SYSTEMATIC REVIEW

The Effect of Neuroscience Education on Pain, Disability, Anxiety, and Stress in Chronic Musculoskeletal Pain

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ABSTRACT. Louw A, Diener I, Butler DS, Puentedura EJ. The effect of neuroscience education on pain, disability, anxiety, and stress in chronic musculoskeletal pain. Arch Phys Med Rehabil 2011;92:2041-56.

Objective: To evaluate the evidence for the effectiveness of neuroscience education (NE) for pain, disability, anxiety, and stress in chronic musculoskeletal (MSK) pain.

Data Sources: Systematic searches were conducted on Biomed Central, BMJ.com, CINAHL, the Cochrane Library, NLM Central Gateway, OVID, ProQuest (Digital Dissertations), PsycInfo, PubMed/Medline, ScienceDirect, and Web of Science. Secondary searching (PEARLing) was undertaken, whereby reference lists of the selected articles were reviewed for additional references not identified in the primary search.

Study Selection: All experimental studies including randomized controlled trials (RCTs), nonrandomized clinical trials, and case series evaluating the effect of NE on pain, disability, anxiety, and stress for chronic MSK pain were considered for inclusion. Additional limitations: studies published in English, published within the last 10 years, and patients older than 18 years. No limitations were set on specific outcome measures of pain, disability, anxiety, and stress.

Data Extraction: Data were extracted using the participants, interventions, comparison, and outcomes (PICO) approach.

Data Synthesis: Methodological quality was assessed by 2 reviewers using the Critical Review Form–Quantitative Studies. This review includes 8 studies comprising 6 high-quality RCTs, 1 pseudo-RCT, and 1 comparative study involving 401 subjects. Most articles were of good quality, with no studies rated as poor or fair. Heterogeneity across the studies with respect to participants, interventions evaluated, and outcome measures used prevented meta-analyses. Narrative synthesis of results, based on effect size, established compelling evidence that NE may be effective in reducing pain ratings, increasing function, addressing catastrophization, and improving movement in chronic MSK pain.

Conclusions: For chronic MSK pain disorders, there is compelling evidence that an educational strategy addressing neurophysiology and neurobiology of pain can have a positive effect on pain, disability, catastrophization, and physical performance.

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PAIN IS A POWERFUL motivating force that guides treatment-seeking behaviors in patients.[1-3] Patient education has long been explored in the management of pain, anxiety, and stress associated with low back pain (LBP).[4-7] In the orthopedic domain, there are a number of studies on the effect of patient education on pain, with outcomes ranging from "excellent"[8] to "poor."[9,10] The study by Udermann et al[8] demonstrated that introduction of an individualized educational booklet on back biomechanics can result in decreased pain and frequency of LBP episodes in patients with chronic LBP (CLBP). In contrast to those findings, 2 systematic reviews[9,10] on the effect of individualized and/or group education for LBP and mechanical neck pain showed little efficacy for such education.

Most education programs for orthopedic patient populations have used anatomic and biomechanical models for addressing pain,[4,11-14] which not only have shown limited efficacy,[4,11,12,15,16] but may even have increased patient fears, anxiety, and stress, thus negatively impacting their outcomes.[11,17-19] Several educational strategies are advocated for patients with LBP, including biomechanical/back school type of education, evidence-based guideline education (ie, *The Back Book*[20]), cognitive behavioral therapy, and recently, neuroscience education (NE).

NE can be best described as an educational session or sessions describing the neurobiology and neurophysiology of pain, and pain processing by the nervous system. Instead of a

List of Abbreviations

BPPT	brachial plexus provocation test
CFS	chronic fatigue syndrome
CLBP	chronic low back pain
CONSORT	Consolidated Standards of Reporting Trials
LBP	low back pain
MSK	musculoskeletal
NE	neuroscience education
NPRS	numeric pain rating scale
PCI	Pain Coping Inventory
PCS	Pain Catastrophization Scale
PICO	participants, interventions, comparison, outcomes
PPT	pressure pain threshold
PSEQ	Pain Self-Efficacy Questionnaire
RCT	randomized controlled trial
RMDQ	Roland Morris Disability Questionnaire
SLR	straight leg raise
SOPA(R)	Survey of Pain Attitudes (Revised)
TSK	Tampa Scale of Kinesiophobia
VAS	visual analog scale
WAD	whiplash-associated disorders

Table 1: Inclusion Criteria Used in the Systematic Review

Criterion	Justification
English Language	Major journals in this area are published in this language.
1999–2010	Ten years captures the most recently used treatments in clinical practice. First such study to be published was by Moseley[27] in 2002.
Humans older than 18 years	This increased the homogeneity of participants between studies, and educational needs are different for infants, adolescents, and teenagers.[82,83]
MSK pain	This increased the homogeneity of conditions being managed with educational strategies incorporating NE.
Quantitative study design including RCTs, nonrandomized clinical trials, or case series	Study designs other than RCTs were included in this review because they provide complementary and relevant clinical detail to the current state of our knowledge and its limitations.[84,85] Single case studies were not included because of the low level of evidence they provide.
NE	Patient education is widely used to address pain, anxiety, and stress, but this review focused on educational strategies incorporating NE.
Outcomes: pain, disability, anxiety, and fear	The primary outcome measures chosen for this review were pain, disability, anxiety, and fear. No limitations were set on the measurement tool used to examine the effect of NE on pain, disability, anxiety, and fear.

traditional model of connecting tissue injury or nociception and pain, NE aims to describe how the nervous system, through peripheral nerve sensitization, central sensitization, synaptic activity, and brain processing, interprets information from the tissues and that neural activation, as either upregulation or downregulation, has the ability to modulate the pain experience. Patients are thus educated that the nervous system's processing of their injury, in conjunction with various psychosocial aspects, determines their pain experience and that pain is not always a true representation of the status of the tissues. By reconceptualizing their pain as the nervous system's interpretation of the threat of the injury, rather than an accurate measure of the degree of injury in their tissues, patients may be more inclined to move, exercise, and push into some discomfort. Depending on the timing of its administration, NE may be viewed as a preventive measure in acute pain situations and as a treatment/rehabilitation intervention in chronic pain situations.

Research into educational strategies for patients with CLBP shows an increased use of NE.[14,21-23] NE is a cognitive-based education intervention that aims to reduce pain and disability by helping patients gain an increased understanding of the biological processes underpinning their pain state.[24] NE differs from traditional education strategies such as back school and biomechanical models, by not focusing on anatomic or biomechanical models, but rather on neurophysiology, neurobiology, and the processing and representation of pain.[22,24,25] Patients are interested in knowing more about pain,[3] and it has been demonstrated that patients are capable of understanding the neurophysiology of pain, while professionals have underestimated patients' ability to understand the "complex" issues related to pain.[26]

Studies that used NE have been shown to decrease fear and positively change a patient's perception of their pain[21] and have an immediate effect on improvements in patients' attitudes about pain.[13] This education intervention also resulted in improvements in pain, cognition, and physical performance[14]; increased pain thresholds during physical tasks[23]; improved outcomes of therapeutic exercises[27]; and a significant reduction in widespread brain activity characteristic of a pain experience.[22] In 1 NE study,[27] results extended beyond the short-term and were maintained at 1-year follow-up.

Despite the proposed positive effects reported as a result of NE and the apparent increased use of NE, very little is known about the efficacy, content, and delivery methods of NE. Therefore, the objective of this systematic review was to source and critically evaluate NE. The results of this review could be used to make evidence-based recommendations regarding the utilization of NE for pain, disability, anxiety, and stress in chronic musculoskeletal (MSK) pain.

METHODS

Search Strategy

An electronic search was performed between February 2010 and July 2010, covering the last decade (1999–2010) from the following databases: Biomed Central, BMJ.com, CINAHL, the Cochrane Library, NLM Central Gateway, OVID, ProQuest (Digital Dissertations), PsycInfo, PubMed/Medline, ScienceDirect, and Web of Science. Each database has its own indexing terms and functions, and therefore different search strategies were developed for each database by the authors. The main search items were *neuroscience, neurobiology, neurophysiology, pain, pain education, pain science, education, stress,* and *anxiety.* In PubMed, medical subject headings (MeSH) terms were used where possible, with Boolean operators. The search strategies for remaining databases included synonyms of the main search items. Secondary searching (PEARLing) was undertaken, whereby reference lists of the selected articles were reviewed for additional references not identified in the primary search. The titles and abstracts of all the identified literature were screened by 1 primary reviewer using the inclusion criteria below. The full text of all potentially relevant articles was retrieved and screened by 2 reviewers using the same criteria, to determine the eligibility of the article for inclusion in the review.

Inclusion Criteria

All titles and abstracts were read to identify relevant articles. Articles were included in this systematic review if they met the inclusion criteria listed in table 1. Although outcome measures aimed at addressing MSK pain, disability, anxiety, and stress were included, no parameters were set on the exact measurement tools used to assess the effect of NE on pain, disability, anxiety, and stress, since a wide variety of outcome measures were used in the studies. When there was uncertainty regarding the eligibility of the article from the abstract, the full text

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