Figure 3. The standardised coefficients (Beta) for each path of the model three weeks after the accident.
Table 4. Linear simple regression analyses for SES – CSQ-sub scales at the one year follow-up.

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</tbody>
</table>

Figure 4. The standardised coefficients (Beta) for each path of the model at the one year follow-up.
Table 5 presents the proportion of common variance due to direct, indirect and total effects of self-efficacy and coping on disability for acute WAD patients and the same patients at the one-year follow-up. The results from these analyses supported the path model, proposing coping as a mediator between self-efficacy and disability. The variance in disability shared with coping and self-efficacy increased over time. This and the results from analyses of direct, indirect and total effects are in line with the results of studies I, III, V.

<table>
<thead>
<tr>
<th></th>
<th>Acute phase</th>
<th>One-year follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct effect (SES)</td>
<td>-0.67</td>
<td>-0.58</td>
</tr>
<tr>
<td>Indirect effect (CSQ)</td>
<td>0.02</td>
<td>-0.28</td>
</tr>
<tr>
<td>Total effect (SES + CSQ)</td>
<td>-0.65</td>
<td>-0.86</td>
</tr>
</tbody>
</table>

Table 5. The proportion of common variance due to direct, indirect and total effects in path analyses three weeks after the accident (n=53) and at the one-year follow-up (n=51).
DISCUSSION

Treatment

In several studies, it has been concluded that early mobilisation as a treatment of acute whiplash associated disorders is more effective than immobilisation (24, 26, 29, 30). In study I the additional treatment group increased their ‘ability to reduce pain’ between the three and six month follow-ups. A possible explanation of this development could be that with the additional exercise, this group considered themselves having better tools to reduce pain. Another explanation might be that the additional exercise could be translated to increases in activity. Further, it was shown in study I that patients who were nonsymptomatic at the six month follow-up had done their exercises more regularly than the symptomatic patients. Thus, the results in study I are in line with previous results.

The primary aim of study IV and V was to describe and evaluate an integration of physiotherapy with elements from psychology in order to initiate, increase and maintain desired behaviour of chronic WAD patients. The functional behaviour analysis (84) is a central feature that can be used for patient evaluations, treatment planning, and rehabilitation in physiotherapy.

The results of the three experimental single case studies (study IV) showed that the combination of physiotherapeutic exercises and the behavioural application of such exercises in daily activities, reduced pain intensity. This is probably due to the fact that patients’ movement behaviour changed towards a more ergonomically sound use of the body in problematic daily activities and situations.

Most of the physiotherapy treatment studies of patients with WAD have used outcome measures like neck ROM, pain intensity and/or different disability questionnaires to describe the response to treatment. So-far, systematic self-monitoring of pain intensity in target situations has not been used extensively. Problematic daily activities do not only provide an excellent arena for the education of postural control and other basic skills, but is also a significant marker, of response to treatment. This is important from a motivational point of view. When patients monitor their own progress in performing difficult activities and they can attribute the achievements to themselves, this will further encourage compliance with the treatment program.

Recently, Harding (86) presented an application of the cognitive behavioural approach in physiotherapy for chronic pain patients. Our aim has been to proceed
somewhat further and assure that the chronic WAD patients used their newly learned skills in daily life. As soon as subjects mastered the basic skills, they were instructed to apply these skills, initially in low, later in medium and finally in situations where high disability was expected. Such behaviour change strategies are based on well-known cognitive behavioural techniques which are derived from and individualised in the functional analysis.

The results of study V showed that there were no significant differences between control and experimental groups over time in disability, pain intensity or in any of the physical measures. However, the self-experienced benefits of the treatment differed significantly. The experimental group perceived a lower pain intensity at post-treatment than did the control group. At the three month follow-up the experimental group’s perceived ability to perform daily activities was better. This group also showed better long-term compliance, i.e. they used the skills they had learned to manage and/or prevent neck pain in daily life more often than the control group. Thus, these results can be regarded as clinically significant changes in treatment benefits in favour of the experimental group.

Cognitive-behavioural approaches generally focus on coping deficits and maladaptive cognitive appraisals which cause difficulties in adapting to chronic conditions (127). For enhancing coping effectiveness, a number of cognitive-behavioural skills can be applied. These include for example stress-management skills, progressive relaxation, breathing control, challenging irrational beliefs, as well as teaching individuals to integrate these skills to everyday life (127). The experimental treatment in study V was conducted by a physiotherapist without any formal psychotherapeutic training. Treatment was directed towards changing behaviour in daily life as well as promoting specific coping strategies, but not towards negative cognitions e.g. catastrophising thoughts. The lack of between-group differences may therefore be explained by the possibility that patients’ thoughts were still dominated by maladaptive cognitions.

Self-efficacy is important for the promotion of self-change. It accounts for latency and rate of change during treatment and for individual variations in behavioural change for subjects receiving the same treatment. In managing chronic diseases, self-efficacy theory provides a framework for structuring and implementation of treatment in the rehabilitation process (65). The first step would be an assessment of the client’s background to identify domains and individual problems to be targeted for self-efficacy improvement. Intervention strategies can then be developed or improved on the basis of this assessment (66).
positive effects in pain control regimens is closely related to adherence and risk of relapse (104). The results in study V showed that patients with high pre-treatment self-efficacy scored lower and had a decreasing pain intensity over time while patients with low self-efficacy scored higher in pain intensity at pre-treatment and had decreasing pain at post-treatment and again increasing at the three-month follow-up. Therefore it is likely that if self-efficacy was boosted by treatment, improvements would last over time. Similarly, Dolce (107) proposed that patients who do not strengthen their self-efficacy but do improve otherwise during the treatment, may be more likely to relapse after completed treatment.

A common methodological weakness in physiotherapy treatment studies for chronic WAD patients is the lack of descriptions of treatment integrity (128). The accuracy and consistency with which independent variables are implemented during the treatment period are seldom attended to. Thus, it is difficult to draw conclusions about the internal validity of the findings, i.e. if effects on the dependent variable really can be attributed to the independent variable (129). In studies I, IV, and V the patients kept an “exercise diary” during the treatment period. The success or problems related to performance of exercises were discussed with patients during each session. Such steps are also considered effective ways of increasing patient compliance with a treatment regime (108).

To sum up, the analysis and clinical treatment of WAD should be developed towards a comprehensive view with an integration of physiotherapy and cognitive behavioural components. This multimodal approach would then maximise the treatment effects in WAD as it does in other pain related conditions (86, 109).

**Predictors**

The results in study I, III and V suggest that self-efficacy is a better predictor of long-term symptomatology than are the initial medical assessment, physical measures or pain intensity. Significant differences in initial self-efficacy were found between patients who were symptomatic and nonsymptomatic after six months. However, no such differences were demonstrable regarding WAD grade, initial pain intensity or physical measures (study I). Thus, medical assessment of symptoms in the acute phase is a poor predictor of future disability levels.

Several earlier studies (68, 69, 71, 74) emphasise the importance of self-efficacy in chronic as well as in acute pain patients. Self-efficacy and perceived disability are also factors that should be taken into consideration in the clinical work
and rehabilitation of WAD patients. Kores and colleagues (71) concluded that patients with higher self-efficacy scores after treatment showed less pain-related avoidant behaviour, i.e. non-verbal pain behaviour, and medication demands. The predictive value of self-efficacy in this thesis and results of the Kores and colleagues study above, show that it could be clinically and economically useful to put more effort into supporting WAD patients’ self-efficacy already in the acute phase (study I).

The relations between self-efficacy and disability as well as between self-efficacy and pain intensity in study III, are consistent with the findings of previous work (68, 73). However, self-efficacy alone is not sufficient for producing effective performance (64). Patients with high self-efficacy beliefs may fail to keep their higher level of functioning because of an environment that reinforces pain behaviours (107). This is illustrated in study III, where spouse support emerged as one of the predictive factors for both disability and pain. It is possible that pain patients high in perceived dependency, i.e. spouse reinforcement with e.g. attention, sympathy, and taking over patients’ responsibilities may be more likely to maintain higher levels of pain (55).

Two other prognostic variables for disability at the one-year follow-up were highlighted in study III, i.e. degree of life control and affective distress. Life control also emerged as prognostic for pain intensity at the one year follow-up. Lack of personal control is typically perceived by chronic pain patients. This could be related to patients’ ongoing efforts to control their pain (47). Jensen and Karoly (54) concluded that control was associated with activity levels and psychological functioning.

Coping

The subjects in study I reported changes in the use of cognitive coping and pain avoidance strategies over time. In a review of chronic low back pain prevention, Weiser and Cedraschi (81) concluded that individuals have a preparedness to cope before the pain begins and that coping will be modified at the onset of pain. Early identification of these individual coping styles are the prerequisite of the prevention of chronicity (81). Pain reduction, return to normal activities and preventing pain from becoming chronic as well as optimising the quality of life, are the primary goals in rehabilitation of acute WAD. The most adaptive coping strategies are those that help the patients towards these goals (58).
In study III the specific coping strategies were examined instead of composite coping scores, i.e. conscious cognitive coping, pain avoidance or behavioural-type strategies (118). Such analyses are likely to give a more detailed understanding of the specific coping strategies that are important for the adaptation to pain. They would also be more sensitive changes of the coping repertoire over time (51). ‘Diverting attention’ and ‘Increasing activities’ correlated positively with disability and emerged in the regression model at several points in time. These findings are in accordance with the results of Keefe and Williams (130) who found that such strategies correlated positively with pain severity. Jensen and Karoly (54) found that strategies like ‘Ignoring pain sensations’, ‘Coping self-statements’ and ‘Increasing activities’ were positively correlated with psychological functioning. Thus, to reduce disability from WAD, such strategies should be employed more frequently by patients. However, apart from ‘Increasing activities’ none of these strategies emerged in the regression model of study III at any point in time. Theoretically, such strategies might be ones that the WAD patients should use more extensively. However, there may be differences in the relations between coping styles and adaptation to recent onset pain and chronic pain. According to Holmes and Stevenson (80) patients with recent onset pain adapted better to their problem when they employed primarily avoidant coping. The results in study III showed that neither Conscious cognitive coping nor Pain avoidance-type strategies emerged in the regression model until after three months, where one avoidant-type strategy (i.e. ‘Diverting attention’) appeared in the analysis. Strategies of Conscious cognitive coping did not emerge until at the one-year follow-up. Thus, subjects did not use more adaptive coping strategies spontaneously and because this is desirable it must be part of the treatment as a whole.

More coping subscales were included in the regression model at the later stages compared to the early ones, suggesting more differentiated patterns in the coping repertoire. In a study of coping strategies in the management of acute pain, patients who experienced the most severe pain appeared to use multiple coping strategies that were ineffective (131). Similar results from Keefe and colleagues (132) made them conclude that the quantity of coping attempts is not as important as the quality. Consequently the “styles” that increase control, reduce pain and minimise negative self-statements would be the priority. Thus, for WAD patients there is a need for a more sophisticated repertoire of coping strategies that takes into account individual and situational factors as well as the characteristics of the individual pain problem.
Initially, the subjects’ main coping style in study III involved using the ‘Pain behaviours’ strategy. This includes mainly passive measures of reducing pain sensations. The ‘Catastrophising’ strategy emerged as an explanatory factor for the first time at six weeks. Thereafter it continued as the strongest factor in explaining the variation of disability throughout the course of the study. Catastrophising has been defined as “self-statements, thoughts, and images anticipating negative outcomes or aversive aspects of an experience, or misinterpreting the outcome of an event as extremely negative” pp.18 (47). Jensen and colleagues (133) found that catastrophising was more strongly associated with poor psychological functioning among patients with pain of a shorter duration as compared to those with longer duration. The authors hypothesised that in the first years following the onset of pain, cognitive responses can have the greatest impact in psychological adjustment.

Since ‘Catastrophising’ is an important explanatory factor for disability already at six weeks it is apparent that there is a need for an intervention that alters patient coping strategies already at an early stage. Thus, catastrophising appears to be a powerful cognitive error that influences disability to a large degree. However, catastrophising has been claimed rather to represent symptoms of depression than coping responses (134). On the other hand, in the same study the authors found support for a conceptual distinction between catastrophising and depression. In addition, research with the CSQ Catastrophising scale has suggested that initial catastrophising scores were able to predict future depression scores and did not merely reflect the effects of depression (135). Thus, in their interventions clinicians should be observant of WAD-patients’ high catastrophising scores. This may be a factor that prevents the use of other more adaptive cognitive coping strategies and can even reflect patients’ depressed state of mind.

One reason why catastrophising emerged so strongly in study III might be patients’ low self-efficacy scores. Self-efficacy has been shown to be a predictor of one-year disability (study III), but also a predictor of the persons’ coping repertoire (study V). Thus, self-efficacy might be an individual characteristic that is mediated by coping, for example catastrophising, which in turn influences disability. Perceptions of self-efficacy influence an individual’s adaptation to persistent pain by influencing cognitive, affective, and physiological responses to pain as well as the initiation and persistence in coping efforts that they believe will result in positive consequences (136). Jensen et al (137) concluded that chronic pain patients’ self-efficacy beliefs regarding their capabilities to perform certain behaviours, were strongly related to their reported coping efforts. Similar conclusions were drawn by
French and colleagues (136) who found that self-efficacy was positively associated with the use of coping strategies.

In study V there were several differences between the high and low self-efficacy groups with respect to the coping repertoire during the course of the study. At pre-treatment, the group with high self-efficacy scored higher in the coping subscale, ‘Ignoring Pain Sensations’. At post-treatment however, the same group scored lower in four coping subscales (‘Re-interpreting Pain Sensations’, ‘Praying and Hoping’, ‘Catastrophizing’, and ‘Pain Behaviours’). Further, they scored lower in five subscales (‘Diverting Attention’, ‘Re-interpreting Pain Sensations’, ‘Praying and Hoping’, ‘Catastrophizing’, and ‘Pain Behaviours’) at the three month follow-up. These results also support findings by Jensen and colleagues (137) who found a strong relationship between self-efficacy expectancies and different coping strategies in the adjustment to chronic pain. In an another study with similar results (138), self-efficacious osteoarthritis knee pain patients were more likely than those with low self-efficacy to cope well with pain by ignoring pain sensations, using calming self-statements and avoiding negative thinking, when having pain. Thus, an increase in self-efficacy during the course of coping skills training can be associated both with short-term and long-term improvements in pain and function.

**Coping as a mediating factor between self-efficacy and disability**

In any attempt to study a process that is dependent on events in the social and physical environment of an individual, it is necessary to examine the same individuals over time. Coping is a typical example of such a process and a definition of a process standpoint of coping emphasises that all coping efforts should be independent of the outcome (75). Thus, the part played by coping in influencing outcomes should be independently assessed and consequently, coping can be seen as a mediating link between individual characteristics and disability. The results of study III and the path analyses presented in this thesis showed that the proportion of variance in disability shared with coping at each point increased over time. Thus, it seems that the importance of coping increases from an acute phase to the one-year follow-up. Given that coping styles changed over time, it is obvious that coping in this thesis can be considered as a process and not a characteristic of the individual.

Several studies (80, 137) point to the importance of coping strategies as mediating factors between individual characteristics, like self-efficacy, and physical as well as psychosocial wellbeing. The results of the path analyses
support this mediating role of coping between self-efficacy and disability, and are consistent with previous research. The results in this thesis imply that the lack of belief in one’s own ability, i.e. self-efficacy may predict the use of different coping strategies which in turn may predict the extend to which individuals with WAD become disabled. The employed statistical methodology used to test hypothesised mediators of disability has the potential to improve the understanding, prevention and treatment of the costly outcomes in WAD. Thus, self-efficacy and coping are important concepts for clinical practice and future research on WAD. Considering the high economic and human costs, understanding of the relationship between sensory, cognitive, affective and behavioural domains i.e. the biopsychosocial approach is needed to solve the problems connected with Whiplash Associated Disorders.

Methodological considerations

Some criticism towards the results in this work can be raised from a statistical angle. The risk of type II errors in the presented results in study I and V should be considered. The groups might not have been large enough to provide the statistical power to detect any further differences between treatment groups.

The results of study III may also have been biased because of the small sample size, i.e. low statistical power. However, in the statistical analyses we took into consideration this fact and reported adjusted R-squares in accordance with the suggestions in the literature (124). Thus, the findings can be considered as reliable.

Another shortcoming was that the samples in study I, III and V consisted of about fifty percent of those who visited orthopaedics clinic during the study periods. It is possible that the patient group included was biased, and that only patients with significant symptoms agreed to participate. Data on the samples of study I and III show that sixty percent of patients were still symptomatic at six months and one-year follow-ups. As other studies (1, 11, 139, 140) present corresponding percentages from 71 (139) but more often less, some overrepresentativeness of patients with significant symptoms is likely in the sample selection in study I and III. However, the WAD patients with significant symptoms after an accident is the group of patients on which the main rehabilitation efforts should be targeted. Thus, methodologically, this is a conservative bias.
Finally, a shortcoming in study II was that the subjects’ classification in different WAD grades was done retrospectively. Data were based partly on patients recollection, and partly on medical records, which raises the question whether the procedure was biased. Another limitation is the cross-sectional and correlational nature of the design in study II, which makes it risky to draw conclusions about any causal relations between coping strategies and pain or disability. On the other hand, conclusions in study II are in line with those on studies I, III and V which were prospective and longitudinal.

Implications and future directions

Study I shows that a home exercise programme including training of neck and shoulder ROM, relaxation and general advice, appears to be sufficient treatment for most acute WAD patients. However, the exercises should be done regularly. In study I only 41% of all patients complied as prescribed. More supervision during the first weeks might increase compliance. Further, the results of study IV suggest that functional behavioural analysis can be used in physiotherapy for structured patient assessment and in the planning of treatment for subjects with WAD. Physiotherapy integrated with cognitive behavioural components is likely to reduce patients’ pain intensity in everyday activities (study IV). Pain intensity-diaries of daily activities can be an important tool in the assessment of problematic activities. The results of study V indicate that physiotherapy with cognitive behavioural components can be useful in physiotherapy treatment for patients with chronic WAD, but further research with larger groups of subjects is needed to investigate effects of this approach.

The significance of coping as an explanatory factor for disability increased during the one-year period after a whiplash injury (study III). This and the fact that the coping strategy patterns changed over time (study I) suggest that coping plays a crucial and mediating role for individual disability. It is also concluded that psychosocial factors, like self-efficacy, control and spouse support were important prognostic variables for disability and pain intensity at the one-year follow-up (study III). Self-efficacy is an important predictor of patients’ use of different coping styles and positive long-term outcomes are likely to be improved by boosting self-efficacy and teaching WAD patients to use adaptive coping strategies (study V). The path model also supports the mediating role of coping. Early identification and
modification of self-efficacy and coping are crucial for successful management of WAD patients and should be added to the physiotherapeutic treatment arsenal.

There is no consensus today on how, why, in which situations or for which individuals coping strategies work. The basic idea is that an individual’s way of coping with stressful situations determines the experience of health. Additional research on the coping process is warranted and future trials should examine the importance of moderating factors. There is also a need for more effective interventions in the management of acute and chronic Whiplash Associated Disorders. Self-efficacy and coping will have central parts in such programmes.
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REFERENCES


57. Johansson E, Lindberg P. Clinical evaluation of a physiotherapy rehabilitation programme for patients with chronic low back pain: Three experimental single-


