A Behavioural Medicine Perspective on Acute Whiplash Associated Disorders

Daily Coping, Prognostic Factors and Tailored Treatment

ANNIKA BRING
Abstract


The overall aim of this thesis was to study the daily process of coping, potential prognostic factors for recovery and evaluating an individually tailored behavioural medicine intervention in the acute stage of Whiplash Associated Disorders (WAD). The studies comprised three samples of patients with acute Whiplash Associated Disorders (WAD). All patients were included within the first month after the whiplash occurrence and were recruited from hospital emergency wards in six Swedish communities.

Study I and II included 51 participants generating 260 daily coping diaries (WAD-DCA) during seven days in the acute stage of WAD. In Study I daily stressors and primary appraisal were analysed and in Study II patterns between stressors, appraisals, coping strategy profiles, daily activity level and well-being were described. The results showed a large variety of situations that the individuals perceive as stressful, not only pain itself. High self-efficacy was associated with high degree of physical/mental well-being. Threatening stressors and catastrophic thoughts were associated with low degree of physical and mental well-being. In Study III potential prognostic factors for good as well as poor recovery were studied more closely in a mildly affected sample (MIAS) (n=98) from within the first month after the accident up to one year later. Pain-related disability at baseline emerged as the only indicator of prognosis after 12 months in MIAS. Study IV (n=55) was a randomised control study, were current clinical recommendations of standard self-care instructions (SC) for the management of acute WAD was compared to an individually tailored behavioural medicine intervention delivered via Internet or face-to-face. The results showed that SC was not as effective as the behavioural medicine intervention. By early identification of situation-specific factors and potential behavioural (physical, cognitive and affective) determinants of activity performance, it seems possible to tailor a self-management intervention that decreases pain-related disability, fear of movement and catastrophising and increases self-efficacy. The use of innovative methods such as the Internet of distributing treatment interventions showed to be a good alternative to more traditional forms.

The results of this thesis uncover new insights in understanding the individual’s specific perspective as applied in a behavioural medicine approach in acute WAD.

Keywords: Behavioural medicine, Acute whiplash associated disorders, Daily coping, Prognostic factors, Tailored treatment, Pain-related disability

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Till min underbara familj
List of Papers

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


IV Bring A, Åsenlöf P, Söderlund A. (2012) Individually tailored behavioural medicine intervention delivered via Internet or Face to face in acute Whiplash Associated Disorders. Submitted

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Abbreviations

CAT  Catastrophising subscale of Coping Strategies Questionnaire
FBA  Functional Behavioural Analysis
FtF  Face-to-Face
ICF  International Classification of Functioning, Disability and Health
IES  Impact of Event Scale
IT   Internet
MIAS Mildly Affected Sample
MOSAS Moderately to Severely Affected Sample
NRS  Numerical Rating Scale
PDI  Pain-related disability
QTF  Quebec Task Force
SC   Self-care instructions
SCT  Social Cognitive Theory
SES  Self-efficacy Scale
TSK  Tampa Scale of Kinesiophobia
WAD  Whiplash Associated Disorders
WAD-DCA Whiplash Associated Disorders-Daily Coping Assessment
Introduction

About the Thesis

The biomedical model in the pain area has in the last decades been challenged by the biopsychosocial model introduced by Engel (1). It includes biological, psychological, behavioural, social, and environmental factors involved in a reciprocal process. An integration of the medical and behavioural perspectives, i.e. behavioural medicine, based on the biopsychosocial model, offers an understanding of the individual beliefs, experiences and consequences of e.g. pain and disability in a broad perspective. It also provides a basis for the development of interventions for prevention and self-management of e.g. pain-related disability. Behavioural medicine is defined as “an interdisciplinary field concerned with development and integration of sociocultural, psychosocial, behavioural, and biomedical knowledge relevant to health and illness and the application of this knowledge to disease prevention, health promotion, etiology, diagnosis, treatment, and rehabilitation” (2).

Hence, a behavioural medicine approach in physical therapy combines knowledge and theories from medical science, e.g. theories of movement and motor control (3), pain (4) and exercise physiology (5), with health psychology and behavioural science theories such as the Transactional model of stress and coping (6, 7) and learning theories, e.g. Social Cognitive Theory (SCT) (8), Respondent and Operant Learning Theory (9).

This thesis applies a behavioural medicine perspective when studying the daily process of coping, potential prognostic factors for recovery and evaluating an individually tailored behavioural medicine intervention in the acute stage of Whiplash Associated Disorders (WAD).

Acute Whiplash Associated Disorders (WAD)

Whiplash is an acceleration-deceleration mechanism of energy transferred to the neck and head, mostly in rear-end or side impact in motor vehicle accidents (10), but can also occur in e.g. sporting activities, accidental falls, and assault. The predominant symptoms associated with the disorders and reported within the first week of the accident are neck pain and neck stiffness followed by headache, interscapular pain, dizziness, paresthesia in arms and
hands, visual and auditory disturbances, temporomandibular symptoms and cognitive symptoms such as problems with concentration and memory (11). The onset of symptoms may occur immediately after the trauma or, as for many patients, may arise after hours or days.

The diagnosis in the acute stage after the accident is solely based on clinical symptoms and physical findings (12). In 1995, the Quebec Task Force (QTF) put forward the Quebec Classification of WAD (10). The QTF system classifies patients with WAD according to the type and severity of signs and symptoms observed shortly after the injury. About 90% of the patients are classified in grade I and II in the QTF system where grade II is the most common, see Table 1.

Table 1. The Quebec Task Force (QTF) classification of whiplash associated disorders (10).

<table>
<thead>
<tr>
<th>QTF classification grade</th>
<th>Clinical presentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No complaint about neck pain</td>
</tr>
<tr>
<td></td>
<td>No physical signs</td>
</tr>
<tr>
<td>I</td>
<td>Neck complaint of pain, stiffness or tenderness only</td>
</tr>
<tr>
<td></td>
<td>No physical signs</td>
</tr>
<tr>
<td>II</td>
<td>Neck complaint</td>
</tr>
<tr>
<td></td>
<td>Musculoskeletal signs, including: deceased range of movement and point tenderness</td>
</tr>
<tr>
<td>III</td>
<td>Neck complaint</td>
</tr>
<tr>
<td></td>
<td>Musculoskeletal signs</td>
</tr>
<tr>
<td></td>
<td>Neurological signs, including: decreased/absent deep tendon reflexes, muscle weakness and sensory deficits</td>
</tr>
<tr>
<td>IV</td>
<td>Neck complaint and fracture or dislocation</td>
</tr>
</tbody>
</table>

Whiplash associated disorders (WAD) are a disabling and costly condition and is the most common injury following car collisions in many Western countries (13, 14). The annual incidence in Sweden in 1997 was 320 per 100,000 inhabitants (15). This rate has been relatively unchanged since then(16). The literature suggests that approximately 50% of those with WAD will report neck pain symptoms 1 year after their injuries (17).

Prognostic factors for recovery

During the last decade the focus on research on prognostic factors in WAD has switched from a strict biomedical and biomechanical to a more psychosocial perspective. Still the complexity of the disorders, i.e. the development of symptoms, which factors are involved and who are at risk for slow recovery, is not fully understood.
Current evidence suggests that greater initial pain intensity (18, 19), more physical symptoms and greater initial pain-related disability (17, 18) are the most salient prognostic factors for poor recovery after a whiplash injury. There are no conclusive results suggesting predictive value for sociodemographic factors such as age, gender, level of education, as well as for collision related factors. However preliminary evidence suggests that the prevailing compensation system is prognostic for recovery in WAD (17). Post injury psychological factors such as symptoms of post-traumatic stress, high pain catastrophising, depressed mood, fear of movement/(re)injury and low self-efficacy, also seem to have predictive value for slow recovery (17, 20). Recent studies also indicate that lower expectations of recovery are predictive of poor recovery (21). In addition the use of pain coping strategies have shown an association with recovery from WAD (22), although questions such as which strategies are adaptive or maladaptive at different times in recovery (23) or if individuals with acute WAD cope with other stressors than pain, still need to be investigated.

Although the number of prediction studies in WAD has increased during the last decade, the majority of the studies have exploratory designs (24-28). Altman and colleagues (29) have argued that a prognostic model is not ready for clinical application until solid validation is achieved, hence external validation is important to establish the generalisability of a predictive model. A limitation in current evidence is for example the lack of reports on how prognostic factors identified in the acute phase develop over time (30) and the significance of changes or lack of changes for recovery. Validation of already known prognostic factors for different WAD subgroups could increase knowledge about prognostic factors for good as well as poor recovery.

Theoretical definitions and perspectives

Some of the biopsychosocial variables studied in this thesis are further described in the following section.

Pain

*Pain* is defined by the International Association for the Study of Pain (IASP) as “An unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage”. According to the current state of the art, it is clear that physiological and psychological as well as social features are viewed as integrated parts of the pain experience. Nevertheless pain in acute WAD is still commonly considered a consequence or a symptom of a patho-physiological lesion, and is analysed and
treated accordingly. However, research has shown that psychosocial factors at an early stage may complicate the situation building a platform where acute pain in WAD might transform to chronic (15, 31). One categorisation of pain is based on the temporal aspects, i.e. pain duration. Various time spans have been suggested: acute pain is often defined as lasting for less than four or six weeks and chronic or persistent pain for more than three, six or twelve months. The term subacute pain is used to define the intermediate interval between acute and persistent pain (32-34). According to these definitions the studies in this thesis focus on acute pain (Study I-IV), but also follow participants during the subacute and persistent pain phase (Studies III and IV).

Pain-related disability

Disability can be defined as the equivalent of decreased participation, i.e. the inability to perform activities of importance for normal role functioning (35). According to the International Classification of Functioning, Disability and Health (ICF) (36), the degree of disability is determined by body functions and personal factors, such as cognitions and emotions, but also by the interactions between the individual and the environment. The disability level can also be described as how activities are carried out in varying situation-specific daily settings (37). To fully understand the process by which a pain condition can develop into a disabling condition, a biopsychosocial perspective is needed (38). Some psychological factors (described below) have been put forward as important in the course of pain-related disability and have furthermore been shown to be more directly linked to movement behaviour and thus motivate special attention in physical therapy management (39). The possibility to influence these factors in the acute stage of WAD still needs to be examined (40).

Fear of movement/(re)injury

Fear of movement/(re)injury where the patient incorrectly believes that physical activity would worsen their health has been theoretically explained in the Fear-Avoidance Model of Pain by Vlaeyen and colleagues (39, 41, 42). A model explains how a vicious circle may be initiated when pain, as a consequence of a whiplash injury, is catastrophically (mis)interpreted. These dysfunctional interpretations give rise to pain-related fear, and associated safety-seeking behaviours such as avoidance/escape of movements and activities and hypervigilance regarding bodily sensations, followed by disuse, distress and disability. The mechanisms of Fear of movement could also be explained by Respondent Learning Theory or learning by association (9). When sudden intense neck pain followed by reflexive fear of movement
occurs in a rear-end collision, the previous neutral stimuli, i.e. sitting in a car, can in itself cause fear, without any pain or car-crash involved. Moreover, if the mere thought of sitting in a car, are followed by avoidance of that behaviour, and subsequently reduced fear, this will increases the probability of avoidant behaviour in the future according to the principles of Operant Learning (43). Thus, these types of learning principles are important to acknowledge in a WAD context.

Catastrophising

*Catastrophising* refers to an exaggerated, (i.e. disproportionate in regard to the circumstances), fixed pattern of negative thinking, when an individual confronts imaginary or actual pain (44). In the *Fear-Avoidance Model of Pain* (41), catastrophising is postulated as a precursor of pain-related fear and subsequent avoidance. Catastrophising can be viewed as an antecedent of avoidance behaviour, which in turn is negatively reinforced by relief from fear according to principles of operant learning theory (43).

Pain catastrophising has been shown to be present in the early stage after a whiplash injury (31, 45, 46). Furthermore, previous research have concluded that catastrophising predicted pain (47) and persistence of post-traumatic stress symptoms (48) in patients with WAD. However, the importance of preventing and intervening catastrophising in acute WAD has not been studied.

Self-efficacy

*Self-efficacy* can be described as the situation-specific belief in one’s capability to successfully perform a particular behaviour (8, 49). Self-efficacy is a key concept in SCT (50), where behaviour is viewed as a dynamic interaction between the individual and the environment, i.e. reciprocal determinism (51). Individuals with high self-efficacy beliefs have been shown to be more persistent in difficult situations and perceive their disabilities as less severe than those experiencing low self-efficacy (52). Self-efficacy beliefs are also important for maintenance of self-management behaviour (53). There is increasing evidence that self-efficacy plays an important role in rehabilitation processes in WAD (54) and in musculoskeletal pain (55). Participants with higher self-efficacy scores reported lower disability and higher quality of life in studies executed in acute (46), subacute (56-58) and chronic WAD (59, 60). Therefore, assessment and interventions targeting self-efficacy beliefs are justified to be incorporated in the management in WAD.

A factor that shares some common ground with Bandura’s self-efficacy construct is *recovery expectations*, that can be conceptualised as a particular type of belief – a belief about the future, e.g. one might believe that one will
have a quick recovery from an injury (positive expectations for recovery) (21, 61, 62). Janzen et al. have suggested a conceptual model for health expectations, which can also be applied to recovery expectations. Such expectations are, apart from the symptoms/signs of the disease or injury, influenced by prior health and prior knowledge of the condition, as well as by psychological characteristics such as anxiety, self-efficacy, and the patient’s beliefs (61). There is good support from two large population-based longitudinal cohorts that expectation to recover is an independent predictor of actual WAD recovery (21, 63) but we still know very little about the possibility to modify those in interventions.

Stressors, appraisal and coping strategies

The Transactional Model of Stress and Coping (6), describes stressful experiences as caused by the transaction between people and their external environment. The term stressor can be described as a stimulus that is perceived as demanding or exceeding a person’s resources and may jeopardize his or her mental and physical well-being and cause stress reactions (7). What is perceived as a stressor depends on the individual’s appraisal of the specific situation or event. According to the model, appraisal could be divided in primary and secondary. Primary appraisal is the judgement of the meaning and significance of the specific event in terms of potential threat, harm or loss, or as a challenge. Susceptibility to and severity of the threat are important perceptions in this evaluation. Secondary appraisal is how a person evaluates the ability to control the stressor and how he/she appraises his/her physical, psychological and social resources to cope with the stressor (7). An important part of secondary appraisal is self-efficacy beliefs and outcome expectations in the sense that they are significant determinants of behaviour (49). Coping efforts could be defined as the actual cognitive or behavioural strategies to manage the negative impact of the stressor and are determined by a dynamic interaction between the individual and the situation (64). Outcomes of coping could be evaluated in terms of emotional well-being, functional status or health behaviours and is influenced by the person’s perception of how successful the coping efforts were in achieving the individual’s goal in the particular situation. These outcomes may result in short-term and long-term positive or negative adaptation (65).

Even though coping is often operationalised according to the Transactional Model of Stress and Coping (6), the coping process according to the model has not previously been described in patients with acute WAD. Coping in WAD has mainly been studied by using retrospective self-report questionnaires with checklists of different coping strategies and with pain as the predefined stressor (22, 46, 66, 67). One of the limitations is that they only provide a static “snapshot” of a process that is probably dynamic and constantly
changing. Most individuals vary their coping efforts to fit a given stressor (68) and general coping styles accumulated over time tend to be poorly correlated with the ways in which one copes in a specific situation (69). An alternative to retrospective and general measures is a daily process method, which enables a day-to-day monitoring of variables, such as stressors and coping, close to their real-time occurrence and as they change over time (70). Process-oriented methods that examine individuals intensively over time may be helpful in understanding the coping process in relation to specific stressors and personal well-being in a WAD context.

Management in acute WAD

Treatment in acute WAD aims to assist the natural course of the condition and prevent development of long-lasting pain and disabling symptoms. Current clinical recommendations for the management of acute WAD include exercises that re-establish normal cervical range of movement and postural alignment in combination with assurance and advice to return to normal activities as soon as possible (10, 71, 72). Although many treatments have been suggested for patients with WAD, scientific evidence supporting their effectiveness is often lacking. Recent systematic reviews have examined the relatively few existing intervention studies in acute WAD (17, 73). Their findings show that there is no early management approach, neither medical (74), physical (75-77), nor educational (78, 79), that has any clear significant effect on the transition from acute to chronic symptoms. One explanation could be that WAD is a complex disorder from physical and psychosocial perspectives respectively. Hence, interventions that consider this complexity are warranted (12, 40). Whether a behavioural medicine management approach in the acute stage of WAD can influence the recovery process and prevent the transition to long-lasting symptoms and disability still need to be investigated.

The Internet and behavioural medicine

The mean age of patients with acute WAD is approximately 40 years and the majority have long working hours as well as families to support. To reach this group the health care system may need to use more innovative techniques as an alternative way of delivering treatments suited to patients’ preferences and lifestyle. Internet-based interventions have shown to be a potential alternative that could overcome access barriers to clinic-based managements such as time, mobility and geography (80). Behavioural medicine treatment over the Internet (IT) is a fairly new form of self-help management. However, positive effects have been reported for Internet-based cogni-
tive behavioural therapy in e.g. chronic back pain (81), recurrent headache (82, 83), tinnitus (84), post-traumatic stress disorder (85), and depression (86, 87). The results also indicate that the Internet facilitates a cost-effective management compared to conventional clinic-based therapy (83). However, studies that evaluate Internet-based behavioural medicine interventions in acute pain conditions, e.g. acute WAD, are still lacking. Research is also requested for comparisons between Internet programmes and their face-to-face counterparts, to clarify possible unique features associated with the Internet as an alternative delivery method (88).

Tailoring of behavioural medicine treatment

An individually tailored management approach uses strategies “intended to reach one specific person, based on characteristics that are unique to that person, related to the outcome of interest, and have been derived from an individual assessment” (89). One way of tailoring is based on the individual’s personal prioritised activity-related goals of everyday life. Physical, behavioural and cognitive factors of importance to achieve these goals are taken into account (55). The individuals assets and problems related to the prioritised goals are assessed prospectively and summarized in a functional behavioural analysis (FBA) where a hypothesis about the relationship between physical, cognitive, affective and environmental factors influencing the activity-related behaviour is set up together with the patient (90). The hypothesis is the fundament for the individually tailored treatment plan, and both are adapted and modified if necessary during the progress of treatment. When using a behavioural medicine approach in physical therapy management, movement is not only viewed as physical but also as psychological and social phenomena. In treatment of movement behaviours it is important to equally consider physical, emotional and cognitive components, including both the social and physical environment (91).

Individually tailored treatment programmes based on behavioural medicine principles have previously successfully been implemented in the treatment of musculoskeletal pain (55, 92), physical activity interventions (93) and in oral hygiene behaviour in patients with periodontal disease (94).

Rationale and scope of this thesis

Although the majority of individuals with an acute whiplash injury recover naturally over a relatively short period of time, a substantial number will suffer from persistent symptoms and disability affecting their lives in many ways. To date, no early management approach has substantively decreased
the incidence of those transitioning from acute to persistent symptoms (17, 73). This clearly indicates that new clinical/research directions are required for the early management of the whiplash-injured patient (40).

It is recognised that WAD presents a heterogeneous disorder from both physical and psychosocial perspectives (17-19) and individuals have different recovery paths (95). Presentations vary from mild, comparatively simple disorders to complex and multifaceted. Management pathways that recognise heterogeneity and are individualised to patients’ presentations are proposed as a first and vital step toward improving treatment outcomes (40). Hence the tailored behavioural medicine perspective to address the issue could be a suitable course of action.

The physical therapist has a key role in early secondary prevention, with an understanding of movement behaviour, physical activity, and behaviour change techniques. In early secondary prevention in WAD the aim is to prevent a bad progression of early prognostic factors, to support patient control over their symptoms, treatment, and capability of coping with daily living (96).

Until now, few studies have applied these perspectives in acute WAD. Therefore, this thesis will focus on the individual perspective in acute WAD, by: a) studying which daily stressors individuals have to deal with and how they associate with the process of coping; b) studying the predictive models of modifiable prognostic factors in order to better understand predictors for persistent symptoms and disability, and c) empirically examining an individually tailored behavioural medicine intervention with different delivery modes and applied in the early stages of WAD.
Aims

The overall aim of the present thesis was to study daily coping processes and prognostic factors, as well as to evaluate an individually tailored behavioural medicine intervention, in the acute stage of WAD.

Specific aims of the studies were:

Study I
To describe daily stressors and how daily stressors were appraised by individuals with acute WAD within 4 weeks after injury occurrence.

Study II
To describe profiles of coping strategies and coping patterns between stressors, primary and secondary appraisals, and coping strategy profiles in relation to reported levels of activity, worries, depressive mood, and pain intensity during the day in individuals with acute WAD within 4 weeks post injury occurrence.

Study III
To compare a mildly affected sample (MIAS) with a moderately to severely affected sample (MOSAS) with regard to background characteristics and pain-related disability, pain intensity, functional self-efficacy, fear of movement/(re)injury, pain catastrophising, post-traumatic stress symptoms in the acute stage and to study the development and changes over the first year in the MIAS. Moreover the aim was to study the validity of a prediction model including baseline levels of variables listed above on pain-related disability 12 months after baseline.

Study III
To investigate the effects of an individually tailored behavioural medicine intervention delivered via; Internet (IT) or face-to-face (FtF), compared to a control group receiving standard self-care instructions (SC), on pain-related disability, pain intensity, self-efficacy in daily activities, catastrophising and fear of movement/(re)injury.
Method

Design

Four studies are included in this thesis. In Study I and II the same sample was used (Sample A). Study III used a sample that was mildly affected (Sample B). In addition a third sample (Sample C) was used as a comparison group in Study III. This third sample (C) was also the sample in Study IV. An overview of the studies is presented in Figure I, and the characteristics of the samples are shown in Table 2.

**Study I 2009–2010**
**Focus:** Description
**Design:** A combined qualitative and quantitative, descriptive design
**Recruitment:** Emergency wards at four Regional county hospitals in Sweden
**Sample:** 260 diaries from 51 subjects with acute WAD
**Point of measurement:** Within 4 weeks after injury occurrence

**Study II 2009–2010**
**Focus:** Description
**Design:** Descriptive design
**Recruitment:** Emergency wards at four Regional county hospitals in Sweden
**Sample:** 229 diaries from 51 subjects with acute WAD
**Point of measurement:** Within 4 weeks after injury occurrence

**Study III 2007–2010**
**Focus:** External validation of potential prognostic factors
**Design:** A prospective, longitudinal, and correlative design
**Recruitment:** Emergency wards at two hospitals in Sweden; one University hospital and one Regional county hospital
**Subjects:** 98 participants with acute WAD; mildly affected
**Point of measurement:** Within 4 weeks after injury occurrence, and follow-up after 3, 6 and 12-months

**Study IV 2006–2010**
**Focus:** Evaluation of group effects
**Design:** A randomized, three-group design
**Recruitment:** Emergency wards at two hospitals in Sweden; one University hospital and one Regional county hospital
**Subjects:** 55 participants with WAD; moderately to severely affected
**Point of measurement:** Pre-treatment; within 4 weeks after injury occurrence, post-treatment and follow-up after 3, 6 and 12-months

*Figure I* Overview of the studies I-IV
Settings, subjects, selection and procedures

The settings of the studies were in the county council of Uppsala and Örebro, Sweden. Studies I and II were carried out in four urban communities with 13,000 – 100,000 inhabitants. Studies III and IV were situated in a university town with 200,000 inhabitants, and in an urban community with 136,000 inhabitants.

Participants were recruited from the hospital emergency wards after an acute whiplash trauma. After physical examination by physicians at the emergency wards the patients received oral and written information about the study from one of the emergency nurses. In addition they were given written standard self-management instructions dealing with information about physical symptoms commonly shown after a trauma involving the neck, and advice about returning to normal activities as soon as possible, for further description see Self-care instructions below. In all studies, individuals giving consent for being contacted by the study co-ordinator were contacted by telephone, within two weeks from the accident. The further procedures are described below for each study.

Study I and II

*Inclusion criteria* in Study I and II were: individuals with acute WAD no longer than two weeks back, classified as WAD grade I–III according to QTF (10), remaining neck pain at the time of the phone call, age 18-65, sufficient Swedish language skills. *Exclusion criteria* were: prior neck injury with sustained symptoms and/or disability, other on-going chronic pain problems or on-going treatment for pain or pain-related symptoms.

Provided verbal agreement, written information, baseline measurements and diaries regarding one week, were distributed by ordinary mail on the day of inclusion in the study. Participants were encouraged to return the questionnaires after one week, but no later than 4 weeks after the accident so that baseline data could be captured from the acute stage. To increase the response rate the participants were contacted by telephone in the middle of the recording week to check how the recordings went and if the participants had any questions.

Study III

*Inclusion criteria* were; age 18 to 65 years, acute WAD no longer than two weeks back, classified as WAD grade I-II according to QTF (10), satisfactory Swedish language skills, and subjective report of not being in need of further treatment due to mild pain and disability 2-4 weeks after the accident.
Exclusion criteria were: prior neck injury with sustained symptoms and/or disability, other on-going chronic pain problems or on-going treatment for pain or pain-related symptoms.

Provided verbal agreement, written information and baseline measurements were distributed by ordinary mail. Participants were encouraged to return the questionnaires immediately, but no later than 4 weeks after the accident so that baseline data could be captured from the acute stage. The mail procedure was repeated at 3, 6, and 12 months for all participants who returned the baseline questionnaires.

Study IV

Inclusion criteria were; age 18 to 65 years, acute WAD no longer than two weeks back, classified as WAD grade I–II according to QTF (10), on-going pain in the neck after the accident, satisfactory Swedish language skills and access to a computer. Exclusion criteria were: prior neck injury with sustained symptoms and/or disability, other on-going chronic pain problems or on-going treatment for pain or pain-related symptoms.

All eligible patients were scheduled to an appointment with the calling physiotherapist (AB), where the standard self-care instructions were reviewed. Patients meeting the eligibility criteria were given further information about the study. Provided verbal and written agreement, baseline measurements were distributed and completed before randomisation. The randomisation procedure is described in Paper IV. For an illustration of participants’ characteristics at inclusion in studies I-IV, see table 2.
Table 2. Participants’ characteristics at inclusion in Studies I, II, III and IV.

<table>
<thead>
<tr>
<th></th>
<th>Sample A Study I &amp; Study II</th>
<th>Sample B Study III</th>
<th>Sample C Study III &amp; Study IV</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age mean (SD)</strong></td>
<td>(n=51) 38.1 (10.9)</td>
<td>(n=98) 34.4 (11.4)</td>
<td>(n=55) 35.7 (10.3)</td>
</tr>
<tr>
<td><strong>Gender n (%)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>(n=51) 35 (69)</td>
<td>(n=98) 52 (53)</td>
<td>(n=55) 37 (67)</td>
</tr>
<tr>
<td>Male</td>
<td>(n=51) 16 (31)</td>
<td>(n=98) 46 (47)</td>
<td>(n=55) 18 (33)</td>
</tr>
<tr>
<td><strong>Education n (%)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elementary school</td>
<td>(n=51) 8 (16)</td>
<td>(n=94) 13 (13)</td>
<td>(n=55) 3 (5)</td>
</tr>
<tr>
<td>High school</td>
<td>(n=51) 31 (61)</td>
<td>(n=94) 46 (47)</td>
<td>(n=55) 25 (45)</td>
</tr>
<tr>
<td>University</td>
<td>(n=51) 12 (24)</td>
<td>(n=94) 35 (37)</td>
<td>(n=55) 27 (50)</td>
</tr>
<tr>
<td><strong>Marital status n (%)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married/living with partner</td>
<td>(n=51) 28 (55)</td>
<td>(n=95) 50 (53)</td>
<td>(n=55) 37 (67)</td>
</tr>
<tr>
<td>Single/living alone</td>
<td>(n=51) 19 (37)</td>
<td>(n=95) 36 (38)</td>
<td>(n=55) 16 (29)</td>
</tr>
<tr>
<td>Living with parents</td>
<td>(n=51) 4 (8)</td>
<td>(n=95) 9 (9)</td>
<td>(n=55) 2 (4)</td>
</tr>
<tr>
<td><strong>Pain intensity (NRS) mean (SD)</strong></td>
<td>(n=51) 7.4 (1.7)</td>
<td>(n=94) 2.3 (1.8)</td>
<td>(n=55) 5.5 (2.0)</td>
</tr>
<tr>
<td><strong>WAD grade n (%)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade I</td>
<td>(n=51) 8 (16)</td>
<td>(n=98) 48 (49)</td>
<td>(n=55) 14 (25)</td>
</tr>
<tr>
<td>Grade II</td>
<td>(n=51) 42 (82)</td>
<td>(n=98) 50 (51)</td>
<td>(n=55) 41 (75)</td>
</tr>
<tr>
<td>Grade III</td>
<td>(n=51) 1 (2)</td>
<td>n.a. 2</td>
<td>n.a. 2</td>
</tr>
<tr>
<td><strong>Involved in accident previously n (%)</strong></td>
<td>(n=51) 2 (3)</td>
<td>(n=98) 9 (9)</td>
<td>(n=55) 12 (22)</td>
</tr>
<tr>
<td>Yes</td>
<td>(n=51) 2 (3)</td>
<td>(n=98) 9 (9)</td>
<td>(n=55) 12 (22)</td>
</tr>
<tr>
<td>No</td>
<td>(n=51) 49 (97)</td>
<td>(n=98) 86 (81)</td>
<td>(n=55) 43 (78)</td>
</tr>
<tr>
<td><strong>Health status before accident n (%)</strong></td>
<td>(n=51) 25 (49)</td>
<td>(n=98) 41 (42)</td>
<td>(n=55) 23 (42)</td>
</tr>
<tr>
<td>Very good</td>
<td>(n=51) 25 (49)</td>
<td>(n=98) 41 (42)</td>
<td>(n=55) 23 (42)</td>
</tr>
<tr>
<td>Good</td>
<td>(n=51) 18 (35)</td>
<td>(n=98) 53 (54)</td>
<td>(n=55) 22 (40)</td>
</tr>
<tr>
<td>Somewhat good</td>
<td>(n=51) 7 (14)</td>
<td>(n=98) 4 (4)</td>
<td>(n=55) 8 (14)</td>
</tr>
<tr>
<td>Bad</td>
<td>(n=51) 1 (2)</td>
<td>(n=98) 0 (0)</td>
<td>(n=55) 2 (4)</td>
</tr>
<tr>
<td><strong>Depressed mood before accident n (%)</strong></td>
<td>(n=51) 41 (80)</td>
<td>(n=94) 77 (79)</td>
<td>(n=55) 39 (70)</td>
</tr>
<tr>
<td>Never</td>
<td>(n=51) 41 (80)</td>
<td>(n=94) 77 (79)</td>
<td>(n=55) 39 (70)</td>
</tr>
<tr>
<td>Sometimes</td>
<td>(n=51) 10 (20)</td>
<td>(n=94) 17 (17)</td>
<td>(n=55) 15 (28)</td>
</tr>
<tr>
<td>Often</td>
<td>(n=51) 0 (0)</td>
<td>(n=94) 0 (0)</td>
<td>(n=55) 1 (2)</td>
</tr>
</tbody>
</table>

Measurements

The collection of demographic data in Study I–IV included background characteristics such as age, gender, marital status, level of education, pain intensity, WAD-grade, involvement in previous accidents, health status, and

---

1 Pain intensity: collected in the questionnaire for demographic information with the question ‘How much pain do you have right now?’ (NRS 0–10: 0 = no pain, 10 = worst pain imaginable)
2 Not applicable for Study III and IV which only included WAD grade I and II
depressed mood before the accident. Other measurements in the studies are presented below.

**Daily coping diary; Whiplash Associated Disorders–Daily Coping Assessment (WAD-DCA)**

In studies I and II a daily coping diary, *Whiplash Associated Disorders–Daily Coping Assessment* (WAD-DCA) was used. The WAD-DCA describes individual and situation-specific stressors, appraisal, coping strategies and perception of activity level, anxiety, mood, and pain intensity during the day. The WAD-DCA has been influenced by and adapted to an acute whiplash population from the original version by Stone and Neale (97) and the Swedish version by Wasteson et al. (70, 98). It has its theoretical foundation in the Transactional Model of Stress and Coping (6).

In Study I the questions concerning situation-specific stressors and primary appraisal was analysed. In Study II the stressor, the primary and secondary appraisal, coping strategies and questions related to activity level, degree of worries, depressed mood and pain intensity during the day were analysed. For more details, see Paper I and II.

**Pain-related disability**

Pain-related disability measured with the Swedish version of *The Pain Disability Index (PDI)* (99, 100) is designed to measure interference with role-functioning due to persistent pain. A general disability score ranging from 0 to 70 was calculated by summing the scores. Higher scores indicate higher disability. For more information see table 3. The PDI is found to be a reliable and valid measurement of disability in patients with persistent pain (99-101) as well as patients with acute pain (31). A Swedish version of the PDI (52) was used in studies III and IV.

**Pain intensity**

In studies I, II and IV pain intensity was operationalised as the experienced pain intensity at present and was collected with the question “*How much pain do you have right now?*” in the questionnaire for demographic information. In Study III pain intensity was operationalised as the average pain intensity experienced over the past two weeks. The scoring of pain intensity in all studies was done on a *numerical rating scale (NRS)* with anchors 0 (no pain) and 10 (worst pain imaginable/unbearable pain) (102). For more information see table 3. The validity of NRSs for pain intensity has found sig-
significant correlations with other measurements of pain intensity and good sensitivity to treatments with expected pain intensity change (102).

Self-efficacy in performing common everyday life activities

Self-efficacy in performing common everyday life activities, also called functional self-efficacy, was measured by the Swedish version of the Self-Efficacy Scale (SES) (52, 103). The SES measures the strength of perceived self-efficacy in performing common everyday life activities. A general self-efficacy score ranging from 0 to 200 was calculated by summing ratings of the 20 activities. Higher scores indicate higher self-efficacy. For more information see table 3. The Swedish version of SES has shown good reliability in evaluating self-efficacy in patients with musculoskeletal pain (52) and WAD (31).

Recovery expectations in Study IV were measured with a question where the respondents were asked to rate how likely it was that they would have a complete recovery “not likely”, “quite likely” or “very likely”. This question has not been psychometrically tested.

Fear of movement and (re)injury

Fear of movement and (re)injury was measured by the Swedish version of the Tampa Scale of Kinesiophobia (TSK) (52, 102). A total score ranging from 17 to 68 was calculated where a higher total sum indicates more fear. For more information see table 3. The Swedish version of TSK has shown good reliability in evaluating fear of movement and (re)injury in patients with musculoskeletal pain and WAD (104).

Pain catastrophising

Pain catastrophising was measured with the catastrophising subscale from the Coping Strategies Questionnaire (CAT) (105). The sum of the items was calculated to a score ranging from 0 to 36. Higher scores indicate higher frequency of catastrophic thinking. For more information see table 3. The catastrophising scale has shown appropriate construct validity (106), and the Swedish version has shown good internal consistency but somewhat less satisfactory test–retest reliability (107).

Post-traumatic stress symptoms

In Study III, post-traumatic stress symptoms were measured with the Impact of Event Scale (IES)(108). The IES consists of 15 items in which the patient is asked to report the occurrence of symptoms during the past seven days.
High values indicate severe symptoms. A total IES-score was calculated, ranging from 0 through 75. For more information see table 3. Psychometric properties of the IES have been found satisfactory (although not as a PTSD diagnostic measure) (109, 110).

Table 3. Measurements used in Study III and IV

<table>
<thead>
<tr>
<th>Variable and measurement</th>
<th>No. items</th>
<th>Response scale</th>
<th>Study III</th>
<th>Study IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain-related disability (PDI)</td>
<td>7</td>
<td>0–10 rating scale</td>
<td>X^1 2</td>
<td>X^1 3</td>
</tr>
<tr>
<td>Pain intensity (NRS)</td>
<td>1</td>
<td>0–10 rating scale</td>
<td>X^2</td>
<td>X^1 4</td>
</tr>
<tr>
<td>Functional Self-efficacy (SES)</td>
<td>20</td>
<td>8-point Likert scale</td>
<td>X^2</td>
<td>X^1 4</td>
</tr>
<tr>
<td>Catastrophising (Subscale from CSQ) (CAT)</td>
<td>6</td>
<td>7-point Likert scale</td>
<td>X^2</td>
<td>X^1 4</td>
</tr>
<tr>
<td>Fear of movement/(re)injury (TSK)</td>
<td>17</td>
<td>4-point Likert scale</td>
<td>X^2</td>
<td>X^1 4</td>
</tr>
<tr>
<td>Post traumatic distress (IES)</td>
<td>15</td>
<td>4-point Likert scale</td>
<td>X^2</td>
<td></td>
</tr>
</tbody>
</table>

1 Dependent variable  
2 Independent variable  
3 Primary outcome variable  
4 Secondary outcome variable

Intervention in Study IV

Experimental conditions; Tailored behavioural medicine intervention

The treatment rationale for the individually tailored behavioural medicine intervention in Study IV was uniform for the two experimental conditions, but the method of delivery differed i.e. carried out either via the Internet (IT-group) or via face-to-face appointments at a physical therapy outpatient ward (FtF group). The treatment, followed 7 phases: 1) Problem- and goal identification; 2) Self-monitoring; 3) Functional behavioural analysis; 4) Basic skills acquisition; 5) Applied skills acquisition; 6) Generalization; and 7) Maintenance and relapse prevention (55, 111), and was aimed at enhanced self-management skills and improved levels of functioning for the participants. Further, strategies for maintenance and relapse prevention were practiced to prevent the development of persistent pain and disability. The treatment rationale was formed from an understanding of human behaviour as an
interaction between physiological, psychological, behavioural and contextual aspects and was theoretically based on health psychological and learning theories (6, 8, 9), theories of movement and motor control (3), as well as theories of pain and exercise physiology (5).

Below, in Table 4, is the description of the theoretical rationale for the specific ingredients in the two experimental intervention groups. Further description of the individually tailored behavioural medicine intervention in the IT and FtF groups are reported in Paper IV and in the study protocol (111).
Table 4. Clarification of assumed change process in the IT and Face-to-Face interventions. Cognitive, affective and behavioural example techniques are based on the Coding Manual to identify Behaviour Change Techniques in Behaviour Change Intervention Description (112).

<table>
<thead>
<tr>
<th>Tailoring components</th>
<th>What was done?</th>
<th>Theory/model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Methods</td>
<td>Example Techniques</td>
</tr>
<tr>
<td>Physical activity in daily activities including: Postural control Range of motion Muscular strength and endurance Ergonomy</td>
<td>Exercises of basic skills and skills applied in targeted daily activities</td>
<td>- Stabilisation and circulation exercises for deep neck muscles - Adjustment of sitting and neck position in front of the computer at work - Ergonomic adjustment of desk at work</td>
</tr>
<tr>
<td>Self-efficacy in daily activities</td>
<td>- Problem and goal identification - Tailored practice in targeted activities</td>
<td>- Prompt specific goal setting - Prompt self-monitoring of behaviour - Prompt barrier identification - Set graded tasks - Model/demonstrate the behaviour - Provide contingent rewards</td>
</tr>
<tr>
<td>Fear of movements/(re) injury in daily activities</td>
<td>Exposure</td>
<td>- Prompt self-monitoring of behaviour and possible feelings of fear of movements/(re) injury - Set graded tasks</td>
</tr>
<tr>
<td>Pain catastrophising in daily activities</td>
<td>Identification and challenging in targeted activities</td>
<td>- Prompt self-monitoring of behaviour - Prompt self-talk e.g. challenge negative thoughts</td>
</tr>
<tr>
<td>Self-efficacy in maintenance and relapse prevention</td>
<td>Realistic and concrete plan for strategies in possible risk situations</td>
<td>- Prompt review of behavioural goals - Prompt barrier identification/relapse prevention - Identification and reconsideration of earlier successful strategies</td>
</tr>
</tbody>
</table>
Control condition; Standard self-care instructions

All participants in study IV received self-care instructions, which are current standard care recommendations in the acute stage of WAD (10, 71, 72). Participants in the control group did not receive any other intervention than this. Self-care instructions consisted of written information and instructions for the physical symptoms commonly shown after a trauma and directed towards a rapid return to normal activity. Further description is given in Paper IV and the study protocol (111).

Data management and analysis

Data management and analyses in Studies I–IV were performed with Statistical Packages for the Social Sciences, IBM SPSS Statistics© version 20.0 and in R version 2.12.1 (114).

Table 5. Data analysis methods in studies I-IV

<table>
<thead>
<tr>
<th>Methods</th>
<th>Studies</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
</tr>
<tr>
<td>Descriptive analyses</td>
<td></td>
</tr>
<tr>
<td>Mean (SD)</td>
<td>X</td>
</tr>
<tr>
<td>Median (IQR)</td>
<td>X</td>
</tr>
<tr>
<td>Median change score</td>
<td></td>
</tr>
<tr>
<td>Cluster analysis</td>
<td>X</td>
</tr>
<tr>
<td>Visualisation of coping patterns</td>
<td></td>
</tr>
<tr>
<td>Qualitative analysis</td>
<td></td>
</tr>
<tr>
<td>Content analysis</td>
<td></td>
</tr>
<tr>
<td>Inferential analyses</td>
<td></td>
</tr>
<tr>
<td>Chi-square test</td>
<td></td>
</tr>
<tr>
<td>Mann-Whitney U test</td>
<td></td>
</tr>
<tr>
<td>Friedman test</td>
<td></td>
</tr>
<tr>
<td>Spearman’s rang correlation</td>
<td></td>
</tr>
<tr>
<td>Multiple linear regression</td>
<td></td>
</tr>
<tr>
<td>Kruskal-Wallis test</td>
<td></td>
</tr>
<tr>
<td>Randomisation test</td>
<td></td>
</tr>
</tbody>
</table>

Descriptive analyses

Frequency, proportion (%), mean value, standard deviation (SD), median value and Inter Quartile Range (IQR) were used on patient characteristics, such as age, gender, WAD-grade etc. in Studies I-IV. Median, IQR (Studies
III and IV) and median change scores (Study IV) were used to evaluate non-parametric data.

To identify groups of diaries with similar response patterns concerning coping strategies in Study II, a robust K-means cluster analysis was used (115). To choose the appropriate number of clusters both clinical interpretability and statistical measurements were used. A validation of the clusters was done by comparing the different clusters with respect to level of activity, worries, depressive mood, and pain intensity during the day.

In Study II general patterns in the daily coping process were identified and graphically visualised. Based on the operationalised parts of the coping process the process was divided into four parts: 1) Stressor; 2) Primary appraisal; 3) Secondary appraisal; and 4) Strategies. For each diary the coping process was tracked. For each of the daily ratings of average activity level, worries, depressive mood and pain intensity, the main patterns through the coping process, from stressors to strategies, was illustrated in relation to reports of high daily level (NRS 7–10), medium daily level (NRS 4–6) and low daily level (NRS 0–3) of activity, worries, depressive mood and pain intensity respectively. The most prominent paths were highlighted.

Qualitative analysis

To classify the answers concerning most stressful event during the day a content analysis approach was used in Study I. The process of analysing the stressors was performed with the following steps: (1) all the answers were gathered in a text file by the first author; (2) the text material was read and re-read to acquire an understanding of the content; (3) the stressors were subsequently coded into more condensed descriptions; (4) content that shared a similar meaning was divided into categories and each category was labelled using content-characteristic words; and (5) three of the authors (AB, PA, AS) independently placed the stressors into the categories and then the agreement between the authors was analysed (116). Overall there was 96% agreement in placing stressors into the categories. The few differences were discussed to accomplish a total agreement.

Inferential analysis

The two samples (sample B and C) in Study III were compared using Chi-square tests and Mann-Whitney U tests. In Study IV Mann-Whitney U tests were used in the pair-wise comparisons between the groups. Within-group changes over time (all time points included) were analysed with the Friedman test in Studies III and IV. The three treatment groups in Study IV were compared using the Kruskal-Wallis test. Randomisation test was used to
calculate the overall effects between the three treatment groups over time, combining all time points in Study IV. For further description of the Randomisation test procedure, see Paper IV. Spearman's rank correlation was used to examine the associations between the dependent variable, and the independent variables in Study III. In Study III a multiple linear regression analysis was performed to regress pain-related disability at the 12-month follow-up, on baseline assessments of pain-related disability, pain intensity, functional self-efficacy, fear of movement/(re)injury, pain catastrophising, and post-traumatic stress symptoms. This regression method was also performed as control for recovery expectations in Study IV.

Ethical approvals

Ethical approval was obtained from the Regional Ethical Committee, Uppsala, Sweden for Studies I and II (Dnr 2008:191) and for Study IV (Dnr 2005:098). At this point in time no particular approval was needed for clinical protocols, not including any intervention, i.e. Study III.
Results

Daily stressors and coping patterns

Stressor categories and primary appraisal

In the included 260 WAD-DCA:s from 51 participants analysed in Study I, stressors from a wide variety of areas were reported. In the content analysis of the individual and situation-specific stressors, thirteen categories emerged, see Table 6. Stressors related to occupation were described in a variety of situations, e.g. in white-collar as well as in blue-collar work environments, e.g. a long time sitting in the same position as well as a heavy physical or mental workload. In the category “Physical symptoms” stressors were mainly related to pain in the neck, shoulders, back, arms, head, or a combination of these. There were also physical symptoms like sensitivity to noise, neurological symptoms and cold or flu symptoms. In the category feelings/cognitions, stressors dealt with worries about slow recovery, return to work and financial consequences, as well as thoughts and memories of the accident and feelings of misunderstanding about the individual’s situation. Information on how the stressors were appraised, i.e. as a threat, challenge or disabling showed that the highest number of disabling stressors was seen in the category physical symptoms and the most threatening stressors were reported in the categories driving/car-related and feelings/cognitions.
## Table 6. Number of stressors and reporting subjects in each category during one week

<table>
<thead>
<tr>
<th>Stressor category</th>
<th>Number of stressors in each category reported during one week (% of total no. of reported stressors), n=260</th>
<th>Number of subjects reporting stressors in the category (% of total no. of subjects), n=51</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic or family-related activities</td>
<td>24 (9)</td>
<td>18 (35)</td>
</tr>
<tr>
<td>Leisure</td>
<td>24 (9)</td>
<td>18 (35)</td>
</tr>
<tr>
<td>Social activities</td>
<td>7 (3)</td>
<td>7 (14)</td>
</tr>
<tr>
<td>Occupation</td>
<td>64 (25)</td>
<td>30 (59)</td>
</tr>
<tr>
<td>Self-care</td>
<td>14 (5)</td>
<td>10 (20)</td>
</tr>
<tr>
<td>Sleeping behaviour</td>
<td>8 (3)</td>
<td>6 (12)</td>
</tr>
<tr>
<td>Physical symptoms</td>
<td>44 (17)</td>
<td>24 (47)</td>
</tr>
<tr>
<td>General functional ability</td>
<td>3 (1)</td>
<td>3 (6)</td>
</tr>
<tr>
<td>Weather</td>
<td>2 (1)</td>
<td>1 (2)</td>
</tr>
<tr>
<td>Contact with authorities</td>
<td>5 (2)</td>
<td>5 (10)</td>
</tr>
<tr>
<td>Feelings/cognitions</td>
<td>34 (13)</td>
<td>18 (35)</td>
</tr>
<tr>
<td>Driving/traffic-related stressors</td>
<td>17 (6)</td>
<td>12 (24)</td>
</tr>
<tr>
<td>Multiple stressors</td>
<td>14 (5)</td>
<td>10 (20)</td>
</tr>
</tbody>
</table>

### Profiles of coping strategies and coping patterns

In Study II, 229 WAD-DCA:s were included in the analyses. In the cluster analysis of the coping strategies three clusters were identified. Based on the most frequently reported coping strategies the clusters were named “Challenging self-talk”, “Accepting and challenging self-talk” and “Catastrophising and taking medication”.

When analysing visually the coping paths between stressors, primary and secondary appraisals and coping strategies, related to the average daily activity level, degree of worries, depressive mood and pain intensity, two explicit patterns through the coping process were identified. The majority of the diaries where high daily activity and a low degree of worries, depressed mood and pain intensity were reported also showed high confidence in handling the stressor (secondary appraisal), and use of coping strategies from the clusters “Challenging self-talk,” and “Accepting and challenging self-talk.” On the other hand, in the diaries with low daily activity and a high degree of worries, depressive mood and pain intensity, the majority of the diaries indicated appraisal of the stressor as a threat and were represented in the coping strategy cluster “Catastrophising and taking medication.” For a graphic illustration of the coping patterns, see Figure II a and b.
Figure II a & b. The coping pattern from stressor to strategies in the diaries reporting a) high daily activity level, low degree of worries, low degree of depressed mood and low pain intensity, and b) low daily activity level, high degree of worries, high degree of depressed mood and high pain intensity. The WAD-DCA is the unit of analysis, hence the same subject contributes with more than one observation. The shaded boxes represent: white 0–24 %, light grey 25–50 % and dark grey >50 % of the diaries. The design of the arrows is equal to the percentage of WAD-DCAs going from one part in the coping process to another: dotted arrow 5–15 %, thick arrow >15 % of the WAD-DCAs.
Prognostic factors in a mildly affected sample

In Study III a mildly affected sample (MIAS) was compared with a moderately to severely affected sample (MOSAS) in the acute stage of WAD. Significant differences were shown in all outcomes; pain-related disability, pain intensity, fear of movement/(re)injury, pain catastrophising, post-traumatic stress symptoms, and functional self-efficacy, where the MIAS reported consistently less burden in all study variables compared to the MOSAS.

From baseline to the 12-month follow-up, pain-related disability, pain catastrophising, and post-traumatic stress symptoms significantly decreased over the first year after the accident in the MIAS, whereas functional self-efficacy and fear of movement/(re)injury increased. Despite the significant changes, the clinical relevance of the change over time can be questioned, since they were small from a clinical perspective. Pain intensity was kept stable over time.

Five percent of the sample reported a clinically relevant deterioration in pain-related disability as opposite to the 10% assumed in advance. Eight percent reported minimally important improvements on the PDI measure, whereas 85% of the sample was stable over the first year.

The multiple linear regression analysis with backward selection showed that pain-related disability at baseline emerged as the only indicator of prognosis after 12 months, Adjusted $R^2 .67$, $F(1, 69) = 139.8$, $p < .0001$. Statistics for the initial and final models respectively are reported in table 7.
Table 7. Multiple linear regression model (backward) of regression coefficient B, Standard error of B, β, 95% CI for B, (p-values) and coefficient of determination (R²). The dependent variable (PDI) at the 12-month follow-up, and the independent variables (predictors) assessed at baseline.

<table>
<thead>
<tr>
<th>Model</th>
<th>Predictors at baseline</th>
<th>B</th>
<th>Std. error of B</th>
<th>β</th>
<th>95% CI for B</th>
<th>p-value</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PDI</td>
<td>0.85</td>
<td>0.09</td>
<td>-0.87</td>
<td>0.67 to 1.04</td>
<td>&lt;.001</td>
<td>.69</td>
</tr>
<tr>
<td></td>
<td>Pain Intensity</td>
<td>-0.28</td>
<td>0.50</td>
<td>-0.05</td>
<td>-1.28 to 0.73</td>
<td>.58</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SES</td>
<td>-0.03</td>
<td>0.04</td>
<td>-0.05</td>
<td>-0.10 to 0.05</td>
<td>.50</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TSK</td>
<td>-0.10</td>
<td>0.12</td>
<td>-0.06</td>
<td>-0.34 to 0.147</td>
<td>.43</td>
<td>.69</td>
</tr>
<tr>
<td></td>
<td>CAT</td>
<td>0.12</td>
<td>0.11</td>
<td>0.08</td>
<td>-0.11 to 0.35</td>
<td>.30</td>
<td></td>
</tr>
<tr>
<td></td>
<td>IES</td>
<td>-0.12</td>
<td>0.08</td>
<td>-0.12</td>
<td>-0.28 to 0.04</td>
<td>.15</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>PDI</td>
<td>0.80</td>
<td>0.07</td>
<td>0.82</td>
<td>0.66 to 0.93</td>
<td>&lt;.001</td>
<td>.67</td>
</tr>
</tbody>
</table>

Tailored behavioural medicine intervention compared to standard self-care instructions

Pain-related Disability (PDI)

Median values for the IT, FtF, and the SC groups in the primary outcome variable, PDI, at baseline, post-treatment, and at 3, 6, and 12-month follow-ups are presented in Figure III. Within-group analyses of the primary outcome variable PDI, for each treatment group over time, showed significant change in all groups (p<.001 in all groups). The difference between all three groups in median change score (the change from baseline to pre-treatment, 3-, 6- and 12-month follow-ups respectively) at each time point, showed a significant difference between the treatment groups in PDI at 3 months (p=.002), at 6 months (p=.001), and at the 12-months follow-up (p=.018), but not at post-treatment. The between-group comparison (all groups) showed a significant difference between the three groups in overall treatment effect (p=.009). For the results of the median change scores and the within- and between-group analyses over all time-points see Table 8. For more details see Paper IV.
The pairwise analysis between IT vs. SC, FtF vs. SC, and IT vs. FtF, in median change in PDI (with Bonferroni correction \( p < .004 \)), showed a significant difference between the IT vs. SC group at 3 months (\( p = .003 \)), at 6 months (\( p = .001 \)), and between the FtF vs. SC group at 3 months (\( p = .002 \)) and at 6 months (\( p = .002 \)). No significant differences in PDI were shown between the two experimental conditions (IT vs. FtF) at any of the four time points.

**Pain intensity**

Within-group analyses of pain intensity for each treatment group over time showed significant change in all groups (\( p < .001 \) in all groups). The between-group analysis in median change score showed a significant difference between the treatment groups at post-treatment (\( p = .032 \)). There was no significant difference between the groups in overall treatment effect concerning

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**Figure III.** Median values for the IT, FtF, and the SC group in PDI at baseline, post treatment, and at 3, 6, and 12 months follow-up. Low scores in PDI indicate low disability (Max 70, min 0)
pain intensity. For the results of the median change scores, and the within- and between-group analyses over all time-points, see Table 8. For more details see Paper IV.

**Self-efficacy in performing common everyday life activities (SES)**

Within-group analysis executed for each treatment group over time concerning SES showed significant change in all groups ($p<.001$ in all groups). The between-group analysis of the median change score showed a significant difference between the treatment groups at post-treatment ($p=.024$), at 3 months ($p<.001$), and at the 12-month follow-up ($p=.028$). There was a significant difference between the three groups in overall effect ($p=.03$). For the results of the median change scores, and the within- and between-group analyses over all time-points see Table 8. For more details see Paper IV.

**Fear of movement/re-injury (TSK)**

There was a significant reduction in TSK in IT and in FtF ($p<.001$ in both groups) over time, in the within-group analysis. No significant change over time was shown in the SC group. In the between-group analysis of the median change score a significant difference between the treatment groups was shown at all time points ($p<.001$ respectively), and subsequently there was a significant difference in overall treatment effect ($p<.001$) between the three groups. For the results of the median change scores, and the within- and between-group analyses over all time-points see Table 8. For more details see Paper IV.

**Catastrophising (CAT)**

A significant reduction in CAT was shown in IT ($p=.016$) and FtF ($p=.004$) over time in the within-group analyses. In the SC group there was no significant change. In the between-group analyses of the median change score, a significant difference between the treatment groups was shown at all time points; post treatment ($p=.023$), at 3 months ($p=.04$), at 6 months ($p=.005$) and at the 12-month follow-up ($p=.005$). Hence, there was a significant difference in overall treatment effect ($p=.002$) between the three groups. For the results of the median change scores, and the within- and between-group analyses over all time-points see Table 8. For more details see Paper IV.
Table 8. Median scores, Inter quartile range (IQR) and within-group analyses over all time-points (Friedman test) in IT, FtF and SC group for each of the outcome variables: pain-related disability (PDI), self-efficacy (SES), fear of movement/(re)injury (TSK), catastrophising (CAT) and pain intensity. The last column shows the p-values of the overall effects between the three groups over time.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Baseline (Median (IQR))</th>
<th>Post-treatment (Median (IQR))</th>
<th>3-month follow-up (Median (IQR))</th>
<th>6-month follow-up (Median (IQR))</th>
<th>12-month follow-up (Median (IQR))</th>
<th>Within-group comparison p-value ($\chi^2$)</th>
<th>Between-group comparison (Overall test) p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain Intensity</td>
<td>IT: 6.5 (3) FtF: 4.5 (3) SC: 4 (4)</td>
<td>IT: 4 (3) FtF: 2.5 (2) SC: 3 (2)</td>
<td>IT: 4 (3) FtF: 2.5 (2) SC: 3 (2)</td>
<td>IT: 3 (2) FtF: 2 (2) SC: 4 (4)</td>
<td>IT: 3 (4) FtF: 2 (2) SC: 2.5 (4)</td>
<td>&lt;.001 (25.1) FtF: &lt;.001 (40.4) SC: &lt;.001 (33.6)</td>
<td>.11</td>
</tr>
<tr>
<td><strong>CAT</strong></td>
<td>IT: 8 (8) FtF: 7.5 (8) SC: 5.5 (6)</td>
<td>IT: 3 (3) FtF: 3 (4) SC: 5 (4)</td>
<td>IT: 4 (4) FtF: 4.5 (4) SC: 5 (7)</td>
<td>IT: 3 (4) FtF: 5.5 (6) SC: 7 (9)</td>
<td>IT: 3 (5) FtF: 3.5 (6) SC: 5.5 (11)</td>
<td>.016 (12.2) FtF: .004 (15.5) SC: .268 (5.2)</td>
<td>.02</td>
</tr>
</tbody>
</table>

Expectations for recovery

When analysing reported expectations about the likelihood of treatment leading to recovery measured at baseline, none of the participants reported “not likely.” A majority of the participants in all three treatment groups expected full recovery as quite likely; 56% in IT, 53% in FtF and 65% in SC, see Table 9.
Table 9. Expectations for recovery in the IT, FtF and SC group measured at baseline.

<table>
<thead>
<tr>
<th></th>
<th>IT</th>
<th>FtF</th>
<th>SC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very likely</td>
<td>8 (44)</td>
<td>7 (41)</td>
<td>6 (35)</td>
</tr>
<tr>
<td>n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quite likely</td>
<td>10 (56)</td>
<td>10 (59)</td>
<td>11 (65)</td>
</tr>
<tr>
<td>n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not likely</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 9. Expectations for recovery in the IT, FtF and SC group measured at baseline.

Associations were shown between expectations for recovery and change in PDI (pre-post). Those reporting expectations of full recovery had a significantly larger positive change (i.e reduction) in PDI (p=.001, Mann-Whitney U test) than those reporting expectations of some recovery (13 units compared to 6 units in PDI). To study if the recovery expectation factor could explain the difference in treatment effects between the three groups (pre-post) a multivariate analysis was performed (regression analysis). When controlling for recovery expectations, there was still a significant difference (p=.009) between the three treatment groups regarding change in PDI (pre-post). Similar results were shown for change a in PDI between baseline and 12 month follow-up.
Discussion

Summary of results

The results of this thesis uncover new insights in understanding the individual’s specific perspective as applied in a behavioural medicine approach in acute WAD. There seems to be a large variety of situations that the individuals perceive as stressful, not only pain itself (Study I). These stressful situations, together with appraisal and use of different coping strategies are associated with physical and psychological daily well-being. High self-efficacy beliefs appear to be important in the coping process during days with high levels of physical and mental well-being, whereas perception of the stressor as a threat and presence of catastrophic thoughts were more prominent during days with low levels of physical and mental well-being (Study II).

Prognostic factors in WAD have previously mainly been studied exploratively. The notion that whiplash is a heterogeneous condition makes clinicians require prognostic indicators both for good as well as poor recovery. In Study III potential prognostic factors for good and poor recovery were studied more closely in a mildly affected sample from within the first month after the accident up to one year later. In this manner findings from previous explorative studies on prognostic factors in acute WAD were externally validated. Pain-related disability at baseline emerged as the only indicator of prognosis after 12 months. Hence the assumption, as suggested by earlier studies, that pain intensity and functional self-efficacy at baseline will be predictors of pain-related disability at 12 months, was not valid in the MIAS. Current generic and physically focused self-care instructions in the acute stage of WAD do not seem to be as effective as an individually tailored behavioural medicine intervention (Study IV). By early identification of situation-specific factors and potential behavioural (physical, cognitive and affective) determinants of activity performance it seems possible to tailor a self-management intervention that decreases pain-related disability, negative thoughts (catastrophising and fear of movement/(re)injury) as well as increase self-efficacy in everyday life activities up to one year after the accident. New alternative ways of delivering the intervention, i.e. via the Internet with e-mail support, were found to be an equally good alternative to more traditional clinic-based therapy sessions.
Daily stressors and coping patterns

The coping process in WAD has previously been sparsely studied, especially, the stressors that patients experience on a daily basis. Previous studies on coping in acute WAD largely focus on the predefined stressor pain and the different strategies used to manage pain, i.e. it is assumed that the main stressful event in everyday life after acute WAD is the pain itself (46, 66). This follows current clinical practice where the anamnesis, physiological examination and management of patients with acute and subacute WAD focus largely on perceived pain intensity and pain location, rather than on activity and participation. Even though subjects in Study I and II reported rather high pain intensity, pain is not exclusively reported as the most prominent stressor. On the contrary, the results in Study I and II indicate that individuals with acute WAD report challenging and threatening stressors from a wide variety of areas in their daily lives.

Days with a reported high daily activity level and a low degree of worries, depressed mood and pain intensity were more often associated with a high confidence in one’s ability to cope with the stressor. This is in accordance with previous studies showing that self-efficacy beliefs mediate disability in patients with acute and sub-acute WAD (45, 56, 117). Thus, our results add support to the notion that self-efficacy beliefs are associated with daily well-being in the early stages of WAD. The causal impact of self-efficacy beliefs on recovery and adjustment after WAD remains to be studied. For WAD-DCAs where high pain intensity was reported, the majority were represented in the ‘Catastrophising and taking medication’ cluster. The relationship between catastrophic thoughts, high pain intensity and disability has previously been shown in patients with persistent WAD showing that these kind of thoughts may focus the patients’ attention on pain and thus affect the experience of pain and subsequently reduce the level of activity due to overprotective behaviour (47). According to our results, this seems to be valid in the acute stage of WAD as well.

The situation-specific assessment yields new important information in contrast to the predefinition of the stressor, eg. pain, which may be misleading information regarding what actually bothers individuals suffering from WAD after an accident. By identifying specific stressors, their appraisals and coping efforts, which is possible with the DCA-WAD, the interventions may be tailored in accordance with individual coping aspects. This has to some extent been investigated in Study IV, but needs to be addressed further in future studies.
Prognostic factors in a mildly affected sample

Pain-related disability at baseline was the only salient predictor of pain-related disability at the 12-month follow-up in Study III. Hence the prediction model, where pain-related disability, pain intensity, and functional self-efficacy at baseline were hypothesised to emerge as predictors of pain-related disability in the MIAS 12 months after the baseline assessment, was not valid, except for the contribution of pain-related disability.

In a meta-analysis by Walton et al. (19), a cut-off point of 5.5 on a visual analogue scale (0–10) for pain intensity was established. Pain intensity greater than 5.5 at the acute phase, correspond to a sixfold increase in the risk of persistent pain or disability over time. In our sample only 8 participants (11%) reported pain intensity ≥ 5 on the NRS at baseline, which could be one possible explanation for why pain intensity did not emerge as a predictor in this sample, opposite to our hypothesis.

It has been proposed that psychological variables mediate the relationship between pain intensity and disability in WAD (117, 118) and this mediation may be stronger when pain intensity and disability are more severe. The samples in earlier predictor studies have mostly consisted of participants with moderate to severe symptoms compared to our study with a mildly affected sample. It is possible that those with mild symptoms have no problems in the psychological area, whereas those with moderate to severe symptoms do have both activity-related and psychological problems that can function as predictive on long-term disability. Further, we did not include any measurement of recovery beliefs, such as expectations for recovery in Study III, but consider the possibility of positive recovery beliefs to be a latent variable for the perception of being in no need of further treatment, see further discussion in the next section. The addition of this variable could have provided valuable information to our findings in Study III. However, our results of disability being the best predictor in a mildly affected sample emphasises the importance of screening for problems related to activity and participation in acute WAD. If we can find those with high disability in an early stage there is a possibility to support these persons and maybe prevent their condition from becoming chronic. In the future, studies including mildly affected samples are needed to further elucidate the role of psychological as well as activity- and participation-related factors in the course of WAD.
Evaluation of a tailored behavioural medicine intervention

As opposed to the majority of previous intervention research in acute WAD, which has focused mainly on managing physical symptoms causing activity limitations (76, 77, 79), the present experimental condition did not focus on reducing symptoms such as pain, per se. Rather, the intervention was directed towards enhancing self-management skills in daily life activities, despite pain or other physical symptoms. This management approach seems to have had a preventive effect for the development of pain-related disability since the results not only showed a larger short-term effect in decreased pain-related disability (PDI) in the experimental conditions, but the effects were also sustained up to one year after the intervention. Behavioural medicine approaches in physiotherapy have previously been found to be successful when treating patients with chronic lower back pain (119, 120), chronic musculoskeletal pain (55, 121) and chronic WAD(122-124). The results from Study IV give support for a behavioural medicine approach in physical therapy in an acute WAD context as well. But since it is small and first of its kind, it needs to be replicated in future studies.

Besides applied activities training, the management approach in this study targeted modifiable prognostic psychological factors for chronicity, i.e. negative thoughts and low self-efficacy, and their assumed link to the participants’ individually prioritised activities. The treatment rationale was that methods for capturing and managing negative thoughts should be included early in the acute stage, when those thoughts might not yet be manifest and possibly cause the development of long-term disability. The importance of individualised treatment in the acute stage of WAD is supported by previous findings from Sterling and colleagues (125), and in a number of systematic reviews(18, 19), which found that acute WAD is a heterogeneous disorder from both physical and psychosocial perspectives, and also that individuals have different recovery paths (95). This suggests that treating patients after a whiplash injury classifiable as WAD I or II (10) as a homogeneous group with a single treatment approach, may not be the most appropriate approach, as evidence suggests in current consensus recommendations of the QTF and the evidence-based recommendations of Conlin et al. (71, 72).

There were no differences between the Internet group and the Face-to-Face group in Study IV. This suggests that Internet-delivered methods, including e-mail supervision, could be an alternative to clinic-based management. One advantage of Internet- treatments lies in overcoming the distance even if patients live far away, and also that they can choose when and where to log into the treatment programme, provided that they have Internet access (88, 126). Thus, this is a relevant aspect especially for this population, the major-
ity of which are in the midst of their active work and family lives. In addition, since this delivery method is administered without any physical contact with the healthcare environment, it may reduce the risk for individuals to regard their condition as a large medical problem that needs to be handled by the healthcare system, but rather as something that can be handled with self-management strategies. Still there is insufficient knowledge about who would benefit the most from an Internet-delivered treatment in contrast to face-to-face delivery as well as the health economic aspects of the different delivery methods in acute WAD.

At baseline the participants in Study IV answered a question about their expectations for recovery. The results, which were not included in paper IV, showed that those reporting expectations of full recovery changed significantly more in pain-related disability than those reporting expectations of some recovery. The importance of recovery beliefs has previously been shown in two large cohort studies (21, 63). Holm and colleagues found that persons who stated that they were less likely to make a full recovery were more likely to have high disability 6 months after the accident, as compared to persons who stated that they were likely to make a full recovery (21). Carroll et al. showed that those who expected to get better soon recovered over 3 times as quickly as those who expected that they would never get better (63). Theoretically, behavioural learning principles (65) may explain how experiences from previous accidents and pain conditions shape the current experience of the WAD and the development over time. For instance, beliefs such as expectations for recovery in the acute phase are associated with prognosis (30) and may be a result of such a previous learning process. Addition of techniques in the treatment rationale to modify this variable may improve the treatment effect even more.

Methodological considerations

Studies I and II

There are some methodological considerations to take into account when collecting data on a daily basis as in Studies I and II. The participants might experience filling in the recordings every day as time-consuming or hard to remember, which would jeopardise the response rate. Despite reminder calls, not all participants filled in the diary every day of the week. Of the 51 participants in Study I and II, twenty-five filled in all seven day assessments, i.e. 49%, and the mean number of returned WAD-DCAs per participant was 5.6. This could also be due to the fact that they did not actually experience any stressful situations the remaining days.
Another methodological consideration concerns the measurement WAD-DCA. This daily coping measurement has not yet been tested in terms of psychometric properties. Thus, the results might be biased by possible low reliability and validity of the measurement. In an individual and situation-specific instrument, such as the WAD-DCA, where there is an option to openly describe the most stressful situation, it could be difficult to test reliability with traditional methods (e.g. test-retest and inter-rater reliability). Hence, the situation can be very inconsistent not only between patients, but also concerning the same individual over time. For example, the patients may not record the same stressful situation at assessment as they do at reassessment (127). This needs to be considered and solved in future work with the instrument.

The coping process in the study was analysed with each daily coping assessment as the unit of analysis, not the subjects. Thus, the same individual contributed with more than one daily assessment. WAD-DCAs from the same individual could therefore be considered dependent observations, i.e. there is a risk that the answers in the daily coping assessments from one individual were influenced by how the previous day was perceived and how the next day would be. The possible difference in WAD-DCAs collected from participants that made their recordings during the e.g. the second week after the accident compared with WAD-DCAs recorded e.g. 4 weeks after the accident, can present a potential temporal bias in the coping process that we did not analyse. Any differences between the different recording weeks could be a confounding factor in the results.

**Study III**

One threat to external validity of the results in Study III is that the sample was partly self-selected based on subjective statements of being mildly affected and in no need of treatment. Nevertheless, the systematically collected clinical data at baseline confirmed the participants’ statements of being mildly affected, at least on a group level.

Our prediction model was based on one point in time measurements, whereas Sterling and colleagues (30) accentuate the value of including time-changing variables for the study of prognostic factors. We considered the inclusion of change scores in our predictive model, but did not find it motivated since changes over time were small in the included sample. Instead we stayed with our initial research question of validation of previously identified predictors of prognosis in this particular subsample.

The risk of floor effects in the pain intensity and pain-related disability measurement should also be considered, particularly in connection to clini-
cally relevant improvements that have been reported to 11 points or more on the PDI (128). Thirty-one participants reported a score of 0 on the PDI at the 12-month follow-up, possibly indicating that the PDI may not be sensitive enough to capture variations in mild residual disability or that these participants did not have any residual disability. Whether such variation is of clinical importance is hard to rule out, however.

Study IV
The external validity and statistical conclusion validity in Study IV need to be reflected on. Since the recruitment of participants was much slower than expected, and the sample size originally planned for was not achieved, the current small sample size may influence the generalisability of our results and limit the statistical power in our study. Various methods were undertaken to enhance the recruitment. However, the main reason for the small number of eligible participants was that the majority with initial symptoms at the emergency unit no longer suffered persistent pain or disabling symptoms when they were contacted for inclusion two weeks after the injury. Despite the low statistical power of the trial, most differences between experimental and control groups were significant and deemed clinically relevant. A correction (Bonferroni) of the significance levels in the pairwise comparisons between the treatment groups in PDI was done to reduce the risk of Type I error due to multiple tests. The use of a correction like Bonferroni is a controversial topic, with many different and conflicting views among statisticians (129-131). This more conservative approach was used in our study since the particular analyses were considered post-hoc analyses, i.e done after the main analyses between all three groups.

Finally some comments about the internal validity of Study IV are needed. This study did not evaluate if any behavioural medicine treatment ingredient was more active than any other. The whole treatment package including seven predefined phases and tailored behaviour change techniques was compared with respect to delivery method and to standard care. The behavioural medicine intervention was based on a previously tested treatment protocol for patients with subacute and chronic musculoskeletal pain in primary healthcare settings (55). For the present study the protocol was modified to suit a quicker progress in the natural course of recovery in acute WAD, e.g. by working parallel with some of the seven phases. Still, all phases in the original protocol were included in this study. In the future, a dismantling study aiming to determine which are the necessary components and strategies of the individually tailored behavioural medicine intervention for acute WAD would be of great value.
Conclusions and future directions

The conclusions are:

- Numerous of regular daily living activities are perceived as stressful threats by individuals with acute WAD. Thus the way of measuring coping strategies only associated with pain as the stressor seems to be too restrictive for understanding how individuals cope in the acute stage of WAD. Hence, activity-related stressors should be acknowledged in the management of acute WAD.

- Two clear coping patterns seemed to be associated with daily activity levels and physical and psychological daily well-being in acute WAD. High self-efficacy beliefs in coping and active coping strategies were associated with higher levels of daily activity and well-being. Threatening stressors, low self-efficacy beliefs and more passive coping strategies, i.e. catastrophising and taking medicine, were associated with lower levels of daily activity and well-being. Thus, identifying components in the coping process in clinical practice can be important in the future management of acute WAD.

- Self-perceived disability in the acute stage of WAD represents a risk for long-term pain-related disability in mildly affected subjects. In clinical practice patients with acute WAD should be screened for their disability levels.

- A behavioural medicine intervention applied in the acute stage of WAD, tailored (by a functional behavioural analysis) to the individual’s preferred activities and level of self-efficacy, fear of movement/(re)injury and catastrophising, was shown to be more effective than current treatment recommendations. This approach is therefore a preferable management in acute WAD.

- The behavioural medicine intervention delivered via the Internet with e-mail support is an effective alternative to more traditional clinic-based face-to-face therapy sessions.
This thesis also highlights the need of further knowledge in some aspects.

*Suggestions for future studies are:*

- The daily coping measurement WAD-DCA needs to be studied in terms of psychometric properties in the future.

- The causal relationship between the daily coping components, as measured with the WAD-DCA, need to be studied to theoretically strengthen the coping pattern model.

- Further studies are needed whether WAD-DCA could be used as tool for the FBA in the behavioural medicine intervention, i.e. in the tailoring to better understand which psychological components that should be included in the intervention.

- Dismantling studies aiming to determine which are the necessary components and strategies in the individually tailored behavioural medicine intervention for acute WAD would be of great value.

- Future studies need to examine more closely under what condition the Internet is preferred to face-to-face delivery, and also study the health economic aspects of the different delivery methods.

- The role of recovery expectations in the acute stage of WAD, and the possibility of modifying them, need to be further investigated.
Trots att majoriteten av de som får whiplashrelaterade besvär (WAD) tillfrisknar, drabbas ca 160/100 000 invånare i Sverige av långvariga symptom och aktivitetsbegränsningar varje år. Detta medför ett stort personligt lidande och en stor ekonomisk börd för såväl samhället som för individen. Evidensläget pekar på att ett brett angreppssätt utifrån ett biopsykosocialt perspektiv behövs för att förstå komplexiteten i WAD problematiken, men det saknas fortfarande forskning kring om beteendemedicinska insatser i det akuta skedet kan påverka faktorer som visat sig vara viktiga för utvecklingen långvariga och aktivitetsnedsättande besvär.

I denna avhandling ingår fyra delstudier. Det övergripande syftet med avhandlingen var att studera olika biopsykosociala faktorer i det akuta skedet av WAD. Genom att öka kunskapen kring påverkbara prognostiska faktorer i syfte att förbättra omhändertagandet i det tidiga skedet, skulle risken för utveckling av långvariga besvär och aktivitetsnedsättning kunna minskas. I samtliga delstudier rekryterades patienter i det tidiga skedet av WAD i samband med att de besökte akutmottagningarna i 6 olika kommuner i Mellansverige. Sammanlagt ingick 3 urvalsgрупп i avhandlingen. Urvalsgrupp A ingick i Studie I och II. Urvalsgrupp B och C ingick i Studie III. Urvalsgrupp C ingick dessutom i Studie IV.

Syftet med Studie I var att undersöka vilka dagliga situationer och händelser, som uppfattas stressfyllda (s.k. stressorer) i det tidiga skedet efter olyckan. Femtoen personer med akut WAD fick dagligen under en vecka fylla i ett för studien nykonstruerat mätinstrument (WAD-DCA), som bland annat undersökte den mest stressfulla händelsen under dagen och hur den uppfattades. Sammanlagt analyserades 260 WAD-DCAs. Resultaten från studien visade att smärta och andra fysiska besvär bara var några av många olika stressorer som rapporterades i det akuta skedet. Allra vanligast var stressorer relaterade till själva arbetssituationen, t.ex. långvarigt sittande framför dator eller arbetsmoment som innebar tunga och monotona lyft. Även stressorer relaterade till känslor och tankar, så som oro och frustration relaterad till själva olyckan, hur den kommer påverka livet samt känslor av att känna sig missförstådd, var ofta förekommande. Resultaten visade att bilden av vilka dagliga hinder och svårigheter personer i det akuta skedet av WAD upplever och behöver hantera är mer komplex än vad tidigare forskning har visat. Att
enbart fokusera på hur individer hanterat smärta som enda stressor i det tidiga skedet av WAD tycks inte tillräckligt väl spegla faktorer som kan påverka individernas aktiviteter i det dagliga livet.

I Studie II analyserades 229 WAD-DCAs från de 51 deltagarna i urvalsgrupp A, i avseende på hur de dagliga stressorerna uppfattades och hanterades i relation till skattad daglig aktivitetsnivå, smärtsintensitet och psykiskt välbefinnande (oro resp. nedstämdhet). Genom att studera hur dessa olika delar i copingprocessen samvarierade visualiserades olika copingmönster. De dagar då personerna rapporterade hög aktivitetsnivå, låg smärta, oro och nedstämdhet skattades oftare hög tilltro till att klara av att hantera stressorn och aktiva copingstrategier användes i högre utsträckning. De dagar då personerna istället hade angivit låg daglig aktivitetsnivå, hög smärta, oro och nedstämdhet uppfattades stressorn som mer hotfull och det var vanligare med katastroftankar och att hantera situationen genom att ta smärtstillande medicin. Det tycks alltså finnas copingmönster som är mer eller mindre gynnsamma för hur personer med akut WAD klarar dagliga aktiviteter och uppfattar sitt dagliga fysiska och psykiska välbefinnande.

I Studie III undersökt om prognostiska faktorer som tidigare visat sig betydelsefulla för långtidsförloppet hos WAD patienter, även gällde för en grupp \((n=98)\) med små initiaala besvär som inte uppfattade sig vara i behov av vård i det akuta skedet (MIAS) (Urvalsgrupp B). Även en jämförelse av karaktäristika i det akuta skedet, gjordes med en grupp \((n=55)\) med måttliga till svåra besvär (MOSAS) (Urvalsgrupp C). Resultaten från studien visade att endast självskattad smärtrelaterad aktivitetsnedsättning vid baslinjen, dvs. 2-4 veckor efter olyckan, var det som predicerade aktivitetsnedsättning 12 månader senare. Enligt studiens resultat tycks därför inte tidigare forskning som pekat på smärtsintensitet och self-efficacy som prediktorer för smärtrelaterad aktivitetsnedsättning vid 12 månader efter olyckan, gäller för en förhållandevis friskare grupp av personer med WAD.

De insatser som för närvarande rekommenderas i det akuta skedet av WAD består av generella egenvårdsinstruktioner (Standardråd) som framförallt är fysiskt inriktade och ofta ges muntligen och skriftligen vid besöket på akutmottagningarna. I Studie IV som var en randomiserad kontrollerad tregruppsstudie, undersökte de kort och långsiktiga effektarna av dessa standardråd jämfört med en individuellt skräddarsydd beteendemedicinsk inriktad behandling administrerad antingen via Internet (IT) eller via ”face-to-face” (FtF) med sjukgymnast i klinik. Femtiofem deltagare randomiserades till behandlingsgrupperna inom 2-4 veckor efter skadetillfället. Resultaten visade att trots att det var en signifikant förbättring \(inom\) samtliga grupper över tid vad gäller smärtrelaterad aktivitetsnedsättning, smärtsintensitet och self-efficacy, så var förbättringen större i IT och FtF grupperna. Det förelåg
en signifikant skillnad mellan grupperna i behandlingseffekt (mätt över alla tidpunkter) i samtliga variabler ovan utom i smärtintensitet. Det fanns dock ingen signifikant skillnad mellan de två grupper som fått beteendemedicinsk behandling, dvs. IT vs FtF. Konklusionen av Studie IV är att en individuellt skräddarsydd beteendemedicinsk behandling tycks vara mer effektiv både på kort och lång sikt än nuvarande rekommenderade standardbehandling i det akuta skedet av WAD och att behandlingen både kan ges via Internet eller ”Face to Face”.

Med ett beteendemedicinskt förhållningssätt redan i det akuta skedet av WAD kan kunskapen kring den komplexa problematiken förbättras ytterligare. Genom tidig identifiering av individ- och situationsspecifika fysiska, kognitiva och beteendemässiga faktorer (så som hög smårtrelaterad aktivitetsnedläggning, rörelserädsla, katastroftankar, och låg self-efficacy) kan omhändertagandet i tidiga sked av WAD förbättras jämfört med nuvarande praxis. Användandet av nya innovativa metoder för distribuering av behandlingsinsatser tycks vara bra alternativ till mer traditionella former. Fortsatt forskning behövs kring utvärderingsinstrument som på bästa sätt kan fånga/screena för betydelsefulla individ- och situationsspecifika faktorer. Även fortsatt forskning kring vilka ingredienser som är mest verksamma i den individuellt skräddarsydda beteendemedicinska behandlingen, liksom hälsoekonomiska aspekter av olika administrationssätt av behandlingen är önskvärd i framtiden.
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