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Multimodal rehabilitation for patients with chronic pain in northern Sweden,

focusing on gender and age

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To my family

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Abstract

The overall aim of this thesis was to study outcomes and experiences of multimodal rehabilitation programmes (MMRP) for patients with chronic pain in northern Sweden, focusing on gender and age.

This thesis is based on four studies that used both quantitative and qualitative methods. The quantitative studies (I-III) investigated patient-reported outcome measures (PROM) from the Swedish Quality Registry for Pain Rehabilitation (SQRP) collected during 2011-2016 at two specialist clinics in northern Sweden. Adults aged 18-65 years were included, n=436 (356 women and 83 men), divided into three age groups (18-30, 31-45 and 46-65 years of age). Data from the two programmes at three measurement occasions were used, at the start of MMRP, immediately after MMRP and at one-year follow-up. Descriptive and multivariate statistics were used in Studies I-III.

The analyses were performed separately for women, men and three different age groups. In Study I, the analysis was performed in two steps: in the first step the two patient populations in the two MMRPs were analysed separately and in the next step, the patients in the two programmes were analysed together. In Studies (II-III), the patient in the programmes were analysed together. In Study IV, a qualitative design was used to explore how patients with chronic pain experienced staying at a residency during participation in MMRP. In Study IV, a grounded theory method with emergent design was used for data collection and analysis. Individual semi-structured interviews with 12 patients (8 women and 4 men) with experiences of MMRP were conducted.

In Study I, patients improved regardless of the design of the MMRP in terms of pain intensity, emotional functioning, activity and physical functioning at the one-year follow-up. For both programmes, the women were found to improve in more variables than the men did.

In Study II, all subgroups (men, women and age groups) improved in terms of pain intensity and emotional functioning immediately after MMRP. The results revealed that the men showed greater short-term improvements than the women did. The women improved in more variables at one-year follow-up than the men did. The youngest age group was found to have greater positive effects of MMRP in terms of pain intensity and emotional functioning, immediately after MMRP and at one-year follow-up, than the other two age groups.

In Study III, a number of interacting factors influenced whether patients participating in MMRP ended up on full-time sick leave at one-year follow-up, or

not. Sick leave at start was an important factor for all subgroups. For women at start, low physical functioning, low health-related quality of life, low work importance and low affective distress were related to full-time sick leave at one-year follow-up.

The results showed that unemployed men who reported widespread pain were related to full-time sick leave at one-year follow-up. The 31-45 years age group, which reported high pain intensity, low emotional functioning and low activity and physical functioning, was related to full-time sick leave at one-year follow-up. Those in the 46-65 years age group with low education, low work importance, low belief in recovery and long duration of pain were found to be related to full-time sick leave at one-year follow-up.

In Study IV, the analysis resulted in a core category “Finding my self-worth”, consisting of the four categories: “Space for myself”, “Mirroring myself”, “I am of value” and “Dealing with returning to everyday life”. The results showed that the patients who stayed at a residency during MMRP were more likely to be released from the obligations of chores in their everyday life at home. This created space and time for reflection and interaction with others. The patients’ participation in MMRP while staying at a residency contributed to experiences of awareness of their own value and the significance of taking care of themselves and changing their behaviour after returning home.

In conclusion, the results showed that MMRP seems to be an effective method of treating patients with chronic pain, in terms of reduced pain, improved emotional functioning, activity and physical functioning and health. The results also revealed that men seemed to need more support after MMRP to sustain the effects of MMRP while woman were more likely to sustain the positive effects at one-year follow-up. Full-time sick leave for patients with chronic pain at one-year follow-up can be affected by a number of interacting factors and these factors differ for women, men and different age groups. The opportunity to be released from everyday obligations, enjoy time for reflection and interaction with others can contribute to personal awareness which facilitates the implementation of changes at home following MMRP.

Sammanfattning på svenska

Långvarig smärta drabbar ca 20% av Sveriges befolkning och leder ofta till begränsad funktion och minskad delaktighet med nedsatt arbetsförmåga och sjukskrivning som följd. Multimodala smärtrehabiliteringsprogram (MMRP) grundar sig på den biopsykosociala modellen och har visat sig vara en effektiv form av rehabilitering för patienter med långvarig smärta. Det finns idag två smärtrehabiliteringskliniker inom specialistvården i Sveriges nordligaste regioner, Norrbotten och Västerbotten som bedriver MMRP och som är anslutna till Nationellt Register över Smärtrehabilitering (NRS). Eftersom regionerna omfattar en stor geografisk yta med långa avstånd till smärtrehabilitering på specialistnivå har patienter som deltar i MMRP ofta behov av att vistas på patienthotell under rehabiliteringsperioden. Det övergripande syftet med denna avhandling var att studera effekter och erfarenheter av två MMRP bland patienter med långvarig smärta i norra Sverige, med fokus på subgrupperna, män och kvinnor och åldersgrupper.

I avhandlingen ingår fyra studier där både kvantitativa och kvalitativa metoder har använts för insamling och analys av data från de två specialistklinikerna i Norrbotten och Västerbotten. I de kvantitativa studierna har patientrapporterade utfallsmått från NRS använts som insamlades under åren 2011-2016 för 439 patienter (356 kvinnor och 83 män), från tre olika mättillfällen: före, direkt efter samt ett år efter avslutad MMRP. Patienterna delades även in i tre åldersgrupper (18-30 år, 31-45 år och 46-65 år). Deskriptiv och multivariat dataanalys har använts för att besvara avhandlingens syfte. Analyserna genomfördes separat för kvinnor, män och de tre åldersgrupperna. I studie I, utfördes analyserna i två steg: först analyserades patientpopulationerna i de olika MMRP separat och därefter de två patientpopulationerna tillsammans. I studie II och III analyserades båda programmen tillsammans. I den kvalitativa studien, studie IV, användes grundad teori med en framväxande design för datainsamling och analys. Individuella semistrukturerade intervjuer utfördes med 12 patienter (8 kvinnor och 4 män) som deltagit i MMRP under 2017.

Resultaten i studie I visade att kvinnorna förbättrades inom fler områden än männen från start av MMRP till ettårsuppföljning efter de båda programmen. De äldsta åldersgrupperna förbättrades inom fler områden än den yngsta gruppen vid ettårsuppföljningen, då programmen analyserades tillsammans.

Resultaten i studie II visade att männen hade god kortvarig effekt av MMRP medan kvinnorna hade en god effekt som kvarstod ett år efter avslutad MMRP. Patienter i den yngsta åldersgruppen hade större effekt med avseende på smärtintensitet och känslomässig funktion, både direkt efter och ett år efter MMRP, jämfört med de äldre åldersgrupperna.

Analysen av studie III visade att sjukskrivning var associerad med flera samverkande faktorer, såsom smärta, ångest, hälsorelaterad livskvalité samt tilltron till arbetsåtergång. Faktorer av betydelse för heltidssjukskrivning ett år efter MMRP skiljde sig åt mellan kvinnor, män och för de olika åldersgrupperna. För kvinnor var sjukskrivning vid start av MMRP, låg aktivitet och fysisk funktion, låg livskvalitet, spridd smärtlokalisation samt smärta under en längre tidsperiod, associerat med heltidssjukskrivning ett år efter MMRP. För män var spridd smärta, avsaknad av anställning och sjukskrivning vid starten av MMRP, associerat med heltidssjukskrivning ett år efter MMRP. Heltidssjukskriving ett år efter MMRP var i åldersgruppen 31-45 år associerat med hög smärtnivå och stor påverkan på emotionella funktioner, stor påverkan på aktivitet och fysisk funktion samt sjukskrivning vid start av programmet. För patienter i åldersgruppen 46-65 år var det låg utbildningsnivå, lågt skattad betydelse av arbete och liten tilltro till att bli återställd, som var associerat med heltidssjukskrivning ett år efter MMRP.

I studie IV visade analysen att patienterna som vistats på patienthotell under MMRP, gavs ökad möjlighet till att fokusera på sin rehabilitering genom mindre ansvar för hem och familj. Vidare framkom det att vistelsen på patienthotell bidrog till tid för egen reflektion men även tillsammans med andra patienter med liknande erfarenheter. Resultatet visade vidare att tid för sig själv bidrog till en medvetenhet om betydelsen av att ta hand om sig själv, vilket upplevdes göra skillnad för hantering av smärta i vardagen.

Sammanfattningsvis visar denna avhandling att MMRP i norra Sverige kan vara en effektiv rehabiliteringsmetod för att minska smärta, förbättra känslomässiga funktioner och hälsa samt öka aktivitet och fysisk funktion hos patienter med långvarig smärta. Resultaten tyder på att män kan ha behov av fortsatt stöd efter MMRP för att bibehålla förbättringar över tid. Heltidssjukskrivning ett år efter MMRP påverkas av ett antal samverkande faktorer som skilde sig åt mellan kvinnor, män och de olika åldersgrupperna. Detta resultat visar på behovet av att skräddarsy rehabiliterande strategier för olika subgrupper. Att vistas på patienthotell vid deltagande i MMRP gav möjlighet till befrielse från dagliga skyldigheter, tid för reflektion och interaktion med andra, vilket bidrog till personlig medvetenhet och genomförande av förändringar i hemmet efter avslutad MMRP.

Abbreviations

ES	Effect size
EQ-5D	European Quality of Life (5 dimensions)
HADS	Hospital Anxiety and Depression Scale
HADS-A	HADS-Anxiety
HADS-D	HADS-Depression
IASP	International Association for the Study of Pain
IQR	Interquartile range
MMRP	Multimodal rehabilitation programme
MPI	Multidimensional Pain Inventory
MPI-distract	MPI distraction response
MPI-distress	MPI affective distress
MPI-gai	MPI general activity index
MPI-lifcon	MPI life control
MPI-pain-interfer	MPI life interference
MPI-pain-severity	MPI pain severity
MPI-punish	MPI punishing response
MPI-socsupp	MPI social support
MPI-solict	MPI solicitous response
NPRS	Numeric pain rating scale
OPLS	Orthogonal Partial Least Square

PROM	Patient-reported outcome measures
SF-36	Short Form health survey
SF36-bp	SF-36 bodily pain
SF36-gh	SF-36 general health
SF36-MCS	SF-36 mental component summary index
SF36-mh	SF-36 mental health
SF36-PCS	SF-36 physical component summary index
SF36-pf	SF-36 physical functioning
SF36-re	SF-36 role emotional
SF36-rp	SF-36 role physical
SF36-sf	SF-36 social functioning
SF36-vt	SF-36 vitality
SQRP	Swedish Quality Registry of Pain Rehabilitation

Original papers

The thesis is based on the following papers, which will be referred to in the text by Roman numerals:

I. Spinord, L., Kassberg, A.C., Stenberg, G., Lundqvist, R., Stålnacke, B.M. (2018). Comparison of two multimodal pain rehabilitation programmes, in relation to sex and age. J Rehabil Med, 50 (7), 619-628.

II. Spinord, L., Kassberg, A. L., Stenberg, G., Stålnacke, B. M. Outcomes after multimodal rehabilitation for patients with chronic pain in northern Sweden with focus on gender and age. (Manuscript).

III. Spinord, L., Kassberg, A. L., Stålnacke, B. M., Stenberg, G. Multivariate correlations between pain, life interference, health-related quality of life and full-time sick leave one year after multimodal rehabilitation, focus on gender and age. Scandinavian Journal of Occupational Therapy (Published online) DOI:10.1080/11038128.2021.1903990

IV. Spinord, L., Kassberg, A. L., Stålnacke, B. M., Stenberg, G. (2020). Finding self-worth—Experiences during a multimodal rehabilitation program when living at a residency away from home. Canadian Journal of Pain, 4(1), 237-246.

The original Studies I and III were reprinted with kind permission from the publishers. Study IV was published as an Open Access article.

Preface

The focus of this thesis was to study outcomes and experiences of multimodal rehabilitation programmes for patients with chronic pain, provided by specialist clinics in northern Sweden. My interest in patients with chronic pain was aroused during my studies to become an occupational therapist (OT). During periods of practice, I have met patients with chronic pain in need of occupational therapy interventions. After my graduating, I began to work in specialist care clinics in teams with the aforementioned patient group. During my time as a Master's student in occupational therapy, my personal interest in development work grew.

My interest in research started when I was made responsible for the local register at the Sunderbyn hospital of the Swedish Quality Registry of Pain Rehabilitation (SQRP). This assignment gave me the opportunity to come in contact with SQRP's research group, a driving force in research of multimodal pain rehabilitation in Sweden. In the work with SQRP, I realized that multimodal pain rehabilitation programmes (MMRP) can differ in Sweden depending on the composition of the professional team as well as in terms of the duration of the programme. However, despite minor differences between specialist clinics and the structure of MMRP, it is important that the effects of MMRP are investigated and analysed in order to be able to offering effective team-based rehabilitation interventions to patients with chronic pain.

During my work as an OT in the team with patients with chronic pain, I noticed that the effects of MMRP varied for different individuals and groups. This also contributed to increased awareness that there was a lack of knowledge of differences and similarities between men, women and different age groups after participation in MMRP. My interest to study if and why the results differed after MMRP led to a contact with Region Norrbotten's Development Department and the holder of the SQRP register in Sweden. Thereafter, in collaboration with Umeå University and Region Norrbotten, my research group and I were given the opportunity to further study effects of MMRP.

At the time my doctoral studies started and throughout the course of my thesis work, I have worked in rehabilitation medicine as an occupational therapist in the team with patients that have chronic pain. Therefore, it was natural to be part of a research group based on SQRP data. This cooperation has meant that I have been able to participate in a wider research context. The collaboration has also contributed to the development of new knowledge about the effects of pain rehabilitation and MMRP as well as inside experiences of patients staying at a residency during MMRP.

Introduction

Chronic pain condition is a threat to individual health and welfare and results in wide-ranging negative effects on a person's life, associated with great suffering [1]. In addition, chronic pain is a major public health problem with a high cost for society [2]. There is evidence of multimodal rehabilitation programmes (MMRP) having better effects on the health of individuals with chronic pain compared with less comprehensive treatment [3]. However, there are no clear guidelines regarding how an MMRP should be designed in terms of intensity and duration. This means that MMRPs in Sweden differ depending on the specialist clinics providing the programme. In this thesis, the primary focus was to investigate MMRP in northern Sweden.

The introduction first provides an overview of chronic pain and its consequences, and sets out a gender and age perspective. It then focuses on multimodal rehabilitation. Finally, the introduction describes the Swedish Quality Registry of Pain rehabilitation and sick leave and at the end the rationale of the thesis.

Definitions of pain

The International Association of the Study of Pain (IASP) has revised the definition of pain. The new definition and notes were revised to better explain the nuances and complexity of pain in order to better assess and manage people with pain [4]. The definition is

"*an unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage".*

This new definition has a supplement which is clearer and easier to interpret and includes the etymology of the word "pain".

"Pain is always a personal experience that is influenced to varying degrees by biological, psychological, and social factors. Pain and nociception are different phenomena. Pain cannot be inferred solely from activity in sensory neurons. Through their life experiences, individuals learn the concept of pain. A person's report of an experience as pain should be respected. Although pain usually serves an adaptive role, it may have adverse effects on function and social and psychological well-being. Verbal description is only one of several behaviors to express pain; inability to communicate does not negate the possibility that a human or a nonhuman animal experiences pain" (4).

Chronic pain

Chronic musculoskeletal pain is represented as being the most common type of chronic pain and it covers most of the patients' conditions in this thesis. The definition of chronic primary pain is: pain in one or more anatomical regions that (i) persists or recurs for longer than 3 months (ii) is associated with significant emotional distress (e.g. anxiety, anger, frustration, or depressed mood) and/or significant functional disability (interference in activities of daily life and participation in social roles) (iii) and the symptoms are not better accounted for by another diagnosis [5].

Chronic pain is a common and complex condition. About 27 % of the adult population lives with chronic pain with significant intensity and according to WHO, chronic pain is the leading global public health problem [6]. In Sweden, almost 20 % of the population suffers from moderate to severe pain [2, 7]. Chronic pain has a significant impact on both individuals and society with major health costs which seems to be increasing world-wide as well as in Sweden [6, 7]. In Sweden, the socio-economic burden related to chronic pain in terms of healthcare spending, lost earnings, and welfare was estimated to about EUR 32 billion per year [8].

Living with chronic pain

Living with chronic pain may include experiences of reduced ability to perform everyday activities due to fatigue, sleep disturbance, anxiety, and depression [1]. It is well-known that various consequences of pain can present a major challenge for how people live their lives and their self-concept [9]. In addition, chronic pain can have an impact on performance of activities in daily life [10] and challenge the individuals to change their way of thinking, feeling and doing [9]. Restrictions on performance of activities that the individual needs, wants and is expected to do can lead to deterioration in life in terms of physical and mental health, and also influence the individual's social environment [11]. Previous research has found that changing daily habits can pose a challenge for individuals, for example, the way the person cleans their house, or manages personal hygiene or goes to work [12, 13]. Individuals with chronic pain may experience that their role in the family and at work has changed and may be reduced in scope because of pain [14, 15]. For example, it has been shown that individuals with chronic pain gave up previous activities and stopped performing meaningful and valued activities due to pain [11]. In addition, the varying daily form with better and worse days led to uncertainty about what patients could or could not do. Consequently, individuals with chronic pain struggle to maintain the sense of themselves and who they are, and describe the feeling of loss and distress as being worse than pain [16]. In addition, it is common that individuals with chronic pain experience mistrust, which results in loss of credibility. To reduce the risk of mistrust, research has found that individuals with chronic pain tend to keep the pain to themselves, as an attempt to fool their surroundings that they are the same as before the pain [17]. Being able to be involved in engaging and meaningful activities is an important factor for general health and well-being [18, 19].

Pain in a biopsychosocial model

The biopsychosocial model, originally proposed by GL Engel in the 1970s, to expand the traditional biomedical health perspective with social and psychological aspects of health [20]. Psychological factors include cognitive aspects such as thoughts, feelings and behaviours and emotional aspects such as depression and anxiety. The social factors, include family relationships, leisure, work, societal expectations, cultural background and environment. Social and psychological aspects can both intensify or reduce the pain experience and can constitute obstacles or be supportive when handling the pain [21, 22].

Chronic pain is more than just pain; it is a complexity of biological, psychological and social factors. Fillingim [22] describes how different parts of the biopsychosocial model affect the individual's experiences and consequences of the pain. The pain experience is unique to each individual and pain is sculptured by a variety of factors that is unique for each individual. Which factor is the most important varies among different individuals depending on, for example, age, previous pain episodes and level of education [22].

The biopsychosocial model is a commonly used clinical explanatory model thanks to the knowledge of the complexity of chronic pain gained over recent decades. To understand and treat chronic pain, a biopsychosocial approach should be reflected in all meetings and throughout the whole rehabilitation process, from the first contact to assessment, planning and interventions as well as in the evaluation phases of the rehabilitation [23]. The model has been developed and is today dominant in multimodal rehabilitation programmes for chronic pain [23].

Rehabilitation of chronic pain

There is broad terminology used for multicomponent treatment approaches and modal pain rehabilitation, both in literature and in clinical practice. IASP has recently approved a definition to clarify the terminology of unimodal treatment, multimodal treatment, multidisciplinary treatment and interdisciplinary treatment [24]. The following descriptions are recommended by the Presidential Task Force on Multimodal Pain treatment:

- Unimodal treatment: a single therapeutic intervention directed at a pain mechanism or diagnosis.

- Multimodal treatment: separate therapeutic interventions with different mechanisms of actions.

- Multidisciplinary treatment: multimodal treatment provided by practitioners from different disciplines working to achieve their own therapeutic aim for the patient and not necessarily communicating with each other.

- Interdisciplinary treatment: multimodal treatment provided by a multidisciplinary team collaborating on assessment and treatment and using a shared biopsychosocial model and goals.

In Sweden, interdisciplinary treatment is often referred to as multimodal rehabilitation or multidisciplinary rehabilitation which uses an interdisciplinary approach. The term, multimodal rehabilitation programme (MMRP) will be used in this thesis.

Multimodal rehabilitation programme

MMRP is a team-based goal-oriented programme that combines physiological, pedagogical and physical interventions such as activities and exercises [25]. The programmes consider each patient's needs from a biopsychosocial perspective. MMRPs are administrated over several weeks, often in group settings by different health professionals and most often based on cognitive behavioural therapy (CBT) or Acceptance Commitment Therapy, (ACT) [25, 26]. This form of rehabilitation is provided to individuals with complex pain conditions, and requires coordinated interventions from several professions. The team work is integrated using an interdisciplinary approach and the patient is an active member of the team. Patients participate actively in collaboration with the team on the setting and achieving of explicit goals [26]. Patients with chronic pain conditions are often offered MMRP in order to improve their ability to cope with the consequences of the pain, to increase participation in society and return to work/reduced sick leave [27]. MMRP generally includes information about bodily and psychosocial reactions to chronic pain, supervised physical exercise and activity training, ergonomic practice and occupational strategies [26]. The general goals for the programmes are reduce sick leave and to improve the ability to return to or continue work. Systematic reviews have revealed that MMRPs are more effective in reducing pain and restoring functioning, as well as return to work than unimodal treatments of chronic pain are [3, 27, 28].

In Sweden, MMRP has a long tradition in pain rehabilitation in specialist care for patients with chronic pain. Today, MMRP is also offered in primary care. The differences between primary and specialist care are that specialist care manages patients with more complex symptoms, for example, more severe pain or comorbid psychological conditions, than primary care does [27]. This thesis focuses on two MMRPs in specialist care in northern Sweden.

Gender perspective

In this thesis, gender is used as a social construct where gender is determined by perceptions of norms, behaviours, task functions and role attributes of being a woman or a man. Gender as a social construct varies from society to society and can change over time [29]. So far, research on gender has often defined men and women with chronic pain as being two separate homogeneous groups and has explored the differences rather than the similarities and studies seldom reflect any real variations within the groups [30].

It has been found that women are more likely than men to report higher pain intensity, and pain sensitivity, and lower pain threshold [31] and more widespread pain [32-34]. In addition, women seemed to report a higher degree of influence on performance of activities at home and in society [35] and a higher degree of anxiety and depression than men, due to pain. Furthermore, it has been shown that women and men might differ in terms of coping styles and beliefs about pain. Men seemed to be more likely than women to view their pain as a physical injury and experienced control over the pain and have a believed in a medical cure. The women on the other hand seemed to be more likely to acknowledge the emotional aspects of pain than most of the men [36]. In addition, men were more likely than women to use avoidance and pacing strategies, while women were more likely than men to use an overdoing pattern (persevering with activities until completed despite significantly increased pain) [37]. Moreover, women seemed to report more frequently problems in household management, while men more often reported activity problems in functional mobility, and personal care [10].

Prejudices about gender can lead to negative consequences for patients in healthcare at several levels, called "gender bias" in the medical literature. Gender bias occurs when it is assumed that similarities and justice are equal between women and men, but where there are differences in terms of biology and disease, as well as in living conditions and experiences [38]. One example of gender bias is when professionals assume that housework is equally distributed between men and women when in reality women more often than men have more responsibilities and workload at home [17]. Gender bias can also occur when differences are pointed out where there are in fact no differences, which can lead to men and women being given different diagnoses and treatment even though it is not medically justified [38]. Women have a tendency to be at risk that physical illnesses are not detected while men tend to be underdiagnosed when it comes to mental illness [36].

To understand the concept of gender differences and similarities in results from MMRP it is important to consider social and cultural aspects in the interpretation of the results [30]. However, it is also of importance to take into account that differences between man and women could also be due to biological differences such as hormones and muscle mass [31]. Furthermore, it is important to consider that differences within the group of women and the group of men are often greater than those between women and men.

Age perspective

Chronic pain affects people of all ages and the incidence has been shown to increase with age [32]. In Sweden, MMRP is offered to people of working age from 18 years old, the mean age being 43 years [39]. Regardless of age, people with chronic pain may need MMRP to develop coping strategies to make it possible to live a meaningful life with chronic pain. Moreover, chronic pain has been shown to be common in adolescents [40]. In a previous study of self-reported chronic pain, including 42 countries, 20.6 % of the adolescents reported pain at least in two sites [40]. Additionally, it has been shown that young adults with chronic pain often perceived a low level of independence, which affected their ability to build up their autonomy [41]. Previous research has shown that young adults' pain behaviours can result in attention from their parents, which strengthens parental involvement [41]. This may imply a further challenge for adolescents and young adults' ability to build up their autonomy. It has also been found that friendships and romantic relationships can be affected through reduced social participation for young adults with chronic pain [41]. Furthermore, research has shown that young adults with chronic pain are less likely to complete higher education or get full-time employment compared with their peers without pain [41]. This knowledge shows how important it is for young people with pain to receive support promptly from the healthcare services and society to regain control of their pain and get the opportunity to build up their autonomy. For those individuals with pain who are in the highly active mid-phase of life (usually 31-45 years), combining busy family life with the demands of career-building, household chores can be a considerable burden [42, 43]. Research has shown that this "middle phase of life" can be linked to a higher risk of mental illness and a higher risk of sick leave [44]. Furthermore, at a later phase in life, it has been found that people with chronic pain are more likely to report better health-related quality of life and healthier mental health than younger people with chronic pain [45].

The findings described above suggest that the consequences of pain affect individuals differently depending on factors such as time period of life. Additionally, different periods in life can mean different needs for support in order to be able to cope with the pain. There is currently limited knowledge on whether the outcome of MMRP differs for different age groups. This thesis focuses on adults aged 18-65 years divided into three age groups (18-30, 31-45 and 46-65 years of age).

Swedish Quality Registry for Pain Rehabilitation (SQRP)

The SQRP for specialist care was founded in 1998 to facilitate the comparison of the rehabilitation programmes in Sweden as well as the results of the different single programmes and outcomes studies. This registry is based on patients-reported outcome measures (PROM) in validated self-reported questionnaires including sociodemographic items. The inclusion criteria for participating in the SQRP are disabling non-malignant musculoskeletal pain for more than 3 months, and referred to participating units for multi-professional assessment and/or multimodal rehabilitation [39].

The aim of the SQRP is to allow participating departments to follow up the healthcare given in order to develop and secure healthcare quality and compare group level results between different participating departments concerning functioning, activity, health-related quality of life and participation in working life and leisure. The majority of the pain specialist clinics in Sweden are linked to the SQRP [46].

Sick leave

Chronic pain together with psychological disorders are the most common cause of long-term sick leave in Sweden. The Swedish Social Insurance Agency (Försäkringskassan) makes it possible for people with a disease or injuries, with a decreased work ability of at least 25 % and up to 100 %, to be entitled to sickness benefit for a maximum of 365 days during a period of 450 days. If work ability is reduced for more than one year, the individual can be granted temporary or permanent sickness compensation [47]. The mean yearly sick leave for people with musculoskeletal diseases in Sweden has been reported to be 46 days off from work [48]. The Swedish labour market is clearly gender-segregated, and women and men dominate in different parts of working life and different occupations and have different work conditions [49]. The social insurance data system in Sweden has found that women and men often have different occupations within the same branch. Previous research has found that men and women respond similarly to occupations that require health and work ability. In healthcare and service professions, the risk of being on sick leave is high for both men and women [47].

The risk of being on long-term sick leave for musculoskeletal diseases has been found to increase markedly with age. In addition, the risk of being on sick leave increases the most for people aged 46-65 years [47]. It is still not known how the proportion of sick leave is affected at one-year follow-up with regard to gender and age.

Rationale

There is a long tradition in Sweden of offering multimodal pain rehabilitation to individuals in need of more complex interventions from several healthcare providers. Research has revealed positive results in terms of reduced pain and restored functioning for patients who have participated in MMRP [3, 27, 28]. However, the MMRP provided to patients with chronic pain differs in terms of length and intensity. In northern Sweden, there are two specialist clinics offering MMRP to patients with chronic pain. While, the two programmes contain predominantly similar interventions, there are some differences in terms of the professionals included and length of the rehabilitation periods. However, there is still a lack of knowledge regarding whether or not the differences between the programmes are significant for the outcomes at one-year follow-up for different age groups and gender. Chronic pain is prevalent all over Sweden, in all age groups and among both women and men. People's lives and contextual conditions and their living conditions are different based on context, social and cultural environmental factors. Today, all patients are often evaluated as one large cohesive group. However, all patients are not equal and they live their lives in different ways. This thesis has endeavoured to study outcomes after MMRP for different age groups and both genders. It is still a rough division of individuals, but the results from this thesis may provide some insight into the outcomes following MMRP for men, women and three different age groups.

Research often defines men and women as two separate homogeneous groups. This may conceal the similarities and differences that exist between men and women [30]. Treatment based on stereotypes and preconceptions may increase the risk of missing, for example, physical symptoms in women and mental symptoms in men with chronic pain [36]. It is also necessary to carry out studies on differences to see the variations within the groups to detect gender bias [38, 50]. Still, there is a limited knowledge about whether the effects of MMRP in the short and long terms are the same for men and women as well as for different age groups. Moreover, there is a need for more knowledge about factors associated with being on full-time sick leave at one-year follow-up. In our geographically expansive country, the MMRP provided to patients with chronic pain differs with respect to design and intensity. In addition, many patients in northern Sweden need to stay at a residency during MMRP due to the long distance to the pain specialist clinics that provide MMRP. There is still a lack of knowledge about patients' experiences of staying at a residency during MMRP. Knowledge from this thesis could be valuable for the future planning and design of MMRPs in order to achieve sustainable results for different subgroups.

Aim of the thesis

The overall aim of this thesis was to study outcomes and experiences after multimodal rehabilitation programmes (MMRP) for patients with chronic pain in northern Sweden, focusing on gender and age.

Specific aims

- To evaluate two different MMRPs at one-year follow-up regarding the outcomes pain intensity, activity and physical functioning, emotional functioning, health-related quality of life (Study I).

- To study the outcomes pain intensity, emotional functioning, activity and physical functioning, social response, and health-related quality of life immediately after and at one-year follow-up (Study II).

- To study the multivariate relationships between full-time sick leave at one-year follow-up and background factors, pain intensity, emotional functioning, activity and physical functioning, and health-related quality of life (Study III).

- To explore patients' experiences of participating in MMRP while staying at a residency (Study IV).

Methods

Study design

This thesis includes four studies. Studies I-III have a quantitative approach and Study IV has a qualitative approach.

Table 1. Overview of study designs, settings, study populations, outcomes and data collection and analysis included in this thesis.

<table>
<tr><th></th><th>Study I</th><th>Study II</th><th>Study III</th><th>Study IV</th></tr>
<tr><td>Study design</td><td>Retrospective longitudinal cohort study</td><td>Retrospective longitudinal cohort study</td><td>Cross-sectional cohort study</td><td>Semi-structured interviews</td></tr>
<tr><td>Settings</td><td colspan="4">Two specialist care clinics in northern Sweden, Department of Rehabilitation medicine, Sunderby County Hospital (Programme S), and Pain Rehabilitation clinic, Umeå University Hospital (Programme U).</td></tr>
<tr><td rowspan="2">Study population</td><td>Programme S n=219
Programme U n=220</td><td></td><td rowspan="2">Patients n=284 (237 women and 47 men)</td><td rowspan="2">Patients=12 (8 women and 4 men)</td></tr>
<tr><td colspan="2">Patients n= 439
(356 women and 83 men)</td></tr>
<tr><td rowspan="2">Outcome measures</td><td>EQ-5D</td><td></td><td rowspan="2">Full-time sick leave at one year follow-up</td><td rowspan="2"></td></tr>
<tr><td colspan="2">HADS
MPI
NPRS
SF-36</td></tr>
<tr><td>Data collection</td><td colspan="3">SQRP during 2011-2016</td><td>Individual interviews during 2017</td></tr>
<tr><td rowspan="2">Data analysis</td><td></td><td>Effect size</td><td>OPLS</td><td rowspan="2">Grounded theory</td></tr>
<tr><td colspan="3">Chi-2, Independent-sample t-test, Wilcoxon signed-rank test, One-way ANOVA, Mann-Whitney U test, Kruskal-Wallis test</td></tr>
</table>

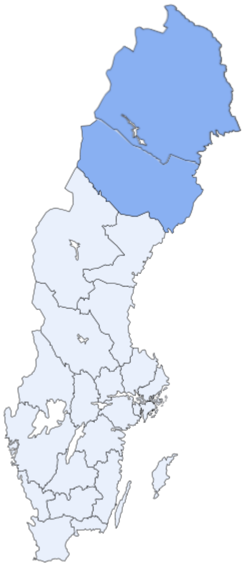
MMRP: Multimodal rehabilitation programme; MPI: Multidimensional Pain Inventory; SF-36: The Short Form health survey; EQ-5D: The EuroQol 5D; NPRS: The Numeric Pain Rating Scale; SQRP: Swedish Quality Registry for Pain Rehabilitation; OPLS: Orthogonal Partial Least Square analysis.

Settings

Northern Sweden

The study population in this thesis consisted of patients who participated in MMRP in the counties of Norrbotten and Västerbotten. These counties are located in northern Sweden and cover more than a third of Sweden's total land area (Fig. 1) but constitute the least populated area with just over 500,000 people [50]. The inland in northern Sweden consists of large sparsely populated areas and the majority of the population lives in the coastal areas. At the time of the data collection, some differences were found in the labour market, for example, northern Sweden had higher unemployment than the national average [49].

There is a pain specialist clinic in each of the two northernmost counties in Sweden. The huge areas of the county councils mean that a number of referred patients have to travel a long distance to visit the pain specialist clinics for assessment and to participate in MMRP (up to 400 km one way). It can be troublesome for patients with chronic pain to travel this distance due to the pain. Patients may require accommodation closer to the clinic where the MMRP takes place. Therefore, the patients are often able to stay at a residency (designated patient hotel) during the MMRP.



Area:

Norrbotten 97,239 km^2

Västerbotten 55,665 km^2

Total: 152,904 km^2

Population:

Norrbotten: 250,093 inhabitants

Västerbotten: 271,736 inhabitants

Total: 521,829 inhabitants

Figure 1. Information about the counties.

Residency

The counties where the MMRPs were performed consist of vast rural areas with low population density. The long-distance to the clinics means that the patients may need to stay at a patient hotel/residency during the MMRP. The hotels were located nearby the rehabilitation clinics and the patients paid only a small amount for food and accommodation. Service personnel were available during the day and were, responsible for services such as: meals, cleaning and transportation. If contact with healthcare providers was needed, service personnel referred the participant to members in the team. The hotels were equipped with indoor and outdoor areas where the patients could perform activities by their own or together. The patients had access to facilities such as computers and the Internet, craft activities, physical exercises equipment and relaxation rooms. The activities were normally organised and supported by professionals but could also be performed individually by the patients. In the hotel entrance, there was an area where the patients could read books and newspapers, chat with others or just sit down and relax when having a break from organised activities.

Assessment before MMRP

The majority of the patients were referred from primary health care to specialist care. At the specialist clinics, they were assessed by interdisciplinary teams. The assessment teams included a nurse, an occupational therapist, a psychologist, a physician, a physiotherapist, and a social worker. The team assessments were based on a biopsychosocial approach. After the individual assessment, the results were discussed at team conferences. If patients fulfilled the inclusion criteria they were offered to participate in the MMRP. If the patients needed further investigations or were assessed to benefit from unimodal treatment and/or did not fulfil the inclusion criteria, they were returned to primary care with a rehabilitation plan with the team's suggestions and recommendations.

The inclusion criteria for MMRP were at the time of the data collection: (i) disabling non-malignant musculoskeletal pain >3 months, (ii) aged between 18 and 65 years and, (iii) prerequisite of coordinated interventions from several professions, in need of assistance to be able to develop coping strategies, be in work or assessed to be able to return to work, and assessed to benefit from receive group rehabilitation. Exclusion criteria for MMRP: (i) ongoing major somatic or psychiatric disease such as heart disease, cancer, schizophrenia, or deep depression, and (ii) substance abuse i.e. of alcohol, narcotics or medication.

Multimodal rehabilitation in northern Sweden

At the time of data collection, the MMRPs in northern Sweden (Programme S and Programme U) were similar in many ways in terms of the interventions provided to patients. For example, most of the interventions were conducted in group form based on cognitive-behavioural principles with a biopsychosocial approach. Both programmes lasted approximately 6 hours/day and included exercise, body awareness, activity training, ergonomics, occupational strategies, coping and pain education. Moreover, in both the MMRPs, the patient together with the team created a rehabilitation plan and the patients were encouraged to take an active role in the settings of goals. The main differences between the two MMRPs were the length of the programmes, geographic location and the professionals in the team. Further details about the differences between the two MMRPs are described in detail in Table 2.

Table 2. Differences between the MMRPs in northern Sweden

	Programme S	**Programme U**
Assessment before MMRP	2-3 days over a 1-2 week period	1-2 days
Geographic location	The assessment took place at a county hospital and the MMRP at another place 30 km from the hospital	The assessment and the MMRP took place at the University hospital.
Duration of the MMRP	5 weeks (2.5 + 2.5) weeks with a period at home for 4-5 weeks.	4 consecutive weeks.
Patients in the group	8-10 patients	6-8 patients
Accommodation during the MMR period	As standard, the patients stay at a residency	Most of the patients live at home.
MMR team	Nurse, occupational therapist physiotherapist, psychologist, and social worker, and other professionals as the assessment team	Occupational therapist, physician, psychologist, physiotherapist, and social worker. The same professionals as in the assessment team.
Sessions by professionals		
Nurse/health coach	6 hours	-
Occupational therapist	16 hours	11.5 hours
Psychologist	5 hours	15 hours
Physician	-	2 hours
Physiotherapist	25 hours	34 hours
Social worker	3 hours	-
Total number of hours of group sessions	110	120

MMRP: Multimodal rehabilitation programme

Study population

Studies I-III

Studies I-III consisted of patients who participated in MMRP during 2011-2015 and had answered questionnaires included in the SQRP at start of MMRP (n=439), immediately after MMRP (n=425) and at one-year follow-up (n=292). (Figure 2).

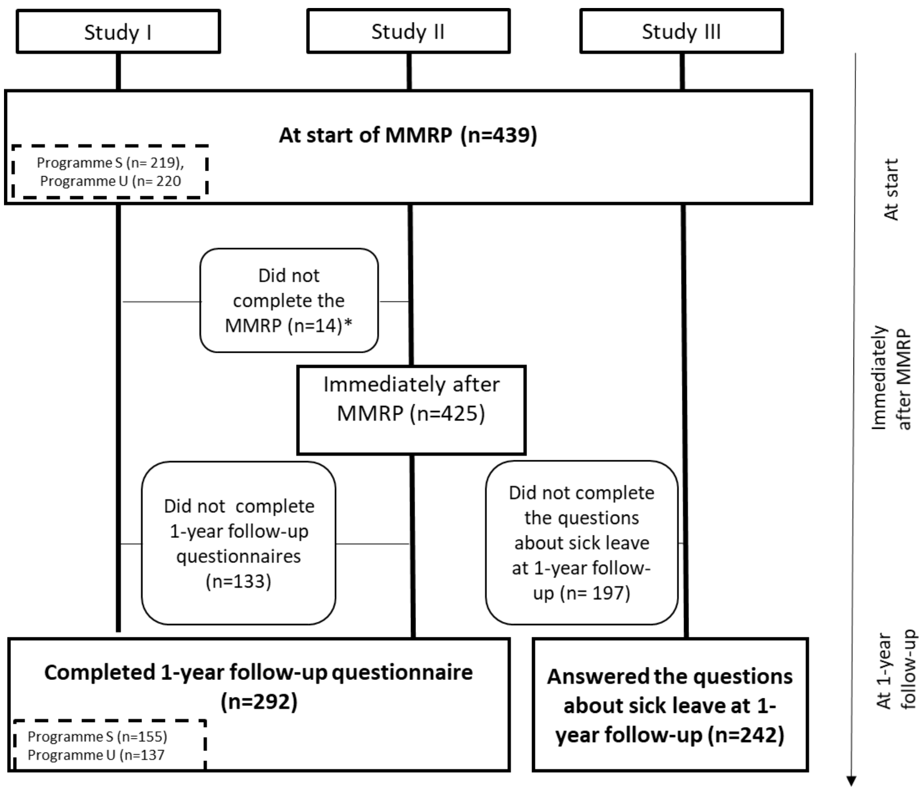


Figure 2. Flow chart over studies I-III. * Needed other medical healthcare treatment contacts (n=1), own decisions (n=5), other reasons for discontinuing (n=8).

The patients in Studies I-III were divided into three age groups: 18-30, 31-45, and 46-65 years in order to study similarities and differences between different age groups based on outcomes after MMRP. This division was decided on the basis of the characteristics of each age group. The age groups were categorised on the assumption that individuals in the youngest age group were living alone or with their parents, studying or at the beginning of their working career [51], while individuals in the middle age group (31-45 years) had progressed further in their professional career and started a family [42]. The individuals in the oldest age group (46-65) were assumed to have a consolidated life role, with grown up children and at the end of their professional career [42].

Study IV

The sample in Study IV comprised of 12 patients who had completed MMRP at a specialist clinic in northern Sweden. Ten of them had stayed at a residency during the MMRP. The patients included in this study were 8 women and 4 men aged between 20-63 years. They reported a pain duration of between 2 and 27 years.

Four patients were working at least 50 %. Four of the patients were on full-time sick leave, three were 100 % jobseekers, and one was on 50 % sick leave and 50 % jobseeker. Six patients were married or cohabitating and six patients had children living at home.

Data collection

In Studies I-III, the PROM data from the questionnaires included in SQRP were used. The patients completed the questionnaires at start of MMRP, immediately after MMRP and at one-year follow-up. In Studies I and III, data from the start and one-year follow-up were used. In Study II, data from all three measurements occasions were included. The short perspective was measured from start to immediately after MMRP while the long perspective was measured from start to one-year follow-up.

The background questionnaire from the SQRP was used in Studies I-III. This questionnaire included demographic questions on age, country of birth, educational level, vocational status, work importance, belief in recovery, sick leave, pain duration and numbers of pain sites. Women and men were identified on the basis of their Swedish personal identity numbers. In addition, sick leave was reported at start and at one-year follow-up. In Study IV, data were collected from semi-structured interviews.

Instruments

The instruments in this thesis were included in SQRP and based on validated self-reported questionnaires covering the biopsychosocial spectra. The outcome measures used are presented in Table 3. To capture psychosocial and behavioural aspects of pain, the Multidimensional Pain Inventory (MPI) was used. Anxiety and depression were assessed using the Hospital Anxiety and Depression Scale (HADS) and for health-related quality of life, the Short Form Health Survey (SF-36) and the EuroQol 5D (EQ-5D) were used. The instruments used were mainly according to the recommendation of the Initiative on Methods, Measurement, and Pain Assessment in Clinical Trials (IMMPACT) [52] and the Validation and Application of a core outcomes set of patient-relevant outcome domains to assess the effectiveness of multimodal pain therapy (VAPAIN) [53].

The Multidimensional Pain Inventory (MPI) measures psychosocial, cognitive and behavioural effects of chronic pain. Sixty-one items are divided into three parts. The first part focuses on psychosocial functioning using five subscales: 1) pain severity (MPI-pain-severity) assesses perceived severity of pain; 2) life interference (MPI-pain-interfer) assesses the individual's perceptions regarding how pain interferes with their lives including interference with family, work, and social recreational activities and satisfaction; 3) life control (MPI-lifcon) assesses perceived life control, incorporating the perceived ability to solve problems and feelings of mastery and competence; 4) affective distress (MPI-distress): ratings of depressed mood, irritability and tension; 5) social support (MPI-socsupp): appraisal of support received from spouses, family and significant others, such as being concerned, supportive and attentive. The second part measures the patient's perceptions of responses given by significant others when there is an expression of pain using three subscales: 1) punishing response (MPI-punish) 2) solicitous response (MPI-solict), and 3) distraction response (MPI-distract). The third part includes four subscales describing frequency of participation in common activities in daily life: 1) household chores; 2) outdoor work; 3) activities away from home and 4) social activities. These four subscales are combined to a general activity index, which is the average sum of the subscales. The general activity index (MPI-gai) is used in this thesis. All items in MPI are rated on a 7-pointed numeric scale, range 0-6. Higher scores indicate greater frequency of occurrence [54].

The Short Form health survey (SF-36) was used to collect information about the individuals' self-rated health status. That is intended to represent a person's conditions and limitations in daily life on 8 dimensions: 1) physical functioning (SF36-pf) assesses the perceived performance of physical activities including bathing or dressing; 2) role-physical (SF36-rp) appraises the performance of work or other daily activities as a result of physical health; 3) bodily pain (SF36-bp) assesses limitations due to pain; 4) general health (SF36-gh) determines the perceived health and belief that the state of health will probably get worse; 5) vitality (SF36-vt) assesses the feeling of being tired and worn out; 6) social functioning (SF36-sf) appraises interference with normal social activities because of physical and emotional problems; 7) role-emotional (SF36-re) assesses perceived performance with work or other daily activities as a result of emotional problems; and 8) mental health (SF36-mh) assesses feelings of nervousness and depression. Higher scores indicate better health status (0–100). Based on these eight dimensions, a physical component summary (SF36-PCS) index and a mental component summary index (SF36-MCS) are calculated [55, 56].

The EuroQol 5D (EQ-5D) investigates the patients' state of health in two parts. The first part defines five dimensions: mobility, self-care, usual activities, pain/discomfort and anxiety/depression. Dimensions are converted to an index (EQ-5D index) ranging from -0.594 to 1 (1 = indicates full health, 0 = indicates dead, below 0 = indicates worse than dead). The second part EQ VAS reports the overall health status using a 100-point scale, with defined end points. High values indicate good health while low values indicate poor health [57].

The Hospital Anxiety and Depression Scale (HADS) is a self-reported assessment that measures anxiety (HADS-A) and depression (HADS-D). The questionnaire consists of 14 items divided into two subscales – anxiety and depression. The total score range in both scales in 0-21. A higher score in each subscale indicates a higher risk of depression and anxiety. [58]. Scores ≥ 11 indicate a probable case in each scale [44].

The Numeric Pain Rating Scale (NPRS) measures self-reported average pain intensity during the previous seven days, using an 11-point scale 0-10. A high value indicates a higher level of pain [59].

The variables from the instruments used for this thesis were categorised into five domains: pain intensity (MPI-pain-severity, SF36-bp, NPRS); emotional functioning (MPI-Distress, SF36-vt SF36-mh, HADS-A, HADS-D); activity and physical functioning (MPI-pain-interfer, MPI-lifcon, MPI-gai, SF36-sf, SF36-rp, SF36-re, SF36-pf); social response (MPI-socsupp, MPI-punish, MPI-solict, MPI-distract); and health (SF36-gh, EQ VAS, EQ-5D Index) (Table 3). The results were reported in domains and the current variables in parentheses.

Table 3. Outcome measures in the domains used in Studies I-III.

Domains	Study I	Study II	Study III
Pain intensity	MPI-pain-severity NPRS	MPI-pain-severity SF36-bp NPRS	MPI-pain-severity SF36-bp NPRS
Activity and physical functioning	Interference in life (MPI-pain-interfer) SF36-PCS	MPI-pain-interfer MPI-gai SF36-sf SF36-rp SF36-re SF36-pf	MPI-pain-interfer MPI-gai SF36-sf SF36-rp SF36-re SF36-pf
Health-related quality of life	EQ VAS	SF36-gh	SF36-gh EQ VAS EQ-5D Index
Emotional functioning	SF36-MCS HADS A HADS D	MPI- distress MPI-lifcon SF36-vt SF36-mh HADS-A HADS-D	MPI- distress MPI-lifcon SF36-vt SF36-mh HADS-A HADS-D
Social response		MPI-socsupp MPI-punish MPI-solict MPI-distract	MPI-socsupp MPI-punish MPI-solict MPI-distract

MPI: Multidimensional Pain Inventory; Pain–Severity: pain severity, Pain-interfere: life interference; Distress: affective distress; lifcon: life control; Socsupp: social support; Punish: punishing response; solict: solicitous; distract: distraction response; gai: general activity index; SF-36: The Short Form health survey; bp: bodily pain; sf: social functioning; rp: role physical; re: role emotional; pf: physical functioning; gh: general health; vt: vitality; mh: mental health; EQ-5D: The EuroQol 5D; NPRS: The Numeric Pain Rating Scale; HADS: Hospital Anxiety and Depression Scale; HADS A: Anxiety; HADS D: Depression.

Semi-structured interviews

In Study IV, semi-structured individual interviews were performed to capture the patients' experiences [60] of participating in MMRP while staying at a residency. The interviews were conducted face-to-face 1-6 months after MMRP. The interviews were conducted at a place chosen by the patients: at the patient's home, the rehabilitation clinic, or at the patient's work place. Data were collected on one occasion which lasted between 54-72 minutes. The interviews focused on the patients' experiences of participating in an MMRP while staying at a residency during the programme. A semi-structured interview guide with open-ended questions covered various aspects of the experiences. The interview started with the question: "Can you describe your experience of participating in an MMRP?" followed by questions about their experiences of staying at a residency as well as their thoughts and feelings before, during and after the MMRP. Theoretical saturation [61] was applied, which means that no more patients were recruited when new data did not add any further insights and/or the discovery of additional properties for those categories.

Data analyses

Several methods were used in this thesis to study outcomes following MMRP and to explore experiences of staying at a residency while participating in MMRP.

Data analysis (Studies I-III)

Descriptive analyses were used to describe the patients' demographics. Non-parametric statistics were used for almost all the data apart from age, number of pain sites and duration of pain which were analysed by parametric statistics. Multivariate data analysis was used in Study III to identify which variables at start of MMRP were of significance for full-time sick leave at one-year follow-up. Separate analyses were performed for women, men, and the three age groups. p-values <0.05 were considered to be statistically significant. The statistical package IBM SPSS 24.0 and 26.0 as well as SIMCA 16.0 (Umetrics Inc., verson 16 Umeå Sweden) were used for the analysis.

In Studies I-III, the differences between women and men were tested with Chi-2 for categorical data. An independent sample t-test was used to analyse differences between men and women on the continuous variables (i.e. age, number of pain sites and duration of pain) and One-way ANOVA was used to analyse differences between the age groups (with a post-hoc test if there were significant differences). Since the PROM data in this thesis are based on ordinal data, a non-parametric test were used. The Mann-Whitney U test was used to investigate differences between women and men on PROM data. Kruskal–Wallis test was used for comparisons between the age groups. Wilcoxon signed-rank test was used to analyse the change between start of MMRP, immediately after MMRP and at one-year follow-up on PROM data.

In Study I, the analyses were performed in two steps. In the first step, the two populations were combined and the outcomes for women and men as well as age groups were analysed. In the second step, the programmes were split up into the two programmes (Programme S and Programme U) and analysed separately.

In Study II, effect sizes (ES) for differences between the age groups as well as between women and men at start vs immediately after MMRP, immediately after MMRP vs one-year follow-up, and at start of MMRP vs one-year follow-up were calculated. ES were calculated (r=z/square root of n) and assessed against Cohen's criteria (0.10 small, 0.30 medium, 0.5 large) [62].

In Study III, an Orthogonal Partial Least Square analysis (OPLS) was performed to identify associated variables for full-time sick leave at one-year follow-up. OPLS reduced the variables and found the relations among them and transformed the variables into new uncorrelated components. These components are known as principal components (PC) and calculated for all X-variables (at start of MMRP) and the Y-variable (full-time sick leave one year follow-up). All variables included in the OPLS were rescaled so higher values indicated more serious problems. The following variables were rescaled: all eight scales in SF-36, both scales in EQ-5D and Life control scale in MPI. Variance scaling and mean-centering were used to give the variables equal importance in the analysis [63]. A Principal Component Analysis (PCA) was carried out to detect whether there were any moderate or strong outliers among the observations. For that analysis, Hotelling's T2 and distance to model in X-space were used. No extreme outliers were identified. In addition, non-linear Iterative Partial Least Squares algorithms were used to handle missing data. This corresponds to a missing completely at random assumption. Furthermore, a jack-knife procedure was used to estimate standard errors for the loadings. Only variables with a 95 % jack-knife confidence interval are shown in the figures (Figures 4 and 8). Variables with loadings ≤ –0.15 and ≥ 0.15 were chosen (the interval is arbitrary, but variables with loadings closer to 0 contribute less to the model), to represent the most important variables in the components, respectively.

Data analysis (Study IV)

In Study IV, a constructivist grounded theory approach was used during data collection and analysis [64]. The grounded theory focuses on process and actions which are considered relevant to the given aim of Study IV. This method was chosen to gain insight into the patients' expression of experiences and to offer a description of the phenomenon "staying at a residency during MMRP". Patients experiences of staying away from home during the MMRP were important to capture, since the time away from home could have an impact on their rehabilitation. The analysis was conducted in analogy with Charmaz [64], and was characterised by alternately collecting and analysing data, coding, memo writing and theoretical coding. The analyses started with the initial coding where the text reads line-by-line and then labelled with codes close to the data and which illustrate actions. Focus coding was used to identify the most significant and most frequently used codes. The focus coding gave the direction of the further analysis process. Codes were compared and clustered into sub-categories and categories. The analysis process is illustrated in Table 4. In the theoretical coding, a model was constructed to illustrate the relationships between the categories and subcategories and how they were related to each other at a more theoretical level. To ensure that the analysis remained close to the data, a constant comparison approach was used which meant constant alternation between the interviews and the analysis [64].

Table 4. Examples of codes and subcategories in the category "Space for myself".

Categories	Subcategories	Codes
Space for myself	Time to focus on myself	Time alone
	Time for reflection	Don't have to consider other people's needs
	A break from everyday life	No household chores Preparations prior to being away from home to go away

Ethical considerations

The principles of the Declaration of Helsinki were followed and all four studies were approved by the Regional Ethical Review Board of Umeå University, Sweden (Dnr 2015/240-31). All patients in Studies I-III had received written information about data being registered in the SQRP. The patients who participated had received information that group-based data were to be used for annual national comparison and for research, and that they had the right to be deleted from the registry. All data from the registry database that were used for the analyses were coded so that no individual patients could be identified. Regarding the qualitative study (Study IV), all patients received a letter with written information about the aim and the design of the study which emphasised that participation was voluntary. In addition, the patients were informed that their participation would not affect their contacts with the healthcare services. Furthermore, they were informed that if questions arose during the course of the study, the first author would help them to contact the right level of healthcare professional. All patients gave their written informed consent to participate.

Results

The analysis in this thesis showed different aspects of patients participating in MMRP with a focus on gender and age, outcomes in the short and long term, multivariate correlations between factors at start of MMRP and sick leave, and patients' experiences of staying at a residency during MMRP. The main findings in this thesis are presented in three sections. In the first section, the findings from Study I with outcomes after the two MMRPs are presented. In the second section, the findings from Studies I-III are presented separately for men, women and the different age groups. The third section presents findings from the patients' experiences of staying at a residency while participating in MMRP (Study VI). In this thesis, statistically significant improvements will hereafter be presented and discussed as "improvements".

Study population at start of MMRP

The study population in this thesis was characterised by long duration of pain, long duration of sick leave, and a low belief in recovery. Details about the population are presented in Table 5.

The analysis of the patients who did not complete the SQRP questionnaires at one-year follow-up showed that they were younger (p=<0.001), had lower scores on anxiety (p=0.023), higher affective distress (p=0.021), less role-emotional function (p=0.011), and had worse mental health (p=0.003) compared with those who completed the one-year follow-up questionnaire.

Outcomes of the two MMRPs in northern Sweden

Outcomes regarding pain intensity, activity and physical functioning, emotional functioning, health-related quality of life after the two MMRPs in northern Sweden were studied, first together and then separately (Study I). Improvements were found in both of the programmes for women and men and all the age groups at one-year follow-up. The results indicate that different design of the MMRPs had little impact on the outcomes at one-year follow-up for the patients.

Table 5. Demographic data at start for the study population in Studies I-III, n=439

Gender	
Women, %	81
Age, mean (SD)	43 (11)
18-30 years, %	15
31-45 years, %	42
46-65 years, %	43
Born in Nordic country, %	97
University degree, %	
Compulsory school	8
Upper secondary/vocational school	53
University/college	33
Vocational situation, %	
Employed	68
Unemployed	16
Consulted a doctor more than 4 times last year, %	67
Sick leave %	61
Partial	26
Full-time	35
Days since work, full-time sick leave, mean (SD)	1090 (1958)
≥ 1 year %	60
Work is of great importance[1], %	84
Positive belief in recovery[2], %	12
Pain duration, years mean, (SD)	7,4 (7)
≥ 2 years %	61
Number of pain sites, mean (SD)	15 (8)
Worst located area, %	
Generalised pain	37
Lower back	20
Neck	15
Upper extremities	6
Trunk	5.5
Lower extremities	5
Head/face	4
Hip/gluteal area	3
Abdomen	1
Chest	0.5

[1] included answers: very important and extremely important on a 5-point Likert scale. [2] included answers: totally convinced and convinced on a 5-point Likert scale.

Outcomes for women after MMRP

The findings in this thesis indicate that women benefit from MMRP in terms of pain intensity, emotional functioning, health-related quality of life as well as activity and physical functioning. The women reported improvements with small to medium ES in several domains both after and at one-year follow-up (Study II) (Table 6) (Figure 3-4). For women, a high level of sick leave, low physical functioning, low health-related quality of life (EQ VAS), and low work importance, and low affective distress at start were found to be associated with being on full-time sick leave at one-year follow-up (Study III) (Figure 5).

In summary, the women who participated in MMRP in northern Sweden showed improvements immediately after MMRP and most of the improvements were sustained at the one-year follow-up.

Table 6. Outcomes variables for women at start, immediately after MMRP and at one-year follow-up

Women	At start of MMRP n=356		After MMRP n=344		1-year follow-up n= 243		Start vs after MMRP		Start vs 1-year follow-up	
	Median (IQR)	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)	Mean (SD)	*p*-value	ES	*p*-value	ES
Pain Intensity										
Pain Severity (MPI-pain-severity)	4.33 (1)	4.39 (0.81)	4 (1)	4.1 (0.87)	4 (1.34)	3.86 (1.17)	**<0.001**	**0.24**	**<0.001**	**0.30**
Bodily Pain (SF36-bp)	22 (11)	24 (13)	31 (19)	30 (14)	31 (19)	33 (17)	**<0.001**	**0.27**	**<0.001**	**0.31**
Numeric Pain Rating Scale (NPRS)	7 (2)	7 (2)	7 (2)	6 (2)	7 (3)	6.1 (2)	**<0.001**	**0.20**	**<0.001**	**0.24**
Emotional functioning										
Affective Distress (MPI-distress)	3.33 (1.67)	3.25 (1.27)	2.67 (2)	2.62 (1.31)	3 (2)	2.76 (1.34)	**<0.001**	**0.3**	**<0.001**	**0.22**
Life control (MPI-lifcon)	2.75 (1.25)	2.87 (1)	3.5 (1.25)	3.43 (1.08)	3.25 (1.5)	3.38 (1.18)	**<0.001**	**0.33**	**<0.001**	**0.24**
Vitality (SF36-vt)	20 (25)	21 (17)	25 (26)	28 (20)	25 (30)	31 (23)	**<0.001**	**0.24**	**<0.001**	**0.27**
Mental health (SF36-mh)	60 (28)	62 (19)	68 (24)	67 (18)	68 (28)	68 (20)	**<0.001**	**0.20**	**<0.001**	**0.20**
Anxiety (HADS-A)	8 (7)	8 (4.5)	7 (6)	7 (4)	6 (6)	6 (4)	**0.002**	**0.12**	**<0.001**	**0.22**
Depression (HADS-D)	8 (5)	8 (4)	6 (5)	7 (4)	6 (6)	6 (4)	**<0.001**	**0.23**	**<0.001**	**0.24**
Activity and physical functioning										
Life interference (MPI-pain-interfer)	4.55 (.2)	4.45 (0.91)	4.45 (1.33)	4.31 (0.91)	4.18 (1.5)	4.03 (1.18)	**0.002**	**0.11**	**<0.001**	**0.25**
General activity index (MPI-gai)	2.54 (1.01)	2.54 (0.74)	2.68 (0.9)	2.64 (0.75)	2.66 (1.04)	2.67 (0.82)	**0.004**	**0.11**	0.074	-
Social functioning (SF36-sf)	50 (38)	48 (24)	50 (38)	50 (24)	50 (37)	55 (25)	0.198	-	**<0.001**	**0.18**
Role physical (SF36-rp)	0 (25)	10 (21)	0 (25)	15 (26)	0 (25)	20 (32)	**0.009**	0.06	**<0.001**	**0.20**
Role emotional (SF36-re)	67 (100)	52 (42)	67 (100)	60 (43)	67 (100)	61 (43)	**<0.001**	0.02	**0.044**	0.09
Physical functioning (SF36-pf)	55 (25)	52 (21)	55 (30)	52 (21)	56 (35)	54 (23)	0.258	-	**0.042**	0.09
Social response										
Social support (MPI-socsupp)	4 (2)	4.05 (1.25)	4 (1.67)	4.01 (1.17)	4 (1.33)	3.79 (1.34)	0.353	-	**<0.001**	**-0.23**
Punishing response (MPI-punish)	1.5 (1.5)	1.67 (1.3)	1.25 (1.75)	1.6 (1.3)	1.5 (2.19)	1.76 (1.36)	0.532	-	**<0.001**	**-0.20**
Solicitous response (MPI-solict)	2.83 (2)	2.88 (1.39)	2.83 (2)	2.93 (1.38)	2.67 (2)	2.78 (1.34)	0.834	-	**0.008**	**0.13**
Distracting response (MPI-distract)	2.5 (1.5)	2.49 (1.16)	2.5 (1.5)	2.52 (1.12)	2.5 (1.75)	2.44 (1.15)	0.477	-	0.168	-
Health										
General health (SF36-gh)	40 (25)	42 (19)	40 (25)	43 (19)	45 (32)	45 (22)	0.318	-	0.10	-

MMRP: Multimodal Rehabilitation Programme; IQR: interquartile range; SD: Standard deviation; ES: effect size; Wilcoxon signed-rank test was used to analyse *p*-value and ES; $p<0.05$ and effect size > 0.1 or < -0.1presented in bold.

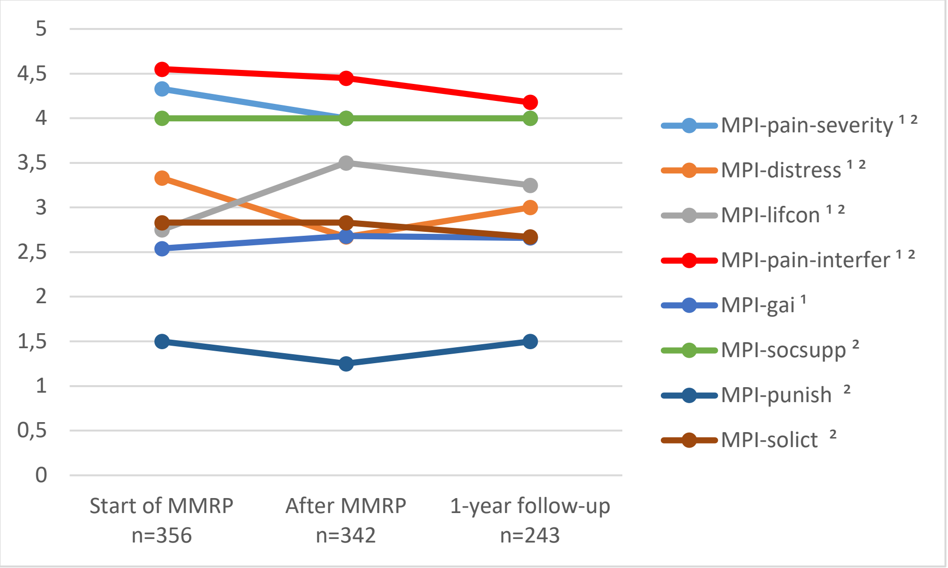


Figure 3. The MPI variables for women in the three occasions (median). Higher score indicates greater frequency of occurrence; [1] Significant changes between start to after; [2] Significant changes between start to one-year follow up.

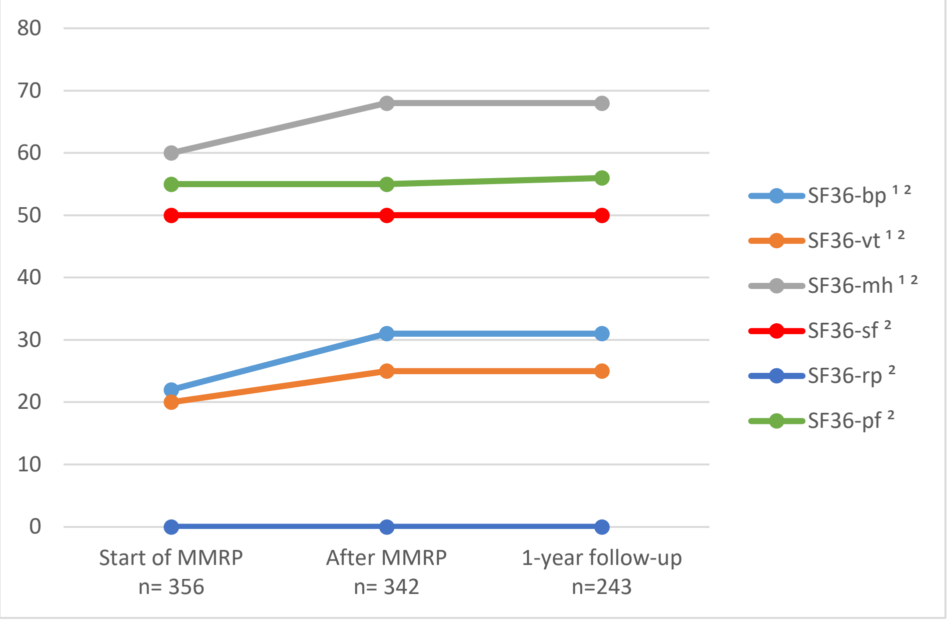


Figure 4. The SF36 variables for women at the three occasions (median). [1] Significant changes between start to after; [2] Significant changes between start to one-year follow up.

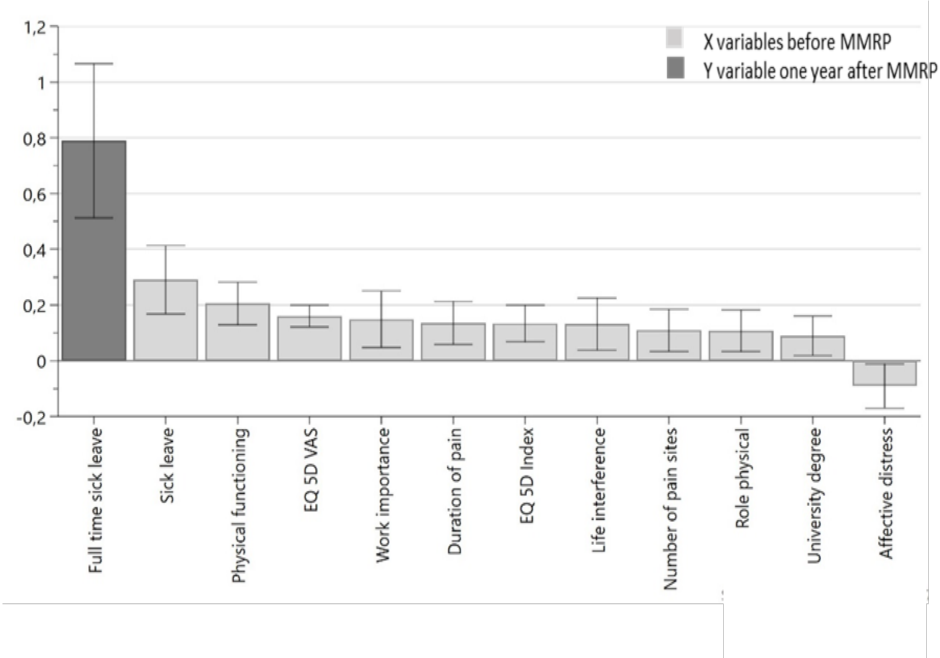


Figure 5. Combined OPLS loading column plot for the predictive component in the model for full-time sick leave with 95% jack-knife confident interval bars for women. Relationship between the X variable loadings before MMRP (light grey) and the Y variable full-time sick leave at one-year follow-up loadings (dark grey). Only significant variables are shown in the model. In the model, column height indicates the importance of each variable, values closer to zero being less important irrespective of sign (+/-). Same sign for Y variable and X variable means they are positively correlated. High loadings of the Y variable indicate high correlation with the predictive component and X. Model variance R2Y =26.3 % and prediction value Q=13.5 %.

Outcomes for men after MMRP

The results from this thesis showed that men benefit from MMRP in terms of pain intensity, emotional functioning, activity and functioning, and health. However, most of the improvements did not sustain to the one-year follow-up. The analysis indicates that men improved significantly with medium ES in the pain intensity and emotional functioning domains from start to immediately after MMRP. Small ES were found in activity and physical functioning domains (MPI-pain-interfer, MPI-gai, SF36-sf) and in health from start to immediately after MMRP. Most of the improvements in the emotional functioning domain decreased between immediately after MMRP to one-year follow-up (Study II) (Table 7) (Figures 6-7). The proportion of men who reported HADS-D≤11 was significantly higher at one-year follow-up than at start (Study I).

The multivariate analysis showed that being on sick leave, having a high number of pain sites, and not being permanently employed at start of MMRP were associated with full-time sick leave at one-year follow-up for men (Figure 8) (Study III).

In summary, the men who participated in MMRP showed improvements in the short term immediately after MMRP but these improvements did not sustain to one-year follow-up except for the variables SF36-bp, SF36-pf, HADS D and MPI-pain-interfere.

Table 7. Outcomes variables for men at start, immediately after MMRP and at one-year follow-up

Men	**At start of MMRP n=83**		**After MMRP n=81**		**1-year follow-up n=49**		**Start vs After MMRP**		**Start vs 1-year follow-up**	
	Median (IQR)	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)	Mean (SD)	*p*-value	ES	*p*-value	ES
Pain Intensity										
Pain Severity (MPI-Pain-severity)	4.33 (1.33)	4.31 (0.85)	4 (1.67)	3.8 (1.02)	4.33 (1.34)	4.08 (1.11)	**<0.001**	**0.37**	0.173	-
Bodily Pain (SF36-bp)	22 (19)	23 (12)	31 (19)	31 (15)	22 (19,5)	29 (15)	**<0.001**	**0.37**	**0.014**	**0.25**
Numeric Pain Rating Scale (NPRS)	7 (3)	6.5 (1.6)	6 (3)	5.6 (1.9)	6.5 (2.75)	6.1 (1.9)	**<0.001**	**0.31**	**0.018**	**0.25**
Emotional functioning										
Affective Distress (MPI-Distress)	3.33 (1.33)	3.26 (1.09)	2.33 (2)	2.31 (1.34)	3.33 (2.34)	2.78 (1.6)	**<0.001**	**0.43**	0.152	-
Life control (MPI-LifCon)	2.75 (1.75)	2.78 (1.15)	3.5 (1.94)	3.44 (1.18)	3.25(1.62)	3.18 (1.19)	**<0.001**	**0.33**	0.110	-
Vitality (SF36-vt)	20 (25)	24 (19)	35 (30)	36 (21)	25(3 9)	32 (25)	**<0.001**	**0.35**	0.059	-
Mental health (SF36-mh)	60 (28)	59 (19)	72 (26)	71 (18)	68(36)	65 (24)	**<0.001**	**0.44**	0.325	-
Anxiety (HADS-A)	8 (5.5)	7.6 (4)	6 (5)	6.7 (3.9)	6(6.5)	6.8 (4.3)	**0.018**	**0.19**	0.751	-
Depression (HADS-D)	8 (6.5)	8.3 (3.8)	6 (5)	6.5 (3.6)	7(5.5)	6.9 (4.3)	**<0.001**	**0.34**	**0.016**	**0.24**
Activity and physical functioning										
Life interference (MPI-Pain-interfer)	4.82 (1.18)	4.6 (0.85)	4.4 (1.09)	4.36 (0.96)	4.4(1.52)	4.18 (1.25)	**0.021**	**0.18**	**0.016**	**0.24**
General activity index (MPI-GAI)	2.29 (1.12)	2.38 (0.89)	2.56 (1.31)	2.64 (0.86)	2.35 (1.33)	2.56 (0.95)	**0.003**	**0.24**	0.47	-
Social functioning (SF36-sf)	50 (38)	48 (24)	50 (37)	55 (25)	50(50)	52 (30)	**0.013**	**0.20**	0.674	-
Role physical (SF36-rp)	0 (25)	10 (19)	0 (25)	15 (29)	0(25)	16 (29)	0.1	-	0.358	-
Role emotional (SF36-re)	33 (100)	49 (44)	67 (100)	55 (42)	67(100)	58 (41)	0.591	-	0.888	-
Physical functioning (SF36-pf)	55 (30)	55 (21)	60 (20)	58 (19)	60(32.5)	57 (22)	0.060	-	**0.024**	**0.23**
Social response										
Social support (MPI-Socsupp)	4.5 (1.66)	4.29 (1.27)	4.33 (1.33)	4.16 (1.02)	4 (1.59)	3.76 (1.53)	**0.014**	**-0.20**	**0.002**	**-0.32**
Punishing response (MPI-Punish)	1.75 (1.62)	1.71 (1.19)	1.5 (1.25)	1.62 (1.18)	1.5 (1.75)	1.89 (1.34)	0.123	-	0.252	-
Solicitous response (MPI-Solict)	3 (1.54)	2.89(1.23)	2.83 (1.42)	2.78 (1.13)	2.67 (2.17)	2.46 (1.38)	0.819	-	**0.011**	**0.27**
Distracting response (MPI-Distract)	2.5 (1.81)	2.53 (1.07)	2.75 (1.62)	2.63 (1.03)	2.5 (1.75)	2.49 (1.24)	0.119	-	0.826	-
Health										
General health (SF36-gh)	35 (17)	39 (20)	40 (32)	43 (21)	35(31)	41 (22)	**0.012**	**0.20**	0.586	-

MMRP: Multimodal Rehabilitation Programme; IQR: interquartile range; SD: Standard deviation; ES: Effect size; Wilcoxon signed-rank test was used to analyse *p*-value and ES; *p*<0.05 and effect size > 0.1 or < -0.1presented in bold.

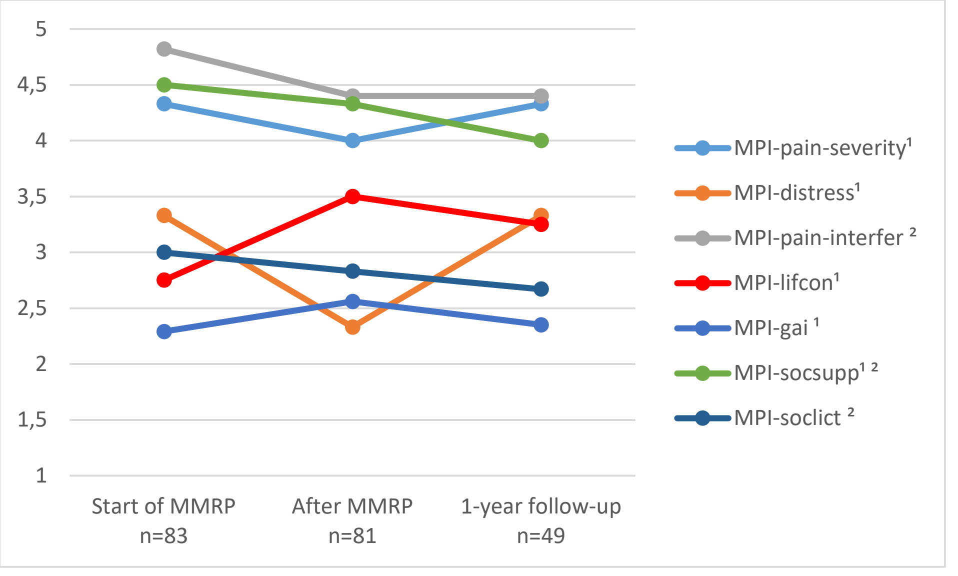


Figure 6. The MPI variables for men in the three occasions (median). Higher score indicates greater frequency of occurrence; [1] Significant changes between start to after; [2] Significant changes between start to one-year follow up.

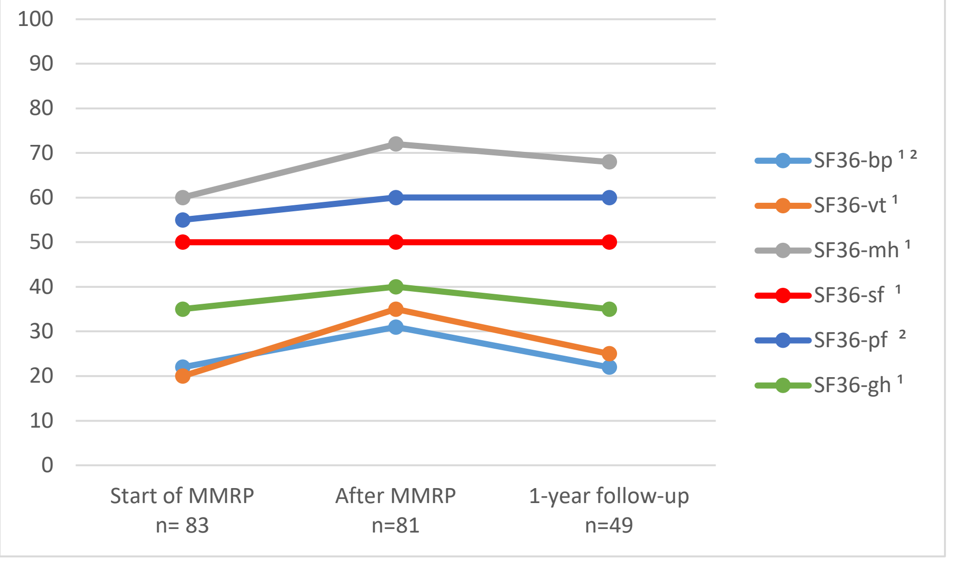


Figure 7. The SF36 variables for men at the three occasions (median). [1] Significant changes between start to after; [2] Significant changes between start to one-year follow up.

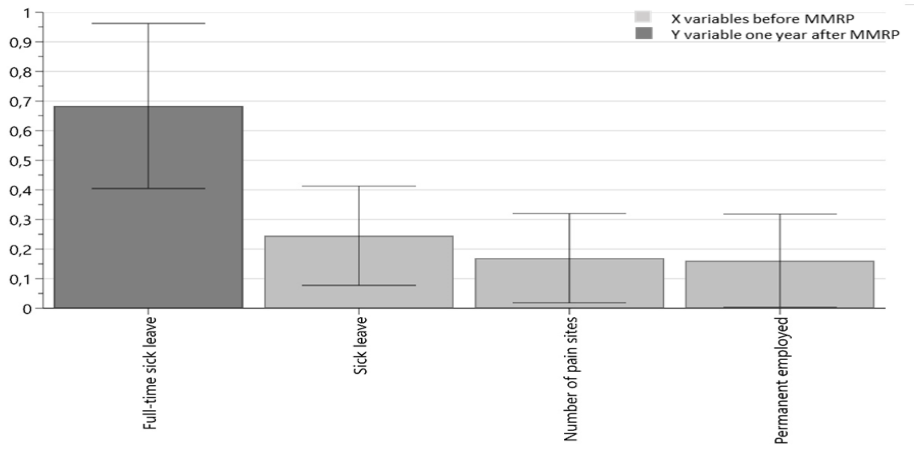


Figure 8. Combined OPLS loading column plot for the predictive component in the model for full-time sick leave with 95% jack-knife confident interval bars for men. Relationship between the X variable loadings before MMRP (light grey) and the Y variable full-time sick leave at one-year follow-up loadings (dark grey). Only significant variables are shown in the model. In the model, column height indicates the importance of each variable, values closer to zero being less important irrespective of sign (+/-). Same sign for Y variable and X variable means they are positively correlated. High loadings of the Y variable indicate high correlation with the predictive component and X. Model variance R2Y =26.3 % and prediction value Q=13.5 %.

Outcomes for the age groups

The results of Studies I-III indicate that all age groups were found to have decreased pain intensity and increased emotional functioning from start to immediately after MMRP.

In the activity and physical functioning domain, the youngest age group (18-30 years) increased in social functioning (SF36-sf), and in health (SF36-gh). For more details about the changes in the 18-30 years age group, see Table 8 and Figures 9 and 10. The older age groups (31-45 years and 46-65 years) showed significant improvements with lower life interference (MPI-lifcon) and higher general activity (MPI-gai) immediately after MMRP compared with start (Study II) (Table 9 and 10). At one-year follow-up, all age groups sustained lower pain intensity and continued lower emotional functioning variables. The oldest age group (45-65 years) seemed to improve in more variables at one-year follow-up than the other age groups. Changes in MPI and SF36 variables for age group 31-45 years and 46-65 years are shown in Figures 11-12 and 14-15. All age groups showed a significant decrease in social support from start to one-year follow-up (Studies I-II).

The multivariate analysis showed that patients in the 31-45 years age group who were on full-time sick leave at one-year follow-up reported a higher number of pain sites, higher pain intensity, lower activity and physical functioning, lower health-related quality of life and lower emotional functioning at start of MMRP than the patients who were not on full-time sick leave (Figure 13). Full-time sick leave at one-year follow-up for patients in age group 45-65 years (Figure 16) was associated with low belief in recovery, low work importance, no permanent employment, having no university degree, having long duration of pain, and being on sick leave at start of MMRP. No significant model for the age group 18-30 years was found in the multivariate analysis (Study III).

In summary: All three age groups benefit from MMRP. However, different patterns were found between the older age groups (31-45, 46-65 years) for factors associated with being on full-time sick leave at one-year follow-up

Table 8. Outcomes variables for age group 18-31 years at start, immediately after MMRP and at one-year follow-up

18-30 years age group	**At start of MMRP n= 65**		**After MMRP n=60**		**1-year follow-up n= 37**		**Start vs after MMRP**		**Start vs 1-year follow-up**	
	Median (IQR)	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)	Mean (SD)	*p*-value	ES	*p*-value	ES
Pain Intensity										
Pain Severity (MPI-pain-severity)	4.67 (1.33)	4.47 (0.82)	4 (1.3)	4.07 (0.87)	4(2)	3.67 (1.32)	**<0.001**	**0.33**	**0.002**	**0.36**
Bodily Pain (SF36-bp)	22 (20)	22 (13)	31 (13)	31(13)	31 (19)	33 (19)	**<0.001**	**0.37**	**0.012**	**0.29**
Numeric Pain Rating Scale (NPRS)	7(7)	7 (1.4)	6 (2)	6 (2)	6 (3)	6 (2)	**0.002**	**0.28**	**0.004**	**0.34**
Emotional functioning										
Affective Distress (MPI-distress)	3.84 (1.66)	3.58 (1.15)	3(1.67)	2.91 (1.21)	2.67 (2)	2.53 (1.38)	**<0.001**	**0.32**	**0.001**	**0.39**
Life control (MPI-lifcon)	2.67 (1.5)	2.59 (1.08)	3.5 (1.44)	3.3 (0.99)	3.25 (1.25)	3.32 (1.14)	**<0.001**	**0.35**	**0.007**	**0.32**
Vitality (SF36-vt)	25 (25)	24 (17)	30(25)	31 (19)	30 (27)	32 (22)	**0.015**	**0.22**	0.147	-
Mental health (SF36-mh)	56 (27)	56 (18)	68 (23)	67 (16)	72 (28)	69 (20)	**<0.001**	**0.37**	**0.007**	**0.31**
Anxiety (HADS-A)	10 (7)	9 (5)	8 (5)	8(4)	7 (7)	8 (4)	0.067	-	0.190	-
Depression (HADS-D)	8 (6)	8 (4)	6(6)	6 (6)	5 (6)	5 (4)	**0.003**	**0.28**	**0.002**	**0.37**
Activity and physical functioning										
Life interference (MPI-pain-interfer)	4.6 (1.19)	4.52 (0.89)	4.6 (1.17)	4.4 (0.95)	4.27 (1.37)	3.98 (1.07)	0.216	-	**0.011**	**0.29**
General activity index (MPI-gai)	2.45 (1.11)	2.45 (0.80)	2.57 (0.99)	2.61 (0.78)	2.61 (0.93)	2.59 (0.82)	0.058	-	0.330	-
Social functioning (SF36-sf)	50 (35)	45 (23)	50(25)	52 (23)	50 (37)	56 (28)	**0.036**	**0.19**	0.097	-
Role physical (SF36-rp)	0 (25)	10 (18)	18 (31)	18 (31)	0 (50)	24 (34)	0.059	-	**0.038**	**0.24**
Role emotional (SF36-re)	67 100)	52 (43)	67 (100)	63 (42)	67 (67)	64 (40)	0.080	-	0.612	-
Physical functioning (SF36-pf)	60 (35)	57 (20)	60 (29)	58(21)	70 (32)	64 (23)	0.462	-	0.124	-
Social response										
Social support (MPI-socsupp)	4.33 (1.33)	4.25 (4.33)	4.33(1.67)	4.15(1.05)	4 (1.67)	3.87(1.26)	0.503	-	**0.005**	**-0.33**
Punishing response (MPI-punish)	1.25 (1.75)	1.63 (1.38)	1.25(1.84)	1.5 (1.37)	1.75 (2.5)	1.71(1.34)	0.888	-	0.124	-
Solicitous response (MPI-solict)	3.17 (1.66)	3.09 (1.17)	3.2 (1.67)	3.15 (1.11)	2.67 (2)	2.93 (1.1)	0.775	-	0.400	-
Distracting response (MPI-distract)	3 (1.25)	2.93 (1.05	3.25 (1.37)	3.07 (0.95)	2.75 (1.75)	2.91 (1.11)	0.217	-	0.680	-
Health										
General health (SF36-gh)	31 (31)	41 (22)	45 (21)	44 (21)	45 (34)	48 (22)	**0.002**	**0.21**	**0.045**	**0.23**

MMRP: Multimodal Rehabilitation Programme; IQR: interquartile range; SD: Standard deviation; ES: Effect size; Wilcoxon signed-rank test was used to analyse *p*-value and ES; *p*<0.05 and effect size > 0.1 or < -0.1presented in bold.

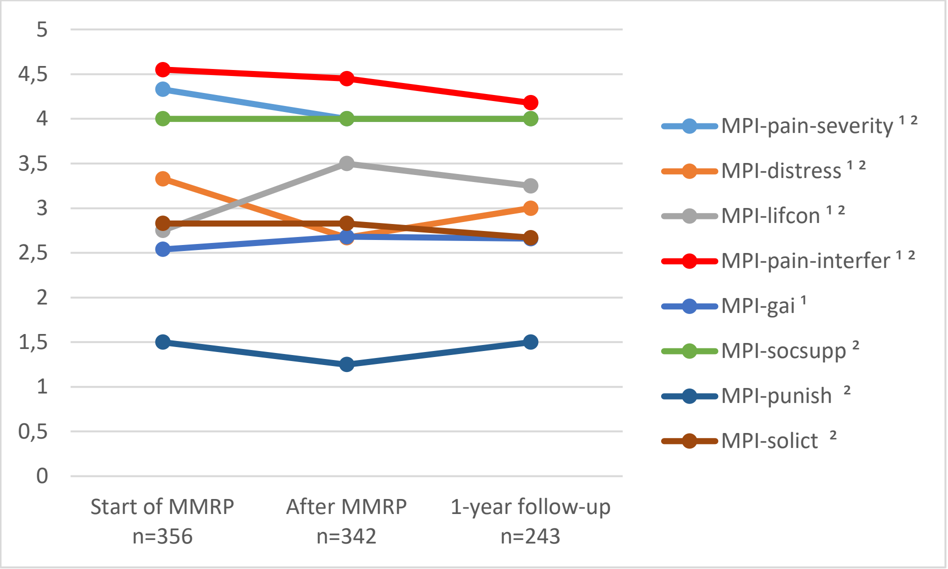


Figure 9. The MPI variables for age group 18-30 years in the three occasions (median). Higher score indicates greater frequency of occurrence; [1] Significant changes between start to after; [2] Significant changes between start to one-year follow up.

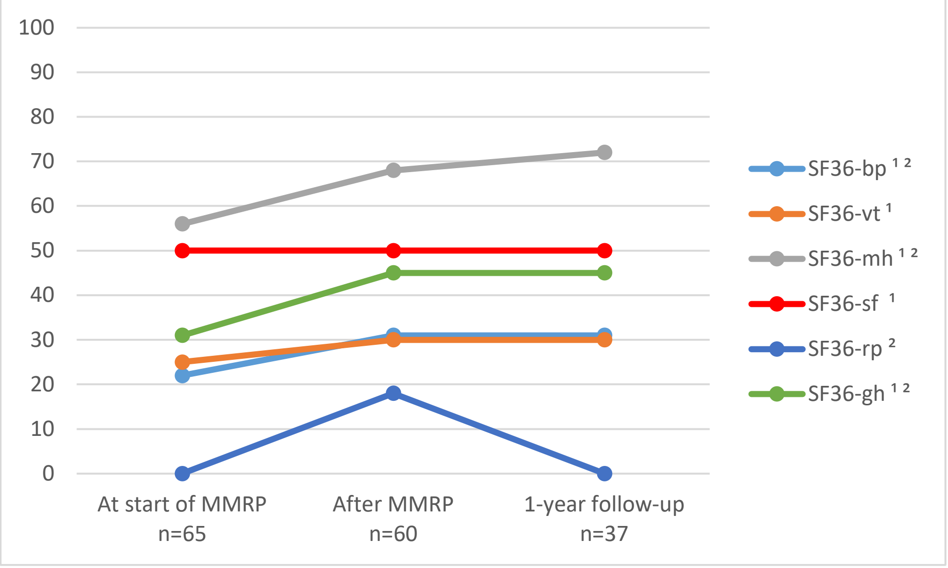


Figure 10. The SF36 variables for age group 18-30 years at the three occasions (median). [1] Significant changes between start to after; [2] Significant changes between start to one-year follow up.

Table 9. Outcomes variables in age group 31-45 years at start, immediately after MMRP and one-year follow-up

31-45 years age group	At start of MMRP n=186		After MMRP n= 179		1-year follow-up n=107		Start vs after MMRP		Start vs 1-year follow-up	
	Median (IQR)	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)	Mean (SD)	*p*-value	ES	*p*-value	ES
Pain Intensity										
Pain Severity (MPI-Pain-severity)	4.33 (1)	4.37 (0.81)	4.33 (1)	4,09 (0.92)	4 (1.34)	3.96 (1.12)	**<0.001**	**0.23**	**<0.001**	**0.25**
Bodily Pain (SF36-bp)	22 (11)	24 (13)	31 (19)	30 (14)	31 (19)	31 (16)	**<0.001**	**0.30**	**<0.001**	**0.30**
Numeric Pain Rating Scale (NPRS)	7 (2)	7 (2)	7 (2)	6 (2)	7 (3)	6 (2)	**0.001**	**0.19**	**0.002**	**0.22**
Emotional functioning										
Affective Distress (MPI-Distress)	3.5 (1.33)	3.38 (1.18)	2.67 (1.33)	2.74 (1.29)	3.33 (2)	3.04 (1.36)	**<0.001**	**0.32**	**0.013**	**0.17**
Life control (MPI-LifCon)	2.75 (1.5)	2.80 (1.03)	3.25 (1.5)	3.25 (1.09)	3 (2.75)	3.23 (1.19)	**<0.001**	**0.27**	**0.004**	**0.20**
Vitality (SF36-vt)	15 (24)	20 (16)	25 (30)	27 (19)	25 (27)	28 (22)	**<0.001**	**0.24**	**<0.001**	**0.25**
Mental health (SF36-mh)	60 (24)	60 (18)	68 (32)	66 (24)	68 (28)	63 (20)	**<0.001**	**0.24**	**0.012**	**0.17**
Anxiety (HADS-A)	8 (6)	8 (4)	7 (6)	7 (2)	7 (5)	7 (4)	**0.014**	**0.13**	0.058	-
Depression (HADS-D)	8 (5)	8 (4)	7 (5)	7 (5)	7 (7)	7 (4)	**<0.001**	**0.23**	**0.002**	**0.21**
Activity and physical functioning										
Life interference (MPI-Pain-interfer)	4.6 (1.18)	4.50 (0.87)	4.45 (1.27)	4.34 (0.91)	4.27 (1.45)	4.14 (1.22)	**0.023**	**0.12**	**0.001**	**0.23**
General activity index (MPI-GAI)	2.48 (0.96)	2.49 (0.72)	2.66 (2.3)	2.62 (0.74)	2.5 (0.92)	2.58 (0.82)	**0.012**	**0.13**	0.780	-
Social functioning (SF36-sf)	50 (38)	47 (22)	50 (35)	49 (23)	50 (25)	52 (25)	0.358	-	**0.032**	**0.15**
Role physical (SF36-rp)	0 (0)	9 (19)	0 (25)	14 (27)	0 (25)	19 (32)	**0.036**	**0.11**	**0.004**	**0.20**
Role emotional (SF36-re)	33 (100)	52 (40)	67 (100)	58 (42)	67 (100)	57 (43)	0.054	-	0.431	.
Physical functioning (SF36-pf)	55 (30)	55 (20)	60 (26)	55 (20)	60 (32)	56 (23)	0.777	-	0.452	-
Social response										
Social support (MPI-Socsupp)	4 (1.67)	4.02 (1.22)	4 (1.42)	3.96 (1.15)	4 (2)	3.69 (1.41)	0.261	-	**<0.001**	**-0.24**
Punishing response (MPI-Punish)	1.5 (1.5)	1.78 (1.31)	1.5 (1.79)	1.65 (1.28)	1.75 (2.25)	1.95 (1.47)	0.078	-	0.264	-
Solicitous response (MPI-Solict)	2.83 (2.08)	2.80 (1.38)	2.67 (2.17)	2.86 (1.35	2.67 (2.17)	2.68 (1.4)	0.944	-	0.159	-
Distracting response (MPI-Distract)	2.5 (1.5)	2.39 (1.10)	2.5 (1.5)	2.45 (1.07)	2.25 (1.37)	2.29 (1.08)	0.469	-	0.528	-
Health										
General health (SF36-gh)	35 (20)	40 (19)	40 (22)	42 (19)	40 (27)	45 (21)	0.213	-	0.384	-

MMRP: Multimodal Rehabilitation Programme; IQR: interquartile range; SD: Standard deviation; ES: Effect size; Wilcoxon signed-rank test was used to analyse *p*-value and effect size; *p*<0.05 and effect size > 0.1 or < -0.1presented in bold.

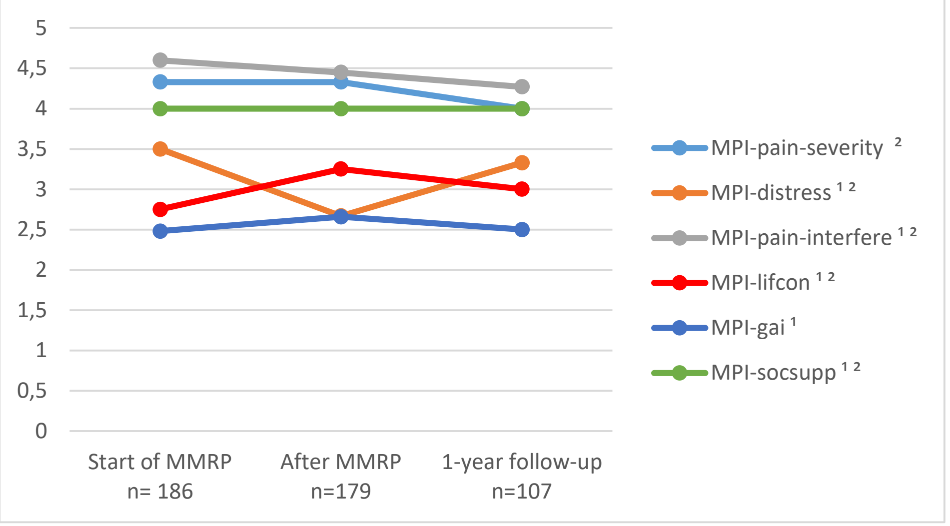


Figure 11. The MPI variables for age group 31-45 years in the three occasions (median). Higher score indicates greater frequency of occurrence; [1] Significant changes between start to after; [2] Significant changes between start to one-year follow up.

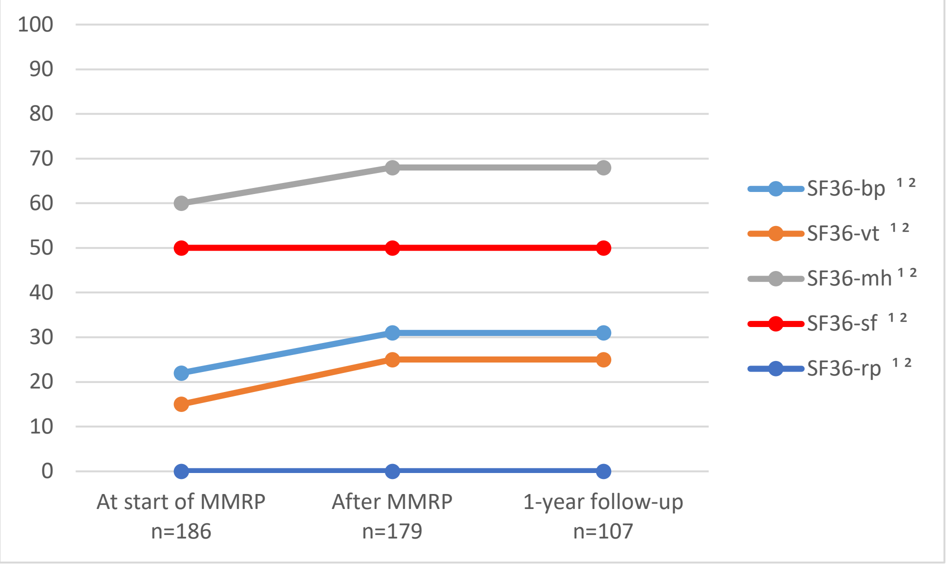


Figure 12. The SF36 variables for age group 31-45 years at the three occasions (median). [1] Significant changes between start to after; [2] Significant changes between start to one-year follow up.

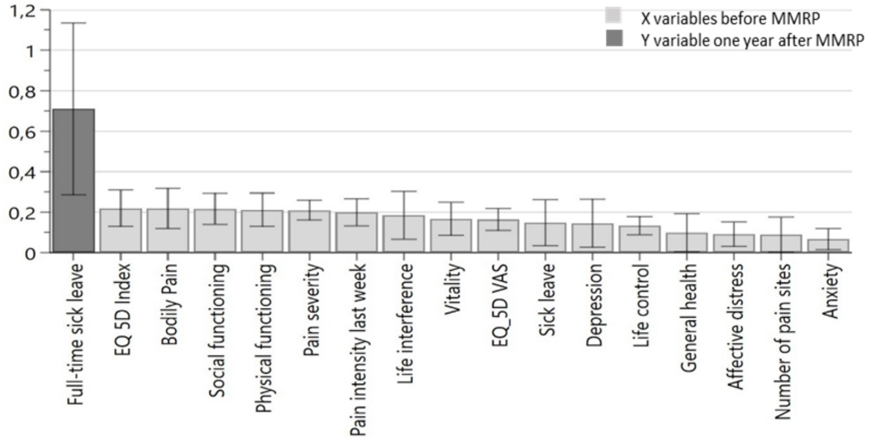


Figure 13. Age group 31-45 years has a combined OPLS loading column plot for the predicative component in the model for full-time sick leave with 95 % jack-knife confident interval bars. Relationship between the X variable before MMRP loadings (light grey) and the Y variable full-time sick leave at one-year follow-up loadings (dark grey). Only significant variables are shown in the model. In the model, column height indicates the importance of each variable, values closer to zero being less important irrespective of sign (+/-). Same sign for Y variable and X variable means they are positively correlated. High loadings of the Y variable indicate high correlation with the predictive component and X. Model variance R2Y =18.3 % and prediction value Q=10 %

Table 10. Outcomes variables in age group 46-65 years at start, immediately after MMRP and one-year follow-up

46-65 years age group	At start of MMRP n= 188		After MMRP n= 184		1-year follow-up n=148		Start vs after MMRP		Start of MMRP vs 1-year after	
	Median (IQR)	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)	Mean (SD)	*p*-value	ES	*p*-value	ES
Pain Intensity										
Pain Severity (MPI-Pain-severity)	4.33 (1.33)	4.35 (0.82)	4 (1.34)	4 (0.9)	4 (1.34)	3.9 (1.13)	**<0.001**	**0.28**	**<0.001**	**0.26**
Bodily Pain (SF36-bp)	22 (10)	24 (12)	31 (19)	29 (14)	31 (19)	33 (17)	**<0.001**	**0.24**	**<0.001**	**0.30**
Numeric Pain Rating Scale (NPRS)	7 (2)	7 (1.4)	6 (2)	6(2)	7 (3)	6 (2)	**<0.001**	**0.24**	**<0.001**	**0.24**
Emotional functioning										
Affective Distress (MPI-Distress)	3 (1.67)	3.02 (1.27)	2.33 (2)	2.28 (2)	2.67 (2)	2.62 (2)	**<0.001**	**0.33**	**0.001**	**0.19**
Life control (MPI-LifCon)	3 (1)	2.98 (1.01)	3.75 (1.5)	3.65 (1.11)	3.5 (1.69)	3.43 (1.69)	**<0.001**	**0.39**	**<0.001**	**0.23**
Vitality (SF36-vt)	20 (25)	23 (19)	30 (30)	32 (21)	30 (35)	33 (24)	**<0.001**	**0.30**	**<0.001**	**0.28**
Mental health (SF36-mh)	68 (25)	64 (19)	72 (28)	70 (19)	72 (24)	70 (21)	**<0.001**	**0.22**	**0.010**	**0.15**
Anxiety (HADS-A)	7 (7)	7 (4)	6 (6)	6 (4)	5 (6)	5 (4)	**0.014**	**0.13**	**<0.001**	**0.23**
Depression (HADS-D)	7 (7)	8 (4)	6 (6)	6 (4)	6 (5)	6 (4)	**<0.001**	**0.28**	**<0.001**	**0.23**
Activity and physical functioning										
Life interference (MPI-Pain-interfer)	4.58 (1.3)	4.43 (0.92)	4.33 (1.36)	4.27 (0.92)	4.05 (1.68)	4.02 (1.21)	**0.004**	**0.15**	**<0.001**	**0.25**
General activity index (MPI-GAI)	2.55 (1.09)	2.55 (0.81)	2.69 (1.05)	2.68 (0.79)	2.71 (1.15)	2.72 (0.86)	**0.014**	**0.13**	0.061	-
Social functioning (SF36-sf)	50 (38)	50 (25)	50 (50)	52 (25)	50 (37)	56 (26)	0.215	-	**0.016**	**0.14**
Role physical (SF36-rp)	0 (25)	11 (23)	0 (25)	14 (25)	0 (25)	19 (31)	0.168	-	**0.008**	**0.16**
Role emotional (SF36-re)	67 (100)	52 (44)	67 (100)	59 (43)	100 (42)	63 (43)	**0.028**	**0.12**	0.095	-
Physical functioning (SF36-pf)	50 (30)	49 (20)	55 (20)	49 (19)	55 (35)	52 (22)	0.760	-	**0.025**	**0.13**
Social response										
Social support (MPI-Socsupp)	4.33 (1.33)	4.12 (1.35)	4.33 (1.57)	4.08 (1.15)	4(2)	3.83 (1.43)	0.218	-	**<0.001**	**-0.23**
Punishing response (MPI-Punish)	1.33 (1.33)	1.59 (0.5)	1.25 (1.75)	1.58 (1.25)	1.5 (1.75)	1.68 (1.27)	0.941	-	0.128	-
Solicitous response (MPI-Solict)	2.83 (1.88)	2.89 (1.39)	2.83 (1.83)	2.87 (1.4)	2.67 (1.84)	2.71 (1.36)	0.861	-	0.051	-
Distracting response (MPI-Distract)	2.5 (1.5)	2.46 (1.18)	2.5 (1.75)	2.46 (1.15)	2.5 (1.75)	2.43 (1.21)	0.638	-	0.924	-
Health										
General health (SF36-gh)	40 (25)	43 (19)	40 (25)	43 (19)	40 (31)	43 (22)	0.646	-	0.857	-

MMRP: Multimodal Rehabilitation Programme; IQR: interquartile range; SD: Standard deviation; ES: Effect size; Wilcoxon signed-rank test was used to analyse *p*-value and effect size; $p<0.05$ and effect size > 0.1 or < -0.1presented in bold.

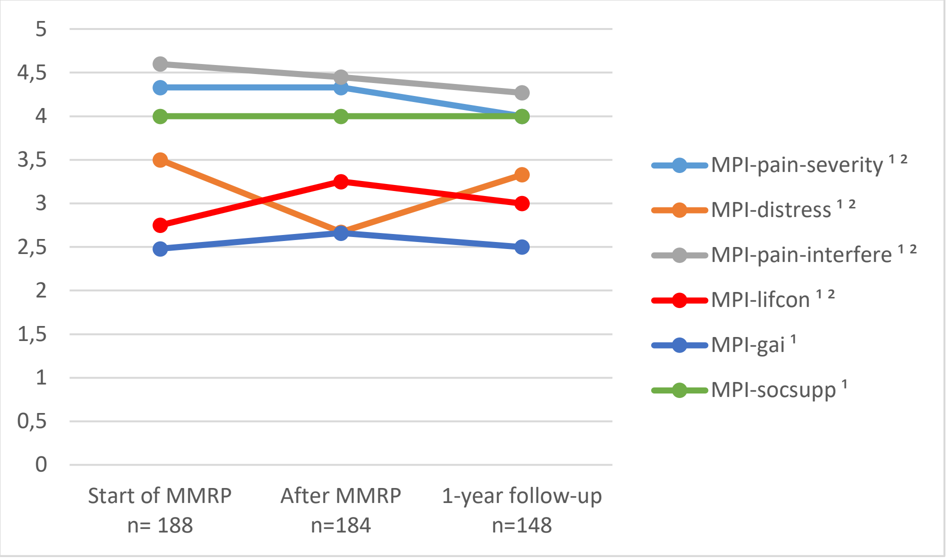


Figure 14. The MPI variables for age group 46-65 years in the three occasions (median). Higher score indicates greater frequency of occurrence; [1] Significant changes between start to after; [2]Significant changes between start to one-year follow up.

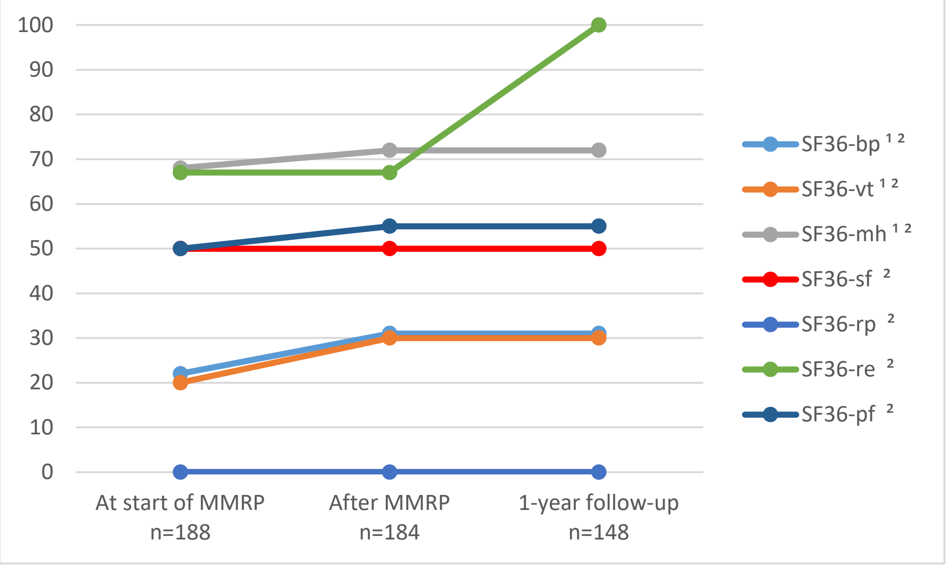


Figure 15. The SF36 variables for age group 46-65 years at the three occasions (median). [1] Significant changes between start to after; [2] Significant changes between start to one-year follow up.

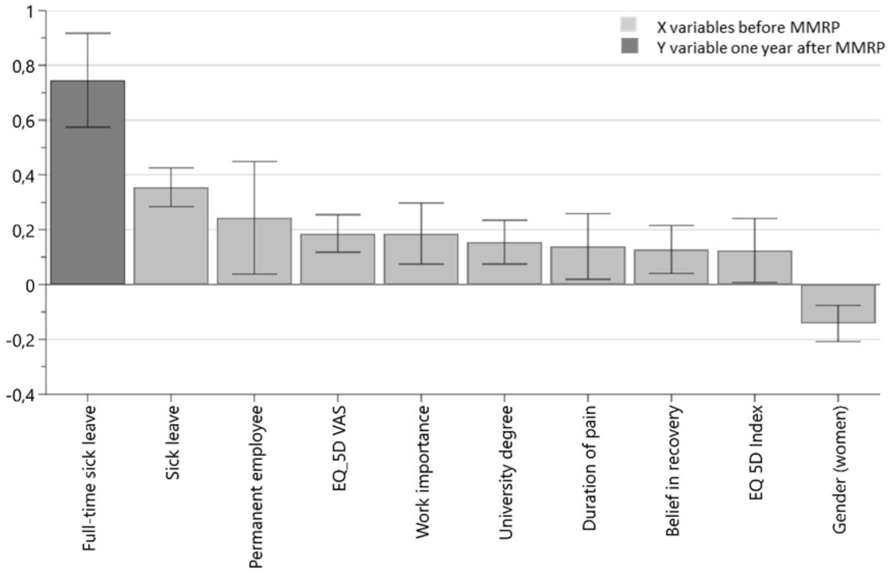


Figure 16. Age group 46-65 years has a combined OPLS loading column plot for the predicative component in the model for full-time sick leave with 95 % jack-knife confident interval bars. Relationship between the X variable before MMRP loadings (light grey) and the Y variable full-time sick leave at one-year follow-up loadings (dark grey). Only significant variables are shown in the model. In the model, column height indicates the importance of each variable, values closer to zero being less important irrespective of sign (+/-). Same sign for Y variable and X variable means they are positively correlated. High loadings of the Y variable indicate high correlation with the predictive component and X. Model variance R2Y =18.3 % and prediction value Q=10 %.

Changes in sick leave from start of the MMRP to one-year follow-up

At the one-year follow-up, 59 % of the patients showed no changes in sick leave, 19 % of the patients had decreased their sick leave, while 22 % had increased their sick leave. For separate details about the women, men and age groups, see Figure 9. Among the patients who did not change their sick leave, 40 % were not on sick leave, and 43 % had 100 % sick leave, and 17 % were on partial sick leave at start of MMRP (Figure 10).

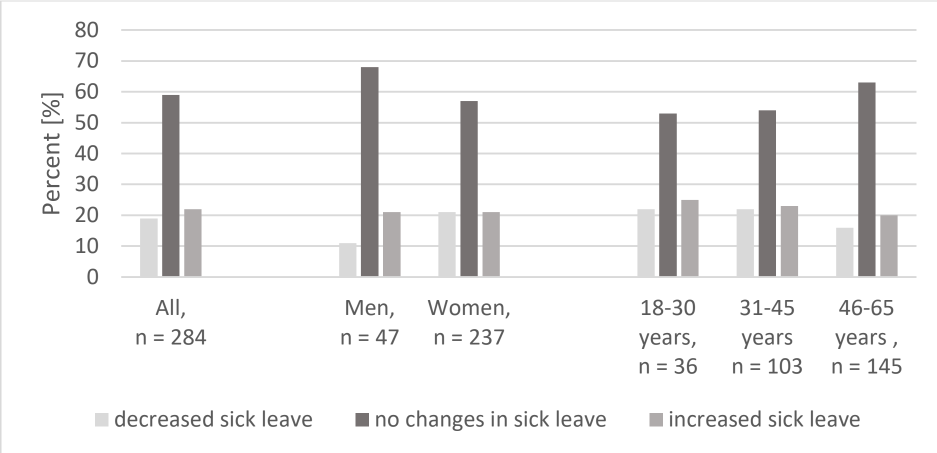


Figure 17. Changes in sick leave from start of MMRP to one-year follow-up.

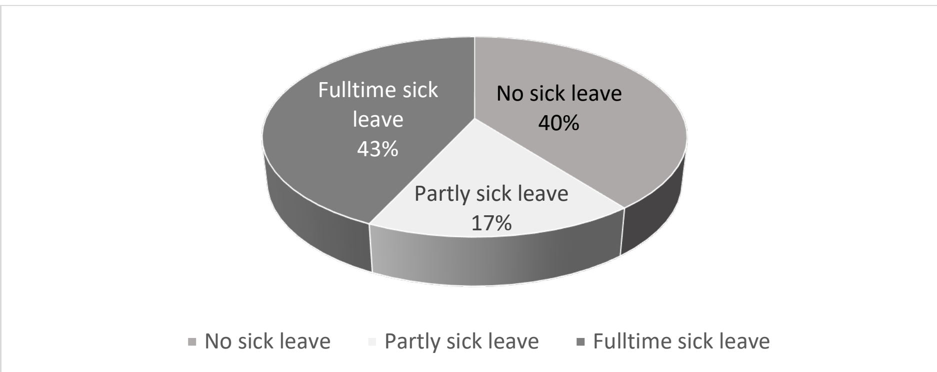


Figure 18. Distribution of the patients who had no changes in sick leave from start of MMRP to one-year follow-up.

Experiences of "Finding my self-worth" during an MMRP when staying at a residency away from home

The findings from the analysis in Study IV resulted in a model with a core category that permeated the entire material. It represented a process of finding my self-worth that comprised four categories: *Space for myself, Mirroring myself, I am of value, Dealing with returning to everyday life* which illustrated how the patients had experienced participation in an MMRP when staying at a residency (Figure 11).

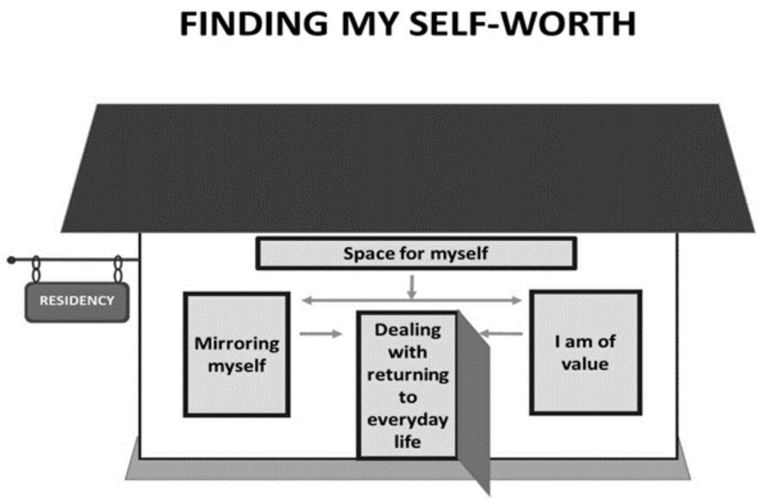


Figure 19. The theoretical model of the process "Finding my self-worth" while staying at a residency during the MMRP was facilitated by the four categories: (1) Space for myself; (2) Mirroring myself; (3) I am of value; and (4) Dealing with returning to everyday life.

The core category **Finding my self-worth** reflected that the staying at a residency provided a space for undisturbed time away from daily chores, both physically (time to be alone) and mentally (time to think), which in turn enabled the patients to reclaim their diminished sense of self. This gave them the opportunity to mirror themselves in interaction with others. Through reflection with their co-residents, the patients gained insights about their own self-worth and found that they were of value. This was important after the rehabilitation when the patients had to deal with returning to everyday life.

The findings in the first category, *Space for myself*, revealed that the residency provided a refuge from responsibilities at home, and gave the patients the opportunity to identify their own needs and focus on their rehabilitation. However, for most of the patients, prioritising their own needs was a new experience. Taking a break from the obligations of everyday life could cause anxiety because they were not in control at home. The patient's absence from home and the family was a new experience for the whole family.

The second category, *Mirroring myself*, described the value of meeting people in similar situations and reflecting on their own behaviour. Discussions with other patients during the sessions at the MMRP and in the evenings gave other perspectives and opportunities to reflect on coping strategies with unwanted side effects. The patients inspired each other to try new activities and supported each other to find an activity that promoted their individual goals.

The third category, *I am of value*, illustrated the insights the patients gained when they had their own space and time and the opportunity to mirror themselves, which helped them to become aware of their own value. Their stay at the residency improved the participants' self-confidence. They focused on themselves and were empowered to take responsibility for and prioritise activities that were important and meaningful for themselves instead of carrying out "imaginary" obligations.

The fourth category, *Dealing with returning to everyday life*, gave a picture of the challenge associated with the patients applying their new knowledge to their previous roles and routines in everyday life at home. The patients had the opportunity to go home for weekends or some weeks during the MMRP. These days at home were a chance to put their acquired knowledge into practice at home, which turned out to be more difficult than they had expected.

Discussion

The overall findings in this thesis suggest that women, men and all age groups benefit from MMRP in the short and long term in the variables pain intensity and emotional functioning. Improvements in the other variables differ between men and women as well as the age groups. The patterns of factors associated with full-time sick leave varied for women, men and age groups. The patients' experiences of staying at a residency provided knowledge of the value of time for reflection and opportunities for interaction with others. The time for reflection contributed to awareness of one's own value, increased motivation and created new patterns of behaviour in terms of meaningful activities and quality of life.

In this section, the main findings from the studies are discussed in relation to previous knowledge and theoretical perspectives. The findings are also considered in relation to implications for clinical praxis of MMRP.

Outcomes after MMRP

The findings of this thesis indicate that patients in northern Sweden who participated in an MMRP improved significantly after the programme and that the effects were sustained one year later (regardless of the design and duration of the programme) (Studies I-II). These positive results are in line with previous studies based on SQRP data that have shown small to moderate/medium ES both from start to after and from start to 12-month follow-up after MMRP in Sweden [65-67]. Several systematic reviews [3, 27, 68, 69] have concluded that MMRP generally is an effective method (small to medium ES) for the treatment of patients with chronic pain. Furthermore, small to medium effects following MMRP are both significant and positive, since these patients often have severe problems with long pain duration and may have experiences from several interventions with no or small effects before being referred to a specialist clinic and participation in MMRP.

Gender aspects of outcomes after MMRP

The findings of this thesis (Studies I-II) showed that both men and women benefited from MMRP in terms of pain intensity, emotional functioning, and in activity and physical functioning. Furthermore, men showed overall improvement with medium ES in pain intensity and emotional functioning, while women showed improvements with small ES during the MMRP. At the one-year follow-up, women's improvements were sustained while men's improvements did not sustain. One explanation for that could be that men and women might have different strategies for coping with pain [70]. Men tend to seek the solution to their pain problem from a biomedical perspective, and search for the cause of pain in external factors beyond the individual's control. They seem to continue to search for the cause of their pain instead of seeking ways to handle it [36] which could be why the results did not sustain for the men in this thesis. On the other hand, women were found to be more likely than men to continue to find and apply coping strategies to cope with their life situation after MMRP. In addition, women tend to search for the solution to their pain problems in themselves and through support from others [66, 71].

Expected behaviours and expressions of pain can be reflected in how women and men communicate and how their problems are interpreted by healthcare providers [71]. In Western cultures, according to gender norms, most boys and men learn to be tough, tolerate pain and can withstand painful experiences, while most girls and women are thought to be sensitive, careful and verbal at an early age [72]. There are notions that men are more demanding while women have a tendency not to want to impose which can have an effect on the treatment they receive from healthcare providers [70]. Furthermore, research has found that men with chronic pain are more likely to request a medical examination, while women seeking healthcare asked for help and advice [30]. In addition, gender norms among healthcare professionals can affect which type of treatment men and women are offered [12, 73]. Previous research has found that the selection of participants for MMRP could be influenced by the healthcare professionals' preconceptions and their belief that women are more suitable for and more likely to benefit from MMRP than men [74, 75]. That could be one reasons why the majority of the participants in the studies in this thesis were women. It has been shown that physicians in Swedish primary healthcare are reluctant to diagnose men with chronic pain such as fibromyalgia because it can be perceived as being unmanly [76]. Previous research has shown that men and women have sometimes been given different treatment [77-79]. One study on chronic pain patients has shown that men were more likely to be recommended physiotherapy and radiological examinations, regardless of differences in pain variables [80]. The findings from this thesis emphasize the importance of healthcare professionals being aware of gender norms in order to be able to offer equal healthcare to patients with chronic pain.

It should also be noted that the patients in this thesis were not given the opportunity to identify themselves as either a man or a woman. The definitions of gender/sex in the SQRP are based on the patient's Swedish personal identity number. This is a limitation since some people identify themselves as non-binary/gender queer instead of male or female. To my knowledge, there are currently no studies focusing on people with non-binary gender identities with chronic pain. This could be regarded as being a limitation in the whole research field of chronic pain.

Age aspects of outcomes after MMRP

In this thesis, the study population covered a wide age span (18-65 years) which reflects the age span of the patients in most MMRPs in specialist care in Sweden. This wide age range covers most of an individual's working life period. That means that during these years, a person passes through several phases of their total lifespan. In addition, individuals with chronic pain may need different forms of support or interventions during different phases in order to cope with living the life the person wants and needs.

Previous studies have shown that, in general, people of an older age are more likely than younger people to report less good physical functioning and better health-related quality of life [45]. This is in line with the findings in this thesis, when comparing the age groups at the start of MMRP. At the same time, at the start of MMRP the younger age groups in this thesis were found to report lower emotional function more often than the oldest age group. One explanation for that result could be that the younger groups were at a phase in their lives which frequently results in much greater pressure in terms of struggling to pursue a successful career at the same time as establishing one's family life [43].

Another finding in this thesis was that all age groups benefited from participation in MMRP. The results showed that participants in all age groups reported improvements in pain intensity and emotional functioning from start to after MMRP. In addition, the improvements sustained to the one-year follow-up. This is of importance since no research has yet been done on long-term follow-up in different age groups following MMRP.

The findings in this thesis indicate that the youngest age group (18-30 years) was found to enjoy greater improvements after MMRP than the other two age groups in terms of pain intensity and emotional functioning. On the other hand, the other age groups were more likely to improve in several variables than the youngest age group. In addition, the two younger age groups (18-30 and 31-45 years) showed improvements in the variable health-related quality of life, while the oldest age group (46-65 years) improved in physical functioning (SF36 PCS). Previous studies have revealed that younger age seems to be a positive predictor in terms of physical function [81] and health-related quality of life [66, 82] after MMRP. Interestingly, in this thesis, the youngest age group (18-30 years) reported reduced social support (medium ES). A possible explanation to this finding is that improvements can be related to the other positive results in terms of pain intensity and emotional functioning. Moreover, improvements can be a support in the later process of achieving autonomy.

Patients form the youngest age group in this thesis (18-30 years of age) were included in MMRP in northern Sweden to a lesser extent compared with the older age groups (> 31 years). In addition, the prevalence of chronic pain in young adults is estimated to be 25-35 % of the population of Sweden [83]. This indicates the need to provide MMRP to younger adults. Besides that, the findings of this thesis indicate that the individuals in the youngest age group (18-30 years of age) benefited from the MMRP. In summary, these findings can provide an understanding of different age groups with chronic pain and their improvements and benefits following participation in MMRP.

Levels of sick leave for patients who participated in MMRP in northern Sweden

The findings of this thesis showed that the patients improved in several variables from start to one-year follow-up (Studies I-II). However, the improvements only small effect on their level of sick leave. Most of the patients (60 %) did not change their level of sick leave between start of MMRP and one-year follow-up. One overall aim of MMRP is to reduce sick leave and improve the ability to return to or continue work. Our results are in contrast to previous studies that have shown that MMRP for patients with chronic pain led to decreased sick leave [84]. It should be pointed out that the patients investigated in this thesis, who were on sick leave at start of MMRP were still on sick leave at one-year follow-up. Of the patients on full-time sick leave at start, 60 % had a duration of sick leave of more than one year. These findings are supported in previous research that found that long duration of sick leave was associated with no return to work 12 months after a MMRP [85]. When the studies in this thesis were conducted, it was not mandatory to have contacts with collaborating partners such as the workplace or the Swedish Social Insurance Agency. That could have had an impact on the results. According to Scascighini [28], the interventions in MMRP focus on patients' psychological and physical well-being and possibilities as well as participation in daily life, and do not focus specifically on return to work. A previous qualitative study showed that these interventions are important and contribute to the ability to return to work [86]. That study also showed that return to work was a long-term process [86]. Another study with data from both the SQRP and the Swedish Social Insurance Agency showed that sick leave decreased one to two years after participation in MMRP [84]. On the other hand, most of the patients who were not on sick leave at start were not on sick leave at one-year follow-up either. This might indicate that MMRP prevents the risk of being on sick leave when having chronic pain.

In addition, the findings in this thesis indicate that patterns of factors associated with full-time sick leave at one-year follow-up differ between men and women. For women, the interplay of the factors sick leave, low physical functioning, low health-related quality of life (EQ VAS), and low work importance, and low affective distress at start of MMRP were associated to full-time sick leave at one-year follow up. For men, the findings indicate that the interplay of sick leave, long pain duration and not being employed at start were the most crucial factors (Study III).

A previous study had investigated the influence of individual variables associated with a successful return to work such as low emotional distress and low perceived physical disabilities [87, 88]. These findings should be viewed in the light of previous research which has presented links between long pain duration and less positive treatment outcomes regarding health-related quality of life [89], as well as return to work, after multimodal pain rehabilitation [90]. The results in this thesis indicate the urgency to offer early interventions to individuals with chronic pain in need of multimodal rehabilitation.

Experiences of staying at a residency while participating in multimodal rehabilitation

The results in Study IV illustrate the process of finding self-worth as a person, and benefits and challenges in terms of staying at a residency while participating in MMRP. The findings demonstrate the importance of patients with chronic pain being given a space for themselves to have the opportunity to focus on their rehabilitation. These findings are in line with previous knowledge, showing the importance of patients with severe conditions being given time and space to recover and focus on themselves and their rehabilitation [91].

Furthermore, being able to reflect on individual and contextual factors with others in the same situation was perceived as necessary for understanding one's self-worth and this is in line with a previous study of patients who lived at a residency while receiving interventions [91]. The results reflected that a turning point was the opportunity provided at the residency for getting time and space to reflect and mirror themselves with others in the same situation. However, being exposed to major changes implicates a risk of losing one's self and raises questions such as "Who am I really?" This can trigger the need for the individual's need to find and challenge their own identity [92]. Our findings are in accordance with a study by Thompson et al. describing a process of living well with chronic pain. One phase in that process was to decide to accept to live with the pain by performing meaningful activities instead of seeking control of the pain [9]. The value of having others in the same situation to reflect with is well-known in research, including patients with chronic pain [93-97].

An interesting finding in Study IV, beyond the aim, was that it appeared to be easier for the men than the women to incorporate their new knowledge at work and to get support from their employers. This is in line with findings from a review by Coutu [17] who found that men seemed to have better support than women did from employers when returning to work. In addition, the Swedish labour market is gender segregated which means that women and men work in different sectors and are exposed to different burdens. For example, most women work in social welfare and most men work in the construction and industrial occupations. The family's commitment and responsibility as well as social constructions and norms related to the work role have proven to be important for women to be able to remain in work [17]. It is important that healthcare providers and society take this into consideration in order to bring about equal conditions for men and woman. Finally, the findings indicate that staying at a residency while participating in an MMRP was an advantage which helped patients with chronic pain focus on their own rehabilitation, instead of having to attend to family and household needs.

The results in this thesis confirm the importance of taking into account individual differences of the various factors included in the biopsychosocial model, for example, gender, age, pain intensity, emotional functions and social response. It is important that these factors are considered right from the start of the rehabilitation process for patients with chronic pain. Furthermore, the professionals in MMRP need to be more aware that different groups can have different needs when it comes to MMRP.

Study population

Each year, SQRP publishes an annual report which is available on the register's website [39]. Compared with the SQRP 2016 report, more of the patients included in this thesis were women, born in Sweden, and had a university degree. In addition, the patients in this thesis also reported longer duration of pain, greater number of pain sites, and were less positive about their future (return to work and recovery) but had a lower risk of anxiety and depression, compared with the SQRP 2016 report of [39].

Methodological considerations

One of the strengths of this thesis is that quantitative and qualitative methods were used. This has broadened the understanding of rehabilitation for people with chronic pain.

Because this study is based on a registry of two clinics, the opportunity to have a control group or treatment as usual is limited and ethically complicated. The lack of a control group might influence our interpretation of the effects of MMRP. The changes from start of MMRP to one-year follow-up could be caused by other factors such as life events or could represent spontaneous improvements over time, i.e. a natural course.

The questionnaires used in Studies I-III are included in the SQRP and are widely used in research and have been shown to have good validity. The outcome variables are in agreement with the biopsychosocial model and Initiative on Methods, Measurement and Pain Assessment in Clinical Trials (IMMPACT) as well as the Validation and Application of a patients-relevant core set of outcome domains to assess multimodal PAIN therapy (VAPIAN) [53].

Furthermore, a total population of patients participating in MMRP at the two specialist clinics was included and outcomes were measured both after the programme and at one-year follow-up. In addition, the drop-outs may influence the results, since the drop-out rates were relatively high. The authors' different professional backgrounds (occupational therapist, physician, and physiotherapist) contributed a wide range of skills and experience of pain rehabilitation to the study.

The multivariate statistics analysis with the use of OPLS statistics gave rise to correlated patterns, repeat measures and regressions that took into account the risk for multicollinearity. Other common methods such as logistic regression and multiple linear regression can quantify the effect of individual factors but disregard interrelationships among different variables [63].

The main strength of the qualitative study (Study IV) is that the patients were able to express their views and their experiences were highlighted. The qualitative study has nuanced the understanding of the importance of having the opportunity to stay at a residency during MMRP.

In interview studies, there is a risk that only patients with positive experiences participate. However, our results showed that the data involved both positive and negative experiences of participating in an MMRP. To ensure trustworthiness, several actions were taken during data collection and analysis. First, a process of triangulation [61] was used, where the researcher involved had different competencies and perspectives. The interviews were performed by the first author (L.S.). The author's pre-understanding was discussed continuously to ensure neutrality. Peer debriefing [61] was used at seminars in the research unit where the preliminary findings were presented and discussed in order to further enrich the data analysis.

However, the patients in this thesis were referred to specialist clinics in northern Sweden and represent a selected group of severe cases of patients with complex consequences of chronic pain. These circumstances affect the ability to generalise our results to all individuals with chronic pain.

Conclusions

The main conclusions of this thesis are as follows:

- Patients who participated in an MMRP in northern Sweden improved regardless of the design of the programme in terms of pain intensity, emotional functioning, and activities and physical functioning.

- The men seemed to improve with larger effects sizes than women immediately after MMRP in terms of pain intensity and emotional functioning, but improvements immediately after MMRP were not sustained at the one-year follow-up.

- The women improved in more variables than men from start of the MMRP to one-year follow-up.

- The youngest age group (18-30 years) improved in pain intensity and health with larger ES than the other age groups (31-45 years and 46-65 years) immediately after MMRP.

- At one-year follow-up, the youngest age group (18-30 years) was found to have improvements with larger ES in pain intensity and emotional functioning than the other two age groups (31-45 years and 46-65 years). The oldest age group (46-65 years) showed improvements in most variables at one-year follow-up.

- All age groups as well as women and men received less social support at one-year follow-up.

- Full-time sick leave was affected by a number of interacting factors. The interacting factors differed among women and men as well as among age groups.

- Staying at a residency during the MMRP was found to be of value for the patients. Not having to worry about the obligations of everyday life may make it easier for the patients to focus on their own rehabilitation.

Further research

In order to improve rehabilitation for individuals with chronic pain, there are factors of importance that need to be addressed in future research.

- Since the completion of the data collection of this thesis, work-directed interventions have been added to the rehabilitation programmes. Further studies are needed to investigate how work interventions affect sick leave at one-year follow-up.

- Research is needed to investigate men's needs for sustained improvements over time.

- Further research is needed to establish whether involving the participant's family or significant others in the rehabilitation process could lead to common goals and increased support in everyday life in order to achieve sustainable results.

- Further research is needed to investigate other factors apart from sick leave for evaluating and studying short-term and long-term effects of MMRP, in relation to women and men as well as age groups.

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