A follow-up of patients with chronic musculoskeletal pain, focusing on multimodal rehabilitation

Daniel Merrick
To my parents for their never fading support and belief in me

*In the confrontation between the stream and the rock, the stream always wins - not through strength but by perseverance.*

- H Jackson Brown
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ABSTRACT

Chronic pain is usually defined as pain of more than three months duration. The prevalence of chronic pain among the general population in Sweden is 18%. Compared with the general population, these patients report lower life satisfaction, decreased activity in daily life and higher levels of depression with decreased work ability, and increased sick leave. Research indicates that multimodal rehabilitation (MMR) programmes, including cognitive behavioural approaches for patients disabled by chronic pain, are effective for return to work.

The primary aim of this thesis was to assess outcomes by a long-term follow-up of patients with chronic musculoskeletal pain. Furthermore, the aim was to evaluate two different rehabilitation strategies regarding impact on pain intensity, activity, depression, life satisfaction, and sick leave.

Two groups, comprising 255 (between the years 1999-2002) and 296 (between 2007-2008) patients respectively, from the Pain Rehabilitation Clinic at Umeå University Hospital, Sweden, were all assessed by interdisciplinary teams. They completed questionnaires regarding pain intensity, disability, life satisfaction, anxiety and depression, and sick leave, before intervention, immediately after intervention (only the first group; n=255), and at one-year follow-up, after participating in a MMR programme in a specialist clinic, or after receiving a rehabilitation plan (RP) with follow-up in primary care. Allocation to either of the two groups was based on the initial interdisciplinary team assessment. Furthermore, a five-year follow-up of 158 patients with whiplash injury was conducted.

Pain intensity decreased and life satisfaction increased significantly regarding somatic health in both groups, at follow-up. In addition, depression improved and disability decreased to a higher extent after participating in the MMR programme as compared to RP and subsequent follow-up in primary care. Patients’ positive beliefs about recovery, and positive expectations about work correlated with favourable rehabilitation outcomes. Sick leave at one year follow-up decreased in both groups.

Regarding whiplash injury, patients who reported moderate or severe disability also reported significantly higher pain intensity, depression and post-traumatic stress scores and lower perception of general health compared with patients who reported mild or no disability.

In conclusion, MMR programmes seem to be beneficial by decreasing pain intensity, depression, disability and sick leave among patients with chronic musculoskeletal pain. Furthermore, patients’ positive beliefs correlate with more favourable long-term outcomes. An interdisciplinary team assessment based on a biopsychosocial approach may be of value for selection of rehabilitation strategy.
SVENSK SAMMANFATTNING

Smärta definieras vanligen som 'långvarig' om den kvarstår längre tid än tre månader. Förekomsten av långvarig smärta bland befolkningen i Sverige är 18 %. Jämfört med befolkningen i allmänhet rapporterar patienter med långvarig smärta lägre livstillförsättelse och minskad daglig aktivitetsnivå samt högre grad av depression, som påverkar arbetsförmåga och sjukskrivning. Forskning visar att multimodala rehabiliteringsprogram (MMR) som inkluderar ett kognitivt arbetssätt vid rehabilitering av patienter med långvarig smärta har betydelse för arbetsåtergång.


Smärtintensitet minskade och livstillförsättelse ökade signifikant avseende fysisk hälsa vid uppföljning i båda grupperna. Dessutom minskade graden av depression och aktivitetsnivån ökade i högre omfattning i gruppen som deltog i MMR jämfört med gruppen som hade mottagit RP och uppföljning inom primärvården. Patientens positiva tilltro till framtidens förbättring och positiva förväntan om arbete föreföll vara viktiga faktorer för framgångsrik rehabilitering. Vid ett-års uppföljningen minskade sjukdomen i både MMR och RP gruppen.

Whiplashpatienter med medellsvår till svår funktionsnedsättning rapporterade högre skattnings av smärtintensitet, depression och posttraumatisk stress samt lägre upplevd hälsa jämfört med patienter med lätt eller ingen funktionsnedsättning.

Sammanfattningsvis förefaller MMR program vara betydelsefulla för att minska smärta, depression och sjukdom samt för att öka aktivitetsnivån hos patienter med långvarig smärta. Patientens tilltro till framtidens förbättring var relaterat till ett gynnsammare långsiktigt resultat. En interdisciplinär teambedömning baserad på ett biopsykosocialt arbetsätt förefaller vara värdefullt för att bestämma vilken rehabiliteringsstrategi som kan vara lämplig.
# Thesis at a glance

Table I. Thesis at a glance. Summary data on population sample, dropout analysis, study design, follow-up period, instruments, intervention, data collection, and results.

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Population</td>
<td>255 patients</td>
<td>296 patients</td>
<td>296 patients</td>
<td>304 patients</td>
</tr>
<tr>
<td>Dropout analysis</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Study design</td>
<td>Retrospective</td>
<td>Prospective</td>
<td>Prospective</td>
<td>Retrospective</td>
</tr>
<tr>
<td>Follow-up</td>
<td>Before and after MMR, and at one-year follow-up</td>
<td>Before and at one-year follow-up</td>
<td>Before and at one-year follow-up</td>
<td>At five-year follow-up</td>
</tr>
<tr>
<td>Instruments</td>
<td>-VAS, -DRI, -Four of the LiSat-11 domains</td>
<td>-VAS, -DRI, -LiSat-11</td>
<td>-Sick leave -MPI (Additional instruments were used, see Paper III)</td>
<td>-NDI, -VAS, -RPQ, -IES, -BDI-II, -LiSat-11</td>
</tr>
<tr>
<td>Intervention</td>
<td>Interdisciplinary assessment and MMR programme</td>
<td>Interdisciplinary assessment and MMR programme or Interdisciplinary assessment with RP and follow-up in primary care</td>
<td>Interdisciplinary assessment and MMR programme or Interdisciplinary assessment with RP and follow-up in primary care</td>
<td>No intervention, a follow-up of symptoms and psychological factors five years after whiplash injury</td>
</tr>
<tr>
<td>Data collection</td>
<td>Self-completed questionnaires</td>
<td>Self-completed questionnaires and reminders by phone</td>
<td>Self-completed questionnaires and reminders by phone</td>
<td>Self-completed questionnaires and reminders by phone</td>
</tr>
<tr>
<td>Results</td>
<td>Pain intensity, life satisfaction, and to a small extent, activity improved.</td>
<td>The MMR group had long-term positive effects on pain intensity, disability, depression and domains of life satisfaction. The RP group, improved in pain intensity and ‘somatic health’.</td>
<td>In both the MMR group, and the RP group sick leave decreased. All MPI scales in the MMR, and some MPI scales in the RP group improved.</td>
<td>The group with the highest disability score reported most health problems with pain intensity, whiplash-related symptoms, depression, post-traumatic stress and decreased life satisfaction.</td>
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# ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>ADL</td>
<td>Activities of Daily Living</td>
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<td>BDI</td>
<td>Beck’s Depression Inventory</td>
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<td>CI</td>
<td>Confidence Interval</td>
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<tr>
<td>CBT</td>
<td>Cognitive Behavioural Therapy</td>
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<tr>
<td>DRI</td>
<td>Disability Rating Index</td>
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<tr>
<td>HADS</td>
<td>Hospital Anxiety and Depression Scale</td>
</tr>
<tr>
<td>HADS-A</td>
<td>HADS-Anxiety</td>
</tr>
<tr>
<td>HADS-D</td>
<td>HADS-Depression</td>
</tr>
<tr>
<td>IES</td>
<td>Impact of Event Scale</td>
</tr>
<tr>
<td>LiSat-11</td>
<td>Life Satisfaction</td>
</tr>
<tr>
<td>MMR</td>
<td>Multimodal Rehabilitation</td>
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<tr>
<td>NDI</td>
<td>Neck Disability Index</td>
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<tr>
<td>RP</td>
<td>Rehabilitation Plan</td>
</tr>
<tr>
<td>RPQ</td>
<td>Rivermead Post-Concussion Symptoms Questionnaire</td>
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<tr>
<td>SQRP</td>
<td>Swedish Quality Registry for Pain Rehabilitation</td>
</tr>
<tr>
<td>VAS</td>
<td>Visual Analogue Scale</td>
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<tr>
<td>WAD</td>
<td>Whiplash Associated Disorders</td>
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</table>
This thesis is based on the following four papers, which will be referred to in the text by their Roman numerals.


**III.** Merrick D, Sundelin G, Stålnacke BM. A follow-up of two different rehabilitation strategies for patients with chronic pain, focusing on sick leave. In manuscript.


Papers I, II and IV are reprinted with kind permission from the publishers.
INTRODUCTION

Definition of pain

The definition of pain according to The International Association of the Study of Pain (IASP) (1) is: ‘An unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage’. Thus, pain is always a subjective experience.

Chronic pain

Chronic pain is defined as pain of at least three months duration (2). The prevalence of chronic musculoskeletal pain with moderate to severe intensity in the general Swedish population is 18% (3). Some studies support that women have higher prevalence rates of chronic musculoskeletal pain, are more likely to report more severe pain, and in a greater number of body regions than men (4-7). Musculoskeletal pain is one of the most common reasons for a visit to primary health care in Scandinavia, where 20-50 % of those seeking health care experience chronic pain (8, 9). Unfortunately, once chronic pain is established, the natural course typically encompasses persistence of pain if no interventions are made (10).

Some cases of musculoskeletal pain are due to injuries related to road accidents, falls, and sports. In Western countries, whiplash injuries as a result of road accidents have a high incidence: 1.0 to 3.2/1000/year (11, 12). Whiplash injuries may lead to a number of clinical symptoms known as whiplash-associated disorders (WAD) with neck pain, neck stiffness, shoulder pain, headache as well as dizziness, concentration problems, fatigue, visual and auditory symptoms and emotional disturbances (13). The long-term outcome of patients with WAD have shown that 14-42% develop chronic neck pain (14).

In general, patients with chronic musculoskeletal pain report more frequent use of health care (15), low levels of life satisfaction (16), low self-perceived level of activity (17), and increased stress, anxiety and depression (18), with impact on work ability, sick leave as well as disability pensions. This generates great suffering for the individual and substantial costs to society (2). Back and/or neck pain together with psychological disorders are reported to be among the leading causes of long-term sick-listing and new disability pensions in Sweden (19).

Apart from the individual suffering, chronic pain causes major consequences and costs for society. In a recent paper, the socio-economic burden of patients with a diagnosis related to chronic pain was estimated to 32 billion Euros per year in Sweden (20).
Biopsychosocial model in chronic pain

Since the etiology of chronic musculoskeletal pain is multifactorial and complex, a biopsychosocial model is needed to cover all aspects of chronic pain conditions and their rehabilitation (21).

In order to fully grasp how patients perceive and respond to chronic pain, one must consider a nexus of interacting biological, psychological and social factors (22). Thus, there is a need to better understand the biological causes of pain such as genetic disposition, anatomical, pathological and physiological disturbances or changes, as well as to better address the psychological aspects of illness like depression, coping strategies, behaviour etc. Additionally, social conditions such as family environment, social support, and culture which all affect chronic pain also need to be taken into account (23).

The biopsychosocial model provides an integrated framework where all three domains are considered. If one or several of these domains are ignored, it will probably lead to less favourable outcomes (24).

Rehabilitation team models

Multidisciplinary team model

The multidisciplinary team model works in a vertically hierarchical manner, where multiple professionals are involved (25). Typically, most interactions occur through one attending physician, who is in charge of the team. The team members are discipline-oriented and conduct investigations regarding the patient, only relating to their own discipline. The team may consist of physicians with different specialties, a physiotherapist, an occupational therapist, a social worker, a psychologist, and a nurse.

Interaction between team members is limited and occurs only if the physician in charge decides it to be necessary. The patient is not an active team member, and therefore not fully involved in the goal settings (25).

Interdisciplinary team model

The interdisciplinary team model works in a horizontal manner (25). The expected norm is group decision making and group responsibility for developing optimal care planning. The patient is considered part of this planning group and has a central role in the team’s considerations and goal settings. One team member usually acts as patient care coordinator.

This type of team model requires training in the team process, something which is not generally part of basic formal training in the individual disciplines (25).
Transdisciplinary team model

Transdisciplinary teams encourage communication and transgressions of disciplinary boundaries (25). Such teams have largely developed out of necessity in situations with inadequate availability of a full team. The patient is in focus and the disciplines work across borders to achieve the goals as defined by the whole group, including the patient. Moreover, exchange of information across disciplines is highly encouraged, with disciplines thereby benefitting from expansion of their own professional expertise.

Whether such informally shared professional knowledge and cotreatment leads to sufficiently competent therapists especially when operating in each other’s fields is however doubtful (25).

Multimodal Rehabilitation (MMR)

MMR programmes are based on the biopsychosocial model (26) where all three previously mentioned domains are addressed simultaneously. The MMR programmes typically utilize a cognitive behavioural therapy (CBT) approach that plays a key role in dealing with the psychosocial component of chronic pain (27). The CBT approach focuses on behaviour activation and modification of dysfunctional thoughts, where the professions work by guiding and supporting the patient’s gradually changing behaviour, thoughts and underlying cognitive structures (28). The term ‘multimodal rehabilitation’ implies rehabilitation using several ‘modalities’ rather than only one or two, and further implies that several professions work in teams, in which the patient is one active member. In MMR the teams work according to the interdisciplinary approach. This is done by way of broad, coordinated, comprehensive and goal-oriented rehabilitation programmes. Patients are expected to participate actively in collaboration with the team in goal setting and in subsequent efforts to reach the decided goals. Hence, MMR programmes include a combination of physical and psychological interventions performed by teamwork. The interventions are partially profession-specific, but also include pedagogical components (e.g. pain education and methods of coping) to be implemented across professional boundaries.

Reviews demonstrate that MMR programmes for patients disabled by chronic pain are more effective than unimodal treatment (29–32) and that they are effective in reducing days on sick leave as well as promoting a return to work (32, 33). The effects appear to be stable over time (34). Compared with other active treatments, MMR seems to yield superior results as regards changes in pain experience, in cognitive coping and appraisal and also in reducing the behavioural expression of pain (29, 30).

However, a recent review also disclosed the heterogeneity of MMR programmes (31). The review revealed that some MMR programmes, occur in an outpatient setting whereas others are conducted in an inpatient setting. Furthermore, the psychological approach differed, with some programmes
using cognitive behaviour approaches and others operant behavioural approaches. The follow-up period after the programmes varied, ranging from 6 up to 60 months with a median of 12 months (31). Outcome measurements likewise differed. In addition, it was concluded that it is still not known which of the programme components that indeed matters for a successful rehabilitation; nor is it known whether all patients benefit from all components in an MMR programme (31).

**Patients’ beliefs about the future**

Unfortunately there is a lack of consistent terminology to express the patients’ pre-treatment beliefs. The terms ‘patients’ beliefs’, ‘expectation’, ‘patients’ motivation’ or ‘self-efficacy beliefs’ (35) are all examples of terms used to cover this dimension. Nevertheless, pre-treatment beliefs seem to be an important predictor for outcome of rehabilitation as regards physical improvement (36, 37), working ability, and quality of life (38). MMR also seems to improve the highly motivated patients quality of life most cost effectively (39).

Good coping strategies and motivation for change are important factors for improving quality of life and the ability to handle daily activities, and may support a favourable treatment outcome (40).

Patients’ beliefs about their future may change during participation in a MMR programme based on cognitive behavioural approach (41). There is support for the view that MMR programmes could increase patients’ self-efficacy beliefs regarding control of their pain, increase their internal locus of control over pain and at the same time reduce their perception of an external locus of control of pain. This is accompanied by improvements in the patients’ perception of their level of disability (41, 42).

**Interdisciplinary team assessment**

Due to the heterogeneity of patients with chronic pain and due to individual differences in patient responses to MMR, it is not clear who will benefit the most from such a rehabilitation programme (31, 32). Although patients may undergo some kind of assessment and selection prior to MMR this procedure is poorly described in the literature (32).

In clinical practise, the great majority of patients who are referred to pain rehabilitation centres in Sweden are only assessed by interdisciplinary teams usually for determining vocational ability, and a minor proportion participate in MMR after the assessment (43).
The Swedish Quality Registry for Pain Rehabilitation (SQRP)

The SQRP has been in operation since 1998 (46). This database includes patient data collected at initial assessment. For those subsequently selected for MMR, data are then also collected immediately after completion of the programme, as well as at one-year follow-up. It contains self-completed questionnaires covering demographics, pain intensity, disability, life satisfaction, anxiety and depression, multidimensional pain inventory, and sick leave.

In 2007, approximately 20,000 patients were thus included from 18 rehabilitation units. Of these patients, about 13,000 were assessed only. The duration of assessment differed between units, ranging from one day to fourteen days. About 7,000 patients were ultimately selected for participation in a MMR programme during the period 1999-2007.

The inclusion criteria for SQRP are: i) age 18-65 years ii) disabling chronic pain (i.e. on sick leave or experiencing major interference in daily life due to chronic pain for more than 3 months).

Swedish social insurance and sickness benefits

Persons, with a medical condition that contributes to a decreased ability to work are entitled to so-called sickness benefits from the Swedish social insurance (44). Depending on residual work capacity, sickness benefits can be obtained for a full, three-quarter, half or a quarter of a day.

Prior to 1 July 2008 there was a potentially unlimited time period for the ultimate duration of sickness benefit (44). After that date changes in the sickness insurance system were implemented by the government. Some of these changes included a Rehabilitation Chain with a fixed schedule for work ability assessment of eligibility for sickness benefits.

Moreover, a time frame of a maximum of 364 days during a 450-day period for sickness benefits (80% of work income) was introduced. If work capacity remains reduced after that time, extended sickness benefit (75% of work income) can be applied for up to 550 days. Furthermore, persons with severe illness may be granted sickness benefits, and persons with long-term disease who probably will never be able to work again may obtain sickness compensation or activity compensation (44).

These political structural changes may have had an impact on the present study results and will be further elaborated on in the discussion section of this thesis.
Scope of the thesis

As has been elaborated so far, there is scientific support for the efficacy of MMR for reducing days on sick leave as well as promoting a return to work (32, 33). However, a vast majority of patients with chronic pain do not receive MMR (32).

Rehabilitation is as such gaining increasing interest. After an agreement in 2008 between the Swedish government and the Swedish Association of Local Authorities and Regions (SALAR), efforts are being made to increase the availability of evidence-based therapies including MMR at primary care health centres (45). It is still too early to evaluate the long-term effects this investment may have on sick-leave and disability pensions. Our studies were initiated before this agreement.

The present studies were performed at the Pain Rehabilitation Clinic, Umeå University Hospital, with a catchment area of close to 1 000 000 inhabitants. Each year about 500-600 patients with chronic pain are referred to the rehabilitation clinic, the majority coming from the primary care physicians in the catchment area.

During the period of the present studies, the patients either underwent an interdisciplinary two-day team assessment and recommended to participate in an MMR programme at the clinic or received a RP with follow-up in primary care.

In total, approximately 75 % of the patients at the Pain Rehabilitation Clinic, Umeå University Hospital, that underwent a two-day interdisciplinary team assessment received a RP with follow-up in primary care. The long-term outcomes after the two-day interdisciplinary team assessment have not been evaluated, and thus comprises an important part of the scope of this thesis. Consequently, 25 % are selected to MMR. The cost of a two-day interdisciplinary team assessment is approximately 2000 Euros and a four-week MMR programme costs 6200 Euros (data from 2012).
AIMS OF THE THESIS

The overall aim of this thesis was to follow-up rehabilitation outcomes of patients with chronic musculoskeletal pain, focusing on MMR.

The specific aims were to analyse:

- the outcomes pain intensity, activity, and life satisfaction of MMR immediately after, and at one-year follow-up after completion of the programme (Paper I).

- the two different rehabilitation strategies (i.e. interdisciplinary assessment and MMR, and interdisciplinary assessment with a RP and follow-up in primary care) at one-year follow-up regarding the outcomes: pain intensity, activity, depression, anxiety and life satisfaction (Paper II).

- the two different rehabilitation strategies (i.e. interdisciplinary assessment and MMR, and interdisciplinary assessment with a RP and follow-up in primary care) at one-year follow-up regarding the outcomes sick leave, and multidimensional pain inventory (Paper III).

- differences between subgroups based on Neck Disability Index (NDI) regarding symptoms, pain intensity, depression, post-traumatic stress and life satisfaction five years after whiplash injury (Paper IV).
PATIENTS AND METHODS

Design

This thesis includes both retrospective observational register studies and prospective studies conducted in a clinical setting. In the first three Papers follow-up was done one year after interventions. In Paper IV no intervention was evaluated, but a general five-year follow-up.

Patients Papers I-III

Patients disabled by chronic pain (i.e. on sick leave or suffering major interference in daily life causing treatment seeking behaviour due to chronic pain) age 18-65 years were referred mainly from primary care units to the pain rehabilitation clinic. If the patient was referred from a specialist working in any of the county hospitals, the patient’s designated general practitioner was contacted to verify that he/she agreed to the patient referral.

Moreover, if the referral was adequate and the patient considered to potentially benefit from a two-day interdisciplinary team assessment, the referral was accepted and the patient invited to a visit at the Pain Rehabilitation Clinic.

Interdisciplinary assessment at the Pain Rehabilitation Clinic

The referred patients were assessed during two consecutive days at the Pain Rehabilitation Clinic by interdisciplinary teams consisting of a specialist physician in rehabilitation medicine, a physiotherapist, a social worker, an occupational therapist, and psychologist if needed. This two-day team assessment was based on a biopsychosocial approach. Each professional interviewed and examined the patients individually. The team also assessed the patients’ expectations and readiness for change. The team discussed their separate findings and then provided suggestions for further investigation and/or rehabilitation at a team conference in the absence of the patient. On the second day, findings, appraisals and recommendation of rehabilitation were discussed at a team conference together with the patient, to which the referring general practitioner also was invited to attend. During the conference, the patient received information and explanations about his/her pain. Patients that met the inclusion criteria and were considered to benefit from MMR were selected to participate in an outpatient MMR programme for four weeks.
Inclusion criteria for the MMR programme were:

- disabling chronic pain (i.e. on sick leave or experiencing major interference in daily life due to chronic pain),
- age 18-65 years
- no further medical investigations needed
- written consent to participate in and attend the MMR programme
- agreement not to participate in other parallel treatments.

Exclusion criteria for the MMR programme were:

- ongoing major somatic or psychiatric disease
- significant substance abuse
- state of acute crisis

If the interdisciplinary team found that the patient needed further investigations, or was considered not sufficiently motivated to participate in the programme, or was considered to benefit as well (or better) from unimodal or intermediary treatment only, and/or did not fulfil inclusion criteria for the MMR programme, a rehabilitation plan (RP) was presented to the patient and his/her general practitioner. The RP included the team’s assessment of the patient’s pain condition and suggestions and recommendations for investigations, and rehabilitation. If the patient’s general practitioner could not attend the conference to which they were invited, the RP was sent to him/her to monitor. The subsequent implementation of the RP was not subjected to further analysis in this thesis.

The overarching goals for both interventions, (i.e. interdisciplinary assessment and MMR, and interdisciplinary assessment with a RP and follow-up in primary care) were reduced pain intensity, improved activity and life satisfaction (especially regarding somatic and psychological health). In addition, the specific goals for the MMR group were to improve coping strategies during the four-week outpatient programme and improve working ability.

**MMR at the Pain Rehabilitation Clinic**

The MMR programme included physiotherapy (exercises, relaxation and body-awareness training) and occupational therapy (ergonomics), information about bodily and psychological reactions to chronic pain, training in coping strategies according to a cognitive-behavioural therapy approaches as well as education in pain management. The patients were encouraged to take an active part in goal setting in the individual team conferences, which were held 2-4 times during the course of the programme.
Most treatments were conducted in groups of 6-8 participants, but each participant also had individually tailored sessions with members of the team.

The group schedule over the 4 weeks contained 34 hours of physiotherapy sessions, 11.5 hours of occupational therapy sessions, 15 hours of psychology sessions, 2 hours of lectures from a specialist physician in rehabilitation medicine and 2 hours of general information. At the end of the programme, contacts were established with external collaborating partners such as the workplace, the social insurance agency and the patient’s general practitioner.

The only systematic difference between the MMR programme in Paper I and Papers II-III was the programme duration. In paper I, the MMR programme lasted five weeks whereas it comprised four weeks in paper II-III. In addition, patients who had ‘WAD’ as primary diagnosis for less than 1.5 years were not included in Paper I, as they were managed in a separate programme at the time.
Figure 1. Flow chart Paper I. Patients were asked to present self-completed questionnaires before, immediately after, and at one year follow-up post-MMR. Outcome measures were: Visual Analogue Scale (VAS), Disability Rating Index (DRI), Life Satisfaction (LiSat-11) domains ‘Life as a whole’, ‘Vocational health’, ‘Somatic’ health and ‘Psychological health’. One hundred and sixty-eight patients (66%) provided data sets both before MMR and at one year follow-up. These were denoted respondents.

In Paper I, out of 255 consecutive patients who were treated in the outpatient MMR programme between March 1999 and October 2002, four patients had to be excluded due to missing data –denoted as ‘non-respondents’ (see flow chart in Figure 1). Of the remaining 251 patients, 83 patients handed in data from the first self-completed questionnaire but only incomplete data from the second and third self-completed questionnaires after the programme and at one year follow-up. These were denoted ‘partial respondents’. The respondents were 168 patients (133 women, 35 men),
In Papers II and III, 296 consecutive patients were assessed for selection to either a MMR (n=76) or a RP with follow-up in primary care (n=220) between March 1999 till October 2002. See Figure 2. Data were missing for ten patients in the RP group and for one patient in the MMR group, and these patients were thus excluded – ‘non respondents’. Both the first questionnaire at the two-day assessment and the second questionnaire after one year regarding pain intensity (VAS current pain and VAS pain average last week), the twelve DRI items, LiSat-11 and HADS were completed by 145 patients (95 women, 50 men) in the RP group and by 51 patients (44 women, 7 men) in the MMR group. These were denoted respondents. A drop-out analysis between dropouts and respondents was carried out, see Figure 2 (arrows) and Paper II.

Figure 2. Flow chart Papers II and III. In both Papers II and III the patients handed in self-completed questionnaires before, and at one year follow-up. Outcome measures for Paper II were: Visual Analogue Scale (VAS), Disability Rating Index (DRI), Life Satisfaction (LiSat-11), and Hospital Anxiety and Depression Scale (HADS). Outcome measures for Paper III were sick leave, and Multidimensional Pain Inventory (MPI).
Patients Paper IV

We used Umeå University Hospital’s injury and trauma register to identify persons who had sustained a whiplash injury during the year 2001. Inclusion criteria were patients seeking acute medical care for whiplash trauma within three days post trauma, and aged 18-64 years. Exclusion criteria were fractures/dislocations of the cervical spine and seeking medical care later than three days post trauma.

Thus, 304 patients were identified. Questionnaires were sent five years post injury. Data were missing for 110 patients and these patients were thus excluded – denoted non-respondents. Twenty-five patients actively declined participation and 21 patients were not reached. In addition, data were incompletely filled out by 33 patients. Altogether, 158 persons completed the NDI (83 women, 75 men). Demographics, injury characteristics, pain intensity (VAS), whiplash-related symptoms (Rivermead Post-Concussion Symptoms Questionnaire RPQ), depression (BDI-II), post-traumatic stress (Impact of Event Scale), life satisfaction (LiSat-11), and some additional questions on pain locations and sick leave were related to the results of the NDI.
Demographics Papers I-IV

Demographics are presented in Table II. In general, more than two thirds of patients were female in Papers I-III. The MMR group in Paper I, the MMR group in Papers II-III, and the RP group in Papers II-III, all had similar education and pain intensity levels, whereas the patients in Paper IV had higher education levels as compared to the other study groups. The MMR groups were more employed, had shorter pain duration, and had more positive beliefs about their future as compared with the RP group in Papers II-III.

Table II. Demographics and pain condition characteristics of the respondents for the four Papers.

<table>
<thead>
<tr>
<th>Paper</th>
<th>MMR Paper I</th>
<th>MMR in Papers II and III</th>
<th>RP in Papers II and III</th>
<th>Whiplash Paper IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>168 patients</td>
<td>51 patients</td>
<td>145 patients</td>
<td>158 patients</td>
</tr>
<tr>
<td>Gender (females)</td>
<td>79 %</td>
<td>86 %</td>
<td>66 %</td>
<td>53 %</td>
</tr>
<tr>
<td>Age (mean/median)</td>
<td>39/39</td>
<td>39/39</td>
<td>40/40</td>
<td>34</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-primary school</td>
<td>14 %</td>
<td>16 %</td>
<td>20 %</td>
<td>7 %</td>
</tr>
<tr>
<td>-secondary school</td>
<td>60 %</td>
<td>64 %</td>
<td>59 %</td>
<td>52 %</td>
</tr>
<tr>
<td>-university</td>
<td>24 %</td>
<td>18 %</td>
<td>19 %</td>
<td>40 %</td>
</tr>
<tr>
<td>-none</td>
<td>1 %</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>-missing data</td>
<td>1 %</td>
<td>2 %</td>
<td>2 %</td>
<td>1 %</td>
</tr>
<tr>
<td>Job status</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-employed</td>
<td>75 %</td>
<td>74 %</td>
<td>64 %</td>
<td>Different</td>
</tr>
<tr>
<td>-unemployed</td>
<td>14 %</td>
<td>16 %</td>
<td>23 %</td>
<td>classification,</td>
</tr>
<tr>
<td>-students</td>
<td>6 %</td>
<td>4 %</td>
<td>4 %</td>
<td>see Paper IV.</td>
</tr>
<tr>
<td>-others</td>
<td>3 %</td>
<td>4 %</td>
<td>8 %</td>
<td></td>
</tr>
<tr>
<td>-missing data</td>
<td>2 %</td>
<td>2 %</td>
<td>1 %</td>
<td></td>
</tr>
<tr>
<td>Pain duration (median)</td>
<td>43 months</td>
<td>46 months</td>
<td>57 months</td>
<td>-</td>
</tr>
<tr>
<td>Most common diagnosis</td>
<td>Columnar pain</td>
<td>Columnar pain</td>
<td>Columnar pain</td>
<td>Whiplash only</td>
</tr>
<tr>
<td>How convinced are you about recovery?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-positive outlook</td>
<td>44 %</td>
<td>53 %</td>
<td>28 %</td>
<td></td>
</tr>
<tr>
<td>-negative outlook</td>
<td>51 %</td>
<td>43 %</td>
<td>67 %</td>
<td></td>
</tr>
<tr>
<td>-missing data</td>
<td>5 %</td>
<td>4 %</td>
<td>5 %</td>
<td>-</td>
</tr>
<tr>
<td>‘Current pain’ (VAS median mm, percentiles 25; 75)</td>
<td>65 mm (47; 76)</td>
<td>64 mm (45; 75)</td>
<td>65 mm (48; 78)</td>
<td>15 mm (1; 45)</td>
</tr>
<tr>
<td>‘Pain average last week’ (VAS median mm, percentiles 25; 75)</td>
<td>66 (50; 78)</td>
<td>70 (51; 80)</td>
<td>70 (53; 82)</td>
<td>-</td>
</tr>
</tbody>
</table>

n = 165 n = 51 n = 145 n = 126
Data collection

The Pain Rehabilitation Clinic, Umeå has participated in SQRP since 1999 (46). Data were obtained for this registry by self-completed questionnaires before (on site; Papers I-III), immediately after (on site; Paper I) and at one year follow-up after (via mail; Papers I-III) the programme. Paper IV was a five year follow-up among patients who had sustained a whiplash injury during 2001.

For Paper I, data were collected from March 1999 to October 2002. For Papers II-III data were collected from 1 October 2007 to 30 September 2008.

For the one-year follow-up (Papers I-III) participants completed the questionnaire at home, to be returned by mail in prepaid addressed envelopes. If the patients had not answered within three weeks reminders were sent out by mail, and in some cases the patients were also reminded by phone.

We gathered data on pain intensity, denoted ‘pain now’/’current pain’ and ‘pain average last week’ (VAS) (47), DRI (48), LiSat-11 (49), HADS (50), MPI (51), and sick leave. Demographic data were obtained from all patients at assessment: age, gender, education, job status, diagnosis (52); number of days with persistent pain and patient’s beliefs about recovery.

For Paper IV information on subjects seeking acute medical care due to whiplash injury during the year 2001 was collected from Umeå University Hospital’s injury and trauma register. A five year follow-up with self-completed questionnaires of symptoms, RPQ (53), depression (BDI-II) (54), post-traumatic stress (IES) (55), disability (NDI) (56) and Life Satisfaction (LiSat-11) (49) were used.
Instruments

Demographic data (i.e. age, gender, education, job status, sick leave), pain condition characteristics (number of months with pain, current pain and pain average last week, diagnosis according to ICD-10 (52) and patients’ beliefs about the future) were all collected from SQRP (46).

Patients’ beliefs about the future

There were three questions regarding patients’ beliefs about the future: I) ‘How convinced are you about recovery?’ The anchor points were 1 = ‘entirely convinced about recovery’; 5 = ‘not at all convinced about recovery’. II) ‘How do you envisage, it will be to return to work, to study, or to extend your working hours?’ The anchor points were 1 = ‘very easy’; 5 = ‘very difficult’. III) ‘When do you expect to return to work, to study, or to extend your working hours?’ The anchor points were 1 = ‘as soon as possible’; 5 = ‘never’. The categories 2-4 were not specified. The responses were dichotomised into: 1-3 = positive outlook and 4-5 = negative outlook (57). These questions have not been validity or reliability tested.

Visual Analogue Scale (VAS)

A VAS was used to rate pain intensity for the previous 7 days (pain average last week) and pain now/current pain (47). The patient was asked to mark on a continuous 100 mm horizontal VAS his or her experienced pain. VAS has proven to be user-friendly and reliable (58), and has been validity tested for chronic pain and shown reproducibility for chronic pain (59).

Disability Rating Index (DRI)

The level of disability was measured by DRI (48). The DRI is a questionnaire covering 12 items concerning physical function and is constructed as a self-completed form, where the patient indicates on a 100-mm VAS their self-rated ability (capacity) to perform various daily physical activities. The anchor points were ‘manage without difficulty’ = 0 and ‘cannot manage at all = 100’. The 12 items were divided into three sections; 1-4, common basic activities; 5-8, more demanding daily physical activities; 9-12, work-related or more vigorous activities. The DRI items can be analysed separately and/or as a total mean index score, the DRI. The instrument has proven to be both reliable and valid for patients with chronic neck, shoulder and low back pain (60).

Life Satisfaction (LiSat-11)

LiSat-11 (49) comprises estimations of life satisfaction in eleven domains. Levels of satisfaction were assessed on a 6-grade scale (from 1 = ‘very dissatisfying’ to 6 = ‘very satisfying’), i.e. higher scores indicating higher
levels of life satisfaction. LiSat-11 scale was dichotomized into either ‘satisfied’ (5-6) or ‘not satisfied’ (1-4). Only persons with a family, partner, etc., were asked to complete the corresponding domains. LiSat-11 has been shown to have a fairly good test-retest reliability, specificity, and sensitivity (49).

**Hospital Anxiety and Depression Scale (HADS)**

HADS (50, 61) was used to identify symptoms of anxiety and depression. It consists of 14 items (7 items in each subscale) to be assessed on a 4-point Likert scale (range 0-3), where the total score is the sum of each subscale (range 0-21). HADS is categorised as ‘normal’ (0-7 points), ‘mild’ (8-10 points) and ‘moderate/severe’ (>10 points). HADS has proven to be reliable, valid, sensitive and specific when used to assess the symptom severity in anxiety and depression among somatic, psychiatric and primary care patients and in the general population (61). HADS-D shows a high correlation (61) to other depression scales such as the Beck Depression Inventory (BDI-II) (54).

**Multidimensional Pain Inventory (MPI)**

The MPI is divided into three sections: one psychosocial part (section one) and two behavioural parts (section two and three) (51). Section one comprises five scales reporting ‘pain severity’, ‘interference’ with life, ‘support’ from significant others, ‘life control’, and ‘affective distress’ and contains altogether twenty-eight questions. The patient is asked to indicate on a 7-category scale ranging from 0-6. Section two contains reports of perceived responses from significant others. Section three contains questions concerning eighteen common activities. In this present study we have only used section one. MPI has been demonstrated to have good reliability and validity for heterogenous samples of patients with chronic pain (63).

**Rivermead Post-Concussion Symptoms Questionnaire (RPQ)**

Headache, dizziness, nausea etc are common symptoms reported after whiplash injuries. These symptoms are also common after concussion. The RPQ consists of 16 items asking the patient about the degree of experienced headaches, dizziness, nausea, noise sensitivity, sleep disturbances, fatigue, irritability, depression, frustration, poor memory, poor concentration, taking longer to drink, blurred vision, light sensitivity, double vision, and restlessness, over the previous, 24 hours, compared with before the head injury. The RPQ uses a rating scale with values 0 –4, from ‘no problem at all’ to ‘severe problem’. A total symptom score can be calculated as a sum of all scores (possible score 0–64) (53). RPQ has been shown to measure postconcussion symptom severity reliably in terms of test-retest and inter-rater reliability for total and individual scores (53).
Impact of Event Scale (IES)

The IES is a widely used validated self-completed scale for screening for post-traumatic stress disorder (PTSD) in high-risk populations (55). The IES comprises 15 self-report items, 7 statements regarding intrusive symptoms and 8 regarding avoidance symptoms associated with the experience of a traumatic event. A total score can vary from 0 to 80 and the score is divided into 4 grades from sub-clinical (0–8), mild (9–25), moderate (26–43) to severe (44–75) stress reactions.

Beck Depression Inventory (BDI-II)

The BDI second edition (BDI-II) is a 21-item self-report of depression over a 7-day period (54, 62). The response format ranges from 0 to 3 (with 3 indicating maximal distress). A total score includes all scores and has a range from 0 to 63. The BDI scores can be divided into 4 grades from minimal to severe depression. BDI-II is a widely used measure of depressive symptoms and is considered as a valid and reliable instrument for depression screening in a general population (64).

Neck Disability Index (NDI)

The NDI (56) is a self-reporting instrument for the assessment of ADL in persons with disabling neck pain. It includes 10 items: pain intensity, personal care (washing, dressing etc), lifting, reading, headaches, concentration, work, driving, sleeping and recreation. For each item, the subject has to choose one of six statements that best relates and describes problems that in turn correlates with a numeric value (0 = ‘no disability’ to ‘total disability’ = 5) for a maximum total score of 100 by adding together the scores for each item, multiplied by two. A higher score indicates greater disability. The scoring interpretation divides the NDI into three groups: 0-8 = recovered; 10-28 = mild; 30-100 = moderate/severe. The NDI is highly reliable, strongly internally consistent and has strong and well-documented convergent and divergent validity with other instruments used in subjects with neck pain (65).
**Data analyses and statistics**

For Paper I, all analyses were done using GraphPad Instat version 3.06 (66). For Papers II-IV versions 14 to 18 of the SPSS were used.

In Paper I, for normally distributed samples, Student’s t-test was used while for two or more comparisons with skewed distributed samples Friedmans test with Dunn’s post hoc test were used. For categorical data, Fischer’s exact test was applied. When multiple comparisons were made within the same domain/item, a p-value of 0.01 was utilized to avoid type one errors.

In Papers II-III data were reported as means ± SD unless otherwise indicated. For the DRI items in Paper II, data were reported as median and interquartiles. Differences between groups before interventions were tested with Mann-Whitney U-tests and chi-square tests. For analyses of the two rehabilitation groups over time, Wilcoxon test and the McNemar test were used. As in Paper I, when multiple comparisons were made within the same domain/item, a p-value of 0.01 was utilized to avoid type one errors.

Furthermore, univariate logistic regression analyses were employed to analyse association between the dependent factors life satisfaction domains ‘life as a whole’, ‘somatic health’ and ‘psychological health’ (Paper II) as well as sick leave (Paper III) and the following dichotomized variables: (normal and mild vs. moderate/severe anxiety), (normal and mild vs. moderate/severe depression), gender (male/female), patients’ beliefs about recovery (positive vs. negative outlook), education (primary school and secondary school vs. university), DRI (0-50 mm vs. 51-100 mm), pain intensity VAS (0-50 mm vs. 51-100), age (≤39 vs. >39) and intervention (MMR vs. RP).

In Paper IV, the following additional variables were included: patients’ vision about work (positive vs. negative), patients’ expectation about work (positive vs. negative outlook), MPI pain severity (dichotomized into 0-2 and 3-6), MPI interference (dichotomized into 0-2 and 3-6), MPI life control (dichotomized into 0-2 and 3-6), MPI affective distress (dichotomized into 0-2 and 3-6) and MPI support (dichotomized into 0-2 and 3-6).

Variables that had a p-value <0.3 in the univariate regression analyses were then included in stepwise multiple regression analyses. The results of the univariate logistic regression analyses are presented as an odds ratio (OR). The reliability of the OR is expressed as a 95% confidence interval (CI). Statistical significance was set at p-value of <0.05 for the multiple regression analyses.

In Paper IV, we classified the subjects into three groups based on the NDI (recovered ≤8, mild disability 10-28, moderate/severe ≥30). Data are reported as means with SD, unless indicated otherwise. Kruskal-Wallis and Mann-Whitney tests were used to test differences between groups (i.e. as post hoc tests). Chi square test was used to analyse whether groups had
different distributions. Multivariate logistic regression was performed to test associations between non-recovered patients and variables both from the time of the injury and five years after the injury (1=non-recovered; mild and moderate/severe disability; and 0=recovered). The statistically significant level was set at $p<0.01$.

**Ethical considerations**

All patients who participated in (SQRP) (46), had received written information regarding the registry and that they had the option to decline participation. The patients also had the right, at any time, to decline further participation and demand that their personal information should be erased from the registry. All data extracted from the registry database for analyses were coded so that individual patients could not be identified.

Papers II-III (Dnr-08-160M) and IV (Dnr-06-010M) were approved by the Regional Ethical Review Board in Umeå. The principles of the declaration of Helsinki were adhered to for all data handling.
RESULTS

Pain intensity

Papers I-III

In Table III, it can be seen that median ‘pain now’/‘current pain’ decreased significantly in 165 patients (by 13 mm) after the MMR programme (p<0.001), and (by 5 mm) after one year (p<0.05) in Paper I. VAS immediately after the programme was only provided for Paper I. See Table III.

In Paper II, the MMR pain intensity ‘pain now’/‘current pain’ decreased significantly from a median of 59 to 46 mm at one-year follow-up (p=0.002).

The corresponding figure for the RP group in Paper II, was a decrease from a median of 62 mm to 57 mm for VAS ‘current pain’ at one-year follow-up (p=0.025).

Table III. Pain now/current pain before(a), and at one-year follow-up(c) for both interventions (MMR and RP). VAS data immediately after (b) were only provided for Paper I. All data are presented in medians, and p-values. P-values < 0.01 are considered to be significant but p-values between 0.01-0.05 are also displayed. Grey panels indicate no data.

<table>
<thead>
<tr>
<th>Papers</th>
<th>n</th>
<th>Before (a)</th>
<th>After (b)</th>
<th>One-year follow-up (c)</th>
<th>P-value (a-b)</th>
<th>P-value (a-c)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I: MMR (median)</td>
<td>165</td>
<td>65 mm</td>
<td>52 mm</td>
<td>60 mm</td>
<td>&lt;0.001</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>II: MMR (median)</td>
<td>51</td>
<td>59 mm</td>
<td>46 mm</td>
<td>57 mm</td>
<td>0.002</td>
<td>0.025</td>
</tr>
<tr>
<td>II: RP (median)</td>
<td>143</td>
<td>62 mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Disability

Paper I

The DRI item ‘participating in ‘exercise/sports’ was the only item that significantly improved after the programme (n=152; p=0.0009), and one year later (n=152; p=0.0144). See Table IV.

<table>
<thead>
<tr>
<th>DRI items</th>
<th>n</th>
<th>Before</th>
<th>After</th>
<th>One year follow-up</th>
<th>p-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Dressing without help</td>
<td>163</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>2. Outdoor walks</td>
<td>166</td>
<td>17</td>
<td>16</td>
<td>20</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>3. Climbing stairs</td>
<td>165</td>
<td>13</td>
<td>21</td>
<td>20</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>4. Sitting for a longer period</td>
<td>164</td>
<td>52</td>
<td>53</td>
<td>52</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>5. Standing bent over a sink</td>
<td>163</td>
<td>51</td>
<td>50</td>
<td>48</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>6. Carrying a bag</td>
<td>165</td>
<td>65</td>
<td>57</td>
<td>55</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>7. Making a bed</td>
<td>161</td>
<td>31</td>
<td>31</td>
<td>28</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>8. Running</td>
<td>157</td>
<td>80</td>
<td>73</td>
<td>80</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>9. Light work</td>
<td>162</td>
<td>44</td>
<td>36</td>
<td>35</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>10. Heavy work</td>
<td>165</td>
<td>91</td>
<td>86</td>
<td>88</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>11. Lifting heavy objects</td>
<td>164</td>
<td>94</td>
<td>91</td>
<td>95</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>12. Participating in exercise/ sports</td>
<td>152</td>
<td>64</td>
<td>53</td>
<td>56</td>
<td>0.0009</td>
<td>0.0144</td>
</tr>
</tbody>
</table>
No significant improvements on DRI could be seen for the RP group at one year follow-up. The MMR (n=51) group showed significant improvements compared with before interventions for DRI items 'light work' (p<0.001), 'heavy work' (p=0.002), and for DRI index (p=0.007; not shown in Table V). See Table V.

Table V. Paper II. DRI items before (a), and at one-year follow-up (c) for RP, and before (d), and at one year follow-up (f) for MMR, presented in medians, and p-values. ('0' – manage without difficulty, and '100' – cannot manage at all). P-values < 0.01 are considered to be significant but p-values between 0.01 – 0.05 are also displayed.

<table>
<thead>
<tr>
<th>DRI items</th>
<th>n</th>
<th>Before (a)</th>
<th>One year follow-up (c)</th>
<th>P-value (a-c)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dressing without help</td>
<td>142</td>
<td>5</td>
<td>5</td>
<td>ns</td>
</tr>
<tr>
<td>Outdoor walks</td>
<td>142</td>
<td>25</td>
<td>31</td>
<td>ns</td>
</tr>
<tr>
<td>Climbing stairs</td>
<td>143</td>
<td>27</td>
<td>30</td>
<td>ns</td>
</tr>
<tr>
<td>Sitting for a longer period</td>
<td>142</td>
<td>50</td>
<td>48</td>
<td>ns</td>
</tr>
<tr>
<td>Standing bent over a sink</td>
<td>137</td>
<td>48</td>
<td>51</td>
<td>ns</td>
</tr>
<tr>
<td>Carrying a bag</td>
<td>143</td>
<td>50</td>
<td>53</td>
<td>ns</td>
</tr>
<tr>
<td>Making a bed</td>
<td>143</td>
<td>31</td>
<td>34</td>
<td>ns</td>
</tr>
<tr>
<td>Running</td>
<td>142</td>
<td>86</td>
<td>86</td>
<td>ns</td>
</tr>
<tr>
<td>Light work</td>
<td>143</td>
<td>41</td>
<td>33</td>
<td>ns</td>
</tr>
<tr>
<td>Heavy work</td>
<td>143</td>
<td>88</td>
<td>82</td>
<td>0.034</td>
</tr>
<tr>
<td>Lifting heavy objects</td>
<td>144</td>
<td>95</td>
<td>91</td>
<td>ns</td>
</tr>
<tr>
<td>Participating in exercise/ sports</td>
<td>143</td>
<td>62</td>
<td>57</td>
<td>ns</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DRI items</th>
<th>n</th>
<th>Before (d)</th>
<th>One year follow-up (f)</th>
<th>P-value (d-f)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dressing without help</td>
<td>50</td>
<td>3</td>
<td>3</td>
<td>ns</td>
</tr>
<tr>
<td>Outdoor walks</td>
<td>50</td>
<td>22</td>
<td>11</td>
<td>0.043</td>
</tr>
<tr>
<td>Climbing stairs</td>
<td>50</td>
<td>22</td>
<td>15</td>
<td>ns</td>
</tr>
<tr>
<td>Sitting for a longer period</td>
<td>50</td>
<td>57</td>
<td>50</td>
<td>0.028</td>
</tr>
<tr>
<td>Standing bent over a sink</td>
<td>50</td>
<td>48</td>
<td>26</td>
<td>ns</td>
</tr>
<tr>
<td>Carrying a bag</td>
<td>50</td>
<td>53</td>
<td>48</td>
<td>ns</td>
</tr>
<tr>
<td>Making a bed</td>
<td>50</td>
<td>21</td>
<td>14</td>
<td>ns</td>
</tr>
<tr>
<td>Running</td>
<td>49</td>
<td>76</td>
<td>66</td>
<td>ns</td>
</tr>
<tr>
<td>Light work</td>
<td>50</td>
<td>31</td>
<td>17</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Heavy work</td>
<td>50</td>
<td>88</td>
<td>65</td>
<td>0.002</td>
</tr>
<tr>
<td>Lifting heavy objects</td>
<td>49</td>
<td>94</td>
<td>87</td>
<td>ns</td>
</tr>
<tr>
<td>Participating in exercise/ sports</td>
<td>50</td>
<td>47</td>
<td>31</td>
<td>0.014</td>
</tr>
</tbody>
</table>
Paper IV

In this paper, disability was assessed by the NDI. According to this instrument, 34.8% (n=55) were found to be recovered, 37.3% (n=59) had ‘mild disability’ and 27.3% (n=44) had moderate/severe disability.

The group with the highest disability score reported most health problems with significantly (p<0.001) higher pain intensity on the VAS, total scores of whiplash-related symptoms on the RPQ, depression scores on the BDI, posttraumatic stress scores on the IES and lower level of life satisfaction, compared with the ‘mild’ and the ‘recovered’ groups. See Table VI.

<table>
<thead>
<tr>
<th>Instruments</th>
<th>NDI</th>
<th>NDI</th>
<th>NDI</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total scores</td>
<td>recovered</td>
<td>mild</td>
<td>moderate/severe</td>
<td>between subgroups</td>
</tr>
<tr>
<td>VAS</td>
<td>3.6±7.8</td>
<td>19.1±17.4</td>
<td>51.9±26.2</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>RPQ total score</td>
<td>3.8±4.6</td>
<td>15.6±10.9</td>
<td>31.9±13.3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>BDI-II</td>
<td>2.9±4.4</td>
<td>6.7±6.3</td>
<td>18.2±9.4</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>IES</td>
<td>4.9±7.1</td>
<td>10.2±12.4</td>
<td>21.9±16.9</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>LiSat-11 ‘life as a whole’</td>
<td>4.9±0.9</td>
<td>4.7±0.8</td>
<td>3.8±1.1</td>
<td>R vs M: ns</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>R vs MS: &lt;0.001</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>M vs MS: &lt;0.001</td>
</tr>
<tr>
<td>LiSat-11 ‘vocational health’</td>
<td>4.7±1.0</td>
<td>4.2±1.2</td>
<td>2.9±1.7</td>
<td>R vs M: ns</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>R vs MS: &lt;0.001</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>M vs MS: &lt;0.001</td>
</tr>
<tr>
<td>LiSat-11 ‘somatic health’</td>
<td>4.8 ± 1.0</td>
<td>4.0±1.2</td>
<td>2.3±1.2</td>
<td>R vs M: &lt;0.001</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>R vs MS: &lt;0.001</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>M vs MS: &lt;0.001</td>
</tr>
<tr>
<td>LiSat-11 ‘psychological health’</td>
<td>5.2±0.9</td>
<td>4.8±1.0</td>
<td>3.8±1.3</td>
<td>R vs M: ns</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>R vs MS: &lt;0.001</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>M vs MS: &lt;0.001</td>
</tr>
</tbody>
</table>

Table VI. Paper IV. VAS, RPQ, BDI-II, IES, and Life satisfaction for the NDI subgroups recovered, mild, and moderate/severe. P-values < 0.01 are considered to be significant but p-values between 0.01 – 0.05 are also displayed.
Life satisfaction

Paper I

Life satisfaction did not significantly improve after the MMR programme or at one-year follow-up regarding the domains ‘life as a whole’ or ‘vocational health’, in Paper I. For the domain ‘somatic health’, life satisfaction did not significantly improve (4 % to 8 % satisfied; p=ns) immediately after the programme, nor one year after the programme (from 4 % satisfied to 10 %; p=0.04). Regarding the domain ‘psychological health’ life satisfaction significantly improved after the programme (from 27 % to 39 %; p=0.002) but not at one year follow-up (from 27 % to 35 %; p=0.053). See Figure 4.

Figure 4. Life satisfaction dichotomised (1-4: not satisfied) and (5-6: satisfied), among the general Swedish population in 1996 (49) and in Paper I. P-values < 0.01 are considered to be significant but p-values between 0.01 – 0.05 are also displayed.
Life satisfaction did not significantly improve for either the MMR or the RP group regarding the domains ‘life as a whole’, and ‘vocational health’. In the MMR group the domain ‘somatic health’ significantly improved at one year follow-up (from 0 % to 20 %; p=0.0012) as well as the domain ‘psychological health’ (from 20 % to 50 %; 0.001). The corresponding figure for the RP group for the domain ‘somatic health’ was from 6 to 13 %; p=0.013). The domain ‘psychological health’ did not improve at one-year follow-up. See Figure 5.

Figure 5. Life satisfaction dichotomised (1-4: not satisfied) and (5-6: satisfied), among the general Swedish population in 1996 (49) and in Paper II for both the MMR group and the RP group with follow-up in primary care. P-values < 0.01 are considered to be significant but p-values between 0.01 – 0.05 are also displayed.
Anxiety and depression

Paper II

Anxiety did not significantly improve for neither the MMR nor the RP group at one-year follow-up.

Depression improved at one-year follow-up for the MMR group (p = 0.007) in that the group of patients classified as ‘normal’ increased from 52 % to 74 %, the subgroup ‘mild depression’ did not vary at one-year follow-up (18 %) and the subgroup with ‘moderate/severe depression’ decreased from 30 % to 8 %. The changes in the RP group at one year follow-up were not significant. See Table VII.

Table VII. Paper II. Table illustrating percent of patients experiencing anxiety and depression in Paper II for both the MMR group, and the RP group with follow-up in primary care (RP). Before (a,d), and at one-year follow-up (d,f). P-values < 0.01 are considered to be significant but p-values between 0.01 – 0.05 are also displayed.

<table>
<thead>
<tr>
<th>MMR</th>
<th>n</th>
<th>Before</th>
<th>One-year follow-up</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(a)</td>
<td>(c)</td>
<td></td>
<td>(a-c)</td>
</tr>
<tr>
<td></td>
<td>HADS-Anxiety</td>
<td>50</td>
<td>56%</td>
<td>68%</td>
</tr>
<tr>
<td></td>
<td>Normal</td>
<td></td>
<td>56%</td>
<td>68%</td>
</tr>
<tr>
<td></td>
<td>Mild</td>
<td></td>
<td>24%</td>
<td>14%</td>
</tr>
<tr>
<td></td>
<td>Moderate/Severe</td>
<td></td>
<td>20%</td>
<td>18%</td>
</tr>
<tr>
<td></td>
<td>HADS-Depression</td>
<td>50</td>
<td>52%</td>
<td>74%</td>
</tr>
<tr>
<td></td>
<td>Normal</td>
<td></td>
<td>52%</td>
<td>74%</td>
</tr>
<tr>
<td></td>
<td>Mild</td>
<td></td>
<td>18%</td>
<td>18%</td>
</tr>
<tr>
<td></td>
<td>Moderate/Severe</td>
<td></td>
<td>30%</td>
<td>8%</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>RP</th>
<th>n</th>
<th>Before</th>
<th>One-year follow-up</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(d)</td>
<td>(f)</td>
<td></td>
<td>(d-f)</td>
</tr>
<tr>
<td></td>
<td>HADS-Anxiety</td>
<td>143</td>
<td>64%</td>
<td>56%</td>
</tr>
<tr>
<td></td>
<td>Normal</td>
<td></td>
<td>64%</td>
<td>56%</td>
</tr>
<tr>
<td></td>
<td>Mild</td>
<td></td>
<td>14%</td>
<td>23%</td>
</tr>
<tr>
<td></td>
<td>Moderate/Severe</td>
<td></td>
<td>22%</td>
<td>21%</td>
</tr>
<tr>
<td></td>
<td>HADS-Depression</td>
<td>143</td>
<td>55%</td>
<td>56%</td>
</tr>
<tr>
<td></td>
<td>Normal</td>
<td></td>
<td>55%</td>
<td>56%</td>
</tr>
<tr>
<td></td>
<td>Mild</td>
<td></td>
<td>23%</td>
<td>19%</td>
</tr>
<tr>
<td></td>
<td>Moderate/Severe</td>
<td></td>
<td>22%</td>
<td>25%</td>
</tr>
</tbody>
</table>
Multidimensional Pain Inventory

MPI was only studied in Paper III.

The MMR group improved significantly regarding all five scales of the first section of MPI. ‘Pain severity’ decreased from 4.3±0.9 to 3.1±1.3 (p< 0.001); ‘Interference’ decreased from 4.4±0.9 to 3.3±1.5 (p<0.001); ‘Life control’ increased from 3.0±0.8 to 3.1±1.2 (p<0.001); ‘Affective distress’ decreased from 3.3±1.2 to 2.5±1.5 (p=0.003) and ‘Support’ decreased from 4.3±1.3 to 3.9±1.3 (p=0.003).

The RP group improved significantly regarding three scales of the first section of the MPI from before intervention compared with one-year follow-up on ‘Pain severity’ from 4.3±0.9 to 3.9±1.2 (p<0.001); ‘Interference’ from 4.3±1.1 to 3.9±1.4 (p<0.001) and ‘Support’ from 4.3±1.3 to 3.8±1.2 (p <0.001). No statistically significant differences were found on the scales ‘Life control’ and ‘Affective distress’.

We also looked at gender differences and MPI.

Only women scored significant changes over time in the MMR group, regarding five scales: Pain severity (p=0.001), Interference (p=0.001), Life control (p=0.001), Affective distress (p=0.005) and Support (p=0.006). The men (n=7) did not improve significantly at one-year follow-up. There were no significant gender differences before the interventions regarding MPI, nor were there any significant differences over time between women and men.

Both women and men improved significantly over time in the RP group. The women regarding three scales: ‘Pain severity’ (p=0.001), ‘Interference’ (p=0.002), and ‘Support’ (p=0.001). The men regarding one scale: ‘Support’ (p=0.001). There were no significant gender differences before the interventions regarding MPI, nor were there any significant differences over time between women and men.
Patients’ beliefs about the future

The domain was studied in Papers I-III.

In Paper I, 44% of patients (respondents) selected to MMR had positive beliefs about recovery. The corresponding figure in Paper II was 52%, whereas 34% of patients in the RP group in Paper II had positive beliefs about recovery. In Paper III, patients were also asked about their vision about work (‘How do you envisage it will be to return to work, to study, or to extend working hours?’) and expectation about work (‘When do you expect to return to work, to study, or to extend your working hours?’). There were also significant differences in favour for the MMR group concerning positive expectation about work. See Table VIII.

In Paper I, we dichotomised patients into positive and negative beliefs about recovery and compared that with pain intensity changes at one-year follow-up. The difference in pain intensity between patients with a positive (n=74) and a negative (n=85) concerning their beliefs before rehabilitation, was 9.6 mm (95% CI: 1.1–18. mm; p=0.028). In Paper II, we analysed the MMR and the RP groups together. All patients with a positive belief about recovery, prior to interventions had a significant mean ‘VAS current pain’ intensity score reduction of 11±27 mm at one-year follow-up compared with a reduction of 3.0±22 mm for those with a negative outlook (p=0.021).

In Papers II-III, the patients with positive beliefs about recovery reported pain duration of 28 months compared with 77 months among those with negative beliefs about recovery.

In the stepwise multivariate regression analyses, in Papers II-III, the variable ‘positive beliefs about recovery’ was associated with satisfied patients regarding the domains ‘life as a whole’ and ‘psychological health’ whereas the variable ‘positive expectation about work’ was associated with being on no sick leave at one-year follow-up. See Table VIII.
Table VIII. Papers I-III. Patients' beliefs about the future

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>MMR</th>
<th>N</th>
<th>RP</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper I: How convinced are you about recovery?</td>
<td>168</td>
<td>44 %</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Papers II-III: How convinced are you about recovery?</td>
<td>73</td>
<td>52 %</td>
<td>198</td>
<td>34 %</td>
<td>0.008</td>
</tr>
<tr>
<td>Papers II-III: How do you envisage, it will be to return to work, to study, or to extend your working hours?</td>
<td>66</td>
<td>38 %</td>
<td>183</td>
<td>36 %</td>
<td>ns</td>
</tr>
<tr>
<td>Papers II-III: When do you expect to return to work, to study, or to extend your working hours?</td>
<td>63</td>
<td>67 %</td>
<td>170</td>
<td>47 %</td>
<td>0.008</td>
</tr>
</tbody>
</table>

Stepwise multivariate analyses

<table>
<thead>
<tr>
<th>Covariates</th>
<th>N</th>
<th>OR (95% CI)</th>
<th>p-value</th>
<th>Dependent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive belief about recovery</td>
<td>176</td>
<td>2.4 (1.1-4.8)</td>
<td>0.019</td>
<td>Satisfied in the domain 'Life as a whole'</td>
</tr>
<tr>
<td>Positive belief about recovery</td>
<td>173</td>
<td>2.0 (1.1-3.9)</td>
<td>0.029</td>
<td>Satisfied in the domain 'psychological health'</td>
</tr>
<tr>
<td>Positive expectation about work</td>
<td>154</td>
<td>3.0 (1.5-5.9)</td>
<td>0.001</td>
<td>Being on no sick leave</td>
</tr>
</tbody>
</table>
Sick leave

The patients on full-time sick leave were defined as being on 100% sick leave and patients on part-time sick leave on at least 25% up to 75% sick leave. The group of patients that was not on sick leave made up all the rest and included patients that worked full time, students, patients on parental leave, unemployed and patients on welfare payments.

The patients on full-time sick leave, part-time sick leave and no sick leave were dichotomized into no sick leave vs. part-time or full-time sick leave. Both groups improved significantly at one-year follow-up regarding decreased sick leave, p<0.001. See Figure 6.

![Work status in percent; n= 191](image)

Figure 6. Sick leave dichotomised into no sick leave vs. part-time and full-time sick leave.
DISCUSSION

At one-year follow-up after MMR, a statistically significant decrease in pain intensity and levels of depression was shown. In the MMR groups in Papers I and II, some of the disability items improved as well as life satisfaction, especially regarding psychological health. In both the MMR and the RP groups, days on sick leave were reduced. The RP group also reported decreased pain intensity. Patients’ positive beliefs about their future prior to intervention were associated with favourable long-term outcomes. An interdisciplinary team assessment based on a biopsychosocial approach may be of value when selecting different rehabilitation strategies. For patients with whiplash injuries, the NDI seems to be a valuable instrument for classifying their disability, thereby optimising the management and treatment of these patients.

Factors affecting rehabilitation

Several changes have occurred in the Swedish social insurance system and sickness benefits since 2008 (44, 67) in order to improve the rehabilitation chain and to get more people back to work and/or increase their working ability. That has in turn contributed to an increased interest in rehabilitation in general and in MMR in particular. Until 2004, musculoskeletal and connective-tissue illnesses were the dominant diagnostic groups for new recipients of sickness and activity compensation (68). However, since 2005, psychological illnesses have grown to become the largest diagnostic group, now comprising approximately 50% for both women and men (68).

Meanwhile, no major improvements occurred during 2004-2005 in managing patients with musculoskeletal illnesses. One can assume that since there is a comorbidity between chronic pain and depression (69, 70), patients who were previously assigned a musculoskeletal diagnosis subsequently have been assigned a psychological diagnosis instead. In 2008, an agreement was made between the Swedish government and the Swedish Association of Local Authorities and Regions (SALAR) (45) to increase evidence-based therapies such as MMR at primary health care centres nationwide in exchange for economic incentives. Access to multimodal teams in primary care settings has thus increased since then (45). The most important change affecting our studies was perhaps the reforms in the Swedish social insurance system and sickness benefits in 2008 where a time frame of maximum days on sickness benefits was introduced.

Rehabilitation delay

The latest annual report from the SQRP (46) in 2010 revealed that, on a national level, the pain duration among the patients who were only assessed was 72 months and the corresponding figure was 67 months for patients in the MMR programmes. In Papers I-III, the pain duration among the respondents was 43-57 months at the initial interdisciplinary assessment at
the Pain Rehabilitation Clinic. These figures are certainly not satisfactory and they indicate that patients should be referred to adequately specialised pain clinics instead of to various individual medical specialists sequentially.

During the period when our studies were conducted, the majority of the patients were referred by general practitioners to the clinic for interdisciplinary assessment. For MMR, a secondary selection process was done by the interdisciplinary team at the Pain Rehabilitation Clinic.

In 2011, a working committee (45) was given the task to determine which patients should receive intervention with MMR. They identified two levels: MMR 1 (a less intensive MMR, primarily in health care centres) and MMR 2 (a more intensive MMR, primarily at specialist level in pain rehabilitation clinics). Hopefully, this selection strategy will reduce the time patients have to wait for MMR. Obviously, there are opportunities for improvements concerning ‘rehabilitation delay’ nationwide.

**Interdisciplinary assessment**

Almost two thirds of the 20 000 patients with chronic pain, from 18 pain rehabilitation units included in the SQRP in 2007, were only assessed (43). The remaining third was assessed and then participated in MMR programmes. Corresponding figures for the Pain Rehabilitation Clinic in Umeå were three quarters and one quarter respectively.

Although a majority of patients in the registry are thus only assessed at a specialist facility, surprisingly few studies have followed up this large group of patients. To our knowledge, there is one recent Swedish study that has followed up this group of patients (71). This is also highlighted in the latest annual report from the SQRP (46) for patients referred to rehabilitation clinics in Sweden in 2010, where it was concluded that evaluation of the assessment group is needed since it may be the case that the evaluation and information per se can have long-lasting positive effects (72, 73). An interdisciplinary assessment based on the biopsychosocial approach (21) seems to be of value. The interdisciplinary assessment in Papers I-III included information and explanation of pain which may have had a positive effect on the results in both the MMR and the RP group at one-year follow-up. In addition, the initial team assessment may be important for appropriate selection of patients for adequate rehabilitation strategies.

Another aspect is the description of the selection procedure which patients with chronic pain undergo before participating in MMR programmes. To date, these procedures have been poorly described in the literature (32, 74). In our studies, we have described the teams’ selection procedure of patients for MMR or RP. Hence, the two-day interdisciplinary assessment with a RP and follow-up in primary care included in these studies is an attempt to fill two knowledge gaps, regarding the outcomes of the RP group and follow-up in primary care, and regarding description of the selection procedure.
Interdisciplinary assessment with RP and follow-up in primary care

Overall, the RP group in Papers II-III was more heterogeneous than the MMR group. In general terms, the RP group consisted of (i) patients where 40% needed further investigation; (ii) patients who were less positive about their recovery, (iii) patients for whom unimodal treatments were more suitable, and (iv) patients who, for different reasons, did/could not participate in the MMR despite the interdisciplinary team’s recommendation.

As MMR programmes do not have the potential to include all patients due to economic limitations and as not all patients are suitable for MMR, the following question must be raised. How can we improve conditions for the vast majority of patients – 75% – who were not selected for MMR? Though this was not the aim of this thesis, several questions come to mind. Firstly, we do not know to what extent the implementation of the RP was carried out. Secondly, this group was more heterogeneous as stated above. Thirdly, for those patients who have negative beliefs about recovery, arguably one should go further and analyse the reasons they put forward. Perhaps this group is more heterogeneous than we think at first sight. Fourthly, one must remember that some of these patients perhaps need to undergo unimodal treatments such as psychological therapy for a period of time before starting MMR.

Aspects of MMR

MMR programmes are more effective (31) than standard medical treatment and non-multimodal treatments. The Swedish Council on Health Technology Assessment Report from 2010 (32) regarding rehabilitation chronic pain concluded that a general evaluation of back pain shows that MMR leads to an overall better result than less comprehensive treatment or no treatment at all. Regarding results per outcome measure, MMR improved a return to work and was more effective for sick leave reduction (32). On the other hand, it was concluded that MMR programmes were not more efficient in reducing pain intensity, disability or other symptoms compared with less intensive actions (32).

However, MMR programmes are time-consuming and as yet there is insufficient evidence in order for firm conclusions about the cost effectiveness of such programmes to be drawn (31, 32). In addition, it is not known whether all patients with chronic pain would benefit from all components in a MMR programme due to the heterogeneity of the patients (31, 75). Moreover, studies show that not all patients in fact require MMR. Some patients may get adequate help by proper information (76) or unimodal rehabilitation such as physiotherapy or cognitive-oriented psychologist sessions (72, 73, 77, 78).
Patients’ beliefs about their future

All in all, positive beliefs about the future seemed to be an important factor for selection to MMR and for favourable outcome in both interventions. The MMR group in Paper II included more patients with positive beliefs about their recovery compared with the RP group. The selection procedure is supported by a study by Foster et al who reported a relationship between poor expectations and poor clinical outcomes in patients with back problems (79). Moreover, the variable ‘positive beliefs about recovery’ predicted satisfaction in the domains ‘life as a whole’, and ‘psychological health’ at one-year follow-up in Papers II-III. These findings are confirmed in other studies (38, 80). In addition, the variable ‘positive expectation about work’ predicted reduced sick leave and increased return to work in line with other studies (38, 81).

There was an association between patients’ positive beliefs and the domain psychological health at one-year follow-up. Unfortunately, the question about patients’ beliefs before recovery was only asked before interventions. For those that had negative beliefs about recovery, it would have been of value to study if the MMR programme could change their beliefs about the future as compared with before the MMR programme. In a separate analysis among the respondents in Papers II and III, the group of patients that had positive beliefs about recovery also had less pain duration. This indicates that long pain duration can have a negative impact on patients’ beliefs about recovery. Therefore, an interdisciplinary assessment at an early stage might have been beneficial instead of several years later as was the case in our studies.

Outcomes

In Paper I, we could see a significant improvement immediately after participating in a five week MMR programme by more than 10 mm, but not at one-year follow-up. No systematic changes in prescription of analgesics occurred during the MMR programme. Moreover, pain intensity decreased by more than 10 mm in Paper II for the MMR group at one-year follow-up, which is consistent with Westman et al’s (82) study. In analogy to the debate of statistical significance and minimal clinically important differences, these results correspond to ‘slightly better’ (83) or ‘minimally improvement’ (84).

Regarding disability, only ‘participating in exercise/sports’ improved significantly after the MMR programme and at one-year follow-up in Paper I. In Paper II, the MMR group improved significantly in two of the twelve DRI items, ‘light work’, and ‘heavy work’. In contrast, no significant changes could be seen for the RP group. Compared with Westman et al (82), who also evaluated the DRI scores before and after MMR, the patients in the MMR groups scored slightly better results. However, our findings regarding disability in the RP group were in contrast to a study by Norrefalk et al (85) who reported better results. One possible reason could be that the interdisciplinary assessment period by Norrefalk et al was 7-14 days whereas
the assessment period in our studies was two days. Nevertheless, the MMR group did significantly increase and the RP group showed a trend that almost reached significance regarding ‘somatic health’ but this could not be portrayed in the disability rating items in an higher extent.

The NDI has been used to assess levels of disability (56). In Paper IV, we evaluated symptoms and psychological factors in subgroups based on the disability level of the NDI. The highest post-traumatic stress scores were reported in the group with moderate/severe disability and the frequency of distinct post-traumatic stress reaction was clearly higher than that reported in whiplash patients early on after injury (86). Since the group with moderate/severe disability also reported more symptoms, higher pain intensity and depression, these findings indicate that classifying persons with whiplash injuries into subgroups based on the NDI levels could facilitate optimisation of treatment and rehabilitation.

Both the MMR and the RP groups in Paper II were less satisfied with the LiSat-11 domains ‘life as a whole’, ‘vocational health’, ‘somatic health’, and ‘psychological health’ than the general population (49). LiSat-11 revealed that only ‘psychological health’ increased significantly after the MMR but not at one-year follow-up in the first study. In Paper II, both the domains ‘somatic health’ and ‘psychological health’ increased significantly whereas in the RP group only the domain ‘somatic health’ improved. The long-term effects of life satisfaction in the MMR groups in our studies are consistent with other studies who also reported increased life satisfaction after MMR (16, 87). However, in contrast to Norrefalk et al (85) we could not see any significant changes regarding life satisfaction at one-year follow-up for patients who had only been assessed.

Depression decreased significantly in both the MMR and the RP groups. In comparison with a Danish MMR programme for patients with chronic pain who reported a HADS depression total score of 6.8 (88), our MMR patients were also more depressed (total score of 7.8).

Chronic pain and depression work in a negatively synergic way in that depression reinforces chronic pain and chronic pain promotes depressive symptoms, both of which may lead to decreased physical activity and life satisfaction (89). Depression is common among patients with chronic pain and has been found to increase the risk of higher pain intensity, reduced activity levels and deteriorated social and occupational functioning and life satisfaction (18). In accordance with Borsbo et al (89), our study emphasises that psychological factors e.g. depression seem to play a key role when it comes to impact on quality of life and disability. The MMR cognitive-behavioural programme managed to decrease patients’ self-perceived levels of depression. This result was reflected by the life satisfaction domain ‘psychological health’ which also improved. Hence, an improvement in chronic pain patients’ depression score over time would possibly result in self-perceived increased activity and life satisfaction, which occurred in the MMR group.
At one-year follow-up, sick leave decreased significantly both in the MMR and the RP group. For the MMR group, this result is in agreement with several other studies that have shown decreased sick leave after multimodal rehabilitation (32, 33, 82, 90). Only a few studies have evaluated the effects of an interdisciplinary assessment on return to work/sick leave. Norrefalk et al reported decreased sick leave at one-year follow-up after 1-2 weeks of interdisciplinary assessment. There are several factors that interact and play a substantial role in return to work/decreased sick leave. For instance, patients are less likely to return to work following a long period of sickness absence (91). Patients are reported to have a greater chance of return to work when partial sickness benefit is provided compared with full benefit (91) when disability compensation is higher (92). In addition, we cannot rule out that the changes made in 2008 in the Swedish social insurance system and sickness benefits affected the decrease in sick leave in Paper III.

**Methodological considerations**

Certain methodological considerations need to be highlighted in the present study.

One of the problems in the field of rehabilitation programmes, is the many outcome measurements used for assessment in the same domains (31). Since we used an already existing registry, the (SQRP) (46), other outcome measures of interest were not included. Although, the SQRP lacks questionnaires covering these topics, the included questionnaires are validated and have been widely used in clinical practice for assessment of pain intensity, anxiety and depression, disability, and life satisfaction in chronic pain patients (47-51, 61). In addition, the questionnaires in Papers I-III are used nationwide since they are included in the registry (46). Accordingly, these instruments can justifiably be considered as appropriate for the assessment of patients with chronic pain. In Paper IV, since similar symptoms are commonly reported after a whiplash injury and concussion and no standardised scale exists for assessment of whiplash-related symptoms, the RPQ (53) was used.

The relationship between statistical significance and minimal clinically important differences (MCID) (93) is of vital clinical interest. The MCID is not a fixed value and depends on the baseline pain intensity score, and how many categorical levels you use for comparison (84, 94). MCID for pain by Salaffi (83) is a reduction of 15% on average. With these results in mind, the MMR group decreased in pain intensity by 13 mm (22%) for ‘current pain’ and by 17 mm (27%) for ‘pain average last week’ which in our study could be considered as clinically important.

Moreover, we did not carry out extensive gender analyses in our studies for MMR due to small sample sizes. In Paper I, only 21% (n=33) of the respondents were men and in Papers II –III only 14% (n=7).

We described the interdisciplinary assessment and the selection procedure in Papers II-III and our aim was to audit the results of rehabilitation in both
the MMR group and the RP groups over time, not to perform a randomised controlled study. A limitation of our study was the lack of control group as our data were generated in a clinical setting in ordinary health care. One may of course argue that the changes observed might represent a spontaneous improvement over time. However, it is known that once chronic pain is established, it is unlikely to resolve itself without interventions (10). In addition, we don’t know what happened after MMR and until the one-year follow-up. Similarly, we don’t know to what extent the RP was carried out in the primary care and what happened until the one-year follow-up.

Compared to the SQRP annual report from 2008 with about 600 chronic pain patients the MMR patients in Papers I-III were in the same age group, were slightly more university educated and were less unemployed (46). Concerning the same comparison with about 1400 chronic pain patients that were only assessed, the RP patients were three years younger (mean), included less females, and were less unemployed (46). Based on the demographic structure of the study populations in Papers I-III, the use of SQRP questionnaires and design of the MMR and RP interventions, the generalisability of the studies seems to be good on a national level. However, factors within each nation such as social insurance and sickness benefits can influence the outcome of sick leave. Some strengths of the studies are that all patients that underwent a team assessment at the Pain Rehabilitation Clinic during one (Papers II and III) and three years (Paper I) were included and the response rate in each study was satisfactory. Moreover, a dropout analysis was carried out for the patients in Papers II-III, and there were no major differences between dropouts and respondents. Regarding the statistical analyses, a p-value of 0.01 was used to avoid type one errors when multiple comparisons were made.
CONCLUSIONS

- MMR seems to have long-term beneficial effects on pain, disability, depression, somatic and psychological health and reduced sick leave.

- An interdisciplinary team assessment based on the biopsychosocial approach for patients with chronic pain prior to their participation in rehabilitation may be of value for selection and recommendation of different rehabilitation strategies.

- A less intense intervention, RP, with follow-up in the primary care can show long-term positive results on pain, somatic health, and reduced sick leave.

- Patients’ positive beliefs about their recovery and positive expectation about work correlated with better long-term outcomes.

- Classifying persons with whiplash injuries into groups based on the NDI may be useful for optimising their rehabilitation.
FUTURE RESEARCH

During the course of work on this thesis, some new questions have arisen.

Further studies are needed to detect which variables that may be important for the selection procedure for MMR. One should also go further with the patients who have negative beliefs about their future, and analyse the reasons they put forward in order to find appropriate rehabilitation strategies for them.

In addition, more studies are needed to see how well the RP is carried out in primary care and if our results in general are consistent with other studies.

Moreover, there is a need to study the effects of rehabilitation for women and men respectively in order to find out which kind of rehabilitation intervention that women and men benefit from most.
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