

Psychological Care, Patient Education, Orthotics, Ergonomics and Prevention Strategies for Neck Pain: An Systematic Overview Update as Part of the ICON[§] Project

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Abstract: *Objectives:* To conduct an overview on psychological interventions, orthoses, patient education, ergonomics, and 1^o/2^o neck pain prevention for adults with acute-chronic neck pain.

Search Strategy: Computerized databases and grey literature were searched (2006-2012).

Selection Criteria: Systematic reviews of randomized controlled trials (RCTs) on pain, function/disability, global perceived effect, quality-of-life and patient satisfaction were retrieved.

Data Collection & Analysis: Two independent authors selected articles, assessed risk of bias using AMSTAR tool and extracted data. The GRADE tool was used to evaluate the body of evidence and an external panel to provide critical review.

Main Results: We retrieved 30 reviews (5-9 AMSTAR score) reporting on 75 RCTs with the following moderate GRADE evidence. For *acute whiplash associated disorder (WAD)*, an education video in emergency rooms (1RCT, 405participants) favoured pain reduction at long-term follow-up thus helping 1 in 23 people [Standard Mean Difference: -0.44(95%CI: -0.66 to -0.23)]. Use of a soft collar (2RCTs, 1278participants) was not beneficial in the long-term. For *chronic neck pain*, a mind-body intervention (2RCTs, 1 meta-analysis, 191participants) improved short-term pain/function in 1 of 4 or 6 participants. In workers, 2-minutes of daily scapula-thoracic endurance training (1RCT, 127participants) over 10 weeks was beneficial in 1 of 4 participants. A number of psychosocial interventions, workplace interventions, collar use and self-management educational strategies were not beneficial.

Reviewers' Conclusions: Moderate evidence exists for quantifying beneficial and non-beneficial effects of a limited number of interventions for acute WAD and chronic neck pain. Larger trials with more rigorous controls need to target promising interventions.

Keywords: overview, psychological, education, orthotics, ergonomics, prevention, neck pain.

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INTRODUCTION

Description of the Condition

Although neck pain can be recurrent, severe, disabling and is a socioeconomic burden on society [1, 2], it is most commonly simple and transient. It is estimated that one third of adults will experience neck pain over the course of one year [1]. The balance of evidence suggests that psychosocial distress has a negative impact on the course of neck pain [3-6], possibly to a greater extent than clinical or physical variables [7]. Chronic neck pain is associated with poor psychological health, including cognitive distress, anxiety and depressed mood, a potential loss of employment and associated reduction of income, increased stress, physical limitations/pain, a reduced self-concept, changes to their social life/status and issues relating to medical adherence [7, 8]. There are significant socioeconomic implications. The

most common presentations seen by psychologists after an Motor Vehicle Accident (MVA) are pain, depression and post-traumatic stress [8]. Helping people/patients change behavior may be an important factor when addressing lifestyle modifications needed for neck pain prevention and management [8]. This overview (review of review) addresses a diverse group of seemingly eclectic interventions that include interventions that may help people understand, independently self-manage, potentially limit the impact of injury on their neck pain/disability or prevent potential injury. Some interventions are intended to manage psychological distress related to neck pain and others such as patient education strategies, use of orthosis (i.e. collar), ergonomic workplace interventions, and prevention strategies, affect change in some aspect of the individual or their environment to aide in the management of neck pain.

Description of the Intervention

A number of psychological treatments (i.e. cognitive-behavioral approach, interpersonal behavioral activation, supportive counselling, etc.), psychosocial interventions (i.e. multidisciplinary care, psychologist as advisor to other health professionals), and mind-body wellness approaches (i.e. yoga) exist [8]. Psychological interventions delivered by a psychologist, psychosocial intervention delivered by non-psychologists health professionals and mind body wellness delivered by a certified instructor are options considered by physicians and other health practitioners when psychological distress arises in the presence of neck pain [8].

Patient education is a foundational component of health care and an essential part of communication between patient and the healthcare provider [9, 10]. The World Health Organization (WHO) defines therapeutic patient education as education helping patients acquire or maintain the skills they need to manage their life with a disease in the best possible way [10].

Medical devices are generally defined as products (article, instrument, apparatus or component) used for medical or therapeutic aims including: (a) the diagnosis, treatment, mitigation or prevention of a disease, disorder or abnormal physical state, or its symptoms, and (b) restoring, correcting or modifying a body function or the body. Class I medical devices (orthosis) such as specific pillows, collar use or taping may be recommended.

Ergonomic workplace interventions may include physical redesign changes at the workplace (i.e. ergonomic workstation modification), organizational system changes at the workplace (i.e. job rotation, production system changes) or individual worker changes (education, exercise, use of orthotics) [11]. The aim of ergonomic change is often prevention. Prevention strategies are defined as preventing the onset of symptoms (primary prevention) and reducing the recurrence rate of signs and symptoms (secondary prevention) [12].

How the Intervention Might Work

A number of these interventions may help people understand, independently self-manage, potentially limit the impact of injury on their neck pain and related disability or prevent potential injury.

Psychological treatments, psychosocial often multidisciplinary interventions and mind-body wellness approaches are designed to influence psychological process that underpin and contribute to pain, distress and disability. Interventions like cognitive behavioral therapy and neuroscience education potentially target cognitive-emotional sensitization (and descending facilitation) in patients with chronic neck pain. They aim to help individuals adjust to the reality of their chronic condition, adhere to a treatment regimen that will manage and reduce symptoms, and improve their quality of life despite their condition [13]. Some psychosocial interventions may target single elements such as stress or anxiety. Other psychoeducation provides information to better understand and cope with pain. Still other behavioral interventions may target compliance and adherence to a regimen through a program of self-monitoring and rewards. Cognitive interventions help individuals analyze their beliefs, thoughts and emotions as well as challenge irrational negative thoughts. Not unlike other chronic diseases, chronic neck pain can give rise to secondary co-morbid diagnoses requiring specific psychological treatments concurrently. Finally, various mind-body approaches like yoga breathing may reduce levels of anxiety, depression and stress and increase optimism [14].

Patient education is an iterative process: an educational diagnosis is made, a tailored education programme is established, group or individualised patient education is planned and provided, acquired skills are assessed, and the education programme is revised [15]. It is anticipated that through patient education strategies knowledge is transmitted, skills are acquired, and abilities are potentially maintained. Educational strategies for patients with neck pain may help patients achieve independence in care and self-management. However, in the context of neck pain, the optimal mode of delivery, and message to be delivered, is yet unknown. While education is a relatively low-cost intervention, in the absence of sound evidence of effectiveness even this is difficult to justify.

Orthosis maintain the neck in alignment or restricts movement minimizing symptom onset or recurrence. Similarly, ergonomic interventions may incorporate workplace physical redesign, organizational system changes or individual worker changes with the aim of reducing or preventing a worker's signs and symptoms related to neck injury.

One overarching foundation to most of these interventions is that many are 'change interventions' [16]. Change interventions help people alter their maladaptive and unwanted behaviors and are especially useful in dealing with lifestyle modifications for disease or injury prevention and management [16]. Understanding the patient's readiness to change, related barriers to change, and relapses may be important to not only improving patient satisfaction but also to producing and maintain health outcomes.

Why it is Important to Do this Overview (Review of Reviews)

The number of clinical trials on neck pain is continually increasing [12] and an ongoing collaborative, interdisciplinary and internationally represented effort at evidence synthesis is warranted. The purpose of this overview was to systematically review existing reviews and

establish evidence-based recommendations on psychological interventions, patient education strategies, orthosis use, ergonomic change, and prevention strategies for acute to chronic neck pain including WAD with and without cervicogenic headache or radiculopathy compared to primarily a control group at immediate post treatment to long-term follow-up. Our primary outcomes of interest were pain, function, disability, work related function, patient satisfaction, global perceived effect and quality of life. Our secondary outcomes include psychological measures such as depressive symptoms.

METHODS

The methodology of this overview is detailed in our International Collaboration on Neck (ICON) methods report [17].

Criteria for Considering Review for Inclusion

Selection criteria are noted in Table 1.

Search Methods for Identification of Reviews

Our systematic overview process used independent assessment by at least two members of our review team and included comprehensive computerized search strategies including MEDLINE, EMBASE, CINAHL, ILC, CENTRAL and LILACS from January 2000 to August 2010. Note that two separate searches were performed - one for treatment and one for harms. The protocol for this review was not registered. Further, we undertook a grey literature search by identifying on going systematic reviews near completion such as Cochrane Reviews up to 2012, by contacting our expert panel and by systematically checking reference lists of primary studies to minimize the risk of missing relevant reviews and trials.

Selection of Reviews, Data Collection and Analysis

We utilized the following triage rules (set a priori) to guide decisions and group treatment reviewed:

- 1) Type of treatment was used to group reviews by treatment category
- 2) Within a treatment category we grouped review data with respect to comparator treatments.
- 3) We prioritized the highest quality reviews (low risk of bias) based on the rules below, per grouping.

- a. If there were few reviews, we included them all due to the paucity of information.
- b. If there were several reviews reporting on the same treatment and comparator, we selected the reviews with the lowest risk of bias [high Assessment of Multiple Systematic Reviews (AMSTAR) scores] for inclusion, according to the approach recommended by Whitlock [11] by considering the following:
 - i. Year of publication. We selected the most current reviews when the data was similar across reviews and when the studies from the older review were also included in the most recent review. Further we ensured consistency among review conclusions before eliminating older reviews. Inconsistency and discordance were highlighted and reasons for these differences were discussed;
 - ii. AMSTAR - risk of bias. We prioritized reviews with a low risk of bias for inclusion in our overview. Reviews that scored 8 or higher on the 11-point AMSTAR scale were considered at low risk of bias; 5 to 7 moderate risk of bias; and 4 or less a high risk of bias (See Table 2). These various reviews were further summarized in the summary of findings table with the goal of providing definitive summaries to inform clinical practice. Inconsistency and discordance were highlighted and discussed across reviews;
 - iii. Effect size estimates: We selected the effect size as the primary summary measure. Within a grouping for treatment and comparator, we selected a review that represented the best estimate of the effect size (or a meta-analytic effect). In cases where there was a large discordance between reviews, we reported our re-analysis of the meta-analysis using the individual studies included in the reviews. Additional data on magnitude of effect such as number-needed-to-treat (NNT), standard mean difference (SMD) and weighted mean difference (WMD) were extracted when available. We further considered the clinical importance of the treatment effects using the following guiding principles: evidence on the minimal detectable change and the minimal clinically important difference for the outcome,

Table 1. Inclusion and Exclusion Criteria Set a Priori

PICOSS	Criteria
Participant	Adult (≥ 18 years), acute to chronic neck pain with or without cervicogenic headache or radiculopathy or WAD
Intervention	Psychological, Psychosocial and Mind-body (Alternative) Interventions, Education strategies, Orthotic use, Ergonomic changes, and Preventions Strategies
Comparison	Control or comparison (i.e. standard care, another treatment)
Outcomes	<i>Primary:</i> pain, function, disability, work related, quality of life <i>Secondary:</i> global perceived effect and patient satisfaction, psychological outcomes
Study Design	Systematic reviews of randomized trials; <i>narrative reviews were excluded</i>
Study Timeframe	Immediate post-treatment (IP), short-term (ST: closest to 3 months); intermediate term (IT: closest to 6 months); long term (LT: closest to 1 year)

with a change from baseline of $\geq 15\%$ representing the minimal clinical important difference when not otherwise determined, the magnitude of the treatment effect (represented by WMD, SMD, NNT, absolute benefit, treatment

advantage), the evidence for a dose response gradient, and evidence on the duration of effect [18].

- 4) Strength of Evidence using the Grading of Recommendations Assessment, Development and

Table 2. AMSTAR Rating of Systematic Reviews

Author	1	2	3	4	5	6	7	8	9	10	11
Aas <i>et al.</i> 2011 [123]	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N
Boschi <i>et al.</i> 2010 [124]	Y	N	Y	Y	N	Y	Y	Y	NA	N	N
Conlin <i>et al.</i> 2005 [125]	Y	N	Y	N	N	Y	Y	Y	Y	N	N
Drescher 2008 [126]	Y	Y	Y	Y	N	Y	Y	Y	NA	N	N
Driessen 2010 [65]	Y	Y	N	N	Y	Y	Y	Y	Y	N	N
Graham <i>et al.</i> 2006 [127]	Y	Y	Y	Y	N	Y	Y	Y	Y	N	N
Gross <i>et al.</i> 2007 [128]	Y	Y	Y	Y	N	Y	Y	Y	Y	N	N
Gross <i>et al.</i> 2012 [30]	Y	Y	Y	Y	Y	Y	Y	Y	NA	N	N
Haines <i>et al.</i> 2009 [129]	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N
Haraldsson <i>et al.</i> 2006 [130]	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N
Hurwitz <i>et al.</i> 2008 [12]	Y	N	N	Y	N	Y	Y	Y	NA	N	N
Jordan <i>et al.</i> 2010 [131]	Y	Y	Y	Y	Y	Y	Y	Y	NA	N	N
Kabisch 2008 [132]	Y	N	Y	N	N	Y	Y	Y	Y	N	N
Karjalainen <i>et al.</i> 2003 [133]	Y	Y	Y	Y	Y	Y	Y	Y	NA	N	N
Kay <i>et al.</i> 2005 [134]	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N
Kay <i>et al.</i> 2012 [25]	Y	Y	Y	Y	Y	Y	Y	Y	NA	N	N
Leaver <i>et al.</i> 2010 [135]	Y	Y	Y	N	N	Y	Y	Y	Y	N	N
Lee <i>et al.</i> 2009 [136]	Y	Y	Y	Y	Y	Y	Y	Y	NA	N	N
Miller <i>et al.</i> 2010 [137]	Y	Y	Y	Y	N	Y	Y	Y	Y	N	N
Nikolaidis <i>et al.</i> 2010 [138]	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N
Patel <i>et al.</i> 2012 [139]	Y	Y	Y	Y	Y	Y	Y	Y	NA	N	N
Salt <i>et al.</i> 2011 [140]	Y	Y	Y	Y	N	Y	Y	Y	Y	N	N
Santaguida <i>et al.</i> 2012 [45]	Y	Y	Y	Y	Y	Y	Y	Y	NA	N	N
Shields 2006 [141]	Y	Y	Y	Y	Y	Y	Y	Y	NA	N	N
Sihawong <i>et al.</i> 2011 [120]	Y	Y	Y	Y	N	Y	Y	Y	NA	N	N
Teasell <i>et al.</i> 2010 [119]	Y	N	Y	N	N	Y	Y	Y	NA	N	N
Teasell <i>et al.</i> 2010 [142]	Y	N	Y	N	N	Y	Y	Y	NA	N	N
Verhagen <i>et al.</i> 2007 [121]	Y	Y	N	N	Y	Y	Y	Y	NA	N	N
Verhagen <i>et al.</i> 2007 [122]	Y	Y	Y	N	Y	Y	Y	Y	Y	N	N
Verhagen <i>et al.</i> 2007 [143]	Y	Y	N	Y	Y	Y	Y	Y	NA	N	N

Key: Y Yes; N No; NA not applicable; CA can't assess; AMSTAR Questions:

1. Was an 'a priori' design provided? The research question and inclusion criteria should be established before the conduct of the review.
2. Was there duplicate study selection and data extraction? There should be at least two independent data extractors and a consensus procedure for disagreements should be in place.
3. Was a comprehensive literature search performed? At least two electronic sources should be searched. The report must include years and databases used (e.g. Central, EMBASE, and MEDLINE). Key words and/or MESH terms must be stated and where feasible.
4. Was the status of publication (i.e. grey literature) used as an inclusion criterion? The authors should state that they searched for reports regardless of their publication type. The authors should state whether or not they excluded any reports.
5. Was a list of studies (included and excluded) provided? A list of included and excluded studies should be provided.
6. Were the characteristics of the included studies provided? In an aggregated form such as a table, data from the original studies should be provided on the participants, interventions and outcomes. The ranges of characteristics in all the studies analyzed eg age, race, sex relevant socioeconomic data, disease status, duration, severity, or other diseases should be reported.
7. Was the scientific quality of the included studies assessed and documented? 'A priori' methods of assessment should be provided (e.g., for effectiveness studies if the author(s) chose to include only randomized, double-blind, placebo controlled studies or allocation concealment as inclusion criteria); for other types of studies alternative items will be relevant.
8. Was the scientific quality of the included studies used appropriately in formulating conclusions? The results of the methodological rigor and scientific quality should be considered in the analysis and the conclusions of the review, and explicitly stated in formulating recommendations.
9. Were the methods used to combine the findings of studies appropriate? For the pooled results, a test should be done to ensure the studies were combinable, to assess their homogeneity (i.e. Chi-squared test for homogeneity, 2). If heterogeneity exists a random effects model should be used and/or the clinical appropriateness of combining should be taken into consideration (i.e. is it sensible to combine?)
10. Was the likelihood of publication bias assessed? An assessment of publication bias should include a combination of graphical aids (e.g., funnel plot, other available tests) and/or statistical tests (e.g., Egger regression test).
11. Was the conflict of interest stated? Potential sources of support should be clearly acknowledged in both the systematic review and the included studies.

Evaluation (GRADE) approach: We used the same prioritized representative systematic review to judge an overall GRADE for the strength of the body of evidence for each type of treatment. The selected reviews may have already reported a GRADE table. The GRADE approach on the quality of evidence from primary trials considers information on design [randomized controlled trials (RCT), information on timing of outcomes (immediately post treatment to long term follow-up); risk of bias or equivalent methodological quality criteria reported in the review i.e. PEDro (Physiotherapy Evidence Database) [19,20]; imprecision (sample size); inconsistency; indirectness and reporting bias. We applied similar principles to evaluate those systematic reviews that did not undertake an evaluation of strength of evidence.

Data Extraction and Management

Data extraction was performed by one reviewer and checked by a second; disagreements were resolved by consensus. We systematically extracted data from selected systematic reviews and developed evidence tables. Factors extracted from the original reviews included the following: 1) descriptive features of the original review such as authors, publication year, source disorder, symptom duration, intervention, comparator (placebo, no care, usual care, other treatment), the search period, the original authors of primary studies; 2) methodological issues of original review such as search period, AMSTAR score, quality ranking system, evidence statement and a final strength of the body of evidence rating using the GRADE tool, and 3) data on benefits and risks, including the direction and magnitude of the effect of primary outcomes with duration of follow-up, reported harms, quality ranking system, evidence statement and final GRADE. Harm information was summarized qualitatively from both the treatment reviews that reported any adverse events and directly from the harms reviews.

Assessment of methodological quality

We used a systematic review methodological quality assessment tool (AMSTAR) [21].

Data Synthesis

Qualitative assessment using the GRADE approach [22, 23] and recommendation presentation was used. When the original review did not report using GRADE methodology, an assessment of the summary of finding estimate for GRADE was based on data extracted in the systematic review. Once reviews were deemed relevant and of low risk of bias, we reported trial findings by “quality of evidence” using the GRADE approach and by “treatment category” for the Summary of Findings Tables (Tables 3 and 4). Those intervention categories achieving moderate to high quality rating on GRADE were recorded in the recommendation table (Table 5). Associated primary outcome effect sizes and their related magnitude of effect [SMD, WMD, relative risk (RR)] were translated to clinically relevant terms (WMD, NNT) to aid knowledge users in judging their clinical importance.

RESULTS

We included 30 reviews on treatment (see Fig. 1 - Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)) [24] flow diagram representing 75 RCTs - 14 RCTs related to psychological interventions, 29 to ergonomic workplace interventions, 22 to orthotics, 22 to patient education, 6 to 1^o prevention and 9 to 2^o prevention; keep in mind that there was some overlap. We did not retrieve any reviews on harm for these interventions. The AMSTAR score ranged from 5 to 9 and the most common methodological limitation were: assessment of publication bias, stating conflict of interest and inclusion of a list of included and excluded studies [10, 17]. See Appendix 1 for the listing of the 24 excluded reviews and reasons for exclusion. We detailed trial findings by the quality of the evidence (GRADE level) and treatment category in the later sections. Tables 3 and 4 provides summary findings by treatment category. Table 5 summarizes the strong and moderate quality recommendations based on the GRADE approach and details the magnitude of the effect in terms of effect size. The primary studies included in our analyses investigated the following 1) psychological categories: psychological, psychosocial interventions and mind-body; 2) workplace interventions and prevention: physical environment change, individual worker change, ergonomic and mental health education; organizational change; 3) patient education categories: advice on activation, advice on rest, pain and stress coping skills education, workplace ergonomic education +pain and stress coping skills education self-management educational strategies; and 4) orthotics categories: specialized pillow, specialized pillow + therapy, rigid collar, soft collar, soft collar + home exercise + physiotherapy, collar + advice for self-mobilization, kinesio taping, oral splint.

FINAL EVIDENCE-BASED RECOMMENDATIONS (TABLE 5)

For *acute whiplash associated disorder (WAD)*, our recommendation from moderate evidence suggests using an education video on advice to activate in emergency rooms for a small but clinically important pain reduction at long-term follow-up thus helping 1 in 23 WAD victims. Evidence of no benefit: We note moderate evidence against the use of a soft collar since it negatively influenced pain, function, quality-of-life and work ability in the long-term.

For *chronic neck pain* based on moderate GRADE evidence, we suggest a mind-body intervention -Dantian Qigong exercises- provided by a certified instructor may help to reduce pain and improve function in 1 of 4 to 6 participants in the short-term. For *chronic myofascial pain* in white collar workers, a small reduction of pain was noted after just 2 minutes of daily scapulothoracic endurance training over 10 weeks in 1 of 4 participants. Thus we would recommend this simple work station exercise approach for office workers. Evidence of no benefit: Again based on moderate GRADE evidence, we suggest that a number of interventions may *not be useful* for *chronic neck pain* reduction or improved function in the long-term:

Table 3. Summary of Findings by Quality of Evidence (GRADE) for Psychological Interventions

Category	Treatments Details Disorder Characteristic	vs Comparison Primary Authors (REVIEW Reference)	Quality of Evidence (GRADE*)		
			Moderate	Low	Very Low
EVIDENCE of BENEFIT					
Psychosocial Intervention by PT	Multimodal (relaxation training, psychological support, exercise, manual therapy) delivered by PT for acute WAD	vs electrotherapy Provinciali <i>et al.</i> 1996 [40] VERHAGEN <i>et al.</i> 2007 [122]; HURWITZ <i>et al.</i> 2008 [12]; CONLIN <i>et al.</i> 2005 [125]			IT pain NSD LT RTW
Psychosocial Intervention by practitioner NR	Values-based exposure and acceptance strategies delivered by practitioner NR for chronic WAD	vs wait list Wicksell <i>et al.</i> 2008 [39] TEASELL <i>et al.</i> 2010 [142]			ST pain disability index ST life satisfaction ST fear of movement depression post-traumatic stress symptoms psychological flexibility ST pain NSD
Psychosocial Body-Mind by certified instructor	Cognitive (mindfulness & emotional balance) during Dantian Qigong exercises + advice delivered by approved Qigong therapists, all being members of the German Qigong Society for chronic neck pain	vs that same advice vonTrott 2009 [27]; Rendant <i>et al.</i> 2011 [28] KAY <i>et al.</i> 2012 [25]; LEE <i>et al.</i> 2009 [136]	IP pain (M-A) ST pain NSD IP function (M-A) ST function NSD IP QoL (M-A) ST QoL NSD IP GPE NSD ST GPE NSD		
Psychosocial Intervention by PT	Cognitive (coaching & motivational CBT) during Exercises + advice delivered by PT for chronic neck pain	vs that same advice Stewart <i>et al.</i> 2007 [38] KAY <i>et al.</i> 2012 [25]; KABISCH 2008 [132]; TEASELL <i>et al.</i> 2010 [142]		IP pain LT pain NSD IP function LT function IP GPE LT GPE NSD IP QoL LT QoL NSD	
EVIDENCE of NO BENEFIT (vs control) or No DIFFERENCE (vs another treatment)					
Psychological Intervention by Psychologist	CBT delivered by clinical psychologist for chronic neck and shoulder pain	vs CBT delivered by psychologist functioning as a coach to other health professionals Jensen 1995 [144] KARJALAINEN <i>et al.</i> 2003 [133]		IT pain NSD LT pain NSD IT disability NSD LT Sick leave NSD IT Cost (favoured control)	
Psychosocial Intervention by PT	Integrated CBT + PT delivered by PT for chronic WAD	vs PT Sonderlund & Lundberg 2001 [82] CONLIN <i>et al.</i> 2005 [125]; HAINES <i>et al.</i> 2009 [129]; JORDAN <i>et al.</i> 2010 [131]; KABISCH 2008 [132]; TEASELL <i>et al.</i> 2010 [142]; VERHAGEN <i>et al.</i> 2007 [122]		ST pain NSD ST disability NSD ST ADL	

(Table 3) contd.....

Category	Treatments Details Disorder Characteristic	vs Comparison Primary Authors (REVIEW Reference)	Quality of Evidence (GRADE*)		
			Moderate	Low	Very Low
EVIDENCE of NO BENEFIT (vs control) or No DIFFERENCE (vs another treatment)					
Psychosocial Intervention by PT	Solution Finding: 1) Guidance to identify the problems correlated to their pain 2) Identification of solutions 3) goal setting based on CBT principles 4) booklet or pamphlet delivered by PT for chronic non-specific neck pain	vs Usual Physiotherapy Manca 2006 [55]; Klaber-Moffett <i>et al.</i> 2005 [56] BOSCHI <i>et al.</i> 2010 [124]	LT QALY (Patient-specific quality-adjusted life years): brief intervention provided only slightly less health benefit on average		
Psychosocial Intervention by PT	Behavioral Graded Activity Program delivered by a PT for chronic non-specific neck pain	vs conventional exercise Vonk <i>et al.</i> 2009 [83] BOSCHI <i>et al.</i> 2010 [124]			ST, IT, LT pain NSD ST, IT, LT function NSD ST, IT, LT GPE NSD ST, IT, LT main complaint NSD ST, IT, LT self- efficacy NSD
Psychosocial Intervention by MD	Group 1: neck booklet with focus to allay unrealistic fears of patients, and to promote activity, despite pain. delivered by occupational health physician for chronic neck pain	vs usual treatment Derebery <i>et al.</i> 2009 [84] BOSCHI <i>et al.</i> 2010 [124]			ST pain & disability NSD IT pain & disability NSD
Psychosocial Intervention by PT	Intensive relaxation training (progressive relaxations, functional relaxation, autogenic training, systematic desensitization) delivered by PT for chronic non-specific neck pain	vs control vs dynamic muscle training of neck and arms Viljanen <i>et al.</i> 2003 [57] LEAVER 2010 [135]; KAY <i>et al.</i> 2012 [25]; VERHAGEN <i>et al.</i> 2007 [143]; VERHAGEN <i>et al.</i> 2007 [121]	LT pain NSD LT function NSD		
Psychosocial Intervention by practitioner NR	Stress management delivered by practitioner NR for mechanical neck disorder (duration NR)	vs non-intervention group Horneij <i>et al.</i> 2001 [58] HAINES <i>et al.</i> 2009 [129]			LT pain NSD
Mind-Body (Alternative) by certified instructor	Gestalt therapy - `philosophy of life` training by trained practitioner for chronic WAD	vs no treatment Ventegodt <i>et al.</i> 2004 [85] TEASELL <i>et al.</i> 2010 [142]			ST pain NSD daily functioning NSD sick leave NSD global QoL NSD

Key: **GRADE***: study design, within study risk of bias, consistency of results, directness (generalizability), precision (sufficient data), reporting bias (publication, language, funding, other); ADL – activity of daily living; WAD – whiplash associated disorder; vs – versus; NR – not reported; NSD – no significant difference; PT – physiotherapy; ADL – activity of daily living; GPE – global perceived effect; QoL – quality of life; IP – immediate post treatment; ST - short term closest to 3 months, IT – intermediate term closest to 6 months, LT – long term closest to 1 year; ROM – range of motion; neg - negative findings or statistically not significant; pos- positive findings or statistically significant findings; M-A – meta-analysis; CBT - cognitive behavioral treatment; RTW – return to work; QALY – quality of life years

Table 4. Summary of Findings by GRADE (Quality of Evidence) for Ergonomic Workplace Interventions, Orthotics, Patient Education and Prevention

Category	Treatments Details Disorder Characteristic	vs ComparisonPrimary Authors (REVIEW Reference)	Quality of Evidence (GRADE*) (no Strong GRADE was Retrieved)		
			Moderate	Low	Very Low
EVIDENCE of BENEFIT					
Workplace Intervention & 1 ^o Prevention: Physical Environment Changes	Physical ergonomic intervention - ergonomic training + an arm board support for non-sick listed neck pain free working population - customer service operator	vs no ergonomic intervention Rempel <i>et al.</i> 2006 [41] DRIESSEN <i>et al.</i> 2010 [65]		LT Pain	
Workplace Intervention & 1 ^o Prevention: Physical Environment Changes	Physical ergonomic intervention - Arm 1 - a chair with a cured seat and miscellaneous items Arm 2 - a chair with a flat seat and miscellaneous items for non-sick listed neck pain free working population - garment workers	vs miscellaneous items (no ergonomic intervention) Rempel <i>et al.</i> 2007 [42] DRIESSEN <i>et al.</i> 2010 [65]		ST Pain	
Workplace Intervention & 2 ^o Prevention: Individual Worker Changes	1a) 2 Minute Training (2-min): Progressive resistance training with elastic tubing. The participants performed shoulder abductions, also known as lateral raise, for effectively targeting several relevant neck/shoulder muscles; raising and lowering the arms in approximately 2 seconds; performed only a single set to failure. 5x/week for 10 weeks 1b) 12 Minute Training (12-min): performed 5 to 6 sets of 8 to 12 repetitions in a progressive manner 5x/week for 10 weeks for workers with acute, subacute and chronic myofascial neck pain in 2 white collar organizations 2) Exercise Group: Strength and endurance training; progression from low load non-postural exercise to endurance strength exercises to dynamic strengthening against resistance targeting the cervical / scapulothoracic region; individually tailored, completed 2x/day lasting 10- 15 minutes, supervised weekly by PT; 6 weeks. for pilots with chronic neck pain and myofascial pain from 2 air force helicopter bases 3) Exercise + control (education): mobilization, stretching, strengthening, and relaxation exercises for computer operators with neck and upper extremity complaints	1) vs control group (weekly email) Andersen <i>et al.</i> 2011 [31] KAY <i>et al.</i> 2012 [25]; GROSS <i>et al.</i> 2012 [30]; 2) vs control group Ang <i>et al.</i> 2009 [37] KAY <i>et al.</i> 2012 [25] 3) vs control (education) Omer <i>et al.</i> 2003 [36] VERHAGEN <i>et al.</i> 2007 [143]; VERHAGEN <i>et al.</i> 2007 [121]	1) IP Pain for both 2- min and 12-min training		2) Pain Prevalence during previous week Between-group regression analyses revealed that the members of the exercising group had a 3.2 times greater chance (odds ratio) than the control group of having been pain-free during the previous 7 days and a 1.9 times great chance (odds ratio) of having been pain-free during the previous 3 months, P = 0.01 3) IP Pain IP depression NSD

(Table 4) contd.....

Category		Treatments Details Disorder Characteristic	vs ComparisonPrimary Authors (REVIEW Reference)	Quality of Evidence (GRADE*) (no Strong GRADE was Retrieved)		
				Moderate	Low	Very Low
EVIDENCE of BENEFIT						
Workplace Intervention & 2 ^o Prevention: Individual Worker Changes	1a) Coordination Training: body awareness therapy b) Strength exercises c) Endurance training for chronic neck/ shoulder complaints (nonspecific) in female workers where the work “contributed” to the disorder. 2a) Strength Exercises b) Endurance training for chronic neck pain in female office workers, work related complaints	1) vs control (discussion + stress management) Waling <i>et al.</i> 2000 [35] Waling <i>et al.</i> 2002 [34] VERHAGEN <i>et al.</i> 2007 [143] VERHAGEN <i>et al.</i> 2007 [121] 2) vs control (home stretching) Ylinen <i>et al.</i> 2003 [33] VERHAGEN <i>et al.</i> 2007 [143] VERHAGEN <i>et al.</i> 2007 [121]		1a) ST Pain NSD LT Pain NSD 1b) ST Pain NSD LT Pain 1c) ST Pain NSD LT Pain 2a) ST Pain 2b) ST Pain		
Orthotics: Collar	Semi-hard Collar for acute, subacute cervical radiculopathy	vs wait list Kuijper 2009 [43] SANTAGUIDA <i>et al.</i> 2012 [45]		ST Pain IT Pain NSD ST Function NSD IT Function NSD ST GPE		
Orthotics: Kinesio Taping	Kinesio Taping of the neck (Kinesio Tex Tape, Kinesio Holing Corporation, Albuquerque, NM) for WAD	vs control Gonzalez-Iglesias 2009 [44] SANTAGUIDA <i>et al.</i> 2012 [45]		IP Pain ST Pain IP ROM NSD ST ROM NSD IP Disability NSD ST Disability NSD		
Orthotics: Pillow	1) Orthopaedic Pillow(s) + active control treatment (n=32) 2) Pillow use plus Exercise plus Active control treatment (n=33) Neck Support Pillows could be one of two designs [Shape of Sleep pillow (Manutex Products, Mississauga, ON, Canada) or the Sissel Design AB pillow (Sissel Design AB, Svedala, Sweden)]. The two types of pillows were randomly assigned equally in each arm. The pillows did not differ in shape but in the firmness of the foam. for acute to chronic neck pain	vs 3) standard (regular) pillow + active control (n=34): The Standard (regular) pillow is assumed to be used by this group. Active control treatment that included massage and thermal modality; vs 4) Standard Pillow + Exercise + Active Control Treatment (n=29) Helewa <i>et al.</i> 2007 [49] SANTAGUIDA <i>et al.</i> 2012 [45]		For 1 vs 3: ST Pain NSD ST Function NSD QoL NSD For 2 vs 4: ST Pain* ST Function QoL NSD		
Orthotics: Pillow	Cervical Pillow a) “The Orthopaedic Pillow” b) A semi-customized Universal Pillow for chronic neck pain	vs generic pillow a) Jochems 1997 [47], b) Erfanian 2004 [46] SHIELDS 2006 [141]; SANTAGUIDA 2012 [45]; GROSS 2007 [128]			a) ST Morning pain ST GPE NSD b) ST Morning Pain ST Evening Pain NSD ST Function NSD	
Orthotics: Pillow	Mediflow Water-based Pillow for chronic neck pain	vs Cervi- Garde roll pillow vs participants regular pillow Lavin <i>et al.</i> 1997 [48] SANTAGUIDA <i>et al.</i> 2012 [45]; SHIELDS <i>et al.</i> 2006 [141]; HURWITZ <i>et al.</i> 2008 [12]			ST Morning Pain ST Evening Pain ST QoL	
Orthotics: Pillow	Curavario cervical pillow (Pala-Medic Co, Pleisweiler, Germany) + PT for chronic cervical radiculopathy	vs regular pillow + PT Bernateck <i>et al.</i> 2008 [50] SANTAGUIDA <i>et al.</i> 2012 [45]			ST Pain LT Pain	
Orthotics : Oral Splint	Oral Splint For chronic neck pain and cervicogenic headache	vs control Karppinen <i>et al.</i> 1999 [51] GROSS <i>et al.</i> 2007 [128]		ST Pain NSD LT Pain		

(Table 4) contd.....

Category		Treatments Details Disorder Characteristic	vs ComparisonPrimary Authors (REVIEW Reference)	Quality of Evidence (GRADE*) (no Strong GRADE was Retrieved)		
				Moderate	Low	Very Low
EVIDENCE of BENEFIT						
Patient Education: Advice on Activation	Educational Booklet about exercise for mechanical neck disorders	vs teaching exercises alone Glossop <i>et al.</i> 1982 [52] GROSS <i>et al.</i> 2012 [30]				ST Knowledge ST Pain NSD
Patient Education: Advice on Activation	Educational Video [reassurance, basic advice about posture, early return to daily activities, range of motion exercises, pain relief methods (ice, heat, analgesic)] given in an Emergency Room for acute WAD	vs no treatment Brison <i>et al.</i> 2005 [29] GROSS 2012 [30]; VERHAGEN 2007 [122]; HURWITZ 2008 [12]	ST Pain IT Pain LT Pain			
Patient Education: Advice on Activation	Advice on act as usual + 5 day prescription of NSAIDS + instructions for self- training exercises to be initiated immediately for acute WAD	vs immobilization group (12 days sick leave and collar use) + 5 day prescription of NSAIDS + instructions for self -training exercises to be initiated Borchgrevink 1998 [53] TEASELL <i>et al.</i> 2010 [119]				ST, IT Pain ST, IT shoulder and cervical ROM ST, IT Cognitive symptoms
Patient Education: Advice on Activation	Mobilization Advice (one 30 min session, included demonstration of neck exercises) for acute WAD	vs physiotherapy (multimodal therapy and active and passive repetitive movements) or rest (general advice to mobilize after 10 to 14 days of rest) McKinney <i>et al.</i> 1989 [54; 78] TEASELL <i>et al.</i> 2010 [119]; HURWITZ 2008 [12]				ST Pain LT Presence of symptoms
EVIDENCE of NO BENEFIT' (vs control) or No DIFFERENCE' (vs another treatment)						
Workplace Intervention: Mental Health Education	1) Relaxation Training included progressive relaxation, autogenic training, functional relaxation, and systematic desensitization. The intervention was instructed and trained by a PT for office workers with neck pain 3) Stress Management Program in groups at the workplace– identify, reach goals/strategies for perceived stress (lack of social support, low work control/decision latitude, perceived high psychological workload). Meetings covered theory and practice; workplace and individual goal attainable within 6 months; immediate supervisors attended last 2 meetings for nursing aids and assistant nurses with neck pain working in home-care services	1) vs minimal intervention Viljanen <i>et al.</i> , 2003 [57] LEAVER <i>et al.</i> 2010 [135]; KAY <i>et al.</i> 2012 [25]; VERHAGEN <i>et al.</i> 2007 [143]; VERHAGEN <i>et al.</i> 2007 [121] 2) vs no intervention Horneij <i>et al.</i> 2001 [58] AAS <i>et al.</i> 2011 [123]; HURWITZ <i>et al.</i> 2008 [12]	1) LT Pain NSD LT Disability NSD	2) LT Pain NSD		

(Table 4) contd.....

Category		Treatments Details Disorder Characteristic	vs ComparisonPrimary Authors (REVIEW Reference)	Quality of Evidence (GRADE*) (no Strong GRADE was Retrieved)		
				Moderate	Low	Very Low
EVIDENCE of NO BENEFIT (vs control) or No DIFFERENCE (vs another treatment)						
Workplace Intervention: Ergonomic Education & Mental Health Education		1) Mental Health Education and Physical Health Education, relaxation, breaks for computer workers with chronic neck pain 2) Weekly Email: physical exercise, advice to stay active in spite of pain, diet, smoking, alcohol use, stress-management, workplace ergonomics for acute to chronic myofascial neck pain in 2 large white collar organizations 3) Health Counselling: workplace ergonomics, diet, health, relaxation and stress-management for acute to chronic neck pain in 7 work places	1) vs no intervention Bernaards <i>et al.</i> 2007 [59] AAS <i>et al.</i> 2011 [123] 2) vs 2 minute exercise 2) vs 12 minute exercise Andersen <i>et al.</i> 2011 [31] 3) vs Arm 1 - general fitness training (bike) 3) vs Arm 2 - specific training group (high-intensity neck and shoulder exercises) Andersen <i>et al.</i> 2008 [60] KAY <i>et al.</i> 2012 [25]; GROSS <i>et al.</i> 2012 [30]	1) IT Pain NSD LT Pain NSD 2) IP Pain favoured both 2 minute and 12 minute training	3) ST Pain NSD	
Workplace Intervention & 1° Prevention: Physical Environment Changes		Physical Environment Modifications 1) Physical Ergonomic Interventions: a) ergonomic training on workplace adjustment for university workers; b) ergonomic training in kitchen workers; c) postural training & work station changes for computer workers; d) adjustment to desk/keyboard/mouse position/ forearm support for call centre workers in a non-sick listed neck pain free working population 2) Physical Ergonomic Changes a) alternative mouse, arm board and mouse for engineering staff b) participatory ergonomic training for kitchen workers c) ergonomic training + either arm board or trackball or both for customer service operators } in a non-sick listed neck pain free working population	1) vs no intervention a) Brisson <i>et al.</i> 1999 [61] b) Haukka <i>et al.</i> 2008 [64] c) Gerr <i>et al.</i> 2005 [63] d) Cook <i>et al.</i> 2004 [62] DRIESSEN <i>et al.</i> 2010 [65]; AAS <i>et al.</i> 2011 [123] 2) vs control a) Conlon <i>et al.</i> 2008 [66] b) Haukka <i>et al.</i> 2008 [64] c) Rempel <i>et al.</i> 2006 [41] DRIESSEN <i>et al.</i> 2010 [65]	1) ST neck Pain Prevalence (M-A) NSD	2) LT Pain Prevalence (M-A) NSD 1b) ST Pain Prevalence NSD LT Pain Prevalence NSD ST Sick Leave NSD IT Sick Leave NSD LT Sick Leave NSD	
Workplace Intervention: Physical Environment Changes		Physical Environment Change a) Activity + Physical Environment Changes [ergonomic counselling (work task, work load, work hours, work station, work method) and work modification] for computer workers - job councillors, medical secretaries b) Physical Environment Changes - install new desktop with submerged VDU screen into the table top; computer screen tilted at two different angles for VDU user in national insurance service; c) Physical Environment Changes - downward tilted computer keyboard on a tray for office workers in worker with neck pain	2) vs another workplace intervention a) Voerman 2007 [69] b) Fostervold 2006 [67] c) Hedge 1999 [68] DRIESSEN <i>et al.</i> 2010 [65]		2a) NR - no between group data available b) LT Pain Prevalence NSD c) ST Pain Prevalence NSD between groups	

(Table 4) contd.....

(Table 4) continu...					
Category	Treatments Details Disorder Characteristic	vs ComparisonPrimary Authors (REVIEW Reference)	Quality of Evidence (GRADE*) (no Strong GRADE was Retrieved)		
			Moderate	Low	Very Low
EVIDENCE of NO BENEFIT (vs control) or No DIFFERENCE (vs another treatment)					
Workplace Intervention: Organizational Changes	Organizational Interventions: Breaks + Control: computer software program designed to stimulate regular work breaks (5 minute rest every 35 minutes and 7 second rest every 5 minutes of computer use) Both groups received ergonomic check, adjustment if needed, booklet with information on neck and upper limb disorders, and a risk test for computer workers from large office organizations with work related neck symptoms	vs control group van den Heuvel <i>et al.</i> 2003 [86] AAS <i>et al.</i> 2011 [123]; DRIESSEN <i>et al.</i> 2010 [65]; HURWITZ <i>et al.</i> 2008 [12]; VERHAGEN <i>et al.</i> 2007 [143]; VERHAGEN <i>et al.</i> 2007 [121]		ST Pain intensity or frequency NSD ST Sick Leave NSD Productivity: more productive Overall Recovery from complaint: more likely to report recovery, less likely to report deterioration	
Workplace Intervention and 1° Prevention: Individual Worker Change	Strengthening Exercise 3 times /week, 30 minutes duration, for 8 weeks for health workers	vs no intervention Hamberg-van Reenen <i>et al.</i> 2009 [87] SIHAWONG <i>et al.</i> 2011 [120]			IP Discomfort NSD
Workplace Intervention and 2° Prevention: Individual Worker Change	Upper Extremity Strengthening 1) Dynamic muscle training; dumbbells with weight 1 to 3kg; stretching followed each exercise 2) Feldenkrais Intervention Individualised (functional integration) teacher guides through movement sequences; Group (awareness through movement) verbally guided through exercises for neck-shoulder complaints; home exercises; 50 minutes per week; individually 4 times and in group (7 to 8 participants) 12 times; required 50% participation in both segments of program General Exercise 3) Group Gymnastics/exercise planned to train whole body; aerobic dynamic exercise; relaxation; stretching of muscles of the trunk and extremities and dynamic and coordination exercises; 45 minutes; 1 time per week for workers with neck pain from a printing company 4) General Fitness Training (bike) for subacute and chronic neck pain from 7 work places	vs no treatment 1) Viljanen <i>et al.</i> 2003 [57] 2) Lundblad 1999 [70] KAY <i>et al.</i> 2012 [25]; VERHAGEN <i>et al.</i> 2007 [143]; VERHAGEN <i>et al.</i> 2007 [121] 3) vs no treatment Takala <i>et al.</i> 1994 [71] KAY <i>et al.</i> 2012 [25] VERHAGEN <i>et al.</i> 2007 [143]; VERHAGEN <i>et al.</i> 2007 [121] 4) vs health counselling Andersen <i>et al.</i> 2008 [145] KAY <i>et al.</i> 2012 [25]	1) LT Pain NSD LT Disability NSD Sick Leave NSD	2) Pain NSD Disability NSD Sick Leave NSD 3) Pain NSD Tenderness NSD 4) IP Pain NSD ST Pain NSD	

(Table 4) contd.....

Category		Treatments Details Disorder Characteristic	vs ComparisonPrimary Authors (REVIEW Reference)	Quality of Evidence (GRADE*) (no Strong GRADE was Retrieved)		
				Moderate	Low	Very Low
EVIDENCE of NO BENEFIT (vs control) or No DIFFERENCE (vs another treatment)						
Workplace Intervention: Ergonomic Education, Mental Health Education, Physical Environment Changes, and Organizational Changes	1) Workplace Intervention - Three components: physical health education, relaxation, breaks, activity modification, and physical environmental modifications. The trainings program was for three groups: employees, employees and supervisors, supervisors for workers with chronic neck pain (prevalence of neck pain 68% at baseline) 2) Physical Health Education, relaxation, break and physical environmental modifications for computer / VDU workers with chronic neck pain 3) Mental Health Education and Physical Environment Modifications (Traditional Neck School plus compliance enhancement measures): psychological counselling, ergonomics, exercise, self-care, relaxation for chronic neck pain in medical secretaries	1) vs no intervention Morken <i>et al.</i> 2002 [88] 2) vs no intervention Ketola 2002 [89] 3) vs no intervention Kamwendo 1991 [90] AAS <i>et al.</i> 2011 [123]; GROSS <i>et al.</i> 2012 [30]; VERHAGEN <i>et al.</i> 2007 [143]; VERHAGEN <i>et al.</i> 2007 [121]		1) LT Pain NSD Prevalence btw all groups 2) IT Pain NSD ST Pain positive	3) ST Pain NSD IT Pain NSD ST Sick Leave NSD IT Sick Leave NSD	
Orthotics: Collar	Soft Collar for acute WAD	vs passive control Gennis 1996 [91] SANTAGUIDA <i>et al.</i> 2012 [45]; GROSS <i>et al.</i> 2007 [128]; HURWITZ <i>et al.</i> 2008 [12]			ST Pain NSD	
Orthotics: Collar	Soft Collar for acute WAD	vs education to act as usual Borchgrevink <i>et al.</i> 1998 [53] GROSS <i>et al.</i> 2007 [128]; HAINES <i>et al.</i> 2009 [129]; VERHAGAN 2007 [122]; TEASELL <i>et al.</i> 2010 [119]; HURWITZ <i>et al.</i> 2008 [12]		IP Pain VAS ST Pain VAS IT Pain VAS IP Sick Leave days ST Sick Leave days IT Sick Leave days IP GPE ST GPE IT GPE		
Orthotics: Collar	Collar + Advice for self- mobilization exercise for acute WAD	vs control Crawford <i>et al.</i> 2004 [93] DRESCHER <i>et al.</i> 2008 [126]; VERHAGEN <i>et al.</i> 2007 [122]			ST Pain VAS IT Pain VAS LT Pain VAS ST Activities of daily living ST RTW IT RTW LT RTW	
Orthotics : Collar	Soft Collar + Home exercise + Physiotherapy for acute WAD	vs manual therapy (intermittent traction)+ Home exercise + physiotherapy Pennie & Agambar 1990 [94] SANTAGUIDA <i>et al.</i> 2012 [45]; GRAHAM <i>et al.</i> 2006 [127]; VERHAGEN 2007 [122]; KAY <i>et al.</i> 2009 [134]			ST Pain VAS IT Pain VAS ST GPE IT GPE	

(Table 4) contd.....

Category		Treatments Details Disorder Characteristic	vs ComparisonPrimary Authors (REVIEW Reference)	Quality of Evidence (GRADE*) (no Strong GRADE was Retrieved)		
				Moderate	Low	Very Low
EVIDENCE of NO BENEFIT (vs control) or No DIFFERENCE (vs another treatment)						
Orthotics: Collar	Soft Collar for acute WAD with cervicogenic headache	vs general physiotherapy a) Giebel <i>et al.</i> 1997 [73]; b) Rosenfeld 2000 [74]; c) Vassiliou <i>et al.</i> 2006 [76], d) Bonk 2000 [72] e) Schnabel <i>et al.</i> 2004 [75]; KAY <i>et al.</i> 2005 [134]; MILLER 2010 [137]; VERHAGEN <i>et al.</i> 2007 [122]; DRESCHER <i>et al.</i> 2008 [126]; HARALDSSON 2006 [130]; TEASELL 2010 [119];	e) ST Pain favour PT IT Pain favour PT ST Disability favours PT	a) ST Pain favour PT (only 5.5% treatment advantage) ST Function NSD b) IT Pain favour PT LT Pain NSD ST RTW NSD Costs significantly low for PT c) ST Pain favour PT IT Pain favour PT ST Disability favour PT IT Disability favour PT d) ST Global effect NSD ST Pain prevalence favours PT ST RTW NSD		
Orthotics: Collar	Soft Collar + Education + Self – mobilization for acute WAD	vs general physiotherapy a) McKinney <i>et al.</i> 1989 [54; 78] b) Mealy <i>et al.</i> 1986 [79] c) Kongsted <i>et al.</i> 2007 [102] GROSS <i>et al.</i> 2007 [128]; VERHAGEN <i>et al.</i> 2007 [122]; KAY <i>et al.</i> 2005 [134]; MILLER <i>et al.</i> 2010 [137]; TEASELL <i>et al.</i> 2010 [119]; HAINES <i>et al.</i> 2009 [129]; HURWITZ <i>et al.</i> 2008 [12]	c) LT Pain NSD LT Function NSD LT QoL NSD LT affected Work Ability NSD	a) ST Pain favoured PT b) ST Pain favoured PT		
Orthotics: Collar	Semi-hard and Rigid Collar for cervical radiculopathy	vs active therapy a) Kuijper <i>et al.</i> 2009 [43] b) Persson <i>et al.</i> 1997 [96] c) Persson & Lilja 2001 [97] HURWITZ <i>et al.</i> 2008 [12]; SALT <i>et al.</i> 2011 [140]; NIKOLAIDIS <i>et al.</i> 2010 [138]; MILLER <i>et al.</i> 2010 [137]; SANTAGUIDA <i>et al.</i> 2012 [45]; KAY <i>et al.</i> 2005 [134]		a) ST Pain NSD IT Pain NSD ST Function NSD IT Function NSD ST GPE Off Work NSD b&c) ST Pain NSD LT Pain NSD ST Function NSD LT Function NSD LT GPE NSD LT Disability NSD		
Orthotics : Collar	Rigid Collar for neck pain with radiculopathy or myelopathy	vs surgery a) Persson <i>et al.</i> 1997 [96] b) Persson & Lilja 2001 [97], HURWITZ <i>et al.</i> 2008 [12]; SALT <i>et al.</i> 2011 [140]; NIKOLAIDIS 2010 [138]; MILLER <i>et al.</i> 2010 [137]; SANTAGUIDA <i>et al.</i> 2012 [45]; KAY <i>et al.</i> 2005 [134]		a&b) ST Pain favoured surgery LT Pain NSD ST Function favoured surgery LT Function NSD LT GPE NSD LT Disability NSD		
Orthotics : Collar	Collar (2 days) + PT 2 day immobilization with a soft cervical collar within 24 h of a WAD injury. After 7 days, all patients started a standardized physiotherapy program for acute WAD	vs collar (7 days) + PT Dehner <i>et al.</i> 2006 [92] TEASELL <i>et al.</i> 2010 [119]			ST Pain NSD IT Pain NSD ST Disability NSD IT Disability NSD	

(Table 4) contd.....

Category		Treatments Details Disorder Characteristic	vs ComparisonPrimary Authors (REVIEW Reference)	Quality of Evidence (GRADE*) (no Strong GRADE was Retrieved)		
				Moderate	Low	Very Low
EVIDENCE of NO BENEFIT (vs control) or No DIFFERENCE (vs another treatment)						
Patient Education: Advice on Activation	Advice focus on Activation for mechanical neck disorder	vs another treatment Glossop <i>et al.</i> 1982 [52] HAINES <i>et al.</i> 2009 [129]				ST Pain NSD
Patient Education: Advice on Activation	Advice focus on Activation - Neck School: instruction for exercise, relaxation, self-care) for mechanical neck disorder	vs no treatment Kamwendo <i>et al.</i> 1991 [90] GROSS <i>et al.</i> 2012 [30]; HAINES <i>et al.</i> 2009 [129]				ST Pain NSD IT Pain NSD ST Function NSD IT Function NSD IT Knowledge NSD
Patient Education: Advice on Activation	Educational Intervention (one lecture on neck pain and recommendations of exercise applied at home and work) for chronic neck pain	vs multimodal treatment approach sessions of active treatment including exercise, relaxation training behavioral support to reduce fear of pain and anxiety) or a home exercise group Taimela <i>et al.</i> 2000 [99] GROSS <i>et al.</i> 2012 [30]				ST Pain favour multimodal LT Pain NSD ST Function NSD LT Function favour multimodal
Patient Education: Advice on Activation	Advice focus on Activation for mechanical neck disorder	vs home exercise Taimela <i>et al.</i> 2000 [99] HAINES <i>et al.</i> 2009 [129]				ST Pain NSD LT Pain NSD ST Function NSD LT Function NSD
Patient Education: Advice on Activation	Brief Educational Intervention based on return to normal activity using the media of manual/book, video tape interview and role playing for subacute/chronic neck pain	vs usual physiotherapy (electrotherapy, manual therapy, advice, home exercise) Klaber Moffet <i>et al.</i> 2005 [56] GROSS <i>et al.</i> 2012 [30]; HURWITZ <i>et al.</i> 2008 [12]; HAINES <i>et al.</i> 2009 [129]		IT Pain favour PT LT Pain favour PT IT Function favour PT LT Function favour PT IT QoL NSD LT QoL NSD		
Patient Education: Advice on Activation	Physician-provided Advice and support to stay active for acute neck pain	vs naprapathy (mobilization, manipulation, massage, stretching) Skillgate <i>et al.</i> 2007 [100] HURWITZ <i>et al.</i> 2008 [12]		ST Pain favours naprapathy		
Patient Education: Advice on Activation	Whiplash Pamphlet (explanation, reassurance, importance of mobilization and continuation of normal activities) for acute WAD	vs generic information sheet Ferrari <i>et al.</i> 2005 [101] GROSS <i>et al.</i> 2012 [30]; TEASELL <i>et al.</i> 2010 [119]; VERHAGEN <i>et al.</i> 2007 [122]; HURWITZ <i>et al.</i> 2008 [12]; HAINES <i>et al.</i> 2009 [129]		ST Pain NSD ST Function NSD ST GPE NSD ST Recovery NSD		

(Table 4) contd.....

Category	Treatments Details Disorder Characteristic	vs ComparisonPrimary Authors (REVIEW Reference)	Quality of Evidence (GRADE*) (no Strong GRADE was Retrieved)		
			Moderate	Low	Very Low
EVIDENCE of NO BENEFIT (vs control) or No DIFFERENCE (vs another treatment)					
Patient Education: Advice on Activation	Advice to Act-as-usual (information about whiplash and rational for staying active, move as naturally as possible, stay active) for acute WAD	vs immobilization in a Philadelphia collar or active mobilization (manual therapy and exercise) Kongsted <i>et al.</i> 2007 [146] GROSS <i>et al.</i> 2012 [30]; TEASELL <i>et al.</i> 2010 [119]; HURWITZ <i>et al.</i> 2008 [12]; HAINES <i>et al.</i> 2009 [129]		LT Pain NSD LT Function NSD LT QoL NSD	
Patient Education: Advice on Activation	Advice to Act-as-usual for acute WAD	vs immobilization (soft collar and 14 days sick leave) Borchgrevink <i>et al.</i> 1998 [53] GROSS <i>et al.</i> 2012 [30]; TEASELL <i>et al.</i> 2010 [119]			ST Pain NSD IT Pain NSD ST GPE NSD IT GPE NSD
Patient Education: Advice on Activation	1 hour Educational Session advice given verbally (explanation fear of pain, acute pain expected, act as usual and a list of key points handed out) for acute WAD	vs educational pamphlet (explanation fear of pain, acute pain expected, act as usual) Kongsted <i>et al.</i> 2008 [103] GROSS <i>et al.</i> 2012 [30]; TEASELL <i>et al.</i> 2010 [119]			ST Pain NSD IT Pain NSD LT Pain NSD ST Disability NSD IT Disability NSD LT Disability NSD
Patient Education: Advice on Activation	Mobilization Advice (one 30 minute session, included demonstration of neck exercises) for acute WAD	vs physiotherapy (multimodal therapy and active and passive repetitive movements) or rest (general advice to mobilize after 10-14 days of rest) McKinney <i>et al.</i> 1989 [54; 78] MILLER <i>et al.</i> 2010 [137]; TEASELL <i>et al.</i> 2010 [119]; HURWITZ <i>et al.</i> 2008 [12]			ST Pain NSD
Patient Education: Advice on Activation	Early (within 96 hours) or Delayed (at 2 weeks) standard treatment (written material advising rest for first 2 weeks, followed by active movement 2 to 3 times daily and outlined benefits of soft collar) for acute WAD	early (within 96 hours) or delayed (at 2 weeks) active treatment (small range, small amplitude neck rotations 10 times every hour Rosenfeld 2000 [74] (ST) Rosenfeld 2003 [74] (LT) TEASELL <i>et al.</i> 2010 [119]		All outcomes favour active treatment IT Pain LT Pain	
Patient Education: Self-management educational strategies	Self-care Booklet for chronic neck pain	vs massage and advice on stretching, body awareness, and increase in water intake Sherman <i>et al.</i> 2009 [104] GROSS <i>et al.</i> 2012 [30]; PATEL <i>et al.</i> 2012 [139]			ST Function NSD IT Function NSD LT Function NSD ST Pain favored massage IT Pain NSD LT Pain NSD IT QoL NSD LT QoL NSD
Patient Education: Self-management educational strategies	Education on aerobic exercise + stretching for chronic non-specific neck pain	vs specific neck strengthening exercise + dynamic exercise for trunk, Upper & Lower Extremity (1 set, 15 repitions) or specific neck endurance exercise + dynamic exercise for trunk, Upper & Lower Extremity (3 sets, 20 repitions) (5 sessions/ week, 45 min) Ylinen <i>et al.</i> 2003 [33] SIHAWONG 2011 [120]	All outcomes favour neck strengthening exercise LT Pain LT Disability		

(Table 4) contd.....

Category		Treatments Details Disorder Characteristic	vs ComparisonPrimary Authors (REVIEW Reference)	Quality of Evidence (GRADE*) (no Strong GRADE was Retrieved)		
				Moderate	Low	Very Low
EVIDENCE of NO BENEFIT (vs control) or No DIFFERENCE (vs another treatment)						
Patient Education: Self-management educational strategies	Education (health-promotion) for non-specific neck pain	vs 1) strengthening exercise; dynamic resistance for arm and shoulder (2 to 3 sets, 10 to 15 repetitions) + static neck exercise (hold 5 second) (3 times/week, required 20 min) vs 2) nonspecific exercise (motivated to increase their daily physical activity) Blangsted <i>et al.</i> 2008 [32] SIHAWONG 2011 [120]				LT duration of Pain favored 1 & 2 LT intensity of Pain favored 1 & 2 LT Work Ability NSD LT Sick Leave NSD LT Discomfort NSD
Patient Education: Self-management educational strategies	Education (anatomy + stretching) for non-specific neck pain	vs 1) self- stretching exercise for tight neck muscles and neck ROM exercises (hold 5 seconds, 10 times) vs 2) term-stretching exercise group I; exercise once a day (hold 5 seconds, 10 times) vs 3) term-stretching exercise group II; exercise twice a day in the morning and afternoon (hold 5 seconds, 10 times) (required 15 to 20 minutes for exercise) Tsauo <i>et al.</i> 2004 [105] SIHAWONG 2011 [120]				ST Pressure Pain Threshold favoured 2 & 3
Patient Education: Self-management educational strategies	Self-management Program (education and information about exercise for chronic WAD	vs multimodal PT program (low-load exercises, low- velocity mobilizing techniques, education and assurance) Jull <i>et al.</i> 2007 [106] MILLER <i>et al.</i> 2010 [137] TEASELL <i>et al.</i> 2010 [119]			ST Pain favoured PT	
Patient Education: Self-management educational strategies	Instruction in home exercises for acute neck pain	vs supervised rehabilitation training Bunketorp <i>et al.</i> 2006 [107] HURWITZ <i>et al.</i> 2008 [12]			All outcomes favoured supervised rehab ST Pain ST Disability ST Sick Leave	
Patient Education: Self-management educational strategies	Advice on neck care for acute neck pain	vs intensive neck exercise Chiu <i>et al.</i> 2005 [80] HURWITZ <i>et al.</i> 2008 [12]	All outcomes favoured exercise ST Pain LT Pain ST Disability LT Disability			

Key: **GRADE***: study design, within study risk of bias, consistency of results, directness (generalizability), precision (sufficient data), reporting bias (publication, language, funding, other); WAD – whiplash associated disorder; PT – physiotherapy; VDU – video display unit; vs – versus; GPE – global perceived effect; QoL – quality of life; IP – immediate post-treatment; ST – short term closest to 3 months, IT – intermediate term closest to 6 months, LT – long term closest to 1 year; ROM – range of motion; VAS – visual analogue scale; RTW – return to work; min – minutes; NR – not reported; NSD – negative findings or statistically not significant; SD – positive findings or statistically significant different findings; * SMD -0.51 [95%CI: -1.05, 0.02] = positive trend; p – probability value.

Table 5. Evidence-Based Recommendations

GRADE Symbol	GRADE ^a and Recommendation	Clinical Importance Magnitude of Effect Duration of Effect	Reported Adverse Effect or Side Effects
	Strong Evidence of Benefit: (Strongly recommend use)		
	No recommendation	NA	NA
	Moderate Evidence of Benefit: (Suggested use)		
●●●●	Patient Education: Advice on Activation Educational video on advice on activation (1 trial [29], 405 participants) vs no treatment for acute WAD at ST, IT and LT follow-up	Magnitude of effect: ST MEDIUM LT SMALL ST Pain (0-5 scale) SMD: -0.67 (95%CI: -0.87 to -0.46) WMD: -1.00 (95%CI: -1.30 to -0.70) IT Pain SMD: -0.38 (95%CI -0.59 to -0.17) WMD: -1.00 (95%CI: -1.56 to -0.44) LT Pain: SMD: -0.44 (95%CI -0.66 to -0.23) WMD: -1.00 (95%CI: -1.48 to -0.52) NNT 23	NR
●●	Mind-Body by certified instructor Cognitive (mindfulness & emotional balance) during Dantian Qigong exercises + advice delivered by approved Qigong therapists, all being members of the German Qigong Society (M-A: 2 trials [27; 28], 191 participants) vs no treatment for chronic neck pain at IP and ST follow-up	Magnitude of effect: ST SMALL ST Pain (VAS 0-100) SMDp: -0.34 (95%CI -0.67 to -0.01) WMDp: -14.90 95%CI: -22.40 to -7.39) ST Function (NDI or NPDI 0-100) SMDp: -0.36 (95%CI -0.68 to -0.03) WMDp: -10.38 (-17.11 to -3.64) Pain NNT 4 to 6 Function NNT 5 to 8	NR
●	Workplace Intervention & 2^o Prevention: Individual Worker Changes 1 trial, 2 arms, 198 participants 1) 2-minute scapulothoracic endurance training program x 10 weeks (1 trial [31], 127 participants) vs control 2) 12-minute scapulothoracic endurance training program x 10 weeks (1 trial [31], 129 participants) vs control for (sub)acute/chronic myofascial neck pain immediately post treatment for workers from white collar organizations at IP follow-up	Magnitude of Effect: 2-minute IP SMALL 12-minute IP SMALL IP Pain (VAS 0 to 10) 2-minute SMD: -0.66 (95%CI: -1.02 to -0.30) WMD: -1.30 (95%CI: -1.98 to -0.62) IP Pain (VAS 0 to 10) 12-minute SMD: -0.59 (95%CI: -0.94 to -0.23) WMD: -1.30 (95%CI: -2.06 to -0.54) Pain NNT 4	No long lasting or major complications. Minor transient side effects: worsening of neck muscle tension, shoulder, upper arm or forearm/wrist joint pain during training ; worsening of headache after training
	Strong Evidence of NO Benefit: (Strongly recommend use)		
	No recommendation	NA	NA
	Moderate Evidence of NO Benefit (Suggested not to use)		
○○○○	Psychosocial Intervention by PT: 1) Cognitive behavioral principles - Solution Finding (1 trial [56], 268 participants): Guidance to identify the problems correlated to their pain; Identification of solutions; goal setting based on CBT principles; booklet or pamphlet delivered by PT vs usual PT at LT follow-up	1) LT QALY (Patient-specific quality-adjusted life years): brief intervention provided only slightly less health benefit on average	NR

(Table 5) contd.....

GRADE Symbol	GRADE* and Recommendation	Clinical Importance Magnitude of Effect Duration of Effect	Reported Adverse Effect or Side Effects
○○○○	2) Intensive relaxation training(1 trial [57], 258 participants) - progressive relaxations, functional relaxation, autogenic training, systematic desensitization- delivered by PT vs no control for chronic non-specific neck pain at LT follow-up	2) LT Pain NSD LT Function NSD	NR
○○○○	Workplace Intervention: Mental Health Education Intensive relaxation training (1 trial [57], 258 participants) -progressive relaxations, functional relaxation, autogenic training, systematic desensitization- delivered by PT vs no control for chronic non-specific neck pain in office workers at LT follow-up	LT Pain NSD LT Function NSD	NR
○○○○	Workplace Intervention: Ergonomic Education & Mental Health Education 1) mental health education and physical health education, relaxation, breaks (1 trial [59], 2 arms, 466 participants) a) work style (1 trial, 210 participants analysed at LT) b) work style + physical activity (1 trial, 209 participants analysed at LT) vs no intervention	1) IT Pain NSD LT Pain NSD	NR
○	2) Weekly Email (1 trial [31], 3 arms, 198 participants): physical exercise, advice to stay active in spite of pain, diet, smoking, alcohol use, stress-management, workplace ergonomics (n=64) vs 2-minute of exercise (n=63) vs 12-minutes of exercise (n=65) for acute to chronic myofascial neck pain in 2 large white collar organizations at IP follow-up	2) IP Pain favoured the comparison treatments: 2-minute or 12-minute training groups	NR
○○	Workplace Intervention & 1^o or 2^o Prevention: Physical Environment Changes Physical Ergonomic Interventions (M-A 4 trials [61-64], 1546 participants): a) ergonomic training on workplace adjustment for university workers; b) ergonomic training in kitchen workers; c) postural training & work station changes for computer workers; d) adjustment to desk/ keyboard/mouse position/ forearm support for call centre workers vs no intervention for non-sick listed neck pain free workers at ST follow-up	ST Neck Pain incidence/ prevalence: (M-A) NSD RRp: 0.93 (95%CI: 0.84 to 1.03)	NR
○○○○	Workplace Intervention & 2^o Prevention: Individual Worker Change Upper extremity stretching & strengthening endurance training (1 trial [57], 265 participants) vs no intervention for chronic neck pain at LT follow-up	IP Pain ST Pain LT Pain IP Disability ST Disability LT Disability LT Sick Leave	NR
○○○○	Orthotics: Collar 1) Soft Collar use in combination with Advice to self-mobilize: collar worn during waking hours for two weeks, after two weeks add active range of motion exercises (no M-A 5 trials [72-76], 637 participants) vs general PT for acute WAD neck pain at LT follow-up	1) LT Pain NSD LT Function NSD LT QoL NSD LT Ability toWork NSD	No side effects reported
○○○	2) Soft collar use (no M-A 3 trials [77-79], 641 participants) vs general PT for acute neck pain with cervicogenic headache at ST and IT follow-up	2) ST Pain favoured PT IT Pain favoured PT ST Disability favoured PT	NR

(Table 5) contd.....

GRADE Symbol	GRADE* and Recommendation	Clinical Importance Magnitude of Effect Duration of Effect	Reported Adverse Effect or Side Effects
○○○○	Patient Education: Self-management strategy 1) Education on aerobic exercise + stretching (1 trial [33], 180 participants) vs specific endurance and strengthening exercises for chronic non-specific neck pain at LT follow-up	1) All outcomes favoured neck strengthening exercise LT Pain LT Disability	NR
○○○○	2) Advice on neck care (1 trial [80], 218 participants) vs intensive neck exercises for acute neck pain for pain and disability at ST and LT follow-up	2) All of the following outcomes favoured intensive exercise ST Pain LT Pain ST Disability LT Disability	NR

GRADE*: study design, within study risk of bias, consistency of results, directness (generalizability), precision (sufficient data), reporting bias (publication, language, funding, other); open symbol= no benefit; closed symbol = beneficial; duration of effect noted by number of symbols: one = IP, two = ST, three = IT, 4 = LT; diamond (♦ or ◇) = high GRADE; dot (● or ○) = moderate GRADE with solid symbol indicating benefit and open symbol indicating no benefit

Clinically Important is determined by considering the following factors: minimal detectable change, minimal clinically important difference ($\geq 15\%$), large magnitude of effect measured by weighted mean difference, number needed to treat, absolute benefit & treatment advantage, high dose response gradient, duration of the effect (IP – immediate post treatment, ST – short term for about 3 months, IT – intermediate term for about 6 months, LT – long term for about 1 year)

Key: WAD – whiplash associated disorder; IP – immediate post-treatment follow-up; ST – short-term follow-up; IT – intermediate-term follow-up; LT – long-term follow-up; SMD_p – pooled standard mean difference; WMD_p – weighted mean difference; RR_p – pooled relative risk; M-A – meta-analysis; NNT – number-needed-to-treat; 95%CI – 95% confidence interval, † no significant difference between groups for this outcome, GPE – global perceived effect; VAS – visual analogue scale; QALY – quality of life years; PT – physiotherapy; CBT – cognitive behavioral training; NR – not reported; NA – not applicable, vs – verses.

- 1) psychosocial interventions by a physical therapy (PT) such as use of a) cognitive behavioral principles in solution finding or b) intensive relaxation training at an office work;
- 2) workplace interventions including ergonomic education and mental health education such as work style education, work style and physical activity increase or weekly emails over a short-term about exercise, advice to stay active, diet, smoking, alcohol use, stress-management and workplace ergonomics;
- 3) individual worker change such as upper extremity stretching and strengthening endurance training 3 times per week for 30 minutes; and
- 4) specific patient education using self-management educational strategies such as education on exercise or neck care. Other interventions are not recommended as they show moderate GRADE evidence of no benefit over the short-term including workplace interventions including physical environment change in non-sick listed workers specifically ergonomic training on workplace adjustment for university workers, ergonomic training for kitchen workers, postural training and work station changes in computer workers and adjustment to desk/keyboard/mouse position/forearm support in call centre workers.

EVIDENCE OF BENEFIT

Strong Evidence

We found no trials that met this standard.

Moderate Evidence

Mind-Body Interventions by Certified Instructor

For Dantian Qigong exercises when compared with a wait list control, two reviews [25; 26] and 1 meta-analysis

[25] (2 trials, 191 participants, von Trott *et al.* 2009 [27], Rendant *et al.* 2011 [28]) found moderate GRADE evidence demonstrating small benefit for chronic neck pain reduction, moderate benefit on function and small benefit for quality of life post treatment but no benefit for global perceived effect immediate post treatment and at short-term follow-up. Kay and colleagues [25] noted one would need to treat 4 to 6 people to achieve this type of pain relief, 5 to 8 people to achieve this functional benefit, and 7 to 10 people for this improvement in quality of life. Qigong exercise includes a cognitive or affective element - mindfulness and emotional balance - thereby influencing the functional status of the psychological system as it is related to movement and was instructed by 5 approved Qigong therapists, all being members of the German Qigong Society.

Patient Education – Advice on Activation

For advice on activation (1 trial; 405 participants, Brison *et al.* 2005 [29]) using an educational video on reassurance, basic advice on posture, early return to daily activities, range of motion exercises, pain relief methods (ice, heat, analgesic) given in an Emergency Room, we found moderate evidence of a small benefit compared to no treatment for acute WAD for short-, intermediate-, and long-term pain [Pain at short-term follow-up SMD -0.67 [95% Confidence Interval (CI): -0.87, -0.46]; Pain at intermediate-term follow-up SMD -0.38 (95%CI: -0.59, -0.17); Pain at long-term follow-up SMD -0.44 (95%CI: -0.66, -0.23)]. The reported NNT was 23 [30].

Workplace Intervention & 2^o Prevention – Individual Worker Change

Exercise interventions that target the worker depend on the type of exercise prescribed. For workers with pre-existing neck pain, moderate to low GRADE evidence (5 trials, 1205 participants) favoured the use of specific strengthening exercises targeting the cervical and scapulothoracic regions for the individual worker. A reduction in the prevalence or intensity of pain was noted

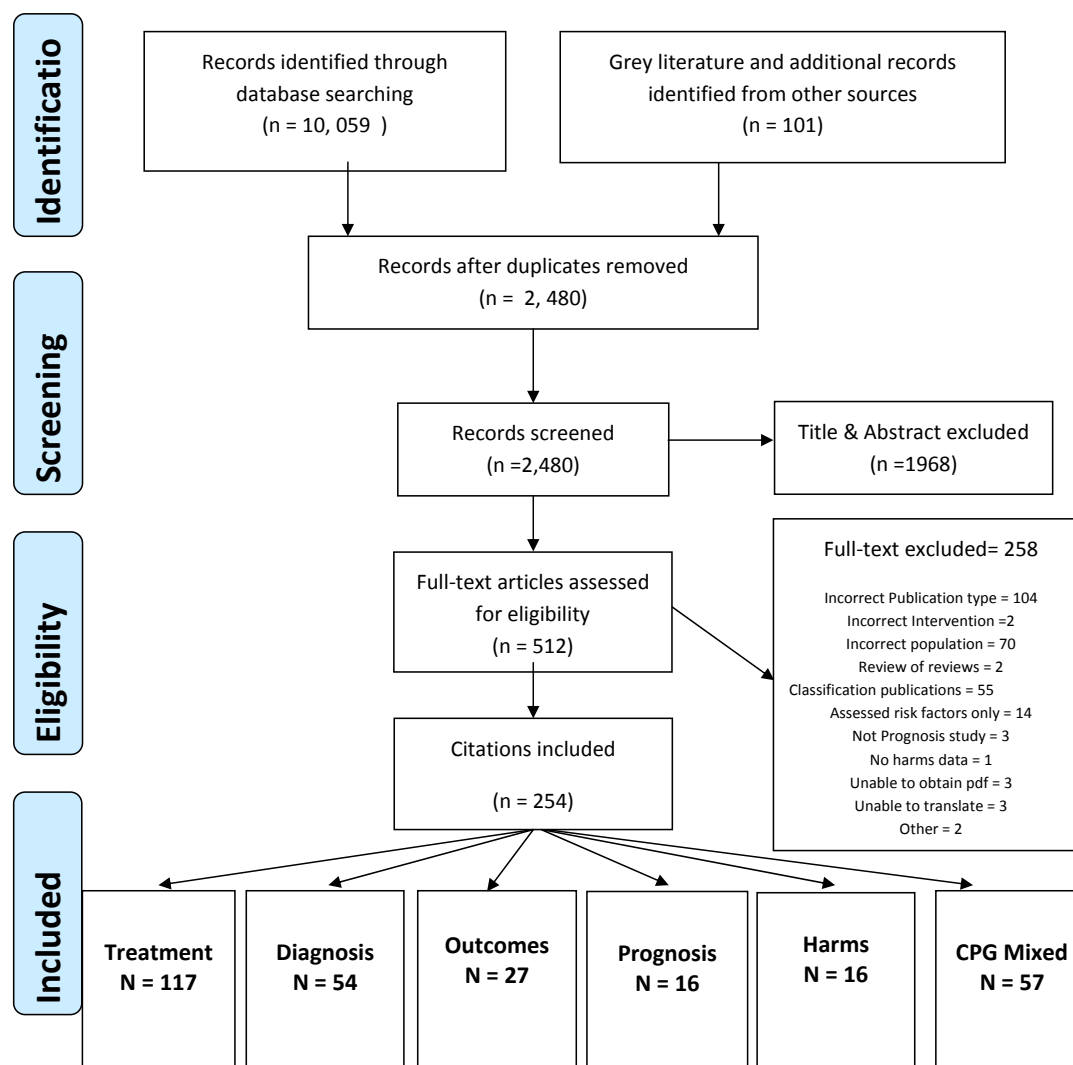


Fig. (1). PRISMA diagram showing the flow of reviews on psychology, ergonomics, prevention, orthotics, and patient education for neck pain.

across different time points. Dosage diversity exists between programs. We note a small clinically meaningful benefit (moderate GRADE, 1 trial; 198 participants, Andersen *et al.* 2011 [31]) favouring both a 2-minute and 12-minute scapulothoracic endurance training program in reducing pain [WMD-2 minute -1.30 (95%CI: -1.98, -0.62) or WMD-12 minute -1.30 (95%CI: -2.06, -0.54)] in workers with acute/chronic myofascial neck pain from two large white collar organizations immediately post 10 weeks (5 times per week) of treatment [25]. A clinician would need to treat four workers to achieve this pain relief in one (NNT 4). Specific strengthening exercises (dynamic resisted) targeting the neck, arm, and shoulder (moderate GRADE, 1 trial, 549 participants Blangsted *et al.* 2008 [32]) reduce the prevalence of neck pain and neck pain intensity in the long term when compared to a control of health promotion education in office workers. There was no difference observed in the workers ability to work or sick leave in this population. Two further trials (low GRADE) suggest strength or endurance training reduces worker's neck pain

compared to different controls at short (Ylinen *et al.* 2003 [33]) and at long-term (Waling 2000 [34, 35]) follow-up. Additionally, there is support for reduction of disability through the use of endurance muscle training in office workers at short-term follow-up (Ylinen *et al.* 2003 [33]). Two other trials (very low GRADE) support 1) strengthening, stretching and relaxation exercise in computer workers (Omer *et al.* 2003 [36]) or 2) progressive training from non-postural low load exercise to endurance strengthening to dynamic moderate resistance through full range of motion training tailored to the individual patient abilities for helicopter pilots with chronic myofascial neck pain (Ang *et al.* 2009 [37]).

Low or Very Low Evidence

Psychosocial Interventions

For exercise including coaching and motivational cognitive elements, we found evidence of benefit (low GRADE, 1 trial, 132 participants, Stewart *et al.* 2007 [38]) in pain, function, global perceived effect and quality of life

post-treatment and for function at long term follow-up when compared with advice alone for chronic mechanical neck disorder. The cognitive behavioral therapy delivered by a physiotherapist included: setting goals of progressively increasing difficulty, shaping, encouraging self-monitoring of progress, and self-reinforcement.

Two trials of very low GRADE addressed two distinct psychosocial interventions. First, values-based exposure and acceptance strategies for chronic WAD were beneficial (very low GRADE, 1 trial, 21 participants, Wicksell *et al.* 2008 [39]) for short-term improvement in pain- disability index, life satisfaction; fear of movement, depression, post-traumatic stress symptoms, psychological flexibility but not pain intensity. The professional background of the practitioner applying this intervention was not reported. Second, a multimodal intervention including relaxation training, psychological support, exercise, and manual therapy (very low GRADE, 1 trial, 60 participants, Provinciali 1996 [40]) delivered by PT for acute WAD was beneficial for long-term return to work but not different in immediately post treatment pain intensity when compared to electrotherapy.

Workplace Intervention & 1^oPrevention - Physical Environment Change

We note low GRADE evidence of benefit in preventing pain in workers using two physical ergonomic interventions - 1) ergonomic training plus an arm board support (1 trial, 83 participants, Rempel *et al.* 2006 [41]) in non-sick listed neck pain free workers in customer service had significant neck pain prevention compared to no ergonomic intervention in the long-term; and 2) The use of either a chair with a curved or flat seat pan (1 trial, 2 arms, 277 participants [42]) - resulted in lower neck pain intensity in non-sick listed neck pain free garment workers at short-term follow-up.

Orthotics – Collar

For semi-hard collars, we note low GRADE evidence of benefit (1 trial, 205 participants, Kuijper *et al.* 2009 [43]) in short-term pain reduction for cervical radiculopathy when compared to being on a wait list. However, there was no difference in pain at intermediate-term. There was also no difference in short-term and intermediate-term function, global perceived effect or working status between these groups.

Orthotics – Kinesio Taping

There is low GRADE evidence of benefit (1 trial, 41 participants, Gozalez-Iglesias *et al.* 2009 [44]) for the use of Kinesiotape when compared with a placebo control. The evidence indicates that Kinesiotape applied for 24 hours resulted in reduced immediate and short term pain when compared to the same tape applied with no tension for acute/subacute WAD. However, there was no difference in immediate and short-term range of motion and disability.

Orthotics - Pillow

There are significant differences in the types of pillows that impede comparisons across studies (very low GRADE, 5 trials, 383 analysed from 422 randomised participants [45]) evaluating specialised pillows in persons with acute and chronic neck pain. When a cervical pillow is compared to a

generic or standard pillow, there is very low GRADE evidence of benefit (3 trials, 56 participants, Erfanian *et al.* 2004 [46] & Jochems *et al.* 1997 [47]) of morning pain relief favouring the cervical pillow for chronic neck pain but no difference in the evening or when evaluating global perceived effect. When comparing a Mediflow water-based pillow to a participant's regular pillow (very low GRADE, 1 trial, 20 participants, Lavin 1997 [48]), evidence shows that a water based pillow resulted in reduced pain in the short-term. This trial also indicated that function, as measured by the Sickness Impact Profile was greatly improved when comparing the water based pillow to the roll pillow. Additionally, different specialised pillows - the Shape of Sleep pillow (Manutex Products, Mississauga, ON, Canada) or the Sissel Design AB pillow (Sissel Design AB, Svedala, Sweden) combined with exercise (low GRADE, 1 trial, 62 participants, Helewa *et al.* 2007 [49]) showed decrease pain and increase function when compared to exercise in persons with acute or chronic neck disorders. However, when these pillows were compared to regular pillows without the exercise interaction effect there was no difference in pain and function outcomes (Helewa *et al.* 2007). Finally, for chronic cervical brachialgia, using a specialized cervical pillow (very low GRADE, 1 trial, 149 participants, Bernateck *et al.* 2008 [50]) reduced pain recurrence significantly at short and long-term follow-up.

Orthotics – Oral Splint

For people with chronic neck pain and headache, occlusal adjustment plus physiotherapy (low GRADE, 1 trial, 40 participants, Karppinen *et al.* 1999 [51]) was significantly better in the long-term (12 and 60 months) than mock adjustment.

Patient Education- Advice on Activation

Advice on activation was given through various means in the studies included in this review. These included educational booklets (for mechanical neck disorder; Glossop *et al.* 1982 [52]), advice on acting as usual and instructions for self-training exercises to be initiated immediately (for acute WAD [53]) and mobilization advice (for acute WAD [54]). Advice on activation given through these modes showed low or very low evidence of benefit when compared to teaching exercises alone (for short-term pain and knowledge (Glossop *et al.* 1982 [52]), immobilization (for short- and intermediate-term pain, range of motion and cognitive symptoms [53]) and physiotherapy or rest (for short-term pain and long-term presence of symptoms [54]).

EVIDENCE OF NO BENEFIT (VS CONTROL) OR NO DIFFERENCE (VS COMPARISON)

Strong Evidence

We found no trials that met this standard.

Moderate Evidence

Psychosocial Intervention by PT

We found 1 trial (moderate GRADE, 268 participants, 2 publications, Manca *et al.* 2007 [55], Klaber-Moffet *et al.* 2005 [56]) on psychosocial intervention delivered by a PT based on cognitive-behavioral principles. It encouraged a return to normal daily activities as soon as possible through

self-management compared to usual physiotherapy. At long-term follow-up, there was a moderate effect size for neck pain and disability SMD 0.30 [0.06, 0.54]; Mean Difference 1.90 [0.39, 3.41] favoured the usual physiotherapy treatment over the brief intervention group. This brief intervention provided only slightly less health benefit on average in the long-term as measured by Patient-specific quality-adjusted life years at long term follow-up.

For intensive relaxation training (progressive relaxations, functional relaxation, autogenic training, systematic desensitization) delivered by a physiotherapist for chronic non-specific neck pain, there was no difference (moderate GRADE, 1 trial, 258 participants, Viljanen *et al.* 2003 [57]) in neck/arm pain relief or improved function when compared to a control or exercise at long-term follow-up.

Workplace Intervention – Mental Health Education

For office workers with neck pain, relaxation training including progressive relaxation, autogenic training, functional relaxation, systematic desensitization showed no significant difference in pain levels or disability over no treatment (moderate GRADE, 1 trial, 258 participants, Viljanen *et al.* 2003 [57]). Likewise, one further trial (stress management versus no intervention, low GRADE, 192 participants, Horneij *et al.* 2001 [58]) showed no significant difference for pain or sick leave at long-term follow-up.

Workplace Intervention – Ergonomic and Mental Health Education

For computer and office workers with neck pain, we note no difference between two-component work-place interventions (work style group) including stimulated workplace adjustment, improved body posture, breaks, and coping behaviors to high work demands over no intervention on pain severity at long-term follow-up (moderate GRADE, 1 trial, 2 arms - 210 and 209 participants, Bernaards *et al.* 2007 [59]). The second arm (work style + physical activity group) included an increase in moderate to heavy physical activities. Two further trials included work ergonomic education and stress coping skills (moderate GRADE, 1 trial 2 arms, 192 participants, Andersen *et al.* 2011 [31]; low GRADE, 1 trial - 2 arms, 42 participants, Andersen *et al.* 2008 [60]) compared to various exercise interventions and found either the 2 or 12 minute exercise was favoured (Andersen *et al.* 2011 [31]) or no difference when compared to general fitness or neck/shoulder exercise (Andersen *et al.* 2008 [60]).

Workplace Intervention & 1^o or 2^o Prevention - Physical Environment Change

Four trials [61-64] (moderate GRADE, 1 meta-analysis [65], 1546 participants) suggests a number of physical environment interventions do not prevent neck pain in the short-term when compared to no intervention for non-sick listed neck pain free (university, kitchen, computer or call centre) workers while three other physical environment interventions (low GRADE, 1 meta-analysis [65], 3 trials [42, 64, 66], 295 participants) did not prevent neck pain in the long-term when compared to a control. Sick leave was also no different from a control [64]. For workers with neck pain, we note three further physical environment modifications (low GRADE, three trials Voerman *et al.*

2007, Fostervold *et al.* 2006, Hedge *et al.* 1999 [67-69], 137 participants) suggesting no evidence of benefit in the long-term for computer or office workers with chronic neck pain when compared to another workplace intervention. We refer the reader to Table 4 for descriptions of the modifications.

Workplace intervention & 2^o Prevention – Individual Worker Change

We suggest two categories of exercise 1) upper extremity stretching and strengthening or 2) general exercise may not reduce pain intensity or pain prevalence in workers. Upper extremity stretching and endurance training (moderate GRADE, one trial, 265 participants, Viljanen *et al.* 2003 [57]) for chronic neck pain and function at immediate post treatment, short- and long-term follow-up and a teacher guided combined exercise approach (Feldenkrais Intervention, low GRADE, one trial, 38 participants Lundblad 1999 [70]) of stabilization of the low back and pelvis, posture awareness, ergonomic training, and strength, coordination, endurance, flexibility/smoothness and rhythm exercises when compared to no intervention or a wait list control for pain reduction with in chronic neck pain at short-term follow-up showed no evidence of benefit. General fitness training (i.e. biking) (low GRADE, 1 trial, 30 participants, Andersen *et al.* 2008 [60]) or group exercise that combined extensibility and coordination exercises with cardiovascular training (low GRADE one trial, 44 participants, Takala *et al.* 1994 [71]) for pain reduction immediately post treatment in patients with neck pain of unspecified duration did was no differ from a control group.

Orthotics – Collar

When a soft collar is used following acute WAD and is compared to general physiotherapy, the research showed moderate evidence of no benefit (5 trials, 637 participants, Giebel *et al.* 1997, Rosenfeld 2000, Schnabel *et al.* 2004, Vassiliou *et al.* 2006, Bonk *et al.* 2000 [72-76]). These trials concluded that there was a greater reduction of pain and increased global effect at short- and intermediate-term follow-up but not at long-term follow-up with physiotherapy treatment versus continuous use of a collar. Similarly, there is moderate evidence of no benefit (3 trials, 641 participants, McKinney 1989, Mealy *et al.* 1986, Kongsted *et al.* 2007 [77-79]) when comparing the use of a soft collar in combination with education to self-mobilize when compared to general physiotherapy [77-79]. Following an acute WAD, the evidence shows that general physiotherapy is better at reducing short-term pain, and increasing short-term cervical ROM than the combined use of a collar and education to self-mobilize [78, 79]. However, there is no significant difference when comparing the effects of these two interventions on long-term pain or function [77].

Patient Education – Self Management Educational Strategy

For a self – management educational strategy (moderate GRADE, 1 trial; 180 participants Ylinen *et al.* 2003 [33]), utilizing education on aerobic exercise plus stretching compared to specific neck, trunk, lower and upper extremity exercises or specific neck endurance and strengthening exercises was not beneficial for chronic non-specific neck pain and disability at long-term follow-up. Additionally, we

note moderate evidence of no benefit (1 trial, 218 participants, Chiu *et al.* 2005 [80]) for a self-management strategy on neck care versus intensive neck exercises for acute neck pain and disability at short- and long-term follow-up.

Low or Very Low Evidence

Psychological Intervention by Clinical Psychologist

Cognitive-behavioral therapy delivered by clinical psychologist for chronic neck and shoulder pain was not different from cognitive-behavioral therapy delivered by psychologist functioning as a coach to other health professionals (low GRADE, 1 trial, 70 participants, Jensen 2005 [81]) for intermediate-term pain relief or disability and long-term pain relief or sick leave. By the intermediate-term, the costs of delivering the intervention favour the coached health professionals.

Psychosocial Intervention by PT

Two trials assessed two different psychosocial interventions conducted by a physiotherapist. For *cognitive behavioral components* integrated with PT delivered by a physiotherapist in chronic WAD, there was no benefit (low GRADE, 1 trial, 33 participants, Soderlund 2001 [82]) over PT alone for pain relief, disability and activity of daily living at short-term follow-up. There were four phases to the cognitive-behavioral therapy: Learning of basic physical and psychological skills, application and generalisation of basic skills in everyday activities derived from functional behavioral analysis and a maintenance phase. One further trial (low GRADE, 1 trial, 139 participants, Vonk 2009 [83]) assessing a *Behavior Graded Activity Program* showed no difference in pain relief, function, global perceived effect and self-efficacy from a conventional exercise program at short-, intermediate- and long-term follow-up but required less treatment. Finally, the Neck Book provided by a physician from an occupational healthcare network intended to allay unrealistic fears of patient and promote activity despite pain (Very low GRADE, 1 trial, 181 analysed/522 randomized participants, Derebery 2009 [84]) noted a great loss to follow-up (n=181 randomized/552 analysed) and make conclusions difficult but demonstrated poor short-term and intermediate-term benefits in pain/disability. One further trial of very low GRADE noted stress management (169 randomized/282 analysed participants, Horneij *et al.* 2001 [58]) for mechanical neck disorder (duration NR) was not beneficial when compared to a non-intervention group for pain relief at long-term follow-up. The profession of the practitioner delivering the intervention was not reported.

Mind-Body (Alternative) Interventions by Certified Instructor

For an alternative mind-body approach – Gestalt therapy '*philosophy of life*' training, we found evidence of no benefit (very low GRADE, 1 trial, 87 participants, Ventegodt 2004 [85]) when compared to no treatment for pain, daily functioning, sick leave and global quality of life at short-term follow-up.

Workplace Intervention – Organizational Change

For computer workers from large office organizations with work related neck symptoms, computer stimulated

breaks showed no evidence (low GRADE, 1 trial, 219 analysed/268 randomized participants, van den Heuvel 2003 [86]) of altering pain intensity/frequency or sick leave but did alter productivity and perceived recovery from complaints.

Workplace Intervention or 2^o Prevention – Individual Worker Change

For healthy pain free workers, doing strengthening exercise (very low grade, 1 trial, 19 participants, Hamberg-van Reenen *et al.* 2009 [87]) did not protect against new onset musculoskeletal discomfort in the short-term.

Workplace Intervention – Ergonomic Education, Mental Health Education, Physical Environment Change, and Organizational Change

Three trials suggest no significant change in pain prevalence [88], pain intensity [89, 90] or sick leave [90] when various combinations of four component workplace interventions were compared to no intervention at intermediate-term (low GRADE, 1 trial, 2 arms – 54, 57 participants; Ketola 2002 [89]; very low GRADE, 1 trial, 76 participants, Kamwendo *et al.* 1991 [90]) or long-term follow-up (low GRADE, 1 trial, 3 arms – 601, 599, 629 participants; Morken *et al.* 2002 [88]).

Orthotics - Collars

There is very low GRADE evidence of no difference (1 trial, 196 participants, Gennis 1996 [91]) when comparing the use of a soft collar following an acute WAD versus rest for short term pain relief or global perceived effect. The research also showed low GRADE evidence of no difference (1 trial, 211 participants, Borchgrevink *et al.* 1998 [53]) when comparing the use of a collar versus advice to "act as usual" for immediate, short-term or intermediate-term pain relief, global perceived effect, improving ROM, or time on sick leave. Also there was no difference in pain at the short- and intermediate-term follow-up if a collar was worn 2 days versus 7 days (1 trials, 70 participants, Dehner *et al.*, 2006 [92]).

Following an acute WAD, there is very low evidence of no benefit (1 trial, 108 participants, Crawford *et al.* 2004 [93]) when comparing the combined use of a collar for 3 weeks followed by a self-mobilization exercise regime versus a control group. This trial found that there was no benefit of collar use on pain, ROM, activities of daily living or return to working in the short-term, intermediate-term or long-term. Advice to self-mobilize was administered by providing participants with advice sheets. Furthermore, there is very low evidence of no difference (1 trial, 135 participants, Pennie 1990 [94]) when comparing the initial use of a soft collar followed by home exercises and late physiotherapy when compared to manual therapy for the treatment of acute WAD. Collar in combination of exercise and physiotherapy showed no difference in reduction of pain and global perceived effect in a short-term and intermediate-term follow-up.

When compared to active physiotherapy, there is low level evidence of no difference (2 trials; one with a 2 year follow-up, 286 participants, Kuijper *et al.* 2009, Persson *et al.* 1997 & Persson *et al.* 2001 [95-97]) for semi-hard and rigid collar use in those with cervical radiculopathy [95-97].

Evidence shows that there is no difference between these two treatments when comparing short-term intermediate-term and long-term pain, function, global perceived effect and long-term disability [95-97].

When compared to surgery, there is also low level evidence of no difference (2 trials; one with a 2 year follow-up, 149 participants, Kadanka *et al.* 2000, Persson *et al.* 1997, Persson *et al.* 2001 [96-98]) for semi-hard and rigid collar use in those with cervical radiculopathy. The evidence shows that there is no significant difference in short- and long-term pain, global perceived effect, and disability as well as intermediate- and long-term function.

Patient Education - Advice on Activation

Low GRADE evidence of no benefit was shown for the following 11 educational interventions:

- 1) Advice on activation versus another treatment [52] or home exercise [99] for mechanical neck pain at short-term [52, 99] and long-term follow-up and function [99];
- 2) Neck school which included instruction for exercise, relaxation and self-care versus no treatment for mechanical neck pain and function at short- and intermediate-term follow-up and knowledge [90];
- 3) Lecture on neck pain and recommendations on exercises versus multimodal treatment of exercise and relaxation training or home exercise for chronic neck pain for short- and long-term pain and function [99];
- 4) Education or control booklet versus no treatment for acute or subacute neck pain for short-term pain and intermediate-term pain and disability [84];
- 5) Education on return to normal activity using media, manual/book, video tape interview and role playing versus physiotherapy for subacute or chronic neck pain for intermediate- and long-term pain, function and quality of life [56];
- 6) Physician advice versus naprapathy for acute neck pain for short-term pain [100];
- 7) Whiplash pamphlet versus generic information sheet for acute WAD for short-term pain, function, recovery and global perceived effect [101];
- 8) Advice to act-as-usual and education on WAD versus immobilization in a collar [53, 102] or manual therapy and exercise [102] for acute WAD for short- and intermediate-term pain and global perceived effect [53] and long-term pain, function and quality of life [102];
- 9) One hour verbal advice plus a hand-out of key points versus an educational pamphlet for acute WAD for short- and intermediate-term pain and disability [103];
- 10) Mobilization advice versus rest for acute WAD for short-term pain and ROM [78];
- 11) Early or delayed standard treatment which included written material advising for rest followed by active movement versus early or delayed active treatment

for acute WAD for intermediate- and long-term pain and ROM [74].

Patient Education - Pain and Stress-Coping Skills Education

We note low GRADE evidence of no benefit for pain and stress-coping skills education from the following 2 trials: 1) education on psychological skills plus physiotherapy versus physiotherapy for subacute WAD for short and intermediate term pain and disability [82]; and 2) education on stress management versus individual training programme or no intervention for mechanical neck pain and disability at short- and long-term follow-up [58].

Patient Education - Work place Ergonomic Education and Pain and Stress-Coping Skills Education

Also, low GRADE evidence from 2 trials suggests workplace education on pain and stress-coping skills was not favoured. First, health counselling versus specific training or general fitness training for chronic neck pain at short-term follow-up [60]; Second, education on physical exercise, advice to stay active, diet, smoking, alcohol use, stress management and workplace ergonomics versus 2 minute or 12 minute exercise program for chronic neck pain at short-term follow-up [31].

Patient Education - Self-Management Educational Strategies

We also note that a variety of educational self-management strategies appear not beneficial (Low GRADE, 5 trials) as follows. 1) Self-care booklet versus massage plus advice on stretching, body awareness and water intake for chronic neck pain, function and quality of life at short-, intermediate- and long-term follow-up [104]; 2) Health promotion versus strengthening arm and shoulder exercises plus static neck exercises or non-specific exercises for neck pain, work ability, sick leave and discomfort at long term follow-up [32]; 3) Anatomy and stretching education versus self-stretching plus neck ROM exercises for non-specific neck pain and pressure pain threshold at short-term follow-up [105]; 4) Self-management program which included education on exercise versus multimodal physiotherapy for chronic pain from WAD at short-term follow-up [106]; 5) Instruction in home exercises versus supervised training rehabilitation for acute neck pain, disability and sick leave at short-term follow-up [107].

Adverse Events

Side effects were consistently not reported in primary trials. For orthotics, two trials reported side effects. Lavin *et al.* 1997 noted 12 of 19 patients reported difficulty using the roll pillow. Jochem *et al.* 1997 noted the following transient side effects with the use of the "orthopaedic pillow" [(migraine (n=1), throat pain (n=1)) and roll pillow [migraine (n=1), headache (n=2), transient pain outer ear (n=2), pain in fingers (n=1), flu like symptoms (n=1)]. For workplace interventions, Andersen and colleagues 2011 note exercises groups also had transient side effects including worsening of neck muscle tension, pain upper arm during training, pain in forearm wrist, and worse headache after training. For educational or psychological interventions, side effects or harm were not addressed.

We did not find a systematic review on harms for any intervention category explored in our overview.

DISCUSSION

Summary of Main Results

There continues to be a lack of high-quality evidence to inform recommendations on the use of psychological interventions, orthotics- collar, pillows, kinesio taping, or oral splint use, patient educational strategies, ergonomic workplace interventions and prevention for neck pain. We found 5 trials meeting the moderate quality evidence threshold and reporting evidence of benefit. For psychological interventions specific to chronic neck pain, there is one mind-body interventions (Dantian Qigong exercise) that assists 1 in 4 to 6 participants a small amount in pain reduction and 1 in 5 to 8 participants in function in the short-term when compared to a wait list control. Of 19 trials on patient education strategies, there is one that supports the use of an educational video given in an Emergency Room for acute WAD and helps 1 in 23 participants reduce pain a small amount in both the short- and long-term. For secondary prevention of acute to chronic myofascial neck pain in white collar workers, small daily amounts (2 or 12 minutes) of progressive resistance training with elastic tubing over 10 weeks reduced pain a small amount in 1 or 4 participant immediately post this treatment period. There is a lack of moderate or strong evidence in other treatment categories upon which to make recommendations. There is emerging and promising evidence from many small low GRADE trials that need verification. In these trials, it is the imprecision (sample size) and indirectness rather than low risk of bias assessment that limits us from making recommendations.

There was more data on moderate evidence of no benefit at short- and long-term follow-up: 2 psychosocial interventions delivered by a PT; 4 workplace interventions; 2 soft collar interventions and 2 self-management educational strategies. Psychosocial interventions by PTs not effective in long-term chronic neck pain management were solution finding using cognitive behavioral principles or intensive relaxation training. Workplace interventions that were ineffective in the long-term pain prevalence were mental health education (intensive relaxation training), ergonomic education plus mental health education (work style or work style plus physical activity training; weekly email on this topic), individual worker change (upper extremity stretching and strengthening endurance training - 3 time per week for 8 weeks) and physical environment changes (ergonomic training plus workplace adjustment in university workers, kitchen workers, computer workers, support call center workers at short-term follow-up). The use of a soft collar or soft collar plus advice was consistently inferior to usual physiotherapy care at long- and intermediate term follow-up respectively. Finally, self-management educational strategies were less effective compared to exercise for reducing pain and disability in the long term.

Lastly, the trials we found rarely report adverse event data. There were no reviews reporting adverse events in this category of treatments. This is consistent with a review of cognitive behavioral therapy for low back pain patients reported that side effects and adverse events related to this

intervention are unknown [108]. Interestingly a prospective study with a two year follow-up of the effect of CBT on patients with chronic low back pain suggested that CBT may indirectly decrease adverse events since participants decreased antidepressant drug use [109].

Overall Completeness and Applicability of Results

We came to realize through our reviewing process that expanding on three facets of our search method could lead to broader overall completeness and applicability of results from our overview. First, for MVA WAD prevention the inclusion of biomechanical studies and cohort trials might better inform overview results. For example, one recent review found a reduction of MVA related WAD claims and subjective complaints of 21 to 49% when energy-absorbing seats aimed at decreasing occupant loads and accelerations were used. Additionally, this same review showed the use of active head restraints that provide early head support to minimize head and neck motions showed evidence of reducing WAD claims and subjective complaints between 43 to 75%. Epidemiological outcomes were changed drastically for WAD prevention [110]. Another example is neck injury rate from use of helmet in biking accidents gleaned only from cohort trials [111, 112]. Clearly, studies addressing anti-whiplash systems may reduce WAD injury through improved prevention strategies especially if they are adapted by industry, the government and the clinic setting. Missing key messages like this is a limitation of this review's search strategy.

Second, we found an absence of psychological interventions performed by a psychologist. A broader search strategy that is not limited to neck pain would enhance our understanding of the treatment for depression or post-traumatic stress by a clinical psychologist and may be applied to those with comorbid conditions of depression and neck pain [113]. Third, are therapeutic educational strategies dependent on the specific disorder or other educational dimensions? The inclusion of educational strategies for chronic musculoskeletal pain may inform us about a greater breadth of educational options not specifically studied in randomized trials for neck pain. Should we be evaluating education for chronic diseases? For example, we excluded a systematic review informing us about the compelling effect of a neuroscience educational strategy addressing a patients understanding of neurophysiological or the neurobiology effects of pain on chronic musculoskeletal pain [112].

Overall in this overview, there was incomplete and limited data. Our overview therefore has limited impact on informing or guiding clinical practice or recommendations. While many of the interventions discussed under moderate GRADE in this overview have a small magnitude of effect but lasting effect on the neck pain and to a lesser extent on function, there are many interventions (low GRADE) that require a second larger trial conducted in an independent setting to impact on our confidence in the estimate of effect. Future research needs a clear navigational strategy mapped out so we may be able to address the effects of some of these promising interventions and decrease the use of limited resources on imprudent trials.

Reporting 'adherence to the intervention' was poorly or not at all monitored in most trials. Since the results in

different studies might be influenced by the therapists' and patients' adherence to treatment regime, the adherence should be better investigated in future studies to be able to analyse adherence as a covariate in effect analyses. In addition, the validity of the therapists' skills in delivering e.g. psychological or cognitive behavioral interventions should be measured and reported in future studies. These measures would strengthen the clinical applicability and interpretability of the study's results.

We agree with Andersen *et al.* [114] and Leyshou and colleagues [115] that the outcomes - productivity (cost) and safety - need to be consistently evaluated. Ergonomic interventions at the work place may alter productivity even when patient comfort (pain and function) may not change. On the one hand, if an intervention is cheap, easy to apply, easy to comply with and safe, we may consider treating even if a small difference is achieved for the short-term. For example there is evidence for some interventions that some types of specialized pillows act to provide relief from morning pain [31-32, 47, 116]. Though this effect is not a long-term effect, it may be clinically meaningful to the patient. On the other hand, if the treatment is expensive and carries further risks, we may not choose to treat.

Finally, in order to use the interventions discussed in this paper effectively with patient populations, clinicians need to determine the patient's readiness to change and choosing the appropriate treatment interventions accordingly. We note, two trials [82]; Ferrari 2005 [101] from one review [30] on educational interventions for WAD consider readiness to change in their trials intervention. The rationale for choosing the optimal treatment for a specific patient must involve consideration of the mechanism of action of the treatment, the patient's readiness to change and how these match with the clinical indications for treatment, as well as evidence that therapeutic objectives can be achieved. By determining the patient's readiness to change, based on the transtheoretical model, we may be able to identify which patients are best suited to an intervention and thus better translate the evidence to the individual patient. The Stages of Change Model - pre-contemplation, contemplation, preparation, action, maintenance and relapse [16] - can help us understand success and failure rates in aiding patients with achieving change and the role of clinicians in improving patient outcomes. The physical and psychological impairments associated with the neck disorder need to be specifically targeted; consider the patient's (and their environment's) readiness to change; and incorporate plausible implementation strategies. Patient education, orthosis use, ergonomic change, and prevention interventions may need to be underpinned by sound adult learning principles, application of stages of change model to a practice setting, and cognitive behavioral theory. Therefore, to establish optimal treatment for a specific patient it is clear that we need conceptually sound and theory driven research in this area.

Quality of the Evidence

Two perspectives - AMSTAR rating of reviews assisted in triaging the evidence and GRADE was either extracted (most often from Cervical Overview Group (COG) or Cochrane reviews where a relatively consistent GRADE

application process was used) or assessed by going back to the original articles to establish the quality of the body of evidence. For low GRADE evidence, further research is very likely to have a significant impact on our confidence in the estimate of effect and may change the estimate while with very low GRADE evidence we remain extremely uncertain about the estimate.

Potential Bias in Review Process

We had several strengths regarding our approach to summarizing this literature. We used a comprehensive, librarian-assisted search and multiple databases. We accessed grey literature through early submitted data for Cochrane Reviews. But we did not use new primary trials published since review updates. For example, one large (n = 3851) trial (the MINT trial - Managing Injury of the Neck Trial) [117] may have an important impact on the direction of education recommendations. Two independent reviewers determined article relevance, assessed the AMSTAR methodological and verified data extraction. Our review used unique methodology, unlike Andersen [114] and colleagues' overview methodology where overlap of original publications is detailed followed by reporting of the aim and main conclusion for each intervention, we created summary of finding tables categorized by the quality of the body of evidence (GRADE). We returned to the description of the original papers, the related GRADE statement and their reported data to be able to extract evidence on the magnitude, NNT, and duration of the effect with related side effects / harm. Consensus was used both by the internal data abstraction team and an interdisciplinary external panel consensus to validate the GRADE of evidence and recommendations. Thus, one potential source of bias is that there are several individuals on this ICON Review panel that were authors of the review papers discussed in this paper. However, these specific authors did not participate in the selection of papers or data extraction. The potential of this particular bias was reduced by using a stringent protocol for this review (as documented in the methods section).

Agreement and Disagreement with Other Studies or Reviews

The main findings in this paper were consistent with those found in previous reviews. In a 2010 overview, psychosocial interventions, patient education, orthotic use, ergonomic change and prevention strategies received minimal clinical directives [12, 118]. Psychological interventions were briefly mentioned. Our overview has expanded on previous reviews findings but continues to find a dearth of information on psychological interventions by psychologists. One would need to expand this review's scope for a complete understanding on psychological interventions. For acute WAD evidence on use of an educational video on activation in the emergency department and avoidance of collar use has been well documented in the past; we have not added new information and are in agreement with others [12, 119]. For work interventions targeting the individual worker such as strengthening, the addition of new evidence (Kay *et al.*) has shifted the evidence from conflicting [120] or limited [121] to moderate GRADE evidence that strengthening of the cervical and scapulothoracic region aides in either preventing or reducing

the recurrence of neck and shoulder pain for workers in both the short and long term. We are in agreement with Andersen (2011) [31] and Driessen 2010 [65] that no strong evidence exists for work place interventions and that there is low quality evidence in support the use of a physical ergonomic intervention (arm board support) to reduce neck pain in the long-term. For chronic neck pain or WAD, there is limited evidence emerging in favour but more against the use of psychosocial interventions. Systematically planning the future research agendas for Neck Care is needed to avoid exploring ineffective treatment pathways. We agree that targeted research of high quality is needed in work place interventions for chronic neck pain and WAD (Verhagen 2007 [122], Andersen 2011 [31]). Prevention strategies from biomechanical studies and cohort trials that showed evidence of benefit included energy absorbing seats and active head rests [24] need to be included in future overview updates.

CONCLUSION

In summary, due to the moderate GRADE evidence available in this domain of research clinical recommendations remain limited at this point. One mind-body intervention strategy, one educational strategy, one workplace intervention on individual worker change showed moderate evidence of benefit for reducing pain and reducing disability. A greater body of evidence has emerged on what may not be effective interventions including the following categories: workplace interventions/prevention strategies including specific physical environment changes and individual worker changes, use of soft collar for WAD and a number of self-management strategies. It is necessary to direct future research towards prevention strategies in order to reduce the burden of neck injuries on the healthcare system; to consider economic outcomes such as productivity and safety; and have a focused research agenda developed by experts in the field.

CONFLICT OF INTEREST

The authors confirm that this article content has no conflict of interest.

ACKNOWLEDGEMENTS

This work was supported by Canadian Institutes of Health Research (CIHR) grant(s) FRN: KRS-102084 and Centric Health Lifemark Industry Partner Grant.

ICON is a multi-disciplinary collaborative group that includes scientist-authors (listed below) and support staff (Margaret Lomotan) that conduct knowledge synthesis and translation aimed at reducing the burden of neck pain.

The ICON authors that provided direction of the project and reviewed the findings/manuscript includes (in alphabetical order): Gert Bronfort, Norm Buckley, Lisa Carlesso, Linda Carroll, Pierre Côté, Jeanette Ezzo, Paulo Ferreira, Tim Flynn, Charlie Goldsmith, Anita Gross, Ted Haines, Jan Hartvigsen, Wayne Hing, Gwendolen Jull, Faith Kaplan, Ron Kaplan, Helge Kasch, Justin Kenardy, Per Kjær, Janet Lowcock, Joy MacDermid, Jordan Miller, Margareta Nordin, Paul Peloso, Jan Pool, Duncan Reid, Sidney Rubinstein, P. Lina Santaguída, Anne Söderlund, Natalie Spearing, Michele Sterling, Grace Szeto, Robert Teasell, Arianne Verhagen, David M. Walton, Marc White.

APPENDIX 1

Excluded Studies with Reason for Exclusion in Square Brackets

Excluded Studies

Brosseau L, Wells G, Tugwell P, *et al.* Ottawa panel evidence-based clinical practice guidelines on massage therapy for neck pain. 2012. (submitted for publication). [INTERVENTION]

Conlin A, Bhogal S, Sequeira K, Teasell R. Treatment of whiplash-associated disorders – Part II: Medical and surgical intervention. *Pain Res Manage* 2005; 10(1): 33-40. [INTERVENTION]

Crawford J, Laiou E. Conservative treatment of work-related upper limb disorders – a review. *Occupational Medicine* 2007; 57: 4-17. [POPULATION]

Cassidy J, Cote P. Is it time for a population health approach to neck pain? *J Manipulative Physiol Ther* 2008; 31: 442-46. [INTERVENTION]

Carragee EJ, Hurwitz EL, Cheng I, *et al.* Treatment of neck pain: injections and surgical interventions: results of the Bone and Joint Decade 2000-2010 Task Force on Neck Pain and Its Associated Disorders. *Spine* 2008; 33(S4): S153-S169. [INTERVENTION]

Furlan A, Yazdi F, Tsertsvadze A, *et al.* Complementary and alternative therapies for back pain II. Evidence report/technology assessment no. 194. (Prepared by the university of Ottawa evidence-based practice center under contract no. 290-2007-10059-I (EPCIII). AHRQ Publication no. 10(11)-E007. Rockville, MD: Agency for healthcare research and quality. October 2010. [INTERVENTION]

Gross A, Miller J, D'Sylva J, Burnie SJ, Goldsmith CH, Graham N, Haines T, Bronfort G, Hoving JL. Manipulation or Mobilisation for Neck Pain. *Cochrane Database of Syst Rev* 2010; (1): CD004249. DOI: 10.1002/14651858.CD004249.pub3. [INTERVENTION]

Kroeling P, Gross AR, Graham N, *et al.* Electrotherapy for neck disorders with and without radiculopathy: a Cochrane systematic review update. *Cochrane Database of Syst Rev* 2012 (submitted) [INTERVENTION]

Kroeling P, Gross A, Goldsmith CH, Burnie SJ, Haines T, Graham N, Brant A. Electrotherapy for neck pain. *Cochrane Database Syst Rev*. 2009 Oct 7; (4): CD004251. [INTERVENTION]

Gross AR, Graham N, *et al.* Electrotherapy for neck disorders with and without radiculopathy: a Cochrane systematic review update. *Cochrane Database of Syst Rev* 2012 (submitted) [INTERVENTION]

Langevin P, Lowcock J, Weber J, *et al.* Botulinum Toxin Intramuscular Injections for Neck Pain: A Systematic Review and Metaanalysis. *J Rheumatol* 2011; 38(2): 203-14. [INTERVENTION]

Lee M, Choi T, Kim J, Choi S. Using guasha to treat musculoskeletal pain: a systematic review of controlled clinical trials. *Chinese Medicine* 2010; 5: 5. [INTERVENTION]

Liu B, Ivers R, Norton R, Blows S, Lo S. Helmets for preventing injury in motorcycle riders. *Cochrane Database of Syst Rev* 2003; (4): CD004333. DOI: 10.1002/14651858.CD004333.pub2. [INTERVENTION; TRIAL DESIGNS OF INCLUDED STUDIES - Cohort]

Macaulay J, Cameron M, Vaughan B. The effectiveness of manual therapy for neck pain: a systematic review of the literature. *Physical Therapy Reviews* 2007; 12: 261-67. [INTERVENTION]

Peake N, Harte A. The effectiveness of cervical traction. *Phys Ther Reviews* 2005; 10: 217-29. [INTERVENTION]

Peloso P, Gross A, Haines T, *et al.* Medicinal and injection therapies for mechanical neck disorders (Review). *Cochrane Database Syst Rev* 2007; (3): CD000319. [INTERVENTION]

Reid S, Rivett D. Manual therapy treatment of cervicogenic dizziness: a systematic review. *Manual Therapy* 2005; 10: 4-13. [INTERVENTION + DESIGN]

Teasell R, McClure A, Walton D, *et al.* A research synthesis of therapeutic interventions for whiplash-associated disorder (WAD): Part 3 – interventions for subacute WAD. *Pain Res Manage* 2010; 15(5): 305-12. [INTERVENTION]

Teasell R, McClure A, Walton D, *et al.* A research synthesis of therapeutic interventions for whiplash-associated disorder (WAD): Part 5 – surgical and injection-based interventions for chronic WAD. *Pain Res Manage* 2010; 15(5): 323-34. [INTERVENTION]

Tsakitzidis G, Remmen R, Peremans L, *et al.* Non-specific neck pain: diagnosis and treatment. *Good Clinical Practice (GCP)*. Brussels: Belgian Health Care Knowledge Centre (KCE). 2009. KCE Reports 119C. D/2009/10.273/56. [DESIGN]

Vernon H, Humphreys K, Hagino C. A systematic review of conservative treatments for acute neck pain not due to whiplash. *J Manipulative Physiol Ther* 2005; 28(6): 443-8. [INTERVENTION]

Vernon H, Humphreys K, Hagino C. Chronic mechanical neck pain in adults treated by manual therapy: a systematic review of change scores in randomized clinical trials. *J Manipulative Physiol Ther* 2007; 30: 215-27. [INTERVENTION]

Vernon H, Humphreys K, Hagino C. The outcome of control groups in clinical trials of conservative treatments for chronic mechanical neck pain: a systematic review. *BMC Musculoskeletal Disorders* 2006; 7: 58. [COMPARISON + INTERVENTION]

Vernon H, Humphreys K. Manual therapy for neck pain: an overview of randomized clinical trials and systematic reviews. *Eura Medicophys* 2007; 43(1): 91-118. [INTERVENTION]

Williams N, Hendry M, Lewis R, Russell I, Westmoreland A, Wilkinson C. Psychological response in spinal manipulation (PRISM): a systematic review of psychological outcomes in randomized controlled trials. *Complementary Therapies in Medicine* 2007; 15: 271-83. [INTERVENTION]

REFERENCES

- [1] Croft PR, Lewis M, Papageorgiou AC, *et al.* Risk factors for neck pain: a longitudinal study in the general population. *Pain* 2001; 9: 317-25.
- [2] Hogg-Johnson S, van der Velde G, Carroll LJ, *et al.* The burden and determinants of neck pain in the general population: results of the Bone and Joint Decade 2000-2010 Task Force on Neck Pain and Its Associated Disorders. *Spine* 2008; 33: S39-S51.
- [3] Gargan M, Bannister G, Main C, Hollis S. The behavior response to whiplash injury. *J Bone Joint Surg* 1997; 79B: 523-6.
- [4] Nieto R, Miro J, Huguet A. The fear-avoidance model in whiplash injuries. *Eur J Pain* 2009; 13: 518-23.
- [5] Radanov BP, Begre S, Sturzenegger M, Augustiny KF. Course of psychological variables in whiplash injury--a 2-year follow-up with age, gender and education pair matched patients. *Pain* 1996; 63: 429-34.
- [6] Thompson DP, Oldham JA, Urmston M, Woby SR. Cognitive determinants of pain and disability in patients with chronic whiplash-associated disorder: a cross-sectional observational study. *Physiotherapy* 2010; 96: 151-9.
- [7] von Korf M, Crane P, Lane M, *et al.* Chronic spinal pain and physical-mental comorbidity in the United States: results from the national comorbidity survey replication. *Pain* 2005; 113: 331-9.
- [8] Linton S. A review of psychological risk factors in back and neck pain. *Spine* 2005; 25: 1148-56.
- [9] Hoving C, Visser A, Dolan Mullen P, van den Borne B. A history of patient education by health professionals in Europe and North America: From authority to shared decision making education. *Patient Educ Counsel* 2010; 78: 275-81.
- [10] World Health Organization. Therapeutic Patient Education; Continuing Education Programmes for Health Care Providers in the Field of Prevention of Chronic Diseases. Copenhagen: World Health Organization Regional Office for Europe 1998.
- [11] van Dieen JH, van der Beek AJ. Work-related low-back pain: Biomechanical factors and primary prevention. In: Kumar S, Ed. *Ergonomics for Rehabilitation Professionals*. 1st ed. Florida: Boca Raton 2009; pp. 359-95.
- [12] Hurwitz EL, Carragee EJ, Van der Velde GM, *et al.* Treatment of neck pain - Noninvasive interventions: Results of the Bone and Joint Decade 2000-2010 Task Force on Neck Pain and Its Associated Disorders. *Spine* 2008; 33(4S): S123-S152.
- [13] Tsang A, von Korf M, Lee S, *et al.* Common chronic pain conditions in developed and developing countries: gender and age differences and comorbidity with depression-anxiety disorders. *J Pain* 2008; 9(10): 883-91.
- [14] Kjellgren A, Bood S, Axelsson K, Norlander T, Saatcioglu F. Wellness through a comprehensive yogic breathing program - a controlled pilot trial. *BMC Compl Alt Med* 2007; 19(7): 43.
- [15] Haute Autorité de Santé. Therapeutic patient education (TPE) Definition, goals, and organisation 2007. <www.has-sante.fr> Accessed: June 16th 2011.
- [16] Zimmerman GL, Olsen CG, Bosworth MF. A "Stages of Change" approach to helping patients change behavior. *Am Fam Phys* 2000; 61: 1409-16.
- [17] Santaguida PL, Keshavarz H, Lomotan M, *et al.* Overview of reviews: Methodology used to evaluate evidence on the treatment, harm, diagnosis / classification, prognosis and outcomes used in Neck Pain management. *Open Orthop J* 2013; In press.
- [18] Furlan AD, Pennick V, Bombardier C, van Tulder M, Editorial Board CBRG. 2009 updated method guidelines for systematic reviews in the Cochrane Back Review Group. *Spine* 2009; 34: 1929-41.
- [19] de Morton N. The PEDro scale is a valid measure of the methodological quality of clinical trials: a demographic study. *Am J Physiother* 2009; 55: 129-33.
- [20] Maher C, Sherrington C, Herbert R, Moseley A, Elkins M. Reliability of the PEDro scale for rating quality of randomized controlled trials. *Phys Ther* 2003; 83: 713-21.
- [21] Shea BJ, Hamel CJ, Wells GA, *et al.* AMSTAR is a reliable and valid measurement tool to assess the methodological quality of systematic reviews. *J Clin Epidemiol* 2009; 62: 1013-20.
- [22] Balshem H, Helfand M, H.J. S, *et al.* GRADE guidelines: 3. Rating the quality of evidence. *J Clin Epidemiol* 2011; 64: 401-6.
- [23] Guyatt GH, Oxman AD, Vist G, *et al.* GRADE guidelines: 4. Rating the quality of evidence--study limitations (risk of bias). *J Clin Epidemiol* 2011; 64: 407-15.

- [24] Liberati A, Altman DG, Tetzlaff J, *et al.* The PRISMA Statement for Reporting Systematic Reviews and Meta-Analyses of Studies That Evaluate Health Care Interventions: Explanation and Elaboration. *PLoS Med* 2009; 6(7): e1000100-doi: 10.1371/journal.pmed.1000100.
- [25] Kay TM, Gross A, Goldsmith CH, *et al.* Exercises for mechanical neck disorders. *Cochrane Database Syst Rev* 2012; 8: CD004250.
- [26] Lee JY, Nassr A, Eck JC, Vaccaro AR. Controversies in the treatment of cervical spine dislocations. *Spine J* 2009; 9: 418-23.
- [27] von Trott P, Wiedemann AM, Ludtke R, Reishauer A, Willich SN, Witt CM. Qigong and exercise therapy for elderly patients with chronic neck pain (QIBANE): a randomized controlled study. *J Pain* 2009; 10: 501-8.
- [28] Rendant D, Pach D, Ludtke R, *et al.* Qigong versus exercise versus no therapy for patients with chronic neck pain. *Spine* 2011; 36: 419-29.
- [29] Brison RJ, Hartling L, Dostaler S, Leger A, Rowe BH, Stiell I. A randomized controlled trial of an educational intervention to prevent the chronic pain of whiplash associated disorders following rear-end motor vehicle collisions. *Spine* 2005; 30: 1799-807.
- [30] Gross A, Forget M, St George K, *et al.* Patient education for neck pain [Systematic Review]. *Cochrane Database Syst Rev* 2012; 3: CD005106.
- [31] Andersen LL, Saervoll CA, Mortensen OS, Poulsen OM, Hannerz H, Zebis MK. Effectiveness of small daily amounts of progressive resistance training for frequent neck/shoulder pain: Randomised controlled trial. *Pain* 2011; 152: 440-6.
- [32] Blangsted AK, Sogaard K, Hansen EA, Hannerz H, Sjogaard G. One-year randomized controlled trial with different physical-activity programs to reduce musculoskeletal symptoms in the neck and shoulders among office workers. *Scand J Work Environ Health* 2008; 34(1): 55-65.
- [33] Ylinen J, Takala EP, Nykanen M. Active neck muscle training in the treatment of chronic neck pain in women: A randomized controlled trial. *JAMA* 2003; 289: 2509-16.
- [34] Waling K. Effects of training on female trapezius myalgia: An intervention study with a 3-year follow-up period. *Spine* 2002; 27: 789-96.
- [35] Waling K. Perceived pain before and after three exercise programs-a controlled clinical trial of women with work-related trapezius myalgia. *Pain* 2000; 85: 201-7.
- [36] Omer SR, Ozcan E, Karan A, Ketenci A. Musculoskeletal system disorders in computer users: Effectiveness of training and exercise programs. *Musculoskeletal Rehabil* 2003; 17: 9-13.
- [37] Ang BO, Monnier A, Harms-Ringdahl K. Neck/shoulder exercise for neck pain in air force helicopter pilots: a randomized controlled trial. *Spine* 2009; 34: E544-E551.
- [38] Stewart MJ, Maher CG, Refshauge KM, Herbert RD, Bogduk N, Nicholas M. Randomized controlled trial of exercise for chronic whiplash-associated disorders. *Pain* 2007; 128: 59-68.
- [39] Wicksell RK, Ahlqvist J, Bring A, Melin L, Olsson GL. Can exposure and acceptance strategies improve functioning and life satisfaction in people with chronic pain and whiplash-associated disorders (WAD)? A randomized controlled trial. *Cog Behav Ther* 2008; 37: 169-82.
- [40] Provinciali L. Multimodal treatment to prevent the late whiplash syndrome. *Scand J Rehabil Med* 1996; 28(2): 105-11.
- [41] Rempel DM, Krause N, Goldberg R, Benner D, Hudes M, Goldner GU. A randomised controlled trial evaluating the effects of two work station interventions on upper body pain and incident musculoskeletal disorders among computer operators. *Occup Environ Med* 2006; 63: 300-6.
- [42] Rempel DM, Wang PC, Janowitz I, Harrison RJ, Yu F, Ritz BR. A randomized controlled trial evaluating the effects of new task chairs on shoulder and neck pain among sewing machine operators: The Los Angeles garment study. *Spine* 2007; 32: 931-8.
- [43] Kuijper B, Tans JT, Beelen A, Nollet F, de Visser M. Cervical collar or physiotherapy versus wait and see policy for recent onset cervical radiculopathy: randomised trial. *BMJ* 2009; 339: b3883.
- [44] Gonzalez-Iglesias J, Fernandez-de-las-Penas C, Cleland J, Huijbregts P, Gutierrez-Vega MD. Short-term effects of cervical kinesio taping on pain and cervical range of motion in patients with acute whiplash injury: a randomized clinical trial. *J Orthop Sports Phys Ther* 2009; 39: 515-21.
- [45] Santaguida PL, Gross A, Goldsmith C, Kay T. Orthoses for mechanical neck disorders. *Cochrane Database Syst Rev* 2012; in press.
- [46] Erfanian P, Tenzif S, Guerriero RC. Assessing the effects of a semi-customized experimental cervical pillow on symptomatic adults. *J Can Chiropr* 2004; 48(1): 20-8.
- [47] Jochems O, Vortman B, Derde M. Gerandomiseerd onderzoek naar het effect van The Pillow op de nachtrust, pijn en voorkeur van patiënten met klachten van de nek- en schouderregio. *Ned Tijdschr Fysiother* 1997; 107: 159-63.
- [48] Lavin RA, Pappagallo M, Kuhlemeier KV. Cervical pain: A comparison of three pillows. *Arch Phys Med Rehabil* 1997; 78(2): 193-8.
- [49] Helewa A, Goldsmith CH, Smythe HA, Lee P, Obricht K, Stitt L. Effect of therapeutic exercise and sleeping neck support on patients with chronic neck pain: a randomized clinical trial. *J Rheumatol* 2007; 34: 151-8.
- [50] Bernateck M, Karst M, Merkesdal S, Fischer MJ, Gutenbrunner C. Sustained effects of comprehensive inpatient rehabilitative treatment and sleeping neck support in patients with chronic cervicobrachialgia: a prospective and randomized clinical trial. *Int J Rehabil Res* 2008; 31: 342-6.
- [51] Karppinen K. Adjustment of dental occlusion in treatment of chronic cervicobrachial pain and headache. *J Oral Rehab* 1999; 26: 715-21.
- [52] Glossop ES, Goldberg E, Smith DS, Williams HM. Patient compliance in back and neck pain. *Physiother* 1982; 68(7): 225-6.
- [53] Borchgrevink GV, Kaasa A, McDougagh D, Stiles TC, Haralseth O, Lereim I. Acute treatment of whiplash neck sprain injuries. A randomized trial of treatment during the first 14 days after a car accident. *Spine* 1998; 23(1): 25-31.
- [54] McKinney L. Early mobilization and outcome in acute sprains of the neck. *BMJ* 1989; 299: 1006-8.
- [55] Manca A, Epstein DM, Torgerson DJ, *et al.* Randomized trial of a brief physiotherapy intervention compared with usual physiotherapy for neck pain patients: cost-effectiveness analysis. *Int J Technol Assess Health Care* 2006; 22: 67-75.
- [56] Klaber-Moffett JA, Jackson DA, Richmond S. Randomised trial of a brief physiotherapy intervention compared with usual physiotherapy for neck pain patients: Outcomes and patient preference. *BMJ* 2005; 3(30): 75-80.
- [57] Viljanen M, Malmivaara A, Uitti J, Rinne M, Palmroos P, Laippala P. Effectiveness of dynamic muscle training relaxation training, or ordinary activity for chronic neck pain: randomised controlled trial. *BMJ* 2003; 327: 475-7.
- [58] Horneij E, Hemborg B, Jensen I, Ekdahl C. No significant differences between intervention programmes on neck, shoulder and low back pain: a prospective randomized study among home-care personnel. *J Rehabil Med* 2001; 33: 170-6.
- [59] Bernaards CM, Ariens GA, Knol DL, Hildebrandt VH. The effectiveness of a work style intervention and a lifestyle physical activity intervention on the recovery from neck and upper limb symptoms in computer workers. *Pain* 2007; 132: 142-53.
- [60] Andersen LL, Kjaer M, Sogaard K, Hansen L, Kryger AI, Sjogaard G. Effect of two contrasting types of physical exercise on chronic neck muscle pain. *Arthritis Rheumat* 2008; 59(1): 84-91.
- [61] Brisson C, Montreuil S, Punnett L. Effects of an ergonomic training program on workers with video display units. *Scand J Work Environ Health* 1999; 25: 255-63.
- [62] Cook C, Burgess-Limerick R. The effect of forearm support on musculoskeletal discomfort during call centre work. *Appl Ergon* 2004; 35: 337-42.
- [63] Gerr F, Marcus M, Manteilh C, Hannan L, Ortiz D, Kleinbaum D. A randomised controlled trial of postural interventions for prevention of musculoskeletal symptoms among computer users. *Occup Environ Med* 2005; 62: 478-87.
- [64] Haukka E, Leino-Arjas P, Viikari-Juntura E, *et al.* A randomised controlled trial on whether a participatory ergonomic intervention could prevent musculoskeletal disorders. *Occup Environ Med* 2008; 65: 849-956.
- [65] Driessen MT, Propert KI, Van Tulder M, Anema J, Bangers PM, van der Beek AJ. The effectiveness of physical and organizational ergonomic interventions on low back pain and neck pain: a systematic review. *Occup Environ Med* 2010; 67: 277-85.
- [66] Conlon CF, Krause N, Rempel DM. A randomised trial evaluating an alternative mouse and forearm support on upper body discomfort and musculoskeletal disorders among engineers. *Occup Environ Med* 2008; 65: 311-8.

- [67] Fostervold KI, Aaras A, Lie I. Work with visual display units: Long-term health effects of high and downward line-of-sight in ordinary office environments. *J Indu* 2012; 36: 331-43.
- [68] Hedge A, Morimoto S, McCrobie D. Effects of keyboard tray geometry on upper body posture and comfort. *Ergonomics* 1999; 42(10): 1333-49.
- [69] Voerman GE, Sandsjo L, Vollenbroek-Hutten MM, Larsman P, Kadefors R, Hermens HJ. Effects of ambulant myofeedback training and ergonomic counselling in female computer workers with work-related neck-shoulder complaints: a randomized controlled trial. *J Occup Rehabil* 2007; 17: 137-52.
- [70] Lundblad I. Randomized controlled trial of physiotherapy and Feldenkrais interventions in female workers with neck-shoulder complaints. *J Occup Rehabil* 1999; 9: 179-94.
- [71] Takala EP, Viikari-Juntura E, Tynkynen EM. Does group gymnastics at the workplace help in neck pain? A controlled study. *Scand J Rehabil Med* 1994; 26: 17-20.
- [72] Bonk AD, Ferrari R, Giebel GD, Edelmann M, Huser R. Prospective randomized controlled study of activity versus collar, and the natural history for whiplash injury, in Germany. *J Musculoskel Pain* 2000; 8(1-2): 123-32.
- [73] Giebel GD, Edelmann M, Huser R. Sprain of the cervical spine: Early functional vs immobilization treatment. [German]. *Zentralblatt Chirurgie* 1997; 122(7): 517-21.
- [74] Rosenfeld M. Early intervention in whiplash-associated disorders: a comparison of two treatment protocols. *Spine* 2000; 25(14): 1782-7.
- [75] Schnabel M, Ferrari R, Vassiliou T, Kaluza G. Randomised, controlled outcome study of active mobilisation compared with collar therapy for whiplash injury. *Emerg Med J* 2004; 21(3): 306-10.
- [76] Vassiliou T, Kaluza G, Putzke C, Wulf H, Schnabel M. Physical therapy and active exercises--an adequate treatment for prevention of late whiplash syndrome? Randomized controlled trial in 200 patients. *Pain* 2006; 124(1-2): 69-76.
- [77] Kongsted A, rgensen LV, Bendix T, Korsholm L, Leboeuf-Yde C. Are smooth pursuit eye movements altered in chronic whiplash-associated disorders? A cross-sectional study. *Clin Rehabil* 2007; 21: 1038-49.
- [78] McKinney LA, Dornan JO, Ryan M. The role of physiotherapy in the management of acute neck sprains following road-traffic accidents. *Arch Phys Med Rehabil* 1989; 6(1): 27-33.
- [79] Mealy K, Brennan H, Fenelon GC. Early mobilisation of acute whiplash injuries. *BMJ* 1986; 292(6521): 656-7.
- [80] Chiu TT, Lam TH, Hedley AJ. A randomized controlled trial on the efficacy of exercise for patients with chronic neck pain. *Spine* 2005; 30: E1-E17.
- [81] Jensen IB, Bergstrom G, Ljungquist T, Bodin L. A 3-year follow-up of a multidisciplinary rehabilitation programme for back and neck pain. *Pain* 2005; 115: 273-83.
- [82] Soderlund A, Lindberg P. Cognitive behavioral components in physiotherapy management of chronic whiplash associated disorders (WAD) - a randomised group study. *Physiother Theory Pract* 2001; 17: 229-38.
- [83] Vonk F, Verhagen AP, Twisk JW, Koke AJA, Luiten MWCT, Koes BW. Effectiveness of a behavioral graded program versus conventional exercise for chronic neck pain patients. *Eur J Pain* 2009; 13: 533-41.
- [84] Derebery J, Giang GM, Gatchel RJ, Erickson K, Fogarty TW. Efficacy of a patient-educational booklet for neck-pain patients with workers' compensation. *Spine* 2009; 34(2): 206-13.
- [85] Ventegodt S, Merrick J, Andersen NJ, Bendix I. A combination of Gastalt therapy, Rosen body work, and craniosacral therapy did not help in chronic whiplash-associated disorders (WAD) - results of a randomized clinical trial. *Sci World J* 2004; 4: 1055-68.
- [86] van den Heuvel SG, de Looze MP, Hildebrands VH, The KH. Effects of software programs stimulating regular breaks and exercises on work-related neck and upper-limb disorders. *Scand J Work Environ Health* 2003; 29(2): 106-16.
- [87] Hamberg-van Reenen HH, Visser B, van der Beek AJ, Blatter BM, van Dieen JH, van Mechelen W. The effect of a resistance-training program on muscle strength, physical workload, muscle fatigue and musculoskeletal discomfort: An experiment. *Appl Ergon* 2009; 40: 396-403.
- [88] Morken T, Moen B, Riise T, *et al.* Effects of training program to improve musculoskeletal health among industrial workers - effects of supervisors role in the intervention. *Int J Indust Ergon* 2002; 30: 115-27.
- [89] Ketola RK, Toivonen R, Hakkanen M, *et al.* Effects of ergonomic intervention in work with video display units. *Scand J Work Environ Health* 2002; 28(1): 18-24.
- [90] Kamwendo K, Linton SJ. A controlled study of the effect of neck school in medical secretaries. *Scand J Rehabil Med* 1991; 23: 143-52.
- [91] Gennis P. The effect of soft cervical collars on persistent neck pain in patients with whiplash injury. *Acad Emerg Med* 1996; 3(6): 568-73.
- [92] Dehner C, Hartwig E, Strobel P, *et al.* Comparison of the relative benefits of 2 versus 10 days of soft collar cervical immobilization after acute whiplash injury. *Arch Phys Med Rehabil* 2006; 87: 1423-7.
- [93] Crawford JR, Khan RJK, Varley GW. Early management and outcome following soft tissue injuries of the neck - a randomised controlled trial. *Injury-Int J Care Inj* 2004; 35(9): 891-5.
- [94] Pennie B, Agambar L. Whiplash injuries: a trial of early management. *J Bone Joint Surg Br* 1990; 72: 277-9.
- [95] Kuijper B, Tans JT, Schimsheimer RJ, *et al.* Degenerative cervical radiculopathy: Diagnosis and conservative treatment. A review. *Eur J Neurol* 2009; 16: 15-20.
- [96] Persson L, Carlsson CA, Carlsson JY. Long lasting cervical radicular pain managed with surgery, physiotherapy, or a cervical collar: a prospective, randomized study. *Spine* 1997; 22(7): 751-8.
- [97] Persson L, Lilja A. Pain, coping, emotional state and physical function in patients with chronic radicular neck pain. A comparison between patients treated with surgery, physiotherapy or neck collar - a blinded, prospective randomized study. *Disabil Rehabil* 2001; 23(8): 325-35.
- [98] Kadanka Z, Bednarik J, Vohanka S, *et al.* Conservative treatment versus surgery in spondylotic cervical myelopathy: a prospective randomised study. *Eur Spine J* 2000; 9: 538-44.
- [99] Taimela S, Takala EP, Asklof T, Seppala K, Parviainen S. Active treatment of chronic neck pain: a prospective randomized intervention. *Spine* 2000; 25: 1021-7.
- [100] Skillgate E, Vingard E, Alfredsson L. Naprapathic manual therapy or evidence-based care for back and neck pain: a randomized, controlled trial. *Clin J Pain* 2007; 23(5): 431-9.
- [101] Ferrari R, Rowe BH, Majumdar SR, *et al.* Simple educational intervention to improve the recovery from acute whiplash: results of a randomized controlled trial. *Acad Emerg Med* 2005; 12(8): 699-706.
- [102] Kongsted A, Qerama E, Kasch H, *et al.* Neck collar, "act-as-usual" or active mobilization for whiplash injury? A randomized parallel-group trial. *Spine* 2007; 32: 618-26.
- [103] Kongsted A, Qerama E, Kasch H, *et al.* Education of patients after whiplash injury: Is oral advice any better than a pamphlet? *Spine* 2008; 33(22): E843-E848.
- [104] Sherman KJ, Cherkin DC, Hawkes RJ, Miglioretti DL, Deyo RA. Randomized trial of therapeutic massage for chronic neck pain. *Clin J Pain* 2009; 25(3): 233-8.
- [105] Tsauo JY, Lee HY, Hsu JH, Chen CY, Chen CJ. Physical exercise and health education for neck and shoulder complaints among sedentary workers. *JAMA* 2004; 289: 2509-16.
- [106] Jull G, Sterling M, Kenardy J, Beller E. Does the presence of sensory hypersensitivity influence outcomes of physical rehabilitation for chronic whiplash?--A preliminary RCT. *Pain* 2007; 129(1-2): 28-34.
- [107] Bunketorp L, Lindh M, Carlsson J, Stener-Victorin E. The effectiveness of a supervised physical training model tailored to the individual needs of patients with whiplash-associated disorders -- A randomized controlled trial. *Clin Rehabil* 2006; 20(3): 201-17.
- [108] Gatchel RJ, Rollings KH. Evidence-informed management of chronic low back pain with cognitive behavioral therapy. *Spine* 2013; 8: 40-4.
- [109] van Hooff ML, Ter Avest W, Horsting PP, *et al.* A short, intensive cognitive behavioral pain management program reduces health-care use in patients with chronic low back pain: two-year follow-up results of a prospective cohort. *Eur Spine J* 2013; 21: 1257-64.
- [110] Ivancic PC. Does knowledge of seat design and whiplash injury mechanisms translate to understanding outcomes? *Spine* 2011; 36: S187.

- [111] Liu B, Ivers R, Norton R, Blows S, Lo S.K. Helmets for preventing injury in motorcycle riders (Review). *Cochrane Database Syst Rev* 2013; 4: Art. No.: CD004333. pub2.
- [112] Louw A, Diener I, Butler D.S., Puentedura E.J. The effect of neuroscience education on pain, disability, anxiety, and stress in chronic musculoskeletal pain. *Arch Phys Med Rehabil* 2011; 92: 2041-56.
- [113] Williams AD, Eccleston C, Morley S. Psychological therapies for the management of chronic pain (excluding headache) in adults. *Cochrane Database Syst Rev* 2013; 11: CD007407. pub3.
- [114] Andersen J.H., Fallentin N, Thomsen J.F., Mikkelsen S. Risk factors for neck and upper extremity disorders among computer users and the effect of interventions: An overview of systematic reviews. *Plos ONE* 2011; e19691.
- [115] Leyshou R, Chalova K, Gerson L, *et al.* Ergonomic interventions for office workers with musculoskeletal disorders: A systematic review. *Work* 2010; 35: 335-438.
- [116] Erfanian P, Hagino C, Guerriero RC. A preliminary study assessing adverse effects of a semi-customized cervical pillow on asymptomatic adults. *JCCA* 1998; 42: 156-62.
- [117] Lamb SE, Williams MA, Williamson EM, *et al.* Managing injuries of the neck trial (MINT): a randomised controlled trial of treatment of whiplash injuries. *Health Technol Assess* 2012; 16(49).
- [118] Haldeman S, Carroll L, Cassidy JD, Schubert J, Nygren A. The Bone and Joint Decade 2000-2010 Task Force on neck pain and its associated disorders. *Spine* 2008; 33(4S): 55-7.
- [119] Teasell RW, McClure JA, Walton D, *et al.* A research synthesis of therapeutic interventions for whiplash-associated disorder (WAD). Part 2 - interventions for acute WAD. *Pain Res Manage* 2010; 15(5): 295-304.
- [120] Sihawong R, Janwantanakul P, Sitthipornvorakul E, Pensri P. Exercise therapy for office workers with nonspecific neck pain: A systematic review. *J Manipul Physiol Ther* 2011; 34: 62-71.
- [121] Verhagen AP, Karels C, Bierma-Zeinstra SMA, *et al.* Exercise proves effective in a systematic review of work-related complaints of the arm, neck, or shoulder. *J Clin Epidemiol* 2007; 60: 110-7.
- [122] Verhagen AP, Scholten-Peeters GGM, van Wijngaarden S, de Bie R, Bierma-Zeinstra SMA. Conservative treatments for whiplash [Cochrane Review]. *Cochrane Database Syst Rev* 2007; 2: Art. No.: CD003338. pub3.
- [123] Aas RW, Tuntland H, Holte KA, *et al.* Workplace interventions for neck pain in workers (Review). *Cochrane Database Syst Rev* 2011; 4: CD008160.
- [124] Boschi M, Santandrea S, Vanti C. Efficacia della terapia cognitivo-comportamentale nella cervicgia aspecifica: una revisione sistematica. (Efficacy of cognitive behavioural therapy in non-specific neck pain: A systematic review). *Sci Riabil* 2010; 12(1): 5-15.
- [125] Conlin A, Bhogal S, Sequeira K, Teasell R. Treatment of whiplash-associated disorders. Part 1 Noninvasive interventions. *Pain Res Manage* 2005; 10(1): 21-32.
- [126] Drescher K, Hardy S, MacLean J, Schindler M, Scott K, Harris SR. Efficacy of postural and neck-stabilization exercises for persons with acute whiplash-associated disorders: a systematic review. *Physiother Can* 2008; 60: 215-23.
- [127] Graham N, Gross AR, Goldsmith C, *et al.* Mechanical traction for mechanical neck disorders: a systematic review. *J Rehabil Med* 2006; 38: 145-52.
- [128] Gross AR, Goldsmith C, Hoving JL, *et al.* Conservative management of mechanical neck disorders: a systematic review. *J Rheumatol* 2007; 34: 1083-102.
- [129] Haines T, Gross AR, Burnie S, *et al.* Patient education for neck pain with or without radiculopathy. *Cochrane Database Syst Rev* 2009; 1: CD005106.
- [130] Haraldsson BG, Gross AR, Myers CD, *et al.* Massage for mechanical neck disorders. *Cochrane Database of Systematic Reviews* 2006; 3: CD004871.
- [131] Jordan JL, Holden MA, Mason EE, Foster NE. Interventions to improve adherence to exercise for chronic musculoskeletal pain in adults. [Review]. *Cochrane Database Syst Rev* 2010; 1: Art.No.: CD005956.
- [132] Kabisch N. Comparison of the effects of physiotherapeutic and alternative treatment modalities in the case of whiplash-associated chronic problems [German]. *Manuelle Ther* 2008; 12: 216-25.
- [133] Karjalainen K, Malmivaara A, van Tulder M, *et al.* Biopsychosocial rehabilitation for upper limb repetitive strain injuries in working age adults. *Cochrane Database Syst Rev* 2003; 2: D002194.
- [134] Kay TM, Gross A, Goldsmith CH, Hoving JL, Bronfort G. Exercises for mechanical neck disorders. *Cochrane Database Syst Rev* 2005; 3: CD004250.
- [135] Leaver AM, Refshauge KM, Maher CG, McAuley JH. Conservative intervention provide short-term relief for non-specific neck pain: a systematic review. *J Physiother* 2010; 56: 73-85.
- [136] Lee MS, Pittler MH, Ernst E. Internal qigong for pain conditions: a systematic review. *J Pain* 2009; 10: 1121-7.
- [137] Miller J, Gross A, D'Sylva J, *et al.* Manual therapy and exercise for neck pain: a systematic review. *Man Ther* 2010; 15(14): 334-54.
- [138] Nikolaidis I, Fouyas IP, Sandercock PA, Statham PF. Surgery for cervical radiculopathy or myelopathy. [Review]. *Cochrane Database Syst Rev* 2010; (2): CD001466.
- [139] Patel KC, Gross A, Graham N, *et al.* Massage for mechanical neck disorders. *Cochrane Database Syst Rev* 2012; 9: Art. No.: CD004871.
- [140] Salt E, Wright C, Kelly S, Dean A. A systematic literature review on the effectiveness of non-invasive therapy for cervicobrachial pain. *Man Ther* 2011; 16: 53-65.
- [141] Shields N, Capper J, Polak T, Taylor N. Are cervical pillows effective in reducing neck pain? *NZ J Physiother* 2006; 34: 3-9.
- [142] Teasell RW, McClure JA, Walton D, *et al.* A research synthesis of therapeutic interventions for whiplash-associated disorders. Part 4 Noninvasive interventions for chronic WAD. *Pain Res Manage* 2010; 15(5): 313-22.
- [143] Verhagen AP, Karels C, Bierma-Zeinstra SM, *et al.* Ergonomic and physiotherapeutic interventions for treating work-related complaints of the arm, neck or shoulder in adults. *Cochrane Database Syst Rev* 2007; 3: CD003471.
- [144] Jensen I, Nygren A, Gamberale F. The role of the psychologist in multidisciplinary treatments for chronic neck and shoulder pain: A controlled cost-effectiveness study. *Scand J Rehab Med* 1995; 27(1): 19-26.
- [145] Andersen LL, Andersen CH, Zebis MK, Nielsen PK, Sogaard K, Sjogaard G. Effect of physical training on function of chronically painful muscles: a randomized controlled trial. *J Appl Physiol* 2008; 105: 1796-801.
- [146] Kongsted A, Qerama E, Kasch H, *et al.* Neck collar, "act-as-usual" or active mobilization for whiplash injury? A randomized parallel-group trial. [Erratum appears in *Spine*. 2007; 32(17): 1933 Note: Winther, Flemming [corrected to Bach, Flemming Winther]]. [Erratum appears in *Spine*. 2007; 32(16): 1801]. *Spine* 2007; 32: 618-26.

Received: February 15, 2013

Revised: March 28, 2013

Accepted: March 28, 2013

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