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CADTH RAPID RESPONSE REPORT:
SUMMARY WITH CRITICAL APPRAISAL

Physiotherapy Interventions for the Management of Neck and/or Back Pain: A Review of Clinical and Cost-Effectiveness

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About CADTH: CADTH is an independent, not-for-profit organization responsible for providing Canada's health care decision-makers with objective evidence to help make informed decisions about the optimal use of drugs, medical devices, diagnostics, and procedures in our health care system.

Context and Policy Issues

Back pain can occur at any point along the spine, from the low back (lumbar region) to the neck (cervical region), and is characterized by symptoms such as burning or tingling sensations, and muscle weakness, tension, or stiffness.[1] Back and neck pain can be acute (i.e., short-term), or chronic (i.e., pain that persists for greater than three months),[2] and can negatively impact both physical and psychological health with profound effects on well-being and health-related quality of life.[3,4]

In Canada, back and neck pain are among the most common chronic conditions; it is estimated that 80% of adults will experience back pain at some point throughout the lifespan.[1] Globally, back and neck pain are among the leading causes of years lived with disability,[5] and can result in substantial financial burden in terms of both direct (e.g., physician services, medications) and indirect (e.g., time away from work) costs.[6]

Treatment for back and neck pain is aimed at relieving pain and restoring function, and may involve rest, pharmacological intervention (e.g., anti-inflammatory drugs, muscle relaxants, analgesics), or physical therapy.[1] While there is some evidence for the efficacy of opioids in the treatment of acute back pain, the long-term effectiveness and safety of opioids for treatment of chronic back pain remains unproven,[7] and the benefits may be outweighed by potential harms (e.g., risks of addiction and overdose).[8] In contrast, physical therapy, also known as physiotherapy, involves non-invasive interventions including education, manual therapy, exercise therapy, and electrophysical modalities. If safe, beneficial and cost-effective, physiotherapy may be an effective alternative to opioid treatment for the management of back and neck pain.

The purpose of this report is to examine the clinical and cost-effectiveness of physiotherapy interventions for the management of acute or chronic neck and/or back pain.

Research Question

1. What is the clinical effectiveness of physiotherapy interventions for the management of acute or chronic neck and/or back pain?
2. What is the cost-effectiveness of physiotherapy interventions for the management of acute or chronic neck and/or back pain?

Key Findings

Evidence regarding the clinical effectiveness of physiotherapy for the management of neck and/or back pain was generally favourable or neutral, and no adverse effects were reported; however, the body of evidence was limited and was largely low- to moderate- in quality. No studies were identified that compared the clinical effectiveness of physiotherapy and opioids. No evidence for the cost-effectiveness of physiotherapy interventions for the management of acute or chronic neck and/or back pain was identified.

Methods

Literature Search Methods

A limited literature search, with main concepts appearing in title, abstract or major subject heading, was conducted on key resources including PubMed, The Cochrane Library, University of York Centre for Reviews and Dissemination (CRD) databases, Canadian and major international health technology agencies, as well as a focused Internet search. Methodological filters were applied to limit retrieval to health technology assessments, systematic reviews, and meta-analyses. Retrieval was limited to the human population where possible, and to English-language documents published between January 1, 2012 and June 2, 2017.

Selection Criteria and Methods

One reviewer screened citations and selected studies. In the first level of screening, titles and abstracts were reviewed and potentially relevant articles were retrieved and assessed for inclusion. The final selection of full-text articles was based on the inclusion criteria presented in Table 1.

Regarding the intervention selection criterion specifically, it is acknowledged that many interventions used in physiotherapy may also be administered by a variety of other health care practitioners (e.g., chiropractors, physicians) and that the characteristics of therapy may differ across these clinical contexts. Therefore, to meet this eligibility criterion, studies were required to explicitly report that the intervention(s) were delivered by physiotherapists. At the title and abstract stage of screening, where physiotherapy was not explicitly stated and the interventions were described so generally that they could not be ascertained specifically as physiotherapy, the full-text article was not retrieved for further review; whereas, if physiotherapy was not explicitly stated, but a specific intervention could reasonably be ascertained as physical therapy, the full text article was retrieved for further review. At the full-text stage of screening, physiotherapy or physical therapy had to be mentioned specifically for inclusion.

Table 1: Selection Criteria

Population	Adults with neck and/or back pain
Intervention	Physiotherapy interventions including: – Manual therapy – Electrophysical agents (e.g., TENS, ultrasound, heat, ice) – Exercise and massage – Acupuncture and dry needling – Education (teaching patients about pain, self-management)
Comparator	Opioids, no treatment, placebo
Outcomes	Q1: Clinical benefits and harms (e.g., pain, physical function, social function [including return to school or work], emotional and psychological functioning [e.g., anxiety, depression, sleep], health-related quality of life, opioid use, opioid prescribing practices) Q2: Cost-effectiveness outcomes (e.g., incremental cost per QALY or health benefit gained)
Study Designs	Health technology assessments, systematic reviews, meta-analyses, and economic evaluations

TENS = transcutaneous electrical nerve stimulation; QALY = quality adjusted life year.

Exclusion Criteria

Articles were excluded if they did not meet the selection criteria outlined in Table 1, the interventions were explicitly described as being delivered by practitioners other than physiotherapists, or they were published prior to 2012.

Critical Appraisal of Individual Studies

The included systematic reviews were critically appraised using the AMSTAR tool.[9] Summary scores were not calculated; rather, the strengths and limitations of each included study were described.

Summary of Evidence

Quantity of Research Available

A total of 600 citations were identified in the literature search. Following screening of titles and abstracts, 567 citations were excluded and 33 potentially relevant reports from the electronic search were retrieved for full-text review. One potentially relevant publication was retrieved from the grey literature search. Of these potentially relevant articles, 20 publications were excluded for various reasons, while 14 publications met the inclusion criteria and were included in this report. Appendix 1 describes the PRISMA flowchart of the study selection.

Note that because all of the included systematic reviews had broader inclusion criteria than the present review (i.e., were wider in scope), only subsets of primary studies from the included systematic reviews that met the selection criteria for the present review are described.

Summary of Study Characteristics

Additional details regarding the characteristics of included publications are provided in Appendix 2.

Study Design

Fourteen systematic reviews (SRs) were identified regarding the clinical effectiveness of a variety of physiotherapy interventions for the management of acute or chronic neck and/or back pain.[1,4,7,10-20] Eleven of the SRs also included meta-analyses.[1,4,7,10,11,13-15,18-20]

Ten of the SRs included eligible primary studies,[1,4,7,10,12,13,15,17,19,20] and four of these pooled data from studies that met the selection criteria for the current review in meta-analyses.[4,10,19,20] Four of these SRs included meta-analyses that pooled data from primary studies ineligible for the present review,[1,7,13,15] and the remaining two studies did not conduct meta-analyses.[12,17]

Four of the included SRs did not identify any primary studies that were relevant to the present review;[11,14,16,18] that is, these SRs had broader selection criteria than the present review, and all of the included primary studies had ineligible comparators (e.g., other types of treatment). Three of these SRs included meta-analyses,[11,14,18] but since the primary studies did not meet the selection criteria for the present review the results are not described in this report.

All SRs included only randomized controlled trials; only one of which was included in more than one SR (see Appendix 5 for overlap between SRs in relevant primary studies).

Country of Origin

The SRs were led by authors based in Australia,[13,18], Belgium,[12] Brazil,[10] Canada,[1,4,20] China,[4] Denmark,[17] Germany,[4,7,13] Indonesia,[19] Iran,[7] Netherlands,[7,13,15,19,20] New Zealand,[10] Norway,[17] Sweden,[19] Switzerland,[15] United Kingdom,[11,14] and USA.[16,19,20]

Patient Population

Among the SRs that included relevant primary studies, two SRs included individuals with non-specific low back pain (LBP; chronic or of unspecified duration),[7,13] one included individuals with LBP with or without sciatica,[19] and one included adults with degenerative lumbar stenosis and pain.[1] Five SRs included individuals with neck pain, including non-specific neck pain or neck disorders associated with cervicogenic headache,[10] neck pain with active or latent trigger points in the neck,[12] chronic mechanical neck disorder,[20] or acute or subacute[4] or chronic neck pain[4,17]. One SR included individuals with chronic non-specific neck- or back-pain, including whiplash-associated disorders.[15] All SRs included individuals with pain of any severity.

The SRs that did not include relevant primary studies included individuals with non-specific LBP of any duration[11,14,16] or of a duration of at least 6 weeks.[18]

Interventions and Comparators

In the SRs that included relevant primary studies, a variety of eligible physiotherapy interventions were included: exercise (e.g., strength and endurance training, muscle energy technique, proprioceptive training),[10,13,15,17,20] electrotherapy (e.g., ultrasound, laser, transcutaneous electrical nerve stimulation [TENS]),[4,7,17] manual therapy,[17] ischemic compression,[12] dry needling,[12] traction,[19] and multi-modal therapies.[1,17] Included comparators were: no intervention, sham therapy (e.g., sham ultrasound), or placebo. No studies compared physiotherapy to opioids.

In the SRs that did not include relevant primary studies, interventions eligible for inclusion were: physiotherapy with a cognitive-behavioural component,[11] physiotherapy with both exercise and a cognitive-behavioural component,[18] exercises progressing into functional activity,[14] and spinal manipulations performed by physical therapists.[16] Eligible comparators were: waitlist, no treatment, placebo, or any control group without a physiotherapy manipulation.

Outcomes

In the SRs that included relevant primary studies, the outcomes related to the clinical effectiveness of physiotherapy interventions in the SRs were: pain;[1,4,10,12,13,15,17,19,20] function, disability, or functional disability;[1,7,10,12,15,17,19,20] psychosocial health or quality of life;[17,20] range of motion;[7] strength;[17] work ability;[17] return-to-work;[19] angle of lordosis;[17] headache;[4] ambulation time on a treadmill test;[1] and patient-rated improvement.[4]

In the SRs that did not include relevant primary studies, eligible outcomes included: pain;[11,14,16,18] function, disability, or functional disability;[11,14,16,18] quality of life;[11,16] costs or return-to-work;[16] and sick leave.[18]

The length of follow-up across the SRs ranged from immediately following the intervention[1,4,7,12,15,17] to up to two years post-intervention.[19]

Summary of Critical Appraisal

Additional detail regarding the strengths and limitations of included SRs are reported in Appendix 3.

The AMSTAR assessments of 14 SRs eligible for this review indicated that nine[1,4,7,11-13,16,18,20] neither explicitly referenced a protocol, nor described their research question(s) or search criteria in advance of the review, whereas five[10,14,15,17,19] made some reference to an *a priori* method. In general, the SRs reported adequate methods for electronic database searching and selection of studies, including duplicate screening to ascertain study eligibility and duplicate data extraction for included studies. However, five SRs[11,12,14-16] described the use of only a single reviewer for either study screening or data collection, and one SR[12] described a limited search of electronic databases. On the other hand, most SRs did not describe any consideration of publication status (i.e., a search of grey and/or unpublished literature), with only three[4,13,20] explicitly reporting the search and inclusion of grey and/or unpublished studies.

With regard to an appropriate description of included studies, half of the eligible SRs[1,4,7,13,14,19,20] provided both a list of included and excluded studies, whereas the other half[10-12,15-18] provided a list of included studies only. Conversely, all but one SR[10] described study characteristics in adequate detail, and all SRs described an assessment of quality for included primary studies.

The assessment of risk of bias concerning analytical methods, reporting of findings and conclusions was limited to the ten SRs[1,4,7,10,12,13,15,17,19,20] that identified primary studies describing data relevant to the current review. Of these, all but two[12,17] appropriately incorporated the study quality assessment findings into the results, interpretation and conclusions of their SR. Both of these SRs[12,17] either excluded studies or did not incorporate the results of otherwise eligible studies based on the findings of their quality assessment. The methods reported describing the synthesis of results from included studies were appropriate in six[1,4,10,13,17,20] of 10 included SRs. Of the remaining four SRs, two[12,15] did not report consideration of the clinical and/or statistical appropriateness of combining studies, and two[7,19] did not report their rationale for the use of fixed effects models in the presence of identified heterogeneity between included studies.

Other sources of bias, assessed in all 14 eligible SRs, included publication bias and transparency concerning conflicts of interest, with four[4,13,15,20] reporting an adequate assessment of publication bias and; two[7,12] appropriately describing conflict of interest. One[19] SR made mention of publication bias but did not describe any assessment, and nine SRs[1,7,10-12,14,16-18] did not address publication bias. As it concerns conflict of interest, nine SRs,[1,4,11,13,14,17-20] provided some declaration of interest for authors, however no mention of any conflict of interest was reported with regard to included studies. Finally, three SRs[10,15,16] made no mention of conflict of interest concerning authors or included studies.

Summary of Findings

Rapid Response reports are organized so that the evidence for each research question is presented separately.

1. What is the clinical effectiveness of physiotherapy interventions for the management of acute or chronic neck and/or back pain?

Fourteen SRs included literature searches for publications related to the clinical effectiveness of a variety of physiotherapy modalities for the management of acute or chronic neck and/or back pain.[1,4,7,10-20] Four of these SRs[11,14,16,18] captured only primary studies with ineligible comparators and therefore contributed no findings to the present review. Findings from the remaining ten reviews[1,4,7,10,12,13,15,17,19,20] are summarized by type of physiotherapy below. A detailed summary of findings is provided in Appendix 4.

Exercise Therapy

Five SRs were identified that provided evidence on the clinical effectiveness of exercise physiotherapy interventions for the management of acute or chronic neck and/or back pain.[10,13,15,17,20]

Findings were mixed, but in general the evidence suggested that strengthening, stretching, and endurance exercises were beneficial (or had no effect) for neck pain, compared to no treatment, wait list, sham mobilization, or sham ultrasound.[17,20] In addition, exercise therapy had either no effect, or a modest beneficial effect on function or functional disability, and no effect on quality of life or global perceived effect of the intervention compared to no treatment.[20]

With respect to specific exercise modalities, physiotherapy with extrinsic feedback (e.g., pressure or electromyography feedback) was more effective than control for neck pain, and was more effective for improving disability at long- but not short- or mid-term follow-up.[10] Proprioceptive training, including balancing and perturbation exercises and joint repositioning, was more effective than control with respect to neck or back pain and head repositioning accuracy, but was not different regarding back-specific functional status.[15] Muscle energy technique (MET) therapy, involving alternating resisted muscle contractions and assisted stretching, was not more effective than sham MET for non-specific LBP in a single primary study.[13] Lastly, myofeedback training (i.e., exercise training with muscle activity feedback) or muscular strength training were not different from control with respect to functional abilities, strength, and psychosocial health.[17]

Importantly, no adverse effects of exercise therapy were reported in any of the five SRs.[10,13,15,17,20]

Electrophysical Therapy

Three SRs were identified that provided evidence on the clinical effectiveness of electrophysical therapy modalities.[4,7,17]

Overall, evidence suggested no effect of repetitive magnetic stimulation (rMS), TENS, electrical muscle stimulation (EMS) or static magnetic field on neck pain compared to control (placebo or sham therapy),[4] but a modest beneficial effect of rMS or TENS compared to sham ultrasound with respect to neck pain and disability.[17] Laser therapy, compared to sham laser therapy, was associated with improved pain in only one out of four trials, and there was no difference between groups in physician assessment of pressure pain, disability, angle of lordosis, or range of motion.[17] Limited evidence from a single primary study demonstrated no difference between ultrasound and sham ultrasound with respect to back-specific functional status or range of motion.[7] Evidence from a single primary study demonstrated no effect of modulated galvanic current on pain or patient-rated improvement compared to placebo,[4] and evidence from another single trial demonstrated no effect of iontophoresis on pain or cervicogenic headache compared to no treatment.[4]

No adverse side effects of electrophysical therapy were reported.[4]

Manual Therapy

One SR containing one relevant primary study with only 100 participants was identified that provided evidence on the clinical effectiveness of manual therapy in individuals with chronic neck pain.[17] In this study, pain was not different between thrust manipulation and placebo manipulation groups post-treatment.[17]

Ischemic Compression

One SR containing one relevant primary study with only 46 participants was identified that provided evidence on the clinical effectiveness of ischemic compression in individuals with neck pain with active or latent trigger points in the neck.[12] Limited evidence suggested that a single session of ischemic compression (compared with a wait-and-see control condition) improved pain and neck range of motion immediately after and at 24 hours and 1 week following treatment.[12]

Dry Needling

One SR containing one relevant primary study with only 20 participants was identified that provided evidence on the clinical effectiveness of dry needling in individuals with neck pain with active or latent trigger points in the neck.[12] This limited evidence suggested that 6 sessions of dry needling over 10 weeks (compared with sham acupuncture) may improve pain and Neck Disability Index.[12]

Traction

One SR was identified that provided evidence on the clinical effectiveness of traction.[19] Overall, evidence suggested that traction had little or no impact on pain, function, global improvement, or return to work in individuals with LBP.[19]

Multi-Modal Therapy

Two SRs were identified that provided evidence on the clinical effectiveness of multi-modal physiotherapy.[1,17] In the first SR, evidence from a single primary study demonstrated no difference in pain or measure of trigger points between multi-modal therapy (ultrasound, massage and exercise), sham therapy, and control groups at 6 month follow-up.[17] In the second SR, evidence from a single primary study demonstrated that pain and disability scores were significantly lower following 3 weeks of multi-modal therapy (ultrasound and exercise) compared to control (no treatment).[1] Ambulation time on a treadmill test was significantly higher in the treatment group, suggesting improved function.[1]

2. What is the cost-effectiveness of physiotherapy interventions for the management of acute or chronic neck and/or back pain?

No relevant evidence regarding the cost-effectiveness of physiotherapy interventions for the management of acute or chronic neck and/or back pain was identified; therefore, no summary can be provided.

Limitations

The primary limitation of this review was that strict inclusion criteria were applied that may have resulted in the exclusion of some relevant studies. Specifically, given that certain types of therapy (e.g., manual therapy) may be administered by a variety of health care practitioners (e.g., chiropractors or physicians), and that the characteristics of the therapy may differ across practitioners, studies were only eligible if it was explicitly reported that the

interventions were performed by physiotherapists and/or in a physical therapy clinic. This may have resulted in exclusion of some potentially relevant studies that examined the clinical effectiveness of interventions that could be delivered by physiotherapists. Although this is a limitation, it also serves to maximize the generalizability of the present findings to the physiotherapy context specifically.

In addition, due to the volume of literature in this area, the search strategy was limited by study design to retrieve only health technology assessments, SRs, and meta-analyses. Therefore, it is possible that relevant primary studies that were not captured in existing health technology assessments, SRs or meta-analyses may have been missed. In particular, no evidence was identified regarding the cost-effectiveness of physiotherapy interventions for the management of neck and/or back pain.

Although the included evidence was from SRs, in many cases findings for particular physiotherapy modalities or outcomes came from single primary studies representing a small number of participants. Overall, the body of evidence was limited and of low- to moderate-quality. This may be due in part to the challenges associated with conducting true placebo-controlled studies when it is not possible to blind participants to the interventions received (e.g., exercise or acupuncture) and in which knowledge of the treatment could bias the results.[21,22] Different physiotherapy interventions are diverse and may be anticipated to have different mechanisms of effect, however results were combined for the purposes of this report.

Lastly, no studies were identified that compared the clinical effectiveness of physiotherapy interventions to the clinical effectiveness of opioids for the management of acute or chronic neck and/or back pain; this is an important research gap that remains to be addressed.

Conclusions and Implications for Decision or Policy Making

This report identified evidence on the clinical effectiveness of physiotherapy interventions for the management of acute or chronic neck and/or back pain. Evidence from 14 SRs provided limited evidence for the effectiveness of a range of physiotherapy interventions.[1,4,7,10-20] Overall, the body of evidence was limited and of low- to moderate-quality.

In general, exercise therapy had a modest beneficial effect, or no effect, on neck and back pain or function compared to no treatment, but evidence for other outcomes was limited.[10,13,15,17,20] Evidence regarding the clinical effectiveness of electrophysical therapies was primarily null, compared to no treatment, placebo, or sham therapy.[4,7,17] Specifically, there was evidence for a modest beneficial effect of rMS or TENS compared to sham ultrasound on neck pain and disability[17], and for laser therapy compared to sham laser on neck pain[17], but there were no other significant effects of other electrophysical modalities (i.e., EMS, static magnetic field control, or ultrasound), or for any other outcomes. There was limited evidence suggesting no effect of manual therapy (thrust manipulation, compared to placebo manipulation),[17] and for a modest benefit of ischemic compression (compared to no treatment) on pain and neck range of motion and of dry needling (compared to sham acupuncture) on pain and disability.[12] Traction (compared to no treatment, placebo, or sham therapy) had little or no impact on pain, functional status, global improvement, and return to work among people with LBP.[19] No adverse effects of any physiotherapy interventions were reported.

No evidence was identified regarding the clinical effectiveness of physiotherapy compared to opioids, or regarding the cost-effectiveness of physiotherapy interventions, for the management of neck and/or back pain. Additional evidence from well-conducted RCTs is required to support conclusions regarding the clinical and cost-effectiveness of physiotherapy interventions for the management of acute or chronic neck and/or back pain.

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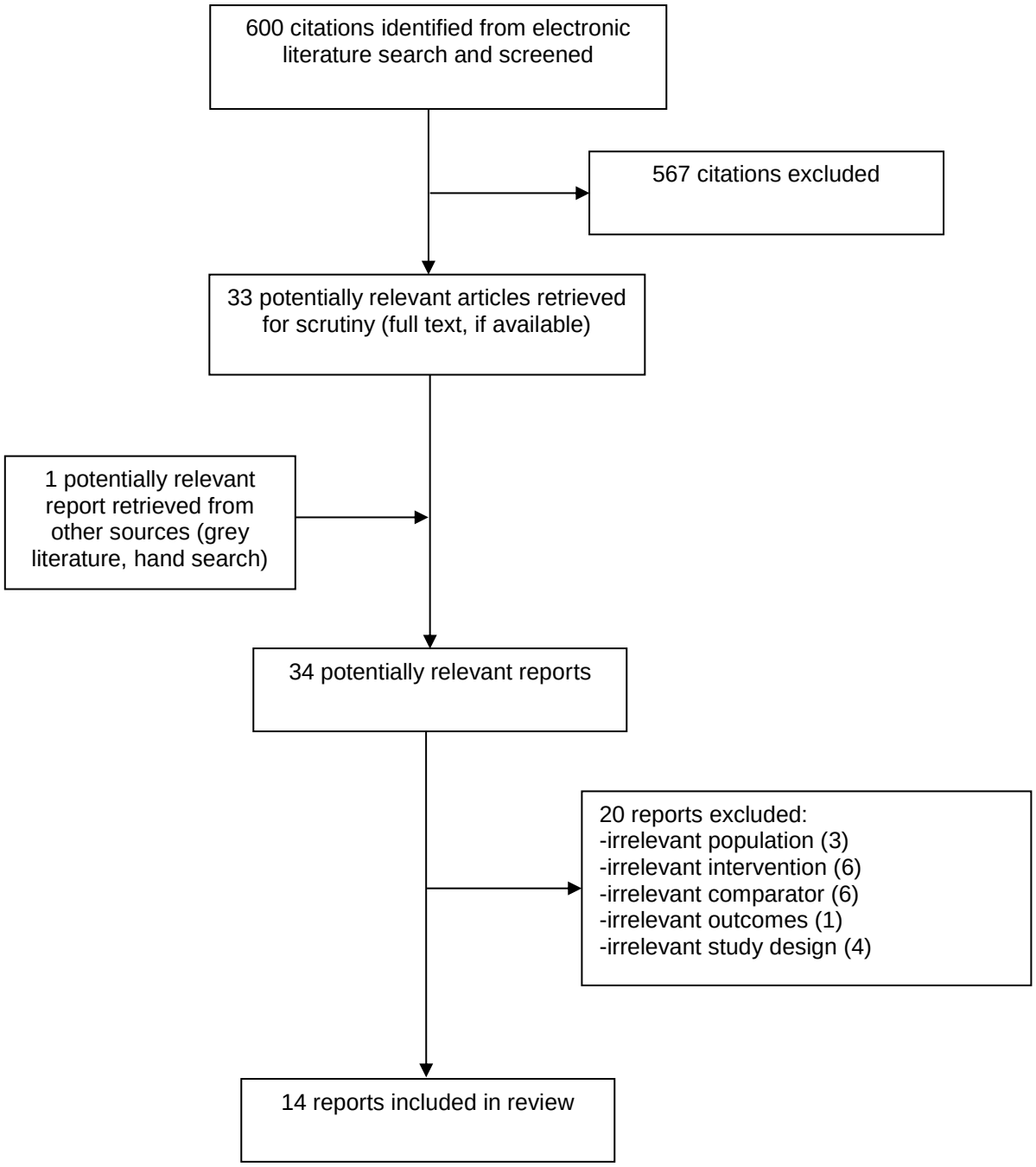
Appendix 1: Selection of Included Studies



Appendix 2: Characteristics of Included Publications

Table A1: Characteristics of Included Systematic Reviews

Author, Publication Year, Country	Types and Numbers of Primary Studies Included	Population Characteristics	Intervention(s), Duration	Comparator(s)	Clinical Outcomes, Length of Follow-up
Systematic Reviews that Included Relevant Primary Studies					
de Araujo et al. 2017[10] **Brazil, New Zealand**	8 studies in total 2 primary studies relevant to the present review: RCT, n = 2	Individuals between ages 18 and 65 y with non-specific neck pain (with or without radicular symptoms) or with neck disorders associated with cervicogenic headache	Physiotherapy with extrinsic feedback (e.g., pressure or electromyography feedback) Duration: 6 weeks (8-12 sessions)	Control (no intervention, or an intervention deemed unlikely to have a therapeutic effect)	Neck pain (NPRS, VAS), functional disability (NPNPQ) Length of follow-up: short-term (0 to 12 wk), mid-term (13-26 wk) and long-term (≥52 wk)
Cagnie et al. 2015[12] **Belgium**	15 studies in total 2 primary studies relevant to the present review: RCT, n = 2	Individuals with neck pain diagnosed with active or latent trigger points in the neck (upper trapezius muscle)	Ischemic compression or dry needling Duration: 1 session to 10 wk (6 sessions)	Sham acupuncture, wait-and-see	Pain (intensity, PPT, PPI), disability (NDI), ROM Length of follow-up: post-intervention to 1 wk
Franke et al. 2015[13] **Australia, Germany, Netherlands**	12 studies in total 1 primary study relevant to the present review: RCT, n = 1	Individuals > 18 y with non-specific LBP	Muscle energy technique (MET; alternating resisted muscle contractions and assisted stretching) Duration: 1 session	Sham MET	Pain (measured by VAS from 0 to 100, where 100 is “worst pain imaginable”) Length of follow-up: 24 h after treatment
Gross et al. 2015[20] **Canada, Netherlands, USA**	27 trials in total 7 primary studies relevant to the present review: RCT, n = 7	Individuals with chronic mechanical neck disorder	Exercise therapy Duration: 1 session to 16 wk	No treatment; sham ultrasound; sham mobilization	Pain (VAS), function (NDI), quality of life (SF-36) Length of follow-up: 8 wk to 12 mo
Ebadi et al. 2014[7] **Germany, Iran, Netherlands**	7 studies in total 1 primary study relevant to the present review: RCT, n = 1	Individuals >18 y with chronic non-specific LBP	Therapeutic ultrasound (1 MHz continuous) Duration: 10 sessions (3 days/wk)	Sham ultrasound	Back-specific function (Functional Rating Index), flexion and extension range of motion (degrees) Length of follow-up: post-intervention period (10

Author, Publication Year, Country	Types and Numbers of Primary Studies Included	Population Characteristics	Intervention(s), Duration	Comparator(s)	Clinical Outcomes, Length of Follow-up
					sessions, 3 days/wk)
McCaskey et al. 2014[15] **Netherlands, Switzerland**	18 studies in total 4 primary studies relevant to the present review: RCT, n = 4	Individuals > 18 y with chronic non-specific neck- or back-pain, including whiplash-associated disorders	Proprioceptive training (PrT; including balancing and perturbation exercises, joint repositioning) Duration: 4 to 48 wk	No treatment control	Pain (NRS, VAS, McGill Pain Rating Index), back-specific functional status (ODI, WDI, PDI), HRA Length of follow-up: post-intervention (4 to 48 wk) or "long-term" (duration not specified)
Damgaard et al. 2013[17] **Denmark, Norway**	42 studies in total 10 primary studies relevant to the present review: RCT, n = 10	Individuals > 18 y with chronic neck pain, defined as: chronic whiplash-associated disorders, chronic non-specific neck pain (work-related, myofascial, upper trapezius myalgia, chronic neck pain associated with degenerative findings with or without radicular findings, other surrogate terms)	Exercise therapy, manual therapy, electrotherapy (e.g., TENS, laser) Duration: 1 session to 3 mo	No treatment control, sham therapy	Pain (NRS, VAS, PPT, pain threshold), pain and disability (NPDS, NPDVAS), functional abilities (cutlery wiping performance test, dexterity, ROM), strength (maximum grip strength), work ability (WAI, working degree, changed work ability), psychosocial health (Copenhagen Psychosocial Questionnaire), pupil diameter, measure of trigger points, angle of lordosis Length of follow-up: post-intervention to up to 12 mo post-intervention
Kroeling et al. 2013[4] **Canada, China, Germany**	20 studies in total 7 primary studies relevant to the present review: RCT, n = 7	Individuals ≥ 18 y with acute (<6 wk), subacute (6 to 12 wk) or chronic (>12 wk) neck pain	Electrotherapy: modulated Galvanic current, iontophoresis, TENS, EMS, rMS Duration: not reported, or 1	Placebo, sham therapy	Pain or pain intensity (rating scale, patient-report, VAS, NPDVAS), PPT, NPD, headache, patient-rated improvement

Author, Publication Year, Country	Types and Numbers of Primary Studies Included	Population Characteristics	Intervention(s), Duration	Comparator(s)	Clinical Outcomes, Length of Follow-up
			session to 3 wk		Length of follow-up: not reported, or immediately to 3 mo post-treatment
Macedo et al. 2013[1] **Canada**	10 studies in total 1 primary study relevant to the present review: RCT, n = 1	Adults >18 y with degenerative lumbar stenosis, pain	Ultrasound with exercise program Duration: 3 wk	No treatment	Pain (VAS), disability (ODI), total ambulation time (s) on a treadmill test Length of follow-up: post-intervention
Wegner et al. 2013[19] **Netherlands, Indonesia, Sweden, USA**	32 trials in total 4 primary studies relevant to the present review: RCT, n = 4	Adults >18 y with LBP, with or without sciatica	Traction (any type) Duration: 12 days to 12 wk	Placebo, sham, no treatment	Pain (VAS), disability (RMDQ), return-to-work (days; individuals who return vs. do not return) Length of follow-up: 3 wk to 2 y
Systematic Reviews that did not Identify Relevant Primary Studies					
Hall et al. 2016[11] **United Kingdom**	5 studies in total *No primary studies relevant to the present review*	Individuals with non-specific LBP of any duration	Physiotherapy with a cognitive-behavioural component (i.e., strategies to change maladaptive thoughts related to pain and physical activity) Duration: 4 to 7 wk	Waitlist, no treatment	Pain, pain-related disability, quality of life
Smith et al. 2014[14] **United Kingdom**	22 studies in total *No primary studies relevant to the present review*	Adults with non-specific LBP of any duration	Stabilization or core stability exercises progressing into functional activity Duration: not reported, 12 sessions, or 4 wk to 3 mo	Placebo, control	Pain, functional disability
Richards et al. 2013[18]	16 studies in total *No primary studies*	Individuals ≥ 18 y with LBP of >6 wk duration	Physiotherapy programs with both exercise and	No intervention, placebo	Pain, function, sick leave

Author, Publication Year, Country	Types and Numbers of Primary Studies Included	Population Characteristics	Intervention(s), Duration	Comparator(s)	Clinical Outcomes, Length of Follow-up
Australia	*relevant to the present review*		cognitive-behavioural components without invasive techniques or substantial passive intervention Duration: minimum 8 sessions, or 4 to 12 wk		
Kuczynski et al. 2012[16] **USA**	6 studies in total *No primary studies relevant to the present review*	Individuals with LBP	Spinal manipulations performed by physical therapists Duration: not reported, or 1 to 7 sessions	Any control group without physical therapy manipulation	Pain, quality of life, disability, costs, return to work

Note: The included systematic reviews had broader inclusion criteria than the present review (i.e., were wider in scope). Therefore, for each systematic review, in addition to the total number of primary studies included in each review, the number of studies relevant to the present review is reported; the remaining study characteristics (i.e., population, intervention, comparators, and outcomes) are reported only for the subset of relevant studies.

EMS = electrical muscle stimulation; h = hours; HRA = head repositioning accuracy; LBP = low-back pain; MET = muscle energy technique; mo = months; NDI = Neck Disability Index; NPD = Neck Pain Disability; NPDS = neck pain and disability scale; NPDVAS = neck pain and disability visual analogue scale; NPNPQ = Northwick Park Neck Pain Questionnaire; NPRS or NRS = numeric pain rating scale; ODI = Oswestry Disability Index; PDI = Pain and Disability Index; PPI = pressure pain index; PPT = pressure pain threshold; PrT = proprioceptive training; RCT = randomized controlled trial; RMDQ = Roland Morris Disability Questionnaire; rMS = repetitive magnetic stimulation; ROM = range of motion; s = seconds; SF-36 = short-form 36; TENS = transcutaneous electrical nerve stimulation; VAS = visual analogue scale; WAI = work ability index; WDI = Wadell Disability Index; wk = weeks; y = years.

Appendix 3: Critical Appraisal of Included Publications

Table A2: Strengths and Limitations of Systematic Reviews and Meta-Analyses using AMSTAR[9]

Strengths	Limitations
Systematic Reviews that Included Relevant Primary Studies	
de Araujo et al. 2017[10]	
– Research question and inclusion criteria published prior to conduct of study – Comprehensive literature search performed, including database searches and hand-searching – Study selection and data extraction performed by two independent reviewers, with a third reviewer resolving conflicts – List of included studies provided – Scientific quality of included studies assessed by two independent reviewers using the PEDro scale – Scientific quality considered in formulation of conclusions – Statistical heterogeneity assessed using I^2 statistic when clinically appropriate to combine studies and random effects meta-analyses used appropriately	– No formal grey literatures search conducted (limited to hand-searching) – List of excluded studies not provided – Limited characteristics of included studies provided; no information on important factors including patient characteristics (e.g., age, duration of neck pain), interventions (e.g., duration, frequency), and outcomes (e.g., tools used to measure pain and disability) – No assessment of publication bias – Conflict of interest not reported for the SR or for the included studies
Cagnie et al. 2015[12]	
– Two electronic databases searched – Full-text study selection and data extraction performed by two independent reviewers – List of included studies, and their key characteristics, provided – Scientific quality assessed by three independent reviewers using a checklist developed by the Dutch Cochrane Centre and Dutch Institute for Healthcare Improvement; only studies with a score of at least 50% on the quality assessment were included – Review authors declared no conflict of interest	– No reference to a protocol, ethics approval, or pre-determined research objectives to indicate that the research question and inclusion criteria were established *a priori* – No grey literature considered for inclusion and key electronic databases not included in the literature search (e.g., Central, EMBASE) – Unclear whether title and abstract screening was performed in duplicate – List of excluded studies not provided – Six studies excluded on the basis of subjective quality assessments – Clinical and statistical appropriateness of combining studies was not considered – No assessment of publication bias – Conflict of interest not reported for included studies
Franke et al. 2015[13]	
– Comprehensive literature search performed, including database searches, trial registry searches, citation tracking, hand-searching, and personal communication with clinical experts – Study selection and data extraction performed by two independent reviewers, with a third reviewer resolving conflicts – Lists of included and excluded studies provided – Key characteristics of included studies provided – Scientific quality of included studies assessed using the Cochrane risk of bias tool and the GRADE approach	– Differences between protocol and final review were reported, but no reference to the original protocol was provided – Conflict of interest not reported for included studies

Strengths	Limitations
– Scientific quality considered in formulation of conclusions – Publication bias considered "*In the event that we included enough studies"* p. 9 – Statistical heterogeneity assessed using I^2 statistic when clinically appropriate to combine studies and random effects meta-analyses used appropriately – Review authors declared no conflict of interest	
Gross et al. 2015[20]	
– Comprehensive literature search performed, including database searches and hand-searching – Consideration of publication status (e.g., grey literature) explicitly reported – Study selection and data extraction performed by two independent reviewers, with a third reviewer resolving conflicts – Lists of included and excluded studies provided – Key characteristics of included studies provided – Scientific quality of included studies assessed using the Cochrane risk of bias tool and levels of evidence per-outcome assessed using the Cochrane GRADE approach – Scientific quality of included studies considered in formulation of conclusions – Clinical appropriateness of combining studies was considered; statistical heterogeneity assessed using I^2 statistic and random effects meta-analyses used appropriately – Assessment of publication bias reported – Sources of funding reported for the review	– No reference to a protocol, ethics approval, or pre-determined research objectives to indicate that the research question and inclusion criteria were established *a priori* – Conflict of interest not reported for included studies
Ebadi et al. 2014[7]	
– Comprehensive literature search performed, including database searches, hand-searching, and personal communication with clinical experts – Study selection and data extraction performed by two independent reviewers, with a third reviewer resolving conflicts – Lists of included and excluded studies provided – Key characteristics of included studies provided – Scientific quality of included studies assessed using the Cochrane risk of bias tool and the GRADE approach – Scientific quality considered in formulation of conclusions – Statistical heterogeneity assessed using I^2 statistic – Conflict of interest was disclosed and managed for SR authors; conflict of interest was reported for included studies	– Differences between protocol and final review were reported, but no reference to the original protocol was provided – No formal grey literature searches conducted – Fixed effect meta-analyses were conducted in the presence of clinical heterogeneity – No assessment of publication bias – Some comparisons presented as "ultrasound vs. sham ultrasound" that include primary studies that actually compared "ultrasound in addition to exercise vs. sham ultrasound in addition to exercise"
McCaskey et al. 2014[15]	
– Provided the *a priori* research question and inclusion criteria as an "Additional file" – Comprehensive database search performed – Study selection performed by two independent reviewers, with a third reviewer resolving conflicts – List of included studies, and their key characteristics,	– No formal grey literature searches conducted – Data extraction performed by a single reviewer and checked for accuracy by a second reviewer, instead of duplicate data extraction – Meta-analyses planned if data were sufficiently homogeneous, but discussion of clinical appropriateness of

Strengths	Limitations
provided – Scientific quality of included studies assessed according to the Cochrane risk of bias tool and the GRADE approach – Scientific quality considered in formulation of conclusions – Likelihood of publication bias assessed using funnel plots – Review authors declared no conflict of interest	combining studies and results of statistical tests of heterogeneity were not reported – Unclear which studies reported in summary of findings tables (references not provided) leading to uncertainty in interpreting findings as reported by the authors – List of excluded studies not provided – Conflict of interest not reported for included studies
Damgaard et al. 2013[17]	
– Research question and inclusion criteria published prior to conduct of study – Comprehensive literature search performed, including database searches and hand-searching – Study selection and data extraction performed by two independent reviewers, with a third reviewer resolving conflicts – List of included studies, and their key characteristics, provided – Risk of bias in individual studies assessed according to the Cochrane risk of bias tool, and considered in formulation of conclusions – Meta-analyses were deemed inappropriate due to few studies for each specific intervention; findings described narratively – Review authors declared no conflict of interest	– No formal grey literature searches conducted – List of excluded studies not provided – Aside from risk of bias, no other factors contributing to evidence quality were considered in formulation of conclusions – Study quality was not considered as an inclusion criterion, however only results from trials considered to have low risk of bias were "*considered as evidence for an intervention*" (p. 3); the authors' conclusions were based on a small subset of the total included studies – No assessment of publication bias – Conflict of interest not reported for included studies
Kroeling et al. 2013[4]	
– Comprehensive literature search performed, including database searches, trial registry searches, a limited grey literature search (of "personal files" and conference proceedings), and communication with clinical experts – Study selection and data extraction performed by two independent reviewers, with a third reviewer resolving conflicts – Lists of included and excluded studies provided – Key characteristics of included studies provided – Scientific quality of included studies assessed according to the Cochrane risk of bias tool and the GRADE approach – Scientific quality considered in formulation of conclusions – Statistical heterogeneity assessed using I^2 statistic when clinically appropriate to combine studies and random effects meta-analyses used appropriately – Publication bias was considered, but could not be formally assessed because there were fewer than 10 included studies for any intervention and outcome of interest – Review authors declared no conflict of interest	– Differences between protocol and final review were reported, but no reference to the original protocol was provided – Conflict of interest not reported for included studies
Macedo et al. 2013[1]	
– Comprehensive database literature search performed – Study selection and data extraction performed by two independent reviewers, with a third reviewer resolving conflicts – List of included and excluded studies provided	– No reference to a protocol, ethics approval, or pre-determined research objectives to indicate that the research question and inclusion criteria were established *a priori* – Consideration of publication status (e.g., grey literature) not explicitly reported

Strengths	Limitations
– Key characteristics of included studies provided – Scientific quality of included studies assessed using the PEDro tool and the GRADE approach – Scientific quality considered in formulation of conclusions – Clinical appropriateness of combining studies was considered; statistical heterogeneity assessed using I^2 statistic and fixed/random effects meta-analyses used accordingly per outcome	– No assessment of publication bias reported – Conflict of interest not reported for included studies
Wegner et al. 2013[19]	
– Reference is made to a published protocol – Comprehensive literature search performed, including database searches and hand-searching – Study selection and data extraction performed by two independent reviewers, with a third reviewer resolving conflicts – List of included and excluded studies provided – Key characteristics of included studies provided – Scientific quality of included studies assessed using the Cochrane Risk of Bias tool and the GRADE approach – Scientific quality considered in formulation of conclusions – Clinical appropriateness of combining studies was considered; statistical heterogeneity assessed using I^2 statistic was assessed – Review authors declared their conflicts of interest	– Consideration of publication status (e.g., grey literature) not explicitly reported – Rationale for performing fixed effects models not described – Publication bias mentioned as a potential concern but not explicitly reported as having been assessed – Conflict of interest not reported for included studies
Systematic Reviews that did not Identify Relevant Primary Studies	
Hall et al. 2016[11]	
– Comprehensive database literature search performed – Study selection and data extraction performed by two independent reviewers, with a third reviewer resolving conflicts – List of included studies, and their key characteristics, provided – Scientific quality of included studies assessed using the Cochrane risk of bias tool and the GRADE approach – Review authors declared no conflict of interest	– No reference to a protocol, ethics approval, or pre-determined research objectives to indicate that the research question and inclusion criteria were established *a priori* – No grey literature considered for inclusion – Initial study selection based on titles only, and methods for full-text selection not described – List of excluded studies not provided – No assessment of publication bias – Conflict of interest not reported for included studies
Smith et al. 2014[14]	
– This systematic review was performed as an update to an earlier review; reference to the *a priori* design provided – Comprehensive literature search performed, including database searches and hand-searching – Full-text study selection performed by two independent reviewers, with a third reviewer resolving conflicts – List of included studies, and their key characteristics, provided – Scientific quality of included studies assessed using the PEDro scale – Review authors declared no conflict of interest	– No formal grey literature searches conducted – Title and abstract screening performed by a single reviewer – Data extraction performed by a single reviewer and checked for accuracy by a second reviewer, instead of duplicate data extraction – List of excluded studies not provided – No assessment of publication bias – Conflict of interest not reported for included studies
Richards et al. 2013[18]	

Strengths	Limitations
– Comprehensive literature search performed, including database searches and hand-searching – Study selection performed by two independent reviewers, with a third reviewer resolving conflicts – List of included studies, and their key characteristics, provided – Scientific quality of included studies assessed using the PEDro scale and the GRADE approach – Review authors declared no conflict of interest	– No reference to a protocol, ethics approval, or pre-determined research objectives to indicate that the research question and inclusion criteria were established *a priori* – No formal grey literature searches were conducted – List of excluded studies not provided – Publication bias "*was only considered present if actual evidence was found*" (p. 22) and was not formally assessed – Conflict of interest not reported for included studies
Kuczynski et al. 2012[16]	
– Comprehensive database search performed – Study selection performed by two independent reviewers, with a third reviewer resolving conflicts – List of included studies, and their key characteristics, provided – Risk of bias assessed with the PEDro tool	– No reference to a protocol, ethics approval, or pre-determined research objectives to indicate that the research question and inclusion criteria were established *a priori* – No formal grey literature searches were conducted – Data extraction performed by a single reviewer and checked for accuracy by a second reviewer, instead of duplicate data extraction – List of excluded studies not provided – No assessment of publication bias – Conflict of interest not reported for the SR or for the included studies

GRADE = Grading of Recommendations, Assessment, Development and Evaluations; PEDro = Physiotherapy Evidence Database; SR = systematic review.

Appendix 4: Main Study Findings and Author's Conclusions

Table A3: Summary of Findings of Included Systematic Reviews

Main Study Findings	Author's Conclusion
de Araujo et al. 2017[10]	
PT+EF vs. Control – Short-term follow-up (0 to 12 wk) – Two trials (n = 242) – Disability scores (NPNPQ) not significantly different between groups: MD = -3.94, 95% CI: -12.06 to 4.18 – Pain scores (NPRS, VAS) significantly lower in PT+EF vs. Control: MD = -1.44, 95% CI: -2.25 to -0.63	"*There is very low quality of evidence that Physiotherapy intervention + EF is more effective than [control] for short-term pain, but not for disability.*" p. 132
PT+EF vs. Control – Mid-term follow-up (13 to 26 wk) – One trial (n = 145) – Disability scores (NPNPQ) not significantly different between groups: MD = 0.2, 95% CI: 0.0 to 0.4, *P* = 0.08 – Pain scores (NPRS) significantly lower in PT+EF vs. Control: MD = 1.2, 95% CI: 0.4 to 2.0, *P* < 0.05	"*There is also low quality evidence supporting that Physiotherapy intervention plus EF is no different to control for disability, but is superior for pain, at mid-term follow-up.*" p. 140
PT+EF vs. Control – Long-term follow-up (≥ 52 wk) – One trial (n = 97) – Disability scores (NPNPQ) significantly lower in PT+EF vs. Control: MD = -7.77, 95% CI: -12.62 to -2.91, *P* = 0.002 – Pain scores (VAS) significantly lower in PT+EF vs. Control: MD = -1.37, 95% CI: -2.31 to -0.42, *P* = 0.005	"*Physiotherapy intervention plus EF is more effective than control for improving disability and pain [at long-term follow-up].*" p. 140 "*Due to high risk of bias within included studies, and the low strength and quality of evidence, future studies with low risk of bias are likely to change the estimates of the effects of Physiotherapy intervention plus EF on neck rehabilitation.*" p. 141
Cagnie et al. 2015[12]	
IC vs. Wait-and-See — immediately post-intervention, 24 h and 1 wk follow-up – One trial (n = 46); 1 session of treatment – PPT increased immediately after and at 24 h and 1 wk post-IC treatment; PPT decreased immediately after wait-and-see (not reported for 24 h and 1 wk post-wait-and-see) – Pressure pain intensity decreased immediately after and at 1 wk post-IC treatment (not reported for wait-and-see) – ROM increased immediately after at 24 h and 1 week post-IC treatment (not reported for wait-and-see)	"*There is moderate evidence for ischemic compression and strong evidence for dry needling to have a positive effect on pain intensity. This pain decrease is greater compared with […] no or placebo intervention.*" p. 573
DN vs. Sham Acupuncture — up to 12 wk follow-up – One trial (n = 20); 6 sessions of treatment over 10 wk – Pain intensity decreased in both groups, but the reduction was greater in DN vs. sham acupuncture at 9 wk of treatment (i.e., longer-lasting effect) – NDI decreased in the DN group only	"*On the basis of this systematic review, ischemic compression and dry needling can both be recommended in the treatment of neck pain patients with trigger points in the upper trapezius muscle. Additional research with high-quality study designs are needed to develop more conclusive evidence.*" p. 573
Franke et al. 2015[13]	
MET vs. Sham MET — immediately post-intervention and 24 h follow-up – One trial (n = 20)	"*[There was] low level evidence (downgraded due to imprecision and indirectness) of no clinically relevant difference between MET and sham MET […] on pain.*" p. 15

Main Study Findings	Author's Conclusion
– Pain scores (VAS) not different in MET vs. Sham MET: MD = 14.20, 95% CI: -10.14 to 38.54 – No adverse events were observed	"*The reliability of the information reported in this study can be questioned given the unusual pattern of baseline pain scores among the two groups. Worst pain in the MET group was much higher than worst pain in the control group (29.3 versus 18.1), but current pain was much lower in the MET group than current pain in the control group (18.2 versus 36.6).*" p. 15
Gross et al. 2015[20]	
Exercise vs. No treatment/wait list — 12 and 24 wk follow-up – Exercise included: cervical stretch/ROM exercises, cervical/scapulothoracic strengthening, and static/dynamic cervical/shoulder stabilization *12-wk follow-up:* – Two trials pooled (n = 147) – Pain scores (VAS) significantly lower in the Exercise group: MD = -14.90, 95% CI: -22.40 to -7.39 – Function (NDI) not significantly different between groups: MD = -0.50, 95% CI: -1.04 to 0.03 – Global perceived effect (General Health Perception; n=70) not significantly different between groups: SMD = 0.09, 95% CI: -0.38 to 0.56 – Quality of life (SF-36; n = 143) not significantly different between groups: MD = -2.22, 95% CI: -5.17 to 0.72 *24-wk follow-up:* – Two trials pooled (n = 140) – Pain scores (VAS) significantly lower in the Exercise group: MD = -10.94, 95% CI: -18.81 to -3.08 – Function (NDI) significantly improved in Exercise group: MD = -0.40, 95% CI: -0.74 to -0.06 – Global perceived effect (General Health Perception; n=66) not significantly different between groups: SMD = -0.21, 95% CI: -0.69 to 0.28 – Quality of life (SF-36; n = 144) not significantly different between groups: MD = 0.06, 95% CI: -4.06 to 4.17	*"Moderate quality evidence […] shows cervical stretch/ROM exercises + cervical/scapulothoracic strengthening + static/dynamic cervical/shoulder stabilization probably has moderate benefit for pain and function, but not global perceived effect and quality of life immediately post treatment and at short-term follow-up. A clinician may need to treat four people to achieve a moderate degree of pain relief and five to achieve moderate functional benefit in one patient."* p. 18
Exercise vs. Sham ultrasound — 8 wk, 6 mo and 12 mo follow-up – Exercise included: cervical/UE Stretch/ROM exercise, cervical/UE strengthening, and dynamic cervical stabilization (n = 45); or cervical stretch/ROM exercise, dynamic cervical stabilization (n =50) – One trial (n = 77 overall) – Pain scores (VAS) not significantly different between groups at any follow-up time point – Function scores (NDI) not significantly different between groups at any follow-up time point	*"Low quality evidence […] shows no difference for pain relief and function immediately post intervention, at six and 12 months follow-up using Cervical/UE Stretch/ROM Exercise + Cervical/UE Strengthening + Dynamic Cervical Stabilization for chronic MND."* p. 18 *"Low quality evidence […] shows no difference for pain relief and function immediately post intervention, at six- and 12-month follow-up using Cervical Stretch/ROM Exercise + Dynamic Cervical Stabilization for chronic MND."* p. 16
Exercise vs. No exercise — 12 mo follow-up – Exercise included: cervical/scapulothoracic strengthening and endurance training – One trial (n = 56 analyzed)	*"Very low quality evidence […] shows we are uncertain whether cervical/scapulothoracic strengthening and endurance-strength exercises improves the prevalence of neck pain in chronic neck pain at immediately post treatment and at long-term follow-up."*

Main Study Findings	Author's Conclusion
– Pain prevalence not significantly different between groups at 12 mo follow-up	p. 20
Exercise vs. No Treatment — 6 wk and 3 mo follow-up – Exercise included: Patterns synchronization, feedforward/feedback vestibular rehabilitation (balance on unstable surfaces and walking with head movements and eyes closed) – One trial (n = 29) – Pain scores (VAS) not significantly different between groups at any follow-up time point	*"Low quality evidence […] shows vestibular rehabilitation type exercises may have little or no difference in neck pain both immediately post treatment and at short-term follow-up."* p. 21
Exercise vs. No Treatment — 52 wk follow-up – Exercise included: general endurance training, dynamic/static ;lowback/pelvic stabilization, general stretching and neuromuscular/body mechanics movement training – One trial (n = 38 analyzed) – Pain scores (VAS) not significantly different between groups	*"Low quality evidence […] shows little to no difference for pain reduction with a combined exercise approach of stabilization of the low back and pelvis, posture awareness, ergonomic training, and strength, co-ordination, endurance, flexibility/smoothness and rhythm exercises when compared to no intervention or a wait list control in chronic neck pain at short-term follow-up."* p. 21
Exercise vs. Sham mobilization — 4 wk and 12 mo follow-up – Exercise included: stretch/ROM (including self-sustained natural apophyseal glide [SNAG]) exercises – One trial (n = 32) – Pain intensity scores (headache questionnaire) significantly improved in the physiotherapy group at both 4 wk and 12 mo follow-up	*"Low quality evidence […] shows people may improve a large amount for pain reduction at short- and long-term follow-up with the use of C1-C2 self-SNAG exercises when compared with a sham for (sub)acute cervicogenic headache. A clinician may need to treat three people to achieve this type of long-term pain relief."* p. 22
Ebadi et al. 2014[7]	
Ultrasound vs. Sham Ultrasound— immediately post-intervention follow-up – One trial (n = 10) – Back-specific functional status (Functional Rating Index) not different between groups: SMD = -0.26, 95% CI: -1.51 to 0.98 – Flexion ROM not different between groups: SMD = 1.39, 95% CI: -0.07, 2.86 – Extension ROM not different between groups: SMD = 0.17, 95% CI: -1.08 to 1.41	*"No high quality evidence was found to support the use of ultrasound for improving pain or quality of life in patients with non-specific chronic LBP. […] Since there are few high quality randomized trials and the available trials are very small, future large trials with valid methodology are likely to have an important impact on our confidence in the estimate of effect and may change the estimate."* p. 2
McCaskey et al. 2014[15]	
PrT vs. Control — 4 to 48 wk follow-up – Of four RCTs (n = 253) investigating pain, three (n=147) reported that pain (VAS, NRS or McGill Pain Rating Index) was significantly lower following 4-5 wk of PrT vs. Control (no treatment) – In two RCTs (n = 156) back-specific functional status (ODI, WDI or PDI) was not significantly different between PrT and Control (no treatment) groups at the end of 4 or 48 wk of treatment or at long-term follow-up (duration not specified) – In two RCTs (n = 97), head repositioning accuracy measures (head repositioning accuracy, relocation from neutral, pre-rotated relocation) were significantly greater following 4-5 wk of PrT vs. Control (no treatment)	"*Low quality evidence suggests PrT may be more effective than not intervening at all."* p. 1

Main Study Findings	Author's Conclusion
Damgaard et al. 2013[17]	
Myofeedback training or Muscular Strength Training vs. Control —1 to 3 mo follow-up – One trial (n = 60) – No difference between groups in the following after one-mo intervention or at three mo of follow-up: WAI, working degree, changed work ability, pain (NRS), Copenhagen Psychosocial Questionnaire, cutlery wiping performance test, dexterity, maximum grip strength **Dynamic Muscle Training or Relaxation Training vs. Control — 3, 6 and 12 mo follow-up** – One trial (n = 393) – No difference in pain (scale, questionnaire) between groups **Strength Training, Endurance Training, or Coordination Training vs. Control — post-intervention follow-up** – One trial (n = 103) – "Pain-at-worst" after 10 wk intervention significantly lower in strength training and endurance training groups vs. control, but no difference on "pain-at-present" or "pain-at-general" and no other between-group differences **Thrust Manipulation at T3-T4 vs. Placebo Manipulation at T3-T4 — immediately post-intervention follow-up** – One trial (n = 100) – No difference in pain (VAS) or pupil diameter between groups **Laser vs. Sham Laser — immediately post-intervention to 12 wk follow-up** – Four trials, not pooled (n=235) – In one (n=90) out of four trials, the improvement in pain (VAS) was significantly greater in laser vs. sham laser groups at 12 wk follow-up – In 3 out of 4 trials (n = 145), there was no difference in pain (VAS) between laser and sham laser groups following 10 days (n = 60), 2 wk (n = 47) or 4 wk (n = 38) of treatment; additionally, there was no difference in physician assessment of pressure pain, angle of lordosis, ROM, or NPDS between groups **Ultrasound, massage, exercise vs. Sham vs. Control — 6 mo follow-up** – One trial (n = 67); no difference in pain (VAS) or measure of trigger points between groups **rMS or TENS vs. Sham Ultrasound —1 to 3 mo follow-up** – One trial (n = 53); NPDVAS significantly improved in rMS group vs. sham ultrasound group post-intervention and at 1 and 3 mo of follow-up; NPDVAS significantly improved in TENS group vs. sham ultrasound group post-intervention but not at 1- or 3-mo follow-up	"*[S]ufficient evidence for application of a specific physiotherapy modality or aiming at a specific patient subgroup is not available.*" p. 1 "*[F]or some of the treatments offered, no definite effect and clinical usefulness can be shown. This does not necessarily implicate that these treatments have no effect, only that the present evidence is not sufficient.*" p. 18

Main Study Findings	Author's Conclusion
Kroeling et al. 2013[4]	
Modulated Galvanic Current vs. Placebo — immediately post-intervention follow-up – One trial (n = 40); 1 wk of treatment – Pain (VAS) not significantly different between groups: RR = 0.69, 95% CI: 0.39 to 1.24 – Patient-rated improvement not different between groups: RR = 0.77, 95% CI: 0.45 to 1.32	*"[T]here was very low quality evidence of no difference in pain or global perceived effect when diadynamic modulated Galvanic current was evaluated at immediate post-treatment."* p. 13
Iontophoresis vs. No Treatment — immediately post-intervention follow-up – One trial (n = 60); duration of treatment not reported – Pain (patient-report) not significantly different between groups: RR = 1.00, 95% CI: 0.56 to 1.79 – Cervicogenic headache not different between groups: RR = 0.66, 95% CI: 0.28 to 1.57	"*[V]ery low quality evidence suggested that iontophoresis when compared to no treatment improved pain and headache for patients with acute WAD with or without cervicogenic headache."* p. 13
TENS vs. Sham Control — immediately post-intervention to 3 mo follow-up – Three trials (n = 112); 1 session to 3 wk of treatment – Two out of three trials reported reduced pain intensity (VAS or NPDVAS) immediately post-treatment in TENS vs. sham control (results not pooled) – One trial (n = 38; 1 session of treatment) reported lower PPT immediately post-treatment in TENS vs. sham control: SMD = -1.43, 95% CI: -2.15 to -0.71 – One trial (n = 31; 2 wk of treatment) reported no difference between groups in pain intensity (NPDVAS) at 3-mo follow-up: SMD = -0.52, 95% CI: -1.24 to 0.20	"*[T]here was very low quality evidence […] showing varied results for TENS therapy, with different frequencies and treatment schedules, immediately post-treatment for patients with chronic neck pain."* p. 14
EMS vs. Sham Control — immediately post-intervention follow-up – One trial (n = 40); 1 session of treatment – No difference between groups in pain intensity (VAS; SMD = -0.36, 95% CI: -0.99 to 0.27) or PPT (SMD = -0.53, 95% CI: -1.17 to 0.10) following treatment	"*[T]here was very low quality evidence […] that a single treatment of EMS had no effect on trigger point tenderness compared to placebo treatment in patients with chronic neck pain."* p. 15
EMS (interferential current) vs. No Treatment — immediately post-intervention follow-up – One trial (n = 26); duration of treatment not reported – No difference between groups in neck pain (patient-report; OR = 0.76, 95% CI: 0.18 to 3.24) or headache (OR = 1.37, 95% CI: 0.29 to 6.53) following treatment	"*[T]here was very low quality evidence […] that EMS neither reduced neck pain nor cervicogenic headache in patients with acute WAD, compared to no treatment."* p. 15
rMS vs. Sham Ultrasound— 2 wk to 3 mo follow-up – Two trials (n = 53); 2 wk of treatment – Reduction in pain and functional disability (NPD) was greater in rMS vs. placebo at 2 wk (SMD = -0.81, 95% CI: -1.73 to -0.24), 1 mo (SMD = -1.35, 95% CI: -1.96 to -0.74) and 3 mo (SMD = -1.01, 95% CI: -1.77 to -0.24) following treatment	"*[W]e found very low quality evidence […] that rMS was effective for a short-term reduction of chronic neck pain and disability compared to placebo."* p. 18
Static magnetic field (necklace) vs. Sham Control — immediately post-intervention follow-up	"*[T]here was low quality evidence […] that permanent magnets were not effective for chronic neck and shoulder pain relief."* p.

Main Study Findings	Author's Conclusion
– One trial (n = 52); 3 wk of treatment – No difference between groups in pain intensity (rating scale; SMD = 0.27, 95% CI: -0.27 to 0.82) or patient-rated improvement (RR = 0.85, 95% CI: 0.48 to 1.50) post-treatment – No adverse side effects or costs were reported in any of the included studies	19 "*The evidence for all electrotherapy interventions for neck pain is of low or very low quality, which means that we are very uncertain about the estimate of effect.*" p. 21 "*Current evidence for rMS, TENS […] show that these modalities might be more effective than placebo […] Galvanic current, iontophoresis, electric muscle stimulation (EMS) and a static magnetic field did not reduce pain or disability.*" p. 21
Macedo et al. 2013[1]	
Ultrasound+Exercise vs. No treatment – 3 wk of treatment – One trial (n = 33 eligible for the present review) – Back pain scores (VAS) significantly lower in ultrasound+exercise group: MD = -23.3, 95% CI: -43.7 to -2.9 – Disability scores (ODI) significantly lower in ultrasound+exercise group: MD = -7.1, 95% CI: -13.7 to -0.5 – Ambulation time on a treadmill test was significantly higher in the ultrasound+exercise group: MD = 293.9 s, 95% CI: -67.1 to 654.9	*"There is low-quality evidence suggesting that exercise [plus ultrasound] therapy leads to better short-term outcomes than no exercise with respect to disability and back and leg pain. However, the mean effect for disability was small (7.1 on a 100 scale) and clinically questionable."* p. 1655
Wegner et al. 2013[19]	
Traction vs. Placebo, sham or no treatment — 3-5 week follow-up – Two trials pooled (n = 247; LBP with/without radiation) – Pain intensity (VAS) scores significantly lower in the traction groups: MD = -18.49, CI: -24.12 to -12.87 **Traction vs. Placebo, sham or no treatment — immediately post-intervention (5 wk), 12 wk and 6 mo follow-up** – One trial (n = 150; LBP with/without radiation) – Function (RMDQ) neither significantly different between groups at 3 to 5 weeks follow-up (MD = -1.3, 95% CI: -2.90 to 0.30) nor any other time point – Global improvement not significantly different at 3 to 5 weeks follow-up: RD = 0.07, 95% CI: -0.22 to 0.09 nor any other time point – Return-to-work (days) not significantly different between groups at 3 to 5 weeks follow-up: RD = -1.80, 95% CI: -5.51 to 1.91 nor any other time point **Traction vs. Placebo, sham or no treatment — 1-2 wk follow-up** – Two trials pooled (n = 79; LBP with radiation) – Pain intensity scores (VAS) not significantly lower in the traction groups: MD = 2.93, 95% CI: -14.73 to 20.59 **Traction vs. Placebo, sham or no treatment — 2 yr follow-up** – One trial (n = 39; LBP with radiation) – Return-to-work not significantly different between groups: RD = 0.15, 95% CI: -0.15 to 0.45	*"There was low-quality evidence that decrease in pain intensity was greater in participants treated with traction at three to five weeks' follow-up[…]"* p. 11-12 *"Moderate-quality evidence indicated there was a small positive effect on functional status favouring the sham group at three to five weeks' follow-up [...]. There was no difference in global improvement at three to five weeks or at six to 12 weeks [...]. Moderate-quality evidence showed mean time to return to work in the traction group was two days earlier."* p.12 *"These findings indicate that traction, either alone or in combination with other treatments, has little or no impact on pain intensity, functional status, global improvement and return to work among people with LBP. There is only limited-quality evidence from studies with small sample sizes and moderate to high risk of bias. The effects shown by these studies are small and are not clinically relevant."* p. 2

Main Study Findings	Author's Conclusion
Traction vs. Sham — 12-16 wk follow-up – One trial (n = 60; LBP without radiation) – Pain intensity scores (VAS) not significantly different between groups: MD = -4.00, 95% CI: -17.65 to 9.65	

Note: "Control" refers to "no treatment". Findings for 4 included systematic reviews were not included in this table because these reviews did not identify any relevant primary studies; therefore, there are no results to report.[11,14,16,18]

DN = dry needling; EF = extrinsic feedback; h = hour; IC = ischemic compression; LBP = low back pain; MD = mean difference; MND = mechanical neck disorder; N/A = not applicable; NDI = Neck Disability Index; NPD = Neck Pain Disability; NPDVAS = neck pain and disability visual analogue scale; NPNPQ = Northwick Park Neck Pain Questionnaire; NRS or NPRS = Numeric Pain Rating Scale; ODI = Oswestry Disability Index; OR = odds ratio; PPT = pressure pain threshold; PrT = proprioceptive training; PT = physiotherapy; RMDQ = Roland Morris Disability Questionnaire; rMS = repetitive magnetic stimulation; ROM = range of motion; RD = risk difference; RR = risk ratio; SF-36 = short form 36; SMD = standardized mean difference; SNAG = self-sustained natural apophyseal glide; UE = upper extremity; VAS = visual analogue scale; WAD = whiplash associated disorders; WAI = work ability index; WDI = Wadell Disability Index; wk = week.

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Appendix 5: Overlap between Included Systematic Reviews

Primary Study Citation	Systematic Review Citation									
	de Araujo et al. 2017[10]	Cagnie et al. 2015[12]	Franke et al. 2015[13]	Gross et al. 2015[20]	Ebadi et al. 2014[7]	McCaskey et al. 2014[15]	Damgaard et al. 2013[17]	Kroeling et al. 2013[4]	Macedo et al. 2013[1]	Wegner et al. 2013[19]
Ang et al. 2009				■						
Ansari et al. 2006					■					
Beinert and Taube 2013						■				
Beurskens et al. 1997										■
Chiu et al. 2005	■									
Chow et al. 2006							■			
Dellve et al. 2011							■			
Fialka et al. 1989								■		
Gam et al. 1998							■			
Goren et al. 2010									■	
Hall et al. 2007				■						
Hansson et al. 2013				■						
Hong et al. 1982								■		
Hsueh et al. 1997								■		
Humphreys and Irgens 2002						■				
Itoh et al. 2007		■								
Jull et al. 2002	■									
Kjellman et al. 2002				■						
Konrad et al. 1992										■
Lundblad et al. 1999				■						
Morone et al. 2012						■				
Oliveira-Campelo et al. 2013		■								
Ozdemir et al. 2001							■			
Pal et al. 1986										■
Philipson et al. 1983								■		
Rendant et al. 2011				■						
Reust et al. 1988										■
Sahin et al. 2011								■		

Primary Study Citation	Systematic Review Citation									
	de Araujo et al. 2017[10]	Cagnie et al. 2015[12]	Franke et al. 2015[13]	Gross et al. 2015[20]	Ebadi et al. 2014[7]	McCaskey et al. 2014[15]	Damgaard et al. 2013[17]	Kroeling et al. 2013[4]	Macedo et al. 2013[1]	Wegner et al. 2013[19]
Schimmel et al. 1986										■
Seidel and Uhlemann 2002							■			
Selkow et al. 2009			■							
Sillevis et al. 2010							■			
Smania et al. 2003								■		
Smania et al. 2005							■	■		
Suni et al. 2006						■				
Thorsen et al. 1992							■			
Viljanen et al. 2003							■			
Von Trott et al. 2009				■						
Waling et al. 2000							■			