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ABSTRACT

# PSiM IV – Pain Practice

## Investigating short-term habituation to pain with FMRI – A protocol integrating self-report, block and trial-by-trial analyses

**MM van der Miesen**[1]; AL Kaas[2]; CJ Vossen[3]; EA Joosten[1,3]; DEJ Linden[4]; JC Peters[2]
[1]*Department of Anesthesiology and Pain Management, School of Mental Health and Neuroscience, Maastricht University, Maastricht, The Netherlands;* [2]*Department of Cognitive Neuroscience, Maastricht University, Maastricht, The Netherlands;* [3]*Department of Anesthesiology, Maastricht University Medical Centre, Maastricht, The Netherlands;* [4]*School of Mental Health and Neuroscience, Maastricht University, Maastricht, The Netherlands*

**Introduction:** Habituation to pain is a generally known phenomenon that involves a decrease in response after repeated painful stimulation[1]. A variety of methods is available to measure short-term habituation. Nevertheless, the neural correlates are not well understood. Therefore, we developed a protocol integrating psychophysical and neural measures.
**Methods:** Participants received three blocks of 25 brief painful electric stimuli while fMRI data was collected. After each stimulus, participants rated their pain on a visual analogue scale (VAS). The protocol was designed in a way to include ratings, allow for habituation and limit the influence of motor responses on the pain response. Analysis of habituation includes multilevel models for pain ratings and brain activity over blocks and on a trial-by-trial basis.
**Results:** Preliminary results ($n$ = 5) indicated a decrease in pain ratings, with large individual differences. In addition, we found brain activity in areas involved in pain processing in general (i.e., insula, cingulate cortex), which showed decreased activity over blocks of painful stimulation. Furthermore, in more refined analyses (trial-by-trial), we expect to find a linear decrease in activity in the anterior/midcingulate cortex, reflecting the decrease in subjective pain perception.
**Discussion:** Our developed protocol allows for the investigation of short-term habituation with fMRI using self-report, block and trial-by-trial analyses and increases our understanding of individual differences in habituation to pain.
**Process evaluation:** Habituation can be measured in multiple ways, which complicates standardisation of paradigms and analyses. A protocol which allows for the integration and comparison of these methods helps to define and understand habituation.
**References:** 1. Rankin CH, Abrams T, Barry RJ, et al. Habituation revisited: an updated and revised description of the behavioral characteristics of habituation. Neurobiology of learning and memory 2009; 92(2): 135–138.
**Keywords:** Habituation; pain; fMRI, methods

## Spine MRI in low back pain: A deep learning approach to modelling new imaging phenotypes

**T McSweeney**[1]; A Tiulpin[1,2]; S Saarakkala[1]; J Karppinen[1]
[1]*Faculty of Medicine, University of Oulu, Finland;* [2]*Department of Computer Science, Aalto University, Finland*

**Introduction:** The relevance of spine MRI data to understanding low back pain (LBP) is questioned but it remains one of the few ways to assess pathoanatomical features of the condition. A need for more reliable quantitative interpretation of clinical MRI data has arisen in step with growing interest in the genetic architecture of LBP and associated systemic and immunometablolic factors.
**Methods:** We aim to quantitatively classify disc degeneration (DD) imaging phenotypes using deep learning (DL). We have identified from the Northern Finland Birth Cohort target phenotypes derived from qualitative DD schemas and Modic change size. We will use DL and radiomic analysis to train models classifying these target phenotypes, externally validated on TwinsUK.
We will then use the results to refine phenotype definitions. These data-driven phenotypes will be investigated in genome wide association studies (GWAS) to locate associated single nucleotide polymorphisms and immunometabolic pathways.
**Results:** We expect the resultant model to accurately classify DD phenotypes, allowing coding of large cohorts for GWAS and other data-driven approaches identifying biological aspects of LBP.
**Discussion:** For MRI to benefit LBP sufferers, quantitative approaches to interpretation are needed. DL can contribute to effective sub-grouping based on MRI that can impact both research and clinical management.

**Process evaluation:** This study is limited by analysing MRI data independent of psychosocial and systemic variables. Future DL studies should tackle this with multimodal solutions.
**Keywords:** MRI; low back pain; phenotyping

## Stress intolerance in patients with chronic widespread pain: Are epigenetic mechanisms the answer to the mystery?

**J Hendrix**[1,2,3]; A Polli[1,2,3]; K Ickmans[1,3,4]; M Ghosh[2]; L Godderis[2,5]; J Nijs[1,4,6]
[1]*Pain in Motion research group (PAIN), Department of Physiotherapy, Human Physiology and Anatomy, Faculty of Physical Education & Physiotherapy, Vrije Universiteit Brussel, Brussels, Belgium;* [2]*Centre for Environment and Health, Department of Public Health and Primary Care, Katholieke Universiteit Leuven, Leuven, Belgium;* [3]*Research Foundation – Flanders (FWO), Brussels, Belgium;* [4]*Department of Physical Medicine and Physiotherapy, University Hospital Brussels, Brussels, Belgium;* [5]*IDEWE, External Service for Prevention and Protection at Work, Heverlee, Belgium;* [6]*Department of Health and Rehabilitation, Unit of Physiotherapy, Institute of Neuroscience and Physiology, Sahlgrenska Academy, University of Gothenburg, Sweden. University of Gothenburg Center for Person-Centred Care (GPCC), Sahlgrenska Academy, University of Gothenburg, Gothenburg, Sweden*

**Introduction:** Many patients with chronic widespread pain (CWP) experience stress intolerance – an exacerbation of symptoms in response to stress. The effect of stress on pain depends on the magnitude of the (autonomic) stress response, which is variable between and even within subjects. This project aims to explain the variability in the autonomic stress response and link it to stress intolerance by investigating the effect of epigenetics on catecholamine expression (messengers of the autonomic nervous system (ANS)) and ANS activity in general.
**Methods:** Patients with CWP ($n$ = 44) and age- and BMI-matched healthy controls ($n$ = 44) are enrolled in a randomised cross-over study. In the experimental procedure, mental stress is induced via the Montreal Imaging Stress Test. The control procedure consists of relaxation breathing. The following outcomes are assessed before, during and after each procedure: (1) biological: DNA methylation of genes encoding for catecholamine-degrading enzymes, enzymatic activity of those enzymes and catecholamine expression; (2) neurophysiological: heart rate variability and blood pressure; (3) clinical: pain thresholds and symptom severity. Symptom severity will also be monitored online one day and seven days after their visits.
**Results:** We expect that higher levels of DNA methylation affect the enzymatic activity of catecholamine-degrading enzymes, in turn leading to dysregulated ANS activity and stress intolerance in patients with CWP.
**Discussion:** This design will allow us to provide causal statements about the role of epigenetics in stress intolerance.
**Process evaluation:** The project will be initiated in May 2022. All laboratory methods will be validated and optimised before the samples of this project will be analysed.
**Keywords:** Stress intolerance; chronic widespread pain; epigenetics; DNA methylation; autonomic nervous system

## End-tidal $CO_2$ in patients with panic, stress-related or persistent somatic symptoms versus healthy controls

**I Ramakers**[1]; M Van Den Houte[1,2]; L Van Oudenhove[2]; O Van den Bergh[3]; K Bogaerts[1,3,4]
[1]*REVAL – Rehabilitation Research Center, Faculty of Rehabilitation Sciences, Hasselt University, Diepenbeek, Belgium;* [2]*Laboratory for Brain-Gut Axis Studies (LABGAS), Translational Research Center for Gastrointestinal Disorders (TARGID), Department of Chronic Diseases and Metabolism, University of Leuven, Leuven, Belgium;* [3]*Health Psychology, Faculty of Psychology and Educational Sciences, University of Leuven, Belgium;* [4]*Tumi Therapeutics, Heusden-Zolder, Belgium*

**Introduction:** A dysregulated autonomic stress physiology is hypothesized to play an important role in the etiology and perpetuation of somatic symptoms that cannot be (fully) medically explained[1,2,3].
**Methods:** The aim of this study was to focus on the role of the respiratory system. We examined end-tidal $CO_2$ concentration ($PetCO_2$) in healthy controls (HC; $n$ = 30), and in patient groups experiencing panic ($n$ = 36), stress-related (overstrain; $n$ = 35, burnout; $n$ = 44) or persistent somatic symptoms in daily life [fibromyalgia (FM) and/or chronic fatigue syndrome (CFS); $n$ = 36]. Further, we explored perfectionism, experiential avoidance, and self-reported trauma in the different groups. Participants filled out questionnaires and went through a rest period and a respiratory challenge with recovery, whilst $PetCO_2$ was continuously monitored.
**Results:** Our results suggest: (1) an overactive respiratory system to be a transdiagnostic underlying factor of panic disorder, overstrain, and burnout, and (2) the presence of a more active fight-flight response in less chronic and severe disorders (overstrain), which gradually becomes more passive as symptoms become more chronic and severe (FM/CFS). Finally, our data show higher perfectionism and experiential avoidance in all patients, and higher self-reported trauma in FM/CFS patients compared to HC.

**Discussion:** Although respiratory dysfunctions are often seen as a specific characteristic of panic disorder, the present study found evidence for an overactive respiratory system be a transdiagnostic underlying factor of both panic and stress-related disorders.
**Process evaluation:** A limitation is that we only studied one respiratory parameter. Research including multiple psychophysiological parameters is needed to confirm the specificity of the current findings.
**References:** 1. Martinez-Martinez L, Mora T, Vargas A, et al. Sympathetic nervous system dysfunction in fibromyalgia, chronic fatigue syndrome, irritable bowel syndrome, and interstitial cystitis: a review of case-control studies. Journal of Clinical Rheumatology; 2014; 20(3): 146–150.
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3. Meeus M, Goubert D, De Backer F, et al. Heart rate variability in patients with fibromyalgia and patients with chronic fatigue syndrome: a systematic review. Seminars in Arthritis and Rheumatism; 2013; 43(2): 279–287.
**Keywords:** Stress; persistent somatic symptoms; panic; $PetCO_2$; respiratory psychophysiology

## An ecoach-pain for patients with chronic musculoskeletal pain in interdisciplinary primary care: A feasibility study

**C Lamper**[1]; I Huijnen[1,2]; M de Mooij[1]; A Köke[1,2]; J Verbunt[1,2]; M Kroese[3]
[1]*Department of Rehabilitation Medicine, Functioning, Participation & Rehabilitation, Faculty of Health, Medicine and Life Sciences, Care and Public Health Research Institute (CAPHRI), Maastricht University, 40 6200MD Maastricht, The Netherlands;* [2]*Centre of Expertise in Rehabilitation and Audiology, Adelante, 111 6432CC Hoensbroek, The Netherlands;* [3]*Department of Health Services Research, Faculty of Health, Medicine and Life Sciences, Care and Public Health Research Institute (CAPHRI), Maastricht University, 40 6200MD Maastricht, The Netherlands*

**Introduction:** eHealth could support cost-effective interdisciplinary primary care for patients with chronic musculoskeletal pain[1,2]. This study aims to explore the feasibility of the eCoach-Pain, comprising a tool measuring pain complexity, diaries, pain education sessions, monitoring options, and chat function.
**Methods:** Feasibility was evaluated (June–December 2020) by assessing learnability, usability, desirability, adherence to the application, and experiences from patients and general practitioners, practice nurses mental health, and physiotherapists. Primary healthcare professionals (PHCPs) participated in a focus group. Patient data was collected by evaluation questionnaires, individual interviews, and eCoach-Pain-use registration.
**Results:** Six PHCPs from two settings participated and recruited 29 patients (72% female, median age 50.0 years (IQR = 24.0)). Patients used the eCoach during the entire treatment phase (on average 107.0 days (IQR = 46.0); 23 patients completed the pain complexity tool and used the educational sessions, and 12 patients the chat function. Patients were satisfied with the eCoach-Pain (median grade 7.0 (IQR = 2.8) on a 0–10 scale) and made some recommendations for better fit with patient-specific complaints.
**Discussion:** The eCoach-Pain is of added value to PHCPs' treatment, and it has treatment benefits for patients. The implementation strategy is important for successful use of the eCoach-Pain. It is recommended to improve this strategy and involve a case-manager per patient.
**Process evaluation:** There was a small sample of patients and PHCPs that participated and the limited use of the eCoach-Pain (selection bias). Not all patients performed all measurements, the completeness of available data per measurement differed (information bias).
**References:** 1. Roberts, A.; Philip, L.; Currie, M.; Mort, A. Striking a balance between in-person care and the use of eHealth to support the older rural population with chronic pain. Int. J. Qual Stud. Health Well-Being 2015, 10, 27536. https://doi.org/10.3402/qhw.v10.27536.2
2. McGuire, B.E.; Henderson, E.M.; McGrath, P.J. Translating e-pain research into patient care. Pain 2017, 158, 190–193. https://doi.org/10.1097/j.pain.0000000000000686
**Keywords:** eHealth; blended care; interdisciplinary care; feasibility; mixed-methods design

## Remote rehabilitation for patients with chronic musculoskeletal pain and treatment outcomes during the COVID-19 pandemic

**VA Oosterwijk**[1]; RJEM Smeets[2,3]; B Winkens[4]; LWME Beckers[2]
[1]*VUmc School of Medical Sciences, Vrije Universiteit, Amsterdam, The Netherlands;* [2]*Department of Rehabilitation Medicine, Care and Public Health Research Institute (CAPHRI), Faculty of Health Medicine and Life Sciences, Maastricht University, Maastricht, The Netherlands;* [3]*Centre for Integral Rehabilitation (CIR), location Eindhoven, The Netherlands;* [4]*Department of Methodology and Statistics, Care and Public Health Research Institute (CAPHRI), Faculty of Health Medicine and Life Sciences, Maastricht University, Maastricht, The Netherlands*

**Introduction:** Due to COVID-19 related interrupted healthcare, alternative remote treatment strategies have been implemented.[1] The objectives of this study are to investigate (1) whether remote rehabilitation for patients

with chronic musculoskeletal pain has equivalent outcomes as conventional, on-site treatment, and (2) whether on-site treatment before and during the pandemic have equivalent outcomes.

**Methods:** Using clinical data from Centre for Integral Rehabilitation (CIR, the Netherlands),[2] a retrospective observational equivalence study was conducted. Five groups of participants were formed, following outpatient, interdisciplinary treatment for ten weeks. For objective 1, participants who followed ≥50% of the treatment remotely during the first lockdown are compared to two groups treated on-site directly before and after the lockdown. For objective 2, participants treated on-site before the pandemic (2019) are compared to two groups treated on-site (2020 and 2021).

Based on the Dutch Dataset Pain Rehabilitation, outcome measures included digital questionnaires regarding various relevant domains, with the Pain Disability Index as primary outcome measure. Change scores were compared using linear regression.

**Results:** No results have been reported yet. It is hypothesized that partial remote rehabilitation has equivalent outcomes as conventional treatment, coherent with earlier findings.[3] Preliminary results may be available before May 2022.

**Discussion:** The major strength is the combination of two objectives in one study. The group of interest receiving only partial remote treatment is a limitation.

**Process evaluation:** It was challenging to form groups retrospectively due to changing COVID-19 lockdown measures and considering similarity on factors other than type of treatment and pandemic status.

**References:** 1. Tauben, D. J., Langford, D. J., Sturgeon, J. A., Rundell, S. D., Towle, C., Bockman, C., & Nicholas, M. (2020). Optimizing telehealth pain care after COVID-19. *Pain, 161*(11), 2437–2445. https://doi.org/10.1097/j.pain.0000000000002048

2. *Chronische pijn? De Behandelingen van CIR helpen je verder*. (2022, 3 januari). CIR Revalidatie. Retrieved 21 januari 2022, from https://cir.nl/?gclid=CjwKCAiA0KmPBhBqEiwAJqKK4-HRTz6gYSX1M0dy-qpy9gEvH1QyN8VrleVXPbIw2MQPv7qd7TlesRoCCVYQAvD_BwE

3. Adamse, C., Dekker-Van Weering, M. G., van Etten-Jamaludin, F. S., & Stuiver, M. M. (2017). The effectiveness of exercise-based telemedicine on pain, physical activity and quality of life in the treatment of chronic pain: A systematic review. *Journal of Telemedicine and Telecare*, *24*(8), 511–526. https://doi.org/10.1177/1357633x17716576

**Keywords:** Remote rehabilitation; chronic musculoskeletal pain.

## Experiences of people with spinal pain receiving a blended biopsychosocial e-health intervention. A qualitative study

**EY Poolman**[1,2]; L Vorstermans[3]; MH Donker[4]; MW Coppieters[1,5]; P Cuijpers[2]; GGM Scholten-Peeters[1]; LM de Wit[2]

[1]*Department of Human Movement Sciences, Faculty of Behavioural and Movement Sciences, Vrije Universiteit Amsterdam, Amsterdam Movement Sciences, The Netherlands;* [2]*Amsterdam Public Health Research Institute, Department of Clinical Psychology, Faculty of Behavioural and Movement Sciences, Vrije Universiteit Amsterdam, The Netherlands;* [3]*Master Musculoskeletal Rehabilitation, HAN University of Applied Sciences, Nijmegen, The Netherlands;* [4]*Department of Health Sciences, Faculty Vrije Universiteit Amsterdam, IHS Institute of Health Sciences, The Netherlands;* [5]*Menzies Health Institute Queensland, Griffith University, Brisbane & Gold Coast, Australia*.

**Introduction:** 'Psychologically informed' care is a recommended physiotherapeutic treatment for people with non-specific spinal pain[1]. However, we lack information about patient experiences with this approach. The aim of this qualitative study is to explore how thoughts, feelings and behaviour are influenced through a blended e- Health intervention in people with non-specific spinal pain.

**Methods:** This is an interpretative qualitative study using semi-structured interviews. Twelve participants who followed (parts of) a blended e-Health intervention[2] were interviewed. Two researchers analysed the interviews using thematic analyses[3], which was an inductive process, whereby all codes were formed and analyzed systematic, repetitive and recursive. A third researcher was invoked during the whole process.

**Results:** Three themes emerged answering how thoughts, feelings and behaviour are influenced through a blended e- Health intervention in people with non-specific spinal pain: (1) patients' stimulators to do the intervention (physiotherapists plays a key role; complaints are driver; online modules provide depth), (2) increasing awareness (own role in pain; importance of activity; pain is not the same as damage; online modules play major role) and (3) inducing changes in life (next step).

**Discussion:** Patients that were motivated to participate in the intervention for variable reasons increased awareness and made steps to change life.

**Process evaluation:** To evaluate the quality of this study (1) a qualitative data expert was actively involved, (2) data triangulation was performed in each phase of the coding process, and (3) deviant cases were included to enrich the data.

**References:** 1. Vitoula, K., Venneri, A., Varrassi, G., Paladini, A., Panagiota, Sykioti, Adewusi, J. & Zis, P. (2018). Behavioral Therapy Approaches for the

Management of Low Back Pain: An Up-To-Date Systematic Review. *Pain Therapy,* 2018 Jun; 7(1): 1–12.
2. Bijker L, de Wit LM, Cuijpers P, Poolman EY, Scholten-Peeters GGM, Coppieters MW (2021). Back2Action: Effectiveness of physiotherapy blended with eHealth consisting of pain education and behavioural activation versus physiotherapy alone: Protocol for a pragmatic randomised clinical trial for people with subacute or persistent spinal pain. *BMJ Open*, in press.
3. Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology,* 3(2), 77–101.
**Keywords:** Persistent pain; pain education; behavioural activation; physiotherapy; qualitative research

### Are physiotherapy websites consistent with low back pain guidelines and the biopsychosocial model?

**R Van der Noord**[1,2]; RR Reezigt[3,4]; D Paap[1,5,6]; HR Schiphorst Preuper[1]; MF Reneman[1]
[1]*Department of Rehabilitation, University Medical Center Groningen, University of Groningen, Groningen, The Netherlands;* [2]*Inter-fysio, Physical therapy practice, Groningen, The Netherlands;* [3]*Department of Human Movement Sciences, Faculty of Behavioural and Movement Sciences, Vrije Universiteit Amsterdam, Amsterdam Movement Sciences, The Netherlands;* [4]*Academy of Health, Department of Physiotherapy, Hanze University of Applied Sciences, Groningen, The Netherlands;* [5]*Department of Rheumatology and Clinical Immunology, University of Groningen, University Medical Center Groningen, Groningen, The Netherlands;* [6]*School of health, Department of physiotherapy, Saxion University of Applied Sciences, Enschede, The Netherlands*

**Introduction:** Low back pain (LBP) is the leading cause of disability in the world[1]. Among many first-line healthcare providers, patients seek help from a physiotherapist. Increasing numbers of physiotherapy practices have information about LBP on their website. At this moment, in the Netherlands, the quality of this information is unknown.
Objective: To what extent is the information on physiotherapy websites about LBP conform LBP guidelines, and the biopsychosocial model?
**Methods:** Cross sectional study design; the content of all existing physiotherapy websites within the Netherlands were studied. Predetermined criteria for content analysis were developed according guidelines and biopsychosocial model. A biomedical score was given with 0 psychosocial factors, limited biopsychosocial with 1–2 psychosocial factors, or fairly biopsychosocial when 3 or more psychosocial factors were mentioned. Descriptive statistics were applied.
**Results:** 8607 entries were identified. After removal of duplicates and entries without information, 834 physiotherapy websites remained. 449 websites contained information about LBP. Most websites, 63.9% described a biomedical explanation regarding the causes of LBP, 27.7% limited biopsychosocial and 8.5% gave a fairly biopsychosocial explanation.
**Discussion:** The minority of the physiotherapy websites within the Netherlands contained information about LBP. Of the websites with information, the majority of the information did not met current guidelines or biopsychosocial explanations. The provided information on a physiotherapy practice website is mostly not according the current state of evidence.
**Process evaluation:** The data shown in this abstract were based on preliminary results and analysis.
**References:** 1. Maher C, Underwood M, Buchbinder R. Non-specific low back pain. Lancet (London, England). 2017 Feb;389(10070):736–47.
2. Ferreira G, Traeger AC, Machado G, O'Keeffe M, Maher CG. Credibility, Accuracy, and Comprehensiveness of Internet-Based Information About Low Back Pain: A Systematic Review. J Med Internet Res. 2019 May;21(5):e13357
**Keywords:** Low back pain; physiotherapist; implementation; online information; biopsychosocial

### Neural processing of pain-related distress to cervical specific movements in people with chronic pain after whiplash injury

**C Murillo**[1,2]; I Coppieters[1,2,3]; L Bernaers[1]; B Cagnie[1]; M Meeus[1,2,4]; I Timmers[1,5,6]
[1]*Department of Rehabilitation Sciences, Faculty of Health Sciences and Medicine, Ghent University, Belgium;* [2]*Pain in Motion international research group,* www.paininmotion.be*;* [3]*Vrije Universteit Brussel, Department of Physiotherapy, Human Physiology and Anatomy, Faculty of Physical Education and Physiotherapy, Belgium.* [4]*Department of Rehabilitation Sciences and Physiotherapy, University of Antwerp, Belgium;* [5]*Department of Anesthesiology, Perioperative, and Pain Medicine, Stanford University School of Medicine, United States;* [6]*Department of Rehabilitation Medicine, Maastricht University, Netherlands.*

**Introduction:** Recent fMRI studies have revealed altered activations in key regions for threat and affective processing of pain in motor imagination tasks. Yet, research in this vein is still lacking in people with chronic whiplash (CWAD).
**Methods:** Sixty CWAD and 32 pain-free participants were included. In the scanner, participants were presented with pictures divided into 3 categories (5 weight bearing, 5 non-weight bearing and 5 neutral pictures) taken from the Pictorial Fear of Activity Scale-Cervical

questionnaire (jittered event-related design). After the scanning, participants were asked to rate each picture in terms of worry, desire to avoidance, anxiety, expected pain. SPM software was used for pre-processing and analysis of the fMRI data.
**Results:** Whole brain analysis revealed greater activation in CWAD for the contrast weight bearing versus neutral pictures in planum temporale/parietal operculum, post/pre-central gyrus, frontal pole, precuneus and posterior cingulate. CWAD have greater activation in precuneus and cerebellum in the non-weight bearing versus neutral contrast. CWAD scored pictures higher than controls, but no correlation between scores and the identified clusters was found.
**Discussion:** The results from this study allow for a better understanding of the maladaptive pain cognitions associated with CWAD by investigating the underlying neural activity alterations.
**Process evaluation:** Several challenges were encountered along the way (data collection and analyses) as this was my first fMRI study.
**Keywords:** fMRI; chronic whiplash; neural pain processing; pain-related fear

**Specific skilled versus general exercise training in recurrent low back pain: A study protocol to unravel underlying peripheral muscle and central brain alterations**

**J Wijnen**[1,2,3†]; S Van Oosterwijck[1,3,4†]; E Dhondt[1,3]; I De Greef[1]; B Jeurissen[5]; T Willems[1]; P Hodges[6]; Danneels L[1,*]; J Van Oosterwijck[1,3,4,*]
[1]*Department of Rehabilitation Sciences, Faculty of Medicine and Health Sciences, Ghent University, Ghent, Belgium;* [2]*Het Rughuis, Roermond, the Netherlands;* [3]*Pain in Motion international research group,* http://www.paininmotion.be/*;* [4]*Research Foundation – Flanders (FWO), Brussels, Belgium;* [5]*Imec-Vision Lab, Department of Physics, University of Antwerp, Antwerp, Belgium;* [6]*School of Health & Rehabilitation Sciences, Queensland University, Brisbane, Australia*

†Shared first authorship; *Shared last authorship.
**Introduction:** Although the cause of persistent non-specific low back pain (NSLBP) remains unknown, structural and functional alterations of the brain[1] and paravertebral muscles[2] have been proposed as underlying mechanisms. To date, it is unknown if improvements through exercise therapy may be attributed to measurable changes in the muscles and/or adaptations in the brain. Therefore, the objective is to examine short and long-term effects of specific skilled motor control training versus unspecific general exercise training.
**Methods:** In this double-blind, randomized controlled clinical trial, 62 recurrent NSLBP patients will be randomly allocated (1:1) to receive either skilled motor training or general exercise training. The primary outcome is LBP-related disability. Secondary measures include: brain structure, structural/functional connectivity, muscle structure, muscle function, and proprioception.
**Results:** We expect changes only after skilled motor training for: brain function (i.e. increased functional connectivity in default mode network and sensory-motor regions), thoracolumbar dissociation and proprioception. In addition, for brain structure (i.e. changed structural connectivity between parieto- and (pre)motor areas and motor cortex reorganization), muscle function (i.e. timing/amplitude of anticipatory/compensatory postural adjustments) and muscle structure (i.e. muscle/fat index, cross-sectional area) we expect changes for both groups, but more pronounced after skilled motor training. More specifically, we expect that changes in muscle structure are training unspecific for superficial trunk muscles, but more pronounced for deep segmental muscles after skilled motor training.
**Process evaluation:** Learning the necessary skills for MRI acquisition and recognizing artefacts took more time than expected. Several MRI sequence alterations were necessary to ensure sufficient image quality.
**References:** 1. Kregel J, Meeus M, Malfliet A, et al. Structural and functional brain abnormalities in chronic low back pain: A systematic review. Seminars in Arthritis and Rheumatism 2015; 45(2), 229–237.
2. Goubert D, Meeus M. Willems T, et al. The association between back muscle characteristics and pressure pain sensitivity in low back pain patients. Scandinavian Journal of Pain 2018; 18(2), 281–293.
**Keywords:** Low back pain; motor control; exercise; randomized controlled trial; brain

## Event-related potentials following cutaneous electrical stimulation in patients with chronic whiplash associated disorders

**D Lenoir**[1,2,3]; W Willaert[1,2,3,4]; K Ickmans[2,3,4,5]; J Nijs[2,3,5,6]; B Cagnie[1]; M Meeus[1,7]; K Vonck[8]; J Delbeke[1]; R De Pauw[1,*]; I Coppieters[1,2,3,4,*]
[1]*Department of Rehabilitation Sciences, Faculty of Medicine and Health Sciences, Ghent University, Ghent, Belgium;* [2]*Pain in Motion Research Group (PAIN), Department of Physiotherapy, Human Physiology and Anatomy (KIMA), Faculty of Physical Education & Physiotherapy, Vrije Universiteit Brussel, Belgium;* [3]*Pain in Motion International Research Group,* http://www.paininmotion.be/*;* [4]*Research Foundation – Flanders (FWO), Brussels, Belgium* [5]*Chronic pain rehabilitation, Department of Physical Medicine and Physiotherapy, University Hospital Brussels, Belgium;* [6]*Department of Health and Rehabilitation, Unit of Physiotherapy, Institute of Neuroscience and Physiology, Sahlgrenska Academy, University of Gothenburg, Sweden. University of Gothenburg Center for Person-Centred Care (GPCC), Sahlgrenska Academy, University of Gothenburg, Gothenburg, Sweden;* [7]*Department of Rehabilitation Sciences and Physiotherapy – MOVANT Research Group, Faculty of Medicine and Health Science, University of Antwerp, Antwerp, Belgium;* [8]*Department of Neurology, 4Brain, Ghent University Hospital, Ghent, Belgium;*

*Equally contributing, shared last authors

**Introduction:** Whiplash injuries typically occur from a motor vehicle collision and lead to chronic whiplash associated disorders (CWAD) in 20–50% of cases. Changes in neurotransmission, metabolism and networks seem to play a role in the pathogenic mechanisms of CWAD.
**Methods:** This case-control study (CWAD patients/healthy controls (HC):50/50), investigated ankle and wrist electrical pain thresholds (EPT) and the amplitude and latency of event-related potentials (ERPs) resulting from 20 electrical stimuli at the intensity of 1,4xEPT. Linear mixed effect models were applied to detect group differences in EPTs and ERP characteristics. Correlations between ERP characteristics, EPT, self-reported pain, disability, pain catastrophizing and symptoms of central sensitisation (CS) were investigated.
**Results:** In CWAD patients, left wrist P3 latency ($t = -2.283$; $p = 0.023$) was prolonged, and their ankle EPT correlated with ankle P1 ($\rho s = 0.293$; $p = 0.044$) and P3 amplitude ($\rho s = 0.306$; $p = 0.033$), and left wrist P3 amplitude ($\rho s = 0.343$; $p = 0.017$). Symptoms of CS correlated with right wrist P3 amplitude ($\rho s = 0.308$; $p = 0.030$) and latency ($\rho s = -0.341$; $p = 0.015$), and the worst pain during the week before the assessment correlated with left wrist P1 latency ($\rho s = 0.319$; $p = 0.029$).
**Discussion:** CWAD patients did not show signs of hypersensitivity, but their ERP characteristics seemed to be related to the intensity of the stimulus, self-reported symptoms of CS, and worst pain during the week before the assessment.
**Process evaluation:** Self-reported disability had changed between time of inclusion and baseline assessment, resulting in the inclusion of 8 CWAD patients with low disability at baseline.
**Keywords:** Chronic whiplash associated disorders; event-related potentials; electroencephalography

## Scapular kinematics and pathoanatomic findings: Are there differences between symptomatic and asymptomatic shoulders?

**LP Ribeiro**[1]; BMD Tazawa[2]; RPG Barreto[3]; PR Camargo[1]
[1]*Laboratory of Analysis and Intervention of the Shoulder Complex, Department of Physical Therapy, Universidade Federal de São Carlos, São Carlos, Brazil;* [2]*Private Practice, São Paulo, Brazil;* [3]*Private Practice, Porto Alegre, Brazil*

**Introduction:** Individuals with shoulder pain commonly present changes in scapular movement and pathoanatomic alterations in the rotator cuff tendons. However, these may not be the main contributors or source of pain in the shoulder. This study compared scapular kinematics and the frequency of pathoanatomic findings across both shoulders of individuals with unilateral shoulder symptoms.
**Methods:** One-hundred and twelve patients ($38.1 \pm 14.2$ years) with unilateral shoulder pain completed the study. Three-dimensional scapular kinematics was measured during arm elevation. The presence of tendinopathy and partial tear of the supraspinatus and infraspinatus was evaluated using magnetic resonance imaging (MRI). A two-way ANOVA (side x angle of arm elevation) was conducted for each scapular rotation. Chi-square tests were used to compare MRI findings. A $p$-value $<0.05$ was considered significant.
**Results:** The interactions and main effect of side for scapular internal rotation (mean difference; 95% confidence interval: 0.5°; −0.4°, 1.6°), upward rotation (-0.8°; −1.8°, 0.1°) and posterior tilt (0.3°; −0.6°,1.2°). Supraspinatus tendinopathy (~68%), infraspinatus tendinopathy (~7%), partial tear in the supraspinatus (~17%) and infraspinatus (~5%) tendons were equally present in both shoulders ($p > 0.05$).
**Discussion:** Scapular movement and pathoanatomic abnormalities in the rotator cuff are similar across shoulders of individuals with unilateral shoulder pain.
**Process evaluation:** Psychosocial aspects should be investigated to help decision-making in the management of patients with shoulder pain.
**Keywords:** Rotator cuff; Dyskinesis; Biopsychosocial model; Clinical symptoms; Clinical decision making.

## The effect of movement-evoked shoulder pain on scapular orientation and muscle activation in healthy individuals

**G Nardese**; D Falla; V Devecchi; A Gallina
*Centre of Precision Rehabilitation for Spinal Pain (CPR Spine), School of Sport, Exercise and Rehabilitation Sciences, College of Life and Environmental Sciences, University of Birmingham, Birmingham, UK*

**Introduction:** Tonic experimentally induced shoulder pain alters the activation of periscapular muscles[1]. However, tonic pain may not entirely reproduce the symptoms experienced by people with painful shoulder conditions[2] since they commonly report an increase of symptoms during movement. In this study we adopted a novel experimental pain model[3] to investigate motor control adaptations of the scapular muscles during movement-evoked pain.
**Methods:** Fifteen healthy participants performed a repeated box-lifting task for twelve sets. Pain was induced over the posterior acromion using electrical stimulation, modulated to induce a pain intensity of 4/10 when the activity of the anterior deltoid was equal or higher than the peak activity measured at baseline, and of 1/10 when lower than 80%. Muscle activity from the Upper (UT), Middle (MT) and Lower (LT) divisions of the Trapezius, and elevation of the scapula, were compared between baseline (sets 1–2), early- and late adaptation (respectively sets 3–4 and 11–12) using a Friedman test and post-hoc comparisons.
**Results:** Early adaptation was characterised by lower scapular elevation ($p$ = 0.002) and decreased activation of the UT ($p$ = 0.006). In the late adaptation phase, participants exhibited lower scapular elevation ($p$ = 0.032), decreased MT activation ($p$ = 0.032) and increased LT activation ($p$ = 0.006).
**Discussion:** Movement-evoked pain results in lower scapular elevation, and different muscle strategies may be responsible for the changes in scapular kinematics in the early- and late-adaptation phase. Those results may provide new insights about motor adaptations and motor control in clinical condition.
**Process evaluation:** Stimulation artifacts in the EMG were removed by filtering.
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**Keywords:** Movement-evoked pain; shoulder pain; nociceptive electrical stimulation; motor control; scapulae

## Does pain neuroscience education improve pain-related psychological disorders on chronic spinal pain?

**S Martín-Pérez**[1,2]; A Vázquez-Bernal[3]; S Anatriello[3]; FP Pilato[3]; J Montaño-Ocaña[1]; Sosa-Reina[4]; A López López[5]; JL Alonso-Pérez[1,2,6]
[1]*Musculoskeletal Pain and Motor Control Research Group, Faculty of Sciences Physical Activity, Sport and Physiotherapy, Universidad Europea de Madrid, Villaviciosa de Odón, Madrid, Spain;* [2]*Musculoskeletal Pain and Motor Control Research Group, Faculty of Health Sciences, Universidad Europea de Canarias, Tenerife, Canary Islands, La Orotava, Spain;* [3]*Master Degree in Orthopedic Manual Therapy, Faculty of Sciences Physical Activity, Sport and Physiotherapy, Universidad Europea de Madrid, Villaviciosa de Odón, Madrid, Spain;* [4]*Faculty of Health Sciences, Universidad Alfonso X El Sabio, Villanueva de la Cañada, Madrid, Spain;* [5]*Department of Psychology, School of Health Sciences, Universidad Rey Juan Carlos, Madrid, Spain;* [6]*Multidisciplinary Pain Treatment Center ONELIFE, 28925 Madrid, Spain.*

**Introduction:** Pain Neuroscience Education (PNE), which consists of the replacement wrong beliefs about pain, is well established as first-line care within a biopsychosocial approach of chronic spinal pain (CSP). However no studies before have addressed its efficacy on pain-related psychological disorders in patients with CSP. We aimed to update the evidence regarding the effectiveness of PNE on pain-related psychological disorders of CSP.
**Methods:** A systematic review was conducted using MeSH keywords "chronic pain" AND "spine" AND "anxiety" AND "depression" AND "catastrophizing" and free terms "pain neuroscience education" AND "kinesiophobia" in electronic databases Cochrane Library, MEDLINE, PEDro and OpenGrey from January 18 to June 18 2021. While methodological quality was assessed with PEDro scale, risk of bias was evaluated with RoB 2.0 tool.
**Results:** 4 RCTs ($n$ = 328) were included and rated as good quality and moderate risk of bias. There was evidence to support PNE and general physical activity or motor control training to decrease kinesiophobia (3 RCTs, $n$ = 328) and catastrophism (2 RCTs, $n$ = 290). However, there was controversial evidence to sustain PNE as treatment for anxiety and depression.
**Discussion:** In patients with CSP, the combination of PNE and active physical therapy improve pain-related psychological disorders (kinesiophobia and catastrophism) but still remains uncertain its usefulness on anxiety and depression.

**Process evaluation:** Generalizability of PNE to other CSP subgroups is still controversial due to the disparity in selection criteria and heterogeneity of the interventions. We recommend to be cautious regarding these findings.
**Keywords:** Pain Neuroscience Education; chronic spinal pain; kinesiophobia; catastrophism

## Effectiveness of a pain neuroscience communication, motivational interviewing and cognition targeted exercise intervention in patients with chronic neck pain

**D Morales Tejera**[1,2,3,4,5]; M Prieto-Aldana[6,7]; M Gallardo-Vidal[7,8]; J Fernández-Carnero[8,9,10,11,12,13]; J Nijs[5,14,15]

[1]*Escuela Internacional de Doctorado, Department of Physical Therapy, Occupational Therapy, Rehabilitation and Physical Medicine, Universidad Rey Juan Carlos, Alcorcón, Spain;* [2]*Department of Physiotherapy, Human Physiology and Anatomy, Faculty of Physical Education and Physiotherapy, Vrije Universiteit Brussel, Laarbeeklaan 103, BE-1090, Brussels, Belgium;* [3]*Department of basic health sciences, Rey Juan Carlos University, Madrid, Spain;* [4]*Department of Physiotherapy, Facultad de Medicina, Universidad San Pablo-CEU, CEU Universities, Madrid, Spain;* [5]*Pain in Motion Research Group (PAIN), Department of Physiotherapy, Human Physiology and Anatomy, Faculty of Physical Education and Physiotherapy, Vrije Universiteit Brussel, Brussels, Belgium;* [6]*Physiotherapy Unit, Primary Health Care Management, Community of Madrid, Madrid, Spain;* [7]*Department of Physiotherapy, La Salle University Centre, Autonoma University of Madrid, Madrid, Spain;* [8]*Department of Physiotherapy, Antonio Nebrija University, Madrid, Spain;* [9]*Department of Physical Therapy, Occupational Therapy, Rehabilitation and Physical Medicine, Rey Juan Carlos University, 28922 Madrid, Spain;* [10]*La Paz Hospital Institute for Health Research, IdiPAZ, 261, Madrid, Spain;* [11]*Grupo Multidisciplinar de Investigación y Tratamiento del Dolor, Grupo de Excelencia Investigadora, URJC-Banco de Santander, Madrid, Spain;* [12]*Motion in Brains Research Group, Institute of Neuroscience and Movement Sciences (INCIMOV), Centro Superior de Estudios Universitarios La Salle, Universidad Autonóma de Madrid, Madrid, Spain;* [13]*Grupo de Investigación de Dolor musculoesqueletico y Control Motor, Universidad Europea de Madrid, Madrid, Spain;* [14]*Department of Physical Medicine and Physiotherapy, University Hospital Brussels, Brussels, Belgium;* [15]*Department of Health and Rehabilitation, Unit of Physiotherapy, Institute of Neuroscience and Physiology, Sahlgrenska Academy, University of Gothenburg, Sweden. University of Gothenburg Center for Person-Centred Care (GPCC), Sahlgrenska Academy, University of Gothenburg, Gothenburg, Sweden.*

**Introduction:** Neck pain is the main consultation reason in primary care (PC) in Spain and with a prevalence of 8.4% in women and 3.2% in men[1]. Pain neuroscience communication (PNC) and motivational interviewing (MI) have been widely tested in chronic pain management and are successful for chronic pain management[2]. Objective: to evaluate the effectiveness of a complex intervention compared with routine PC physiotherapy to improve disability and intensity and severity of pain in patients with chronic neck pain (CNP).
**Methods:** Randomized clinical trial. Subjects: Patients 18–65 years old with CNP referred from their physician. Sample: 142 patients. Intervention: PNC, MI and cognition targeted exercise (CTE). Control group: Standard PC health education program. Variables: Main: pain intensity. Secondary: pain severity, conditioned pain modulation, temporal summation, neck disability, fear/avoidance behaviours, kinesiophobia catastrophism, quality of life, and adherence. Follow-up: Baseline, 3, 6, 12 months.
**Results:** We expect that patients with CNP in the intervention of PNC, MI and CTE will have a higher improvement in pain intensity, compared to the control group.
**Discussion:** The results may suggest a novel approach which be more efficient in reducing CNP and become a potential standard protocol in the PC of Madrid.
**Process evaluation:** We have recruited 32 clinicians from the PC, they will change their location so we will wait until that to start recruiting, also due to the pandemic, big group therapies are restricted so they will be reduced. Patients cannot be blind to the intervention, so appointments in different days to avoid communication will be made.
**References:** 1. Palacios-Ce.a D, Alonso-Blanco C, Hern. ndez-Barrera V, et al. Prevalence of neck and low back pain in community-dwelling adults in Spain: an updated population-based national study (2009/10-2011/12). Eur Spine J 2015;24:482–92. https://doi.org/10.1007/s00586-014-3567-5
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**Keywords:** Pain; health education; motivational interviewing; exercise therapy; neck pain

## Influence of preoperative pain, cognitions and sensory function on the treatment effect of perioperative pain neuroscience education in patients with lumbar radiculopathy

**W Van Bogaert**[1,2,3]; I Coppieters[1,4,5]; J Nijs[1,4,6]; R Buyl[7,8]; K Ickmans[1,3,4]; M Moens[9,10,11,12]; L Goudman[1,3,9,10,12]; K Putman[2,7,*]; E Huysmans[1,2,3,4,7,*]
[1]*Pain in Motion Research Group (PAIN), Department of Physiotherapy, Human Physiology and Anatomy, Faculty of Physical Education and Physiotherapy, Vrije Universiteit Brussel, Brussels, Belgium;* [2]*Interuniversity Centre for Health Economics Research (I-CHER), Department of Public Health (GEWE), Faculty of Medicine and Pharmacy, Vrije Universiteit Brussel, Brussels, Belgium;* [3]*Research Foundation – Flanders (FWO), Brussels, Belgium;* [4]*Department of Physical Medicine and Physiotherapy, University Hospital Brussels, Brussels, Belgium;* [5]*Department of Rehabilitation Sciences and Physiotherapy, Faculty of Medicine & Health Sciences, Ghent University, Ghent, Belgium;* [6]*Institute of Health and Care Sciences, and the University of Gothenburg Centre for Person-Centered Care (GPCC), Sahlgrenska Academy, University of Gothenburg, Gothenburg, Sweden;* [7]*Department of Public Health (GEWE), Faculty of Medicine and Pharmacy, Vrije Universiteit Brussel, Brussels, Belgium;* [8]*Department of Biostatistics and Medical Informatics, Faculty of Medicine and Pharmacy, Vrije Universiteit Brussel, Brussels, Belgium;* [9]*Department of Neurosurgery, Universitair Ziekenhuis Brussel, Brussels, Belgium;* [10]*STIMULUS consortium (reSearch and TeachIng neuroModULation Uz bruSsel), Universitair Ziekenhuis Brussel, Brussels, Belgium;* [11]*Department of Radiology, Universitair Ziekenhuis Brussel, Brussels, Belgium;* [12]*Center for Neurosciences, Faculty of Medicine and Pharmacy, Vrije Universiteit Brussel, Brussels, Belgium*

*Shared last author

**Introduction:** The benefits of perioperative pain neuroscience education (PPNE) for people undergoing surgery for lumbar radiculopathy have recently been established.[1,2] However so far, not much is known about which factors influence PPNE's treatment success. Therefore, this study aims to assess the potential influence of preoperative pain intensity, pain cognitions and sensory function on the PPNE treatment effect for postoperative quality of life 1 year following surgery for lumbar radiculopathy.
**Methods:** This study is a secondary analysis of a randomized controlled trial in which 120 patients were randomized to receive either PPNE or perioperative biomedical education (PBE).[3] Quality of life was assessed using the Short Form 36-item Health Survey (SF-36) at baseline (1 week pre-surgery), and 6 weeks, 6 months and 1 year post-surgery. Linear mixed models will be built for the SF-36 Physical component, SF-36 Mental component, and SF-6D utility scores using the following independent variables: treatment (PPNE versus PBE), time, and baseline scores for back pain intensity, leg pain intensity, pain catastrophizing, kinesiophobia, hypervigilance, and measures of quantitative sensory testing (i.e., electrical pain threshold, temporal summation, and conditioned pain modulation).
**Results:** It is hypothesized that patients who report unfavorable scores for these preoperative factors will show a larger treatment effect of PPNE on postoperative quality of life.
**Discussion:** Findings will provide novel insight into the potential moderating effect of preoperative factors on treatment outcome following PPNE in people undergoing surgery for lumbar radiculopathy.
**Process evaluation:** Analysis for this study is underway and results are expected in Spring 2022.
**References:** 1. Louw A, Diener I, Landers MR, Puentedura EJ. Preoperative pain neuroscience education for lumbar radiculopathy: a multicenter randomized controlled trial with 1-year follow-up. Spine (Phila Pa 1976). 2014;39(18):1449–1457.
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3. Ickmans K, Moens M, Putman K, et al. Back school or brain school for patients undergoing surgery for lumbar radiculopathy? Protocol for a randomised, controlled trial. J Physiother. 2016;62(3):165.
**Keywords:** Lumbar surgery; pain cognitions; pain intensity; pain neuroscience education; quality of life

## A PhD research plan: Cultural adaptation and implementation of pain education program for chinese chronic low back pain population in a Chinese physiotherapeutic environment

**YiJun Li**[1,2,3]; Paul van Wilgen[2,4]; Jikke Gramser[1]; Jo Nijs[2]; Lennard Voogt[1,2]
[1]*Research Centre for Health Care Innovations, Rotterdam University of Applied Sciences, Rotterdam, the Netherlands;* [2]*Pain in Motion Research Group, Vrije Universiteit Brussel, Brussel, Belgium;* [3]*AcuFysio, Physiotherapy Clinic, Rotterdam, the Netherlands;* [4]*Transcare, Transdisciplinary Pain Management Centre, Groningen, the Netherlands*

**Introduction:** This project aims to culturally adapt and implement a pain education (PE) program for chronic-low-back-pain (CLBP) patients in a Chinese physiotherapeutic environment. PE is a clinical treatment to cultivate patients' understanding of biopsychosocial view of pain and to promote active pain-coping-strategies. It has

considerable clinical improvement on pain and disability during the treatment of chronic pain. However, due to the variations of pain perceptions[1] and treatments[2] in China, culturally adapting and implementing a non-native PE-program should be studied before implementation.
**Methods:** The project originates from a suggested cultural-adaptation-framework3, including two qualitative studies and one quantitative study: (1) Conduct in-depth and semi-structured individual interviews to explore Chinese physiotherapists' comprehension about pain, PE and the implementation of PE in clinical practices. We will account the interview results into our preliminary PE-program. (2) Organize focus groups with Chinese physiotherapists and CLBP patients to discuss our preliminary program. The results will reflect in the final construct of the PE-program. (3) Perform a randomized-controlled-trial to assess the PE-program's effect on disability (primary outcome), pain, illness perceptions, pain catastrophizing, kinesiophobia and self-efficacy in Chinese CLBP patients.
**Results:** This project constructs a culturally-sensitive PE-program and emphasizes systematic adaption by considering the environmental factors that influence the program implementation and people involved. Conducting this project itself, e.g., balancing the expectation of the European research team and Chinese partners, is a cultural adaptation.
**Discussion:** Based on current interview results, educating pain neuroscience to Chinese physiotherapists is necessary.
**Process evaluation:** We are in data-analysis-phase of the first study.
**References:** 1. Li Y, Coppieters MW, Setchell J, et al. How do people in China think about causes of their back pain? A predominantly qualitative cross-sectional survey. BMC musculoskeletal disorders 2020; 21(1): 1–1.
2. Yuan QL, Guo TM, Liu L, et al. Traditional Chinese medicine for neck pain and low back pain: a systematic review and meta-analysis. PLoS One 2015; 10(2): e0117146.
3. Barrera Jr M, Castro FG, Strycker LA, et al. Cultural adaptations of behavioral health interventions: a progress report. Journal of consulting and clinical psychology 2013; 81(2): 196.
**Keywords** Neuroscience pain education; Persistent Low back pain; Chinese rehabilitation; Chinese healthcare; Traditional Chinese medicine

## The effect of a pain educational video intervention upon child pain-related outcomes: A randomized controlled study

**E Rheel**[1,2,3]; K Ickmans[1,2,4,5]; A Wauters[3]; DML Van Ryckeghem[3,6,7]; A Malfliet[1,2,5,8]; T Vervoort[3]
[1]*Pain in Motion Research Group (PAIN), Department of Physiotherapy, Human Physiology and Anatomy, Faculty of Physical Education & Physiotherapy, Vrije Universiteit Brussel, Laarbeeklaan 103, 1090 Brussels, Belgium;* [2]*Pain in Motion International Research Group,* www.paininmotion.be*;* [3]*Department of Experimental-Clinical and Health Psychology, Ghent University, Henri Dunantlaan 2, 9000 Gent, Belgium;* [4]*Movement & Nutrition for Health & Performance research group (MOVE), Department of Movement and Sport Sciences, Faculty of Physical Education and Physiotherapy, Vrije Universiteit Brussel, Pleinlaan 2, 1050 Brussel, Belgium;* [5]*Department of Physical Medicine and Physiotherapy, Universitair Ziekenhuis Brussel, Laarbeeklaan 101, 1090 Brussels, Belgium;* [6]*Section Experimental Health Psychology, Clinical Psychological Science, Faculty of Psychology and Neuroscience, Maastricht University, Maastricht, The Netherlands;* [7]*Institute for Health and Behavior, INSIDE, University of Luxembourg, Luxembourg City, Luxembourg;* [8]*Research Foundation – Flanders (FWO), Brussels, Belgium*

**Introduction:** Pain (neuro)science education (PNE) has received increasing research attention demonstrating beneficial effects on pain-related outcomes in adults, whereas studies on the effectiveness of PNE in children are scarce.
**Methods:** This study investigated the effect of a PNE video intervention on pain-related outcomes (i.e., experienced pain intensity, pain-related fear and pain catastrophizing, heat pain threshold, pain knowledge) in 89 healthy children (8–15 years old) undergoing an experimental heat pain task. Furthermore, the moderating role of children's sex, age, baseline pain knowledge and anticipated pain intensity, pain-related fear and pain catastrophizing was examined. Participants were randomized to either an experimental condition wherein children watched a PNE video prior to the experimental pain task, or to a control condition (i.e., no video).
**Results:** Accurate pain knowledge and pain thresholds were higher amongst children in the experimental group compared to the control group. No other main effects of the video intervention were found. Moderation analyses indicated that the video intervention contributed, compared to the control condition, to higher levels of pain knowledge amongst younger children only and to higher pain thresholds amongst boys only.
**Discussion:** Further investigation is needed to optimize PNE video interventions and to determine whether more beneficial outcomes can be found in non-experimental situations and in children with chronic pain.

**Process evaluation:** Published in European Journal of Pain (PMID: 34155720).
**Keywords:** Children; experimental pain; pain experience; pain knowledge; pain education

### Pain mechanisms in adults with haemophilia: A research protocol of a cross-sectional study

**A Foubert**[1,2,3]; V-A Chantrain[1,2,3]; M Meeus[1,2,4]; C Hermans[3]; C Lambert[3]; S Lobet[3,5,6]; Roussel N[1].
[1]*Research Group MOVANT, Department of Rehabilitation Sciences and Physiotherapy (REVAKI), University of Antwerp, Wilrijk, Belgium;* [2]*Pain in Motion, International Research Group,* www.painimotion.be; [3]*Haemostasis and Thrombosis Unit, Division of Hematology, Clinique universitaires Saint-Luc, Brussels, Belgium;* [4]*Department of Rehabilitation Sciences and Physiotherapy, Ghent University, Ghent, Belgium;* [5]*Neuromusculoskeletal Lab (NMSK), Secteur des Sciences de la Santé, Institut de Recherche Expérimentale et Clinique, Université Catholique de Louvain, Belgium;* [6]*Secteur de kinésithérapie, Cliniques universitaires Saint-Luc, Brussels, Belgium.*

**Introduction:** Haemophilic arthropathy is the hallmark of people with haemophilia (PwH) causing morbidity and (chronic) pain.(1) It has recently became evident that clinical pain experience in the majority of chronic musculoskeletal conditions results from alterations in peripheral and central pain mechanisms.(2) However, evidence exploring these pain mechanisms by use of quantitative evaluation of the somatosensory system and endogenous pain modulation is still scarce in PwH.(3)
**Methods:** One hundred adults with moderate to severe haemophilia A or B between 18 and 65 years and thirty age-matched healthy controls were recruited. They underwent a Quantitative Sensory Testing (QST) protocol to assess the function of the somatosensory system, statically to evaluate pain sensitivity and dynamically with conditioned pain modulation (CPM) paradigm to examine the function of endogenous pain inhibition. Synovial joints, forehead and wrist as reference locations were examined.
**Results:** We hypothesize that PwH will demonstrate a combination of peripheral sensitization, more widespread alterations of the somatosensory system suggestion central sensitization and reduced endogenous pain inhibitory efficacy compared to healthy controls.
**Discussion:** In line with other chronic musculoskeletal conditions we expect, at least in a subgroup of PwH, altered somatosensory functioning and impaired efficacy of endogenous pain inhibition.
**Process evaluation:** Since pain research and especially clinical pain assessments are new in this population, we have no evidenced haemophilia-specific protocols. However, since the clinical presentation of haemophilic arthropathy is very similar to osteoarthritis, we followed validated protocols for other musculoskeletal conditions. Like many other studies, our recruitment process was also hampered by the COVID-pandemic.
**References:** 1. Ceponis A, Wong-Sefidan I, Glass C, Von Drygalski A. Rapid musculoskeletal ultrasound for painful episodes in adult haemophilia patients. Haemophilia. 2013;19(5):790–798.
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**Keywords:** Haemophilia; haemophilic arthropathy; pain; quantitative sensory testing, conditioned pain modulation

### Quantitative sensory testing in complex regional pain syndrome: A systematic review and meta-analysis

**MG Sobeeh**[1,2]; KA Hassan[1]; AG Silva[3]; MM Mohammed[1]; EF Youssef[1,4]
[1]*Department of Physical Therapy for Musculoskeletal Disorder and its Surgeries, Faculty of Physical Therapy, Cairo University, Giza, Egypt;* [2]*Faculty of Physical Therapy, Sinai University, Ismailia, Egypt;* [3]*CINTESIS. UA, School of Health Sciences, University of Aveiro, Aveiro, Portugal;* [4]*Dean of Faculty of Physical Therapy, 6 October University, Cairo, Egypt*

**Introduction:** Complex regional pain syndrome (CRPS) is a chronic pain condition lacking clear understanding of associated pain mechanisms[1,2]. Thus, the aim of this review is to synthetize existing evidence on the sensory profile and indicators of central sensitization in individuals with CRPS.
**Methods:** Based on a priori published protocol, Embase, Scopus, WoS, PubMed, Cochrane library, Sage, EBSCO host, and ProQuest databases were searched. Eligible studies compared the quantitative sensory testing (QST) outcomes (warm, cold, and mechanical detection thresholds, heat, cold, mechanical, and pressure pain thresholds, wind-up ratio, mechanical pain sensitivity, or presence of allodynia) between individuals with CRPS and healthy controls.
**Results:** Studies included in the quantitative analysis ($n = 30$) showed a significant loss of warm, cold, and mechanical sensations and gain of heat, cold, mechanical, and pressure pain thresholds ($p < 0.05$) at the affected region. At contralateral side, there was a significant loss of vibration and mechanical sensations with gain of cold and pressure pain stimuli ($p < 0.05$).

**Discussion:** Individuals with CRPS have Ipsilateral hypoesthesia and primary hyperalgesia and contralateral vibration and mechanical hypoesthesia and cold and pressure secondary hyperalgesia. Secondary hyperalgesia and contralateral hypoesthesia were considered primary indicators of central mechanisms.
**Process evaluation:** Heterogeneity of the results was solved based on subgroup analysis according to the quality of studies. New treatment strategies should target the central mechanisms involved in CRPS.
**References:** 1. Harden NR, Bruehl S, Perez RSGM, Birklein F, Marinus J, Maihofner C, Lubenow T, Buvanendran A, Mackey S, Graciosa J, Mogilevski M, Ramsden C, Chont M, Vatine JJ. Validation of proposed diagnostic criteria (the "Budapest Criteria") for Complex Regional Pain Syndrome. Pain. 2010 Aug;150(2):268–274. 2. de Mos, M., De Bruijn, A., Huygen, F., Dieleman, J., Stricker, B. C., & Sturkenboom, M. J. P. (2007). The incidence of complex regional pain syndrome: a population-based study. *129*(1–2), 12–20.
**Keywords:** Complex regional pain syndrome; quantitative sensory testing; pain mechanisms; sensory profile; central sensitization

## Central sensitization in adolescents with generalized hypermobility spectrum disorder or hypermobile ehlers-danlos syndrome – A feasibility study

**E Schubert-Hjalmarsson**[1,2]; A Fasth[3,4]; K Ickmans[5,6,7]; EL Mårdbrink[2]; AC Söderpalm[8]; M Lundberg[9,10]
[1]*Division of Physiotherapy, Department of Health and Rehabilitation, Institute of Neuroscience and Physiology, University of Gothenburg, Gothenburg, Sweden;* [2]*Department of Physiotherapy, Queen Silvia Children's Hospital, Sahlgrenska University Hospital, Gothenburg, Region Västra Götaland, Sweden;* [3]*Department of Pediatrics, Institute of Clinical Sciences, Sahlgrenska Academy, University of Gothenburg, Gothenburg, Sweden;* [4]*Department of Rheumatology and Immunology, Queen Silvia Children's Hospital, Sahlgrenska University Hospital, Gothenburg, Region Västra Götaland, Sweden;* [5]*Pain in Motion research group (PAIN), Department of Physiotherapy, Human Physiology and Anatomy, Faculty of Physical Education & Physiotherapy, Vrije Universiteit Brussel, Brussels, Belgium;* [6]*Department of Physical Medicine and Physiotherapy, University Hospital Brussels, Brussels, Belgium;* [7]*Movement & Nutrition for Health & Performance research group, Department of Movement & Sport Sciences, Faculty of Physical Education & Physiotherapy, Vrije Universiteit Brussel, Belgium;* [8]*Department of Orthopedics, Institute for Clinical Sciences, Sahlgrenska Academy at University of Gothenburg, Sweden;* [9]*Department of Health Promoting Science, Sophiahemmet University, Stockholm, Sweden;* [10]*University of Gothenburg Centre for Person-Centred Care (GPCC), Sahlgrenska Academy, University of Gothenburg, Sweden*

**Introduction:** Pain is a major symptom in adolescents with generalized Hypermobility Spectrum Disorder (HSD) or Hypermobile Ehlers-Danlos Syndrome (hEDS) (1). Central sensitization (CS) of pain has been suggested as a possible explanation (2). The aim of this study was to investigate the feasibility of a study protocol investigating features of CS in adolescents with HSD or hEDS for further studies.
**Methods:** Features of central sensitization, determined by three different measures, were measured in ten patients and nine healthy controls, age 13–17 years. Primary and secondary hyperalgesia were measured by pressure pain thresholds (PPT) using kg/cm$^2$ (3). Endogenous pain modulation was measured by conditioned pain modulation (CPM) where cold water was used as the "conditioning stimulus" and pressure as a "test stimulus". Exercise-induced hypoalgesia was measured by repeating the PPT measurements immediately after performing a training test on a bicycle ergometer.
**Results:** All three measurements were well tolerated by all participants (patients and control). When measuring endogenous pain modulation through CPM, there were five participants (patients and control), who did not

experience pain when immersing their hand in the cold water and as such a CPM reaction was not achieved.
**Discussion:** The test protocols proved to have a good feasibility but there is a need to adapt the protocol to obtain more reliable data in the main study. For example, reduction of the water sample temperature.
**Process evaluation:** One suggestion for improving the study is to add additional measurements for example time required for examinations, time required for completing the questionnaire.
**References:** 1. Castori M, Tinkle B, Levy H, Grahame R, Malfait F, Hakim A. A framework for the classification of joint hypermobility and related conditions. Am J Med Genet C Semin Med Genet. 2017;175(1):148–157.
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**Keywords:** Feasibility study; Central sensitization; Pain, Hypermobility; Ehlers Danlos Syndrome

## Identifying pain generators and potentiators of residual complaints following lumbar discectomy: protocol of prospective cohort study

**S Van Oosterwijck**[1,2,3]; L Danneels[1]; J Van Oosterwijck[1,2,3]
[1]*SPINE Research Unit Ghent, Department of Rehabilitation Sciences, Faculty of Medicine and Health Sciences, Ghent University, Ghent, Belgium;* [2]*Pain in Motion international research group,* www.painimotion.be*;* [3]*Research Foundation – Flanders (FWO), Brussels, Belgium*

**Introduction:** Up to 37% of lumbar radiculopathy patients experience residual pain and disability following lumbar discectomy. Although it is assumed that dysfunctional pain processing may play a mechanistic role in symptom persistence, research in this area is lacking. Therefore, this study will evaluate pain processing in lumbar radiculopathy patients prior to and 3 months following lumbar discectomy.
**Methods:** Lumbar radiculopathy patients ($n$ = 122) scheduled for discectomy will be recruited through Flemish hospitals. At follow-up, patients with ≥1.5/10 average pain intensity on a visual analogue scale and <20% improvement on the Oswestry Disability Index will be categorized as having residual complaints. These will be compared to matched patients without residual complaints and pain-free controls. Pain sensitivity will be evaluated using Quantitative Sensory Testing including thermal, mechanical, and electrical perception and pain thresholds. Spinal modulation will be assessed using nociceptive flexion reflex thresholds; pain facilitation by the presence of psychocognitive factors through questionnaires and temporal summation of mechanical stimuli and the NFR; and pain inhibition using a conditioned pain modulation paradigm.
**Results:** Not applicable.
**Discussion:** We hypothesize that pre-operative pain characteristics are predictive of residual complaints and that patients with residual complaints exhibit dysfunctional pain processing compared to individuals without residual complaints as expressed by impaired pain inhibition and enhanced spinal modulation, pain sensitivity and facilitation. The findings will provide the potential to identify patients at risk of poor surgical outcome and explore treatment strategies according to dysfunctions in pain processing.
**Process evaluation:** Currently recruiting and completing ethical committee applications for multicentric recruitment.
**Keywords:** Radiculopathy; discectomy; central sensitization; quatitative sensory testing; neuropathic pain

## The classical conditioning of pain

**S Kang**[1]; D van Ryckeghem[1,3]; J Vlaeyen[2]; G Crombez[1]
[1]*Department of Experimental Clinical and Health Psychology, Ghent University, Ghent, Belgium;* [2]*Faculty of Psychology and Educational Sciences, KU Leuven, Leuven, Belgium;* [3]*Experimental Health Psychology, Clinical Psychological Science, Faculty of Psychology and Neuroscience, Maastricht, The Netherlands*

**Introduction:** The idea that chronic pain may be a consequence of classical conditioning has been advocated in contemporary theories aiming to explain pain maintenance in medically unexplained pain conditions [1–3]. Supposedly, conditioned stimuli themselves may be reported as the cause of pain, in the absence of the painful input (US). Empirical evidence is largely lacking.
**Methods:** In a virtual reality driven task, healthy participants ($N$ = 21) learned that one pen (CS+) was predictive of a painful electrocutaneous stimulus (US; US low = pin prick threshold, US high = added 20%), while another pen (CS-) was not. The acquisition phase was one block of 20 trials (CS+: 80% reinforcement; CS−: 0%). Consecutively, 4 identical test phases had 32 trials each (CS+: 37.5% reinforcement; CS−: 0%). The main outcome was reporting the US in its absence (false alarm).
**Results:** Self-reported attention, pain, fear and US expectancy were significantly ($p$ < 0.0005) higher for CS+, showing successful conditioning. False alarms occurred in 2.52% trials (1.51% for the CS+). The CS+ ($n$ = 33) had significantly more (.50%) false alarms than CS-.

**Discussion:** The results provide first evidence that a low form of pain i.e. pin prick can be classically conditioned. Further research is needed to better understand the conditions under which it is most possible.
**Process evaluation:** The process of coming up with the most efficient paradigm and translating it into the VR has been a tremendous learning process. One significant challenge that stands out is identifying a measure to gain better insight into the nature of each false alarm.
**References:** 1. Konorski, J. (1967). Integrative activity of the brain; an interdisciplinary approach.
2. Sokolov, E. N. (1963). Perception and the conditioned reflex.
3. Moseley, G. L., & Vlaeyen, J. W. (2015). Beyond nociception: the imprecision hypothesis of chronic pain. *Pain*, *156*(1), 35–38.
**Keywords:** Classical conditioning; pain; virtual reality; false alarms; chronic pain

## Kinematic adaptations to movement-evoked pain experimentally induced in the lumbar region

**V Devecchi**[1]; D Falla[1]; H Cabral[1]; J Abboud[2]; PW Hodges[3]; A Gallina[1]
[1]*Centre of Precision Rehabilitation for Spinal Pain (CPR Spine), School of Sport, Exercise and Rehabilitation Sciences, College of Life and Environmental Sciences, University of Birmingham, Edgbaston, Birmingham, B15 2TT, UK;* [2]*Department of Human Kinetics, Université du Québec À Trois-Rivières, 3351 Boul. des Forges, C.P. 500, Trois-Rivières, QC, G8Z 4M3, Canada;* [3]*School of Health and Rehabilitation Sciences, The University of Queensland, Brisbane, QLD, 4072, Australia*

**Introduction:** Pain is a motivational stimulus that influences motor behaviour.[1] To identify whether motor adaptation may be a purposeful strategy to avoid pain-provocative movements,[2] we investigated kinematic adaptations to experimentally induced pain modulated by lumbar flexion.
**Methods:** Sixteen healthy adults performed a lifting task consisting of 15 sets of 10 cycles each. Pain was induced in the lumbosacral region (sets 3–13) using electrical stimulation modulated in real-time[3] to induce pain intensity of 5/10 when lumbar flexion was equal or higher than the peak flexion recorded at baseline. Repeated-measures ANOVA followed by post-hoc analyses were conducted to assess changes in lumbar kinematics between baseline (sets 1–2), early adaptation (sets 3–4), late adaptation (sets 12–13), and post-pain (sets 14–15).
**Results:** Compared to baseline, participants reduced lumbar flexion in the late adaptation ($p < 0.05$) and post-pain ($p < 0.05$), and increased lumbar extension during both early ($p < 0.05$) and late adaptation ($p < 0.05$). The reduction of lumbar flexion during late adaptation was inversely associated to reported pain intensity ($r = -0.52$, $p < 0.05$).
**Discussion:** When pain is modulated by lumbar flexion, individuals increase lumbar extension and learn to reduce lumbar flexion over time to limit pain. The adopted movement strategy (reduction in lumbar flexion) was maintained after pain resolution.
**Process evaluation:** Pain perception could be affected by habituation to electrical stimulation and exercise-induced hypoalgesia. To ensure consistency across trials, the pain threshold was regularly reassessed.
**References:** 1. Vlaeyen JWS, Crombez G. Behavioral Conceptualization and Treatment of Chronic Pain. Annu Rev Clin Psychol. 2020 May 7;16:187–212.
2. Hodges PW, Tucker K. Moving differently in pain: A new theory to explain the adaptation to pain. Pain 2011; 152(3):S90-S98.
3. Gallina A, Abboud J, Blouin JS. A task-relevant experimental pain model to target motor adaptation. J Physiol 2021;599(9):2401–2417.
**Keywords:** Movement-evoked pain; low back pain; nociceptive electrical stimulation; neuromuscular adaptations; kinematics

## The influence of attention on movement-related outcomes in non-specific low back pain: A systematic review

**J Wijnen**[1,2,3]; S Van Damme[4]; I De Greef[1]; E Pinto[4]; L Danneels[1]; J Van Oosterwijck[1,3,5]
[1]*Department of Rehabilitation Sciences, Faculty of Medicine and Health Sciences, Ghent University, Ghent, Belgium;* [2]*Het Rughuis, Roermond, Netherlands;* [3]*Pain in Motion International Research Group,* http://www.painimotion.be*;* [4]*Department of Experimental Clinical and Health Psychology, Ghent University, Ghent, Belgium;* [5]*Research Foundation – Flanders (FWO), Brussels, Belgium*

**Introduction:** There is abundant evidence for compromised movement performance in non-specific low back pain (NSLBP)[1,2]. It has been proposed that not only pain severity, but also cognitive-affective factors such as attention might influence movement[3]. The objective of this study is to review current knowledge concerning the effects of attention on movement-related outcomes in NSLBP.
**Methods:** A systematic search was performed and reported following the PRISMA-guidelines. A comprehensive search strategy was used by using five electronic databases. Possible risk-of-bias was evaluated by using the adjusted version of the Newcastle-Ottawa Scale. Levels of evidence and conclusion were assigned according to guidelines of the Dutch Institute for Healthcare Improvement.
**Results:** Twenty-two articles were included (ROB 18.2% – 72.7%), the majority (77%) performed in chronic LBP.

Limited evidence indicated attentional suppression (measured with coping strategy questionnaire) to be negatively associated with activity of the trunk muscles in acute NSLBP. Furthermore, limited evidence indicated that when attention is divided over tasks (i.e. dual-tasks) this results in lower variability of postural strategies in recurrent NSLBP and lower/delayed anticipatory trunk muscle activation in chronic NSLBP.
**Discussion:** Ignoring pain effects trunk muscle activity in acute NSLBP. When attention is divided (i.e. dual-tasks), individuals with recurrent/chronic NSLBP are less capable to control their trunk muscles.
**Process evaluation:** The different possibilities to operationalize 'attention' posed a difficulty. Included studies used two main operationalizations: 'attentional control of pain' (i.e. attention focus, attentional suppression/distraction) and 'attention as a capacity' (i.e. cognitive load of pain competes for available attentional resources for postural control).
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2. Van Dieën JH, Reeves NP, Kawchuk G, et al. Motor control changes in low back pain: divergence in presentations and mechanisms. Journal of Orthopaedic & Sports Physical Therapy 2019: 49(6), 370–379.
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**Keywords:** Low back pain; attention; motor control; attentional control; dual-tasks

## Category-based generalisation of pain-related avoidance behaviour

**E Glogan**[1,2]; R Gatzounis[1]; M Bennett[3]; K Holthausen[1]; P Liu[1]; A Meulders[1,2]
[1]*Centre for the Psychology of Learning and Experimental Psychopathology, Faculty of Psychology and Educational Sciences, KU Leuven, Leuven, Belgium;* [2]*Research Group Experimental Health Psychology, Department of Clinical Psychological Science, Faculty of Psychology and Neuroscience, Maastricht University, Maastricht, The Netherlands;* [3]*Medical Research Council, Cognition and Brain Science Unit, University of Cambridge, Cambridge, UK*

**Introduction:** People with chronic pain often fear and avoid movements and activities that are safe[2]. This may be due to these safe behaviours being associated with the same category as a painful behaviour[1].
**Methods:** In two studies, we investigated category-based pain-related avoidance generalisation. In Study 1, participants performed activities from two different real-life categories (gardening and cleaning) in a computer environment, using a joystick. Participants learned to avoid a painful stimulus in one of the categories, by performing the activity in a costlier way. The other category was always safe. Subsequently, four novel exemplars from each of the two categories were introduced, in the absence of pain. In Study 2, two groups learned to categorise the same arm-movements in different ways, using a robot. Subsequently, the groups underwent an avoidance acquisition phase, where two movements were paired with pain and one was not. Finally, the movements categorically related to the acquisition movements were made available, in the absence of pain.
**Results:** In both experiments, pain-related avoidance generalised as expected. In Study 1, participants avoided during novel exemplars of the pain-associated category. In Study 2, the two groups generalised avoidance differently, based on the categories they previously learned.
**Discussion:** This shows that pain-related avoidance can generalise to safe behaviors categorically. This form of generalization is important because category-based relations can be extremely wide-reaching and idiosyncratic.
**Process evaluation:** In the real world, avoidance can become extremely costly[3]. In Study 1, avoidance was costly, but not in Study 2. This may complicate the comparability of the two studies.
**References:** 1. Dunsmoor JE, Murphy GL. Categories, concepts, and conditioning: how humans generalize fear. *Trends Cogn Sci*. 19:73–77, 2015
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**Keywords:** Chronic pain; avoidance; generalisation; category-learning; operant conditioning

## Experiences of general practitioners explaining central sensitization to patients with persistent physical symptoms

**C den Boer**; B Terluin; JC van der Wouden; AH Blankenstein; HE van der Horst
*Department of General Practice, Amsterdam Public Health Research Institute, Amsterdam UMC, Vrije Universiteit, The Netherlands*

**Introduction:** Patients with persistent physical symptoms (PPS) require an explanation that is acceptable and comprehendible to them. (1) Central sensitization (CS) is an explanatory model for PPS and chronic pain that has been used in physiotherapy and rehabilitation medicine, but, until recently, not by general practitioners (GPs). (2) (3) We explored how GPs used the CS model in their consultations with patients with PPS.

**Methods:** We instructed 33 GPs on how to explain CS to patients with PPS. After 0.5–1.5 years of using the CS model, 26 GPs participated in focus groups and interviews to report and discuss their experiences with CS as an explanatory model. Audio recordings were transcribed and two researchers independently analysed the data.
**Results:** The GPs regarded the CS model as evidence-based, credible and giving recognition to the patient, but on the other hand difficult and time-consuming. They tailored the CS model to their patients' needs and used multiple consultations to explain the model. They reported that the use of the CS model seemed to improve the understanding and acceptance of the symptoms of the patients. Furthermore, patients seemed to become more motivated to accept appropriate therapy.
**Discussion:** GPs who applied the CS model in consultations with patients with PPS, reported that patients seemed to have more understanding. The GPs regarded the model as evidence-based, credible, and giving recognition to the patient, but also as difficult and time-consuming.
**Process evaluation:** GPs were, after a brief training, able to provide explanation with the CS model to their patients with PPS.
**References:** 1. Burton C, Lucassen P, Aamland A, Olde Hartman T. Explaining symptoms after negative tests: towards a rational explanation. J R Soc Med. 2015;108(3):84–88.
2. den Boer C, Terluin B, van Wilgen CP. [Explanation of central sensitisation to patients with medically unexplained symptoms helps acceptation]. Ned Tijdschr Geneeskd. 2020;164.
3. den Boer C, Dries L, Terluin B, van der Wouden JC, Blankenstein AH, van Wilgen CP, et al. Central sensitization in chronic pain and medically unexplained symptom research: A systematic review of definitions, operationalizations and measurement instruments. J Psychosom Res. 2019;117:32–40.
**Keywords:** Persistent physical symptoms; chronic pain; central sensitization; explanations; medically unexplained symptoms

## How does pain neuroscience approach work in people with chronic spinal pain? A secondary mediation analysis of a randomized controlled trial in primary care

**C Murillo**[1,2]; MA Galan-Martin[3,†]; F Montero-Cuadrado[3]; E Lluch[2,4]; A Mayo-Iscar[5]; M Meeus[1,2,6]; Loh WW[7].
[1]*Department of Rehabilitation Sciences, Faculty of Health Sciences and Medicine, Ghent University, Belgium;* [2]*Pain in Motion international research group,* www.paininmotion.be*;* [3]*Unit for Active Coping Strategies for Pain in East-Valladolid Primary Care, Castilla and León Public Health System, Spain;* [4]*Department of Physical Therapy, University of Valencia, Spain;* [5]*Department of Statistics and Operational Research and IMUVA, University of Valladolid, Spain;* [6]*Department of Rehabilitation Sciences and Physiotherapy, University of Antwerp; Belgium;* [7]*Department of Data Analysis, Ghent University, Belgium. †Deceased*

**Introduction:** Mediation analysis (MA) is becoming popular in pain research since allows for treatment effect decomposition by assessing indirect and direct effects. However, limitations specific to MA prevent from an unbiased causal inference of the current evidence.
**Methods:** A MA was conducted in an RCT where Pain Neuroscience Approach (PNA) was compared to usual care in people with chronic spinal pain. Four mediators (pain catastrophizing, fear of movement, central sensitization and pain intensity) measured at post-intervention and three outcomes (disability, medication intake and health-related quality of life) measured at follow-up were included into the analysis. Confounding, interaction terms and causal (sequential) structure were accounted for in the model.
**Results:** Reductions in fear of movement and central sensitization mediated improvements in disability and medication intake after PNA under various sequential decompositions (proportion mediated range: 29% to 58%).
**Discussion:** Reductions in fear of movement as well as central desensitization seem to contribute to the effects of PNA when compared to usual care. Further research in this vein is needed for a strong interpretation about the causal structure of this process.
**Process evaluation:** These results are part of a 2-year project divided in: (1) meta-analysis of current MAs in pain rehabilitation literature, (2) MA application in PNA. Thus, results from (2) will be framed within the context of the limitations highlighted in (1).
**Keywords:** Mediation analysis; causal inference; pain neuroscience approach; chronic spinal pain

## Effectiveness of pain neuroscience education in patients at risk for unfavorable outcome following surgery for lumbar radiculopathy: A randomized controlled trial protocol

**W Van Bogaert**[1,2,3]; I Coppieters[1,4,5]; J Nijs[1,4,6]; K Putman[2,7]; R Buyl[7,8]; E Huysmans[1,2,3,4,7]
[1]*Pain in Motion Research Group (PAIN), Department of Physiotherapy, Human Physiology and Anatomy, Faculty of Physical Education and Physiotherapy, Vrije Universiteit Brussel, Brussels, Belgium;* [2]*Interuniversity Centre for Health Economics Research (I-CHER), Department of Public Health (GEWE), Faculty of Medicine and Pharmacy, Vrije Universiteit Brussel, Brussels, Belgium;* [3]*Research Foundation – Flanders (FWO), Brussels, Belgium;* [4]*Department of Physical Medicine and Physiotherapy, University Hospital Brussels, Brussels, Belgium;* [5]*Department of Rehabilitation Sciences and Physiotherapy, Faculty of Medicine & Health Sciences, Ghent University, Ghent, Belgium;* [6]*Institute of Health and Care Sciences, and the University of Gothenburg Centre for Person-Centred Care (GPCC), Sahlgrenska Academy, University of Gothenburg, Gothenburg, Sweden;* [7]*Department of Public Health (GEWE), Faculty of Medicine and Pharmacy, Vrije Universiteit Brussel, Brussels, Belgium;* [8]*Department of Biostatistics and Medical Informatics, Faculty of Medicine and Pharmacy, Vrije Universiteit Brussel, Brussels, Belgium.*

**Introduction:** Current perioperative education for patients undergoing lumbar surgery is only limited effective in preventing unfavorable outcome. Perioperative pain neuroscience education (PPNE) is a recently introduced intervention that aims to inform such patients about what to expect from their recovery, to improve maladaptive pain cognitions, and to reconceptualize pain. As such, this study aims to evaluate the effectiveness of PPNE on quality of life at 6 weeks post-surgery in at-risk patients undergoing surgery for lumbar radiculopathy.
**Methods:** Following screening, 108 at-risk patients (i.e., having chronic pain ≥ 6 months, and maladaptive degrees of kinesiophobia and pain catastrophizing) undergoing surgery for lumbar radiculopathy will be randomized into an experimental (PPNE) or control (perioperative biomedical education) group. Intervention includes a pre- and postoperative in-person session with a physiotherapist, and access to an educational web application. The primary outcome measure is quality of life which will be assessed at 1 week pre-surgery, and 6 weeks, 6 months and 1 year post-surgery.
**Results:** The central hypothesis describes that due to the effect of PPNE these patients, despite their risk profile for unfavorable outcome, will have good surgical outcome with improvements in quality of life.
**Discussion:** Findings will provide insight in the effectiveness of PPNE as a preventive measure for unfavorable surgical outcome and will be valuable for all clinicians working with such at-risk patients.
**Process evaluation:** Though recruitment for this study has recently started, the process has been slow. As such, updated recruitment strategies are needed to help overcome current barriers.
**Keywords:** Lumbar surgery; pain catastrophizing; kinesiophobia; pain neuroscience education; quality of life

## Evidence for altered systemic cytokine levels in chronic musculoskeletal spinal pain and associations with pain severity: A systematic review

**Billens A**[1,2b,*], Canli K[3,*], Van Oosterwijck J[1,2], De Meulemeester K[1,2], Meeus M[1,2,4]
[1]*Spine, Head and Pain Research Unit Ghent, Department of Rehabilitation Sciences, Faculty of Medicine and Health Sciences, Ghent University, Ghent, Belgium;* [2]*Pain in Motion international research group,* http://www.paininmotion.be/*;* [3]*Faculty of Physical Therapy and Rehabilitation, Hacettepe University, Ankara, Turkey;* [4]*Department of Rehabilitation Sciences and Physiotherapy, Faculty of Medicine and Health Sciences, University of Antwerp, Antwerp, Belgium; *shared first authorship*

**Introduction:** Chronic spinal pain (CSP) is the most common form of chronic musculoskeletal pain in which the cytokine mechanism appears to play a role[1–3]. This study reviewed the evidence on circulating cytokine level in people with CSP compared to healthy people and potential associations with pain severity.
**Methods:** A systematic review was conducted. Three databases were searched to identify relevant literature. Risk-of-bias (ROB) was assessed using the Newcastle-Ottawa Scale (NOS). Level of evidence (LOE) and strength of conclusion were assigned using the EBRO-classification.
**Results:** Nine articles were included (NOS mean score 83%) with a total of 437 patients suffering from chronic whiplash associated disorders (CWAD) or chronic low back pain (CLBP). Moderate evidence indicated elevated TNF-α and IL-6 levels in CLBP and CRP levels in CWAD. Results regarding IL-1β in CLBP and TNF-α and IL-10 levels in CWAD were inconclusive. Moderate evidence indicated normal IFNγ and IL-2 levels in LBP and no association between TNF-α-, IL-6, IFNγ, IL-2 and pain severity in CLBP. Results for the relation between IL-1β levels and pain severity in LBP and between TNF-α, CRP, and IL-10 levels and pain severity in CWAD were inconclusive.
**Discussion:** Enhanced levels of increased cytokines, e.g. TNF-α, IL-6 and CRP, in CSP indicates the presence of systemic inflammation. Changes in TNF-α or IL-6 levels are not associated with pain severity in CLBP. Evidence for the association between other cytokine levels and pain severity is inconclusive and limited.

**Process evaluation:** Only case-control studies were included and therefore received a moderate LOE.
**References:** 1. Lim YZ, Wang Y, Cicuttini FM, et al. Association Between Inflammatory Biomarkers and Nonspecific Low Back Pain: A Systematic Review. *Clin J Pain* 2020; 36: 379–389.
2. Farrell SF, de Zoete RMJ, Cabot PJ and Sterling M. Systemic inflammatory markers in neck pain: A systematic review with meta-analysis. *Eur J Pain* 2020; 24: 1666–1686.
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**Keywords:** cytokines; inflammation; low back pain; neck pain; pain severity

## Cytokine expression in cancer patients suffering from chronic pain: A systematic review

**A De Groote**[1,2]; T Vande Vyvere[1,2,3]; A De Groef[1,4]; M Meeus[1,5]
[1]*MOVANT, Department of Rehabilitation Sciences and Physiotherapy, Faculty of Medicine and Health Sciences, University of Antwerp, Wilrijk, Belgium;* [2]*Pain in Motion International Research Group,* www.paininmotion.be*;* [3]*Department of Radiology, Antwerp University Hospital, Edegem, Belgium;* [4]*KU Leuven – University of Leuven, Department of Rehabilitation Sciences, Leuven, Belgium;* [5]*Department of Rehabilitation Sciences, Faculty of Medicine and Health Sciences, Ghent University, Ghent, Belgium*

**Introduction:** Chronic pain during and after cancer treatment is a commonly underdiagnosed and undertreated symptom. Recent insights suggest the immune system, e.g., cytokine signaling, plays an important role in the development and maintenance of persistent pain. In (non-cancer) patients without pain, differences in cytokine expression have already been observed compared to controls. However, it is less clear how cytokine expression relates to chronic pain in cancer patients. The goal of this study is to systematically review the literature and to investigate cytokine expression between cancer patients with chronic pain and healthy volunteers or patients without pain.
**Methods:** To retrieve studies, a systematic literature search will be conducted in PubMed, Web of Science, and Embase. Data deduplication, screening, and extraction will be performed by two independent reviewers using Covidence. Risk of bias will be evaluated using the Newcastle-Ottawa Scale. When possible, a meta-analysis will be conducted otherwise data will be presented as a narrative summary. Heterogeneity will be evaluated using the Chi² test and I² test.
**Results:** It is expected that cancer patients with chronic pain show persisting differences in cytokine expression after cancer treatment that contribute to their chronic pain experience. Specific results will follow upon data synthesis.
**Process evaluation:** The broad and sensitive literature search provided 3045 articles to screen, containing a lot of noise.
**Keywords:** Chronic pain; cancer; cytokines

## Brain derived neurotrophic factor negatively responded to transcranial direct current stimulation: Randomized controlled trail

**Y Hussein**[1,2,3]; M Nema[3]; H Mohamed[4]
[1]*Koç University Research Center for Translational Medicine (KUTTAM), Graduate School of Health Sciences, Koç University, Istanbul, Turkey;* [2]*Department of Physical Therapy and Rehabilitation, Faculty of Health Sciences, Marmara University, Istanbul, Turkey;* [3]*Department of Zoology, Faculty of Science, Alexandria University, Alexandria, Egypt;* [4]*Department of Neuropsychiatry, Faculty of Medicine, Alexandria University, Alexandria, Egypt*

**Introduction:** Brain-derived neurotrophic factor (BDNF) levels could indicate synaptic plasticity, modulation of BDNF might be a part of transcranial direct current stimulation (tDCS) mechanisms on synaptic connectivity [1]. BDNF associated with changes to chronic pain and stress [2]. The study aims to investigate BDNF level change in response to tDCS in subacute ischemic stroke patients. Clinical trial registration ID NCT04770363.
**Methods:** 36 stroke survivors participated, randomly assigned to bihemispheric (Anodal over affected M1, and cathodal over healthy M1), or unihemispheric (Anodal over affected M1, and cathodal over supraorbital bone), or sham (No current). ActivaDose tDCS (USA), consisted of 20 minutes of 2 mA intensity; in each session for 12 sessions three per week. A 3 ml blood was withdrawn in first and last sessions. BDNF determined using ELISA kits.
**Results:** Statistically significant difference (Negative) within groups for bihemispheric ($p$ = 0.011), unihemispheric stimulation ($p$ = 0.003), but not for sham group ($p$ = 0.492). Significant difference between groups ($p$ = 0.005). Post-hoc test by pairwise revealed both bihemispheric & unihemispheric stimulation significantly decreased BDNF levels more than sham ($p$ = 0.001), ($p$ = 0.021), respectively and no significant difference between both experimental groups ($p$ = 0.217).
**Discussion:** Negative decrease in BDNF levels associated with positive improving of motor measures, and upper extremity pain relieving.
**Process evaluation:** long-term effect of tDCS, electrode placements, and polarity change of electrodes should

considered for future studies. Applying the same current intensity/dose for all participants was a critical limitation.

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**Keywords:** Stroke; transcranial direct current stimulation; pain; brain derived neurotrophic factor

## The relation between cortisol and anxiety in patients with myalgic encephalomyelitis/chronic fatigue syndrome and healthy people

**J Hendrix**[1,2,3]; A Polli[1,2,3]; K Ickamns[1,3,4]; M Creta[2]; J Bakusic[2]; M Ghosh[2,3]; D Monteyne[5]; B Velkeniers[5]; J Nijs[1,4,6]; L Godderis[2,7]

[1]*Pain in Motion Research Group (PAIN), Department of Physiotherapy, Human Physiology and Anatomy, Faculty of Physical Education & Physiotherapy, Vrije Universiteit Brussel, Brussels, Belgium;* [2]*Centre for Environment and Health, Department of Public Health and Primary Care, Katholieke Universiteit Leuven, Leuven, Belgium;* [3]*Research Foundation – Flanders (FWO), Brussels, Belgium;* [4]*Department of Physical Medicine and Physiotherapy, University Hospital Brussels, Brussels, Belgium;* [5]*Department of Internal Medicine and Endocrinology, University Hospital Brussels, Brussels, Belgium;* [6]*Department of Health and Rehabilitation, Unit of Physiotherapy, Institute of Neuroscience and Physiology, Sahlgrenska Academy, University of Gothenburg, Sweden. University of Gothenburg Center for Person-Centred Care (GPCC), Sahlgrenska Academy, University of Gothenburg, Gothenburg, Sweden;* [7]*IDEWE, External Service for Prevention and Protection at Work, Heverlee, Belgium;*

**Introduction:** Myalgic Encephalomyelitis/Chronic Fatigue Syndrome (ME/CFS) is a debilitating disease with unknown pathophysiology. Previous studies found lower salivary cortisol in patients with ME/CFS, which is referred to as hypocortisolism and is moreover associated with anxiety disorders. Therefore, we examined the relation between cortisol and anxiety specifically in patients with ME/CFS.

**Methods:** Saliva of 28 patients with ME/CFS and 26 healthy controls (HCs) was collected twice. Cortisol levels were determined via liquid chromatography – mass spectrometry. Anxiety was assessed via the Beck Anxiety Inventory (BAI).

**Results:** Cortisol levels were not significantly different between patients with ME/CFS (mean = 0.907 ng/ml; 95% C.I. 0.595 to 1.1219) and HCs (mean = 1.379 ng/ml; 95% C.I. 0.998 to 1.759; F = 3,702; $p$ = 0.060). Patients with ME/CFS (mean = 39.582; 95% C.I. 37.320 to 41.844) had higher BAI scores than HCs (mean = 27.988; 95% C.I. 25.641 to 30.335; F = 49,984; $p < 0.001$). A weak, but significant, correlation was found between cortisol levels and anxiety on day 1 ($r = -0.343$; $p$ = 0.03) and day 2 ($r = -0.363$; $p$ = 0.018) in the entire group.

**Discussion:** This study did not identify hypocortisolism in patients with ME/CFS. However, the negative correlation between anxiety and cortisol levels combined with the higher BAI scores in patients is consistent with literature, in which anxiety disorders are associated to hypocortisolism.

**Process evaluation:** The study design was not ideal to determine differences in cortisol levels as this was not the main focus of the project. Cortisol levels were determined only once each day whereas, in ideal situations, daily cortisol output is determined via multiple measures per day because of the diurnal fluctuations in cortisol levels.

**Keywords:** myalgic encephalomyelitis/chronic fatigue syndrome; anxiety; cortisol

## Identification of biomarkers for chronic pain after breast cancer treatment

**A De Groote**[1,2]; T Vande Vyvere[1,2,3]; A De Groef[1,4]; M Meeus[1,5]

[1]*MOVANT, Department of Rehabilitation Sciences and Physiotherapy, Faculty of Medicine and Health Sciences, University of Antwerp, Wilrijk, Belgium;* [2]*Pain in Motion International Research Group,* www.paininmotion.be*;* [3]*Department of Radiology, Antwerp University Hospital, Edegem, Belgium;* [4]*KU Leuven – University of Leuven, Department of Rehabilitation Sciences, Leuven, Belgium;* [5]*Department of Rehabilitation Sciences, Faculty of Medicine and Health Sciences, Ghent University, Ghent, Belgium*

**Introduction:** Worldwide, breast cancer has the highest incidence rate. Chronic pain during and after cancer treatment is a commonly underdiagnosed and undertreated symptom influencing the patients' quality of life. Generally, breast cancer survivors do not have pain at the time of diagnosis but up to 40% reports to develop chronic pain post-treatment. To improve pain management, biomarkers related to pain chronification would be valuable. Therefore, this study aims to identify susceptibility/risk, nociceptive, prognostic, and diagnostic biomarkers for chronic pain after breast cancer treatment.

**Methods:** A prospective longitudinal study will be performed including 150 breast cancer patients followed from pre-surgery until 12 months post-surgery. At 4 time points, data will be generated through pain assessment, neuroimaging, psychological questionnaires, quantitative sensory testing (QST), and blood analysis. Data will be entered and managed in Research Electronic Data Capture. Multivariable regression analysis will be used to detect candidate biomarkers. Longitudinal changes will be assessed using linear mixed model analyses and correlation analyses will be used to study interrelationships.
**Results:** Based on pain perception in other patient populations, it is hypothesized that neuroimaging, QST, and blood analysis could possibly serve in the different classes of biomarkers whereas psychological factors are expected to fall under prognostic and susceptibility/risk biomarkers.
**Process evaluation:** Necessary contracts are being established. Expected hurdles are patient recruitment and scheduling the data collection.
**Keywords:** Chronic pain; breast cancer; biomarkers

## The association between work-related physical and psychosocial factors and musculoskeletal disorders in healthcare workers: Moderating role of fear of movement

**S Keyaerts**[1,2]; L Godderis[1,2]; E Delvaux[1,3]; L Daenen[1,2,4,5]
[1]*Knowledge, Information and Research Center (KIR), Group Idewe (External Service for Prevention and Protection at Work), Leuven, Belgium;* [2]*Department of Public Health and Primary Care, KU Leuven, Leuven, Belgium;* [3]*Department of Social and Cultural Psychology, Faculty of Psychology and Educational Sciences, KU Leuven, Belgium;* [4]*Department of Physiotherapy, Human Physiology and Anatomy, Faculty of Physical Education and Physiotherapy, Vrije Universiteit Brussel, Brussels, Belgium;* [5]*Pain in Motion International Research Group, Brussels, Belgium*

**Introduction:** Knowledge is lacking on the interaction between fear of movement (FOM) and work-related physical and psychosocial factors in the development and persistence of musculoskeletal disorders (MSDs).
**Methods:** In this cross-sectional study, 305 healthcare workers from several Belgian hospitals filled out a questionnaire including socio-demographic factors, work-related factors (social support, autonomy at work, workload and physical job demands), FOM and MSDs for different body regions during the past year. Path analysis was performed to investigate (1) the association between the work-related factors, FOM and MSDs, and (2) the moderating role of FOM on the association between the work-related factors and MSDs among healthcare workers.
**Results:** Complaints were most frequently located at the neck-shoulder region (79.5%) and lower back (72.4%). Physical job demands (odds ratio (OR) 2.38 and 95% confidence interval (CI) [1.52–3.74]), autonomy at work (OR 1.64 CI [1.07–2.49]) and FOM (OR 1.07 CI [1.01–1.14] and OR 1.12 CI [1.06–1.19]) were positively associated with MSDs. Healthcare workers who experienced high social support at work (OR 0.61 CI [0.39–0.94]) were less likely to have MSDs. Fear of movement interacted negatively with workload (OR 0.92 CI [0.87–0.97]) and autonomy at work (OR 0.94 CI [0.88–1.00]) on MSDs.
**Discussion:** Work-related physical and psychosocial factors as well as FOM are related to MSDs in healthcare workers. FOM is an important moderator of this relationship and should be assessed in healthcare workers in addition to work-related physical and psychosocial factors to prevent or address MSDs.
**Process evaluation:** Under review
**Keywords:** Pain beliefs; pain cognitions; fear of movement; physical job demands; work-related psychosocial factors

## The effect of personality type on attentional bias within a chronic back pain population

**MW Esselaar**[1,2]; P Holmes[3]; D Wright[3]; B Marshall[1,2]; D Smith[1,2]; Z Franklin[1,2]
[1]*Department of Sport and Exercise Sciences, Musculoskeletal Science and Sports Medicine Research Centre, Faculty of Science & Engineering, Manchester Metropolitan University, Manchester, UK;* [2]*Manchester Metropolitan University Institute of Sport, Manchester, UK;* [3]*Health, Psychology and Communities Research Centre, Department of Psychology, Manchester Metropolitan University, UK*

**Introduction:** Attentional biases towards threatening information have been found in the chronic pain population, however results are inconsistent[1]. Recent research has used eye-trackers to assess attention rather than the traditional method of reaction time[2]. Furthermore, personality type may explain differences in attention[3]. This study will use eye-tracking and social desirability as additional measures to assess attentional biases in chronic back pain patents.
**Methods:** Participants completed a dot-probe task with images of actions that involve the back (threatening), positive or neutral. There were 350 trials, 100 threatening/neutral images, 100 positive/neutral images, 100 positive/threat images and 50 neutral/neutral images. Stimuli were shown for 2000 ms, the images disappeared and one of the images was replaced with a probe (: or ..). The participant pressed as quickly and accurately as possible, one of two keys identifying the probe.
**Results:** Initial results show that the controls have no specific bias towards either images. I hypothesize that

the defensive high anxious will have an attentional bias towards the threatening images, whereas the repressors will show initial vigilance followed by avoidance.
**Discussion:** The results of this study will add to the existing knowledge and might explain contradiction findings within attentional biases in the pain population.
**Process evaluation:** This study is part of a PhD and has suffered delays because of COVID. Recruitment for back pain patients has restarted.
**References:** 1. Todd, J., van Ryckeghem, D. M. L., Sharpe, L., and Crombez, G. (2018). Attentional bias to pain-related information: a meta-analysis of dot-probe studies. Health Psychol. Rev. 12, 419–436. https://doi.org/10.1080/17437199.2018.1521729
2. Jones, E. B., Sharpe, L., Todd, J., MacDougall, H., Nicholas, M., & Colagiuri, B. (2021). Examining attentional biases, interpretation biases, and attentional control in people with and without chronic pain. Pain, 162, 2110– 2119.
3. Z. Franklin, P. Holmes, N. Fowler (2019). Eye gaze markers indicate visual attention to threatening images in individuals with chronic back pain. Journal of Clinical Medicine, 8 (1), p. 31
**Keywords** Chronic-low-back-pain; Attentional-bias; Dot-Probe; Eye-tracking

## The prevalence of perceived injustice and factors associated with perceived injustice in people with pain: A systematic review with meta-analysis

**E Roose**[1,2,3,4]; A Lahousse[1,2,3,4,5]; A Robbeets[3]; E Smout[3]; J Nijs[1,7,8]; P van Wilgen[1,9]; E Huysmans[1,5,6,7]; D Beckwée[2,3]; M De Couck[1,10]; A Timmermans[4]; R Bults[1,9]; L Leysen[1,2,3,5]
[1]*Pain in Motion Research Group (PAIN), Department of Physiotherapy, Human Physiology and Anatomy, Faculty of Physical Education and Physiotherapy, Vrije Universiteit Brussel, Laarbeeklaan 103, 1090 Brussels, Belgium;* [2]*Rehabilitation Research (RERE) Research Group, Department of Physiotherapy, Human Physiology and Anatomy, Faculty of Physical Education & Physiotherapy (KIMA), Vrije Universiteit Brussel, Laarbeeklaan 103, 1090 Brussels, Belgium;* [3]*Department of Physiotherapy, Human Physiology and Anatomy, Faculty of Physical Education and Physiotherapy, Vrije Universiteit Brussel, Building F-kine, Laarbeeklaan 103, BE-1090 Brussels, Belgium;* [4]*Universiteit Hasselt, REVAL, Agoralaan-gebouw A, 3590 Diepenbeek, Belgium;* [5]*Research Foundation Flanders (FWO), Brussels, Belgium;* [6]*Department of Public Health (GEWE), Faculty of Medicine and Pharmacy, Vrije Universiteit Brussel, Brussels, Belgium;* [7]*Chronic pain rehabilitation, Department of Physical Medicine and Physiotherapy, University Hospital Brussels, Brussels, Belgium;* [8]*Institute of Neuroscience and Physiology, University of Gothenburg, Gothenburg, Sweden;* [9]*Transcare Pain Transdisciplinary pain treatment center, Groningen, the Netherlands;* [10]*Faculty of Health Care, Odisee University College, Campus Aalst & Brussels, Belgium*

**Introduction:** Research about perceived injustice (PI) in people with pain is expanding[1]. PI predicts adverse pain-related and disability outcomes[2], and increases the risk of long-term opioid use potentially leading to side-effects[3]. Therefore, understanding PI in people with pain is necessary to target interventions and prevent pain chronicity.
**Methods:** A systematic search was conducted. Two independent reviewers screened and evaluated the literature and extracted the data. Meta-analyses were performed for prevalence rates and factors associated with PI in people with pain.
**Results:** Fifty-four studies were found eligible. Prevalence of PI ranged between 23–77% ($I^2 = 99\%$). Significant associations were found with pain catastrophizing, posttraumatic stress, anger, anxiety, pain acceptance, depressive symptoms, kinesiophobia, academic functioning, disability, emotional functioning, pain interference, state anger, mental functioning, central sensitization, social functioning, physical functioning, pain perceptions, trait anger, pain intensity, and anger inhibition.

**Discussion:** Prevalence was ≥33 in 75% of the studies. Considering PI in the treatment of people with pain is important due to its association with adverse pain, psychological, and quality of life characteristics.
**Process evaluation:** This is the first systematic review estimating the prevalence and factors associated with PI. Methodologically, not all association measures (e.g., odds-ratios, beta-coefficients) could be included in the meta-analyses. Since we focussed on associations, we cannot draw any conclusions on causal interactions between PI and related factors in people with pain.
**References:** 1. Rodero, B., et al., Perceived injustice in fibromyalgia: psychometric characteristics of the Injustice Experience Questionnaire and relationship with pain catastrophising and pain acceptance. J Psychosom Res, 2012. 73(2): 86–91.
2. Sullivan, M.J., et al., Perceived injustice is associated with heightened pain behavior and disability in individuals with whiplash injuries. Psychological Injury and Law, 2009. 2(3–4): 238–247.
3. Paice, J.A., et al., Management of chronic pain in survivors of adult cancers: American Society of Clinical Oncology clinical practice guideline. Journal of Clinical Oncology, 2016. 34(27): 3325–3345.
**Keywords:** Pain; perceived injustice; systematic review; meta-analysis; prevalence

## Association between cognitive function and chronic low back pain – A protocol for a repeated-measures observational study

**EH Nery Pereira**[1]; NP Rocha[1]; VT Cruz[2]; AG Silva[3]
[1]*Department of Medical Sciences, University of Aveiro, Aveiro, Portugal;* [2]*Department of Neurology, University of Porto, Porto, Portugal;* [3]*CINTESIS.UA, School of Health Sciences, University of Aveiro, Aveiro, Portugal*

**Introduction:** Chronic pain is associated with maladaptive plasticity of the nervous system [1]. It has also been proposed that there is an association between cognitive function and chronic pain [2]. To our knowledge, there are no longitudinal studies exploring this association. The main purpose of this study is to compare cognitive function in individuals with chronic low back pain (cLBP) and asymptomatic individuals for a three-month period.
**Methods:** Participants will be individuals with cLBP ($n$ = 67) and asymptomatic controls ($n$ = 67) matched for age, sex, and educational levels. Assessment of pain characteristics and cognitive function will occur three times over a 3 month period (T1-first assessment; T2 -one week after first assessment; T3 - three months after first assessment). Pain and psychological factors will be assessed using a mobile app (AvaliaDOR: pain phenotype and intensity, catastrophizing and fear of movement), and the Central Sensitization Inventory and the Hospital Anxiety and Depression Scale (HAS).. Cognitive function will be assessed using a web-based system (Brain on Track®). Two-point discrimination will be used as an indicator of cortical reorganization.
**Results:** We hypothesized that individuals with cLBP will demonstrate a reduced cognitive function compared with asymptomatic individuals; and that higher pain intensity and duration, psychosocial factors and cortical reorganization will be related to decreased cognitive function.
**Discussion:** This study may further elucidate the association between cLBP characteristics and cognitive function and provide potential recommendations for the assessment and management of cLBP and future research.
**Process evaluation:** We anticipate difficulty in enrolling the expected number of participants.
**References:** 1. McCarberg B, Peppin J. Pain Pathways and Nervous System Plasticity: Learning and Memory in Pain. Pain Medicine 2019; 20(12):2421–37.
2. Moriarty O, McGuire BE, Finn DP. The effect of pain on cognitive function: A review of clinical and preclinical research. Progress in Neurobiology 2011; 93(3):385–404.
**Keywords:** Chronic low back pain; cognitive function; pain.

## The effect of praying on endogenous pain modulation and pain intensity in healthy religious individuals: A randomized controlled experiment

**C Najem**[1,2,3]; M Meeus[1,3,4]; B Cagnie[1]; F Ayoubi[2,5]; M Al Achek[2]; P Van Wilgen[3,7,8]; J Van Oosterwijck[1,3,4,6]; De Meulemeester K[1,3]
[1]*Spine, Head and Pain Research Unit Ghent, Department of Rehabilitation Sciences, Faculty of Medicine and Health Sciences, Ghent University, Belgium;* [2]*Department of physiotherapy, Faculty of Public Health, Antonine University, Lebanon;* [3]*Pain in Motion International Research Group,* www.painimotion.be*;* [4]*MOVANT Research group, Department of Rehabilitation Sciences and Physiotherapy, Faculty of Medicine and Health Sciences, University of Antwerp, Belgium;* [5]*Department of physiotherapy, Faculty of Public Health, Lebanese University, Lebanon;* [6]*Research Foundation - Flanders (FWO), Belgium;* [7]*Transcare Transdisciplinary Pain Management Center, Groningen, the Netherlands;* [8]*PAIN – VUB Pain in Motion Research Group, Department of Physiotherapy, Human Physiology and Anatomy, Faculty of Physical Education & Physiotherapy, Vrije Universiteit Brussel, Belgium.*

**Introduction:** Prayer is the most common therapy used in alternative medicine[1]. The objective of this study was to explore the effect of prayers on endogenous pain modulation, pain intensity, and sensitivity in healthy religious participants.

**Methods:** Two hundred and eight healthy religious participants were enrolled in this study and randomly distributed into two groups, a prayer group ($n$ = 156) and a poem reading or control group ($n$ = 52). Participants from the prayer group were allocated to either an active prayer group ($n$ = 94) receiving an active type of praying or to a passive prayer group ($n$ = 62) receiving a passive type of praying. Pain assessments were performed prior to and following the prayer or poem reading interventions and included pressure pain threshold assessment, conditioned pain modulation, and a numerical pain rating scale for perceived pain intensity.
**Results:** A significant group-by-time interaction for PPT ($p$ = 0.014) indicated post-intervention increases in PPT in the prayer group but not in the poem reading control group. Also, a significant group-by-time interaction for PPT ($p$ = 0.005) indicated that these effects were greater in the active prayer group than in the passive prayer group. Participants experienced a decrease in CPM efficacy ($p$ = 0.030) and an increase in pain intensity ($p$ < 0.001) following the interventions, independent of their group allocation.
**Discussion:** The results showed that prayer, irrespective to type, can positively affect pain sensitivity and intensity, but does not influence endogenous pain inhibition.
**Process evaluation:** Future research should focus on understanding the mechanism behind "prayer induced analgesia".
**References:** 1. Tippens K, Marsman K, Zwickey H. Is prayer CAM? Journal of alternative and complementary medicine 2009; 15(4): 435–438.
**Keywords:** Pressure pain threshold; conditioned pain modulation; prayer; religion; pain.

## Back2Action: Effectiveness of physiotherapy blended with ehealth consisting pain education and behavioral activation – protocol for a pragmatic randomized clinical trial

**L Bijker**[1,2]; LM de Wit[2]; P Cuijpers[2]; EY Poolman[1]; GGM Scholten-Peeters[1]; MW Coppieters[1,3]
[1]*Department of Human Movement Sciences, Faculty of Behavioural and Movement Sciences, Vrije Universiteit Amsterdam, Amsterdam Movement Sciences, The Netherlands;* [2]*Amsterdam Public Health Research Institute, Department of Clinical Psychology, Faculty of Behavioural and Movement Sciences, Vrije Universiteit Amsterdam, The Netherlands;* [3]*Menzies Health Institute Queensland, Griffith University, Brisbane & Gold Coast, Australia*

**Introduction:** Psychosocial factors predict recovery in patients with spinal pain. Several of these factors are modifiable. However, physiotherapists indicate that they do not feel sufficiently equipped to address these factors. We developed an eHealth intervention to support physiotherapists in managing psychosocial factors in patients with spinal pain. This paper describes the protocol for a pragmatic randomised clinical trial which evaluates the effectiveness of this eHealth intervention blended with physiotherapy compared to physiotherapy alone.
**Methods:** Participants with non-specific low back pain and/or neck pain for at least six weeks who also experience psychosocial symptoms will be recruited in a pragmatic multi-centre cluster randomised clinical trial. The experimental intervention consists of physiotherapy blended with six online modules of pain education and behavioural activation. The control intervention consists of usual care physiotherapy. The primary outcomes are disability and perceived effect. Outcomes will be assessed at baseline, and at 2, 6 and 12 months after baseline. The results will be analysed using linear mixed models.
**Results:** At this moment, 357 patients were assessed for eligibility and 140 patients are included.
Our hypothesis is that the blended intervention is more effective than usual physiotherapy at 12 month follow-up.
**Process evaluation:** Inclusion of participants has proven challenging, we have extended the inclusion phase with 1.5 years and recruited more physiotherapy practices.
**Keywords:** Persistent pain; pain education; behavioural activation; physiotherapy; RCT protocol

## Does multidisciplinary therapy improve pain, functionality and return to work in employed (sub)acute low back pain sufferers? A systematic review

**E Cnockaert**[1,2,3,*]; L Bernaers[1,4,*]; L Braeckman[4]; P Mairiaux[5]; O Poot[5]; T Willems[1]
[1]*Faculty of Medicine and Health Sciences, Department of Rehabilitation Sciences, Ghent University, Campus UZ Ghent, Corneel Heymanslaan 10, 9000 Ghent, Belgium;* [2]*Pain in Motion international research group,* www.paininmotion.be*;* [3]*Pijncentrum AZ Sint-Lucas, Ghent, Belgium;* [4]*Faculty of Medicine and Health Sciences, Department of Public Health and Primary Care, Ghent University, Campus UZ Ghent, Corneel Heymanslaan 10, 9000 Ghent, Belgium;* [5]*Federal Agency for Occupational Risks, Sterrenkundelaan 1, 1210 Brussels, Belgium*

*Shared first authorship
**Introduction:** Low back pain (LBP) is characterized with enormous costs originating from e.g. work absenteeism[1]. This study examined the effectiveness of a multidisciplinary intervention, with or without additional workplace intervention (WPI), in improving pain, functionality and return to work in employed (sub)acute LBP sufferers.
**Methods:** A comprehensive search in six electronic databases was performed. The risk of bias (RoB) was assessed using the Cochrane RoB 2-tool and the ROBIS-tool. A level of evidence (LoE) and conclusion was determined according to the Dutch EBRO checklist.

**Results:** Twelve studies were included (one A1, seven A2, four B LoE studies). A multidisciplinary intervention has beneficial effects on pain intensity and functionality compared to usual care. Contradictory results exist when compared with another intervention or an additional WPI. Regarding work-related outcomes conflicting results were found when a multidisciplinary intervention was compared to usual care, and no superior effects were found in comparison to other types of interventions. Adding a WPI to usual care might result in earlier work resumption.
**Discussion:** A multidisciplinary intervention has favorable effects compared with usual care on pain and functionality. An additional WPI on top of usual care might be beneficial for RTW.
**Process evaluation:** Most important limitations: 3 articles with coherent samples, the lack of articles containing an additional WPI and difficulty to compare results due to heterogeneity.
**References:** 1. van Tulder MW, Koes BW, Bouter LM. A cost-of-illness study of back pain in The Netherlands. Pain. 1995;62(2):233–40.
**Keywords:** Low back pain; Multidisciplinary treatment; Return to work; Sick Leave; Disability

## Get-Backyouth – Development of a person-centered digital support platform for adolescents with low back pain who are seeking primary care

**A Ahlqwist**[1]; M Lundberg[2,3]; H Brisby[4]; E Varkey[5,6]; M Kemani[7]
[1]*Department of Health and Rehabilitation, Unit of Physioterapy, Institute of Neuroscience and Physiology, Sahlgrenska Academy, University of Gothenburg, Gothenburg, Sweden;* [2]*Department of Health and Rehabilitation/Physiotherapy, Institute of Neuroscience and Physiology, Sahlgrenska Academy, University of Gothenburg, Box 455, SE-40530, Gothenburg, Sweden;* [3]*Department of Health and Rehabilitation/Physiotherapy, Institute of Neuroscience and Physiology, Sahlgrenska Academy, University of Gothenburg, Box 455, SE-40530, Gothenburg, Sweden;* [4]*Department of Orthopedics, Institute of Clinical Sciences, Sahlgrenska Academy, University of Gothenburg, Gothenburg, Sweden;* [5]*Region Västra Götaland, Sahlgrenska University Hospital, Department of Occupational Therapy and Physiotherapy, Diagnosvägen 11, SE-41650, Gothenburg, Sweden;* [6]*Department of Health and Rehabilitation/Physiotherapy, Institute of Neuroscience and Physiology, Sahlgrenska Academy, University of Gothenburg, Box 455, SE-40530, Gothenburg, Sweden;* [7]*Karolinska University Hospital/ Karolinska Institutet, Behavioral Medicine, Department of Clinical Neuroscience, Solna, Sweden*

**Introduction:** The incidence of low back pain (LBP) has increased among adolescents[1]. Adolescents with pain experience more stress, use more healthcare resources and experience poorer school results compared with peers who do not report pain[2]. We have shown that an individually tailored exercise program led by a physiotherapist reduces pain intensity and increases physical function[3]. In a subsequent interview study, adolescents emphasized knowledge about the pain and support from the physiotherapist as meaningful to their ability to manage their pain. This study aims to develop Get-Backyouth, a person-centered, digital pain education for adolescents with LBP.
**Methods:** Get-Backyouth will be developed and designed over a three-year period. During the first part of the process, the pain education part itself will be developed and designed. Later in the process the usage and effect of the digital support platform will be evaluated. We will combine a number of different research methods, co-design, qualitative research, single-case studies leading to a randomized controlled trial. Adolescents with LBP are included as partners in the research group from design to publication.
**Discussion:** How should Get-Backyouth be designed with regard to content, design and user-friendliness in order to best promote knowledge about pain in adolescents with LBP? Whether the Get-Backyouth program and its usage can result in a change of effect variables; pain education, self-efficacy, fear avoidance and physical activity level?
**References:** 1. Calvo-Munoz I, Gomez-Conesa A, Sanchez-Meca, J. Prevalence of low back pain in children and adolescents: a meta-analysis. BMC Pediatrics 2013;14:1–12.
2. Eccleston C, Crombez G, Scotford A, et al. Adolescent chronic pain: patterns and predictors of emotional distress in adolescents with chronic pain and their parents. Pain 2004;108(3): 221–229.
3. Ahlqwist A, Hagman M, Kjellby-Wendt G, Beckung E. Physical therapy treatment of back complaints on children and adolescents. Spine 2008; Sep.15;33(20):721–727.
**Keywords:** Pain; low back pain; adolescents; physiotherapy

## Feasibility of get b@ck – A person-centred prehabilitation program for vulnerable patients planned for lumbar spine surgery

**R Hanafi**[1]; M Kemani[2]; A Fors[3,4]; H Brisby[5,6]; J Nijs[7,8,9]; M Lundberg[1,9]
[1]*Department of Health Promoting Science, Sophiahemmet University, Stockholm, Sweden;* [2]*Theme Women's Health and Allied Health Professionals, Medical Unit Medical Psychology, Karolinska University Hospital, Stockholm, Sweden;* [3]*Institute of Health and Care Sciences, Sahlgrenska Academy at University of Gothenburg, Gothenburg, Sweden;* [4]*Centre for Person-Centred care (GPCC), Institute of Health and Care Sciences, Sahlgrenska Academy at University of Gothenburg, Gothenburg, Sweden;* [5]*Department of Orthopaedics, Sahlgrenska University Hospital, Gothenburg, Sweden;* [6]*Department of Orthopaedics, Institute for clinical sciences, Sahlgrenska Academy, University of Gothenburg, Gothenburg, Sweden;* [7]*Pain in Motion Research Group (PAIN), Department of Physiotherapy, Human Physiology and Anatomy, Faculty of Physical Education & Physiotherapy, Vrije Universiteit Brussels, Brussels, Belgium;* [8]*Chronic Pain Rehabilitation, Department of Physical Medicine and Physiotherapy, University Hospital Brussels, Brussels, Belgium;* [9]*Unit of Physiotherapy, Department of Health and Rehabilitation, Institute of Neuroscience and Physiology, University of Gothenburg Center for Person-Centred Care (GPCC), Sahlgrenska Academy, University of Gothenburg, Gothenburg, Sweden;* [10]*University of Gothenburg Centre for Person-Centred Care (GPCC), Sahlgrenska Academy, University of Gothenburg, Sweden*

**Introduction:** Get Back is a further development of a prior person-centered prehabilitation project for lumbar fusion surgery (1). The program showed good effect on the patient's health related quality of life and had a high adherence rate and was found to be safe. Get Back aims to expand this program to include patients with lumbar spinal stenosis, who before surgery, have a worse starting position. This project aims to: (1) identify patients planned for surgery by screening for fear of movement and pain catastrophizing; (2) with person centered approach, via an e-health platform, support patients to challenge their fears of moving towards personal goals.
**Methods:** The primary outcome is process feasibility conducted by the variables: recruitment rate, session compliance, and acceptability (2). Acceptability will more specifically be evaluated using questionnaires about the patient's and the physical therapist's satisfaction with the intervention. Preliminary treatment effects will be analyzed using validated self-report questionnaires, actigraph for measuring physical activity and functional capacity tests (3).
**Results:** The hypothesis is that Get Back will: (1) be acceptable and increase patients' participation in their care. (2) increase patients' physical activity and health related quality of life compared to usual care.
**Discussion:** The feasibility study will be followed by a multi-center randomized controlled trial.
**Process evaluation:** The next step is to initiate a patient involvement process together with persons who have lived with lumbar spinal stenosis and undergone surgery to get input on the content and setup.
**References:** 1. Lotzke H, Jakobsson M, Brisby H, Gutke A, Hägg O, Smeets R, Lundberg M. Person-Centered Preoperative Cognitive-Behavioral–Based Physical Therapy for Patients Scheduled for Lumbar Fusion Surgery – A Randomized Controlled Trial. Phys Ther. 2019; 21. pii: pzz020. https://doi.org/10.1093/ptj/pzz020. [Epub ahead of print]. PMID: 30951604
2. Thabane L, Ma J, Chu R, Cheng J, Ismaila A, Rios L, et al. A tutorial on pilot studies: the what, why and how. BMC Medical Research Methodology. 2010; 10:1. https://doi.org/10.1186/1471-2288-10-1 PMID: 20053272
3. Jakobsson M, Lundberg M, Brisby H, Gutke A, Smeets R. One-minute stair-climbing, 50-foot walk, and timed up-and-go but not 5-minute walk displayed good responsiveness for patients with severe low back pain who undergo lumbar fusion surgery. BMC Musculoskelet Disord. 2019 Mar 30;20(1):137. https://doi.org/10.1186/s12891-019-2512-5. PMID: 30927913 3.
**Keywords:** Lumbar spine surgery; spinal stenosis; fear of movement; pain catastrophizing; feasibility

## Systematic description of an interdisciplinary treatment program for patients with chronic musculoskeletal pain using the tidier checklist

**L Breugelmans**[1]; E Scheffer[2]; R Smeets[1,3]; R Oosterwijk[3]; G Nijland[3]; L Beckers[1]
[1]*Department of Rehabilitation Medicine, Faculty of Health, Life Sciences and Medicine, Maastricht University, Maastricht, Netherlands;* [2]*Lifestyle and Health Research Group, Healthy and Sustainable Living Research Centre, University of Applied Sciences Utrecht, Utrecht, Netherlands;* [3]*CIR Rehabilitation, Netherlands*

**Introduction:** Promising clinical results support the positive effects of interdisciplinary multimodal pain treatment (IMPT) for patients with chronic musculoskeletal pain (CMP). Additional scientific evidence is warranted however, specifically on long-term effectiveness[1]. Inadequate descriptions of interventions often impede interpreting treatment effectiveness and comparing study results[2]. The objective therefore, is to provide a systematic and thorough description of a 10-week IMPT program for patients with CMP provided at the *Centre for Integral Rehabilitation (CIR)* in the Netherlands.

**Methods:** We used the TIDieR-checklist[3] as a guide, although we added subsections describing the eligibility criteria and evaluation procedures in order to provide a complete description of the intervention. We included a detailed overview of all sessions in each phase of the program, as well as their timing and duration.
**Results:** The CIR program aims to increase patients' daily functioning by supporting them to adapt their behaviour so that they can better manage their complaints, and consists of three phases: a start phase, an education phase and a skill-learning phase. The treatment incorporates pain education, Acceptance and Commitment Therapy (ACT), cognitive behavioural therapy (CBT) like graded activity and exposure in vivo, and physical training (experiential learning).
**Discussion:** All patients follow the same schedule with the same sessions, however tailoring takes place on a per-session basis to address a patient's specific needs and goals.
**Process evaluation:** Due to the individual tailoring it is not possible to provide an exact description of the treatment which is identically replicable. Individualisation however does increase the effectiveness of IMPT programs.
**References:** 1. Elbers S, Wittink H, Konings S, Kaiser U, Kleijnen J, Pool J, Köke A, Smeets R. Longitudinal outcome evaluations of Interdisciplinary Multimodal Pain Treatment programmes for patients with chronic primary musculoskeletal pain: A systematic review and meta-analysis. European Journal of Pain 2022; 26: 310– 335.
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**Keywords:** CMP; interdisciplinary; CBT; TIDieR; ACT

## Are pain, disability, quality of life, psychological factors and central sensitization related to quantitative sensory testing in chronic whiplash associated disorders?

**D Lenoir**[1,2,3,4]; W Willaert[1,2,3,6]; K Ickmans[3,6,7]; L Bernaers[2]; J Nijs[3,7,8]; A Malfliet[1,3,6]; L Danneels[2]; L Leysen[1,3]; R De Pauw[2]; B Cagnie[2]; I Coppieters[1,2,3,6]; M Meeus[1,2,5]
[1]*Pain in Motion International Research Group,* www.paininmotion.be*;* [2]*Department of Rehabilitation Sciences, Ghent University, Campus Heymans – Building B3, Corneel Heymanslaan 10, 9000 Ghent, Belgium;* [3]*Pain in Motion Research Group (PAIN), Department of Physiotherapy, Human Physiology and Anatomy, Faculty of Physical Education & Physiotherapy, Vrije Universiteit Brussel, Belgium;* [4]*Bijzonder Onderzoeksfonds Gent (BOF);* [5]*Faculty of Medicine and Health Science, Department of Rehabilitation Sciences and Physiotherapy – MOVANT research group, University of Antwerp, Antwerp, Belgium;* [6]*Research Foundation – Flanders (FWO), Egmontstraat 5, 1000 Brussels, Belgium;* [7]*Chronic pain rehabilitation, Department of Physical Medicine and Physiotherapy, University Hospital Brussels, Belgium;* [8]*Department of Health and Rehabilitation, Unit of Physiotherapy, Institute of Neuroscience and Physiology, Sahlgrenska Academy, University of Gothenburg, Sweden. University of Gothenburg Center for Person-Centred Care (GPCC), Sahlgrenska Academy, University of Gothenburg, Gothenburg, Sweden*

**Introduction:** Chronic Whiplash Associated Disorders (CWAD) are characterized by long-lasting symptoms of neck pain occurring after an acceleration-deceleration injury. Central sensitization (CS) has been suggested as the possible underlying mechanism for these symptoms, and is characterized by changes in the central nervous system. Besides CS, psychological factors are believed to play an important role in the experience of (chronic) pain.
**Methods:** 72 CWAD patients and 55 healthy controls underwent electrical stimuli-based quantitative sensory testing (QST). Detection and pain thresholds (EPT), temporal summation (TS) and conditioned pain modulation (CPM) were examined. Spearman correlations and linear mixed models analyses were performed to assess respectively the hypothesized associations with and group differences in QST.
**Results:** The Pain Catastrophizing magnification subscale correlated with left wrist EPT ($r = -0.332$; $p = 0.004$), and the Pain Anxiety Symptom Scale-20 with left wrist ($r = -0.325$; $p = 0.005$) and ankle ($r = -0.330$; $p = 0.005$) EPT. TS at the ankle correlated with the CS Inventory ($r = 0.303$; $p = 0.010$), Short Form 36 pain subscale ($r = -0.325$; $p = 0.005$), and Illness Perception Questionnaire revised consequences subscale ($r = 0.325$; $p = 0.005$). EPTs of left ($p = 0.011$) and right wrist

($p$ = 0.023) were lower in the CWAD group, but CPM and TS did not differ between groups.
**Discussion:** QST outcomes relate to psychological constructs, rather than to self-reported pain intensity and distribution. Local hyperalgesia was found in CWAD patients, but no differences in endogenous pain facilitation nor inhibition.
**Process evaluation:** Both CWAD patients reporting unilateral as bilateral neck pain were included, which complicated the interpretation of distal hyperalgesia.
**Keywords:** Chronic whiplash associated disorders; Chronic pain; Correlations; Quantitative sensory testing

### The natural course of frozen shoulder: central pain processing, autonomic function and association with psychological variables

**MGCAM Mertens**[1,2]; F Struyf[1]; O Verborgt[1,3,4]; L Dueñas[5]; M Balasch-Bernat[5]; S Navarro-Ledesma[6]; M Fernandez-Sanchez[6]; A Luque-Suarez[6]; E Lluch Girbes[2,5,7]; M Meeus[1,2,8]
[1]*Research Group MOVANT, Department of Rehabilitation Sciences and Physiotherapy (REVAKI), University of Antwerp, Wilrijk, Belgium;* [2]*Pain in Motion International Research Group,* www.paininmotion.be*, Belgium;* [3]*Department of Orthopedic Surgery and Traumatology, AZ Monica, Antwerp, Belgium;* [4]*Department of Orthopaedic Surgery, University Hospital (UZA), Edegem;* [5]*Department of Physical Therapy, University of Valencia, Valencia, Spain;* [6]*Department of Physiotherapy, University of Malaga, Malaga, Spain;* [7]*Department of Physiotherapy, Human Physiology and Anatomy (KIMA), Faculty of Physical Education & Physiotherapy, Vrije Universiteit Brussel, Brussels;* [8]*Department of Rehabilitation Sciences and Physiotherapy, Ghent University, Ghent, Belgium.*

**Introduction:** The natural course of frozen shoulder (FS) remains unclear and factors like altered central pain processing and autonomic dysfunction might play a role in the disease course and incomplete recovery in a subset of patients. Psychological factors (e.g. catastrophizing and hypervigilance) might influence pain severity and measurements in patients with chronic pain and an interrelation might be present.
**Methods:** Patients with FS completed six questionnaires and underwent quantitative sensory testing, including tactile sensitivity (allodynia), pressure pain thresholds (hyperalgesia), temporal summation and conditioned pain modulation four times (at baseline and 3, 6 and 9 months after baseline).
**Results:** One hundred and forty-nine patients with frozen shoulder were initially recruited and 88 completed all the follow-up measurements. Pain intensity, shoulder pain and disability, catastrophizing, hypervigilance, allodynia and hyperalgesia improved over time. Fair correlation was found between pain intensity and catastrophizing and catastrophizing and hypervigilance, while poor correlation was found between pain intensity and hypervigilance, allodynia and hyperalgesia, between catastrophizing and hyperalgesia and autonomic symptoms and between hypervigilance and hyperalgesia.
**Discussion:** Patients with FS improve in several pain variables and psychological pain related variables over the course of 9 months. This improvement might be related to each other in a small extent, due to the presence of correlations between some of these variables.
**Process evaluation:** Data analysis is in process.
**Keywords:** frozen shoulder; natural course; pain processing; quantitative sensory testing.

### The roles of childhood adversity and immune reactivity in promoting pain and fatigue after insult

**GJ Bedwell**[1]; R Parker[1]; MR Hutchinson[2]; VJ Madden[1,3]
[1]*Department of Anaesthesia and Perioperative Medicine, University of Cape Town, Cape Town, South Africa;* [2]*Adelaide Medical School, University of Adelaide, Adelaide, South Australia, Australia;* [3]*HIV Mental Health Research Unit, Department of Psychiatry and Mental Health, University of Cape Town, Cape Town, South Africa.*

**Introduction:** Childhood adversity (CA) is robustly associated with persistent pain (PP) and fatigue. However, the physiological relationships between CA, PP and fatigue are unclear. CA is associated with immune and neural upregulation in adulthood[1]. We aim to clarify whether neuroimmune responsiveness underlies the link between CA, PP and fatigue.
**Methods:** PP and fatigue are operationalised as secondary hyperalgesia (SH) and conditioned pain modulation (CPM), and heart rate variability (HRV), respectively. Healthy adults with a range of CA history will undergo blood draw for in vitro immune challenge, and repeated assessments of SH and HRV before and after in vivo neural challenge (medium-frequency electrical stimulation) expected to induce SH. Participants will undergo assessments of CPM and HRV before and 24 hours after an in vivo immune challenge (influenza vaccine)[2].
**Results:** We hypothesise that levels of IL-6 and TNF-α after in vitro immune challenge will be positively associated with the area of SH and HRV after in vivo neural challenge, and CPM and HRV after in vivo immune challenge.
**Discussion:** Characterising both neural and inflammatory responsiveness within the same individual will facilitate early identification of and interventions for individuals vulnerable to pain and fatigue.
**Process evaluation:** This study is in the piloting stage. Challenges thus far include high intra-individual variation in pressure pain thresholds (PPT) at the deltoid

testing site, and 0 – 100 NRS providing insufficient indication of change in sensation. Our solutions: deltoid insertion (less variation in PPT) for the testing site and use SPARS[3], given its non-painful range.

**References:** 1. Elwenspoek, M.M.C., et al., The effects of early life adversity on the immune system. Psychoneuroendocrinology, 2017. 82: 140–154.
2. Radin, A.S., et al., Using the influenza vaccine as a mild, exogenous inflammatory challenge: When does inflammation peak? Brain, Behavior, & Immunity - Health, 2021. 13: p. 100239.
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**Keywords** pain; immune reactivity; childhood adversity; fatigue, neuroimmune

## The effect of cognition targeted physical therapy in people with non-specific neck pain: A mixed-method multiple case study

**M Kragting**[1,2]; L Voogt[1,3]; AL Pool-Goudzwaard[2,4]; J Twisk[5]; MW Coppieters[2,6]
[1]*Department of Physical Therapy, Research Centre for Health Care Innovations, Rotterdam University of Applied Sciences, Rotterdam, The Netherlands;* [2]*Department of Human Movement Sciences, Faculty of Behavioural and Movement Sciences, Amsterdam Movement Sciences, Vrije Universiteit Amsterdam, Amsterdam, The Netherlands;* [3]*Pain in Motion research group, Department of Physiotherapy, Human Physiology and Anatomy, Faculty of Physical Education & Physiotherapy, Vrije Universiteit Brussel, Brussels, Belgium;* [4]*Somt University of Physiotherapy, Amersfoort, The Netherlands;* [5]*Department of Epidemiology and Data Science, VU University Medical Center, Amsterdam, The Netherlands;* [6]*Menzies Health Institute Queensland, Griffith University, Brisbane and Gold Coast, Australia.*

**Introduction:** Tailoring interventions more specifically to individual patients' needs may improve clinical efficacy of interventions[1]. This study aimed to evaluate the effects of an individually tailored intervention addressing dysfunctional illness perceptions in people with non-specific neck pain (NSNP).
**Methods:** In this mixed-method study, 12–18 patients with NSNP and a risk profile for chronicity (Start Neck Tool score≥4) will receive a tailored intervention (upto 5–7 consultations) aimed at influencing dysfunctional illness perceptions by means of education and functional exercises (exposure). Before and after the intervention, a content analysis of semi-structured interviews will be conducted using an inductive analytical approach. Qualitative outcomes include: (1) psychological processes of change regarding illness perceptions and how people cope with pain, (2) perceived health condition and (3) evaluating the intervention. Quantitative outcomes include the mediation role of illness perceptions (measured by the IPQ-k and FABQ-pa) on overall change, self-efficacy, function and pain. Outcomes will be self-reported and measured twice a week from enrolment till the end of the intervention, with a 3 months follow-up.
**Results:** We hypothesise that influencing dysfunctional cognitions and negative emotions will affect the way people cope with their pain and will improve their health condition[2,3].
**Discussion:** This study provides insight into the underlying mechanisms of individually tailored interventions.
**Process evaluation:** Single-case designs are valuable in unraveling working mechanisms in individually tailored interventions.

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3. 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(6):935–946.

**Keywords** Neck Pain; Illness Beliefs; Behaviour; Mediation analyses; Qualitative research

## Breathe-(H)IT Trial: High-intensity training to improve diaphragm functioning in persons with chronic nonspecific low back pain: protocol for a randomized controlled trial

**S Klaps**[1]; J Verbrugghe[1]; N Goossens[1]; A Köke[2,3]; J Verbunt[2,3]; D Langer[4]; L Janssens[1]; A Timmermans[1]
[1]*REVAL Rehabilitation Research Center, UHasselt, Diepenbeek, Belgium;* [2]*Adelante Centre of Expertise in Rehabilitation and Audiology, Hoensbroek, The Netherlands;* [3]*Department of Rehabilitation Medicine, Maastricht University Medical Center, Maastricht, The Netherlands;* [4]*Faculty of Kinesiology and Rehabilitation Sciences, Department of Rehabilitation Sciences, Research Group for Cardiovascular and Respiratory Rehabilitation, KU Leuven, and Respiratory Rehabilitation and Respiratory Division, University Hospital Leuven, Leuven, Belgium*

**Introduction:** Persons with chronic nonspecific low back pain (CNSLBP) benefit more from high-intensity training (HIT) compared to (usual care) moderate-intensity training (MIT) to improve physical[1] and psychosocial[2] outcomes. However, the underlying mechanisms for these effects are unknown. A possible underlying

mechanism is an improvement in diaphragm functioning. The diaphragm plays an important role in postural control[3], and an impaired postural control due to diaphragm dysfunction has been shown to contribute to the development of CNSLBP.
**Methods:** Sixty-four persons with CNSLBP will be randomly assigned to a 12-week HIT- or MIT-program. Both programs will consist of cardiorespiratory, limb strength and core muscle training. The only difference between both groups, will be the intensity of the exercise therapy. Primary outcomes will include diaphragm activation during postural control (EMG), and diaphragm strength (maximal inspiratory pressure), endurance and fatigue. Secondary outcomes will include pain processing (quantitative sensory testing), exercise capacity, and lumbar proprioceptive use during postural control. Questionnaires about pain intensity, disability, anxiety, and depression will also be inventoried. Outcomes will be assessed at baseline, during and immediately post-intervention, and at 3- and 12-months follow-up. Effects and relations will be investigated using, respectively, linear mixed models and multiple linear regression.
**Results:** We hypothesize that diaphragm functioning will improve more after HIT compared to MIT in persons with CNSLBP.
**Discussion:** The Breathe-(H)IT Trial will be the first study investigating the effects of HIT on diaphragm functioning in persons with CNSLBP.
**Process evaluation:** Ethical approval is currently being requested from the Medical Ethical Committee of UHasselt.
**References:** 1. Verbrugghe J, Agten A, Stevens S, et al. Exercise intensity matters in chronic nonspecific low back pain rehabilitation. Med Sci Sports Exerc 2019; 51(12), 2434–2442.
2. Klaps S, Haesevoets S, Verbunt J, Köke A, Janssens L, Timmermans A, Verbrugghe J. The influence of exercise intensity on psychosocial outcomes in musculoskeletal disorders: A systematic review ["Manuscript accepted for publication"]. Sports Health 2021.
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**Keywords:** High-intensity training; chronic nonspecific low back pain; diaphragm

## Can exercise therapy influence endogenous analgesia in knee osteoarthritis patients? A systematic review with meta-analysis

**S Puts**[1,2,3]; C Vander Aa[1,2,3]; S Vermeersch[1,2,3]; L Leysen[2,3,4]; D Beckwée[1,3,4,5]; J Nijs[2,4,6]; I Bautmans[1]
[1]*Gerontology and Frailty in Ageing (FRIA) research department, Vrije Universiteit Brussel, Laarbeeklaan 103, B-1090 Brussels, Belgium;* [2]*Pain in Motion International Research Group;* [3]*Rehabilitation Research (RERE) Group, Vrije Universiteit Brussel, Laarbeeklaan 103, B-1090 Brussels, Belgium;* [4]*Department of Physiotherapy, Human Physiology and Anatomy, Faculty of Physical Education and Physiotherapy, Vrije Universiteit Brussel, Building F-kine, Laarbeeklaan 103, BE-1090 Brussels, Belgium;* [5]*Research Group MOVANT, Department of Rehabilitation Sciences and Physiotherapy (REVAKI), University of Antwerp, Wilrijk, Belgium;* [6]*Department of Physical Medicine and Physiotherapy, University Hospital Brussels, Brussels, Belgium*

**Introduction:** Central sensitization is common in knee osteoarthritis patients (KOAP)[1]. Exercise therapy is suggested to be beneficial by activating endogenous analgesia[2]. Therefore, this systematic review aims to summarize the basal and/or acute effects of exercises on endogenous analgesia in KOAP.
**Methods:** PubMed, Web of Science, and Embase were systematically searched. If possible, a meta-analysis was performed. Risk of bias was scored using the Cochrane ROB 2.0 or ROBINS-I and strength of evidence was assessed by the GRADE approach.
**Results:** A total of 19 studies were included: 4 studies investigated pain thresholds after an acute bout of exercise; 15 articles focused on basal levels of endogenous analgesia (as measured by pain thresholds ($n = 15$), -facilitation ($n = 3$), and -inhibition ($n = 2$)). A meta-analysis combining 2 studies demonstrated that KOAP did not become more tolerant for pressure pain than healthy controls immediately after resistance training ($p > 0.05$). Besides that, one study with moderate quality of evidence showed that exercising KOAP had higher pain thresholds than non-exercising KOAP immediately after exercise ($p < 0.05$). A meta-analysis combining three studies showed that strength training of 6–12 weeks caused a significant increase in pain thresholds in KOAP compared to non-exercising KOAP ($p < 0.05$).
**Discussion:** Very low quality of evidence proved that strength training of at least 6 weeks is effective in increasing pain thresholds in KOAP. Moderate quality of evidence demonstrated that an acute bout of exercise effectively increases pain thresholds in KOAP.
**Process evaluation:** Literature about this topic is scarce, especially studies investigating pain facilitation ($n = 3$) and inhibition ($n = 1$).
**References:** 1. Zolio L, Lim KY, McKenzie JE, Yan MK, Estee M, Hussain SM, Cicuttini F, Wluka A.

Systematic review and meta-analysis of the prevalence of neuropathic-like pain and/or pain sensitization in people with knee and hip osteoarthritis. Osteoarthritis Cartilage. 2021 Aug;29(8):1096–1116. https://doi.org/10.1016/j.joca.2021.03.021. Epub 2021 May 8. PMID: 33971205.
2. Naugle KM, Fillingim RB, Riley JL III: A meta-analytic review of the hypoalgesic effects of exercise. J Pain 13:1139–1150, 2012
**Keywords:** Osteoarthritis; exercise; endogenous analgesia; central sensitization; pain

## The presence of central sensitization in the continuum of migraine: A case control study

**E Cnockaert**[1,2,3]; B Cagnie[1]; M Meeus[1,2,4]; J Van Oosterwijck[1,2,*]; R De Pauw[1,5*]
[1]*SPINE Research Unit Ghent, Department of Rehabilitation Sciences, Faculty of Medicine and Health Sciences, Ghent University, Ghent, Belgium;* [2]*Pain in Motion international research group,* www.paininmotion.be*;* [3]*Pijncentrum AZ Sint-Lucas, Ghent, Belgium;* [4]*Department of Rehabilitation Sciences and Physiotherapy, Faculty of Medicine and Health Sciences, University of Antwerp, Antwerp, Belgium;* [5]*Lifestyle and chronic diseases service, Sciensano, Brussels, Belgium*

*Shared last authorship
**Introduction:** Migraine is conceptualized as a continuum, with at the one hand episodic migraine and at the other hand chronic migraine (CM) which is more frequent[1]. Recent studies support the presence of central sensitization (CS) in migraine patients[2,3], but controversial evidence exists about where in the continuum exactly CS appears and which mechanisms are underlying. Therefore this study aims to determine the occurrence and mechanisms of CS within the migraine continuum.
**Methods:** Self-reported and psychophysiological data will be collected from 30 migraine patients and 30 healthy controls. Pain sensitivity will be evaluated using Quantitative Sensory Testing including mechanical and thermal thresholds. Pain facilitation and inhibition will be assessed by using respectively temporal summation and conditioned pain modulation paradigms. Assessments are performed unilateral at the painful side and interictally.
**Results:** Widespread pain and impaired pain facilitation and inhibition are expected to be more pronounced in patients with more migraine days (further along the continuum) than in those with less migraine days.
**Discussion:** This research will show whether signs of CS are present in migraine patients, where in the migraine continuum these symptoms are appearing, and whether impaired pain inhibition and/or facilitation underlie these symptoms.
**Process evaluation:** Data collection is currently going on. Testing patients with CM interictally is a challenge.
**References:** 1. Aurora SK. Is chronic migraine one end of a spectrum of migraine or a separate entity? Cephalalgia. 2009;29(6):597–605.
2. Burstein R, Yarnitsky D, Goor-Aryeh I, Ransil BJ, Bajwa ZH. An association between migraine and cutaneous allodynia. Ann Neurol. 2000;47(5):614–24.
3. Filatova E, Latysheva N, Kurenkov A. Evidence of persistent central sensitization in chronic headaches: A multi-method study. J Headache Pain. 2008;9(5):295–300.
**Keywords:** Migraine; headache; central sensitization; quantitative sensory testing; conditioned pain modulation

## Do pain pressure thresholds in myofascial trigger points differ between bruxist and pain-free controls?

**S Martín-Pérez**[1,2]; I Martín-Pérez[3]; E Sánchez-Romero[1]; Sosa-Reina[4]; JL Alonso-Pérez[1,2,5]
[1]*Musculoskeletal Pain and Motor Control Research Group, Faculty of Physical Activity and Sport, Universidad Europea de Madrid, Villaviciosa de Odón, Madrid, Spain;* [2]*Musculoskeletal Pain and Motor Control Research Group, Faculty of Health Sciences, Universidad Europea de Canarias, Tenerife, Canary Islands, La Orotava, Spain;* [3]*Grado en Medicina, Facultad de Ciencias de la Salud, Universidad La Laguna, San Cristóbal de La Laguna, Islas Canarias, España;* [4]*Faculty of Health Sciences, Universidad Alfonso X El Sabio, Villanueva de la Cañada, Madrid, Spain;* [5]*Multidisciplinary Pain Treatment Center ONELIFE, 28925 Madrid, Spain*

**Introduction:** We aimed to compare PPTs of MTrPs in Trapezius and masticatory muscles between patients with self-reported bruxism and non-bruxist controls.
**Methods:** A case-control was conducted from September 2020 to September 2021 with a sample of 32 students at Universidad Europea de Canarias of which 16 cases had self-reported bruxist with pain (22.7, SD = 4.06 years; BMI 23.7, SD = 2.66 Kg/m$^2$) and 16 were non-bruxist controls (20.9, SD = 1.65 years; BMI 24.7, SD = 1.78 Kg/m$^2$). PPTs were assessed with pressure algometry in left Trapezius (*MTrP-Trap*), Anterior Temporalis (*MTrP-AT*) and Masseter (*MTrP-Mass*). Once data normality was confirmed, a two tailed independent T-test with $\alpha = 0.05$ was conducted to compare the means of both groups.
**Results:** We found significative statistical differences in PPTs of *MTrP-Trap* (2.02, SD = 0.783 KgF/cm$^2$ vs 2.91, SD = 1.210 KgF/cm$^2$; TS = 2.46, $p = 0.020$; Cohen´s d = 0.871), *MTrP-AT* (1.31, SD = 0.354 KgF/cm$^2$, vs 2.33, SD = 0.803 KgF/cm$^2$; TS = 4.66, $p < 0.001$; Cohen´s d = 1.646) and *MTrP-Mass* (.914, SD = 0.234 KgF/cm$^2$ vs 1.56, SD = 0.432 KgF/cm$^2$; TS = 5.22, $p < 0.001$; Cohen´s d = 1.846).

**Discussion:** PPTs of MTrPs of Trapezius and masticatory muscles differ between bruxists and pain-free controls.
**Process evaluation:** Generalizability of our results could be limited because of the small size of the sample and the lack of evaluation of other MTrPs.
**References:** 1. Piekartz HV, Rösner C, Batz A, Hall T, Ballenberger N. Bruxism, temporomandibular dysfunction and cervical impairments in females - Results from an observational study. Musculoskelet Sci Pract. 2020 Feb;45:102073. https://doi.org/10.1016/j.msksp.2019.102073.
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**Keywords** Bruxism; pressure pain threshold; myofascial trigger point; masticatory

## Comparison of two clinically applicable conditioned pain modulation and temporal summation protocols in breast cancer survivors with persistent pain

**V Haenen**[1,2,3]; L Dams[1,2]; B Morlion[4,5]; M Meeus[1,2,3,6]; N Devoogdt[3]; A De Groef[1,2,3]
[1]*Research Group MOVANT, Department of Rehabilitation Sciences and Physiotherapy (REVAKI), University of Antwerp, Wilrijk, Belgium;* [2]*Pain in Motion International Research Group (PiM),* www.painimotion.be*;* [3]*Department of Rehabilitation Sciences, KU Leuven - University of Leuven, Leuven, Belgium;* [4]*Department of Cardiovascular Sciences, Section Anaesthesiology & Algology, KU Leuven, University of Leuven, Belgium;* [5]*The Leuven Centre for Algology and Pain Management, University Hospitals Leuven, Leuven, Belgium;* [6]*Department of Rehabilitation Sciences and Physiotherapy, Ghent University, Ghent, Belgium*

**Introduction:** Mechanism-based approaches to pain are becoming increasingly popular in recent years. Unfortunately, mechanism-based approaches require assessment using quantitative sensory testing which is rarely available in clinical practice. Therefore, this study compared two clinically applicable test protocols for conditioned pain modulation (CPM) and temporal summation (TS) to a laboratory reference test regarded as a golden standard.
**Methods:** Twenty breast cancer survivors (BCS) experiencing persistent pain were assessed with three different CPM and TS protocols. Two clinically applicable protocols were compared to a reference test. The CPM protocols consisted of a cold water bath or a blood pressure cuff as conditioning stimulus, with pressure pain threshold (PPT) as a test stimulus. TS was applied by using a Von Frey filament or an algometer. The TSA-2 by Medoc (Ramat Yishay, Israel) was used as a reference test for both CPM and TS. Heat was used as stimulus for both reference test protocols.
**Results:** Strong and significant correlation was found for the two clinically applicable CPM test protocols ($r > 0.802$, $p < 0.001$). No correlation was found between the CPM reference test and the alternative CPM test protocols. In regard to TS, no correlation was found between the alternative test protocols and the reference TS test protocol.
**Discussion:** No correlation was found between the proposed CPM and TS test protocols and their respective reference test.
**Process evaluation:** Limitations: limited sample size, TS with TSA-2 was performed without the CHEPS thermode however protocol was based upon prior research in healthy individuals and adapted to BCS.
**Keywords:** Breast cancer survivor; Conditioned Pain Modulation; Temporal Summation; Pain; Quantitative Sensory Testing

## The influence of attention and expectations on the efficacy of conditioned pain modulation: An experimental study

**A Billens**[1,2]; E Dhondt[1,2]; M Meeus[1,2,3]; S Van Damme[4]; I De Greef[1]; J Van Oosterwijck[1,2,3]
[1]*Spine, Head and Pain Research Unit Ghent, Department of Rehabilitation Sciences, Faculty of Medicine and Health Sciences, Ghent University, Ghent, Belgium;* [2]*Pain in Motion international research group,* http://www.paininmotion.be*;* [3]*Department of Rehabilitation Sciences and Physiotherapy, Faculty of Medicine and Health Sciences, University of Antwerp, Antwerp, Belgium;* [4]*Department of Experimental Clinical and Health Psychology, Faculty of Psychology and Educational Sciences, Ghent University, Ghent, Belgium*

**Introduction:** Despite the considerable amount of research performed on conditioned pain modulation (CPM), there are still uncertainties concerning the influence of cognitive mechanisms on CPM efficacy.[1] This study aimed to investigate whether the CPM effect is influenced by attention and expectations in healthy adults.
**Methods:** Seventy-two healthy pain-free adults participated in this cross-sectional study undergoing CPM evaluation (i.e. pain pressure threshold (PPT) assessment (= test stimulus (TS)) in response to hot water hand submersion (=conditioning stimulus (CS)) during three experimental protocols administered in randomized order, i.e. (1) a sequential 'neutral' protocol, (2) a 'focus' protocol during which attention was focused on the CS,

and (3) a 'distraction' protocol during which attention was directed away from the CS using a distraction task. Participants their pain expectations were recorded before each of the three protocols.
**Results:** Compared to the other protocols, focusing the attention on the CS resulted in smaller CPM magnitudes ($p < 0.001$), and the distraction protocol resulted in lower NRS ratings for the CS ($p < 0.001$). A priori expectations accounted for 6.6% of the CPM effect of the neutral protocol ($p = 0.035$), with expectations of analgesia predicting more efficient CPM.
**Discussion:** It is recommended to rate CS-related pain intensity after CS completion rather than during CS to prevent a reduction of the inhibitory effects by the CPM paradigm. Participants' a priori expectations should be registered as these can influence the induced CPM magnitude.
**Process evaluation:** Building the appropriate statistical models, which took into account confounding factors as well as randomization sequence, was challenging.
**Reference:** 1. Hermans L, Van Oosterwijck J, Goubert D, Goudman L, Vanderlinden E, Crombez G, Calders P, Meeus M. Inventory of Personal Factors Influencing Conditioned Pain Modulation in Healthy People: A Systematic Literature Review. Pain Practice 2016;16(6):758–769.
**Keywords:** Attention; expectations; CPM; DNIC; healthy

## Patient-practitioner interaction about pain rehabilitation: orientations to the institutional need for consensus

**BB Stinesen**[1,2]; P Sneijder[2]; AJA Köke[1,3,4]; RJEM Smeets[1,5]
[1]*Research School CAPHRI, Faculty of Health, Medicine and Life Sciences, Maastricht University, Maastricht, The Netherlands;* [2]*Research group Communication in digital transition, HU University of Applied Sciences, Utrecht, The Netherlands;* [3]*Adelante Centre of Expertise in Rehabilitation and Audiology, Hoensbroek, The Netherlands;* [4]*Faculty of Health and Technology, Zuyd University of Applied Sciences, Heerlen, The Netherlands;* [5]*CIR Revalidatie, Eindhoven, The Netherlands.*

**Introduction:** Before patients with chronic pain enter pain rehabilitation treatment, they are examined by an interdisciplinary team of practitioners. To start treatment, patient and practitioners need to have a shared understanding of the psychosocial factors contributing to the patient's disabilities. Therefore, the findings of the team's examination are discussed with the patient to reach consensus. This study explores how patients and practitioners talk through the team's hypotheses regarding the psychosocial factors involved in the pain problem.
**Methods:** Nine consultations were recorded at various Dutch rehabilitation units, resulting in approximately 4.5 hours of audio material. All nine patients participating had chronic primary musculoskeletal pain. Seven practitioners participated. The recordings were transcribed and analysed on a micro-level combining an applied conversation analytic research approach[1,2] with discursive psychology[3].
**Results:** Both patients and practitioners orient to the institutional need for consensus. Patients treat agreement as the relevant response to practitioners' deliveries of the team's findings. When it remains unclear whether the patient is in agreement, practitioners tend to pursue an unequivocal response. Their question design pre-empts resistance and encourages patients to confirm the team's findings, rather than to voice their own perspectives.
**Discussion:** Findings can be used by practitioners to consider communication practices that are more likely to bring patients' potential concerns regarding the rehabilitation team's findings out into the open.
**Process evaluation:** As the current study is exploratory, it would be worthwhile to conduct a larger, experimental study to systematically compare various question designs used by practitioners with respect to their interactional outcomes.
**References:** 1. Lester J, O'Reilly M. *Applied Conversation Analysis: Social Interaction in Institutional Settings*. Sage; 2019. https://doi.org/10.4135/9781071802663
2. Antaki C. *Applied Conversation Analysis. Intervention and Change in Institutional Talk*. Palgrave Macmillan; 2011.
3. Wiggins S, Potter J. Disursive psychology. In: Willig C, Stainton-Rogers W, eds. *The SAGE Handbook of Qualitative Research in Psychology*. 2nd ed. Sage; 2017:93–109.
**Keywords:** Patient-practitioner interaction; chronic pain; consensus; applied conversation analysis.

## Development of a program for learning primary care physiotherapists to use the biopsychosocial model in working with chronic pain

**J Van Dijk**[1]; S Elbers[1]; A Köke[2]; RJEM Smeets[2,3]; H Wittink[1]
[1]*Research Group Lifestyle and Health, Utrecht University of Applied Sciences, Utrecht, Netherlands;* [2]*School for Public Health and Primary Care, Rehabilitation Medicine, Maastricht University;* [3]*CIR, Location Eindhoven*

**Introduction:** Despite the importance of a biopsychosocial approach in chronic pain, many physiotherapists still adhere to a biomedical framework. Designing a teaching program that supports obtaining adequate competencies in the participant's context is challenging.[1] This study describes the development of a program for learning primary care physiotherapists to use the biopsychosocial model in chronic pain.

**Methods:** Participatory Action Research methodology, including experts in chronic pain, education and co-design as well as the target audience, was used. Information gathered from literature and curricula of EFIC and IASP was combined with interviews and focusgroups with stakeholders. Co-design methods structured by several design-sprints were used to create, iterate and pilot-test choices of content, and design- and educational solutions.[2] Data were summarized in a Plan of Requirements.
**Results:** Based on the Plan of Requirements a three-month program was developed containing three days of face-to-face learning, online learning and facilitated learning in the workspace.[3] The program challenges participants to move out of their comfort zone, with room for active personal learning and respect for the dynamic nature of skills needed for working with chronic pain.
**Discussion:** The use of a broad range of stakeholders strengthens the consistency, content and validity of the program. Co-design as a method for development is, though rich, difficult to replicate and present in a transparent manner. Next a feasibility study is needed to evaluate the program.
**Process evaluation:** Because of COVID the design-process had to take place online hindering the interaction. However, it also facilitated the possibility for stakeholders to join for a brief consultation.
**References:** 1. Overmeer T, Boersma K, Denison E, et al. Does teaching physical therapists to deliver a biopsychosocial treatment program result in better patient outcomes? a randomized controlled trial. *Phys Ther* 2011;91:804–19.
2. Elbers S, Gessel C Van, Renes RJ, et al. Innovation in pain rehabilitation using co-design methods during the development of a relapse prevention intervention: Case study. *J Med Internet Res* 2021;23:1–10.
3. Bouw E, Zitter I, de Bruijn E. Characteristics of learning environments at the boundary between school and work – A literature review. *Educ Res Rev* 2019;26:1–15.
**Keywords:** Postgraduate teaching; chronic pain; primary care; physiotherapy; biopsychosocial

## Implementing explain pain and chronic pain treatment guidelines in 8 health care disciplines in belgium: A 6-months follow-up study

**W Munneke**[1]; M De Kooning[1]; A Berquin[2]; M Meeus[3]; C Demoulin[4]; J Nijs[1,5]
[1]*Pain in Motion Research Group (PAIN), Department of Physiotherapy, Human Physiology and Anatomy, Faculty of Physical Education and Physiotherapy, Vrije Universiteit Brussel, 1090 Brussels, Belgium;* [2]*Institute of Neuroscience, Université catholique de Louvain, Brussels, Belgium;* [3]*Department of Rehabilitation Sciences, Ghent University, Ghent, Belgium, Pain in Motion International Research Group, Belgium, Department of Rehabilitation Sciences and Physiotherapy, University of Antwerp, Antwerp, Belgium;* [4]*Department of Sport and Rehabilitation Sciences, Université de Liège, Liege, Belgium;* [5]*Instititute of Neuroscience and Physiology, Department of Health and Rehabilitation, Unit of Physiotherapy, University of Gothenburg, Sweden.*

**Introduction:** Numerous scientific studies have established the necessity of a biopsychosocial (BPS) approach in the treatment of chronic pain, however, the implementation into clinical practice falls short. The aim of this study is to investigate the effectiveness of a BPS pain educational program for primary healthcare providers (PHCP) on changes in knowledge and attitude, and the guideline adherence.
**Methods:** Within an implementation project of the Belgian Federal Government, a BPS pain educational program was developed based on recent scientific research, and barriers and facilitators formulated by an expert panel. 300 PHCP from various disciplines followed the course which contains two e-learning sessions and two one-day face-to-face trainings. Changes in knowledge and attitudes regarding chronic pain were measured using the KNowledge and Attitudes of Pain (KNAP). Guideline adherence was measured with two clinical case vignettes. Participants were measured pre-course, post-course and at a 6-month follow-up. The satisfaction of participants regarding the training and implementation into practice was measured during the course and at the follow-up.
**Results:** A shift towards the biopsychosocial perspective that is in line with clinical guidelines is expected after completing the chronic pain course.
**Discussion:** The pain course developed in the present study might increase the biopsychosocial perspective and guideline adherence of PHCP.
**Process evaluation:** The selection of adequate evaluation tools to assess multidisciplinary groups was challenging. Furthermore, it remains to be established whether the improvements observed in knowledge and attitude questionnaires and the guideline adherence based on clinical vignettes reflect actual change in clinical practice.

**Keywords:** Implementation; healthcare professionals; biopsychosocial approach; attitude; guideline adherence

## Perceptions of lebanese physiotherapists towards the management of chronic low back pain and the knowledge of pain neuroscience education: A qualitative study

**C Najem**[1,2,3]; M Meeus[1,3,4]; B Cagnie[1]; F Ayoubi[2,5]; J Van Oosterwijck[1,3,4,6]; K De Meulemeester[1,3]; A Wijma[3,7]; P Van Wilgen[3,7,8]
[1]*Spine, Head and Pain Research Unit Ghent, Department of Rehabilitation Sciences, Faculty of Medicine and Health Sciences, Ghent University, Belgium;* [2]*Department of physiotherapy, Faculty of Public Health, Antonine University, Lebanon;* [3]*Pain in Motion International Research Group,* www.paininmotion.be*;* [4]*MOVANT Research group, Department of Rehabilitation Sciences and Physiotherapy, Faculty of Medicine and Health Sciences, University of Antwerp, Belgium;* [5]*Department of physiotherapy, Faculty of Public Health, Lebanese University, Lebanon;* [6]*Research Foundation - Flanders (FWO), Belgium;* [7]*Transcare Transdisciplinary Pain Management Center, Groningen, the Netherlands;* [8]*PAIN – VUB Pain in Motion Research Group, Department of Physiotherapy, Human Physiology and Anatomy, Faculty of Physical Education & Physiotherapy, Vrije Universiteit Brussel, Belgium.*

**Introduction:** There is growing acknowledgement of the benefits of incorporating a bio-psychosocial model of understanding pain within physical therapist practice[1]. Consequently this has led to an increasing interest in interventions such Pain neuroscience education (PNE). However, pain management strategies developed by clinicians in one culture may not necessarily be understood, appropriate, or effective in another culture[2].
**Methods:** This study is part of a broader research in the development of culturally sensitive pain neuroscience education for the Lebanese population. Therefore, the purpose of this paper is to first gain an in-depth understanding of the Lebanese physiotherapists' perceptions towards the management of chronic low back pain as well as the knowledge regarding PNE. A qualitative one-to-one semi-structured interviews with 10 practicing physical therapists were conducted. The transcribed text from the interviews was analyzed using inductive thematic analysis.
**Results:** Several themes were generated, identified, and constructed by the researchers: (1) physiotherapists use of a biomechanical approach. (2) Poor knowledge about the bio-psychosocial approach or PNE. (3) Barrier and facilitation for the implementation of PNE.
**Discussion:** The preliminary results showed a limited knowledge of the bio-psychosocial approach, or PNE, and that the Lebanese physical therapist use more a biomechanical approach in the treatment and assessment of people with chronic low back pain.
**Process evaluation:** The results showed that training is needed for physiotherapists to deliver a broader model of care, and that future research should focus on developing a culturally sensitive PNE material.
**References:** 1. Foster N, Delitto A. Embedding Psychosocial Perspectives within Clinical Management of Low Back Pain: Integration of Psychosocially Informed Management Principles Into Physical Therapist Practice—Challenges and Opportunities. Physical Therapy 2011; 91(5): 790–803.
2. Orhan C, Cagnie B, Favoreel A, Van Looveren E, Akel U, Mukhtar NB, De Meulemeester K, Pas R, Lenoir D, Meeus M. Development of culturally sensitive Pain Neuroscience Education for first-generation Turkish patients with chronic pain: A modified Delphi study. Musculoskelet Sci Pract 2019; 39: 1–9.
**Keywords:** Physiotherapy; back pain; bio-psychosocial approach; pain neuroscience education.

## Somatosensory profiling: think before you act

**V Haenen**[1,2,3]; L Dams[1,2]; B Morlion[5,6]; M Meeus[1,2,3,4]; N Devoogdt[3]; A De Groef[1,2,3]
[1]*Research Group MOVANT, Department of Rehabilitation Sciences and Physiotherapy (REVAKI), University of Antwerp, Wilrijk, Belgium;* [2]*Pain in Motion International Research Group (PiM),* www.paininmotion.be*;* [3]*Department of Rehabilitation Sciences, KU Leuven - University of Leuven, Leuven, Belgium;* [4]*Department of Rehabilitation Sciences and Physiotherapy, Ghent University, Ghent, Belgium;* [5]*Department of Cardiovascular Sciences, Section Anaesthesiology & Algology, KU Leuven, University of Leuven, Belgium;* [6]*The Leuven Centre for Algology and Pain Management, University Hospitals Leuven, Leuven, Belgium*

**Introduction:** Characterizing somatosensory profiles or phenotypes in subgroups of patients may provide indirect insights into underlying pathophysiological mechanisms. The most common method for quantifying somatosensory function is quantitative sensory testing (QST). This paper describes a protocol for determining these somatosensory profiles in a breast cancer population.
**Methods:** A standardized QST protocol is implemented including nine static and dynamic QST methods (mechanical detection-pain thresholds, pressure pain thresholds, thermal detection-pain thresholds for heat and cold, temporal summation and conditioned pain modulation) performed in the surgical area and more distant regions. After the QST assessment, distribution of the data is checked and data is transformed if necessary (raw or log-transformed data).[1,2] Subsequently, QST data is z-transformed using the mean and standard deviation of a

control group as reference data. The algebraic sign of the resulting z score is adjusted appropriately for clarity of data presentation (increased-decreased sensitivity to the tested stimuli).[3]

**Results:** The z-scores acquired with this protocol can inform at a glance whether there is a loss or gain in somatosensory function. Findings can be visualized using a scatter or bar chart.

**Discussion:** Although this protocol was used to determine somatosensory profiles in a breast cancer population, the methodology for determining these profiles can be applied to data from other populations as well.

**Process evaluation:** To correctly interpret QST results, data from a reference population that matches in QST method and test site is required. The proactive development of normative databases for specific QST protocols will improve the efficiency of QST data processing in the future.

**References:** 1. Rolke R, Baron R, Maier C et al. Quantitative sensory testing in the German Research Network on Neuropathic Pain (DFNS): standardized protocol and reference values. Pain. 2006;123(3):231–243. 2. Magerl W, Krumova EK, Baron R et al. Reference data for quantitative sensory testing (QST): refined stratification for age and a novel method for statistical comparison of group data. Pain. 2010;151(3):598–605. 3. Maier C, Baron R, Tolle TR, Binder A, Birbaumer N, Birklein F, et al. Quantitative sensory testing in the German Research Network on Neuropathic Pain (DFNS): somatosensory abnormalities in 1236 patients with different neuropathic pain syndromes. Pain. 2010;150(3):439–450.

**Keywords:** Quantitative sensory testing; somatosensory profiling; normative data

## Identifying prognostic variables for persistent upper limb dysfunctions after breast cancer treatment: Protocol of a longitudinal cohort study

**N Vets**[1,2]; N Devoogdt[1,2]; A Smeets[3,4]; D Van Assche[5]; J Emmerzaal[1]; A De Groef[1,2,7*]; L De Baets[6*]

[1]*Department of Rehabilitation Sciences, Rehabilitation in Internal Disorders, KU Leuven, Leuven, Belgium;* [2]*CarEdOn Research Group, KU Leuven, Belgium;* [3]*Department of Oncology, KU Leuven, Leuven, Belgium;* [4]*Department of Surgical Oncology, University Hospitals Leuven, Leuven, Belgium;* [5]*Department of Rehabilitation Sciences, Musculoskeletal Rehabilitation, KU Leuven, Leuven, Belgium;* [6]*Pain Science in Motion Research Group, Vrije Universiteit Brussel, Brussels, Belgium;* [7]*Department of Rehabilitation Sciences, MOVANT research group, University of Antwerp, Antwerp, Belgium;* [*]*contributed to this work equally*

**Introduction:** Breast cancer is the most frequently occurring cancer with increasing surviving rates thanks to improving accuracy of detecting methods, early diagnosis and advances in cancer treatment. However, many breast cancer survivors (BCS) suffer of persistent upper limb (UL) dysfunctions. Therefore, the aim of this study is to identify the contributing factors to persistent UL dysfunctions in terms of identifying targets for prospective evaluation and specific treatment approaches at specific time points during breast cancer treatment.

**Methods:** A cohort study will be performed in 250 BCS with a unilateral primary cancer, assessing different aspects of the International Classification of Function, Disease and Health (ICF). The BCS will be assessed at 5 different timepoints (baseline, 1 month post-surgery, 1 month post-chemotherapy, 1 and 6 months post-radiotherapy).

**Results:** Candidate contributors to persistent UL dysfunctions are: specific pain characteristics, soft tissue stiffness, lymph node and lymph vessels functions, breast cancer treatment modalities, personal factors such as, pain catastrophizing, self-efficacy, depression, anxiety, stress and fear of movement, access to healthcare and movement alterations of the upper limb.

**Discussion:** A prediction model for persistent UL dysfunctions will be formed covering all aspects of the ICF.

**Process evaluation:** The study is now prepared for ethical committee, with appreciated assistance of a clinical trial assistant who guide us through the complex process.

**Keywords:** Breast cancer; Upper limb dysfunction; International Classification of Function, Disease and Health; prediction model

## The effect of perceived injustice targeted pain neuroscience education among breast cancer survivors: A protocol for a randomized controlled trial

**E Roose**[1,2,3,4]; L Leysen[1,2,3,5]; A Lahousse[1,2,3,4,5]; P van Wilgen[1,6]; R Bults[1,6]; E Huysmans[1,5,7,8]; M De Couck[1,9]; D Beckwée[2,3]; A Timmermans[4]; J Nijs[1,7,10]
[1]*Pain in Motion Research Group (PAIN), Department of Physiotherapy, Human Physiology and Anatomy, Faculty of Physical Education and Physiotherapy, Vrije Universiteit Brussel, Laarbeeklaan 103, 1090 Brussels, Belgium;* [2]*Rehabilitation Research (RERE) Research Group, Department of Physiotherapy, Human Physiology and Anatomy, Faculty of Physical Education & Physiotherapy (KIMA), Vrije Universiteit Brussel, Laarbeeklaan 103, 1090 Brussels, Belgium;* [3]*Department of Physiotherapy, Human Physiology and Anatomy, Faculty of Physical Education and Physiotherapy, Vrije Universiteit Brussel, Building F-kine, Laarbeeklaan 103, BE-1090 Brussels, Belgium;* [4]*Universiteit Hasselt, REVAL, Agoralaan-gebouw A, 3590 Diepenbeek, Belgium;* [5]*Research Foundation Flanders (FWO), Brussels, Belgium;* [6]*Transcare Pain Transdisciplinary pain treatment center, Groningen, the Netherlands;* [7]*Chronic pain rehabilitation, Department of Physical Medicine and Physiotherapy, University Hospital Brussels, Brussels, Belgium;* [8]*Department of Public Health (GEWE), Faculty of Medicine and Pharmacy, Vrije Universiteit Brussel, Brussels, Belgium;* [9]*Faculty of Health Care, Odisee University College, Campus Aalst & Brussels, Belgium;* [10]*Institute of Neuroscience and Physiology, University of Gothenburg, Gothenburg, Sweden*

**Introduction:** Twenty-two percent of breast cancer survivors (BCSs) with pain are experiencing perceived injustice (PI)[1]. PI predicts adverse pain outcomes and opioid prescription due to increased pain behavior[2]. Educational interventions including reassurance and encouragement towards activity re-engagement are suggested to target PI[3].
**Methods:** Female BCSs ($n$ = 156) experiencing pain+PI (≥3 months post oncological treatment) are recruited. PI-targeted pain neuroscience education (PI-PNE) including motivational interviewing (rather biopsychosocially driven) is compared with biomedical pain education. The randomisation is done separately for each of the 6 treatment locations. Both interventions include an online session, information leaflet, and three one-to-one sessions. Online questionnaires assess pain, quality of life (QoL), PI, healthcare costs, sleep, fatigue, and cognitive-emotional factors at baseline and 0-, 6-, 12-, and 24-months post-intervention. A linear mixed model for repeated measures will evaluate whether the groups differ in terms of pain, PI, opioid use, and QoL after 12 months.
**Results:** We expect that PI-PNE is superior to biomedical education at reducing pain, PI, and opioid use, and improving QoL in BCSs with pain and PI.
**Discussion:** This is the first randomized controlled trial investigating the effectiveness of PI-PNE as a non-pharmacological strategy in BCSs with pain+PI.
**Process evaluation:** Preparational work (e.g., ethical approval, interventions) is finalized. Recruitment started in April 2021 but is going slow due to COVID-19. Analyses are planned in 2023.
**References:** 1. Leysen, L., et al., The mediating effect of pain catastrophizing and perceived injustice in the relationship of pain on health-related quality of life in breast cancer survivors. Support Care Cancer, 2021.
2. Carriere, J.S., et al., Pain behavior mediates the relationship between perceived injustice and opioid prescription for chronic pain: a Collaborative Health Outcomes Information Registry study. J Pain Res, 2017. 10: 557–566.
3. Carriere, J.S., et al., Expectancies mediate the relationship between perceived injustice and return to work following whiplash injury: A 1-year prospective study. Eur J Pain, 2017. 21(7): 1234–1242.
**Keywords** Breast cancer survivors; pain; perceived injustice; pain neuroscience education; motivational interviewing

## Pain-detact: Exploring determinants of physical activity levels in populations with persistent pain: A study protocol

**S Van Dijck**[1]; N Roussel[1]; A De Groef[1,2,3]; M Meeus[1,3,4]
[1]*Department of Rehabilitation Sciences and Physiotherapy, MOVANT, University of Antwerp, Antwerp, Belgium;* [2]*Department of Rehabilitation Sciences, KU Leuven, University of Leuven, Leuven, Belgium;* [3]*Pain in Motion International Research Group, Brussels, Belgium;* [4]*Department of Rehabilitation Sciences, Ghent University, Belgium*

**Introduction:** Although physical activity is considered a pillar in the treatment of chronic pain, being physically active poses a challenge for these patients. Patients with low back pain and cancer survivors are not equal in terms of diagnosis, received treatment or life experiences, but both populations are impacted by a high prevalence of persistent pain. With this commonality, it is of interest to compare determinants of physical activity in both populations.
**Methods:** A cross-sectional design is used. Demographic data, condition-specific characteristics, physical activity levels, beliefs on illness and exercise and pain-related emotional factors are collected using questionnaires through an online survey. The aim is to present data on the associations between collected data and physical activity levels within each population and to compare these relationships between both populations.

**Results:** We hypothesize that significant associations will be found between the collected psychosocial factors and self-reported physical activity levels. We hypothesize that the found associations will differ between these two populations.
**Discussion:** The understanding and comparison of the relationship between researched factors and physical activity can lead to more optimal interventions to promote physical activity in these populations.
**Process evaluation:** A difficulty was finding valid and reliable questionnaires on beliefs, barriers and facilitators of exercise which could be applied in both populations. Recruitment of the study will start in December of 2021.
**Keywords:** Chronic pain; Chronic low back pain; Cancer survivor; Physical activity

## The effect of behavioural graded activity on biopsychosocial outcomes in cancer patients and survivors: Systematic review and meta-analysis

**A Lahousse**[1,2,3]; I Reynebeau[2]; J Nijs[2,4,5]; D Beckwée[3,6]; P Van Wilgen[2,7]; C Fernández-de-las-Peñas[8]; E Roose[2,3]; L Leysen[2,3]
[1]*Research Foundation – Flanders (FWO), Brussels, Belgium;* [2]*Pain in Motion Research Group (PAIN), Department of Physiotherapy, Human Physiology and Anatomy, Faculty of Physical Education and Physiotherapy (KIMA), Vrije Universiteit Brussel, Laarbeeklaan 103, 1090 Brussels, Belgium;* [3]*Rehabilitation Research (RERE) Research Group, Department of Physiotherapy, Human Physiology and Anatomy, Faculty of Physical Education & Physiotherapy (KIMA), Vrije Universiteit Brussel, Laarbeeklaan 103, 1090 Brussels, Belgium;* [4]*Department of Physical Medicine and Physiotherapy, University Hospital Brussels, Brussels, Belgium;* [5]*Institute of Neuroscience and Physiology, University of Gothenburg, Gothenburg, Sweden;* [6]*Department of Rehabilitation Sciences and Physiotherapy, Faculty of Medicine and Health Sciences, University of Antwerp, Wilrijk, Belgium;* [7]*Transcare Transdisciplinary Pain Management Centre, Groningen, the Netherlands;* [8]*Department of Physical Therapy Occupational Therapy, Physical Medicine and Rehabilitation, Universidad Rey Juan Carlos, Alcorcon, Madrid, Spain*

**Introduction:** Behavioural graded activity (BGA) has gained acceptance in chronic pain populations and is widely used in psychological informed practices (PIP)[1]. However, no review has been published about the effect of BGA in cancer populations. Therefore, the aim of this systematic review was to investigate the effectiveness of PIP with BGA compared to (1)waitlists (WLC), (2)other interventions (OI), (3)PIP-, or (4)BGA alone in cancer patients and survivors (CPaS).
**Methods:** Three databases were screened for randomized controlled trials encompassing PIP with BGA in CPaS. Effect sizes of physical activity (PA), quality of life (QoL) and debilitating symptoms were inventoried. Subgroup analyses were undertaken to reduce heterogeneity ($I^2 > 50\%$).
**Results:** Thirty-three studies were included, comprising 4330 participants. Significant effects of PIP+BGA comparing to WLC were found for anxiety (SMD:−1.29[−1.71;−0.86], $I^2 = 0\%$), fatigue (SMD:−0.86[−1.18;−0.54], $I^2 = 61\%$), depression (SMD:−0.79[−1.10;−0.48], $I^2 = 0\%$), functional impairment (SMD:−0.72[−0.95;−0.50], $I^2 = 0\%$), psychological distress (SMD:−0.58[−0.82;−0.34], $I^2 = 51\%$), PA (SMD:−0.58[−0.84;−0.32], $I^2 = 47\%$ and SMD:−0.51[−0.90;−0.13], $I^2 = 0\%$), QoL (SMD:−0.38[−0.68;−0.09], $I^2 = 51\%$), social impairment (SMD:−0.33[−0.58;−0.08], $I^2 = 0\%$) and only the psychological distress (SMD:−0.89[−1.76;−0.02], $I^2 = 82\%$) remained significantly after one-to-three months. When comparing PIP+BGA to OI, significant effects were found for anxiety (SMD:−0.47[−0.88;−0.06], $I^2 = 83\%$), depression (SMD:−0.46[−0.84;−0.09], $I^2 = 82\%$), fatigue (SMD:−0.35[−0.51;−0.20], $I^2 = 48\%$), and PA (SMD:−0.26[−0.41;−0.11], $I^2 = 44\%$). One-to-three months post-intervention, effects for anxiety (SMD:−1.54[−2.88;−0.21], $I^2 = 87\%$), depression (SMD:−0.46[−0.84;−0.09], $I^2 = 82\%$) and fatigue (SMD:−0.34[−0.58;−0.10], $I^2 = 47\%$) remained significant. After four-to-six months significance only remained for anxiety (SMD:−0.14[−0.33;0.06], $I^2 = 0\%$). No significant effects were observed in the meta-analyses comparing PIP+BGA to BGA or PIP alone.
**Discussion:** PIP with BGA is superior to non-behavioural interventions in improving anxiety, fatigue, depression, functional and social impairment, psychological distress, PA, and QoL in CPaS. Long-term improvements remained for anxiety, fatigue, depression and psychological distress.
**Process evaluation:** Further research is needed on 'how' and 'when' BGA should be provided in cancer rehabilitation.
**Reference:** 1. Main, C.J. and S.Z. George, *Psychologically informed practice for management of low back pain: future directions in practice and research*. Phys Ther, 2011. **91**(5): 820–824.
**Keywords:** Behaviour Therapy; GRADE Approach; Meta-analysis; Cancer

## Tests for central sensitization in general practice: A Delphi study

**C den Boer**[1]; B Terluin[1]; JC van der Wouden[1]; AH Blankenstein[1]; HE van der Horst[1]
[1]*Department of General Practice, Amsterdam Public Health Research Institute, Amsterdam UMC, Vrije Universiteit, the Netherlands*

**Introduction:** Central sensitization (CS) may explain the persistence of symptoms in patients with chronic pain and persistent physical symptoms (PPS)[1]. There is a need for assessing CS in the consultation room. In a recently published systematic review, we made an inventory of tests for CS[2]. In this study we aimed to assess which tests might have added value, might be feasible and thus be suitable for use in general practice.
**Methods:** We conducted a Delphi study to reach a consensus among experts in chronic pain and PPS. We invited 40 national and international experts on chronic pain and PPS, 27 agreed to participate. We selected 12 tests from our systematic review and additional searches; panellists added three more tests in the first round. We asked the panellists, both clinicians and researchers, to rate these 15 tests on technical feasibility for use in general practice, added value and to provide an overall judgement for suitability in general practice.
**Results:** In two rounds the panellists reached consensus on 14 of the 15 tests: three were included, eleven excluded. Included were the Central Sensitization Inventory (CSI), pressure pain thresholds (PPTs) and monofilaments. No consensus was reached on the Sensory Hypersensitivity Scale.
**Discussion:** In a Delphi study, three tests for measuring CS were considered to be suitable for use in general practice: the Central Sensitization Inventory (CSI), pressure pain thresholds (PPTs) and monofilaments. (3)
**Process evaluation:** In a Delphi study a panel of (international) experts reached consensus in two e-mail rounds.
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**Keywords:** Persistent physical symptoms; chronic pain; central sensitization; tests; medically unexplained symptoms

## Reproducibility of pressure pain threshold testing in physiotherapy students, a rater dependent skill

**RR Reezigt**[1,2]; G Slager[2]; MW Coppieters[1,3]; GGM Scholten-Peeters[1]
[1]*Department of Human Movement Sciences, Faculty of Behavioural and Movement Sciences, Vrije Universiteit Amsterdam, Amsterdam Movement Sciences, The Netherlands;* [2]*Academy of Health, Department of Physiotherapy, Hanze University of Applied Sciences, Groningen, The Netherlands;* [3]*Menzies Health Institute Queensland, Griffith University, Brisbane and Gold Coast, Australia*

**Introduction:** Although experienced raters show good reproducibility[1] of Pressure Pain Thresholds (PPT) in most body locations[2], it is unknown if inexperienced physiotherapy students perform comparably. Recruiting students as raters would increase opportunities for the student's development and the design of studies.
**Methods:** A total of 175 participants were measured by ten undergraduate students using either a Wagner ($n$ = 87) or Somedic ($n$ = 88) digital algometer on four body locations; the lower leg, upper leg, arm and neck. Each student measured a subsample of ~9 participants. Agreement (reported as a coefficient of variance; standard error of measurement divided by the average threshold) and reliability (intraclass correlation (ICC)) were measured for both the individual rater and the total group.
**Results:** Agreement ranged from 9–17% per body location, whereas individual raters differed from the group result from −7.9% up to +6.6%. Reliability was good to excellent, ICCs (1,1) ranging from 0.88 to 0.95. Individual ICCs (2,1) were between 0.00 to 0.99.
**Discussion:** Reproducibility of the total group was good; however, it varies per student. Even though reliability is affected by group variance differences, agreement parameters also show individual differences. PPTs seem rater dependent, which may explain different findings in the literature. Consequently, using reproducibility values of other studies/raters should be done cautiously. Students may be recruited as research assistants to perform PPTs.
**Process evaluation:** Organising raters and participants together is challenging. Using parallel rooms with observational tools helped. Dependency on raters was a threat, resulting in an excluded rater due to sickness.
**References:** 1. de Vet HCW, Terwee CB, Knol DL, Bouter LM. When to use agreement versus reliability measures. Journal of Clinical Epidemiology 2006;59:1033–1039. https://doi.org/10.1016/j.jclinepi.2005.10.015.
2. Fisher AA. Pressure algometry over normal muscles. Standard values, validity and reproducibility of pressure threshold. Pain 1987;30:115–126. https://doi.org/10.1016/0304-3959(87)90089-3.

**Keywords:** Pain Measurement; Quantified Sensory Testing; Reproducibility; Experience

## Personal influencing factors for pressure pain threshold in healthy people: A systematic review

**S Vervullens**[1,2,3]; V Haenen[1,3,4]; M Meeus[1,3,5]; RJEM Smeets[2,3,6]; I Baert[1,3]; MGCAM Mertens[1,3]
[1]*Research Group MOVANT, Department of Rehabilitation Sciences and Physiotherapy (REVAKI), University of Antwerp, Wilrijk, Belgium;* [2]*Research School CAPHRI, Department of Rehabilitation Medicine, Maastricht University;* [3]*Pain in Motion International Research Group (PiM),* www.paininmotion.be*;* [4]*Department of Rehabilitation Sciences, KU Leuven - University of Leuven, Leuven, Belgium;* [5]*Department of Rehabilitation Sciences and Physiotherapy, Ghent University, Ghent, Belgium;* [6]*CIR Revalidatie, location Eindhoven, The Netherlands*

**Introduction:** To date, it is unclear which personal influencing factors need to be considered when determining normative values for pressure pain threshold (PPT). Therefore, the aim was to synthesize all studies that investigate personal factors influencing PPT in healthy people.
**Methods:** PubMed, Web of Science, and Embase were systematically searched. Also hand-search methods were performed until the 19th May, 2021. All data was summarized and results were pooled per influencing factor, and included in a meta-analysis when sufficiently homogenous.
**Results:** Fifty studies were eligible. Five had low, nine moderate, and 36 a high risk of bias. Most conclusions were based on a strength of recommendation level IV. Age PPT measured at shoulder/arm region, blood pressure, gender, and scapula position may influence PPT following the meta-analytic approach. Hand dominance, psychomotor function and manual work may influence PPT based on the qualitative summary. Other personal factors showed no influence or conflicting results.
**Discussion:** Age (when PPT is measured at shoulder/arm region), blood pressure, gender, scapula position, hand dominance, psychomotor function and performing manual work are personal factors that could be considered when determining normative PPT values. However, caution is advised, because many studies were not eligible to include in meta-analyses. The performed meta-analyses had high heterogeneity, and most conclusions were weak due to high risk of bias in the included studies. More research is necessary.
**Process evaluation:** Limitations: 20 studies were retrieved by hand-search. Difficulties: to interpret and present the results, because meta-analyses were only possible with a part of the studies.

**Keywords:** Pain; Pressure Pain Threshold; Normative values; Healthy people; Influencing factors

## Reference values of a conditioned pain modulation paradigm using heat thermodes

**L Meert**[1,2]; S Vervullens[1,2]; R Smeets[2,3,4]; M Meeus[1,2,5]
[1]*Research Group MOVANT, Department of Rehabilitation Sciences and Physiotherapy (REVAKI), University of Antwerp, Wilrijk, Belgium;* [2]*Pain in Motion International Research Group (PiM),* www.paininmotion.be*;* [3]*Department of Rehabilitation Medicine, Research School CAPHRI, Maastricht University, Maastricht, The Netherlands;* [4]*CIR Revalidatie, Eindhoven, The Netherlands;* [5]*Department of Rehabilitation Sciences, Faculty of Medicine and Health Sciences, Ghent University, Ghent, Belgium*

**Introduction:** The aim of this cross-sectional study is to provide reference values of a conditioned pain modulation (CPM) paradigm using thermal stimulation. Reference values would allow patient phenotyping according to their CPM functional status and can hopefully improve the ability to predict the efficacy of treatments.
**Methods:** Healthy pain-free adults will be recruited. A CPM paradigm using heat thermodes will be applied. The intensity of the test stimulus (TS) will be determined individually based on a NRS score of 4/10. The conditioning stimulus (CS) will be 0.5°C higher than the TS temperature. The CPM effect will be reported both as absolute difference between the NRS scores during and before the CS, as well as the percent change from baseline (1). Influencing factors that will be considered are: age, gender, level of physical activity, chronic stress, intake of oral contraceptives, attentional focus, pain perception and phase of menstrual cycle (2).
**Results:** We expect the average NRS score to decrease after the CS (= positive CPM effect).
**Discussion:** To our knowledge, the present study will be the first one that specifically tries to determine reference values of CPM in pain-free adults using heat for both the TS and CS. However, it is important to note that the reliability and validity of the CPM paradigm used in this study has not been investigated yet.
**Process evaluation:** Subject recruitment has just started and it is clear that successful recruitment will be the most difficult aspect of this study due to the strict inclusion criteria and the current Covid-19 situation.
**References:** 1. Yarnitsky D, Arendt-Nielsen L, Bouhassira D, et al. Recommendations on terminology and practice of psychophysical DNIC testing. European Journal of Pain. 2010;14(4):339-.
2. Mertens MGCAM, Hermans L, Crombez G, et al. Comparison of five conditioned pain modulation paradigms and influencing personal factors in healthy adults. European Journal of Pain. 2021;25(1):243–256.

**Keywords:** conditioned pain modulation; reference values; heat thermodes; endogenous pain modulation

## Establishing clinically relevant cut-off values for the central sensitisation inventory (CSI)

**I Schuttert**[1]; AP Wolff[1]; MF Reneman[2]; R Soer[1,2]; HR Schiphorst Preuper[2]; GGA Malmberg[3]; H Timmerman[1]
[1]*Department of Anaesthesiology, Pain Center, University of Groningen, University Medical Center Groningen, Groningen, Netherlands;* [2]*Department of Rehabilitation, University of Groningen, University Medical Center Groningen, Groningen, The Netherlands;* [3]*Department of Obstetrics and Gynaecology, University of Groningen, University Medical Center Groningen, Groningen, Netherlands*

**Introduction:** Central sensitisation (CS) can't be demonstrated and thus only be assumed to be present in humans: Human Assumed Central Sensitization (HACS)[1]. The Central Sensitisation Inventory (CSI)[2] is a screening instrument for HACS with a cut-off score of 40 (range 0–100)[3]. This study aims to re-establish the optimal cut-off value for the CSI and to study associated factors.
**Methods:** Via ROC-analyses we compared patients with chronic pain with healthy controls. Regression analysis was performed on factors (descriptives; pain-related characteristics) possibly associated with CSI-score.
**Results:** Based on patients ($n$ = 1730) and controls ($n$ = 250), CSI cut-off values for the presence of HACS were established at ≥30 (women: ≥33; men: ≥25(table)). Regression analyses showed that the CSI-score was associated with all factors (adjusted $R^2$ = 54–58%). A low association between the CSI-score and pain severity was shown in women and men separately.
TABLE: ROC-analyses

| | Area under the curve | Cut-off value | Youden Index | Sensitivity | Specificity |
|---|---|---|---|---|---|
| Total group | 0.95 | 30 | 0.78 | 85% | 93% |
| Women | 0.96 | 33 | 0.79 | 82% | 97% |
| Men | 0.95 | 25 | 0.80 | 89% | 91% |

**Discussion:** In contrast with previous studies, a lower cut-off score is established for patients with chronic pain, being higher for women than for men.
**Process evaluation:** The question rises whether CSI should be used with a dichotomous, categorical or continuous scale. More insight is needed in the presence of HACS and, the influence of sex, other characteristics and specific sub-populations of patients.
**Reeferences:** 1. Schuttert I, Timmerman H, Petersen KK, et al. The Definition, Assessment, and Prevalence of (Human Assumed) Central Sensitisation in Patients with Chronic Low Back Pain: A Systematic Review. Journal of Clinical Medicine 2021;10(24):5931.
2. Mayer TG, Neblett R, Cohen H, et al. The development and psychometric validation of the central sensitization inventory. Pain Practice 2012;12(4):276–285.
3. Available from: https://www.pridedallas.com/questionnaires/ accessed 3 January 2022.
**Keywords:** Chronic pain; human assumed central sensitisation; central sensitisation inventory; central sensitisation

## Using network analysis to understand the link between pain and insomnia in patients with knee osteoarthritis

**N Runge**[1,2]; L de Baets[1]; C Labie[1,2]; J Nijs[1,3,4]; S Verschueren[2]; A Malfliet[1,3,5]; K de Vlam[6,7]; D Van Assche[2,6]; O Mairesse[8,9]
[1]*Pain in Motion Research Group (PAIN), Department of Physiotherapy, Human Physiology and Anatomy, Faculty of Physical Education & Physiotherapy, Vrije Universiteit Brussel, Belgium;* [2]*Musculoskeletal Rehabilitation Research Group, Department of Rehabilitation Sciences, Faculty of Movement and Rehabilitation Sciences, KU Leuven, Belgium;* [3]*Chronic pain rehabilitation, Department of Physical Medicine and Physiotherapy, University Hospital Brussels, Belgium;* [4]*Department of Health and Rehabilitation, Unit of Physiotherapy, Institute of Neuroscience and Physiology, Sahlgrenska Academy, University of Gothenburg, Sweden;* [5]*Research Foundation Flanders (FWO), Brussels, Belgium;* [6]*Division of Rheumatology, University Hospitals Leuven, Belgium;* [7]*Skeletal Biology & Engineering Research Center, Dept. of Development & Regeneration, KU Leuven, Belgium;* [8]*Department of Brain Body and Cognition (BBCO), Vrije Universiteit Brussel (VUB), Brussels, Belgium;* [9]*Sleep Laboratory and Unit for Chronobiology U78, Department of Psychiatry, Brugmann University Hospital, Université Libre de Bruxelles (ULB) and Vrije Universiteit Brussel (VUB), Brussels, Belgium.*

**Introduction:** Up to >50% of individuals with symptomatic knee osteoarthritis (KOA) also report insomnia. Research suggests that the insomnia-pain link is bidirectional and complex with other factors like anxiety and mood being relevant. Network analysis allows to estimate these dynamic system interactions and to illustrate them graphically. This is an advantage over traditional statistical models (e.g. regression models) which investigate aspects of systems in isolation[1]. However, network analysis has not yet been utilized in the field of KOA and insomnia.
**Methods:** We will use baseline data from a randomized controlled trial to estimate a cross-sectional network model connecting insomnia and pain in patients with KOA. The network structure will be

estimated using Gaussian Graphical models with LASSO-regularization[2]. Established measures for sleep, pain, depression, anxiety, physical activity, pain catastrophizing and fatigue will be included. We will further analyse global network density and node centrality[1].
**Results:** The results will provide us a better understanding of how the network connecting pain and insomnia is built and which factors are most influential.
**Discussion:** Our study will be the first that uses network analysis to understand the connection between KOA pain and insomnia. This will provide relevant clinical insights and interest other researchers in this exciting area of research.
**Process evaluation:** Network analyses are new to me and there are not many examples in the field of chronic pain. It took me some time to understand the basics but the more I read the more excited I get about the opportunities these methods offer.
**References:** 1. Hevey D. Network analysis: a brief overview and tutorial. Health Psychol Behav Med. 2018;6(1):301–28.
2. Epskamp S, Waldorp LJ, Mõttus R, Borsboom D. The Gaussian Graphical Model in Cross-Sectional and Time-Series Data. Multivar Behav Res. 2018;53(4):453–80.
**Keywords:** Network analysis; knee osteoarthritis; insomnia

## The effect of the evoked temporal summation in lateral elbow region on neck muscles fatigue characteristics

**K Canlı**[1]; M Meeus[2,3,4]; K De Meulemeester[2,3]
[1]*Department of Physiotherapy and Rehabilitation, Hacettepe University, Ankara, Turkey;* [2]*Department of Rehabilitation Sciences, Spine, Pain and Head Research Unit Ghent, Ghent University, Belgium;* [3]*Pain in Motion International Research Group, Belgium;* [4]*Department of Rehabilitation Sciences and Physiotherapy, University of Antwerp, Antwerpen, Belgium*

**Introduction:** Central sensitization (CS) can lead to muscle motor dysfunction including fatigue via inducing cortical reorganization in specific brain regions in chronic pain populations, such as patients with lateral elbow pain (LEP)[1,2]. Aim of this study was to investigate the effect of temporal summation, one aspect of CS on the fatigue of the neck muscles that is the most prominent region affected by CS in LEP. To eliminate other factors that may influence fatigue in LEP, healthy participants were included for this study to investigate specifically the effect of TS on fatigue.
**Methods:** Healthy participants were randomly divided into two groups: an experimental ($n$ = 30) and a control ($n$ = 30) group. In the experimental group, pain was induced at the dominant lateral elbow by means of a temporal summation (TS) protocol via applying pressure at the average level of pressure pain thresholds (PPTs) that was assessed twice. Pain intensity was asked to participants at first, fifth and tenth pulse using a Visual Analog Scale. In the control group, a placebo TS protocol was performed by identifying PPTs once. The muscle fatigue of both sternocleidomastoid and upper trapezius muscles was evaluated during a neck flexor/extensor endurance test using surface electromyography. This was performed before and after the intervention.
**Results:** Evoked TS on the lateral elbow may result in neck muscle fatigue.
**Process evaluation:** Participants had a variety of endurance duration that pushed us to determine window interval during EMG analysis. As participants had different kind of interval, we had to make time normalization using Matlab.
**References:** 1. Roussel NA, Nijs J, Meeus M, et al. Central sensitization and altered central pain processing in chronic low back pain: fact or myth? Clin J Pain 2013; 29(7): 625–638.
2. Fernández-Carnero J, Fernández-de-Las-Peñas C, de la Llave-Rincón AI, et al. Widespread mechanical pain hypersensitivity as sign of central sensitization in unilateral epicondylalgia: a blinded, controlled study. Clin J Pain 2009; 25(7): 555–561.
**Keywords:** Temporal summation; fatigue; elbow pain

## The assessment of fatigue and pain in multiple osteochondromas: A Dutch Cohort Study

**I Amajjar**[1]; K Vergauwen[2]; N Willigenburg[1]; J Ham[1]; R Smeets[2]
[1]*OLVG Hospital, Amsterdam, The Netherlands;* [2]*Maastricht University Medical Center, Maastricht, The Netherlands*

**Introduction:** Multiple Osteochondromas (MO) is a rare skeletal disorder. Previous literature reported that pain is one of the greatest problems in MO. In our clinical practice, fatigue seems to be a major problem as well, however this has not been investigated in literature, nor has its possible association with pain.
**Methods:** For this cross-sectional study 386 adult patients were invited to participate in an online survey. Pain was assessed using NRS (0–10) and the DN4 (0–10). Fatigue was assessed using the NRS and the Checklist-Individual-Strength-Fatigue (CIS; range = 8–56). The results were compared with reference scores of normative data of healthy subjects, as well as patients with Rheumatoid arthritis (RA) and Chronic Fatigue Syndrome (CFS). The association of pain and fatigue was analysed using bivariate correlations.
**Results:** A total of 342 patients completed the survey. Mean age was 41.86 ± 16.28. Almost 80% of the patients reported pain (mean NRS = 4.50 ± 3.19), of which 47.6% screened positive for neuropathic pain. Fatigue was reported by 90.8% of the patients (mean NRS = 5.46 ± 2.99).

Severe fatigue (CIS-score > 35) was reported by 55.1% (Mean CIS-score = 36.21 ± 7.98). Fatigue-scores in MO patients were significantly higher compared to healthy population (mean = 22.98; $p < 0.001$) and patients with RA (mean = 31.64; $p < 0.001$) but lower compared to CFS (mean = 50.40; $p < 0.001$). A Spearman's correlation analysis showed a significant association between fatigue and pain (rs = 0.52; $p < 0.001$).

**Discussion:** Fatigue and pain in MO were frequently reported and deviated significantly from normative data of healthy subjects and other patient populations. These results evoke further research and clinical attention aimed at reducing pain and fatigue in patients with MO.

**Process evaluation:** Limitation: selection bias, internal validity. Solution: longitudinal study.

**Keywords:** Multiple Osteochondromas; Multiple Hereditary Exostosis; Pain; Fatigue; Survey

## Health-related quality of life and physical activity level in a specific and non-specific pain and fatigue disorder

**K Vergauwen**[1,2,3,4]; I Amajjar[5]; M Meeus[3,4,6]; IPJ Huijnen[2,4,7]; J Nijs[4,8,9]; RJEM Smeets[2,4,10]

[1]*Occupational Therapy, Department of Health & Social Care, AP University College, Antwerp, Belgium;* [2]*Department of Rehabilitation Medicine, Faculty of Health, Medicine and Life Sciences, CAPHRI, Maastricht University, Maastricht, The Netherlands;* [3]*MOVANT Research Group, Department of Rehabilitation Sciences and Physiotherapy, Faculty of Medicine and Health Sciences, University of Antwerp, Antwerp, Belgium;* [4]*Pain in Motion International Research Group,* www.paininmotion.be*, Belgium;* [5]*Department of Orthopaedic Surgery, OLVG, Amsterdam, The Netherlands;* [6]*Department of Rehabilitation Sciences and Physiotherapy, Faculty of Medicine and Health Sciences, Ghent University, Ghent, Belgium;* [7]*Department of Rehabilitation Medicine, Adelante Centre of Expertise in Rehabilitation and Audiology, Hoensbroek, The Netherlands;* [8]*Pain in Motion Research Group, Department of Physical Medicine and Physiotherapy, University Hospital Brussels, Belgium;* [9]*Department of Health and Rehabilitation, Unit of Physiotherapy, Institute of Neuroscience and Physiology, Sahlgrenska Academy, University of Gothenburg, Sweden;* [10]*CIR Revalidatie, Eindhoven, The Netherlands*

**Introduction:** Numerous variables are associated with the physical activity level (PAL) and health-related quality of life (HRQOL) in various populations with chronic pain and fatigue. This study aims to identify transdiagnostic and disease-specific determinants of HRQOL and PAL in two distinct patient groups experiencing chronic pain and fatigue: patients with chronic fatigue syndrome (CFS) and multiple osteochondromas (MO).

**Methods:** Data on sociodemographic, symptomatology, psychosocial variables, HRQOL and the PAL of patients with MO ($n$ = 342) were collected at OLVG Amsterdam through a survey. The same data was collected at Vrije Universiteit Brussel of patients with CFS ($n$ = 103). Determinants of HRQOL and PAL are explored with multiple linear regression models.

**Results:** Preliminary results showed that both groups have a significantly lower HRQOL and PAL ($p \leq 0.001$) than the general population. PAL is expected to be positively associated with HRQOL in both groups. Pain and fatigue intensity and depression are hypothesized to be negatively associated with HRQOL and the PAL. The level of catastrophizing is lower in patients with MO; catastrophizing is hypothesized to be negatively associated with the PAL and HRQOL in patients with CFS, but not MO.

**Discussion:** These results are expected to assist research and clinical practice in the development of evidence-based interventions aimed at maximizing HRQOL for patients with CFS and/or MO.

**Process evaluation:** Explanatory variables are not measured with the same measurement instruments in both groups and require recoding. We need to compare associated variables between patient groups, dummy coding for the chronic condition seems the most appropriate procedure.

**References:** 1. Garnaes KK, Mørkved S, Salvesen Ø, Tønne T, Furan L, Grønhaug G, Vasseljen O, Johannessen HH. What factors are associated with health-related quality of life among patients with chronic musculoskeletal pain? A cross-sectional study in primary health care. BMC Musculoskeletal Disorders 2021; 22(1): 102. https://doi.org/10.1186/s12891-020-03914-x.

2. Börsbo B, Peolsson M, Gerdle B. The complex interplay between pain intensity, depression, anxiety and catastrophising with respect to quality of life and disability. Disability and Rehabilitation 2009; 31(19): 1605–1613. https://doi.org/10.1080/09638280903110079.

3. Anokye NK, Trueman P, Green C, Pavey TG, Taylor RS. Physical activity and health related quality of life. BMC Public Health. 2012; 12: 624. https://doi.org/10.1186/1471-2458-12-624.

**Keywords:** chronic fatigue; chronic pain; health-related quality of life; physical activity

### Towards precision medicine for osteoarthritis: added value of cognitive behavioural therapy for insomnia (The PREMEO trial)

**C Labie**[1,2]; N Runge[1,2]; O Mairesse[3,4]; A Malfliet[1,5,6]; S Verschueren[2]; D Van Assche[2,7]; K de Vlam[7,8]; A Arribas[9]; J Nijs[1,5,10]; L De Baets[1]
[1]*Pain in Motion Research Group (PAIN), Department of Physiotherapy, Human Physiology and Anatomy, Faculty of Physical Education & Physiotherapy, Vrije Universiteit Brussel, Belgium;* [2]*Musculoskeletal Rehabilitation Research Group, Department of Rehabilitation Sciences, Faculty of Movement and Rehabilitation Sciences, KU Leuven, Belgium;* [3]*Department of Brain Body and Cognition (BBCO), Vrije Universiteit Brussel (VUB), Brussels, Belgium;* [4]*Sleep Laboratory and Unit for Chronobiology U78, Department of Psychiatry, Brugmann University Hospital, Université Libre de Bruxelles (ULB) and Vrije Universiteit Brussel (VUB), Brussels, Belgium;* [5]*Chronic pain rehabilitation, Department of Physical Medicine and Physiotherapy, University Hospital Brussels, Belgium;* [6]*Research Foundation Flanders (FWO), Brussels, Belgium;* [7]*Division of Rheumatology, University Hospitals Leuven, Belgium;* [8]*Skeletal Biology & Engineering Research Center, Dept. of Development & Regeneration, KU Leuven, Belgium;* [9]*Department of Physical Therapy, Occupational Therapy, Rehabilitation and Physical Medicine, Rey Juan Carlos University, Madrid, Spain;* [10]*Department of Health and Rehabilitation, Unit of Physiotherapy, Institute of Neuroscience and Physiology, Sahlgrenska Academy, University of Gothenburg, Sweden.*

**Introduction:** Insomnia is a common sleep disorder in people with knee osteoarthritis (KOA), adversely affecting daily function and general health[1]. It represents a barrier for effective conservative management. Clinical guidelines for KOA recommend integrating comorbidity-specific interventions as a part of patient-centred care[2]. However, insomnia is rarely addressed in the often joint-targeted KOA treatment.
**Methods:** A two-arm randomized controlled trial (RCT) will be conducted on 128 patients with KOA and insomnia in a community setting. Subjects will randomly be allocated to the intervention group (cognitive behavioral therapy for insomnia (CBT-I) additional to best-practice KOA-care (education and exercise therapy)) or to the control group (best-practice KOA-care). The physiotherapist-led programme for both treatment arms will contain 18 sessions within 14 weeks, 30 minutes each. The primary outcome is pain intensity. Pain interference, sleep-related outcomes and physical activity/function are secondary outcomes. The tertiary outcomes are inflammation and healthcare utilisation. Blinded assessment will be conducted at baseline, post-intervention, and at 3 months, 6 months, and 12 months follow-up.
**Results:** The results will give insights into the clinical and cost-effectiveness of CBT-I combined with best-practice physiotherapy.
**Discussion:** This will be the first RCT integrating CBT-I in best-practice KOA-care in KOA patients with established insomnia whereby inflammation and sleep will be objectively assessed. This could help to improve the outcomes of a large proportion of KOA patients.
**Process evaluation:** Being involved as a therapist in the trial and in the meanwhile developing my skills as a researcher, seems challenging. Is it all about getting the balance right?
**References:** 1. Akintayo, R.O., et al., *Tossing and turning with degenerative arthropathy: an assessment of poor sleep quality in knee osteoarthritis*. Reumatologia, 2019. **57**(4): 207–213.
2. Bannuru, R.R., et al., *OARSI guidelines for the non-surgical management of knee, hip, and polyarticular osteoarthritis*. Osteoarthritis and cartilage, 2019. **27**(11): 1578–1589.
**Keywords:** Randomized controlled trial; osteoarthritis; insomnia; cognitive behavioral therapy

### The effect of pain neuroscience education and behavioural graded activity among breast cancer survivors: A protocol for a randomised controlled trial

**A Lahousse**[1,2,3]; J Nijs[2,4,5]; D Beckwée[3,6]; C Fernández-de-las-Peñas[6]; R Eva[2,3,4]; M Kenza[2,3,4]; L Leysen[1,2,3]
[1]*Research Foundation – Flanders (FWO), Brussels, Belgium;* [2]*Pain in Motion Research Group (PAIN), Department of Physiotherapy, Human Physiology and Anatomy, Faculty of Physical Education and Physiotherapy (KIMA), Vrije Universiteit Brussel, Laarbeeklaan 103, 1090 Brussels, Belgium;* [3]*Rehabilitation Research (RERE) Research Group, Department of Physiotherapy, Human Physiology and Anatomy, Faculty of Physical Education & Physiotherapy (KIMA), Vrije Universiteit Brussel, Laarbeeklaan 103, 1090 Brussels, Belgium;* [4]*Department of Physical Medicine and Physiotherapy, University Hospital Brussels, Brussels, Belgium;* [5]*Institute of Neuroscience and Physiology, University of Gothenburg, Gothenburg, Sweden;* [6]*Department of Rehabilitation Sciences and Physiotherapy, Faculty of Medicine and Health Sciences, University of Antwerp, Wilrijk, Belgium;* [7]*Department of Physical Therapy Occupational Therapy, Physical Medicine and Rehabilitation, Universidad Rey Juan Carlos, Alcorcon, Madrid, Spain*

**Introduction:** Chronic pain in breast cancer survivors (BCSs) impacts the health-related quality of life (HRQoL) and participation in activities of daily living tremendously[1–5]. Over the past decades, the use of pain neuroscience education (PNE) has been shown to be effective in reducing pain[6–8]. Since PNE alone has

relatively small effect sizes, it should ideally be combined with a physical component[6], such as behavioural graded activity (BGA)[9,10]. Therefore, this study aims to investigate the effectiveness of PNE with BGA compared to usual care on chronic pain in BCSs.
**Methods:** Two hundred BCSs with chronic pain will be randomly assigned to the intervention or usual care group. The intervention group will receive a 12-week treatment program consisting of 6 sessions, in which PNE and BGA are integrated. Whereas the usual care group will receive an information leaflet regarding "Pain in and after cancer". The primary outcome is pain, and the secondary outcomes are endogenous hyperalgesia and HRQoL. Explanatory variables such as pain cognitions, sleep, depression will be inventoried as well. All variables will be assessed at baseline, immediate, 3-and, 12-months post-treatment. To examine the added effect of PNE and BGA, a linear mixed model for repeated measurements will be conducted[11,12].
**Results:** We hypothesise that PNE with BGA will lead to more beneficial outcomes compared to usual care in BCSs with chronic pain.
**Discussion:** PNE with BGA might lead to proper non-pharmacological treatment for pain in BCS.
**Process evaluation:** Currently, 82/200 participants were recruited. The recruitment was delayed due to the COVID-19 outbreak.
**References:** 1. Gureje, O., et al., *Persistent pain and well-being: a World Health Organization Study in Primary Care*. Jama, 1998. **280**(2): 147–151.
2. Louw, A., et al., *The effect of neuroscience education on pain, disability, anxiety, and stress in chronic musculoskeletal pain*. Arch Phys Med Rehabil, 2011. **92**(12): 2041–2056.
3. Meeus, M., et al., *Moving on to movement in patients with chronic joint pain*. Pain, 2016.
**Keywords:** Pain Neuroscience Education; Behavioural Graded Activity; Chronic Pain; Breast Cancer Survivors

## Development of an integrated aftercare approach for the prevention and treatment of chronic pain in breast cancer survivors: An intervention mapping approach

**Y Slaghmuylder**[1]; E Lauwerier[1,2]; P Pype[1]
[1]*Department of Public Health and Primary Care, Faculty of Medicine and Health Sciences, Ghent University, Belgium;* [2]*Department of Experimental Clinical and Health Psychology, Faculty of Psychology and Educational Sciences, Ghent University, Belgium*

**Introduction:** After completing breast cancer treatment, a great number of patients experience pain but are not monitored in an interdisciplinary and integrated manner[1]. This study describes the development of an integrated aftercare approach for managing (chronic) pain after breast cancer treatment in Flanders, Belgium.
**Methods:** We used an intervention mapping approach to guide our development and planning process. This approach consists of six steps[2].
**Results:** The different steps of intervention mapping are described, resulting in an integrated aftercare approach to stimulate prevention and an interdisciplinary response in treating (chronic) pain among breast cancer survivors. Several change mechanisms are targeted, such as awareness/knowledge, beliefs, professional confidence, outcome expectancies, and professional role/identity[3]. The developed aftercare approach consists of an e-learning for healthcare providers, a guideline with facilitating tools for screening and referral regarding pain in breast cancer aftercare, and a reminder system. Additionally, the implementation and evaluation plan are presented.
**Discussion:** Intervention mapping offers a useful framework to undertake a theory-based and ecological approach for decision-making during developing and planning an intervention. This study can be used as a reference for the future development of aftercare approaches.
**Process evaluation:** We would like to address the need to develop interventions that also aim to change the awareness and knowledge of society regarding (chronic) pain after breast cancer treatment. Our qualitative research on the current needs of breast cancer survivors and healthcare providers regarding pain management showed that the environment is not always aware of the long-term side effects of breast cancer treatment.
**References:** 1. Kress HG, Aldington D, Alon E, Coaccioli S, Collett B, Coluzzi F, et al. A holistic approach to chronic pain management that involves all stakeholders: change is needed. Current Medical Research and Opinion 2015; 31(9): 1743–1754.
2. Kok G, Gottlieb NH, Peters GJ, Mullen PD, Parcel GS, Ruiter RA, et al. A taxonomy of behaviour change methods: an Intervention Mapping approach. Health psychology review 2016; 10(3): 297–312.
3. Atkins L, Francis J, Islam R, O'Connor D, Patey A, Ivers N, et al. A guide to using the Theoretical Domains Framework of behaviour change to investigate implementation problems. Implementation Science 2017; 12.
**Keywords:** Breast cancer survivors; integrated aftercare; pain management; intervention mapping

## Multimodal patient-centered teleprehabilitation for patients with breast cancer: A protocol for a feasibility study

**K Mostaqim**[1]; E Huysmans[1,2]; A Timmermans[3]; T Deliens[4]; M Vanhoeij[5]; C Fontaine[6]; E De Jonge[7]; J Van Hoecke[7]; M De Couck[1,8]; L Polastro[9]; M Lamotte[10]; A Cuesta-Vargas[11]; O Mouton[12]; J Nijs[1,3]
[1]*Pain in Motion Research Group (PAIN), Department of Physiotherapy, Human Physiology and Anatomy, Faculty of Physical Education and Physiotherapy, Vrije Universiteit Brussel, Laarbeeklaan 103, 1090 Brussels, Belgium;* [2]*Research Foundation Flanders (FWO), Brussels, Belgium;* [3]*Universiteit Hasselt, REVAL, Agoralaan-gebouw A, 3590 Diepenbeek, Belgium;* [4]*Department of Movement and Sport Sciences, Vrije Universiteit Brussel, Pleinlaan 2, 1050 Brussels, Belgium;* [5]*Department of Oncological Surgery, UZ Brussel, Brussels, Belgium;* [6]*Department of Medical Oncology, UZ Brussel, Brussels, Belgium;* [7]*Ziekenhuis Oost-Limburg, Genk, Belgium;* [8]*Faculty of Health Care, Odisee University College, Campus Aalst & Brussels, Belgium;* [9]*Department of Medical Oncology, Institut Jules Bordet, Université Libre de Bruxelles, Brussels, Belgium;* [10]*CUB Hôpital Erasme, Université Libre de Bruxelles, Brussels, Belgium;* [11]*Faculty of Health Sciences, Universidad de Malaga, Malaga, Spain;* [12]*vzw Think Pink, Researchdreef 12, 1070 Brussel, Belgium.*

**Introduction:** Surgery, the cornerstone of most cancer treatments, is associated with considerable postoperative complications[1]. Adjusting patients' health behavior before surgery may have beneficial effects on postoperative outcomes. The objective of this trial is to investigate the feasibility and safety of, and patient-satisfaction and adherence with, patient-centered teleprehabilitation in patients undergoing breast cancer (BC) surgery.
**Methods:** Women ($n$ = 50) who will undergo breast surgery because of stage I-III BC are eligible. All participants will receive multimodal patient-centered teleprehabilitation comprising of motivational interviewing, education, exercise therapy, and stress management. Feasibility, participation rate, patient satisfaction, intervention safety, and treatment adherence will be monitored as primary outcomes. Fatigue, pain, quality of life (QoL), self-efficacy, and healthcare utilization will be assessed by self-reported questionnaires at baseline, 0-, 2-, and 6-months post-intervention.
**Results:** Proof of concept for using telecommunication and exercise therapy in prehabilitation prior to BC surgery is available[2,3]. We expect the proposed intervention to be feasible and effective at reducing fatigue, pain, and healthcare use, and at improving treatment adherence, QoL, and self-efficacy.
**Discussion:** Effective prehabilitation interventions can reduce the long-term symptoms that arise/persist beyond treatment completion, improving patients' QoL. By using telecommunication technologies, socio-economic barriers can be reduced, making care accessible to all.
**Process evaluation:** With timely recruitment being the greatest challenge, a thorough mitigation strategy was put in place. Recruitment, drop-out, and loss-to-follow-up will constantly be monitored. Additional study centers confirmed their willingness to participate, and other study centers can easily be contacted through our collaboration with the Belgian Society of Medical Oncology.
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**Keywords:** Prehabilitation; breast cancer; feasibility

## Direct access to physiotherapy for acute low back pain in Belgium: Protocol for a pragmatic pilot trial (The Direct-Physio Trial)

**P Severijns**[1,*]; **C Denis**[1,*]; W Dankaerts[2]; N Roussel[3]; L Pitance[4]; A Timmermans[1]; W Marneffe[5]; J Luyten[5]; A Fourré[3,6]; N Goossens[1]; L Janssens[1]
[1]*REVAL Rehabilitation Research Center, UHasselt, Diepenbeek, Belgium;* [2]*Department of Rehabilitation Sciences, KU Leuven, Leuven, Belgium;* [3]*Department of Rehabilitation Sciences and Physiotherapy, University of Antwerp, Antwerp, Belgium;* [4]*Institut de recherche expérimentale et Clinique, Neuro-Musculo-Skeletal Lab, Université Catholique de Louvain, Brussels, Belgium;* [5]*Faculty of Business Economics, UHasselt, Diepenbeek, Belgium;* [6]*Department of Neurosciences, Research Institute for Biosciences, University of Mons, Mons, Belgium*

[*]Shared first authorship

**Introduction:** In several countries[1], direct access to physiotherapy (PT) for acute low back pain (aLBP) had a positive impact on clinical outcomes[2] and health-care usage and costs[3]. The aim of this study is to investigate the effect of direct PT access on pain, disability and costs compared to usual care by the general practitioner (GP) for aLBP within the Belgian care system.
**Methods:** Six hundred adults (French-speaking: $n$ = 300; Dutch-speaking: $n$ = 300) with aLBP (>24 hours and <6 weeks) will be recruited and semi-randomly allocated to the usual care or the direct PT pathway in this ethically approved study (CME2021/066). Primary outcomes include

pain intensity, pain location and disability. Secondary, a cost-effectiveness analysis will evaluate the patient- and societal costs associated with aLBP and its treatment. Other secondary outcomes include beliefs and cognitions related to LBP, quality of life, work disability, amount of flare ups and perceived effect of change. All outcomes will be evaluated through validated questionnaires at baseline, during and at the end of intervention and at 3 months, 1 and 2 years following enrolment. Effects and relations will be investigated using, respectively, linear mixed models and multiple linear regression.

**Results:** It is hypothesized that direct PT access will result in higher reductions in pain and disability and lower costs compared to usual care for aLBP.

**Discussion:** The study results will be used to optimize the Belgian care pathway for aLBP.

**Process evaluation:** Challenges to this trial include an unbiased organization within the Belgian care and political system and patient recruitment in the direct PT pathway.

**References:** 1. Bury TJ, Stokes EK. A Global view of direct access and patient self-referral to physical therapy: Implications for the profession. *Phys Ther* 2013;93:449–59.

2. Fritz JM, Lane E, McFadden M, et al. Physical Therapy Referral From Primary Care for Acute Back Pain With Sciatica: A Randomized Controlled Trial. *Ann Intern Med* 2021;174:8–17.

3. Liu X, Hanney WJ, Masaracchio M, et al. Immediate physical therapy initiation in patients with acute low back pain is associated with a reduction in downstream health care utilization and costs. *Phys Ther* 2018;98:336–47.

**Keywords:** Direct access; physiotherapy; acute low back pain; disability; cost-effectiveness

## Best practices in the rehabilitation of single- and double level lumbar fusion surgery: Results of a modified Delphi process

**L Bogaert**[1,2,*]; T Thys[1,*]; B Depreitere[3]; P Wambeke[1]; W Dankaerts[4]; S Brumagne[1,4]; L Moke[5,6]; S Schelfaut[5,6]; K Jacobs[5,7]; A Spriet[1]; K Peers[1]; L Janssens[2,**]; TW Swinnen[4,**]

[1]*Department of Physical and Rehabilitation Medicine, University Hospitals Leuven, Leuven, Belgium;* [2]*REVAL Rehabilitation Research, Hasselt University, Diepenbeek, Belgium;* [3]*Department of Neurosurgery, University Hospitals Leuven, Leuven, Belgium;* [4]*Department of Rehabilitation Sciences, KU Leuven, Leuven, Belgium;* [5]*Institute for Orthopaedic Research and Training (IORT), Department of Development and Regeneration, KU Leuven, Leuven, Belgium;* [6]*Department of Orthopaedics, University Hospitals Leuven, Leuven, Belgium;* [7]*Leuven institute for Health Care Policy, Department of Public Health and Primary Care, KU Leuven, Leuven, Belgium*

*Shared first authors, (**) shared last authors

**Introduction:** Paucity of evidence on good practices in the rehabilitation of patients requiring single- and double level lumbar fusion surgery (LFS), leads to uncertainty and extensive variability in current rehabilitation regimes. Therefore, this study aims to formulate consensus statements on the optimal rehabilitation of LFS, representing the viewpoints of Belgian and Dutch experts on spinal surgery and rehabilitation.

**Methods:** A modified Delphi study consisted of a 3-round online Delphi questionnaire, followed by an in-person consensus meeting. In each round, experts could suggest new items, and received feedback for reconsidered statements. The threshold for consensus agreement was set at ≥75%. Afterwards, perspectives of nine patients that underwent LFS were solicited through a questionnaire and patient focus group.

**Results:** A total of 31 experts participated in the first online round, of which 27 (87%) completed all online rounds, and 17 (55%) attended the in-person consensus meeting. Consensus was reached on 122 statements relating to the pre-, peri- and postoperative rehabilitation of LFS, including the importance of uniform communication, patient-specific education and specific physiotherapeutic interventions. Patient perspective on optimal rehabilitation was gained from nine patients.

**Discussion:** The final compilation of 122 consensus statements is a solid base for developing and implementing a novel and much-needed rehabilitation pathway for LFS. Benchmarking this consensus against patient perspectives helps understanding patient expectations and potential barriers for implementation.

**Process evaluation:** These results represent the consensus established by Belgian and Dutch experts. Future

research should consider transfer this consensus to other regions, including non-European countries.

**Keywords:** Lumbar fusion surgery; Rehabilitation; Consensus; Delphi technique; care pathway

### Variability in recovery after lumbar microdiscectomy followed by physiotherapy: A latent class trajectory analysis

**S Willems**[1]; M Coppieters[1,2]; S Rooker[3,4]; R Ostelo[5,6]; T Hoekstra[7]; G Scholten-Peeters[1]
[1]*Faculty of Behavioural and Movement Sciences, Vrije Universiteit Amsterdam, Amsterdam Movement Sciences, Amsterdam, The Netherlands;* [2]*Menzies Health Institute Queensland, Griffith University, Brisbane and Gold Coast, Australia;* [3]*Department of Orthopaedics and Research, Kliniek ViaSana, Mill, The Netherlands;* [4]*Department of Epidemiology and Social Medicine, University of Antwerp, Antwerp, Belgium;* [5]*Department of Health Sciences, Faculty of Science, Vrije Universiteit Amsterdam, Amsterdam Movement Sciences research institute Amsterdam, The Netherlands;* [6]*Department of Epidemiology and Data Science, Amsterdam UMC, Location VUmc, Amsterdam Movement Sciences Research Institute, Amsterdam, The Netherlands;* [7]*Department of Health Sciences and the Amsterdam Public Health Research Institute, Faculty of Science, Vrije Universiteit Amsterdam, The Netherlands*

**Introduction:** The clinical course after lumbar microdiscectomy is heterogenous. The primary aim was to evaluate the variability in long-term recovery and to identify outcome trajectories. The secondary aim was to assess whether factors at baseline could predict poor outcome trajectories.
**Methods:** A latent class trajectory analysis was performed to identify outcome trajectories for leg pain (VAS), back pain (VAS), and disability (RMDQ). The best number of clusters was determined by using the Bayesian Information Criterion, Akaike's information criteria, entropy, and overall interpretability. Prediction models for poor outcome trajectories were assessed using multivariable logistic regression analyses.
**Results:** We performed a prospective cohort study with 24 months follow-up and included 479 patients who underwent microdiscectomy. A four-class model provided the best fit for the data. Patients were assigned to the 'large improvement trajectory', the 'moderate improvement, the 'minimal improvement trajectory', and the 'relapse trajectory'. In total, 156 patients (32.6%) belonged to one or more than one poor outcome trajectory. Patients with previous treatment and those who had higher baseline pain and disability scores were more likely to belong to the poor outcome trajectories.
**Discussion:** Patients who were classified as a member of the poor outcome trajectory for a specific outcome were not necessarily a member of a poor outcome trajectory for the other outcomes. Clinicians and patients should set appropriate expectations prior to surgery by illustrating the postoperative outcome trajectories that fit the patients' specific goals and expectations.
**Process evaluation:** This study used commonly captured preoperative data. The role of other biomedical, personal and external factors should be further assessed.

**Keywords:** Disc herniation; rehabilitation; latent class analysis; prognosis; prediction models

### A systematic review protocol on the effectiveness of neural mobilization on pain intensity, disability, and physical performance in adults with musculoskeletal pain

**FM Baptista**[1]; EB Cruz[2]; V Afreixo[3]; AG Silva[4]
[1]*Department of Medical Sciences, University of Aveiro, Aveiro, Portugal;* [2]*Department of Physiotherapy, Escola Superior de Saúde, Instituto Politécnico de Setúbal, Setúbal, Portugal;* [3]*CIDMA – Center for Research and Development in Mathematics and Applications, Department of Mathematics, University of Aveiro (UA), Aveiro, Portugal;* [4]*Center for Health Technology and Services Research (CINTESIS.UA), School of Health Sciences, University of Aveiro, Aveiro, Portugal*

**Introduction:** Musculoskeletal disorders are the most prevalent conditions requiring physiotherapy[1]. Neural mobilization (NM) has been used in the management of musculoskeletal pain, but its effectiveness is unclear[2]. Our aim is to synthesize existing evidence on the effectiveness of NM in the treatment of adults with musculoskeletal pain.
**Methods:** Randomized and quasi-randomized trials will be included. The target population will be adults with musculoskeletal pain. Web of Science, PubMed, CINAHL Plus, CENTRAL, Scopus, and PEDro will be searched. Open Access Scientific Repositories of Portugal and Clinical Trial Registration Platforms will also be consulted. Main outcomes will be pain intensity, functionality, and physical performance. Risk of bias will be assessed by the RoB 2 tool. Certainty of the evidence will be evaluated using the GRADE approach. Depending on our findings, meta-analysis will be performed.
**Results:** Previous systematic reviews suggest that NM is effective for back and neck pain but remains unclear for other conditions[2,3]. We hope to update current evidence for these conditions and provide evidence for other conditions.
**Discussion:** We intend to develop a comprehensive systematic review including studies related to any musculoskeletal condition and conducted in any setting. This will provide a broad spectrum of scientific evidence on the effectiveness of NM in people with musculoskeletal pain.

**Process evaluation:** Considering the expected heterogeneity in relation to the results we expect to obtain, we intend to deal with this problem by carrying out analyzes by subgroups.

**References:** 1. Cieza A, Causey K, Kamenov K, Hanson SW, Chatterji S, Vos T. Global estimates of the need for rehabilitation based on the Global Burden of Disease study 2019: a systematic analysis for the Global Burden of Disease Study 2019. Lancet [Internet]. 2020 Dec 19 [cited 2021 Sep 7];396(10267):2006–17. Available from: http://www.thelancet.com/article/S0140673620323400/fulltext
2. Basson A, Olivier B, Ellis R, Coppieters M, Stewart A, Mudzi W. The effectiveness of neural mobilization for neuromusculoskeletal conditions: A systematic review and meta-Analysis. J Orthop Sports Phys Ther. 2017;47(9):593–615.
3. Neto T, Freitas SR, Marques M, Gomes L, Andrade R, Oliveira R. Effects of lower body quadrant neural mobilization in healthy and low back pain populations: A systematic review and meta-analysis. Musculoskelet Sci Pract [Internet]. 2017;27:14–22. Available from: https://doi.org/10.1016/j.msksp.2016.11.014

**Keywords:** Musculoskeletal pain; neural mobilization; pain intensity; disability; functionality

## Comparision of proprioceptive and tactil acuity training effect on pain

**K Canlı**[1]; F Can[1]; Z Erden[1]; S Çıtaker[2]; G Demirkıran[3]
[1]*Faculty of Physical Therapy and Rehabilitation, Hacettepe University, Ankara, Turkey;* [2]*Department of Physiotherapy and Rehabilitation, Faculty of Health Sciences, Ankara, Turkey;* [3]*Department of Orthopedics and Traumatology, Hacettepe Universty Hospital, Ankara Turkey.*

**Introduction:** Tactile acuity and proprioceptive disturbances lead to incongruent information between sensory system and movement in chronic neck pain (CNP). [1] This process ultimately results in pain and recovery is correlated with reduced disturbances in proprioception and tactile acuity.[2,3] The aim is to compare the proprioceptive training (PT) or tactile acuity training (TAT) effects on pain in CNP.

**Methods:** After identifying the pressure pain thresholds twice with a 30 s interval, temporal summation (TS) and conditioned pain modulation (CPM) will be assessed on the more painful upper trapezius and dominant side tibialis anterior muscle in a random order. Participants will be divided into two groups as PT and TAT groups. All participants will receive classical physiotherapy (CP) during the first two weeks in addition to PT or TAT. Then, one group will continue to receive PT and the other group will receive TAT for four weeks.

**Results:** There is a difference between CP + PT and CP+ TAT in patients with CNP in terms of the pain parameters.

**Process evaluation:** We can not directly compare trainings at the beginning of the study. Patients may feel pain and dizziness during PT that include eye and neck movement. To prevent this, CP will be added for all participants for two weeks. Then a three days interval will be added to avoid the summation effect of CP and then try to specifically compare the trainings.

**References:** 1. Harris AJ. Cortical origin of pathological pain. Lancet. 1999; 354(9188):1464–1466.
2. Pleger B, Tegenthoff M, Ragert P, Förster AF, Dinse HR, Schwenkreis P, Nicolas V, Maier C. Sensorimotor retuning [corrected] in complex regional pain syndrome parallels pain reduction. Ann Neurol. 2005;57(3):425–429.
3. Jull G, Falla D, Treleaven J, Hodges P, Vicenzino B. Retraining cervical joint position sense: the effect of two exercise regimes. J Orthop Res. 2007 Mar;25(3):404–412. https://doi.org/10.1002/jor.20220. PMID: 17143898.

**Keywords:** Neck pain; two point discrimination; oculomotor exercises

## Effectiveness of a high-intensity training program on quality of life in persons with chronic nonspecific low back pain

**Klaps S**; Haesevoets S; Agten A; Stevens S; Vandenabeele F; Verbrugghe J; Timmermans
*REVAL Rehabilitation Research Center, UHasselt, Diepenbeek, Belgium*

**Introduction:** The quality of life (QoL) in persons with chronic nonspecific low back pain (CNSLBP) is poorer than in healthy persons. Exercise therapy is a valuable therapeutic modality in CNSLBP rehabilitation. Recent research has shown that high-intensity training (HIT) is more effective than moderate-intensity training (MIT) to improve physical fitness and decrease disability[1]. Possibly, HIT also improves QoL more than MIT. The aim of the study was to compare the effects of HIT to MIT on QoL in persons with CNSLBP.

**Methods:** Persons with CNSLBP performed a 12-week training program (24 sessions, 1.5 h per session, twice per week) at high or moderate intensity. The primary outcome measure, QoL, was assessed with the Short Form Health Survey (SF-36) at baseline and immediately post-intervention. A linear mixed model was carried out to evaluate the therapy effects.

**Results:** In total, thirty-five persons (11 male, age = 43.3 y ± 9.7) participated. Between group differences ($p$ = 0.0387) in favor of HIT were found for the physical component score (PCS) of the SF-36. Within group analysis showed an improvement in the SF-36 total score (HIT:+14.48, MIT:+11.82) and the PCS (HIT:+11.06, MIT:+10.44) in both groups. However, within group

improvements in the mental component score were lacking (HIT:-1.41, MIT:-2.78).
**Discussion:** Exercise intensity, and especially HIT, appears to be important to maximize the impact of exercise therapy on QoL in persons with CNSLBP.
**Process evaluation:** Although HIT is an effective treatment modality in CNSLBP rehabilitation, this study did not report on the long-term effects of HIT.
**Reference:** Verbrugghe J, Agten A, Stevens S, et al. Exercise intensity matters in chronic nonspecific low back pain rehabilitation. Med Sci Sports Exerc 2019; 51(12), 2434–2442.
**Keywords:** High-intensity training; chronic nonspecific low back pain; quality of life

### Biopsychological differences between the start back tool and central sensitization inventory in people with low back pain in primary care

**H den Bandt**[1,2]; K Ickmans[2,3,4]; R Buyl[6]; L Leemans[2,5]; J Nijs[2,3,7]; L Voogt[1,2]
[1]*Research Centre for Health Care Innovations, University of Applied Sciences Rotterdam, Rotterdam, The Netherlands;* [2]*Pain in Motion Research Group, dept. of Physiotherapy, Human Physiology and Anatomy, Faculty of Physical Education and Physiotherapy, Vrije Universiteit Brussel, Brussels, Belgium;* [3]*Department of Physical Medicine and Physiotherapy, University Hospital Brussels, Brussels, Belgium;* [4]*Research Foundation – Flanders (FWO), Brussels, Belgium;* [5]*Rehabilitation Research Department, Vrije Universiteit Brussel, Laarbeeklaan 103, B-1090 Brussels, Belgium;* [6]*Department of Biostatistics and Medical Informatics, Vrije Universiteit Brussel, Brussels, Belgium;* [7]*Department of Health and Rehabilitation, Unit of Physiotherapy, Institute of Neuroscience and Physiology, Sahlgrenska Academy, University of Gothenburg, Sweden. University of Gothenburg Center for Person-Centred Care (GPCC), Sahlgrenska Academy, University of Gothenburg, Gothenburg, Sweden*

**Introduction:** Psychological factors and changes in sensory system play a role in low back pain (LBP). Psychological factors are examined by questionnaires and the sensory system by quantitative sensory testing (QST). Questionnaires Start Back screening Tool (SBT) and Central Sensitization Inventory (CSI) subgroup patients into risk respectively severity levels. The aim of this study was investigating the linear trend across the risk and severity levels based on the SBT and CSI for various psychological factors and sensitivity changes in the sensory system.
**Methods:** Participants with LBP were recruited. Demographic information was taken, psychological questionnaires were filled in. Comprehensive QST was taken and linear contrast analysis was conducted in this cross-sectional study.
**Results:** Psychological variables (e.g. kinesiophobia, catastrophizing) show significant positive linear trends across the risk levels of the SBT ($p < 0.001$) and severity levels of the CSI. Several QST-measurements show significant linear trends between the risk and severity levels based on the SBT (e.g. heat pain threshold$_{\text{low leg}}$, $p = 0.005$) and CSI (e.g. pressure pain threshold$_{\text{L4}}$, $p = 0.012$).
**Discussion:** Psychological factors increase as risk and severity levels increase. As the risk and/or severity levels increase some responsiveness of nociceptive neurons increased measured by pressure pain thresholds and heat pain thresholds. Temporal summation and conditioned pain modulation show no significant linear trends.
**Process evaluation:** Recruiting people with LBP in primary care was challenging. Patients do not have often time to participate in research. It is helpful to actively approach different physiotherapists and to recruit participant in one's own working environment.
**Keywords:** Non-specific low back pain; prognostic indicators; subgroups; sensitivity; psychosocial

### Hospital for special surgery lumbar spine surgery expectations survey: Dutch translation and validation

**S Van Oosterwijck**[1,2,3]; B Poffyn[5,6]; L Danneels[1,3]; J Van Oosterwijck[1,2,3]
[1]*SPINE Research Unit Ghent, Department of Rehabilitation Sciences, Faculty of Medicine and Health Sciences, Ghent University, Ghent, Belgium;* [2]*Pain in Motion international research group,* www.paininmotion.be*;* [3]*Research Foundation – Flanders (FWO), Brussels, Belgium;* [4]*Department of Rehabilitation Sciences and Physiotherapy, Faculty of Medicine and Health Sciences, University of Antwerp, Antwerp, Belgium;* [5]*Department of Physiotherapy and Orthopaedics, Department of Rehabilitation Sciences, Faculty of Medicine and Health Sciences, Ghent University, Ghent, Belgium;* [6]*Orthopaedics and Traumatology, Ghent University Hospital, Ghent, Belgium*

**Introduction:** Although a positive correlation between patients' expectations and outcome after surgery appears evident, evidence is rather conflicting. This can be attributed to the lack of uniform, validated, and reliable methods to assess patients' expectations. A valid and reliable questionnaire to assess patients' expectations of lumbar spine surgery is not yet available in Dutch.
**Methods:** The forward-backward translation method will be applied to the original Hospital for Special Surgery Lumbar Spine Surgery Expectations Survey [1]. The translations will be revised by an expert committee, including translators, methodologist, spinal surgery experts and psychology experts. The pre-final Dutch survey will be piloted in a sample ($n = 50$) of patients scheduled for lumbar surgery. Based on these results, the expert committee will improve the survey.

The final survey will then be administered in a sample ($n$ = 300) of patients twice before their spinal surgery. Based on the acquired data, validity (i.e. content, construct, and discriminative validity) and reliability (i.e. internal consistency and test-retest reliability) will determined.
**Results:** Not applicable.
**Discussion:** A Dutch validated survey for assessment of expectations of lumbar surgery patients may assist clinicians in determining the quality of spinal surgical care and any discrepancies that might exist between clinician and patient. Researchers will benefit as well, as uniform and valid surveys are essential to unravel the relation between pre-surgical patients' expectations and satisfaction following spinal surgery.
**Process evaluation:** The study is currently in the backward-translation stage. Finding translators with the appropriate requirements according to the WHO guidelines proves to be challenging.
**Reference:** 1. Mancuso CA, Cammisa FP, Sama AA, Hughes AP, Ghomrawi HMK, Girardi FP. Development and testing of an expectations survey for patients undergoing lumbar spine surgery. J Bone Jt Surg - Ser A 2013;95:1793–1800.
**Keywords:** Spinal surgery; low back pain; questionnaire; psychometric properties

## The development and measurement properties of the Dutch version of the fear-avoidance component scale (FACS-D) in persons with chronic musculoskeletal pain

**A Sergooris**[1]; R Neblett[2]; T Matheve[1,3]; S Mingels[1,4]; A Van Goethem[5,6,7]; X Huybrechts[8]; C Kristoff[9]; D Gerits[1]; D Vandevoort[1;] A Timmermans[1;] L Janssens[1]; L De Baets[10]
[1]*REVAL Rehabilitation Research, Faculty of Rehabilitation Sciences, Hasselt University, Diepenbeek, Belgium;* [2]*PRIDE Research Foundation, Dallas, TX, USA;* [3]*Spine, Head and Pain Research Unit Ghent; Department of Rehabilitation Sciences, Ghent University, Belgium;* [4]*Research Group for Musculoskeletal Rehabilitation, Faculty of Movement and Rehabilitation Sciences, Leuven University, Leuven, Belgium;* [5]*Multidisciplinary pain centre, Ziekenhuis Oost-Limburg, Genk, Belgium;* [6]*Physical medicine and rehabilitation, Ziekenhuis Oost-Limburg, Genk, Belgium;* [7]*Centre for Translational Psychological Research (TRACE), Hospital ZOL Limburg, Genk, Belgium;* [8]*Department of Physical and Rehabilitation Medicine, Jessa Hospital, Hasselt, Belgium;* [9]*Department of Orthopaedics, Ziekenhuis Oost-Limburg, Genk, Belgium;* [10]*Pain in Motion Research Group (PAIN), Department of Physiotherapy, Human Physiology and Anatomy, Faculty of Physical Education and Physiotherapy, Vrije Universiteit Brussel, Brussels, Belgium*

**Introduction:** The Fear-Avoidance Components Scale (FACS) has been developed within the framework of the most current fear-avoidance model.[1] This study aimed to translate the FACS into Dutch, and to investigate its measurement properties in patients with chronic musculoskeletal pain.
**Methods:** The original English FACS was translated in Dutch through forward-backward translation. The FACS-D's measurement properties were evaluated in 224 persons with chronic musculoskeletal pain. Internal consistency, test-retest reliability and measurement error were assessed with the Cronbach's alpha coefficient (α), intraclass correlation coefficient (ICC), standard error of measurement (SEM) and smallest detectable change (SDC). Construct validity (including structural validity and hypothesis testing) was assessed through inter-item correlation analyses, exploratory factor analysis and by examining relationships between the FACS-D and other patient-reported instruments.
**Results:** Internal consistency and test-retest reliability were high (α = 0.92; ICC = 0.92), and the SEM was 5.6 points. Regarding structural validity, low inter-item correlations were found for item 12. A two-factor model was found to best fit the data: one factor covered pain-related cognitions and emotions, the second factor covered items regarding avoidance behaviour. Five out of seven of the a priori-formulated hypotheses were confirmed.
**Discussion:** The FACS-D has good reliability and validity, and can be used to evaluate fear-avoidance in persons with chronic musculoskeletal pain. It's a two-dimensional scale that assesses two clinically relevant constructs of fear-avoidance behaviour. One factor covers pain-related cognitions and emotions, while the other factor covers avoidance behaviour.
**Process evaluation:** Notwithstanding the sound methodology, the paper's content is considered of low priority by editors.
**Reference:** 1. Neblett R, Mayer TG, Hartzell MM, Williams MJ, Gatchel RJ. The Fear-avoidance Components Scale (FACS): Development and Psychometric Evaluation of a New Measure of Pain-related Fear Avoidance. Pain Practice. 2016;16(4):435–450.
**Keywords:** Psychometric; pain-related fear; kinesiophobia; self-report; avoidance.

## The impact of parental presence on their children during painful medical procedures: A systematic review

**Rheel E**[1,2,3], Malfliet A[1,2,4,5], Van Ryckeghem DML[3,6,7], Pas R[1,2], Vervoort T[3], Ickmans K[1,2,5,8]
[1]*Pain in Motion Research Group (PAIN), Department of Physiotherapy, Human Physiology and Anatomy, Faculty of Physical Education & Physiotherapy, Vrije Universiteit Brussel, Laarbeeklaan 103, 1090 Brussels, Belgium;* [2]*Pain in Motion International Research Group,* www.paininmotion.be*;* [3]*Department of Experimental-Clinical and Health Psychology, Ghent University, Henri Dunantlaan 2, 9000 Gent, Belgium;* [4]*Research Foundation – Flanders (FWO), Brussels, Belgium;* [5]*Department of Physical Medicine and Physiotherapy, Universitair Ziekenhuis Brussel, Laarbeeklaan 101, 1090 Brussels, Belgium;* [6]*Section Experimental Health Psychology, Clinical Psychological Science, Faculty of Psychology and Neuroscience, Maastricht University, Maastricht, The Netherlands;* [7]*Institute for Health and Behavior, INSIDE, University of Luxembourg, Luxembourg City, Luxembourg;* [8]*Movement & Nutrition for Health & Performance research group (MOVE), Department of Movement and Sport Sciences, Faculty of Physical Education and Physiotherapy, Vrije Universiteit Brussel, Pleinlaan 2, 1050 Brussel, Belgium.*

**Introduction:** Whether parental presence during their children's painful medical procedures is beneficial for children's pain-related outcomes is questionable and research regarding this topic is ambiguous. Therefore, we systematically reviewed and critically appraised the literature regarding the impact of parental presence versus absence during their children's painful medical procedures on children's pain-related outcomes.
**Methods:** The review protocol was registered on Prospero (ID CRD42018116614). A systematic search in PubMed, Web of Science, and PsycArticles resulted in 22 eligible studies, incorporating 2157 children. Studies were considered eligible if they included children (≤18 years old) undergoing a painful medical procedure and compared parental presence and/or involvement with parental absence during the procedure.
**Results:** Children's pain-related outcomes included self-reported pain intensity, self-reported fear, anxiety and distress, observed pain-related behavior, and physiological parameters. Overall, evidence pointed in the direction of beneficial effects of parental presence versus absence with regard to children's self-reported pain intensity and physiological parameters, whereas mixed findings were recorded for children's self-reported fears, anxiety and distress, and for observed pain-related behaviors.
**Discussion:** In order to provide clear recommendations on how to involve the parent during the procedure, as well as for which type of children and parents parental presence has the best effects, further research is needed, as indicated in this review.
**Process evaluation:** Recently published in Pain Medicine (PMID: 34453832).
**Keywords:** Child; parent; parental involvement; parental presence; procedural pain

## A multiple single-case experimental design investigating individual patterns and temporal trajectories of changes in fear and pain following exposure in vivo in patients with chronic pain

**E Cnockaert**[1,2,3]; J Bontinck[1,2]; M den Hollander[4,5]; AL Kaas[6]; JR De Jong[4,7]; I Timmers[1,4]
[1]*Department of Rehabilitation Sciences and Physiotherapy, Ghent University, Ghent, Belgium;* [2]*Pain in Motion International research group, Department of Physiotherapy, Human Physiology and Anatomy, Faculty of Physical Education & Physiotherapy, Vrije Universiteit Brussel, 1090 Brussels, Belgium;* [3]*Pijncentrum AZ Sint-Lucas, Ghent, Belgium;* [4]*Maastricht University, Department of Rehabilitation Medicine, Maastricht, Netherlands;* [5]*Adelante Centre of Expertise in Rehabilitation and Audiology, Hoensbroek/Maastricht, Netherlands;* [6]*Maastricht University, Department of Cognitive Neuroscience, Maastricht, Netherlands;* [7]*Intergrin, Geleen, Netherlands*

**Introduction:** Exposure in vivo (EXP) is an effective treatment to reduce pain-related fear and disability. Although pain is no primary target, some also experience pain relief. Yet, it remains unclear how reductions in fear and pain relate to each other. This single-case experimental design study attempted to identify patterns in the individual responses to EXP based on daily measurements of fear and pain.
**Methods:** Daily diaries were completed before, during and after EXP. Multilevel modelling analyses were performed to evaluate the overall effect, using MULTISCED [1]. Temporal effects were scrutinized by individual regression analyses and determination of the time to reach a minimal clinically important difference. Furthermore, individual graphs were inspected for potential patterns.
**Results:** Twenty patients with chronic pain were included. On a group level, both fear and pain were reduced following EXP. Individually, fear was significantly reduced in 65% of the patients, while pain in only 20%. A decrease in fear was seen mostly in the first weeks, while pain levels reduced later or were unchanged.
**Discussion:** Daily measurements provided rich data on temporal trajectories of reductions in fear and pain. Overall, reductions in fear preceded pain relief and seem to be essential to achieve pain reductions.
**Process evaluation:** This study is completed and ready to submit. The biggest limitations were the incompleteness of daily measurements and the absence of a long-term follow-up.

**Reference:** 1. Declercq L, Cools W, Beretvas SN, Moeyaert M, Ferron JM, Van den Noortgate W. MultiSCED: A tool for (meta-)analyzing single-case experimental data with multilevel modeling. Behav Res Methods 2020;52(1):177–192.
**Keywords:** Chronic pain; exposure in vivo, pain-related fear; chronic low back pain; complex regional pain syndrome

## Knowledge, attitudes and beliefs of physiotherapists in the management of low-back pain: A cross-sectional study

**A Fourré**[1,2]; R Vanderstraeten[2]; J Michielsen[2,3]; C Demoulin[4]; H Bastiaens[2]; L Ris[1]; N Roussel[2]
[1]*Department of Neurosciences, Research Institute for Health Sciences and Technology, University of Mons, Mons, Belgium;* [2]*Faculty of Medicine and Health Sciences, Rehabilitation Sciences and Physiotherapy (MOVANT), University of Antwerp, Belgium;* [3]*Orthopedic department, University Hospital, Antwerp, Belgium;* [4]*Département des sciences de la motricité, Université de Liège, 4000 Liège, Belgium*

**Introduction:** Many clinical guidelines promote a bio-psycho-social framework for the management of low-back pain (LBP) [1–3]. The objective of this study was to examine the current knowledge, attitudes and beliefs of physiotherapists (PTs) about guideline-adherent approach in the management of LBP.
**Methods:** PTs were recruited in 3 regions (French and Dutch speaking part of Belgium and France) using an online platform. Participants filled in the Health Care Providers' Pain and Impairment Relationship Scale (HC-PAIRS), Back Pain Attitudes Questionnaire (Back-PAQ), Neurophysiology of Pain Questionnaire (NPQ) and two clinical vignettes (non-specific and specific LBP).
**Results:** In total 527 PTs participated. 62% of the physiotherapists are uncertain or don't know the guidelines on the management of LBP and only 37% apply them in clinical practice. 63% of the physiotherapists give guidelines inconsistent recommendations about work and 23% for activity. Score of the HC-PAIRS, Back-PAQ, NPQ and clinical vignette on non-specific LBP are significantly correlated with the knowledge of the guidelines ($p < 0.001$).
**Discussion:** Most PTs report being uncertain or unaware of clinical guidelines for the management of LBP, which is concerning. The beliefs and attitudes of these PTs are less guidelines oriented. Hence it is crucial to develop efficient strategies to enhance best practice and guidelines knowledge among PTs.
**Process evaluation:** These results concern baseline assessment of a large RCT in 2 populations, i.e. PTs and General Practitioners. The preparation of this study was more time consuming than expected (e.g. using different arms in Qualtrics to include 2 different populations, from 3 regions, randomized over 2 interventions).

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2. Van Wambeke Leuven PU, President G, Desomer A, Ailliet L, Berquin A, Demoulin Université de Liège C, de Liège C, Depreitere B, Dewachter J, Dolphens M, Forget Brussel PU, Fraselle V, Hans G, Hoste Sint Lucas DA, Mahieu G, Michielsen J, Nielens H, Orban T, Parlevliet T, Simons CHU E, Brugmann U, Tobbackx Y, Van Schaeybroeck Imelda Ziekenhuis P, Tienen R, Van Zundert ZOL J, Vanderstraeten J, Vlaeyen J, Jonckheer P. KCE report 287Cs summary low back pain and radicular pain: assessment and management. 2017; Available from: www.kce.fgov.be
3. Bernstein IA, Malik Q, Carville S, Ward S. Low back pain and sciatica: summary of NICE guidance. BMJ 2017 Jan 6;i6748. https://doi.org/10.1136/bmj.i6748
**Keywords:** Guideline Adherence; Musculoskeletal Pain; Knowledge; Attitude; Spine

## Building optimal therapeutic alliances in multicultural physiotherapy practices: A participatory action research

**R Annevelink**[1,2]; S Don[1,3]; J Nijs[3,4]; D Beckwée[5]; M Cardol[2]; K Ickmans[3,4,6]; L Voogt[1,2,3]
[1]*Department of Physiotherapy, Healthcare Institute, Rotterdam University of Applied Sciences, Rotterdam, The Netherlands;* [2]*Research Centre of Healthcare Innovations, Rotterdam University of Applied Sciences, Rotterdam, The Netherlands;* [3]*Pain in Motion research group (PAIN), Department of Physiotherapy, Human Physiology and Anatomy, Faculty of Physical Education & Physiotherapy, Vrije Universiteit Brussel, Brussels, Belgium;* [4]*Department of Physical Medicine and Physiotherapy, Universitair Ziekenhuis Brussel, Brussels, Belgium;* [5]*Rehabilitation Research group (RERE), Department of Physiotherapy, Human Physiology and Anatomy, Faculty of Physical Education & Physiotherapy, Vrije Universiteit Brussel, Brussels, Belgium;* [6]*Movement & Nutrition for Health & Performance research group (MOVE), Department of Movement and Sport Sciences, Faculty of Physical Education and Physiotherapy, Vrije Universiteit Brussel, Brussels, Belgium*

**Introduction:** Therapeutic alliance (TA) is a necessity for optimal physiotherapy treatment for patients with

musculoskeletal (MSK) pain[1,2]. Mutual understanding and open communication are important in building strong TA[1,2]. Building TA with patients from socio-cultural vulnerable groups seems to be difficult and might be related with higher risk on poor treatment outcomes[3]. Therefore, the aims of this study are to: (1) determine facilitators and barriers for building optimal TA with patients with MSK pain from socio-cultural vulnerable groups (2) develop and implement interventions to optimize TA.

**Methods:** This participatory action research consists of multiple cycles of five phases in which researchers, clinicians and patients work closely together to investigate and optimize TA. Both observational research and semi-structured interviews will be conducted to gather data for reflection and deep understanding. Preliminary results will be used to collectively develop and implement interventions to optimize TA. This cycle of data collection and reflection will be repeated until optimal outcomes in TA are achieved from both therapist and patient perspective.

**Results:** Diverse facilitators and barriers in TA are expected such as communication styles, language barriers, and expectations of treatment. Working together with patients and physiotherapists as co-researchers creates the ability to jointly investigate and optimize TA.

**Discussion:** Since MSK pain is a frequent and debilitating health problem in patients from socio-cultural vulnerable groups, research into improving TA is important. By using participatory action research, knowledge about barriers and facilitators for TA can be obtained and changes in current physiotherapy practice may be facilitated.

**Process evaluation:** Currently, the research design and practical preparations are being finalized.

**References:** 1. Calner T, Isaksson G, Michaelson P. Physiotherapy treatment experiences of persons with persistent musculoskeletal pain: A qualitative study. Physiother Theory Pract. 2021;37(1): 28–37.

2. Kinney M, Seider J, Beaty AF, et al. The impact of therapeutic alliance in physical therapy for chronic musculoskeletal pain: A systematic review of the literature. Physiother Theory Pract. 2018;36(8): 886–898.

3. Yoshikawa K, Brady B, Perry MA, et al. Sociocultural factors influencing physiotherapy management in culturally and linguistically diverse people with persistent pain: a scoping review. Physiotherapy (United Kingdom) 2020;107: 292–305.

**Keywords:** Therapeutic alliance; participatory action research; musculoskeletal pain

## Physiotherapists using the biopsychosocial model: Barriers and facilitators. A scoping review

**J Van Dijk**[1]; S Elbers[1]; J Mollema[1]; A Köke[2]; RJEM Smeets[2,3]; H Wittink[1]

[1]*Research Group Lifestyle and Health, Utrecht University of Applied Sciences, Utrecht, Netherlands;* [2]*Maastricht University, School for Public Health and Primary Care, Rehabilitation Medicine;* [3]*CIR, location Eindhoven*

**Introduction:** Despite the importance of a biopsychosocial approach in chronic pain, many physiotherapists still adhere to a biomedical framework.[1] To facilitate the adoption of a biopsychosocial view, more insight into barriers and facilitators for using this approach is required. The aim for this study is to map these barriers and facilitators.

**Methods:** A scoping review was performed.[2] Eligible studies present data on barriers and facilitators, chronic pain, primary care physiotherapy and a biopsychosocial perspective. Extracted data on barriers and facilitators was discussed and sub grouped in themes following a qualitative content analysis approach, using the Theoretical Domains Framework[3] and a micro-meso-macro layout to organise and map the different themes.

**Results:** Twenty-three studies were included. Although analyses are ongoing preliminary results show that on a micro-level barriers and facilitators concern the therapist (knowledge, skills, attitudes, confidence, role clarity, patient perception, etc.), the patient (expectations, etc.) and the patient-therapist relationship. On a meso-level barriers relating to the environmental context (time, treatment-fee, etc.) were identified.

**Discussion:** It appears that a level of saturation was reached, suggesting a complete picture of known barriers and facilitators. There is, however, a large variety in used terminology and unclarity of what a biopsychosocial model entails. The presented overview can be used to inform professionals, researchers and policy-makers when designing strategies for implementation.

**Process evaluation:** The focus in the search strategy was on studies mentioning the biopsychosocial model. This might have resulted in missing studies that implicitly adopted this approach.

**References:** 1. Ng W, Slater H, Starcevich C, et al. Barriers and enablers influencing healthcare professionals' adoption of a biopsychosocial approach to musculoskeletal pain: a systematic review and qualitative evidence synthesis. *PAIN* 2021;162(8):2154–2185

2. Tricco AC, Lillie E, Zarin W, et al. PRISMA extension for scoping reviews (PRISMA-ScR): Checklist and explanation. *Ann Intern Med* 2018;169:467–73.
3. Atkins L, Francis J, Islam R, et al. A guide to using the Theoretical Domains Framework of behaviour change to investigate implementation problems. *Implement Sci* 2017;12:1–18.
**Keywords:** Chronic pain; physiotherapy; primary care; biopsychosocial model; barriers

### The usability of a blended biopsychosocial treatment 'Back2Action' for patients with persistent spinal pain from the perspective of physiotherapists

**L Bijker**[1,2]; GGM Scholten-Peeters[1]; V Busink[2]; P Cuijpers[2]; M Donker[3]; LM de Wit[2]; MW Coppieters[1,4]
[1]*Department of Human Movement Sciences, Faculty of Behavioural and Movement Sciences, Vrije Universiteit Amsterdam, Amsterdam Movement Sciences, Netherlands;* [2]*Amsterdam Public Health Research Institute, Department of Clinical Psychology, Faculty of Behavioural and Movement Sciences, Vrije Universiteit Amsterdam, Netherlands;* [3]*Faculty of Science, Methodology and Applied Biostatistics, Vrije Universiteit Amsterdam, Netherlands;* [4]*Menzies Health Institute Queensland, Griffith University, Brisbane & Gold Coast, Australia*

**Introduction:** Targeting psychosocial factors in patients with persistent spinal pain is recommended for more favourable outcomes in physiotherapy. However, some clinical challenges hinder a biopsychosocial treatment. Hence, Back2Action was developed. This study aims to gain insight into the experiences of physiotherapists using this blended treatment for patients with persistent spinal pain.
**Methods:** The design of this study is mixed methods; The qualitative component is a thematic content analysis of semi-structured interviews with physiotherapists ($N$ = 15) from the RCT 'Back2Action'. The quantitative component used digital questionnaires assessing user-friendliness.
**Results:** Five themes emerged from the interviews; (1) Back2Action is an unexpected shift in treatment. The added eHealth intervention provides quality of information and structure. (2) Physiotherapists report becoming aware of their own biases and capabilities. (3) Their expectations towards patients with persistent pain and perceived patient expectations of a 'quick fix', could lead to a resistance of this new approach. (4) A surprising strengthening of the therapeutic relationship is reported due to growing experience and confidence. (5) Successful implementation requires supervision, intervision and means. The quantitative analyses showed that the overall intervention is perceived as user-friendly with a mean score of 74 (range 0–100) and a net promotor score of 7.9 (range 0–10).
**Discussion:** Back2Action is considered a valuable treatment tool for physiotherapists.
**Process evaluation:** A limitation of this study is the expert level of the physiotherapists and the generalisation of these results.
**Keywords:** Spinal pain; psychosocial factors; physiotherapists; mixed methods; eHealth

### Negotiating (dis)ability: Challenges in patient–practitioner interaction in the context of chronic pain rehabilitation

**BB Stinesen**[1,2]; P Sneijder[2]; RJEM Smeets[1,3]
[1]*Research School CAPHRI, Faculty of Health, Medicine and Life Sciences, Maastricht University, Maastricht, The Netherlands;* [2]*Research group Communication in digital transition, HU University of Applied Sciences, Utrecht, The Netherlands.* [3]*CIR Revalidatie, Eindhoven, The Netherlands*

**Introduction:** Chronic pain rehabilitation aims at increasing patients' functioning. However, conversations between patients and practitioners about pain-related disabilities that patients experience can be challenging. This study explores patients' and practitioners' talk about pain-related disability during admission interviews.
**Methods:** Nine admission interviews were audio recorded. Participants were nine patients with chronic musculoskeletal pain and six practitioners. Recordings were transcribed and analysed taking a discursive psychology perspective. Discursive psychology focuses on how participants in interaction construct social realities through language and examines the social functions of such constructions[1]. We examined patients' and practitioners' constructions of patient's (in)ability to engage in daily life activities.
**Results:** Patients construct themselves as *willing but physically unable* to engage in certain activities. Such constructions of mind/body distinctions function as an interactional resource to build up the authenticity of the patient's pain and disabilities. Practitioners, however, challenge patient's body-oriented accounts, for example by constructing patient's inability as insufficiently accounted for. Their constructions reveal that they orient to the potential delicacy of their communication practices.
**Discussion:** Various studies have addressed that the lack of a clear biomedical explanation for chronic pain may threaten patients' credibility[2]. This study is the first to provide insight into how this dilemma is dealt with by patients and practitioners as they interact.
**Process evaluation:** Detailed interaction analyses such as conducted for this study are time consuming. Therefore, the analysis was limited to admission interviews. It

would be worthwhile for future research to look into patients' and practitioners' constructions of disability in other interactional contexts.

**References:** 1. Wiggins S, Potter J. Disursive psychology. In: Willig C, Stainton-Rogers W, eds. *The SAGE Handbook of Qualitative Research in Psychology*. 2nd ed. Sage; 2017:93–109.
2. Snelgrove S, Liossi C. An interpretative phenomenological analysis of living with chronic low back pain. *Br J Health Psychol*. 2009;14(4):735–749. https://doi.org/10.1348/135910709X402612

**Keywords:** Chronic pain; disability; patient-practitioner interaction; discursive psychology

## Interdisciplinary care networks in rehabilitation care for patients with chronic musculoskeletal pain: A systematic review

**C Lamper**[1]; L Beckers[1]; M Kroese[2]; J Verbunt[1,3]; I Huijnen[1,3]
[1]*Department of Rehabilitation Medicine, Functioning, Participation & Rehabilitation, Faculty of Health, Medicine and Life Sciences, Care and Public Health Research Institute (CAPHRI), Maastricht University, 40 6200MD Maastricht, The Netherlands;* [2]*Department of Health Services Research, Faculty of Health, Medicine and Life Sciences, Care and Public Health Research Institute (CAPHRI), Maastricht University, 40 6200MD Maastricht, The Netherlands;* [3]*Centre of Expertise in Rehabilitation and Audiology, Adelante, 111 6432CC Hoensbroek, The Netherlands*

**Introduction:** This systematic review aims to identify what rehabilitation care networks have been described for patients with chronic musculoskeletal pain (CMP), and their impact on the Quadruple Aim outcomes (health; health care costs; quality of care experienced by patients; work satisfaction for health care professionals)[1].
**Methods:** Studies with original descriptions of interventions in Dutch, English, or German published between 1/1/1994 and 11/4/2019 were identified in PubMed, CINAHL, Web of Science, and PsycInfo. They were included if the main population comprised patients with CMP, intervention was implemented in primary care, or a combination of primary care and other health care settings, with a rehabilitation aim and an interdisciplinary care network. After data extraction, it became evident that interventions, outcome measures, and study designs were too heterogeneous to justify meta-analysis.
**Results:** Of the 34 included interventions (49 articles), 21 consisted of a collaboration within primary care. Results on impact were presented in 19 randomized, 12 non-randomized, and 7 qualitative studies. The collaborations ranged from performing an assessment to giving a complete interdisciplinary treatment in primary care.
**Discussion:** There is a wide variety of content, collaboration, and evaluation methods of interventions. It seems that patient-centered interdisciplinary interventions are more effective than usual care. Further initiatives should be performed for interdisciplinary interventions within and across health care settings and evaluated with mixed methods on all Quadruple Aim outcomes.
**Process evaluation:** Interventions were often not described in full detail and/or the health care settings left unclear, potentially resulting in erroneous exclusions or classification of studies.

**Reference:** 1. Bodenheimer, T.; Sinsky, C. From triple to quadruple aim: Care of the patient requires care of the provider. Ann. Fam. Med. 2014, 12, 573–576.

**Keywords:** Interdisciplinary care; rehabilitation care; primary care, care networks; Quadruple Aim

## Change in physiotherapy student's attitudes & beliefs regarding the management of chronic low back pain and osteoarthritis: A 7-year follow-up study

**W Munneke**[1,2]; C Demoulin[3]; N Roussel[4]; M Leysen[1,2,4,5]; P Van Wilgen[1,2]; L Pitance[6,7]; R Reezigt[8]; L Voogt[1,2,9]; W Dankaertse[10]; L Danneels[5]; A Köke[11]; M De Kooning[1]; J Nijs[1,2,12]
[1]*Department of Physiotherapy, Human Physiology and Anatomy, Faculty of Physical Education and Physiotherapy, Vrije Universiteit Brussel, 1090 Brussels, Belgium;* [2]*Pain in Motion International Research Group (PiM),* www.paininmotion.be*;* [3]*Department of Sport and Rehabilitation Sciences, Université de Liège, Liege, Belgium;* [4]*Department of Physiotherapy and Rehabilitation Sciences (REVAKI), Antwerp, Belgium;* [5]*Faculty of Kinesiology and Rehabilitation Sciences, Katholieke Universiteit Leuven, Leuven, Belgium;* [6]*Institute of Neuroscience, Université Catholique de Louvain, Brussels, Belgium;* [7]*Stomatology and Maxillofacial Surgery Department, Brussels, Belgium;* [8]*Department of Health Care Studies, School for Physiotherapy, Hanze University of Applied Sciences Groningen, P.O. Box 70030, 9714, CA, the Netherlands;* [9]*Department of Physical Therapy, University of Applied Sciences Rotterdam, Rotterdam, The Netherlands;* [10]*Department of Rehabilitation Sciences and Physical Therapy, Universiteit Gent, Ghent, Belgium;* [11]*Adelante Centre of Expertise in Rehabilitation and Audiology, Hoensbroek, The Netherlands;* [12]*Institute of Neuroscience and Physiology, Department of Health and Rehabilitation, Unit of Physiotherapy, University of Gothenburg, Sweden*

**Introduction:** In 2013, a study showed low guideline adherence regarding chronic low back pain (CLBP) in physiotherapy students concerning activity and work recommendations (47% and 16%)[1]. The aim of this study is to investigate if the 2020' physiotherapy students'

attitudes and beliefs regarding CLBP and osteoarthritis (OA) and the guideline adherence have changed since 2013, by using the same protocol.

**Methods:** Physiotherapy students in their 2nd and 4th year of education from 6 Belgian and 2 Dutch institutions participated. The attitudes and beliefs regarding CLBP and OA were measured using the Pain attitudes and beliefs scale (BAPS), the Health Care Providers' Pain and Impairment Relationship Scale (HC-PAIRS) and a questionnaire regarding therapeutic exercise and knee OA. A clinical case vignette was used to measure the guideline adherence regarding CLBP.

**Results:** In total, 2738 students participated, 1624 in 2013 and 1114 in 2020. Compared to 2013, students in 2020 scored lower on a biomedical orientation ($p < 0.001$) and higher on psychosocial orientations ($p < 0.001$) regarding CLBP and OA. Medium effect size (cohens'd = 0.548) was found on the psychosocial orientation of the PABS, other differences only had small effect sizes. In 2020, 54% provided clinical guidelines' consistent recommendations for activity and 28% for work, which significantly improved compared to 2013.

**Discussion:** A positive shift occurred towards a more biopsychosocial approach between students of 2013 and 2020. However, the improved guideline adherence concerning activity and work recommendations remains low.

**Process evaluation:** Additional clinical case vignette to measure clinical recommendations regarding OA would have strengthen this study.

**Reference:** 1. Leysen M, Nijs J, Van Wilgen P, et al. Attitudes and beliefs on low back pain in physical therapy education: A cross-sectional study. Brazilian journal of physical therapy 2021; 25(3): 319–328.

**Keywords:** Physical therapy education; Biopsychosocial model; Attitude; Beliefs; Guideline adherence