VU VRIJE UNIVERSITEIT AMSTERDAM

VU Research Portal

The Percept Study

de Raaij, Eduard Jozef

2021

document version
Publisher's PDF, also known as Version of record

Link to publication in VU Research Portal

citation for published version (APA)
de Raaij, E. J. (2021). *The Percept Study: Illness Perceptions in Physiotherapy*. [PhD-Thesis - Research and graduation internal, Vrije Universiteit Amsterdam]. GVO drukkers & vormgevers.

General rights
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal ?

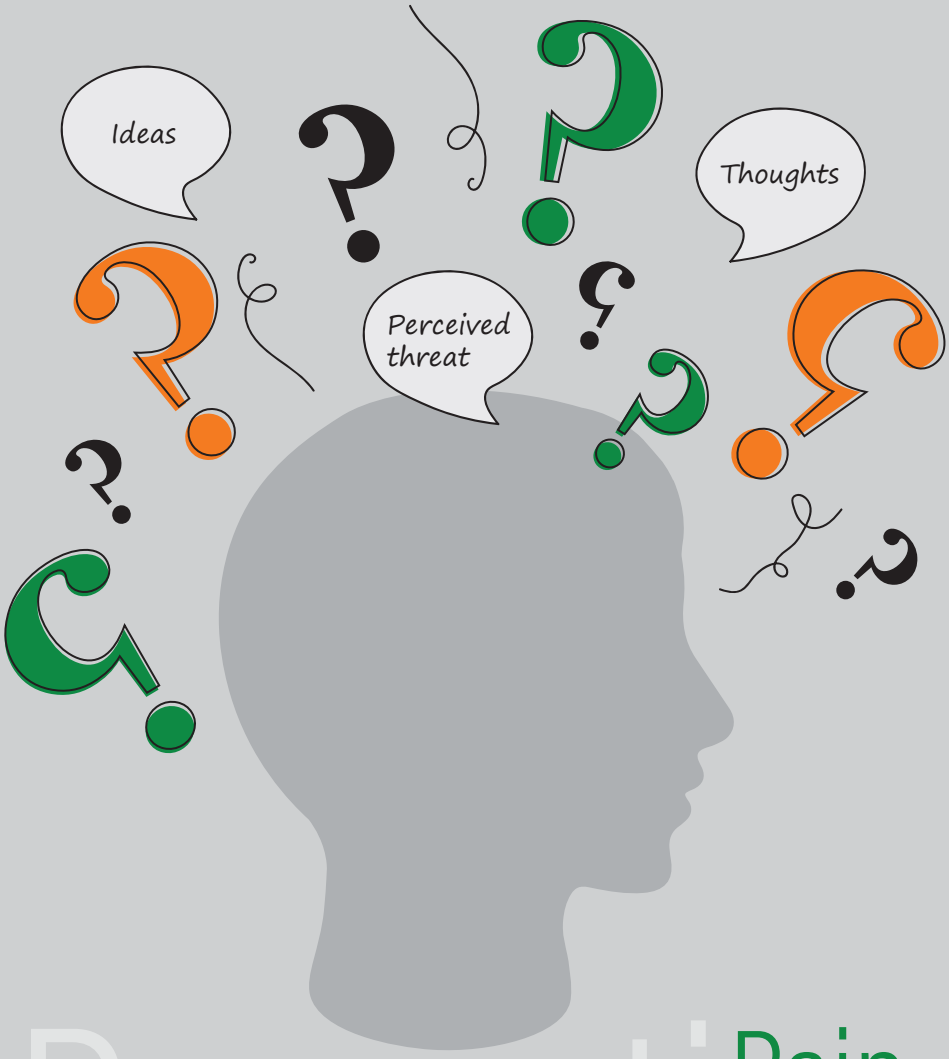
Take down policy
If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

E-mail address:
vuresearchportal.ub@vu.nl

Download date: 03. Mar. 2023

THE PERCEPT STUDY

Illness Perceptions in Physiotherapy



Perception

Pain

Physical function

Edwin de Raaij

THE PERCEPT STUDY

Illness Perceptions in Physiotherapy

Edwin de Raaij

Cover:	Marieke Schalken
Layout:	Marieke Schalken
Printed by:	GVO drukkers & vormgevers
ISBN:	978-94-6332-762-6

The research in this thesis was embedded in Amsterdam Movement Sciences Research Institute, at the department of the VU medical Center, Amsterdam UMC, Vrije Universiteit Amsterdam/ University of Amsterdam, Netherlands and the Lifestyle and Health Research group of the Utrecht University of Applied Sciences, Netherlands

This study was supported by a grant of the Dutch government; NWO-023.005.029
Lifestyle and Health Research group of the Utrecht University of Applied Sciences, Netherlands
Financial support for the printing of this thesis has kindly been provided by:
steunfonds faculteit gezondheidszorg HU university of Applied Science, the Scientific College Physical Therapy (WCF) of the Royal Dutch Society for Physical Therapy (KNGF).

Some terms used in this thesis have been standardized throughout the different chapters.
Therefore, the text might slightly differ from the articles that have been published.

©2021 Edwin de Raaij
All rights reserved. No part of this publication may be reproduced or transmitted in any form or by any other means, electronical or mechanical, included photocopy, recording or any information storage or retrieval system, without permission of the copyright holder.

VRIJE UNIVERSITEIT

The Percept Study

Illness Perceptions in Physiotherapy

ACADEMISCH PROEFSCHRIFT

ter verkrijging van de graad Doctor aan
de Vrije Universiteit Amsterdam,
op gezag van de rector magnificus
prof.dr. C.M. van Praag,
in het openbaar te verdedigen
ten overstaan van de promotiecommissie
van de Faculteit der Geneeskunde
op donderdag 16 december 2021 om 11.45 uur
in een bijeenkomst van de universiteit,
De Boelelaan 1105

door
Eduard Josef de Raaij

geboren te Schiedam

promotor :	prof.dr. R.W.J.G. Ostelo
copromotor :	dr. H. Wittink
promotiecommissie :	prof.dr.ir. H.C.W. de Vet prof.dr. A.M.C.F. Verbunt prof.dr. T.P.M. Vliet Vlieland prof.dr. J.W.S. Vlaeyen prof.dr. M. Meeuws

Table of contents

1

General introduction

Musculoskeletal pain

Musculoskeletal pain (MSP) is one of the most important disorders accounting for the global burden of years lived with disabilities (YLDs)[37,61] and a significant factor affecting the wellbeing of people. Globally, almost half of the YLDs due to MSP in 2010 was attributable to low back pain (LBP) (49.6%), followed by neck pain (20.1%), other musculoskeletal disorders (17.3%), and osteoarthritis (OA) (10.5%), with relatively small contributions from rheumatoid arthritis (RA) (2.3%) and gout (0.1%). The increasing proportion of elderly people in the global population, with even more rapid growth in less-developed countries, predicts an increasing prevalence of MSP which is therefore expected to become a major global health problem in the coming decades[4].

Management of musculoskeletal disorders, with LBP as the most prevalent one in recent decades, is challenging, and action was called for in the Lancet's *Low back pain* series (2018)[9,10,13,19]. The authors came to the conclusion that, while LBP is a complex condition, it is an extremely common one in populations world wide[19]. It is widely recognized that pain can persist in the absence of visible tissue damage or beyond the normal time of tissue healing[15,25,30,41-43,62-64]. Persistent pain is defined as pain lasting beyond this normal time, usually taken to be 12 weeks[40], and is a condition that needs to be addressed from biomedical, psychological, and social perspectives. Such approaches do not only apply to LBP but are also indicated for persistent musculoskeletal disorders in general[5,11,20,30,36].

The challenge: from a biomedical model to a biopsychosocial model

The biomedical model

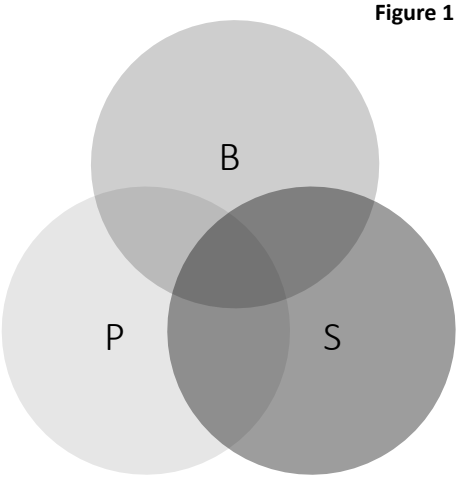
The biomedical model, focusing on purely biological factors, was the predominant health care model in industrialized countries until the mid-twentieth century. Then a new model was introduced by, notably, Engel: the Biopsychosocial (BPS) model[12]. Engel's contribution to the way illness, suffering, and healing should be viewed is that these should not solely be approached from a biomedical point of view but also from their interaction with diverse causal factors, such as psychological and social[12]. Health care professionals have historically been trained in the biomedical model, the essence of which is that physical complaints can be explained by the biological processes underlying an illness or disease. This model, however, does not explain chronic MSP, as often no obvious biological cause for the disorder can be found. Research has shown that these chronic complaints are, among others, associated with psychological factors[3,32,35,46,48]. As purely medical approaches have proved unsuccessful, a shift has occurred towards applying the biopsychosocial model in practice. This holds that the

experience of pain and responses to pain are sculpted by complex and dynamic interactions of biological, psychological, and sociocultural factors[38,47,51].

The biopsychosocial model

Ever since the introduction of Engel's biopsychosocial model (**Figure 1**)[12], health care providers have been encouraged to assess illnesses from a biopsychosocial perspective[6].

Figure 1



B = Biomedical; P = Psycological; S = Social

This was also put forward in the Lancet series that highlighted contributing factors to LBP and disability, such as genetics, biophysical factors, comorbidities, social, and psychological factors, emphasizing the need for a biopsychosocial approach[10]. To reiterate, this approach to the management of LBP takes into consideration not only biomedical variables but also psychological variables (such as behaviour, emotions, and beliefs) and social variables (such as cultural norms and values, social network support, socioeconomic status). For other persistent musculoskeletal disorders, contributing factors for pain and disability include widespread nature (≥ 2 pain sites), high levels of functional disability, somatization, and high pain intensity[1]. Additionally, psychological factors such as distress, depressive mood and somatization have been identified as risk factors in general for the transition from acute to chronic pain[46].

The World Health Organization recognizes that persistent pain can be seen as a chronic condition in itself, instead of a symptom, and has added 'chronic pain' to the International Classification of Diseases, seeing it as a centrally important chronic condition in primary care[54]. For the management of chronic conditions, such as persistent pain, many theories and biopsychosocial models have been proposed: the onion model by Loeser[33], the neuromatrix by Melzack[39], the Common-Sense Model (CSM) by Leventhal[26], the mature organism model by Gifford[15], the fear avoidance model by Vlaeyen[60], and, recently, the predictive processing model proposed by Ongaro and Kaptchuk[45].

Within the physiotherapy community, the paradigm shift from a biomedical model to a biopsychosocial one has proved challenging. There is a growing body of literature confirming that physiotherapists do not yet (fully) address psychosocial problems or patient beliefs[22,50,56,59].

Implementing the biopsychosocial model in physiotherapy treatments for MSP demands not only knowledge transfer, but also skills training to build physiotherapists' confidence in delivering such interventions. Previous research has identified that acknowledgement of the impact of pain on a person's psychological health by a clinician is greatly valued by patients[34]. Although many physiotherapists may feel unprepared to address psychosocial problems, an effective plan of care must include addressing these factors[66].

Implementation

A potentially beneficial model for implementing the BPS approach within physiotherapy is Leventhal's CSM of self-regulation of health and Illness[27,28]. It has been proposed that this model be used in physiotherapy[59], as illness perceptions (IPs) can strengthen certain behaviours, including with physical functioning, which is the core domain of physiotherapists. IPs are also reportedly associated with a variety of health-related outcomes in research into several musculoskeletal disorders[14,23,58].

The Common-Sense Model of self-regulation of health and illness

The Model

This thesis explores the possibilities of using the CSM as a guiding principle for the management of chronic musculoskeletal pain. The CSM relates to the benefits physiotherapist may experience in: "*identifying specific strategies for combining the best of traditional physiotherapy approaches with a greater focus on patients' beliefs, fears and social context*"[51]. The CSM originated with '*Findings and Theory in the study of Fear Communications*' by H. Leventhal (1970)[29]; the model has evolved over the last four decades and is nowadays defined as "a conceptual framework for examining the perceptual, behavioural and cognitive processes involved in individuals' self-management of ongoing and future health threats"[28], viewing the patient as an 'active problem-solver'. The CSM is a parallel processing model **(Fig. 2)**[26] that describes both cognitive and *Emotional Response* of perceived health threats, leading to patients' IPs about these health threats.

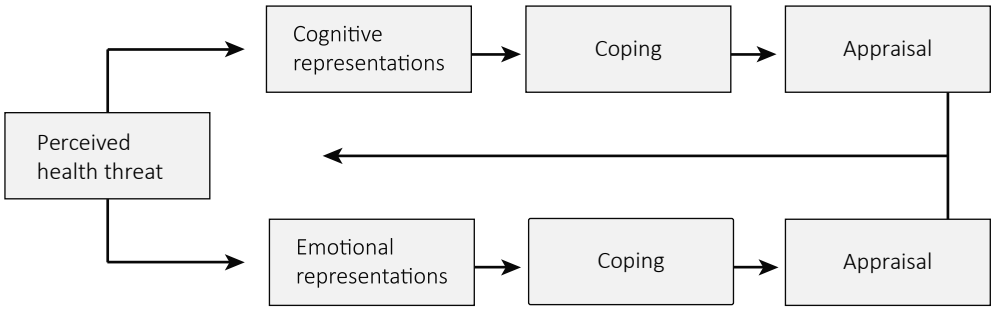


Figure 2 = CSM model

These IPs often emerge from somatic sensations (e.g. pain) and aberration from normal physical functioning (e.g. limitations in daily functioning), as well as from observations and discussions of illness with others (including the exchange of medical information) and from other environmental/societal/contextual cues (e.g. mass and social media)[17].
IPs are grouped into five illness perception dimensions:

1. **Identity** : the label or name given to the illness by patients and the symptoms that are perceived to go with it
2. **Timeline** : how long the patient believes the illness or symptoms will last
3. **Consequences** : how strong the impact of the patient's illness is on, for example, pain or physical function
4. **Causal** : the patient's beliefs about what causes the illness
5. **Control** : the patient's beliefs about how to control or recover from the illness

The Evidence
A meta-analytic review of the CSM of Illness Representations from 2003 showed associations of IPs with psychological wellbeing, role and social functioning, and vitality in mainly non-musculoskeletal disorders[17]. Associations of IPs with MSP have been reported[7,16,21,24,31,49,53,55], though a systematic overview of relevant literature is lacking.

Measurements
The assessment of individual IP dimensions has evolved from taking interviews to using validated questionnaires[48]. For the current thesis, three questionnaires need to be discussed in more detail: Illness Perception Questionnaire (IPQ), Illness Perception Questionnaire-Revised (IPQ-R) and the Brief Illness Perception Questionnaire (Brief IPQ). In 1996, Weinman et al. published the IPQ which explicitly assesses the initial five IP dimensions[65]. Empirical research on the IPQ made clear that some dimensions needed to be re-evaluated and/or further defined, resulting in additional dimensions (*Coherence*, *Concern*, *Emotional Response*). Consequently, the IPQ was adapted and relabeled the IPQ-R[44]. In the IPQ-R, the Control dimension was divided into the *Personal Control* and *Treatment Control* dimensions. The *Timeline* dimension was complemented with the *Cyclical Timeline* dimension. The *Emotional Response* dimension incorporates negative emotional reactions. The *Concern* and *Coherence* dimensions reflect the individual's ideas about distress and making sense of the illness. For use in daily practice, a nine-item Brief IPQ was developed[8]. All three questionnaires have been validated within English-speaking countries but, by 2010, none of these questionnaires had been validated for Dutch-speaking populations.

Aim of this thesis

The overall aim of the research presented in this thesis is to explore the contribution of Illness Perceptions (IPs) to the management of patients with musculoskeletal pain (MSP) in primary physiotherapy care. IPs have been shown to be associated with several health outcomes, such as pain and disability, in a variety of mostly non-musculoskeletal chronic disorders[17]. There is a lack of published research on the impact of IPs on MSP in primary physiotherapy care. More is needed since the International Association for the Study of Pain (IASP) advocates physiotherapy treatments for patients with persistent MSP[52].
This thesis therefore focuses on three themes:

1. **Measurement**
   The measurement of IPs in MSP;
2. **Associations and predictions**
   The association and predictive value of IPs on pain intensity and physical functioning in patients with MSP;
3. **Treatment**
   The treatment of MSP conditions, taking into account the various dimensions of IPs.

Measurement
To assess IPs in primary care physiotherapy practice, the use of a short instead of a long questionnaire has advantages in terms of administrative burden and acceptability for both patients and clinicians.

In **Chapter 2**, the nine-item IPQ-B English version will be cross-culturally adapted into the IPQ-B Dutch Language Version. Further, the assessment of its face validity, content validity, reproducibility, and concurrent validity in a sample of Dutch patients will be researched. Finally, the Smallest Detectable Change (SDC) will be determined.

Associations and predictions
Three projects are designed assessing the associations and the predictive value of IPs in patients with MSP. In terms of the main outcomes, we will focus on pain intensity and physical functioning.
The systematic literature review in **Chapter 3** has two aims:

1. To determine the associations between IPs and pain intensity and physical functioning in patients with MSP and
2. To establish whether IPs predict pain intensity and physical functioning in patients with MSP.

In **Chapter 4**, this thesis focuses on the "additional association", of IPs over and above well-known independent risk factors for poor prognosis, such as number of pain sites, pain duration, somatization, distress, anxiety, and depression. Patients from primary physiotherapy care with MSP are included in the study. The outcomes are pain intensity and limitations in physical functioning.
In **Chapter 5**, the thesis investigates the predictive value of baseline IPs for poor recovery after three months of physiotherapy treatment, in a longitudinal cohort study. The primary outcomes are pain intensity, physical functioning and global perceived effect (GPE). We will look at the extra predictive effect of IPs on top of the well-known independent risk factors for poor outcome listed above. In addition, we will compare the predictive values of the Brief IPQ-DLV and the Four-Dimensional Symptom Questionnaire (4DSQ)[57].

We aim to answer the following three research questions:
1. Do baseline IPs in MSP patients have added predictive value for poor recovery in terms of pain intensity, physical functioning and patient General Perceived Effect after 3 months?
2. Is there an association between the 4DSQ and the Brief IPQ-DLV?
3. Is there a difference in the predictive value for poor recovery between the 4DSQ and the Brief IPQ-DLV?

Treatment
We will set-up two intervention studies in primary care physiotherapy on the association of IPs and changes in pain intensity, physical functioning and GPE.
In **Chapter 6**, a case study is described in which the process and outcome of an intervention study is outlined. Dysfunctional IPs will be targeted, and we hypothesize that changing dysfunctional IPs could reduce pain intensity and limitations in physical functioning.

In **Chapter 7**, a multiple baseline Single-Case Experimental Design is used to investigate the possible modifying or mediating effect of dysfunctional IPs on pain intensity and limitations in physical functioning. A matched care physiotherapy treatment targets the dysfunctional IPs in order to convert them into more functional ones.

The research questions are:
1. Do pain intensity, physical functioning and pain interference change significantly during and after matched-care physiotherapy treatment?
2. Do IPs mediate the effect of matched-care physiotherapy on pain intensity, physical functioning and pain interference?
3. Do baseline IPs modify the effect of matched-care physiotherapy on pain intensity, physical functioning and pain interference?

References

1. Artus M, Campbell P, Mallen CD, Dunn KM, van der Windt DAW. Generic prognostic factors for musculoskeletal pain in primary care: a systematic review. BMJ Open. 2017;7(1):e012901-e012910.
2. Ben Darlow. Beliefs about back pain: The confluence of client, clinician and community. International Journal of Osteopathic Medicine. 2016;20(C):53-61.
3. Bishop FL, Yardley L, Prescott P, Cooper C, Little P, Lewith GT. Psychological Covariates of Longitudinal Changes in Back-related Disability in Patients Undergoing Acupuncture. The Clinical Journal of Pain. 2015;31(3):254-264.
4. Blyth FM, Briggs AM, Schneider CH, Hoy DG, March LM. The Global Burden of Musculoskeletal Pain-Where to From Here? Am J Public Health. 2019;109(1):35-40.
5. Booth J, Moseley GL, Schiltenwolf M, Cashin A, Davies M, Hübscher M. Exercise for chronic musculoskeletal pain: A biopsychosocial approach. 2017;93(11):2109-2109.
6. Borrell-Carrió F, Suchman AL, Epstein RM. The biopsychosocial model 25 years later: principles, practice, and scientific inquiry. Ann Fam Med. 2004;2(6):576-582.
7. Broadbent E, Niederhoffer K, Hague T, Corter A, Reynolds L. Headache sufferers' drawings reflect distress, disability and illness perceptions. Journal of Psychosomatic Research. 2009;66(5):465-470.
8. Broadbent E, Petrie KJ, Main J, Weinman J. The brief illness perception questionnaire. Journal of Psychosomatic Research. 2006;60(6):631-637.
9. Buchbinder R, van Tulder M, Öberg B, et al. Low back pain: a call for action. lancet. March 2018.
10. Clark S, Horton R. Low back pain: a major global challenge. lancet. March 2018.
11. Crombez G, Eccleston C, Van Damme S, Vlaeyen JWS, Karoly P. Fear-avoidance model of chronic pain: the next generation. Clin J Pain. 2012;28(6):475-483.
12. Engel GL. Engel The need for a new medical model a challenge for biomedicine. Science. 1977;196:129-136.
13. Foster NE, Anema JR, Cherkin D, et al. Prevention and treatment of low back pain: evidence, challenges, and promising directions. lancet. March 2018.
14. Frostholm L, Hornemann C, Ørnbøl E, Fink P, Mehlsen M. Using Illness Perceptions to Cluster Chronic Pain Patients. The Clinical Journal of Pain. 2018;34(11):991-999.
15. Gifford L. Pain, the Tissues and the Nervous System: A conceptual model. Physiotherapy. 1998;84(1):27-36.
16. Gillanders DT, Ferreira NB, Bose S, Esrich T. The relationship between acceptance, catastrophizing and illness representations in chronic pain. European Journal of Pain. 2012;17(6):893-902.
17. Hagger M, Orbell S. A Meta-Analytic Review of the Common-Sense Model of Illness Representations. Psychology & Health. 2003;18(2):141-184.
18. Hallegraeff JM, Van Der Schans CP, Krijnen WP, de Greef MH. Measurement of acute nonspecific low back pain perception in primary care physical therapy: reliability and validity of the brief illness perception questionnaire. BMC Musculoskelet Disord. 2013;14(1):1-1.
19. Hartvigsen J, Hancock MJ, Kongsted A, Lancet QLT, 2018. What low back pain is and why we need to pay attention. Elsevier. 2018;391(10137):2356-2367.
20. Henschke N, Ostelo RW, van Tulder MW, et al. Behavioural treatment for chronic low-back pain. Cochrane

Database Syst Rev. 2010;(7):CD002014.

21. Hill S, Dziedzic K, Thomas E, Baker SR, Croft P. The illness perceptions associated with health and behavioural outcomes in people with musculoskeletal hand problems: findings from the North Staffordshire Osteoarthritis Project (NorStOP). Rheumatology (Oxford). 2007;46(6):944-951.
22. Holopainen R, Simpson P, Piirainen A, et al. Physiotherapists' perceptions of learning and implementing a biopsychosocial intervention to treat musculoskeletal pain conditions. Pain. 2020;Articles in Press:1-19.
23. Hyphantis T, Kotsis K, Tsifetaki N, et al. Depressive and anxiety symptoms and illness perceptions associated with physical health-related quality of life in rheumatologic disorders. Journal of Psychosomatic Research. 2013;74(6):548.
24. Järemo P, Arman M, Gerdle B, Larsson B, Gottberg K. Illness beliefs among patients with chronic widespread pain- associations with self- reported health status, anxiety and depressive symptoms and impact of pain. BMC Psychol. 2017;5(1):1-10.
25. Lee H, Hübscher M, Moseley GL, et al. How does pain lead to disability? A systematic review and meta-analysis of mediation studies in people with back and neck pain. Pain. March 2015:1-10.
26. Leventhal H, Diefenbach M, Leventhal EA. Illness Cognition: Using Common Sense to Understand Treatment Adherence and Affect Cognition Interactions. Cognitive Therapyand Research. 1992;16(2):143-163.
27. Leventhal H, Meyer D, nerenz D. The Common Sense Representation of Illness Danger. In: Rachman S, ed. Medical Psychology. Vol II. Pergamon Press; 1980:7-29.
28. Leventhal H, Phillips LA, Burns E. The Common-Sense Model of Self-Regulation (CSM): a dynamic framework for understanding illness self-management. J Behav Med. August 2016:1-12.
29. Leventhal H. Findings and Theory in the study of Fear Communications. advances in experimental social psychology. 1970;5:119-186.
30. Lewis J, OSullivan P. Is it time to reframe how we care for people with non-traumatic musculoskeletal pain? British Journal of Sports Medicine. 2018;52(24):1543-1544.
31. Leysen M, Nijs J, van Wilgen CP, et al. Illness Perceptions Explain the Variance in Functional Disability, but Not Habitual Physical Activity, in Patients With Chronic Low Back Pain: A Cross-Sectional Study. Pain Pract. 2017;354:581-589.
32. Linton SJ, Shaw WS. Impact of psychological factors in the experience of pain. physical therapy. 2011;91(5):700-711.
33. Loeser JD. Perspectives on pain. In: Turner, ed. Clinical Pharmacology and Therapeutics. London: Macmillan; 1980:313-316.
34. Lærum E, Indahl A, Sture Skouen J. WHAT IS "THE GOOD BACK-CONSULTATION?" A COMBINED QUALITATIVE AND QUANTITATIVE STUDY OF CHRONIC LOW BACK PAIN PATIENTS' INTERACTION WITH AND PERCEPTIONS OF CONSULTATIONS WITH SPECIALISTS. Journal of Rehabilitation Medicine. 2006;38(4):255-262.
35. Løchting I, Garratt AM, Storheim K, Werner EL, Grotle M. The impact of psychological factors on condition-specific, generic and individualized patient reported outcomes in low back pain. Health Qual Life Outcomes. 2017;15(1):280–10. doi:10.1186/s12955-017-0593-0.
36. Main CJ, Williams AC de C. Musculoskeletal pain. BMJ. 2002;325(7363):534-537.

37. March L, Smith EUR, Hoy DG, et al. Burden of disability due to musculoskeletal (MSK) disorders. Best Practice & Research Clinical Rheumatology. 2014;28(3):353-366.
38. McCarthy CJ, Arnall FA, Strimpakos N, Freemont A, Oldham JA. The Biopsychosocial Classification of Non-Specific Low Back Pain: A Systematic Review. Phys Ther Rev. 2004;9(1):17-30.
39. Melzack R. From the gate to the neuromatrix. Pain. 1999;Suppl 6:S121-S126.
40. Merskey H, BOGDUK N. Association for the Study of Pain.(2012) Classification of Chronic Pain: Descriptions of Chronic Pain Syndromes and Definitions of Pain Terms. (Revised). IASP Press Seattle
41. Moseley GL, Butler DS. Explain Pain Supercharged. Adelaide: Noigroup Publications; 2017.
42. Moseley GL, Vlaeyen JWS. Beyond nociception. Pain. 2015;156(1):35-38.
43. Moseley GL. Reconceptualising pain according to modern pain science. Phys Ther Rev. 2007;12(3):169-178.
44. Moss-Morris R, Weinman J, Petrie KJ, Horne R, Cameron LD, Buick D. The revised Illness Perception Questionnaire (IPQ-R). Psychology & Health. 2002;17(1):1-17.
45. Ongaro G, Kaptchuk TJ. Symptom perception, placebo effects, and the Bayesian brain. Pain. 2019;160(1):1-4.
46. Pincus T, Burton AK, Vogel S, DO, Field AP, PhD. A Systematic Review of Psychological Factors as Predictors of Chronicity/Disability in Prospective Cohorts of Low Back Pain. spine. February 2002:1-12.
47. Pincus T, Kent P, Brønfort G, Loisel P, Pransky G, Hartvigsen J. Twenty-five years with the biopsychosocial model of low back pain-is it time to celebrate? A report from the twelfth international forum for primary care research on low back pain. In: Vol 38. 2013:2118-2123.
48. Pincus T, Vogel S, Burton AK, Santos R, Field AP. Fear avoidance and prognosis in back pain: A systematic review and synthesis of current evidence. Arthritis Rheum. 2006;54(12):3999-4010.
49. Roios E, Paredes AC, Alves AF, Pereira MG. Cognitive representations in low back pain in patients receiving chiropractic versus physiotherapy treatment. January 2016:1-13.
50. Roussel NA, Neels H, Kuppens K, et al. History taking by physiotherapists with low back pain patients: are illness perceptions addressed properly? Disabil Rehabil. 2015;38(13):1268-1279.
51. Sanders T, Foster NE, Bishop A, Ong BN. Biopsychosocial care and the physiotherapy encounter: physiotherapists' accounts of back pain consultations. BMC Musculoskelet Disord. 2013;14(1):1-1.
52. Slater H, Sluka K, Söderlund A. IASP Curriculum Outline on Pain for Physical Therapy. 2018. https://www.iasp-pain.org/Education/CurriculumDetail.aspx?ItemNumber=2055#_edn1.
53. Sluiter JK, Frings-Dresen MHW. Quality of life and illness perception in working and sick-listed chronic RSI patients. Int Arch Occup Environ Health. 2007;81(4):495-501.
54. Smith BH, Fors EA, Korwisi B, et al. The IASP classification of chronic pain for ICD-11. Pain. 2019;160(1):83-87.
55. Stuifbergen AK, Phillips L, Voelmeck W, Browder R. Illness perceptions and related outcomes among women with fibromyalgia syndrome. 2006;16(6):353-360.
56. Synnott A, O'Keeffe M, Bunzli S, Dankaerts W, OSullivan P, O'Sullivan K. Physiotherapists may stigmatise or feel unprepared to treat people with low back pain and psychosocial factors that influence recovery: a systematic review. J Physiother. 2015;61(2):68-76.
57. Terluin B, van Marwijk HW, Adèr HJ, et al. The Four-Dimensional Symptom Questionnaire (4DSQ): a validation study of a multidimensional self-report questionnaire to assess distress, depression, anxiety and somatization.

BMC Psychiatry. 2006;6(1):538–20. doi:10.1186/1471-244X-6-34.

58. van Os S, Norton S, Hughes LD, Chilcot J. Illness perceptions account for variation in positive outlook as well as psychological distress in Rheumatoid Arthritis. 2012;17(4):427-439.
59. van Wilgen P, Beetsma A, Neels H, Roussel N, Nijs J. Physical therapists should integrate illness perceptions in their assessment in patients with chronic musculoskeletal pain; a qualitative analysis. manual therapy. 2014;19(3):229-234.
60. Vtlaeyen JW, Kole-Snijders AM, Boeren RG, van Eek H. Fear of movement/(re)injury in chronic low back pain and its relation to behavioral performance. Pain. 1995;62(3):363-372.
61. Vos T, Flaxman AD, Naghavi M, Lozano R, Michaud C. Years lived with disability (YLDs) for 1160 sequelae of 289 diseases and injuries 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. lancet. 2013;380(9859):2163-2196.
62. Waddell G, Burton A. Concepts of rehabilitation for the management of low back pain. Best Practice & Research Clinical Rheumatology. 2005;19(4):655-670.
63. Waddell G, McCulloch J, Kummel E, Venner R. Nonorganic Physical Signs in Low-Back Pain. spine. 1980;5(2):117-125.
64. Waddell G. The Back Pain Revolution. Churchill Livingstone, Edinburgh. (Waddell G, ed.). Edinburgh: Churchill Livingstone; 1998.
65. Weinman J, Petrie KJ, Moss-Morris R, Horne R. The Illness Perception Questionnaire: a new method for assessing the cognitive representation of illness. Psychology & Health. 1996;11:431-446.
66. Wittink H, Oosterhaven J. Patient education and health literacy. Musculoskeletal Science and Practice. 2018;38:120-127.

2

Cross-cultural adaptation and measurement properties of the Brief Illness Perception Questionnaire-Dutch Language Version

Edwin de Raaij
Carin Schröder
François Maissan
Jan Pool
Harriët Wittink

Manual Therapy 17 (2012) 330-335

Abstract

Introduction: Ever since Engel's Biopsychosocial Model (1977) emotions, thoughts, beliefs and behaviors are accepted as important factors of health. The Brief Illness Perception Questionnaire (Brief IPQ) assesses these beliefs. Aim of this study was to cross-culturally adapt the Brief IPQ into the Brief IPQ Dutch Language Version (Brief IPQ-DLV), and to assess its face validity, content validity, reproducibility, and concurrent validity.

Methods: Beaton's guideline was used for cross-culturally adaptation. Face and content validity were assessed in 25 patients, 15 physiotherapists and 24 first-grade students. Reproducibility was established in 27 individuals with chronic obstructive pulmonary disease using Cohen's kappa coefficient (Kw) and the Smallest Detectable Change (SDC). Concurrent validity was assessed in 163 patients visiting 11 different physical therapists.

Results: The Brief IPQ-DLV is well understood by patients, health care professionals and first-grade students. Reliability at 1 week for the dimensions *Consequences*, *Concern* and *Emotional respons* Kw> 0.70, for the dimensions *Personal control*, *Treatment control*, *Identity*, Kw < 0.70. A time interval of 3 weeks, reliability coefficients were lower for almost all dimensions. SDC was between 2.45 and 3.37 points for individual me asurement purposes and between 0.47 and 0.57 points for group evaluative measurement purposes. Concurrent validity showed significant correlations (P<.05) for four out of eight illness perceptions (IPs) dimensions.

Conclusion: The face and content properties were found to be acceptable. The reproducibility and concurrent validity needs further investigated

Keywords: illness perceptions, cross-cultural adaptation, questionnaire, activity limitations

Introduction

Ever since the introduction of Engel's Biopsychosocial Model[7] emotions, thoughts, beliefs and behaviors are more and more accepted as important factors of health[1]. Understanding the patient's subjective experience can be an essential contributor to accurate diagnosis and treatment[3]. In the field of manual and physical therapy a call for research including not only biomedical measurements but also psychosocial measurements is emerging[18,22].

Illness perceptions (IPs), or patients' personal thoughts about the symptoms they experience can be seen as one of the psychosocial factors by which variance in physical functioning in patients can be explained[11]. Illness perceptions are well recognized as target for treatment[19,10,17]. Nijs et al. recently discussed the importance of assessing IPs in this journal. They suggested the use of IPs in tailoring an educational program for patients with unexplained chronic musculoskeletal pain[21].

IPs belong to the core concepts in the Common-Sense Model of Self-Regulation (CSM), developed by Leventhal[16]. The CSM is based on a parallel processing model,describing behavior in response to health threats. In this model, a health threat is theorized to generate both cognitive representations(danger control) and emotional states of fear and distress (fear control). Based on initial clinical research evidence[15], five dimensions of illness perceptions have been identified.

1. **Identity** : the label or name given to the illness by patients and the symptoms that are perceived to go with it
2. **Timeline** : how long the patient believes the illness or symptoms will last
3. **Consequences** : how strong the impact of the patient's illness is on, for example, pain or physical function
4. **Causal** : the patient's beliefs about what causes the illness
5. **Control** : the patient's beliefs about how to control or recover from the illness

The assessment of illness perceptions has evolved from interviews to validated questionnaires[13], three questionnaires can be discerned: IPQ, IPQ-R and Brief IPQ[30]. Weinman et al. (1996) published the Illness Perception Questionnaire (IPQ) in 1996 which explicitly assesses the five dimensions of illness perceptions. Empirical research with the IPQ[20] made clear that some concepts needed to be assessed with additional subscales (e.g. *Coherence*). Therefore the IPQ was adapted and labeled as Revised Illness Perception Questionnaire (IPQ-R)[20]. In the IPQ-R, the Control dimension was split into the *Personal Control* dimension and *Treatment Control* dimension. The *Timeline* dimension was complemented with the *Cyclical timeline*

dimension. The *Emotional Response* dimension incorporates negative emotional reactions. The *Concern* and *Coherence* dimension reflect on the individual's ideas about distress and making sense of the illness.
Since clinicians wanted to assess illness perceptions quickly and concisely, the nine-item Brief Illness Perception Questionnaire (Brief IPQ) was developed[4].The IPQ, IPQ-R and IPQ-B questionnaires were developed and validated in English speaking countries. However, the dimensions of illness perceptions are thought to be shared across cultures[14,5]. To assess illness perceptions, the use of a questionnaire which is adapted to the target language and culture is recommended by a number of authors[2,31].

To use an Illness Perception Questionnaire for measurement in intervention studies, it is important to know its measurement characteristics. These measurement properties can be assessed by calculating the Smallest Detectable Change[26].

The aim of this study was to cross-culturally adapt the nine-item IPQ-B English version (Appendix A) into the IPQ-B Dutch Language Version (Brief IPQ-DLV, Appendix B), and to determine its face validity, content validity, reproducibility, and concurrent validity in a sample of Dutch patients. Secondly, the Smallest Detectable Change as part of reproducibility was assessed.

Methods

Cross-cultural adaptation
The IPQ-B[4] was cross-culturally adapted using the guideline by Beaton et al. (2000). This guideline consists of five stages:

Stage I: initial translation
Two translators performed forward translations from English into Dutch. They were bilingual, with their native language being the target language.

Stage II: synthesis of the translations
Goal is consensus by discussion among the translators and research leader.

Stage III: back translation
Two translators translated the synthesized translation into the original English language. The first author of the Brief IPQ[4] was contacted for approval of the backward translation.

Stage IV: expert committee
This committee existed of experts in the field of CSM (Kaptein and Broadbent), a Dutch language linguist and all translators. The goal was consensus among these members on semantic equivalence between the IPQ-B and Brief IPQ-DLV.

Stage V: field-testing pre-final version
Completing the questionnaire should not require reading skills beyond that of 12-year-old. This was tested among 24 first-grade students (11e13 years) of a secondary school in the Netherlands. After they read the Brief IPQ-DLV they were asked what they thought was meant by each question.

Twenty-five patients and 15 Dutch physiotherapists tested the pre-final version of the Brief IPQ-DLV for face and content validity. After completing the Brief IPQ-DLV, the patients were asked about what they thought was meant by each question.

The physiotherapists completed two questions;
1. How relevant is this Brief IPQDLV questionnaire for your daily practice?
2. Do you find the questionnaire appropriate for your patient? The psychometric properties face validity, content validity, reproducibility, and concurrent validity of the cross-culturally adapted Brief IPQ (IPQ-DLV) were evaluated.

Reproducibility
Was assessed in a convenience sample of patients, diagnosed with Chronic Obstructive Pulmonary Disease (COPD) for at least six months and who were already attending an ongoing training programme took part in our study. Reproducibility is defined as the degree in which repeated measurements in stable study persons provide similar results[6]. In reproducibility a distinction can be made between reliability and agreement[6,26]. Reliability *concern*s the degree to which patients can be distinguished from each other, despite measurement errors. Agreement *concern*s measurement error of the instrument (standard error of measurement SEM), and can therefore best be established in individuals with stability of the Response variable [23,26]. The illness perceptions are the Response variables in this study and are known to be unstable over time. We, consequently, measured reproducibility in a population of individuals with a chance of stable condition, namely COPD undergoing a long-term training programme to maintain their level of physical functioning. Such a pulmonary rehabilitation programme may contribute to a stable level of an individual's physical functioning[32], thereby reducing the risk of unstable illness perceptions due to change in level of physical functioning. The change in health condition was assessed by one dichotomous item (yes/no) asking about

change in their health condition due to their COPD in the last 4 weeks. Reproducibility was assessed with a time interval of one and three weeks and was administrated independently by physiotherapists of the rehabilitation program.

Concurrent validity

Was assessed in a group of patients who were recruited from 11 private physiotherapy practices in The Netherlands. There were no exclusion criteria, but patients had to be able to read and comprehend the Dutch language. Patients completed a package of questionnaires assessing demographic items, the cross-culturally adapted Brief IPQ-DLV, and additional validated Dutch questionnaires: The Illness- Cognition-Questionnaire[9], Multidimensional Health Locus of Control scale[12], Spielberger State-Trait Anxiety Inventory[27] and the RAND-36[28].

In order to find a Dutch validated equivalent questionnaire for each illness perception dimension the handbook of test research by Evers and colleagues was used[8]. **Table 1** presents the questionnaires judged to be eligible for the assessment of concurrent validity. No validated Dutch questionnaires were found to assess concurrent validity of the dimensions *Identity*, *Timeline*, and *Coherence*. For the dimension *consequences* of the IPQ-B dimension the Illness-Cognition-Questionnaire[9] was used.

Table 1: *IP dimension with their Dutch validated equivalent.*

IPQ-K DLV	ZCL[a]	ZCL[b]	ZCL[c]	MHLC [d]	MHLC [e]	STAI-DY [f]	RAND [g]
Consequences	X	X					
Timeline			X	X			
Personal Control					X		
Treatment Control							
Identity							
Concern						X	
Coherence							
Emotional respons							X

a The Illness-Cognition-Questionnaire, subscale perceived benefit.
b The Illness-Cognition-Questionnaire, helplessness.
c The Illness-Cognition-Questionnaire, acceptance.
d Multidimensional Health Locus of Control scale, subscale internal orientation.
e Multidimensional Health Locus of Control scale, subscale external orientation.
f Spielberger State-trait anxiety inventory, subscale trait.
g RAND-36, subscale mental health.

For the dimensions *personal Control* and *treatment Control* of the IPQ-B dimensions the Multidimensional Health Locus of Control scale[12] was used. For the dimensions *Concern* and *Emotional Personal Controle* of the IPQ-B dimension, the Spielberger State-Trait Anxiety

Inventory[27] was used. The 'state anxiety' scale was hypothesized to be significantly associated with both the *Concern* and the *Emotional Response* dimensions.

For the dimension *Emotional Response* of the IPQ-B dimension the Rand-36[28] was used. The subscale Mental Health was hypothesized to be significantly associated with the *Emotional Response* dimension.

Statistical analysis

1. For cross-cultural adaptation of the IPQ-B into the Brief IPQDLV, the percentage of agreement on semantic equivalence in first-grade students, patients and physiotherapists for face and content validity was calculated.
2. For evaluation of the measurement properties of the Brief IPQDLV, reliability and agreement statistics as entity of reproducibility were calculated. For reliability the Kappa statistics (weighted) or percentage agreement and for agreement the smallest detectable change (SDC) was used. We consider Kw 0.70 as minimum standard[26].

Descriptive statistics of the sample used in concurrent validity research were calculated. To assess the concurrent validity, Spearman's Rho correlation coefficient was used. Statistical analyses were performed with SPSS 11 and MedCalc" version 8.0.2.0.

Results

Translation, face and content validity

Testing of the pre-final version Brief IPQ-DLV was performed among first-grade students, patients, and physiotherapists. There was a 75% semantic equivalence between the Brief IPQ-DLV question and the 24 students' description. Seventeen percent stated that they understood the question, but did not give a semantically equivalence. The other eight percent did not assess the questions.

Twenty-five patients (mean age 48.2 years, SD 14.1, range 18-71) from private physiotherapy practices completed the Brief IPQ-DLV in a mean of 4.4 min (SD 2.1, range 2-10). There was a 65% semantic equivalence between the Brief IPQ-DLV question and the patient's description of that question. The other 35% were descriptions that reflected the status of the individual's health problem. Ninety-three percent of patients stated the questionnaire was understandable.

Table 2: *Characteristics of patients in reproducibility test-retest assessment.*

N=27	Private practice PT	Private practice PT	General hospital	Total
Gender				
Male	5	5	7	17
Female	3	3	4	10
Age in years				
Mean (SD)	67.7 (7.9)	62.5 (8.8)	62.3 (9.4)	63.7 (8.8)
Range	59-80	49-75	43-73	43-75
GOLD classification	1-2	1-2	2-3-4	
Duration of COPD in years				
Mean (SD)	12.1 (19.6)	13.1 (21.6)	9.6 (5.9)	11.2 (15.5)
Range	0.75-51.0	1.75-57.0	1.5-19.0	0.8-57
Change in health last 4 weeks				
Yes	3	1	1	4
No	4	6	9	19
Non responders	0	2	2	4

PT = physiotherapy.

Table 3*: Test-retest reproducibility of the Brief IPQ-DLV.*

Item	COPD sample N=27					
	1 Week			3 Weeks		
	K_w	SDC_{indiv}	SDC_{group}	K_w	SDC_{indiv}	SDC_{group}
Consequences	0.73	2.76	0.53	0.65	3.12	0.60
Timeline	0.59	2.45	0.47	0.53	2.45	0.47
Personal control	0.51	3.37	0.65	0.23	3.90	0.75
Treatment control	0.66	2.56	0.49	0.49	2.85	0.55
Identity	0.68	2.95	0.57	0.65	3.04	0.59
Concern	0.75	2.95	0.57	0.74	2.95	0.57
Coherence	0.57	3.04	0.59	0.46	3.21	0.62
Emotional respons	0.57	3.04	0.59	0.46	3.21	0.62

K_w = quadratic weighted Cohen's kappa; SDC_{indiv} = smallest detectable change in an individual; SDC_{group} = smallest detectable change in a group.

Table 4: *Characteristics of patients in concurrent validity reliability assessment*.

N=163 Primary care	Primary care physiotherapy practice
Gender	
Male	59
Female	104
Age in years	
Mean (SD)	48.8 (14.96)
Range	18-82
Location of health problem %	
Head	5.5
Neck, shoulder, upper back	41.5
Elbow, wrist, hand	4.3
Lower back	19.5
Hip, knee	14.6
Ankle, foot	4.9
Missing	9.8
Duration of health problem in years	
Mean (SD)	4.24 (7.61)
Range (min-max)	0.08-57

Table 5: *Spearman's Rho correlation coefficient for concurrent validity n=163 patients*

IPQ-K DLV	ZCL[a]	ZCL[b]	ZCL[c]	MHLC [d]	MHLC [e]	STAI-DY [f]	RAND [g]
Consequences	.18*	.71**	-.40**	.20*	-.07	.14*	-.11
Timeline	.17*	.33**	-.04	.27**	-.18*	.00	.09
Personal Control	.16	-.27**	.40**	-.29**	-.05	-.15	.18*
Treatment Control	-.13	-.15	.14	-.16*	.14	-.12	-.02
Identity	.07	.55**	-.43**	.17*	-.17*	.21*	-.16
Concern	.26**	.66**	-.50**	.23**	-.32**	.35**	-.21**
Coherence	.10	-.14	.30**	-.06	.23**	-.05	.07
Emotional respons	.21**	.59**	-.52**	.26**	-.16	.42**	.39**

**P < .05; **P <.01.*
a The Illness-Cognition-Questionnaire, subscale perceived benefit.
b The Illness-Cognition-Questionnaire, helplessness.
c The Illness-Cognition-Questionnaire, acceptance.
d Multidimensional health locus of control scale, subscale internal orientation.
e Multidimensional health locus of control scale, subscale external orientation.
f Spielberger state-trait anxiety inventory, subscale trait.
g RAND-36, subscale mental health.

Fifteen physiotherapists (mean age 41.2 years, SD 8.9, range 23-52) from private hysiotherapy practices tested 'the pre-final version' of the Brief IPQ-DLV. Self-administered time for scoring the Brief IPQ-DLV was a mean of 4.7 min (SD 1.3, range 3-7).

Reproducibility of the Brief IPQ-DLV

Twenty-seven patients with COPD, mean age of 63.7 (SD 9.2, range 43-80) years, participated in the reproducibility measurement. **Table 2** summarizes their demographic characteristics
At a time interval of 1 week, the dimensions *Consequences*, *Concern* and *Emotional Response* reached a Kw of 0.70. The dimensions, *Personal Control*, *Treatment Control*, Identity and *Coherence* did not reach the 0.70 reliability coefficient. At a time interval of 3 weeks, the dimensions *Concern* and *Emotional Response* reached the 0.70 reliability coefficient but the reliability of the other dimensions declined. The last question of Brief IPQ-DLV showed an 85 percent agreement at a time interval of 1 week and an 81 percent agreement at a time interval of 3 weeks.

Agreement was assessed for as well individual as for group evaluative purposes for the first 8 questions of the Brief IPQ-DLV. For individual purposes SDC_{indiv} for the eight illness perception dimensions was between 2.45 and 3.37 points. For group evaluative purposes SDC_{group} was between 0.47 and 0.57 points **(Table 3)**. Table 3 summarizes reproduc ibility outcome.

Nineteen patients reported no change in health condition, four reported change during the reproducibility study and four did not respond. All patients filled out the complete Brief IPQ-DLV, so there were no missing items.

Concurrent validity of the Brief IPQ-DLV

A total of 163 patients, mean age of 48.8 years (SD 15.2, range 18-82) from 11 different physiotherapy private practices participated in the concurrent validity study. **Table 4** summarizes their demographic characteristics.

The concurrent validity showed significant correlations existed for the dimensions Consequence, *Personal Control*, *Concern*, and *Emotional Response*. For the dimensions *Treatment Control* no significant correlation was found **(Table 5)**.

Discussion

The Brief IPQ-DLV was adapted from the original English version IPQ-B. All stages for cross-cultural translation and adaptation recommended by Beaton et al. (2000) were sucessfully followed.

Results indicate that the Brief IPQ-DLV is easy to use, and takes less than 5 min for patients to complete and physiotherapists to score. Both first-grade students and individuals attending physiotherapy practice were able to understand and answer the questions of the IPQ-B-DLV. Therefore, it seems justified to conclude that the Brief IPQ-DLV is easy to understand. However, in a think aloud study conducted by van Oort et al. using this questionnaire several problems were identified[29]. Especially the control item gave rise to misinterpretations indicating that there is a need to pay greater attention to interpretation and comprehension of the IPQ items by patients. Future studies need to address these issues of interpretation and need to establish responsiveness of this questionnaire.

Assessment of the reproducibility showed moderate to good reliability in a time interval of 1 week. The *Consequences*, *Concern*, and *Emotional Response* dimensions reached the predetermined goal of Kw >0.70[26]. The other dimensions showed moderate reliability coefficients between 0.51 and 0.68. To our knowledge this study is the only one, which assessed reliability with Kw statistics. Therefore comparison with earlier studies cannot be made. The original study of the Brief IPQ used the Pearson's r[4]. This is in our opinion not the most appropriate statistic for reliability because systematic differences are not taken into account[26].

Questions by which illness perceptions were assessed can be seen as a measurement involving judgment using idiosyncratic criteria[24]. This means there is a chance that response shift phenomena could play a role in the reliability assessment of the Brief IPQ-DLV. It is not known whether patients interpret an illness perception question equally at two different moments in time. When interpreting reliability coefficients of the Brief IPQ-DLV, this idiosyncratic issue must be considered.

The SDC, as part of agreement, of the Brief IPQ-DLV is an important measurement property that can be used in intervention studies *concern*ing Illness Perceptions. If in an intervention study the outcome on a Brief IPQ-DLV dimension extends the SDC it is an indication for a 'real' change in illness perception following the intervention. The SDC for individual evaluation purposes for five Brief IPQ-DLV dimensions was less than three points. This means that a

change of three points or more, in repeated measurements, indicates a real difference within these dimensions. Two dimensions (*Emotional Response*, *Coherence*) scored 3.04, and one dimension (*Personal Control*) scored 3.37 as measurement error. This means that only a change of four points or more, in repeated measurements, indicates a 'real' difference in these dimensions. The absolute measurement error for group evaluation purposes for all eight Brief IPQ-DLV dimensions was less than one point. This means that a change of one point, in repeated group measurements, indicates a 'real' difference in Brief IPQ-DLV outcome out. Generalization of measurement error is limited because only patients with COPD were included in our study. However, our study design met 9 out of 11 items on the COnsensus-based Standards for the selection of health Measurement INstruments checklist which is a checklist that can be used to rate the quality of the design of studies on measurement properties[25]. The criterion on sample size and stable response could not be met completely. Four out of 26 patient reported improvement in health during the agreement assessment. So at least 20% of the patients reported change of health, which may have affected the results of the SDC.

For concurrent validity we hypothesized a significant association between a validated Dutch questionnaire and an illness perception dimension. However, equivalent questionnaires were only found for 5 out of 8 dimensions of the Brief IPQ-DLV. For four of these five equivalent questionnaires showed low to moderate significant correlations with the IPQ dimensions **(Table 5)**. The *Treatment Control* dimensions showed a low non-significant correlation. This may be due to low variability in answers to this question[23]. Further analyses indicated that the scores on the illness perceptions *Treatment Control* dimension indeed showed low variability with a median and mode being 8, on a 0-10 rating scale.

The validity of concurrent validity assessment of illness perceptions dimensions with validated Dutch equivalent questionnaires can be debated. The underlying rationale and concepts of the questionnaires used are not exactly the same as the equivalent question of the Brief IPQ-DLV. For example, the *Concern* dimension (item 6) was compared with State anxiety scale[27]. Whether 'state anxiety' is the right concept to assess concurrent validity for the IP-dimension *Concern* is not clear. In **Table 5**, State anxiety showed a higher significant correlation with the *Emotional Response* than with *Concern*. Interpretation of the concurrent validity correlations must therefore be done with some caution. Unfortunately although a gold standard for comparison representing a similar (theoretical) construct is not available.

Conclusion

The Brief IPQ-DLV is well understood by patients, health care professionals and first-grade students. It is easy to use, and takes less than 5 min to complete and score. The face and content properties were found to be acceptable. The reproducibility showed moderate to good reliability and a SDC of 1 point for group evaluation measurement and 3-4 points for individual evaluation measurement. The concurrent validity could only be assessed in a limited amount indicating that this needs to be further investigated. Unfortunately a gold standard for comparison representing similar (theoretical) constructs is not readily available. Responsiveness and interpretation of the items by different patient groups have not been investigated yet (Appendix B).

References

1. Alonso Y. The biopsychosocial model in medical research: the evolution of the health concept over the last two decades. Patient Education and Counseling2004;53(2):239-44.
2. Beaton DE, Bombardier C, Guillemin F, Ferraz MB. Guidelines for the process ofcross-cultural adaptation of self-report measures. Spine 2000;25(24):3186-91.
3. Borrell-Carrió F, Suchman AL, Epstein RM. The biopsychosocial model 25 yearslater: principles, practice, and scientific inquiry. Annals of Family Medicine 2004;2(6):576-82.
4. Broadbent E, Petrie K, Main J,Weinman J. The brief illness perception questionnaire. Journal of Psychosomatic Research 2006;60(6):631-7.
5. Ciofu Baumann L. Culture and illness representation. In: Cameron LD, Leventhal H, editors. The self-regulation of health and illness behaviour. London: Routledge; 2003. p. 245.
6. de Vet H, Terwee C, Knol D, Bouter L. When to use agreement versus reliability measures. Journal of Clinical Epidemiology 2006;59(10):1033-9.
7. Engel GL. The need for a new medical model a challenge for biomedicine. Science 1977;196:129-36.
8. Evers AWM, Vliet-Mulder van JC, Groot CJ. Documentatie van tests en test research in Nederland. Assen: van Gorcum; 2000.
9. Evers AW, Kraaimaat FW, van LankveldW, Jongen PJ, Jacobs JW, Bijlsma JW. Beyond unfavorable thinking: the illness cognition questionnaire for chronic diseases. Journal of Consulting and Clinical Psychology 2001;69(6):1026-36.
10. Foster NE, Bishop A, Thomas E, Main C, Horne R, Weinman J, et al. Illness perceptions of low back pain patients in primary care: what are they, do they change and are they associated with outcome? Pain 2008;136(1-2):177-87.
11. Hagger M, Orbell S. A meta-analytic review of the common-sense model of illness representations. Psychology & Health 2003;18(2):141-84.
12. Halfens R, Philipsen H. Een gezondheidsspecifieke beheersingsorientatie-schaal: validiteit en betrouwbaarheid van de MHLC. Tijdschrift voor Sociale Gezondheidszorg 1988;66:399-403.
13. Kaptein AA, Broadbent E. Illness cognition assessment, Cambridge handbook of psychology, health and medicine. Cambridge: Cambridge University Press; 2007. p. 268-73.
14. Kleinman A, Eisenberg L, Good B. Culture, illness, and care: clinical lessons from anthropology and cross-cultural research. Annals of Internal Medicine 1978;88: 251-8.
15. Leventhal H, Brisette I, Leventhal EA. The common-sense model of self-regulation of health and illness, The self-regulation of health and illness behaviour. London: Routledge; 2003. p. 42-65.
16. Leventhal H, Meyer D, Nerenz D. The common sense representation of illness danger. In: Rachman S, editor. Contributions to medical psychology, Vol. II. New York: Pergamon Press; 1980. p. 7-30.
17. Macfarlane GJ. Changing patient perceptions of their illness: can they contribute to an improved outcome for episodes of musculoskeletal pain? Pain 2008; 136(1-2):1-2.

18. McCarthy CJ, Arnall FA, Strimpakos N, Freemont A, Oldham JA. The biopsychosocial classification of non-specific low back pain: a systematic review. Physical Therapy Reviews 2004;9(1):17-30.
19. Moseley GL. Evidence for a direct relationship between cognitive and physical change during an education intervention in people with chronic low back pain. European Journal of Pain 2004;8(1):39-45.
20. Moss-Morris R, Weinman J, Petrie KJ, Horne R, Cameron LD, Buick D. The revised illness perception questionnaire (IPQ-R). Psychology & Health 2002;17(1):1-17.
21. Nijs J, Paul van Wilgen C, Van Oosterwijck J, van Ittersum M, Meeus M. How to explain central sensitization to patients with "unexplained" chronic musculoskeletal pain: practice guidelines. Manual Therapy 2011;16(5):413-8.
22. Pool JJM, Hiralal SR, Ostelo RWJG, van der Veer K, de Vet HCW. Added value of qualitative studies in the development of health related patient reported outcomes such as the pain coping and cognition list in patients with sub-acute neck pain. Manual Therapy 2010;15(1):43-7.
23. Portney LG, Watkins MP. Statistical measures of reliability, Foundations of clinical research. 2nd ed. New Jersey: Prentice Hall Health; 2000. p. 578-9.
24. Schwartz CE, Rapkin BD. Reconsidering the psychometrics of quality of life assessment in light of response shift and appraisal. Health and Quality of Life Outcomes 2004;2:16.
25. Terwee CB, Mokkink LB, Knol DL, Ostelo RWJG, Bouter LM, Vet HCW. Rating the methodological quality in systematic reviews of studies on measurement properties: a scoring system for the COSMIN checklist. Quality of Life Research; 2011.
26. Terwee C, Bot S, de Boer M, van der Windt D, Knol D, Dekker J, et al. Quality criteria were proposed for measurement properties of health status questionnaires. Journal of Clinical Epidemiology 2007;60(1):34-42.
27. van der Ploeg HM. Validity of the Zelf-Beoordelings-Vragenlijst [A Dutch version of the Spielberger state-trait anxiety inventory]. Nederlands Tijdschrift voor de Psychologie en haar Grensgebieden 1980;35:243-9.
28. van der Zee KI, Sanderman R, Heyink JW, de Haes H. Psychometric qualities of the RAND 36-item health survey 1.0: a multidimensional measure of general health status. International Journal of Behavioral Medicine 1996;3(2):104-22.
29. van Oort L, Schröder C, French DP. What do people think about when they answer the brief illness perception questionnaire? A "think-aloud" study. British Journal of Health Psychology 2011;16(Pt 2):231-45.
30. Weinman J, Petrie KJ, Moss-Morris R, Horne R. The illness perception questionnaire: a new method for assessing the cognitive representation of illness. Psychology & Health 1996;11:431-46.
31. Wild D, Grove A, Martin M, Eremenco S, McElroy S, Verjee-Lorenz A, et al. Principles of good practice for the translation and cultural adaptation process for patientreported outcomes (PRO) measures: report of the ISPOR task force for translation and cultural adaptation. Value in Health: The Journal of the International Society for Pharmacoeconomics and Outcomes Research; 2005, February.
32. Wilt TJ, Niewoehner D, MacDonald R, Kane RL. Management of stable chronic obstructive pulmonary disease: a systematic review for a clinical practice guideline. Annals of Internal Medicine 2007;147(9):639-53.

Appendix A: *The Brief Illness Perception Questionnaire* [4]

For the following questions, please circle the number that best corresponds to your views:

1. How much does your illness affect your life?

0 1 2 3 4 5 6 7 8 9 10

No affect at all — Severely affects my life

---

2. How long do you think your illness will continue?

0 1 2 3 4 5 6 7 8 9 10

A very short time — Forever

---

3. How much control do you feel you have over your illness?

0 1 2 3 4 5 6 7 8 9 10

Absolutely no control — Extreme amount of control

---

4. How much do you think your treatment can help your illness?

0 1 2 3 4 5 6 7 8 9 10

Not at all — Extremely helpful

---

5. How much do you experience symptoms from your illness?

0 1 2 3 4 5 6 7 8 9 10

No symptoms at all — Many severe symptoms

---

6. How concerned are you about your illness?

0 1 2 3 4 5 6 7 8 9 10

Not at all concerned — Extremely concerned

---

7. How well do you feel you understand your illness?

0 1 2 3 4 5 6 7 8 9 10

Don't understand at all — Understand very clearly

---

8. How much does your illness affect you emotionally? (e.g. does it make you angry, scared, upset or depressed?)

0 1 2 3 4 5 6 7 8 9 10

Not at all affected emotionally — Extremely affected emotionally

---

9. Please list in rank-order the three most important factors that you believe caused your illness.
The most important causes for me:

1. .....

2. .....

3. .....

Appendix B: Ziekteperceptie Vragenlijst IPQ-K *Edwin de Raaij, Carin Schröder, Ad Kaptein 2007*

Omcirkel alstublieft bij elke vraag het getal dat uw mening het beste weergeeft:

1. Hoeveel beÏnvloedt uw ziekte uw leven?
0 1 2 3 4 5 6 7 8 9 10
Helemaal geen invloed Zeer veel invloed

---

2. Hoe lang denkt u dat uw ziekte zal duren?
0 1 2 3 4 5 6 7 8 9 10
Een zeer korte tijd Mijn hele leven

---

3. Hoeveel controle vindt u dat u heeft over uw ziekte?
0 1 2 3 4 5 6 7 8 9 10
Helemaal geen controle Zeer veel controle

---

4. Hoeveel denkt u dat uw behandeling kan helpen bij uw ziekte?
0 1 2 3 4 5 6 7 8 9 10
Helemaal niet Zeer veel

---

5. Hoe sterk ervaart u klachten door uw ziekte?
0 1 2 3 4 5 6 7 8 9 10
Helemaal geen klachten Veel ernstige klachten

---

6. Hoe bezorgd bent u over uw ziekte?
0 1 2 3 4 5 6 7 8 9 10
Helemaal niet bezorgd Zeer bezorgd

---

7. In welke mate vindt u dat u uw ziekte begrijpt?
0 1 2 3 4 5 6 7 8 9 10
Helemaal geen begrip Zeer veel begrip

---

8. Hoeveel invloed heeft de ziekte op uw stemming? (Bv : maakt de ziekte u boos, bang, van streek of somber?)
0 1 2 3 4 5 6 7 8 9 10
Helemaal geen invloed Zeer veel invloed

---

9. Noem s.v.p. de drie belangrijkste factoren die naar uw opvatting uw ziekte hebben veroorzaakt, in volgorde van belangrijkheid. *De belangrijkste oorzaken voor mij zijn:*

1. .....

2. .....

3. .....

IPQ-K available at: www.zieketeperceptie.nl

3

The association of illness perception and prognosis for pain and physical function in patients with noncancer musculoskelpain. A systematic literature review

Edwin de Raaij
Raymond Ostelo
François Maissan
Jurgen Mollema
Harriët Wittink

Journal of orthopaedic & sports physical therapy | volume 48 | number 10 | october 2018

Abstract

Introduction: In the literature, illness perceptions have been reported to be important psychological factors associated with pain intensity and physical function in individuals with musculoskeletal pain.

Objective: To assess the relationship of illness perceptions with pain intensity and physical function in individuals with noncancer musculoskeletal pain.

Methods: In this systematic review, relevant literature databases, including PubMed, Embase,PsycINFO, CINAHL, and SPORTDiscus, were searched from inception through December 12, 2017. Two authors (E.D.R. and H.W.) independently performed the search procedures, according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses and the A MeaSurement Tool to Assess systematic Reviews guidelines, and the risk-of-bias assessment, using the QUality In Prognosis Studies tool. A qualitative best-evidence synthesis was performed.

Results: A total of 26 articles were included in the review. There were 11 cross-sectional studies concerning associations of illness perceptions with pain intensity and 11 cross-sectional studies of associations of illness perceptions with physical function. For the prognosis of pain intensity by illness perceptions, the authors found 4 longitudinal studies, and for the prognosis of physical function by illness perceptions, the authors found 12 longitudinal studies. All studies except 1 had high risk of bias. Across 15 cross-sectional studies on 9 different musculoskeletal conditions, the researchers found limited to moderate evidence for a consistent direction of the relationship of illness perceptions with pain intensity and physical function. Higher dysfunctional illness perceptions imply stronger pain intensity and more limitation in physical function. Evidence in longitudinal studies is lacking, especially on pain.

Conclusion: There is limited to moderate evidence for the cross-sectional relationship between illness perceptions and various musculoskeletal conditions. The prognostic value, however, remains unclear. Future research is recommended to investigate the longitudinal relationship between illness perception domains and outcomes in greater detail.

Keywords: disability, low back pain, pain management

Introduction

Musculoskeletal pain is a common global condition. The prevalence of this condition is high, and musculoskeletal pain causes many years lived with disability. For instance, global prevalence for low back pain (LBP) is 9.4%, and LBP ranks first among causes of years lived with disability[41,58]. Musculoskeletal pain also poses an economic burden on society. Direct health care costs, social compensation, retirement pensions, and other indirect costs contribute to this load[3,60]. To reduce this burden, effective management of pain and physical function for individuals with musculoskeletal pain is a challenge to society and clinicians.

Emotions, thoughts, beliefs, behaviors, and perceptions are increasingly accepted as important elements in the management of musculoskeletal pain[39]. Illness perceptions are the organized rep- resentations patients have about their illness and belong to the core concepts of the Common-Sense Model of Self-Regulation of Health and Illness (CSM). The CSM is based on a parallel-processing model that describes behavior in Response to health threats. In this model, a health threat is theorized to generate both cognitive representations (danger control) and emotional states of fear and distress (fear control)[33]. Based on initial clinical research, 5 illness perception dimensions have been identified.

1. **Identity** : the label or name given to the illness by patients and the symptoms that are perceived to go with it
2. **Timeline** : how long the patient believes the illness or symptoms will last
3. **Consequences** : how strong the impact of the patient's illness is on, for example, pain or physical function
4. **Causal** : the patient's beliefs about what causes the illness
5. **Control** : the patient's beliefs about how to control or recover from the illness

Ongoing research has explored and added the dimensions of *Timeline*-cyclical (periodic changes in symptoms), *Coherence* (making sense of the illness), *Emotional Response* (impact on emotional level), and *Concern* (anxiousness about the illness) to the CSM[6,43]. Recent research shows that illness perceptions have associations with several outcomes in acute and chronic illness, including self-management behaviors and quality of life[35]. These perceptions are associated with outcomes in a variety of diseases[19]. Although promising, the literature is not unambiguous. For instance, the illness perception dimensions of *Timeline*-chronic, *Consequences*, and *Personal* and *Treatment Control* have been recognized as prognostic factors for limitation in physical function in patients with LBP[12,40]. But, other studies have shown different perception dimensions to be associated with outcomes of LBP[2,15].

It has been suggested that changes in illness perceptions may predict subsequent physical function in conditions such as LBP, but relatively few intervention studies have been conducted. In a randomized controlled trial for LBP, Siemonsma et al[53] concluded that there were improvements in patient-relevant physical activities at 18-week follow-up after cognitive treatment of illness perceptions. This study and others have shown that influencing perceptions can improve physical functioning[42].

Evaluating and addressing illness perceptions may be an important component in the treatment of patients with musculoskeletal pain. However, to the authors' knowledge, no systematic review has evaluated the relationship between illness perceptions and pain intensity and physical functioning in individuals with musculoskeletal pain.

Therefore, this review explores the relationship of illness perceptions with pain intensity and physical function in patients with musculoskeletal pain in both cross-sectional and longitudinal studies. This review specifically asked (1) what associations illness perceptions may have with pain intensity and physical function in patients with musculoskeletal pain and (2) whether illness perceptions may be prognostic for pain intensity and physical function in patients with musculoskeletal pain.

Methods

This systematic review was written in accordance with Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines[38] and the A MeaSurement Tool to Assess systematic Reviews checklist[52]. Details of the protocol for this study were registered with PROSPERO. The following terms with their definitions were used in this review: musculoskeletal pain is pain felt within the context of the following musculoskeletal conditions, according to the European Musculoskeletal Conditions Surveillance and Information Network[11]:
1) joint conditions (ie, rheumatoid-, osteoarthritis), 2) bone conditions (ie, osteoporosis), 3) spinal disorders (ie, LBP), 4) regional and widespread pain disorders, 5) musculoskeletal injuries and 6) multisystem inflammatory diseases.

Illness perceptions are the organized representations patients have about their illness that belong to the core concepts of the CSM[34]. Illness perceptions can be assessed by 3 validated questionnaires: (1) the Illness Perception Questionnaire (IPQ)[59], (2) the Illness Perception Questionnaire revised (IPQ-R)[43], and (3) the Brief IPQ[29]. All 3 questionnaires have good psychometric properties[36].

Table 1 presents the number of items per questionnaire per illness perception dimension and their outcome scores range. The authors of this systematic review hypothesized that a high score on the dimensions of *Consequences*, *Timeline*, *Identity*, *Concern*, and *Emotional Response* would be indicative of dysfunctional illness perceptions. On the dimensions of *Personal* and *Treatment Control* and *Coherence*, a low score would indicate dysfunctional illness perceptions[4]. The authors considered a positive association between illness perceptions and higher pain intensity or limited physical function to constitute dysfunctional illness perceptions. Therefore, the associations found for the illness perception dimensions of *Personal* and *Treatment Control* and *Coherence* were converted before being presented in this study's results. The illness perception dimension of *Causal* beliefs is the only dimension that has a nominal measurement scale. Because of this nominal scale, it was not possible within this review to report an association or prognostic value of the illness perception dimension of *Causal* beliefs with pain intensity or physical function.

Table 1: *Number of Questions Per Illness Perception Dimension and Their Outcome Score Ranges*

Domain	IPQ	IPQ-R	Brief IPQ
Consequences	7 items (7-35)*	6 items (6-30)*	1 item (0-10)†
Timeline-chronic	3 items (3-15)*	6 items (6-30)*	1 item (0-10)†
Timeline-cyclical		4 items (4-20)*	
Personal Control	6 items (6-30)*	6 items (6-30)*	1 item (0-10)†
Treatment Control		5 items (5-25)*	1 item (0-10)†
Identity	12 items	14 items	1 item (0-10)†
Concern			1 item (0-10)†
Coherence		5 items (5-25)*	1 item (0-10)†
Emotional Response		6 items (6-30)*	1 item (0-10)†
Causal beliefs	18 items (no sum)	19 items (4 categories,‡ no sum)	1 item (0-10)†
			1 item (open)

Abbreviations: IPQ, Illness Perception Questionnaire; IPQ-R, Illness Perception Questionnaire revised.
**= Scored on a 5-point Likert scale (1-5), †= Scored on a numeric rating scale (0-10), ‡ = Psychological, risk, immune, chance.*

Pain is defined as an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage[30]. Questionnaires assessing pain intensity may have opposing scores. For instance, a high score on the numeric painrating scale indicates higher pain intensity, whereas a high score on the bodily pain dimension of the Medical Outcomes Study 36-Item Short-Form Health Survey indicates less pain. To resolve such discrepancies, the authors converted all pain measurement scales so that higher scores would indicate higher pain intensity.

Physical function is the self-reported capability to perform physical activities, rather than an objective assessment of performance. This includes the functioning of one's upper extremities (dexterity), lower extremities (walking or mobility), and central regions (neck, back), as well as instrumental activities of daily living, such as running errands[23]. Questionnaires assessing physical function may also have opposing scores. For instance, a high score on the Roland-Morris Disability Questionnaire indicates more limitation, but a high score on the physical functioning dimension of the Medical Outcomes Study 36-Item Short-Form Health Survey indicates less limitation. To resolve such differences, the reported association was converted so that higher scores would indicate more limitation in physical function.

Because most longitudinal studies had follow-up assessments at 3, 6, and 12 months, the authors summarized the data from the longitudinal studies by time intervals of less than 6 months, 6 to 12 months, and greater than 12 months.

Data sources and searches

Potentially relevant studies were identified through searches in the following electronic databases: PubMed, Embase, PsycINFO, CINAHL, and SPORTDiscus.

The databases were searched from inception to December 12, 2017. A comprehensive search strategy was developed in consultation with a medical information specialist (JM). The search strategy consisted of 2 major elements: musculoskeletal pain and illness perceptions. The authors used 2 search strategies for musculoskeletal pain and combined the results: one strategy used terms regarding pain in combination with musculoskeletal diseases and/or musculoskeletal systems, and the other strategy used terms regarding musculoskeletal pain. For each search, the researchers used all known synonyms and related terms to develop as sensitive a search as possible. The key terms were mapped to medical subject headings, and title and abstract search words and phrases were added.

The authors built the search string for PubMed and then translated it to the other databases. All databases were individually searched. The researchers imported identified references into RefWorks (ProQuest LLC, Ann Arbor, MI) and removed duplicates with the close deduplication algorithm from RefWorks. They manually verified the result of the automatic deduplication. The search strings for all databases are available on request from the corresponding author. In addition to the database searches, the authors also searched the gray literature, including the following electronic sources up to October 5, 2016: the DART-Europe E-theses Portal, Open Access Theses and Dissertations, Networked Digital Library of Theses and Dissertations, ClinicalTrials.gov, and World Health Organization International Clinical Trials Registry Platform.

In addition, the references of the included articles and recently published review articles were screened for additional publications.

Study selection

In the first round, 2 authors (EDR and HW) independently reviewed all titles and abstracts and excluded all studies that did not fulfill the inclusion criteria. If an abstract was noninformative but potentially relevant, the full-text article was read. In the second round, the full texts of all articles were read for fulfillment of all inclusion criteria and selected by 2 independent authors. Articles on psychometric properties or with qualitative designs were excluded. Any disagreement was resolved by discussion and consensus with a third author (RO).

The studies had to meet the following criteria for final inclusion:

1) study population of individuals with musculoskeletal pain, as defined by the European Musculoskeletal Conditions Surveillance and Information Network[11], 2) measures of illness perceptions with questionnaires based on the CSM, 3) measures of pain and physical function with self-reported questionnaires and 4) study designs that included cohort studies, cross-sectional studies, and randomized controlled trials. To answer the research questions concerning associations of illness perceptions with pain intensity and physical function, the authors considered crosssectional studies or longitudinal studies most appropriate.

To answer the research questions concerning prognoses by illness perceptions of increased pain intensity and increased limitation in physical function, the researchers considered longitudinal studies most appropriate. They excluded qualitative studies.

Data extraction and quality assessment

Two authors developed and independently completed the data-extraction form, which included author, publication year, study design, number of participants, study setting, characteristics of the study population (eg, musculoskeletal disorder, type of illness perceptions), measurement instruments of pain and limitation in physical function, and outcome and statistical measures (correlations, odds ratios, and regression coefficients).

The risk of bias was assessed using the Quality in Prognosis Studies (QUIPS) tool[20] by 2 authors independently. This tool has 31 items that are scored as “yes” (fulfilled), “/”(partial), “no” (not fulfilled), or “?” (unclear whether criterion is ful- filled). The 31 items cover 6 domains for potential bias: study participation, study attrition, prognostic factor measurement, outcome measurement, study confounding, and statistical analysis. These domains are labeled “high,” “moderate,” or “low” risk of bias, based on the individual item’s score within each domain, as described by Hayden et al[22]. A study has a low risk of bias if all 6 domains are rated as low risk

of bias. Any disagreement was resolved by discussion and consensus. It is recommended not to report a total score of the 31 items for overall study quality[22].

Data synthesis and analysis

Descriptive statistics were used to summarize the medical condition, number of participants, age, sex, study design, and questionnaires used for illness percepions/pain intensity/physical function across all included studies. Extraction of results focused on obtaining unadjusted and adjusted correlations, regression co- efficients, relative risks, odds ratios, and 95% confidence intervals. To explore possible publication bias or outcome reporting bias, funnel plots were made by plotting all extracted data against the number of participants in each study.

To assess statistical heterogeneity, the I2 test was used. As proposed by Higgins et al[24], a value higher than 50% was considered an indicator of substantial heterogeneity. As outcomes were considered too heterogeneous, the authors refrained from statistical pooling and summarized the evidence qualitatively, according to Hayden et al[21] (**Table 2**).

Table 2: *Levels of evidence*

Level	Description
Strong	Consistent findings (defined as greater than 75% of studies showing the same direction of effect) in multiple low-risk-of-bias studies
Moderate	Consistent findings in multiple high-risk-of-bias studies and/or 1 study with low risk of bias 1 study available
Limited	Inconsistent findings across studies
Conflicting	No association between variables for association or prognosis
No evidence	Inconsistent findings across studies No association between variables for association or prognosis

Results

Study selection

The literature search generated a total of 1418 references: PubMed, 411; PsycINFO, 381; Embase, 314; CI-NAHL, 253; and SPORTDiscus, 59. A total of 114 references were identified in the gray literature. After screening for duplicates (J.M.), 1045 were included for screening. Two authors (EDR and HW) independently screened all 1159 studies for eligibility, using the inclusion/exclusion criteria. A total of 26 studies met these criteria and were included in the review **(Figure 1)**.

Study characteristics

The study characteristics of the 26 included papers are presented in **Table 3**. The number of participating patients in studies varied from 11[17] to 2113[25]. Twelve different musculoskeletal conditions were identified:

1) rheumatoid arthritis[18,45,48,50,51,56], 2) LBP[2,7,12,16,37,49], 3) chronic pain[14,32,42,44], 4) chronic headache[4], 5) fibromyalgia[55,57], 6) systemic lupus erythematosus[17], 7) hand problems[26], 8) chronic repetitive strain injuries[54], 9) acute injury[8], 10) chronic orofacial pain[13], 11) gout[9] and 12) osteoarthritis of the knee[27]. For the research question concerning associations of illness perceptions with pain intensity, authors found 11 cross-sectional studies (Appendix A), and for illness perceptions with physical function, 11 cross-sectional studies (Appendix B). The study of Groarke et al[18] has a longitudinal design, but cross-sectional associations were also reported and were used to answer the questions of illness perceptions' association with pain intensity or physical function. For the prognosis of pain intensity by illness perception, the researchers found 4 longitudinal studies (Appendix C), and for the prognosis of physical function by illness perception, 10 longitudinal studies (Appendix D).

Risk of bias

All studies but 1 had a high risk of bias **(Table 4)**. The study by Foster et al[12] was scored as low risk on all 6 domains. There was considerable variance between studies in percentages of items scored "yes," ranging from 29%[47] to 87%[2,12,13,28,45], with an average of 66%. The QUIPS domain "study confounding" was most frequently scored as high risk of bias, and "study participation" was scored most frequently as low risk of bias. After initial assessment, there was 82% agreement on the risk-of-bias assessment of the 6 QUIPS domains between the 2 independent reviewers (E.D.R. and H.W.). Differences were resolved between the 2 assessors without the need to consult a third assessor. Funnel plots were processed and showed risk of publication bias for all illness perception dimensions.

Results of individual studies

The data extraction for all 26 studies is presented in tables comprising Appendices A- D. The authors found a total of 321 different variables for illness perceptions' association with or prognosis for pain intensity and physical function. These variables ranged from univariate, multivariate, beta, and odds ratio to relative risk. For the prognostic value of illness perceptions for pain, the researchers found only 4 studies with short- or medium-term results[16,18,27,51]. They found no studies with long-term results of more than 1 year.

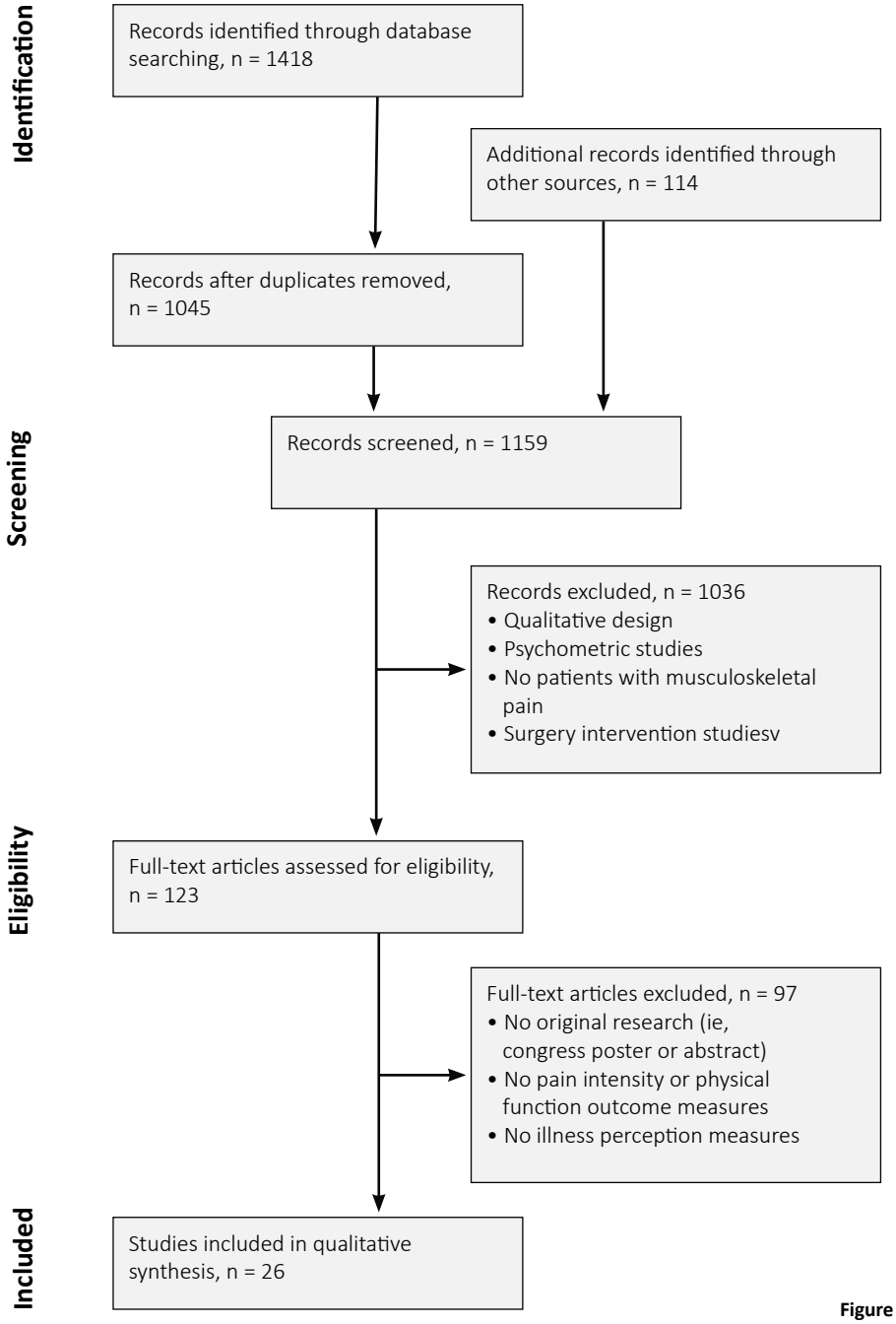

Identification
Records identified through database searching, n = 1418
Additional records identified through other sources, n = 114
Records after duplicates removed, n = 1045
Screening
Records screened, n = 1159
Records excluded, n = 1036
• Qualitative design
• Psychometric studies
• No patients with musculoskeletal pain
• Surgery intervention studiesv
Eligibility
Full-text articles assessed for eligibility, n = 123
Full-text articles excluded, n = 97
• No original research (ie, congress poster or abstract)
• No pain intensity or physical function outcome measures
• No illness perception measures
Included
Studies included in qualitative synthesis, n = 26

Figure 1

Table 3: *Study characteristics*

Patient Characteristics			Measurement Instruments				
Study	Condition	Study Sample	Study Design	IP	Pain	Physical Function	Comments
Scharloo et al[50]	RA, 12.0 ± 8.2 y	n = 84; 51.7 ± 12.6 y; 75% female	Cross-sectional	IPQ		SF-20, HAQ	SF-20: higher score, fewer limitations; HAQ: higher score, more limitations
Scharloo et al[51]	RA, 12.4 ± 8.5 y	n = 71; 52.2 ± 12.2 y; 75% female	Longitudinal	IPQ	VAS	HAQ	Time interval, 12 ± 2 mo VAS: higher score, more pain; HAQ: higher score, more limitations
Groarke et al[18]	RA, 12.6 ± 10.8 y	n = 75 at baseline and n = 52 at follow-up; 60.1 ± 12.1y; 100% female	Cross-sectional, longitudinal	IPQ	AIMS	AIMS	Time interval, 12 and 24 mo AIMS: higher score, more pain and more limitations
Goodman et al[17]	Systemic lupus erythematosus	n = 11; age and sex unknown	Longitudinal	IPQ-R		SF-36	Time interval, 7 wk SF-36: higher score, fewer limitations
Stuifbergen et al[55]	Fibromyalgia, >1 y	n = 160; 18-75 y; 100% female	Cross-sectional	IPQ-R		SF-36	SF-36: higher score, fewer limitations
Hill et al[26]	Musculoskeletal hand problems (chronic)	n = 2113; 65.4 ± 9.6 y; 63% female	Cross-sectional	IPQ-R	AIMS	AIMS	AIMS: higher score, more pain and more limitations
Moss-Morris et al[42]	Chronic pain, 7.1 ± 6.9 y	n = 98; 42.4 ± 9.5 y; 65% female	Longitudinal	IPQ-R		SF-36	Time interval, 4 wk SF-36: higher score, fewer limitations
Sluiter and Frings-Dresen[54]	Chronic RSI, 5.8 ± 3.2 y	n = 1121; 40.8 ± 8.7 y; 67% female	Cross-sectional	Brief IPQ	SF-36, VAS	SF-36	VAS: higher score, more pain; SF-36:higher score, less pain and fewer limitations
Foster et al[12]	LBP, >1 mo to <3 y	n = 1591; 43.9 ± 10.3 y; 59% female	Longitudinal	IPQ-R		RMDQ	Time interval, 6 mo RMDQ: higher score, fewer limitations
van Wilgen et al[57]	Fibromyalgia, about 10 y	n = 51; 44.0 ± 10.0 y; 92% female	Cross-sectional	IPQ-R	NRS		NRS: higher score, more pain
Broadbent et al[4]	Persistent headache	n = 65; age and sex	Cross-sectional	Brief IPQ	NRS		NRS: higher score, more pain
Chaboyer et al[8]	Injury (acute)	n = 114; <45 y, 24%; 33% female	Longitudinal	IPQ-R		SF-36	Time interval, 6 mo SF-36: higher score, fewer limitations

Table 3: *Study Characteristics (Continued)*

Patient Characteristics				Measurement Instruments			
Study	Condition	Study Sample	Study Design	IP	Pain	Physical Function	Comments
Galli et al[13]	Chronic orofacial pain, >3 mo	n = 82; 45.7 ± 16.0 y; 75% female	Longitudinal	IPQ-R	NRS	GCPS	Time interval, 3 and 6 mo NRS: higher score, more pain; GCPS: higher score, more limitations
Nicklas et al[44]	Nonmalignant chronic pain, 10 y (6 mo to 42 y)	n = 217; age and sex unknown	Cross-sectional	IPQ-R	NRS		NRS: higher score, more pain
Dalbeth et al[9]	Gout, <10 y	n = 132; 57 y (21-85 y); 0% female	Longitudinal	Brief IPQ		HAQ	Time interval, 12 mo HAQ: higher score, more limitations
van Os et al[56]	RA, 12.5 ± 10.7 y	n = 230; 57.3 ± 15.1 y; 76% female	Cross-sectional	IPQ-R	EQ-5D	HAQ	EQ-5D: higher score, more pain HAQ: higher score, more limitations
Gillanders et al[14]	Chronic pain, >6 mo	n = 150; 50.8 ± 13.2 y; 67% female	Cross-sectional	IPQ-R	MPQ	RMDQ	MPQ: higher score, more pain; RMDQ: higher score, fewer limitations
Campbell et al[7]	LBP, 22.3% for >3 y	n = 488; 47.4 ± 9.0 y; 62% female	Longitudinal	IPQ-R		CPGS	Time interval, 6 mo and 5 y CPGS: higher score, more pain-related limitations
Glattacker et al[16]	Chronic LBP, 96% for >1 y	n = 105; 54.9 ± 11.0 y; 63% female	Longitudinal	IPQ-R	VAS	SF-36, ODI	Time interval, 1 mo and 6 mo VAS: higher score, more pain; SF-36: higher score, fewer limitations; ODI: higher score, more limitations
Norton et al[45]	RA, 5.7 ± 5.7 y	n = 227; 57.7 ± 15.0 y; 76% female	Cross-sectional	IPQ-R	EQ-5D	HAQ	EQ-5D: higher score, more pain; HAQ: higher score, more limitations
Rezaei et al[48]	RA, 12.5 ± 10.7 y	n = 100; 45.5 ± 14.0 y; 72% female	Cross-sectional	Brief IPQ	RAPS		RAPS: higher score, less pain

Table 3: *Study Characteristics (Continued)*

Patient Characteristics				Measurement Instruments			
Study	Condition	Study Sample	Study Design	IP	Pain	Physical Function	Comments
Bishop et al[2]	LBP, 12.6% for <6 wk	n = 485; 55.0 ± 15.1 y; 69% female	Longitudinal	Brief IPQ		RMDQ	Time interval, 2 wk, 3 and 6 mo RMDQ: higher score, fewer limitations
Hirsch[27]	OA of the knee, 6.3 ± 7.3 y	n = 141; 63.8 ± 11.2 y; 62% female	Longitudinal	IPQ-R	VAS, WOMAC		Time interval, 3 and 9 wk VAS: higher score, more pain
Roios et al[49]	LBP, >3 mo	CT group, n = 213 and PT group, n = 125; 46.2 ± 11.6 y and 48.0 ± 13.0 y; 51% female and 70% female	Cross-sectional	IPQ-R		ODI	ODI: higher score, more limitations
Järemo et al[32]	Chronic pain	n = 152; 46.3 ± 14 y; 91% female	Cross-sectional	IPQ-R	SF-36	SF-36	SF-36: higher score, fewer limitations
Leysen et al[37]	Chronic LBP, >3 mo	n = 48; 47.0 ± 15 y; 61% female	Cross-sectional	IPQ-R		ODI	ODI: higher score, more limitations

Abbreviations: AIMS, Arthritis Impact Measurement Scales; CPGS, Chronic Pain Grade Scale; CT, chiropractic; EQ-5D, EuroQol-5 dimensions; GCPS, Graded Chronic Pain Scale; HAQ, Health Assessment Questionnaire; IP, illness perception; IPQ, Illness Perception Questionnaire; IPQ-R, Illness Perception Question- naire revised; LBP, low back pain; MPQ, McGill Pain Questionnaire; NRS, numeric rating scale; OA, osteoarthritis; ODI, Oswestry Disability Index; PT, physical therapy; RA, rheumatoid arthritis; RAPS, Rheumatoid Arthritis Pain Scale; RMDQ, Roland-Morris Disability Questionnaire; RSI, repetitive strain injury; SF-20, Medical Outcomes Study 20-Item Short-Form Health Survey; SF-36, Medical Outcomes Study 36-Item Short-Form Health Survey; VAS, visualanalog scale; WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index.

Table 4 : *Scores on methodological quality assessment*

Study	Study Participation	Study Attrition	Prognostic Factor Measurement	Outcome Measurement	Study Confounding	Statistical Analysis and Reporting
Cross-sectional designs						
Scharloo et al[50]	Moderate	Not applicable	Low	Low	Moderate	Low
Groarke et al[18]	Low	Not applicable	High	Low	High	Low
Stuifbergen et al[55]	Moderate	Not applicable	Low	Low	High	Low
Hill et al[26]	Low	Not applicable	Low	Low	High	Low
Sluiter and Frings Dresen[54]	Moderate	Not applicable	Moderate	Low	High	Low
van Wilgen et al[57]	Moderate	Not applicable	Low	Low	High	Low
Broadbent et al[4]	High	Not applicable	Moderate	Moderate	High	Low
Nicklas et al[44]	Low	Not applicable	Moderate	Moderate	High	Low
van Os et al[56]	Moderate	Not applicable	Low	Low	Low	Low
Gillanders et al[14]	Low	Not applicable	Low	Low	High	Low
Norton et al[45]	Low	Not applicable	Low	Low	High	Low
Rezaei et al[48]	Low	Not applicable	Low	Low	High	Low
Roios et al[49]	Low	Not applicable	Low	Low	High	Low
Järemo et al[32]	Low	Not applicable	Moderate	Low	High	Low
Leysen et al[37]	Low	Not applicable	Low	Low	High	Low
Longitudinal designs						
Scharloo et al[51]	Low	High	High	Low	Low	Low
Groarke et al[18]	Low	Moderate	High	Low	High	Low
Goodman et al[17]	High	High	Moderate	Low	High	Low
Moss-Morris et al[42]	Low	Moderate	Moderate	Low	High	Low
Foster et al[12]	Low	Low	Low	Low	Low	Low
Chaboyer et al[8]	Low	High	Moderate	Low	High	Moderate
Galli et al[13]	Low	High	Low	Low	Low	Low
Dalbeth et al[9]	Low	Low	Low	Low	High	Low
Glattacker et al[16]	Low	Moderate	Low	Low	Low	Low
Campbell et al[7]	Low	Low	Low	Low	High	Low
Bishop et al[2]	Low	Moderate	Low	Low	Low	Low
Hirsch[27]	Low	Low	Moderate	Low	Low	Low

Synthesis of results

The authors considered methodological heterogeneity based on the I^2 test of more than 50% on all associations and prognostic outcome scores of the included studies[24]. Clinical heterogeneity differed among studies due to the diversity of study characteristics, such as number of patients, age, musculoskeletal condition, and duration of symptoms. The measurement instruments of illness perceptions, pain intensity, and physical function were also diverse across studies. Three different versions of the IPQ were used: the IPQ,[59] the IPQ-R[43], and the Brief IPQ[6]. For the outcome measures of pain intensity, 8 different instruments were used, and for limitations in physical function, 8 instruments were employed **(Table 3)**. Due to heterogeneity, the authors could not perform a meta-analysis; the data were summarized qualitatively.

Table 5 shows the level of evidence, according to Hayden et al[21], for illness perception dimensions associated to pain intensity or physical function in musculoskeletal pain.

Table 5: *Evidence for illness perception dimensions associated to pain or physical function in musculoskeletal pain**

	Cross-sectional		Longitudinal: Pain			Longitudinal: PF		
Dimension	Pain	PF	T1	T2	T3	T1	T2	T3
Consequences	+	+	+	+		+		+
Timeline-chronic	+	+		+		+	+	
Timeline-cyclical	+	+				+		
Personal Control	+	+	+			+		+
Treatment Control	+	+	+				+	
Identity	+	+		+		+	+	+
Concern	+	+				+		+
Coherence	+	+	–			+		
Emotional Response	+	+	+			+		+

Strong evidence **Moderate evidence** **Limited evidence** **Conflicting evidence** **No evidence**

*Abbreviations: PF, physical function; T1, time interval of less than 6 months; T2, time interval of 6 to 12 months; T3, time interval of greater than 12 months. *From Hayden et al; +, possitive associated; -, negative associated*

Association of illness perceptions with pain or physical function

Pain Intensity There is moderate evidence in 9 cross-sectional studies for a positive association (ie, dysfunctional illness perceptions are associated with higher levels of pain), based on univariate regression, of all illness perception dimensions with pain intensity **(Table 5)**. This positive direction of the associations of all illness perceptions with pain intensity

was consistent across 8 different conditions (Appendix A). The strongest associations were found for the illness perception dimensions of *Consequences* and *Identity*. For instance, the study by Gillanders et al[14] reported a positive association of illness perception (*Consequences*) with increased pain (r = 0.47) in 150 patients with chronic pain, meaning a high score on the dimension of *Consequences* is associated with increased pain intensity.

Physical Function The authors found moderate evidence in 10 cross-sectional studies for a positive association (ie, dysfunctional illness perceptions are associated with limitations in physical function), based on univariate regression, of all illness perception dimensions with physical function **(Table 5).** The positive direction of the relationship of all illness perception domains with physical function was consistent across 8 different conditions. The strongest associations were found for the dimensions of *Consequences* and *Identity* (Appendix B). For instance, the study by Sluiter and Frings-Dresen[54] reported a positive association between illness perception (*Consequences* domain) and increased limitation in physical function (r= 0.49) in 1122 patients with chronic repetitive strain injury, meaning that a high score on the illness perception dimension of *Consequences* was associated with in- creased limitations in physical function.

Prognostic value of illness perceptions for pain intensity or physical function

Pain intensity Two longitudinal studies[16,27] with a time interval of less than 6 months found moderate evidence of illness perceptions being prognostic for greater pain intensity on the dimension of *Consequences*, and limited evidence for dysfunctional illness perceptions being prognostic for greater pain intensity on the dimensions of *Personal* and *Treatment Control*, *Coherence*, and *Emotional Response* (Appendix C).Three longitudinal studies[16,18,51] with time intervals of 6 to 12 months found limited evidence for illness perceptions being prognostic for more pain intensity on the illness perception dimensions of *Consequences*, *Timeline-chronic*, and *Identity* (Appendix C).None of the studies reported evidence for pain at the time interval of greater than 12 months.

Physical function Nine longitudinal studies[7-9,12,13,16-18,42] with a time interval of less than 6 months found moderate evidence for illness perceptions being prognostic for more limitations in physical function on the illness perception dimensions of *Consequences*, *Timeline* (chronic/ cyclical), *Personal Control*, *Identity*, and *Emotional Response*, and limited evidence for illness perceptions being prognostic for more limitations in physical function on the dimensions of *Concern* and *Coherence* (Appendix D). The positive direction of the relationship of these illness perceptions with physical function is consistent across 8 different conditions.

One longitudinal study[16] with a time interval of 6 to 12 months found limited evidence for illness perceptions being prognostic for more limitations in physical function on the dimensions of *Timeline chronic*, *Treatment Control*, and *Identity* (Appendix D).

Two longitudinal studies[2,7] with a time interval of greater than 12 months, found moderate evidence for illness perceptions being prognostic for more limitations in physical function on the illness perception dimensions of *Consequences*, *Personal Control*, and *Identity*, and limited evidence for dysfunctional illness perceptions being prognostic for more limitations in physical function on the dimensions of *Timeline*-chronic, *Concern*, and *Emotional Response* (Appendix D).

Discussion

The aim of this study was to systematically review the relationship between illness perceptions and pain intensity or physical function in patients with musculoskeletal pain. For cross-sectional study designs, there is moderate evidence for all illness perception dimensions being positively associated with pain intensity and physical function. Overall, the evidence for the longitudinal relationship was less evident. For pain intensity, there is moderate evidence for the illness perception dimension of *Consequences* to be prognostic at a time interval of less than 6 months. For physical function, there is moderate evidence that the dimensions of *Consequences*, *Timeline* (chronic/cyclical), *Personal Control*, and *Identity* are prognostic factors for physical function at a time interval of less than 6 months. In addition, there is moderate evidence that the illness perception dimensions of *Consequences*, *Personal Control*, and *Identity* are prognostic factors for physial function at a time interval of greater than 12 months.

Across studies, the strength of associations and prognoses varied among all illness perception domains (Appendices A-D). The authors found no explanation for this variation, based on differences in number of participants, age, symptom duration, or the questionnaires used to assess illness perceptions, pain intensity, and physical function. Comparison of these findings with previous systematic reviews on illness perception and musculoskeletal pain is not possible, due to an absence of these studies in the scientific literature. Comparing the relevance of the present study's results with other reviews in the field of illness perception, the authors found their results to be in line. In 2 meta-analyses on illness perception, the same sizes of associations are reported[10,19]. One study[19] included a total of 23 illnesses (mostly nonmusculoskeletal) and outcome measures concerning physical health–related quality of life. The other study[10] included a total of 31 conditions (varying from musculoskeletal to

cancer) and outcome measures on depression, anxiety, and quality of life. This means that the strength of the observed relations of illness perceptions with pain intensity and physical function in this review is comparable to those found in other studies on this topic.

Prognosis is the probable course and outcome of a health condition over time, and in explanatory prognostic research, 3 phases can be identified [20]: phase 1, identifying associations; phase 2, testing independent associations; and phase 3, understanding prognostic pathways. The authors identified no phase 3 studies, 9 phase 2 studies [2,10,12,13,16,27,28,31,51], and 20 phase 1 studies [4] .This means for phase 1 studies that illness perceptions, as prognostic factors, were reported without controlling for other prognostic factors. Therefore, the interpretation of reported associations and prognoses should be treated with caution.

This is the first review to the authors' knowledge that focuses on the relationship between illness perceptions and pain intensity and physical function in individuals with musculoskeletal pain. The search strategy was designed in collaboration with a librarian information specialist (J.M.). It is known that the contribution of a librarian information specialist in designing a search strategy for systematic reviews is highly correlated with the quality of the reported search strategy [47]. Therefore, the authors consider their search strategy a strong element of the study. The risk-of-bias assessment was performed according to the recommendation of Hayden et al [22], and led to determination of high risk of bias for all studies but 1.

A cutoff point of 9 on a 15-item scale (60%) as indicating a low-risk-of-bias study, while the present study did not employ a total score to indicate overall study quality. As a result, this assessment of risk of bias may be called stric The quality of the studies included in this review is not in line with the reported study quality found in another review on prognostic factors of musculoskeletal pain [1]. After performing a sensitivity analysis, that study used t, a characteristic that should be considered when interpreting conclusions about the quality of each individual study included in this review.

There are several limitations of this systematic review to be considered. First, the diversity of musculoskeletal pain condi- tions included may have influenced this synthesis. However, despite this diversity, the direction of the association is consistent throughout the included studies. Second, the strength of the association could not be assessed in a meta-analysis; therefore, a qualitative analysis of the data was performed. Because of this limitation, the authors cannot report on the strength of the pooled association or prognostic factor. The association of illness perceptions with prognosis for pain intensity and physical function, though small in strength for cross-sectional studies and limited in evidence for longitudinal

studies overall, seems to be independent of the nature of the musculoskeletal condition. This finding aligns with another systematic review that focused on generic prognostic factors for musculoskeletal pain[1]. The authors found 15 possible relevant prognostic factors identified in studies of patients with at least 2 different pain sites. Regardless of the location of the musculoskeletal pain, generic factors such as pain intensity, widespread pain, high functional disability, somatization, and movement restriction were reported as prognostic factors for pain. The authors see the same pattern in the present study; regardless of the musculoskeletal pain condition, the direction of the relationship was consistent. As a result, this study provides supplementary information for understanding the role of illness perception in musculoskeletal pain.

The authors considered higher scores on the illness perception domains of *Consequences*, *Timeline*, *Identity*, *Concern*, and *Emotional Response*, and lower scores on the domains of *Personal and Treatment Control* and *Coherence*, to be dysfunctional, because they are positively associated with, or prognostic for, increased pain intensity and increased limitations in physical function. The consistency of these findings, independent of musculoskeletal pain condition, contributes to understanding the role of illness perception in musculoskeletal pain. For instance, baseline assessment of dysfunctional illness perceptions in patients with musculoskeletal pain provides some insight in how patients themselves think about their pain or physical function.

For clinicians, addressing patients' illness perceptions may open new possibilities for management. In this review, the authors found 3 validated questionnaires for illness perception assessment. These findings show no real differences of strength of association between illness perceptions and pain or physical function among these questionnaires. The most used questionnaire was the IPQ-R, which consists of 71 items. The Brief IPQ has 9 items. The latter might have less patient burden and so may be preferred for use in daily practice.

Changing dysfunctional illness perceptions may have a positive influence on pain and physical function. The authors found 1 randomized controlled trial that addressed dysfunctional illness perceptions of patients with chronic LBP with a cognitive treatment protocol, which showed promising results in a better level of patient-specific physical function after 18 weeks[14]. The cognitive treatment targeted dysfunctional illness perceptions of patients about their back pain and aimed to alter these perceptions. In 10 to 14 one-hour treatment sessions, dysfunctional illness perceptions were assessed and challenged, and alternative illness perceptions were formulated. This was done by mapping the illness perceptions with the IPQ-R and further exploring these perceptions with a Socratic

style of dialog. More research on incorporating dysfunctional illness perceptions in inter- vention studies for the management of musculoskeletal pain is recommended, as well as research on the prognoses of illness perceptions for pain and physical function.

Conclusion

There is limited to moderate evidence for the cross-sectional relationship between illness perceptions and various musculoskeletal pain conditions. The prognostic value of these relationships, however, remains unclear. For future research, the authors suggest investigating the longitudinal relationship between illness perception domains and outcome in more detail. In addition, studies on the feasibility and impact of incorporating illness perceptions in interventions for the management of musculoskeletal pain are recommended.

References

1. Artus M, Campbell P, Mallen CD, Dunn KM, van der Windt DA. Generic prognostic factors for musculoskeletal pain in primary care: asystematic review. BMJ Open. 2017;7:e012901.
2. Bishop FL, Yardley L, Prescott P, Cooper C, Little P, Lewith GT. Psychological covariates of longitudinal changes in back-related disability in patients undergoing acupuncture. Clin J Pain. 2015;31:254-264.
3. Breivik H, Collett B, Ventafridda V, Cohen R, Gallacher D. Survey of chronic pain in Europe: prevalence, impact on daily life, and treatment. Eur J Pain. 2006;10:287-333.
4. Broadbent E, Niederhoffer K, Hague T, Corter A, Reynolds L. Headache sufferers' drawings reflect distress, disability and illness perceptions. J Psychosom Res. 2009;66:465-470.
5. Broadbent E, Petrie KJ, Main J, Weinman J. The Brief Illness Perception Questionnaire. J Psychosom Res. 2006;60:631-637.
6. Broadbent E, Wilkes C, Koschwanez H, Weinman J, Norton S, Petrie KJ. A systematic review and meta-analysis of the Brief Illness Perception Questionnaire. Psychol Health. 2015;30:1361-1385.
7. Campbell P, Foster NE, Thomas E, Dunn KM.Prognostic indicators of low back pain in primary care: five-year prospective study. J Pain. 2013;14:873-883.
8. Chaboyer W, Lee BO, Wallis M, Gillespie B, Jones C. Illness representations predict health-related quality of life 6 months after hospital discharge in individuals with injury: a predictive survey. J Adv Nurs. 2010;66:2743-2750.
9. Dalbeth N, Petrie KJ, House M, et al. Illness perceptions in patients with gout and the relationship with progression of musculoskeletal disability. Arthritis Care Res (Hoboken). 2011;63:1605-1612.
10. Dempster M, Howell D, McCorry NK. Illness perceptions and coping in physical health conditions: a meta-analysis. J Psychosom Res. 2015;79:506-513.
11. Executive Agency for Health and Consumers. Musculoskeletal Health in Europe. Truro, UK: European Musculoskeletal Conditions Surveillance and Information Network; 2012.
12. Foster NE, Bishop A, Thomas E, et al. Illness perceptions of low back pain patients in primary care: what are they, do they change and are they associated with outcome? Pain. 2008;136:177-187.
13. Galli U, Ettlin DA, Palla S, Ehlert U, Gaab J. Do illness perceptions predict pain-relateddisability and mood in chronic orofacial pain patients? A 6-month follow-up study. Eur J Pain. 2010;14:550-558.
14. Gillanders DT, Ferreira NB, Bose S, Esrich T. The relationship between acceptance, catastrophizing and illness representations in chronic pain. Eur J Pain. 2013;17:893-902.
15. Glattacker M, Heyduck K, Meffert C. [Development of a questionnaire to assess treatment representations in rehabilitation patients]. Rehabilitation (Stuttg). 2009;48:345-353.
16. Glattacker M, Heyduck K, Meffert C. Illness beliefs and treatment beliefs as predictors of short-term journal of orthopaedic & sports physical therapy | volume 48 | number 10 | october 2018 | 799 and medium-term outcome in chronic back pain. J Rehabil Med. 2013;45:268-276.
17. Goodman D, Morrissey S, Graham D, Bossingham D. The application of cognitive–behaviour therapy in altering illness representations ofsystemic lupus erythematosus. Behav Change. 2005;22:156-171.

18. Groarke AM, Curtis R, Coughlan R, Gsel A. Predictors of physical, psychological and social adjustment in women with rheumatoid arthritis. Irish J Psychol. 2005;26:161-176.
19. Hagger MS, Orbell S. A meta-analytic review of the common-sense model of illness representations. Psychol Health. 2003;18:141-184.
20. Hayden JA, Côté P, Steenstra IA, Bombardier C, QUIPS-LBP Working Group. Identifying phases of investigation helps planning, appraising, and applying the results of explanatory prognosis studies. J Clin Epidemiol. 2008;61:552-560.
21. Hayden JA, Tougas ME, Riley R, Iles R, Pincus T. Individual recovery expectations and prognosis of outcomes in non-specific low back pain: prognostic factor exemplar review. Cochrane Database Syst Rev. 2014:CD011284.
22. Hayden JA, van der Windt DA, Cartwright JL, Côté P, Bombardier C. Assessing bias in studies of prognostic factors. Ann Intern Med. 2013;158:280-286.
23. HealthMeasures. Intro to PROMIS®. Available at: http://www.healthmeasures.net/exploremeasurement-systems/promis/intro-to-promis. Accessed December 31, 2017.
24. Higgins JP, Thompson SG, Deeks JJ, Altman DG. Measuring inconsistency in meta-analyses. BMJ. 2003;327:557-560.
25. Hill JC, Lewis M, Sim J, Hay EM, Dziedzic K. Predictors of poor outcome in patients with neck pain treated by physical therapy. Clin J Pain. 2007;23:683-690.
26. Hill S, Dziedzic K, Thomas E, Baker SR, Croft P. The illness perceptions associated with health and behavioural outcomes in people with musculoskeletal hand problems: findings from the North Staffordshire Osteoarthritis Project (NorStOP). Rheumatology (Oxford). 2007;46:944-951.
27. Hirsch G. Somatic and psychological predictors of Response to intra-articular corticosteroid injection in knee osteoarthritis [thesis]. Manchester, UK: University of Manchester; 2015.
28. Hirsch G, Hale E, Kitas G, Klocke R. Psychological factors including illness perceptions may predict Response to corticosteroid injection in osteoarthritis [abstract]. Rheumatology (Oxford). 2012;51:iii100.
29. The Illness Perception Questionnaire. Available at: https://www.uib.no/ipq/index.html. Accessed March 9, 2017.
30. International Association for the Study of Pain. Pain terms. Available at: http://www.iasp-pain.org/Education/Content.aspx?ItemNumber=1698#Pain. Accessed August 16, 2018.
31. Israel JI, White KS, Gervino EV. Illness perceptions, negative emotions, and pain in patients with noncardiac chest pain. J Clin Psychol Med Settings. 2015;22:77-89.
32. Järemo P, Arman M, Gerdle B, Larsson B, Gottberg K. Illness beliefs among patients with chronic widespread pain- associations with self-reported health status, anxiety and depressive symptoms and impact of pain. BMC Psychol. 2017;5:24.
33. Leventhal H, Brissette I, Leventhal EA. The common-sense model of self-regulation of health and illness. In: Cameron LD, Leventhal H,eds. The Self-Regulation of Health and Illness Behaviour. London, UK: Taylor & Francis/Routledge; 2003:42-65.

34. Leventhal H, Meyer D, Nerenz D. The common sense representation of illness danger. In: Rachman SJ, ed. Contributions to Medical Psychology: Volume 2. Oxford, UK: Pergamon; 1980:7-30.
35. Leventhal H, Phillips LA, Burns E. The Common-Sense Model of Self-Regulation (CSM): a dynamic framework for understanding illness self-management. J Behav Med. 2016;39:935-946.
36. Leysen M, Nijs J, Meeus M, et al. Clinimetric properties of Illness Perception Questionnairerevised (IPQ-R) and Brief Illness Perception Questionnaire (Brief IPQ) in patients with musculoskeletal disorders: a systematic review. Man Ther. 2015;20:10-17.
37. Leysen M, Nijs J, Van Wilgen CP, et al. Illness perceptions explain the variance in functional disability, but not habitual physical activity, in patients with chronic low back pain: a crosssectional study. Pain Pract. 2018;18:523-531.
38. Liberati A, Altman DG, Tetzlaff J, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. J Clin Epidemiol. 2009;62:e1-e34.
39. Linton SJ, Shaw WS. Impact of psychological factors in the experience of pain. Phys Ther. 2011;91:700-711.
40. Macfarlane GJ. Changing patient perceptions of their illness: can they contribute to an improved outcome for episodes of musculoskeletal pain? Pain. 2008;136:1-2.
41. March L, Smith EU, Hoy DG, et al. Burden of disability due to musculoskeletal (MSK) disorders. Best Pract Res Clin Rheumatol. 2014;28:353-366.
42. Moss-Morris R, Humphrey K, Johnson MH, Petrie KJ. Patients' perceptions of their pain condition across a multidisciplinary pain management program: do they change and if so does it matter? Clin J Pain. 2007;23:558-564.
43. Moss-Morris R, Weinman J, Petrie K, Horne R, Cameron L, Buick D. The revised Illness Perception Questionnaire (IPQ-R). Psychol Health. 2002;17:1-16.
44. Nicklas LB, Dunbar M, Wild M. Adherence to pharmacological treatment of nonmalignant chronic pain: the role of illness perceptions and medication beliefs. Psychol Health. 2010;25:601-615.
45. Norton S, Hughes LD, Chilcot J, et al. Negative and positive illness representations of rheumatoid arthritis: a latent profile analysis. J Behav Med. 2014;37:524-532.
46. Radat F, Lantéri-Minet M, Nachit-Ouinekh F, et al. The GRIM2005 study of migraine consultation in France. III: psychological features of subjects with migraine. Cephalalgia. 2009;29:338-350.
47. Rethlefsen ML, Farrell AM, Osterhaus Trzasko LC, Brigham TJ. Librarian co-authors correlated with higher quality reported search strategies in general internal medicine systematic reviews. J Clin Epidemiol. 2015;68:617-626.
48. Rezaei F, Doost HT, Molavi H, Abedi MR, Karimifar M. Depression and pain in patients with rheumatoid arthritis: mediating role of illness perception. Egypt Rheumatol. 2014;36:57-64.
49. Roios E, Paredes AC, Alves AF, Pereira MG. Cognitive representations in low back pain in patients receiving chiropractic versus physiotherapy treatment. J Health Psychol. 2017;22:1012-1024.
50. Scharloo M, Kaptein AA, Weinman J, et al. Illness perceptions, coping and functioning in patients with rheuma-

toid arthritis, chronic obstructive pulmonary disease and psoriasis. J Psychosom Res. 1998;44:573-585.

51. Scharloo M, Kaptein AA, Weinman JA, Hazes JM, Breedveld FC, Rooijmans HG. Predicting functional status in patients with rheumatoid arthritis. J Rheumatol. 1999;26:1686-1693.
52. Shea BJ, Hamel C, Wells GA, et al. AMSTAR is a 800 | october 2018 | volume 48 | number 10 | journal of orthopaedic & sports physical therapy [research report] reliable and valid measurement tool to assess the methodological quality of systematic reviews. J Clin Epidemiol. 2009;62:1013-1020.
53. Siemonsma PC, Stuive I, Roorda LD, et al. Cognitive treatment of illness perceptions in patients with chronic low back pain: a randomized controlled trial. Phys Ther. 2013;93:435-448.
54. Sluiter JK, Frings-Dresen MH. Quality of life and illness perception in working and sicklisted chronic RSI patients. Int Arch Occup Environ Health. 2008;81:495-501.
55. Stuifbergen AK, Phillips L, Voelmeck W, Browder R. Illness perceptions and related outcomes among women with fibromyalgia syndrome. Womens Health Issues. 2006;16:353-360.
56. van Os S, Norton S, Hughes LD, Chilcot J. Illness perceptions account for variation in positive outlook as well as psychological distress in rheumatoid arthritis. Psychol Health Med. 2012;17:427-439.
57. van Wilgen CP, van Ittersum MW, Kaptein AA, van Wijhe M. Illness perceptions in patients with fibromyalgia and their relationship to quality of life and catastrophizing. Arthritis Rheum. 2008;58:3618-3626.
58. Vos T, Flaxman AD, Naghavi M, et al. Years lived with disability (YLDs) for 1160 sequelae of 289 diseases and injuries 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010. Lancet. 2012;380:2163-2196.
59. Weinman J, Petrie KJ, Moss-Morris R, Horne R. The Illness Perception Questionnaire: a new method for assessing the cognitive representation of illness. Psychol Health. 1996;11:431-445.
60. Woolf AD, Pfleger B. Burden of major musculoskeletal conditions. Bull World Health Organ. 2003;81:646-656.

Appendix A: Cross-sectional associations between illness perception domains and musculoskeletal pain at baseline

Illness/Study	Measure	Consequences	Timeline Chronic	Timeline Cyclical	Control Personal	Control Treatment	Identity	Concern	Coherence	Emotional Response
Rheumatoid arthritis										
Groarke et al[18]	AIMS*	ß = 0.21	ß = –0.05			r =0.38† ß= 0.31†	ß = 0.23			
van Os et al[56]	EQ-5D‡	r = 0.34†	r = 0.09	r = 0.08	r = 0.15§	r = 0.19†	r = 0.32†		r = 0.01	
Norton et al[45]	EQ-5D‡	r = 0.54	r = 0.15	r = 0.20	r = 0.35	r = 0.35	r = 0.54		r = 0.12	r = 0.29
Rezaei et al[48]	RAPS‖	r = 0.54†	r = 0.41†		r = –0.34†	r = –0.11	r = 0.34†	r = 0.25§	r = –0.18	r = 0.39†
Chronic pain										
Nicklas et al[44]	NRS‡	r = 0.33†	r = 0.23†	r = –0.14§	r = 0.21†	r = 0.24	r = 0.06		r = 0.14§	r = 0.27†
Gillanders et al[14]	MPQ‡	r = 0.47†	r = 0.34†	r = 0.02	r = 0.07	r = 0.22	r = 0.50†		r = 0.12	r = 0.29†
Järemo et al[32]	SF-36‡	r = 0.47†	r = 0.13	r = 0.06	r = 0.23†	r = 0.17§	r = 0.41†		r = 0.11	r = 0.24†
Fibromyalgia										
van Wilgen et al[57]	NRS‡	r = 0.28	r = –0.23	r = 0.23	r = –0.01	r = 0.02	r = 0.10		r = 0.20	r = 0.09
Hand problems										
Hill et al[26]	AIMS‡	1.29 (1.25, 1.32)¶	2.51 (2.07, 3.04)¶							
Chronic RSI										
Sluiter and Frings Dresen[54]	VAS-intensity‖	r = 0.51	r = 0.18	r = 0.36	r = 0.19	r = 0.64	r = 0.46	r = 0.16		r = 0.35
	SF-36‖	r = 0.62	r = 0.15		r = 0.42	r = 0.21	r = 0.67	r = 0.49	r = 0.19	r = 0.41
Headache										
Broadbent et al[4]	NRS-average‖	r = 0.34†	r = 0.25§		r = 0.30§	r = 0.05	r = 0.32§	r = 0.45†	r = 0.10	r = 0.14
	NRS-worst‖	r = 0.37†	r = 0.30§		r = 0.15§	r = –0.06	r = 0.36§	r = 0.27§	r = 0.12	r = 0.12

Abbreviations: r, pearson correlation; ß , standardized regression coefficient; AIMS, Arthritis Impact Measurement Scales; EQ-5D, EuroQol-5 dimensions; MPQ, McGill Pain Questionnaire; NRS, numeric rating scale; RAPS, Rheumatoid Arthritis Pain Scale; RSI, repetitive strain injury; SF-36, Medical Outcomes Study 36-Item Short-Form Health Survey; VAS, visual analog scale.
** = Correlated with the Illness Perception Questionnaire. † = P<.01. ‡Correlated with the Illness Perception Questionnaire revised. § = P<.05. ‖ = Correlated with the Brief Illness Perception Questionnaire. ¶ = Values are adjusted odds ratio (95% confidence interval).*

Appendix B: Cross-sectional associations between illness perceptions and musculoskeletal physical function at baseline ***at baseline***

Illness/Study	Measure	Consequences	Timeline Chronic	Timeline Cyclical	Control Personal	Control Treatment	Identity	Concern	Coherence	*Emotional Response*
Rheumatoid arthritis										
Scharloo et al[50]	SF-20* (T0)					ß = 0.25†‡	ß = –0.33†§			
	HAQ* (T0)					ß = –0.24†‡	ß = 0.50†‡			
Groarke et al[18]	AIMS* (T0)	r =0.35‡ ß =0.23‖	ß = 0.05‖			ß = –0.20‖¶	r = 0.38§ ß = 0.29‖¶			
	AIMS* (T1)	r =0.55‡ ß= 0.14‖	r = 0.03 ß = 0.10‖			ß = –0.13‖	r =0.34§ ß= 0.14‖			
	AIMS* (T2)	r =0.43‡ ß =0.25‖	ß = 0.07‖			ß = –0.06‖	ß = 0.10‖			
van Os et al[56]	HAQ# (T0)	r = 0.55§	r = 0.10	r = 0.03	r = 0.22§	r = –0.18§	r = 0.34§		r = 0.03	
Norton et al[45]	HAQ# (T0)	r = 0.56	r = 0.12		r = 0.30	r = –0.32	r = 0.42		r = –0.05	r = 0.23
Chronic pain										
Gillanders et al[14]	RMDQ# (T0)	r = 0.60¶ r = 0.36§	r = 0.40¶	r = –0.07	r = 0.13 r = 0.33§	r = 0.30¶	r = 0.34¶ r = 0.28¶		r = 0.04	r = 0.37¶
Järemo et al[32]	SF-36 PF# (T0)	ß = 0.49†§	r = 0.13	r = 0.11	ß = 0.66†§	r = 0.22¶	ß = 0.83†§		r = 0.07	r = 0.04
Fibromyalgia										
Stuifbergen et al[55]	SF-36 PF#				ß = 0.33‖					
Hand problems										
Hill et al[26]	AIMS# (T0)	1.26 (1.23, 1.29)** 1.26 (1.22, 1.29)†† 1.18 (1.14, 1.23)‡‡					5.34 (4.29, 6.64)** 5.34 (4.19, 6.81)†† 2.32 (1.73, 3.12)‡‡			
Chronic RSI										
Sluiter and Frings-Dresen[54]	SF-36 PF§§ (T0)	r = 0.49	r = 0.16		r = 0.34	r = 0.15	r = 0.49	r = 0.30	r = 0.12	r = 0.25
Chronic low back pain										
Roios et al[49]	CT: ODI# (T0)						ß = 0.18†			
	PT: ODI# (T0)				ß = –0.10†		ß = 0.18†			
Leysen et al	ODI# (T0)	ß = 1.25¶		ß = 0.64¶	ß = 0.92¶					ß = 0.64¶

Abbreviations: r, pearson correlation; ß , standardized regression coefficient; AIMS, Arthritis Impact Measurement Scales; CT, chiropractic; GCPS, Graded Chronic Pain Scale; HAQ, Health Assessment Questionnaire; ODI, Oswestry Disability Index; PF, physical functioning; PT, physical therapy; RMDQ, Roland-Morris Disability Questionnaire; RSI, repetitive strain in- jury; SF-12, Medical Outcomes Study 12-Item Short-Form Health Survey; SF-20, Medical Outcomes Study 20-Item Short-Form Health Survey; SF-36, Medical Outcomes Study 36-Item Short-Form Health Survey; T0, baseline; T1, time interval of less than 6 months; T2, time interval of 6 to 12 months.
** = Correlated with the Illness Perception Questionnaire, † = Values are unadjusted, ‡ = P<.001. § P<.01., ‖ = Values are adjusted, ¶ = P<.05., # = Correlated with the Illness Perception Questionnaire revised, ** = Values are unadjusted odds ratio (95% confidence interval), †† = Values are odds ratio (95% confidence interval) adjusted for age/sex/perceived diagnoses, ‡‡ = Values are odds ratio (95% confidence interval) adjusted for all other variables, §§ = Correlated with the Brief Illness Perception Questionnaire.*

Appendix C: Longitudinal associations between illness perceptions and musculoskeletal pain

Illness/Study	Measure	Consequences	Timeline Chronic	Timeline Cyclical	Control Personal	Control Treatment	Identity	Concern	Coherence	*Emotional Response*
Rheumatoid arthritis										
Scharloo et al[51]	VAS* (T2)	r = 0.39§								
Groarke et al[18]	AIMS* (T2)						r = 0.39§			
Low back pain										
Glattacker et al[36]	VAS‖ (T1)	ß = 0.24†				ß = 0.17†				
	SF-36 BP‖ (T1)							ß = –0.20†		
	VAS‖ (T2)		ß = 0.28†							
	SF-36 BP‖ (T2)		ß = 0.38†							
Knee osteoarthritis										
Hirsch[27]	VAS‖ (3 wk)	0.90 (0.84, 0.97)¶ 0.93 (0.86, 1.01)#				1.25 (1.1, 1.4)¶ 1.40 (1.1, 1.8)#				
	VAS‖ (9 wk)	0.82 (0.75, 0.90)¶ 0.83 (0.75, 0.93)#				1.25 (1.08, 1.44)¶ 1.24 (1.05, 1.47)#				0.91 (0.84, 0.98)¶ 0.99 (0.90, 1.09)#
	POA subset									
	VAS‖ (3 wk)	0.81 (0.73, 0.91)¶ 0.92 (0.82, 1.02)#			1.14 (1.01, 1.28)¶	1.30 (1.09, 1.50)¶ 1.20 (1.0, 1.45)#				
	VAS‖ (9 wk)	0.81 (0.73, 0.90)¶ 0.82 (0.75, 0.93)#			1.20 (1.05, 1.40)¶ 1.12 (0.94, 1.33)#	1.30 (1.09, 1.50)¶ 1.27 (1.01, 1.59)#				0.90 (0.81, 0.99)¶ 0.96 (0.86, 1.07)#

Abbreviations: r, pearson correlation; ß , standardized regression coefficient; AIMS, Arthritis Impact Measurement Scales; BP, bodily pain; POA, primary osteoarthritis; SF-36, Medical Outcomes Study 36-Item Short-Form Health Survey; T1, time interval of less than 6 months; T2, time interval of 6 to 12 months; VAS, visual analog scale,
** = Correlated with the Illness Perception Questionnaire, † = Values are adjusted, ‡ = P<.01. §P<.05, ‖ = Correlated with the Illness Perception Questionnaire revised, ¶ = Values are unadjusted odds ratio (95% confidence interval), # = Values are adjusted odds ratio (95% confidence interval).*

Appendix D: *Longitudinal associations between illness perceptions and musculoskeletal physical function*

Illness/study	Measure	Consequences	Timeline chronic	Timeline cyclical	Control Personal	Control Treatment	Identity	Concern	Coherence	*Emotional Response*
Rheumatoid arthritis										
Groarke et al[18]	AIMS* (T1)	r = 0.35[†]								
Low back pain										
Foster et al[12]										
	RMDQ[‡] (T1)	1.61 (1.2, 2.1)[§] 1.38 (1.0, 1.9)[‖]	2.00 (1.5, 2.6)[§] 1.83 (1.4, 2.5)[‖]	0.97 (0.7, 1.3)[§] 1.09 (0.8, 1.4)[‖]	1.59 (1.2, 2.1)[§] 1.49 (1.1, 2.0)[‖]	1.52 (1.2, 2.0)[§] 1.40 (1.1, 1.8)[‖]	1.19 (0.9, 1.5)[§] 1.04 (0.8, 1.4)[‖]		1.11 (0.8, 1.5)[§] 1.08 (0.8, 1.5)[‖]	1.34 (1.0, 1.8)[§] 1.23 (0.9, 1.7)[‖]
Campbell et al[7]	CPGS[‡] (T1)	1.09 (1.1, 1.1)[§] 1.09 (1.1, 1.1)[‖]	1.07 (1.0, 1.1)[§] 1.09 (1.1, 1.1)[‖] 1.04 (1.0, 1.1)[¶#]	1.00 (0.96, 1.0)[§] 1.01 (0.97, 1.1)[‖]	0.93 (0.90, 0.97)[§] 0.91 (0.88, 0.95)[‖]	0.93 (0.90, 0.97)[§] 0.90 (0.86, 0.94)[‖]	1.15 (1.1, 1.2)[§] 1.16 (1.1, 1.2)[‖]		1.02 (0.99, 1.0)[§] 1.03 (1.0, 1.1)[‖]	1.07 (1.1, 1.1)[§] 1.06 (1.0, 1.1)[‖]
	CPGS[‡] (T3)	1.01 (0.97, 1.1)[§] 1.03 (0.97, 1.1)[‖]	1.04 (1.0, 1.1)[§] 1.06 (1.0, 1.1)[‖] 1.06 (1.0, 1.1)[†¶]		0.97 (0.93, 1.0)[§] 0.98 (0.97, 1.0)[‖]	1.03 (0.97, 1.1)[§] 1.01 (0.95, 1.1)[‖]	1.02 (0.95, 1.1)[§] 0.98 (0.90, 1.1)[‖]		1.01 (0.98, 1.1)[‖]	1.07 (0.97, 1.1)[§] 0.95 (0.91, 0.99)[‖] 0.98 (0.94, 1.0)[¶]
Glattacker et al[16]	SF-36 PF[‡] (T1)								ß = 0.12[#**]	
	SF-36 SF[‡] (T1)	ß = 0.26[#**]							ß = 0.17[#**]	
	ODI[‡] (T1)								ß = 0.22[#**]	
	SF-36 PF[‡] (T2)		ß = 0.20[#**]							
	SF-36 SF[‡] (T2)					ß = 0.26[#**]				
	ODI[‡] (T2)						ß = 0.20[#**]			
Bishop et al[2]	RMDQ[††]: BPE (T3)	ß = 1.04[†**]	ß = –0.03**		ß = 0.24[#**]	ß = –0.02**	ß = 0.39[#**]	ß = 0.13**	ß = –0.12**	ß = 0.16**
	RMDQ[††]: WPE (T3)	ß = 0.35[†**]	ß = –0.02**		ß = 0.24[†**]	ß = 0.13**	ß = 0.34[†**]	ß = 0.28[†**]	ß = 0.13[#**]	ß = 0.26[†**]
Orofacial pain										
Galli et al[13]	GCPS[‡] (3 mo)	r = 0.30[#]	r = –0.04	r = 0.05	r = 0.04				r = 0.004	r = –0.01
	GCPS[‡] (6 mo)	r = 0.16	r = –0.07	r = 0.12	r = 0.15				r = –0.04	r = –0.11

Appendix D: *Longitudinal associations between illness perceptions and musculoskeletal physical function (Continued)*

Illness/study	Measure	Consequences	Timeline chronic	Timeline cyclical	Control Personal	Control Treatment	Identity	Concern	Coherence	*Emotional Response*
Chronic pain										
Moss-Morris et al[42]	SF-36 PF[‡] (T1)	ß = 0.29[†]**	ß = 0.01**		ß = –0.05**				ß = 0.07**	ß = 0.07**
Systemic lupus erythematosus										
Goodman et al[17]	SF-36[‡] (T1)	r = 0.26	r = 0.29	r = 0.39[#]	r = 0.16	r = 0.16	r = 0.58[‡‡]		r = 0.28	r = 0.20
Injury										
Chaboyer et al[8]	SF-36 PF[‡] (T1)		ß= –11.19 ß =–0.51				ß =–3.30 ß =–0.27			
Gout										
Dalbeth et al[9]	HAQ[††] (T1)	ß = 0.29**			ß = 0.23**	ß = 0.24**	ß = 0.22**			

Abbreviations: r, pearson correlation; ß , standardized regression coefficient; AIMS, Arthritis Impact Measurement Scales; BPE, between-persons effect; CPGS, Chronic Pain Grade Scale; GCPS, Graded Chronic Pain Scale; HAQ, Health Assessment Questionnaire; ODI, Oswestry Disability Index; PF, physical functioning; RMDQ, Roland-Morris Disability Questionnaire; SF, social functioning; SF-36, Medical Outcomes Study 36-Item Short-Form Health Survey; T1, time interval of less than 6 months; T2, time interval of 6 to 12 months; T3, time interval of greater than 12 months; WPE, within-persons effect,
** = Correlated with the Illness Perception Questionnaire, [†] = P<.01. [‡] Correlated with the Illness Perception Questionnaire revised. [§] = Values are unadjusted relative risk (95% confidence interval). [||] = Values are adjusted relative risk (95% confidence interval). [¶] = Values are final-model relative risk (95% confidence interval). [#] = P<.05. ** = Values are adjusted. [††] = Correlated with the Brief Illness Perception Questionnaire. [‡‡] = P<.001.*

4

Illness perceptions associated with patient burden with musculoskeletal pain in outpatient physical therapy practice. A cross-sectional study

Edwin de Raaij
Raymond Ostelo
François Maissan
Paul Westers
Jan Pool
Harriët Wittink

Musculoskeletal Science and Practice 45 (2020) 102072

Abstract

Introduction: Musculoskeletal pain (MSP) is a burden to patients and to society. In addition to well-known prognostic factors, illness perceptions (IPs) may be associated with pain intensity and physical functioning in MSP but their role is not fully understood.
Our research focused on these questions:

1. Do IPs differ between patients with acute, sub-acute and persistent MSP
2. Are IPs, in addition to well-known prognostic factors, associated with pain intensity and with limitations in physical functioning?

Methods: Eligible MSP patients from 29 physical therapy practices were invited to participate in a cross-sectional study. IPs were measured with the Brief IPQ-DLV. We compared IPs between patients with acute, sub-acute and persistent MSP (1-way ANOVA with Tukey post-hoc tests). Secondly, associations between IPs with pain intensity and physical functioning were assessed (multiple linear regression).

Results: With 658 participants, most IP dimensions showed small differences between acute, sub-acute or persistent pain. For pain intensity, the IP dimensions *Consequences, Identity* and *Coherence* explained an additional 13.3% of the variance. For physical functioning, the dimensions *Consequences, Treatment Control, Identity* and *Concern* explained an additional 26.5% of the variance.

Discussion/Conclusion: Most IP dimensions showed small differences between acute, sub-acute or persistent pain. In addition to some well-known prognostic variables, higher scores on some IP dimensions are associated with higher pain intensity and more limitations in physical functioning in patients with MSP. Longitudinal studies are needed to explore the longitudinal associations.

Keywords: illness perceptions, musculoskeletal pain, pain intensity, physical functioning

Introduction

Musculoskeletal pain (MSP) is recognized worldwide as a main cause of increased years lived with disability. This illustrates clearly that Musculoskeletal pain (MSP) is a burden on patients as MSP is a major cause of pain and limitations in physical functioning[29]. These limitations include problems in the mobility of patients but also limitations in the ability to work and problems in actively participating in all aspects of life[18]. In addition, MSP is also a burden to society. Direct health care costs, social compensation, retirement pensions, and other indirect costs contribute to this load[31].

Understanding the associations between various patient and disease characteristics in MSP is one important challenge in order to be able to improve the management for MSP and to reduce the burden of MSP, both to patients and society.

Patients' beliefs about their pain, is one of these patient characteristics that may be associated with the intensity of pain and limitations in physical functioning in MSP[8]. Across 15 cross-sectional studies on 9 different musculoskeletal conditions, the researchers found limited to moderate evidence for a consistent direction of the relationship of illness perceptions with pain intensity and physical function. Higher dysfunctional illness perceptions imply stronger pain intensity and more limitation in physical function.

A framework which explores patients' beliefs about their MSP is the Common Sense Model of Self-Regulation of health and illness[17]. This CSM is based on a parallel processing model, describing individual representations in response to health threats. These representations are called Illness Perceptions (IPs). Based on initial clinical research, five IP dimensions were identified **(Box 1)**.

Box 1. *Illness Perception dimensions*
1. Identity: the label or name given to the condition by patients and the symptoms that are perceived to go with it *2. Timeline Chronic: how long the patient believes the illness will last* *3. Consequences: how strong the impact is of patients' illness on e.g. pain or physical functioning* *4. Causal beliefs: patient's beliefs about what causes the illness* *5. Control beliefs: patient's beliefs about how to control or recover from the illness*

Ongoing research explored this in more depth and added the dimensions of *Timeline cyclical* (periodical changes in symptoms), *Coherence* (making sense of the illness), *Emotional Response* (impact on emotional level) and *Concern* (anxiousness about the illness) to the CSM[19,5].

In most MSP cases (i.e. low back pain), a specific cause for the pain cannot be identified and consequently MSP is frequently labelled as non-specific[14,6]. Non-specific MSP can be classified according to the duration of pain as acute (< 7 weeks), subacute (7-13 weeks) or persistent (> 13 weeks)10 (Dionne et al. 2008). It is not known whether IPs differ between acute and chronic patients with MSP.
Therefore, our first research question was:
Do illness perceptions differ between patients with acute, subacute and persistent musculoskeletal pain?

A second important topic is to identify prognostic factors for MSP outcomes and there are a few well-known prognostic factors in relation to the ongoing patient burden of MSP: pain intensity, limitations in physical functioning, multiplicity of pain-sites, pain duration and the psychological factors somatization, distress, anxiety and depression[23,14,22,1,20]. However, little is known about the additional role IPs might play in pain intensity and limitations in physical functioning, up and above the prognostic value of these well-known prognostic factors. Especially in outpatients with MSP attending physical therapy practices this is unknown. In this multicentre explorative cross-sectional study, we hypothesized that higher scores on IPs, in addition to these well-known factors, would be associated with higher pain intensity and limitations in physical functioning in MSP.
Therefore, our second research question was:
What is the additional association of illness perceptions with pain intensity or limitations in physical functioning in addition to the independent factors pain sites, pain duration, and the psychological factors somatization, distress, anxiety, and depression in patients with musculoskeletal pain, adjusted for gender and age?

Methods

Design and Setting

This multicentre cross-sectional study took place at 29 primary care physiotherapy clinics across The Netherlands. Physiotherapists at these centres collected the data as part of their Master of Physiotherapy study at University of Applied Sciences Utrecht, The Netherlands Participants were asked to complete several questionnaires prior to their first consultation.

Demographic characteristics and clinical variables collected in daily practice included age, gender, pain intensity (PI), and the completed Patient-Specific Functional Scale (PSFS) for limitations in physical functioning. The known prognostic factors of persistent pain were measured with questions about the number of pain sites, pain duration, and the Four-Dimensional Symptom Questionnaire (4DSQ). Finally, illness perceptions (participants' beliefs about their MSP) were measured using the Brief Illness Perception Questionnaire Dutch Language Version (Brief IPQ-DLV).

Study population

Over a period of three months, all consecutive patients, if eligible, were asked to participate in the study. Included were patients with MSP, aged between 18 – 75 years. Exclusion criteria were the presence of red flags, specific musculoskeletal diseases or physiotherapy treatment within six months prior to the first consultation. The study was approved by the Medical Ethical Committee of the Medical Ethical Committee of the University of Applied Sciences, Utrecht (ref. no. 430002016) and all participating patients signed an informed consent form.

Measurements Overview

In this study, pain intensity (PI) and the Patient-Specific Functional Scale (PSFS) for limitations in physical functioning were the primary outcomes. IPs were the observed exposure variables of primary interest. Based on published research, multiple pain sites, pain duration, and the psychological factors somatization, distress, anxiety, and depression were considered to be important prognostic factors for the persistence of MSP and were therefore included in this study[23,14,22,1,20] .

Pain intensity

To measure the average PI in the last 24 hours, we used the Numeric Rating Scale (NRS). This is an 11-point rating scale in which 0 is no pain and 10 the worst pain imaginable[11].

Patient-Specific Functional Scale

Physical functioning was assessed with the PSFS, which is known to be a feasible and reliable instrument[27,2].

Multiple pain sites

Participants were asked to register the number of different sites in which they experienced pain. We categorized the outcomes into 2 groups:

- 1 pain site
- ≥ 2 pain sites

Pain duration

Participants were asked how long their pain had existed prior to consultation. We categorized the outcomes into 3 groups:

- acute pain < 7 weeks
- subacute pain 7 – 13 weeks
- persistent pain > 13 weeks

Psychological measures

The Four-Dimensional Symptom Questionnaire (4DSQ) was used to assess participants' levels of risk for distress, depression, anxiety, and somatization: it is reported to show good reliability . Sum scores were calculated and cut-off points[28] applied to categorize each participant as being at low, medium or high risk .**(Box 2)**

Box 2: *cut off points 4DSQ*

	Distress	Depression	Anxiety	Somatization
Low risk	0-10	0-2	0-3	0-10
Medium risk	11-20	3-5	4-9	11-20
High risk	21-32	6-12	10-24	21-32

Illness perceptions

The Brief IPQ-DLV was used as it has acceptable psychometric properties[8,13]. This questionnaire consists of nine questions: eight questions are scored on a 0 – 10 scale; the ninth question is an open-ended question about the dimension 'Cause'.

Statistics

Descriptive statistics of demographic variables were reported as mean and standard deviation. Missing value analysis was performed and < 5% missing data was assumed to be inconsequential[24]. For sample size in stepwise regression, several rules of thumbs are reported in literature. Ranging from 50 participants + 8 - 30 per independent variable. We used a rule of thumb for a minimum sample size of 50 + >30 per independent variable based on the recommendations when expecting small associations[30]. The one-way ANOVA with Tukey post-hoc test was used to examine the differences between the three pain duration groups.

To examine the additional association of illness perceptions with pain intensity or limitation in physical functioning, a multiple linear regression was used. First, age, gender and the well-known prognostic factors were entered as 'fixed' in the model. Second, with univariate

association we detected the most promising IPs (defined as those with $p < 0.10$) and added these to the model. We checked on multicollinearity between the IPs, and the distribution of residuals. A variable was considered redundant if its VIF value (indication of multicollinearity) was above 5. Our final model will report if IPs significantly add to the explained variance of pain and physical function, after adjusting for age, gender and well-known prognostic factors.

Results

A total of 658 patients were included in this study: their demographic characteristics are reported in **Table 1**. For the IPs in the univariate association **(Table 3)** missing value analyses showed that no IPs variable exceeded over 3.8 percent assumed to be inconsequential.

Table 1: *Demographic characteristics of participating patients N =658.*

	Pain duration groups in weeks prior to consultation					
	<7 (n =226)		7–13 (n =116)		>13 (n =316)	
Age years, mean (sd)	44.5	(13.7)	48.8	(13.0)	46.9	(14.6)
Female (%)	134	(63.3)	79	(68.1)	224	(71.0)
Pain duration in weeks mean (sd)	3.2	(1.5)	9.7	(1.8)	181.0	(336.6)
Pain intensity < 24 h 0–10 mean (sd)	5.2	(2.2)	5.0	(2.2)	5.2	(2.4)
Physical functioning 0–10 mean (sd)	6.2	(2.4)	5.9	(2.2)	6.3	(2.2)
≥2 pain sites (%)	25	(11.1)	23	(19.8)	115	(36.4)
Direct access (%)	130	(57.6)	56	(48.7)	118	(37.3)

sd = standard deviation.

Differences in illness perceptions and pain duration

Illness perceptions mean scores and standard deviations are reported in **Table 2**. The total between-groups difference was statistically significant, apart from the IP dimension *Coherence*. The mean differences between acute pain and subacute pain were significant for two out of eight IP dimensions, namely *Timeline* and *Concern*. The mean differences between acute pain and persistent pain were significant for seven out of eight IP dimensions (not *Coherence*). For subacute pain and persistent pain, the differences were significant for two out of eight IP dimensions, namely *Timeline* and *Identity*. Overall, absolute point differences were small, with the largest between-groups points differences, ranging between 1 and 3, being for the IP dimensions *Timeline*, *Concern* and Emotional.

Table 2 *Comparisons of mean scores (sd) on the illness perception dimensions between three pain duration groups*

	Mean (sd) per group				Tukey post hoc test					
	1	2	3	Overall	Group 1-2		Group 2-3		Group 1-3	
	< 7 weeks	7 – 12 weeks	≥ 13 weeks	*p*	*p*	d	p	d	*p*	d
Consequences	4.4 (2.8)	4.9 (2.7)	5.6 (3.0)	< 0.005	0.43	- 0.04	0.51	- 0.08	< 0.005	- 0.12
Timeline	3.3 (2.7)	4.7 (2.9)	6.2 (3.4)	< 0.005	< 0.005	- 0.06	< 0.005	- 0.07	0.00	- 0.07
Personal Control	4.9 (2.5)	5.1 (2.5)	5.2 (2.6)	0.04	0.78	- 0.04	0.38	- 0.08	0.03	- 0.12
Treatment Control	2.5 (1.9)	2.9 (1.9)	3.2 (2.3)	< 0.005	0.13	- 0.08	0.57	- 0.04	< 0.005	- 0.12
Identity	5.3 (2.4)	5.3 (2.3)	6.1 (2.4)	< 0.005	0.98	0.01	< 0.005	- 0.11	< 0.005	- 0.11
Concern	3.1 (2.8)	4.0 (2.8)	4.8 (3.0)	< 0.005	0.01	- 0.07	0.05	- 0.05	< 0.005	- 0.13
Coherence	3.1 (2.4)	3.6 (2.5)	3.3 (2.5)	0.10	0.18	- 0.16	0.66	0.09	0.42	- 0.06
Emotional	3.8 (2.9)	4.3 (3.0)	4.9 (3.0)	< 0.005	0.31	- 0.06	0.20	- 0.07	< 0.005	- 0.13

sd = standard deviation, p = statistical significant, d = Cohen's d effect size

Table 3 *Univariate associations (r) between the illness perceptions and pain intensity or physical functioning*

IP dimension	Pain Intensity N = 648			Physical Functioning N = 630		
	N	r	p	N	r	p
Consequences	635	0.36	p < 0.005	618	0.48	p < 0.005
Timeline	624	0.18	p < 0.005	606	0.23	p < 0.005
Personal Control	633	0.06	0.131	616	0.02	0.590
Treatment Control	626	-0.04	0.319	612	- 0.16	p < 0.005
Identity	633	0.41	p < 0.005	616	0.47	p < 0.005
Concern	630	0.28	p < 0.005	613	0.26	p < 0.005
Coherence	623	0.10	0.011	606	- 0.10	(0.011)
Emotional	633	0.28	p < 0.005	614	0.32	p < 0.005

N = sample size, IP = Illness Perception, r = pearson correlation

Association of IPs with pain intensity and physical functioning

Univariate associations of IPs with pain intensity and physical functioning are reported In **Table 3**. The IP dimensions that were significantly correlated ($p \leq 0.10$) with pain and physical function were added into the multiple linear regressions. The strength of the significant IP dimensions association with pain intensity varies; Identity r = 0.41, *Consequences* r = 0.36, *Concern* and Emotional r = 0.28, *Timeline* r = 0.18, *Coherence* r = 0.10. Also, the IP dimensions association with physical function varies: *Consequences* r = 0.48, Identity r = 0.47, Emotional r = 0.32, *Concern* r = 0.26, *Timeline* r = 0.23, *Treatment Control* r =-0.16.

Multiple regression: pain intensity/physical functioning and illness perceptions.

For the independent variable pain intensity, the IP dimensions *Personal Control* and *Treatment Control* were not univariately significantly correlated and were therefore not added to the model. Also, for physical functioning, the IP dimension *Personal Control* was not added to the model. No multicollinearity was found between the IPs, and residuals were found to be distributed normally.

Table 4: *Final model multiple linear regression of illness perceptions on pain intensity and physical functioning*

Illness perception dimensions	R2	Changed* R2	effect	95% CI	SE	*p*
Pain intensity N = 607	22.9%	13.3%				
Consequences			0.098	(0.005, 0.192)	0.127	0.04
Identity			0.273	(0.167, 0.378)	0.285	< 0.005
Coherence			0.084	(0.016, 0.152)	0.092	0.02
Physical functioning N = 588	32.2%	26.5%				
Consequences			0.283	(0.194, 0.372)	0.368	< 0.005
Treatment Control			- 0.113	(-0.194,-0.033)	- 0.107	0.01
Identity			0.240	(0.139, 0.340)	0.255	< 0.005
Concern			- 0.108	(-0.185,-0.030)	- 0.143	0.01

** = changed explained variance after adding illness perceptions to the model. SE = Standard Error*
Effects adjusted for Age, Gender, ≥ 2 pain sites, pain duration, risk of: Distress, Depression, Somatization, and Anxiety
Only significant illness perceptions are reported.

Pain intensity
The multiple linear regression **(Table 4)** showed 22.9% of explained variance. The IP dimensions *Consequences* (beta = 0.098), Identity (beta = 0.273) and *Coherence* (beta = 0.084) were the statistically-significant contributors to pain intensity.

In the first step (where the confounders and prognostic factors were entered into the model), the explained variance was 9.6%. This means that an additional 13.3% of the variance was explained by adding the IPs to the model.

Physical functioning
The multiple linear regression **(Table 4)** showed 32.2% of explained variance. The IP dimensions *Consequences* (beta = 0.283), Identity (beta =-0.113), *Treatment Control* (beta = 0.240)and *Concern* (beta =-0.108) were the statistically-significant contributors to physical functioning. In the first step (where the confounders and prognostic factors were entered into the model), the explained variance was 5.7%. This means that an additional 26.5% of the variance was explained by adding the IPs to the model.

Discussion

To our knowledge, this is the first multicentre study of IPs in patients with MSP in primary care physiotherapy. Our findings enhance the understanding of IPs as possible associating factors with pain intensity and limitations in physical functioning in MSP.

Illness perceptions and pain duration
Our results show most IPs being significantly different between the pain-duration groups of acute, subacute and persistent pain. However, looking at the absolute mean differences between pain-duration groups, most IPs show no relevant difference apart from the IP *Timeline*. This invites the hypothesis that, the longer a patient experiences MSP, the higher the score on the IP *Timeline* will be. None of the other IP dimensions exceeded the smallest detectable change of 2.5[8]. Therefore, the differences according to pain duration in most IPs are not clinically relevant. This might indicate that high scoring (dysfunctional) IPs are equally important for patients with acute, sub-acute and persistent pain. This is supported by qualitative research about perceptions, such as vulnerability, and poor prognoses for back pain[7]. In this study, patients shared the same beliefs about their pain condition despite having acute or persistent pain. Though caution in the interpretation of the results is required, due to recall bias[12] and the cross-sectional design, we see possible implications for the management of MSP.

First, if dysfunctional IPs contribute to the burden of MSP, screening for these in patients with acute or sub-acute MSP might be advised and could be done by using validated questionnaires[19,5,8]. Second, considering IPs could be a supplementary procedure to the use of risk stratification tools, such as the Keele STarT MSK Tool or STarT Back Screenings Tool[16,3] for predicting poor recovery from MSP. In this way, the assessment of IPs might contribute to the identification of possible relevant psychosocial risk factors for poor recovery from MSP.

Illness perceptions and pain intensity

The IP dimensions *Consequences*, Identity and *Coherence* explained an additional 13.3% to the initially-explained variance for pain intensity. As this is a rather substantial increase, this might imply that these IPs could potentially be relevant for the management of these patients. For instance, if a patient with MSP shows dysfunctional IPs, such as 'My condition has a high impact on my daily life' or 'I don't understand where my pain comes from', these IPs could be risk factors for poor recovery and therefore should be assessed. Also, identifying dysfunctional IPs opens opportunities for treatment options in trying to change these perceptions. To our knowledge, no studies have to date researched associations of IPs with pain intensity, or the changing of dysfunctional IPs, within primary physiotherapy care[8]. Consequently, we recommend further research to explore the possibilities of identifying IPs as risk factors and to study the feasibility of changing dysfunctional IPs.

Illness perceptions and limitations in physical functioning

For physical functioning, the additional explained variance of the IP dimensions *Consequences*, *Timeline*, *Personal Control*, Identity and *Emotional Response* was 26.5%. This could mean that these IPs are potentially important for clinical practice. This is in line with the results from a RCT for persistent low back pain. A total of 10 – 14 hours of cognitive treatment of IPs by occupational therapists resulted in statistically-significant and clinically-relevant improvements in patient-relevant physical activities at 18 weeks[25]. Included were patients with persistent LBP of, on average, more than one year's duration. We know of no intervention studies targeting high IP scores within a population having less than one year's MSP. We recommend further exploration of the feasibility of changing IPs by physiotherapists for improving patients' physical functioning, not only for persistent LBP but also for acute and sub-acute LBP.

Limitations and strengths

First, the cross-sectional design prevents a causal interpretation of the findings. The main aim of this study, however, was to explore whether IPs and, if so, which IPs were associated with pain intensity and physical functioning. Secondly, despite the large and geographically wide-

ranging sample in the Netherlands, selection bias may exist since there is no information available regarding patients that did not sign an informed consent form and were therefore not included in this study. Thirdly, bias on the outcomes of pain duration cannot be excluded since these rely on the recall of the patients, which has been found to be unreliable. Patients with persistent MSP have to search further back in their memory than those with acute MSP, thereby producing less reliable data[12]. Fourthly, the well-known prognostic factors did not contribute to the model. This may be explained by the fact that we chose well-known prognostic factors from studies on chronicity of MSP. We did not find studies on prognostic factors for pain intensity in MSP so we hypothesized that prognostic factors for chronicity might also be factors that mediate in the association of IPs with pain intensity and physical functioning. Our findings suggest that most prognostic factors for chronicity of MSP do not mediate the association between IPs, pain intensity and physical functioning.

A major strength of our study is its multi-centred basis in the primary care setting throughout the Netherlands. This means that the MSP population in this research can be compared with patients attending any general physiotherapist in the Netherlands, and results can be generalized to the Dutch MSP patients visiting physiotherapists. Secondly, for prognostic studies, Hayden et al. proposed a three-phase framework: "Phase 1, identifying associations; Phase 2, testing independent associations; and Phase 3, understanding prognostic pathways"[15]. We have performed the first Phase 2 study exploring the cross-sectional independent association of IPs with pain intensity and physical functioning in primary physiotherapy care. We recommend further exploration of these pathways in a Phase 3 explanatory study, where IPs are explored longitudinally for their predictive value for pain intensity and physical functioning.

Practical implications

Dysfunctional beliefs about MSP may contribute to pain intensity and limitations in physical functioning. Higher IP scores on *Consequences*, Identity and *Coherence* were associated with higher pain intensity. Higher IP scores on *Consequences*, *Treatment Control*, Identity and *Concern* were associated with greater limitations in physical functioning. Due to the cross-sectional design of our study, a causal interpretation is not possible in patients with MSP, but this has already been shown in cohorts of patients with persistent pain from repetitive strain injury[26] and low back pain[4]. This highlights the therapeutic potential of targeting higher IP scores and trying to alter *dysfunctional* IPs to more favourable, adaptive, ones. Changing IPs is not only relevant for alleviating the burden of MSP, but also for reducing dependence on physiotherapy treatment. Higher scores on IPs are associated with more frequent use of physiotherapy[21]. Finally, our study calls for a Phase 3 explanatory study in which the IPs are explored

longitudinally for their predictive value on pain intensity and physical functioning.

Conclusion

Most IP dimensions showed small differences between acute, sub-acute or persistent pain. In addition to some well-known prognostic factors, some higher scores in IP dimensions are associated with higher pain intensity and more limitations in physical functioning in patients with MSP. Longitudinal studies are needed to indicate the direction of the association.

Acknowledgements

All authors contributed to the paper and discussed the results and commented on the manuscript. EJ de Raaij participated in the design of the study, data collection, discussion of core ideas and writing of the paper. HW Wittink participated in the design of the study, discussion of core ideas and writing of the paper. RWJG Ostelo, JF Maissan and J Pool participated in discussion of core ideas and writing of the paper. P Westers participated in designing the statistic strategies.Special acknowledgement to the physiotherapists at twenty-nine primary care physiotherapy clinics across The Netherlands, whom participated in the data collection as part of their Master Physiotherapy study at the University of Applied Sciences Utrecht. Editing and proofreading by Les Hearn (Scientific Editing & Proofreading: les_hearn@yahoo.co.uk).

References

1. Artus M et al., 2017. Generic prognostic factors for musculoskeletal pain in primary care: a systematic review. BMJ Open, 7(1), pp.e012901–10.
2. Beurskens AJ et al., 1999. A patient-specific approach for measuring functional status in low back pain. Journal of Manipulative and Physiological Therapeutics, 22(3), pp.144–148.
3. Bier JD et al., 2017. Validity and reproducibility of the modified STarT Back Tool (Dutch version) for patients with neck pain in primary care. Musculoskeletal Science and Practice, 31, pp.22–29.
4. Bishop FL et al., 2015. Psychological Covariates of Longitudinal Changes in Back-related Disability in Patients Undergoing Acupuncture. The Clinical Journal of Pain, 31(3), pp.254–264.
5. Broadbent E et al., 2006. The brief illness perception questionnaire. journal; of psycho, 60(6), pp.631–637.
6. Carlson H & Carlson N, 2011. An overview of the management of persistent musculoskeletal pain. Therapeutic advances in musculoskeletal disease, 3(2), pp.91–99.
7. Darlow B et al., 2015. Easy to Harm, Hard to Heal. Spine, pp.1–9.
8. de Raaij EJ et al., 2012. Cross-cultural adaptation and measurement properties of the Brief Illness Perception Questionnaire-Dutch Language Version. Manual Therapy, 17(4), pp.330–335.
9. de Raaij EJ et al., 2018. The Association of Illness Perception and Prognosis for Pain and Physical Function in Patients With Noncancer Musculoskeletal Pain: A Systematic Literature Review. Journal of Orthopaedic and Sports Physical Therapy, 48(10), pp.789–800.
10. Dionne CE et al., 2008. A consensus approach toward the standardization of back pain definitions for use in prevalence studies. Spine, 33(1), pp.95–103.
11. Ferreira-Valente MA, Pais-Ribeiro JL & Jensen MP, 2011. Validity of four pain intensity rating scales. Pain, 152(10), pp.2399–2404.
12. Grimes DA & Schulz KF, 2002. Bias and causal associations in observational research. The Lancet, 359(9302), pp.248–252.
13. Hallegraeff JM et al., 2013. Measurement of acute nonspecific low back pain perception in primary care physical therapy: reliability and validity of the brief illness perception questionnaire. BMC Musculoskeletal Disorders, 14(1), pp.1–1.
14. Hartvigsen J.et al., 2018. What low back pain is and why we need to pay attention. The Lancet.
15. Hayden JA et al., 2008. Identifying phases of investigation helps planning, appraising, and applying the results of explanatory prognosis studies. Journal of Clinical Epidemiology, 61(6), pp.552–560.
16. Hill JC et al., 2008. A primary care back pain screening tool: Identifying patient subgroups for initial treatment. Arthritis & Rheumatism, 59(5), pp.632–641.
17. Leventhal H, Phillips LA & Burns E, 2016. The Common-Sense Model of Self-Regulation (CSM): a dynamic framework for understanding illness self-management. Journal of behavioral medicine, pp.1–12.
18. March L et al., 2014. Burden of disability due to musculoskeletal (MSK) disorders. Best Practice & Research Clinical Rheumatology, 28(3), pp.353–366.

19. Moss-Morris R et al., 2002. The revised Illness Perception Questionnaire (IPQ-R). Psychology & Health, 17(1), pp.1–17.
20. Nahit ES et al., 2003. Effects of psychosocial and individual psychological factors on the onset of musculoskeletal pain: common and site-specific effects. Annals of the Rheumatic Diseases, 62(8), pp.755–760.
21. Opseth G et al., 2017. Negative perceptions of illness and health are associated with frequent use of physiotherapy in primary healthcare. 16(1), pp.133–138.
22. OSullivan P et al., 2016. Unraveling the Complexity of Low Back Pain. Journal of Orthopaedic and Sports Physical Therapy, 46(11), pp.932–937.
23. Pincus T et al., 2002. A Systematic Review of Psychological Factors as Predictors of Chronicity/Disability in Prospective Cohorts of Low Back Pain. Spine, pp.1–12.
24. Schafer JL, 1999. Multiple imputation: a primer. Statistical methods in medical research, 8(1), pp.3–15.
25. Siemonsma PC et al., 2013. Cognitive treatment of illness perceptions in patients with chronic low back pain: a randomized controlled trial. Physical Therapy, 93(4), pp.435–448.
26. Sluiter JK & Frings-Dresen MHW, 2007. Quality of life and illness perception in working and sick-listed chronic RSI patients. International Archives of Occupational and Environmental Health, 81(4), pp.495–501.
27. Stevens A et al., 2017. Ready for goal setting? Process evaluation of a patient-specific goal-setting method in physiotherapy. BMC Health Services Research, 17(1), pp.1–10.
28. Terluin B et al., 2016. The Four-Dimensional Symptom Questionnaire (4DSQ) in the general population: scale structure, reliability, measurement invariance and normative data: a cross-sectional survey. Health and Quality of Life Outcomes, 14(1), pp.1–16.
29. Vos T et al., 2013. Years lived with disability (YLDs) for 1160 sequelae of 289 diseases and injuries 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. The Lancet, 380(9859), pp.2163–2196.
30. Wilson Van Voorhis CR & Morgan BL, 2007. Understanding Power and Rules of Thumb for Determining Sample Sizes. Tutorials in Quantitative Methods for Psychology, 3(2), pp.43–50.
31. Woolf AD et al., 2012. The need to address the burden of musculoskeletal conditions. Elsevier 26(2), pp.183–224.

5

Limited predictive value of illness perceptions for short-term poor recovery in musculoskeletal pain. A multi-center longitudinal study

Edwin de Raaij
Harriët Wittink
François Maissan
Paul Westers
Raymond Ostelo

BMC Musculoskeletal disorders
Bmc Musculoskelet Di 22, 522 (2021)

Abstract

Background

Musculoskeletal pain (MSP) is recognized worldwide as a major cause of increased years lived with disability. In addition to known generic prognostic factors, illness perceptions (IPs) may have predictive value for poor recovery in MSP. We were interested in the added predictive value of baseline IPs, over and above the known generic prognostic factors, on clinical recovery from MSP. Also, it is hypothesized there may be overlap between IPs and domains covered by the Four-Dimensional Symptom Questionnaire (4DSQ), measuring distress, depression, anxiety and somatization. The aim of this study is twofold; 1) to assess the added predictive value of IPs for poor recovery and 2) to assess differences in predictive value for poor recovery between the Brief Illness Perception Questionnaire- Dutch Language Version (Brief IPQ-DLV) and the 4DSQ.

Methods

An eligible sample of 251 patients with musculoskeletal pain attending outpatient physical therapy were included in a multi-center longitudinal cohort study. Pain intensity, physical functioning and Global Perceived Effect were the primary outcomes. Hierarchical logistic regression models were used to assess the added value of baseline IPs for predicting poor recovery. To investigate the performance of the models, the levels of calibration (Hosmer-Lemeshov test) and discrimination (Area under the Curve (AUC)) were assessed.

Results

Baseline *Treatment Control* added little predictive value for poor recovery in pain intensity [Odds Ratio (OR) 0.80 (Confidence Interval (CI) 0.66-0.97), increase in AUC 2%] and global perceived effect [OR 0.78 (CI 0.65-0.93), increase in AUC 3%]. Baseline *Timeline* added little predictive value for poor recovery in physical functioning [OR 1.16 (CI 1.03-1.30), increase in AUC 2%]. There was a non-significant difference between AUCs in predictive value for poor recovery between the Brief IPQ-DLV and the 4DSQ.

Conclusion

Based on the findings of this explorative study, assessing baseline IPs, over and above the known generic prognostic factors, does not result in a substantial improvement in the prediction of poor recovery. Also, no recommendations can be given for preferring either the 4DSQ or the Brief IPQ-DLV to assess psychological factors

Keywords:

Illness perceptions, musculoskeletal pain, prediction, pain intensity, physical functioning

Introduction

Musculoskeletal pain (MSP) is a major cause of increased years lived with disability [37]. There are several generic factors prognostic of poor recovery from MSP [2]: widespread pain (≥2 pain sites), high functional disability, somatization, and high pain intensity. Psychological factors such as distress, depressive mood and somatization have also been identified as risk factors for the transition from acute to chronic low back pain [8,12,18,14]. These domains have been identified, but no recommendation can be made as to the best instrument for identifying these factors. In The Netherlands, the Four-Dimensional Symptom Questionnaire (4DSQ) is commonly used to assess distress, depression, anxiety and somatization [35]. In addition, illness perceptions (IPs), as the core element of the Common-Sense Model of Self-regulation of Health and Illness (CSM), have been recognized as possible risk factors for poor recovery from MSP. The Brief Illness Perceptions Questionnaire (Brief IPQ) is frequently used to assess these IPs [7]. A recent systematic review showed limited to moderate evidence for the association of some IPs with pain intensity (PI) and physical functioning (PF) in MSP [29]. Pathways by which these associations can influence MSP are not known. IPs might act as moderators or mediators or affect MSP through fear avoidance or catastrophizing. Another important finding of the review was that longitudinal research is lacking. Therefore, it is desirable to explore the added predictive value of IPs, over and above the well-known generic factors for poor recovery from MSP, in the physiotherapy setting.

The CSM model provides a framework for identifying unhelpful cognitions and emotions people may have about their MSP condition [25]. It is based on a parallel processing model, describing individual representations (i.e. IPs) in response to health threats (i.e. MSP). There are 9 IP dimensions included in the CSM: *Consequences*, *Timeline*, *Personal Control*, *Treatment Control*, *Identity*, *Concern*, *Coherence*, *Emotional Response*, and *Causal* [27,6].

To investigate the added predictive value of IPs, we used the term 'predictor' defined as: "A patient characteristic that identifies subgroups of treated patients having different outcomes" [1]. In our study, IPs were seen as predictors, the treatment was usual care physiotherapy, and the disease was non-specific MSP.

Previous research has found that IPs are predictive for and associated with psychological factors, such as depression and anxiety, in patients with fibromyalgia [21], chronic back pain [11] systemic lupus erythematosus [28] and informal carers of patients with depression [31]. Therefore, overlap may exist between the domains included in the 4DSQ and in the Brief IPQ. Because of this potential overlap, we were interested in the correlation of these questionnaires. We

were also interested in the difference between the added predictive values of the 4DSQ and the Dutch language version of the Brief IPQ (Brief IPQ-DLV) for poor recovery.
The following are our three research goals; First, to what extent do baseline illness perceptions in MSP patients have added predictive value for poor recovery in PI, PF and patient GPE after 3 months? Second, what is the correlation between the 4DSQ and the Brief IPQ-DLV? Third, what is the difference in added predictive value for poor recovery between the 4DSQ and the Brief IPQ-DLV?

Methods

Design and Setting

Twenty-eight primary care physiotherapy centres participated in this five-month-long exploratory study, approved by the Medical Ethical Committee of the University of Applied Sciences Utrecht (HU) (Ref. no. 430012019). Physiotherapists at these centres collected the data as part of their HU Master of Physiotherapy study. All participating patients were treated according to the Good Clinical Practice guidelines [36].

A consecutive sample of patients attending outpatient physiotherapy was invited at first contact by participating physiotherapists to take part. As part of an assignment in their master's program, these physiotherapists included in the study 10-30 consecutive patients over a period of 2 months (after screening for in- and exclusion criteria: **Box 1**. After baseline (T0) assessment, a follow-up assessment after three months (T1) was performed, using a questionnaire assessing the dependent and independent variables (see Measurements).

Patients who met the inclusion criteria and gave written informed consent were recruited. We defined MSP as: Pain felt within the context of the musculoskeletal conditions listed in **Box 1**, according to the European Musculoskeletal Conditions Surveillance and Information Network.

Box 1: *Inclusion criteria*
• Musculoskeletal pain Joint conditions (i.e. rheumatoid arthritis (RA), osteoarthritis (OA)), bone conditions (i.e. osteoporosis), spinal disorders (i.e. low back pain), regional and widespread pain disorders, musculoskeletal injuries, multisystem inflammatory diseases • Age 18 – 75 years • No physiotherapy treatment in the previous 6 months from baseline • Signed informed consent • No serious musculoskeletal diseases Fractures, malignancy, neurological signs

All clinical procedures used in this study were carried out in accordance with relevant guidelines and regulations of the Royal Dutch Society of Physiotherapy (KNGF).

Measurements

At baseline (T0), we collected data on demographic characteristics, the independent and depended variables listed below.

Independent variables:

Pain intensity (PI)

Average pain in the last 24 hours (11-point Numeric Rating Scale (NRS): 0 = no pain; 10 = worst pain imaginable) [13].

Physical functioning (PF)

Difficulty in performing daily activities (11-point Patient-Specific Functional Scale (PSFS): 0 = no difficulty; 10 = unable to perform activity). The PSFS is reportedly feasible and reliable [34,4].

Pain duration

Patients rated how long their pain had existed prior to consultation: 1: pain < 7 weeks; 2: pain 7-13 weeks; 3: > 13 weeks.

Number of pain sites

Based on patients' reports, the number of different pain sites were categorized as: 1: 1-2 sites; 2: > 2 sites.

Psychological measures

The Four-Dimensional Symptom Questionnaire (4DSQ) was used to assess patients' level of risk (low, medium or high) for developing Distress (16 items), Somatization (16 items), Anxiety (12 items), and Depression (6 items). The 4DSQ is suitable for clinical applications. The items are answered on a 5-point frequency scale. To calculate sum scores, responses are coded on a 3-point scale: "no" (0 points), "sometimes" (1 point), "regularly", "often", and "very often or constantly" (2 points). Then, sum scores are calculated for each dimension, and cut-off points applied to categorize each patient as at low, medium or high risk [35].

Illness perceptions

The cross-cultural adapted and validated Brief Illness Perceptions Questionnaire- Dutch language Version (IPQ-DLV) was used [17,30]: this consists of nine questions of which eight were scored on an 11-point scale and cover the IP dimensions of *Consequences*, *Timeline*, *Personal*

Control, *Treatment Control*, *Identity*, *Concern*, *Coherence*, and *Emotional Response*. The IP dimensions of Control beliefs (Personal/Treatment) and *Coherence* were converted before statistical analyses as they are scored in reverse. Higher scores on Brief IPQ-DLV were theorized to have a greater chance on poor recovery. The ninth IP question, the *Causal* dimension, has rank-ordered free-text responses and was not added as a predictor.

Dependent variables:

For Global Perceived Effect (GPE), we used a 7-point scale ranging from 'completely recovered' to 'very much worsened'. The GPE is a reliable measurement [22] with a clinically-meaningful improvement cut-off point at ≤ 2 on a 7-point scale [23].

We defined the depended variable poor recovery in three different ways [24];

- pain intensity at follow-up; score of ≥ 3 on an 11-point NRS (0-10)
- physical function (PF) at follow-up; score of ≥ 3 on an 11-point NRS (0-10)
- Global Perceived Effect; score of ≥ 3 on 7-point GPE ordinal scale

Statistics

In addition to age and gender, baseline scores were assessed for PI, PSFS, pain duration, number of pain sites, the 4DSQ, and the Brief IPQ-DLV, as percentages or means (standard deviation (SD)).

Hierarchical logistic regression models were constructed to examine the added predictive value of baseline 'poor recovery' (at 3 months). In the first block, age, gender and baseline scores for generic prognostic factors (psychological measures, PI, limitations in PF, number of pain sites and duration of pain) were entered as fixed (independent) variables. In the second block, baseline IPs with univariate significant ORs ($p < 0.10$) were added to the model. The final model was obtained by using the backward stepwise method. The goodness-of-fit of the model was described by the Nagelkerke R2 and the Receiver Operating Characteristics (ROC) curve with Area Under the Curve (AUC). Goodness-of-fit of the AUC was judged thus: 0.90 - 1.0 Excellent; 0.80- 0.89 Good; 0.70- 0.79 Fair; 0.60- 0.69 Poor; 0.50- 0.59 Fail. For calibration, we checked the goodness-of-fit using the Hosmer & Lemeshow test ($p < 0.05$). The SPSS package 25™ was used to analyze the data.

For our research question 'Is there an association between the 4DSQ and the Brief IPQ-DLV?', we used the non-parametric Spearman's rank correlation coefficient. To interpret the strength of the correlation, we used the following classification; 0.00-0.10 negligible, 0.10-0.39 weak, 0.40-0.69 moderate, 0.70-0.89 strong and 0.90-1.00 very strong [32].

For our research question *'Is there a difference in added predictive value of poor recovery between the 4DSQ and the Brief IPQ-DLV?'*, two regression models were built to examine the predictive value of baseline 'poor recovery' at 3 months.
In our first model, we entered age, gender and the baseline scores for generic prognostic factors (PI, limitations in PF, number of pain sites and duration of pain) and added the baseline score of the 4DSQ.
In our second model, we replaced the 4DSQ with the Brief-IPQ-DLV. To test the discrimination of the each model, a ROC-curve with Area Under the Curve (AUC) was applied. To compare the two AUCs, we used the empirical (non-parametric) method with NCSS 2020 software.

Results

A total of 251 (N_{max}) participants was included in this study **(Table1)**. We found missing data to be Missing Completely at Random (Little's MCAR test $p > 0.05$). Numbers of missing items are reported in **Table 2** in the 'n' column. A total of 237 participants was present at follow-up. The baseline characteristics of the fourteen participants lost to follow-up are described in **Table 1** last column.

We found poor clinical recovery in 79 out of 204 participants (39%) for PI, 109 out of 200 (54.5%) for PF, and 59 out of 199 (30%) for GPE. Distribution of the generic prognostic factors according at baseline IPs for good or poor recovery, see **Table 3**.

Univariate logistic regression of Illness Perceptions with poor clinical recovery
Table 4 shows the results of the univariate logistic regression of baseline IPs with poor clinical recovery.
For the hierarchical model, the following IP dimensions were statistically significant and were therefore selected for entering in Block 2: for the clinical outcome PI, *Timeline*, *Treatment Control*, *Identity*, *Concern*, *Coherence* and *Emotional Response*; for PF, *Consequences*, *Timeline*, *Identity*, *Concern* and *Emotional Response*; for GPE, *Consequences*, *Timeline*, *Treatment Control*, *Identity*, *Concern* and *Emotional Response*.

In Block 2 of the model, we added all the univariate significantly associated IPs **(Table 4)** with the backward stepwise method. We report only the final models.

Table 1: *Demographic characteristics, baseline generic prognostic baseline factors and baseline illness perceptions N = 251*

		Lost to follow up N= 14
Age mean (SD)	46.1 (13.8)	41.3 (13.7)
Female (%)	68.9	85.7
Body pain locations (%)		
Head	4.7	0.0
Neck, shoulder, upper spins	35.6	50.0
Elbow, pols, hand	3.8	7.1
Lower back	16.5	21.4
Hip, knee	14.8	0.0
Ankle, foot	5.5	7.2
Multiple locations	19.1	14.3
Musculoskeletal pain conditions (%) N = 192		
Joint conditions (i.e. rheumatoid arthritis	2.1	0
Osteoarthritis	18.2	25.0
Bone conditions (i.e. osteoporosis)	3.1	0
Musculoskeletal injuries (e.g. low back pain)	64.1	70.0
Regional and widespread pain disorders	12.5	0
multisystem inflammatory diseases	0	0
Pain intensity mean (SD) range 0-10	6.3 (2.8)	7.0 (2.4)
Physical functioning mean (SD) range 0-10	6.3 (2.2)	6.2 (1.5)
Pain duration (%)		
< 7 weeks	32.3	28.6
7-13 weeks	20.7	7.1
> 13 weeks	47.0	64.3
> 2 pain sites (%)	19.1	14.3
4DSQ risk of		
Somatization (%)		
Low range (0-10)	59.8	50.0
Medium range (11-20)	29.5	41.7
High range (21-32)	10.7	8.3
Distress (%)		
Low range (0-10)	61.2	72.7
Medium range (11-20)	22.7	9.1
High range (21-32)	16.1	18.2

Table 1: *Demographic characteristics, baseline generic prognostic factors and baseline illness perceptions N = 251 (Continued)*

Anxiety (%)			
Low	range (0-3)	75.4	69.2
Medium	range (4-9)	10.3	23.1
High	range (10-24)	14.3	7.7
Depression (%)			
Low	range (0-2)	81.5	61.5
Medium	range (3-5)	7.3	23.1
High	range (6-12)	11.3	15.4
Baseline illness perceptions mean (SD) range 0-10			
Consequences		5.4 (2.9)	5.1 (3.8)
Timeline		5.1 (3.2)	4.1 (3.0)
Personal Control*		4.8 (2.6)	4.4 (3.7)
Treatment Control*		7.3 (2.1)	6.1 (3.3)
Identity		5.8 (2.3)	5.9 (3.2)
Concern		4.1 (3.6)	5.1 (3.7)
Coherence*		6.8 (2.5)	6.0 (3.6)
Emotional Response		4.5 (3.1)	4.9 (3.9)

SD = standard deviation; 4DSQ: Four-Dimensional Symptom Questionnaire. reversed score*

Table 2: *Missing values analyses*

	N	Mean	SD	n	%
T0 Pain Intensity	245	6.3	2.3	6	2.4
T1 Pain Intensity	233	2.6	2.2	18	7.2
T0 Patient Specific Functioning Scale	244	6.3	2.1	7	2.8
T1 Patient Specific Functioning Scale	224	3.3	2.6	27	10.8
Global perceived Effect	224			17	10.8

N = number of respondents, SD = Standard Deviation, n = number of non-responders

Table 3 : *Distribution of generic prognostic factors at baseline according to good/poor clinical recovery*

	Pain intensity recovery		Physical Function recovery		Global Perceived Effect recovery	
	Good N = 140	Poor N = 93	Good N = 99	Poor N = 125	Good N = 54	Poor N = 180
Pain intensity mean (sd)	6.3 (2.2)	6.3 (2.2)	6.4 (2.0)	6.2 (2.5)	6.4 (2.2)	6.1 (2.4)
Physical function mean (sd)	6.0 (2.5)	6.1 (2.3)	6.6 (2.0)	6.0 (2.1)	6.4 (2.2)	6.1 (2.2)
Pain duration %						
< 7 weeks	38.7	14.6	40.8	16.9	41.8	18.3
7-13 weeks	21.0	25.0	17.7	31.0	18.3	29.6
> 13 weeks	40.3	60.4	41.5	52.1	39.9	52.1
>2 pain sites (%)	14.9	35.4	14.3	28.2	15.0	29.6
4DSQ risk of						
Somatization (%)						
Low range (0-10)	64.8	40.4	65.7	51.4	64.0	53.7
Medium range (11-20)	25.0	46.8	24.5	34.3	27.3	31.3
High range (21-32)	10.2	12.2	9.8	14.3	8.7	14.9
Distress (%)						
Low range (0-10)	62.1	53.2	63.6	54.9	62.4	58.6
Medium range (11-20)	22.6	27.7	23.1	25.4	26.2	20.0
High range (21-32)	15.3	19.1	13.3	19.7	11.4	21.4
Anxiety (%)						
Low range (0-3)	76.6	70.8	79.0	68.6	78.5	71.4
Medium range (4-9)	8.0	16.7	7.7	14.3	10.1	7.1
High range (10-24)	15.4	12.5	13.3	17.1	11.4	21.4
Depression (%)						
Low range (0-2)	82.7	81.3	84.2	80.3	85.5	77.5
Medium range (3-5)	6.7	6.3	6.2	7.0	6.6	7.0
High range (6-12)	10.6	12.5	9.6	12.7	7.9	15.5
IPs mean (SD) range 0-10						
Consequences	5.2 (2.8)	6.0 (2.9)	5.3 (2.8)	5.8 (2.9)	5.2 (2.9)	5.7 (2.6)
Timeline	4.9 (3.3)	6.2 (3.0)	4.7 (3.2)	6.3 (3.2)	4.7 (3.3)	6.4 (3.0)
Personal Control*	4.9 (2.6)	4.7 (2.2)	4.8 (2.4)	4.7 (2.6)	4.9 (2.6)	4.9 (2.5)
Treatment Control*	7.5 (1.9)	7.1 (2.4)	7.5 (1.9)	7.0 (3.0)	7.6 (1.9)	6.6 (2.1)
Identity	5.7 (2.3)	6.3 (2.3)	5.9 (2.2)	6.1 (2.3)	5.2 (2.3)	6.0 (2.3)
Concern	3.4 (3.0)	4.8 (3.0)	3.9 (2.9)	4.3 (3.1)	3.9 (3.0)	4.6 (3.0)
Coherence*	7.0 (2.5)	6.6 (2.1)	6.9 (2.6)	7.0 (1.9)	6.9 (2.6)	6.8 (2.1)
Emotional Response	4.1 (3.0)	5.6 (3.0)	4.0 (3.0)	5.2 (3.0)	4.1 (3.0)	4.9 (2.9)

*sd = standard deviation, 4DSQ: Four-Dimensional Symptom Questionnaire , * reversed score*

Table 4: *Univariate association Baseline Illness Perceptions with poor recovery N = 251*

	Pain Intensity N = 221			Physical Functioning N = 212			GPE N = 222		
T0 IP dimension	OR	CI	*P*	OR	CI	*P*	OR	CI	*P*
Consequences	1.1	1.0-1.2	**.021**	1.1	1.0-1.2	**.016**	1.2	1.1-1.3	**.004**
Timeline	1.1	1.0-1.2	**.007**	1.2	1.1-1.3	**.000**	1.2	1.1-1.4	**.000**
Personal Control	.98	.88-1.1	.686	.98	.88-1.1	.746	1.0	.89-1.1	.896
Treatment Control	.82	.71-.94	**.004**	.96	.84-1.1	.581	.76	.63-.96	**.004**
Identity	1.2	1.0-1.3	**.009**	1.2	1.0-1.3	**.015**	1.2	1.0-1.3	**.042**
Concern	1.2	1.1-1.3	**.000**	1.1	1.0-1.2	**.011**	1.2	1.1-1.3	**.003**
Coherence	.85	.76-.95	**.005**	.93	.83-1.1	.196	.93	.82-1.1	.296
Emotional	1.2	1.1-1.3	**.000**	1.2	1.1-1.3	**.002**	1.1	1.0-1.3	**.018**

IPs = Illness Perceptions, OR = Odds Ratio, GPE = Global Perceived Effect, CI = Confidence interval, p = .05, Bold = threshold p < .10

5

Table 5: *Final hierarchical logistic regression models for predicting poor recovery at 3 months and added predictive probability value (AUC) IPs for poor outcome (Nmax = 251)*

		95% CI					95% CI		Δ AUC	Block 1-Block 2	
Poor outcome	OR	Lower	Upper	*p*	R2	AUC	Lower	Upper	Total	%	*p*
Pain Intensity (N= 204)									.02	2.6	<.00
Block 1					.336	.76	.70	.83			
Block 2 IP Treatment Control	0.80	0.66	0.96	.02	.388	.78	.72	.84			
Physical Function (N = 200)									.02	2.8	<.00
Block 1					.234	.72	.65	.79			
Block 2 IP Timeline	1.16	1.03	1.30	.02	.267	.74	.67	.81			
GPE (N = 199)									.03	4.2	<.00
Block 1					.238	.71	.64	.79			
Block 2 IP Treatment Control	0.78	0.65	0.93	.01	.307	.74	.67	.82			

R2 = Nagelkerke, AUC = Area Under the Curve, CI = Confidence Interval, OR = Odds Ratio, GPE = Global Perceived Effect
Entered in block 1 for all regression models: age, gender, pain intensity, physical functioning, number of pain sites, duration of pain and the psychological measures, IP = Illness Perception

Baseline IPs

After being added to Block 2, most IP dimensions did not increase predictive values for poor outcomes on PI, PF or GPE. Two IP dimensions did add predictive value: lower scores on *Treatment Control* for PI and GPE; and a higher score on *Timeline* for PF. The discrimination of each model after adding IPs increased slightly (the AUC increased by 2-3%). The goodness-of-fit was adequate (Hosmer & Lemeshow test (PI: p = 0.57; PSFS: p = 0.68; GPE: p = .08)) **(Table 5)**.

Association baseline scores 4DSQ with the Brief IPQ-DLV

The Spearman rank correlations showed small associations between the Brief IPQ-DLV and the 4DSQ. The IP dimensions '*Personal Control*', '*Treatment Control*' and '*Coherence*' showed non-significant associations **(Table 6)**.

Table 6: *Baseline Spearman's Rank-Order correlations of the Brief IPQ-DLV with the 4DSQ*

IP dimension	Distress	Anxiety	Depression	Somatization
Consequences	.37*	.37*	.34*	.32*
Timeline	.25*	.20*	.22*	.32*
Personal Control	.01	.01	.01	-.01
Treatment Control	-.01	.02	.00	.03
Identity	.26*	.24*	.25*	.25*
Concern	.27*	.22*	.27*	.32*
Coherence	.11	.07	.12	.10
Emotional	.40*	.34*	.34*	.38*

** Correlation is significant at the ≤.01 level (2-tailed)*

Difference in predictive value of poor recovery between the Brief IPQ-DLV and the 4DSQ

Table 7 presents the predictive value of poor recovery between the Brief IPQ-DLV and the 4DSQ

Table 7: Difference in predictive value of poor recovery between the Brief IPQ-DLV and the 4DSQ (Nmax = 251)

	4DSQ 95% CI			Brief IPQ-DLV 95% CI			Δ AUC1-AUC2		
	AUC1	Lower	Upper	AUC2	Lower	Upper	Absolute	%	*p*
Pain Intensity (N= 204)	0.65	0.54	0.74	0.63	0.50	0.73	0.03	4.0	0.61
Physical Function (N = 200)	0.62	0.53	0.69	0.59	0.49	0.67	0.04	4.4	0.50
Global Perceived Effect (N = 199)	0.67	0.57	0.74	0.68	0.59	0.76	0.01	1.9	0.72

AUC = Area Under the Curve, CI = Confidence Interval

Discussion

In addition to generic prognostic factors, two of the IP dimensions, *Treatment Control* and *Timeline*, give a small added predictive value for poor recovery from MSP in pain intensity, physical functioning and Global Perceived Effect. The Brief IPQ-DLV showed weak correlation with the 4DSQ for all IP dimensions. The highest correlations (0.32 to 0.40) were for the IP dimensions *Consequences* and *Emotional Response*. There were no significant differences in the added predictive values for poor recovery between the Brief IPQ-DLV and the 4DSQ.

Added predictive value of illness perceptions

Most IPs did not add predictive value for poor recovery. The amount of explained variance in Block 1 increased when adding Block 2 **(Table 5)** but the increase was small and most of the variance remained unexplained. This is also seen in the increase of the AUC from Step 1 to 2 by just 2-3 percent. Furthermore, from our data a higher score on *Treatment Control* (hypothesized as increasing the chance of poor recovery) showed the opposite. This is not in line with other research in patients attending a general physician, an inpatient rehabilitation program, or an acupuncturist for low back pain, where reporting higher scores for IPs was predictive of greater limitations in PF with low back pain [15,16,9,5]. We researched outpatients receiving usual physiotherapy care for a wide range of MSP, which makes comparison of results difficult. Looking at the difference between good and poor clinical recovery for *Treatment Control* scores **(Table 3)** we see very small differences. This means that, although *Treatment Control* contributes to added predictive value, the clinical importance is limited. In contrast with previous research, we adjusted our findings for known generic prognostic factors and psychological factors.

The IP *Timeline* (patients' beliefs about how long their condition will last) is an additional prognostic factor of poor recovery in PF **(Table 5)**. This is in line with published research about recovery expectations, in which *Timeline* was found to be a factor in general expectations for individual recovery [20].

For interpretation of our findings on the additional predictive value of baseline IPs, the chosen generic prognostic factors must be taken into account. Using other prognostic factors may lead to different outcomes and interpretation of the predictive value of baseline IPs.

Association and difference in predictive value between 4DSQ and Brief IPQ-DLV

The weak associations of the Brief IPQ-DLV with the 4DSQ indicate that they address different constructs. Additionally, both performed equally weakly as predictors for poor recovery in all

three clinical outcomes. This indicates that the Brief IPQ-DLV (9-items) could not be replaced by the 4DSQ (50-items), and that neither makes a clinical contribution of added predictive value for poor recovery.

Limitations and strengths

First, despite the large number of participating primary care physiotherapy centers, selection bias may have occurred. Gender differences are reported for increased female risk of chronic pain and more severe pain [3]. This might be of influence on the outcome since 68.9% of our population was female. Additionally, we have no information about patients who were invited but did not participate. Further, we used the Brief IPQ-DLV and, although this is frequently used [7], it is debatable whether dimensions of beliefs about MSP can be measured with questionnaires alone [38]. Qualitative research might add extra in-depth information, but this was outside the scope of this study. Finally, the general prognostic factors were based on a systematic review among a range of musculoskeletal disorders [2]. Though this suited our population well, it is possible that we have overlooked other general relevant factors, such as sleep or central sensitization.

A strength of this study is that it is the first multicenter study done in primary care physiotherapy centers, with 28 primary care physiotherapy centers, geographically spread throughout the Netherlands. Hence, our findings are generalizable to patients in private practice in the Netherlands. Secondly, according to Hayden et al.'s criteria [19], our design is the first Phase 3 outcome prediction study focusing on the added predictive value of IPs. A systematic review of association and prognosis of IPs in MSP reported no other similar studies [29]. Thirdly, although there were missing data, the highest rate was 11%, making our dataset robust enough without the need for imputation. As this is the first paper to report on IPs and poor recovery in primary care physiotherapy, we built exploratory models based on univariate p-values **(Table 4)**. To overcome the issue of excluding possible relevant IPs we set the p-value threshold to 0.10.

Practical implications/ future directions

Overall, the additional contribution of the two IP dimensions, *Treatment Control* and *Timeline*, to predictions of poor recovery after three months of usual physiotherapy care were small, the increase in the AUC being only 2-3 percent. Based on these results, assessing baseline IPs, over and above the known generic prognostic factors, does not result in a substantial improvement in the prediction of poor recovery. In addition, the baseline outcome score of the Brief IPQ-DLV does not indicate the use of the questionnaire as a baseline predictor of poor recovery.

However, this does not rule out a value for IPs in MSP, as their possible role as mediators has yet to be researched. Other research designs, such as Single-Case Experimental Designs, have been shown to be of value when looking for relevant factors for recovery from low back pain [10,33].

In this study, treatment followed KGNF guidelines or, when not relevant, the physical therapist's usual practice. Therefore, specific interventions aimed at patients' beliefs cannot be assumed to have taken place. This could influence existing poor recovery outcomes of 39% for PI, 55% for PF and 30% for GPE. Tailoring interventions that match specific risk factors and patients' needs has recently brought forward as a preventative strategy for the transition of acute to chronic low back pain [26], so matching interventions with patients' high baseline IPs is conceivable. We recommend future research into the feasibility and effectiveness of an illness perception-based physiotherapy intervention for patients with disabling MSP.

Conclusion

Based on the findings of this explorative study, assessing baseline IPs, over and above the known generic prognostic factors, does not result in a substantial improvement in the prediction of poor recovery. Also, no recommendations can be given for preference between the 4DSQ and the Brief IPQ-DLV to assess psychological factors.

The role of IPs as possible mediators has still to be researched. We recommend future research with suitable designs that can look at changeability and possible effectiveness of high IPs on PI, PF and GPE in patients with musculoskeletal pain.

Acknowledgements
Special acknowledgement to the physiotherapists at twenty-eight primary care physiotherapy clinics across the Netherlands, who participated in the data collection as part of their Master of Physiotherapy study at the University of Applied Sciences Utrecht. Also, we thank J. Pool for his support during the initial phase of data collection.
Thanks to Les Hearn for scientific proofreading and English editing (les_hearn@yahoo.co.uk).

References

1. Adolfsson J, Steineck G. Prognostic and treatment-predictive factors-is there a difference? Nature Publishing Group; 2000 Dec;3(4):265–8.
2. Artus M, Campbell P, Mallen CD, Dunn KM, van der Windt DAW. Generic prognostic factors for musculoskeletal pain in primary care: a systematic review. BMJ Open. 2017 Jan 17;7(1):e012901–10.
3. Bartley EJ, Fillingim RB. Sex differences in pain: a brief review of clinical and experimental findings. British Journal of Anaesthesia. 2013 Jul;111(1):52–8
4. Beurskens AJ, de Vet HC, Köke AJ, Lindeman E, van der Heijden GJ, Regtop W, et al. A patient-specific approach for measuring functional status in low back pain. Journal of Manipulative and Physiological Therapeutics. 1999 Feb;22(3):144–8.
5. Bishop FL, Yardley L, Prescott P, Cooper C, Little P, Lewith GT. Psychological Covariates of Longitudinal Changes in Back-related Disability in Patients Undergoing Acupuncture. The Clinical Journal of Pain. 2015 Mar;31(3):254–64.
6. Broadbent E, Petrie KJ, Main J, Weinman J. The brief illness perception questionnaire. Journal of Psychosomatic Research. 2006 Jun;60(6):631–7.
7. Broadbent E, Wilkes C, Koschwanez H, Weinman J, Norton S, Petrie KJ. A systematic review and meta-analysis of the Brief Illness Perception Questionnaire. Psychology & Health. 2015 Jul 21;30(11):1361–85.
8. Buchbinder R, van Tulder M, Öberg B, Costa LM, Woolf A, Schoene M, et al. Low back pain: a call for action. lancet. 2018 Mar 20.
9. Campbell P, Foster NE, Thomas E, Dunn KM. Prognostic Indicators of Low Back Pain in Primary Care: Five-Year Prospective Study. The Journal of Pain. Elsevier Ltd; 2013 Aug 1;14(8):873–83.
10. Caneiro JP, Smith A, Linton SJ, Moseley GL, OSullivan P. "How does change unfold?" an evaluation of the process of change in four people with chronic low back pain and high pain-related fear managed with Cognitive Functional Therapy_ A replicated single-case experimental design study. Behav Res Ther. Elsevier; 2019 Mar 7;:1–12.
11. Chojnacka-Szawłowska G, Kloc W, Zdun-Ryżewska A, Basiński K, Majkowicz M, Leppert W, et al. Impact of Different Illness Perceptions and Emotions Associated with Chronic Back Pain on Anxiety and Depression in Patients Qualified for Surgery. Pain Manag Nurs. 2019 May 15;20(6):599–603.
12. Clark S, Horton R. Low back pain: a major global challenge. lancet. 2018 Mar 20.
13. Ferreira-Valente MA, Pais-Ribeiro JL, Jensen MP. Validity of four pain intensity rating scales. Pain. International Association for the Study of Pain; 2011 Oct 1;152(10):2399–404.
14. Foster NE, Anema JR, Cherkin D, Chou R, Cohen SP, Gross DP, et al. Prevention and treatment of low back pain: evidence, challenges, and promising directions. lancet. 2018 Mar 20.
15. Foster NE, Bishop A, Thomas E, Main C, Horne R, Weinman J, et al. Illness perceptions of low back pain patients in primary care: What are they, do they change and are they associated with outcome? Pain. 2008 May;136(1):177–87.

16. Glattacker M, Heyduck K, Meffert C. Illness beliefs and treatment beliefs as predictors of short-term and medium-term outcome in chronic back pain. Journal of Rehabilitation Medicine. 2013 Mar;45(3):268–76.
17. Hallegraeff JM, Van Der Schans CP, Krijnen WP, de Greef MH. Measurement of acute nonspecific low back pain perception in primary care physical therapy: reliability and validity of the brief illness perception questionnaire. BMC Musculoskelet Disord. BMC Musculoskeletal Disorders; 2013 Feb 1;14(1):1–1.
18. Hartvigsen J, Hancock MJ, Kongsted A, Lancet QLT, 2018. What low back pain is and why we need to pay attention. Elsevier. 2018 Jun;391(10137):2356–67.
19. Hayden JA, Côté P, Steenstra IA, Bombardier C, QUIPS-LBP Working Group. Identifying phases of investigation helps planning, appraising, and applying the results of explanatory prognosis studies. Journal of Clinical Epidemiology. Elsevier; 2008 Jun;61(6):552–60.
20. Hayden JA, Wilson MN, Riley RD, Iles R, Pincus T, Ogilvie R. Individual recovery expectations and prognosis of outcomes in non-specific low back pain: prognostic factor review. Cochrane Database Syst Rev. 2019;2019(11):CD011284.
21. Heer de EW, Vriezekolk JE, van der Feltz-Cornelis CM. Poor Illness Perceptions Are a Risk Factor for Depressive and Anxious Symptomatology in Fibromyalgia Syndrome: A Longitudinal Cohort Study. Front Psychiatry. Frontiers; 2017 Nov 1;8:6–8.
22. Kamper SJ, Ostelo RWJG, Knol DL, Maher CG, de Vet HCW, Hancock MJ. Global Perceived Effect scales provided reliable assessments of health transition in people with musculoskeletal disorders, but ratings are strongly influenced by current status. Journal of Clinical Epidemiology. Elsevier Inc; 2010 Jul 1;63(7):760–1.
23. Kamper SJ, Maher CG, Mackay G. Global rating of change scales: a review of strengths and weaknesses and considerations for design. Manual & Manipulative Thera. 3rd ed. 2009;17(3):163–70.
24. Karran EL, McAuley JH, Traeger AC, Hillier SL, Grabherr L, Russek LN, et al. Can screening instruments accurately determine poor outcome risk in adults with recent onset low back pain? A systematic review and meta-analysis. BMC Medicine. BioMed Central; 2017 Jan 19;15(1):13.
25. Leventhal H, Phillips LA, Burns E. The Common-Sense Model of Self-Regulation (CSM): a dynamic framework for understanding illness self-management. J Behav Med. Springer US; 2016 Aug 11;:1–12.
26. Linton SJ, Nicholas M, Shaw W. Why wait to address high-risk cases of acute low back pain? A comparison of stepped, stratified, and matched care. Pain. 2018 Dec;159(12):2437–41.
27. Moss-Morris R, Weinman J, Petrie KJ, Horne R, Cameron LD, Buick D. The revised Illness Perception Questionnaire (IPQ-R). Psychology & Health. 2002 Jan 23;17(1):1–17.
28. Nowicka-Sauer K, Hajduk A, Kujawska-Danecka H, Banaszkiewicz D, Smoleńska Ż, Czuszyńska Z, et al. Illness perception is significantly determined by depression and anxiety in systemic lupus erythematosus. Lupus. 2017 Dec 12;27(3):454–60.
29. Raaij de EJ, Ostelo RW, Maissan F, Mollema J, Wittink H. The Association of Illness Perception and Prognosis for Pain and Physical Function in Patients With Noncancer Musculoskeletal Pain: A Systematic Literature Review. J Orthop Sports Phys Ther. 2018 Oct;48(10):789–800.
30. Raaij de EJ, Schröder C, Maissan FJ, Pool JJ, Wittink H. Cross-cultural adaptation and measurement properties

of the Brief Illness Perception Questionnaire-Dutch Language Version. manual therapy. 2012 Aug;17(4):330–5.

31. Scerri J. Illness perceptions, depression and anxiety in informal carers of persons with depression: a cross-sectional survey. Qual Life Res. Springer International Publishing; 2019 Jan 30;28(2):451–60.
32. Schober P, Boer C, Schwarte LA. Correlation Coefficients: Appropriate Use and Interpretation. Anesth Analg. 2018 May;126(5):1763–8.
33. Simons EL, Vlaeyen JWS, Declercq L, M Smith A, Beebe J, Hogan M, et al. Avoid or engage? Outcomes of graded exposure in youth with chronic pain using a sequential replicated single-case randomized design. Pain. 2019 Oct;:1–12.
34. Stevens A, Köke A, Weijden T, Beurskens A. Ready for goal setting? Process evaluation of a patient-specific goal-setting method in physiotherapy. BMC Health Serv Res. BMC Health Services Research; 2017 Aug 30;17(1):1–10.
35. Terluin B, Smits N, Brouwers EPM, de Vet HCW. The Four-Dimensional Symptom Questionnaire (4DSQ) in the general population: scale structure, reliability, measurement invariance and normative data: a cross-sectional survey. Health Qual Life Outcomes. Second. Health and Quality of Life Outcomes; 2016 Sep 13;14(1):1–16.
36. Vijayananthan A, Nawawi O. The importance of Good Clinical Practice guidelines and its role in clinical trials. Biomed Imaging Interv J. 2008;4(1):1–4.
37. Vos T, Flaxman AD, Naghavi M, Lozano R, Michaud C. Years lived with disability (YLDs) for 1160 sequelae of 289 diseases and injuries 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. lancet. 2013;380(9859):2163–96.
38. Wilgen van P, Beetsma A, Neels H, Roussel N, Nijs J. Physical therapists should integrate illness perceptions in their assessment in patients with chronic musculoskeletal pain; a qualitative analysis. manual therapy. Elsevier; 2014 Jun;19(3):229–34.

6

Illness perceptions and activity limitations in osteoarthritis of the knee. A case report intervention study

Edwin de Raaij
Jan Pool
François Maissan
Harriët Wittink

Manual Therapy 19 (2014) 169-172

Abstract

Introduction: This case report describes the process and outcome of an intervention where illness perceptions (IPs) were targeted in order to reduce limitations in daily activities.

Case description: The patient was a 45-year-old woman diagnosed with post-traumatic secondary osteoarthritis of the lateral patella-femoral cartilage of the right knee.
At baseline, the patient reported dysfunctional IPs on the Brief Illness Perception Questionnaire Dutch Language Version and limitations in walking stairs, cycling and walking. Fewer limitations in daily activities are hypothesized by changing dysfunctional IPs into more favourable IPs.

Intervention: In this case report, discussing dysfunctional IPs with the patient was the main intervention. A participatory decision making model was used as a design by which the dysfunctional IP were discussed.

Results: Six out of eight dysfunctional IPs changed favourably and there was a clinically relevant decrease in limitations of daily activities. The Global Perceived Effect was rated as much improved.

Keywords: illness perception, osteoarthritis, case report

Introduction

Osteoarthritis (OA) is the most common joint disease in The NetherlandsActivities in daily life (ADL)[22] are negatively affected by OA. Limitations in ADL as a consequence of osteoarthritis cannot be explained by biomedical or sociodemographic factors alone. Ever since the introduction of Engel's Biopsychosocial Model[9] emotions, thoughts, beliefs and behaviours are more and more accepted as important factors of health[1]. The suggestion has been made that interventions on these factors should be part of physical therapy treatment[8].

In the literature Illness Perceptions (IPs) are seen as an important psychological factor. Perceptions about increased *Consequences*, chronic *Timeline* and negative emotions are predictive for more limitations in ADL after 6 years in patients with OA[11,5]. IPs belong to the core concepts in the Common-Sense Model of Self-Regulation (CSM)[17]. In this model, a health threat is theorized to generate both cognitive representations (danger control) and emotional states of fear and distress (fear control). Five dimensions of illness perceptions have been identified;

1. **Identity** : the label or name given to the illness by patients and the symptoms that are perceived to go with it
2. **Timeline** : how long the patient believes the illness or symptoms will last
3. **Consequences** : how strong the impact of the patient's illness is on, for example, pain or physical function
4. **Causal** : the patient's beliefs about what causes the illness
5. **Control** : the patient's beliefs about how to control or recover from the illness

IPs can be seen as dysfunctional if they lead to limitations in ADL. An example is when a patient thinks that physical activity is harmful, but findings from physical assessment do not underscore such belief.

Changing patients' dysfunctional IPs can be seen as a patient centred approach in which communication is the most important pathway [2]. This means that communication plays an important role in changing IPs. In this case report, discussing dysfunctional IPs with the patient was the main intervention. A participatory decsion making (PDM) model by Epstein [10] was used as a design by which the dysfunctional IPs were discussed.

PDM is associated with better outcomes in patients with a chronic illness such as diabetes[23,13,12].

This case report describes the process and outcome of an intervention study. Dysfunctional IPs were targeted and it was hypothesized that changing dysfunctional IPs would reduce limitations in ADL.

Case description

Patient history

The patient was a 45-year-old female with post-traumatic secondary osteoarthritis of the lateral patella-femoral cartilage of the right knee based on magnetic resonance imaging (MRI). The treatment by the orthopaedic surgeon consisted of non-steroid anti-inflammatory drugs and advice to stay active. After one year,because of on-going pain and activity limitations the patient consulted a physiotherapist.

Examination

At baseline the patient's (weight 86.5 kg, height 176 cm, no comorbidity), signs and symptoms were recorded **(Table 1, Figure 1)**[21].

Tests and measures.

At baseline IPs, activity limitations, knee pain, knee flexion and extension strength, passive flexion and extension mobility and the use of medication were recorded. Also the algo-functional indices for hip and knee osteoarthritis were administered and recorded as part of the Dutch Osteoarthritis knee-hip Guideline [16,22].

The IPs were assessed using the Brief Illness Perception Questionnaire Dutch Language Version (Brief IPQ-DLV)[19]. The Brief IPQ-DLV covers all IP dimensions and has nine items. Eight of these items are rated using a 0-10 Numeric Rating Scale (NRS) of which five items assess cognitive illness perceptions: *Consequences* (Item 1), *Timeline* (Item 2), *Personal Control* (Item 3), *Treatment Control* (Item 4), and *Identity* (Item 5). Two of the items assess emotional perceptions: *Concern* (Item 6) and emotions (Item 8) and one item assesses illness *Coherence* (Item 7). The ninth item assesses *Causal* perception, which asks the patient to list the three most important *Causal* factors in their illness and is rated as an open-ended response (Item 9). The Brief IPQ-DLV has a Smallest Detectable Change (SDC) of 3 points for items 1-8 for individual evaluation purpose. Reliability has a Kappa of K =0.57-0.75 [19]. Responses to the *Causal* item (item 9) can be grouped into 4 categories:

1. psychological attribution
2. risk factors
3. immunity
4. accident or chance

Activity limitations were assessed by using the Patient Specific Functional Scale (PSFS)[4]. The SDC of the PSFS is 2.5 points. The PSFS is known to be reliable[3]. Present knee pain was

assessed using an NRS. The NRS varies from zero indicating no pain to 10 the worst pain imaginable Reliability, validity and responsiveness have been shown[14]. The SDC is 2 points[18].

Knee extension strength was measured using the MicorFET2 (MF2 Hoggan Health Industries) hand-held dynamometer. The SDC for knee extension strength is 21.5 N [20]. The passive flexion/extension range of motion of the knee was measured using the Microfet5 digital goniometric measurement instrument[7].

Measurements were taken before every treatment session. In addition, in the last session the patient was asked to rate the Global Perceived Effect (GPE) by rating the change between baseline and the last session, on a 6 point Likert scale.

At baseline, the patient presented with significant pain and limitations in ADL on the PFSF. A decrease was shown in muscle strength of the right quadriceps and hamstrings, with no decrease in range of motion of her knee. The Brief IPQ DLV questions 1, 2, 4, 5, 6, 7, 8 showed a high score and question 3 a low score **(Table 1)**.

The scores on the Brief IPQ DLV may well be indicative for dysfunctional IPs. Patient's IPs of her OA on *Consequences*, *Timeline*, *Identity*, *Concern* and emotional *Consequences* could be associated with baseline outcome on the PFSF. It was hypothesized that changing her dysfunctional IPs would result in fewer limitations as measured by the PFSF. The patient was monitored six times from baseline within a 3-month period. Changes on measurements smaller than the SDC will reject the hypothesis.

Intervention

Physical therapy treatment was in accordance with the Dutch knee-hip Osteoarthritis guideline. Informing, advising and instructing the patient to keep engaged in normal ADL are considered to be major treatment modalities[22]. The intervention consisted of targeting dysfunctional IPs. The IPs were discussed in relation to limitations in ADL in each treatment session using the steps of the PDM-model **(Box 1)**. For example, if the patient pointed out (step 1 & 2) to be highly *Concern*ed about the progress of her OA over time ('I think my knee will have to be replaced within a few years'), the physiotherapist communicated evidence about the actual progression of OA[22] (step 3). Information about the slow progression of OA over time, and the fact that symptoms may well be minor during this process was given (step 4). After providing this information, checking for understanding and agreement was part of each treatment session (step 5). Co-interventions, like regular active and passive exercise therapy were given[22]. No other medical interventions, besides medication, took place.

Table 1: *Baseline- and follow up measurements from T1 - T7.*

Signs & symptoms	Outcome						
	T1	T2	T3	T4	T5	T6	T7
Knee pain (present)	6	3	6	6	3	2	1
MicroFet 2 in Newton:							
m. Quadriceps left	258	260	262	288	283	354	361
m. Quadriceps right	142	140	145	289	305	352	339
m. Hamstrings left	210	221	223	268	239	222	274
m. Hamstrings right	181	199	237	283	259	283	252
Passive mobility Δ:							
Flexion	No	a	a	No	a	a	No
Extension	No	a	a	No	a	a	No
Activity limitations:							
Walking stairs	7	8	7	4	2	2	1
Cycling	9	5	7	0	0	0	1
Walking	10	5	6	3	3	1	2
Illness Perception dimension:							
1 Consequences	8	8	7	4	3	3	1
2 Timeline	8	7	8	6	7	2	1
3 Personal Control	2	3	7	4	8	8	10
4 Treatment Control	9	8	8	9	9	9	10
5 Identity	10	8	7	4	3	2	1
6 Concern	10	7	9	6	7	2	1
7 Coherence	8	8	9	5	5	9	10
8 Emotional Response	9	8	7	4	6	3	1
9 Causal[b]	2&4	2&4	2&4	2	1	2	2
Algofunctional Index	9	8	9	8	4	3	3
Medication use (in % of T0)	100	100	75	50	50	0	0
Work status (%)	100	100	100	100	100	100	100
Global Perceived Effect							2

T1 = Baseline.
a: Measurement did not take place.
b: 1 = psychological attribution, 2 = risk factors, 3 = immunity, 4 = accident or chance

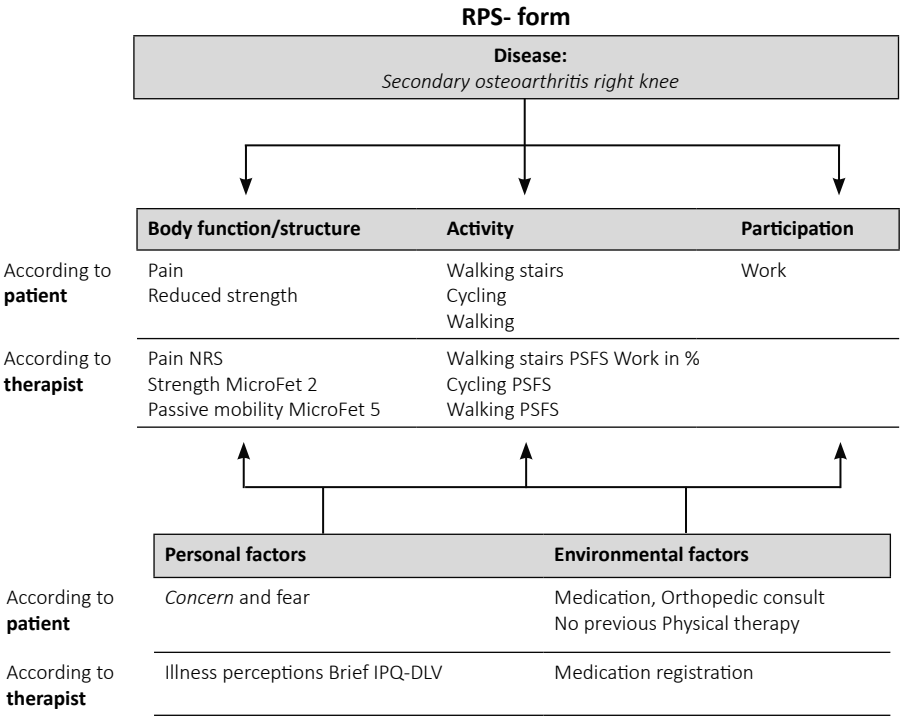


Figure 1: *Rehabilitation problem solving form adapted from Steiner et al* [21]

Box 1: *Steps for shared decision making adapted from Epstein et al*[10].
Steps for shared decision making
1. Understand the patient's experience and expectations (including illness perceptions EdR)
2. Build Partnerships
3. Provide Evidence, Including Uncertainties
4. Present Recommendations
5. Check for Understanding and Agreement

Results

The patient attended seven treatment sessions (T1-T7) within three months and the outcomes are presented in **Table 1**. Six out of eight IPs items changed beyond the SDC of 3 points between T1 and T7. The *Treatment Control* and *Coherence* dimension showed a difference of 1 and 2 points, respectively **(Figure 2)**.

At baseline, the patient's attribution to the cause of her illness was her medical condition (OA) and her previous injury (IP *Causal* dimension). At T7, she changed *Causal* perception to her own behaviour as attribution factor.

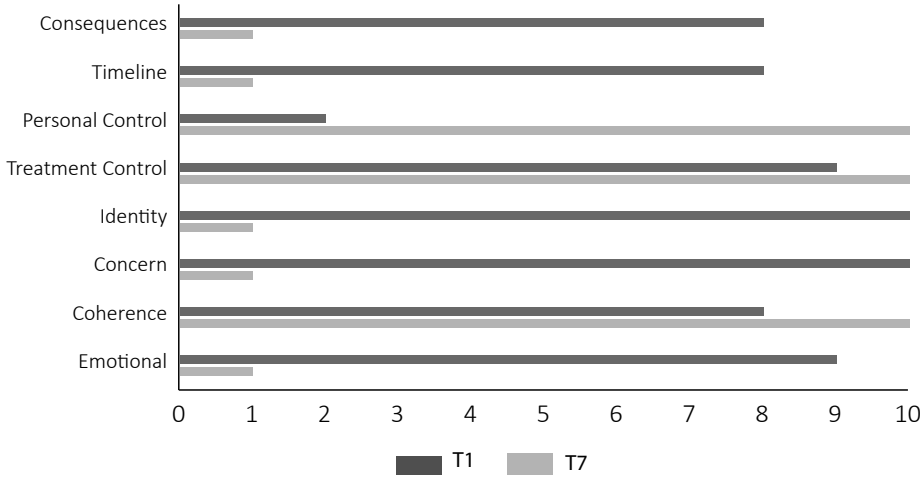


Figure 2: *Outcome on the IPQ-DLV per dimension T1 & T7*

All activity limitations scored with the PSFS changed beyond the SDC, showing clinical relevant decreases in limitations in walking stairs, cycling and walking. Knee pain decreased significantly. For all outcomes see **Table 2**. The GPE was 2, meaning the patient felt much improved.

Discussion

In this case report, changes in IPs in a patient with secondary osteoarthritis of the right knee are reported. They changed in favourable directions. The question that should be asked is: due to which intervention?

The dysfunctional IPs were the starting point for the patient's need for information. For instance, *Concern* scored high at baseline, accompanied by *Causal* attributions of injury and aging. Discussing these issues made it clear that she worried about more degeneration of her knee and that she thought exercise might damage the knee further. The patient also had a high score on Emotional *Consequences* at baseline, indicating a high level of distress Concerning her knee condition. The IPs of the patient gave direction to the communication and education about her OA. This approach may have led to a shift in IPs as shown in **Table 1**. Conversely, it can also be argued that the applied co-interventions may have led to better physical function, thereby leading to a shift in IPs.

In a case report, no *Causal* attributions can be drawn. It is unclear whether the changes in IPs are responsible for the changes in outcome on pain intensity, ADL and knee impairments, or whether changes in these outcomes positively influenced IPs. What favours the idea that a change in IPs might be the driving factor for improved outcomes is the fact that the patientexperienced progressive pain and disability in the year prior to physical therapy, despite the advice of an orthopaedic surgeon to stay active. During physical therapy treatment in which her dysfunctional IPs were explicitly targeted, positive changes in health status were reported.

The body of knowledge in both OA related and non OA related literature suggests an association between IPs and activity limitations[11,6,5]. The study by Bijsterbosch et al[5]. shows a relation between increased dysfunctional IPs and progression in disability. They draw an important conclusion: "interventions aimed at changing illness perceptions can contribute to better functional outcome". Findings in this case report are in line with their conclusion.

The physiotherapist in our case report can be classified as an expert based on the criteria mentioned by Jensen[14]. Knowledge and skills in areas of patient-centeredness, clinical reasoning, clinical assessment and commitment to patient preferences values are conditional. Physiotherapists should be taught the process of participatory decision making and to address IPs as an important attribute of patients' health status.

Outcome scores in **Figure 2** suggest little change in time for IPs dimensions *Treatment Control* and *Coherence*. However, when assessing an IPs question about *Coherence*, one should take notice of the fact that a patient may well report a high score on item 7, but this may not mean that the illness is well understood. A patient might be convinced of having a correct understanding of the illness, but from a medical point of view, such understanding may well be incorrect. In our case report, the patient believed prior to treatment that her activity limitations were due to the medical condition (OA) of her knee and aging. After treatment the patient realized these were dysfunctional perceptions and that her current level of activities was not affected by her medical condition. In addition, the patient's beliefs about *Treatment Control* had changed from an external locus of control (therapist will help) to an internal locus of control (I can help my self). PTs should also try to find out the rationale behind the IPs.

The change in IPs outcome during three months of physical therapy can well be seen as a change from dysfunctional IPs to adaptive IPs. Assessing IPs in order to change the way people experience their disease may help PT's to cope with possibly less limitations in physical functioning.

Further research in large samples of patients is needed to explore the associations between IPs and limitations in physical functioning.

References

1. Alonso Y. The biopsychosocial model in medical research: the evolution of the health concept over the last two decades. Patient Education and Counseling 2004;53(2):239-44.
2. Bensing J, Verhaak PFM, Dumen AM, Visser AP. Communication: the royal pathway to patient-centered medicine. Patient Education and Counseling 2000;39(1):1-3.
3. Beurskens AJ, de Vet HC, Köke AJ. Responsiveness of functional status in low back pain: a comparison of different instruments. Pain 1996;65(1):71-6.
4. Beurskens AJ, de Vet HC, Köke AJ, Lindeman E, van der Heijden GJ, Regtop W, et al. A patient-specific approach for measuring functional status in low back pain. Journal of Manipulative and Physiological Therapeutics 1999;22(3):144-8.
5. Bijsterbosch J, Scharloo M, Visser AW, Watt I, Meulenbelt I, Huizinga TWJ, et al. Illness perceptions in patients with osteoarthritis: change over time and association with disability. Arthritis & Rheumatism 2009;61(8):1054-61.
6. Botha-Scheepers S, Riyazi N, Kroon HM, Scharloo M, Houwing-Duistermaat JJ, Slagboom E, et al. Activity limitations in the lower extremities in patients with osteoarthritis: the modifying effects of illness perceptions and mental health. Osteoarthritis and Cartilage 2006;14(11):1104-10.
7. Cleffken B, van Breukelen G, Brink P, van Mameren H, Damink SO. Digital goniometric measurement of knee joint motion. Evaluation of usefulness for research settings and clinical practice. The Knee 2007;14(5):385-9.
8. Dziedzic KS, Hill JC, Porcheret M, Croft PR. New models for primary care are needed for osteoarthritis. Physical Therapy 2009;89(12):1371-8.
9. Engel GL. Engel the need for a new medical model a challenge for biomedicine. Science 1977;196:129-36.
10. Epstein RM, Alper BS, Quill TE. Communicating evidence for participatory decision making. JAMA: The Journal of the American Medical Association 2004;291(19): 2359-66.
11. Hagger M, Orbell S. A meta-analytic review of the common-sense model of illness representations. Psychology & Health 2003;18(2):141-84.
12. Heisler M, Bouknight RR, Hayward RA, Smith DM, Kerr EA. The relative importance of physician communication, participatory decision making, and patient understanding in diabetes self-management. Journal of Gene al Internal Medicine 2002;17(4):243-52.
13. Hurtado MP, Swift EK, Corrigan JM. Envisioning the national health care quality report. B. O. H. C. S. committee on the national quality report on health care delivery. 2001st ed. The National Academies Press; 2001.
14. Jensen GM. Expert practice in physical therapy; 2000. p. 1-16.
15. Jensen MP, Karoly P, Braver S. The measurement of clinical pain intensity: a comparison of six methods. Pain 2002;1986(27):117-26.
16. Lequesne MG, Samson M. Indices of severity in osteoarthritis for weight bearing joints. The Journal of Rheumatology 1991;1991:16-8.

17. Leventhal H, Meyer D, Nerenz D. The common sense representation of illness danger. In: Rachman S, editor. Contributions to medical psychology, vol. II. New York: Pergamon Press; 1980. p. 7-30.
18. Ostelo RWJG, Deyo RA, Stratford P, Waddell G, Croft P, Korff, Von M, et al. Interpreting change scores for pain and functional status in low back pain: towards international consensus regarding minimal important change. Spine 2008;33: 90-4.
19. de Raaij EJ, Schröder C, Maissan JF, Pool JJ, Wittink H. Cross-cultural adaptation and validation of IPQ-B DLV. Manual Therapy 2012;17(4):330-5.
20. Roebroeck ME, Harlaar J, Lankhorst GJ. Reliability assessment of isometric knee extension measurements with a computer-assisted hand-held dynamometer. Archives of Physical Medicine and Rehabilitation 1998;79(4): 442-8.
21. Steiner WA, Ryser L, Huber E, Uebelhart D, Aeschlimann A, Stucki G. Use of the ICF model as a clinical problem-solving tool in physical therapy and rehabilitation medicine. Physical Therapy 2002;82(11):1098-107.
22. Vogels E, Hendriks H, Baar VM, Dekker J, Hopman-Rock M, Ooostendorp R. KNGFguidelines for physical therapy in patients with osteoarthritis of the hip or knee. The Netherlands: Amersfoort; 2005.
23. Williams GC, Freedman ZR, Deci EL. Supporting autonomy to motivate patients with diabetes for glucose control. Diabetes Care 1998;21(10):1644-51.

7

Illness Perceptions; exploring mediators and/or moderators in disabling persistent low back pain. multiple baseline single-case experimental design

Edwin de Raaij
Harriët Wittink
François Maissan
Jos Twisk
Raymond Ostelo

BMC Musculoskeletal disorders.
Under review

Abstract

Introduction: Illness Perceptions (IPs) may play a role in the management of persistent low back pain. The mediation and/or moderation effect of IPs on primary outcomes in physiotherapy treatment is unknown.

Methods: A multiple single-case experimental design, using a matched care physiotherapy intervention, with three phases (phases A-B-A') was used including a three month follow up (phase A'). Primary outcomes: pain intensity, physical functioning and pain interference in daily life. Analyzes: linear mixed models, adjusted for fear of movement, catastrophizing, avoidance, sombreness and sleep.

Results: Nine patients were included by six different primary care physiotherapists. Repeated measures on 196 data points showed that IPs *Consequences, Personal control, Identity, Concern* and *Emotional* response had a mediation effect on all three primary outcomes. The IP *Personal contro*l acted as a moderator for all primary outcomes, with clinically relevant improvements at three month follow up.

Conclusion: Our study seems to suggest that some IPs have a mediating or a moderating effect on the outcome of a matched care physiotherapy treatment. At baseline, assessing *Personal control* could be a relevant moderator for the outcome prognosis of successful physiotherapy management of persistent low back pain in our study.

Keywords: Low back pain; Illness Perceptions; Mediation; Moderation; SCED-study; Physiotherapy

Introduction

For decades now, low back pain (LBP) has been recognized as the main cause of years lived with disabilities[40]. Managing the global impact of LBP on patients, the increase of economic costs and the impact on society are challenging issues and therefore The Lancet Series on Low Back Pain 2018 included a call for action[2,6,14,17]. Management of persistent LBP has been proposed to shift from a unidimensional (focused on a patho-anatomical disorder) to a more holistic approach, making the transition from the biomedical model to a more biopsychosocial model[4,31,32]. Following this proposal, a physiotherapy treatment of LBP that incorporates biopsychosocial factors that play an important role in the patients' LBP has the potential to increase the positive effect of physiotherapy. Examples of such treatment strategies are described in a Cochrane review on behavioral therapy for LBP; operant, cognitive-. and respondent strategies[19].

Most of the extensive body of knowledge on the management of LBP derives from systematic reviews and randomized controlled trials (RCTs). These designs represent the highest level of evidence in evidence based medicine. In addition, the randomized n-of-1 trials are also recognized as level 1 evidence in the Oxford Center for Evidence-Based Medicine 2011 levels of evidence[28,34]. The use of evidence from systematic reviews and RCTs is a form of "reference class forecasting" and can be challenging for clinicians when making clinical relevant decisions for individual patients[22]. Does this patient fit within the "reference class" that has been reported to progress well with the intervention?
Recently, the call for a more personalized approach for LBP was made[25]. Such an approach could be a matched-care intervention, in which patients' individual prognostic factors for recovery are assessed, and a response guided treatment package can be designed. A response guided treatment means that the treatment is matched to the 'risk-profile' of the patient. Known factors in such risk-profiles are psychological factors like fear of movement[39], catastrophizing[33], avoidance[38], somberness[23] and sleep[36]. It is hypothesized that such matched-care intervention may result in better treatment outcomes[29]. In this study we investigate the impact of taking into account another psychological factor in the risk-profile, namely Illness Perceptions' (IPs), which is the core element of Leventhal's Common Sense Model of health and Illness Representations (CSM)[24 8].

The CSM is a parallel processing model that describes both cognitive and emotional representations of perceived health threats, leading to patients' IPs resulting from these health threats. Higher IPs scores reflect a more threatening perception of illness and can be called 'dysfunctional IPs'. These dysfunctional IPs may mediate or moderate persistent pain and

disability[9] and personalizing management of LBP might involve addressing these IPs. Dysfunctional IPs have shown to attribute to higher pain intensity and lower physical functioning and quality of life in a variety of conditions[15]. It is not known how this attribution unfolds during a matched-care physiotherapy treatment, whether, for instance, IPs act as a mediator or moderator for LBP outcomes. A mediator indicates a part of the causal pathway. The intervention effect on the outcome goes through the mediator. A moderator on the other hand indicates that the intervention effect is different for different subgroups of the moderator[23]. This has not yet been researched in primary care physiotherapy, which is important in our health care system.

It is hypothesized IPs can mediate and/or moderate the association between intervention and outcome. To research the possible mediation and/or moderation effect of IPs on pain and disability, a multiple baseline Single Case Experimental Design (SCED) can be used to screen and measure patients' individual prognostic factors for recovery before, during and after an intervention. In this study we use matched-care physiotherapy as the intervention for patients with persistent LBP and dysfunctional levels of IPs. In order to analyze the results from our experiment in this study, we pose the following three research questions:

1. *Do pain intensity, physical function and pain interference change significantly during and after matched-care physiotherapy treatment?*
2. *Do Illness Perceptions mediate the effect of matched-care physiotherapy on pain intensity, physical function and pain interference?*
3. *Do baseline Illness Perceptions moderate the effect of matched-care physiotherapy on pain intensity, physical function and pain interference?*

Methods

This study is designed according to The Single-Case Reporting Guideline In Behavioural Interventions (SCRIBE) checklist[38] and six primary care physiotherapy practices in The Netherlands participated. After a recruitment call on social media and within the professional network of the lead author (EdR), a group of physiotherapists signed up for a two day course, six hours/day. Within the course, the aim of the study, the design and lay-out of the matched-care intervention (treatment package see paragraph 2.3) were addressed. After this course, six eligible physiotherapists, each from different primary care physiotherapy practice, were included in the study after signing an informed consent. They had access to videos that summarized the discussed topics. The lead author was available at any time during the research period for support on the implementation of the project.

Design

A multiple baseline SCED was applied. Participants completed repeated measurements during pre-treatment (phase A), during the treatment period (phase B) and a post-treatment period (phase A'). During all three phases of the study, the patients were asked to complete an online questionnaire (Appendix C), twice a week in phase A and weekly in phases B and A'. Phase A acts as a control phase (no treatment given) for comparison with phases B and A'. The duration of phase A was three weeks with five to six measures. During phase B the patients received a matched-care treatment package (paragraph 2.3) by their physiotehrapist. The number of sessions was left to the discretion of the physiotehrapist, and therefore the duration of this phase varies accross patients. The content of the matched-care was response guided, meaning the intervention was based on the outcomes of the online questionnaires, which were administered by the patient the day before each consecutive intervention. The post-intervention period phase A' took 12 weeks, independent of the duration of phase B. The study followed the guidelines of the declaration of Helsinki and the code of conduct for scientific research of our institute and was approved by the Medical Ethical Committee of the University of Applied Sciences, Utrecht (ref. no. 950002019).

Patients

Eligible patients for this study were enrolled from six different primary care physiotherapy practices in The Netherlands within a period of three months. The invitation and treatment were performed by the same physiotherapist. Resulting from the design of the SCED, patients had to be willing to undertake phase A, which meant a three week wait while completing a total of five to six outcome measures before the first treatment in the clinic. We foresaw that this 'waiting' for a first treatment might be unattractive to patients and therefore of influence on the number of patients wanting to participate. This concern was addressed in a patient information letter by explaining the purpose of phase A; to determine a detailed baseline assessment which is important to design the match-care intervention. Inclusion criteria were age 18 years or older, LBP for at least 3-months, experiencing a movement problem in daily life due to LBP and having dysfunctional levels of at least one out of eight IP dimensions. Dysfunctional levels of IPs were based on a secondary analysis of an earlier study on the associations of IPs with patient burden with musculoskeletal pain[10] (Appendix A). We chose the fourth quartile as threshold (**box 1**), expecting these high-level scores to represent dysfunctional IPs. When an eligible patient was identified at the clinic, a patient information letter was presented in which the study design was outlined. From there on, patients were free to choose whether to participate in the study, without any risk of being withheld from physiotherapy care.

Box 1					
	IP-dimension	Threshold		IP-dimension	Threshold
IP1	Consequences	8	IP5	Identity	8
IP2	Timeline	8	IP6	Concern	8
IP3	Personal Control	7	IP7	Coherence	5
IP4	Treatment Control	4	IP8	Emotional Response	8

Exclusion criteria were specific LBP and existing (and diagnosed) psychiatric illness. When matching the inclusion criteria, patients were invited to participate by their physiotherapist after reading the patient information letter. Their decision on participating in the study did not have consequences for their treatment. After signing the informed consent, patients were included in the study.

Matched-care treatment package

We used the Dutch guideline for LBP, and added a treatment package which was based on three frequently applied strategies for persistent LBP[19] (Appendix B). The specific aim of this response guided treatment package was to alter the dysfunctional levels of IPs by using cognitive, exposure and/or respondent strategies[19]. For instance, a cognitive strategy showed successful improvements in patient- relevant physical activities in patients with more than one year LBP[35]. Participating physiotherapists were asked to record the number of times each treatment strategy was applied during treatment phase B.

The treatment package offered the patient and physiotherapist the possibility to create a matched-care intervention as advised in the Dutch Guideline for Low Back Pain. This means that patients' 'risk-profile' scores were assessed before each intervention and consequently these scores were used to design the response guided treatment, thereby providing matched-care (see paragraph 2.4).

Measures

An online questionnaire was developed for assessing primary outcomes (pain intensity, physical function, and pain interference), secondary outcome (Illness Perceptions) and the co-variates (fear for damage/pain, pain anxiety, depressive mood, avoidance beliefs and sleep). Frequent administration allowed for monitoring the effect of the treatment package on all outcomes. These items are described below.

Primary outcome

Three outcome measures were chosen as primary outcome based on consensus recommendations from the literature; 1) pain intensity in the last 24-hours[1]. 2) limitation in patients' own selected physical function and 3) pain interference in daily activities[12].

All three primary outcome were assessed with an 11-point numeric rating scale (0-10). High scores for these three primary outcome measures mean respectively 1) higher levels of pain intensity, 2) stronger limitations in physical function and 3) greater interference of pain in daily activities. The physical function measure was adjusted to patients' specific limitation in physical function (i.e. bending forward).

Illness Perceptions secondary outcome

The Brief Illness Perception Questionnaire was used to assess patients' Illness Perceptions representation on LBP[10,16]. This questionnaire contains nine questions, of which the questions IP1 – IP8 were used in this study. Each item represents a different dimension of IPs. In order to ensure that all higher scores signify stronger dysfunctional IPs, data of the IP3-4 and IP7 were reversed before entering into the analyses.

Co-variates

The selection of co-variates was based on research showing these factors being associated with treatment outcome of LBP. They have also previously been used in a SCED study on persistent LBP[5]. The co-variates are: fear of movement[39], catastrophizing[34], avoidance[39], somberness[24] and sleep[37]. For all these co-variates we hypothesized that the higher their scores, the more negative impact they will have on the primary outcome.

Statistical analysis

To investigate whether primary outcomes change during and after matched-care physiotherapy treatment, linear mixed model analyses were performed, including all repeated measurements as outcome, and 'phase' as independent variables. First a crude analysis was performed. In a next analysis we controlled for the co-variates.

To investigate whether IPs mediate the effect of matched-care physiotherapy on primary outcomes, these adjusted analyses were performed including the IPs. Based on the change in the coefficient for treatment phase (two dummies, with phase A as reference category) the mediating role of each IP was evaluated independently. The magnitude of the mediation effect, the Indirect Effect, was calculated by subtracting the Direct Effect from the Total Effect.

Finally, to investigate whether baseline IPs moderate the effect of matched-care physiotherapy on primary outcomes, effect sizes were calculated for treatment phase and post-treatment phase (two dummies, with phase A as reference category) by adding the baseline IPs to the adjusted linear mixed models. The importance of the moderation was evaluated on significance ($p<0.05$) of the interaction terms.

In addition to statistical significant effects, we evaluated the outcomes on their clinical meaningful effect using a threshold of ≥ 30% change in phase A' on primary outcome from baseline scores phase A[31]. All analyses were performed with STATA® (version 15).

Results

Table 1 presents the characteristics of participating physiotherapists. Six physiotherapists participated in the study, all working in different primary care physiotherapy practices across the Netherlands.

Table 1: *Participating physiotherapists*

Pht	Work setting	Years' experience	Specialist	Particularities
I	Primary care	11	PSF	ACT-trainer
II	Primary care	6	PSF	none
III	Primary care	5	MMT	member pain network
IV	Primary care	5	PSF	none
V	Primary care	35	MMT	Lecturer
VI	Primary care	34	MSc MMT	Lecturer, EFIC pain Pht

Pht = participating physiotherapist, MSc = Master of Science, PSF = Psycho-Social Physiotherapy, MT = Manual Therapy, MMT = Master Manual Therapy, ACT = Acceptance and Commitment Therapy

Table 2 presents the characteristics of the nine participating patients, a sample size which was logistically a realistic achievement. Age ranged from 25 – 74 years. Reported baseline primary outcomes, mean (SD) were for Pain Intensity 5.6 (2.5), Physical Functioning 5.8 (2.7) and Pain Interference in Daily Life 5.9 (2.7). No adverse events were reported by the participating physiotherapists

Table 2: *Baseline scores participating patients*

						Baseline Primary Outcome range 0-10		
patient	Gender	Age	Duration LBP (in weeks)	Oswestry (0-100)	Co-morbidity	PI	PF	PIDL
1	Male	74	> 500	70	Heart condition	8	6	8
2	Male	40	15	52	-	7	8	8
3	Female	43	12	38	-	3	2	2
4	Male	49	> 250	70	RA	7	8	9
5	Male	49	> 150	42	-	7	9	8
6	Female	25	32	80	RA	9	8	8
7	Female	40	> 200	32	-	7	9	7
8	Male	66	12	24	Osteoarthritis	2	5	1
9	Female	30	52	38	PCOS. Hashimoto	3	6	6

PI = Pain Intensity, PF = Physical Functioning, PIDL = Pain Interference in Daily Life, RA = Rheumatoid Arthritis

Table 3 shows which baseline IPs dimensions reached the threshold score, as one of the inclusion criteria, per patient.

Table 3: *IPs dimension inclusion criteria per patients' exceeded threshold*

	Patient								
IP-dimension	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Consequences									
Timeline									
Personal Control									
Treatment Control									
Identity									
Concern									
Coherence									
Emotional Response									

= exceeded threshold

Table 4 a synthesis of the applied treatment packages is reported. The duration average of phase B was 8 weeks, with a minimum of 3 weeks and a maximum of 15 weeks . The number of treatment sessions varied from 3 to 10. Participating physiotherapists applied a combination of treatments strategies, as described in Appendix B, within one treatment session. The cognitive strategy was the most frequently reported strategy.

Table 4: *Duration phase B and synthesis of interventions per participating patient*

					Treatment strategy*		
patient	Gender	Age	Duration Phase B (in weeks)	Number of treatments	Cognitive strategy	Operant strategy	Classical conditioning
1	Male	74	6	7	6	2	2
2	Male	40	15	9	-	-	-
3	Female	43	8	5	5	4	4
4	Male	49	9	5	3	1	4
5	Male	49	8	7	5	4	3
6	Female	25	8	5	5	2	2
7	Female	40	7	10	9	5	6
8	Male	66	8	6	4	3	4
9	Female	30	3	3	3	1	2

** Number of times each treatment strategy was applied during treatment phase B, self-reported by physiotherapist.*

Table 5 shows the results of the linear mixed model analyses to investigate whether primary outcomes changed during and after matched-care physiotherapy. During treatment, all three outcomes show a significant and clinical meaningful improvement of ≥ 30% effect. The adjusted effects shows clinical meaningful improvement of ≥ 30% for pain and physical functioning. Post treatment, the effect did not wash-out. Remaining in significant and clinical meaningful improvement of ≥ 30% for all three outcomes.

Table 5: *Final linear mixed model Regression effects, study phase A as reference class*

	During treatment				Post treatment			
	Effect crude Mean	95% CI	Effect adjusted*	95% CI	Effect crude Mean	95% CI	Effect adjusted*	95% CI
PI range 0-10	-2.2^	-2.9, -1.5	-1.3	-1.9, -0.7	-3.5^	-4.2, -2.8	-1.8^	-2.4, -1.2
PF range 0-10	-2.4^	-3.1, -1.8	-1.6^	-2.2, -1.1	-4.1^	-4.5, -3.4	-2.6^	-3.2, -1.1
PIDL range 0-10	-2.4^	-3.1, -1.7	-1.3	-1.9, 0.7	-4.2^	-4.9, -3.6	-2.4^	-3.0, -1.8

*PI = Pain Intensity, PF = Physical Functioning, PIDL = Pain Interference in Daily Life, All outcome = P <.05, ^ = Clinical meaningful improvement ≥ 30% baseline score[29],*adjusted for: fear of movement, catastrophizing, avoidance, somberness and sleep*

Table 6 shows the results of the mediation analyses performed on the adjusted models.
Five of the 8 IP dimensions substantially mediated the total effect on all three primary outcomes. For instance, the IP dimension ***Consequences*** mediated for 38.5% the effect of the treatment on pain intensity during the treatment (Phase B) and this increased to 38.9% for the post-treatment (Phase A'). The IP *Consequences* and *Identity* were strong mediators in all three primary outcomes. The other dimensions that mediated the effect of the treatment on the outcome were *Identity, Concern, Emotional and Personal control*. Three IPs showed lesser mediation effects, with *Timeline* being the smallest mediator by 1.7% for Physical functioning post treatment.

Table 7 shows the statistically significant results of the moderation analyses performed on the adjusted models. The IPs dimension *Personal control* moderated the treatment effects for all three primary outcomes. There is a stronger treatment effect for patients with a low baseline score (0-7) on *Personal control* versus patients with high baseline scores (8-10) on Personal control. This means that when patients experienced higher control (0-7) over their condition at baseline, the stronger the positive effect on the primary outcome was in both the treatment and the post-treatment phases.
The IPs dimension *Treatment control* showed a moderating effect for Physical functioning. This indicates a stronger treatment effect for patients with a low baseline score (0-4) on

Treatment control versus patients with high baseline scores (5-10) on *Treatment control.* This means that the more patients expected treatment to control their condition at baseline, the stronger the effect on the primary outcome was in both the treatment phase B and the post-treatment phase A'.

For Pain Interference in Daily Life, baseline low scores in the IPs dimensions *Identity* (0-8), *Concern* (0-8) and *Emotional response* (0-8) showed stronger effects for both treatment and post-treatment phase versus patients with high baseline scores.

The moderating effect of the IPs dimensions *Personal Control, Identity, Concern* and *Emotional response* did not wash out during the post treatment phase.

Table 6: *Results of the analyses to evaluate the mediating influence of IPs on adjusted treatment effect on primary outcomes*

Total adjusted effect of treatment on primary outcomes												
	Pain Intensity direct effect				Physical functioning direct effect				Pain interference daily life direct effect			
	During Treatment -1.3 (CI-1.9, -0.7)		Post Treatment -1.8 (CI-2.4, -1.2) ^		During Treatment -1.6 (-2.2, -1.1) ^		Post Treatment -2.6 (CI-32, -1.1)^		During Treatment -1.3 (CI-1.9, 0.7)		Post Treatment -2.4 (CI-3.0, -1.8)	
Indirect Effect (mediation) of Illness Perception Dimension	**IE**	**%**	**IE**	**%**	**IE**	**%**	**IE**	**%**	**IE**	**%**	**IE**	**%**
Consequences	-0.5	38.5	-0.7	38.9	-0.5	31.3	-1.2	46.2	-0.6	46.2	-1.3	54.2
Timeline	0.0	0.0	-0.1	5.6	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	4.2
Personal Control	-0.2	15.4	-0.2	11.1	-0.2	12.5	-03	11.5	-0.1	7.7	-0.2	8.3
Treatment Control	-0.1	7.8	-0.1	5.6	-0.1	6.3	0.0	0.0	-0.1	7.7	0.0	0.0
Identity	-0.5	39.5	-0.7	38.9	-0.5	31.3	-1.2	46.2	-0.7	53.8	-1.5	62.5
Concern	-0.4	30.8	-0.2	11.1	-0.5	31.3	-0.8	30.8	-0.4	30.8	-0.8	33.3
Coherence	-0.1	7.8	-0.1	5.6	-0.1	6.3	-0.1	3.8	-0.1	7.7	-0.1	4.2
Emotional response	-0.2	15.4	-0.7	38.9	-0.1	6.3	-0.6	23.1	-0.2	15.4	-0.8	33.3

CI = 95% Confidence Interval, ^ = Clinical meaningful improvement ≥ 30% baseline score 31, IE = Indirect Effect (Mediation Effect), % = Percentage mediation

Table 7 : *Final linear mixed model effects for IPs as moderator for Primary Outcomes with Study phase A as reference class, adjusted for co-variates*

	Pain Intensity				Physical functioning				Pain interference daily life			
	During Treatment		Post Treatment		During Treatment		Post Treatment		During Treatment		Post Treatment	
Illness Perception	TE	CI	TE	CI	TE	CI	TE	CI	TE	CI	TE	CI
Personal control												
Low baseline score (0-7) n=140	-2.1^	-2.9, -1.2	-2.7^	-3.5, -1.8	-2.1^	-2.9, -1.2	-3.3^	-4.2, -2.6	-2.1^	-3.0, -1.3	-3.7^	-4.5, -2.8
High baseline score (8-10) n= 56	-0.8	-1.5, -0.1	-1.3	-2.0, -0.5	-1.3	-2.0, -0.7	-2.1^	-2.8, -1.4	-0.8	-1.5, -0.1	-1.6	-2.3, -0.9
Treatment control												
Low baseline score (0-4) n=127					-2.1^	-2.8, -1.4	-2.9^	-3.6, -2.2				
High baseline score (5-10) n= 69					-1.0	-1.8, -0.2	-2.3^	-3.1, -1.5				
Identity												
Low baseline score (0-8) n=144									-2.0^	-2.8 /-1.2	2.8^	-3.6, -2.0
High baseline score (9-10) n= 52									-0.7	-1.5 / 0.1	2.1^	-3.0, -1.3
Concern												
Low baseline score (0-8) n=153									-1.8^	-2.5 /-1.0	2.6^	-3.2, -1.9
High baseline score (9-10) n= 43									-0.8	-1.6 / 0.1	2.3^	-3.2, -1.4
Emotional response												
Low baseline score (0-8) n=145									-2.0^	-2.8 /-1.2	2.8^	-3.6, 2.0
High baseline score (9-10) n= 51									-0.7	-1.5 / 0.1	2.1^	-3.0, -1.3

TE = Total Effect, CI = 95% Confidence Interval, Outcome = P <.01, ^ = Clinical meaningful improvement ≥ 30% baseline score 31

Discussion

In this matched-care physiotherapy treatment for patients with persistent LBP SCED-study, we showed a statistically significant and clinically meaningful improvement in decreasing pain intensity, increased physical function and lesser pain interference in daily life during and three months post-treatment. We did not observe a wash-out phenomenon during the post treatment phase. Furthermore, we found five IP dimensions mediating the effect on all three primary outcomes; namely, *Consequences* (45.2-56.3) *Personal control* (8.1-15.7), *Identity* (46.7-52.9), *Concern* (15.6-34.3) and *Emotional response* (24.3-38.9). At baseline, the IP ***Personal control*** acted as a moderator for all primary outcomes. In the post treatment phase the IPs *Personal Control, Identity, Concern* and *Emotional response* also acted as moderator.

Illness Perceptions as mediator

The search for causal mechanisms for non-specific LBP has been a quest for decades now[21,27.] Identifying such mechanisms is useful, for instance, when designing a 'Magic Bullet' cure, for a condition that is primarily caused by a pathoanatomical impairment[11]. In the case of persistent musculoskeletal pain like LBP, such pathoanatomical impairment most likely cannot be identified. LBP is considered to be a symptom of a complex condition with multiple contributors to both pain and associated limitations in physical function, including psychological factors, social factors, biophysical factors, co-morbidities, and pain-processing mechanisms[17]. Models for management of complex conditions should incorporate these multiple contributors, including patients' beliefs about their condition[3,7]. IPs are thought of as one aspect of these beliefs[3]. Through mediation analyses we identified five IP dimensions that mediated the total effect of our matched-care physiotherapy treatment package. Intervention studies on how to alter IPs in LBP are scarce. We know of one RCT that looked at altering baseline IPs with cognitive treatment to improve patient relevant physical activities[36]. In this study IP dimensions *Timeline cyclical, Consequences, Personal control* and *Coherence* attributed 14.4% of the explained variance to physical activities. This partly overlaps with our results. We found IP dimensions *Consequences* and *Personal control* also significantly mediating the total effect on all three primary outcomes.

The effects in our study are found within a non-controlled design and should be further tested in a larger population and with a different design such as a randomized controlled trial.

Illness Perceptions as moderator

The course and prognosis of developing persistent LBP have been extensively researched[7]. The overall findings are reported as; "Low to moderate levels of pain and disability were still present at one year, especially in the cohorts with persistent pain." In a Cochrane review on

individual recovery expectations it is concluded: "Our findings suggest that recovery expectations should be considered in future studies, to improve prognosis and management of low back pain"[18]. We found the IP dimension *Personal control* to be moderating the effect on all three primary outcomes. This IP dimension can be seen as reflecting patients' expectations about the effect of the treatment. We therefore would like to advise to consider the IP *Personal control* in future research concerning treatment and prognosis of LBP.

Study limitations

Several limitations need to be considered. First, there was no randomization. The effects in our study are found within a non-controlled design. We explicitly focused on a 'matched care intervention'. Meaning that the intervention was tailored on the patients' clinical presentation, and therefore randomization was not included in our design. Secondly, selection bias of patients. The patients were selected by the participating physiotherapists, therefore the generalizability of our results is somewhat limited. Thirdly, patients were required to complete a questionnaire, monitoring their progress on a weekly basis for several months. This may have given rise to the awareness of being studied. This possibly impacted behavior, resulting in a Hawthorne effect[28]. Fourthly, there is a potential sampling bias of treating / participating physiotherapists due to the use of convenience sampling of physiotherapists via social media and within the network of the first author. They were invited to our two-day course to be informed on the design of the study. These physiotherapists might not be representative of the physiotherapy community in the Netherlands. Fifthly, we do not have data to analyze the treatment fidelity of participating physiotherapists on delivering the matched-care treatment package. The weight this has on the effects is not clear. We tried to minimize this limitation by including several implementation interventions addressing fidelity of the physiotherapists to participate in the study: a two day course, videos were accessible demonstrating how to apply treatment strategies and the use of repeated measures during the treatment phase.
Finally, due to the design of this study conclusions about causal relations between IPs and the primary outcome cannot be drawn. Further studies on the temporal order of the associations between matched-care physiotherapy, IPs and treatment outcomes are recommended.

Study strengths

There are several strengths of this study to be considered. First, the use of repeated measures and a matched-care intervention instead of a strict treatment protocol allowed the physiotherapists to adjust their interventions to the clinical status of the patient with each new appointment. This dynamic and cyclical process is commonly used by physiotherapists and is a reflection of their clinical reasoning process[13], making this design representative for daily practice. For example, if the patient shows a sufficient decrease of safety behaviors, than

withdrawal of safety behavior strategy is justified[20]. Secondly, within the model of Illness Representations by Leventhal it is hypothesized that dysfunctional perceptions affect pain and limitations in physical functioning. The use of an IP threshold as an inclusion criterion implies good diagnostics for creating a window of opportunity to improve pain and physical functioning by altering IPs. Thirdly, this study is a good example of how to include physiotherapists' clinical relevant decisions for avoiding problems concerning "reference class forecasting". Such forecasting relies on prediction from past reference classes, a model which may not be the most suitable because of the large variability in clinical signs and symptoms in patients with low back pain. In our study we explicitly incorporated psycho-social elements which were relevant for that patient as was shown in their 'risk-profile'.

Practical implications

The use of a matched-care physiotherapy treatment is accompanied by a decrease of pain and physical function related health problems in patients with persistent low back pain. This type of research, looking at treatments that incorporate a dynamic and cyclical process is a reproduction of daily physiotherapy practice. We would like to encourage this way of working and researching the effectiveness of physiotherapy.

In earlier research, we concluded based on a longitudinal study with two timepoints that baseline IPs did not predict poor recovery on pain and/or physical function after three months. The results of this study are not in line with these findings. For instance, dysfunctional baseline IP *Personal control* scores (7-10) moderate the effect significantly, meaning that physiotherapists could consider to use item 3 of the Brief IPQ-DLV for the baseline assessment of patients' perceptions on controllability of their condition. A specific intervention targeting this dysfunctional perception might than be appropriate. Further, it can be considered to evaluate the change in the IPs dimension ***C****onsequences, Personal control, Identity, Concern* and *Emotional response* during treatment because our results showed a mediating effect of change in these perceptions. If one of these perceptions does not change during treatment there might still be room for improvement by specifically targeting these perceptions with interventions. Thereby, applying the principles of matched-care treatment.

Conclusion

Our study seem to suggest that some IPs have a mediating or a moderating effect on pain intensity, physical function and pain interference during a matched care physiotherapy treatment.

Our findings indicate that the IP dimensions *Consequences, Personal control, Identity, Concern* and *Emotional response,* might be important to include in a matched-care treatment of LBP, because they enhance the positive mediation effect of all three primary outcomes. In addition, at baseline, assessing *Personal control* may be relevant to determine the outcome prognosis of successful physiotherapy management of persistent LBP.

acknowledgements

We would like to thank the attributing patients for participating in this research. Further, the contribution to this study by primary care physiotherapists Alisha van den Waarsenburg, Esther Beker, Jef Huibers, Daron Buenting and Ben van Koppen is much appreciated. Thanks to Les Hearn for scientific proofreading and English editing (les_hearn@yahoo.co.uk)

This study is supported by a grant of the Dutch government; NWO- 023.005.029

References

1. Beurskens AJ, de Vet HC, Köke AJ, et al. A patient-specific approach for measuring functional status in low back pain. Journal of Manipulative and Physiological Therapeutics. 1999;22(3):144-148.
2. Buchbinder R, van Tulder M, Öberg B, et al. Low back pain: a call for action. lancet. March 2018.
3. Caneiro JP, Bunzli S, OSullivan P. Beliefs about the body and pain: the critical role in musculoskeletal pain management. Brazilian Journal of Physical Therapy. June 2020:1-13.
4. Caneiro JP, Roos EM, Barton CJ, et al. It is time to move beyond "body region silos" to manage musculoskeletal pain: five actions to change clinical practice. British Journal of Sports Medicine. October 2019:bjsports–2018–100488–2.
5. Caneiro JP, Smith A, Linton SJ, Moseley GL, OSullivan P. "How does change unfold?" an evaluation of the process of change in four people with chronic low back pain and high pain-related fear managed with Cognitive Functional Therapy_ A replicated single-case experimental design study. Behav Res Ther. March 2019:1-12.
6. Clark S, Horton R. Low back pain: a major global challenge. lancet. March 2018. doi:10.1016/S0140-6736(18)30725-6.
7. Costa L, Maher CG, Hancock MJ, J JMCMA, 2012. Prognosis in People with Back Pain. Vol 184. 2012:1229-1230.
8. de Raaij EJ, Ostelo RW, Maissan F, Mollema J, Wittink H. The Association of Illness Perception and Prognosis for Pain and Physical Function in Patients With Noncancer Musculoskeletal Pain: A Systematic Literature Review. J Orthop Sports Phys Ther. 2018;48(10):789-800.
9. de Raaij EJ, Ostelo RWJG, Maissan JF, Pool J, Westers P, Wittink H. Illness perceptions associated with patient burden with musculoskeletal pain in outpatient physical therapy practice, a cross-sectional study. Musculoskeletal Science and Practice. 2020;45:102072.
10. de Raaij EJ, Schröder C, Maissan FJ, Pool JJ, Wittink H. Cross-cultural adaptation and measurement properties of the Brief Illness Perception Questionnaire-Dutch Language Version. manual therapy. 2012;17(4):330-335.
11. Delitto A. Research in low back pain: time to stop seeking the elusive "magic bullet". physical therapy. 2005;85(3):206-208.
12. Dionne CE, Dunn KM, Croft PR, et al. A consensus approach toward the standardization of back pain definitions for use in prevalence studies. spine. 2008;33(1):95-103.
13. Doody C, McAteer M. Clinical Reasoning of Expert and Novice Physiotherapists in an Outpatient Orthopaedic Setting. Physiotherapy. 2002;88(5):258-268.
14. Foster NE, Anema JR, Cherkin D, et al. Prevention and treatment of low back pain: evidence, challenges, and promising directions. lancet. March 2018.
15. Hagger M, Orbell S. A Meta-Analytic Review of the Common-Sense Model of Illness Representations. Psychology & Health. 2003;18(2):141-184.
16. Hallegraeff JM, Van Der Schans CP, Krijnen WP, de Greef MH. Measurement of acute nonspecific low back pain perception in primary care physical therapy: reliability and validity of the brief illness perception questionnaire. BMC Musculoskelet Disord. 2013;14(1):1-1.

17. Hartvigsen J, Hancock MJ, Kongsted A, Lancet QLT, 2018. What low back pain is and why we need to pay attention. Elsevier 2018;391(10137):2356-2367.
18. Hayden JA, Tougas ME, Riley R, Iles R. Individual recovery expectations and prognosis of outcomes in non-specific low back pain: prognostic factor exemplar review. 2014.
19. Henschke N, Ostelo RW, van Tulder MW, et al. Behavioural treatment for chronic low-back pain. Cochrane Database Syst Rev. 2010;(7):CD002014.
20. Hoffman LJ, Chu BC. When Is Seeking Safety Functional? Taking a Pragmatic Approach to Distinguishing Coping From Safety. Cognitive and Behavioral Practice. 2019;26(1):176-185.
21. Hoy D, Brooks P, BLYTH F, Buchbinder R. The Epidemiology of low back pain. Best Practice & Research Clinical Rheumatology. 2010;24(6):769-781.
22. Kent DM, Steyerberg E, van Klaveren D. Personalized evidence based medicine: predictive approaches to heterogeneous treatment effects. BMJ. 2018;45:k4245–18.
23. Kraemer HC, Wilson GT, Fairbum CG, Agras WS. Mediators and moderators of treatment effects in randomized clinical trials. Arch Gen Psychiatry. 2002;59(10):877-883.
24. Lee H, Mansell G, McAuley JH, et al. Causal mechanisms in the clinical course and treatment of back pain. Best Practice & Research Clinical Rheumatology. 2016;30(6):1074-1083.
25. Leventhal H, Meyer D, nerenz D. The Common Sense Representation of Illness Danger. In: Rachman S, ed. Medical Psychology. Vol II. Pergamon Press; 1980:7-29.
26. Linton SJ, Nicholas M, Shaw W. Why wait to address high-risk cases of acute low back pain? A comparison of stepped, stratified, and matched care. Pain. 2018;159(12):2437-2441.
27. Maher C, Underwood M, Buchbinder R. Non-specific low back pain. lancet. 2017;389(10070):736-747.
28. McCambridge J, Witton J, Elbourne DR. Systematic review of the Hawthorne effect: New concepts are needed to study research participation effects. Journal of Clinical Epidemiology. 2014;67(3):267-277.
29. Medicine OCFE-B. OCEBM Levels of Evidence Working Group. the Oxford 2011 Levels of Evidence. 2011.
30. Nicholas MK, Linton SJ, Watson PJ, Physical CM, 2011. Early identification and management of psychological risk factors (“yellow flags”) in patients with low back pain: a reappraisal. academicoupcom
31. Ostelo RWJG, Deyo RA, Stratford P, et al. Interpreting change scores for pain and functional status in low back pain: towards international consensus regarding minimal important change. In: Vol 33. 2008:90-94.
32. OSullivan P, Caneiro JP, O’Keeffe M, O’Sullivan K. Unraveling the Complexity of Low Back Pain. J Orthop Sports Phys Ther. 2016;46(11):932-937.
33. OSullivan P. It’s time for change with the management of non-specific chronic low back pain. British Journal of Sports Medicine. 2012;46(4):224-227.
34. Picavet HSJ. Pain Catastrophizing and Kinesiophobia: Predictors of Chronic Low Back Pain. American Journal of Epidemiology. 2002;156(11):1028-1034.
35. Shamseer L, Bukutu C, Schmid CH, et al. CONSORT extension for reporting N-of-1 trials (CENT) 2015: explanation and elaboration. Journal of Clinical Epidemiology. 2016;76:18-46.

36. Siemonsma PC, Stuive I, Roorda LD, et al. Cognitive treatment of illness perceptions in patients with chronic low back pain: a randomized controlled trial. physical therapy. 2013;93(4):435-448.
37. Sivertsen B, Lallukka T, Petrie KJ, Steingrímsdóttir ÓA, Stubhaug A, Nielsen CS. Sleep and pain sensitivity in adults. Pain. 2015;156(8):1433-1439.
38. Tate RL, Perdices M, Rosenkoetter U, et al. The Single-Case Reporting Guideline In BEhavioural Interventions (SCRIBE) 2016: Explanation and elaboration. Archives of Scientific Psychology. 2016;4(1):10-31.
39. Vlaeyen JW, de Jong J, Geilen M, Heuts PH, van Breukelen G. Graded exposure in vivo in the treatment of pain-related fear: a replicated single-case experimental design in four patients with chronic low back pain. Behav Res Ther. 2001;39(2):151-166.
40. Vlaeyen JW, Kole-Snijders AM, Boeren RG, van Eek H. Fear of movement/(re)injury in chronic low back pain and its relation to behavioral performance. Pain. 1995;62(3):363-372.
41. Vos T, Flaxman AD, Naghavi M, Lozano R, Michaud C. Years lived with disability (YLDs) for 1160 sequelae of 289 diseases and injuries 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. lancet. 2013;380(9859):2163-2196.

Appendix A

Dysfunctional IP levels based on a secondary analysis of quartile distribution of patient symptoms [22]

	IP1 Consequences		IP2 Timeline		IP3 Personal control		IP4 Treatment control	
	Q1	Q4	Q1	Q4	Q1	Q4	Q1	Q4
IP quartile score	0 - 2	8 - 10	0 - 2	8 - 10	0 - 2	7 - 10	0 - 1	4 - 10
PI (sd)	3.9 (2.1)	6.0 (2.4)	4.6 (2.2)	5.4 (2.4)	4.3 (2.5)	5.1 (2.8)	5.0 (2.4)	5.0 (2.3)
PFSF (sd)	4.6 (2.4)	7.1 (1.7)	5.3 (2.4)	6.6 (2.1)	5.7 (2.7)	6.1 (2.2)	6.4 (2.4)	5.7 (2.2)
% > 2 pain sites	9.0	42.5	12.6	50.7	20.7	21.5	7.7	24.7
% high risk 4DSQ								
Distress	4.4	29.9	5.2	22.6	11.0	14.4	11.0	15.0
Depression	1.8	22.5	2.2	16.4	10.4	9.1	6.3	10.6
Anxiety	2.4	24.7	1.7	18.7	9.5	12.4	11.6	9.8
Somatization	0.4	21.9	1.1	20.2	8.8	11.1	9.7	12.0

IP 1 How much does your illness effect your life?
IP 2 How long do you think your illness will continue?
IP 3 How much control do you feel you have over your illness?
IP 4 How much do you think your treatment can help your illness?
Q1 = 1st quartile, Q4 = 4th Quartile, PI = Pain Intensity last 24 hours, PSFS = Patient Specific Functioning Scale, 4DSQ = Four-Dimensional Symptom Questionnaire

Dysfunctional IP levels based on a secondary analysis of quartile distribution of patient symptoms [22]

	IP5 Identity		IP6 Concern		IP7 Comprehensibility		IP8 Emotional	
	Q1	Q4	Q1	Q4	Q1	Q4	Q1	Q4
IP quartile score	0 - 4	8 - 10	0 - 2	8 - 10	0	5 - 10	0 - 2	8 - 10
PI (sd)	3.9 (2.1)	6.2 (2.3)	4.7 (2.2)	6.1 (2.2)	4.2 (2.6)	5.4 (2.1)	4.3 (2.2)	6.0 (2.5)
PFSF (sd)	4.8 (2.4)	7.3 (1.6)	5.8 (2.3)	7.1 (1.8)	5.8 (2.1)	6.2 (2.2)	5.3 (2.4)	7.1 (1.9)
% > 2 pain sites	16.0	35.6	13.4	44.5	27.8	24.9	12.3	38.2
% high risk 4DSQ								
Distress	6.3	24.5	7.3	36.4	5.7	16.5	3.3	47.0
Depression	1.7	18.1	3.0	30.8	4.4	8.4	1.8	32.5
Anxiety	4.5	21.6	5.0	33.7	6.7	13.0	3.7	32.5
Somatization	2.3	21.4	2.8	27.7	8.0	10.4	1.4	25.7

IP 5 How much do you experience symptoms from your illness?
IP 6 How concerned are you about your illness?
IP 7 How well do you feel you understand your illness?
IP 8 How much does your illness affect you emotionally? (e.g. does it make you angry. scared. upset or depressed?
Q1 = 1st quartile, Q4 = 4th Quartile, PI = Pain Intensity last 24 hours, PSFS = Patient Specific Functioning Scale, 4DSQ = Four-Dimensional Symptom Questionnaire

Appendix B

Intervention

The intervention is based on usual care following the low back pain guideline of the Royal Dutch Physiotherapy Association[16] and will target patients whom are classified in 'patient profile 3'. This means that this study includes patients that have an abnormal course with dominant presence of psychosocial factors impeding recovery.

The intervention is considered to be delivered as proposed in the guideline, with an additional matched-care treatment package. This package focusses on patients' specific Illness Perception (IPs) regarding his or her low back pain. This means if IPs are considered to be dysfunctional before and during treatment, these IPs will be seen as prognostic factor for poor recovery of pain intensity and physical function. The aim is to alter dysfunctional IPs to more functional perceptions by the advised strategies for consistent (back) pain [5,8,15,17]. These cognitive, exposure and respondent strategies will be response guided at the beginning and during each intervention session.

The additional treatment package will be matched with the scores of the IPs before each treatment session. Patients whose score are within the 4th-quartile range **(Box 1)**, are seen as indicative for dysfunctional IPs, will be challenged to rethink their perception by a combination of the three proposed strategies. This means that the physiotherapist together with the patient must decide on which strategy to start with and when to switch to another strategy. This decision-making process is an essential part of the intervention and will be shaped by shared decision-making[2] and can be seen as a response guided intervention.

This treatment approach can be seen more as reflective than as descriptive. Meaning the patient guides her or his own meaningful and safe strategies to cope with their pain condition. The physiotherapist is more a reflective, instead of a problem-solving practitioner.

Treatment package

Each strategy within the treatment package consists of a diagnostic- and a treatment-phase. The diagnostic-phase determines if the strategy is indicated to be used and if so, the treatment phase will then deliver the treatment as intended within this specific strategy.

The cognitive-based strategy

Pain neuroscience education has been proven to be useful for reducing pain, improving patient knowledge of pain, improving function and lowering disability, reducing psychosocial factors, enhancing movement, and minimizing healthcare utilization [9].

- *Diagnostic-phase*
  The revised neuro physiology pain questionnaire will be used for assessing patients' baseline knowledge of pain physiology[1]. The outcome of this questionnaire, together with The Brief-IPQ-DLV baseline scores will be determining the content of

the treatment-phase.

- *Treatment-phase*
  By a number of tools, the patients' knowledge and perceptions about their pain condition will be discussed. Important part of the intervention will be pain neuroscience education. Main message will be that pain mainly is about being a symptom that is formed from past experiences, sensory input and contextual circumstances[14], not about tissue damage alone.

The Operant-based strategy

Is based on the Operant Learning Theory (OLT) introduced by Fordyce for managing chronic pain[3]. The use of OLT has been shown to be useful[4], treatment is advised to be customized to the bio-psych-social needs of the patient[12].

- *Diagnostic-phase*
  The Phoda will be used to rate the level of patients' fear related avoidance of daily activities. The outcome of this method, 3-5 most highly feared daily activities, together with The Brief-IPQ-DLV baseline scores will be selected to be expose the feared activities with movement/exercise related OLT.
- *Treatment-phase*
  Exposure with movement will be used to adjust patients' fear and beliefs about the harmfulness of the daily activity. There will be no upfront defined route of 'graded exposure' before the treatment session. The start of the exposure will always be aimed on the least feared activity first but might be directly followed with the most feared activity, depending on the pace in which patients' fear and beliefs are responding.

The respondent-based strategy

Is based on safety behaviour expression, such as propping with hands and avoiding loading painful body part[13].

- *Diagnostic-phase*
  The diagnostics is primarily done via observation by the physiotherapist during interview, examination and treatment. These observations will focus on safety and communication behaviors and sympathetic responses.
- *Treatment-phase*
  Cited from O'sullivan 2018: "These observations then form the basis of a series of guided behavioral experiments. These guided experiments explicitly seek to reduce sympathetic responses and abolish safety and communicative behaviors (via relaxed diaphragmatic breathing, body relaxation, awareness, and control), prior to and while gradually exposing individuals to their feared, avoided, and painful tasks."

References Appendix B

1. Catley MJ, O'Connell NE, Moseley GL. How Good Is the Neurophysiology of Pain Questionnaire? A Rasch Analysis of Psychometric Properties. The Journal of Pain. 2013;14(8):818-827.
2. Epstein RM, Alper BS, Quill TE. Communicating evidence for participatory decision making. jama: The Journal of the American Medical Association. 2004;291(19):2359-2366.
3. Fordyce WE. Behavioral factors in pain. Neurosurg Clin N Am. 1991;2(4):749-759.
4. Gatzounis R, Schrooten MGS, Crombez G, Vlaeyen JWS. Operant Learning Theory in Pain and Chronic Pain Rehabilitation. Curr Pain Headache Rep. 2012;16(2):117-126.
5. Henschke N, Ostelo RW, van Tulder MW, et al. Behavioural treatment for chronic low-back pain. Cochrane Database Syst Rev. 2010;(7):CD002014.
6. Hoffman LJ, Chu BC. When Is Seeking Safety Functional? Taking a Pragmatic Approach to Distinguishing Coping From Safety. Cognitive and Behavioral Practice. 2019;26(1):176-185..
7. Hollander den M, Goossens M, de Jong J, et al. Expose or protect? A randomized controlled trial of exposure in vivo vs pain-contingent treatment as usual in patients with complex regional pain syndrome type 1. Pain. 2016;157(10):2318-2329.
8. Jensen M. Toward the development of a motivational model of pain self-management. The Journal of Pain. 2003;4(9):477-492.
9. Louw A, Diener I, Butler DS, Puentedura EJ. The Effect of Neuroscience Education on Pain, Disability, Anxiety, and Stress in Chronic Musculoskeletal Pain. Archives of Physical Medicine and Rehabilitation. 2011;92(12):2041-2056.
10. Moseley GL, Butler DS. Fifteen Years of Explaining Pain: The Past, Present, and Future. The Journal of Pain. 2015;16(9):807-813. doi:10.1016/
11. Moseley GL, Vlaeyen JWS. Beyond nociception. Pain. 2015;156(1):35-38.
12. Nielson WR, Weir R. Biopsychosocial approaches to the treatment of chronic pain. The Clinical Journal of Pain. 2001;17(4 Suppl):S114-S127.
13. O'Sullivan PB, Caneiro JP, O'Keeffe M, et al. Cognitive Functional Therapy: An Integrated Behavioral Approach for the Targeted Management of Disabling Low Back Pain. physical therapy. 2018;98(5):408-423.
14. Ongaro G, Kaptchuk TJ. Symptom perception, placebo effects, and the Bayesian brain. Pain. 2019;160(1):1-4.
15. Rudy TE, Kerns RD, Turk DC. Chronic pain and depression: toward a cognitive-behavioral mediation model. Pain. 1988;35(2):129-140.
16. Staal JB, Hendriks EJM, Heijmans M, et al. KNGF Guideline Low back pain. January 2013:1-7.
17. Vlaeyen JW, Haazen IW, Schuerman JA, Kole-Snijders AM, van Eek H. Behavioural rehabilitation of chronic low back pain: comparison of an operant treatment, an operant-cognitive treatment and an operant-respondent treatment. Br J Clin Psychol. 1995;34 (Pt 1):95-118.

Appendix C

Online questionnaire to assess primary outcomes, Illness Perceptions and co-variates.
All items scored on 11-point scale (0-10) and anchored by words appropriately related to each question. Outcome score were reversed to lower score meaning less dysfunction.

Primary outcome

- What was the average back pain over the past 24 hours?
- In the past week, how difficult was it to perform your self-proclaimed activity?
- How much has the back pain limited you in your daily activities?

Illness Perceptions secondary outcome

- How much does your illness affect your life?
- How long do you think your illness will continue?
- How much control do you feel you have over your illness?
- How much do you think your treatment can help your illness?
- How much do you experience symptoms from your illness?
- How concerned are you about your illness?
- How well do you feel you understand your illness?
- How much does your illness affect you emotionally? (e.g. does it make you angry, scared, upset or depressed?)

Co-variates

- My pain complaints will decrease if I were to exercise.
- When I am in pain, I wonder whether something serious may happen.
- I avoid important activities when I hurt.
- How much have you been bothered by feeling depressed in the last 24-hours?
- I can sleep at night.

8

General discussion

General discussion

The overall aim of the research presented in this thesis is to explore the contribution of Illness Perceptions (IPs) for the management of patients with musculoskeletal pain in primary physiotherapy care. IPs, or patients' personal idea's and thoughts about the symptoms they experience can be seen as one of the psychosocial factors by which variance in health related outcome in patients can be explained[17,18] and are recognized as target for treatment[15,24,27]. For example, it is suggested that educating patients on dysfunctional IPs about musculoskeletal pain (MSP) is associated with better physical and somatic outcomes and lower pain levels[3,6].

Musculoskeletal conditions are one of the main contributors to Global Burden of Diseases causing many years lived with disability [4,39]. Disability-adjusted life years for musculoskeletal disorders rose between 2006-2016 with 61.6 percent [4]. In health-care systems, primary care practitioners, including physiotherapists are important providers of care in treating patients with musculoskeletal disorders.

As a result of the ongoing burden of MSP, management of musculoskeletal conditions evolved from a traditional mechanical/structural approach to a more biopsychosocial approach [5,12,19,22,29,31]. This shift also implies incorporating patient's perceptions about their condition and possible treatments. For example, exploring patients' fear avoidance is well-documented in literature, and recently it is proposed to see this as a patients' common-sense Response to deal with low back pain. [8,11]. This makes IPs an interesting field for physiotherapists to explore.

IPs belong to the core concepts in the Common Sense Model of self-regulation of health and Illness (CSM), developed by Leventhal[21]. The CSM is based on a parallel processing model, describing behavior in Response to health threats. In this model, a health threat is hypothesized to generate both cognitive representations (danger and/or control) and emotional states of fear and distress (fear control). Based on initial clinical research evidence, five IP dimensions have been identified.

1. **Identity** : the label or name given to the illness by patients and the symptoms that are perceived to go with it
2. **Timeline** : how long the patient believes the illness or symptoms will last
3. **Consequences** : how strong the impact of the patient's illness is on, for example, pain or physical function
4. **Causal** : the patient's beliefs about what causes the illness
5. **Control** : the patient's beliefs about how to control or recover from the illness

The assessment of IPs has evolved from interviews to validated questionnaires. Three questionnaires can be discerned:
1. The IPQ, an 80-item Illness Perception Questionnaire published in 1996 which explicitly assesses the five IP dimensions[40].
2. The IPQ-R, an over 80-item Illness Perception Questionnaire Revised is the revised version of the IPQ. It deals with psychometric problems by selection of items through principal component analysis, whereby four additional dimensions were added (Personal/*Treatment Control*, *Coherence*, *Emotional Response*) [28].
3. The Brief IPQ, an 9-item Brief Illness Perception Questionnaire was developed for clinicians and researchers to assess IPs concisely [6]. The *Concern* dimension was added.

In this thesis, a Dutch version of the Brief IPQ is presented to assess IPs in daily physiotherapy practice in The Netherlands. Further, we present a literature overview of the existing associations and prognosis of IPs on MSP and functioning and we explore these associations in primary physiotherapy care in The Netherlands. Finally, we study the impact of a matched care physiotherapy package, matched to dysfunctional IPs, and MSP and physical functioning. In this thesis, three themes (ie. measurement, association / prediction and treatment) are explored for their contribution to physiotherapy management of MSP in general, and especially for low back pain.

First, we cross-culturally adapted and assessed psychometric properties of a Brief Illness Perception Questionnaire Dutch Language Version (Brief IPQ-DLV). The aim of the project was to provide a questionnaire which would be easy to use in daily practice and could be used in consecutive research projects of this thesis.
Secondly, we aimed to assess the associations between IPs on the one hand and MSP and physical functioning on the other hand, by systematically describing current literature and by exploring these associations in cross-sectional studies and in longitudinal studies in physiotherapy primary care settings.
Thirdly, we explored the possible effectiveness of a physiotherapy intervention by targeting IPs in order to improve patients' musculoskeletal condition e.g., pain and physical functioning
These three themes will be discussed in this general discussion.

Theme 1
Measurement Illness Perceptions

Research aim:
To cross-culturally adapt the nine-item IPQ-B English version into the IPQ-B Dutch Language Version (Brief IPQ-DLV), and to determine its face validity, content validity, reprducibility, and concurrent validity.

Summary of main findings
In **chapter 2**, the translation and cross-cultural adaptation of The Brief IPQ-DLV is presented. The original 9-item English version of the Brief IPQ was developed by Broadbent et al. in 20066. They state, that the previous 80-items IPQ-R from 2002[28], could be a burden for patients and clinicians for situations in which there is little time to administer a questionnaire or if the patient is very ill. A shorter version should have less burden on patients and administration time.

The Brief IPQ-DLV is well understood by 93% of the participating patients (n=25), health care professionals (n=15) and 24 first-grade students. The research shows it takes less than 5 min (mean 4.4 sd 2.1 min.) to complete and score, meaning a minimum of burden for both physiotherapists and patients. The face and content validity were found to be acceptable and the reproducibility showed moderate to good reliability. The Brief IPQ-DLV, (scored on a scale 0-10) showed a Smallest Detectable Change, varying per IPs dimension, of <1 point for group evaluation measurement and 3-4 points for individual evaluation measurement. The concurrent validity could only be assessed for five out of the 9 IP dimensions, indicating that this needs to be further investigated. Responsiveness and interpretation of the items by different patient groups have not been investigated yet. We do not recommend the use of a sum score for the IPQ-DLV.

Discussion
The Brief IPQ-DLV was adapted from the original English version IPQ-B using all stages for cross-cultural translation and adaptation recommended by Beaton et al. [2]. Nevertheless, the content validity needs to be taken into consideration. Van Oort [37] reports in a think aloud study, that in using this questionnaire several problems were identified. The *Identity, Personal Control, Illness Coherence, and Causal* dimensions gave rise to misinterpretations indicating that there is a need to pay greater attention to the interpretation and comprehension of the IPQ items by patients. From their qualitative data, it can be stated that it is difficult for patients to answer only one single question about a cognitive/emotional dimension. For in-

stance, one participant answered the question on the *Coherence* dimension (How well do you feel you understand your illness?) as:
"How well do you feel you understand your illness? Djee ... Again a question that does not make sense to me. How well do you feel you understand your illness? [... silence ...] Yes, how well ... That's a lousy question ... How well do you feel you understand your illness? Well, I understand I have knee complaints, but ... Let's think. Understand very clearly or do not understand at all. Well, I do understand it ... I get it ... They've looked inside, so ... They've told me what's wrong with it. Well, what do I have to... Should I have understanding then? Do I understand it? It developed in the course of time, but... (Participant 4, Study 2.) "

The struggle of this participant illustrates the challenge on how to interpret the question. This may be indicative that one should be cautious on using only one single question about a cognitive/emotional to measure a patients' IP dimension. A qualitative assessment is recommend by Van Wilgen [38], meaning that further exploration of patients' IPs, i.e. after filling out the Brief IPQ-DLV, could be recommended[7-9]. This means for clinicians it could be meaningful to explore the IPs more extensively using interview techniques after a patient filled out the Dutch IPQ-DLV.

Methodological considerations
For the assessment of the different IP dimensions, using the sum score of the Brief IPQ is sometimes suggested. For instance, the construct validity of a sum score of the Portuguese Brief IPQ has been studied by Machado [25]. In this study the sum score of the Brief IPQ showed internal consistency of the scale (α = .80). Our understanding of the CSM on which the IP dimension are based is that each question represents a unique IP dimension. To combine these different dimensions into one sum score is eating 9 types of different fruits and then be asked; "Which apple did you like best?". Therefor we did not assess the internal consistency of the Brief IPQ-DLV. The emerging perceptions when facing a health threat (ie. MSP) is expressed in the different IP-dimensions stated in the general introduction. To merge these different dimensions into one construct to represent the patients' IPs, violates the diversity of these dimensions.

Further, to address the *Concern*s around the content validity of the Brief IPQ-DLV, a revised version could be considered, though it is unlikely that an adapted version could resolve this issue. Besides the semantic issue of individual patients' understanding of the content of the questions asked, there is a more fundamental matter to consider. The original English Brief IPQ reduced the number of questions from more than 75 questions in The Revised Illness Perception Questionnaire [28], to 9 questions, 1 per IP-dimension. Broadbent et al did not re-

port the method on how they achieved this reduction[6]. So, it is difficult to judge if the reduction was done in a valid way so that indeed each single question correctly represents one IP-dimension. An adapted version of the Brief IPQ-DLV will not overcome this issue. A way to overcome *Concern*s around the content validity would be to evaluate the Revised IPQ with methods of factor analysis. Hereby, all of the questions of the Revised IPQ which are part of the same IP-dimension can be loaded onto this one dimension and the question with the highest factor loading could be chosen as the most representative question of that specific IP-dimension. In addition, a think aloud study would be a next step in order to assess the content validity.
Further, the content validity of the Brief IPQ-DLV can evaluated by using the recommended item from the COSMIN risk of bias list box 2; asking patients and professionals about relevance and comprehensiveness and *Coherence* [32,36, 26].

A final recommendation we would like to make regarding further research is that the responsiveness needs to be studied as no study has been done yet that addressed the responsiveness of the Brief IPQ-DLV. Responsiveness, also known as longitudinal validity, is the ability to measure changes that are clinically important. For instance, it is an important measurement property, not only in daily practice to measure a patients' relevant improvement or decline, but also an important measurement property to be used in intervention studies to assess the effectiveness of interventions on IPs. Therefore, we recommend further research on the longitudinal validity of the Brief IPQ-DLV. This will reveal how to interpret change scores.

Practical implications
To overcome the above addressed problem and still find a meaningful way of using the Brief IPQ-DLV in daily practice we recommend using qualitative interview techniques in combination with the Brief IPQ-DLV. This means, that after a patient has filled out the Brief IPQ-DLV a physiotherapist can interview the patient for a more in depth understanding on the meaning of scores from the Brief IPQ-DLV means. For instance, by using a Socratic style of dialog as used in the study by Siemonsma et al. [34].

For example, suppose a patient with persistent low back pain scores 8 (0-10, higher score means a better understanding) on the 'How do you feel you understand your illness? '. This does not necessarily mean this perception is functional for this individual. A score on the Brief IPQ-DLV does not tell you what this patient exactly understands, it could be that he or she thinks that their lower back vertebras are out of position and needs re-adjustment. Although this perception might be considered as dysfunctional, we only can explore this perception in more depth by interviewing this patient after completion of the questionnaire, using the

score as a point of departure. To use the Brief IPQ-DLV as starting point might help clinicians to overcome the difficulty they experience in applying biopsychosocial and person-centred approaches [19].

Overall, the conclusions that can be drawn from the first theme of this thesis are:

- The Brief IPQ-DLV is available for use in daily practice as a questionnaire for the first step in exploring IPs. A further exploration is recommended by conducting in depth interviews of the IPs with the respondents, especially those who are indicative for dysfunctional IPS
- Further research is needed to address the psychometric properties content validity and responsiveness.

Theme 2

Association and prognosis Illness Perceptions

1. *Systematic literature review in* **chapter 3**

Research question:
What are the associations of Illness Perceptions with pain intensity and physical functioning in patients with musculoskeletal pain? A systematic review of literature.

Summary of main findings

From the literature review we concluded that there is limited to moderate evidence for a cross-sectional association of IPs with pain and physical functioning for various MSP conditions. The prognostic value in longitudinal studies remains unclear due to the lack of such studies. Further, the findings show a consistent direction of the association among twelve different musculoskeletal conditions, meaning patients with higher scores on IPs dimensions (indicative for dysfunctional IPs) experience more pain and limitations in physical functioning, independent of the nature of the condition. For future research, we advise to investigate the longitudinal relationship between IP domains and outcome in more detail. In addition, studies on the impact on pain and physical functioning of incorporating IPs in interventions for the management of musculoskeletal pain are recommended.

Discussion

A meta-analysis shows that the CSM has been researched extensively in a large number of diseases and illnesses such as cardiovascular disease, diabetes, cancers, arthritis, forms of chronic pain, chronic obstructive pulmonary disease, end-stage renal disease, chronic fa-

tigue, multiple sclerosis, irritable bowel syndrome, psoriasis and hypertension[18]. Overall, Hagger et al.[18] report associations of the IP-dimensions *Identity*, *Consequences*, *Control*, *Timeline*, *Coherence* and *Emotional Response* with physical and social functioning. However, the musculoskeletal domain is not fully represented in these data. Our systematic review enriches the existing evidence and shows besides low to moderate associations of IPs with MSP and functioning a lack of longitudinal studies to address the possible prognostic value of IPs. Also, we found no studies within primary physiotherapy settings, a setting in which a large number of people with musculoskeletal pain present themselves. To further explore the association and prognostic value of IPs in primary physiotherapy care, we designed a cross-sectional and longitudinal study, see **chapters 4 and 5**.

Methodological considerations

A strength is that our systematic review was written in accordance with Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines[23] and the Measurement Tool to Assess systematic Reviews checklist[33]. Details of the protocol for this study were registered with PROSPERO and can be accessed at http://www. crd.york.ac.uk/PROSPERO/display_ record.asp?ID=CRD42016026759. Our study is fully executed as described in the protocol.

A possible explanation for the reported limited to moderate associations of IPs with pain and physical functioning can be found in the validity of questionnaires that were used in the included studies to assess the IPs. All three IPs questionnaires are constructed to explore IPs in a quantitative way, using a Likert Scale or a Numeric Rating Scale. It is debatable if such measures are sufficient enough to assess patients' IPs about their MSP. As stated earlier in **chapter 2**, IPs can be explored in more depth by the use of interviews, and may lead to other conclusions about the impact of IPs on pain and physical functioning[11, 8].

Practical implications

Based on the cross-sectional studies in our review, we conclude that a higher score on an IP dimension is associated with higher score on pain and limitation in physical functioning. This is consistent among all IPs dimensions. Therefore, we conclude that a higher score on IPs could be indicative for dysfunctional IPs. When taking the methodological consideration about measuring IPs quantitatively into account, we propose the use of an IPs questionnaire at baseline and follow-up with more in-depth assessment of IPs by an interview based on the outcome score of the IPs questionnaire (see also **chapter 2**).

For clinicians, this suggests that addressing patients' IPs in this manner may open new possibilities for management of MSP, but this needs to be further explored.

2. *The additional association of Illness Perceptions with pain or limitations in physical functioning in* **chapter 4**.

Research question:
What is the additional association of Illness Perceptions with pain intensity or limitations in physical functioning in addition to the independent factors pain sites, pain duration, and the psychological factors somatization, distress, anxiety, and depression in patients with musculoskeletal pain, adjusted for gender and age? A cross-sectional cohort study.

Summary of main findings
On most IP dimensions there were only small differences in scores between patients with acute, subacute or persistent pain. In addition to some well-known prognostic factors (number of pain sites, pain duration, and the psychological factors somatization, distress, anxiety, and depression), higher scores on the IP dimensions *Consequences*, *Identity* and *Coherence* are associated with higher pain intensity. For physical functioning, the IP dimensions *Consequences*, *Treatment Control*, *Identity* and *Concern* are associated with more limitations.

For cross-sectional associations our findings are in line with our systematic review: a higher IP score indicates higher pain scores and more limitations in physical functioning. However, due to the cross-sectional design these results do not support the prognostic value of IPs.

Discussion
With exception of the IP dimension *Timeline*, we found no clinically relevant mean differences for the other 7 IP dimensions in acute, subacute or persistent phase of MSP. These findings are in line with qualitative research that reported comparable beliefs of vulnerability and poor prognosis among people with acute or persistent low back pain[13]. Therefore, it may by equally important to integrate IPs in physiotherapy management of chronic and acute MSP.

Methodological considerations
The associations that were reported in this study are small to moderate. IPs not being strongly associated with pain and physical functioning can be understood when taking into account that pain and physical functioning are associated with a large variety of biopsychosocial factors. Meaning that strong associations are not to be expected for any one individual factor. Nevertheless, the outcomes of this study for the IPs association with pain still showed that the IP dimensions added a 13.3% explained variance (total 22.9%) and for physical functioning 26.5% additional explained variance (total 32.2%), which means that IPs were seen as a contributing factor in the explained variance.

Practical implications

Dysfunctional beliefs about MSP may contribute to pain intensity and limitations in physical functioning. Higher IP scores on *Consequences*, *Identity* and *Coherence* were associated with higher pain intensity. Higher IP scores on *Consequences*, *Treatment Control*, *Identity* and *Concern* were associated with greater limitations in physical functioning. Due to the cross-sectional design of our study, a *Causal* inference cannot be drawn, but this *Causal* interference has already been shown in cohorts of patients with persistent pain from repetitive strain injury[35] and low back pain[3]. This highlights the therapeutic potential of targeting higher IP scores and trying to alter dysfunctional IPs to more favourable, functional, ones. Changing IPs is not only relevant for alleviating the burden of MSP, but also for reducing dependence on physiotherapy treatment. Higher scores on IPs are associated with more frequent use of physiotherapy[30]. Finally, our study calls for a study in which the IPs are explored longitudinally for their predictive value on pain intensity and physical functioning.

3. *The added predictive value of baseline Illness Perceptions for short-term poor recovery in musculoskeletal pain in* **chapter 5**.

Research questions:

Do Illness Perceptions add predictive value for short-term poor recovery in musculoskeletal pain? This question was split into three sub-questions:

- Do baseline IPs in MSP patients have added predictive value for poor recovery in pain intensity, physical functioning and patient global perceived effect after 3 months?
- Is there an association between the Four-Dimensional Symptom Questionnaire and the Brief IPQ-DLV?
- Is there a difference in added predictive value of poor recovery between the Four-Dimensional Symptom Questionnaire (4DSQ) and the Brief IPQ-DLV?

Summary of main findings

In addition to generic prognostic factors, the IP dimensions *Treatment Control* and *Timeline* have a small added predictive value for poor recovery from MSP in pain intensity, physical functioning and the global perceived effect. The clinical implication is limited and therefore we find assessing baseline IPs as predictors for poor recovery is not supported by the results of this study. Furthermore, the Brief IPQ-DLV showed a weak correlation with the 4DSQ for all IPs dimensions. The highest correlations (.32- .40) were found for the IP dimensions *Consequences* and *Emotional Response*. There was no difference between the predictive value for the psychological factors between these two questionnaires on poor recovery on pain

intensity, physical functioning or global perceived effect. Accordingly, no recommendations can be given for the preferred use of the 4DSQ or the Brief IPQ-DLV to assess psychological factors. One could argue that the level of patient and administrative burden is in favor of the 9-item Brief IPQ-DLV in with respect to 50-item 4DSQ [1].

The role of IPs as possible mediator has still to be researched. We recommend future research with suitable designs that can look at changeability and possible effectiveness of high IPs in patients with musculoskeletal pain.

Discussion

Most IPs did not show an added predictive value on poor recovery. The increase of explained variance is small and most of the variance remains unexplained. This is also seen in the increase of the Area Under the Curve: just 2-3 percent after adding the IPs. Furthermore, from our data a higher score on *Treatment Control* (hypothesized as higher chance for poor recovery) showed lower odds for poor recovery. This is not in line with research in patients attending a general physician, an inpatient rehabilitation program or an acupuncturist for low back pain reporting higher scores on IPs to be predictive for more limitations in physical functioning in low back pain[3,10,15,16]. We researched outpatients receiving usual physical therapy care for a wide range of MSP, which makes comparison of results difficult. Looking at the difference between good and poor clinical recovery of *Treatment Control* scores we see very small differences. This means that, although *Treatment Control* has an added predictive value, the clinical implication of our research on poor recovery prediction related to this IP is limited.

Methodological considerations

Our data originates from a convenient sample of patients who were treated in primary care by physiotherapists undergoing a 3-year master program at the University of Applied Sciences Utrecht. In this cohort study we looked at which patients, undergoing physiotherapy treatment, could be identified at baseline as being at risk for poor outcome. This means that we assumed that the physiotherapy treatment would have an effect on changing dysfunctional perceptions and improve treatment outcomes, although we did not have control on the content of the treatment delivered (usual care). Within our design, we did not have consecutive datapoints in time in order to address a mediation effect. We advise future studies on the effect of physiotherapy to address the possible mediation effect of IPs in an effect study with a repeated measure design.

Practical implications

Based on these results, we cannot recommend assessing baseline IPs as predictors for poor recovery. Nonetheless, this does not rule out the value of assessing IPs in MSP. In our study, the treatment was according to the guidelines of the Royal Dutch Society of Physical therapy or, in their absence, according to the physiotherapy usual practice. Therefore, it is unlikely that specific interventions aimed at patients' beliefs were part of the treatment. This could be of influence on the outcome of poor recovery. We recommend future research on the possible effectiveness of an IP based physical therapy intervention targeting the specific dysfunctional IPs of individual patients with disabling MSP.

Overall, the conclusions that can be drawn from the second theme of this thesis are:

- IPs do have a limited to moderate association with pain and physical function.
- A higher score on IPs could be indicative for dysfunctional IPs.
- Further research into the mediating and moderating effect of a physiotherapy treatment for dysfunctional IPs in people with MSP is recommended.

Theme 3

Treatment of Illness Perceptions

1. *The process and outcome of a case report intervention study, hypothesizing that changing dysfunctional IPs would reduce limitations in daily life* in **chapter 6**.

Research aim:

Describing the process and outcome of a case report intervention study, hypothesizing that changing dysfunctional IPs would reduce limitations in daily life.

Summary of main findings

After the patient attended seven treatment sessions within three months, six out of eight IPs items changed beyond the Smallest Detectable Change of 3 points between the first and the last treatment. The IP dimensions *Treatment Control* and *Coherence* showed a difference of 1 and 2 points. At baseline, the patient's attribution to the cause of her illness was her medical condition (OA) and her previous injury (IP *Causal*). At last treatment session she changed *Causal* Perception to her own behaviour as attribution factor. Changes in health-related outcomes were also reported. All activity limitations scored with the Patient Specific Function Score changed beyond the Smallest Detectable Change, showing clinically relevant decreases in limitations in climbing stairs, cycling and walking. Knee pain decreased significantly.

Discussion

Changing dysfunctional IPs was the starting point for each treatment session, this shaped the communication and pointed out the direction to patient's need for information. For instance, *Concern* scored high at baseline, accompanied by *Causal* attributions of injury and aging. Discussing these issues made it clear that she worried about more degeneration of her knee and that she thought exercise might damage the knee further. The patient also had a high score on *Emotional Response* and *Consequences* at baseline, indicating a high level of distress concerning her knee condition. The IPs gave direction to the communication and education about her Osteo Arthritis. This may have led to a shift in IPs. Conversely, it can also be argued that the applied co-interventions, i.e. exercise may have led to better physical functioning, thereby leading to a shift in IPs. The *Causal* pathway led to better functioning cannot be given.

Methodological considerations

The physiotherapist in our case report can be classified as an expert based on the criteria mentioned by Jensen et al[20]. Knowledge and skills in areas of patient-centeredness, clinical reasoning, clinical assessment and commitment to patient preferences and values are conditional. Physiotherapists should be taught in applying the process of participatory decision making and in addressing IPs as an attribute of patients' health status.

Practical implications

The implications from this case report for physiotherapy management are limited, but our result stimulate further research on the possible attribution on changing dysfunctional IPs. Its mediation or moderation effect on health outcome is relevant for understanding pathways of the effect of IPs on outcomes. A better understanding of this pathway gives direction on how to interpret the importance of changing dysfunctional IPs for better health related outcomes.

2. *Illness Perceptions mediate and moderate the effect of matched-care physiotherapy in patients with disabling persistent low back pain:*
a multiple Single-Case Experimental Design in **chapter 7**.

Research questions:

- Do pain intensity, physical functioning and pain interference change significantly during and after matched care physiotherapy treatment?
- Do Illness Perceptions mediate the relation between matched care physiotherapy with pain intensity, physical functioning and pain interference?
- Do baseline Illness Perceptions moderate the effect of Illness Perceptions on pain intensity, physical functioning and pain interference?

Summary of main findings

Nine patients with persistent back pain were included by six different primary care physiotherapists. These patients were measured several times before, during and after treatment, resulting in 196 data points. For all three primary outcomes (pain intensity, physical functioning and pain interference in daily life) there was a significant treatment effect during treatment which continued after treatment. Adjustment for fear of movement, catastrophizing, avoidance, somberness and sleep slightly attenuated the results. Overall, the effect of all 3 primary outcomes during treatment did not wash-out within 3-months post treatment and all three primary outcomes maintained a clinical meaningful improvement of ≥ 30% from baseline.

Regarding the mediation effect of IPs, expressed as percentage of the total effect of the intervention on the three outcomes our data showed the following results: for the IP dimensions *Consequences* (45-56%), *Personal Control* (11-19%), *Identity* (41-60%), *Concern* (15-34%) and *Emotional Response* (12-38%).

As for the moderating effect of IPs on the three outcomes, *Personal Control* acted as a moderator for all three primary outcomes, with clinically relevant changes 3-months post treatment (≥30% improvement from baseline).

Discussion

The findings of this study might be heuristic for future research to focus on how targeting a treatment on dysfunctional IPs could potentially influence pain and physical functioning. This SCED study was especially designed to match a patient's needs to specific treatment strategies and treatment modalities. To apply such strategies requires a physiotherapist who is able to address patients' specific needs and is able to choose relevant strategies for intervention that matches these needs. These needs can be found in dysfunctional IPs. For instance, a patient with safety behaviors may avoids certain movements such as bending forward based on dysfunctional IPs on the dimensions of *Consequences*, *Personal Control*, *Identity*, *Concern* and Emotional Response. The physiotherapist has to reason by which strategy (cognitive, exposure or respondent) this patient is best managed in order to change the dysfunctional IPs. This suggests that physiotherapists need a variety of competences in order to be able to deliver such approach and this may not be present without specific education.

Methodological considerations

In the paper several issues were already discussed. Here we would like to address additional considerations. For instance, the decision of the therapist to apply a certain cognitive, ex-

posure or respondent strategy, in order to which dysfunctional IPs, the therapist aimed to intervene on, was not made transparent. Hereby, the reproducibility the study Concerning the selection of the treatment strategy was hampered. So, in further research we would like to focus on the treatment validity of the intervention. Hereby it makes the understanding on when to choose which strategy more feasible.

Further, we choose to analyse our data by using a linear mixed model with repeated measures. This is not in line with the recommendation by SCED guidelines. The reason for our choice is that more robust results can be presented with linear mixed model analysis on the mediation and moderation effect of IPs, besides visual analysis as recommended by SCED guidelines.

Practical implications

An important finding of this study is that baseline IP *Personal Control* moderates the physiotherapy treatment effects. For daily practice we advise physiotherapist therefore to assess patients' baseline beliefs on how they feel they are in control of their MSK pain. This can be easily assessed by the third question of the Brief IPQ-DLV. A low, non-converted, score on this IP dimension (3 or less on 0-10) can be used to design a part of a matched care with the goal of improving patients' controllability of their MSP.

Furthermore, to monitor the IP dimensions *Consequences*, *Personal control*, *Identity*, *Concern* and *Emotional Response* during treatment can be advised for their mediation effect on treatment outcome.

Overall, the conclusions that can be drawn from the third theme of this thesis are:

- The IPs dimension *Personal Control* moderates the outcome of a matched care physiotherapy treatment. So, it is worthwhile to address patients' *Personal Control* beliefs at baseline and if dysfunctional, alter it to a more functional perception.
- The IP dimensions *Consequences*, *Personal Control*, *Identity*, *Concern* and *Emotional Response* had a mediation effect and therefor are recommended to be incorporated during physiotherapy treatment to alter them from dysfunctional to more functional perceptions.
- Further research is needed to explore which modalities of a physiotherapy intervention are best to use for altering dysfunctional perceptions. In addition, intervention studies with control groups on the effect of a marched care physiotherapy intervention to alter dysfunctional perception is recommended.

General conclusions

This thesis presents research that indicates the supportive role of IPs in the physiotherapy management of MSP. Using a short, for the Netherlands, validated questionnaire can be seen as a first step for clinicians to inventory patients' perceptions about their MSP. Subsequently, further in-depth qualitative analysis of IPs and their role on how they affect patients' pain and physical functioning within the physiotherapy community is needed since such research is lacking in literature.

When looking to *if* and *how* IPs contribute to the burden patients with MSP experience, our research diverges from traditional research done in the more psychological literature[18]. We used different designs and statistical analyses to research the impact of IPs on pain intensity and physical functioning, resulting in our conclusions:

- The Brief Illness Perception Questionnaire Dutch Language Version can be used, in combination with a personal interview, in primary physiotherapy care to assess patients' perceptions about their illness.
- Baseline Illness Perceptions are not predictive for poor recovery at 3-months in standard physiotherapy management of musculoskeletal pain.
- The Illness Perceptions *Consequences*, *Personal Control*, *Identity*, *Concern* and *Emotional Response* significantly mediate the effect of matches care physiotherapy management in patients with persistent low back pain.
- The Illness Perception *Personal Control* significantly moderates the effect of matches care physiotherapy management in patients with persistent low back pain.

Based on this research we support the ongoing development in physiotherapy practice towards a more systematic inclusion of management of IPs in interventions on MSP. Taking IPs into account has some positive effect on physiotherapy care and the health of the population. In addition, new approaches like making use of these IPs builds on knowledge and expertise from different domains and fits into modern health care systems.

Recommendations for research:

- Investigate the possible improvement of the Brief IPQ-DLV by 'thinking-aloud' studies within population of people with MSP.
- Carry out additional matched care intervention studies of changing dysfunctional IPs and their impact om PI and FP in people with musculoskeletal pain.
- Conduct research on larger groups to investigate more precisely the moderation and mediation effect of each individual IP on MSP management outcomes.

Recommendations for clinical practice:

- To this end, make use of the Brief IPQ-DLV, followed up by interview to qualitative explore patients' perceptions.
- Explore patients' disfunctional perception about *Personal Control* before treatment and try to alter the disfunctional level of *Personal Control* perception.
- Monitor patients' perceptions about *Consequences*, *Personal Control*, *Identity*, *Concern* and *Emotional Response* during treatment and try to avoid disfunctional levels of these perceptions.

REFERENCES

1. Auger C, Demers L, Swaine B. Making sense of pragmatic criteria for the selection of geriatric rehabilitation measurement tools. Archives of Gerontology and Geriatrics. 2006;43(1):65-83.
2. Beaton DE, Bombardier C, Guillemin F, Ferraz MB. Guidelines for the Process of Cross-Cultural Adaptation of Self-Report Measures. spine. 2000;25(24):3186-3191.
3. Bishop FL, Yardley L, Prescott P, Cooper C, Little P, Lewith GT. Psychological Covariates of Longitudinal Changes in Back-related Disability in Patients Undergoing Acupuncture. The Clinical Journal of Pain. 2015;31(3):254-264.
4. Blyth FM, Briggs AM, Schneider CH, Hoy DG, March LM. The Global Burden of Musculoskeletal Pain-Where to From Here? Am J Public Health. 2019;109(1):35-40.
5. Booth J, Moseley GL, Schiltenwolf M, Cashin A, Davies M, Hübscher M. Exercise for chronic musculoskeletal pain: A biopsychosocial approach. 2017;93(11):2109-2109.
6. Broadbent E, Petrie KJ, Main J, Weinman J. The brief illness perception questionnaire. Journal of Psychosomatic Research. 2006;60(6):631-637.
7. Bunzli S, McEvoy S, Dankaerts W, OSullivan P, O'Sullivan K. Patient Perspectives on Participation in Cognitive Functional Therapy for Chronic Low Back Pain. physical therapy. 2016;96(9):1397-1407.
8. Bunzli S, Smith A, Schütze R, lin I, OSullivan P. Making Sense of Low Back Pain and Pain-Related Fear. J Orthop Sports Phys Ther. 2017;47(9):628-636.
9. Bunzli S, Smith A, Schütze R, OSullivan P. Beliefs underlying pain-related fear and how they evolve: a qualitative investigation in people with chronic back pain and high pain-related fear. BMJ Open. 2015;5(10):e008847–11.
10. Campbell P, Foster NE, Thomas E, Dunn KM. Prognostic Indicators of Low Back Pain in Primary Care: Five-Year Prospective Study. The Journal of Pain. 2013;14(8):873-883.
11. Caneiro JP, Bunzli S, OSullivan P. Beliefs about the body and pain: the critical role in musculoskeletal pain management. Brazilian Journal of Physical Therapy. June 2020:1-13.
12. Caneiro JP, Roos EM, Barton CJ, et al. It is time to move beyond "body region silos" to manage musculoskeletal pain: five actions to change clinical practice. British Journal of Sports Medicine. October 2019:bjsports–2018–100488–2.
13. Darlow B, Dean S, Perry M, Mathieson F, Baxter GD, Dowell A. Easy to Harm, Hard to Heal. spine. March 2015:1-9.
14. Diefenbach MA, Leventhal H. The common-sense model of illness representation: Theoretical and practical considerations. journal of social distress and the homeless. 1996;5(1):11-38.
15. Foster NE, Bishop A, Thomas E, et al. Illness perceptions of low back pain patients in primary care: What are they, do they change and are they associated with outcome? Pain. 2008;136(1):177-187.
16. Glattacker M, Heyduck K, Meffert C. Illness beliefs and treatment beliefs as predictors of short-term and medium-term outcome in chronic back pain. Journal of Rehabilitation Medicine. 2013;45(3):268-276.
17. Hagger M, Orbell S. A Meta-Analytic Review of the Common-Sense Model of Illness Representations. Psychology & Health. 2003;18(2):141-184.

18. Hagger MS, Koch S, Chatzisarantis NLD, Orbell S. The Common Sense Model of Self-Regulation: Meta-Analysis and Test of a Process Model. Psychological Bulletin. August 2017:1-39.
19. Holopainen R, Simpson P, Piirainen A, et al. Physiotherapists' perceptions of learning and implementing a biopsychosocial intervention to treat musculoskeletal pain conditions. Pain. 2020;Articles in Press:1-19.
20. Jensen GM, Gwyer J, Shepard KF. Expert practice in physical therapy. physical therapy. 2000;80(1):28–43–discussion44–52.
21. Leventhal H, Meyer D, nerenz D. The Common Sense Representation of Illness Danger. In: Rachman S, ed. Medical Psychology. Vol II. Pergamon Press; 1980:7-29.
22. Lewis J, OSullivan P. Is it time to reframe how we care for people with non-traumatic musculoskeletal pain? British Journal of Sports Medicine. 2018;52(24):1543-1544.
23. Liberati A, Altman DG, Tetzlaff J, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. Journal of Clinical Epidemiology. 2009;62(10):e1-e34.
24. Macfarlane GJ. Changing patient perceptions of their illness: Can they contribute to an improved outcome for episodes of musculoskeletal pain? Pain. 2008;136(1-2):1-2.
25. Machado V, Botelho J, Ramos C, et al. Psychometric properties of the Brief Illness Perception Questionnaire (Brief-IPQ) in periodontal diseases. J Clin Periodontol. 2019;46(12):1183-1191. doi:10.1111/jcpe.13186.
26. Mokkink LB, de Vet HCW, Prinsen CAC, et al. COSMIN Risk of Bias checklist for systematic reviews of Patient-Reported Outcome Measures. Qual Life Res. 2018;27(5):1171-1179. doi:10.1007/s11136-017-1765-4.
27. Moseley GL. Evidence for a direct relationship between cognitive and physical change during an education intervention in people with chronic low back pain. European Journal of Pain. 2004;8(1):39-45.
28. Moss-Morris R, Weinman J, Petrie KJ, Horne R, Cameron LD, Buick D. The revised Illness Perception Questionnaire (IPQ-R). Psychology & Health. 2002;17(1):1-17.
29. O'Sullivan K, Dankaerts W, O'Sullivan L, O'Sullivan PB. Cognitive Functional Therapy for Disabling Nonspecific Chronic Low Back Pain: Multiple Case-Cohort Study. physical therapy. 2015;95(11):1478-1488.
30. Opseth G, Wahl AK, Bjørke G, Mengshoel AM. Negative perceptions of illness and health are associated with frequent use of physiotherapy in primary healthcare. 2017;16(1):133-138.
31. OSullivan P, Caneiro JP, O'Keeffe M, O'Sullivan K. Unraveling the Complexity of Low Back Pain. J Orthop Sports Phys Ther. 2016;46(11):932-937.
32. Prinsen CAC. COSMIN guideline for systematic reviews of patient-reported outcome measures. Qual Life Res. 2018;0(0):0-0.
33. Shea BJ, Hamel C, Wells GA, et al. AMSTAR is a reliable and valid measurement tool to assess the methodological quality of systematic reviews. Journal of Clinical Epidemiology. 2009;62(10):1013-1020.
34. Siemonsma PC, Stuive I, Roorda LD, et al. Cognitive treatment of illness perceptions in patients with chronic low back pain: a randomized controlled trial. physical therapy. 2013;93(4):435-448.
35. Sluiter JK, Frings-Dresen MHW. Quality of life and illness perception in working and sick-listed chronic RSI patients. Int Arch Occup Environ Health. 2007;81(4):495-501.

36. Terwee CB. COSMIN methodology for evaluating the content validity of patient- reported outcome measures: a Delphi study. Qual Life Res. 2018;0(0):0-0.
37. van Oort L, Schröder C, French DP. What do people think about when they answer the Brief Illness Perception Questionnaire? A "think-aloud" study. British Journal of Health Psychology. 2011;16(Pt 2):231-245.
38. van Wilgen P, Beetsma A, Neels H, Roussel N, Nijs J. Physical therapists should integrate illness perceptions in their assessment in patients with chronic musculoskeletal pain; a qualitative analysis. manual therapy. 2014;19(3):229-234.
39. Vos T, Flaxman AD, Naghavi M, Lozano R, Michaud C. Years lived with disability (YLDs) for 1160 sequelae of 289 diseases and injuries 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. lancet. 2013;380(9859):2163-2196.
40. Weinman J, Petrie KJ, Moss-Morris R, Horne R. The Illness Perception Questionnaire: a new method for assessing the cognitive representation of illness. Psychology & Health. 1996;11:431-446.

A

Summary

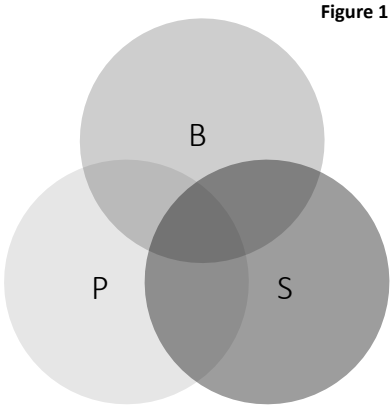
Introduction

Introduction and aim of this thesis.

Chapter 1

For decades, the number of people with musculoskeletal pain (MSP) and limitations in physical functioning has been increasing. These people regularly seek help from physiotherapists using the BioPsychoSocial model **(Figure1)** for diagnosis and treatment. In this model, each domain comprises different factors that contribute to the cause or continuity of MSP and to limitations in physical functioning. One of these factors in the psychological domain is that of illness perceptions.

Figure 1



B = Biomedical; P = Psycological; S = Social

These illness perceptions (IPs) are the ideas and thoughts that people have about the pain and the limitations in physical functioning that they experience. Ideas and thoughts can affect the continuity of pain and limitations in physical functioning so the assessment and treatment of IPs could be a part of physiotherapy health care. IPs are described in the 'The Common-Sense Model of self-regulation of health and illness' (CSM, **figure 2**).

The CSM starts with an experience that threatens the health of a person. This can be an illness or the development of symptoms (such as pain or limitations in physical functioning). Following this experience, for example low back pain (LBP), the person will ask such questions about the pain as:

- What is wrong with me?
- How long will it last?
- What are the consequences?
- What can be done about it?
- What is the cause?

The answers to these questions are called representations or perceptions. These perceptions will influence the different coping styles people use. Some people might stop moving their backs and seek help or treatment from health care professionals, while others continue life as if there is no health threat present. The feedback loop in the model evaluates whether the health threat is reduced because of the person's perceptions and behaviours.

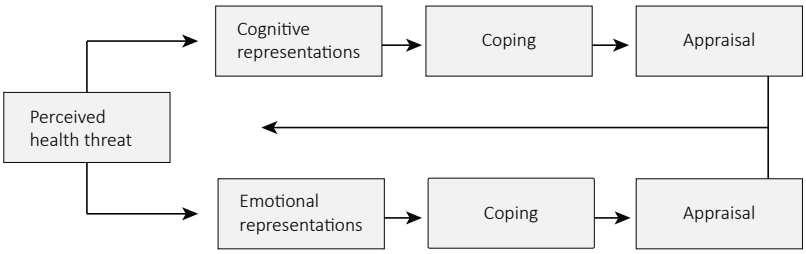


Figure 2 = CSM model

Nine different dimensions of perceptions are reported in the literature:

1. *Consequences* : The expected effects and outcome of the health threat on sign and symptoms
2. *Timeline* : How long will the illness last
3. *Personal Control* : The amount of control over the illness by the person himself
4. *Treatment Control* : The effectiveness of a treatment for the illness
5. *Identity* : Symptoms experienced by the individual
6. *Concern* : Concerns about the illness
7. *Coherence* : Understanding of the illness
8. *Emotional Response* : The effects of the illness on emotions
9. *Cause* : Cause of the illness

Perceptions can be labelled as functional or dysfunctional. Perceptions are dysfunctional when associated with increasing signs and symptoms, such as pain intensity and limitations in physical functioning. For many years, the CSM has been the starting point for research into the associations of perceptions and symptoms of medical disorders like rheumatism, heart failure and lung diseases. Less research has been done into the MSP population.

The aim of the research reported in this thesis was to investigate the role of IPs in patients with MSP, i.e. low back pain, in primary physiotherapy care in the Netherlands.
In this thesis, three themes are presented:

1. Assessing illness perceptions by use of a questionnaire. **(Chapter 2)**.
2. The association of illness perceptions with pain intensity and of illness perceptions with physical functioning **(Chapters 3, 4 and 5**).
3. The effectiveness of a physiotherapy intervention on IPs, pain intensity and physical functioning **(Chapters 6 and 7)**.

Theme 1

Assessing illness perceptions by use of a questionnaire.

Chapter 2

We have translated and adapted an existing English language illness perceptions questionnaire We have translated and adapted an existing English language IP questionnaire into a Dutch language version (Brief IPQ-DLV), using all stages of cross-cultural translation and validation, including a research team of native speakers in Dutch and/or English.

The Brief IPQ-DLV has nine items, each question representing one IP dimension.
Our research showed it takes less than five minutes to complete the Brief IPQ-DLV. The content validity was tested on a panel of patients from primary physiotherapy care and freshman high school students and found to be acceptable. All participants understood the meaning of all nine questions.

We were able to assess the concurrent validity (Do they measure what they are designed for to measure?) of four questions (i.e. dimensions); there was no comparable measurement instrument found eligible for the other five questions. The four dimensions, *Consequences, Personal Control, Concern and Emotional Response*, showed significant associations with a comparable measuring instrument for each domain.

Theme 2

The association of illness perceptions with pain intensity and of illness perceptions with physical functioning

Chapter 3

The systematic literature review had two research questions:

1. What are the associations of illness perceptions with pain intensity and of illness perceptions with physical functioning in patients with musculoskeletal pain?
2. Can illness perceptions predict the degree of pain intensity or physical functioning in patients with musculoskeletal pain?

Ad 1: There is evidence that all IP dimensions are positively associated with pain intensity and/or physical functioning. This is demonstrated in nine cross-sectional studies. The outcomes show that higher scores on IP questions are associated with higher pain intensity and higher limitations in physical functioning. Therefore, a high score on an IP question can be labelled as dysfunctional.

These associations are not strong, and all studies are of a moderate methodological quality. The associations of IPs with pain intensity and physical functioning were consistent across various musculoskeletal disorders, such as rheumatoid arthritis, low back pain, different forms of chronic pain, and fibromyalgia.

Ad 2: In the systematic review, two studies showed a predictive value for the illness perceptions dimensions *Consequences, Personal Control, Treatment Control, Coherence* and *Emotional Response* for higher pain intensity six months after the baseline measurements. Three studies reported a predictive value for the IP dimensions *Consequences, Timeline* and *Identity* for higher pain intensity between six and 12 months after the baseline measurements. No studies included a follow-up more than twelve months. The predictive values found are not strong and of moderate methodological quality.

Studies on whether illness perceptions can predict limitations in physical functioning were found more often. Nine studies report a predictive value of all IPs dimensions except *Treatment Control* for more limitations in physical functioning six months after baseline measurements. One study shows a predictive value of the IPs dimensions *Timeline, Personal Control* and *Identity* for more disabilities in physical functioning between six and twelve months after baseline measure. Two studies report predictive values of IPs dimensions *Consequences, Timeline, Treatment Control* and *Identity* more than twelve months after baseline measurements. It must be noted that the predictive values found are not strong and the methodological quality of the studies is moderate.

Chapter 4

We performed a cross-sectional study among 658 patients with MSP in 29 primary care physiotherapy settings. First, we were interested in whether the IPs that patients have about MSP differ as pain persists longer. Pain duration was classified as follows: acute pain (< 7 weeks), subacute pain (7-13 weeks) and persistent, chronic pain (> 13 weeks). Significant differences were found in IPs with regard to pain duration but these differences were small, less than two points on a 0-10 scale. Only the IP dimension *Timeline* shows a larger difference between acute and persistent pain, namely three points on a 0-10 scale. Patients who had experienced pain for more than 13 weeks also scored higher on the question 'How long do you think your pain will last?'

Secondly, we were interested in the association between IPs and pain intensity and the association with limitations in physical functioning. We took into account other known prognostic factors like pain intensity, duration of pain, degree of disabilities in daily life, located in more than two pain sites and psychological factors of distress, somatization, depression and fear. By means of a multiple linear regression, adjusted for gender, age and

the known factors as described above, we analysed the additional explained variance of IPs on pain intensity and limitations in physical functioning. The model showed for pain intensity an explained variance without the IPs of 9.6%, and with the IP dimensions *Consequences, Identity* and *Coherence* 22.9%.

For physical functioning, the model showed an explained variance without the IPs of 5.7%, and with the IPs dimensions *Treatment Control, Identity* and *Concern* 32.2%.

Due to the cross-sectional design, a causal inference cannot be drawn.
We concluded that some IP dimensions showed extra explained variance. Therefore, we recommended future research with different designs on the predictive and/or causal associations between IPs and pain intensity or limitations in physical functioning.

Chapter 5
In this chapter, we explored whether baseline IPs have added predictive value for poor recovery after three months. We performed a longitudinal study among 251 patients with MSP in 29 different primary care physiotherapy settings.
We looked at global perceived effect of regular physiotherapy treatment and poor recovery of pain intensity and physical functioning. By means of a hierarchical logistical regression, IPs were added to the model after adjusting for gender, age, pain intensity, duration of pain, degree of limitations in physical functioning in daily life, pain located in more than two pain sites and psychological factors like distress, somatisation, depression and fear. The outcome of the analysis showed that baseline IPs did not add predictive value for poor recovery after three months. The IP dimensions Timeline and *Treatment Control* made statistically significant contributions to the model. The 'Area Under the Curve' increased by 2-3% after the addition of these IPs. This small increase led to the conclusion that IPs in our study did not add predictive value for poor recovery in pain intensity, limitations in physical functioning and the global perceived effect.

Theme 3

The effectiveness of a physiotherapy intervention on IPs, pain intensity and physical functioning

Chapter 6
This chapter describes a case study of a female patient aged 45 with post-traumatic secondary osteoarthritis of the lateral patellofemoral cartilage and persistent pain with limitations in physical functioning. The course of changed IPs, pain intensity and limitations in physical functioning was described. The presence of dysfunctional IPs prior to the treatment made

this patient eligible for assessment of changes in IPs, pain intensity and limitations in physical functioning during the physiotherapy treatment.

The hypothesis was that changing dysfunctional IPs into more functional ones would reduce pain intensity and limitations in physical functioning.

After the patient had attended seven treatment sessions within three months, changes to more functional perceptions were found on all IP dimensions. Although the dimension *Coherence* could not be evaluated as dysfunctional (score 9 on 0-10 scale) before treatment started, the dimension did change (with this patient) during the treatment. Initially, she had the perception that the symptoms were caused by a degenerated knee due to her age. Her perception changed after the explanation that the medical classification of the condition of her knee did not necessarily imply persistent symptoms like pain and limitations in physical functioning.

Based on this case study, no conclusions can be drawn on whether changes in perception had a causal association with changes in pain intensity and limitations in physical functioning. Neither can a direction be given for a possible causal association. Do the perceptions change pain intensity and physical functioning or do pain intensity and physical functioning change the perceptions?

Further and more extensive research on the role, mediation and/or moderation, of perceptions on changes of pain intensity and physical functioning is recommended.

Chapter 7

In this study, a multiple baseline single-case experimental design (SCED) was used to evaluate the effects of changed IPs on pain intensity and limitations in physical functioning. The IPs' moderating and/or mediating effects in a "matched-care" physiotherapy on pain intensity and physical functioning were evaluated. Nine patients with persistent back pain were included in the study.

First of all, physiotherapy treatment showed a significant decrease in pain intensity and limitations in physical functioning after treatment, which continued three months post-treatment. Each matched-care intervention was specifically adjusted, prior to a physiotherapy intervention, for the dysfunctional IPs at that moment.

This research showed that dysfunctional IPs mediated the effect of the treatment. In particular, changes in the IP dimensions C*onsequences, Personal Control, Identity, Concern* and *Emotional Response* explained a significant part of the outcome, during treatment as well

as post-treatment. For future research, it would be useful to assess the IPs and their changes during physiotherapy treatment and to integrate the assessments into the treatment plan. Furthermore, we established that the IP dimension *Personal Control* acted as a moderator in our study. This means that, if a patient at the beginning of the physiotherapy treatment exhibited a dysfunctional *Personal Control* IP, it predicted a poorer result for the physiotherapy treatment. We recommend assessing patients' *Personal Control* IPs at baseline, before the start of the physiotherapy treatment, and try to improve these by, for instance, building on self-efficacy.

Chapter 8

General conclusions:

Based on this thesis and looking at whether and how IPs affect the symptoms of MSP, we conclude:

- The Brief IPQ-DLV can be used, in combination with a personal interview, in primary physiotherapy care to assess patients' perceptions about their illness.
- Baseline IPs are not predictive for recovery outcomes at 3 months in the physiotherapeutic management of MSP.
- The IPs *Consequences, Personal Control, Identity, Concern* and *Emotional Response* significantly mediate the effect of physiotherapy management in patients with persistent low back pain.
- The IP *Personal Control* significantly modifies the effect of physiotherapy management in patients with persistent low back pain.

Recommendations for further research:

- Investigate potential improvements of the Brief IPQ-DLV with 'thinking-aloud' studies with people with MSP.
- Carry out additional matched-care intervention studies of changing dysfunctional IPs and the impact of this on pain intensity and physical functioning in people with MSP.
- Conduct research on larger groups to investigate more precisely the modifying and mediation effects of each individual IP on MSP management outcomes.

Recommendations for clinical practice:

- To this end, make use of the Brief IPQ-DLV, followed up by interview to qualitatively explore patients' perceptions.
- Explore dysfunctional IP dimensions *Consequences, Personal Control, Identity, Concern* and *Emotional Response* during physiotherapy treatment, for their mediating effect.
- Explore the dysfunctional IP dimension *Personal Control* before physiotherapy treatment for its moderating effect.

A

Samenvatting

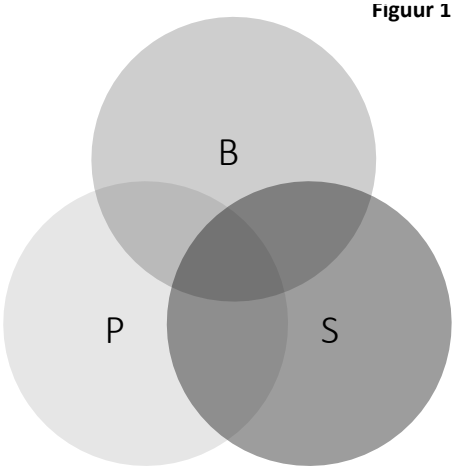
Introductie

De inleiding en aanleiding van dit proefschrift.

Hoofdstuk 1

Al decennialang stijgt het aantal mensen met musculoskeletale pijn en beperkingen in fysiek functioneren. Vaak wordt hiervoor hulp gezocht bij de fysiotherapie. Voor de diagnostiek en behandeling gebruikt de fysiotherapeut het BioPsychoSociaal model (**figuur 1**).

Figuur 1



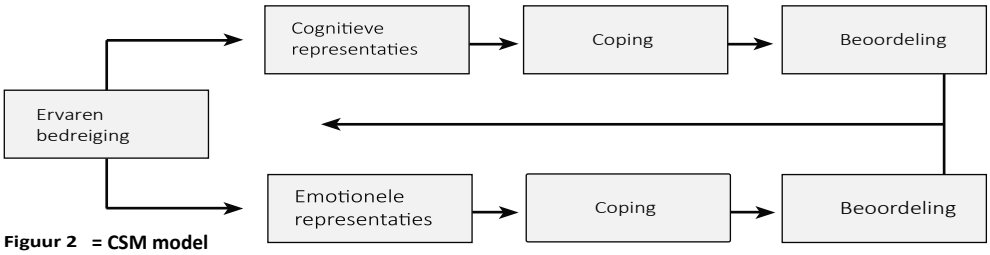
B = Biomedisch; P = Psychologisch; S = Sociaal

Dit model bestaat uit een biomedisch, psychologisch en sociologisch domein. Ieder domein heeft verschillende factoren die bijdragen aan het ontstaan of het in stand houden van musculoskeletale pijn en beperkingen. Een van deze factoren binnen het Psychologische domein zijn ziektepercepties. Deze ziektepercepties zijn de ideeën en gedachten die mensen hebben over de pijn en de beperkingen die ze ervaren en kunnen het ontstaan of het in stand houden van pijn en beperkingen beïnvloeden. Hierdoor is het inventariseren en behandelen van deze ziektepercepties een onderdeel van het fysiotherapeutisch handelen.

Ziektepercepties worden beschreven in de Engelstalige literatuur vanuit het volgende model: 'The common-sense model of self-regulation of health and illness' (CSM, **figuur 2**). Het CSM start met een ervaring, waarbij de gezondheid bedreigd wordt. Dit kan een ziekte zijn of het ontwikkelen van klachten (bijvoorbeeld pijn of beperkingen in fysiek functioneren). Als gevolg van de ervaren bedreiging, bijvoorbeeld lage rugpijn, vragen mensen zich af:

- Wat heb ik?
- Hoelang gaat het duren?
- Wat zijn de gevolgen?
- Wat is eraan te doen?
- Wat is de oorzaak?

De antwoorden op deze vragen worden representaties of percepties genoemd. Het zijn deze percepties die het gedrag van mensen beïnvloeden. De een zal hulp zoeken, de ander zal doorgaan alsof er niets aan de hand is. Door de feedback loop in het model wordt beoordeeld de klachten afnemen door de percepties en het gedrag.



Figuur 2 = CSM model

Er worden negen verschillende dimensies van percepties in de literatuur beschreven:

1. *Gevolgen* : de invloed van de klachten op het leven
2. *Tijdsduur* : hoelang de klachten zullen duren
3. *Persoonlijke controle* : de controle die je zelf hebt over de klachten
4. *Behandelcontrole* : de werkzaamheid van een behandeling voor de klachten
5. *Mate van klachten* : hoe sterk worden de klachten ervaren
6. *Bezorgdheid* : de zorgen over de klachten
7. *Begrip* : begrijpen over wat er aan de hand is
8. *Emotionele gevolgen* : de invloed van de klachten op emoties
9. *Oorzaak* : de oorzaak van de klachten

Percepties kunnen als functioneel of disfunctioneel gezien worden. Percepties zijn disfunctioneel als ze geassocieerd worden met toenemende klachten, zoals pijn en beperkingen in fysiek functioneren. Het CSM is al vele jaren het uitgangspunt voor onderzoek naar de invloed van ziektepercepties op klachten bij medische aandoeningen zoals reuma, hartfalen en longziekten. Er is minder onderzoek gedaan naar de invloed van percepties op musculoskeletale klachten.

Het doel van dit proefschrift is de invloed van ziektepercepties op musculoskeletale klachten te onderzoeken, bijvoorbeeld bij lage rugpijn, in de eerstelijns fysiotherapie in Nederland.

Dit proefschrift heeft drie thema's:

1. Het inventariseren van ziektepercepties door middel van een vragenlijst **(Hoofdstuk 2)**,
2. De associatie tussen ziektepercepties en pijnintensiteit en tussen ziektepercepties en fysiek functioneren **(Hoofdstuk 3, 4 en 5)**,
3. De invloed van een fysiotherapie behandeling op de ziektepercepties, de pijnintensiteit en fysiek functioneren **(Hoofdstuk 6 en 7)**.

Thema 1

Het inventariseren van ziektepercepties door middel van een vragenlijst.

Hoofdstuk 2

We hebben een bestaande Engelstalige ziekteperceptie-vragenlijst vertaald voor het Nederlandse taalgebied. Daarbij zijn de richtlijnen gevolgd voor cross-culturele adaptatie en validatie. De verschillende fases van het vertalen zijn doorlopen. Hierbij was een team van onderzoekers met als moedertaal Nederlands en/of Engels een voorwaarde.

Daarna is de 9-vragen tellende vragenlijst (IPQ-k), waarvan iedere vraag één dimensie representeert, getoetst op haar kwaliteit in de eerstelijns fysiotherapie. Hieruit is gebleken dat de vragenlijst snel is in te vullen, gemiddeld in minder dan vijf minuten. De content validiteit is zowel bij patiënten uit de eerstelijns fysiotherapie met musculoskeletale klachten en brugklasleerlingen van een middelbare school getoetst, zij gaven aan alle 9 vragen te begrijpen.

We hebben van vier vragen kunnen onderzoeken of deze meten wat ze beogen te meten, de concurrente validiteit. Voor de andere vijf vragen is geen vergelijkbaar meetinstrument gevonden om deze validiteit te onderzoeken. Voor de vier onderzochte dimensies, Gevolgen, Persoonlijke controle, Bezorgdheid en Emotionele gevolgen, zijn significante associaties gevonden met een vergelijkbaar meetinstrument voor dat domein.

Thema 2

De associatie tussen ziektepercepties en pijnintensiteit en tussen ziektepercepties en fysiek functioneren

Hoofdstuk 3

De systematische literatuurreview had twee onderzoeksvragen:

1. Wat is de associatie tussen ziektepercepties en pijnintensiteit en tussen ziektepercepties en fysiek functioneren bij mensen met musculoskeletale pijn?
2. Voorspellen ziektepercepties de mate van pijnintensiteit of fysiek functioneren bij mensen met musculoskeletale pijn?

Ad 1: We hebben bewijs gevonden dat alle dimensies van de ziektepercepties positieve associaties hebben met pijnintensiteit en/of fysiek functioneren. Dit is gevonden in negen cross-sectionele studies. De uitkomsten laten zien dat, hoe hoger de score op een ziekteperceptie vraag, hoe intensiever de pijn wordt ervaren en hoe meer beperkingen mensen bij het fysiek

functioneren ervaren. Dit betekent dat een hoge score op een ziekteperceptie dimensie gelabeld kan worden als disfunctionele.

Deze verbanden zijn echter niet heel sterk en de studies zijn van een matige methodologische kwaliteit. De richting van de verbanden tussen de ziektepercepties en pijnintensiteit en fysiek functioneren waren consistent bij verschillende musculoskeletale aandoeningen, zoals reumatoïde artritis, lage rugpijn, chronisch pijn en fibromyalgie.

Ad 2: Of ziektepercepties pijnintensiteit kunnen voorspellen,blijkt in de literatuur weinig onderzocht. In twee studies wordt een voorspellende waarde van de ziekteperceptie-dimensies *Gevolgen, Persoonlijke controle, Behandelcontrole, Begrip* en *Emotionele gevolgen* gerapporteerd voor een sterkere pijnintensiteit na zes maanden na de baseline meting. In drie studies wordt een voorspellende waarde van de ziekteperceptie-dimensies *Gevolgen, Tijdsduur* en *Mate van klachten* gerapporteerd voor sterkere pijnintensiteit tussen zes en twaalf maanden na de baseline meting. Er is geen onderzoek gevonden over voorspellende waarden langer dan 12 maanden na baseline. De gevonden voorspellende waarden zijn niet sterk en de literatuur is van matige methodologische kwaliteit.

Of ziektepercepties beperkingen in fysiek functioneren kunnen voorspellen, is in de literatuur vaker onderzocht. In negen studies wordt een voorspellende waarde van alle ziekteperceptie-dimensies behalve *Behandelcontrole* gerapporteerd voor meer beperkingen in fysiek functioneren na zes maanden van de baseline meting. In één studie wordt een voorspellende waarde van de ziekteperceptie dimensies *Tijdsduur, Persoonlijke controle* en *Mate van klachten* gerapporteerd voor meer beperkingen in fysiek functioneren tussen de zes en twaalf maanden na de baseline meting. Er zijn twee onderzoeken gevonden die voorspellende waarden van de ziekteperceptie-dimensies *Gevolgen, Tijdsduur, Behandelcontrole* en *Mate van klachten* rapporteren voor langer dan 12 maanden na de baseline meting. Opgemerkt moet worden dat ook hier de gevonden voorspellende waarden niet sterk zijn en dat de studies van matige methodologische kwaliteit zijn.

Hoofdstuk 4

We hebben een cross-sectionele studie uitgevoerd onder 658 patiënten met musculoskeletale pijnklachten bij 29 verschillende eerstelijns fysiotherapiepraktijken.

Ten eerste waren we benieuwd of de ziektepercepties die mensen hebben over pijnklachten verschillen naar mate de klachten langer aanhouden. Daarbij zijn pijnklachten als volgt ingedeeld: acute pijn (< 7 weken), subacute pijn (7-13 weken) en aanhoudende pijn (> 13 weken). Er bleken statistisch significante verschillen te zijn in de ziektepercepties, afhankelijk

van de duur van de pijn. Groot zijn deze verschillen niet. Alleen bij de ziekteperceptie-dimensie *Tijdsduur* is het verschil tussen acute en aanhoudende pijn gemiddeld bijna 3 punten op een 0-10 schaal. Dit betekent dat patiënten die langer dan 13 weken pijn ervaren ook hoger scoren op de vraag 'Hoelang denkt u dat uw klacht zal duren?'.

Ten tweede waren we geïnteresseerd in de associatie tussen ziektepercepties en pijnintensiteit en de associatie met beperkingen in fysiek functioneren. We hebben daarbij rekening gehouden met belangrijke andere bekende factoren, zoals pijnintensiteit, pijnduur, mate van beperkingen in het dagelijks leven, pijn op meer dan twee plaatsen en de psychologische factoren zoals di-stress, somatisatie, depressie en angst. Door middel van een meervoudige lineaire regressie, gecorrigeerd voor geslacht, leeftijd en de bekende factoren, zoals hierboven beschreven, hebben we de extra verklaarde variantie van ziektepercepties geanalyseerd.

Voor pijnintensiteit laat het model een verklaarde variantie zien zonder de ziektepercepties van 9,6% en met de ziekteperceptie dimensies *Gevolgen, Mate van klachten* en *Begrip* 22,9%. Voor de beperkingen in fysiek functioneren laat het model een verklaarde variantie zien zonder de ziektepercepties van 5,7% en met de ziekteperceptie dimensies *Gevolgen, Behandelcontrole, Mate van klachten* en *Bezorgdheid* 32,2%.

Door het cross-sectioneel ontwerp kunnen deze verbanden niet causaal worden uitgelegd. Wel zien we in de resultaten dat sommige ziekteperceptie-dimensies extra verklaarde variantie aangeven. Daarom adviseren we verder onderzoek te doen met andere ontwerpen om een duidelijker beeld te krijgen van de voorspellende en of de causale verbanden tussen ziektepercepties en pijnintensiteit of ziekteperceptie en ervaren beperkingen in het fysiek functioneren.

Hoofdstuk 5

In dit hoofdstuk is onderzocht of baseline ziektepercepties voorspellend zijn voor slecht herstel na drie maanden. We hebben een longitudinale studie uitgevoerd onder 251 patiënten met musculoskeletale pijnklachten bij 29 verschillende eerstelijns fysiotherapiepraktijken.

Gekeken is naar het herstel op pijnintensiteit, fysiek functioneren en het algemeen ervaren effect van de fysiotherapie behandeling. Via een hiërarchische logistische regressie zijn ziektepercepties toegevoegd aan het model na invoering van geslacht, leeftijd, pijnintensiteit, pijnduur, mate van beperkingen in het dagelijks leven, pijn op meer dan twee plaatsen en de psychologische factoren, zoals disstress, somatisatie, depressie en angst. De uitkomsten van deze analyse laten zien dat baseline ziektepercepties geen prognostische bijdrage leveren aan slecht herstel na drie maanden. De ziekteperceptie-dimensies *Tijdsduur* en *Behandelcontrole*

laten een statistisch significante bijdrage zien aan het model. De 'Area Under the Curve' neemt na het toevoegen van deze percepties met 2-3% toe. Dit zijn kleine toenames, waardoor wij concluderen dat ziektepercepties in ons onderzoek geen prognostische factor zijn voor slecht herstel van de pijnintensiteit, ervaren beperkingen in fysiek functioneren en het algemeen ervaren effect.

Tevens hebben we onderzocht of de ziekteperceptie-vragenlijst IPQ-k in vergelijking met de Vier-Dimensionele Klachtenlijst (4-DKL) een andere voorspellende waarde kan hebben voor slecht herstel. De associatie tussen de IPQ-k en de 4-DKL was zwak tot matig, wat betekent dat beide vragenlijsten qua inhoud voor een deel overlap vertonen, maar mogelijk ook andere constructen in kaart brengen.

Thema 3

De invloed van een fysiotherapie behandeling op de ziektepercepties, de pijnintensiteit en fysiek functioneren.

Hoofdstuk 6

In deze casestudie wordt het verloop van ziektepercepties, pijnintensiteit en ervaren beperkingen in fysiek functioneren beschreven bij een vouw van 45 jaar met posttraumatische secundaire artrose van het laterale patello-femorale kraakbeen met aanhoudende pijn en beperkingen in het dagelijks leven. De disfunctionele ziektepercepties, pijnintensiteit en beperkingen in fysiek functioneren voorafgaande aan de behandeling maakte deze patiënt geschikt om het proces van veranderingen in percepties, pijnintensiteit en de beperkingen in fysiek functioneren te volgen gedurende het fysiotherapeutische traject. Een aanname vooraf was dat het veranderen van disfunctionele ziektepercepties naar meer functionele percepties een afname zou laten zien op de pijnintensiteit en afname van de beperkingen in fysiek functioneren.

Gedurende zeven behandelingen in drie maanden zijn op alle ziekteperceptie-dimensies veranderingen te zien naar meer functionele percepties. Hoewel de dimensie *Begrip* niet voorafgaande aan de behandeling als disfunctioneel beoordeeld kon worden (score 9 op schaal 0-10), bleek dat deze patiënt op deze dimensie wel veranderde gedurende de behandeling. Ze had aanvankelijk de perceptie dat de klachten kwamen, doordat 'de knie is versleten door de leeftijd', dit veranderde naar de perceptie dat de medische classificatie van haar knie niet betekende dat ze er klachten van hoefde te (blijven) ervaren.

Op basis van deze casestudie kunnen geen conclusies getrokken worden of veranderingen in percepties een oorzakelijk verband hebben met de veranderingen op pijn en beperkingen

in fysiek functioneren. Ook kunnen we niet beoordelen welke richting een mogelijk verband heeft. Veranderen de percepties de pijnintensiteit of het fysiek functioneren of de pijnintensiteit en het fysiek functioneren de percepties?

Een vervolgstudie, waarin uitgebreider gekeken gaat worden naar de rol, mediatie en/of moderatie, van percepties op het veranderen van pijn en fysiek functioneren, wordt geadviseerd.

Hoofdstuk 7

In deze studie is een Single-Case Experimental Design gebruikt om naar de effecten te kijken die veranderende ziektepercepties hebben op het behandelresultaat van een 'matched-care' fysiotherapie behandeling. We waren daarbij geïnteresseerd of ziektepercepties een mediatie en/of een moderatie effect hebben op het behandelresultaat. Negen patiënten met aanhoudende rugpijn zijn hiervoor geïncludeerd in deze studie.

Allereerst zagen we dat de fysiotherapiebehandeling een betekenisvolle afname liet zien in pijnintensiteit en beperking in het fysiek functioneren. Deze verbeteringen hielden aan tot en met drie maanden na het stoppen van de behandeling. Iedere behandeling werd afgestemd op de pateient z'n disfunctionele percepties.

Uit dit onderzoek blijkt dat disfunctionele ziektepercepties een mediatie effect hebben op het resultaat van de. Met name de veranderingen van de ziekteperceptie-dimensies *Gevolgen, Persoonlijke controle, Mate van klachten, Bezorgdheid* en *Emotionele gevolgen* verklaren een belangrijk deel van het resultaat, voor zowel gedurende als na de behandeling. Voor vervolg onderzoek is lijkt het aan te rade om de ziekteperceptie dimensies en hun veranderingen tijdens een fysiotherapiebehandeling te meten en mee te nemen in de behandeling.

Tevens hebben we kunnen vaststellen dat de ziekteperceptie-dimensie *Persoonlijke controle* in ons onderzoek als moderator werkt. Dus als mensen bij het begin van de fysiotherapie behandeling minder *Persoonlijke controle* ervaren dan voorspelt dit een minder goed behandelresultaat. Hierdoor adviseren wij om vóór de fysiotherapie behandeling te informeren in welke mate mensen *Persoonlijke controle* ervaren over de klachten. Indien dit disfunctioneel is, kan het zinvol zijn om tijdens de fysiotherapie behandeling de *Persoonlijke controle* toe te laten nemen door bijvoorbeeld het versterken van de zelfcontrole.

Hoofdstuk 8

De algemene conclusies:

Op basis van dit onderzoek en kijkend naar *of* en *hoe* ziektepercepties de klachten bij musculoskeletale pijn beïnvloeden concluderen wij:

- De IPQ-k kan worden gebruikt in combinatie met een vervolg interview in de eerstelijns fysiotherapie om ziektepercepties van de patiënt te inventariseren.
- Ziektepercepties aan het begin van een fysiotherapeutische behandeling zijn geen voorspeller voor slecht herstel na drie maanden.
- De ziekteperceptie-dimensies *Gevolgen, Persoonlijke controle, Bezorgdheid* en *Emotionele gevolgen* zijn mediatoren voor het effect van fysiotherapie bij chronisch lage rugpijn.
- De ziekteperceptie-dimensie *Persoonlijke controle* is een moderator voor het effect van fysiotherapie bij chronisch lage rugpijn.

Aanbevelingen voor vervolgonderzoek:

- Naar verbeteringen van de Ziekteperceptie vragenlijst IPQ-K door 'thinking-aloud' studies bij mensen met musculoskeletale pijn.
- Naar de veranderbaarheid van disfunctionele ziektepercepties en de invloed daarvan op klachten bij mensen met musculoskeletale pijn.
- Naar het mediatie en moderatie effect van individuele disfunctionele ziektepercepties op musculoskeletale pijnmanagement onder grote groep patiënten.

Aanbevelingen voor de praktijk:

- Maak gebruik van de Ziekteperceptie vragenlijst IPQ-K met een vervolg vraaggesprek om de ziektepercepties verder te exploreren.
- Onderzoek de disfunctionele ziekteperceptie dimensies *Persoonlijke controle, Bezorgdheid* en *Emotionele gevolgen* gedurende een fysiotherapie behandeling vanwege het mediatie effect.
- Onderzoek de disfunctionele ziekteperceptie dimensie *Persoonlijke controle* vooraf aan de fysiotherapie behandeling vanwege het moderatie effect.

A

Dankwoord

Met dit proefschrift aan de Vrije Universiteit van Amsterdam voltooi ik na meer dan 10 jaar een belangrijk persoonlijk project. Samen met mijn werk als fysiotherapeut en het docentschap aan het Instituut voor Beweeg Studies Hogeschool Utrecht vertegenwoordigt dit proefschrift een onderdeel van wie ik ben als fysiotherapeut. 'Een proefschrift schrijf je niet alleen', veel mensen hebben bijgedragen aan de voltooiing hiervan. Het is fijn om hier bij stil te kunnen staan.

Inspiratie, plezier en waardering kenmerkte de bijeenkomsten met het promotieteam, bestaande uit **promotor professor Ostelo** en **copromotor doctor Wittink**. Het is bijzonder om de mogelijkheid te hebben gehad een onderwerp te onderzoeken wat mij als fysiotherapeut kenmerkt. De leercurve was groot en onvoorspelbaar. Zonder dit promotieteam was het mij ook zeker niet gelukt.

Beste **Raymond.** Iedere promotiebijeenkomst was een feestje.
In onze eerste ontmoeting gebeurde er iets kenmerkends, wat gaande de promotie vaker is voorgekomen; een confrontatie met mijzelf. Bij deze kennismaking vertelde ik jou onder andere dat ik klinimetrie een warm hart toedraag. Maar het moet wel relevant zijn voor de praktijk, zei ik. Zo vertelde ik enthousiast over een Nederlandstalig artikel uit 2003 met de titel; 'Klinimetrie in de fysiotherapie: een handleiding ter voorkoming van een datakerkhof', waarvan ik me alleen de 1ste auteur herinnerde .
"Dit is een mooi voorbeeld van hoe we in de praktijk ervoor kunnen zorgen geen datakerkhof te creëren. Ken je dit artikel?" vroeg ik. Je keek me aan, volgens mij een beetje vertwijfeld en zei: "Ja, dat heb ik samen met professor de Vet geschreven……"
Dus……., verder lezen dan je neus lang is. Jij bent een van de drijvende krachten die me dat geleerd heeft.
Iedere promotiebijeenkomst was van mens tot mens. Dank daarvoor!

Beste **Harriët**. Vanaf dag 1, en dat is al wat jaartjes geleden, ben jij betrokken bij dit project. We hebben daarin veel samen gedeeld. Mijn eerste herinnering is bij de Fysiotherapiewetenschap opleiding in 2006, je gaf mij de ruimte en het vertrouwen een nieuwe ontwikkeling te presenteren over psychometrie, wat later uitgroeide tot de COSMIN. Dit typeert jouw begeleiding, ruimte geven als je voelt dat het kan. We hebben ook meegemaakt dat dit niet altijd door mij goed in te vullen was, onzekerheid overviel me dan. Voor jouw niet aflatende steun en vertrouwen ben ik je zeer dankbaar.

Bij de meeste promotiebijeenkomsten waren ook Jan Pool en François Maissan aanwezig.

Beste **François**. Partner in crime noem ik je.
Onze vriendschap en samenwerking gaat terug naar de tijd in het Rotterdamse IJsselmonde. Wat een energie, humor en betrouwbaarheid. Zelden maak ik mensen mee die zich zo belangeloos opstellen om andere te helpen. Je bent een rots in de branding, een vitaal onderdeel van mijn project. Fijn dat ik je ben tegengekomen en je heb leren kennen!

Beste **Jan**. Je was in de opstart van mijn promotietraject belangrijk. Vanuit jouw netwerk is mijn introductie bij Raymond voortgekomen. Ook bedank ik je voor de bijdrage aan de eerste publicatie (hoofdstuk 2) en de initiatie van de dataverzameling onder de Master Fysiotherapie studenten Hogeschool Utrecht, waaruit hoofdstuk 4 en 5 zijn voortgekomen.

Geachte **leden van de promotiecommissie**, prof.dr.ir. H.C.W. de Vet, prof.dr. A.M.C.F. Verbunt, prof.dr. T.P.M. Vliet Vlieland, prof.dr. J.W.S. Vlaeyen en prof.dr. M Meeuws ik vind het een eer dat mijn prowefschrift door jullie is gelezen en beoordeeld. Hartelijk dank daarvoor.
Hartelijke dank dr. A. de Groef voor het vervangen van een van de leden van de promotiecommissie tijdens de verdediging van mijn proefschrift.

Stilstaan bij het besef hoeveel mensen hebben bijgedragen aan het tot stand komen van dit proefschrift is overweldigend. Het aantal is nauwelijks te benoemen, laat staan de bijdragen die ze hebben geleverd. Toch een oprechte poging om recht te doen aan de inspanningen van mensen die mij hebben gesteund. Ik realiseer me dat ik niet volledig ben.

Familie
Mijn ouders, **Ans en Aad de Raaij-van Zuijdam**, hebben voor de mogelijkheid gezorgd in 1982 te gaan studeren. Dat het Fysiotherapie werd komt door mijn broer **Martin**. Jij bent in die jaren een voorbeeld geweest, iemand waaraan ik mij kon optrekken. Een aantal jaren nadat jij was begonnen aan de studie volgde ik bijna als vanzelfsprekend. Dat mijn keuze goed heeft uitgepakt, blijkt onder andere uit de voltooiing van dit proefschrift. Mijn zus **Berry**. Jij was altijd paraat als er op het gebied van Nederlands taalgebruik het een en ander moest worden bekeken. Taalvoutjes, best een sterk punt van mij!
Fleur, mijn dochter. Dat tijd vliegt en er heel wat jaren in de promotie zijn gaan zitten, wordt ook duidelijk door naar jouw leven te kijken. In het begin hielp je zelf als kind mee, met het dicht plakken van de enveloppen, bij mijn eerste onderzoek. Nu ben je inmiddels zelf moeder .....tijd vliegt inderdaad!

Studie Fysiotherapie

Tijdens mijn ontwikkeling als fysiotherapeut zijn er vele momenten geweest, waarin zaadjes zijn geplant en waaruit later iets is gegroeid. Zo kan ik mij een moment herinneren ergens in het 1e studiejaar 1983, bij een les psychologie door Leo Juffermans kwam de opmerking: "We gaan het over pijn hebben, en dat is best ingewikkeld". Ik heb toen iets gedacht in de geest van: 'Nu moet ik goed opletten dan ga ik het vast begrijpen.' Ik moet zeggen, tot op de dag van vandaag moet ik goed blijven opletten, begrijpen doe ik het nog steeds niet.
Leo Hagenaars, helaas vroeg overleden, een collega die mij op vele manieren heeft geïnspireerd. Bij hem herkende ik verwondering en nieuwsgierigheid over wat fysiotherapie is en hoe het kan werken. Hij heeft mij in aanraking gebracht met Leventhal's Commons-Sense Model, het centrale thema van dit proefschrift.

In diezelfde periode was mijn eerste stage een grote frustratie. Als mijn tweede stageplek niet bij **Rik** was geweest, was ik geen fysiotherapeut geworden en had ik hem ook niet als vriend in mijn leven gehad. Hij heeft me laten inzien dat de mens achter de klacht interessant en belangrijk is. Met warme herinneringen denk ik aan onze vriendschap.

Werken bij Fysiotherapie Bonnier

De eerste 15 jaar heb ik als fysiotherapeut in Rotterdam gewerkt. Daar heb ik met **Alfred** talloze discussies, oefenavonden en biertjes gedeeld. Met hem heb ik mijn kritische blik op ons vak kunnen aanscherpen, dank vriend!

Werken bij AdFysio De Lier

Ondanks de verandering van loondienstmedewerker naar mede-praktijkhouder in De Lier werd mijn inhoudelijke ontwikkeling niet belemmerd. In deze periode zijn **Guido** en **Alfred** de klankborden geweest met vele discussies. Het gezamenlijk zien van patiënten was zowel leuk als leerzaam.

A

Studie Manueel therapie SOMT

Leo, Lennard, John, Roel en Erwin zijn collega's die een bijdrage hebben geleverd aan mijn niveau van klinisch redeneren en het opbouwen van zelfvertrouwen als behandelaar. Vanuit hun constructief kritische houding zijn daar de eerste contouren zichtbaar geworden van mijn klinische onzekerheid, dank daarvoor.

Studie Fysiotherapiewetenschap Universiteit Utrecht

Tijdens de afronding van mijn manueel therapie opleiding nam ik deel aan de 'Commissie Prins'. Deze commissie had als opdracht een herziening van het curriculum SOMT te schrijven en ik was als 4de-jaarsstudent gevraagd daaraan deel te nemen. Het was Nico van Meeteren

die tijdens een van de laatste bijeenkomsten in de lift naar de uitgang vroeg: "Wat ga je doen als je deze studie hebt afgerond?" Deze vraag leidde tot het volgen van Fysiotherapiewetenschap aan de Universiteit Utrecht. Dit bleek een 'game changer'. De klinische onzekerheid werd hier nog meer onder een vergrootglas gelegd. Gaandeweg leerde ik academische vaardigheden om die klinische onzekerheid juist om te zetten in stappen die een verandering gaven in kennis, vaardigheid en attitude. Wat een inspirerende omgeving!
Met de begeleiding van **Nico, Jaap, Mirandais, Janke G, Jan P, Rob, Roland, Frank, Carin en Harriët** heb ik een mooi leertraject doorgemaakt. Gedurende deze intensieve 3-jaar waren mijn peers met eenzelfde ontwikkeling bezig. Wij hebben elkaar gesteund, met elkaar gelachen en ook tranen gedeeld. Vele van ons hebben nog steeds contact met elkaar; **Carla, Leendert, Liesbeth, Marlies, Mercia, Geerts, Paul, Jordi, Corrien, Yvonne, Karin, Barbara, Marianne en Marjolein.** Wat een enerverende reis hebben we gemaakt! **Francois** was 1 jaar eerder deze studie gaan volgen, ook daar hebben we samen vele uurtjes met elkaar doorgebracht.

Carin Schröder. Als ik me het goed herinner, kwam jij vanuit Schotland terug naar Nederland en ging je meteen aan de slag als docente bij de Fysiotherapiewetenschap. Je hebt aan het begin gestaan van de cross-culturele translatie en validatie van de IPQ-k en tot het einde aan toe eraan meegewerkt. Jouw ervaring en kennis uit het psychologische domein kwamen zeer van pas. Met enthousiasme en doortastendheid, bijvoorbeeld door me aan te moedigen om contact op te nemen met hoogleraar **Ad Kaptein**, heb je mij begeleidt. Je was altijd beschikbaar om feedback te geven, ook in de avonduren. Zeer veel dank daarvoor!

Master Fysiotherapie Hogeschool Utrecht Instituut voor Beweegstudies
Na de Fysiotherapiewetenschap werd ik gevraagd om bij het docenten team van de Orthopedische Manueel Therapie Hogeschool Utrecht aan te sluiten. Ik werd aangenomen door Harriët Wittink en heb daar sinds 2007 tot heden kunnen werken in een omgeving met zeer gedreven collega's. **François, Rob, Roland, Jaap, Jan, Jorrit, Rutger, Linda, Barbara, Marc, Sabrine, Martine, Mohamed, Jeroen, Stefan J, Sijmen, Peter, Norman, Han, Janke O, Stefan E** en **Allard** zijn daar voorbeelden van net als en vele, vele anderen. Wat fijn om met zulke bijzondere mensen te kunnen samenwerken.
Het Instituut voor Beweegstudies samen met het Lectorraat Leefstijl en gezondheid is de plek geweest die de voorwaarden heeft gemaakt om mijn persoonlijke ontwikkeling vorm te geven, dank!

Lectoraat Leefstijl en Gezondheid Hogeschool Utrecht
Naast de NWO-subsidie werd ik door dit lectoraat onder leiding van **Harriët Wittink** gefaciliteerd in mijn promotietraject. Deze omgeving, bestaande uit gepromoveerde collega's

en promovendi, heeft mijn academische vaardigheden verder aangescherpt. De bijeenkomsten zijn belangrijk geweest voor de verschillende stappen in mijn promotie; het bedenken, vormgeven, uitvoeren van onderzoek en het begrijpen van de resultaten. Het lectoraat heeft hier sterke invloed op gehad. Met **François, Janke O, Stefan E, Michiel, Martine, Tim, Jan, Manon, Marleen, Marike, Imke, Hannelies, Claudia, Henri, Jacqueline O, Jacqueline N, Kristel, Karlijn, Barabara** en **Ryan** Waren er constructieve en kritische peer review sessies, talloze bakkies koffie, waardering en respect. Door jullie bijdragen en de gezelligheid heb ik de eindstreep gehaald. Dank!

Deelnemers aan de onderzoeken

Ik bedank alle patiënten, studenten en collega's die voor de projecten in dit proefschrift onmisbaar zijn geweest. Ik ben blij voor de ondersteuning van de statistici **Jos** en **Paul** en de informatie specialist **Jurgen**. Tevens bedank ik de fysiotherapie collega's **Jef, Daron, Alisha, Ben** en **Esther** voor hun bijdrage aan hoofdstuk 7.

Fysiotherapiepraktijk Sluijters te Boxtel

Dank **Hans** dat je mij hebt 'durven' aannemen met als doel een andere wind door de praktijk te laten waaien. Gedurende mijn promotietraject heb ik daar het klinische werk in de eerstelijns fysiotherapie voort kunnen zetten. Er was altijd bereidheid om de agenda te vormen naar de promotiewerkdruk, die soms even prioriteit had. Die flexibiliteit waardeer ik enorm.

Wolbert Fysiotherapie te Uden

Een warme en fijne omgeving om aan de afronding van mijn proefschrift te kunnen werken. **Bas** en **collegae** bedankt daarvoor.

Beste **Radboud**. Wat fijn om jou als rots in de branding in de laatste fase erbij gehad te hebben. Je scherpe blik en opbouwende kritiek zijn zeer gewaardeerd.

Lieve **Marieke**. Mijn thuisfront. De plek waar zowel de hoogte- als dieptepunten die je meemaakt als promovendus het duidelijkst zichtbaar zijn. Met jou samen heb ik het allemaal gezien, gehoord, gevoeld en gedeeld. De talloze uren dat 'ik er niet was' hebben niet kunnen bestaan zonder dat jij er voor mij was. Het spreekwoordelijke 'Woorden schieten te kort' is van toepassing, hoewel alle woorden in dit proefschrift zijn doordrenkt van jouw aanwezigheid is er meer, ook wat er niet geschreven is verwijst naar jou.

A

Publications

Publications

de Raaij EJ, Wittink H, Maissan JF, Westers P, Ostelo RWJG.
Limited predictive value of illness perceptions for short-term poor recovery in musculoskeletal pain. A multi-center longitudinal study. Bmc Musculoskelet Di 22, 522 (2021).

de Raaij EJ, Ostelo RWJG, Maissan JF, Pool J, Westers P, Wittink H.
Illness perceptions associated with patient burden with musculoskeletal pain in outpatient physical therapy practice, a cross-sectional study. Musculoskelet Sci Pract. 2020 Feb;45:102072.

Verwoerd M, Wittink H, Maissan JF, **de Raaij EJ**, Smeets RJEM.
Prognostic factors for persistent pain after a first episode of nonspecific idiopathic, non-traumatic neck pain: A systematic review. Musculoskelet Sci Pract. 2019 Jul;4 2:13-37.

de Raaij EJ, Ostelo RW, Maissan JF, Mollema J, Wittink H (2018).
Illness Perceptions' Association and Prognosis With Pain and Physical Function in Patients With Non-Cancer Musculoskeletal Pain: A Systematic Literature Review.
J Orthop Sports Phys Ther. 2018 May 10:1-48.

Maissan JF, Pool J, **de Raaij EJ**, Mollema J, Ostelo R, Wittink H.
The clinical reasoning process in randomized clinical trials with patients with non-specific neck pain is incomplete: A systematic review. Musculoskelet Sci Pract. 2018 Jun;35:8-17.

de Raaij EJ, Pool J, Maissan JF, Wittink H. (2014).
Illness perceptions and activity limitations in osteoarthritis of the knee: a case report intervention study. Manual Therapy, 19(2), 169–172.

de Raaij EJ, Schröder C, Maissan JF, Pool JJ, Wittink H. (2012).
Cross-cultural adaptation and measurement properties of the Brief Illness Perception Questionnaire-Dutch Language Version. Manual Therapy, 17(4), 330–335.

Brueren MM, **de Raaij EJ**, Maissan JF.
Facilitatie en inhibitie van beenmusculatuur na een amputatie aan de onderste extremiteit. Nederlands Tijdschrift voor Fysiotherapie 2009, (jaargang 120), nummer 2, p. 57-64

Maissan JF, van Maris RF, Aerts MGF, **de Raaij EJ**.
Cervicale range of motion en manuele therapie; Tijdschrift Manuele Therapie. 2010;6(1) p. 31-32.

van den Berg MJM, Wolswinkel MG, van de Wateringen J, **de Raaij EJ**.
Clinical Prediction Rules: de nieuwe richtlijn!? De visie van studenten master MT Hogeschool Utrecht. KNGF-congres 2009; 13/14 november 2009

Maissan JF, Pruijssers P, **de Raaij EJ**.
Klinische predictieregels en manuele therapie: een succesvol huwelijk?
Tijdschrift voor Manuele Therapie. 2009;5(2) p. 13-16

de Raaij EJ.
Ziektepercepties een onderdeel van het domein persoonlijke factoren binnen het ICF.
Nederlands Tijdschrift voor Fysiotherapie 2009, (jaargang 119), nummer 2, p. 63-67

de Raaij EJ, Maissan JF, Kingma JJ, van Maanen CJ, Vossen HPLM.
Onderzoeksvragen op het gebied van diagnostiek en prognostiek onder de Nederlandse deelnemers van het IFOMT-2008 congres manuele therapie.; Tijdschrift voor Manueel Therapie

de Raaij EJ, Schröder CD.
Ziektepercepties. Wat kan de fysiotherapeut ermee? ; FysioPraxis november 2008

Maissan JF, **de Raaij EJ**, Prins JCM , van Genderen FR.
Is er een klinisch relevante benadering van betrouwbaarheidsonderzoek geldend voor de fysiotherapeut? Nederlands Tijdschrift voor Fysiotherapie 2008 (jaargang 118), nummer 2 (april 2008), p. 42-46 Met reacties van prof. dr. ir. HCW de Vet & dr. S Beurskensde

de Raaij EJ, Maissan JF, Vossen HPLM, Maanen van CJ.
IFOMT-2008 Wetenschapsenquête. Tijdschrift voor Manuele Therapie. 2008;5(1)6.

Maissan JF, **de Raaij EJ**.
"KNGF-richtlijnen als procesindicator en de uitkomstmaat als uitkomstindicator; een kans of bedreiging?"; FysioPraxis 2007, 16 (12) p. 18-20

Kleijn A, Schuurmans R, **de Raaij EJ**, Van de Hart M, Baijens H, Van Peppen RPS.
Manuele Therapie bij heuparthrose: Een evidence-based manueeltherapeutisch behandelprotocol met objectivering van behandelresultaten. MoveMens, 2007;8(5):44-45

Re-submission

de Raaij EJ, Wittink H, Maissan JF, Twisk J, Ostelo RWJG.
Illness Perceptions; exploring mediators and/or moderators in disabling persistent low back pain. multiple baseline single-case experimental design

A

About the author

ABOUT THE AUTHOR

During his Bachelor education in Rotterdam The Netherlands (1982-1986), the focus of learning was on basic skills like exercise therapy, massage, electrotherapy and hands-on mobilization technics. He was trained to use these skills within a biopsychosocial framework called 'Het Meerdimensionale Belasting-belastbaarheidsmodel'13. This framework had adopted a biopsychosocial perspective. This fostered his personal attitude as a physiotherapist to incorporate patients' ideas and preference in the physiotherapy clinical reasoning process. In his first years as a novice physiotherapist, working in primary physiotherapy care, a better understanding grew about the importance of patients' preferences and ideas on the recovery of pain and physical function. Then, his slowly but steady progression as a physiotherapist led to the idea that patients' psychosocial factors may play a key-role in some poorly recovering patients. This further led to the need for a better understanding of these factors. Ever since his bachelor education, the leading model in his work had been the Common-Sense Model of self-regulation of health and illness by Leventhal, an exponent of a biopsychosocial framework. It was this model which guided him to explore and address patients' ideas and preference in daily practice. Finally, it stood at the very beginning of his journey to scientifically explore this model in primary physiotherapy care as a junior researcher.

Edwin is currently working in several institutions:

- Teacher and junior researcher at Institute for Human Movement Studies University of Applied Sciences Utrecht The Netherlands
- Pain clinic University Medical Center Utrecht The Netherlands
- Primary physiotherapy care Wolbert Fysio at Uden The Netherlands
- Fysiometrics educational platform

Amsterdam Movement Sciences

VU VRIJE UNIVERSITEIT AMSTERDAM

Amsterdam UMC University Medical Centers

Amsterdam Movement Sciences conducts scientific research to optimize physical performance in health and disease based on a fundamental understanding of human movement in order to contribute to the fulfillment of a meaningful life.