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NPTF: Treatment & Prognosis of Neck Pain

Is multimodal care effective for the management of patients with whiplash-associated disorders or neck pain and associated disorders? A systematic review by the Ontario Protocol for Traffic Injury Management (OPTIMa) Collaboration

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Abstract

BACKGROUND CONTEXT: Little is known about the effectiveness of multimodal care for individuals with whiplash-associated disorders (WAD) and neck pain and associated disorders (NAD).

FDA device/drug status: Not applicable.

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PURPOSE: To update findings of the Bone and Joint Decade 2000–2010 Task Force on Neck Pain and Its Associated Disorders and evaluate the effectiveness of multimodal care for the management of patients with WAD or NAD.
STUDY DESIGN/SETTING: Systematic review and best-evidence synthesis.
PATIENT SAMPLE: We included randomized controlled trials (RCTs), cohort studies, and case-control studies.
OUTCOME MEASURES: Self-rated recovery, functional recovery (eg, disability, return to activities, work, or school), pain intensity, health-related quality of life, psychological outcomes (eg, depression, fear), or adverse events.
METHODS: We systematically searched five electronic databases (MEDLINE, EMBASE, CINAHL, PsycINFO, and Cochrane Central Register of Controlled Trials) from 2000 to 2013. RCTs, cohort, and case-control studies meeting our selection criteria were eligible for critical appraisal. Random pairs of independent reviewers critically appraised eligible studies using the Scottish Intercollegiate Guidelines Network criteria. Scientifically admissible studies were summarized using evidence tables and synthesized following best-evidence synthesis principles.
RESULTS: We retrieved 2,187 articles, and 23 articles were eligible for critical appraisal. Of those, 18 articles from 14 different RCTs were scientifically admissible. There were a total of 31 treatment arms, including 27 unique multimodal programs of care. Overall, the evidence suggests that multimodal care that includes manual therapy, education, and exercise may benefit patients with grades I and II WAD and NAD. General practitioner care that includes reassurance, advice to stay active, and resumption of regular activities may be an option for the early management of WAD grades I and II. Our synthesis suggests that patients receiving high-intensity health care tend to experience poorer outcomes than those who receive fewer treatments for WAD and NAD.
CONCLUSIONS: Multimodal care can benefit patients with WAD and NAD with early or persistent symptoms. The evidence does not indicate that one multimodal care package is superior to another. Clinicians should avoid high utilization of care for patients with WAD and NAD.

Keywords: Systematic review; Neck pain and associated disorders; Whiplash-associated disorders; Recovery; Multimodal care; Outcome

Introduction

Most people experience neck pain during their lifetime [1,2]. Neck pain is a public health problem and a leading cause of disability [1,3–5]. Nonspecific neck pain results in significant health-care utilization, work absenteeism, and lost productivity [1,6–9].

Neck pain is a complex biopsychosocial disorder and is associated with physical and psychological symptoms, and its consequences range from transient limitations of daily activities to prolonged work absenteeism [10–15]. The clinical management of neck pain can be complex and may involve combining multiple interventions (multimodal care) to address its symptoms and consequences.

Although understanding the effectiveness of multimodal care is challenging, it is necessary to guide clinical practice. Clinicians manage patients according to their training, beliefs, preferences, and understanding of the evidence and are likely to combine various interventions in a multimodal program of care. Randomized controlled trials (RCTs) can examine the effectiveness of single interventions [16]. However, examining combinations of interventions as delivered in multimodal care affords greater insight into routine practice [17–20].

Few systematic reviews have evaluated the effectiveness of multimodal care for the management of neck pain [16,17,21]. Past reviews have combined trials of multimodal care with trials of specific interventions [22]. Methodologically, this approach is problematic because it may lead to biased conclusions about the effectiveness of a specific intervention. This is because the effectiveness (or ineffectiveness) of an intervention embedded within a multimodal program of care cannot easily be extracted from the effect of other interventions included in the multimodal approach.

In 2008, the Bone and Joint Decade 2000–2010 Task Force on Neck Pain and Its Associated Disorders (NPTF) reported on the effectiveness of noninvasive combined approaches, or multimodal care, for the management of neck pain and associated disorders (NAD), whiplash-associated disorders (WAD), and cervicobrachial pain [23]. The NPTF described multimodal care as combinations of single treatments, rehabilitation programs, or packages of care. The NPTF found evidence from one Québec cohort study that a coordinated multidisciplinary management approach was associated with faster claim closure in individuals with WAD [5]. This finding was not supported by a Saskatchewan cohort study that found referrals to community-based inpatient or outpatient rehabilitation programs were

associated with delayed self-rated recovery from WAD [24]. Similarly, the NPTF found inconsistent evidence that multimodal care was more effective than other interventions for the management of individuals with persistent NAD or cervicobrachial pain [23].

The objective of our systematic review was to update the review of the NPTF on the effectiveness of multimodal care for the management of NAD and WAD. Specifically, we evaluated the effectiveness of multimodal care in improving self-rated recovery, functional recovery, or clinical outcomes in adults or children with WAD (grades I–III), and NAD (grades I–III).

Methods

Registration

This review protocol was registered with the International Prospective Register of Systematic Reviews on July 3, 2013 (CRD42013004999).

Eligibility criteria

Population

Studies of adults and children diagnosed with WAD grades I to III or NAD grades I to III were included in our review. We excluded studies of neck pain because of major structural pathology (eg, fractures, dislocations, spinal cord injury, or neoplasms). WAD was defined using the Québec Task Force classification (Table 1) [3]. We defined NAD according to the definition proposed by the NPTF (Table 2) [25].

Interventions

We defined multimodal care as a treatment approach that includes at least two distinct therapeutic modalities (Table 3), provided by one or more health-care disciplines [16,22]. We excluded studies where the effectiveness of one intervention could be isolated.

Comparison groups

Studies that compared multimodal care to other interventions, placebo/sham interventions, or no intervention were considered.

Outcomes

Eligible studies included self-rated recovery, functional recovery (eg, return to activities at work or school), disability, pain intensity, health-related quality of life, psychological outcomes (eg, depression, fear), or adverse events.

Study characteristics

Eligible studies met the following criteria: English language; published between January 1, 2000 and May 16, 2013 and not reviewed by the NPTF; RCTs, cohort studies, or case-control studies; and included an inception cohort of at least 30 participants per treatment arm with the condition for RCTs or 100 subjects per group with the condition in cohort studies or case-control studies. Study exclusion criteria included: letters, editorials, commentaries, unpublished manuscripts, dissertations, government reports, books and book chapters, conference proceedings, meeting abstracts, lectures and addresses, consensus development statements, or guideline statements; pilot studies, cross-sectional studies, case reports, case series, qualitative studies, narrative reviews, systematic reviews, clinical practice guidelines, biomechanical studies, or laboratory studies; or cadaveric or animal studies.

Information sources

Our search strategy was developed with a health sciences librarian (Appendix I). A second librarian reviewed the search for completeness and accuracy using the Peer Review of Electronic Search Strategies Checklist [26,27]. The following databases were searched: MEDLINE, EMBASE, CINAHL, PsycINFO, and the Cochrane Central Register of Controlled Trials from January 1, 2000 to May 16, 2013. We reviewed the reference list of the NPTF to identify additional eligible studies [22].

The search strategy was first developed in MEDLINE and subsequently adapted to the other databases. The search terms included subject headings specific to each database and free-text words relevant to multimodal care, NAD grades I to III, and WAD grades I to III. Databases containing the results of the searches were created using EndNote X6 (http://endnote.com/if/online-user-manual).

Study selection

Eligible studies from the NPTF were included in our synthesis. New eligible studies were selected through a

Table 1
The Québec Task Force classification of grades of whiplash-associated disorders [3]

Grade	Definition
I	Subjects with neck pain and associated symptoms in the absence of objective physical signs
II	Subjects with neck pain and associated symptoms in the presence of objective physical signs and without evidence of neurologic involvement
III	Subjects with neck pain and associated symptoms with evidence of neurologic involvement including decreased or absent reflexes, decreased or limited sensation, or muscular weakness
IV	Subjects with neck pain and associated symptoms with evidence of fracture or dislocation

Table 2
The Neck Pain Task Force classification of grades of neck pain and associated disorders [25]

Grade	Definition
I	No signs or symptoms suggestive of major structural pathology and no or minor interference with activities of daily living
II	No signs or symptoms of major structural pathology but major interference with activities of daily living
III	No signs or symptoms of major structural pathology but presence of neurologic signs such as decreased deep tendon reflexes, weakness, or sensory deficits
IV	Signs or symptoms of major structural pathology

two-phase screening process. In Phase 1, two randomly paired reviewers independently screened titles and abstracts to determine eligibility. Studies were classified as relevant, possibly relevant, or irrelevant. In Phase 2, the same reviewers independently reviewed manuscripts of possibly relevant studies to make a final determination of eligibility. Reviewers met to resolve disagreements and reach consensus in both phases. We involved a third independent reviewer if consensus could not be reached.

Assessment of risk of bias

Independent reviewer pairs critically appraised the internal validity of eligible studies using the Scottish Intercollegiate Guidelines Network (SIGN) criteria for RCTs, cohort studies, and case-control studies (Table 4) [28]. The SIGN criteria assist with the evaluation of the impact of selection bias, information bias, and confounding on the results of a study. We did not use a quantitative score or a cut-off point to determine the internal validity of studies [29]. Rather, the SIGN criteria were used to assist reviewers in making an informed overall judgment on the internal validity of studies. This methodology has been previously described [30–34].

Specifically, we critically appraised the following methodological aspects of a study: clarity of the research question, randomization method, concealment of treatment allocation, blinding of treatment and outcomes, similarity of baseline characteristics between treatment arms, cointervention/contamination, validity and reliability of outcome measures, attrition, intention-to-treat analysis, and comparability of results across study sites (where applicable). All reviewers were trained in the evaluation of studies using the SIGN criteria. Consensus between reviewers was reached through discussion. An independent third reviewer was used to resolve disagreements if consensus could not be reached. We contacted authors when additional information was needed to complete the critical appraisal. Studies with adequate internal validity were included in our synthesis [35].

Data extraction and synthesis of results

The lead author extracted data from scientifically admissible studies and built evidence tables (Table 5). A second reviewer independently checked the extracted data. Meta-analysis was not performed because of heterogeneity of scientifically admissible studies. A qualitative synthesis of the scientifically admissible studies was performed according to principles of best-evidence synthesis [35].

We stratified our synthesis according to disorder type (ie, WAD or NAD) and duration of the disorder (ie, recent [<3 months], persistent [≥3 months], variable [all duration]). We further stratified the multimodal programs of care according to their effectiveness to determine the components of intervention that are associated with superior outcomes: superior (associated with a minimal clinically important change compared with its comparator) [36], equivalent (no clinically important differences between groups), and inferior (associated with worse outcomes than its comparator). The following minimal clinically important change thresholds were employed: 10 mm on the 100 mm Visual Analog Scale, 2 points on the 11 point a Numeric Rating Scale, 25/100 difference on the Northwick Neck Pain Questionnaire (NPQ), and 5 points on the 50 point Neck Disability Index [37–44]. We estimated the intensity of care in each outcome group by computing the mean number of visits for each category.

Statistical analyses

The interrater agreement for article screening was computed using the kappa coefficient (κ) and 95% confidence intervals (CIs) [45,46]. The percentage agreement for critical appraisal was calculated for admissible/inadmissible results. Similarly, we computed the difference in mean change between groups and its 95% CI to quantify effect sizes. The computation of the 95% CI for the difference in mean change assumed that the preintervention and postintervention outcomes were highly correlated (r=0.8) [47,48].

Reporting

The systematic review was organized and reported based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement [49].

Results

Study selection

Our search yielded 2,187 articles. We removed 570 duplicates and screened 1,618 articles (Figure). A total of 1,543 articles did not meet our selection criteria leaving 23 articles eligible for critical appraisal. Nine studies (11 articles) published from 2007 to 2013 were deemed scientifically admissible and included in our synthesis [50–59]. A further six studies (seven articles) from 2000 to 2006

Table 3
Therapeutic modalities: definitions and examples

Intervention Category	Distinct modality	Definition	Examples of modality components
	Acupuncture	Any body needling, moxibustion, electric acupuncture, laser acupuncture, microsystem acupuncture, and acupressure	Traditional needling Dry needling Burning of specific herbs Electro-acupuncture Photo-acupuncture
	Education	Any structured, standardized, and condition-specific intervention learning experience intended to influence a patient's health knowledge and behavior	Pamphlets Books Videos Neck schools Discussion with health-care providers
	Exercise	A series of specific movements with the aim of training or developing the body by routine practice or as physical training to promote good physical health	Strengthening Flexibility Range of motion
Manual therapy	Manipulation	Techniques incorporating a high-velocity low-amplitude impulse or thrust applied at or near the end of a joint's passive range of motion	Cervical manipulation Thoracic manipulation
	Mobilization	Techniques incorporating a low-velocity and small or large amplitude oscillatory movement, within a joint's passive range of motion	Cervical mobilization Thoracic mobilization
	Traction	Manual or mechanically assisted application of an intermittent or continuous distractive force	Cervical traction
	Prescribed medication	A substance used in treating disease or relieving pain	Acetaminophen Nonsteroidal anti-inflammatory drugs Muscle relaxants Antidepressants
Passive physical modalities		A form of cold, heat, or light application affecting the body at the skin level or ultrasonic or electromagnetic radiation affecting structures beneath the skin surface	Heat application: heat pack, hydrotherapy Cryotherapy: cold pack, vapocoolant spray Low-level laser Electrical muscle stimulation Pulsed electromagnetic therapy
	Passive assistive devices	Device to encourage immobilization in anatomic positions or actively inhibit or prevent movement	Pillows Seat cushions Collars Corsets Rest splints
	Functional assistive devices	Device to align, support, or otherwise facilitate function in the affected region	Shoe orthotics Taping Braces
	Psychological interventions	Methods used to treat emotional disturbances or mental illness primarily by verbal or nonverbal communication	Cognitive behavioral therapy Interpersonal therapy Relaxation Biofeedback
	Soft-tissue therapies	A mechanical form of therapy where soft-tissue structures are pressed and kneaded, using physical contact with the hand or mechanical device	Massage Muscle energy technique Strain-counterstrain

Table 4
Risk of bias for accepted randomized controlled trials based on the SIGN Criteria [32]

Reference	Research question	Randomization	Concealment	Blinding	Similarity at baseline	Similarities between arms	Outcome measurement	Percent dropout	Intention to treat	Multiple sites
Bronfort et al. [50]	Y	Y	Y	Y	Y	Y	Y	Wk 12: DC 3.3%, MD 23.3%, PT 14.3% Wk 26: DC 11.0%, MD 36.7%, HEA 36.3% Wk 52: DC 26.4%, MD 57.8%, HEA 38.5%	Y	NA
Cleland et al. [51]	Y	Y	Y	Y	N	CS	Y	Multimodal+manipulation 14% Multimodal 23%	Y	CS
Escortell-Mayor et al. [52]	Y	Y	Y	Y	N	CS	Y	1 mo: multimodal 4%, TENS 2% 6 mo: multimodal 23%, TENS 19%	Y	CS
Gustavsson et al. [53,54]	Y	Y	Y	Y	N	CS	Y	During intervention: PASS 14%, PT 6% 10 wk: PASS 20%, PT 24% 20 wk: PASS 18%, PT: 22% 1 y: PASS 25%, PT 28% 2 y: PASS 30%, PT 37%	Y	CS
Jull et al. [67]	Y	Y	Y	Y	N	CS	Y	MPT 0% SMP 5.7%	Y	CS
Lamb et al. [55,56]	Y	Y	Y	Y	Y	CS	Y	4 mo: 8% 8 mo: 13% 12 mo: 20% (not available per group)	Y	Y
Pool et al. [57]	Y	Y	Y	Y	Y	N	Y	6 wk: graded exercise 4%, PT 4% 13 wk: graded exercise 4%, PT 7% 26 wk: graded exercise 15%, PT 14% 52 wk: graded exercise 7%, PT 8%	Y	CS
Skillgate et al. [58]	Y	Y	Y	Y	Y	CS	Y	Naprapathy 10% GP 21%	Y	NA
Walker et al. [59]	Y	Y	Y	Y	N	Y	Y	PT 0% MIN 0%	Y	NA

CS, cannot say; DC, chiropractor; GP, general practitioner; HEA, home exercise with advice; MD, medical doctor; MIN, minimal intervention; MPT, multimodal physical therapy; N, no; NA, not applicable; PASS, Pain and Stress Self-Management Group; PT, physical therapy; SMP, self-management program; SIGN, Scottish Intercollegiate Guidelines Network; STT, soft-tissue therapy; TENS, transcutaneous electrical nerve stimulation; Y, yes.

Table 5
Evidence table for accepted RCTs on multimodal care for WAD and NAD

Reference	Subjects and setting, number (n) enrolled	Interventions, number (n) of subjects	Comparisons, number (n) of subjects	Follow-up	Outcomes	Key findings*
Bronfort et al. [50]	Residents from Minnesota (18-65 y.o.); recruited from a pain clinic Case definition: acute/subacute NAD Grade I/II (2–12 wk); neck pain intensity (NRS) ≥3/10 (n=272)	Multimodal care provided by DC (12 wk): manipulation, mobilization, soft-tissue massage, assisted stretching, hot/cold packs, advice to stay active, or modify activity as needed (n=91)	Multimodal care provided by MD (15–20 min visit): NSAIDs, acetaminophen, (narcotics and muscle relaxants if required), advice to stay active or modify activity (n=90) HEA by physical therapists (two 1-h sessions, 1–2 wk apart): instruction on self-mobilization of neck/shoulder provided in person and in handout format; information on cervical spine anatomy, advice about postural instruction, and daily activities (n=91)	12, 26, and 52 wk	Primary outcome: neck pain severity (NRS score 0–10) Secondary outcomes: neck disability (NDI), global improvement, medication use (days/week), satisfaction with care, general health status (SF-36), cervical spine ROM (CA 6000 Spine Motion Analyzer); additional health-care visits Adverse events	Difference in mean change score (DC-MD) Neck pain: 12 wk 0.94 (95% CI 0.37–1.51) 26 wk: 0.78 (95% CI 0.20–1.36) 52 wk: 0.87 (95% CI 0.27–1.47) Neck disability: 26 wk: 2.59 (95% CI 0.03–5.15) Global improvement: 12 wk: 0.42 (95% CI 0.06–0.78) 26 wk: 0.40 (95% CI 0.02–0.77) Medication use: 26 wk: 1.20 (95% CI 0.50–1.90) 52 wk: 1.26 (95% CI 0.53–1.99) Satisfaction score: 12 wk: 0.64 (95% CI 0.36–0.93), 26 wk: 0.61 (95% CI 0.31–0.91), 52 wk: 0.81 (95% CI 0.50–1.12) Physical SF-36: 12 wk: 1.80 (95% CI 0.22–3.37) 26 wk: 2.21 (95% CI 0.57–3.84) 52 wk: 2.41 (95% CI 0.71–4.11) CROM: flexion/extension: 12 wk: 3.11 (95% CI 0.23–5.99) Difference in mean change score (DC-HEA) Satisfaction score: 52 wk: 0.32 (95% CI 0.11–0.54)

(*Continued*)

Table 5
(*Continued*)

Reference	Subjects and setting, number (n) enrolled	Interventions, number (n) of subjects	Comparisons, number (n) of subjects	Follow-up	Outcomes	Key findings*
						Difference in mean change score (HEA-MD) Neck pain: 26 wk: 0.69 (95% CI 0.10–1.28) Neck disability: 26 wk: 2.95 (95% CI 0.37–5.53) Global improvement: 0–52 wk: 0.28 (95% CI 0.01–0.56) Medication use: 26 wk: 1.49 (95% CI 0.78–2.20) 52 wk: 1.00 (95% CI 0.27–1.73) Satisfaction score: 0–52 wk: 0.42 (95% CI 0.11–0.73) Physical SF-36: 26 wk: 2.28 (95% CI 0.63–3.93), 52 wk: 2.24 (95% CI 0.54–3.93) CROM: flexion/extension: 12 wk: 3.51 (95% CI 0.62–6.40) Rotation: 12 wk: 3.60 (95% CI 0.03–7.17) Visits to other health-care providers: 52 wk: DC: 19.8%; HEA: 18.7%; GP: 15.6% Nonserious adverse events: DC: 40%; HEA: 46%; GP: 60%
Cleland et al. [51]	Patients (18–60 y.o.) from 1 of 5 physical therapy clinics in the United States (NH, WI, CO, MA) between July 2007 and December 2008 Case definition: neck pain with or without unilateral	Multimodal care provided by PT with manipulation: manipulation, active ROM, exercise, and soft-tissue therapy by physical therapists (5 sessions over 4 wk): thoracic manipulation using 2	Multimodal care provided by PT without manipulation: exercise and soft-tissue therapy by physical therapists (5 sessions over 4 wk): strengthening and flexibility exercises to neck and shoulder muscles	1 and 4 wk and 6 mo	Primary outcomes: neck disability (NDI score 0–100); neck pain (NPRS score 0–10); self-perceived recovery (GRC score −7 to 7)	No difference between groups for neck pain at 4 wk and 6 mo Difference in mean change (multimodal with manipulation–multimodal) Neck disability:

	upper-extremity symptoms (NDI score of at least 20%) (n=140)	thrust procedures and neck ROM exercises; soft-tissue therapy, strengthening, and flexibility exercises were the same as comparison group (n=70)	with advice to stay active; soft-tissue therapy involved passive manual stretching to neck muscles (n=70)			1 wk: 3.6 (95% CI 1.2–6.0) 4 wk: 3.5 (95% CI 1.3–5.6) 6 mo: 4.6 (95% CI 2.2–7.0) Neck pain: 1 wk: 0.7 (95% CI 0.32–1.1) Self-perceived recovery: (% a very great deal, great deal or quite a bit better; ≥5) 1 wk: manipulation RR 1.63 (95% CI 0.72–3.68) 4 wk: manipulation RR 1.64 (95% CI 1.08–2.48) 6 mo: manipulation RR 2.24 (95% CI 1.60–3.13)
Escortell-Mayor et al. [52]	Residents (18–60 y.o.) from Madrid, Spain (n=90) Case definition: subacute or chronic mechanical neck disorders (NPTF Grade I/II)	Multimodal care provided by PT (10 sessions on alternate days): neuromuscular technique, post-isometric stretching, spray and stretching, and Jones technique; information on postural skills, isometric exercises, neck exercises to perform at home (n=47)	TENS provided by PT (10 sessions on alternate days): frequency of 80 Hz, ≤150 μs pulse duration; information on postural skills, isometric exercises, and neck exercises to perform at home (n=43)	6 mo	Primary outcome: pain intensity (current, average, and worst in previous 2 wk) (VAS score 0–100) Secondary outcome: neck disability (NDI), health-related quality of life (SF-12) Adverse events	No statistically or clinically significant differences in the outcomes No adverse effects reported
Gustavsson et al. [53,54]	Patients with persistent neck pain (18–65 y.o.) recruited from physiotherapy clinics in Sweden (n=156) Case definition: persistent tension-type neck pain (>3 mo) defined as subjective and palpable tenderness in the neck without neurologic signs	Multimodal care provided by PT: PASS group (7 sessions per 7 wk and 1 booster session at 20 wk): progressive, autogenic, and conditioned relaxation training, body awareness exercises, informational lectures and group discussion (pain theory, concepts, and beliefs) (n=77)	Multimodal care provided by PT: manipulation, mobilization, massage, traction, acupuncture, hot pack, TENS, ultrasound, exercise program (home, gym, water based) (n=79)	1 and 2 y	Primary outcome: ability to control pain (CSQ score 0–6), self-efficacy (self-efficacy scale score 0–200) Secondary outcome: ability to reduce pain (CSQ score 0–6); other health-care visits; sick leave (number of days in previous 3 mo); pain intensity (present, average, worst; NRS score 0–10); pain in other body regions (yes/no); analgesic use for neck pain; analgesic use for other body pain; neck disability (NDI score 0–100); pain catastrophizing subscale (CSQ); work-related fear of movement (FABQ work subscale); anxiety and/or	Difference in mean change score (PASS–PT) Ability to control pain 1 y: −0.4 (95% CI −0.63 to −0.17)† Self-efficacy 1 y: −13.7 (95% CI –21.95 to −5.45)† 2 y: −13.0 (95% CI −21.25 to −4.75)† Pain catastrophizing subscale 1 y: 4.2 (95% CI 2.68–5.72)† 2 y: 2.6 (95% CI 1.10–4.10)† Neck disability 1 y: 4.4 (95% CI 1.60–7.20)† 2 y: 4.3 (95% CI 1.35–7.25)† Ability to reduce pain 1 y: −0.5 (95% CI –0.70 to −0.30)† 2 y: −0.5 (95% CI –0.70 to −0.30)†

(*Continued*)

Table 5
(*Continued*)

Reference	Subjects and setting, number (n) enrolled	Interventions, number (n) of subjects	Comparisons, number (n) of subjects	Follow-up	Outcomes	Key findings*
					depression (HADS); satisfaction with care; and use of skills acquired in treatment	Pain intensity: present 1 y: 0.5 (95% CI 0.04–0.96)† 2 y: 0.6 (95% CI 0.13–1.08)† Pain intensity: average 1 y: 0.5 (95% CI 0.04–0.96)† Pain intensity: worst 1 y: 0.5 (95% CI 0.03–0.97)† 2 y: 0.8 (95% CI 0.24; 1.36)† Depression: 1 y: 1.1 (95% CI 0.45–1.75)† 2 y: 1.4 (95% CI 0.72–2.08)† Anxiety: 2 y: 1.5 (95% CI 0.71–2.30)† Satisfaction with care: statistically significant difference favoring PASS at all follow-ups Use of coping skills acquired in treatment: statistically significant difference favoring PASS at all follow-ups
Hoving et al. [61,62]	Patients 18–70 y.o.; referred by 42 GPs in The Netherlands; between February 1997 to October 1998 Case definition: nonspecific neck pain (≥2 wk); reproducible symptoms on physical examination (n=183)	Multimodal care provided by manual therapists (MT) (1×/wk/6 wk): muscular mobilization, articular mobilization, coordination or stabilization exercises, home exercises, able to continue medication, or use over the counter medications (n=60)	Multimodal care provided by PT (2×/wk/6 wk): exercises (strength, ROM, postural, stretching, relaxation, functional); traction; massage; passive stretching, modalities (eg, interferential current, heat) (n=59) Multimodal care provided by GP (1 visit, optional follow-up every 2 wk/6 wk): ergonomic advice; educational booklet; and analgesics	7, 13, 26, and 52 wk	Primary outcomes: self-perceived recovery (6-point ordinal scale); practitioner-rated physical dysfunction (0–10); pain intensity in previous week: average, most severe (NRS score 0–10); neck disability (NDI score 0–50) Secondary outcomes: severity of self-perceived most important functional limitation (NRS score 0–10); CROM (Cybex Electronic Digital Inclinometer 320); general health status (EuroQoL score 0-100); work absence (diary), analgesic use (diary) Adverse events	Mean difference change (MT–GP) Self-perceived recovery (% completely recovered or much improved): 7 wk: 32.4 (95% CI 15.8–49.0) 13 wk: 29.5 (95% CI 12.9–46.1) Physical dysfunction: 7 wk: 1.7 (95% CI 0.9–2.5) 13 wk: 1.6 (95% CI 0.8–2.3) 52 wk: 0.9 (95% CI 0.01–1.7) Pain severity: previous week Bothersomeness: 7 wk: 1.5 (95% CI 0.4–2.5) Average pain: 7 wk: 0.9 (95% CI 0.9–1.7) 13 wk: 0.9 (95% CI 0.1–1.8) Most severe pain: 7 wk: 1.4 (95% CI 0.4–2.4) Main functional limitation: 13 wk: 1.2 (95% CI 0.2–2.2)

						Range of motion: greater improvement in flexion-extension favoring MT at 13 and 52 wk General health status: 7 wk: 8.0 (95% CI 3.4–12.7) 13 wk: 5.8 (95% CI 0.7–11.0) Mean difference change (PT–GP) Physical dysfunction: 7 wk: 1.1 (95% CI 0.3–1.9) 13 wk: 1.3 (95% CI 0.5–2.1) Mean difference change (MT–PT) Self-perceived recovery (%): 7 wk: 17.5 (95% CI 0.1–34.8) Pain severity previous week Average pain: 52 wk: 1.0 (95% CI 0.1–1.9) Most severe pain: 7 wk:1.2 (95% CI 0.2–2.3) Range of motion: improvement in flexion-extension and rotation favoring MT General health status: 7 wk: 6.2 (95% CI 1.4–11.0) Work absence: 7 wk: MT 13%; PT 29%; GP 26% Analgesic use: 7 wk: MT 51%; PT 53%; GP 80% Adverse events (0–52 wk) Minor short term: headache, increased neck pain, tingling in upper extremities, dizziness MT 30.5%; PT 57.6%; GP 62.5%
Jull et al. [67]	Patients (18–65 y.o.) referred from GPs or through advertising from Queensland, Australia Case definition: WAD Grade	Multimodal PT care (MPT): exercises, low-velocity mobilization, education (ergonomic advice), reassurance, and home	SMP: education booklet, whiplash mechanism, reassurance of recovery, stay active, ergonomic advice, and exercise (2×	10 wk	Primary outcome: self-rated neck pain and disability (NPQ score 0–36) Secondary outcomes: Cervical ROM (3D	Change score NPQ (%): MPT (−10.4 [SD±14]) vs. SMP (−4.6 [SD±8.8]) TSK:

(*Continued*)

Table 5
(*Continued*)

Reference	Subjects and setting, number (n) enrolled	Interventions, number (n) of subjects	Comparisons, number (n) of subjects	Follow-up	Outcomes	Key findings*
	II, 3 mo to 2 y postinjury) (n=71)	exercise (n=36)	per day) (n=35)		measurement device; Fastrac), cervical muscle test, craniocervical flexion test (EMG), emotional distress (GHQ-28), fear of reinjury (TSK score 17–68), stress (IES score 0–75), perceptions of treatment efficiency and relief (VAS score 0–10)	MPT (−1.3 [SD±4.3] vs. SMP (−3.4 [SD±4.3]) Perceived treatment efficiency: MPT (7.3 [SD±1.9]) vs. SMP (4.2 [SD±2.7]) Perceived relief: MPT (6.9 [SD±1.9]) vs. SMP (4.2 [SD±2.7])
Klaber Moffett et al. [65]	Patients (≥18 y.o.) referred from GPs and consultants to 8 community services offering physiotherapy in the United Kingdom, recruited September 1999 to August 2001 Case definition: neck pain of MSK origin lasting at least 2 wk (n=268)	Multimodal PT care: treatments given according to judgment of physiotherapist: may include electrotherapy (interferential, ultrasound, pulsed short wave, Likons TENS, Laser Rebox); manual therapy or mobilization (Cyriax, passive stretching, Maitland, McKenzie, Nags & Snags, traction); advice (postural, lifting, lifestyle); home exercises; acupuncture; collar; relaxation; massage; hot packs; and ice (n=129)	Education: education provided by trained physiotherapists (1–3 sessions) Encouraged to return to normal activities as soon as possible through self-management The physiotherapists had training to improve communication skills, demedicalize the problem, and teach the application of principles of CBT (but not use CBT as an intervention) Allowed cross-over to PT (n=20) n=139	3 and 12 mo	Primary outcome: neck pain and disability (NPQ score 0–36) Secondary outcomes: health-related quality of life (SF-36); fear and avoidance of movement (TSK score 17-68); distress (0–10 scale; 0 not at all distressed to 10 as distressed as it could be) Adverse events	Difference in mean change NPQ Education—multimodal PT care 12 mo 1.99 (95% CI 0.45–3.52) SF-36 Role: physical 12 mo: −6.70 (95% CI −12.96 to −0.44) Role: emotional 12 mo: −11.72 (95% CI −17.57 to −5.86) Mental health 3 mo: −4.68 (95% CI −8.37 to −0.98) 12 mo: −9.36 (95% CI −15.05 to −3.67) Energy and fatigue 3 mo: −4.55 (95% CI −8.80 to −0.29) 12 mo: −9.24 (95% CI -14.66; −3.82) Pain 12 mo: −6.75 (95% CI −13.18 to −3.82) General health perception 12 mo: −8.15 (95% CI −12.35 to −3.95)‡ TSK 3 mo: −2.23 (95% CI −3.73 to −0.74)‡ Adverse events None reported

Lamb et al. [55,56]	Patients (≥18 y.o.) attending EDs in 12 NHS trusts in England Case definition: WAD Grade I–III <6 wk duration with symptoms that persisted >3 wk after presenting to ED (n=599)	Multimodal care provided by PT (maximum 6 sessions per 8 wk): MT: Maitland cervical and thoracic mobilization; Maitland thoracic spine manipulation; NAGS and SNAGS; shoulder complex mobilizations Exercise: cervical, thoracic, and shoulder ROM, cervical or scapular stability, and proprioception Psychological strategies: goal setting or pacing, education about pain and recovery, effective coping strategies, reassurance, relaxation, referral for stress reaction, and self-management advice (posture and positioning) (n=300)	One session with PT to reinforce the advice given in ED (n=299)	4, 8, and 12 mo	Primary outcome: Self-rated disability (NDI score 0–100) Secondary outcomes: health-related quality of life (SF-12 physical and mental components); workdays lost; self-rated benefit; self-reported NHS and private health-care resource use; prescribed medications; diagnostic tests; community health resource use; compensation claim history at 12 mo; and adverse events	Difference in mean change score (multimodal PT–PT advice) Self-rated disability: 4 mo: −3.7 (95% CI −6.1 to −1.3) Secondary outcome: mean workdays lost: 4 mo: −4 (95% CI −7.9 to −1.1) 8 mo: −4 (95% CI −7.7 to −0.5) 12 mo −4 (95% CI −7.5 to −0.2) Self-rated benefit: 4 mo: PT: OR=2.19 (95% CI 1.54–3.11)[§] Health service resource use: multimodal care by PT reported statistically significant greater GP consultations and ED visits Prescription drugs Multimodal care by PT reported statistically significant greater use of pain killers, anti-inflammatory drugs, gels and creams, and sleeping medication No serious adverse events
McReynolds and Sheridan [66]	Patients (18–50 y.o.) from emergency departments of 3 teaching hospitals in Texas, USA, recruited from January 1999 to June 2002 Case definition: acute MSK neck pain <3 wk duration (n=58)	Multimodal care provided by osteopathic physician (1 session <5 min): high-velocity, low-amplitude manipulation, muscle energy technique, soft-tissue techniques (n=29)	IM ketorolac: provided by nurse (30 mg) (1) (n=29)	1 h	Pain intensity (NRS score 1–10); 5-point Pain Scale (A no relief, D complete relief) Adverse events	Difference in mean change (calculated) Pain intensity: (multimodal care–IM ketorolac) 1 h: 1.1 (95% CI 0.36–1.85) Adverse events: IM ketorolac: 27% reported arm soreness, bad taste in mouth, dizziness, drowsiness, dyspepsia, heart racing, lightheadedness, nausea, or vomiting Multimodal care: 3% reported odd arm sensation but had normal neurologic examination

(*Continued*)

Table 5
(*Continued*)

Reference	Subjects and setting, number (n) enrolled	Interventions, number (n) of subjects	Comparisons, number (n) of subjects	Follow-up	Outcomes	Key findings*
Pool et al. [57]	GP patients (18–70 y.o.) in The Netherlands Case definition: neck pain 4–12 wk duration (n=146)	Multimodal care provided by PT: graded exercise program (18 sessions) with focus on modification of patient behavior (n=71)	Multimodal care provided by PT (6 sessions in 6 wk): manipulation, mobilization, exercises, and advice (n=75)	6, 13, 26, and 52 wk	Primary outcome: self-rated recovery (GPE score 1–7); neck pain severity (NRS score 0–10); neck disability (NDI score 0–50) Secondary outcomes: fear of movement (TSK); pain catastrophizing, pain coping, and pain control (PCCL); distress, depression, fear, and somatization (4DSQ); pain intensity, activity interference, persistent pain (GCPS); general health status (SF-36)	Self-rated recovery: reference group: graded exercise program 13 wk: OR 0.39 (95% CI 0.12–1.28) 52 wk: OR 0.76 (95% CI 0.21–2.68) Neck pain severity (β [95% CI]: 52 wk: 0.99 (95% CI 0.15–1.83) Neck disability (β [95% CI]): 13 wk: 2.05 (95% CI 0.17–3.93) 52 wk: 2.42 (95% CI 0.52–4.32)
Scholten-Peeters et al. [63]	Patients (18–55 y.o.) referred from GP and 3 ED in The Netherlands recruited from June 1999 to June 2002 Case definition: Grade I or II WAD caused by road-traffic accident; not functionally recovered within 4 wk (n=80)	GP care: education and advice (over 9 mo): reassurance, stay active, resume activities, and expected prognosis (n=42)	Multimodal care provided by PT: education, advice, graded activity, and exercise therapy by PT (over 9 mo): reassurance, stay active, resume activities, expected prognosis, graded activity, progressive loading exercises for the neck and shoulder, ROM, posture, balance, functional activities, and manual techniques permitted. (n=38)	8, 12, 26, and 52 wk	Primary outcomes: neck pain intensity (VAS score 0–100); headache intensity (VAS score 0–100); work activities in daily living (VAS score 1–100) Secondary outcomes: functional recovery (VAS); general health status (SF-36); cervical ROM (cervical range-of-motion device); fear of movement (TSK); coping (PCI); disability (NDI); disability in housekeeping and social activities (VAS) Adverse events	Mean difference change (GP–PT) Neck pain intensity: 52 wk: 9.3 (95% CI −1.4 to 19.9) Headache intensity: 52 wk: 13.0 (95% CI −4.2 to 30.3) Work activities in daily living: 52 wk: 11.3 (95% CI −1.0 to 23.7) No statistically significant differences between groups for any primary outcomes Cervical rotation: 12 wk: −12.3 (95% CI −21.9 to −2.7)‡ Functional recovery (GP vs. PT) Reference group: PT: 52 wk: RR 2.3 (95% CI 1.0–5.0) No statistically significant differences for SF-36, lateroflexion, flexion-extension, total ROM,

						TSK, PCI, NDI, disability in housekeeping, and social activities Co-interventions (GP vs. PT): co-interventions were given significantly more often to GP patients 12 wk: 14.3% vs. 0% 52 wk: 28.6% vs. 10.5% Adverse events: none
Skillgate et al. [58,64]	Employees of two public companies in Stockholm, Sweden Case definition: neck pain (>2 wk) with marked dysfunction at work and/or in leisure time (n=265)	Multimodal care provided by naprapath: individualized naprapathic manual therapy (up to 6 sessions per 6 wk) including spinal manipulation and mobilization, massage, and stretching; advice on physical activity and ergonomics; physician-prescribed medication (n=131)	Multimodal care provided by GP: support and advice by a physician: 15-min session staying active, exercises, and pain coping strategies; booklet of exercises and general information provided; physician-prescribed medication (n=134)	7, 12, 26, and 52 wk	Primary outcomes: neck pain and disability modified CPQ score (score 0-10) and WDQ score (score 0-10) Secondary outcome: health-related quality of life (SF-36); symptom improvement Adverse events	Difference in mean change score (naprapath– GP Neck pain (modified CPQ) 12 wk: 1.3 (95% CI 0.8–1.8) 26 wk: 0.9 (95% CI 0.3–1.6) 52 wk: 0.8 (95% CI 0.2–1.4) Neck disability (modified CPQ) 12 wk: 0.6 (95% CI 0.0–1.2) 52 wk: 0.7 (95% CI 0.1–1.4) Neck disability (modified WDQ) 12 wk: 0.5 (95% CI 0.1–0.9) 52 wk: 0.5 (95% CI 0.1–1.00) Symptom improvement (reference group: GP) Very much improved 12 wk: RR 4.3 (95% CI 2.6–6.9) Naprapathic adverse reactions: muscle soreness, tiredness, increased pain after first and second appointments
Taimela et al. [60]	Participants recruited from workplaces in Finland (30–60 y.o.) Case definition: nonspecific, recurrent or chronic neck pain ≥3 mo (n=76)	Active Multimodal care provided by a physical therapist (2× per wk for 12 wk, 45 min per session): cervicothoracic stabilization; relaxation, behavioral support, eye fixation, and seated wobble board (n=25)	Home Multimodal care provided by a physical therapist (2× over 2 wk): pain lecture, home exercises, and progress diary (n=25) Work Multimodal care provided by a physical therapist (1 session): pain lecture and home and work exercises (n=26)	3 and 12 mo	Primary outcomes: cervical ROM; pain intensity (VAS score 0–100); PPT Secondary outcomes: physical impairment (VAS score 0 to 100); fear avoidance (FABQ); self-perceived benefit; symptom reduction; mood, general health; working ability Adverse events	Difference in mean change score (active–home) Cervical ROM Sagittal mobility: 3 mo: −10.5 (95% CI −3.65 to −17.35)† Trapezius PPT: 3 mo: −13.4 (95% CI −3.85 to −22.95)† Active–work Cervical ROM Sagittal mobility:

(*Continued*)

Table 5
(*Continued*)

Reference	Subjects and setting, number (n) enrolled	Interventions, number (n) of subjects	Comparisons, number (n) of subjects	Follow-up	Outcomes	Key findings*
						3 mo: −7.6 (95% CI −1.10 to −14.10)† Trapezius PPT 3 mo: −7.7 (95% CI −15.31 to 0.09)† Home–work Trapezius PPT 12 mo: −7.8 (95% CI −13.65 to −1.95)† Adverse events: muscular pain and dizziness: active 8%; home 0%; work 0%
Walker et al. [59]	Patients of 3 US military treatment facilities (>18 y.o.) Case definition: neck pain, with/without unilateral UE symptoms; ≥10 NDI; ≥30 mm composite pain VAS (n=98)	Multimodal care provided by PT (2× per wk for 3 wk): thrust/nonthrust joint mobilization; muscle energy, stretching and home exercise (cervical retraction, deep neck flexor strengthening, cervical rotation ROM) (n=50)	Multimodal minimal intervention by PT: postural advice; encouragement to maintain neck motion and daily activities; cervical rotation ROM exercise; instructions to continue prescribed medication; subtherapeutic pulsed ultrasound to the neck and cervical ROM exercises (3 wk; 2× per wk) (n=48)	3, 6, and 52 wk	Primary outcome: neck disability (NDI score 0–50); pain intensity: cervical; upper extremity (VAS score 0–100); self-perceived recovery (GRC score −7 to +7) Secondary outcome: self-perceived treatment success rate (≥6 on GRC); number of patients' seeking follow-up care post treatment	Mean difference (PT–minimal intervention PT) NDI: 3 wk: −4.4 (95% CI −6.9 to −1.9) 6 wk: −5.6 (95% CI −8.2 to −3.0) 52 wk: −5.1 (95% CI −8.1 to −2.1) Cervical pain: 3 wk: −12.9 (95% CI −21.4 to −4.3) 6 wk: −14.2 (95% CI −22.7 to −5.6) 52 wk: −6.8 (95% CI −16.3 to −2.7) GRC (great deal or very great deal better): statistically significant difference between groups, in favor of multimodal PT, for GRC at each time point, 95% CI not provided. 3 wk: 1.9 6 wk: 2.1 52 wk: 1.9 Treatment success: 3 wk: PT 53%; minimal intervention 28%

6 wk: PT 49%; minimal intervention 28%
52 wk: PT 62%; minimal intervention 32%
Post treatment health-care utilization:
52 wk: PT 29%; minimal intervention 43%

DSQ, Dimensional Symptom Questionnaire; BGA, Behavioral Graded Activity; CBT, cognitive behaviour therapy; CI, confidence interval; CPQ, Chronic Pain Questionnaire; CSQ, Coping Strategies Questionnaire; ED, emergency department; EMG, electromyography; FABQ, Fear-Avoidance Beliefs Questionnaire; GCPS, Graded Chronic Pain Scale; GP, general practitioner; GPE, global perceived effect; GRC, global Rating of Change Scale; HADS, Hospital Anxiety and Depression Scale; HEA, home exercise with advice; IES, Impact of Events Scale; IM, intramuscular; MT, manual therapy; MND, mechanical neck disorder; MPT, multimodal physical therapy; MSK, musculoskeletal; NAD, neck pain and associated disorders; NHS, National Health Service; NAGS, Natural Apophyseal Glides; NDI, Neck Disability Index; NPQ, Northwick Pain Questionnaire; NPRS, Numeric Pain Rating Scale; NPTF, Bone and Joint Decade 2000 to 2010 Task Force on Neck Pain and Its Associated Disorders; NRS, Numeric Rating Scale; NSAID, Nonsteroidal anti-inflammatory drug; OR, odds ratio; PASS, Pain and Stress Self-Management; PCCL, Pain Coping and Cognition List; PCI, Pain Coping Inventory; PT, physiotherapist/physical therapist; PPT, pressure pain threshold; RCT, randomized controlled trial; ROM, range of motion; RR, relative risk; SA, support and advice; SD, standard deviation; SES, Self-efficacy Scale; SF-36, Medical Outcomes Study Short Form-36 Health Survey; SMP, Self-Management Program; SNAGS, Sustained Apophyseal Glides; TENS, transcutaneous electrical nerve stimulation; TSK, Tampa Scale of Kinesiophobia; UE, upper extremity; VAS, Visual Analog Scale; WAD, Whiplash-associated disorders; WDQ, Whiplash Disability Questionnaire; y.o., years old.

* Clinical or statistical significant differences only reported.

† Calculated by OPTIMa team [47,48].

‡ Group by time interaction, NDI baseline as covariate, and Bonferroni correction.

§ OR, ordinal logistic regression, adjusted for WAD grade, cluster, and therapist. SF-12 recall period in the previous week. NDI recall period in the past month. Workdays lost recalled in the past 4 months. Self-report change in neck symptoms recalled in the past 4 months.

were included in the NPTF [60–66]. Of these, five studies were not included in the NPTF evidence of multimodal care. We therefore included these five studies in our evidence synthesis of multimodal care [61–66].

The interrater agreement for the screening of articles was κ=0.80 (95% CI 0.70–0.89). We achieved 90% agreement (10/11) for the critical appraisal of studies.

Study characteristics

All 14 scientifically admissible studies (18 articles) were RCTs. Three studies addressed recent neck pain [50,57,66], two addressed persistent neck pain [53,54,60], and six targeted neck pain of variable duration [51,52,58,59,61,62,64,65]. Two studies investigated NAD Grade III [51,57], two addressed recent WAD [55,56,63], and one addressed persistent WAD Grade II [67].

The multimodal programs included a range of interventions: education, exercise, manipulation, mobilization, traction, soft-tissue therapy, acupuncture, heat and/or cold, electrotherapy, prescribed medication, and psychological interventions (Table 6). The most commonly used interventions were exercise (13/14), manual therapy (12/14), and education (12/14). Five health-care professions delivered multimodal care: physical therapists, physicians (MD, GP, osteopathic physician), naprapaths, nurses, and chiropractors (DC). One study included more than one health-care provider in a single treatment arm [58,64].

Risk of bias within studies

All admissible RCTs used appropriate randomization procedures, concealment of treatment allocation, blinding (where possible), appropriate outcome measures, and performed an intention-to-treat analysis (Table 4). Some studies had limitations: differences in baseline characteristics [51–54,67] and cointervention information unavailable. The follow-up rate for most RCTs was more than 75% [51–56,58,64,67], except two RCTs with follow-up rates more than 60% [50,53,54].

Twenty-three percent (5/22) of critically appraised studies had poor internal validity [68–72]. The methodological weakness of the excluded RCTs include inadequate methods of randomization (2/4), concealment (2/4), and blinding (2/4) [70,71]. All four RCTs had important differences in baseline characteristics and high attrition [68,70–72] and three trials did not address cointerventions [68,71,72]. Intention-to-treat analyses could not be confirmed in two trials [68,72]. The inadmissible cohort study did not describe the source population or sampling frame; it had high attrition (60%) and the validity and reliability of the outcome could not be established [69].

Summary of evidence

Recent whiplash-associated disorders Grades I to III

Evidence from one RCT suggests that multimodal care by a physiotherapist is more effective than one education

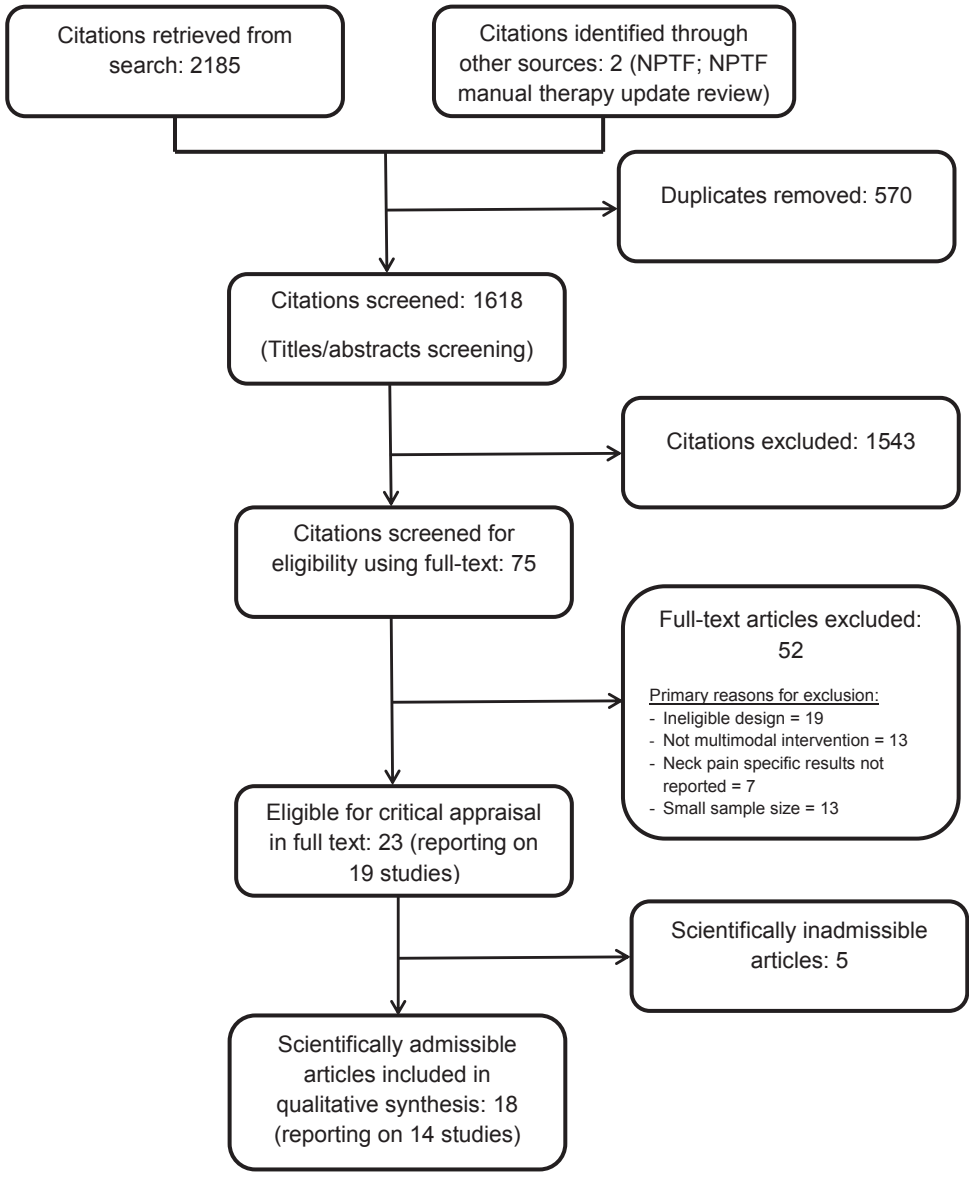

Figure. Identification and selection of articles.

session for the management of patients with recent WAD grades I to III (Table 5) [55,56]. In the RCT by Lamb et al. [55,56], patients with symptoms persisting 3 weeks after attending an emergency department were randomized to multimodal care or an education intervention. Multimodal care (up to 6 visits per 8 weeks) could include manual therapy, heat or cold, exercise (eg, range of motion, proprioceptive training), and psychological strategies (eg, relaxation, coping strategies). Compared with education, multimodal care led to statistically but nonclinically important improvement in self-rated disability (mean change difference −3.7/100 [95% CI −6.1 to −1.3]). Multimodal care was also associated with greater self-perceived benefit (OR=2.19 [95% CI 1.54–3.11]) and reduced workdays lost (mean change difference 4 [95% CI −7.9 to −1.1]) at 4 months.

A second RCT suggests that education from a general practitioner (GP) leads to superior outcomes compared to multimodal care by a physiotherapist. Scholten-Peeters et al. [63] reported no statistically significant difference in neck pain intensity, headache intensity, and activities of daily living between participants randomized to education by a GP and those allocated to multimodal care (education and advice, exercise) (Table 5). However, those who received the GP intervention were more likely to report self-perceived functional recovery (relative risk [RR]=2.3 [95% CI 1.0–5.0]) at the 1-year follow-up. The intensity of care was lower for GP care (mean=3.9/18.8 weeks) than multimodal care (mean=12.7/19.9 weeks).

Persistent whiplash-associated disorder Grade II

Evidence from one RCT suggests that multimodal care provided by physiotherapists (exercise, mobilization, education, and ergonomic advice) provides similar outcomes to a self-management program based on an educational booklet

Table 6
Combinations of interventions in multimodal care reported in scientifically admissible randomized controlled trials, 2000 to 2013

Reference	Treatment provider	Number of visits	Treatment period (wk)	Education	Exercise	Manual therapy			Soft-tissue therapy	Acupuncture	Passive modalities		Medication	Psychological
						Manipulation	Mobilization	Traction			Heat/cold	Electrotherapy		
Bronfort et al. [50]	DC*	15.3	12	✓		✓	✓		✓		✓			
	PT*	2	12	✓	✓									
	MD*	4.8	12	✓									✓	
Cleland et al. [51]	PT‡	5	4	✓	✓	✓			✓					
	PT†	5	4	✓	✓				✓					
Escortell-Mayor et al. [52]	PT*	10	2.7		✓				✓		✓			
	PT*	10	2.7		✓							✓		
Gustavsson et al. [53,54]	PT*	7	20											✓
	PT*	11	20		✓	✓	✓	✓	✓	✓	✓	✓		
Hoving et al. [61,62]	PT‡	6	6		✓		✓							
	PT†	9	6		✓			✓	✓		✓	✓		
	GP†	2	6	✓									✓	
Jull et al. [67]	PT*	15	10	✓	✓		✓							
	PT*	UK	10	✓										
Klaber Moffett et al. [65]	PT*	1	UK	✓										
	PT*	UK	UK	✓	✓		✓	✓	✓	✓	✓	✓		
Lamb et al. [55,56]	PT‡	6	8	✓	✓	✓	✓							✓
	PT†	1	1	✓										
McReynolds and Sheridan [66]	Osteopathic Physician*	1	<5 min			✓			✓					
	Nurse*	1	1 min										✓	
Pool et al. [57]	PT*	8.2	6		✓									✓
	PT*	5.2	6	✓	✓	✓	✓							
Scholten-Peeters et al. [63]	GP‡	3.9	18.8	✓										
	PT†	12.7	19.9	✓	✓	✓								
Skillgate et al. [58,64]	Naprapath/MD‡	6	3	✓		✓	✓		✓				✓	
	MD†	2	3	✓									✓	
Taimela et al. [60]	PT*	24	12	✓	✓									✓
	PT*	2	12	✓	✓									
	PT*	1	12	✓	✓									
Walker et al. [59]	PT‡	6	3		✓		✓		✓					
	PT†	6	3	✓	✓							✓		

DC, chiropractor; GP, general practitioner; MD, medical doctor; PT, physical therapist; UK, unknown.
Note: Empty cells indicate that the intervention component was not provided in the treatment arm. Table includes only modalities reported in scientifically admissible studies.
* Equivalent multimodal programs of care.
† Inferior multimodal programs of care.
‡ Superior multimodal programs of care.

(mechanism of whiplash, reassurance of recovery, stay active, ergonomic advice, exercise) for the management of persistent WAD Grade II [67]. Both interventions were provided over a 10-week period. The multimodal care intervention led to a statistically but not clinically important reduction in self-rated neck pain and disability (mean change from baseline −10.4% [standard deviation {SD}±14]), compared with the self-management program (−4.6% [SD±8.8]). Clinically important differences in secondary outcomes were not observed.

Recent neck pain and associated disorders Grades I to III

Evidence from one RCT suggests that multimodal care by chiropractors (manipulation, mobilization, soft-tissue massage, hot/cold packs, and advice), multimodal care by an MD (pain medication and advice to stay active or modify activity), or a program of home exercise (self-mobilization of neck/shoulders) and education by a physiotherapist provide equivalent outcomes for the management of recent NAD grades I to II (Table 5) [50]. All interventions were provided over a 12-week period. The mean number of visits was lowest for the home exercise group (2 visits), followed by multimodal care by MDs (4.8 visits) and last multimodal care by chiropractors (15.3 visits).

Evidence from an RCT suggests that multimodal care (manipulation, mobilization, coordination and stabilization exercises, and advice) by manual therapists and a behavioral graded activity program by physiotherapists provide equivalent outcomes for the management of recent NAD grades I to III (Table 5) [57]. Pool et al. [57] reported no differences in global perceived effect or neck pain intensity. The mean number of visits for behavioral graded activity (8.2 visits) was greater than multimodal care (5.2 visits).

Evidence from one RCT suggests that one session of multimodal care (manipulation, soft-tissue techniques) provided by an osteopath and an intramuscular injection of ketorolac by a nurse provide equivalent outcomes for recent NAD grades I–II (Table 5) [66]. The interventions were delivered on presentation to the emergency department, and the outcome was assessed 1 hour later. The multimodal care intervention led to a statistically but not clinically important reduction in pain intensity (mean change difference 1.1/10 [95% CI 0.36–1.85]) compared with the intramuscular ketorolac group. No difference in self-perceived pain relief was found.

Persistent neck pain and associated disorder Grades I–II

Evidence from one RCT suggests that a physiotherapist-provided group-based pain and stress self-management program (relaxation, balance and body awareness exercise, pain and stress self-management lectures and discussion) offers equivalent outcomes to individualized multimodal care (manual therapy, massage, acupuncture, heat, transcutaneous electrical nerve stimulation, exercise, and ultrasound) by physiotherapists for persistent neck pain (Table 5) [53,54]. Compared with individualized care, there were small statistically but not clinically important changes in favor of the self-management group for all outcomes. The mean intensity of care was 7 visits per 20 weeks for the self-management group compared with 11 visits per 20 weeks for the individualized multimodal physiotherapy group.

Evidence from one RCT suggests that a multimodal program of care that emphasizes proprioceptive training leads to similar outcomes as multimodal care that combines education and instruction about neck exercises. In their RCT, Taimela et al. [60] randomized participants to multimodal care (cervicothoracic stabilization, relaxation, behavioral support, eye fixation, seated wobble board), a home multimodal exercise and education program [60] or a home and work exercise program. Individuals randomized to the clinic-based multimodal care reported greater improvement in sagittal ROM at 3 months but not at 12 months (Table 5). It should be noted that important baseline differences in pain intensity were reported in this trial; however, they were not controlled in the analyses. Therefore, we cannot comment on the impact of these treatments on pain intensity. It is important to consider this source of bias when synthesizing the evidence.

Neck pain and associated disorders Grades I to III (variable duration)

Evidence from one RCT suggests that multimodal care (mobilization and home exercise) by manual therapists is superior to continued GP care (pain medication and advice) and multimodal physiotherapy care (exercises, traction, soft-tissue techniques, and passive electromodalities) by physiotherapists for the management of recent NAD grades I to II (Table 5) [61,62]. All interventions were provided over a 6-week period. Multimodal care was more effective than continued GP care in improving self-perceived recovery (recovered or much improved 32.4% [95% CI 15.8–49.0] at 7 weeks, 29.5% [95% CI 12.9–46.1] at 13 weeks) and pain (mean change difference: bothersomeness 1.5/10 [95% CI 0.4–2.5], most severe 1.4/10 [95% CI 0.4–2.4]) in the short term. Furthermore, multimodal care was more effective than multimodal physiotherapy care in improving self-perceived recovery (recovered or much improved: 17.5% [95% CI 0.1–34.8]) and pain (mean change difference: most severe 1.2/10 [95% CI 0.2–2.3]) in the short term. Patients allocated to continued GP care had fewer visits (median=2) than those in the multimodal manual therapy (median=6) and multimodal physiotherapy (median=9).

Evidence from one RCT suggests that multimodal care (mobilization, muscle energy techniques, and home strengthening and range-of-motion exercises) is superior to multimodal minimal intervention (postural advice, range-of-motion exercise, subtherapeutic ultrasound, and direction to continue prescribed medication) by physiotherapists, for the management of NAD grades I to II (Table 5) [59]. Each group received two treatments per

week over a 3-week period by physiotherapists. Participants randomized to multimodal care receiving mobilization, exercise, and muscle energy techniques reported long-term statistically and clinically important improvement in neck disability (mean change difference: 52 weeks −5.1/50 [95% CI −8.1 to −2.1]) compared with those in the control group. However, only short-term statistically and clinically important differences in neck pain were found favoring multimodal care receiving mobilization, exercise, and muscle energy techniques (mean change difference: 6 weeks −14.2/100 [95% CI −22.7 to −5.6]). Finally, a greater proportion of participants in the minimal intervention group required health-care services postintervention [59].

Evidence from another RCT suggests that adding two sessions of thoracic spine manipulation and neck range-of-motion exercise to a multimodal care program (strengthening and flexibility exercises, advice, and stretching) by physiotherapists does not lead to clinically important improvements in neck pain and neck disability. However, adding manipulation is associated with a higher incidence of reporting improvement at 6 months: RR=2.2 (95% CI 1.6–3.1) (Table 5) [51].

Evidence from a fourth RCT suggests that multimodal care (manipulation, mobilization, massage, stretching, and advice regarding physical activity and ergonomics) provided by a naprapath plus medication prescribed by a physician is superior to MD care (two sessions of education and prescribed medication) for the management of workers with NAD grades I and II (Table 5) [73,74]. Skillgate et al. [58,64] reported small statistically significant (but nonclinically important) differences in neck pain favoring multimodal care by naprapaths. Naprapath care was more effective than MD care in promoting functional recovery (RR 4.3 [95% CI 2.6–6.9]).

Evidence from one RCT suggests that one education session by a physiotherapist provides similar outcomes to multimodal care (electrotherapy, mobilization, education, exercise, acupuncture, massage, relaxation, collar, heat/cold) provided by a physiotherapist for NAD grades I and II of at least 2 weeks duration (Table 5) [65]. Klaber Moffett et al. [65] reported small statistically significant (but nonclinically important) differences in neck pain disability favoring education at 12 months. Small and clinically nonimportant differences in health-related quality of life favored multimodal care.

Evidence from a sixth RCT suggests that a multimodal program focused on soft-tissue therapy (neuromuscular technique, post-isometric stretching, spray, and stretching) provides similar outcomes to transcutaneous electrical nerve stimulation in patients with subacute and chronic NAD grades I and II during 10 visits over 3 weeks (Table 5) [52]. Both groups received verbal and written information during the first two sessions on postural skills, isometric exercises, and neck exercises to perform at home. The authors reported no statistically or clinically significant differences between groups in pain intensity, physical disability, or general health state.

Components of multimodal program of care

The multimodal treatment arms associated with superior outcomes included exercise (67%), manual therapy (83%), and education (67%) [51,55,56,58,59,61–64], whereas programs with equivalent outcomes included education (77%) and exercise (61%) [50,52–54,57,60,65–67] (Table 6). Among all treatment arms, the number of visits ranged from 1 to 15.3 (except one trial that reported 52 visits [53,54]), with treatment duration ranging from 1 minute to 20 weeks. On average, multimodal care included six visits per 8 weeks of care. The inferior treatment arms had an average five visits per 7 weeks [51,55,56,58,59,61–64], whereas superior treatment arms included an average six visits per 8 weeks [51,55,56,58,59,61–64] (Table 6).

Adverse events

Nine admissible RCTs reported adverse events [50,52,55,56,58,60–66]. No RCT reported serious adverse events. Most adverse events were minor (eg, headache, increased neck pain, tingling in upper extremities, dizziness). The proportion of adverse events in participants enrolled in a multimodal program of care ranged from 3% after one multimodal osteopathic treatment [66] to 63% after a multimodal program of care [61,62].

Discussion

Summary of evidence

Our systematic review suggests that there is a role for multimodal care in the management of patients with NAD and WAD. These patients may benefit from a multimodal program of care that includes manual therapy, education, and exercise. The relative effectiveness of the reviewed programs of care does not appear to be related to a specific provider type.

Our review suggests that the intensity of multimodal care is a determinant of outcome. The evidence suggests that patients with recent WAD and NAD who receive more than six visits per 8 weeks do not report better outcomes than those who receive fewer treatments [50,63]. This finding agrees with the results of two Canadian population-based cohort studies that investigated the association between type and intensity of health care received in the first 30 days post-collision and time to recovery from WAD (both studies were reviewed and deemed admissible by the NPTF) [9,75]. In both studies, whiplash patients were stratified into GP low utilization (one or two visits), GP high utilization (more than two visits), DC low utilization (one to six visits), DC high utilization (more than six visits), GP and DC low utilization (one to six visits), GP and DC high utilization (one to six visits), GP and specialists, and general medical groups. Both cohorts provide

consistent evidence that the rate of recovery was faster for individuals receiving low-utilization GP care than for those in the high-utilization chiropractic care (DC), GP plus DC care, or care provided by GP plus specialists. The association between type and intensity of care was strongest during the first 6 months postcollision.

Update of the NPTF

Our review is a significant update of the NPTF. Based on the evidence available up to 2007, the NPTF found inconsistent evidence that multimodal care was more effective than other noninvasive interventions for the management of individuals with NAD and WAD [23]. Our results update the work of the NPTF from two perspectives. First, we refined the methodology to systematically review the evidence on multimodal care by expanding the definition of multimodal care to include at least two distinct therapeutic modalities, provided by one or more health-care disciplines. We clearly specified the distinct therapeutic modalities under consideration. Second, we combined the evidence used by the NPTF with the more recent evidence from high-quality RCTs.

Other systematic reviews

Systematic reviews dedicated exclusively to multimodal care are uncommon. However, studies that include multimodal care have been considered within the context of systematic reviews of single interventions. There are differences in our results compared with those reported by previous systematic reviews. Karjalainen et al. [21] reported that multidisciplinary biopsychosocial rehabilitation did not demonstrate better pain and disability outcomes than a coaching model of care provided by a single health-care provider or traditional rehabilitation for neck and shoulder pain. Leaver et al. [76] reported that multimodal physical therapy, that excluded manual therapy, did not provide better disability outcomes or pain relief than minimal treatment. Binder et al. [77] reported that cognitive behavioral therapy plus physiotherapy may be superior to education and advice but equal to cognitive behavioral therapy alone at reducing the risk of being off work. Finally, Yadla et al. [78] reported that acute WAD patients receiving early and frequent active cervical rotation exercise experienced reduced pain intensity and sick leave compared with a multimodal treatment consisting of rest, soft-collar, and gradual self-mobilization. However, these reviews had important limitations: conclusions based on studies with small sample sizes [21,76] and did not stratify results for neck pain only [21,77].

Strengths and limitations

Our review has strengths. First, we searched five databases, and the search strategy was peer reviewed by a second librarian to minimize errors. Second, we used clear inclusion and exclusion criteria for study selection, only considering studies with a clearly defined inception cohort of individuals with neck pain. Third, the critical appraisal process was standardized using the SIGN criteria. Fourth, we provide a unique method of qualitatively summarizing the results allowing for a clustering of effective therapies. Finally, our conclusions are based on the best-evidence synthesis method to minimize the risk of bias associated with using low-quality studies.

Some limitations are noted in our review. First, we restricted our search to include articles in the English language, which may have excluded some relevant studies. However, other systematic reviews of clinical trials have also limited their search to the English language and this did not lead to biased results [79]. Other systematic reviews reported similar results when studying the effect of language restrictions in conventional medicine [80–83].

We did not review qualitative studies exploring the lived experience of patients receiving multimodal care. We are therefore unable to comment on how patients valued and experienced their exposure to multimodal interventions. Although this is not a source of bias in our review, it is recommended that future systematic reviews consider examining qualitative studies to gain insight into the patients' perspective of multimodal care. Furthermore, our systematic review included clinically heterogeneous samples with different diagnoses and heterogeneous multimodal programs of care. This level of clinical heterogeneity did not allow for the pooling of results through meta-analysis.

Conclusions

Multimodal care reflects the combination of therapeutic interventions that are used by health-care providers to manage patients with neck pain. Overall, our review suggests that multimodal care including education, exercise, and manual therapy can benefit patients with WAD and NAD. However, our systematic review also suggests that there is no additional benefit to providing frequent sessions of multimodal care to patients with WAD and NAD over an extended time period. Furthermore, our systematic review highlights the need for additional quality explanatory randomized controlled trials.

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Supplementary data

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