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## **PNE – Lots of Talk, Superficial Results**

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# PNE – lots of talk, superficial results

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Honors Project

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## **Abstract**

**Objective:** A narrative review (NR) of meta-analyses (MA) and systematic reviews (SR) that assess the effectiveness or efficacy of pain neuroscience education (PNE) on various outcome measures in individuals with chronic musculoskeletal (MSK) pain. **Methods:** This was a mixed methodology review involving systematic searches across 4 databases (PubMed, ScienceDirect, CENTRAL (Cochrane), and Google Scholar). Inclusion criteria stipulated MAs and SRs that assessed the effectiveness or efficacy of PNE on CP population. Quantitative eligibility criteria included randomized controlled trials (RCTs), adults (18+ years of age), English or Spanish speaking individuals, and reporting of chronic pain (persistent or recurrent pain lasting  $\geq 3$  months). Qualitative eligibility criteria included individuals reporting chronic pain and experienced a PNE intervention. Two reviewers screened 9,760 articles via COVIDENCE. 11 reviews met inclusion criteria and underwent full text review, specifically examining methodology and outcomes. **Conclusions:** This narrative review, including 11 reviews, emphasizes the need for further research pertaining to the efficacy and effectiveness of PNE utilization in healthcare. Each of these reviews are laced with varying levels of heterogeneity or low-quality evidence. Additionally, it remains unknown which information is pertinent to be included with PNE to achieve desired outcomes and belief reconceptualization. This is the result of a lack of thorough research and evaluation of PNE due to its recent establishment within healthcare. An updated systematic review should be performed that includes recently published literature with broad inclusion criteria to obtain a full-picture perspective of PNE.

**Key Words:** Chronic pain; pain, neuroscience; neurophysiology; education; PNE; biopsychosocial; explain pain; pain neuroscience education; therapeutic neuroscience education; meta-Analysis

**Discipline:** Health Sciences

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## Introduction

Pain is a human universality that is characterized by an unpleasant sensory and emotional experience associated with, or resembling association with, actual or potential tissue damage (Raja 2020). Additionally, musculoskeletal (MSK) related-pain is currently a leading cause of disability around the world that involves a complex interaction of biological, psychological, and sociological factors; often co-occurring with comorbid health issues (Caneiro 2021, El-Tallawy 2021, Sato 2021, Stilwell 2019). Within healthcare, a patient's experience with pain and their interactions in physical and social contexts can positively or negatively affect disability and actions afforded (Cormack 2022). The multifactorial phenomenon of pain is typically dichotomized as acute vs chronic based on temporality (Coninx 2021). Although the relationship between pain reporting and tissue status is variable, most assume acute pain is related to noxious stimuli (e.g., thermal, mechanical, or chemical) resulting in nociceptive activation potentially giving rise to pain experiences to protect the organism's existential integrity (Wall 1979, Cohen 2018, Apkarian 2019). Alternatively, chronic pain (CP) is considered persistent or recurring pain lasting 3 months or longer (Treede 2015 and Coninx 2021). In general, chronic pain is one of the most common reasons adults seek medical care (Perrot 2019). Approximately 1.5 billion people worldwide experience CP (Polaski 2019). Based on 2019 data, in the US, approximately 20.5% of adults (50.2 million) are dealing with CP on most days or every day, leading to limitations in social, daily, and work-related activities (Yong 2022). The umbrella of chronic pain encompasses a variety of titles and conditions; however, we will specifically focus on chronic pain not otherwise attributable to cancer or post-surgical/post traumatic situations. See table 1 for included chronic pain definitions.

Guideline concordant care stipulates a patient-centered approach with a focus on education, shared decision-making, self-management support, and patient-centered communication (Hutting 2022, Lin 2019). Pain neuroscience education (PNE) has emerged as a way with which to aid patients seeking healthcare for their chronic pain experience. PNE is synonymous to other terminology such as explain pain, therapeutic neuroscience education, pain neurophysiology education, neurophysiology education, patient education, pain education, pain biology education, and pain physiology education. Broadly, pain education consists of teaching patients about variables related to their pain experience, aiding reconceptualization of pain when appropriate. Specific to PNE, education focuses on neurobiology and neurophysiology of pain (Louw 2016). The use of PNE in healthcare has increased in recent years, giving rise to various programs (see table 2 for PNE interventions).

A narrative review aims to approach a specific research question and provide a comprehensive summary of available studies after a thorough and methodical literature review (Baethge 2019). Along with the recent popularity of PNE in healthcare there has also been an increasing number of studies that evaluate PNE. Our narrative review (NR) aims to collectively assess available literature and draw conclusions regarding the utilization of PNE in comparison to alternative interventions (e.g. exercise, manual therapy) or in combination to affect outcomes of pain and disability.

## **Methods**

This NR was conducted with The Scale for Assessment of Narrative Review Articles (SANRA) guidelines (Baethge 2019). 1st and 2nd authors collaborated with a research librarian (3rd author) to establish quantitative and qualitative research databases, keyword selections, and article eligibility criteria. The following databases were searched: PubMed,

ScienceDirect, CENTRAL (Cochrane), and Google Scholar. Searches were conducted up to September 2nd, 2022. We utilized separate keyword search terms for quantitative and qualitative searches (see table 3 for keyword search terms). 1st and 2nd authors utilized Covidence (Covidence systematic review software, Veritas Health Innovation, Melbourne, Australia. Available at [www.covidence.org](http://www.covidence.org)) to screen articles based on eligibility criteria. Quantitative eligibility criteria included randomized controlled trials (RCTs), adults (18+ years of age), English or Spanish speaking individuals, reporting of chronic pain (persistent or recurrent pain lasting  $\geq 3$  months), and pain outcomes (e.g., numerical pain rating scale). Qualitative eligibility criteria included individuals reporting chronic pain and experienced a PNE intervention. In recent years, 11 similar systematic reviews (SR) and meta-analyses (MA) included 56 quantitative (see Figure 1) and 4 qualitative (see Figure 2) RCTs for review.

## **Discussion**

In 2016, a SR was conducted to update and explore the efficacy of PNE as a treatment approach for people suffering from various conditions of chronic MSK related pain (e.g., low back pain, neck pain, and fibromyalgia) (Louw 2016b). Throughout this review, efficacy was assessed based on quantitative outcomes. However, only five included studies examined PNE in isolation and no meaningful effect was found with primary outcome of pain in comparison to other interventions (Louw 2016b). In 2019, a mixed-methods SR and MA was conducted to evaluate the effectiveness of PNE as an intervention for the management of adults with chronic MSK related pain while also assessing participants' perceptions of PNE (Watson 2019). Qualitative findings indicated various themes amongst study participants, such as degrees of reconceptualization, personal relevance, importance of beliefs (before and after PNE), and perceived benefits of PNE (see table 5 for qualitative themes) (Watson 2019). Additionally, there

were examples of positive and negative experiences with PNE, such as the adverse event of distress associated with PNE (Watson 2019). It should be noted that the review by Watson and colleagues was the first recorded report of an adverse event in the literature (see Figure 2). Quantitative findings indicated that PNE is more effective for disability in the medium term ( $\geq 3$ -6 months) instead of pain. Furthermore, PNE appeared effective on kinesiophobia (i.e., fear of movement) as demonstrated by a 13% reduction in the short term on the Tampa Scale of Kinesiophobia (TSK) (Watson 2019). This percentage is considered to be statistically significant and clinically relevant. Statistical significance is essential to ensure that results are not due to chance, whereas clinical relevance offers an appropriate measure of effect size and magnitude of difference expected to be seen in clinical practice (Mellis 2018). For example, if a sample size is very large, a tiny clinical irrelevant difference could be extremely statistically different (Mellis 2018). Additionally, clinical significance refers to the magnitude of the actual treatment effect, which determines whether the results will impact current medical practices (Ranganathan 2015). The minimal clinically important difference (MCID) is the lowest value a treatment effect can hold in order to be considered influential on medical practice. In Watson's 2019 study, most of the results were statistically significant, but did not reach the threshold of MCID.

In 2021, a SR and MA was conducted to investigate the effectiveness and safety of PNE on pain intensity, disability and psychological distress at post-intervention and long-term follow-up in MSK related pain (Bulow 2021). The study found low quality evidence in support of PNE having a small to moderate effect on pain intensity, disability, and psychological distress at post intervention, with larger long-term effects on pain intensity (Bulow 2021).

Additional prior reviews have examined PNE in specific contexts such as multimodal (Saracoglu 2022) and with exercise (Siddall 2022, Jensen 2022). Collectively, these reviews are

focused on select populations of individuals and do not provide a full-picture perspective of PNE utilization across healthcare. Saracoglu and colleagues conducted a SR and MA that evaluated PNE efficacy in a population of patients with fibromyalgia - a chronic widespread pain syndrome, characterized by muscle and joint stiffness, fatigue, sleep problems, cognitive impairment, and depression/anxiety (Saracoglu 2022). They found that PNE added to a multimodal approach could be an effective approach for addressing various outcomes (see Table 4). However, they cited limitations such as a small pool of included studies and no consensus on optimal duration or dosage of PNE. Siddall and colleagues conducted a SR and MA that assessed the short-term impact of combining PNE with exercise for CMP. They found that combining PNE and exercise resulted in greater improvements in pain, disability, kinesiophobia, and pain catastrophizing compared to exercise alone (Siddall 2022).

Jensen and colleagues conducted a MA that assessed the effects of PNE combined with therapeutic exercise (TE) for chronic non-specific LBP (see Table 4). They found that PNE combined with TE was shown to be more effective in decreasing pain intensity and functional disability compared to standard physical therapy for individuals with chronic non-specific LBP. The Jensen review concluded their database search for included studies in November 2021 (Jensen 2022). This marks the latest and most recent database search for RCTs examining PNE effectiveness and efficacy. Through our database search that concluded in September 2022, we have found an additional 31 RCTs that meet our broad inclusion criteria, demonstrating the need for an updated review. While these reviews were specific, our NR is more inclusive and broader to accomplish a full-picture perspective.



In summary, two of the most recent and similar reviews primarily examined effectiveness over efficacy. While effectiveness evaluates a treatment under ‘real-world’ conditions, efficacy evaluates a treatment under controlled conditions, increasing practitioner confidence the observed outcomes are directly attributable to the intervention (Singal 2014). Determining efficacy can be difficult because symptoms can improve for a variety of reasons that are unrelated to the treatment itself (Hartman, 2009). For example, patients may be biased to confirm desires and expectations of others due to social norms requiring it. If a patient sees their practitioner as well-trained and compassionate, they may believe that a treatment was helpful because their perception of the “patient” role demanded it (Hartman 2009). It should also be noted that the distinction between efficacy and effectiveness is more of a continuum opposed to a dichotomy, as pure efficacy or pure effectiveness trials are likely impossible to perform (Singal 2014). In the review examining efficacy of PNE, there was no meaningful effect in comparison to other available interventions such as exercise or manual therapy.

Through examination of quantitative reviews in recent years (2016-2022), it is evident that there is a lack of cross-over with included studies (see Figure 1). Specifically, a lack of cross-over with studies that evaluate the same population (i.e. CMP, non-specific LBP, fibromyalgia, osteoarthritis). For example, only 6.2% (9 of the 56) included studies were utilized within three or more of the quantitative reviews examining CMP. It should additionally be noted that the CMP category is the most broad of potential study populations. This lack of cross-over limits available literature because it does not provide a ‘full-picture’ perspective of PNE utilization. Furthermore, each of the reviews reported varying levels heterogeneity with outcomes in included studies, due to each utilizing different methodological approaches. While this heterogeneity is beneficial for examining PNE usage in different populations, strength in

evidence comes with more homogenous literature. There is also a lack of qualitative reviews and literature surrounding PNE. Within the literature included in this review, Watson 2019 is the only review that included a qualitative analysis (n=4). This restricts a full understanding of PNE because it does not account for the patient's voice and lived experience.

Future research should continue focusing on PNE utilization amongst different patient populations and chronic pain in general. Additionally, it remains unknown which information is pertinent to be included with PNE to achieve desired outcomes and belief reconceptualization. It is possible particular information is more helpful with other information being harmful. Furthermore, this research should be directed towards PNE dosage and duration. There should also be more studies conducted to evaluate qualitative data pertaining to PNE in order to better comprehend patient experience, while including their perspectives in the creation of future educational interventions.

## **Conclusion**

This NR, including 11 reviews, emphasizes the need for further research pertaining to the efficacy and effectiveness of PNE utilization in healthcare. While there are numerous studies that examine these aspects, they are laced with varying levels of heterogeneity or low quality of evidence. This is the result of a lack of thorough research and evaluation of PNE due to its recent establishment within healthcare. An updated systematic review should be performed that includes recently published literature with broad inclusion criteria to obtain a full-picture perspective of PNE.

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Figure 1. Included Quantitative Studies Cross-Over

Key	
1	4
2	5
3	6

Included Studies	Study Populations				
	Chronic Musculoskeletal Pain	Non-Specific Low Back Pain	Fibromyalgia	Osteoarthritis	
	Low 2016 (n=13) Waisson 2019 (n=17) Waisson 2020 (n=5) Bulow 2021 (n=18) Siddall 2022 (n=5)	Wood 2019 (n=7) Jensen 2022 (n=4) Kwan-Yee Ho 2022 (n=19)*	Saracoglu 2021 (n=4) Suso - Marti 2022 (n=8)	Ordoñez-Mora 2022 (n=4)	
Amer-Cuenca 2020			X		
Barrenengoa-Cuadra 2021			X	X	
Beltran-Alacreu 2015	X				
Bendix AE 1998			X		
Bendix AF 1998			X		
Bodes Pardo 2018	X				
Ceballos-Laita 2020		X	X	X	
Deguchi 2019					X
Dufour 2010			X		
Galan-Martin 2020		X	X		
Gallagher 2013	X X X X				
Gardner 2019			X		
Godfrey 2020			X		
Kohns 2020				X	
Luch 2018	X	X			X
Löchting 2016		X			
Louw 2014	X X X X		X		
Louw 2016	X				
Louw 2017		X			
Louw 2019a					X
Louw 2019b				X	X
Luciano 2013			X		
Malfliet 2018a	X X X	X			
Malfliet 2018b		X			
Matias 2019		X			
Meeus 2010	X X	X			
Mehling 2005			X		
Monticone 2013			X		
Monticone 2016		X			
Moseley 2002	X		X		
Moseley 2003	X				
Moseley 2004	X X	X			
Moseley 2009		X			
Núñez-Cortés 2019		X			
Paolucci 2017			X		
Pardo 2018		X			
Pires 2015	X X X X X X				
Poole 2007			X		
Rabiei 2021		X	X		
Ryan 2010	X	X			
Saracoglu 2019			X		
Saracoglu 2021			X	X	
Serrat 2020			X		
Serrat 2021			X		
Shariat 2019			X		
Téllez-García 2014	X X	X			
Traeger 2019		X			
Turner 1990			X		
Únal 2020			X		
van Ittersum 2013	X X X X			X	
van Oosterwijk 2013	X X	X		X	
Von Bertouch 2011	X				
Vibe Fersum 2013	X				
Vong 2011			X		
Wälti 2015		X	X		
Werner 2016		X			
Yao 2020			X		

\*Kwan-Yee Ho conducted a broad review on various psychological interventions. We only utilized studies that were specific to PNE as an intervention.



Figure 2. Included Qualitative Studies Cross-Over

Key		Study Populations				
		Chronic Musculoskeletal Pain	Non-Specific Low Back Pain	Fibro-myalgia	Osteo-arthritis	
1	4	Louw 2016 (n=13)	Wood 2019 (n=7)	Kwan-Yee Ho 2022 (n=19)*	Saracoglu 2021 (n=4)	Ordoñez-Mora 2022 (n=4)
2	5	Watson 2019 (n=17)	Jensen 2022 (n=4)	Saracoglu 2021 (n=4)	Suso - Marti 2022 (n=8)	
3	6	Watson 2020 (n=5)				
		Bulow 2021 (n=18)				
		Stiddall 2022 (n=5)				
Included Studies		King 2016	X			
		King 2018	X			
		Robinson 2016	X			
		Wijma 2017	X			

Table 1. Chronic Pain Definitions*	
Chronic Primary Pain	pain in 1 or more body regions persistent or recurring longer than 3 months associated with individual distress and disability not otherwise explained (e.g., back pain, chronic widespread pain, fibromyalgia, and irritable bowel syndrome)
Chronic Neuropathic Pain	persistent or recurrent pain attributable to a lesion or disease of the nervous system (e.g., post-hepatic, diabetic neuropathy, or post-cerebral vascular accident)
Chronic Headache and Orofacial Pain	headaches or orofacial pains occurring on half the days over the prior 3 months (e.g., temporomandibular joint syndrome and primary migraines)
Chronic Visceral Pain	persistent or recurrent pain specific to internal organs (e.g., head, neck, thoracic, abdomen, and pelvic)
Chronic Musculoskeletal Pain	persistent or recurrent pain related to bones, joints, muscles, or related soft tissues (e.g., rheumatoid arthritis, osteoarthritis, non-specific)
*Note cross-classification may occur based on diagnostic label.	
Adapted from Treede RD, Rief W, Barke A, Aziz Q, Bennett MI, Benoliel R, Cohen M, Evers S, Finnerup NB, First MB, Giamberardino MA, Kaasa S, Kosek E, Lavand'homme P, Nicholas M, Perrot S, Scholz J, Schug S, Smith BH, Svensson P, Vlaeyen JWS, Wang SJ. A classification of chronic pain for ICD-11. Pain. 2015 Jun;156(6):1003-1007. doi: 10.1097/j.pain.000000000000160. PMID: 25844555; PMCID: PMC4450869.	

Table 2. PNE Interventions	
Dr. Adriaan Louw – ‘Why You Hurt’ Pain Neuroscience Education System	PNE system that utilizes an interactive workbook and flashcard system with easily internalized metaphors, examples, and images to teach patients about pain and how it functions (Rufa, 2019, <a href="https://www.optp.com/Why-You-Hurt-Pain-Neuroscience-Education-System">https://www.optp.com/Why-You-Hurt-Pain-Neuroscience-Education-System</a> ).
Dr. David Butler & Dr. G. Lorimer Moseley – ‘Explain Pain’	Therapeutic intervention with a range of educational strategies (quirky imagery and thorough descriptions) aimed to help patients reconceptualize pain (Stilwell, 2019, Cite: <a href="https://www.optp.com/Explain-Pain">https://www.optp.com/Explain-Pain</a> ).

Table 3. Database Keyword Search Terms	
Quantitative	(“chronic pain” OR pain OR CP OR “persistent pain” OR “chronic primary pain” OR “chronic primary musculoskeletal pain” OR “chronic widespread pain” OR “musculoskeletal pain”) AND (“pain neuroscience education” OR PNE OR “explain pain” OR “therapeutic neuroscience education” OR “pain neurophysiology education” OR “neurophysiology education” OR “patient education” OR “pain education” OR “pain biology education” OR “pain physiology education”)
Qualitative	((“chronic pain” OR pain OR CP OR “persistent pain” OR “chronic primary pain” OR “chronic primary musculoskeletal pain” OR “chronic widespread pain” OR “musculoskeletal pain”) AND (“pain neuroscience education” OR PNE OR “explain pain” OR “therapeutic neuroscience education” OR “pain neurophysiology education” OR “neurophysiology education” OR “patient education” OR “pain education” OR “pain biology education” OR “pain physiology education”)) AND ((qualitative research[MeSH Terms]) OR (evaluation, qualitative[MeSH Terms]) OR (evaluations, qualitative[MeSH Terms]) OR (qualitative evaluation[MeSH Terms]) OR (qualitative evaluations[MeSH Terms]))

Table 4. Quantitative Studies.

Author (s)	Title	Study Design	Population	Interventions	Outcomes	Findings
Louw 2016 (n=13)	The efficacy of pain neuroscience education on musculoskeletal pain: A systematic review of the literature	SR with RCTs	Individuals $\geq$ 18 years old with musculoskeletal, nonmalignant pain (MSKP)	PNE, PNE + other interventions	Pain, function, psychosocial factors, movement, healthcare utilization	High heterogeneity was detected for included studies. PNE results in significant reduction in pain ratings when paired with exercise. No effect as education-only intervention. Significant reduction of healthcare utilization 1 year after PNE.
Watson 2019 (n=13)	Pain neuroscience education for adults with chronic musculoskeletal pain: a mixed-methods systematic review and meta-analysis	SR/MA with RCTs	Individuals $\geq$ 18 years old with chronic musculoskeletal pain (CMP)	PNE, PNE + other interventions, head-to-head PNE studies	Primary – pain, disability. Secondary – any validated measure which investigates individual physical and/or psychosocial wellbeing	PNE showed little clinical benefit with pain reduction and disability. Clinically meaningful improvement in the medium- term for pain catastrophizing. Greater effect on kinesiophobia than any other short-term measure.
Watson 2020 (n=5)	Inter-individual differences in the responses to pain neuroscience education in adults with chronic musculoskeletal pain: A systematic review and meta-analysis of randomized controlled trials	SR/MA with RCTs	Individuals $\geq$ 18 years old with CMP	PNE, PNE + other interventions, head-to-head PNE studies	Disability	Inter-individual difference in disability change in response to PNE not considered clinically significant. Insufficient evidence for the existence of inter-individual differences in people’s response to PNE.

Bulow 2021 (n=18)	Effectiveness of pain neurophysiology education on musculoskeletal pain: A systematic review and meta-analysis	SR/MA with RCTs	Mean age $\geq 18$ years old with MSKP	Any PNE intervention compared to a control	Pain intensity, disability, psychological distress	Low overall quality of evidence. Small to moderate effect on pain intensity, disability, and psychological distress at post-intervention. Significant effect on pain intensity at long-term follow-up.
Siddall 2022 (n=5)	Short-term impact of combining pain neuroscience education with exercise for chronic musculoskeletal pain: a systematic review and meta-analysis	SR/MA with RCTs	Individuals $\geq 18$ years old with CMP	PNE + exercise therapy vs. exercise therapy alone	Pain intensity, disability, and kinesiophobia (all studies), pain catastrophizing (4/5 studies).	High heterogeneity was detected for all outcomes. PNE combined with exercise in short-term significantly reduced pain intensity scores, produced a statistically significant and medium effect on disability, statistically significant and large effect on kinesiophobia, and reduced pain catastrophizing scores compared to exercise therapy alone.
Wood 2019 (n=7)	A systematic review and meta-analysis of pain neuroscience education for chronic low back pain: Short- and long-term outcomes of pain and disability	SR/MA with RCTs	Individuals $\geq 18$ years old with chronic non-specific low back pain (LBP)	PNE, therapeutic neuroscience education, or “explain pain” as experiment group	Pain and disability	Moderate quality evidence for PNE as an addition to usual therapy interventions to improve disability and pain scores in the short term. Uncertainty with PNE improving long-term pain and disability.

Jensen 2022 (n=4)	The effects of pain neuroscience education combined with therapeutic exercise for non-specific chronic low back pain: a meta-analysis	MA with RCTs	Individuals 18-65 years old, with chronic non-specific LBP	PNE + form of active treatment (such as therapeutic exercise (TE))	Pain and functional disability	Statistical significance in favor of PNE + TE over standard physical therapy for pain intensity and functional disability.
Kwan - Yee Ho (n=19*)	Psychological interventions for chronic, non-specific low back pain: systematic review with network meta-analysis	SR/network MA with RCTs	Individuals $\geq 18$ years with chronic non-specific LBP	Psychological interventions with any comparison interventions *	Primary outcomes of physical function and pain intensity of lower back with secondary outcomes of fear avoidance, health related quality of life, intervention compliance and safety	Psychological interventions (such as PNE) are most effective when paired with physiotherapy care (PC), opposed to PC alone.
Saracoglu 2021 (n=4)	Efficacy of adding pain neuroscience education to a multimodal treatment in fibromyalgia: A systematic review and meta-analysis	SR/MA with RCTs	Individuals $\geq 18$ years old with fibromyalgia (FM)	Multimodal interventions involving PNE	Primary - FM severity. Secondary - pain intensity, catastrophizing, depression, and anxiety.	Good quality of evidence. Moderate effect size indicated potential benefit of PNE on severity of FM, pain intensity, catastrophizing, depression, and anxiety.
Suso-Martí 2022 (n=8)	Effectiveness of pain neuroscience education in patients with fibromyalgia: a systematic review and meta-analysis	SR/MA with RCTs	Individuals $\geq 18$ years old with fibromyalgia (FM)	PNE with planned and structured sessions	Pain intensity, FM impact, anxiety, and pain catastrophizing.	Low quality of evidence. Statistically significant differences with a moderate clinical effect on pain intensity post-intervention. Statistically significant PNE intervention differences with a small clinical effect on FM impact follow-up.

Ordoñez-Mora 2022 (n=4)	Effectiveness of interventions based on pain neuroscience education on pain and psychosocial variables for osteoarthritis: A systematic review	SR with RCTs	Individuals $\geq$ 18 years old with osteoarthritis (OA)	Cognitive educational interventions (PNE, pain neurophysiology, pain therapeutic education, explanation of pain)	Primary - pain, catastrophizing, kinesiophobia, disability, and quality of life	Improvement in PNE managed groups, with a small effect in favor of variables such as kinesiophobia, with no changes observed in the other outcomes evaluated. Certainty analysis categorized two outcomes with very low certainty, one with low certainty and only one with high certainty.
*Kwan-Yee Ho conducted a broad review on various psychological interventions. We only utilized studies that were specific to PNE as an intervention (Pain education (PE), PE + physiotherapy care)						

Table 5. Qualitative Studies.						
Author (s)	Title	Study Design	Population	Interventions	Outcomes	Findings
Watson 2019 (n=4)	Pain neuroscience education for adults with chronic musculoskeletal pain: a mixed-methods systematic review and meta-analysis	SR/MA with RCTs	Individuals $\geq$ 18 years old with chronic musculoskeletal pain (CMP)	Individual semi-structured interviews with open questions	Experiences and perceptions of adults with CMP who had received PNE	Assessment allowing the patient to tell their own story should occur to ensure they feel heard. Achieving pain reconceptualization can enhance patients' ability to cope with their condition. In order for this to occur, PNE should be delivered by health care professionals skilled in PNE delivery.