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NPTF: Treatment & Prognosis of Neck Pain

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

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Abstract

BACKGROUND CONTEXT: In 2008, the Neck Pain Task Force (NPTF) recommended exercise for the management of neck pain and whiplash-associated disorders (WAD). However, no evidence was available on the effectiveness of exercise for Grade III neck pain or WAD. Moreover, limited evidence was available to contrast the effectiveness of various types of exercises.

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PURPOSE: To update the findings of the NPTF on the effectiveness of exercise for the management of neck pain and WAD grades I to III.
STUDY DESIGN/SETTING: Systematic review and best evidence synthesis.
SAMPLE: Studies comparing the effectiveness of exercise to other conservative interventions or no intervention.
OUTCOME MEASURES: Outcomes of interest included self-rated recovery, functional recovery, pain intensity, health-related quality of life, psychological outcomes, and/or adverse events.
METHODS: We searched eight electronic databases from 2000 to 2013. Eligible studies were critically appraised using the Scottish Intercollegiate Guidelines Network criteria. The results of scientifically admissible studies were synthesized following best-evidence synthesis principles.
RESULTS: We retrieved 4,761 articles, and 21 randomized controlled trials (RCTs) were critically appraised. Ten RCTs were scientifically admissible: nine investigated neck pain and one addressed WAD. For the management of recent neck pain Grade I/II, unsupervised range-of-motion exercises, nonsteroidal anti-inflammatory drugs and acetaminophen, or manual therapy lead to similar outcomes. For recent neck pain Grade III, supervised graded strengthening is more effective than advice but leads to similar short-term outcomes as a cervical collar. For persistent neck pain and WAD Grade I/II, supervised qigong and combined strengthening, range-of-motion, and flexibility exercises are more effective than wait list. Additionally, supervised Iyengar yoga is more effective than home exercise. Finally, supervised high-dose strengthening is not superior to home exercises or advice.
CONCLUSIONS: We found evidence that supervised qigong, Iyengar yoga, and combined programs including strengthening, range of motion, and flexibility are effective for the management of persistent neck pain. We did not find evidence that one supervised exercise program is superior to another. Overall, most studies reported small effect sizes suggesting that a small clinical effect can be expected with the use of exercise alone.

Keywords: Whiplash-associated disorders; Neck pain; Exercise; Systematic review; Treatment; Rehabilitation

Introduction

Neck pain is common in the general population with 30% to 50% of adults experiencing neck pain annually [1]. In the United States, neck pain is the fourth leading cause of morbidity and chronic disability [2]. In 2008, The 2000 to 2010 Bone and Joint Decade Task Force on Neck Pain and Its Associated Disorders (NPTF) reported that 50% to 75% of individuals with neck pain report pain 1 to 5 years later [3]. The episodic nature of neck pain also poses a clinical management challenge as few interventions have been identified as effective and treatment effects are often small and short lived [3,4].

Clinical practice guidelines promote exercise for the management of neck pain and associated disorders (herein referred to as neck pain) and whiplash-associated disorders (WAD) [5,6] (Jessica J. Wong, Pierre Côté, Heather M. Shearer, et al. unpublished data, 2013). Moreover, evidence from population-based surveys suggests that it is commonly prescribed by health-care providers [7]. However, guidelines lack consistency in the type, intensity (frequency, duration), and mode of delivery of recommended exercises.

In 2008, the NPTF synthesized evidence on the effectiveness of exercise for the management of neck pain and WAD. Two trials focused on persistent Grade I/II neck pain and compared exercise interventions with other conservative interventions. One trial [8,9] demonstrated that exercise (aerobic exercise, stretching, progressive upper body strengthening, and dynamic resistance exercises for the neck) with or without spinal manipulative therapy resulted in greater long-term improvements in pain and disability than spinal manipulative therapy alone. In another trial by Chiu et al. [10,11], both exercise (activation of deep neck flexors and progressive dynamic flexion/extension resistance training) and Transcutaneous electrical nerve stimulation (TENS) led to similar outcomes in patients with persistent neck pain. Both interventions resulted in greater reductions in neck pain and disability compared with infrared irradiation. The NPTF found three trials that focused on female office workers with persistent neck pain. Two trials [12–14] demonstrated that strengthening and endurance exercises for the neck flexors and upper extremities, either alone or when added to a multimodal physical therapy program, yield similar outcomes with respect to pain and disability. In one trial [15], group exercises (dynamic resistance training for the neck and shoulder) resulted in similar long-term clinical outcomes as group-based relaxation training or advice to continue usual activities. The Task Force found only one trial on exercise for the management of WAD. In a trial by Rosenfeld et al. [16], home-based range-of-motion exercises resulted in greater pain reduction and diminished need for sick leave compared with written information and advice for patients recently exposed to whiplash trauma. The NPTF did not find evidence related to exercise for the management of Grade III neck pain or WAD.

Since the publication of the NPTF, three systematic reviews have commented on the effectiveness of exercise

for the management of neck pain [17–19]. However, all reviews had important limitations. First, their synthesis of results included both high- and low-quality studies [17–19]. Second, two of the three reviews only commented on the statistical significance of results, without reference to clinical significance [18,19]. These methodological limitations may have led to biased recommendations. Moreover, the reviews had a limited scope. Two reviews focused on the subpopulations: workers [18] and those injured in motor vehicle collisions [19]. In the third review, studies that compared exercise with alternative nonexercise interventions were excluded [17]. This limits our ability to understand the comparative effectiveness of exercise interventions for the management of neck pain.

The purpose of our systematic review is to update the work of the NPTF on the effectiveness of exercise compared with other interventions, placebo/sham interventions, or no intervention for the management of adults or children with Grade I, II, or III neck pain or WAD.

Methods

Registration

This review protocol was registered with the International Prospective Register of Systematic Reviews on January 23, 2013 (CRD42013003717).

Eligibility criteria

Population

Our review targeted studies of adults or children with neck pain Grade I, II, or III or WAD Grade I, II, or III. We excluded studies of neck pain caused by major structural pathology (eg, fractures, dislocations, spinal cord injury, infection, neoplasms, or systemic disease). We defined neck pain according to the definition proposed by the NPTF (Table 1) [20]. We used the Quebec Task Force classification to define WAD (Table 2) [21].

Interventions

We restricted our review to studies that tested the effectiveness of exercise. We defined exercise as any series of movements with the aim of training or developing the body by routine practice or as physical training to promote good physical health [22]. We chose a broad definition of exercise therapy to be inclusive of a wide variety of techniques common in the treatment and rehabilitation of neck pain and WAD. Exercise interventions could include any prescribed movements with the intent of affecting clinical outcomes with respect to neck pain and WAD. We excluded studies where the intervention was advice or education only, for example, advice to engage in physical activity.

Table 1
The Neck Pain Task Force classification of grades of neck pain and associated disorders [20]

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

Table 2
The Québec Task Force classification of grades of WAD [21]

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

WAD, whiplash-associated disorders.

Comparison groups

We included studies that compared exercise interventions with other modes of nonsurgical care, wait-list, or no intervention.

Outcomes

To be eligible, studies had to include one of the following outcomes: self-rated recovery; functional recovery (eg, disability, return to activities, work, or school); pain intensity; health-related quality of life; psychological outcomes such as depression or fear; or adverse events.

Study characteristics

Eligible studies met the following criteria: English language; studies published between January 1, 2000 and January 23, 2013 that had not been reviewed by the NPTF; randomized controlled trials (RCTs), cohort studies, or case-control studies; and included an inception cohort of a minimum of 30 participants per treatment arm with the specified condition for RCTs or 100 participants per group with the specified condition in cohort or case-control studies. We excluded studies with the following characteristics: 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

We developed our search strategy with a health sciences librarian (Supplementary data). A second librarian reviewed the search strategy for completeness and accuracy using the Peer Review of Electronic Search Strategies Checklist [23,24]. We searched the following databases: MEDLINE, EMBASE, CINAHL, PsycINFO, the Cochrane Central Register of Controlled Trials, the Database of Abstracts of Reviews of Effects, PubMed, and the Index to Chiropractic Literature. Although our search aimed to update the NPTF search (that ended in 2006), we searched all bibliographic databases from January 1, 2000 to January 23, 2013. This ensured that any relevant studies published before 2006 and missed by the NPTF would be captured in our review.

The search strategy was first developed in MEDLINE and subsequently adapted to the other bibliographic databases. The search terms included subject headings (eg, MeSH) specific to each database and free-text words relevant to exercise and neck pain (neck pain grades I–III and WAD grades I–III). We used EndNote X6 to create a bibliographic database to manage the search results. All citations were exported from EndNote X6 into Excel for screening.

Study selection

We used a two-phase screening process to select eligible studies. In Phase 1, random pairs of independent reviewers screened citation titles and abstracts to determine the eligibility of studies. Phase 1 screening resulted in studies being classified as relevant, possibly relevant or irrelevant. In Phase 2, the same pairs of reviewers independently screened the possibly relevant studies to determine eligibility. Reviewers met to resolve disagreements and reach consensus on the eligibility of studies. We involved a third reviewer if consensus could not be reached.

Assessment of risk of bias

Random pairs of independent reviewers critically appraised the internal validity of eligible studies using the Scottish Intercollegiate Guidelines Network (SIGN) criteria [25]. The SIGN criteria were used to qualitatively evaluate the presence and impact of selection bias and information bias and confound on the results of a study. We did not use a quantitative score or a cutoff point to determine the internal validity of studies [26]. Rather, the SIGN criteria were used to assist reviewers make an informed overall judgment on the internal validity of studies. This methodology has been previously described [21,27–31].

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/among treatment arms; co-intervention contamination; validity and reliability of outcome measures; follow-up rates; analysis according to intention-to-treat principles; and comparability of results across study sites (where applicable). Reviewers reached consensus 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 had a low risk of bias and were included in our evidence synthesis [32].

Data extraction and synthesis of results

We computed agreements among reviewers for the screening of articles and reported the kappa statistic (k) and 95% confidence interval (CI) [33]. We computed differences in mean changes between groups (with 95% CI) where data were available. The computation of CIs assumed an $r=0.80$ between baseline and follow-up outcome values [34,35].

The lead author extracted data from scientifically admissible studies into a Microsoft Access database, which was then used to build evidence tables. A second reviewer independently checked the extracted data. Meta-analysis was not performed because of heterogeneity of scientifically admissible studies with respect to patient populations, interventions, comparators, and outcomes. We performed a qualitative synthesis of findings from scientifically admissible studies to develop evidence statements according to principles of best-evidence synthesis [32]. We used standardized cutoff values to determine if clinically significant changes were reached in each trial for common outcome measures. These include a between-group 2/10 difference on the Numeric Rating Scale [36], 10/100 mm or 10% difference on the visual analog scale (VAS) [37], and 5/50 difference on the neck disability index (NDI) [37–39]. We stratified our results according to the type (neck pain vs. WAD), severity (Grade I/II vs. Grade III neck pain and WAD), and duration: recent (symptoms lasting <3 months) versus persistent (symptoms lasting ≥ 3 months).

Reporting

The systematic review was organized and reported based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement [40].

Results

Study selection

Our search retrieved 4,761 articles. We removed 1,035 duplicates and screened 3,726 articles for eligibility (Figure). After screening, 3,705 articles did not meet our selection criteria, whereas 21 studies were critically appraised. The interrater agreement for the screening of articles was $k=0.92$ (95% CI 0.88–0.97). We accepted 11 articles as scientifically admissible. One of the scientifically

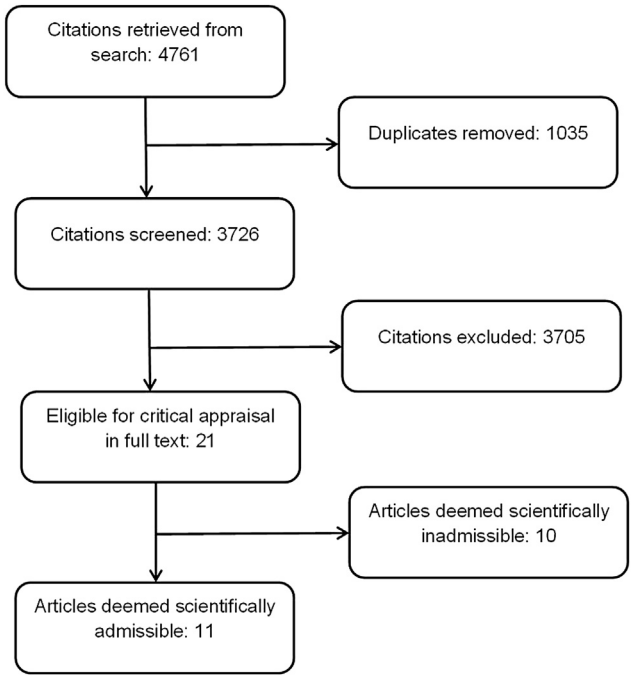

Figure. Identification and Selection of Studies.

admissible articles [41] was a secondary analysis of another admissible study [42].

Study characteristics

All 10 scientifically admissible studies were RCTs. Of those, eight assessed the effectiveness of exercise interventions for patients with recent or persistent neck pain Grade I/II [41–49]. One RCT [50] addressed recent neck pain Grade III and one RCT [51] included subjects with persistent WAD Grade I/II.

The exercise programs varied across studies (Table 3). We identified seven different types of exercises: craniocervical flexion exercises [44,50], cervical range-of-motion exercises [43,44,46–48], cervical isometric strengthening exercises [41–43,46,47], cervical dynamic resistance strengthening exercises [45,49], shoulder range-of-motion or strengthening exercises [41,42,45,47–50], stretching [41–43,46,47], and general exercise programs [43,46,47,51] (Table 3). The majority (8/10) of RCTs combined different types of exercises within one exercise program [41–47,49,50].

Seven RCTs included supervised exercises [41–43,46,47,49–51]. Most supervised programs were supplemented with home exercise, with the exception of one study [49]. Five RCTs included an unsupervised or home-based exercise intervention arm [41,42,44,47–49]. All unsupervised programs were accompanied by written materials, and most provided at least one instructional session [41,42,44,48,49]. One study provided mixed supervised and unsupervised sessions in the workplace with two formal instructional sessions [45]. Exercise interventions were delivered to groups of participants in five studies [41–43,45–47]. Delivery was one-on-one clinician/patient in the remaining studies [44,48–51]. The exercise interventions in most studies (9/10) were provided in clinics. In one study, exercise was delivered in the workplace [45].

The frequency of unsupervised exercise varied from three times per week in two studies [41,42,47] to daily in four RCTs [44,48–50]. Supervised sessions were provided once per week in three RCTs [41,42,46,47] and twice per week in four RCTs [43,49–51]. Mixed supervised and

Table 3
Exercise program components in scientifically admissible studies

	Exercise components						
Included studies	Craniocervical flexion exercise	Cervical range of motion	Cervical isometric strengthening	Cervical dynamic resistance strengthening	Shoulder range of motion or strengthening	Stretching	General exercise program
Bronfort et al. [48]		✓			✓		
Evans et al. [49]		✓					
				✓	✓		
Griffiths et al. [44]	✓	✓					
		✓					
Hakkinen et al. [37]			✓		✓	✓	
Salo et al. [41]						✓	
Kuijper et al. [50]	✓				✓		
Michalsen et al. [47]							✓
		✓	✓		✓	✓	
Rendant et al. [46]							✓
		✓	✓			✓	
Stewart et al. [51]							✓
Von Trott et al. [43]							✓
		✓	✓			✓	
Zebis et al. [45]				✓	✓		

Note: Areas marked with a checkmark indicate the components of each exercise intervention arm. For trials that compared one exercise intervention with another, exercise intervention arms are presented separately. Empty areas indicate that the component was not included.

unsupervised sessions were provided at a frequency of three times per week in one study [45]. Three studies provided exercise programs that progressively increased in intensity [45,49,51]. The duration of the exercise programs ranged from 6 weeks [48,51] to 12 months [41,42].

Risk of bias within studies

We critically appraised 21 studies; of those, 10 studies (48%) had poor internal validity [52–61]. The methodological weakness of the excluded studies included failure to describe or inadequate methods for randomization (three trials) [58,60,61], concealment (six trials) [52–55,57,60,61], or blinding (five trials) [52–55,58]. Clinically important differences in baseline characteristics among treatment arms were present in seven studies [52–57,60], and co-interventions were not adequately described or accounted for in eight trials [52–54,56–58,60,61]. Five trials reported high attrition or differential attrition among treatment arms [52–54,56–58]. Intention-to-treat analyses could not be confirmed in five trials [55–58,60].

The methodological quality of the scientifically admissible studies is presented in Table 4. Most studies (9/10) used appropriate methods of randomization with the exception of one study where details were not described [51]. All but one study adequately described the method used to conceal treatment allocation [43]. The follow-up rate was greater than 80% in 6/10 studies [41,42,44,46,49–51] and greater than 70% in 8/10 [44,48] studies. All studies used intention-to-treat analyses.

Summary of evidence

Recent Grade I/II neck pain and associated disorders

Home exercises. Evidence from one RCT suggests that a home exercise program, nonsteroidal anti-inflammatory drugs (NSAIDs) and acetaminophen, or multimodal manual therapy lead to similar outcomes for patients with recent Grade I/II neck pain [48] (Table 5). This trial by Bronfort et al. [48] compared the effectiveness of an exercise program, multimodal manual therapy, and medication in participants with recent neck pain Grade I/II. Participants in the exercise group were allocated to a 12-week home exercise program consisting of daily cervical range-of-motion exercises, education, and advice regarding daily activities. Participants randomized to manual therapy received 12 weeks of manipulation, mobilization, soft-tissue massage, assisted stretching, hot and cold packs, and advice to stay active or modify activities as needed. The medication group received NSAIDs, acetaminophen, and advice to stay active or modify activities. At 26 weeks, the home exercise group reported lower pain and disability scores than the medication group. However, these differences did not reach clinical significance (difference in mean change from baseline: numeric rating scale 0.69 [95% CI 0.10–1.28]; NDI 2.95 [95% CI 0.37–5.53]). There were no clinically significant differences in pain or disability between the home exercise group and the manual therapy group at all follow-up intervals.

Recent Grade III neck pain and associated disorders

Supervised graded strengthening exercises. For recent Grade III neck pain, the evidence suggests that a supervised graded strengthening exercise program is more effective than advice but leads to similar outcomes as a semi-hard cervical collar with prescribed rest [50] (Table 5). In an RCT by Kuijper et al. [50], participants with cervical radiculopathy of less than 1-month duration were randomized to one of the three groups: 6 weeks of supervised graded strengthening exercises for the shoulder and advice, advice to continue activities, or semi-hard cervical collar and rest. Participants in the graded activity group reported greater reduction in arm and neck pain than the advice group at 6-week follow-up. This difference in reduction of both arm and neck pain was clinically important (difference in mean change from baseline: arm VAS 13.9 mm [95% CI 7.33–20.47]; neck VAS 21.0 mm [95% CI 14.38–27.62]). There were no clinically significant differences between these two groups at 6-month follow-up. There were no clinically significant differences in neck pain and disability between the exercise group and those randomized to wear a semi-hard cervical collar and rest. However, a higher proportion of participants in the exercise group (45%) remained on partial or complete sick leave after completing the 6-week intervention compared those treated with a collar (29%) and those in the control group (38%) (Table 5).

Persistent Grade I/II neck pain and associated disorders

Qigong. Qigong is a gentle focused exercise for the mind and body that aims to increase and restore the flow of qi energy and encourage healing [62]. Evidence from two RCTs suggests that supervised qigong exercise is more effective than wait-listing in reducing neck pain and disability for persistent neck pain Grade I/II [43,46] (Table 5). Rendant et al. [46] found that 18 group sessions over a 6-month period of supervised Nei Yang Gong qigong (ie, a silent and slow form of qigong incorporating neck, shoulder, and breathing exercises) were associated with greater improvements in neck pain compared with wait-list in the short term. The differences in neck pain reduction among groups were clinically important after the 6-month intervention (difference in mean change from baseline VAS 18.6 mm [95% CI 13.3–24.0]). There were no clinically significant differences among participants in the qigong group and those randomized to 18 supervised exercise sessions combining cervical range-of-motion, strengthening, and flexibility exercises [46]. Another RCT found that 24 group sessions of supervised Dantian qigong (ie, a seated form of qigong incorporating breathing and imaginative elements with slow controlled movements) over a 3-month period were associated with clinically important reductions in neck pain compared with a wait list after the 6-month intervention period (difference in mean change from baseline VAS 13.3 mm [95% CI 5.5–21.1]) [43]. There

Table 4
Risk of bias for scientifically admissible RCTs based on the SIGN criteria [16]

Authors, year	Research question	Randomization	Concealment	Blinding	Similarity at baseline	Differences between arms	Outcome measurement	Percent dropout*	Intention to treat	Multiple sites
Bronfort et al. [48]	AA	AA	WC	AA	WC	WC	AA	12 wk: SMT 3.3%, medication 23.3%, and HEA 14.3% 26 wk: SMT 11.0%, medication 36.7%, and HEA 36.3% 52 wk: SMT 26.4%, medication 57.8%, and HEA 38.5%	AA	NAp
Evans et al. [49]	AA	WC	WC	WC	AA	WC	AA	12 wk: ET+SMT 6.6%, ET 7.9%, and HEA 5.6% 26 wk: ET+SMT 13.2%, ET 12.4%, and HEA 15.6% 52 wk: ET+SMT 15.4%, ET 16.9%, and HEA 14.4%	WC	NAp
Griffiths et al. [44]	AA	WC	WC	AA	AA	PA	WC	6 wk: GE 5.4% and SE 13.5% 6 mo: GE 8.1% and SE 8.1%	WC	AA
Hakkinen et al. [42], Salo et al. [41]	AA	AA	AA	AA	AA	AA	AA	2 mo: CSSG 6.1% and SG 5.8% 12 mo: CSSG 14.3% and SG 13.5%	WC	NAp
Kuijper et al. [50]	WC	WC	WC	AA	WC	AA	WC	6 wk: collar 1.4%, PT 2.9%, and control 1.5% 6 mo: collar 8.7%, PT 2.9%, and control 7.6%	WC	NAp
Michalsen et al. [47]	AA	WC	WC	PA	WC	AA	AA	10 wk: yoga 34.2% and self-care/ exercise 28.2%	WC	NAp
Rendant et al. [46]	AA	WC	AA	WC	AA	AA	WC	3 mo: qigong 2.4%, ET 7.7%, and control 0% 6 mo: qigong 7.1%, ET 10.3%, and control 4.9%	WC	NAd
Stewart et al. [51]	AA	PA	WC	AA	WC	AA	PA	6 wk: advice 2.9% and advice+ exercise 0% 12 mo: advice 8.8% and advice+exercise 4.5%	WC	NAd
von Trott et al. [43]	AA	WC	NR	WC	AA	AA	AA	3 mo: qigong 18.4%, ET 10.3%, and control 12.5% 6 mo: qigong 28.9%, ET 12.8%, and control 20.0%	WC	NAp
Zebis et al. [45]	AA	WC	AA	AA	AA	AA	AA	20 wk: training 25.2% and control 7.1%	AA	AA

AA, adequately addressed; CSSG, cervical strengthening and stretching group; ET, exercise therapy; GE, general exercise; HEA, home exercise and advice; NAd, not addressed; NAp, not applicable; NR, not reported; PA, poorly addressed; PT, physiotherapy; RCT, randomized controlled trials; SE, specific exercise; SG, stretching group; SIGN, Scottish Intercollegiate Guidelines Network; SMT, spinal manipulative therapy; WC, well covered.

* Percent dropout: incorporates both participant withdrawal and loss to follow-up.

Table 5
Evidence table for scientifically admissible RCTs on exercise for WAD and neck pain and associated disorders

Authors, year	Subjects and setting, number (n) enrolled	Interventions, number (n) of subjects	Comparisons, number (n) of subjects	Follow-up	Outcomes	Key findings
Bronfort et al., 2012 [48]	Residents from Minnesota (18–65 y.o.) Case definition: acute/subacute neck pain Grade I/II (2–12 wk) and neck pain intensity ≥3/10 n=272	SMT by chiropractors (12 wk): manipulation and mobilization, soft-tissue massage, assisted stretching, hot and cold packs, and advice to stay active or modify activity as needed n=91	HEA by physical therapists with in-person instruction (two 1-h sessions with daily home exercise): individualized program of neck and shoulder self-mobilization and education and advice regarding posture and daily activities n=91 Medication by physician: NSAIDs, acetaminophen, (narcotics and muscle relaxants if necessary), and advice to stay active or modify activity n=90	2, 4, 8, 12, 26, and 52 wk	Primary outcome: neck pain (NRS) Secondary outcomes: disability (NDI); global improvement, medication use (days/week); satisfaction with care, health-related quality of life (SF-36), cervical spine range of motion (CA 6,000 Spine Motion Analyzer), and additional health-care visits Adverse events	Statistically significant differences in mean (SMT–HEA) Satisfaction score (0–12 wk): 0.33 (95% CI 0.11–0.56), (0–52 wk): 0.32 (95% CI 0.11–0.54) No statistically significant difference among groups for mean change in neck pain, disability, medication use, physical or mental health-related quality of life, or ranges of motion No statistically significant difference in mean global improvement Statistically significant differences in mean change (HEA–medication) Neck pain (26 wk): 0.69 (95% CI 0.10–1.28) Disability (26 wk): 2.95 (95% CI 0.37–5.53) Medication use (26 wk): 1.49 (95% CI 0.78–2.20) 52 wk: 1.00 (95% CI 0.27–1.73). Physical SF-36 (26 wk): 2.28 (95% CI 0.63–3.93), 52 wk: 2.24 (95% CI 0.54–3.93) Flexion-extension (4 wk): 4.25 (95% CI 1.39–7.11), 12 wk: 3.51 (95% CI 0.62–6.40) Statistically significant differences in mean (HEA–medication) Global improvement (0–12 wk): 0.30 (95% CI 0.01–0.58), 0 to 52 wk: 0.28 (95% CI 0.01–0.56)

						Satisfaction score (0–12 wk): 0.36 (95% CI 0.13–0.58), 0–52 wk: 0.38 (95% CI 0.16–0.59) No statistically significant differences among groups for mean change in mental health-related quality of life. Visits to other health-care providers 52 wk: 19.8% in the SMT group, 15.6% in the medication group, and 18.7% in the HEA group Nonserious adverse events SMT: 40%, HEA: 46%, medication: 60%
Evans et al., 2012 [49]	Residents from Minnesota (18–65 y.o.) Case definition: chronic neck pain Grade I/II (≥12 wk) and neck pain intensity ≥3/10 n=270	ET: 20 supervised sessions/12 wk delivered by exercise therapists and neck and upper body dynamic resistance strengthening program n=89 ET combined with SMT (ET+SMT): 20 sessions/12 wk of exercise (as described previously) plus cervical and thoracic spine SMT (up to 5 min of light soft-tissue massage if necessary) n=91	HEA by physical therapists with in-person instruction (two 1-h sessions with daily home exercise): individualized program of neck and shoulder self-mobilization and education and advice regarding posture and daily activities n=90	4, 12, 26, and 52 wk	Primary outcome: neck pain (NRS) Secondary outcomes: disability (NDI); global perceived effect, medication use (days/week); satisfaction with care, health-related quality of life (SF-36), additional health-care visits Adverse events	Statistically significant difference in mean change at 12 wk (ET+SMT–HEA) Pain: 1.40 (95% CI 1.05–1.75)* Disability: 4.30 (95% CI 2.51–6.09)* Statistically significant difference in mean at 12 wk (ET+SMT–HEA) Global perceived effect: −0.82 (95% CI −1.29 to −0.35) Satisfaction: −1.33 (95% CI −1.67 to −1.00) No significant differences in other secondary outcomes Statistically significant difference in mean change at 12 wk (ET–HEA) Pain: 1.20 (95% CI 0.84–1.56)* Statistically significant difference in mean at 12 wk (ET–HEA) Global perceived effect: −0.70 (95% CI −1.17 to −0.23) No significant differences in other secondary outcomes

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Authors, year	Subjects and setting, number (n) enrolled	Interventions, number (n) of subjects	Comparisons, number (n) of subjects	Follow-up	Outcomes	Key findings
						Statistically significant difference in mean change at 12 wk (ET+SMT–ET) Disability: 3.2 (95% CI 1.33–5.07)* PCS: −1.50 (95% CI −2.74 to −0.26)* No significant differences in other primary or secondary outcomes Statistically significant difference in mean at 52 wk (ET+SMT–HEA) Satisfaction: −0.75 (95% CI −1.26 to −0.25) No significant differences in other primary or secondary outcomes Statistically significant difference in mean change at 52 wk (ET–HEA) Pain: 0.70 (95% CI 0.28–1.12)* PCS: 1.60 (95% CI 0.33–2.87)* No significant differences in other secondary outcomes No significant difference between ET+SMT and ET for primary and secondary outcomes at 52 wk Additional health care reported at 52 wk ET+SMT: 25.3%, ET: 25.8%, and HEA: 20% Nonserious adverse events ET+SMT: 98.9%, ET: 96.6%, and HEA: 33.3% Moderate adverse event reported by one patient in ET group

Griffiths et al., 2009 [44]	Patients (≥18 y.o.) referred for outpatient physical therapy in the United Kingdom Case definition: chronic neck pain (≥3 mo) n=74	Specific exercise: up to four sessions/6 wk by physical therapists. Active range of motion, posture correction techniques, and neck stabilization/isometric exercises Advice to perform exercises at home 5–10 times daily n=37	General exercise: up to four sessions for 6 wk by physical therapists. Active range-of-motion exercises and posture correction techniques Advice to perform exercises at home 5–10 times daily n=37	6 wk, 6 mo	Primary outcome: disability (NPDS) Secondary outcomes: disability (NPQ), pain affect (NRS), severity of patient-identified worst problem (NRS), medication use (48-h recall), global improvement, cointervention, and health-related quality of life (SF-36)	Difference in mean change (specific exercise–general exercise) NPDS 6 wk: −0.15 (95% CI −6.46 to 6.16)* NPDS 6 mo: 6.46 (95% CI −0.81 to 13.73)* No significant difference in secondary outcomes except for medication use (general exercise–specific exercise) Percent reporting medication use: 6 wk: 0.29 (95% CI 0.10–0.84), 6 mo: 1.16 (95% CI 0.37–3.59)
Hakkinen et al., 2008 [42], Salo et al., 2012 [41]	Patients (25–53 y.o.) from occupational health centers in Finland Case definition: nonspecific chronic neck pain (≥6 mo) and neck pain intensity ≥30/100 mm (VAS) n=101	CSSG: weekly supervised session for 6 wk then every second month (10 sessions) by physical therapists Strength training: isometric exercises for the neck flexors and extensors, dynamic shoulder and upper extremity exercises, abdominal and back exercises, and squats Stretching: neck, shoulders, and upper extremities Education and advice to perform home exercises three times per week n=49	SG: one session by physical therapists. Stretching: neck, shoulders, and upper extremities Education and advice to perform home exercises three times per week n=52	12 mo	Primary outcomes: perceived neck pain (VAS), disability (neck and shoulder pain disability index, NDI) Secondary outcomes: subjective improvement, physician visits, therapies received, days of sick leave, isometric neck strength and range of motion, and health-related quality of life (RAND-36)	No significant difference among groups at 12 mo for primary or secondary outcomes No significant difference among groups in mean health-related quality of life at 12 mo Pain worsened because of training in 6% of CSSG and 2% of SG
Kuijper et al., 2009 [50]	Patients (18–75 y.o.) from Dutch hospitals Case definition: cervical radiculopathy <1 mo; pain intensity ≥40/100 VAS; radiation of arm pain distal to elbow; one of: arm pain reproduced by neck movements, sensory changes, reduced deep tendon reflexes, or muscle weakness n=205	PT: two times per week for 6 wk. Supervised graded strengthening exercises for the shoulder and daily home exercises to strengthen the superficial and deep neck muscles n=70 Semi-hard cervical collar and rest: 6 wk of collar daily for 3 wk then weaned off for wk 3–6) n=69 All patients were allowed to use pain killers	Advice to continue daily activities n=66 All patients were allowed to use pain killers	3 wk, 6 wk, 6 mo	Primary outcomes: neck pain intensity (VAS), arm pain intensity (VAS), and disability (NDI) Secondary outcomes: satisfaction, opioid use, and work status	No significant differences in mean change for arm pain, neck pain, or disability between PT and collar Difference in mean improvement (PT–control) Arm pain 6 wk: 13.9 (95% CI 7.33–20.47)* Neck pain 6 wk: 21.0 (95% CI 14.38–27.62)* Disability 6 wk: 7.4 (95% CI 3.44–11.36)*

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Authors, year	Subjects and setting, number (n) enrolled	Interventions, number (n) of subjects	Comparisons, number (n) of subjects	Follow-up	Outcomes	Key findings
						No significant difference among groups for median arm pain, neck pain, or disability at 6 mo Clinically significant difference in proportion of participants on partial or complete sick leave Collar: 29% PT: 45% Control: 38% No significant differences among groups for treatment satisfaction, NSAID use, or opioid use at 3 and 6 wk
Michalsen et al., 2012 [47]	Residents of Berlin, Germany (18–60 y.o.) Case definition: chronic neck pain (≥3 mo), neck pain >40/100 mm (VAS), and painful cervical mobility restriction n=77	Yoga: weekly yoga (Iyengar) classes for 9 wk Advised to practice postures at home for 2–3 times per week n=38	Self-care/exercise: education and home neck and shoulder stretching, and strengthening and joint mobility exercises provided in a self-care manual n=39	4 and 10 wk	Primary outcome: neck pain at rest (VAS) Secondary outcomes: pain at motion (VAS), pain bothersomeness (VAS), functional impairment (NPAD), disability (NDI), health-related quality of life (SF-36), depression (CES-D), emotional and psychological well-being (POMS), and global rating of effectiveness of interventions Adverse effects	Statistically significant difference in mean change (yoga–self-care) Pain at rest 10 wk: 23.80 (95% CI −17.78 to 29.82)* Pain at motion 10 wk: 21.50 (95% CI 15.61 −27.39)* Bothersomeness 10 wk: 18.30 (95% CI 12.61 −23.99)* Disability 10 wk: 5.70 (95% CI 4.15–7.25)* Function 10 wk: 32.20 (95% CI 21.76–42.63)* Physical health-related quality of life 10 wk: −7.40 (95% CI −9.33 to −5.47)* Mental health-related quality of life 10 wk: −5.70 (95% CI −8.83 to −2.57)* Depression 10 wk: 10.20 (95% CI 7.26–13.14)*

						No clinically significant difference among groups at 10 wk for depression, fatigue, vigor, or anger/hostility as measured by the POMS No adverse events
Rendant et al., 2011 [46]	Residents of Berlin, Germany (20–60 y.o.) Case definition: chronic neck pain (6 mo to 5 y) with pain intensity of ≥40/100 mm (VAS) and normal cervical spine flexibility n=123	Qigong: 18 group sessions of Neiyanggong/6 mo supervised by qigong teachers: neck, shoulder, breathing, and moving exercises Home exercises (n=42) ET: 18 supervised group sessions/6 mo: active cervical rotations, strengthening, and flexibility exercises Home exercises (n=39)	Waiting list (n=41)	3 and 6 mo	Primary outcome: neck pain intensity (VAS) Secondary outcomes: neck pain and disability (NPDS); health-related quality of life (SF-36); perceived self-efficacy (GSE); questions on sleep quality, exercise frequency, and satisfaction Adverse events	Statistically significant difference in mean change (qigong–wait-list) at 6 mo VAS: 18.6 (95% CI 13.3–24.0)* NPDS: 8.9 (95% CI 5.1–12.7)* SF-36 PCS: −4.1 (95% CI 6.2–2.0)* SF-36 MCS: −4.6 (95% CI −7.3 to −1.9)* No significant difference between qigong and wait-list groups for self-efficacy Statistically significant difference in mean change (exercise–wait list) at 6 mo VAS: 17.7 (95% CI 12.5–22.9)* Self-efficacy: −1.7 (95% CI −2.9 to −0.5)* SF-36 MCS: −5.5 (95% CI −8.4 to −2.6)* Statistically significant difference in mean change (qigong–exercise) at 6 mo NPDS: 6.0 (95% CI 2.2–9.8)* Self-efficacy: 1.2 (95% CI 0.1–2.3)* SF-36 PCS: −2.9 (95%CI −5.0 to −0.8)* No significant difference between qigong and exercise for pain or mental health-related quality of life Adverse events Qigong: 45% (pain, vertigo, headache, thirst, engorged Hands, urinary urgency). Exercise: 41% (pain, vertigo, headache, change in mood, tinnitus)

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Authors, year	Subjects and setting, number (n) enrolled	Interventions, number (n) of subjects	Comparisons, number (n) of subjects	Follow-up	Outcomes	Key findings
Stewart et al., 2007 [51]	Insurance claimants from Sidney, Australia Case definition: chronic WAD Grade I/II (3–12 mo) and pain bothersomeness or functional ability ≥2/10 n=134	Exercise and advice: 12 sessions for 6 wk supervised by a physiotherapist: stretching, aerobic, strengthening, and coordination exercises and functional activities Individualized home exercise program Advice as in advice group n=66	Advice: one in-person session and two follow-up calls by a physiotherapist. Standardized education: prognosis, reassurance, and encouragement to resume light activity n=68	6 wk, 12 mo	Primary outcomes: pain intensity (NRS), pain bothersomeness (NRS), and functional ability (PSFS) Secondary outcomes: disability (NDI), global perceived effect, health-related quality of life (SF-36), and work status Adverse effects	Statistically significant difference in mean change at 6 wk (exercise and advice–advice) Pain: 1.0 (95% CI 0.5–1.5)* Bothersomeness: 0.9 (95% CI 0.33–1.47)* Functional ability: −1.0 (95% CI −1.42 to −0.58)* Disability: 2.2 (95% CI 0.7–3.7)* SF-36 PCS: −3.6 (95% CI −5.6 to 1.6)* SF-36 MCS: −4.0 (95% CI −6.5 to −1.5)* Global perceived effect: −0.7 (95% CI −1.2 to 0.2)* Statistically significant difference in mean change at 12 mo (exercise and advice–advice) Functional ability: −0.8 (95% CI −1.3 to 0.3)* Disability: 1.9 (95% CI 0.1–3.7)* No significant differences in mean change in pain, bothersomeness, physical or mental health-related quality of life, or global perceived effect at 12 mo Adverse events: no serious adverse events Exercise and advice: 20% reported pain Advice: 18% reported pain or headache
von Trott et al., 2009 [43]	Residents (≥55 y.o.) from elderly residences in central Berlin, Germany	Qigong: 24 supervised group sessions for 3 mo followed by 3 mo of home exercises	Wait list n=40	3 and 6 mo	Primary outcome: average 7-d neck pain intensity (VAS)	Statistically significant difference in mean change (qigong–wait list)

Case definition: chronic neck pain (≥6 mo) with a pain intensity ≥20/100 mm VAS in previous 7 d n=121	n=38 ET: 24 supervised group sessions for 3 mo delivered by physical therapists. Exercises included active cervical rotations, isometric strengthening, and flexibility exercises followed by 3 mo of home exercises n=39	Secondary outcomes: neck pain and disability (NPDS), health-related quality of life (SF-36), depression (ADS), sleep habits, falls, medication use, consultation with health services, and cointervention Adverse events and side effects	3 mo Pain: 14.0 (95% CI 5.8–22.2) * Neck pain and disability: 7.2 (95% CI 1.0–13.4)* 6 mo Pain: 13.3 (95% CI 5.5–21.1) * No significant differences in mean change in depression, mental or physical health-related quality of life at 3 or 6 mo No significant differences in mean change in neck pain and disability at 6 mo Statistically significant difference in mean change (exercise–wait list) 3 mo Pain: 7.6 (95% CI 0.3–14.9)* Neck pain and disability: 11.2 (95% CI 4.6–17.8)* SF-36 PCS: −3.6 (95% CI −6.2 to −1.4)* 6 mo Pain: 9.4 (95% CI 1.7–17.1)* Neck pain and disability: 12.7 (95% CI 6.0–19.4)* No significant differences in mean change in depression or mental health-related quality of life at 3 or 6 mo No significant differences in mean change in physical health-related quality of life at 6 mo Statistically significant difference in mean change (qigong–exercise) 6 mo Neck pain and disability: −8.8 (95% CI −15.9 to −1.7)* No significant differences in mean change in pain, depression, physical or mental health-related quality of life at 3 or 6 mo

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Authors, year	Subjects and setting, number (n) enrolled	Interventions, number (n) of subjects	Comparisons, number (n) of subjects	Follow-up	Outcomes	Key findings
						No significant differences in mean change in neck pain and disability at 3 mo No adverse events related to study interventions Mild side effects (ie, nausea, aching muscles, muscle tension) reported by four patients in the qigong group and two patients in the ET group
Zebis et al., 2011 [45]	Industrial workers from Copenhagen, Denmark Case definition: neck pain intensity ≥3/9 n=172	Combined supervised and unsupervised high-intensity strength training at the workplace for 20 wk n=95	Advice: stay physically active and consultation with supervisor one time a week for 20 wk n=77	20 wk	Primary outcome: neck/shoulder pain intensity (modified Nordic questionnaire) Adverse events	Neck/shoulder pain Difference in mean change from baseline (training–advice): 1.2 (95% CI 0.82–1.58)* Adverse events Training: 15.8% reported minor and transient complaints No reports of adverse events in control group

ADS, Anxiety and Depression Scale; CES-D, Center for Epidemiological Studies—Depression Scale; CI, confidence interval; CSSG, cervical strengthening and stretching group; ET, exercise therapy; GE, general exercise; GSE, general self-efficacy scale; HEA, home exercise and advice; MCS, mental component score; NDI, neck disability index; NPAD, Neck Pain and Disability Scale; NPQ, Northwick Park Neck Pain Questionnaire; NRS, Numeric Rating Scale; NSAIDs, nonsteroidal anti-inflammatory drugs; NSPD, Neck and Shoulder Pain and Disability Index; PCS, physical component score; POMS, profile of mood states; PSFS, Patient-Specific Functional Scale; PT, physiotherapy; RCTs, randomized controlled trials; SE, specific exercise; SF-36, short-form (36) health survey; SG, stretching group; SMT, spinal manipulative therapy; VAS, visual analog scale; WAD, whiplash-associated disorders; y.o., years old.

* Calculated by current authors using methods outlined in Abrams et al. [34] and Follmann et al. [35].

were also no clinically important differences between the qigong group and a group receiving 24 supervised exercise sessions combining cervical range-of-motion, isometric strengthening, and flexibility exercises [43].

Yoga. Evidence from one RCT suggests that supervised yoga is more effective than education and home exercise for short-term improvement in neck pain and disability [47,49] (Table 5). Michalsen et al. [47] randomized adults with chronic neck pain to nine weekly supervised Iyengar yoga classes or to an unsupervised home strengthening and mobility program for the neck and shoulders. In Iyengar yoga, a range of classical yoga poses are adapted to patients with neck pain with the use of supportive props. The home exercise program included 12 seated exercises for the neck and shoulder with emphasis on muscle strengthening, stretching, joint mobility, and proper posture. After the intervention, the yoga group reported greater improvements in pain intensity, symptom bothersomeness, disability, health-related quality of life, and depression than the control group. Clinically important between-group differences (mean change) at 1 week postintervention included VAS at rest 23.8 mm (95% CI −17.8 to 29.8), VAS at motion 21.5 mm (95% CI 15.6–27.4), VAS bothersomeness 18.3 mm (95% CI 12.6–24.0), NDI 5.7 (95% CI 4.2–7.3), Short-Form (36) Health Survey −7.4 (95% CI –9.3 to –5.5), and depression 10.2 (95% CI 7.3–13.1).

Supervised strengthening exercises. The evidence suggests that supervised strengthening exercises alone are not superior to home range-of-motion or stretching exercises [41,42,49] (Table 5). In a three-arm RCT, Evans et al. [49] compared the effectiveness of supervised high-dose dynamic resistance strengthening exercises for the neck and upper body; supervised high-dose strengthening (as in Group 1) with multimodal manual therapy including cervical and thoracic spinal manipulation and light massage; and advice regarding posture and daily activities and home-based range-of-motion exercises for the neck and shoulder. No clinically important differences in neck pain intensity or disability were found among groups at short- (12 weeks), intermediate- (26 weeks), or long- (52 weeks) term follow-up points. Another RCT found that adding supervised isometric neck exercises and dynamic resistance shoulder/upper extremity exercises to home-based stretching provided no added benefit to patients with chronic neck pain [41,42]. Therefore, the evidence indicates that supervised strengthening exercises alone or with multimodal manual therapy are not superior to home range-of-motion or stretching exercises or multimodal manual therapy for the management of persistent neck pain.

Combined supervised strengthening, range-of-motion, and flexibility exercises. Consistent evidence from two RCTs suggests that combined strengthening, range-of-motion, and flexibility exercises are superior to wait list in reducing pain and disability for persistent neck pain Grade I/II [43,46] (Table 5). Rendant et al. [46] found that participants randomized to 18 supervised sessions of exercise therapy (combining strengthening exercises with cervical range-of-motion and flexibility exercises) reported greater pain reduction than those randomized to a wait list after the 6-month intervention period. Differences in pain reduction among groups were clinically important (difference in mean change from baseline VAS 17.7 mm [95% CI 12.5–22.9]). Similarly, von Trott et al. [43] randomized patients to receive 18 supervised exercise sessions (including isometric strengthening, cervical range-of-motion, and flexibility exercises) followed by 3 months of home exercise or a wait list. Participants in the exercise therapy group reported greater improvement in neck pain and disability after the supervised (3 months) and unsupervised (6 months) components of the intervention. The differences in improvement in neck pain and disability were clinically important after the 6-month intervention period (neck pain and disability scale 12.7% [95% CI 6.0–19.4]). Therefore, the evidence suggests that combining supervised strengthening, range-of-motion, and flexibility exercises is effective in reducing pain and disability in patients with persistent neck pain.

Unsupervised strengthening exercises. Evidence from one RCT suggests that unsupervised, specific, isometric neck and range-of-motion exercises lead to similar outcomes in patients with persistent neck pain. In their RCT, Griffiths et al. [44] tested the effectiveness of unsupervised, specific, isometric neck stabilization exercises by randomizing patients to two groups. The control group received unsupervised active range-of-motion exercises and postural correction techniques. The intervention group received unsupervised active range-of-motion exercises and postural correction techniques supplemented by isometric neck stabilization exercises. The addition of isometric exercises did not result in added benefits in terms of pain or disability reduction or improvement in health-related quality of life.

Persistent Grade I/II WAD

Supervised general exercise. We found evidence that supervised general exercise and advice or advice alone leads to similar short-term pain reduction in adults with persistent WAD Grade I/II [51] (Table 5). In their RCT, Stewart et al. [51] randomized participants with chronic WAD Grade I/II to receive advice (education regarding prognosis, reassurance, and encouragement to resume light activity) or advice supplemented with 6 weeks of supervised general exercise (including stretching, aerobic, strengthening, coordination, and functional activity exercises). The supervised general exercise group reported a greater short-term (6 weeks) reduction in pain intensity compared with the advice group. However, this difference was not clinically important (difference in mean change from baseline NRS 1.0 [95% CI 0.5–1.5]). There were no clinically significant differences among groups in symptom bothersomeness or disability. Additionally, there were no clinically significant

differences among groups at 1-year follow-up. Therefore, this study indicates that a general exercise program is not more effective than structured advice alone in patients with persistent WAD Grade I/II.

Neck pain and associated disorders in workers

Workplace-based exercise. We found evidence that a workplace exercise program and advice provided in the workplace led to similar outcomes for the management of neck pain in workers [45] (Table 5). Zebis et al. [45] compared a 20-week workplace exercise program to advice to stay active in industrial workers with neck pain of unspecified duration. Mixed supervised and unsupervised high-intensity strength training for the neck and shoulder led to a similar reduction in neck/shoulder pain compared with advice.

Adverse events

Eight of the 10 admissible RCTs addressed adverse events [41–43,45–49,51]. None of these studies reported serious adverse events. The rate of minor adverse events associated with exercise therapy varied among studies. Transient nonserious events included worsening of presenting symptoms, neck pain, headache, muscle ache, muscle tension, and nausea. The frequency of these events ranged from 2% in participants performing home stretching exercises [41,42] to 45% and 41% in those randomized to supervised qigong and combined exercise, respectively [46], and 97% in those receiving supervised high dose neck and upper body strengthening exercises [49].

Discussion

Summary of evidence

Our systematic review suggests that patients with recent neck pain Grade I/II have similar outcomes whether they are managed with home exercises, multimodal manual therapy, or medication (ie, NSAIDs or acetaminophen). However, the risk of mild transient adverse events is higher for those who receive NSAIDs or acetaminophen [48]. We also found evidence that supervised graded strengthening exercises are more effective than advice to continue daily activities but lead to similar outcomes as a semi-hard cervical collar with rest for neck pain Grade III [50]. However, short-term sick leave may be higher among those receiving supervised graded strengthening exercise. We found that supervised qigong exercises, yoga, and combined range-of-motion, strengthening, and flexibility exercises may provide benefit for patients with persistent neck pain [43,46,47]. We found evidence that supervised high-dose strengthening exercises with or without multimodal manual therapy and home range-of-motion exercises lead to similar clinical outcomes in patients with persistent neck pain Grade I/II [49]. Similarly, the evidence suggests that supervised strengthening exercises with home stretching provide no additional benefit over home stretching exercises alone for the management of persistent neck pain [41,42,49]. Finally, a supervised general exercise program with advice and advice alone provide similar reductions in neck pain intensity in patients with persistent WAD Grade I/II [51]. The rate of transient nonserious events is highest in patients receiving high-dose supervised strengthening exercises and lowest in those receiving home-based stretching exercises.

In summary, the evidence does not suggest a clearly superior exercise intervention. Thus, we recommend that clinicians and health policy makers use patient preferences and cost-effectiveness data and consider the risk for transient nonserious events when determining which exercise intervention to recommend for the management of patients with neck pain.

Update of the Bone and Joint Decade 2000 to 2010 Task Force on Neck Pain and Its Associated Disorders

Our review updated the NPTF methodology and results on effectiveness of exercise therapy for the management of neck pain and WAD. In their review, the NPTF included several studies where exercise was a component of a multimodal intervention. Therefore, it was difficult to conclude if the effect of the intervention was specific to exercise or to the other interventions included in the multimodal care. Nonetheless, the NPTF concluded that exercise was more beneficial than manual therapy, TENS, neck collar, or simple advice for the management of persistent neck pain [4]. We restricted our review to studies designed to isolate the effectiveness of exercise and found evidence that supervised exercise programs including qigong, Iyengar yoga, and combined range-of-motion, strengthening, and flexibility exercises were more effective than advice or wait list [43,46,47]. The NPTF did not find evidence that strengthening exercises were more effective than endurance exercises [4]. Our review supports and expands on this finding. The recent evidence suggests that supervised strengthening exercises are equivalent to home exercises for the management of persistent neck pain [41,42,44,49]. Moreover, qigong exercise programs were equally effective to programs combining strengthening, range-of-motion, and flexibility exercises [43,46]. Therefore, we did not find evidence of superiority of one type of exercise intervention over another.

The NPTF did not find any evidence on exercise for the management of recent neck pain grade I/II. We updated this finding and found that for recent neck pain grade I/II, home exercise, multimodal manual therapy, or medication leads to similar outcomes [48].

Our results suggest that a general exercise program provides minimal short-lived benefits over advice alone for the management of persistent WAD Grade I/II [51]. Finally, our update adds to the evidence of the NPTF; our review includes one trial suggesting that patients with Grade III neck pain treated with supervised graded strengthening exercises experience similar outcomes as those treated with a semi-rigid collar and rest [50].

Other systematic reviews

Our results add to the results of reviews conducted because of the publication of the NPTF report in 2008. Kay et al. [17] conducted a focused review in 2012 and found evidence favoring neck stretching and strengthening exercises for the management of persistent neck pain. They also concluded that upper extremity stretching and strengthening and general exercise programs were ineffective for the management of neck pain [17]. However, their review was restricted to studies comparing exercise with sham, placebo or no treatment, or with studies comparing exercise and another intervention versus that same intervention. Therefore, they excluded studies that inform the discussion on comparative effectiveness. Another review by Sihawong et al. [18] included studies conducted only in populations of office workers with neck pain. The authors found evidence that strengthening and endurance training were superior to stretching or general exercise. Our review does not support this finding. We found that a workplace high-intensity strength-training program and advice to stay active provide similar outcomes in workers with neck and shoulder pain [45]. Conclusions from other reviews may be systematically different from our own considering that they were derived from a synthesis of evidence from both high- and low-quality trials.

Strengths and limitations

Our study has strengths. First, we developed a sensitive search strategy that was checked through peer review. Second, we defined an explicit set of inclusion and exclusion criteria to identify all possibly relevant citations from the searched literature. Third, we used two independent reviewers for screening and critical appraisal to minimize error and bias. Fourth, we used a well-accepted and valid set of criteria (SIGN) for critical appraisal. In addition, we performed a best-evidence synthesis using only internally valid studies to minimize bias in the reported results. Finally, our methodology was standardized, and all reviewers were trained in critical appraisal before commencing the systematic review.

Our review has limitations. First, we restricted our search to studies published in the English language, which may have resulted in the exclusion of some relevant studies. However, previous reviews have found that the restriction of systematic reviews to English language studies has not led to a bias in the reported results [63]. Second, critical appraisal requires scientific judgment that may vary among reviewers. This potential bias was minimized by training reviewers to use a standardized critical appraisal tool and using a consensus process among reviewers to reach decisions regarding scientific admissibility. Third, our search may not have retrieved all relevant studies, despite our efforts to create a sensitive search strategy. Fourth, we searched the literature from 2000 onward. Clinically relevant studies published before 2000 would have been excluded from this review but were likely captured by the NPTF.

Conclusions

Since 2008, new published evidence is available to inform the debate on the comparative effectiveness of exercise for the management of neck pain and WAD. We found evidence from two RCTs that supervised qigong, and combined programs including strengthening, range-of-motion, and flexibility exercises are effective for the management of persistent neck pain. Similarly, we found evidence from one trial supporting the effectiveness of Iyengar yoga. Evidence from three RCTs indicates that supervised or unsupervised strengthening exercises alone are not more effective than home exercises (stretching or range of motion). Overall, the evidence suggests that supervised exercise interventions (including graded activity, qigong, and combined strengthening, range of motion, and flexibility) are more effective than wait list or advice to stay active in patients with persistent neck pain. However, there is evidence from one RCT that supervised strengthening exercises and home range-of-motion exercises lead to similar outcomes as other conservative interventions (ie, manual therapy, NSAIDs, and acetaminophen) for the management of recent neck pain. Finally, we did not find evidence that one supervised exercise program is superior to another. Overall, most studies reported small effect sizes suggesting that a small clinical effect can be expected with the use of exercise alone.

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Appendix

Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.spinee.2014.02.014.

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