Technical report

Guidelines for the management of **acute whiplash** associated disorders for health professionals.

3rd Edition 2014

NSW GOVERNMENT

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1 On 1 September 2015, the functions of the Motor Accidents Authority (MAA) were assumed by the State Insurance Regulatory Authority (SIRA).

Contents

Preface

We have developed new Guidelines for the management of whiplash-associated disorders (WAD), which is the single most frequently recorded injury among compulsory third party (CTP) claimants in NSW.

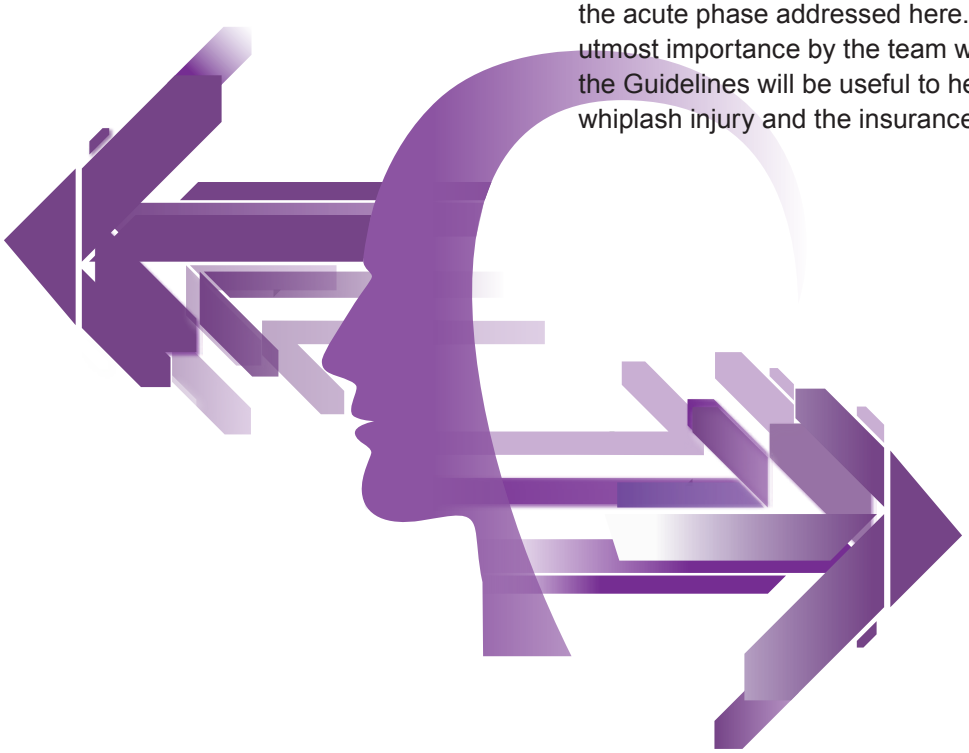
Of all the claims lodged since 2007, 46 per cent of claimants had WAD as one of their reported injuries. The Guidelines provide recommendations to health practitioners, insurers and patients for the best possible management of adults with WAD in the first 12 weeks following a motor vehicle crash (MVC).

The first edition of the Guidelines was developed in 2001.[1] They were based on an update of the Quebec Task Force (QTF) guidelines, released in 1995[2] that reviewed 10,000 publications and focused on clinical issues, specifically risk, diagnosis, prognosis and treatment of whiplash.

The second edition of the Guidelines was published in 2007.[3] A comprehensive review was undertaken using the 2001 Guidelines as a starting point. The aim was to systematically review and summarise relevant literature from 1999 to November 2005 on the assessment and diagnosis, the prognosis and the effectiveness of treatment in people with acute and subacute (less than 12 weeks' duration) WAD.

This third edition (2014) of the Guidelines includes more recently published evidence based recommendations for the management of acute WAD. A systematic review was undertaken to identify and summarise relevant literature from 2005 to July 2012. Recommendations for practice were developed by the working group on the basis of the current evidence. For areas of practice not adequately addressed by research, recommendations were developed based on expert consensus. This technical report provides a complete guide to the methods used in this review.

The 2014 Guidelines cover the first 12 weeks following an MVC. However, they recognise that each person's experience of recovery is different and the natural course of the condition can go beyond the acute phase addressed here. Clinical utility has been given utmost importance by the team working on this project. We hope the Guidelines will be useful to health professionals, people with whiplash injury and the insurance industry.



Purpose of these Guidelines

The Guidelines are intended to assist health professionals delivering primary care to adults (18 years and beyond) with acute or subacute simple neck pain after an MVC in the context of CTP insurance.

The Guidelines specifically seek to assist health professionals to:

- conduct a comprehensive assessment and physical examination
- classify the WAD grade according to the Quebec Taskforce classification system
- apply the Canadian C-Spine rule to determine whether an X-ray is required to confirm the diagnosis of a fracture or dislocation
- consider the role of radiological imaging and special tests
- identify clinical and psychosocial risk factors
- inform and educate patients and emphasise the importance of staying positive and active
- review progress including physical and psychological status and take recommended action
- encourage coordinated care for improved health outcomes.

Definition

The QTF definition of WAD has been adopted as the definition of acute or subacute simple neck pain for the purposes of these Guidelines. It states:

> Whiplash is an acceleration-deceleration mechanism of energy transfer to the neck. It may result from … motor vehicle collisions … The impact may result in bony or soft tissue injuries (whiplash injury), which in turn may lead to a variety of clinical manifestations (Whiplash-Associated Disorders).[2]

Grades of WAD

The clinical classification of grades of WAD provided by the QTF is shown in the table below. Symptoms and disorders that can manifest in all grades include deafness, dizziness, tinnitus, headache, memory loss, dysphagia and temporomandibular joint pain.

Table 1.1 Quebec Task Force Classification of Grades of WAD

GRADE	CLASSIFICATION
0	No complaint about the neck. No physical sign(s).
I	Complaint of neck pain, stiffness or tenderness only. No physical sign(s).
II	Neck complaint AND musculoskeletal sign(s). Musculoskeletal signs include decreased range of motion and point tenderness.
III	Neck complaint AND neurological sign(s). Neurological signs include decreased or absent tendon reflexes, weakness and sensory deficits.
IV	Neck complaint AND fracture or dislocation.

Scope

The scope of the Guidelines covers WAD grades I, II and III following an MVC. Grade IV is only considered to the extent of diagnosis of the condition and immediate referral to an emergency department or appropriate medical specialist.

These Guidelines are applicable in the first 12 weeks after an MVC regardless of whether WAD is the only injury or associated with other injuries. They also form the basis for treatment decisions beyond this initial 12-week period.

When to consult the Guidelines

The Guidelines are intended to guide GPs and health professionals in managing people who present with neck pain after a recent MVC. They will guide GPs and health professionals when:

- taking a patient history
- conducting an examination
- determining what, if any, investigations are required
- providing education and advice
- treating or referring a patient for treatment from other health professionals, such as physiotherapists and chiropractors; and reviewing progress.

In many cases, recovery from WAD occurs quickly. However, some adults with WAD will have persisting symptoms. To identify and deal with more complex cases the Guidelines recommend:

- educating primary health care professionals about adverse prognostic indicators which may indicate the need for more intensive treatment or early referral
- confirming that the diagnosis of a fracture or dislocation warrants immediate referral to an emergency department or a medical specialist
- providing indications of when generalist clinicians should refer patients to clinicians with specific expertise in WAD. This may include specialist physiotherapists, specialist chiropractors or musculoskeletal medicine practitioners. They may also include rehabilitation physicians, pain medicine specialists, psychologists and occupational physicians.

Intended users

The Guidelines are relevant for health professionals involved in primary care in NSW including:

- health professionals working in emergency departments
- general practitioners
- physiotherapists
- chiropractors
- psychologists.

Disclaimer

The Guidelines are not intended to be used prescriptively; rather health professionals should use their experience and expertise in applying the Guidelines. These Guidelines are based on the highest quality research currently available. It is possible that new and emerging treatments will develop a sufficiently strong evidence base to be included as recommended interventions in subsequent updates to the Guidelines. For this reason, it is recommended that the Guidelines be reviewed every five years.

First edition: 2001 Second edition: 2007 Third edition: 2014 Guidelines review date: 2019

Methodology

The method for development of the Guidelines was guided by National Health and Medical Research Council (NHMRC) recommendations for the development of clinical practice guidelines. The WAD Guidelines published in 2007[3] were used as the starting point for the current review.

The process

The aim of the current review was to comprehensively search for and identify gaps, and analyse new evidence regarding the management of WAD since the 2007 review. The quality of the new evidence was examined and the necessary refinements made to the existing Guidelines. The three key areas for review were:

- assessment and diagnosis
- prognosis
- treatment.

A comprehensive search of appropriate electronic databases from 2005 to July 2012 was conducted using defined eligibility criteria for each of the three key areas. Bibliographies from identified papers and systematic reviews were searched recursively to identify any papers missed by the electronic search process. Papers were screened for inclusion by two independent reviewers and where necessary an external expert was consulted to determine whether any major studies had been missed. Included studies were critically appraised in terms of internal and external validity. The statistical and clinical relevance and applicability of results were determined utilising the NHMRC dimensions of evidence. Level of evidence reflects the best study types for the specific type of question (see Appendix G, page 150).

Summary tables outline the details of included studies and their results. The grade of evidence was determined based on the NHMRC evidence hierarchy matrix as detailed in Table 1.2, below.

Table 1.2 NHMRC evidence hierarchy: designations of 'levels of evidence' according to type of research question

Level	Intervention	Diagnostic accuracy	Prognosis	Aetiology	Screening intervention
I	A systematic review of level II studies	A systematic review of level II studies	A systematic review of level II studies	A systematic review of level II studies	A systematic review of level II studies
II	A randomised controlled trial	A study of test accuracy with: an independent, blinded comparison with a valid reference standard, among consecutive persons with a defined clinical presentation	A prospective cohort study	A prospective cohort study	A randomised controlled trial
III-1	A pseudorandomised controlled trial (i.e. alternate allocation or some other method)	A study of test accuracy with: an independent, blinded comparison with a valid reference standard, among non-consecutive persons with a defined clinical presentation	All or none	All or none	A pseudorandomised controlled trial (i.e. alternate allocation or some other method)

Level	Intervention	Diagnostic accuracy	Prognosis	Aetiology	Screening intervention
III-2	A comparative study with concurrent controls: • Non-randomised, experimental trial • Cohort study • Case-control study • Interrupted time series with a control group	A comparison with reference standard that does not meet the criteria required for level II and III-1 evidence	Analysis of prognostic factors amongst persons in a single arm of a randomised controlled trial	A retrospective cohort study	A comparative study with concurrent controls: • Non-randomised, experimental trial • Cohort study • Case-control study
III-3	A comparative study without concurrent controls: • Historical control study • Two or more single arm study • Interrupted time series without a parallel control group	Diagnostic case-control study	A retrospective cohort study	A case-control study	A comparative study without concurrent controls: • Historical control study • Two or more single arm study
IV	Case series with either post-test or pre-test/post-test outcomes	Study of diagnostic yield (no reference standard)	Case series, or cohort study of persons at different stages of disease	A cross-sectional study or case series	Case series

The tables and recommendations based on the systematic review were presented to the scientific advisory committee. This group examined the findings of the review process and discussed any modifications to the proposed Guidelines. Recommendations were presented to the full working group and agreed changes were incorporated into the final document. Each member of the working group was expected to consult with the group they were representing. Key messages for assessment, prognosis and treatment are reported with the highest level of evidence available to support the recommendation. Harms and benefits of each recommendation were considered by the working group. Consumers were consulted through a 'Survey on Consumer Guide' to get feedback on the content clarity and presentation of the Guidelines. There was a broad consultation of stakeholders to inform and develop implementation strategies for the Guidelines.

Assessment and diagnosis

One of the primary difficulties in diagnosing WAD is that whiplash essentially describes a mechanism of injury. This mechanism of injury may, in turn, lead to a variety of clinical manifestations, the most common of which is neck pain.

In 1995, the QTF developed a classification system that was designed to improve the management of WAD by providing a guide to the signs and symptoms of whiplash indicative of the seriousness of the injury sustained (Table 1.1, page 5). This system has helped guide the assessment and diagnosis of WAD over the past 15 years. It is important that clinicians can identify signs and symptoms indicative of the various levels of severity of WAD so that appropriate management can be undertaken.

The review for the 'Assessment and diagnosis' section aimed to evaluate appropriate tests or markers that are important in diagnosing and classifying people with acute WAD and to identify any procedures or markers that help differentiate patients with WAD from other populations (such as asymptomatic patients, or patients with neck pain of non-traumatic origin). Furthermore, the aim of assessment is to identify individuals with a good versus a poor prognosis.

A comprehensive search of appropriate electronic databases was conducted by two authors. Bibliographies from identified papers and systematic reviews were searched recursively to identify papers missed by the electronic search process. Studies were screened for inclusion using defined eligibility criteria. An external expert was consulted to determine whether any major studies had been missed by the search process. Where appropriate, diagnostic studies meeting the appropriate eligibility criteria were assessed using the STARD checklist.[4] If a clinical decision rule was identified, this was assessed using the method outlined by McGinn et al.[5] A summary table, outlining the details of the included studies and their results and rating their quality (where appropriate), was prepared along with written recommendations concerning the existing Guidelines. This table and recommendations were presented to the technical working group. This group examined the findings of the review process and discussed modifications to the proposed Guidelines. Recommendations were then presented to the full working group and agreed changes were incorporated into the final document.

For the 'Assessment' section of the Guidelines, the results of the diagnosis review were combined with the results of the prognosis review (outlined below).

Prognosis

A large number of prognostic studies have been undertaken for WAD in the past decade; however there remains considerable uncertainty regarding the course of the condition. Some studies report an uncomplicated recovery where pain and symptoms resolve quickly and completely. Other studies report ongoing and often debilitating symptoms in a large proportion of people with WAD.

A comprehensive search of appropriate electronic databases for relevant research published from 2005 to 2012 was conducted using defined eligibility criteria. For example, in the review of studies on the prognosis of WAD, bibliographies and systematic reviews were searched recursively and an expert was consulted to determine whether any studies had been missed by the search process. Papers were screened by two independent reviewers. Papers meeting the eligibility criteria were independently assessed by two authors for methodological quality using the checklist proposed by Kamper et al[6] and appropriate data was extracted. The details of the additional studies, their results and quality scores were combined with the results. A summary table was constructed and written recommendations were made on the basis of these results. This table and recommendations were presented to the technical working group. This group then examined the findings of the review process and discussed modifications to the proposed Guidelines. Recommendations were put to the full working group and agreed changes were then incorporated into the final document.

Treatment

A comprehensive search of appropriate electronic databases was conducted using defined eligibility criteria. Bibliographies were searched recursively and an expert was consulted to determine whether any studies had been missed by the search process. Papers were screened for inclusion by two independent reviewers. Randomised controlled trials (RCTs) were assessed for methodological quality using the PEDro scale.[7] Systematic reviews were scored for methodological quality using a modified AMSTAR guidelines checklist.[8] This modified checklist included items concerning the conduction of the review, reporting of results and discussion of results that were deemed important for the current review. Appropriate data were independently extracted. Summary tables were constructed and written recommendations were made on the basis of these results. These tables and recommendations were presented to the technical working group. The technical group examined the findings of the review process and discussed any modifications to the proposed Guidelines. Recommendations were then put to the full working group and agreed changes were incorporated into the final document.

The Guidelines working group identified key stakeholders who will have a major influence on the uptake of the Guidelines. For each of the stakeholder groups, the factors that may be potential barriers to implementing the Guidelines were identified. Implementation interventions that mitigate these potential barriers have been considered and form the implementation plan. A suite of resources for consumers, professionals and insurers will be available on the SIRA website.

Assessment of acute WAD

Introduction

As noted earlier, one of the primary difficulties in diagnosing WAD is that the term whiplash essentially describes a mechanism of injury. The mechanism of injury may, in turn, lead to a variety of clinical manifestations, the most common of which is neck pain.

Symptoms following WAD injury may be diverse and include pain, stiffness, neurological symptoms, headache, dizziness, jaw pain, headache, hearing disorders, memory loss, tinnitus and dysphagia. However, neck pain is the predominant symptom. In 1995, the QTF developed a classification system that was designed to improve the management of WAD by providing a guide to the signs and symptoms of WAD indicative of the seriousness of the injury sustained (Table 1.1, page 5). It is important for clinicians to be able to identify patients who are at risk of developing, or who have developed, serious consequences (such as fractures) following an MVC so that injuries can be addressed appropriately. Furthermore, it is important that clinicians are able to identify signs and symptoms that indicate various levels of severity of injury so that appropriate management can be undertaken.

Aim of the systematic review

The aim of this section of the review was to evaluate appropriate tests or markers important in diagnosing and classifying subjects with acute and subacute (< 12 weeks duration) WAD and to examine studies in which patients with WAD (or subgroups of patients with WAD) were compared with other populations (for example, normal asymptomatic subjects, subjects with idiopathic neck pain or other subgroups) to assess whether patients with WAD (or subgroups of patients with WAD) differ from the comparison group. Such an assessment will aid diagnosis and assist in developing our understanding of the pathology and dysfunctions underlying the condition(s) that fall under the banner of WAD as well as assist in improving treatment of WAD.

Inclusion criteria

Studies were included if the following criteria were met:

1. included participants had acute or subacute WAD (< 12 weeks duration) as a result of an MVC
2. included participants with neck pain of all durations but that the acute/subacute group could be easily differentiated in the analysis
3. if participants with acute/subacute WAD were compared to other groups such as asymptomatic controls, other clinical conditions or within WAD sub-groups
4. if they described the sensitivity/specificity or precision of a given diagnostic test that would assist diagnosis and classification of patients with acute/subacute WAD.

Search strategies

An extensive literature search was conducted to identify papers for inclusion. Electronic databases were searched in addition to PubMed and Web of Science, and a hand search of relevant systematic reviews and journals. The following search strategy was used for electronic sources:

Electronic database search

The Embase, Cinahl, PsychINFO, Medline (Ovid), PEDro and the Cochrane Database of Systematic Reviews were searched.

Keywords

The following search terms (as key words) were used to identify papers included in the review:

- Population: (whiplash) OR (whiplash injury) OR (whiplash associated disorder) OR (neck pain) NOT (spinal AND cord) NOT (cancer)
- Category terms: (diagnosis) OR (diagnostic) OR (analysis) OR (evaluation)
- Filters (when available): English, 2005-2012, human.

Systematic review methods

Assessment for inclusion of articles

A three-step screening process was undertaken to identify papers for inclusion within this systematic review (Figure 1.1).

1. All articles identified on the electronic database search were screened by title.
2. Retained abstracts were screened using the inclusion criteria outlined above.
3. Detailed review of full papers for inclusion and exclusion criteria.

Study quality appraisal

Where appropriate, diagnostic studies were assessed for methodological quality by two reviewers using the STARD check list.[4] There were no additional diagnostic studies found in the search and therefore no studies were assessed this way.

Data extraction

Two reviewers were used to extract data as appropriate.

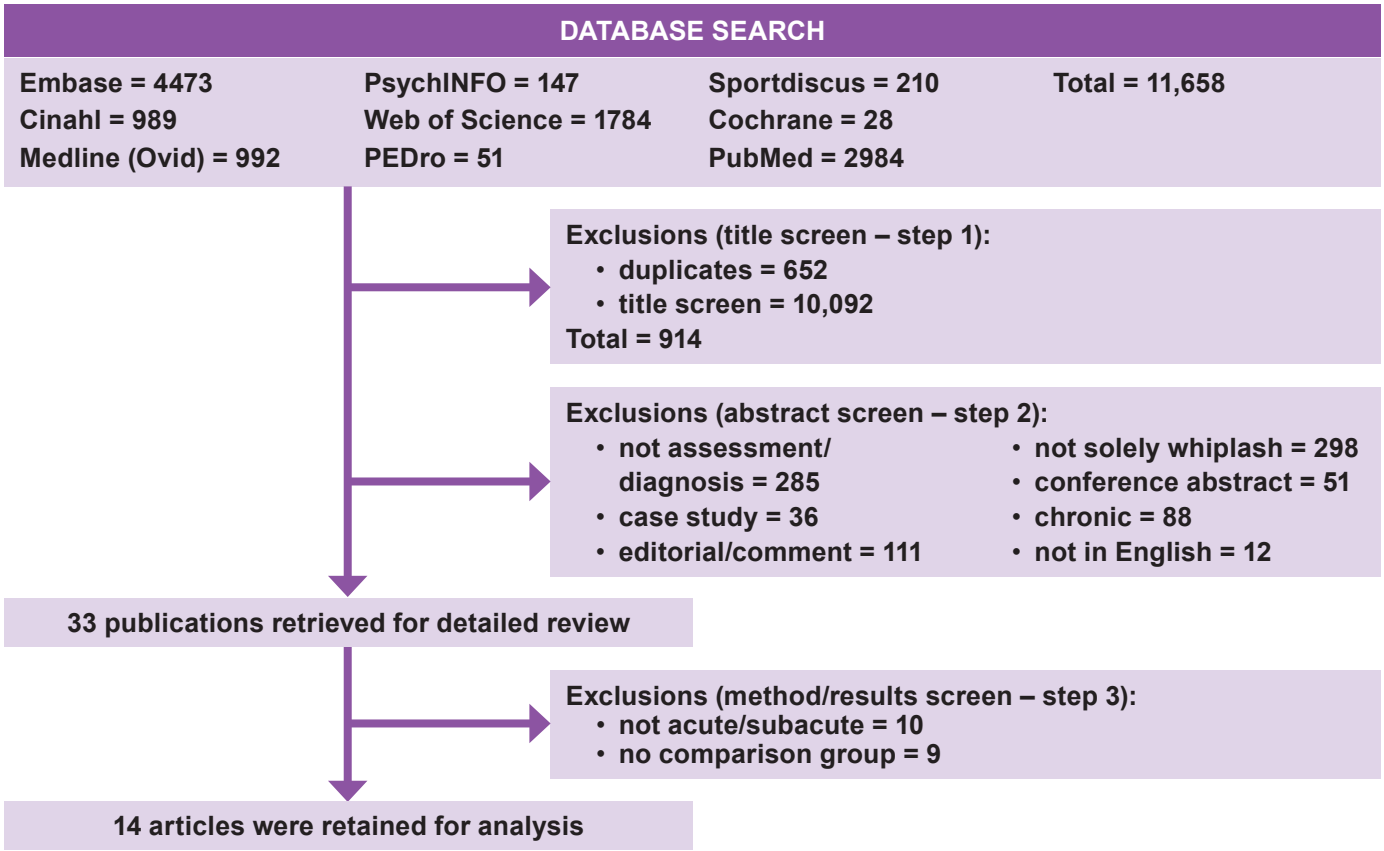
Results

Figure 1.1 (page 11) outlines the study selection for diagnosis and assessment.

Fourteen studies were included that compared acute/subacute WAD to another group and details of these are depicted in Table 2.1 (page 11).

No studies were found that specifically investigated diagnostic capacity of clinical tests or other methods for the diagnosis of WAD.

Figure 1.1 Search strategy and results for literature on assessment and diagnosis associated with WAD, from 2005-2012
Table 2.1 Studies on the comparison of acute/subacute WAD to other study



population reviewed for 2014 Guidelines

AUTHOR, YEAR, TITLE	STUDY AIM	STUDY POPULATION	MAIN OUTCOMES	STARD CHECKLIST SCORE	COMMENTS
Anderson S., et al (2012), Are there cervical spine findings at MR imaging that are specific to acute symptomatic whiplash injury?[9]	To compare the MRI imaging findings in patients with acute whiplash injury with those of matched control subjects	100 patients with acute WAD recruited through emergency departments compared to 100 matched controls	10 findings thought to be specific to whiplash trauma were significantly ($p<0.01$) more frequent in patients; they were also found in controls	NA	MR imaging reveals only limited evidence of specific injuries to the cervical spine in acute WAD
Chien A. et al (2008), Hypoaesthesia occurs in acute WAD irrespective of pain and disability levels and the presence of sensory hypersensitivity[10]	To investigate the presence of sensory hypoaesthesia in acute WAD	42 patients with acute WAD from mixed sources and 31 controls	The WAD groups showed elevated sensory detection thresholds ($p<0.05$)	NA	Hypoaesthesia as well as hypersensitivity may be present in acute WAD
Dehner et al (2008), Postural control in acute QTF grade II whiplash injuries[11]	To investigate balance control in patients with acute WAD grade II	40 patients with acute WAD and 40 controls	Patients with acute whiplash injuries of the cervical spine achieved significantly poorer results for both ST(Sigma) and FA(Sigma) than the healthy controls($p<0.001$)	NA	Patients with acute WAD may have disturbed balance control
Dispenza et al (2011), Analysis of visually guided eye movements in subjects after whiplash injury[12]	To analyse visually guided eye movements of subjects with acute WAD compared to a control group	33 patients with WAD (11 with acute WAD) and imbalance and 20 controls	There was no statistically significant difference between the groups	NA	Visually guided eye movement evaluation does not differentiate patients and controls
Elliott J. et al (2011), The temporal development of fatty infiltrates in the neck muscles following whiplash injury: an association with pain and posttraumatic stress[13]	To 1) investigate the temporal development of MFI following whiplash injury, 2) investigate differences in MFI between those who recover and those who report persistent symptoms at six months post injury, 3) investigate the relationship between initial pain levels and MFI at 6 months post injury and whether this relationship is mediated by loss of neck ROM and symptoms of PTSD	44 patients with acute WAD classified on NDI	There was no difference in muscle fat between the groups at 4 weeks post injury. By 3 months those with moderate/severe symptoms had higher levels of muscle fat ($p<0.01$)	NA	Muscle fat may develop between 4 and 12 weeks in those with moderate/sever pain and disability
McLean S. et al (2011), COMT haplotype predicts immediate musculoskeletal neck pain and psychological symptoms after MVC[14]	To investigate the association between COMT genotype and acute neck pain characteristics	89 patients with acute WAD from emergency departments. Patients sub-grouped on COMT genotype	Individuals with a COMT pain vulnerable genotype were more likely to report moderate-to-severe musculoskeletal neck pain (76 versus 41%, RR = 2.11 (1.33 - 3.37)), moderate or severe headache (61 versus 33%, RR = 3.15 (1.05 - 9.42)), and moderate or severe dizziness (26 versus 12%, RR = 1.97 (1.19 - 3.21)). Individuals with a pain vulnerable genotype also experienced more dissociative symptoms in the ED, and estimated a longer time to physical recovery (median 14 versus 7 days, $p = .002$) and emotional recovery (median 8.5 versus 7 days, $p = .038$)	NA	The identification of genes associated with post-MVC symptoms may also provide new insights into pathophysiology

Table 2.1 Continued

AUTHOR, YEAR, TITLE	STUDY AIM	STUDY POPULATION	MAIN OUTCOMES	STARD CHECKLIST SCORE	COMMENTS
Pedler and Sterling (2011), Assessing fear-avoidance beliefs in patients with WAD: a comparison of 2 measures[15]	To examine the development of fear avoidance behaviours after whiplash injury	Inception cohort study. 98 patients with acute WAD from mixed sources. Patients grouped on NDI	Patients with moderate/severe symptoms showed higher fear avoidance than those with lesser symptoms	NA	
Solarino et al (2009), Vestibular evoked myogneic potentials (VEMPs) in whiplash injury: a prospective study[16]	To evaluate changes in VEMPs in the assessment of whiplash injuries	14 patients with acute WAD from emergency departments and 15 controls	At time 0 and at time 90 days p1 latency was significantly higher in whiplash patients compared with healthy subjects on both sides ($p < 0.002$). The amplitude of p1-n1 was significantly lower in whiplash patients at time 0 ($p = 0.003$ on the right and $p = 0.018$ on the left), but not at 90 days	NA	Patients with acute WAD may have alterations of vestibular evoked myogenic potentials
Sterling and Pedler (2009), A neuropathic component is common in acute whiplash and associated with a more complex clinical presentation[17]	To investigate the presence of a neuropathic pain component in acute whiplash using the Self-reported Leeds Assessment of Neuropathic Signs and Symptoms scale (S-LANSS) and evaluated relationships among S-LANSS responses, pain/disability, sensory characteristics (mechanical, thermal pain thresholds, and Brachial plexus provocation test [BPPT] responses) and psychological distress (General Health Questionnaire-28 [GHQ-28])	85 patients with acute WAD recruited from mixed sources. Patients sub-grouped based on S-LANSS scores	Those with a neuropathic component (score >12) showed higher pain/disability, hyperalgesia and sensitivity with the BPPT (all $p<0.03$). There were no differences for pressure pain thresholds or GHQ28 scores	NA	The S-LANSS may be a useful assessment tool for acute WAD
Sterling (2010), Differential development of sensory hypersensitivity and a measure of spinal cord hyper excitability following whiplash injury[18]	To compare the temporal development of sensory hypersensitivity and NFR responses from soon after injury to either recovery or to transition to chronicity	62 patients with acute WAD from mixed sources sub grouped based on NDI	All whiplash groups demonstrated spinal cord hyperexcitability (lowered NFR thresholds) at 3 weeks post injury	NA	Whiplash injury induces spinal cord hyperexcitability

Table 2.1 Continued

AUTHOR, YEAR, TITLE	STUDY AIM	STUDY POPULATION	MAIN OUTCOMES	STARD CHECKLIST SCORE	COMMENTS
Ulbrich E. et al (2011), Alterations of the transverse ligament: an MRI study comparing patients with acute whiplash and matched control subjects[19]	To evaluate whether there is injury to the transverse ligament of the atlas in patients with acute whiplash	90 patients with acute WAD from emergency departments and 90 healthy controls	Patients had a minimally thicker transverse ligament (posttraumatic swelling) than control subjects, and the difference in thickness was significant in men only (p = 0.03). In patients, a significant signal alteration of the transverse ligament (p = 0.03) was seen on STIR (posttraumatic oedema) and native VIBE sequences. The contrast between the transverse ligament and the CSF on VIBE images was significantly (p = 0.005) lower in patients than in control subjects. With the application of a contrast agent, the contrast difference between the transverse ligament and CSF in patients and control subjects was less pronounced (p = 0.038). There was no abnormal uptake of contrast agent by the transverse ligament or CSF	NA	Possible involvement of the transverse ligament in acute WAD
Ulbrich E. et al (2011), Cervical muscle area measurements in acute whiplash patients and controls[20]	To quantitatively compare the muscle cross-sectional areas (CSAs) of the cervical muscles in symptomatic acute whiplash patients versus healthy controls	38 consecutive patients with acute WAD from emergency departments and 38 controls	There were no significant differences between patients and controls for all CSAs	NA	There was no difference in the cross-sectional area of neck muscles
Valenza et al (2012), Alteration in sleep quality in patients with mechanical insidious neck pain and WAD[21]	To determine difference in sleep quality between patients with mechanical neck pain, patients with WAD and health controls	19 patients with mechanical neck pain. 22 with WAD (<22 days) and 18 controls. Patients recruited form a regional hospital	Significant differences in sleep quality (p< 0.001), sleep latency (p = 0.005), sleep efficiency (p = 0.002), sleep disturbances (p<0.001), use of sleeping medication (p<0.001), daytime dysfunction (p<0.001), and total Pittsburgh Sleep Quality Index score (p<0.001) but not for sleep duration (p = 0.096) were found; patients with mechanical neck pain and WAD pain exhibited higher scores in all components compared with healthy controls. Seventeen (77%) patients with WAD and 13 (68%) with mechanical neck pain reported poor sleep quality (Pittsburgh Sleep Quality Index score, >8). Significant positive correlations between mean intensity of ongoing pain with sleep quality (rs = 0.693; p<0.001), sleep duration (rs = 0.433; p = 0.044), sleep efficiency (rs = 0.644; p = 0.001) and total Pittsburgh Sleep Quality Index score (rs = 0.643; p = 0.001) were found in patients with WAD pain, the higher the intensity of ongoing pain, the worse the sleep quality	NA	Sleep disturbances are common in patients with neck pain

Table 2.1 Continued

AUTHOR, YEAR, TITLE	STUDY AIM	STUDY POPULATION	MAIN OUTCOMES	STARD CHECKLIST SCORE	COMMENTS
Vetti et al (2011), Magnetic resonance imaging of the alar and transverse ligaments in acute whiplash associated disorders 1 and 2 [22]	To describe alar- and transverse-ligament magnetic resonance imaging (MRI) high-signal changes in acute whiplash-associated disorders (WAD) grades 1 and 2 in relation to the severity and mechanics of trauma, and to compare them with controls	114 consecutive patients with WAD grades 1 and 2 from emergency departments in Bergen, Norway and 157 controls	MRI showed grades 2 to 3 alar ligament changes in 40 (35.1%) and grades 2 to 3 transverse ligament changes in 27 (23.7%) of the patients. Such changes were related to contemporary head injury ($p = 0.041$ alar), neck pain ($p = 0.042$ transverse), and sex ($p = 0.033$ transverse) but did not differ between patients and controls ($p = 0.433$ alar; and 0.254 transverse)	NA	No difference between patients and controls indicating that whiplash trauma does not induce high signal changes

Summary of findings

The above studies have investigated a variety of factors for their presence in acute WAD in order to further characterise and understand this condition. These factors include: sensory measures, measures of muscle morphology, MRI measures of ligamentous structures, postural balance measures and genetic markers.

Whilst these findings are of interest, they do little at this stage to guide clinical decision making. Further investigation of the role of these factors in health outcomes and recovery after WAD is required to realise any clinical benefit.

Prognosis

Aim of systematic review

To systematically review and summarise the current literature from 2005 to July 2012, with reference to the prognosis of WAD.

Inclusion criteria

Studies were included in the systematic review if they met the following eligibility criteria:

1. The study aimed to assess prognostic factors associated with recovery of patients with WAD.
2. The design was a prospective cohort study (outcomes measured ⩾6 months post recruitment).
3. Inception to the study was within six weeks of MVC.
4. Included whiplash only or separately analysed groups of adults with neck pain following MVC.
5. Article published between 2005 and July 2012.
6. The article was published in English.
7. The study included one or more of the following outcome measures: self-reported pain or disability, psychological factors or symptoms, or return to work/work ability.

Studies were excluded from the systematic review if the study:

1. assessed risk factors including biomechanical stress studies or crash studies for the onset of a whiplash in healthy persons (aetiology)
2. included patients with WAD IV, animals, children or cadavers.

Systematic reviews were included if the review:

1. investigated primary cohort studies assessing prediction of recovery for patients with acute (<6 weeks) WAD
2. included a comprehensive search (for example ⩾2 databases)
3. stated inclusion/exclusion criteria and key words or MESH terms
4. provided a list of included studies
5. was published between 2005 and July 2012.

Search strategy

An extensive literature search was conducted to identify papers for inclusion. Electronic databases were searched in addition to PubMed and a hand search of relevant systematic reviews and journals. The following search strategy was used for electronic sources (Figure 2.1, page 19).

Electronic database search

The Embase, Cinahl, PsychINFO, Medline (Ovid), Ahmed, Web of Science, PEDro and the Cochrane Database of Systematic Reviews were searched.

Keywords

The following search terms (as key words) were used to identify papers included in the review:

- Population: (whiplash) OR (whiplash injury) OR (whiplash associated disorder) OR (neck pain) NOT (spinal AND cord) NOT (cancer)
- Category terms: (prognos*) OR (predict*) OR (recovery) OR (prospective) OR (incidence) OR (follow-up)
- Filters (if available): English, 2005-2012, human.

  * For consistency, the same items were used as per the 2007 Guidelines.

Systematic review methods

Assessment for inclusion of articles

A three-step screening process was undertaken to identify papers for inclusion within this systematic review (Appendix A, page 133).

1. All articles identified through the searches were screened by title.
2. Retained abstracts were screened using the inclusion criteria outlined above.
3. Detailed review of full papers for inclusion and exclusion criteria.

Study quality appraisal

Papers meeting the eligibility criteria and utilising cohort study designs were assessed for methodological quality using the checklist proposed by Kamper et al.[23] The NHMRC recommends the GATE checklist for assessment of methodological quality of prognostic studies. To address several factors included on the GATE checklist, the original checklist was amended to include items about sample size (item D), data collection (item I), and prognostic groups (item Q) (Table 3.2, page 18). Additionally, it has become accepted that recovery from a whiplash injury plateaus after six months, hence the original criteria for follow-up of at least 12 months was amended to a follow-up of ⩾6 months (item E). A score of '1' was given to each item addressed satisfactorily by the paper and a score of '0' if the item was not adequately addressed. Two reviewers independently scored each paper for quality. If there was disagreement between reviewers, each paper was discussed until consensus was achieved. Studies were considered high quality if they satisfied at least 50 per cent of the maximum score available (that is ⩾10 points).

Two reviewers used standardised forms to extract data including author, title, year of publication, source population (Table 3.1), cohort location, inclusion/exclusion criteria, prognostic indicators (categorised as per Table 3.1), follow-up period, outcomes and recovery data.

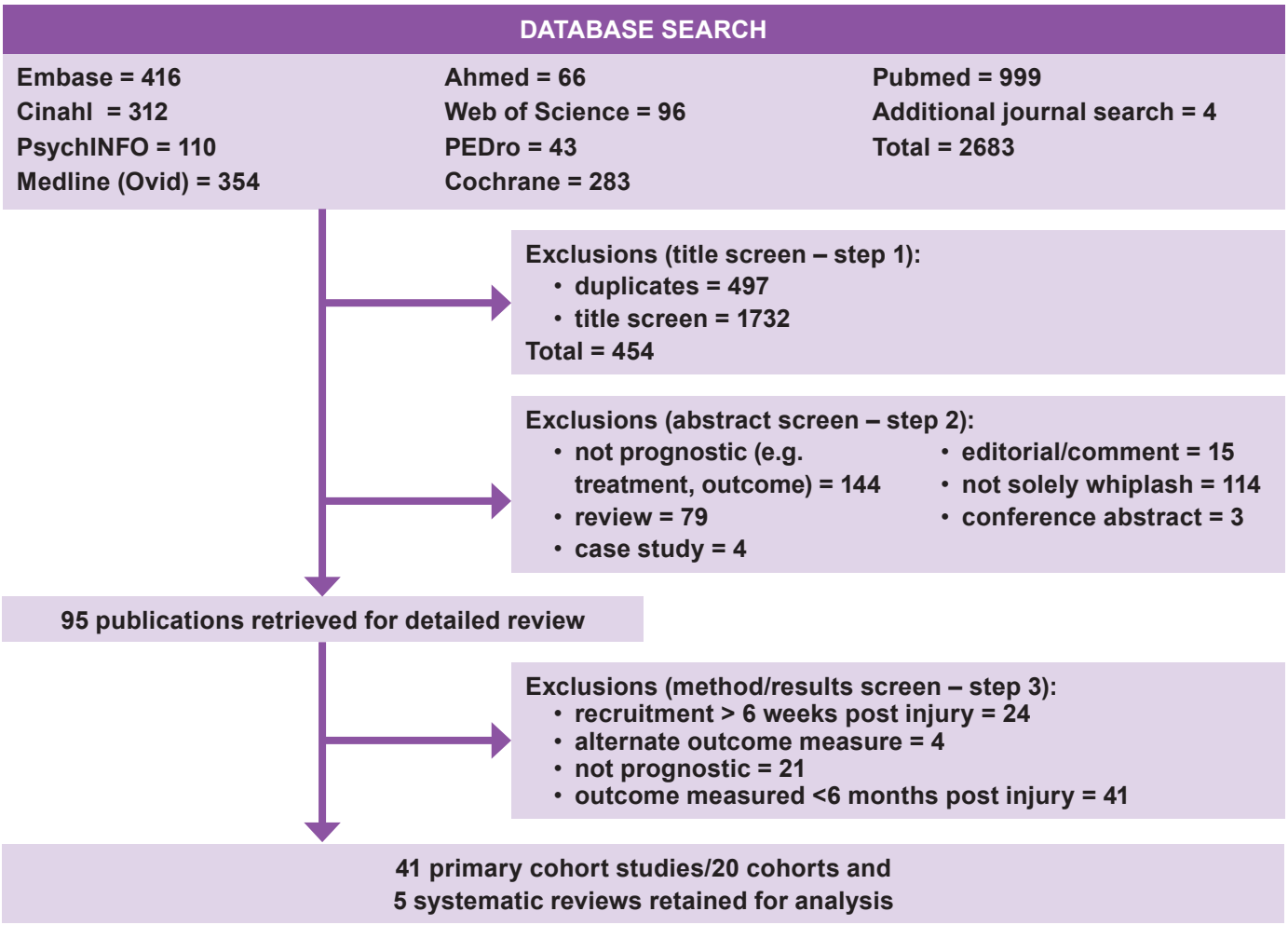
Table 3.1 Codes for items in prognostic review

SOURCE POPULATION CODES	CATEGORIES OF PROGNOSTIC FACTORS
1. Hospital emergency departments	1. Symptoms e.g. pain, disability, headache, dizziness
2. Primary care	2. Radiological
3. Insurance populations	3. Psychological
4. General populations	4. Sociodemographic e.g. age, sex, educational levels
5. Others or mixed	5. Crash related factors
	6. Physical measures (e.g. sensory measures, muscle/motor measures)
	7. Pre-existing factors
	8. Compensation factors

Table 3.2 Criteria list for the methodological assessment of studies on prognostic factors for non-recovery in patients with WAD

STUDY POPULATION	
A: Inception cohort	
B: Description of source population (location, study setting, sample representation)	
C: Description of relevant inclusion and exclusion criteria	
D: Adequate sample size/subject numbers	
FOLLOW-UP	
E: Follow-up at least 6 months	
F: Drop-outs/loss to follow-up <20%	
G: Information completers versus loss to follow-up/drop-outs	
H: Prospective data collection	
I: Information on data collection – blind assessment of prognostic and/or outcome measures	
TREATMENT	
J: Treatment in cohort is fully described/standardised	
PROGNOSTIC FACTORS	
K: Clinically relevant potential prognostic factors (includes justification)	
L: Standardised or valid measurements	
M: Data presentation of most important prognostic factors	
OUTCOME	
N: Clinically relevant outcome measures	
O: Standardised or valid measures	
P: Data presentation of most important outcome measures	
ANALYSIS	
Q: Appropriate selection of prognostic groups	
R: Appropriate univariate crude, estimates	
S: Appropriate multivariate analysis techniques	
TOTAL	/19

Figure 2.1: Search strategy and results for literature on prognostic factors associated with WAD, from 2005-2012



Evidence was assessed as per the NHMRC Evidence Statement Form (Appendix G, page 150) that sets out the basis for rating five key components of the 'body of evidence'. These are the:

1. evidence base, in terms of the number of studies, level of evidence and quality of studies (risk of bias)
2. consistency of the study results
3. potential clinical impact of the proposed recommendation
4. generalisability of the body of evidence to the target population for the guideline
5. applicability of the body of evidence to the Australian healthcare context.

An overall grade for each recommendation was then made in line with the NHMRC grades of recommendations (Table 3.3).

Table 3.3 Definition of NHMRC grades of recommendations

GRADE OF RECOMMENDATION	DESCRIPTION
A	Body of evidence can be trusted to guide practice
B	Body of evidence can be trusted to guide practice in most situations
C	Body of evidence provides some support for recommendation(s) but care should be taken in its application
D	Body of evidence is weak and recommendation must be applied with caution

Results

Table 3.4 lists details of the studies included such as population information, location of cohort, inclusion/exclusion criteria, follow-up period and prognostic factors studied.

Table 3.5 provides information regarding patient outcomes, recovery and the quality scores given.

Tables 3.6 to 3.12 provide positive and negative findings for each prognostic indicator, the level of evidence for each included study and the NHMRC Evidence Statement Matrix and recommendation for prognostic indicators and outcomes.

Table 3.4 Details of new studies on the prognosis of WAD identified for inclusion in the updated Guidelines 2014

AUTHOR	YEAR	SOURCE POPULATION	COHORT	INCLUSION	EXCLUSION	FOLLOW-UP	PROGNOSTIC FACTORS
Ameratunga, S., Tin, S.T., Connor, J., Norton, R. [24]	2010	1	Auckland	Hospitalised and non-hospitalised car occupants involved in non-fatal crash	<16, not usual resident of Auckland, unable to provide informed consent	5 months, 18 months	SF36, pre-crash health, sociodemographics, seatbelt, pre-existing medical conditions, injury severity score, depression, impact of events scale, drinking habits
Atherton, K., Wiles, N. J., Lecky, F.E., Hawes, S.J., Silman, A.J., Macfarlane, G.J., Jones, G.T. [25]	2006	1	Manchester, UK	17-70 years, ED with neck pain within 24 hrs of MVC	Fracture or dislocation of neck, distracting injury or suspected alcohol or drug intoxication, those with episode of neck pain in month prior to collision	1 month, 3 months, 12 months	Pre-accident general health, number of GP consultations in previous 12 months, lifetime experience of neck pain, other bodily pain, psychosocial work environment, collision factors (speed, direction, severity, position, airbag, seatbelt, headrest, awareness of collision), general health questionnaire, modified somatic perceptions questionnaire, VAS, NDI, dizziness, tinnitus, vision, WAD, age, gender
Berglund, A., Bodin, L., Jensen, I., Wiklund, A., Alfredsson, L.[26]	2006	3	Sweden (Karolinska)	MVC and insured with Folksam Insurance Group with acute whiplash injury - soft tissue injury to neck	Fracture or dislocation of neck, non-Swedish speaking, early disability pension, comorbidity, pregnancy	1 month, 6 months, 12 months, 24 months	Health locus of control, socioeconomic status (disposable income, educational level), physical disability (disability rating index), hospital anxiety and depression scale, sick leave, VAS
Borenstein, P., Rosenfeld, M., Gunnarsson, R.[27]	2010	5 (1 and 2)	Sweden (Goteborg)	Acute neck sprain caused by MVC, working age = 16-66 years	Fracture or dislocation, head injury, previous symptomatic chronic neck pain, alcohol abuse, dementia, serious mental disease	6 months, 36 months	Cervical ROM, shoulder, head and neck pain, subjective cognitive symptoms, age
Buitenhuis, J., de Jong, P.J., Jaspers, J.P.C., Groothoff, J.W.[28]	2008	3	Netherlands Bu (C - total dispatched =1252, eligible =156)	Neck complaints following MVC who initiated claim procedures, 16-65 years	History of whiplash, fractures, loss of consciousness for >1min	1 month, 6 months, 12 months	Age, gender, VAS, initial headache, subjective severity of injury, helplessness (rheumatology attitudes index), NDI, pain catastrophising scale, casual beliefs questionnaire whiplash
Buitenhuis, J., de Jong, P.J., Jaspers, J.P.C., Groothoff, J.W.[29]	2009	3	Netherlands Bu (D - total dispatched =3752, eligible = 879)	Neck complaints following MVC who initiated claim procedures, 16-65 years	History of whiplash, fractures, loss of consciousness for >1min	1 month, 6 months, 12 months	Age, gender, job description, neck pain, neck stiffness, other symptoms, medication use, level of education, employment status, concentration

Table 3.4 Continued

AUTHOR	YEAR	SOURCE POPULATION	COHORT	INCLUSION	EXCLUSION	FOLLOW-UP	PROGNOSTIC FACTORS
Buitenhuis, J., de Jong, P.J., Jaspers, J.P.C., Groothoff, J.W.[30]	2006	3	Netherlands Bu (B - total dispatched =997, eligible =240)	Neck complaints following MVC who initiated claim procedures, 16-65 years	Neck complaints following MVC who initiated claim procedures, 16-65 years	1 month, 6 months, 12 months	Age, gender, loss of consciousness, hospital visit, hospital admittance, GP visit, back and neck pain intensity, neck stiffness, severity of neck movement restriction, radiating pain in arms, concentration complaints, difficulty reading, difficulty concentrating on a conversation, dizziness, medication use, sleep disturbance, frequency of neck pain, onset of neck complaints, PTSD (SPS-PTSD)
Buitenhuis, J., Jaspers, J., Fidler, V.[31]	2006	3	Netherlands Bu (A - total dispatched =889, eligible 367)	Neck complaints following MVC who initiated claim procedures, 16-65 years	Neck complaints following MVC who initiated claim procedures, 16-65 years	1 month, 6 months, 12 months	Age, gender, head restraints, collision anticipated, seat in car, site of collision, seatbelt use, back and neck pain intensity, neck stiffness, severity of neck movement restriction, radiating pain in arms, concentration complaints, difficulty reading, difficulty concentrating on a conversation, dizziness, medication use, sleep disturbance, frequency of neck pain, onset of neck complaints, TSK (Tampa scale of kinesiophobia), course of symptoms
Carroll, L., Cassidy, J.D., Cote, P[32]	2006a	3	Saskatchewan (Dec 1997-Nov 1999)	Neck or shoulder pain following traffic related incidents, ≥18 years	Individuals claiming under workers' compensation, non-English speaking, serious illness (e.g. Alzheimer's Disease), hospitalisations >2 days	6 weeks, 3, 6, 9, 12 months	Coping (pain management inventory), possible confounders: pre-injury health, demographics, socioeconomics, injury related pain intensity and location, post-injury symptoms, depression
Carroll L., Ferrari R., Cassidy D.[33]	2007	3	Saskatchewan (Dec 1994-Nov 1995)	Neck or shoulder pain following traffic related incidents, ≥18 years	Individuals claiming under workers' compensation, non-English speaking, serious illness (e.g. Alzheimer's Disease), hospitalisations ≥2 days	1 month, 6 weeks, 4, 8, 12 months	Demographic factors, pre-collision health, collision parameters, collision related symptoms
Carroll, L., Holm, L., Ferrari, R., Ozegovic, D., Cassidy, J.D.[34]	2009	3	Saskatchewan (Dec 1997-Nov 1999)	Neck or shoulder pain following traffic related incidents, ≥18 years	Individuals claiming under workers' compensation, non-English speaking, serious illness (e.g. Alzheimer's Disease), hospitalisations ≥2 days	6 weeks, 3, 6, 9, 12 months	Expectations of recovery - single question - do you think that your injury will: 4 options for response, possible confounders as above
Carroll, L., Liu, Y., Holm, L., Cassidy, D., Cote, P.[35]	2011	3	Saskatchewan (1994-1995)	Self-reported neck pain from MVC, ≥18 years	Hospitalised ≥2 days	6 week, 4, 8, 12 months	Pain related emotions - VAS scale for each of negative emotional states: depression, anxiety, fear, anger, frustration

Table 3.4 Continued

AUTHOR	YEAR	SOURCE POPULATION	COHORT	INCLUSION	EXCLUSION	FOLLOW-UP	PROGNOSTIC FACTORS
Carstensen, T., Frostholm, L., Oernboel, E., Kongsted, A., Kasch, H., Jensen, T., Fink, P.[36]	2009	1, 2	4 counties in Denmark (April 2001-June 2003): RCT - no diff across treatment groups	18-70 years, rear-end or frontal MVC, WAD symptoms within 72 hr, understood Danish	Examination >10 days post-MVC, WAD grade 4, amnesia or unconscious, injuries other than whiplash, significant pre-collision physical or psych disorder, self-reported neck pain in preceding 6 months, alcohol or drug abuse	12 months	Pre-collision psychological distress: Whitely 7 (illness worrying), SCL-SOM (somatisation), SCL-OC (obsessive-compulsive), SCL-HOS (hostility), SCL-8 (mental illness), SCL-ANX4 (anxiety), pre-collision health problems (persistent illness, hospitalisations, persistent pain condition), pre-neck pain, collision related characteristics (speed, damage to car, time of accident), age, gender, education, occupation, work capacity, VAS
Carstensen, T., Frostholm, L., Oernboel, E., Kongsted, A., Kasch, H., Jensen, T., Fink, P.[37]	2012	1, 2	4 counties in Denmark (April 2001-June 2003): RCT - no diff across treatment groups	18-70 years, rear-end or frontal MVC, WAD symptoms within 72 hr, understood Danish	Examination ≥10 days post-MVC, WAD grade 4, amnesia or unconscious, injuries other than whiplash, significant pre-collision physical or psych disorder, self-reported neck pain in preceding 6 months, alcohol or drug abuse	12 months	Coping strategies questionnaire (5 subscales - distraction, ignoring, reinterpreting, catastrophising, praying and hoping), age, gender, education, occupation, living conditions, collision related severity, pre-collision psychological distress (SCL-8)
Cobo, E., Mesquida, E., Fanegas, E., Atanasio, E., Pastor, B., Pont, C., Prieto, C., Gomez, G., Cano, L.[38]	2010	2	Mataro Hospital, Spain (Oct 2005-June 2007)	18-75 years, WAD I or II as result of MVC with symptoms such as neck pain, headache or dizziness within 48 hrs	WAD III or IV, fractures, traumatic brain injury, cervical spine surgery before accident, oncologic or rheumatic pathology	6 months	Gender, age, education level, working condition before accident, transitory labour disability after accident, pre-existing health problems, presence of pre-accident neck, dorsal or low back pain, medication use, crash related factors, situation of vehicle, WAD, presence of headache, dizziness, and dorsal, low back, shoulder and temporomandibular joint pain, time to get to emergency room, VAS, Goldberg depression and Anxiety Scale, Northwick Park Neck Pain questionnaire
Elliot, J., Pedler, A., Kenardy, J., Galloway, G., Jull, G., Sterling, M.[39]	2011	1, 2, 4	Unknown location (n=55)	Neck pain from MVC, WAD II	One or more previous MVC treatment for neck pain disorders in past 10 years, nervous or metabolic system disorder	3, 6 months	NDI (trichotomised), neck pain VAS, PDS, total CROM
Gabel, C., Burkett, B., Neller, A., Yelland, M.[40]	2008	2	Unknown (pilot study)	Unknown	Unknown	6 months	Demographics, cervical rotation at impact, psychosocial generic screening tool (GST which is a modified Orebro musculoskeletal pain questionnaire [OMPQ]), NDI

Table 3.4 Continued

AUTHOR	YEAR	SOURCE POPULATION	COHORT	INCLUSION	EXCLUSION	FOLLOW-UP	PROGNOSTIC FACTORS
Goldsmith, R., Wright, C., Bell., S. Rushton, A.[41]	2012		Systematic review (inception -2011) - 6 articles accepted: 5 originals within this review				
Gun, R., Osti, O., O'Riordan, A., Mpelasoka, F., Eckerwall, C., Smyth, J.[42]	2005	1, 2	Unknown location	Neck pain as result of soft-tissue injury following MVC, completion of questionnaire within 6 weeks of accident	Radiologic abnormalities and/ or neurologic signs, those with fracture or intracranial, intra-thoracic or inter-abdominal injury	12 months	SF36, determinant variables - prior workers' compensation or third party claim, prior neck pain, consulting a lawyer, having attended a physiotherapist or chiropractor
Hendriks, E., Scholten-Peeters, G., van der Windt, D., Neeleman-van der Steen, C., Oostendorp, R., Verhagen, A.[43]	2005	1, 2	Netherlands (June 1999-May 2002) (n=125)	Living in the Netherlands, 18-55 years, WAD I or II as result of MVC with symptoms of neck pain or headache or dizziness within 48 hours	WAD III or IV, cervical hernia or past cervical spondylodesis, insufficient knowledge of Dutch language	52 weeks	Symptom checklist (SCL-90), socio-demographics, crash related characteristics, pre-existing physical health characteristics, VAS, CROM, additional radiological or imaging in first 2 weeks, use of collar, retained a lawyer
Holm, L., Carroll, L., Cassidy, J.D., Skillgate, E., Ahlbom, A.[44]	2007	3	Saskatchewan (1994-1995)	Self-reported neck pain from MVC, ≥18 years	Excluded widespread pain at entry (other than head, neck, pain)	6 weeks, 4, 8, 12 months	Demographics, previous health, neck pain (VAS) and symptoms after MVC, pain drawing, CES-D,
Holm, L., Carroll, L., Cassidy, J.D., Skillgate, E., Ahlbom, A.[45]	2008	3	Sweden (Jan 2004-Jan 2005) (n=1259)	18-74 years, no fatal injury to another occupant, WAD (yes to do you have pain/ ache in the neck due to the accident?)	Non-Swedish residents, complete recovery at baseline, those with new injury at 6 month f/up	6 months	Expectations of recovery (numerical rating scale), with potential confounders: demographics, prior general health, HADS, IES, Pain Management Inventory (coping), eight pain-associated symptoms
Ichihara, D., Okada, E., Chiba, K., Toyama, Y., Fujiwara, H., Momoshima, S., Nishiwaki, Y., Hashimoto, T., Ogawa, J., Watanabe, M., Takahata, T., Matsumoto, M.[46]	2009		Unknown (1993-1996) (n=133)	Unable to locate previous studies via journal or web of science		10 years	MRI, accident related details, symptoms (neck pain, stiffness, pain in upper extremities, nausea, headache, vertigo, tinnitus), age, sex, accident related information
Johansson, M., Liane M., Kasch, H., Kongsted, A.[47]	2011	1, 2	Number of counties in Denmark (April 2001-June 2003) not specified but think it is 2: RCT - no diff across treatment groups	WAD 1-3, 18-70 years, rear-end or frontal MVC, WAD symptoms within 72hr, understood Danish	Examination >10 days post-MVC, WAD grade 4, amnesia or unconscious, injuries other than whiplash, significant pre-collision physical or psych disorder, self-reported neck pain in preceding 6 months, alcohol or drug abuse	12 months	MRI (categories - lordosis, kyphosis or straight), socio-demographic factors

Table 3.4 Continued

AUTHOR	YEAR	SOURCE POPULATION	COHORT	INCLUSION	EXCLUSION	FOLLOW-UP	PROGNOSTIC FACTORS
Kamper, S., Rebbeck, T., Maher, C., McAuley, J., Sterling, M.[23]	2008		Systematic review (inception -2007) - 67 articles accepted: 8 originals within this review				
Kasch, H., Qerama, E., Kongsted, A., Bach, F. Bendix, T., Jensen, T.[48]	2011	1	Aarhus Denmark (Jan 1997-Jan 1998)	Rear collision MVC, present to ER within 2 days with neck pain or headache, 18-70 years	Previous neck or low back pain disorder or head injury, unconsciousness during accident or amnesia, previous severe psych disorder or known alcohol or medication abuse	1, 3, 6, 12 months	McGill Pain Questionnaire, Million Behaviour Health Inventory, Symptom Checklist-90 Revised, Copenhagen Neck Functional Disability Scale, pressure pain (5 sites + distal), cold pressor pain, ROM, Max Vol. Contraction, duration time neck flexion and neck extension
Kasch, H., Qerama, E., Kongsted, A., Bendix, T., Jensen, T., Bach, F.[49]	2008	1, 2	4 counties in Denmark (April 2001-June 2003): RCT - no diff across treatment groups	WAD 1-3, 18-70 years, rear-end or frontal MVC, WAD symptoms within 72 hr, understood Danish	Examination >10 days post-MVC, WAD grade 4, amnesia or unconscious, injuries other than whiplash, significant pre-collision physical or psych disorder, self-reported neck pain in preceding 6 months, alcohol or drug abuse. Disability pension because of headache, neck pain or shoulder pain, sick leave for more than 3 months in last year because of neck, shoulder, low back or headache pain	3, 12 months	Total cervical range of motion, initial neck pain (VAS), initial headache (VAS), initial number of non-painful symptoms, number of movement directions with local pain during CROM test, total palpation pain score, neck and jaw muscle-pairs, age, reported seriousness of car accident, initial expectation of returning to work at 6 weeks (VAS score 0-10)
Kivioja, J., Jensen, I., Lindgren, U.[50]	2005	1	Stockholm, Sweden (Dec 1996-June 1997) (n=96)	18-65 years, fluent in Swedish, examination <1 week after injury, whiplash following MVC	Previous neck injury, neurological disease or presence of cervical fracture or dislocation	1 year	Age, gender, pre-accident neck or shoulder pain, coping strategies questionnaire
Kongsted, A., Bendix, T., Qerama, E., Kasch, H., Bach, F., Korsholm, L., Jensen, T.[51]	2008a	1, 2	4 counties in Denmark (April 2001-June 2003): RCT - no diff across treatment groups	WAD 1-3, 18-70 years, rear-end or frontal MVC, WAD symptoms within 72 hrs, understood Danish	Examination >10 days post-MVC, WAD grade 4, amnesia or unconscious, injuries other than whiplash, significant pre-collision physical or psych disorder, self-reported neck pain in preceding 6 months, alcohol or drug abuse	12 months	IES (total and intrusion and avoidance subscales), SF36, neck pain, headache pain, socio-demographics, crash related data

Table 3.4 Continued

AUTHOR	YEAR	SOURCE POPULATION	COHORT	INCLUSION	EXCLUSION	FOLLOW-UP	PROGNOSTIC FACTORS
Kongsted, A., Jorgensen, L., Leboeuf-Yde, C., Qerama, E., Korsholm, L., Bendix, T.[52]	2008b	1, 2	2 of counties in Denmark (above) (April 2001-June 2003): RCT - no diff across treatment groups	WAD 1-3, 18-70 years, rear-end or frontal MVC, WAD symptoms within 72 hrs, understood Danish	Examination >10 days post-MVC, WAD grade 4, amnesia or unconscious, injuries other than whiplash, significant pre-collision physical or psych disorder, self-reported neck pain in preceding 6 months, alcohol or drug abuse	3, 6, 12 months	Early smooth pursuit eye movement (electrooculography)
Kongsted, A., Sorensen, J., Andersen, H., Keseler, B., Jensen, T., Bendix, T.[53]	2008c	1, 2	2 of counties in Denmark (above) (April 2001-June 2003): RCT - no diff across treatment groups	WAD 1-3, 18-70 years, rear-end or frontal MVC, WAD symptoms within 72 hrs, understood Danish	Examination >10 days post-MVC, WAD grade 4, amnesia or unconscious, injuries other than whiplash, significant pre-collision physical or psych disorder, self-reported neck pain in preceding 6 months, alcohol or drug abuse	12 months	MRI findings - 10 factors scaled findings (no abnormal findings, mild pre-existing degeneration, mod/severe pre-existing degeneration, traumatic finding)
Ozegovic, D., Carroll, L., Cassidy, J.D. [54]	2009	3	Saskatchewan (Dec 1997-Nov 1999)	Neck or shoulder pain following traffic related incidents, ≥18 years	Individuals claiming under worker's compensation, non-English speaking, serious illness (e.g. Alzheimer's Disease), hospitalisations ≥2 days. Excluded unemployed and those who had already returned to their usual employment prior to completing application for benefits	6 weeks, 3, 6, 9, 12 months	Expectation to return to work: do you think that you will recover enough to return to your usual job? Dichotomous: Yes or no + don't know
Pedler, A., Sterling, M.[15]	2011	1, 2, 4	Unknown location (n = 98)	Neck pain from MVC that occurred within last 4 weeks, 18-65 years, WAD I, II, III	WAD IV, history of neck pain requiring treatment, loss of consciousness, concussion or head injury due to MVC	3, 6, 12 months	VAS, fear avoidance beliefs (TSK-17), PFActS-C, age, sex
Phillips, L., Carroll, L., Cassidy, J.D., Cote, P.55	2010	3	Saskatchewan (Dec 1997-Nov 1999)	Neck or shoulder pain following traffic related incidents, ≥18 years	Individuals claiming under workers' compensation, non-English speaking, serious illness (e.g. Alzheimer's), hospitalisations ≥2 days. Excluded unemployed and those who had already returned to their usual employment prior to completing application for benefits	6 weeks, 3, 6, 9, 12 months	Demographics (gender, age, marital status, income, education), pre-crash health (self-report general health, pre-existing comorbid conditions including mental health), crash related factors (position in vehicle, impact, fractures), pain/symptoms after collision, pain intensity (VAS), percentage of body in pain

Table 3.4 Continued

AUTHOR	YEAR	SOURCE POPULATION	COHORT	INCLUSION	EXCLUSION	FOLLOW-UP	PROGNOSTIC FACTORS
Sterling, M.[18]	2010	1, 2, 4	Unknown location (n = 62)	WAD II or III	WAD IV, history of neck pain or headache requiring treatment or if diagnosed with previous tension-type headache or migraine, whiplash, loss of consciousness, concussion or head injury due to MVC	3, 6 months	Pressure pain thresholds, cold pain thresholds, VAS, NDI, GHQ-28, IES, sex
Sterling, M., Hendrikz, J., Kenardy, J.[56]	2010	1, 2, 4	Unknown location (n = 155)	WAD I, II or III	WAD IV, history of whiplash, neck pain or headache requiring treatment, concussion or head injury due to MVC, receiving treatment for psychiatric or psychological condition	3, 6, 12 months	NDI, PDS, compensation claim
Sterling, M., Hendrikz, J., Kenardy, J.[57]	2011	1, 2, 4	Unknown location however same population as above (n = 155)	WAD I, II or III	WAD IV, history of whiplash, neck pain or headache requiring treatment, concussion or head injury due to MVC, receiving treatment for psychiatric or psychological condition	3, 6, 12 months	VAS, age, gender, PPT neck, PPT arm, CPT as bivariate, SVR (QI and SRF)
Sterling, M., Jull, G., Kenardy, J.[58]	2006a	1, 2, 4	Unknown location however same population as above (n = 76)	Neck pain from MVC that occurred within last 4 weeks, WAD II, III. Data available for 6 months also	WAD IV, history of neck pain or headache requiring treatment, whiplash, loss of consciousness, concussion or head injury due to MVC	2 to 3 years	Age, gender, ROM, pressure pain thresholds (articular pillars (c2/3, c5/6), elbow, tibialis anterior), thermal pain thresholds (hot, cold), brachial plexus provocation test, sympathetic vasoconstrictor response, NDI, General Health Questionnaire, TSK (Tampa Scale of Kinesophobia), Impact of Events Scale, compensation status
Sterling, M., Jull, G., Vincenzino, B., Kenardy, J., Darnell, R.[59]	2005	1, 2, 4	Unknown location (n = 80)	Neck pain from MVC that occurred within last 4 weeks, WAD II, III	WAD IV, history of neck pain or headache requiring treatment, whiplash, loss of consciousness, concussion or head injury due to MVC	6 months	Age, gender, ROM, pressure pain thresholds (articular pillars (c2/3, c5/6), elbow, tibialis anterior), thermal pain thresholds (hot, cold), brachial plexus provocation test, sympathetic vasoconstrictor response, NDI, General Health Questionnaire, TSK (Tampa Scale of Kinesophobia), Impact of Events Scale
Sterling, M., Kenardy, J.[60]	2006b	1, 2, 4	Unknown location however same population as above (n = 80)	Neck pain from MVC that occurred within last 4 weeks, WAD I (added to inclusion in this study), II, III	WAD IV, history of neck pain or headache requiring treatment, whiplash, loss of consciousness, concussion or head injury due to MVC	6 months	Age, gender, ROM, pressure pain thresholds (articular pillars (c2/3, c5/6), elbow, tibialis anterior), thermal pain thresholds (hot, cold), sympathetic vasoconstrictor response, NDI

Table 3.4 Continued

AUTHOR	YEAR	SOURCE POPULATION	COHORT	INCLUSION	EXCLUSION	FOLLOW-UP	PROGNOSTIC FACTORS
Sterling M., Hendrikz J. et al [61]	2012	1,2,4	Multicentre-Brisbane, Melbourne, Montreal, Reyjavik n = 286	Acute WAD <4 weeks	WAD IV, history of neck pain or headache requiring treatment, whiplash, loss of consciousness, concussion or head injury due to MVC	12 months	Age, gender, cold pain threshold, IES, ROM
Vetti, N., Krakens, J., Eide, G., Rorvik, J., Gilhus, N., Espeland, A.[62]	2010	1, 2	Norway (March 2007-March 2009) (n = 114)	WAD 1-2, 18-80 years, Norwegian speaking, MVC during last 7 days and onset of neck pain within 48 hrs of MVC	Fracture or dislocation, prior neck injury or whiplash trauma, prior neck problem or severe head injury, previous cervical spine surgery, rheumatic disease, cancer or other somatic or psych condition, pregnancy	12 months	High resolution proton-weighted MRI, IES, patient expectations of recovery, NRS, localisation of max neck pain, accident related factors, education, age, gender
Walton, D., Pretty, J., Macdermid, J., Teasell, R.[63]	2009		Systematic review (1995-2007) - 14 articles accepted: 4 originals within this review				
Williams, M., Williamson, E., Gates, S., Lamb, S., Cooke, M.[64]	2007		Systematic review (inception -2006) - 38 articles accepted: 7 originals within this review				
Williamson, E., Williams, M., Gates, S., Lamb, S.[65]	2008		Systematic review (inception -2006) - 25 articles accepted: 5 originals within this review				
Yang, X., Cote, P., Cassidy, J.D., Carroll, L.[66]	2007	3	Saskatchewan (1994-1995)	Self-reported shoulder or neck pain, ≥18 years	Multiple claims, medical conditions that prevented completion of questionnaire, hospitalised ≥2 days	22 to 39 months	BMI using self-report height and weight and tri-chotomised

Table 3.5: Information on patient outcomes, patient recovery rates and rating scores for studies on the prognosis of WAD identified for inclusion in the updated Guidelines 2014.

AUTHOR	YEAR	RATING SCORE	UNIVARIATE ANALYSIS RESULTS	MULTIVARIATE ANALYSIS RESULTS	FOLLOW-UP	PERCENTAGE RECOVERED
Ameratunga, S., Tin, S.T., Connor, J., Norton, R. [24]	2010	13	Neck pain at 5 and 18 months significantly associated with older age (+45 years), male, fair or poor general health at baseline and symptoms of depression or PTSD at 5 months	OR 3.47 (1.54, 7.84) depression at 5 months, IES >27 at 5 months OR 2.93 (1.28, 6.70), no diff - age, gender, general health baseline	18 months	No neck pain or neck stiffness = 81%
Atherton, K., Wiles, N J., Lecky, F.E., Hawes, S.J., Silman, A.J., Macfarlane, G.J., Jones, G.T.[25]	2006	15	Persistent symptoms (neck pain lasting for one day or longer in week prior to questionnaire) associated with widespread pain prior to collision and self-report medium or high severity collision and high level of general psych distress (GHQ) and high somatic awareness (MSPQ) and high injury severity and high initial NDI and high number of WAD symptoms	GHQ RR = 1.3 (0.8 - 2.1), pre-collision widespread pain RR = 1.9 (1.1 - 3.2), vehicle other than car RR = 1.8 (1.04 - 3.2), number of other symptoms RR = 2.0 (1.2 - 3.2), initial NDI RR = 1.9 (1.2 - 2.9)	12 months	No persistent neck pain (neck pain lasting ⩾1 day) = 73%
Berglund, A., Bodin, L., Jensen, I., Wiklund, A., Alfredsson, L.[26]	2006	13	Neck pain intensity (VAS) associated with initial neck pain intensity, gender, severity of whiplash injury, headache, helplessness, education and time, disability rating index associated with same variables, anxiety associated with same except education, depression associated with initial neck pain intensity, severity of whiplash injury, helplessness and time	Neck pain intensity: moderate neck pain at baseline higher than mild OR 3.9 (3.0 - 4.9), initial severe higher than mild OR 8.4 (6.5 - 10.9), high degree of helplessness OR 2.7 (2.1 - 3.4). Neck pain disability: moderate pain baseline higher disability than mild OR 3.5 (2.8 - 4.5), severe neck pain at baseline OR 6.4 (4.8 - 8.4), numbness/pain in arms/hands and severe neck pain at baseline OR 6.5 (2.5 - 17.0), higher helplessness OR 3.5 (2.1 - 6.1). Anxiety: severe baseline neck pain OR 2.6 (1.9 - 3.5) and moderate baseline neck pain OR 1.9 (1.5 - 2.6), female OR 1.6 (1.0 - 2.5), helplessness OR 3.4 (1.8 - 6.3). Depression: initial moderate baseline neck pain OR 2.2 (1.5 - 3.2), initial severe neck pain OR 2.9 (2.0 - 4.3), helplessness OR 2.5 (1.7 - 3.6)	24 months	Recovery percentages not shown
Borenstein, P., Rosenfeld, M., Gunnarsson, R.[27]	2010	11	NA	Sick leave of any length: cognitive symptom (easily irritated) OR 31 (3.2 - 306) and (easily distracted) 10 (1.1 - 88). Sick leave more than 30 days: easily distracted OR 24 (2.2 - 268)	6 months, 36 months	No sick leave = 80%, no extended sick leave (⩾30 days) = 85%
Buitenhuis, J., de Jong, P.J., Jaspers, J.P.C., Groothoff, J.W.[28]	2008	17	NDI associated with casual beliefs questionnaire initially (Spearmans = 0.58, p<.01), at 6 months (Spearmans = 0.58, p<.01) and 12 months (Spearmans = 0.52, p<.01)	NDI at 6 month predicted with initial NDI OR 1.197 (p<.001), casual beliefs - psychological OR 4.335, p<.005, casual beliefs-vertebral OR 3.686, p<.006, casual beliefs-whiplash OR 3.430, p<.001, pain catastrophising scale OR 0.885m p<.004. NDI at 12 months predicted with initial NDI OR 1.156, p<.001, casual beliefs-psych OR 2.670, p<.031, and casual beliefs-whiplash OR 2.657, p<.006	6 months, 12 months	No post whiplash syndrome: 6 months = 34%, 12 months = 44%

Table 3.5 Continued

AUTHOR	YEAR	RATING SCORE	UNIVARIATE ANALYSIS RESULTS	MULTIVARIATE ANALYSIS RESULTS	FOLLOW-UP	PERCENTAGE RECOVERED
Buitenhuis, J., de Jong, P.J., Jaspers, J.P.C., Groothoff, J.W.[29]	2009	14	Work disability at 6 months associated with: age, neck pain intensity, neck stiffness, severity of restricted neck movements, radiating pain in arms, paraesthesia, concentration complaints, headache intensity, dizziness, use of medication. Work disability at 12 months associated with: age, neck pain intensity, severity of restricted neck movements, radiating pain in arms, paraesthesia, concentration complaints, headache intensity, dizziness, use of medication	Work disability at 6 months predicted with concentration complaints OR 1.251 (1.149 - 1.362), p<.001. work disability at 12 months predicted with age OR 1.028 (1.004 - 1.052), p<.022 and concentration complaints OR 1.242 (1.128 - 1.368), p<.001	6 months, 12 months	No work disability (no reduced working hours because of complaints): 6 months = 81%, 12 months = 87%
Buitenhuis, J., de Jong, P.J., Jaspers, J.P.C., Groothoff, J.W.[30]	2006	15	Post whiplash syndrome associated with females, PTSD	Post whiplash syndrome at 6 months associated with gender OR .226, p<.014, initial neck pain OR 1.423, p<.005, and hyperarousal symptoms OR 1.459, p<.003. post whiplash syndromes at 12 months associated with hyperarousal symptoms OR 2.248, p<.005 and neck pain OR 1.549, p<.002	6 months, 12 months	No post whiplash syndrome (absence of persistent neck pain): 6 months = 62%, 12 months = 67%
Buitenhuis, J., Jaspers, J., Fidler, V.[31]	2006	16	Neck stiffness, radiating pain in arms and difficulty falling asleep correlated, TSK correlated with age, males, neck pain and sleep disturbance	TSK-DV score of >10 corresponds to reduced probability of becoming symptom free (HR = 0.47, p<.001), head restraint associated with longer duration of neck symptoms (HR = 3.06, p<.021), model without TSK - neck stiffness (HR = 0.83, p<.007), radiating pain in arms (HR = 0.80, p<.003) and difficulty falling asleep (HR = 2.27, p<.007) associated with longer duration neck symptoms, model with TSK and symptoms - TSK no relationship with neck symptoms (HR = 0.73, p<.089)	12 months	Free of neck pain symptoms = 51%
Carroll, L., Cassidy, J.D., Cote, P.[32]	2006a	17	Depressive symptomatology (CES-D >16) effect modifier on passive coping and recovery (HRR = .96 95% CI 0.93 - 0.99, p<.013)	No depressive symptoms: passive coping and recovery HRR = .97 (95% CI .95 - .97), those with depressive symptoms HRR = .97 (95% CI .91 - .96), tri-chotomised passive coping scores - high levels of passive coping and depressive symptoms - recovery 75% slower (HRR = .25 95% CI .17 - .38) and high levels of passive coping and no depressive 38% slower (HRR = .62 95% CI .43 - .89). No association with active coping and recovery with confounders HRR = 1.0 (95% CI .99 - 1.02)	6 weeks, 3, 6, 9, 12 months	Recovery percentages not shown

Table 3.5 Continued

AUTHOR	YEAR	RATING SCORE	UNIVARIATE ANALYSIS RESULTS	MULTIVARIATE ANALYSIS RESULTS	FOLLOW-UP	PERCENTAGE RECOVERED
Carroll L., Ferrari R., Cassidy D.[33]	2007	16	WAD claimants 3.36 times greater risk of developing jaw pain compared with non-WAD claimants	Women more likely to experience onset of jaw pain (OR 1.46 (1.25 - 1.7)), subjects >50 years less likely to experience jaw pain (OR = 0.65 (0.51 - 0.83)), subjects who reported post-collision difficulties swallowing (OR 3.75 (3.1 - 4.54)) or those with ringing in the ears (OR 2.0 (1.7 - 2.36)) were more likely to experience jaw pain. Initial neck pain, headache, numbness, dizziness, nausea and visual difficulties not statistically associated with development of jaw pain	6 weeks, 4, 8, 12 months	Recovery percentages not shown
Carroll, L., Holm, L., Ferrari, R., Ozegovic, D., Cassidy, J.D.[34]	2009	14	More positive expectations for recovery associated with lower pain scores, less depressed mood, better prior health, higher education and higher family income	Global self-assessed recovery model: get better soon HRR 3.62 (2.55 - 5.13) - e.g. recovery 3.5 times quicker, get better slowly HRR 2.66 (1.88 - 3.75) - adjusted for baseline confounders - post-injury depressive symptoms, post-injury self-reported health, post-injury neck pain and back pain intensity. Neck pain outcome model: expected to get better soon - pain recovery HRR 1.81 (1.34 - 2.44), get better slowly - pain recovery HRR 1.49 (1.11 - 2.01) - adjusted for baseline confounders-post-injury self-reported health, post-injury neck pain and back pain intensity. pain disability model: those who expected to recover soon resolution of pain related disability HRR 3.01 (2.05 - 4.43), get better slowly HRR 2.38 (1.62 - 3.48) - a number of confounders adjusted for	6 weeks, 3, 6, 9, 12 months	Recovery percentages not shown
Carroll, L., Liu, Y., Holm, L., Cassidy, D., Cote, P.[35]	2011	16	Significant relationship between emotion intensity and self-reported prior emotional status: depression (F(3) =2 8.44, p<.001), anxiety (F(3) = 8.56, p<.001), fear (F(3) = 14.46, p<.001), anger (F(3) = 9.61, p<.001), frustration (F(3) = 14.86, p<.001). Significant association with neck pain intensity and all pain related emotions. Emotional intensity lower with higher income levels, higher if consulted a lawyer	Pain related emotional intensity at 6 weeks and neck pain: depression OR 1.009 (1.004 - 1.013), anxiety OR 1.007 (1.002 - 1.013), fear OR 1.005 (1.001 - 1.010), anger OR 1.006 (1.001 - 1.010), frustration OR 1.007 (1.003 -1 .012)	12 months	VAS ≤10 = 42%

Table 3.5 Continued

AUTHOR	YEAR	RATING SCORE	UNIVARIATE ANALYSIS RESULTS	MULTIVARIATE ANALYSIS RESULTS	FOLLOW-UP	PERCENTAGE RECOVERED
Carstensen, T., Frostholm, L., Oernboel, E., Kongsted, A., Kasch, H., Jensen, T., Fink, P.[36]	2009	16	Women and individuals with pre-collision neck pain and individuals with pre-collision persistent illness more likely to be highly distressed, students more likely to be medium distressed. Baseline high psychological distress more likely to be work affected and to have considerable neck pain	Affected work capability: female gender OR 1.7 (1.0 - 2.9) p<.04, unemployed OR 3.8 (1.5 - 9.7), p<.005, blue collar OR 2.7 (1.1 - 6.3) p<.02, pre-collision unspecified pain condition OR 2.4 (1.4 - 4.2) p<.002. Less likely to be work affected: skilled OR 0.54 (.3 - .99), formal education OR 0.17 (.05 -. 62) p<.007. Considerable neck pain: female OR 2.3 (1.5 - 3.6) p<.000, pre-collision unspecified pain OR 3.5 (2.0 - 5.9) p<.000, pre-collision highly distressed OR 2.1 (1.1 - 4.2) p<.03. Lower neck pain formal education OR 0.33 (.14 -. 81) p<.02	12 months	Minimal neck pain VAS (0-3) = 67%, unaffected work capability (no sick days or reduced working hours) = 85%
Carstensen, T., Frostholm, L., Oernboel, E., Kongsted, A., Kasch, H., Jensen, T., Fink, P.[37]	2012	16	Women more likely to live alone, have a formal education <4 years, had psych distress pre-collision and neck pain at follow-up. Men were more likely to be self-employed, blue collar workers and live with parents	Odds for neck pain twice as high in women than men OR 2.17 (1.4 - 3.37) p<.001. Coping strategies: distraction OR 1.03 (1.01 - 1.05) p<.003, reinterpreting OR 1.03 (1.01 - 1.06) p<.018, catastrophising OR 1.14 (1.1 - 1.18) p<.000, praying and hoping OR 1.09 (1.05 - 1.13) p<.000 predicted neck pain at 12 months	12 months	VAS 0-3 = 65%
Cobo, E., Mesquida, E., Fanegas, E., Atanasio, E., Pastor, B., Pont, C., Prieto, C., Gomez, G., Cano, L.[38]	2010	17	VAS at six months significantly associated with sex, working condition, pre-existing neck pain, headache and dizziness at initial evaluation, age, initial VAS, Goldberg scale, NPH	6 month VAS significantly influenced by age (b = .180, p<.001), self-employed worker (b = -.578, p<.016), presence of dizziness (b = .391, p<.02), initial VAS (b = .237, p<.001), and initial NPH (b = .309, p<.001)	6 months	VAS 0-30 (mild) = 56%
Elliot, J., Pedler, A., Kenardy, J., Galloway, G., Jull, G., Sterling, M.[39]	2011	16	No difference is MFI between NDI groups at baseline. Mod/severe group significantly different (increased) from other two at 3 and 6 months	Higher baseline pain associated with increased MFI at 6 months (unsure of statistics to present - mediation analysis), PTSD symptoms and reduced CROM. When these mediators controlled for effect of baseline pain not significant. When baseline pain controlled for, PTSD symptoms had significant positive association with MFI while CROM did not	6 months	NDI recovered (<10%) = 38%
Gabel, C., Burkett, B., Neller, A., Yelland, M.[40]	2008	7	Significant difference in total treatments between non-recovered (average treatment = 15) and recovered (average treatment = 8)	Female classification predictive of non recovery (no statistics). GST >109 LR = 5.4 (sensitivity = 78%, spec = 86%) - not sure what outcome variable? Combining GST >109 and cervical rotation at impact LR = 7.7 (sensitivity 100%, spec 87%). Initial NDI sensitivity = 100% spec = 40%	6 months	NDI recovered (≤8%) = 70%
Goldsmith, R., Wright, C., Bell., S. Rushton, A.[41]	2012	NA	Systematic review			

Table 3.5 Continued

AUTHOR	YEAR	RATING SCORE	UNIVARIATE ANALYSIS RESULTS	MULTIVARIATE ANALYSIS RESULTS	FOLLOW-UP	PERCENTAGE RECOVERED
Gun, R., Osti, O., O'Riordan, A., Mpelasoka, F., Eckerwall, C., Smyth, J.[42]	2005	16		No association with gender and any of outcome variables. Age association with improvement in neck pain outcome (b = .20, p<.05). SF36-bodily pain and all outcomes: neck pain outcome (b = .18, p<.05), improvement in VAS (b = .02, p<.05), not being treated OR 1.03, p<.01, RTW OR 1.05, claim settled OR 1.03. Role emotional showed some associations as did mental health component and physical component. Consulting a lawyer associated with worse outcomes for all 5 variables. No associations with accident factors. Significant association with prior claim and neck pain outcome and VAS. Patients treated by physio or chiro statistically lesser improvements in neck pain outcome and VAS	12 months	Completed treatment = 31%, claim settled = 41%, return to work = 89%, no information on recovery rate NPOS and VAS
Hendriks, E., Scholten-Peeters, G., van der Windt, D., Neeleman-van der Steen, C., Oostendorp, R., Verhagen, A.[43]	2005	18	Results of univariate logistic regression with poor recovery at 52 weeks showed significance for: female gender, low level of education, no seatbelt use, pain medication before the accident, initial VAS, total CROM, high number of complaints, SCL-90 subscales somatisation and other, and negative association with VAS for work activities	Poor recovery predicted by female gender OR 4.6 (1.5 - 14.0), a low level of education OR 3.5 (1.1 - 11.7), higher baseline VAS OR 1.0 (1.0 - 1.03), higher somatisation OR 1.1 (1.0 - 1.2), lower VAS for work related activities OR .99 (.98 - 1.0)	12 months	Functional recovery (VAS <30 or VAS for activities ⩾78 and no pain medications) = 64%, VAS neck pain <30 = 74%, return to work = 91%
Holm, L., Carroll, L., Cassidy, J.D., Skillgate, E., Ahlbom, A.[44]	2007	16	Onset of WP (widespread pain) more frequent in women, those reporting poor health before the injury, a greater number of painful body areas at baseline, greater initial neck pain intensity, greater number of WADs and more depressive symptoms	Onset of widespread pain and depressive mood OR 3.2 (1.6 - 6.3), high neck pain intensity (55 - 100) OR 3.2 (1.3 - 8.0), mod neck pain intensity (31 - 54) OR 2.4 (0.9 - 6.5), symptoms 3 or more OR 1.9 (0.9 - 3.8), number painful body areas 4-5 OR 2.6 (1.3 - 5.4)	12 months	111 (no WP) + 33 (recovered from WP) = 144/167 (86%)
Holm, L., Carroll, L., Cassidy, J.D., Skillgate, E., Ahlbom, A.[45]	2008	16	PDI at six months significantly associated with expectation, lower education, frequent neck pain, frequent headache pain, neck pain VAS, low back pain VAS, number of symptoms, IES, HADS anxiety, HADS depression, CROM	Odds of high disability (PDI >22) individuals who stated they were less likely to make a full recovery were 4.2 times the odds in individuals who stated they were likely to make a full recovery OR 4.2 (2.1 - 8.5)	6 months	Pain Disability Index 0 - 4 = 50%
Ichihara, D., Okada, E., Chiba, K., Toyama, Y., Fujiwara, H., Momoshima, S., Nishiwaki, Y., Hashimoto, T., Ogawa, J., Watanabe, M., Takahata, T., Matsumoto, M.[46]	2009	12	No statistical association between presence and absence of progression of each MRI finding and neck pain, stiff shoulders or numbness in upper extremities. Unfavourable prognosis sue to neck pain associated with double collision OR 5.83 (p<.034) and serious vehicular damage OR 2.87 (p<.043). Unfavourable prognosis due to stiff shoulders associated with female gender OR 2.83 (p<.015). Unfavourable prognosis due to numbness in upper extremities associated with serious vehicular damage OR 3.39 (p<.028)	* Only 33% follow-up rate	10 years	No neck pain = 78%, no stiff shoulders = 74%, no numbness = 91%

Table 3.5 Continued

AUTHOR	YEAR	RATING SCORE	UNIVARIATE ANALYSIS RESULTS	MULTIVARIATE ANALYSIS RESULTS	FOLLOW-UP	PERCENTAGE RECOVERED
Johansson, M., Liane M., Kasch, H., Kongsted, A.[47]	2011	18	Participants with kyphosis younger and significantly higher level of headache pain. Kyphotic group (measured at baseline) had higher mean headache intensities at 12 months than other groups	No significant differences between postures at baseline and pain levels at 12 months. No significant differences re: gender or age and 12 month neck pain or headache pain	12 months	Recovery percentages not shown
Kamper, S., Rebbeck, T., Maher, C., McAuley, J., Sterling, M.[23]	2008	NA	Systematic review			
Kasch, H., Qerama, E., Kongsted, A., Bach, F. Bendix, T., Jensen, T.[48]	2011	12	Risk strata significantly associated with (all p<.004) McGill pain, pain rating index affective, pain rating index evaluative, pain rating index misc., pain rating index total. Risk strata significant association with pressure pain (p<.002) and methodical palpation (p<.000) and time to peak pain in cold pressor test (p<.01), symptom checklist of WHIP (p<.003), COGN (p<.004) and SLEEP (p<.02), initial Copenhagen Neck Disability Index (p<.002), neck flexion (p<.001), neck extension (p<.004), duration of flexion (p<.001) and extension (p<.001)	Risk assessment score (7 stratum grouped from 'a priori' decided factors: CROM, neck/ head VAS, number of non-painful symptoms) predicted no recovery based on work disability ROC = 0.899 (.737 - 1.0). Kruskal-Wallis showed significant relationship with 1 year work disability and risk score (p<.000) and sick days (p<.000)	12 months	Recovery percentages not shown
Kasch, H., Qerama, E., Kongsted, A., Bendix, T., Jensen, T., Bach, F.[49]	2008	17	High risk (risk score including CROM + neck/pain headache VAS + female gender + number of non-painful symptoms OR VAS alone >4 and total CROM <240) patients less vocationally trained than low risk. No diff actual occupation, marital status or number of children at home. Handicapped higher intensity and frequency of cognitive symptoms, neck pain, shoulder, arm, low back pain	Handicapped at one year: gender not significant, high risk group 10-fold higher (rr = 1 0.5 (3.9 - 28.2)), initial neck pain (rr = 3.5 (2.2 - 5.5), p<.01 and headache pain (rr = 3.7 (2.4 - 5.7), p<.02 significant, reduced active CROM rr = 4.6 p<.001, large number of non-painful symptoms (p<.007). Neck disability: women significantly greater (rr = 1.3 (1.0 - 1.7)). Long term neck pain: women significantly higher (rr = 1.5 (1.2 - 1.9) p<.004), severe initial neck pain	3, 12 months	Recovery percentages not shown
Kivioja, J., Jensen, I., Lindgren, U.[50]	2005	15	Initial VAS significantly higher in symptomatic group (neck pain at 12 months). Women significantly different to men in 4 of 7 coping subscales. History of previous neck pain engaged more with 2 of coping subscales	Only significant predictor of neck pain at 12 months was neck or shoulder pain within a periods of 1 month before the accident OR 4.5 (1.1 - 8.8) p<.035	12 months	No neck pain = 66%

Table 3.5 Continued

AUTHOR	YEAR	RATING SCORE	UNIVARIATE ANALYSIS RESULTS	MULTIVARIATE ANALYSIS RESULTS	FOLLOW-UP	PERCENTAGE RECOVERED
Kongsted, A., Bendix, T., Qerama, E., Kasch, H., Bach, F., Korsholm, L., Jensen, T.[51]	2008a	16	Increased IES associated with female gender OR 2.6 (1.5 - 4.6), higher initial pain intensities, self-reported car damage OR 2.6 (1.5 - 4.6), self-reported severe accident OR=5.0 (3.0 - 8.4). No difference with IES and SF36, prior neck or headache pain	Baseline IES significantly associated (all p<.001) with pain OR 2.4 (1.4 - 3.4), pain >3 OR 3.3 (1.8 - 5.9), reduced working ability OR 2.8 (1.6 - 4.9), disability OR 3.2 (1.7 - 6.0), SF36 physical health OR -7.7 (-11.0 - -4.3) and SF36 mental health -7.6 (-10.9 - -4.2). With age and gender: IES baseline significant associated with pain OR 1.5 (.5 - 2.4) p<.05, disability OR 2.1 (1.1 - 4.2) p<.05, SF36 physical health OR -5.1 (-8.3 - -1.9) p<.05, and SF26 mental health OR -7.6 (-10.9 - -4.2), not working disability. Stratified by baseline pain - low initial pain and high IES - significant increase pain OR 7.1 (2.3 - 21.8) and working disability OR 7.2 (1.6 - 32.8) NOT for those with initial severe pain	12 months	Neck pain 0-3 = 57%, Copenhagen Disability 0 - 6 = 66%, unaffected work ability = 84%
Kongsted, A., Jorgensen, L., Leboeuf-Yde, C., Qerama, E., Korsholm, L., Bendix, T.[52]	2008b	15	No significant differences between measures of electrooculography (gains and SPNT-diff values) and neck or headache pain, neck disability or work ability		12 months	Neck pain 0-3 = 42%, headache pain 0–3 = 42%, work ability = 80%, no information disability
Kongsted, A., Sorensen, J., Andersen, H., Keseler, B., Jensen, T., Bendix, T.[53]	2008c	15	Patients with traumatic findings significantly more intense headache at baseline and at 12 months	Baseline traumatic MRI findings associated with headache OR 2.8 (0.4 - 17) (not significant). No other relevant associations between MRI and outcomes	12 months	Neck pain 0-4 3 months = 67%, 12 months = 67%. Copenhagen disability 0-6 3 months = 81%, 12 months = 50%. Unaffected work disability 12 months = 88%
Ozegovic, D., Carroll, L., Cassidy, J.D.[54]	2009	12	Similar baseline characteristics for baseline characteristics in responders who stated no and don't know so grouped together. Responders - no and don't know more likely to be male, had more depressive symptoms at baseline, had greater initial headache and low back pain	Positive return to work expectation and time to recover (adjusted for depression at baseline, self-assessed health in the month prior to collision, numerical rating for neck/shoulder pain at baseline and percentage of body in pain at baseline) adjusted HR 1.42 (1.26 - 1.60)	6 weeks, 3, 6, 9, 12 months	Recovery percentages not shown
Pedler, A., Sterling, M.[15]	2011	15	NDI significantly correlated to VAS, TSK and PFActS-C. gender significantly associated with PFActS-C. Initial VAS significantly associated with TSK and PFActS-C. TSK significantly associated with PFActS-C	Initial pain and initial TSK-17 significant predictors of NDI at 6 months (r2 = .387, p<.001). Initial PFActS-C not a predictor	6 months	NDI recovered (<10) = 33/80 (41%)

Table 3.5 Continued

AUTHOR	YEAR	RATING SCORE	UNIVARIATE ANALYSIS RESULTS	MULTIVARIATE ANALYSIS RESULTS	FOLLOW-UP	PERCENTAGE RECOVERED
Phillips, L., Carroll, L., Cassidy, J.D., Cote, P.[55]	2010	16	Did univariate and multivariate analysis of factors associated with initial post-crash depressive symptomatology but significance only shown for multivariate analysis (see Table 3)	Initial depressive symptoms with resolution, no recurrence: less likely to develop depressive symptoms that resolves - older than 50 years OR 0.71 (.52 - .98), university grad OR 0.59 (.41 - .85), income > 20K OR 0.78 (0.61 - 1.0), rear direction of impact OR .65 (.51 - .82), % of body in pain OR 1.01 (1.01 - 1.02), neck pain intensity OR 1.16 (1.10 - 1.22), dizziness OR 1.92 (1.57 - 2.35), vision problems OR 1.49 (1.06 - 2.10), anxiety OR 3.92 (3.22 - 4.76), fracture OR 2.31 (1.44 - 3.69), mild MSK pain OR 0.76 (.6 - .96), prior mild mental health problems OR 1.62 (1.22 - 2.34), prior severe mental health problems OR 3.38 (1.54 - 7.42), good prior general health OR 1.44 (1.09 - 1.91). See next few columns	12 months	CES-D <16 = 74%
Sterling, M.[18]	2010	18	PPTs, CPT and NFR significantly different between groups. NFR threshold at 6 months significantly correlated with VAS, NDI and CPT	Initial NDI only significant predictor of NFR threshold (r2=.24, p<.003)	6 months	NDI recovered (<8%) = 25/67 (40%)
Sterling, M., Hendrikz, J., Kenardy, J.[56]	2010	15	Optimum recovery trajectories for NDI and PDS	Compensation claim added as covariate. Mild and moderate trajectories - submission of claim within first month associated with significantly elevated NDI (Wald x^2 = 103.6, p<.01 and 78.6, p<.01 respectively). For resilient PDS group, claims submitted after 3 months associated within increasingly significant predicted elevations in mean PDS severity (Wald x^2 = 18.6 and 29.3 at 6 and 12 months, p<.01). For the recovering group, submitting a claim at any time corresponded to significant increase in mean PDS symptoms (Wald x^2 >43.6, p<.01).For the mod/severe group: submitting a claim >3 months associated with increased PDS symptom severity (Wald x^2 >12.3, p<.01)	6, 12 months	No PTSD 3 months = 78%, 6 months = 83%. NDI mild 12 months = 45%
Sterling, M., Hendrikz, J., Kenardy, J.[57]	2011	14	CPT group, PPT neck, PPT arm, VAS, gender and age all significant candidates for multivariate analysis (p<.10) with NDI. CPT group, PPT neck, PPT arm, VAS and age all significant candidates for multivariate analysis (p<.10) with PDS	Membership to chronic/severe NDI group significantly linked to CPT (>13) OR 26.3 (4.98 - 139.1), initial VAS OR 4.3 (2.5 - 7.3) and age OR 1.11 (1.0 - 1.2). Membership to moderate NDI group significantly linked to CPT (>13) OR 3.6 (1.3 - 9.8) and initial VAS OR 1.99 (1.4 - 2.8). Membership to mod/sever PDS group significantly linked to CPT (>13) OR 9.7 (2.2 - 42.4) and VAS OR 2.1 (1.4 - 3.2). Membership to recovery PDS group linked to initial VAS OR 1.8 (1.3 - 2.6)	3, 6, 12 months	Recovery percentages not shown

Table 3.5 Continued

AUTHOR	YEAR	RATING SCORE	UNIVARIATE ANALYSIS RESULTS	MULTIVARIATE ANALYSIS RESULTS	FOLLOW-UP	PERCENTAGE RECOVERED
Sterling, M., Jull, G., Kenardy, J.[58]	2006a	15	Significant differences between groups with variable not shown to be predictors of group membership: ROM values, EMG, PPT, heat pain, BBPT, TSK and GHQ	NDI at 2 to 3 years predicted by initial NDI, age, cold pain and IES (r2 = .588, p<.001). Mod/severe group at 2 to 3 years predicted with initial NDI OR 1.05 (1. - 1.1), age OR 1.1 (1.0 - 1.13), cold pain OR 1.1 (1.0 - 1.13) and IES OR 1.1 (1.03 - 1.2). Mild group membership compared with recovered only predictor initial NDI OR 1.13 (1.04 - 1.21). Previous prognostic variables ROM and QI and also compensation status not significant predictors of NDI at 2 to 3 years	2 to 3 years	NDI recovered (<8%) = 26/65 (40%)
Sterling, M., Jull, G., Vincenzino, B., Kenardy, J., Darnell, R.[59]	2005	16		Higher NDI associated with higher initial NDI, older age, female gender, decreased active range of left rotation, decreased cold pain thresholds, less vasoconstriction with SVR test and higher levels of IES symptoms (r2 = .674). Predictors of mod/severe group: initial Indi (OR 1.06 (1.0 - 1.12), age OR 1.13 (1.0 3 - 1.23), cold pain OR 1.29 (1.05 - 1.58), and IES OR 1.11 (1.03 - 1.2). Predictors of mild versus recovered: initial NDI OR 1.15 (1.03 - 1.28), GHQ OR 1.15 (1.04 - 1.28), and QI of SVR OR 1.1 (1.03 - 1.25). No significant predictive capacity for joint position error, EMG activity, PPT, heat pain, brachial plexus test, TSK	6 months	NDI <8 = 29/76 (38%)
Sterling, M., Kenardy, J.[60]	2006b	18	Persistent moderate PTSR significantly greater VAS and NDI, lower PPT and CPT, higher QI and lower SRF. Significant effect of gender but not age on PPT and TPT	Sensory measures (PPT, HPT, CPT) associated with PTSR (b = .28, p<.02) and initial NDI however insignificant finding of sensory measures on PTSR when mediated by initial NDI. No significant association between sympathy disturbances and NDI	6 months	IES <36 = 87%
Sterling M., Hendrikz J. et al [61]	2012	18		Initial NDI and cold pain threshold predicted current observed 12-month NDI scores (r2 = 0.50, 95% confidence interval 0.42 to 0.58). There was a significant site effect, and the estimated marginal mean ± SE of 12-month NDI for Iceland (27.6 ± 1.79%) was higher than the other 3 sites (Melbourne 11.2 ± 5.03%, Canada 16.4 ± 2.36%, Brisbane 16.8 ± 1.17%). After adjusting for site, age and Impact of Events Scale scores regained significance (r2 = 0.56, 95% confidence interval 0.48 to 0.64). Good accuracy to discriminate participants with moderate to severe disability at 12 months (area under the receiver operating characteristic curve 0.89 [95% confidence interval 0.84 – 0.94], p< .001)	12 months	Not reported

Table 3.5 Continued

AUTHOR	YEAR	RATING SCORE	UNIVARIATE ANALYSIS RESULTS	MULTIVARIATE ANALYSIS RESULTS	FOLLOW-UP	PERCENTAGE RECOVERED
Vetti, N., Krakens, J., Eide, G., Rorvik, J., Gilhus, N., Espeland, A.[62]	2010	18	NDI at 12 months associated with initial NRS, IES and low expectation of recovery. Risk of high NRS at 12 months associated with high initial NRS, IES, low expectation of recovery and female gender	High NDI related to higher IES OR 1.46 (1.1 - 1.94) and low expectation of recovery OR 4.66 (1.5 - 4.5). High Neck pain (NRS) related to higher IES OR 1.93 (1.2 - 3.0), low expectation of recovery OR 21.56 (2.5 - 184.2) and female gender OR 3.25 (1.0 - 10.5). MRI ligament changes in acute phase not related to 12 month NDI or NRS	12 months	NDI <8% = 56%, NRS 0-4 = 79%
Walton, D., Pretty, J., Macdermid, J., Teasell, R.[63]	2009	NA	Systematic review			
Williams, M., Williamson, E., Gates, S., Lamb, S., Cooke, M.[64]	2007	NA	Systematic review			
Williamson, E., Williams, M., Gates, S., Lamb, S.[65]	2008	NA	Systematic review			
Yang, X., Cote, P., Cassidy, J.D., Carroll, L.[66]	2007	15	Overweight and obese more likely to be male, older, injured in previous traffic collision, have grade 3 injury (WAD grades)	BMI not associated with time to recovery (HRR all close to unity with overlapping 95% CIs)	22 to 39 months	Time to recovery (number of days from injury to insurance claim closure) = 87.7%

Table 3.6 Evidence for post-accident symptom factors and their association with recovery after WAD (pain)

AUTHOR	YEAR	RATING SCORE	PROGNOSTIC FACTOR	POSITIVE FINDINGS	NEGATIVE FINDINGS	LEVEL OF EVIDENCE
NECK PAIN INTENSITY						
OUTCOME – NECK PAIN						
Berglund, A., Bodin, L., Jensen, I., Wiklund, et al[26]	2006	13	Neck pain VAS, headache, injury severity	Initial neck pain intensity influenced 2-year neck pain intensity OR 8.4 (6.5 - 10.9) and depression OR 2.9 (2.0 - 4.3).	Initial neck pain intensity did not influence 2 year neck pain disability (DRI) (p = .68) or anxiety (p = .37).	II
Buitenhuis, J., de Jong, P.J., Jaspers, J.P.C., Groothoff, J.W.[30]	2006	15	Neck pain intensity, back pain intensity, neck pain frequency, dizziness	Neck pain associated with post whiplash syndrome yes/no persistent neck pain) at 6 months (OR 1.4 (1.1 - 1.8), p<.005), and 12 months (OR 1.5 (1.1 - 2.0), p<.003), when number of PTSD symptoms included in multivariate analysis. When three PTSD clusters (re-experiencing, avoidance, hyperarousal) included in the multivariate analysis, only neck pain associated with post whiplash syndrome at 6 (OR 1.5 (1.1 - 1.9), p<.003) and 12 (OR 1.5 (1.2 - 2.0), p<.002) months		II
Cobo, E., Mesquida, E., Fanegas, E., Atanasio, E. et al[38]	2010	16	WAD classification, headache, dizziness, dorsal pain, low back pain, shoulder pain, temporomandibular pain	Multivariate analyses showed initial VAS associated with 6-month VAS scale (p<.001) and categorised (p<.001)		II
Hendriks, E., Scholten-Peeters, G., van der Windt, D., et al[43]	2005	18	Neck pain intensity, high number of complaints, ability to perform activities of daily living (changed to work activities in table)	Baseline neck pain intensity included in multivariate model to predict poor recovery at 52 weeks (neck pain VAS >30 or activity VAS <78) OR = 1.02 (1.0 - 1.04)		II
Kasch, H., Qerama, E., Kongsted, A., Bendix, T. et al[49]	2008	17	Neck pain VAS, headache pain VAS, number of non-painful symptoms	Initial neck pain (rr = 3.5 (2.2 - 5.5), p<.01) associated with handicap (work) at 1 year. Initial neck pain associated with 12-month neck pain	Initial neck pain not associated with 12-month headache pain	II
Kongsted, A., Bendix, T., Qerama, E., Kasch, H., Bach, F., Korsholm, L., Jensen, T.[51]	2008a	16	Neck and headache pain intensity	Baseline pain intensity significantly associated with 12-month pain (dichotomised >3) OR 1.4 (1.3 - 1.6), reduced working ability OR 1.3 (1.2 - 1.5), disability (dichotomised >6) OR 1.4 (1.2 - 1.5), disability (continuous) OR 1.4 (1.2 - 1.4), SF36 physical OR -1.6 (-2.0 - -1.2) and SF36 mental health OR -0.9 (-1.4 - -0.5)		II
Kivioja, J., Jensen, I., Lindgren, U.[50]	2005	15	Severity of neck pain		Initial VAS not significantly associated with persistent neck pain at 12 months	II

Table 3.6 Continued

AUTHOR	YEAR	RATING SCORE	PROGNOSTIC FACTOR	POSITIVE FINDINGS	NEGATIVE FINDINGS	LEVEL OF EVIDENCE
NECK PAIN INTENSITY						
OUTCOME – NECK PAIN						
Vetti, N., Krakens, J., Eide, G. et al[62]	2010	18	Neck pain (NRS), localisation of max pain	Initial pain NRS significantly associated with 12-month NDI >8% (OR 1.2 p<.016) and NRS >4 (OR 1.5 p<.001)		II
Kamper, S., Rebbeck, T., Maher, C., McAuley, J., Sterling, M.[23]	2008	NA	Neck pain intensity, disability, WAD grade, number of complaints, neurological symptoms, shoulder/arm/hand pain, headache, back pain, visual disturbance, neck stiffness, auditory disturbance, dizziness	Initial pain (risk of not recovering by 12 months increases 3% for every mm increase on 100 pain VAS) and disability (risk of not recovering at 12 months increases 1% for every mm on the 100 mm activity VAS) indicators of poor prognosis		I
Walton, D., Pretty, J., Macdermid, J., Teasell, R.[63]	2009	NA	Neck pain intensity, sleep disturbance, presence of headache, presence of neck pain, WAD grade	Development of persistent pain/disability significantly associated with initial neck pain intensity >55/100 OR 5.8 (2.9 - 11.5), presence of neck pain OR 2.9 (1.5 - 5.5)		I
Williams, M., Williamson, E., Gates, S., Lamb, S., Cooke, M.[64]	2007	NA	Neck pain intensity, shoulder pain intensity, back pain intensity, headache, neck pain disability, WAD, early onset symptoms, number of symptoms, blurred vision, sensitivity to noise or light, dizziness, difficulty swallowing, fatigue	Moderate evidence for association of development of late whiplash syndrome with initial neck pain intensity		I

SUBSET SUMMARY: OUTCOME NECK PAIN: NHMRC Evidence Statement Matrix

1. Evidence base: A Three systematic reviews, (eight primary cohort studies, seven cohorts: six positive and one negative)

2. Consistency: A

3. Clinical impact: A

4. Generalisability: A

5. Applicability: A

Initial levels of neck pain predict non-recovery (in terms of neck pain) in patients with WAD. Grade of recommendation: A

Table 3.6 Continued

AUTHOR	YEAR	RATING SCORE	PROGNOSTIC FACTOR	POSITIVE FINDINGS	NEGATIVE FINDINGS	LEVEL OF EVIDENCE
NECK PAIN INTENSITY						
OUTCOME – NECK PAIN DISABILITY						
Berglund, A., Bodin, L., Jensen, I., Wiklund et al[26]	2006	13	Neck pain VAS, headache, injury severity	Initial neck pain intensity influenced 2-year neck pain intensity OR 8.4 (6.5 - 10.9) and depression OR 2.9 (2.0 - 4.3)	Initial neck pain intensity did not influence 2-year neck pain disability (DRI) (p = .68) or anxiety (p = .37)	II
Holm, L., Carroll, L., Cassidy, J.D., Skillgate, E., Ahlbom, A.[45]	2008	16	Pain intensity in neck, low back and other body parts, headache pain, number of painful areas, number of pain associated symptoms (reduced CROM, numbness in arms and/or legs, ringing in the ears, memory difficulties, concentration difficulties, dizziness, nausea), severity of reduced CROM, severity of numbness in arms, severity of ringing in ears	Univariate logistic regressions showed following associations with PDI >4: pain intensity in neck OR 1.5 (1.3 - 1.6)		II
Kongsted, A., Bendix, T., Qerama, E., Kasch, H., Bach, F., Korsholm, L., Jensen, T.[51]	2008a	16	Neck and headache pain intensity	Baseline pain intensity significantly associated with 12-month pain (dichotomised >3) OR 1.4 (1.3 - 1.6), reduced working ability OR 1.3 (1.2 - 1.5), disability (dichotomised >6) OR 1.4 (1.2 - 1.5), disability (continuous) OR 1.4 (1.2 - 1.4), SF36 physical OR -1.6 (-2.0 - -1.2) and SF36 mental health OR -0.9 (-1.4 - -.5)		II
Pedler, A., Sterling, M.[15]	2011	15	VAS	Initial VAS significant predictor of 6-month NDI R2,=.294, p<.001, initial extension ROM R2,=.316, p<.001, and initial rotation ROM R2,=.347, p<.001		II
Sterling, M., Hendrikz, J., Kenardy, J.[57]	2011	14	VAS	Membership to chronic/severe NDI group significantly linked to initial VAS OR 4.3 (2.5 - 7.3). Membership to moderate NDI group significantly linked to initial VAS OR 1.99 (1.4 - 2.8). Membership to moderate/severe PDS group significantly linked to VAS OR 2.1 (1.4 - 3.2). Membership to recovery PDS group linked to initial VAS OR 1.8 (1.3 - 2.6)		II
Sterling, M., Jull, G., Vincenzino, B., Kenardy, J. et al[59]	2005	16	VAS, NDI		VAS scores failed to demonstrate significant predictive capacity (NDI)	II
Vetti, N., Krakens, J., Eide, G. et al[62]	2010	18	Neck pain (NRS), localisation of max pain	Initial pain NRS significantly associated with 12-month NDI>8% (OR 1.2 p<.016) and NRS >4 (OR 1.5 p<.001)		II

Table 3.6 Continued

AUTHOR	YEAR	RATING SCORE	PROGNOSTIC FACTOR	POSITIVE FINDINGS	NEGATIVE FINDINGS	LEVEL OF EVIDENCE
NECK PAIN INTENSITY						
OUTCOME – NECK PAIN DISABILITY						
Kamper, S., Rebbeck, T., Maher, C., McAuley, J., Sterling, M.[23]	2008	NA	Neck pain intensity, disability, WAD grade, number of complaints, neurological symptoms, shoulder/arm/hand pain, headache, back pain, visual disturbance, neck stiffness, auditory disturbance, dizziness	Initial pain (risk of not recovering by 12 months increases 3% for every mm increase on 100 pain VAS) and disability (risk of not recovering at 12 months increases 1% for every mm on the 100 mm activity VAS) indicators of poor prognosis		I
Walton, D., Pretty, J., Macdermid, J., Teasell, R.[63]	2009	NA	Neck pain intensity, sleep disturbance, presence of headache, presence of neck pain, WAD grade	Development of persistent pain/disability significantly associated with initial neck pain intensity >55/100 OR 5.8 (2.9 - 11.5), presence of neck pain OR 2.9 (1.5 - 5.5)		I
Williams, M., Williamson, E., Gates, S., Lamb, S., Cooke, M.[64]	2007	NA	Neck pain intensity, shoulder pain intensity, back pain intensity, headache, neck pain disability, WAD, early onset symptoms, number of symptoms, blurred vision, sensitivity to noise or light, dizziness, difficulty swallowing, fatigue	Moderate evidence for association of development of late whiplash syndrome with initial neck pain intensity		I

SUB-SET SUMMARY – OUTCOME NECK PAIN DISABILITY: NHMRC Evidence Statement Matrix

1. Evidence base: A Three systematic reviews, (seven primary cohort studies (seven cohorts): five positive and two negative)

2. Consistency: A

3. Clinical impact: A

4. Generalisability: A

5. Applicability: A

Initial levels of neck pain predict non-recovery (in terms of neck pain related disability) in patients with WAD. Grade of recommendation: A

Table 3.6 Continued

AUTHOR	YEAR	RATING SCORE	PROGNOSTIC FACTOR	POSITIVE FINDINGS	NEGATIVE FINDINGS	LEVEL OF EVIDENCE
NECK PAIN INTENSITY						
OUTCOME – PSYCHOLOGICAL SYMPTOMS						
Berglund, A., Bodin, L., Jensen, I., Wiklund et al[26]	2006	13	Neck pain VAS, headache, injury severity	Initial neck pain intensity influenced 2-year neck pain intensity OR 8.4 (6.5 - 10.9) and depression OR 2.9 (2.0 - 4.3)	Initial neck pain intensity did not influence 2-year neck pain disability (DRI) (p = .68) or anxiety (p = .37)	II
Kongsted, A., Bendix, T., Qerama, E., Kasch, H., Bach, F., Korsholm, L., Jensen, T.[51]	2008a	16	Neck and headache pain intensity	Baseline pain intensity significantly associated with 12-month pain (dichotomised >3) OR 1.4 (1.3 - 1.6), reduced working ability OR 1.3 (1.2 - 1.5), disability (dichotomised >6) OR 1.4 (1.2 - 1.5), disability (continuous) OR 1.4 (1.2 - 1.4), SF36 physical OR -1.6 (-2.0 - 1.2) and SF36 mental health OR -0.9 (-1.4 - -0.5)		II
Phillips, L., Carroll, L., Cassidy, J.D., Cote, P.[55]	2010	16	Percentage of body in pain, numbness in arms and/or legs, dizziness, memory difficulties, concentration difficulties, irritability, vision problems, hearing problems, sleep problems, unusual fatigue or tiredness, painful neck movements, reduced neck movement, sore jaw	Initial neck pain OR 1.3 (1.2 - 1.5) significantly associated with development of persistent depressive symptoms		II
Sterling, M., Hendrikz, J., Kenardy, J.[57]	2011	14	VAS	Membership to chronic/severe NDI group significantly linked to initial VAS OR 4.3 (2.5 - 7.3). Membership to moderate NDI group significantly linked to initial VAS OR 1.99 (1.4 - 2.8). Membership to moderate/severe PDS group significantly linked to VAS OR 2.1 (1.4 - 3.2). Membership to recovery PDS group linked to initial VAS OR 1.8 (1.3 - 2.6)		II

SUB-SET SUMMARY – OUTCOME PSYCHOLOGICAL SYMPTOMS: NHMRC Evidence Statement Matrix

1. Evidence base: A Four primary cohort studies (four cohorts): four positive and one negative (anxiety)

2. Consistency: B

3. Clinical impact: A

4. Generalisability: A

5. Applicability: A

Initial levels of neck pain predict non-recovery (in terms of psychological symptoms) in patients with WAD. Grade of recommendation : B

Table 3.6 Continued

AUTHOR	YEAR	RATING SCORE	PROGNOSTIC FACTOR	POSITIVE FINDINGS	NEGATIVE FINDINGS	LEVEL OF EVIDENCE
NECK PAIN INTENSITY						
OUTCOME – WORK DISABILITY						
Buitenhuis, J., de Jong, P.J., Jaspers, J.P.C., Groothoff, J.W.[29]	2009	14	Neck pain intensity, neck stiffness, severity of restricted neck movements, radiating pain in arms, paraesthesia , concentration complaints, headache intensity, dizziness		Neck pain intensity not associated with work disability at 6 and 12 months	II
Kasch, H., Qerama, E., Kongsted, A., Bach, F., Bendix, T., Jensen, T.[48]	2011	12	Risk assessment score includes CROM, neck/head VAS and number of non pain symptoms (paraesthesia, dizziness, vision disturbances, tinnitus, hyperacusis, globulus, fatigue, irritation, concentration disturbances, memory difficulties, sleep disturbances)	Risk assessment score able to identify non recovery in terms of sick days and work disability		II
Kasch, H., Qerama, E., Kongsted, A., Bendix, T. et al[49]	2008	17	Neck pain VAS, headache pain VAS, number of non-painful symptoms	Initial neck pain (rr = 3.5 (2.2 - 5.5), p<.01) associated with handicap (work) at 1 year. Initial neck pain associated with 12-month neck pain	Initial neck pain not associated with 12-month headache pain	II
Kongsted, A., Bendix, T., Qerama, E., Kasch, H., Bach, F., Korsholm, L., Jensen, T.[51]	2008a	16	Neck and headache pain intensity	Baseline pain intensity significantly associated with 12-month pain (dichotomised >3) OR 1.4 (1.3 - 1.6), reduced working ability OR 1.3 (1.2 - 1.5), disability (dichotomised >6) OR 1.4 (1.2 - 1.5), disability (continuous) OR 1.4 (1.2 - 1.4), SF36 physical OR -1.6 (-2.0 - -1.2) and SF36 mental health OR -0.9 (-1.4 - -0.5)		II

SUB-SET SUMMARY – OUTCOME WORK DISABILITY: NHMRC Evidence Statement Matrix

1. Evidence base: A Four primary cohort studies (three cohorts) – one cohort positive, one cohort negative and one cohort with neck pain as part of a risk assessment score with positive influence on chronic work disability

2. Consistency: C

3. Clinical impact: A

4. Generalisability: A

5. Applicability: B

Initial levels of neck pain may predict non-recovery (work disability) in patients with WAD. Grade of recommendation-: C

Table 3.6 Continued

AUTHOR	YEAR	RATING SCORE	PROGNOSTIC FACTOR	POSITIVE FINDINGS	NEGATIVE FINDINGS	LEVEL OF EVIDENCE
NECK PAIN INTENSITY						
OUTCOME – OTHER						
Borenstein, P., Rosenfeld, M., Gunnarsson, R.[27]	2010	11	Head, neck and shoulder pain VAS		Multivariate analysis showed no predictive ability for initial cervical pain intensity. Initial neck pain was significantly correlated with reduced cervical range of movement (CROM) and CROM was a predictor of poor prognosis (sick leave). Pain intensity itself was not an independent predictor	II
Buitenhuis, J., Jaspers, J., Fidler, V.[31]	2006	16	Neck pain intensity, headache intensity, neck stiffness, severity of restricted neck movements, radiating pain in arms, paraesthesia, concentration complaints, difficulty reading, difficulty attending to a conversation, dizziness, sleep disturbance		Duration of neck symptoms not related to initial neck pain intensity	II
Elliot, J., Pedler, A., Kenardy, J., Galloway, G., Jull, G., Sterling, M.[13]	2011	16	Neck pain VAS	Higher baseline pain associated with increased muscle fat infiltrate (MFI) at 6 months (regression coefficient .006, p<.05). Relationship between baseline pain and MFI mediated by PTSD symptoms (regression coefficient .002, p<.05)		II
Holm, L., Carroll, L., Cassidy, J.D., Skillgate, E., Ahlbom, A.[44]	2007	16	Neck pain intensity, number of symptoms (reduced/painful neck movement, jaw movement, numbness, tingling or pain in arms/hands or in legs/feet, dizziness or unsteadiness, nausea, vomiting, difficulty swallowing, ringing in the ears, memory problems, concentration problems, vision problems), number of painful body areas	High baseline neck pain predicted onset of widespread pain reported at any follow-up (6 weeks, 4, 8, 12 months) OR 3.2 (1.3 - 8.)		II
Kasch, H., Qerama, E., Kongsted, A., Bendix, T. et al[49]	2008	17	Neck pain VAS, headache pain VAS, number of non-painful symptoms	Initial neck pain (rr = 3.5 (2.2 - 5.5), p<.01) associated with handicap (work) at 1 year. Initial neck pain associated with 12-month neck pain	Initial neck pain not associated with 12-month headache pain	II
Pedler, A., Sterling, M.[67]	2011	15	VAS	Initial VAS significant predictor of 6-month NDI R2 = .294, p<.001, initial extension ROM R2 = .316, p<.001, and initial rotation ROM R2 = .347, p<.001		II
Sterling, M.[18]	2010	18	VAS, NDI		Initial VAS was not significantly associated with 6-month flexor withdrawal responses (NFR)	II

Table 3.6 Continued

AUTHOR	YEAR	RATING SCORE	PROGNOSTIC FACTOR	POSITIVE FINDINGS	NEGATIVE FINDINGS	LEVEL OF EVIDENCE
NECK PAIN INTENSITY						
OUTCOME – OTHER						

SUB-SET SUMMARY – OUTCOME OTHER: NHMRC Evidence Statement Matrix

1. Evidence base: A Seven primary cohort studies (seven cohorts) assessed predictive capacity of initial neck pain intensity with other outcomes. Three positive and four negative. Positive association with other outcome measures such as muscle fat infiltrate, widespread pain and extension/rotation ROM. Negative association with other outcome measures such as CROM, duration of symptoms (measured as time to claim), headache pain and NFR.

2. Consistency: D

3. Clinical impact: C

4. Generalisability: A

5. Applicability: C

Initial levels of neck pain may predict non-recovery (in terms of other outcomes such as muscle changes, range of movement, flexor withdrawal responses) in patients with WAD. Grade of recommendation: D

AUTHOR	YEAR	RATING SCORE	PROGNOSTIC FACTOR	POSITIVE FINDINGS	NEGATIVE FINDINGS	LEVEL OF EVIDENCE
NECK PAIN INTENSITY						
NECK DISABILITY						
Atherton, K., Wiles, N.J., Lecky, F.E., Hawes, S.J., Silman, A.J., Macfarlane, G.J., Jones, G.T.[25]	2006	15	Injury severity VAS, NDI, list of other symptoms (headaches, abnormal/tingling sensation, dizziness, tinnitus, problems with vision, memory/ concentration problems, neck pain, back pain, arm pain, shoulder pain))	Univariate analyses: positive association with persistent pain (any pain in shaded area around neck) initial NDI (RR 2.8 (1.8 - 4.2)		II
Buitenhuis, J., de Jong, P.J., Jaspers, J.P.C., Groothoff, J.W.[28]	2008	17	NDI, severity of paraesthesia, radiating pain in arms	Initial NDI significant relationship with persistent post whiplash syndrome at 6 months OR 1.2 (1.0 - 1.3), p<.001 and 12 months OR 1.2 (1.1 - 1.3) p<.001		II
Gabel, C., Burkett, B., Neller, A., Yelland, M.[40]	2008	7	NDI		Initial NDI not shown to be a predictor of non-recovery (NDI 6 months >8%) – sensitivity = 100%, specificity = 40%	II
Sterling, M.[18]	2010	18	VAS, NDI	Multiple regression showed initial NDI significantly associated with 6-month NFR (t value = -3.057, p<.003)		II
Sterling, M., Jull, G., Kenardy, J.[58]	2006a	15	NDI	NDI at 2 to 3 years predicted by initial NDI (t-value = 3.78, p<.001). Moderate/severe group at 2 to 3 years predicted with initial NDI OR 1.05 (1. - 1.1). Mild group membership compared with recovered only predictor initial NDI OR 1.13 (1.04 - 1.21).		II

Table 3.6 Continued

AUTHOR	YEAR	RATING SCORE	PROGNOSTIC FACTOR	POSITIVE FINDINGS	NEGATIVE FINDINGS	LEVEL OF EVIDENCE
NECK PAIN INTENSITY						
NECK DISABILITY						
Sterling, M., Jull, G., Vincenzino, B., Kenardy, J., Darnell, R.[59]	2005	16	VAS, NDI	Higher NDI associated with higher initial NDI (t-value = 4.67, p<.000). Initial NDI predictor of moderate/severe group (OR 1.06 (1.0 - 1.12), and mild versus recovered OR 1.15 (1.03 - 1.28)		II
Sterling, M., Kenardy, J.[60]	2006b	18	NDI		Sensory measures (PPT, HPT, CPT) associated with PTSD symptoms (b = .28, p<.02) and initial NDI however insignificant finding of sensory measures on PTSD symptoms when mediated by initial NDI. No significant association between sympathy disturbances and NDI	II
Sterling M., Hendrikz J. et al [61]	2012	18	NDI, age, CROML, CPT, SVR (QI quotient of integrals), IES	When adjusted for site NDI, age, CPT and IES were significant predictors of NDI at 12 months. The predictive set could discriminate between recovered/mild participants and moderate/severe participants at 12 months (ROC AUC: 0.89 [95% confidence interval 0.84 – 0.94], p< .001	CROM, SVR were not significant predictors of NDI at 12 months	II
Kamper, S., Rebbeck, T., Maher, C., McAuley, J., Sterling, M.[23]	2008	NA	Neck pain intensity, disability, WAD grade, number of complaints, neurological symptoms, shoulder/arm/hand pain, headache, back pain, visual disturbance, neck stiffness, auditory disturbance, dizziness	Initial disability (risk of not recovering at 12 months increases 1% for every mm on the 100 mm activity VAS) indicators of poor prognosis		I
Williams, M., Williamson, E., Gates, S., Lamb, S., Cooke, M.[64]	2007	NA	Neck pain intensity, shoulder pain intensity, back pain intensity, neck pain disability, WAD, early onset symptoms, number of symptoms, blurred vision, sensitivity to noise or light, dizziness, difficulty swallowing, fatigue	Moderate evidence for association of development of late whiplash syndrome with initial neck pain disability		I

SUB-SET SUMMARY – NECK DISABILITY: NHMRC Evidence Statement Matrix

1. Evidence base: A Two systematic reviews: Both systematic reviews concluded that there was moderate evidence for an association with initial neck pain disability and development of chronic pain/disability. Eight primary cohort studies (six cohorts): five positive and one negative: four high quality cohorts indicated positive association and one low quality study indicated no association and one high quality showed no significant association with initial NDI and sensory disturbances therefore not included in mediation analysis.

2. Consistency: B

3. Clinical impact: A

4. Generalisability: A

5. Applicability: A

Initial levels of neck disability predict non-recovery (in terms of disability) in patients with WAD. Grade of recommendation: A

Table 3.6 Continued

AUTHOR	YEAR	RATING SCORE	PROGNOSTIC FACTOR	POSITIVE FINDINGS	NEGATIVE FINDINGS	LEVEL OF EVIDENCE
NECK PAIN INTENSITY						
INJURY SEVERITY						
Atherton, K., Wiles, N.J., Lecky, F.E., Hawes, S.J., Silman, A.J., Macfarlane, G.J., Jones, G.T.[25]	2006	15	Self-perceived injury severity VAS, NDI, list of other symptoms (headaches, abnormal/tingling sensation, dizziness, tinnitus, problems with vision, memory/ concentration problems, neck pain, back pain, arm pain, shoulder pain)	Univariate analyses: positive association with persistent pain (any pain in shaded area around neck) and injury severity (RR 2.3 (1.6 - 3.5))		II
Berglund, A., Bodin, L., Jensen, I., Wiklund, A., Alfredsson, L.[26]	2006	13	Neck pain VAS, headache, self-reported injury severity	Rating of whiplash severity influenced 2-year neck pain intensity OR 3.0 (1.3 - 6.7), disability OR 6.5 (2.5 - 17.0), anxiety OR 2, and depression (OR 2.0-3.9)		II

SUB-SET SUMMARY – INJURY SEVERITY: NHMRC Evidence Statement Matrix

1. Evidence base: B Two primary cohort studies (two cohorts) both positive association with self-reported severity of injury and development of persistent pain (both studies), disability (one study) and depression (one study).

2. Consistency: A

3. Clinical impact: C

4. Generalisability: A

5. Applicability: C

Self-perceived injury severity predicts non-recovery in patients with WAD. Grade of recommendation: B

Table 3.6 Continued

AUTHOR	YEAR	RATING SCORE	PROGNOSTIC FACTOR	POSITIVE FINDINGS	NEGATIVE FINDINGS	LEVEL OF EVIDENCE
HEADACHE						
Berglund, A., Bodin, L., Jensen, I. et al[26]	2006	13	Neck pain VAS, headache, injury severity	Initial headache influenced 2-year disability (OR 2), anxiety (OR 1.5), and depression (OR 1.6 - 2.5)	Initial headache not significantly associated with 2-year neck pain intensity	II
Borenstein, P., Rosenfeld, M., Gunnarsson, R.[27]	2010	11	Head, neck and shoulder pain VAS		Initial head pain, significantly correlated with reduced CROM and CROM was a predictor of poor prognosis (sick leave). Pain intensity itself was not an independent predictor	II
Buitenhuis, J., de Jong, P.J., Jaspers, J.P.C., Groothoff, J.W.[28]	2009	14	Neck pain intensity, neck stiffness, severity of restricted neck movements, radiating pain in arms, paraesthesia, concentration complaints, headache intensity, dizziness		Headache intensity not associated with work disability at 6 and 12 months	
Buitenhuis, J., Jaspers, J., Fidler, V.[31]	2006	16	Neck pain intensity, headache intensity, neck stiffness, severity of restricted neck movements, radiating pain in arms, paraesthesia, concentration complaints, difficulty reading, difficulty attending to a conversation, dizziness, sleep disturbance		Duration of neck symptoms not related to headache intensity	II
Cobo, E., Mesquida, E., Fanegas, E., Atanasio, E. et al[38]	2010	16	WAD classification, headache, dizziness, dorsal pain, low back pain, shoulder pain, temporomandibular pain	Univariate analysis showed headache (y/n) associated with 6-month VAS (p<.001)	Headache not significant in multivariate analysis	II
Holm, L., Carroll, L., Cassidy, J.D., Skillgate, E., Ahlbom, A.[45]	2008	16	Pain intensity in neck, low back and other body parts headache pain number of painful areas number of pain associated symptoms (reduced CROM, numbness in arms and/or legs, ringing in the ears, memory difficulties, concentration difficulties, dizziness, nausea), severity of reduced CROM, severity of numbness in arms, severity of ringing in ears	Univariate logistic regressions showed following associations with PDI >4: headache pain OR 1.3 (1.2 - 1.4)		II
Kasch, H., Qerama, E., Kongsted, A., Bach, F. Bendix, T., Jensen, T.[48]	2011	12	Risk assessment score includes CROM, neck/head VAS and number of non-pain symptoms (paraesthesia, dizziness, vision disturbances, tinnitus, hyperacusis, globulus, fatigue, irritation, concentration disturbances, memory difficulties, sleep disturbances)	Risk assessment score able to identify non recovery in terms of sick days and work disability		II
Kasch, H., Qerama, E., Kongsted, A., Bendix, T., Jensen, T., Bach, F.[49]	2008	17	Neck pain VAS, headache pain VAS, number of non-painful symptoms	Headache pain (RR = 3.7 (2.4 - 5.7), p<.02) associated with handicap (work) at 1 year. Initial headache pain associated with 12-month headache pain	Initial headache pain not associated with 12-month neck pain	II

Table 3.6 Continued

AUTHOR	YEAR	RATING SCORE	PROGNOSTIC FACTOR	POSITIVE FINDINGS	NEGATIVE FINDINGS	LEVEL OF EVIDENCE
HEADACHE						
Kongsted, A., Bendix, T., Qerama, E., Kasch, H., Bach, F., Korsholm, L., Jensen, T.[51]	2008a	16	Neck and headache pain intensity	Baseline pain intensity significantly associated with 12-month pain (dichotomised >3) OR 1.4 (1.3 - 1.6), reduced working ability OR 1.3 (1.2 - 1.5), disability (dichotomised >6) OR 1.4 (1.2 - 1.5), disability (continuous) OR 1.4 (1.2 - 1.4), SF36 physical OR -1.6 (-2.0 - -1.2) and SF36 mental health OR -0.9 (-1.4 - -0.5)		II
Kamper, S., Rebbeck, T., Maher, C., McAuley, J., Sterling, M.[23]	2008	NA	Neck pain intensity, disability, WAD grade, number of complaints, neurological symptoms, shoulder/arm/hand pain, headache, back pain, visual disturbance, neck stiffness, auditory disturbance, dizziness		Inconclusive evidence for headache	I
Walton, D., Pretty, J., Macdermid, J., Teasell, R.[63]	2009	NA	Neck pain intensity, sleep disturbance, presence of headache, presence of neck pain, WAD grade	Development of persistent pain/disability significantly associated with presence of headache OR 2.7 (2.2 - 3.4)		I
Williams, M., Williamson, E., Gates, S., Lamb, S., Cooke, M.[64]	2007	NA	Neck pain intensity, shoulder pain intensity, back pain intensity, headache, neck pain disability, WAD, early onset symptoms, number of symptoms, blurred vision, sensitivity to noise or light, dizziness, difficulty swallowing, fatigue		Inconclusive evidence for headache pain intensity	I

SUMMARY – HEADACHE: NHMRC Evidence Statement Matrix

1. Evidence base: A Three systematic reviews. One systematic review concluded positive association with initial headache and development of persistent pain/disability and two systematic reviews indicated inconclusive evidence for positive association. Nine primary cohort studies (six cohorts and two additive Es) and Primary cohort: positive associations - two positive, and one positive for headache outcome, and one included combination of head/neck pain and one included combination head/neck pain as part of risk assessment score (positive relationship with persistent disability). Whereas, five negative (three cohorts plus three Es) with varied outcomes. Positive association with outcomes: neck pain disability, neck pain VAS, depression and headache pain. Negative association with outcome measures neck pain VAS, work disability and duration of symptoms.

2. Consistency: D

3. Clinical impact: D

4. Generalisability: A

5. Applicability: C

The initial presence of headache may predict non-recovery in patients with WAD. Grade of recommendation: D

Table 3.6 Continued

AUTHOR	YEAR	RATING SCORE	PROGNOSTIC FACTOR	POSITIVE FINDINGS	NEGATIVE FINDINGS	LEVEL OF EVIDENCE
NUMBER OF SYMPTOMS						
Atherton, K., Wiles, N.J., Lecky, F.E., Hawes, S.J., Silman, A.J., Macfarlane, G.J., Jones, G.T.[25]	2006	15	Injury severity VAS, NDI, list of other symptoms (headaches, abnormal/tingling sensation, dizziness, tinnitus, problems with vision, memory/concentration problems, neck pain, back pain, arm pain, shoulder pain)	Univariate analyses: positive association with persistent pain (any pain in shaded area around neck) and number of WAD symptoms (RR 2.9 (1.9 - 4.3)). Number of symptoms (RR 2.0 (1.2 - 3.3)) added to multivariate model (with age, GHQ, pre-collision widespread body pain and vehicle = car) to yield positive predictor of persistent neck pain		II
Hendriks, E., Scholten-Peeters, G., van der Windt, D. et al[43]	2005	18	Neck pain intensity, high number of complaints, ability to perform activities of daily living (changed to work activities in table)		High number of complaints not associated with poor recovery at 52 weeks	II
Holm, L., Carroll, L., Cassidy, J.D., Skillgate, E., Ahlbom, A.[44]	2007	17	Neck pain intensity, number of symptoms (reduced/painful neck movement, jaw movement, numbness, tingling or pain in arms/hands or in legs/feet, dizziness or unsteadiness, nausea, vomiting, difficulty swallowing, ringing in the ears, memory problems, concentration problems, vision problems), number of painful body areas	Onset of widespread pain reported at any follow-up (6 weeks, 4, 8, 12 months) predicted by 3 or more symptoms OR 1.9 (0.9 - 3.8)		II
Holm, L., Carroll, L., Cassidy, J.D., Skillgate, E., Ahlbom, A.[45]	2008	16	Pain intensity in neck, low back and other body parts, headache pain, number of painful areas, number of pain associated symptoms (reduced CROM, numbness in arms and/or legs, ringing in the ears, memory difficulties, concentration difficulties, dizziness, nausea), severity of reduced CROM, severity of numbness in arms, severity of ringing in ears	Univariate logistic regressions showed following associations with PDI >4: number of painful areas OR 1.2 (1.1 - 1.2), number of pain associated symptoms OR 1.4 (1.3 - 1.6)		II
Kasch, H., Qerama, E., Kongsted, A., Bach, F. Bendix, T., Jensen, T.[48]	2011	12	Risk assessment score includes CROM, neck/head VAS and number of non-pain symptoms (paraesthesia, dizziness, vision disturbances, tinnitus, hyperacusis, globulus, fatigue, irritation, concentration disturbances, memory difficulties, sleep disturbances)	Risk assessment score able to identify non recovery in terms of sick days and work disability		II
Kasch, H., Qerama, E., Kongsted et al[49]	2008	17	Neck pain VA, headache pain VAS, number of non-painful symptoms	Large number of non-painful symptoms (p<.007) associated with handicap (work) at 1 year	Number of symptoms not associated with 12-month neck pain or headache pain	II

Table 3.6 Continued

AUTHOR	YEAR	RATING SCORE	PROGNOSTIC FACTOR	POSITIVE FINDINGS	NEGATIVE FINDINGS	LEVEL OF EVIDENCE
NUMBER OF SYMPTOMS						
Kamper, S., Rebbeck, T., Maher, C., McAuley, J., Sterling, M.[23]	2008	NA	Neck pain intensity, disability, WAD grade, number of complaints, neurological symptoms, shoulder/arm/hand pain, headache, back pain, visual disturbance, neck stiffness, auditory disturbance, dizziness	Risk of not recovering at 12 months 2.6 times higher for subjects with 9 or more complaints		I
Williams, M., Williamson, E., Gates, S., Lamb, S., Cooke, M.[64]	2007	NA	Neck pain intensity, shoulder pain intensity, back pain intensity, neck pain disability, WAD, early onset symptoms, number of symptoms, blurred vision, sensitivity to noise or light, dizziness, difficulty swallowing, fatigue		Inconclusive evidence for number of symptoms	I

SUMMARY – NUMBER OF SYMPTOMS: NHMRC Evidence Statement Matrix

1. Evidence base: A

2. Consistency: C

3. Clinical impact: D

4. Generalisability: A

5. Applicability: C

A greater number of initial symptoms may predict non-recovery in patients with WAD. Grade of recommendation: C

Six primary cohort studies (six cohorts) plus two systematic reviews. One systematic review positive for risk of not recovering and one systematic review inconclusive. Primary cohorts: five high quality positive (outcome measures neck pain, neck pain disability, work disability and handicap) and two negative (outcome measures poor recovery, neck pain and headache pain) (71%).

Table 3.6 Continued

AUTHOR	YEAR	RATING SCORE	PROGNOSTIC FACTOR	POSITIVE FINDINGS	NEGATIVE FINDINGS	LEVEL OF EVIDENCE
WAD GRADE						
Cobo, E., Mesquida, E., Fanegas, E., Atanasio, E. et al[38]	2010	16	WAD classification, headache, dizziness, dorsal pain, low back pain, shoulder pain, temporomandibular pain		WAD classification, not associated with 6-month VAS by scale of category (trichotomised)	II
Kamper, S., Rebbeck, T., Maher, C., McAuley, J., Sterling, M.[23]	2008	NA	Neck pain intensity, disability, WAD grade, number of complaints, neurological symptoms, shoulder/arm/hand pain, headache, back pain, visual disturbance, neck stiffness, auditory disturbance, dizziness	Subjects with QTF grade 2 or 3 are 2.17 times more likely to have disability affecting work or leisure at 16 months		I
Walton, D., Pretty, J., Macdermid, J., Teasell, R.[63]	2009	NA	Neck pain intensity, sleep disturbance, presence of headache, presence of neck pain, WAD grade	Development of persistent pain/disability significantly associated with WAD grade 3 (compared with grade 2) OR 2.4 (1.6 - 3.6), and WAD grade 2 or 3 (compared with WAD grade 0 or 1) OR 2.0 (1.4 - 2.7)		I
Williams, M., Williamson, E., Gates, S., Lamb, S., Cooke, M.[64]	2007	NA	Neck pain intensity, shoulder pain intensity, back pain intensity, neck pain disability, WAD, early onset symptoms, number of symptoms, blurred vision, sensitivity to noise or light, dizziness, difficulty swallowing, fatigue		Inconclusive evidence for WAD grade	I

SUMMARY – WAD GRADE: NHMRC Evidence Statement Matrix

1. Evidence base: A

2. Consistency: C

3. Clinical impact: C

4. Generalisability: A

5. Applicability: C

Initial WAD grade may predict non-recovery in patients with WAD. Grade of recommendation: C

One primary cohort study and three systematic reviews: Primary cohort negative. Two systematic reviews positive and one inconclusive.

Table 3.6 Continued

AUTHOR	YEAR	RATING SCORE	PROGNOSTIC FACTOR	POSITIVE FINDINGS	NEGATIVE FINDINGS	LEVEL OF EVIDENCE
BACK PAIN						
Buitenhuis, J., de Jong, P.J., Jaspers, J.P.C., Groothoff, J.W.[30]	2006	15	Neck pain intensity, back pain intensity, neck pain frequency, dizziness		Back pain intensity not associated with whiplash severity score or post-whiplash syndrome at 6 and 12 months	II
Cobo, E., Mesquida, E., Fanegas, E., Atanasio, E. et al[38]	2010	16	WAD classification, headache, dizziness, dorsal pain, low back pain, shoulder pain, temporomandibular pain		Low back pain not associated with 6-month VAS by scale of category (trichotomised)	II
Holm, L., Carroll, L., Cassidy, J.D., Skillgate, E., Ahlbom, A.[45]	2008	16	Pain intensity in neck, low back and other body parts, headache pain, number of painful areas, number of pain associated symptoms (reduced CROM, numbness in arms and/or legs, ringing in the ears, memory difficulties, concentration difficulties, dizziness, nausea), severity of reduced CROM, severity of numbness in arms, severity of ringing in ears	Univariate logistic regressions showed following associations with PDI >4: pain intensity in low back OR 1.2 (1.1 - 1.3)		II
Kamper, S., Rebbeck, T., Maher, C., McAuley, J., Sterling, M.[23]	2008	NA	Neck pain intensity, disability, WAD grade, number of complaints, neurological symptom, shoulder/arm/hand pain, headache, back pain, visual disturbance, neck stiffness, auditory disturbance, dizziness		Inconclusive evidence for back pain	I
Williams, M., Williamson, E., Gates, S., Lamb, S., Cooke, M.[64]	2007	NA	Neck pain intensity, shoulder pain intensity, back pain intensity, neck pain disability, WAD, early onset symptoms, number of symptoms, blurred vision, sensitivity to noise or light, dizziness, difficulty swallowing, fatigue		Inconclusive evidence for back pain intensity	I

SUMMARY – BACK PAIN: NHMRC Evidence Statement Matrix

1. Evidence base: A

2. Consistency: C

3. Clinical impact: C

4. Generalisability: A

5. Applicability: C

The initial presence of back pain may predict non-recovery in patients with WAD. Grade of recommendation: C

Three primary cohort studies (three cohorts) plus two systematic reviews. Both systematic reviews concluded back pain inconclusive predictive factor. Primary cohort: one positive (outcome neck pain disability) and two negative (whiplash severity score and neck pain VAS).

Table 3.6 Continued

AUTHOR	YEAR	RATING SCORE	PROGNOSTIC FACTOR	POSITIVE FINDINGS	NEGATIVE FINDINGS	LEVEL OF EVIDENCE
SHOULDER PAIN						
Borenstein, P., Rosenfeld, M., Gunnarsson, R. [27]	2010	11	Head, neck and shoulder pain VAS		Multivariate analysis showed no predictive ability for initial shoulder	II
Cobo, E., Mesquida, E., Fanegas, E., Atanasio, E. et al [38]	2010	16	WAD classification, headache, dizziness, dorsal pain, low back pain, shoulder pain, temporomandibular pain		No results reported for shoulder pain (percentage of subjects at baseline with shoulder pain <4%)	II
Kamper, S., Rebbeck, T., Maher, C., McAuley, J., Sterling, M [23]	2008	NA	Neck pain intensity, disability, WAD grade, number of complaints, neurological symptoms, shoulder/arm/hand pain, headache, back pain, visual disturbance, neck stiffness, auditory disturbance, dizziness		Inconclusive evidence shoulder/arm/hand pain	I
Williams, M., Williamson, E., Gates, S., Lamb, S., Cooke, M [64]	2007	NA	Neck pain intensity, shoulder pain intensity, back pain intensity, neck pain disability, WAD, early onset symptoms, number of symptoms, blurred vision, sensitivity to noise or light, dizziness, difficulty swallowing, fatigue		Inconclusive evidence for shoulder	I

SUMMARY - SHOULDER PAIN: NHMRC Evidence Statement Matrix

1. Evidence base: A

2. Consistency: A

3. Clinical impact: C

4. Generalisability: A

5. Applicability: B

The initial presence of shoulder pain does not predict non-recovery in patients with WAD. Grade of recommendation: A

Two primary cohort studies (two cohorts) plus one systematic review: all inconclusive.

Table 3.6 Continued

AUTHOR	YEAR	RATING SCORE	PROGNOSTIC FACTOR	POSITIVE FINDINGS	NEGATIVE FINDINGS	LEVEL OF EVIDENCE
DIZZINESS						
Buitenhuis, J., de Jong, P.J., Jaspers, J.P.C., Groothoff, J.W.[29]	2009	14	Neck pain intensity, neck stiffness, severity of restricted neck movements, radiating pain in arms, paraesthesia, concentration complaints, headache intensity, dizziness		Work disability at 6 and 12 months not associated with dizziness	II
Buitenhuis, J., de Jong, P.J., Jaspers, J.P.C., Groothoff, J.W.[30]	2006	15	Neck pain, intensity, back pain intensity, neck pain frequency, dizziness	Neck pain and dizziness associated with post whiplash syndrome at 6 months (OR 1.4 (1.1 - 1.8), p<.005), (OR 1.3 (1.0 - 1.7), p<.032) and 12 months (OR 1.5 (1.1 - 2.0), p<.003), (OR 1.3 (1.0 - 1.6), p<.040) when number of PTSD symptoms included in multivariate analysis. When three PTSD clusters (avoid, hyperarous) included in the mulitvariate analysis, only neck pain associated with post whiplash syndrome		II
Buitenhuis, J., Jaspers, J., Fidler, V.[31]	2006	16	Neck pain intensity, headache intensity, neck stiffness, severity of restricted neck movements, radiating pain in arms, paraesthesia, concentration complaints, difficulty reading, difficulty attending to a conversation, dizziness, sleep disturbance		Dizziness not associated with TSK-DV	II
Cobo, E., Mesquida, E., Fanegas, E., Atanasio, E. et al[38]	2010	16	WAD classification, headache, dizziness, dorsal pain, low back pain, shoulder pain, temporomandibular pain	Multivariate analyses showed dizziness associated with 6 months VAS scale (p<.02)	Dizziness not associated with categorised VAS	II
Phillips, L., Carroll, L., Cassidy, J.D., Cote, P.[55]	2010	16	Percentage of body in pain, numbness in arms and/or legs, dizziness, memory difficulties, concentration difficulties, irritability, vision problems, hearing problems, sleep problems, unusual fatigue or tiredness, painful neck movements, reduced neck movement, sore jaw	Dizziness OR 3.7 (2.4 - 5.6) significantly associated with development of persistent depressive symptoms		II
Kamper, S., Rebbeck, T., Maher, C., McAuley, J., Sterling, M.[23]	2008	NA	Neck pain intensity, disability, WAD grade, number of complaints, neurological symptoms, shoulder/arm/hand pain, headache, back pain, visual disturbance, neck stiffness, auditory disturbance, dizziness		Inconclusive evidence for dizziness	I
Williams, M., Williamson, E., Gates, S., Lamb, S., Cooke, M.[64]	2007	NA	Neck pain intensity, shoulder pain intensity, back pain intensity, neck pain disability, WAD, early onset symptoms, number of symptoms, blurred vision, sensitivity to noise or light, dizziness, difficulty swallowing, fatigue		Inconclusive evidence for dizziness	I

SUMMARY – DIZZINESS: NHMRC Evidence Statement Matrix

1. Evidence base: A

2. Consistency: D

3. Clinical impact: C

4. Generalisability: A

5. Applicability: C

The initial presence of dizziness may predict non-recovery in patients with WAD. Grade of recommendation: C

Five primary cohort studies (two cohorts plus three Es) plus two systematic reviews. Both systematic reviews indicated inconclusive evidence for dizziness as predictive factor. Primary cohorts: three cohorts indicated a positive association with dizziness (outcome measures – two psychological symptoms and one neck pain VAS) and one cohort negative association (outcome work disability and psychological symptoms) (75%).

Table 3.6 Continued

AUTHOR	YEAR	RATING SCORE	PROGNOSTIC FACTOR	POSITIVE FINDINGS	NEGATIVE FINDINGS	LEVEL OF EVIDENCE
OTHER SYMPTOMS						
Buitenhuis, J., de Jong, P.J., Jaspers, J.P.C., Groothoff, J.W.[29]	2009	14	Neck pain intensity, neck stiffness, severity of restricted neck movements, radiating pain in arms, paraesthesia, concentration complaints, headache intensity, dizziness	Work disability at 6 months (OR 1.3 (1.1 - 1.4), p<.001) and 12 months (OR 1.2 (1.1 - 1.4), p<.001) independently associated with intense concentration complaints		II
Buitenhuis, J., Jaspers, J., Fidler, V.[31]	2006	16	Neck pain intensity, headache intensity, neck stiffness, severity of restricted neck movements, radiating pain in arms, paraesthesia, concentration complaints, difficulty reading, difficulty attending to a conversation, dizziness, sleep disturbance	Concentration problems significantly associated with TSK-DV (p<.001)	Duration of neck symptoms not related to concentration complaints, difficulty reading	II
Phillips, L., Carroll, L., Cassidy, J.D., Cote, P.[55]	2010	16	Percentage of body in pain, numbness in arms and/or legs, dizziness, memory difficulties, concentration difficulties, irritability, vision problems, hearing problems, sleep problems, unusual fatigue or tiredness, painful neck movements, reduced neck movement, sore jaw		Concentration and memory difficulties not associated with depressive symptoms	II
Buitenhuis, J., de Jong, P.J., Jaspers, J.P.C., Groothoff, J.W [28]	2008	17	Initial headache, subjective severity of injury, NDI, severity of paraesthesia, radiating pain in arms		Paraesthesia, radiating pain to the arms not contributors to multivariate model predicting post whiplash syndrome at 6 or 12 months	II
Buitenhuis, J., de Jong, P.J., Jaspers, J.P.C., Groothoff, J.W.[29]	2009	14	Neck pain intensity, neck stiffness, severity of restricted neck movements, radiating pain in arms, paraesthesia, concentration complaints, headache intensity, dizziness		Work disability at 6 and 12 months not associated with neck stiffness, severity of restricted neck movements, radiating pain in arms, paraesthesia	II
Buitenhuis, J., Jaspers, J., Fidler, V.[31]	2006	16	Neck pain intensity, headache intensity, neck stiffness, severity of restricted neck movements, radiating pain in arms, paraesthesia, concentration complaints, difficulty reading, difficulty attending to a conversation, dizziness, sleep disturbance	Duration of neck symptoms related to severity of restricted movements (HR .85 (.74 - .98), p<.020), radiating pain in the arms (HR .82 (.71 - .95), p<.01), and sleep disturbance (HR 2.1 (1.1 - 3.8), p<.019)	Duration of neck symptoms not related to neck stiffness, paraesthesia, concentration complaints, difficulty reading	II
Cobo, E., Mesquida, E., Fanegas, E., Atanasio, E. et al [38]	2010	16	WAD classification, headache, dizziness, dorsal pain, low back pain, shoulder pain, temporomandibular pain		Dorsal pain, and temporomandibular joint pain not associated with 6-month VAS by scale of category (trichotomised)	II

Table 3.6 Continued

AUTHOR	YEAR	RATING SCORE	PROGNOSTIC FACTOR	POSITIVE FINDINGS	NEGATIVE FINDINGS	LEVEL OF EVIDENCE
OTHER SYMPTOMS						
Holm, L., Carroll, L., Cassidy, J.D., Skillgate, E., Ahlbom, A.[45]	2008	16	Pain intensity in neck, low back and other body parts, headache pain, number of painful areas, number of pain associated symptoms (reduced CROM, numbness in arms and/or legs, ringing in the ears, memory difficulties, concentration difficulties, dizziness, nausea), severity of reduced CROM, severity of numbness in arms, severity of ringing in ears	Univariate logistic regressions showed the following associations with PDI >4: severity of reduced CROM OR 2.1 (1.7 - 2.5), severity of numbness in arms OR 2.1 (1.7 - 2.7), severity of ringing in ears OR 1.5 (1.1 - 2.1)		II
Phillips, L., Carroll, L., Cassidy, J.D., Cote, P.[55]	2010	16	Percentage of body in pain, numbness in arms and/or legs, dizziness, memory difficulties, concentration difficulties, irritability, vision problems, hearing problems, sleep problems, unusual fatigue or tiredness, painful neck movements, reduced neck movement, sore jaw	Hearing problems OR 2.9 (1.5 - 5.7) significantly associated with development of persistent depressive symptoms	Vision problems and numbness, tingling in arms and hands not significantly associated with development of persistent depressive symptoms	II
Kamper, S., Rebbeck, T., Maher, C., McAuley, J., Sterling, M.[23]	2008	NA	Neck pain intensity, disability, WAD grade, number of complaints, neurological symptoms, shoulder/arm/hand pain, headache, back pain, visual disturbance, neck stiffness, auditory disturbance, dizziness		Inconclusive evidence for neurological symptoms, shoulder/arm/hand pain, visual disturbance, neck stiffness, auditory disturbance	I
Walton, D., Pretty, J., Macdermid, J., Teasell, R.[63]	2009	NA	Neck pain intensity, sleep disturbance, presence of headache, presence of neck pain, WAD grade		Sleep disturbance not associated with development of persistent pain/ disability	I
Williams, M., Williamson, E., Gates, S., Lamb, S., Cooke, M.[64]	2007	NA	Neck pain intensity, shoulder pain intensity, back pain intensity, neck pain disability, WAD, early onset symptoms, number of symptoms, blurred vision, sensitivity to noise or light, dizziness, difficulty swallowing, fatigue		Inconclusive evidence for early onset of symptoms, blurred vision, sensitivity to noise or light, dizziness, difficulty swallowing, fatigue	

SUMMARY – OTHER SYMPTOMS: Several other symptoms assessed in only one cohort and inconclusive evidence from systematic reviews.

Systematic reviews reported inconclusive evidence for visual, hearing, sleep and fatigue factors. Inconclusive findings likely due to insufficient number of studies including the factor as a possible prognostic factor.

Combining severity of restricted movement, self-reported cervical range of movement and neck stiffness yields inconsistent results – for example: positive association with reduced range of movement and duration of symptoms (however not neck stiffness) and neck pain disability and negative for work disability outcome.

Evidence not rated due to heterogeneous predictors and outcomes.

Table 3.7 Evidence for radiological factors and their association with recovery of pain symptoms after WAD

AUTHOR	YEAR	COHORT	QUALITY SCORE	PROGNOSTIC FACTORS	POSITIVE RADIOLOGICAL RESULTS	NEGATIVE RADIOLOGICAL RESULTS	LEVEL OF EVIDENCE
Hendriks, E., Scholten-Peeters, G., van der Windt, D., et al[43]	2005	G	18	Additional radiological or imaging in first 2 weeks		Additional radiological or other imaging techniques not associated with poor recovery at 4, 12 and 52 weeks	II
Ichihara, D., Okada, E., Chiba, K., Toyama, Y., Fujiwara, H. et al[46]	2009	H	12	MRI		MRI factors evaluated: a decrease in the signal intensity of the intervertebral disc, anterior compression of the dura and the spinal cord, posterior disc protrusion, disc space narrowing, and foraminal stenosis. Degenerative changes of the cervical spine on MRI were not associated with clinical symptoms during 10-year follow-up	II
Johansson, M., Liane M., Kasch, H., Kongsted, A.[47]	2011	A	18	MRI (categories - lordosis, kyphosis or straight)		Kyphotic deformity was not associated with an increased risk of long-lasting neck pain or headache	II
Kongsted, A., Sorensen, J., Andersen, H., Keseler, B., Jensen, T., Bendix, T.[53]	2008c	A	16	MRI findings - 10 factors scaled findings (no abnormal findings, mild pre-existing degeneration, mod/severe pre-existing degeneration, traumatic finding)		Although considerable headache more frequent in groups with traumatic finding (bleeding/ oedema, or separation of the disc from vertebral endplate, or traumatic bulge/protrusion), association was not significant	II
Vetti, N., Krakens, J., Eide, G., Rorvik, J., Gilhus, N., Espeland, A.[62]	2010	J	18	High resolution proton-weighted MRI		Grade 2-3 ligament (alar and transverse ligaments) changes in the acute phase were not related to disability or neck pain at 12 months	II
Williams, M., Williamson, E., Gates, S., Lamb, S., Cooke, M.[64]	2007	Sys	NA			Inconclusive evidence for MRI (1 low quality study showing negative association) and x-ray (3 low quality studies showing a positive association and 4 low quality studies showing a negative association)	I

SUMMARY: RADIOLOGICAL FINDINGS NHMRC Evidence Statement Matrix

1. Evidence base: A

2. Consistency: A

3. Clinical impact: A

4. Generalisability: A

5. Applicability: A

Radiological findings are not predictive of non-recovery in patients with WAD. Grade of recommendation: A

One systematic review and five primary cohort studies (four cohorts) assessed association of radiological changes with prognosis of pain or disability following whiplash. No studies reported a positive association.

Table 3.8 Summary of evidence for specific psychological symptom factors and their association with recovery of pain symptoms after WAD

AUTHOR	YEAR	COHORT	TOTAL CR	PROG CAT 3 (PSYCH)	POSITIVE PSYCH RESULTS	NEGATIVE PSYCH RESULTS	LEVEL OF EVIDENCE
DEPRESSION							
Carroll, L., Liu, Y., Holm, L., Cassidy, D., Cote, P.[35]	2011	L	16	Pain related emotions - depression, anxiety, fear, anger, frustration	Depression OR 1.009 (1.004 - 1.013) associated with neck pain recovery at 12 months		II
Cobo, E., Mesquida, E., Fanegas, E., Atanasio, E., Pastor, B., Pont, C., Prieto, C., Gomez, G., Cano, L.[38]	2010	F	16	Goldberg depression and anxiety scale		Depression not independent factor in the multivariate analysis to predict neck pain VAS at 6 months	II
Hendriks, E., Scholten-Peeters, G., van der Windt, D., Neeleman-van der Steen, C., Oostendorp, R., Verhagen, A.[43]	2005	G	18	Symptom checklist (SCL-90) - subscales: somatisation, obsessive-compulsive, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, sleep difficulty, other		Subscale depression not significantly associated with poor recovery (neck pain VAS >30 or work VAS <78)	
Holm, L., Carroll, L., Cassidy, J.D., Skillgate, E., Ahlbom, A.[44]	2007	L	17	Depressive symptomatology (CES-D)	Depressive mood associated with onset of widespread pain OR 3.2 (1.6 - 6.3)		II
Holm, L., Carroll, L., Cassidy, J.D., Skillgate, E., Ahlbom, A.[45]	2008	M	16	Expectations of recovery (numerical rating scale), with potential confounders: HADS, IES, Pain Management Inventory (coping)	Univariate regression: HADS Depression >6 significantly associated with high disability (PDI >22) OR 9.5 (6.2 - 14.6)		II
Kamper, S., Rebbeck, T., Maher, C., McAuley, J., Sterling, M[23]	2008	Sys	NA	Psychological distress (depression, anxiety), personality factors, social function, coping strategies	Some psychological factors may be important, in particular indicators of generalised psychological distress such as anxiety and depression have been investigated in a number of cohorts with relatively consistent findings		I
Walton, D., Pretty, J., Macdermid, J., Teasell, R.[63]	2009	Sys	NA	Depression, catastrophising		Depressive symptoms do not appear to play role in outcome following WAD	I

Table 3.8 Continued

AUTHOR	YEAR	COHORT	TOTAL CR	PROG CAT 3 (PSYCH)	POSITIVE PSYCH RESULTS	NEGATIVE PSYCH RESULTS	LEVEL OF EVIDENCE
DEPRESSION							
Williamson, E., Williams, M., Gates, S., Lamb, S.[65]	2008	Sys	NA	Personality, general psych distress, self-efficacy, PTSD, wellbeing, life control, social support, previous psych problems, blame and anger, perceived threat, cognitive function, anxiety, depression, irritability, fear-avoidance, catastrophising, coping, somatisation		No association found for development of late whiplash syndrome with depression	I

SUMMARY – DEPRESSION: NHMRC Evidence Statement Matrix

1. Evidence base: A

2. Consistency: C

3. Clinical impact: C

4. Generalisability: A

5. Applicability: C

Early depression may predict non recovery in patients with WAD. Grade of recommendation: C

Five primary cohort studies (four cohorts) and three systematic reviews. Two sys reviews – no association between depression and chronic whiplash, and one sys review – may be an important predictor. Primary cohorts: three positive for association (various outcomes – neck pain, widespread pain, disability) and two no association (both outcome of neck pain) (67%).

Table 3.8 Continued

AUTHOR	YEAR	COHORT	TOTAL CR	PROG CAT 3 (PSYCH)	POSITIVE PSYCH RESULTS	NEGATIVE PSYCH RESULTS	LEVEL OF EVIDENCE
ANXIETY							
Carroll, L., Liu, Y., Holm, L., Cassidy, D., Cote, P.[35]	2011	L	16	Pain related emotions - depression, anxiety, fear, anger, frustration	Anxiety OR 1.007 (1.002 - 1.013) associated with neck pain recovery at 12 months		II
Cobo, E., Mesquida, E., Fanegas, E., Atanasio, E., Pastor, B., Pont, C., Prieto, C., Gomez, G., Cano, L.[38]	2010	F	16	Goldberg depression and anxiety scale		Anxiety not independent factors in the multivariate analysis to predict neck pain VAS at 6 months	II
Hendriks, E., Scholten-Peeters, G., van der Windt, D., Neeleman-van der Steen, C., Oostendorp, R., Verhagen, A.[43]	2005	G	18	Symptom checklist (SCL-90) - subscales: somatisation, obsessive-compulsive, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, sleep difficulty, other		Subscale anxiety not significantly associated with poor recovery (neck pain VAS >30 or work VAS <78)	II
Holm, L., Carroll, L., Cassidy, J.D., Skillgate, E., Ahlbom, A.[45]	2008	M	16	Expectations of recovery (numerical rating scale), with potential confounders: HADS, IES, Pain Management Inventory (coping)	Univariate regression: HADS Anxiety >6 significantly associated with high disability (PDI >22) OR 4.7 (3.4 - 6.5)		II
Pedler, A., Sterling, M.[15]	2011	St2	15	PFActS-C, TSK-17		Initial PFActS-C not a significant predictor of 6-month NDI	II
Kamper, S., Rebbeck, T., Maher, C., McAuley, J., Sterling, M.[23]	2008	Sys	NA	Psychological distress (depression, anxiety), personality factors, social functioning, coping strategies	Some psychological factors may be important, in particular indicators of generalised psychological distress such as anxiety and depression have been investigated in a number of cohorts with relatively consistent findings		I
Williamson, E., Williams, M., Gates, S., Lamb, S.[65]	2008	Sys	NA	Personality, general psychological distress, self-efficacy, PTSD, wellbeing, life control, social support, previous psychological problems, blame and anger, perceived threat, cognitive function, anxiety, depression, irritability, fear-avoidance, catastrophising, coping, somatisation		No association found for development of late whiplash syndrome with anxiety	I

SUMMARY – ANXIETY: NHMRC Evidence Statement Matrix

1. Evidence base: A

2. Consistency: D

3. Clinical impact: C

4. Generalisability: A

5. Applicability: C

Initial anxiety is not predictive of non-recovery in patients with WAD. Grade of recommendation: D

Five primary cohort studies (five cohorts) and two systematic reviews. One sys review – may be an important predictor and one sys review concluded no association. Primary cohorts: two positive association (outcomes pain and disability) and four no association (outcomes – work, neck pain, disability).

Table 3.8 Continued

AUTHOR	YEAR	COHORT	TOTAL CR	PROG CAT 3 (PSYCH)	POSITIVE PSYCH RESULTS	NEGATIVE PSYCH RESULTS	LEVEL OF EVIDENCE
POSTTRAUMATIC STRESS DISORDER SYMPTOMS							
Buitenhuis, J., de Jong, P.J., Jaspers, J.P.C., Groothoff, J.W.[30]	2006	E2	15	Self-rating scale for PTSD	Hyper arousal symptoms OR 1.459, p<.003 associated with post whiplash syndrome at 6 months and 12 months OR 2.248, p<.005	Re-experiencing and avoidance symptoms not significant predictors	II
Elliot, J., Pedler, A., Kenardy, J., Galloway, G., Jull, G., Sterling, M.[13]	2011	St1	16	PDS	PTSD symptoms associated with higher baseline pain at 6 months (unsure of statistics to present - mediation analysis). When these mediators controlled for effect of baseline pain not significant. When baseline pain controlled for, PTSD symptoms had significant positive association with MFI while CROM did not		II
Holm, L., Carroll, L., Cassidy, J.D., Skillgate, E., Ahlbom, A.[45]	2008	M	16	Expectations of recovery (numerical rating scale), with potential confounders: HADS, IES, Pain Management Inventory (coping)	Univariate regression: IES >25 significantly associated with high disability (PDI >22) OR 6.2 (4.2 - 9.2)		II
Kongsted, A., Bendix, T., Qerama, E., Kasch, H., Bach, F., Korsholm, L., Jensen, T.[51]	2008a	A	16	IES (total and intrusion and avoidance subscales)	Baseline IES significantly associated (all p<.001) with pain OR 2.4 (1.4 - 3.4), pain >3 OR 3.3 (1.8 - 5.9), reduced working ability OR 2.8 (1.6 - 4.9), disability OR 3.2 (1.7 - 6.0), SF36 physical health OR -7.7 (-11.0 - -4.3) and SF36 mental health -7.6 (-10.9 - -4.2). With age and gender: IES baseline significant association with pain OR 1.5 (.5 - 2.4) p<.05, disability OR 2.1 (1.1 - 4.2) p<.05, SF36 physical health OR -5.1 (-8.3 - 1.9) p<.05, and SF26 mental health OR -7.6 (-10.9 - -4.2), not working disability. Stratified by baseline pain - low initial pain and high IES - significant increase pain OR 7.1 (2.3 - 21.8) and working disability OR 7.2 (1.6 - 32.8) NOT for those with initial severe pain		II
Sterling, M.[18]	2010	St3	18	GHQ-28, IES		IES not significant predictors of NFR	II
Sterling, M., Jull, G., Kenardy, J.[58]	2006a	St4	15	GHQ-28, IES, TSK-17	Initial IES predicted NDI score at 2 to 3 years (r2 = .588, p<.001), and membership to moderate/ severe group at 2 to 3 years OR 1.1 (1.03 - 1 .2)		II
Sterling, M., Jull, G., Vincenzino, B., Kenardy, J., Darnell, R.[59]	2005	St4	16	GHQ-28, IES, TSK-17	Higher levels of IES symptoms associated with higher NDI (r2 = .674), and predictor of moderate/ severe group membership OR 1.11 (1.03 - 1.2)		II

Table 3.8 Continued

AUTHOR	YEAR	COHORT	TOTAL CR	PROG CAT 3 (PSYCH)	POSITIVE PSYCH RESULTS	NEGATIVE PSYCH RESULTS	LEVEL OF EVIDENCE
POSTTRAUMATIC STRESS DISORDER SYMPTOMS							
Sterling M., Hendrikz J. et al[61]	2012	St5	18	NDI, age, CROML, CPT, SVR (QI quotient of integrals), IES	When adjusted for site NDI, age, CPT and IES were significant predictors of NDI at 12 months. The predictive set could discriminate between recovered/mild participants and moderate/severe participants at 12 months (ROC AUC: 0.89 [95% confidence interval 0.84 – 0.94], p <.001		II
Vetti, N., Krakens, J., Eide, G., Rorvik, J., Gilhus, N., Espeland, A.[62]	2010	J	18	IES, expectation of recovery	Higher IES associated with NDI OR 1.46 (1.1 - 1.94), and neck pain OR 1.93 (1.2 - 3.0)		II
Williamson, E., Williams, M., Gates, S., Lamb, S.[65]	2008	Sys	NA	Personality, general psychological distress, self-efficacy, PTSD, wellbeing, life control, social support, previous psychological problems, blame and anger, perceived threat, cognitive function, anxiety, depression, irritability, fear-avoidance, catastrophising, coping, somatisation	Limited evidence to support association of self-efficacy and PTSD with the development of late whiplash syndrome		I

SUMMARY – PTSD SYMPTOMS: NHMRC Evidence Statement Matrix

1. Evidence base: A

2. Consistency: A

3. Clinical impact: A

4. Generalisability: A

5. Applicability: A

Initial symptoms of posttraumatic stress predict non-recovery in patients with WAD. Grade of recommendation: A

Nine primary cohort studies (eight cohorts) plus one systematic review. Sys review indicated limited evidence for association and needs further investigation. All primary cohort studies found an association between posttraumatic stress symptoms and outcome.

Table 3.8 Continued

AUTHOR	YEAR	COHORT	TOTAL CR	PROG CAT 3 (PSYCH)	POSITIVE PSYCH RESULTS	NEGATIVE PSYCH RESULTS	LEVEL OF EVIDENCE
COPING							
Carroll, L., Cassidy, J.D., Cote, P.[32]	2006a	I	17	Coping (Pain Management Inventory)	Passive coping at 6 weeks with no depressive symptomatology associated with time to recovery HRR = .97 (95% CI .95 - .97), and with depressive symptoms HRR = .97 (95% CI .91- .96). Trichotomised passive coping scores - high levels of passive coping and depressive symptoms - recovery 75% slower (HRR = .25 95% CI .17 - .38) and high levels of passive coping and no depressive 38% slower (HR R = .62 95% CI .43 - .89)	No association with active coping and time to recovery HRR = 1.0 (95% CI .99 - 1.02)	II
Carstensen, T., Frostholm, L., Oernboel, E., Kongsted, A., Kasch, H., Jensen, T., Fink, P.[37]	2012	A	16	Coping strategies questionnaire (5 subscales - distraction, ignoring, reinterpreting, catastrophising, praying and hoping), pre-collision psychological distress (SCL-8)	Coping strategies: distraction OR 1.03 (1.01 - 1.05) p<.003, reinterpreting OR 1.03 (1.01 - 1.06) p<.018, catastrophising OR 1.14 (1.1 - 1.18) p<.000, praying and hoping OR 1.09 (1.05 - 1.1.3) p<.000 predicted neck pain at 12 months	Ignoring not predictive of neck pain at 12 months	II
Kivioja, J., Jensen, I., Lindgren, U.[50]	2005	P	15	Coping strategies questionnaire (7 categories - diverting attention, reinterpreting pain sensation, coping self-statements, ignoring pain sensations, praying and hoping, catastrophising, increasing behavioural activities)		None of the coping subscales (diverting attention, reinterpreting pain sensation, coping self-statements, ignoring pain sensations, praying and hoping, catastrophising, increasing behavioural activities) were associated with prediction of chronic neck pain	II
Kamper, S., Rebbeck, T., Maher, C., McAuley, J., Sterling, M.[23]	2008	Sys	NA	Psychological distress (depression, anxiety), personality factors, social function, coping strategies	No specific comments regarding coping however table includes column showing 3 or 4 studies analysing coping as a significant predictor with HRR of 1.02 for active coping and HRR 0.95 for passive coping		I
Williamson, E., Williams, M., Gates, S., Lamb, S.[65]	2008	Sys	NA	Personality, general psychological distress, self-efficacy, PTSD, wellbeing, life control, social support, previous psychological problems, blame and anger, perceived threat, cognitive function, anxiety, depression, irritability, fear-avoidance, catastrophising, coping, somatisation		No association found for development of late whiplash syndrome with coping strategies	I

SUMMARY – COPING: NHMRC Evidence Statement Matrix

1. Evidence base: A

2. Consistency: D

3. Clinical impact: B

4. Generalisability: B

5. Applicability: B

Coping strategies may predict non-recovery in patients with WAD. Grade of recommendation: D

Three primary cohort studies (three cohorts) plus two systematic reviews. One review – inconclusive and one review no association. Primary cohorts: two positive (one positive with four of five subscales AND one positive for passive not active coping) and one primary cohort – no association.

Table 3.8 Continued

AUTHOR	YEAR	COHORT	TOTAL CR	PROG CAT 3 (PSYCH)	POSITIVE PSYCH RESULTS	NEGATIVE PSYCH RESULTS	LEVEL OF EVIDENCE
KINESIOPHOBIA							
Buitenhuis, J., Jaspers, J., Fidler, V.[31]	2006	E1	16	Tampa Scale of Kinesiophobia	TSK-DV score of >10 corresponds to reduced probability of becoming symptom free (HR =0.47, p<.001)	Model with TSK and symptoms - TSK no relationship with persistent neck symptoms (HR0.73, p<.089)	II
Pedler, A., Sterling, M.[67]	2011	St2	15	PFActS-C, TSK-17	Initial TSK-17 significant predictor of NDI at 6 months (r2 =.387, p<.001)		II
Sterling, M., Jull, G., Kenardy, J.[58]	2006a	St4	15	GHQ-28, IES, TSK-17		TSK not significant predictor of NDI score or tri-chotomised group at 6 months or 2 years	II
Sterling, M., Jull, G., Vincenzino, B., Kenardy, J., Darnell, R.[59]	2005	St4	16	GHQ-28, IES, TSK-17		TSK showed no predictive capacity for 6-month NDI	II
Williamson, E., Williams, M., Gates, S., Lamb, S.[65]	2008	Sys		Personality, general psychological distress, self-efficacy, PTSD, wellbeing, life control, social support, previous psychological problems, blame and anger, perceived threat, cognitive function, anxiety, depression, irritability, fear-avoidance, catastrophising, coping, somatisation		No association found for development of late whiplash syndrome with fear avoidance	I

SUMMARY – KINESIOPHOBIA: NHMRC Evidence Statement Matrix

1. Evidence base: A

2. Consistency: C

3. Clinical impact: C

4. Generalisability: B

5. Applicability: B

Kinesiophobia (fear of movement) does not predict non-recovery in patients with WAD. Grade of recommendation: C

Four primary cohort studies (three cohorts) plus one systematic review. Sys review – no association for fear avoidance. Primary cohorts: one positive (NDI at six months) and one positive when baseline symptoms not included in the multivariate model. One cohort no association at two time points (six months and two to three years) and one no association when model included baseline symptoms.

Table 3.8 Continued

AUTHOR	YEAR	COHORT	TOTAL CR	PROG CAT 3 (PSYCH)	POSITIVE PSYCH RESULTS	NEGATIVE PSYCH RESULTS	LEVEL OF EVIDENCE
EXPECTATION OF RECOVERY							
Carroll, L., Holm, L., Ferrari, R., Ozegovic, D., Cassidy, J.D.[34]	2009	I	14	Expectation of recovery	'Get better soon' (expectation) associated with global recovery HRR 3.62 (2.55 - 5.13), resolution of neck pain HRR 1.81 (1.34 - 2.44), and pain related limitations HRR 3.01 (2.05 - 4.43)		II
Holm, L., Carroll, L., Cassidy, J.D., Skillgate, E., Ahlbom, A.[45]	2008	M	16	Expectations of recovery (numerical rating scale), with potential confounders: HADS, IES, Pain Management Inventory (coping)	Individuals who stated they were less likely to make a full recovery were more likely to have a high disability (PDI >22) than individuals who stated they were likely to make a full recovery OR 4.2 (2.1 - 8.5)		II
Ozegovic, D., Carroll, L., Cassidy, J.D.[54]	2009	I	12	Expectation to return to work	Positive return to work expectation associated with self-perceived recovery, adjusted HR 1.42 (1.26 - 1.60)		II
Vetti, N., Krakens, J., Eide, G., Rorvik, J., Gilhus, N., Espeland, A.[62]	2010	J	18	IES, expectation of recovery	Low expectation of recovery associated with NDI OR 4.66 (1.5 - 4.5), and neck pain (NRS) OR 21.56 (2.5 - 184.2)		II

SUMMARY – EXPECTATIONS OF RECOVERY: NHMRC Evidence Statement Matrix

1. Evidence base: A

2. Consistency: A

3. Clinical impact: B

4. Generalisability: B

5. Applicability: B

Positive expectations of recovery predict recovery in patients with WAD. Grade of recommendation: A

Four primary cohort studies (three cohorts with one expectation to return to work): All three cohorts positive association

Table 3.8 Continued

AUTHOR	YEAR	COHORT	TOTAL CR	PROG CAT 3 (PSYCH)	POSITIVE PSYCH RESULTS	NEGATIVE PSYCH RESULTS	LEVEL OF EVIDENCE
GENERAL HEALTH/PSYCH DISTRESS							
Ameratunga, S., Tin, S.T., Connor, J., Norton, R. [24]	2010	B	13	SF36 (inception and 18 months), 2 item depression and IES (5 months only)		Fair or poor general health not associated with prevalence of neck discomfort at 18 months	II
Atherton, K., Wiles, N.J., Lecky, F.E., Hawes, S.J., Silman, A.J., Macfarlane, G.J., Jones, G.T.[25]	2006	C	15	General health questionnaire, modified somatic perceptions questionnaire	Univariate analysis: high level of general psych distress (GHQ) (RR 2.4 (1.5 - 3.7) associated with persistent symptoms (neck pain lasting for one day or longer in week prior to questionnaire). Multivariate analysis: general psychological distress (0-5 or >6) significantly associated with persistent neck pain/stiffness (RR1.3 (0.8 - 2.1)		II
Carstensen, T., Frostholm, L., Oernboel, E., Kongsted, A., Kasch, H., Jensen, T., Fink, P.[36]	2009	A	16	Pre-collision psychological distress: Whitely 7 (illness worrying), SCL-SOM (somatisation), SCL-OC (obsessive-compulsive): SCL-HOS (hostility), SCL-8 (mental illness), SCL-ANX4 (anxiety)	Latent class analysis of psych factors resulted in 3 categories from 6 subsets. Highly distressed significant predictive variable for development of neck pain at 12 months OR 2.1 (1.1 - 4.2)		II
Gun, R., Osti, O., O'Riordan, A., Mpelasoka, F., Eckerwall, C., Smyth, J.[42]	2005	Q	16	SF36 (physical functioning, role physical, bodily pain, general health, vitality, social functioning, role emotional, mental health)	SF36 - bodily pain associated with all outcomes: improvement in neck pain outcome score (b = .18, p<.05), improvement in VAS (b = .02, p<.05), not being treated OR 1.03, p<.01, RTW OR 1.05, claim settled OR 1.03. Role emotional associated with improvement in neck pain outcome score (b = .07, p<.05), improvement in VAS (b = .01, p<.05), not being treated OR 1.02, p<.01, RTW OR 1.02, claim settled OR 1.01. SF36 mental component summary improvement associated with neck pain outcome score (b = .22, p<.05), improvement in VAS (b = .04, p<.05), not being treated OR 1.05, and claim settled OR 1.04. SF26 physical component summary associated with not being treated OR 1.04, p<.01, RTW OR 1.05, claim settled OR 1.07. Summary: 5 outcomes and 4 subscales = 20; 17 positive and 3 negative (85% positive)	SF36 mental component summary not significantly associated with return to work. SF26 physical component summary not associated with no improvement in neck pain outcome score or improvement in VAS	II
Sterling, M [18]	2010	St3	18	GHQ-28, IES		GHQ-28 not significant predictor of NFR	II

Table 3.8 Continued

AUTHOR	YEAR	COHORT	TOTAL CR	PROG CAT 3 (PSYCH)	POSITIVE PSYCH RESULTS	NEGATIVE PSYCH RESULTS	LEVEL OF EVIDENCE
GENERAL HEALTH/PSYCH DISTRESS							
Sterling, M., Jull, G., Kenardy, J.[59]	2006a	St4	15	GHQ-28, IES, TSK-17		GHQ-28 not significant predictor of NDI score or trichotomised group at 6 months or 2 years	II
Sterling, M., Jull, G., Vincenzino, B., Kenardy, J., Darnell, R.[59]	2005	St4	16	GHQ-28, IES, TSK-17	GHQ predictor of membership to group with persistent milder symptoms OR 1.15 (1.04 - 1.28)		II

SUMMARY – GENERAL HEALTH/PSYCH DISTRESS: NHMRC Evidence Statement Matrix

1. Evidence base: A

2. Consistency: D

3. Clinical impact: B

4. Generalisability: B

5. Applicability: B

Evidence is too inconsistent to provide a recommendation

Seven primary cohort studies (six cohorts). Three positive associations with various components or subscales and four negative with various outcomes.

Table 3.8 Continued

AUTHOR	YEAR	COHORT	TOTAL CR	PROG CAT 3 (PSYCH)	POSITIVE PSYCH RESULTS	NEGATIVE PSYCH RESULTS	LEVEL OF EVIDENCE
SOMATIC PERCEPTIONS							
Atherton, K., Wiles, N.J., Lecky, F.E., Hawes, S.J., Silman, A.J., Macfarlane, G.J., Jones, G.T.[25]	2006	C	15	General health questionnaire, modified somatic perceptions questionnaire	Univariate analysis: high somatic awareness (MSPQ) (RR 1.6 (1.2 - 2.2) associated with persistent symptoms (neck pain lasting for one day or longer in week prior to questionnaire)		II
Hendriks, E., Scholten-Peeters, G., van der Windt, D., Neeleman-van der Steen, C., Oostendorp, R., Verhagen, A.[43]	2005	G	18	Symptom checklist (SCL-90) - subscales: somatisation, obsessive-compulsive, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, sleep difficulty, other	Higher somatisation associated with poor recovery (neck pain VAS >30 or work VAS <78) OR1.1 (1.0 - 1.2)		II
Williamson, E., Williams, M., Gates, S., Lamb, S.[65]	2008	Sys		Personality, general psych distress, self-efficacy, PTSD, wellbeing, life control, social support, previous psych problems, blame and anger, perceived threat, cognitive function, anxiety, depression, irritability, fear-avoidance, catastrophising, coping, somatisation		Inconclusive evidence for somatisation	I

SUMMARY – SOMATIC PERCEPTIONS: NHMRC Evidence Statement Matrix

1. Evidence base: A

2. Consistency: B

3. Clinical impact: B

4. Generalisability: B

5. Applicability: B

Somatization predicts non-recovery in patients with WAD. Grade of recommendation: B

Two primary cohort studies (two cohorts) and one sys review. Review indicated inconclusive evidence for association. Both primary cohort studies indicated a positive association with higher somatic awareness and development of chronic whiplash.

Table 3.8 Continued

AUTHOR	YEAR	COHORT	TOTAL CR	PROG CAT 3 (PSYCH)	POSITIVE PSYCH RESULTS	NEGATIVE PSYCH RESULTS	LEVEL OF EVIDENCE
PAIN CATASTROPHISING							
Buitenhuis, J., de Jong, P.J., Jaspers, J.P.C., Groothoff, J.W.[28]	2008	E3	17	Pain catastrophising scale, casual beliefs questionnaire – whiplash.	Pain catastrophising scale OR 0.885, p<.004 predicted NDI at 6 months	Pain catastrophising not significant predictors of NDI at 12 months	II
Walton, D., Pretty, J., Macdermid, J., Teasell, R.[63]	2009	Sys		Depression, catastrophising	High catastrophising significant risk for poor outcome OR 3.8 (1.3 - 10.7)		I
Williamson, E., Williams, M., Gates, S., Lamb, S.[65]	2008	Sys		Personality, general psychological distress, self-efficacy, PTSD, wellbeing, life control, social support, previous psychological problems, blame and anger, perceived threat, cognitive function, anxiety, depression, irritability, fear-avoidance, catastrophising, coping, somatisation		No association found for development of late whiplash syndrome with catastrophising	I

SUMMARY – PAIN CATASTROPHISING: NHMRC Evidence Statement Matrix

1. Evidence base: A

2. Consistency: C

3. Clinical impact: B

4. Generalisability: B

5. Applicability: B

Pain catastrophising may predict non-recovery in patients with WAD. Grade of recommendation: C

One primary cohort study and two systematic reviews. One systematic review indicated that catastrophising was a significant predictor of poor outcome while one sys review indicated that there was no association. The primary cohort study found a positive association with NDI at six months but not at 12 months.

Table 3.8 Continued

AUTHOR	YEAR	COHORT	TOTAL CR	PROG CAT 3 (PSYCH)	POSITIVE PSYCH RESULTS	NEGATIVE PSYCH RESULTS	LEVEL OF EVIDENCE
OTHER							
Berglund, A., Bodin, L., Jensen, I., Wiklund, A., Alfredsson, L.[26]	2006	D	13	Helplessness (Rheumatology Attitudes Index), health locus of control	High degree of helplessness associated with neck pain intensity OR 2.7 (2.1 - 3.4), neck pain disability OR 3.5 (2.1 - 6.1), anxiety OR 3.4 (1.8 - 6.3), and depression OR 2.5 (1.7 - 3.6)	Locus of control neither improved models goodness of fit not acted as effect modifier	II
Borenstein, P., Rosenfeld, M., Gunnarsson, R.[27]	2010	O	11	Cognitive symptoms (abnormal fatigue, forgetfulness, easily irritated, excessively emotional, easily distracted)	Easily irritated significant prognostic marker of sick leave at 3 years (OR 31 (3.2 - 3 06), p<.001). Easily distracted significant prognostic marker of sick leave more than 30 days, 3 years later (OR 24 (2.2 - 268), p<.001)	Abnormal fatigue, forgetfulness, excessively emotional not significant prognostic factors	II
Buitenhuis, J., de Jong, P.J., Jaspers, J.P.C., Groothoff, J.W.[28]	2008	E3	17	Pain catastrophising scale, casual beliefs questionnaire – whiplash	Casual beliefs - psychological OR 4.335, p<.005, casual beliefs - vertebral OR 3.686, p<.006, casual beliefs - whiplash OR 3.430, p<.001 predicted NDI at 6 months. Casual beliefs - psych OR 2.670, p<.031, and casual beliefs - whiplash OR 2.657, p<.006 predicted NDI at 12 months	Casual beliefs-vertebral not significant predictor of NDI at 12 months	II
Carroll, L., Liu, Y., Holm, L., Cassidy, D., Cote, P [35]	2011	L	16	Pain related emotions - depression, anxiety, fear, anger, frustration	Fear OR 1.005 (1.001 - 1.010), anger OR 1.006 (1.001 - 1 .010), and frustration OR 1.007 (1.003 - 1.012) associated with neck pain recovery at 12 months		II
Gabel, C., Burkett, B., Neller, A., Yelland, M.[40]	2008	K	7	Psychosocial generic screening tool (GST which is a modified Orebro musculoskeletal pain questionnaire (OMPQ)	GST >109 LR = 5.4 (sens = 78%, spec = 86%) - predictive of moderate/severe impairment (NDI >28). Combining GST >109 and cervical rotation at impact LR = 7.7 (sens 100%, spec 87%)		II
Hendriks, E., Scholten-Peeters, G., van der Windt, D., Neeleman-van der Steen, C., Oostendorp, R., Verhagen, A.[43]	2005	G	18	Symptom checklist (SCL-90) - subscales: somatisation, obsessive-compulsive, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, sleep difficulty, other		Subscales obsessive-compulsive, interpersonal sensitivity, hostility, phobic anxiety, and sleep difficulty not significantly associated with poor recovery (neck pain VAS >30 or work VAS <78)	II
Kamper, S., Rebbeck, T., Maher, C., McAuley, J., Sterling, M.[23]	2008	Sys		Psychological distress (depression, anxiety), personality factors, social functioning, coping strategies		Personality factors and social functioning not significant predictors	I

Table 3.8 Continued

AUTHOR	YEAR	COHORT	TOTAL CR	PROG CAT 3 (PSYCH)	POSITIVE PSYCH RESULTS	NEGATIVE PSYCH RESULTS	LEVEL OF EVIDENCE
OTHER							
Williamson, E., Williams, M., Gates, S., Lamb, S.[65]	2008	Sys		Personality, general psychological distress, self-efficacy, PTSD, wellbeing, life control, social support, previous psychological problems, blame and anger, perceived threat, cognitive function, anxiety, depression, irritability, fear-avoidance, catastrophising, coping, somatisation	Limited evidence to support association of self-efficacy with the development of late whiplash syndrome	No association found for development of late whiplash syndrome with personality traits, general psychological distress, wellbeing, social support, life control and psychosocial work factors. Inconclusive evidence for psychosocial stress, blame and anger, perceived threat, cognitive function, irritability	I

SUMMARY – OTHER: Number of other psych symptoms with various results.
Due to heterogeneity further evaluation not undertaken.

Table 3.9 Summary of evidence for specific demographic factors

AUTHOR	YEAR	RATING SCORE	PROG CAT 4 (SOCDEM)	POSITIVE DEMOGRAPHIC FACTORS	NEGATIVE DEMOGRAPHIC FACTORS	LEVEL OF EVIDENCE
AGE						
OUTCOME - NECK PAIN						
Ameratunga, S., Tin, S.T., Connor, J., Norton, R. [24]	2010	13	Age, gender, education, living situation, income	Univariate: older age (+45 years) associated with neck pain at 5 and 18 months	Multivariate: no association with age and neck pain	II
Atherton, K., Wiles, N.J., Lecky, F.E., Hawes et al[25]	2006	15	Age, sex		No significant association with age and persistent pain	II
Berglund, A., Bodin, L., Jensen, I. et al[26]	2006	13	Age, gender, education, income		Age and not associated with any outcome variables – pain	II
Buitenhuis, J., de Jong, P.J., Jaspers, J.P.C., Groothoff, J.W.[28]	2008	17	Age, sex		Age not a significant independent variable for post whiplash syndrome (yes/no) at 6 and 12 months	II
Buitenhuis, J., de Jong, P.J., Jaspers, J.P.C., Groothoff, J.W.[29]	2009	14	Age, gender, employment status, work education	Age significant independent predictor of post whiplash syndrome (yes/no) at 12 months OR 1.03 (1.0 - 1.05), p<.022		II
Buitenhuis, J., de Jong, P.J., Jaspers et al[30]	2006	15	Age, gender		Age not a significant independent predictor of post whiplash syndrome at 6 and 12 months	II
Buitenhuis, J., Jaspers, J., Fidler, V.[31]	2006	16	Age, gender	Age (HR 0.78 (.63 - .97), p<.025) significant independent predictor (post whiplash syndrome – pain) only when baseline symptoms not included in analysis	Age not a significant independent predictor when baseline symptoms included in analysis	II
Cobo, E., Mesquida, E., Fanegas, E., Atanasio, E., Pastor, B. et al[38]	2010	16	Gender, age, education level, working condition	Age (b = .18, p<.001) associated with VAS at 6 months		II
Gun, R., Osti, O., O'Riordan, A. et al[42]	2005	16	Age, gender		Age not associated with change in pain	II
Hendriks, E., Scholten-Peeters, G., van der Windt, D. et al[43]	2005	18	Age, gender, education, marital status, insurance (private), employment status		Age not associated with poor recovery (neck pain VAS <30 or activity VAS >78)	II
Ichihara, D., Okada, E., Chiba, K. et al[46]	2009	12	Age, sex		Age not significant predictor of poor prognosis for neck pain measured at 10 years	II
Johansson, M., Liane M., Kasch, H., Kongsted, A.[47]	2011	18	Age, gender		Age not associated with neck pain at one year	II
Kasch, H., Qerama, E., Kongsted, A. et al[49]	2008	17	Age, gender		No results presented for age	II

Table 3.9 Continued

AUTHOR	YEAR	RATING SCORE	PROG CAT 4 (SOCDEM)	POSITIVE DEMOGRAPHIC FACTORS	NEGATIVE DEMOGRAPHIC FACTORS	LEVEL OF EVIDENCE
AGE						
OUTCOME - NECK PAIN						
Kivioja, J., Jensen, I., Lindgren, U.[50]	2005	15	Age, gender		Age not associated with neck pain intensity at 1 year	II
Vetti, N., Krakens, J., Eide, G. et al[62]	2010	18	Age, gender		Age not associated with NRS >4 at 12 months	II
Kamper, S., Rebbeck, T., Maher, C., McAuley, J., Sterling, M.[63, 23]	2008		Female gender, older age, lower education		Older age (4 of 15 studies) does not appear to be related to poor outcome	I
Walton, D., Pretty, J., Macdermid, J., Teasell, R.[63]	2009		Age, education, gender		Age not significantly associated with persistent pain or persistent disability	I

SUMMARY: PREDICTOR (AGE), OUTCOME (NECK PAIN): NHMRC Evidence Statement Matrix

1. Evidence base: A

2. Consistency: B

3. Clinical impact: C

4. Generalisability: A

5. Applicability: A

Older age is not predictive of non-recovery (in terms of pain) in patients with WAD. Grade of recommendation: B

15 primary cohort studies (10 and 4xEs cohorts) and 2 systematic reviews. Both systematic reviews concluded no association with age and development of persistent pain and disability (did not differentiate outcome). Primary cohort studies: 2 cohorts positive and 13 (including E2 and E3) no association. Therefore, little evidence for age as predictor of development of persistent pain.

Table 3.9 Continued

AUTHOR	YEAR	RATING SCORE	PROG CAT 4 (SOCDEM)	POSITIVE DEMOGRAPHIC FACTORS	NEGATIVE DEMOGRAPHIC FACTORS	LEVEL OF EVIDENCE
AGE						
OUTCOME – NECK PAIN DISABILITY						
Berglund, A., Bodin, L., Jensen, I. et al[26]	2006	13	Age, gender, education, income		Age not associated with any outcome variables (disability)	II
Gun, R., Osti, O., O'Riordan, A. et al[42]	2005	16	Age, gender	Age significantly associated with improvement in neck pain outcome score b = -.20, p<.01		II
Holm, L., Carroll, L., Cassidy, J.D. et al[45]	2008	16	Age, sex, education		Age not associated with persistent high neck pain disability	II
Sterling, M., Hendrikz, J., Kenardy, J.[57]	2011	14	Gender, age	Age linked to membership of chronic/severe NDI group OR 1.11 (1.0 - 1.2), p<.001		II
Sterling, M., Jull, G., Kenardy, J.[58]	2006a	15	Age, gender	Age significantly contributed to prediction of NDI (continuous) (t = 2.75, p<.001), and moderate/severe group membership OR 1.1 (1.0 - 1.13), p<.05 at 2 to 3 years		II
Sterling, M., Jull, G., Vincenzino, B., Kenardy, J., Darnell, R.[59]	2005	16	Age, gender	Age significant predictor of NDI at 6 months (t = 3.4, p<.001) and membership to moderate/severe disability group OR 1.13 (1.03 - 1.23), p<.01		II
Vetti, N., Krakens, J., Eide, G. et al[62]	2010	18	Age, gender		Age not associated with NDI >8% at 12 months	II
Sterling M., Hendrikz J. et al[61]	2012	18	NDI, age, CROML, CPT, SVR (QI quotient of integrals), IES	When adjusted for site NDI, age, CPT and IES were significant predictors of NDI at 12 months. The predictive set could discriminate between recovered/mild participants and moderate/severe participants at 12 months (ROC AUC: 0.89 [95% confidence interval 0.84 – 0.94], p<.001		II
Kamper, S., Rebbeck, T., Maher, C., McAuley, J., Sterling, M.[23]	2008		Female gender, older age, lower education		Older age (4 of 15 studies) does not appear to be related to poor outcome	I
Walton, D., Pretty, J., Macdermid, J. Teasell, R.[63]	2009		Age, education, gender		Age not significantly associated with persistent pain or persistent disability	I

SUMMARY: PREDICTOR (AGE), OUTCOME (NECK PAIN DISABILITY): NHMRC Evidence Statement Matrix

1. Evidence base: A

2. Consistency: C

3. Clinical impact: C

4. Generalisability: A

5. Applicability: B

Evidence is too inconsistent to provide a recommendation.

Eight primary cohort studies (seven cohorts) and two systematic reviews. Both systematic reviews indicated age not associated with development of persistent pain and disability (did not differentiate). Primary cohort studies: four cohorts (one cohort measured at six months and two years) indicated a significant association with age and development of persistent neck pain disability, and three cohorts no association.

Table 3.9 Continued

AUTHOR	YEAR	RATING SCORE	PROG CAT 4 (SOCDEM)	POSITIVE DEMOGRAPHIC FACTORS	NEGATIVE DEMOGRAPHIC FACTORS	LEVEL OF EVIDENCE
AGE						
OUTCOME – PSYCHOLOGICAL SYMPTOMS						
Berglund, A., Bodin, L., Jensen, I. et al[26]	2006	13	Age, gender, education, income		Age and associated with any outcome variables (depression)	II
Phillips, L., Carroll, L., Cassidy, J.D., Cote, P.[55]	2010	16	Gender, age, marital status, income, education	Older than 50 years OR 0.71 (.52 - .98) predictor of initial depressive symptoms with resolution, no recurrence. Age 30-39 years OR 1.7 (1.09 - 2.64), and age 40-49 OR 1.94 (1.23 - 3.05), predictors of initial depressive symptoms which resolve but recur. Over 24 years OR 2.45 (1.11 - 5.42) predictive of persistent depressive symptoms. Age >30 OR 2.19 (1.14 - 3.4) predictive of later onset depressive symptoms		II
Sterling, M., Hendrikz, J., Kenardy, J.[57]	2011	14	Gender, age	Age linked to membership of chronic moderate/ severe PDS group OR 1.1 (1.0 - 1.1), p<.02		II

SUMMARY: PREDICTOR (AGE), OUTCOME (PSYCHOLOGICAL SYMPTOMS): NHMRC Evidence Statement Matrix

1. Evidence base: A

2. Consistency: B

3. Clinical impact: C

4. Generalisability: A

5. Applicability: B

Older age is predictive of non-recovery (in terms of psychological symptoms) in patients with WAD. Grade of Recommendation: B

Three primary cohort studies (three cohorts). Two significant association with age as predictor of chronic psychological symptoms and one no association.

Table 3.9 Continued

AUTHOR	YEAR	RATING SCORE	PROG CAT 4 (SOCDEM)	POSITIVE DEMOGRAPHIC FACTORS	NEGATIVE DEMOGRAPHIC FACTORS	LEVEL OF EVIDENCE
AGE						
OUTCOME – WORK DISABILITY						
Borenstein, P., Rosenfeld, M., Gunnarsson, R.[27]	2010	11	Age, sex		Age did not have any independent prognostic value for sick leave	II
Carstensen, T., Frostholm, L., Oernboel, E., Kongsted, A., Kasch, H., Jensen, T., Fink, P.[36]	2009	16	Age, gender, education, occupation, work capacity		Age not associated with affected work capability or persistent neck pain	II
Gun, R., Osti, O., O'Riordan, A. et al[42]	2005	16	Age, gender		Age not associated with change not being treated, return to work or claim settled	II

SUMMARY: PREDICTOR (AGE), OUTCOME (WORK DISABILITY): NHMRC Evidence Statement Matrix

1. Evidence base: A

2. Consistency: A

3. Clinical impact: C

4. Generalisability: A

5. Applicability: B

Older age is not a predictor of non-recovery (in terms of work disability) in patients with WAD. Grade of recommendation: A

Three primary cohort studies (three cohorts) – all concluded no association with age and persistent work disability.

Table 3.9 Continued

AUTHOR	YEAR	RATING SCORE	PROG CAT 4 (SOCDEM)	POSITIVE DEMOGRAPHIC FACTORS	NEGATIVE DEMOGRAPHIC FACTORS	LEVEL OF EVIDENCE
AGE						
OUTCOME – OTHER						
Holm, L., Carroll, L., Cassidy, J.D. et al[44]	2007	16	Age, sex		Age did not change the estimates and was not included in the final regression model (outcome – widespread pain)	II
Ichihara, D., Okada, E., Chiba, K. et al [46]	2009	12	Age, sex		Age not significant predictor of poor prognosis for stiff shoulders or numbness in the extremities measured at 10 years	II
Johansson, M., Liane M., Kasch, H., Kongsted, A.[47]	2011	18	Age, gender		Age not associated with headache at 1 year	II

Summary: Other – several other outcomes (widespread pain, stiff shoulders, numbness in extremities and headache) – all showed no significant association with age and development of chronic problem. Evidence not graded due to heterogeneity of outcomes used.

Table 3.9 Continued

AUTHOR	YEAR	RATING SCORE	PROG CAT 4 (SOCDEM)	POSITIVE DEMOGRAPHIC FACTORS	NEGATIVE DEMOGRAPHIC FACTORS	LEVEL OF EVIDENCE
GENDER						
Ameratunga, S., Tin, S.T., Connor, J., Norton, R. [24]	2010	13	Age, gender, education, living situation, income	Univariate: male associated with neck pain at 5 and 18 months	Multivariate: no association with gender and neck pain	II
Atherton, K., Wiles, N.J., Lecky, F.E. et al [25]	2006	15	Age, sex		No significant association with sex and persistent pain	II
Berglund, A., Bodin, L., Jensen, I., Wiklund, A., Alfredsson, L.[26]	2006	13	Age, gender, education, income	Female gender significantly associated with neck pain intensity OR 1.3 (1.0 - 1.6), p<.02, and neck pain disability	Female gender not associated with depression	II
Borenstein, P., Rosenfeld, M., Gunnarsson, R.[27]	2010	11	Age, sex		Sex did not have any independent prognostic value for sick leave	II
Buitenhuis, J., de Jong, P.J., Jaspers, et al[28]	2008	17	Age, sex		Gender was not significant independent variable for post whiplash syndrome (yes/no) at 6 and 12 months	II
Buitenhuis, J., de Jong, P.J., Jaspers, J.P.C., Groothoff, J.W.[29]	2009	14	Age, gender, employment status, work education		Gender not significantly associated with post whiplash syndrome (yes/no)	II
Buitenhuis, J., de Jong, P.J., Jaspers, J.P.C., Groothoff, J.W.[30]	2006	15	Age, gender	Gender significant predictor of post whiplash syndrome at 6 months OR 0.23 (.96 - 1.0)	Gender not a significant predictor of post whiplash syndrome at 12 months	II
Buitenhuis, J., Jaspers, J., Fidler, V.[31]	2006	16	Age, gender	Gender (HR 1.77 (1.0 - 3.0), p<.034) significant independent predictor only when baseline symptoms not included in analysis	Gender not significant independent predictor when baseline symptoms included in analysis	II
Carstensen, T., Frostholm, L., Oernboel, E., Kongsted, A., Kasch, H., Jensen, T., Fink, P.[36]	2009	16	Age, gender, education, occupation, work capacity	Female gender significantly associated with affected work capability OR 1.7 (1.0 - 2.9), p<.04 and neck pain OR 2.3 (1.5 - 3.6), p<.000		II
Cobo, E., Mesquida, E., Fanegas, E. et al[38]	2010	16	Gender, age, education level, working condition		Gender not associated with VAS at 6 months	II
Gabel, C., Burkett, B., Neller, A., Yelland, M.[40]	2008	7	Gender, employment status	Female gender predictive of non-recovery (NDI <8) (no statistics provided)		II
Gun, R., Osti, O., O'Riordan, A. et al [42]	2005	16	Age, gender		Gender not associated with any outcomes (change in pain, change in disability, not being treated, return to work, claim settled)	II
Hendriks, E., Scholten-Peeters, G., van der Windt, D. et al [43]	2005	18	Age, gender, education, marital status, insurance (private), employment status	Female gender OR 4.6 (1.5 - 14.0) predictor of poor recovery (neck pain VAS <30 or activity VAS >78)		II

Table 3.9 Continued

AUTHOR	YEAR	RATING SCORE	PROG CAT 4 (SOCDEM)	POSITIVE DEMOGRAPHIC FACTORS	NEGATIVE DEMOGRAPHIC FACTORS	LEVEL OF EVIDENCE
GENDER						
Holm, L., Carroll, L., Cassidy, J.D., Skillgate, E., Ahlbom, A.[44]	2007	16	Age, sex		Gender did not change the estimates and were not included in the final regression model (outcome widespread pain)	II
Holm, L., Carroll, L., Cassidy, J.D., Skillgate, E., Ahlbom, A.[45]	2008	16	Age, sex, education	Univariate analyses: female gender OR 1.3 (1.0 - 1.8), associated with persistent high neck pain disability (PDI >22)		II
Ichihara, D., Okada, E., Chiba, K. et al[46]	2009	12	Age, sex	Female gender significant predictor of stiff shoulders at 10 years OR 2.8 (1.2 - 6.5), p<.015	Female gender not predictive of neck pain or numbness in the upper extremities at 10 years	II
Johansson, M., Liane M., Kasch, H., Kongsted, A.[47]	2011	18	Age, gender		Gender not associated with neck pain or headache at one year	II
Kasch, H., Qerama, E., Kongsted, A. et al[49]	2008	17	Age, gender	Female gender significant predictor of neck disability (rr = 1.3 (1.0 - 1.7)), and long term neck pain (rr = 1.5 (1.2 - 1.9) p<.004)	Gender not significant risk factor for work handicap (sick leave) at 1 year	II
Kivioja, J., Jensen, I., Lindgren, U.[50]	2005	15	Age, gender		Gender not associated with neck pain intensity at 1 year	II
Kongsted, A., Bendix, T., Qerama, E. et al[51]	2008a	16	Gender	Female gender significant association with neck pain VAS dichotomised (>3) OR 1.9 (1.3 - 2.9), and SF36 physical health OR -1.8 (-3.5 - 00.1)	Gender not associated with reduced working ability and disability (Copenhagen neck functional disability scale)	II
Pedler, A., Sterling, M.[15]	2011	15	Gender		Gender was not a significant predictor of NDI at 6 months	II
Phillips, L., Carroll, L., Cassidy, J.D., Cote, P.[55]	2010	16	Gender, age, marital status, income, education	Female gender associated with persistent depressive symptoms OR 0.63 (0.42 - 0.95)		II
Sterling, M.[18]	2010	18	Gender		Gender not associated with NFR	II
Sterling, M., Hendrikz, J., Kenardy, J.[57]	2011	14	Gender, age		Gender not a significant factor in the multivariate analyses trajectory analyses for NDI and PDS	II
Sterling, M., Jull, G., Kenardy, J.[58]	2006a	15	Age, gender		Data not presented for gender	II
Sterling, M., Jull, G., Vincenzino, B. et al[59]	2005	16	Age, gender	Results state that higher NDI associated with female gender, however no data presented in tables		II
Vetti, N., Krakens, J., Eide, G. et al[62]	2010	18	Age, gender	Female gender significant predictor of NRS >4 at 12 months OR 3.3 (1.0 - 10.5), p<.038	Gender not associated with NDI at 12 months	II
Kamper, S., Rebbeck, T., Maher, C., McAuley, J., Sterling, M.[23]	2008	NA	Female gender, older age, lower education		Female gender (2 of 17 studies) does not appear to be related to poor outcome	I

Table 3.9 Continued

AUTHOR	YEAR	RATING SCORE	PROG CAT 4 (SOCDEM)	POSITIVE DEMOGRAPHIC FACTORS	NEGATIVE DEMOGRAPHIC FACTORS	LEVEL OF EVIDENCE
GENDER						
Walton, D., Pretty, J., Macdermid, J., Teasell, R.[63]	2009	NA	Age, education, gender	Moderate evidence for a predictive effect of female gender OR 1.5 (1.2 - 2.1) was concluded		I

SUMMARY – GENDER: NHMRC Evidence Statement Matrix

1. Evidence base: A

2. Consistency: D

3. Clinical impact: C

4. Generalisability: A

5. Applicability: B

Evidence is too inconsistent to provide a recommendation

27 primary cohort studies (23 cohorts) and two systematic reviews. One systematic review indicated no association with gender and persistent pain and disability and one systematic review indicated moderate evidence for an association of female gender and development of chronic pain or disability. Primary cohort studies: 15 cohorts positive and 19 cohorts no association. Examining relationship of gender and specific outcome yielded inconclusive results except for gender and work disability where a significant association was found for one cohort and no association for four cohorts (80%) indicating strong evidence for no association with gender and development of work disability: for neck pain as an outcome (seven positive and nine no association); neck pain disability (five positive and four no association); psychological symptoms (two positive and two no association); and work disability (one positive and four no association).

AUTHOR	YEAR	RATING SCORE	PROG CAT 4 (SOCDEM)	POSITIVE DEMOGRAPHIC FACTORS	NEGATIVE DEMOGRAPHIC FACTORS	LEVEL OF EVIDENCE
EDUCATIONAL LEVEL						
Ameratunga, S., Tin, S.T., Connor, J., Norton, R. [24]	2010	13	Age, gender, education, living situation, income		Multivariate: no association with education and neck pain	II
Berglund, A., Bodin, L., Jensen, I., Wiklund, A., Alfredsson, L.[26]	2006	13	Age, gender, education, income	Low level of education significantly more likely to have moderate/severe VAS OR 1.8 (1.3 - 2.4), p<.001, and slight association with disability	Educational level not associated with depression	II
Buitenhuis, J., de Jong, P.J., Jaspers, J.P.C., Groothoff, J.W.[29]	2009	14	Age, gender, employment status, work, education		Work education not significantly associated with post whiplash syndrome (yes/no)	II
Carstensen, T., Frostholm, L., Oernboel, E. et al[36]	2009	16	Age, gender, education, occupation, work capacity	Low educational level significantly associated with affected work capability OR 0.44 (0.22 - 0.89), p<.02	Educational level not associated with persistent neck pain	II
Cobo, E., Mesquida, E., Fanegas, E. et al[38]	2010	16	Gender, age, education level, working condition		Educational level not associated with VAS at 6 months	II
Hendriks, E., Scholten-Peeters, G., van der Windt, D. et al[43]	2005	18	Age, gender, education, marital status, insurance (private), employment status	Low level of education OR 3.5 (1.1 - 11.7) predictor of poor recovery (neck pain VAS <30 or activity VAS >78)		II
Holm, L., Carroll, L., Cassidy, J.D., Skillgate, E., Ahlbom, A.[45]	2008	16	Age, sex, education	Univariate analyses: lower level of education OR 2.5 (1.6 - 3.8) associated with persistent high neck pain disability (PDI >22)		II

Table 3.9 Continued

AUTHOR	YEAR	RATING SCORE	PROG CAT 4 (SOCDEM)	POSITIVE DEMOGRAPHIC FACTORS	NEGATIVE DEMOGRAPHIC FACTORS	LEVEL OF EVIDENCE
EDUCATIONAL LEVEL						
Phillips, L., Carroll, L., Cassidy, J.D., Cote, P.[55]	2010	16	Gender, age, marital status, income, education	University grad OR 0.59 (.41 - .85), predictor of initial depressive symptoms with resolution, no recurrence. Tech college or some university OR .55 (.38 - .80) predictor of initial depressive symptoms which resolve but recur. At least high school education OR 0.42 (.25 - .7) predictive of persistent depressive symptoms. Tech or some uni OR 0.59 (.42 - .83) predictive of later onset depressive symptoms		II
Kamper, S., Rebbeck, T., Maher, C., McAuley, J., Sterling, M.[23]	2008		Female gender, older age, lower education		Table 3 indicates lower education significant in only 2 of 4 included studies, and no conclusions included within the review	I
Walton, D., Pretty, J., Macdermid, J., Teasell, R.[63]	2009		Age, education, gender	Lower education (no postsecondary education) risk factor for persistent pain or disability OR 2.1 (1.7 - 2.8)		I

SUMMARY – EDUCATIONAL LEVEL: NHMRC Evidence Statement Matrix

1. Evidence base: A

2. Consistency: D

3. Clinical impact: C

4. Generalisability: A

5. Applicability: B

Evidence is too inconsistent to provide a recommendation

Eight primary cohort studies (eight cohorts) and two systematic reviews. One systematic review concluded that lower education is a risk factor for development of persistent pain or disability and one systematic review concluded no association. Primary cohort studies: five significant associations found (outcomes – pain, disability, work and depression) and five cohorts with no association (outcome – pain x 4 and depression x1).

AUTHOR	YEAR	RATING SCORE	PROG CAT 4 (SOCDEM)	POSITIVE DEMOGRAPHIC FACTORS	NEGATIVE DEMOGRAPHIC FACTORS	LEVEL OF EVIDENCE
WORK/OCCUPATIONAL STATUS						
Buitenhuis, J., de Jong, P.J., Jaspers, J.P.C., Groothoff, J.W.[29]	2009	14	Age, gender, employment status, work, education		Employment status (e.g. blue versus white collar and paid versus self-employment) not significantly associated with post whiplash syndrome (yes/no)	II
Carstensen, T., Frostholm, L., Oernboel, E., Kongsted, A., Kasch, H., Jensen, T., Fink, P.[36]	2009	16	Age, gender, education, occupation, work capacity	Being blue collar worker or unemployed significantly associated with significantly associated with affected work capability OR 2.7 (1.1 - 6.3), p<.02. Being unemployed significantly associated with affected work capability OR 3.8 (1.5 - 9.7), p<.001	Occupational status not associated with persistent neck pain	II

Table 3.9 Continued

AUTHOR	YEAR	RATING SCORE	PROG CAT 4 (SOCDEM)	POSITIVE DEMOGRAPHIC FACTORS	NEGATIVE DEMOGRAPHIC FACTORS	LEVEL OF EVIDENCE
WORK/OCCUPATIONAL STATUS						
Cobo, E., Mesquida, E., Fanegas, E., Atanasio, E., Pastor, B. et al[38]	2010	16	Gender, age, education level, working condition	Being self-employed (b = -.58, p<.016) associated with VAS at 6 months		II

SUMMARY – WORK STATUS: NHMRC Evidence Statement Matrix
1. Evidence base: A
2. Consistency: C
3. Clinical impact: C
4. Generalisability: B
5. Applicability: C
Work status may not predict non-recovery in patients with WAD. Grade of recommendation: C
Three primary cohort studies (three cohorts). One positive for association with work status and work outcome two no association with outcome of neck pain.

AUTHOR	YEAR	RATING SCORE	PROG CAT 4 (SOCDEM)	POSITIVE DEMOGRAPHIC FACTORS	NEGATIVE DEMOGRAPHIC FACTORS	LEVEL OF EVIDENCE
INCOME						
Ameratunga, S., Tin, S.T., Connor, J., Norton, R. [24]	2010	13	Age, gender, education, living situation, income		Multivariate: no association with income and neck pain	II
Berglund, A., Bodin, L., Jensen, I. et al[26]	2006	13	Age, gender, education, income		Income not associated with any outcome variables	II
Phillips, L., Carroll, L., Cassidy, J.D., Cote, P.[55]	2010	16	Gender, age, marital status, income, education	Income >20K predictor of initial depressive symptoms with resolution OR 0.78 (0.61 - 1.0), no recurrence, initial depressive symptoms which resolve but recur OR 0.62 (0.44 - .87), persistent depressive symptoms OR 0.46 (0.29 - .73), and development of later onset depressive symptoms OR 0.71 (.52 - .98)		II

SUMMARY – INCOME: NHMRC Evidence Statement Matrix
1. Evidence base: A
2. Consistency: B
3. Clinical impact: B
4. Generalisability: C
5. Applicability: C
Level of income may not be predictive of non-recovery in patients with WAD. Grade of Recommendation: C
Three primary cohort studies (three cohorts). One positive for association with income and outcome of depression, and two no association for income and outcome of neck pain or disability.

Table 3.9 Continued

AUTHOR	YEAR	RATING SCORE	PROG CAT 4 (SOCDEM)	POSITIVE DEMOGRAPHIC FACTORS	NEGATIVE DEMOGRAPHIC FACTORS	LEVEL OF EVIDENCE
LIVING SITUATION						
Ameratunga, S., Tin, S.T., Connor, J., Norton, R. [24]	2010	13	Age, gender, education, living situation, income		Multivariate: no association with living situation and neck pain	II
Hendriks, E., Scholten-Peeters, G., van der Windt, D. et al[43]	2005	18	Age, gender, education, marital status, insurance (private), employment status		Marital status not associated with poor recovery (neck pain VAS <30 or activity VAS >78)	II
Phillips, L., Carroll, L., Cassidy, J.D., Cote, P.[55]	2010	16	Gender, age, marital status, income, education		No statistical results presented for marital status	II

SUMMARY – LIVING SITUATION: NHMRC Evidence Statement Matrix

1. Evidence base: B

2. Consistency: A

3. Clinical impact: C

4. Generalisability: B

5.Applicability: C

Living situation is not predictive of non-recovery in patients with WAD. Grade of recommendation: B

Three primary cohort studies (three cohorts). All three no association with marital status/living situation and development of chronic WAD.

Table 3.10 Summary of evidence for specific crash related factors

AUTHOR	YEAR	PROGNOSTIC CATEGORY – CRASH RELATED FEATURES	POSITIVE CRASH RELATED FINDINGS	NEGATIVE CRASH RELATED FINDINGS	LEVEL OF EVIDENCE
SEATBELT USE					
Ameratunga, S., Tin, S.T., Connor, J., Norton, R. [24]	2010	Seatbelt use		Wearing a seatbelt at the time of collision not associated with the prevalence of neck discomfort at 18 months	II
Atherton, K., Wiles, N.J., Lecky, F.E., Hawes, S.J., Silman, A.J., Macfarlane, G.J., Jones, G.T.[25]	2006	Speed and direction of both vehicles, participant rated severity of collision (100mm VAS), position in vehicle, use of airbag, use of seatbelt, headrest, awareness of impending collision		Univariate analyses: no increased risk of persistent neck pain for seatbelt use	II
Berglund, A., Bodin, L., Jensen, I., Wiklund, A., Alfredsson, L.[26]	2006	Position in vehicle, direction of MVC, awareness of collision, use of headrest, use of seatbelt, head position at impact, whether car seat was broken		Use of seatbelt - not included within multivariate final models because these factors neither improved the models' goodness of fit nor acted as effect modifiers	II
Buitenhuis, J., Jaspers, J., Fidler, V.[31]	2006	Use of head restraints, seat position in car, site of collision, seatbelt use		No association with seatbelt use	II
Hendriks, E., Scholten-Peeters, G., van der Windt, D., Neeleman-van der Steen, C., Oostendorp, R., Verhagen, A.[43]	2005	Direction of impact, location in vehicle, seatbelt use, unprepared for collision, head restraint and correctly positioned, traffic situation		No associations with crash related characteristics and poor recovery	II
Vetti, N., Krakens, J., Eide, G., Rorvik, J., Gilhus, N., Espeland, A.[62]	2010	Impact direction, head turned at impact, head injury at accident, seatbelt use, head restraint present, airbag deployment at impact, patient car speed at impact, relative car speed at impact		No accident related variables related to disability or neck pain at 12 months	II
Kamper, S., Rebbeck, T., Maher, C., McAuley, J., Sterling, M.[23]	2008	Direction of impact, higher speed of vehicles, aware of impending collision, head rest, seating position, rotated head position, seatbelt use, stationary or moving		Crash related factors do not appear to be related to poor outcome	I
Walton, D., Pretty, J., Macdermid, J., Teasell, R.[63]	2009	Vehicle stationary when hit, frontal collision, rear-end collision, side or other collision, driver of vehicle, front passenger, unprepared for the collision, no seatbelt use, no head restraint used	Not wearing a seatbelt at the time of collision led to nearly 2-fold increase in risk of developing persistent WAD related pain or disability at follow-up		I

SUMMARY – SEATBELT USE: NHMRC Evidence Statement Matrix

1. Evidence base: A

2. Consistency: A

3. Clinical impact: C

4. Generalisability: A

5. Applicability: C

Seatbelt use is not predictive of non-recovery in patients with WAD. Grade of recommendation: A

Two systematic reviews with one review stating positive association of seatbelt use and development of WAD related pain or disability. Discussion Walton data for seatbelt use – four primary cohorts of which two are included above (Atherton and Hendriks) which showed no significant association with seatbelt use. Walton report of Atherton data shows OR of 1.86 however OR is 1.5 (0.7-3.3) in univariate analysis and authors conclude that only moderate association (and CIs cross 1.0) therefore not included in multivariate analysis. Walton report of Hendriks data shows OR of 2.28 however although seatbelt use included in multivariate analysis (univariate B=.825, p=.078), seatbelt use was not a predictor of poor recovery at any time point (4 weeks, 12 weeks or 52 weeks). Six primary cohort studies (six cohorts): No positive findings (therefore strong evidence for no association).

Table 3.10 Continued

AUTHOR	YEAR	PROGNOSTIC CATEGORY – CRASH RELATED FEATURES	POSITIVE CRASH RELATED FINDINGS	NEGATIVE CRASH RELATED FINDINGS	LEVEL OF EVIDENCE
SELF RATED COLLISION SEVERITY					
Atherton, K., Wiles, N.J., Lecky, F.E., Hawes, S.J., Silman, A.J., Macfarlane, G.J., Jones, G.T.[25]	2006	Speed and direction of both vehicles, participant rated severity of collision (100mm VAS), position in vehicle, use of airbag, use of seatbelt, headrest, awareness of impending collision	Univariate analyses: increased risk of persistent pain for individuals who rated collision as medium or high severity, and being in vehicle other than a car. Multivariate: only being in vehicle other than car statistically independent within model (RR 1.7 (0.9 - 3.2))		II
Kasch, H., Qerama, E., Kongsted, A., Bendix, T., Jensen, T., Bach, F.[49]	2008	Reported seriousness of car accident (mild, moderate, severe)		No results reported regarding association of perceived seriousness of accident and outcome variables	II
Ichihara, D., Okada, E., Chiba, K., Toyama, Y., Fujiwara, H., Momoshima, S. et al[46]	2009	Place of injury, seating, seatbelt usage, direction of impact, degree of car damage	Unfavourable prognosis (neck pain) significantly serious car damage OR 2.9 (1.0 - 8.0) p<.043. Unfavourable prognosis (numbness in upper extremities) associated with serious car damage OR 3.4 (1.1 - 10.1) p<.028		II

SUMMARY – SELF RATED COLLISION SEVERITY: NHMRC Evidence Statement Matrix

1. Evidence base: A

2. Consistency: C

3. Clinical impact: C

4. Generalisability: A

5. Applicability: C

Self-rated collision severity may predict non-recovery in patients with WAD. Grade of recommendation: C

Three primary cohort studies (three cohorts): Two-thirds positive univariate associations and one-third positive multivariate association.

Table 3.10 Continued

AUTHOR	YEAR	PROGNOSTIC CATEGORY – CRASH RELATED FEATURES	POSITIVE CRASH RELATED FINDINGS	NEGATIVE CRASH RELATED FINDINGS	LEVEL OF EVIDENCE
AIRBAG					
Atherton, K., Wiles, N.J., Lecky, F.E., Hawes, S.J., Silman, A.J., Macfarlane, G.J., Jones, G.T.[25]	2006	Speed and direction of both vehicles, participant rated severity of collision (100mm VAS), position in vehicle, use of airbag, use of seatbelt, headrest, awareness of impending collision		Univariate analyses: no increased risk of persistent neck pain for use of airbag	II
Vetti, N., Krakens, J., Eide, G., Rorvik, J., Gilhus, N., Espeland, A.[62]	2010	Impact direction, head turned at impact, head injury at accident, seatbelt use, head restraint present, airbag deployment at impact, patient car speed at impact, relative car speed at impact		No accident related variables related to disability or neck pain at 12 months	II

SUMMARY – AIRBAG: NHMRC Evidence Statement Matrix

1. Evidence base: B

2. Consistency: A

3. Clinical impact: C

4. Generalisability: A

5. Applicability: C

Air-bag deployment does not predict poor functional recovery in patients with WAD. Grade of recommendation: C

Two primary cohort studies (two cohorts): both negative.

Table 3.10 Continued

AUTHOR	YEAR	PROGNOSTIC CATEGORY – CRASH RELATED FEATURES	POSITIVE CRASH RELATED FINDINGS	NEGATIVE CRASH RELATED FINDINGS	LEVEL OF EVIDENCE
HEAD RESTRAINT					
Atherton, K., Wiles, N.J., Lecky, F.E., Hawes, S.J., Silman, A.J., Macfarlane, G.J., Jones, G.T. [25]	2006	Speed and direction of both vehicles, participant rated severity of collision (100mm VAS), position in vehicle, use of airbag, use of seatbelt, headrest, awareness of impending collision		Univariate analyses: no increased risk of persistent neck pain for lack of headrest	II
Berglund, A., Bodin, L., Jensen, I., Wiklund, A., Alfredsson, L.[26]	2006	Position in vehicle, direction of MVC, awareness of collision, use of headrest, use of seatbelt, head position at impact, whether car seat was broken		Use of head rest not included within multivariate final models because these factors neither improved the models' goodness of fit nor acted as effect modifiers	II
Buitenhuis, J., Jaspers, J., Fidler, V.[31]	2006	Use of head restraint, seat position in car, site of collision, seatbelt use	Model 1 (all variables): presence of head restraints negatively associated with longer duration of neck symptoms Hazard Ratio (HR) = 3.06 (1.2 - 7.9), p<.021. Conclusion - cannot explain negative association except that "we feel that the negative relation found is an indication of the very limited value of mechanical factors on the development of post whiplash syndrome"	Use of head restraints not significant within linear regression analysis	II
Hendriks, E., Scholten-Peeters, G., van der Windt, D., Neeleman-van der Steen, C., Oostendorp, R., Verhagen, A.[43]	2005	Direction of impact, location in vehicle, seatbelt use, unprepared for collision, head restraint and correctly positioned, traffic situation		No associations with crash related characteristics and poor recovery	II
Vetti, N., Krakens, J., Eide, G., Rorvik, J., Gilhus, N., Espeland, A.[62]	2010	Impact direction, head turned at impact, head injury at accident, seatbelt use, head restraint present, airbag deployment at impact, patient car speed at impact, relative car speed at impact		No accident related variables related to disability or neck pain at 12 months	II
Kamper, S., Rebbeck, T., Maher, C., McAuley, J., Sterling, M.[23]	2008	Direction of impact, higher speed of vehicles, aware of impending collision, head rest, seating position, rotated head position, seatbelt use, stationary or moving		Crash related factors do not appear to be related to poor outcome	I
Walton, D., Pretty, J., Macdermid, J., Teasell, R.[63]	2009	Vehicle stationary when hit, frontal collision, rear-end collision, side or other collision, driver of vehicle, front passenger, unprepared for the collision, no seatbelt use, no head restraint used		No significant predictive power for no head restraint used	I

SUMMARY -HEAD RESTRAINT: NHMRC Evidence Statement Matrix

1. Evidence Base: A

2. Consistency: B

3. Clinical impact: C

4. Generalisability: A

5. Applicability: C

The use of head restraints does not predict poor functional recovery in patients with WAD. Grade of Recommendation: B

5 primary cohort studies (5 cohorts) and 2 systematic review: 4/5 negative (therefore strong evidence for no association) and both reviews negative– and one cohort with and unexpected finding that was explained with the statement "we feel that the negative relation found is an indication of the very limited value of mechanical factors on the development of post whiplash syndrome."

Table 3.10 Continued

AUTHOR	YEAR	PROGNOSTIC CATEGORY – CRASH RELATED FEATURES	POSITIVE CRASH RELATED FINDINGS	NEGATIVE CRASH RELATED FINDINGS	LEVEL OF EVIDENCE
AWARENESS OF IMPENDING COLLISION					
Atherton, K., Wiles, N.J., Lecky, F.E., Hawes, S.J., Silman, A.J., Macfarlane, G.J., Jones, G.T.[25]	2006	Speed and direction of both vehicles, participant rated severity of collision (100mm VAS), position in vehicle, use of airbag, use of seatbelt, headrest, awareness of impending collision		Univariate analyses: no increased risk of persistent neck pain for anticipation of the collision	II
Berglund, A., Bodin, L., Jensen, I., Wiklund, A., Alfredsson, L.[26]	2006	Position in vehicle, direction of MVC, awareness of collision, use of headrest, use of seatbelt, head position at impact, whether car seat was broken		Awareness of collision not included within multivariate final models because these factors neither improved the models' goodness of fit nor acted as effect modifiers	II
Hendriks, E., Scholten-Peeters, G., van der Windt, D. et al [43]	2005	Direction of impact, location in vehicle, seatbelt use, unprepared for collision, head restraint and correctly positioned, traffic situation		No associations with crash related characteristics and poor recovery	II
Kamper, S., Rebbeck, T., Maher, C., McAuley, J., Sterling, M.[23]	2008	Direction of impact, higher speed of vehicles, aware of impending collision, head rest, seating position, rotated head position, seatbelt use, stationary or moving		Crash related factors do not appear to be related to poor outcome	I
Walton, D., Pretty, J., Macdermid, J., Teasell, R.[63]	2009	Vehicle stationary when hit, frontal collision, rear-end collision, side or other collision, driver of vehicle, front passenger, unprepared for the collision, no seatbelt use, no head restraint used		No significant predictive power for unprepared for the collision	I

SUMMARY - AWARENESS OF IMPENDING COLLISION: NHMRC Evidence Statement Matrix

1. Evidence base: A

2. Consistency: A

3. Clinical impact: C

4. Generalisability: A

5. Applicability: C

Awareness of impending collision does not predict poor functional recovery in patients with WAD. Grade of recommendation: A

Three primary cohort studies (three cohorts) and two systematic reviews – no positive findings.

Table 3.10 Continued

AUTHOR	YEAR	PROGNOSTIC CATEGORY – CRASH RELATED FEATURES	POSITIVE CRASH RELATED FINDINGS	NEGATIVE CRASH RELATED FINDINGS	LEVEL OF EVIDENCE
SEAT POSITION IN CAR					
Atherton, K., Wiles, N.J., Lecky, F.E., Hawes, S.J., Silman, A.J., Macfarlane, G.J., Jones, G.T.[25]	2006	Speed and direction of both vehicles, participant rated severity of collision (100mm VAS), position in vehicle, use of airbag, use of seatbelt, headrest, awareness of impending collision		Univariate analyses: no increased risk of persistent neck pain for position in vehicle	II
Berglund, A., Bodin, L., Jensen, I., Wiklund, A., Alfredsson, L.[26]	2006	Position in vehicle, direction of MVC, awareness of collision, use of headrest, use of seatbelt, head position at impact, whether car seat was broken		Seating position not included within multivariate final models because these factors neither improved the models' goodness of fit nor acted as effect modifiers	II
Buitenhuis, J., Jaspers, J., Fidler, V.[31]	2006	Use of head restraints, seat position in car, site of collision, seatbelt use		No association with seat position in car	II
Cobo, E., Mesquida, E., Fanegas, E., Atanasio, E. et al[38]	2010	Location of impact, situation inside the vehicle		No significant association between 6-month VAS and situation inside the vehicle	II
Hendriks, E., Scholten-Peeters, G., van der Windt, D. et al[43]	2005	Direction of impact, location in vehicle, seatbelt use, unprepared for collision, head restraint and correctly positioned, traffic situation		No associations with crash related characteristics and poor recovery	II
Ichihara, D., Okada, E., Chiba, K., Toyama, Y., Fujiwara, H. et al[46]	2009	Place of injury, seating, seatbelt usage, direction of impact, degree of car damage		No significant relationship between seating position (driver's seat) and persistent neck pain, stiff shoulders and numbness in upper extremities	II
Kamper, S., Rebbeck, T., Maher, C., McAuley, J., Sterling, M.[23]	2008	Direction of impact, higher speed of vehicle, aware of impending collision, head rest, seating position, rotated head position, seatbelt use, stationary or moving		Crash related factors including direction and estimated speed of impact do not appear to be related to poor outcome	I
Walton, D., Pretty, J., Macdermid, J., Teasell, R.[63]	2009	Vehicle stationary when hit, frontal collision, rear-end collision, side or other collision, driver of vehicle, front passenger, unprepared for the collision, no seatbelt use, no head restraint used		No significant predictive power for driver of vehicle, front passenger	I

SUMMARY- SEAT POSITION IN CAR: NHMRC Evidence Statement Matrix

1. Evidence base: A

2. Consistency: A

3. Clinical impact: C

4. Generalisability: A

5. Applicability: C

Seating position in the vehicle does not predict poor functional recovery in patients with WAD. Grade of recommendation: A

Two systematic reviews and six primary cohort studies (six cohorts): All reported no association with position (e.g. seating) within the car at time of collision and development of chronic pain/disability.

Table 3.10 Continued

AUTHOR	YEAR	PROGNOSTIC CATEGORY – CRASH RELATED FEATURES	POSITIVE CRASH RELATED FINDINGS	NEGATIVE CRASH RELATED FINDINGS	LEVEL OF EVIDENCE
DIRECTION OF IMPACT					
Berglund, A., Bodin, L., Jensen, I., Wiklund, A., Alfredsson, L.[26]	2006	Position in vehicle, direction of MVC, awareness of collision, use of headrest, use of seatbelt, head position at impact, whether car seat was broken		Direction of MVC not included within multivariate final models because these factors neither improved the models' goodness of fit nor acted as effect modifiers	II
Kongsted, A., Bendix, T., Qerama, E., Kasch, H. et al[51]	2008a	Rear-end collision		No results reported regarding association of rear-end collision and outcome variables	II
Cobo, E., Mesquida, E., Fanegas, E. et al[38]	2010	Location of impact, situation inside the vehicle		No significant association between 6-month VAS and localisation of the impact	II
Hendriks, E., Scholten-Peeters, G., van der Windt, D., Neeleman-van der Steen, C., Oostendorp, R., Verhagen, A.[43]	2005	Direction of impact, location in vehicle, seatbelt use, unprepared for collision, head restraint and correctly positioned, traffic situation		No associations with crash related characteristics and poor recovery	II
Ichihara, D., Okada, E., Chiba, K., Toyama, Y. et al [46]	2009	Place of injury, seating, seatbelt usage, direction of impact, degree of car damage	Unfavourable prognosis (neck pain) significantly associated with double collisions OR 5.8 (1.1 - 29.7, p<.034)		II
Phillips, L., Carroll, L., Cassidy, J.D., Cote, P.[55]	2010	Position in the vehicle, direction of main impact, whether the head was struck in the collision (fractured bones or having struck head)	Multivariate model: rear-end collision associated with less likelihood of having depression that resolves OR 0.65 (.51 - .82), p<.05	Direction of impact not associated with persistent depressive symptoms	II
Vetti, N., Krakens, J., Eide, G., Rorvik, J., Gilhus, N., Espeland, A.[62]	2010	Impact direction, head turned at impact, head injury at accident, seatbelt use, head restraint present, airbag deployment at impact, patient car speed at impact, relative car speed at impact		No accident related variables related to disability or neck pain at 12 months	II
Kamper, S., Rebbeck, T., Maher, C., McAuley, J., Sterling, M.[23]	2008	Direction of impact, higher speed of vehicles, aware of impending collision, head rest, seating position, rotated head position, seatbelt use, stationary or moving		Crash related factors including direction and estimated speed of impact do not appear to be related to poor outcome	I
Walton, D., Pretty, J., Macdermid, J., Teasell, R.[63]	2009	Vehicle stationary when hit, frontal collision, rear-end collision, side or other collision, driver of vehicle, front passenger, unprepared for the collision, no seatbelt use, no head restraint used		No significant predictive power for frontal collision, rear-end collision, side or other collision	I

SUMMARY -DIRECTION OF IMPACT: NHMRC Evidence Statement Matrix
1. Evidence base: A
2. Consistency: B
3. Clinical impact: C
4. Generalisability: A
5. Applicability: C
The direction of impact does not predict poor functional recovery in patients with WAD. Grade of recommendation: B
Both systematic reviews and six primary cohort studies showed no association with direction of impact, one primary cohort showed a positive association.

Table 3.10 Continued

AUTHOR	YEAR	PROGNOSTIC CATEGORY – CRASH RELATED FEATURES	POSITIVE CRASH RELATED FINDINGS	NEGATIVE CRASH RELATED FINDINGS	LEVEL OF EVIDENCE
SPEED					
Atherton, K., Wiles, N.J., Lecky, F.E., Hawes, S.J., Silman, A.J., Macfarlane, G.J., Jones, G.T.[25]	2006	Speed and direction of both vehicles, participant rated severity of collision (100mm VAS), position in vehicle, use of airbag, use of seatbelt, headrest, awareness of impending collision		Univariate analyses: no increased risk of persistent neck pain for speed	II
Carstensen, T., Frostholm, L., Oernboel, E., Kongsted, A., Kasch, H., Jensen, T., Fink, P.[36]	2009	Delta speed (speed difference of cars - risk if difference >30km/hr), extent of damage to car (risk if >50%). Not severe = neither delta speed risk nor damage risk		No significant association between collision severity (speed + damage) and psychological distress, or work capability, or neck pain	II
Carstensen, T., Frostholm, L., Oernboel, E., Kongsted, A., Kasch, H., Jensen, T., Fink, P.[37]	2012	Delta speed (speed difference of cars - risk if difference >30km/hr), extent of damage to car (risk if >50%). Not severe = neither delta speed risk nor damage risk		Collision severity (speed + damage) not associated with considerable neck pain at 12 months	II
Vetti, N., Krakens, J., Eide, G., Rorvik, J., Gilhus, N., Espeland, A.[62]	2010	Impact direction, head turned at impact, head injury at accident, seatbelt use, head restraint present, airbag deployment at impact, patient car speed at impact, relative car speed at impact		No accident related variables related to disability or neck pain at 12 months	II
Kamper, S., Rebbeck, T., Maher, C., McAuley, J., Sterling, M.[23]	2008	Direction of impact, higher speed of vehicles, aware of impending collision, head rest, seating position, rotated head position, seatbelt use, stationary or moving		Crash-related factors including estimated speed of impact do not appear to be related to poor outcome	I

SUMMARY –SPEED: NHMRC Evidence Statement Matrix
1. Evidence base: A
2. Consistency: A
3. Clinical impact: C
4. Generalisability: A
5. Applicability: C
The speed of impact does not predict poor functional recovery in participants with WAD. Grade of recommendation: A
Four primary cohort studies (three cohorts) and one systematic review: All no association of speed and development of chronic pain/disability, therefore strong evidence for no association.

Table 3.10 Continued

AUTHOR	YEAR	PROGNOSTIC CATEGORY – CRASH RELATED FEATURES	POSITIVE CRASH RELATED FINDINGS	NEGATIVE CRASH RELATED FINDINGS	LEVEL OF EVIDENCE
HEAD POSITION AT IMPACT					
Berglund, A., Bodin, L., Jensen, I., Wiklund, A., Alfredsson, L.[26]	2006	Position in vehicle, direction of MVC, awareness of collision, use of headrest, use of seatbelt, head position at impact, whether car seat was broken		Head position at impact not included within multivariate final models because these factors neither improved the models' goodness of fit nor acted as effect modifiers	II
Gabel, C., Burkett, B., Neller, A., Yelland, M. [40]	2008	Cervical rotation at impact	Cervical rotation at impact combined with psychosocial screening tool (generic screening tool) predictive of non-recovery (NDI >8%) (LR = 7.7, sensitivity = 100%, specificity = 87%)		II
Vetti, N., Krakens, J., Eide, G., Rorvik, J., Gilhus, N., Espeland, A.[62]	2010	Impact direction, head turned at impact, head injury at accident, seatbelt use, head restraint present, airbag deployment at impact, patient car speed at impact, relative car speed at impact		No accident related variables related to disability or neck pain at 12 months	II
Kamper, S., Rebbeck, T., Maher, C., McAuley, J., Sterling, M.[23]	2008	Direction of impact, higher speed of vehicles, aware of impending collision, head rest, seating position, rotated head position, seatbelt use, stationary or moving		Crash related factors do not appear to be related to poor outcome	I

SUMMARY – HEAD POSITION AT IMPACT: NHMRC Evidence Statement Matrix
1. Evidence base: A
2. Consistency: B
3. Clinical impact: C
4. Generalisability: A
5. Applicability: C
Head position at the time of impact does not predict poor functional recovery in patients with WAD. Grade of recommendation: B
Three primary cohort studies (three cohorts) and one systematic review: two high quality studies (Berglund scores 13/16 and Vetti scores 18/18) and systematic review indicated no association with head position at impact; one low quality (Gable scores 7/10) indicated association in combination with generic screening tool.

Table 3.11 Summary of evidence for specific physical/impairment measures

AUTHOR	YEAR	COHORT	RATING SCORE	PROG CAT 6 (PHYS)	POSITIVE RESULTS PHYSICAL FACTORS	NEGATIVE RESULTS PHYSICAL FACTORS	LEVEL OF EVIDENCE
CERVICAL RANGE OF MOVEMENT							
Borenstein, P., Rosenfeld, M., Gunnarsson, R.[27]	2010	O	11	CROM (lateral flexion, extension/flexion, rotation)	Total CROM and three measures (flexion-extension, lateral flexion, rotation) with cognitive symptom (easily irritated) significantly predicted sick leave at 3 years OR 31 (3.2 - 3 06), p<.003		II
Elliot, J., Pedler, A., Kenardy, J., Galloway, G. et al [13]	2011	St1	16	Total CROM		Mediational effect of reduced CROM on MFI was not supported suggesting that pain and ROM interact separately and/or possibly in tandem through other biophysical pathways	II
Hendriks, E., Scholten-Peeters, G. et al[43]	2005	G	18	Total CROM		CROM not associated with poor recovery (VAS >30 or activity VAS >78) at 1 year	II
Kasch, H., Qerama, E., Kongsted, A., Bach, F., Bendix, T., Jensen, T.[48]	2011	N	12	CROM	Risk assessment score (7 stratum grouped from 'a priori' decided factors: CROM, neck/head VAS, number of non-painful symptoms) predicted non-recovery based on work disability ROC = 0.899 (.737 - 1.0). Kruskal-Wallis showed significant relationship with 1-year work disability and risk score (p<.000) and sick days (p<.000)		II
Kasch, H., Qerama, E., Kongsted, A. et al[49]	2008	A	17	Total CROM, total palpation pain score (neck and jaw muscle pairs)	Reduced CROM associated with 4.6-fold increase in chronic handicap (sick leave). Active CROM best prognostic marker of handicap (sick leave) at 1 year (accuracy 74%)	CROM not associated with long term neck pain or headache	II
Sterling, M., Jull, G., Kenardy, J.[58]	2006a	St4	15	CROM, PPTs, thermal pain thresholds, SVR (QI and SRF), BPPT		ROM (right rotation, left rotation), not significant predictor of 2 to 3 year NDI	II
Sterling, M., Jull, G., Vincenzino, B., Kenardy, J., Darnell, R.[59]	2005	St4	16	ROM, pressure pain thresholds (articular pillars (c2/3, c5/6), elbow, tibialis anterior), thermal pain thresholds (hot, cold), brachial plexus provocation test, SVR	Left rotation predicted NDI score at 6 months (t value = -1.9, p<.05). Decreased cervical extension significant predictor of those with mild symptoms (NDI) compared with recovered OR 1.1 (1.03 - 1.25), p<.03		II

Table 3.11 Continued

AUTHOR	YEAR	COHORT	RATING SCORE	PROG CAT 6 (PHYS)	POSITIVE RESULTS PHYSICAL FACTORS	NEGATIVE RESULTS PHYSICAL FACTORS	LEVEL OF EVIDENCE
CERVICAL RANGE OF MOVEMENT							
Sterling M., Hendrikz J. et al[61]	2012	St5	18	NDI, age, CROML, CPT, SVR (QI quotient of integrals), IES	When adjusted for site NDI, age, CPT and IES were significant predictors of NDI at 12 months. The predictive set could discriminate between recovered/mild participants and moderate/severe participants at 12 months (ROC AUC: 0.89 [95% confidence interval 0.84 – 0.94], p<.001		
Kamper, S., Rebbeck, T., Maher, C. et al[23]	2008	Sys	NA	CROM, cold sensitivity, altered muscle recruitment, joint position error, BMI		Inconclusive evidence for association of all factors and persistent pain/disability	I
Walton, D., Pretty, J. et al[63]	2009	Sys	NA	CROM		Inconclusive evidence for association of CROM with development of persistent whiplash-related problems	I
Williams, M., Williamson, E., Gates, S., Lamb, S., Cooke, M.[64]	2007	Sys	NA	ROM, neck muscle EMG, motor evoked potentials, muscle spasm, cold hyperalgesia, PPTs, BMI, height and weight		All other factors inconclusive evidence for an association with late whiplash syndrome	I

SUMMARY – CERVICAL RANGE OF MOVEMENT AND DISABILITY AS OUTCOME: NHMRC Evidence Statement Matrix
1. Evidence base: A
2. Consistency: A
3. Clinical impact: B
4. Generalisability: A
5. Applicability: B
Initial cervical range of movement does predict non-recovery (in terms of disability) in patients with WAD. Grade of recommendation: A
SUMMARY – CERVICAL RANGE OF MOVEMENT AND NECK PAIN AS OUTCOME: NHMRC Evidence Statement Matrix
6. Evidence base: A
7. Consistency: B
8. Clinical impact: B
9. Generalisability: A
10. Applicability: B
Initial cervical range of movement does not predict non-recovery (in terms of pain) in patients with WAD. Grade of recommendation: B
Eight primary cohort studies (six cohorts) plus three systematic reviews. All systematic reviews indicate inconclusive evidence for association of CROM and persistent pain or disability. Primary cohort studies: two cohorts showed significant association with sick leave and another cohort included CROM as part of a risk assessment score that showed a significant relationship with work disability, and there were no studies with work disability as outcome that showed no association (therefore may be predictive of chronic disability measured as work disability?). However, CROM as predictive factor inconclusive for other outcome measures – there was no association with neck and headache pain in two cohorts and in one cohort CROM was predictive of NDI at six months but not at two to three years.

Table 3.11 Continued

AUTHOR	YEAR	COHORT	RATING SCORE	PROG CAT 6 (PHYS)	POSITIVE RESULTS PHYSICAL FACTORS	NEGATIVE RESULTS PHYSICAL FACTORS	LEVEL OF EVIDENCE
THERMAL PAIN THRESHOLDS							
Sterling, M.	2010	St3	18	Pressure pain thresholds, cold pain thresholds		Cold pain threshold not predictive of 6-month NFR	II
Sterling, M., Hendrikz, J., Kenardy, J.[57]	2011	St5	14	PPT, CPT, SVR	CPT (>13) significantly linked to membership to chronic/severe NDI group OR 26.3 (4.98 - 139.1), membership to moderate NDI group OR 3.6 (1.3 - 9.8), membership to moderate/severe PDS group OR 9.7 (2.2 - 42.4)		II
Sterling, M., Jull, G., Kenardy, J.[58]	2006a	St4	15	CROM, PPTs, Thermal pain thresholds, SVR (QI and SRF), BPPT	Cold pain threshold significantly predicted membership to moderate/severe group at 2 to 3 years OR 1.1 (1.0 - 1.13)	Heat pain threshold not a significant predictor of 2 to 3 year NDI	II
Sterling, M., Jull, G., Vincenzino, B., Kenardy, J., Darnell, R.[59]	2005	St4	16	ROM, pressure pain thresholds (articular pillars (c2/3, c5/6), elbow, tibialis anterior), thermal pain thresholds (hot, cold), brachial plexus provocation test, sympathetic vasoconstrictor response	Cold pain threshold predictor of moderate/ severe group OR 1.29 (1.05 - 1.58)	No significant predictive capacity for heat pain	II
Sterling, M., Kenardy, J.[60]	2006b	St4	18	PPTs, thermal pain thresholds, SVR (QI and SRF), BPPT		Sensory measures (PPT, HPT, CPT) associated with PTSR b = .28, p<.02) and initial NDI however insignificant finding of sensory measures on PTSD when mediated by initial NDI. No significant association between sympathy disturbances and ND	II
Sterling M., Hendrikz J. et al[61]	2012	St6	18	NDI, age, CROML, CPT, SVR (QI quotient of integrals), IES	When adjusted for site NDI, age, CPT and IES were significant predictors of NDI at 12 months. The predictive set could discriminate between recovered/mild participants and moderate/severe participants at 12 months (ROC AUC: 0.89 [95% confidence interval 0.84 – 0.94], p<.001		II
Goldsmith, R., Wright, C., Bell., S. Rushton, A.[41]	2012	Sys	NA	Cold hyperalgesia	Moderate evidence from 2 study groups on 4 cohorts to support cold hyperalgesia as an independent prognostic factor for long term pain and disability		I
Kamper, S., Rebbeck, T., Maher, C. et al[23]	2008	Sys	NA	CROM, cold sensitivity, altered muscle recruitment, joint position error, BMI		Inconclusive evidence for association of all factors and persistent pain/disability	I

Table 3.11 Continued

AUTHOR	YEAR	COHORT	RATING SCORE	PROG CAT 6 (PHYS)	POSITIVE RESULTS PHYSICAL FACTORS	NEGATIVE RESULTS PHYSICAL FACTORS	LEVEL OF EVIDENCE
THERMAL PAIN THRESHOLDS							
Williams, M., Williamson, E., Gates, S., Lamb, S., Cooke, M.[64]	2007	Sys	NA	ROM, neck muscle EMG, motor evoked potentials, muscle spasm, cold hyperalgesia, PPTs, BMI, height and weight	Moderate evidence for an association with late whiplash syndrome - cold hyperalgesia		I

SUMMARY – THERMAL PAIN THRESHOLDS: NHMRC Evidence Statement Matrix
1. Evidence base: A
2. Consistency: A
3. Clinical impact: B
4. Generalisability: A
5. Applicability: B
Initial cold hyperalgesia predicts non-recovery (in terms of disability) in patients with WAD. Grade of recommendation: A
Six primary cohort studies (four cohorts) and three systematic reviews. Two systematic reviews concluded that there was moderate evidence for cold hyperalgesia as a predictor of persistent pain/disability and one systematic review indicated evidence was inconclusive. Primary cohorts: two cold pain predictive of NDI and PDS however insignificant when mediated by initial NDI.

Table 3.11 Continued

AUTHOR	YEAR	COHORT	RATING SCORE	PROG CAT 6 (PHYS)	POSITIVE RESULTS PHYSICAL FACTORS	NEGATIVE RESULTS PHYSICAL FACTORS	LEVEL OF EVIDENCE
PRESSURE PAIN THRESHOLDS							
Sterling, M.[18]	2010	St3	18	Pressure pain thresholds, cold pain thresholds		PPTs not predictive of 6-month NFR	II
Sterling, M., Hendrikz, J., Kenardy, J.[57]	2011	St5	14	PPT, CPT, SVR	PPT neck predictive of membership to chronic mod/severe PDS group OR 0.99 (.98 - 1.0), p<.05	PPT neck and PPT arm not predictive of 12-month NDI	II
Sterling, M., Jull, G., Kenardy, J.[58]	2006a	St4	15	CROM, PPTs, thermal pain thresholds, SVR (QI and SRF), BPPT		PPT neck, PPT median nerve, PPT tibany, not significant predictors of 2 to 3-year NDI	II
Sterling, M., Jull, G., Vincenzino, B., Kenardy, J., Darnell, R.[59]	2005	St4	16	ROM, pressure pain thresholds (articular pillars (c2/3, c5/6), elbow, tibialis anterior), thermal pain thresholds (hot, cold), brachial plexus provocation test, sympathetic vasoconstrictor response		No significant predictive capacity for PPT	II
Sterling, M., Kenardy, J.[60]	2006b	St4	18	PPTs, thermal pain thresholds, SVR (QI and SRF), BPPT		Sensory measures (PPT, HPT, CPT) associated with PTSD (b = .28, p<.02) and initial NDI however insignificant finding of sensory measures on PTSD when mediated by initial NDI. No significant association between sympathy disturbances and NDI	II
Williams, M., Williamson, E., Gates, S., Lamb, S., Cooke, M.[64]	2007	Sys	NA	ROM, neck muscle EMG, motor evoked potentials, muscle spasm, cold hyperalgesia, PPTs, BMI, height and weight		All other factors inconclusive evidence for an association with late whiplash syndrome	I

SUMMARY – PRESSURE PAIN THRESHOLDS: SUMMARY – CROM AND DISABILITY AS OUTCOME: NHMRC Evidence Statement Matrix

1. Evidence base: A

2. Consistency: A

3. Clinical impact: B

4. Generalisability: A

5. Applicability: B

Initially lower pressure pain thresholds (mechanical hyperalgesia) do not predict non-recovery in patients with WAD. Grade of recommendation: A

Five primary cohort studies (St4 x 3, and St3, St5) and one systematic review. Systematic review indicated inconclusive evidence. One cohort showed that PPT neck was predictive of chronic PDS symptoms and two cohorts showed no association with NDI as an outcome and one cohort no association with NFR as an outcome.

Table 3.11 Continued

AUTHOR	YEAR	COHORT	RATING SCORE	PROG CAT 6 (PHYS)	POSITIVE RESULTS PHYSICAL FACTORS	NEGATIVE RESULTS PHYSICAL FACTORS	LEVEL OF EVIDENCE
MEASURES OF MOTOR AND SENSORY-MOTOR DYSFUNCTION							
Kongsted, A., Jorgensen, L., Leboeuf-Yde, C. et al[52]	2008b	A1	15	Eye movement control		Measures of electrooculography (gains and SPNT-diff values) were not predictive of neck or headache pain, neck disability or work ability at 1 year	II
Sterling, M., Jull, G., Kenardy, J.[58]	2006a	St4	15	CROM, PPTs, thermal pain thresholds, SVR (QI and SRF), BPPT, muscle function, joint position error (JPE)		JPE, neck flexor EMG activity with cervical flexion not significant predictor of 2 to 3-year NDI	II
Sterling, M., Jull, G., Vincenzino, B., Kenardy, J., Darnell, R.[59]	2005	St4	16	ROM, muscle function, JPE pressure pain thresholds (articular pillars (c2/3, c5/6), elbow, tibialis anterior), thermal pain thresholds (hot, cold), brachial plexus provocation test, sympathetic vasoconstrictor response	QI of SVR predictor of mild versus recovered SVR OR 1.1 (1.03 - 1.25)	JPE, neck flexor EMG activity with cervical flexion not significant predictor of 2 to 3-year NDI	II
Kamper, S., Rebbeck, T., Maher, C., McAuley, J., Sterling, M.[23]	2008	Sys	NA	CROM, cold hyperalgesia, altered muscle recruitment, JPE, BMI		Inconclusive evidence for association of all factors and persistent pain/disability	I
Williams, M., Williamson, E., Gates, S., Lamb, S., Cooke, M.[64]	2007	Sys	NA	ROM, neck muscle EMG, motor evoked potentials, muscle spasm, cold hyperalgesia, PPTs, BMI, height and weight		All other factors inconclusive evidence for an association with late whiplash syndrome	I

SUMMARY – MOTOR/SENSORY-MOTOR FUNCTION: NHMRC Evidence Statement Matrix
1. Evidence base: A
2. Consistency: A
3. Clinical impact: B
4. Generalisability: A
5. Applicability: B
Initial motor/sensory-motor dysfunction does not predict non-recovery in patients with WAD. Grade of recommendation: A
Both systematic reviews and all primary cohort studies showed no predictive association with motor/sensory-motor dysfunction and pain or disability.

Table 3.11 Continued

AUTHOR	YEAR	COHORT	RATING SCORE	PROG CAT 6 (PHYS)	POSITIVE RESULTS PHYSICAL FACTORS	NEGATIVE RESULTS PHYSICAL FACTORS	LEVEL OF EVIDENCE
SYMPATHETIC NERVOUS SYSTEM ACTIVITY							
Sterling, M., Hendrikz, J., Kenardy, J.[57]	2011	St5	14	PPT, CPT, sympathetic vasoconstrictor response (SVR)		QI and SRF parameter not associated with PDS or NDI	II
Sterling, M., Jull, G., Kenardy, J.[58]	2006a	St4	15	CROM, PPTs, thermal pain thresholds, SVR, BPPT		BBPT, SVR-QI and SVR-SRF not significant predictors of 2 to 3-year NDI	II
Sterling, M., Jull, G., Vincenzino, B., Kenardy, J., Darnell, R.[59]	2005	St4	16	ROM, pressure pain thresholds (articular pillars (c2/3, c5/6), elbow, tibialis anterior), thermal pain thresholds (hot, cold), brachial plexus provocation test, SVR	QI of SVR predictor of mild versus recovered SVR OR 1.1 (1.03-1.25)	No significant predictive capacity for joint position error, EMG activity, brachial plexus test	II
Sterling, M., Kenardy, J.[60]	2006b	St4	18	PPTs, thermal pain thresholds, (SVR), BPPT		Sensory measures (PPT, HPT, CPT) associated with PTSR (b = .28, p<.02) and initial NDI however insignificant finding of sensory measures on PTSR when mediated by initial NDI. No significant association between sympathy disturbances and NDI	II
Sterling M., Hendrikz J. et a [61]	2012	St6	18	NDI, age, CROML, CPT, SVR (QI quotient of integrals), IES	When adjusted for site NDI, age, CPT and IES were significant predictors of NDI at 12 months. The predictive set could discriminate between recovered/mild participants and moderate/severe participants at 12 months (ROC AUC: 0.89 [95% confidence interval 0.84 – 0.94], p<.001		II

SUMMARY – SYMPATHETIC NERVOUS SYSTEM ACTIVITY: NHMRC Evidence Statement Matrix
1. Evidence base: B
2. Consistency: A
3. Clinical impact: C
4. Generalisability: A
5. Applicability: B
Initial sympathetic nervous system activity (vasoconstriction) does not predict non-recovery in patients with WAD. Grade of recommendation: B
No association was indicated with two cohorts. Initial sympathetic nervous system activity was included in the predictive set of one cohort.

Table 3.11 Continued

AUTHOR	YEAR	COHORT	RATING SCORE	PROG CAT 6 (PHYS)	POSITIVE RESULTS PHYSICAL FACTORS	NEGATIVE RESULTS PHYSICAL FACTORS	LEVEL OF EVIDENCE
BODY MASS INDEX (BMI)							
Yang, X., Cote, P., Cassidy, J.D., Carroll, L.[66]	2007	L	15	Body Mass Index (BMI)		BMI not associated with time to recovery (number of days from injury to insurance claim) (HRR all close to unity with overlapping 95% CIs)	II
Kamper, S., Rebbeck, T., Maher, C., McAuley, J., Sterling, M.[23]	2008	Sys	NA	CROM, cold sensitivity, altered muscle recruitment, joint position error, BMI		Inconclusive evidence for association of all factors and persistent pain/disability	I
Williams, M., Williamson, E., Gates, S., Lamb, S., Cooke, M.[64]	2007	Sys	NA	ROM, neck muscle EMG, motor evoked potentials, muscle spasm, cold hyperalgesia, PPTs, BMI, height and weight		All other factors inconclusive evidence for an association with late whiplash syndrome	I

SUMMARY – BODY MASS INDEX: NHMRC Evidence Statement Matrix
1. Evidence base: A
2. Consistency: A
3. Clinical impact: B
4. Generalisability: A
5. Applicability: B
Body Mass Index does not predict non-recovery in patients with WAD. Grade of recommendation: A
All indicated no predictive association with BMI and outcome measures.

Table 3.12 Summary of evidence for specific pre-collision factors

AUTHOR	YEAR	COHORT	RATING SCORE	PROG CAT 7 (PREV HX)	POSITIVE RESULTS PRE-CRASH HEALTH	NEGATIVE RESULTS PRE-CRASH HEALTH	LEVEL OF EVIDENCE
PRE-COLLISION NECK PAIN							
Atherton, K., Wiles, N.J., Lecky, F.E. et al[25]	2006	C	15	Pre-crash general health, pre-crash neck pain, bodily pain		Hx of neck pain prior was not associated with increased risk of persistent pain at 12 months	II
Cobo, E., Mesquida, E., Fanegas, E., Atanasio, E., Pastor, B., Pont, C., Prieto, C. et al[38]	2010	F	16	Pre-existing health problems, presence of pre-accident neck, dorsal or low back pain, medication use prior		Univariate analysis showed pre-existing neck pain significant predictor of VAS at 6 months (p<.003). Pre-existing neck pain not significant in multivariate analysis	II
Carstensen, T., Frostholm, L., Oernboel, E., Kongsted, A., Kasch, H., Jensen, T., Fink, P.[36]	2009	A	16	Pre-collision psychological, distress, pre-collision health problems (illness, unspecified pain condition, neck pain)		Pre-collision neck pain was not associated with work capability or neck pain at 12 months	II
Gun, R., Osti, O., O'Riordan, A. et al[42]	2005	Q	16	Prior neck pain		No data provided for prior neck pain	II
Hendriks, E., Scholten-Peeters, G., van der Windt, D. et al[43]	2005	G	18	Previous neck pain, headache, participation problems, co-morbidity and prior pain medication use		Pre-existing neck pain not associated with poor recovery (VAS >30, activity VAS <78)	II
Holm, L., Carroll, L., Cassidy, J.D., Skillgate, E., Ahlbom, A.[44]	2007	L		Prior general health, prior neck pain, prior headache		Prior neck pain did not change estimates and were therefore not included in final regression mode	II
Holm, L., Carroll, L., Cassidy, J.D., Skillgate, E., Ahlbom, A.[45]	2008	M	16	Prior general health, prior neck pain, prior headache	Prior neck pain (OR 6.7 (3 - 15) associated with neck pain disability at 6 months in univariate analyses, therefore included as confounders in multivariate analysis		II
Kivioja, J., Jensen, I., Lindgren, U.[50]	2005	P	15	Prior neck pain, prior shoulder pain	Prior neck and shoulder pain the only predictor of neck pain at 1 year OR 4.5 (1.1 - 8.8), p<.035		II
Kamper, S., Rebbeck, T., Maher, C., McAuley, J., Sterling, M.[23]	2008	Sys	NA	prior neck pain or headache		No comment on pre-accident neck pain. Table 3 indicates 3 of 7 significant findings	I
Walton, D., Pretty, J., Macdermid, J., Teasell, R.[63]	2009	Sys	NA	Pre-accident neck pain, headache	Hx of neck pain small but significant risk of developing persistent WAD-related problems OR 1.7 (1.2 - 2.5)		I
Williams, M., Williamson, E., Gates, S., Lamb, S., Cooke, M.[64]	2007	Sys	NA	Pre-injury neck pain, pre-injury headache, pre-injury back pain, pre-injury widespread pain, pre-injury degeneration		Inconclusive evidence for pre-injury neck pain	I

Table 3.12 Continued

AUTHOR	YEAR	COHORT	RATING SCORE	PROG CAT 7 (PREV HX)	POSITIVE RESULTS PRE-CRASH HEALTH	NEGATIVE RESULTS PRE-CRASH HEALTH	LEVEL OF EVIDENCE
PRE-COLLISION NECK PAIN							

SUMMARY – PRE-COLLISION NECK PAIN: NHMRC Evidence Statement Matrix
1. Evidence base: A
2. Consistency: B
3. Clinical impact: B
4. Generalisability: A
5. Applicability: B
Pre-collision neck pain does not predict non-recovery in patients with WAD. Grade of recommendation: B
Eight primary cohort studies (eight cohorts) and three systematic reviews. Two systematic reviews concluded that there was inconclusive evidence for pre-injury neck pain as a predictor of chronic whiplash and one systematic review indicated that there was limited evidence for pre-existing neck pain as a predictor of persistent WAD. Primary cohorts: one study found a significant association of prior neck and shoulder pain as predictors of persistent neck pain and prior neck pain was included as confounder in the analyses of prognostic factors with another study. No association was found with six cohorts (75%) therefore moderate-strong evidence for no association.

AUTHOR	YEAR	COHORT	RATING SCORE	PROG CAT 7 (PREV HX)	POSITIVE RESULTS PRE-CRASH HEALTH	NEGATIVE RESULTS PRE-CRASH HEALTH	LEVEL OF EVIDENCE
PRE-COLLISION HEADACHE							
Hendriks, E., Scholten-Peeters, G., van der Windt, D. et al[43]	2005	G	18	Previous neck pain, headache, participation problems, co-morbidity and pain medication use prior		Pre-existing headache not associated with poor recovery (VAS >30, activity VAS <78)	II
Holm, L., Carroll, L., Cassidy, J.D., Skillgate, E., Ahlbom, A.[44]	2007	L		Prior general health, prior neck pain, prior headache		Prior headache did not change estimates and were therefore not included in final regression model	II
Holm, L., Carroll, L., Cassidy, J.D., Skillgate, E., Ahlbom, A.[45]	2008	M	16	Prior general health, prior neck pain, prior headache	Prior headache (OR 4.1 (1.3 - 11) associated with neck pain disability at 6 months in univariate analyses, therefore included as confounders in multivariate analysis		II
Phillips, L., Carroll, L., Cassidy, J.D., Cote, P.[55]	2010	I	16	Pre-crash health (self-report general health, pre-existing co-morbid conditions including mental health)	Prior headaches associated with resolution with recurrence OR 1.66 (1.09 - 2.53) and later onset of depressive symptoms OR 1.66 (1.11 - 2.47)		II
Kamper, S., Rebbeck, T., Maher, C. et al [23]	2008	Sys	NA	Prior neck pain or headache		No comment on pre-accident headache. Table 3 indicates 3 of 7 significant findings	I
Walton, D., Pretty, J., Macdermid, J., Teasell, R.[63]	2009	Sys	NA	Pre-accident neck pain, headache		History of headache not significant in predicting development of persistent WAD-related symptoms OR 2.2 (0.7 - 6.7)	I

Table 3.12 Continued

AUTHOR	YEAR	COHORT	RATING SCORE	PROG CAT 7 (PREV HX)	POSITIVE RESULTS PRE-CRASH HEALTH	NEGATIVE RESULTS PRE-CRASH HEALTH	LEVEL OF EVIDENCE
PRE-COLLISION HEADACHE							
Williams, M., Williamson, E., Gates, S., Lamb, S., Cooke, M.[64]	2007	Sys	NA	Pre-injury neck pain, pre-injury headache, pre-injury back pain, pre-injury widespread pain, pre-injury degeneration		Inconclusive evidence for pre-injury headache	I

SUMMARY – PRE-COLLISION HEADACHE: NHMRC Evidence Statement Matrix
1. Evidence base: A
2. Consistency: B
3. Clinical impact: B
4. Generalisability: A
5. Applicability: B
Pre-collision headache does not predict non-recovery in patients with WAD. Grade of recommendation: B
Four primary cohort studies (four cohorts) and three systematic reviews. All three systematic reviews indicated no association. Primary cohorts: a significant relationship was found for pre-collision headache and development of depressive symptoms in one cohort and headache was included as a confounder in another study, however prior headache was found to have no significant predictive value with two other cohorts.

AUTHOR	YEAR	COHORT	RATING SCORE	PROG CAT 7 (PREV HX)	POSITIVE RESULTS PRE-CRASH HEALTH	NEGATIVE RESULTS PRE-CRASH HEALTH	LEVEL OF EVIDENCE
PRE-COLLISION BODILY PAIN							
Atherton, K., Wiles, N.J., Lecky, F.E. et al[25]	2006	C	15	Pre-crash general health, pre-crash neck pain, bodily pain	Pre-collision widespread bodily pain significant independent predictor of persistent neck pain RR = 1.9 (1.1 - 3.3)		II
Carstensen, T., Frostholm, L., Oernboel, E., Kongsted, A., Kasch, H., Jensen, T., Fink, P.[36]	2009	A	16	Pre-collision psych distress, pre-collision health problems (illness, unspecified pain condition, neck pain)	Pre-collision unspecified pain significantly increased the odds for affected work capability OR 2.4 (1.4 - 4.2) and persistent neck pain OR 3.5 (2.0 - 5.9)		II
Cobo, E., Mesquida, E., Fanegas, E., Atanasio, E., Pastor, B., Pont, C., Prieto, C. et al[38]	2010	F	16	Pre-existing health problems, presence of pre-accident neck, dorsal or low back pain, medication use prior		Pre-existing dorsal pain and low back pain not associated with VAS at 6 months. Pre-existing neck pain not significant in multivariate analysis	II
Kivioja, J., Jensen, I., Lindgren, U.[50]	2005	P	15	Prior neck pain, prior shoulder pain	Prior neck and shoulder pain the only predictor of neck pain at 1 year OR 4.5 (1.1 - 8.8), p<.035		II

Table 3.12 Continued

AUTHOR	YEAR	COHORT	RATING SCORE	PROG CAT 7 (PREV HX)	POSITIVE RESULTS PRE-CRASH HEALTH	NEGATIVE RESULTS PRE-CRASH HEALTH	LEVEL OF EVIDENCE
PRE-COLLISION BODILY PAIN							
Phillips, L., Carroll, L., Cassidy, J.D., Cote, P.[55]	2010	I	16	Pre-crash health (self-report general health, pre-existing co-morbid conditions including mental health)	Mild MSK pain associated with resolution of depressive symptoms OR 0.76 (0.6 - 0.96) and resolution with recurrence OR 0.67 (0.48 - 0.92)		II
Williams, M., Williamson, E., Gates, S., Lamb, S., Cooke, M.[64]	2007	Sys		Pre-injury neck pain, pre-injury headache, pre-injury back pain, pre-injury widespread pain, pre-injury degeneration	Limited evidence (1 study - Atherton) for an association with pre-injury widespread pain and the development of late whiplash syndrome	Inconclusive evidence for back pain and degeneration	I

SUMMARY – PRE-COLLISION BODILY PAIN: SUMMARY: NHMRC Evidence Statement Matrix
1. Evidence base: A
2. Consistency: B
3. Clinical impact: B
4. Generalisability: A
5. Applicability: B
Pre-collision bodily pain may predict non-recovery in patients with WAD. Grade of recommendation: B
Five cohorts included self-reported measures of other types of pain – back pain, shoulder pain, or general measures such as bodily pain and widespread pain. The one systematic review that concluded limited evidence for predictive value of widespread pain based the conclusion on the Atherton study only.

AUTHOR	YEAR	COHORT	RATING SCORE	PROG CAT 7 (PREV HX)	POSITIVE RESULTS PRE-CRASH HEALTH	NEGATIVE RESULTS PRE-CRASH HEALTH	LEVEL OF EVIDENCE
PRE-COLLISION GENERAL HEALTH							
Ameratunga, S., Tin, S.T., Connor, J., Norton, R.[24]	2010	B	13	Pre-crash SF36, pre-crash psych disorders		General health at baseline (I think SF36 for prior health) not associated with neck pain/ stiffness at 18 months	II
Atherton, K., Wiles, N.J., Lecky, F.E., Hawes, S.J., Silman, A.J., Macfarlane, G.J., Jones, G.T.[25]	2006	C	15	Pre-crash general health, pre-crash neck pain, bodily pain		Self-reported general health (single question, Likert type response) prior to the collision was not associated with increased risk of persistent pain at 12 months	II
Carstensen, T., Frostholm, L., Oernboel, E., Kongsted, A., Kasch, H., Jensen, T., Fink, P.[36]	2009	A	16	Pre-collision psych distress, pre-collision health problems (illness, unspecified pain condition, neck pain)		Pre-collision persistent illness was not associated with work capability or neck pain at 12 months	II

Table 3.12 Continued

AUTHOR	YEAR	COHORT	RATING SCORE	PROG CAT 7 (PREV HX)	POSITIVE RESULTS PRE-CRASH HEALTH	NEGATIVE RESULTS PRE-CRASH HEALTH	LEVEL OF EVIDENCE
PRE-COLLISION GENERAL HEALTH							
Hendriks, E., Scholten-Peeters, G., van der Windt, D., Neeleman-van der Steen, C. et al[43]	2005	G	18	Previous neck pain, headache, participation problems, co-morbidity and pain medication use prior		Pre-existing participation problems and co-morbidity not associated with poor recovery (VAS >30, activity VAS <78)	II
Holm, L., Carroll, L., Cassidy, J.D., Skillgate, E., Ahlbom, A.[44]	2007	L	16	Prior general health, prior neck pain, prior headache		Prior general health did not change estimates and was therefore not included in final regression model	II
Holm, L., Carroll, L., Cassidy, J.D., Skillgate, E., Ahlbom, A.[45]	2008	M	16	Prior general health, prior neck pain, prior headache			
Kongsted, A., Bendix, T., Qerama, E., Kasch, H., Bach, F., Korsholm, L., Jensen, T.[51]	2008a	A	16	SF36 for 4 weeks prior to MVC		Self-reported general health (SF36) prior to the MVC did not differ significantly between individuals with mild and distinct IES at baseline therefore not included in multivariate analyses	II
Phillips, L., Carroll, L., Cassidy, J.D., Cote, P.[55]	2010	I	16	Pre-crash health (self-report general health, pre-existing co-morbid conditions including mental health)	Prior self-reported fair or poor general health associated with persistent depressive symptoms OR 2.44 (1.09 - 5.47)	Prior GI problems not associated with any of the categories for progression of depression	II

SUMMARY – PRE-COLLISION GENERAL HEALTH: NHMRC Evidence Statement Matrix
1. Evidence base: A
2. Consistency: A
3. Clinical impact: B
4. Generalisability: A
5. Applicability: B
Pre-collision general health does not predict non-recovery in patients with WAD. Grade of recommendation: A
Eight primary cohort studies (seven cohorts). All seven reported no significant association with various measures of self-report pre-collision general health and development of WAD outcomes. One cohort reported that self-reported fair or poor health was predictive of development of persistent depressive symptoms.

Table 3.12 Continued

AUTHOR	YEAR	COHORT	RATING SCORE	PROG CAT 7 (PREV HX)	POSITIVE RESULTS PRE-CRASH HEALTH	NEGATIVE RESULTS PRE-CRASH HEALTH	LEVEL OF EVIDENCE
PRE-COLLISION PSYCHOLOGICAL HEALTH							
Ameratunga, S., Tin, S.T., Connor, J., Norton, R. [24]	2010	B	13	Pre-crash SF36, pre-crash psych disorders		Pre-crash psychiatric disorders not associated with neck pain/stiffness at 18 months	II
Carstensen, T., Frostholm, L., Oernboel, E., Kongsted, A., Kasch, H., Jensen, T., Fink, P.[36]	2009	A	16	Pre-collision psych distress, pre-collision health problems (illness, unspecified pain condition, neck pain)	Pre-collision psychological distress significantly increased odds for considerable neck pain OR 2.1 (.1 - 4.2)	Pre-collision psych distress was not associated with work capability at 12 months	II
Phillips, L., Carroll, L., Cassidy, J.D., Cote, P.[55]	2010	I	16	Pre-crash health (self-report general health, pre-existing co-morbid conditions including mental health)	Prior severe mental health problems associated with resolution of depressive symptoms OR 3.38 (1.54 - 7.42), resolution with recurrence OR 6.26 (2.67 - 14.69), and persistent depressive symptoms OR 16.78 (6.73 - 41.83)		II

SUMMARY – PRE-COLLISION PSYCHOLOGICAL HEALTH: NHMRC Evidence Statement Matrix
1. Evidence base: A
2. Consistency: C
3. Clinical impact: B
4. Generalisability: A
5. Applicability: B
Pre-collision psychological health may predict non-recovery in patients with WAD. Grade of recommendation: C
Three primary cohort studies (three cohorts). Varied results and all with caveats of difficulties assessing prior mental health. Two cohorts significant association of self-reported prior mental health distress with persistent neck pain or depression and two cohorts concluded no association with neck pain or work capability.

Table 3.12 Continued

AUTHOR	YEAR	COHORT	RATING SCORE	PROG CAT 7 (PREV HX)	POSITIVE RESULTS PRE-CRASH HEALTH	NEGATIVE RESULTS PRE-CRASH HEALTH	LEVEL OF EVIDENCE
PRE-COLLISION MEDICATION USE							
Cobo, E., Mesquida, E., Fanegas, E., Atanasio, E., Pastor, B., Pont, C., Prieto, C., Gomez, G., Cano, L.[38]	2010	F	16	Pre-existing health problems, presence of pre-accident neck, dorsal or low back pain, medication use prior		Pre-accident medication use (antidepressives, sedatives) not associated with VAS at 6 months	II
Hendriks, E., Scholten-Peeters, G., van der Windt, D. et al[43]	2005	G	18	Previous neck pain, headache, participation problems, co-morbidity and pain medication use prior		Prior pain medication use significant in univariate analysis (b = .981, p<.018) but not significant in multivariate analysis	II

SUMMARY – PRE-COLLISION MEDICATION USE: NHMRC Evidence Statement Matrix
1. Evidence base: B
2. Consistency: A
3. Clinical impact: B
4. Generalisability: A
5. Applicability: B
Pre-collision medication use may not predict non-recovery in patients with WAD. Grade of recommendation: B
Two primary cohort studies (two cohorts). Both reported no significant association with prior medication use and development of persistent pain, therefore strong evidence for no association

Table 3.13 Summary of evidence for compensation related factors

	AUTHOR	YEAR	COHORT	RATING SCORE	PROG CAT 8 (COMP)	POSITIVE ASSOCIATION COMPENSATION	NEGATIVE ASSOCIATION COMPENSATION	LEVEL OF EVIDENCE
1	Ameratunga, S., Tin, S.T., Connor, J., Norton, R. [24]	2010	B	13	Disability benefit (5 months)		Disability benefit/compensation at 5 months was not associated with neck pain at 18 months	II
2	Atherton, K., Wiles, N.J., Lecky, F.E., Hawes et al[25]	2006	C	15	Compensation claim, resolution of claim	Individuals with persistent symptoms significantly more likely to have claimed compensation (95% versus 87%, p<.008), and among claimants, individuals with persistent symptoms less likely to report resolution of this claim (29% versus 57%, p<.001)		II
18	Gun, R., Osti, O., O'Riordan, A., Mpelasoka, F., Eckerwall, C., Smyth, J. [42]	2005	Q	16	Previous workers' compensation claim, consulting a lawyer (12-month assessment)	Consulting a lawyer at any time during the 12 months post accident was significantly associated with change in neck pain disability (b = -7.1, p<.01), not being treated (b = .09, p<.01), RTW (b = .20, p<.05) and claim settled (b = 0.11, p<.01). A history of a previous workers' compensation claim was significantly associated with change in neck pain disability (b = -10.5, p<.01) and change in neck pain (b = -1.13, p<.05)	Consulting a lawyer was not associated with a change in neck pain. A previous workers' compensation claim was not associated with not being treated, RTW or claim settled	II
19	Hendriks, E., Scholten-Peeters, G., van der Windt et al [43]	2005	G	18	Retained a lawyer		Retaining a lawyer was not associated with poor recovery (VAS <30) at 1 year	II
35	Sterling, M., Hendrikz, J., Kenardy, J. [56]	2010	St5	15	Compensation claim lodgement	Submission of claim within first month associated with significantly elevated NDI within mild and moderate trajectories (Wald x^2 = 103.6, p<.01 and 78.6, p<.01 respectively). For resilient PDS group, claims submitted after 3 months associated within increasingly significant predicted elevations in mean PDS severity (Wald x^2 = 18.6 and 29.3 at 6 and 12 months, p<.01). For the recovering group, submitting a claim at any time corresponded to significant increase in mean PDS symptoms (Wald x^2>43.6, p<.01). For the mod/severe group: submitting a claim >3 months associated with increased PDS symptom severity (Wald x^2>12.3, p<.01)		II
37	Sterling, M., Jull, G., Kenardy, J.[58]	2006a	St4	15	Compensation status		Compensation status was not a significant predictor of NDI at 2 years or of membership to mod/severe whiplash group at 2 years	II

SUMMARY – COMPENSATION RELATED FACTORS: NHMRC Evidence Statement Matrix
1. Evidence base: A (6 primary cohort studies, 6 cohorts: 3 positive and 3 negative)
2. Consistency: D
3. Clinical impact: C
4. Generalisability: D
5. Applicability: C
The evidence for compensation related factors on recovery from whiplash is inconsistent. No recommendation can be made.
It should be noted that this factor cannot usually be measured at baseline (that is, within six weeks of injury as per the inclusion for this review).

Summary of prognostic indicators

Prognostic indictors for non-recovery and factors not associated with non-recovery and their Grades of Recommendation are summarised below.

Table 3.14 Summary of recommendations for evidence of prognostic factors predictive of non-recovery in patient with WAD

Factors PREDICTIVE of poor recovery

FACTOR	OUTCOME/S*	STRENGTH OF EVIDENCE
SYMPTOMS		
Higher initial neck pain levels	Ongoing pain	A
	Ongoing disability	A
	Ongoing psychological symptoms	B
	Work disability	C
	Other (muscle function etc.)	D
Higher initial disability	Ongoing disability	A
Self-perceived injury severity	Ongoing pain/disability	B
Headache	Ongoing pain/disability	D
Higher number of symptoms	Ongoing pain/disability	C
WAD grade	Ongoing pain/disability	C
Back pain	Ongoing pain/disability	C
Dizziness	Ongoing pain/disability	C
PSYCHOLOGICAL		
Posttraumatic stress symptoms	Ongoing pain/disability	A
Negative expectation of recovery	Ongoing pain/disability	A
Somatisation	Ongoing pain/disability	B
Depression	Ongoing pain/disability	C
Pain catastrophising	Ongoing pain/disability	C
Coping strategies	Ongoing pain/disability	D
CRASH-RELATED		
Self-rated collision severity	Ongoing pain/disability	C
DEMOGRAPHICS		
Age	Ongoing psychological symptoms	B
PHYSICAL		
Cervical range of movement	Ongoing disability	A
Cold hyperalgesia	Ongoing disability	A
Pre-collision		
Pre-collision bodily pain	Ongoing pain/disability	B
Pre-collision psychological health	Ongoing pain/disability	C

Factors NOT PREDICTIVE of poor recovery

FACTOR	OUTCOME/S*	STRENGTH OF EVIDENCE
SYMPTOMS		
Shoulder pain	Ongoing pain/disability	A
PSYCHOLOGICAL		
Kinesiophobia (fear of movement)	Ongoing pain/disability	C
Anxiety	Ongoing pain/disability	D
CRASH-RELATED		
Seatbelt use	Ongoing pain/disability	A
Awareness of collision	Ongoing pain/disability	A
Position in vehicle	Ongoing pain/disability	A
Speed of collision	Ongoing pain/disability	A
Head position at impact	Ongoing pain/disability	B
Use of head restraints	Ongoing pain/disability	B
Direction of impact	Ongoing pain/disability	B
Airbag deployment	Ongoing pain/disability	C
RADIOLOGICAL FINDINGS		
Radiological findings	Ongoing pain/disability	A
DEMOGRAPHICS		
Age	Ongoing pain	B
	Work disability	A
Living situation	Ongoing pain/disability	B
Work status	Ongoing pain/disability	C
Income	Ongoing pain/disability	C
PHYSICAL		
Lower pressure pain thresholds	Ongoing pain/disability	A
Motor/sensory-motor dysfunction	Ongoing pain/disability	A
BMI	Ongoing pain/disability	B
Cervical range of movement	Ongoing pain/disability	B
Sympathetic vasoconstriction	Ongoing pain/disability	B
PRE-COLLISION		
Pre-collision neck pain	Ongoing pain/disability	B
Pre-collision headache	Ongoing pain/disability	B
Pre-collision general health	Ongoing pain/disability	B
Pre-collision medication use	Ongoing pain/disability	B

* Outcomes have been differentiated where there are enough studies to enable this to be undertaken (for example pain, disability, psychological symptoms, work disability). Where there are fewer studies with more heterogeneous outcomes, the term 'ongoing pain/disability' has been used.

Factors WITH INCONSISTENT evidence

(equal numbers of studies both for and against predictive capacity):

FACTOR
Gender
Educational levels
Self-perceived general health
Compensation related factors

Treatment of acute WAD

Aim of systematic review

This aim of this review was to review relevant literature from 2005 to July 2012 in order to evaluate the effectiveness of interventions for patients with acute and subacute WAD (<12 weeks' duration).

Inclusion criteria

Studies were included in the systematic review if they met the following criteria:

1. Patients with acute or subacute WAD (<12 weeks) were included in the study. Trials of interventions for patients with neck pain in general were included if the patients with WAD could be easily differentiated.
2. More than 50 per cent of the included patients reported neck pain or neck pain and headache or neck pain and arm pain or neck pain and dizziness as their primary complaint.
3. Patients were >18 years of age and were of either sex.
4. Studies investigating pharmacological and non-pharmacological interventions. As per the previous systematic review, interventions may have included medication, surgery, radiofrequency neurotomy, injections, massage, manipulation, mobilisation, electrical stimulation, transcutaneous electrical stimulation (TENS), thermal modalities, EMG biofeedback, electrotherapy, mechanical traction, cognitive behavioural therapy, multimodal treatment, prescribed rest, collars and orthotics, exercise and education.
5. The treatment effect involved measurable outcomes.
6. Randomised controlled trials (RCTs) and quasi RCTs.
7. Published from 2005 to July 2012.
8. Available in English.

Systematic reviews were included if the review:

1. investigated treatment of patients with acute or subacute (<12 weeks) WAD or interventions for patients with neck pain in general if the patients with WAD could be easily differentiated
2. included a comprehensive search (for example ⩾2 databases)
3. stated inclusion/exclusion criteria and key words or MeSH terms
4. provided a list of included studies
5. published from 2005 to July 2012.

Search strategies

The following search strategies were used to identify appropriate papers.

Electronic database search

An electronic database search for relevant studies published between November 2005 and July 2012 was conducted on the following databases: MEDLINE, CINAHL, EMBASE, PEDro, PsychINFO, SportDiscus and the Cochrane Register of Clinical Trials. Additional searches were conducted on PubMed and Web of Science. Only trials not included in the 2005 Guidelines were included.

A combination of MeSH heading and text words (title and abstract) were used for each database in accordance with the methods outlined by Dickersin[68] and recommended by the NHMRC (see Appendix B for Medline search strategy).

Bibliographic search

The bibliographies of all published RCTs and systematic reviews identified in Figure 3.1 (page 116) were searched to identify any additional trials.

Systematic reviews

The electronic databases were searched to identify any relevant reviews. The bibliographies of these reviews were searched to identify trials missed by results from Figure 3.1 (page 116).

Methodological quality assessment

RCTs and quasi RCTs

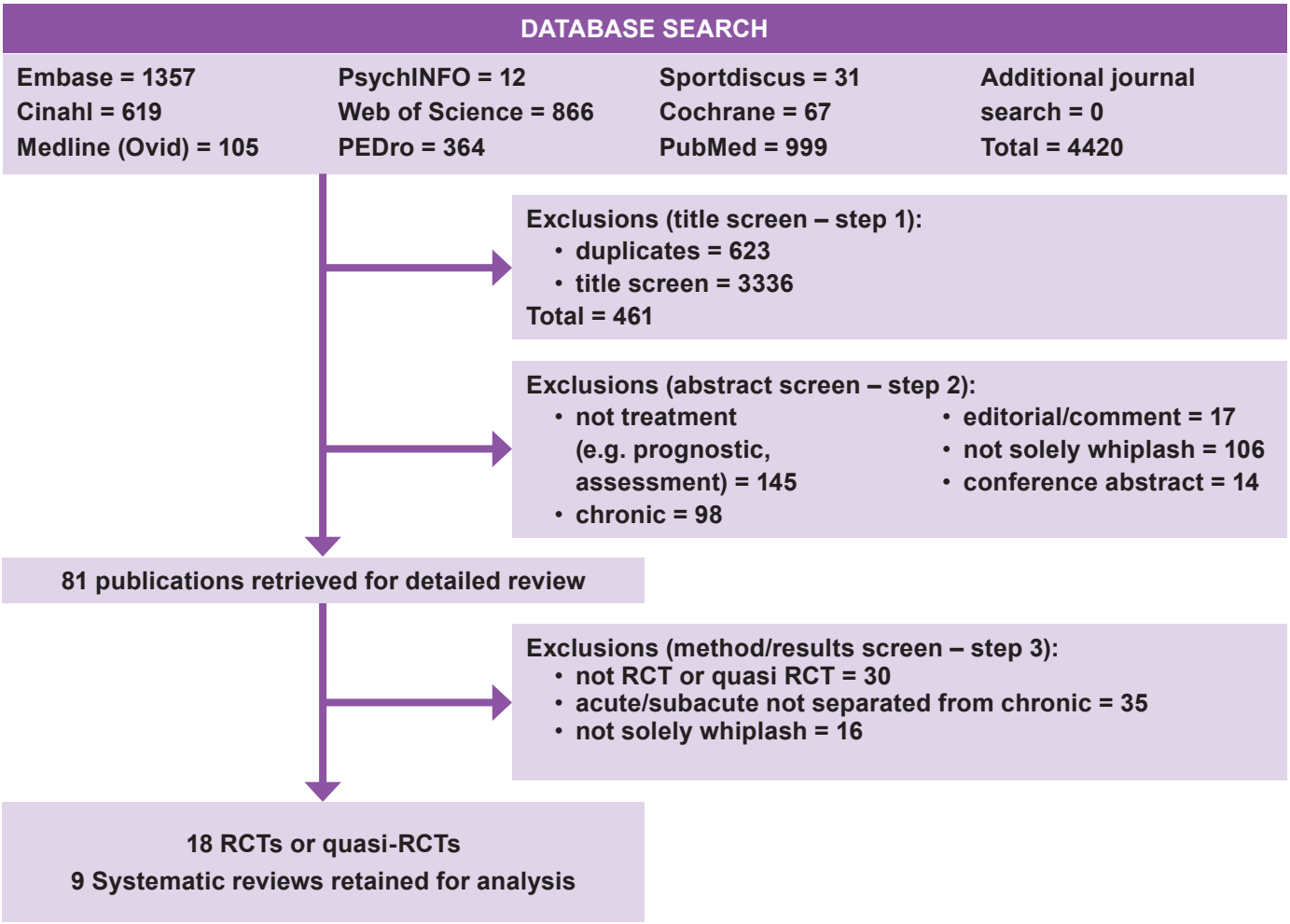
The abstracts of studies that met the eligibility criteria were assessed for methodological quality using the Physiotherapy Evidence Database (PEDro) Scale. This evaluation tool was designed specifically for assessing physical therapy research and has been validated for the quality assessment of RCTs.[4] The PEDro scale consists of 10 equally weighted yes/no questions relating to issues of methodological quality (Table 4.1) and can be accessed at **www.pedro.org.au**.

Two independent raters reviewed each article and discrepancies were resolved through consensus or, when that was not possible, by the review of a third rater. Studies with PEDro scores of 9 to 10 were considered to be of 'excellent' methodological quality, while scores of 6 to 8 were considered to be 'good' quality and scores of 4 to 5 were considered to be 'fair' quality. Studies scoring below 4 were judged to be of 'poor' quality and were considered to be methodologically equivalent to non-RCTs in terms of formulating conclusions.[69]

Table 4.1 The PEDro scoring system

CRITERIA	YES/NO
1. Subjects were randomly allocated to groups (in cross-over studies, subjects were randomly allocated an order in which treatments were received)	
2. Allocation was concealed	
3. The groups were similar at baseline regarding the most important prognostic indicators	
4. There was blinding of all subjects	
5. There was blinding of all therapists who administered the therapy	
6. There was blinding of all assessors who measured at least one key outcome	
7. Measures of at least one key outcome were obtained from more than 85 per cent of the subjects initially allocated to groups	
8. All subjects for whom outcome measures were available received the treatment or control condition as allocated or, where this was not the case, data for at least one key outcome was analysed by 'intention to treat'	
9. The results of between-group statistical comparisons were reported for at least one key outcome	
10. The study provided a point estimate and measure of variability for at least one key outcome	
	/10

Figure 3.1: Search strategy and results for literature on treatment of WAD, 2005 – 2012



Systematic reviews

The abstracts of 21 reviews of treatment for WAD were retrieved and fully screened for eligibility. Nine systematic reviews met the inclusion criteria and were assessed for methodological quality using the AMSTAR standards checklist (Appendix C, page 135).[70]

Results

Eighteen RCTs and nine systematic reviews were included. Several of the systematic reviews included papers from the last review conducted (publications prior to 2005) and therefore provide an overall summary of the evidence for the management of acute WAD. It is noteworthy that there are almost as many systematic reviews as there are primary RCTs indicating an urgent need for intervention studies in this area.

The PEDro scores for the RCTs are included in Table 4.2 (page 117). The majority of trials were of good quality, with two fair quality [71, 72] and one of low quality.[73] This has been taken into account in the recommendation of evidence levels. Table 4.4 (page 129) provides information on the included systematic reviews.

Table 4.5 (page 132) provides a summary of the findings.

Some interventions that were included in the 2007 review have not been investigated further and these are listed in Table 4.6 (page 132).

Table 4.2 Included RCTs with PEDro scores

AUTHOR	ELIGIBILITY CRITERIA	RANDOM ALLOCATION	CONCEALED ALLOCATION	BASELINE COMPARABILITY	SUBJECT BLINDING	THERAPIST BLINDING	ASSESSOR BLINDING	85% FOLLOWUP	ITT ANALYSIS	BETWEEN GRP COMPARISON	POINT ESTIMATES	TOTAL
Aigner et al 2006	-	✔	-	-	✔	-	-	✔	-	✔	-	4
Ask et al 2006	✔	✔	✔	✔	-	-	✔	-	✔	✔	✔	7
Brison et al 2005	✔	✔	✔		✔	-	✔	✔	✔	✔	✔	9
Bunketorp et al 2006	✔	✔	✔	✔	-	-	✔	✔	✔	✔	✔	8
Carroll et al 2008	✔	✔	✔	✔	✔	✔	✔	-	-	✔	✔	8
Dehner et al 2006	✔	✔	-	-	-	-	-	✔	✔	✔	✔	5
Dehner et al 2009	✔	✔	✔	✔	-	-	-	✔	-	✔	-	5
Gonzalez-Iglesias, J. et al 2009	✔	✔	✔	✔	✔	-	✔	✔	-	✔	✔	8
Khwaja et al 2010	✔	✔	✔	✔	✔	✔	-	✔	✔	✔	✔	9
Kongsted et al 2007	✔	✔	✔	✔	-	-	✔	✔	✔	✔	✔	8
Kongsted et al 2008	✔	✔	✔	✔	-	-	-	✔	-	✔	✔	6
Oliviera et al 2006	✔	-	-	-	-	-	-	✔	-	✔	✔	3
Picelli et al 2011	✔	✔	-	✔	-	-	✔	✔	✔	✔	✔	7
Rebbeck et al 2006	✔	✔	✔	✔	-	-	-	✔	-	✔	✔	6
Rosenfeld et al 2006	✔	✔	✔	✔	-	-	✔	✔	✔	✔	✔	8
Scholten-Peeters et al 2006	✔	✔	✔	✔	-	-	✔	✔	✔	✔	✔	8
Tough et al 2010	✔	✔	✔	✔	✔	-	✔	-	✔	✔	✔	8
Vassiliou, T. et al 2006	✔	✔	✔	✔	-	-	-	✔	✔	✔	✔	7

Table 4.3 Overview treatment RCTs by intervention type and previous systematic reviews that included corresponding RCTs

COMMENTS – STUDY	PREVIOUS SYS REVIEWS	AUTHOR	YEAR	STUDY DESIGN	INTERVENTION/ REVIEW OVERVIEW	LEVEL OF EVIDENCE (PEDRO RATING – RCT) (AMSTAR – SYS REVIEWS)	RESULTS	CONCLUSIONS/ COMMENTS
EDUCATIONAL INTERVENTIONS								
	Tsys4 Tsys5 Tsys7	Brison, R., Hartling, L., Dostaler, S., Leger, A., Rowe, B., Stiell, I., Pickett, W.[74]	2005	RCT	Educational video (QTF recommendations) compared with usual care	II (9)	Proportion of subjects in intervention group experiencing WAD symptoms at 24 weeks 11% lower (p<.02) however did not reach clinically significant difference of 15%. Change in pain was significantly greater for intervention group (p<.02)	The video group demonstrated a trend toward less severe WAD symptoms
	Tsys2	Kongsted, A., Qerama, E., Kasch, H.,Bach, F., Korsholm, L., Jensen, T., Bendix, T.[75]	2008	Randomised parallel-group trial	Oral advice compared with pamphlet	II (6)	At 3 months: no significant differences. At 6 months: disability significantly less frequent in oral advice group (OR 3.5, p<.01) and no other significant differences, no significant differences at 12 months	Prognosis did not differ between patients who received personal education and those who got a pamphlet. However, a systematic tendency toward better outcome with personally communicated info was observed and should be researched further
Not solely whiplash from MVC (unknown percentage). Inconsistent subject numbers between text (n = 126) and tables (n = 200)	Tsys2 Tsys5 Tsys7	Oliveira, A., Gevirtz, R., Hubbard, D.[54]	2006	Pseudo random (alternate)	Psycho-educational video versus control (usual care)	III-I (3)	Significant improvement in SFMA (F = 43.65, p<.001) and VRS (F = 51.8, p<.001) for intervention group. Intervention group improved on all others - patient satisfaction, life change and work days missed (all p<.001 though no other statistical data provided)	Brief video emphasising mind/ body or psycho-physiologic aspects of chronic pain and simple behavioural and physical home interventions had dramatic effects on the severity, time course and management of chronic cervical strain disorder
	Tsys3 Tsys5 Tsys7	Scholten-Peeters, G., Neeleman-van der Steen, C., van der Windt, D., Hendriks, E., Verhagen, A., Osstendorp, R.[76]	2006	RCT	Comparison of education and advice by GP with education, advice and active exercise by physio	II (8)	GP significantly better on work activities at 52 weeks however no longer statistically significant when adjusted for baseline values. Physio better on CROM at 12 weeks. GP care better on functional recovery, coping strategy (relaxation and resting), physical functioning and bodily pain (SF36) at 52 weeks	No significant differences were found for neck pain, headache or work activities. Long term GP care seemed better for functional recovery, coping and physical functioning. Physio seems more effective for CROM
		Teasell, R., McClure, A., Walton, D., Pretty, J., Salter, K., Meyer, M., Sequeira, K., Death, B.[77]	2010	Tsys2	Evaluation of the strength of evidence of therapies for acute (<2 weeks) WAD	I (8)	It has not been demonstrated that educational interventions are effective	

Table 4.3 Continued

COMMENTS – STUDY	PREVIOUS SYS REVIEWS	AUTHOR	YEAR	STUDY DESIGN	INTERVENTION/ REVIEW OVERVIEW	LEVEL OF EVIDENCE (PEDRO RATING – RCT) (AMSTAR – SYS REVIEWS)	RESULTS	CONCLUSIONS/ COMMENTS
EDUCATIONAL INTERVENTIONS								
		Teasell, R., McClure, A., Walton, D., Pretty, J., Salter, K., Meyer, M., Sequeira, K., Death, B.[78]	2010	Tsys3	Evaluation of the strength of evidence of therapies for subacute (2 to 12 weeks) WAD	I (8)	No conclusions regarding the effect of educational interventions for subacute WAD	
		Haines, T., Gross, A., Burnie, S., Goldsmith, C., Perry, L., Graham, N.[79]	2009	Tsys4	Effectiveness of patient education for neck pain	1 (9)	Trials did not demonstrate evidence of benefit or inferiority for pain. Specifically - advice: focus on activation compared with rest: 2 studies WAD moderate evidence of no difference in pain, disability or quality of life at 6 months and 1 year	
		Shaw, L., Descarreaux, M., Bryans, R., Duranleau, M., Marcoux, H., Potter, B., Ruegg, R., Watkin, R., White, E.[80]	2010	Tsys5	Effect of chiropractic management of clients with WAD on health status	1 (8)	Acute: low quality evidence (4 controlled studies satisfying best evidence synthesis) suggests information/ instruction within multimodal treatment regimens improve pain and CROM	
		Verhagen, A., Scholten-Peeters, G., van Wijngaarden, S., de Bie, R., Bierma-Zeinstra, S.[81] 2007	Tsys7	Effectiveness of conservative treatment for patients with grade 1 or 2 whiplash injuries	1 (9)	No clear conclusions can be drawn about the most effective therapy for WAD patients. There is a trend that active interventions are probably more effective than passive interventions but no clear conclusion can be drawn		

SUMMARY EDUCATIONAL INTERVENTIONS: NHMRC Evidence Statement Matrix
1. Evidence base: A
2. Consistency: C
3. Clinical impact: A
4. Generalisability: A
5. Applicability: A
Educational interventions may be effective for the management of acute WAD. Grade of recommendation: C
Five systematic reviews, four RCTS – all RCTs have been included in previous systematic reviews.

Table 4.3 Continued

COMMENTS – STUDY	PREVIOUS SYS REVIEWS	AUTHOR	YEAR	STUDY DESIGN	INTERVENTION/ REVIEW OVERVIEW	LEVEL OF EVIDENCE (PEDRO RATING – RCT) (AMSTAR – SYS REVIEWS)	RESULTS	CONCLUSIONS/ COMMENTS
ACTIVITY/EXERCISE								
		Ask, T., Strand, L., Skouen, J.[82]	2009	RCT (although stratified for age and gender)	Motor control compared with an endurance and strength training program in subacute	II (7)	No significant diffs found between groups at 1 year	No statistically significant differences concerning primary and secondary outcome measures were demonstrated between the groups
		Rosenfeld, M., Seferiadis, A., Gunnarsson, R.[83]	2006	Single-blind RCT	Active involvement and intervention (active exercise protocol -McKenzie principles) versus standard care (written and verbal info)	II (7)	At 6 months, active group significantly better change in pain intensity (Friedman - p<.019, ANOVA p<.004). At 3 years, active group significant better change in pain (Friedman p<.028, ANOVA p<.02) and sick days (Friedman p<.03)	The active involvement and intervention were significantly superior in reducing experienced pain and reducing sick leave
	Tsys3 Tsys5 Tsys7	Bunketorp, L., Lindh, M., Carlsson, J., Stener-Victorin, E.[84]	2006	RCT	Home training compared with supervised training with subacute WAD	II (8)	Self-efficacy, fear of movement and disability improvement significantly better in supervised group at 3 months but not at 9 months. No significant differences in pain intensity, pain duration, pain location, sensory and affective dimensions of pain, muscle tenderness, CROM. Supervised group significantly reduced use of analgesics at 3 months. At 9 months, grip strength reduced in home training group compared with supervised group	Supervised physical training is significantly more favourable than a home training program in terms of improvement in self-efficacy, fear of movement/re-injury, pain disability and analgesic consumption in the short term
	Tsys2	Vassiliou, T., Kaluza, G., Putzke, C., Wulf, H., Schnabel, M.[85]	2006	Unblinded RCT	Physical therapy and active exercises compared with standard treatment	II (7)	Physical therapy group significantly lower pain intensity and disability at 6 weeks and 6 months. Significantly more patients in physical therapy group were pain free at 6 months (p<.02)	Physical therapy regime which includes active exercises is superior in reducing pain 6 weeks and 6 months after whiplash injury compared with standard treatment of a soft collar

Table 4.3 Continued

COMMENTS – STUDY	PREVIOUS SYS REVIEWS	AUTHOR	YEAR	STUDY DESIGN	INTERVENTION/ REVIEW OVERVIEW	LEVEL OF EVIDENCE (PEDRO RATING – RCT) (AMSTAR – SYS REVIEWS)	RESULTS	CONCLUSIONS/ COMMENTS
ACTIVITY/EXERCISE								
	Tsys2	Dehner, C., Elbel, M., Strobel, P., Scheich, M., Schneider, F., Krischak, G., Kramer, M.[86]	2009	RCT for 2 therapies + one group - historical control (act as usual)	Active (trigger point treatment, posture training, electrotherapy, coordination training, joint mobilisation) versus passive PT (moist heat, massage, electrotherapy) compared with act as usual	II (6)	Change in pain for active group significantly better than passive and act as usual. Period of disability/ sickness for active and passive group significantly better than act as usual	Active physical therapy results in enhanced pain reduction and shortening of post-injury disability
		Teasell, R., McClure, A., Walton, D., Pretty, J., Salter, K., Meyer, M., Sequeira, K., Death, B.[77]	2010	Tsys2	Evaluation of the strength of evidence of therapies for acute (<2 weeks) WAD	1(8)	Exercise programs appear to improve recovery if this is most effective	
		Teasell, R., McClure, A., Walton, D., Pretty, J., Salter, K., Meyer, M., Sequeira, K., Death, B.[78]	2010	Tsys3	Evaluation of the strength of evidence of therapies for subacute (2 to 12 weeks) WAD	1(8)	Exercise not supported by the literature	
		Shaw, L., Descarreaux, M., Bryans, R., Duranleau, M., Marcoux, H., Potter, B., Ruegg, R., Watkin, R., White, E.[80]	2010	Tsys5	Effect of chiropractic management of clients with WAD on health status	1(8)	Acute: low quality evidence (4 controlled studies satisfying best evidence synthesis) suggests unsupervised and supervised CROM exercise within multimodal treatment regimens improve pain and CROM. Subacute: low quality evidence (2 controlled studies satisfying best evidence synthesis) suggests multimodal treatment: CROM exercise improves pain	

Table 4.3 Continued

COMMENTS – STUDY	PREVIOUS SYS REVIEWS	AUTHOR	YEAR	STUDY DESIGN	INTERVENTION/ REVIEW OVERVIEW	LEVEL OF EVIDENCE (PEDRO RATING – RCT) (AMSTAR – SYS REVIEWS)	RESULTS	CONCLUSIONS/ COMMENTS
ACTIVITY/EXERCISE								
		Verhagen, A., Scholten-Peeters, G., van Wijngaarden, S., de Bie, R., Bierma-Zeinstra, S.[81]	2007	Tsys7	Effectiveness of conservative treatment for patients with grade 1 or 2 whiplash injuries	1(9)	No clear conclusions can be drawn about the most effective therapy for WAD patients. There is a trend that active interventions are probably more effective than passive interventions but no clear conclusion can be drawn	
		Mercer, C., Jackson, A., Moore, A.[87]	2007	Tsys6	Examine evidence relating to the physiotherapy treatment of acute, subacute or chronic whiplash	1(3)	Acute WAD: there is strong evidence that active exercise started within 4 days of injury reduces pain, and education on self-management decreases symptoms, and individuals should be encouraged to return to normal activity ASAP. Subacute: there is strong evidence that a multimodal program (manual therapy, postural training and psych input) helps decrease pain and return to work. There is moderate evidence that kinaesthetic exercise is not a benefit. There is consensus opinion that soft tissue techniques may help reduce pain, deep neck muscle retraining may be effective in improving function and manual therapy may help improve function and reduce pain	
		Drescher, K., Hardy, S., MacLean, J., Schindler, M., Scott, K., Harris, S.[88]	2008	Tsys8	In adults with acute WAD, do neck stabilisation and postural exercises have an effect on pain, ROM and time off work?	1(9)	Moderate evidence to support the use of postural exercise for reducing pain and time off work. Conflicting evidence on the use of neck stabilisation exercises in treatment of WAD	

SUMMARY – ACTIVITY/EXERCISE: NHMRC Evidence Statement Matrix
1. Evidence base: A
2. Consistency: B
3. Clinical impact: A
4. Generalisability: A
5. Applicability: A
Exercise/activation/advice to stay active is effective in the management of acute WAD. Grade of recommendation: B
Five RCTs – two that have not been previously reported in systematic reviews and two that have been included in previous reviews.

Table 4.3 Continued

COMMENTS – STUDY	PREVIOUS SYS REVIEWS	AUTHOR	YEAR	STUDY DESIGN	INTERVENTION/ REVIEW OVERVIEW	LEVEL OF EVIDENCE (PEDRO RATING – RCT) (AMSTAR – SYS REVIEWS)	RESULTS	CONCLUSIONS/ COMMENTS
IMMOBILISATION								
	Tsys2	Dehner, C., Hartwig, E., Strobel, P., Scheich, M., Schneider, F., Elbel, M., Kinzl, L., Kramer, M.[71]	2006	RCT	2 versus 10 days immobilisation with a soft collar	II (4)	No significant differences in VAS, disability of ROM between groups at 2 months or 6 months	No short term or long term difference between 2-day and 10-day immobilisation with a cervical collar in terms of pain, ROM or disability
	Tsys2 Tsys4 Tsys5	Kongsted, A., Qerama, E., Kasch, H., Bendix, T., Bach, F., Korsholm, L., Jensen, T.[89]	2007 1	Randomised parallel-group trial	Comparison of three treatments: immobilisation (collar), act as usual or active mobilisation	II (8)	No significant differences between groups for any of the outcome measures	Immobilisation, act as usual and active mobilisation had similar effects regarding prevention of pain, disability and work capability 1 year after a whiplash injury
		Teasell, R., McClure, A., Walton, D., Pretty, J., Salter, K., Meyer, M., Sequeira, K., Death, B.[77]	2010	Tsys2	Evaluation of the strength of evidence of therapies for acute (<2 weeks) WAD	1 (8)	Strong evidence that immobilisation with soft collar not only ineffective but may impede recovery. Active mobilisation and advice to act as usual all appear to improve recovery however not clear which of these is most effective	
		Shaw, L., Descarreaux, M., Bryans, R., Duranleau, M., Marcoux, H., Potter, B., Ruegg, R., Watkin, R., White, E.80	2010	Tsys5	Effect of chiropractic management of clients with WAD on health status	1 (8)	Acute: low quality evidence (4 controlled studies satisfying best evidence synthesis) suggests early mobilisation, unsupervised and supervised CROM exercise within multimodal treatment regimens improve pain and CROM. Subacute: low quality evidence (2 controlled studies satisfying best evidence synthesis) suggests multimodal treatment: posture instruction, mobilisation, massage and CROM exercise improves pain	

SUMMARY – IMMOBILISATION: NHMRC Evidence Statement Matrix
1. Evidence base: A
2. Consistency: A
3. Clinical impact: A
4. Generalisability: A
5. Applicability: A
Immobilisation is ineffective for the management of acute WAD. Grade of recommendation: A
Two systematic reviews three RCTs – all included in previous systematic reviews.

Table 4.3 Continued

COMMENTS – STUDY	PREVIOUS SYS REVIEWS	AUTHOR	YEAR	STUDY DESIGN	INTERVENTION/ REVIEW OVERVIEW	LEVEL OF EVIDENCE (PEDRO RATING – RCT) (AMSTAR – SYS REVIEWS)	RESULTS	CONCLUSIONS/ COMMENTS
MANUAL THERAPY/MANIPULATION								
Small sample size - pilot study		Picelli, A., Ledro, G., Turrina, A., Stecco, C., Santilli, V., Smania, N.[90]	2011	Pilot, single-blind, RCT	Comparison of neck fascial manipulation and conventional rehabilitation starting 2 to 4 weeks post MVC	II (7)	Group A significantly better than group B in flexion post-treatment (P = .03, Z = 2.17) but not f/up. Group A improved on all ROM dimensions pre-post and to f/up while group B only improved in right and left rotation. No significant differences between groups on VAS, NDI or PPT	Patients with subacute WAD who underwent fascial manipulation technique showed better post-treatment improvements in neck flexion compared to those who performed conventional rehabilitation
		Teasell, R., McClure, A., Walton, D., Pretty, J., Salter, K., Meyer, M., Sequeira, K., Death, B.[78]	2010	Tsys3	Evaluation of the strength of evidence of therapies for subacute (2 to 12 weeks) WAD	1 (8)	Manual therapy/manipulation may provide some benefit in sub-acute WAD but this is based on two low quality RCTs	
		Mercer, C., Jackson, A., Moore, A.[87]	2007	Tsys6	Examine evidence relating to the physiotherapy treatment of acute, subacute or chronic whiplash	1 (3)	Acute WAD: There is moderate evidence that manual mobilisation techniques should be considered for the reduction of pain	
		Rushton, A., Wright, C., Heneghan, N., Eveleigh, G., Calvert, M., Freemantle, N.[91]	2011	Tsys9	Investigation of the effectiveness of physiotherapy outpatient management for WAD	1 (10)	There is some evidence that specific physiotherapy (kinesio taping, magnetic therapy and manipulation) reduces pain	

SUMMARY MANUAL THERAPY/MANIPULATION : NHMRC Evidence Statement Matrix
1. Evidence base: C
2. Consistency: B
3. Clinical impact: A
4. Generalisability: A
5. Applicability: A
Manual therapy/manipulation may provide some benefit in the management of acute WAD. Grade of recommendation: C

Table 4.3 Continued

COMMENTS – STUDY	PREVIOUS SYS REVIEWS	AUTHOR	YEAR	STUDY DESIGN	INTERVENTION/ REVIEW OVERVIEW	LEVEL OF EVIDENCE (PEDRO RATING – RCT) (AMSTAR – SYS REVIEWS)	RESULTS	CONCLUSIONS/ COMMENTS
PHARMACOLOGICAL INTERVENTIONS								
		Khwaja, S.M., Minnerop, M., Singer, A.[92]	2010	RCT	Comparison of centrally acting muscle relaxant to NSAIDs alone or in combo in terms	II (9)	Significant reduction in pain scores for all three groups. No significant differences between groups	The addition of cyclobenzaprine to ibuprofen does not result in better pain relief or earlier resumption of normal daily activities than ibuprofen alone
	Tsys3	Carroll, A., Barnes, M., Comiskey, C.[93]	2008	Double-blind RCT	Botulinum toxin A versus saline	II (8)	No significant differences between two groups at 4 weeks or 3 months. The drug group showed a clinically significant improvement at 3 months however the diff was not statistically significant from placebo	The improvements in outcome measures suggest that botulinum toxin type A may have a role to play in the management of whiplash-associated disorder but larger studies are required to clarify the situation
		Teasell, R., McClure, A., Walton, D., Pretty, J., Salter, K., Meyer, M., Sequeira, K., Death, B.[78]	2010	Tsys3	Evaluation of the strength of evidence of therapies for subacute (2 to 12 weeks) WAD	1 (8)	Botulinum toxin A injections not supported by the literature	

SUMMARY PHARMACOLOGICAL TREATMENT (botulinum toxin A): NHMRC Evidence Statement Matrix
1. Evidence base: A
2. Consistency: A
3. Clinical impact: A
4. Generalisability: A
5. Applicability: A
Botulinum toxin A injections are ineffective in the management of acute WAD. Grade of recommendation: A
(Addition of cyclobenzaprine to ibuprofen): NHMRC Evidence Statement Matrix
1. Evidence base: B
2. Consistency: NA
3. Clinical impact: C
4. Generalisability: C
5. Applicability: C
The addition of cyclobenzaprine to ibuprofen appears not to be effective in the management of acute WAD. Grade of recommendation: D

Table 4.3 Continued

COMMENTS – STUDY	PREVIOUS SYS REVIEWS	AUTHOR	YEAR	STUDY DESIGN	INTERVENTION/ REVIEW OVERVIEW	LEVEL OF EVIDENCE (PEDRO RATING – RCT) (AMSTAR – SYS REVIEWS)	RESULTS	CONCLUSIONS/ COMMENTS
NEEDLING TECHNIQUES								
Underpowered - feasibility study		Tough, E., White, A., Richards, S., Campbell, J.[94]	2010	Pilot RCT	Needling of MTrPs and standardised physio compared with sham needling and standardised physio on whiplash symptoms	II (8)	Underpowered except for SF-McGill - needling group significantly lower on affective subscale (p<.09). Significantly more subjects in needling group had stopped taking analgesics	A phase III RCT investigating needling of MTrPs in whiplash injured is both feasible and clinically relevant

SUMMARY NEEDLING TECHNIQUES: NHMRC Evidence Statement Matrix
1. Evidence base: D
2. Consistency: NA
3. Clinical impact: B
4. Generalisability: B
5. Applicability: B
Trigger point needling may offer some benefit in the management of acute WAD. Grade of recommendation: D

Table 4.3 Continued

COMMENTS – STUDY	PREVIOUS SYS REVIEWS	AUTHOR	YEAR	STUDY DESIGN	INTERVENTION/ REVIEW OVERVIEW	LEVEL OF EVIDENCE (PEDRO RATING – RCT) (AMSTAR – SYS REVIEWS)	RESULTS	CONCLUSIONS/ COMMENTS
LASER ACUPUNCTURE								
	Tsys2 Tsys7	Aigner, N., Fialka, C., Radda, C., Vecsei, V.[72]	2006	Randomised (method of randomisation not stated)	Collar and laser acupuncture compared with collar and placebo acupuncture	II (4)	No significant differences between laser and placebo group - ROM, cervicalgia, headache, vertigo, tinnitus	Adjuvant laser acupuncture appears to be ineffective in the management of whiplash injuries
		Teasell, R., McClure, A., Walton, D., Pretty, J., Salter, K., Meyer, M., Sequeira, K., Death, B.[77]	2010	Tsys2	Evaluation of the strength of evidence of therapies for acute (<2 weeks) WAD	1 (8)	It has not been demonstrated that laser acupuncture is effective	
		Verhagen, A., Scholten-Peeters, G., van Wijngaarden, S., de Bie, R., Bierma-Zeinstra, S.[81]	2007	Tsys7	Effectiveness of conservative treatment for patients with grade 1 or 2 whiplash injuries	1 (9)	No clear conclusions can be drawn about the most effective therapy for WAD patients. There is a trend that active interventions are probably more effective than passive interventions but no clear conclusion can be drawn	

SUMMARY LASER ACUPUNCTURE: NHMRC Evidence Statement Matrix
1. Evidence base: D
2. Consistency: NA
3. Clinical impact: B
4. Generalisability: B
5. Applicability: B
Laser acupuncture appears to be ineffective in the management of acute WAD. Grade of recommendation: D

Table 4.3 Continued

COMMENTS – STUDY	PREVIOUS SYS REVIEWS	AUTHOR	YEAR	STUDY DESIGN	INTERVENTION/ REVIEW OVERVIEW	LEVEL OF EVIDENCE (PEDRO RATING – RCT) (AMSTAR – SYS REVIEWS)	RESULTS	CONCLUSIONS/ COMMENTS
KINESIO TAPING								
		Gonzalez-Iglesias, J., Fernandez-de-las-Penas, C., Cleland, J., Huijbregts, P., Gutierrez-Vega, M.[95]	2009	RCT	Kinesio taping versus placebo tape application	II (8)	Kinesio tape group significantly reduced pain immediately post and 24 hours post (both p<.01) and improved CROM immediately post and 24 hours post (both p<.001)	Kinesio taping with proper tension exhibited statistically significant improvements immediately following application of the tape and at 24-hour follow-up

SUMMARY KINESIO TAPING: NHMRC Evidence Statement Matrix
1. Evidence base: B
2. Consistency: NA
3. Clinical impact: C
4. Generalisability: B
5. Applicability: C
Kinesio taping may be effective in the management of acute WAD. Grade of recommendation: C

COMMENTS – STUDY	PREVIOUS SYS REVIEWS	AUTHOR	YEAR	STUDY DESIGN	INTERVENTION/REVIEW OVERVIEW	LEVEL OF EVIDENCE (PEDRO RATING – RCT) (AMSTAR – SYS REVIEWS)	RESULTS	CONCLUSIONS/COMMENTS
IMPLEMENTATION STRATEGY FOR PHYSIOTHERAPISTS								
		Rebbeck, T., Maher, C., Refshauge, K.[96]	2006	Cluster-randomised trial	Effect of active implementation strategy for physios about Guidelines compared with passive dissemination only	II (6)	No difference between implementation and dissemination groups on FRI, core outcome measure (whiplash) or global perceived effect	Active implementation program did not affect patient outcomes, may be due to high quality of treatment prescription at baseline by both groups

SUMMARY IMPLEMENTATION STRATEGY FOR PHYSIOTHERAPISTS: NHMRC Evidence Statement Matrix
1. Evidence base: C
2. Consistency: NA
3. Clinical impact: C
4. Generalisability: B
5. Applicability: C
An implementation strategy for physiotherapists may not be effective in the management of acute WAD. Grade of recommendation: C

Table 4.4 Overview of systematic reviews for treatment

NUMBER	AUTHOR	YEAR	STUDY QUESTION	STUDIES INCLUDED	TREATMENT/ INTERVENTION GROUPINGS	STUDY OUTCOME	LEVEL OF EVIDENCE (AMSTAR SCORE)
Tsys1	Teasell, R., McClure, A., Walton, D., Pretty, J., Salter, K., Meyer, M., Sequeira, K., Death, B.[69]	2010	Evaluation of the strength of evidence of therapies for acute (<2 weeks), subacute (2 to 12 weeks) and chronic (>12 weeks) WAD		Educational interventions, exercise regimes, mobilisation exercises, manual therapies, interdisciplinary interventions, pharmacological interventions, surgical or injection-based interventions, alternative interventions	See below	I (8)
Tsys2	Teasell, R., McClure, A., Walton, D., Pretty, J., Salter, K., Meyer, M., Sequeira, K., Death, B.[77]	2010	Evaluation of the strength of evidence of therapies for acute (<2 weeks) WAD	16 RCTs (Ferrari et al 05) (Pettersson et al 1998) (Foley-Nolan et al 1992) (Vassiliou et al 2006) (Kongsted et al 2008) (McKinney et al 1989) (Konsgted et al 2007) (Dehner et al 2006) (Schnabel et al 2004) (Aigner et al 2006) (Borchgrevink et al 1998) (Rosenfeld et al 2000) (Dehner et al 2009) (Soderlund et al 2000) (Thuile et al 2002) + 5 non-RCTS (Oliveira et al 2006) (Baltaci et al 2003) (Crawford et al 2004) (Gennis et al 1996) (Pennie et al 1990)	As above	Strong evidence that immobilisation with soft collar not only ineffective but may impede recovery. Exercise programs, active mobilisation and advice to act as usual all appear to improve recovery however not clear which of these is most effective. There is some evidence to suggest that both pulsed electromagnetic field therapy and methylprednisolone infusion may improve recovery over the short term however literature is very limited. It has not been demonstrated that laser acupuncture or educational interventions are effective	I (8)
Tsys3	Teasell, R., McClure, A., Walton, D., Pretty, J., Salter, K., Meyer, M., Sequeira, K., Death, B.[78]	2010	Evaluation of the strength of evidence of therapies for subacute (2 to 12 weeks) WAD	6 RCTs (Bunketorp et a 2006) (Carroll et al 2008) (Scholten-Peeters et al 2006) (Fernandex-des-las Penas et al 2004) (Provinciali et al 1996) (Fernandex-des-las Penas et al 2004), and 7 non-RCTs (Amifeyz et al 2009) (Cassidy et al 2007) (Goodman et al 2000) (Adams et al 2007) (Suissa et al 2006) (Suter et al 2002) (Osterbauer et al 1992)	As above	Exercise and botulinum toxin A injections not supported by the literature. Weak evidence that interdisciplinary interventions and manual joint manipulation may provide some benefit however further research needed	I (8)
Tsys4	Haines, T., Gross, A., Burnie, S., Goldsmith, C., Perry, L., Graham, N.[79]	2009	Effectiveness of patient education for neck pain	Trials with subacute WAD: (Brison et al 2005) (Ferrari et al 2005) (Borchgrevnik et al 1998) (Konsted et al 2007)	Advice: focus on rest versus any comparison group (no studies). Advice: focus on activation (8 trials). Advice: focus on activation - compared with no treatment or another treatment added to both trial arms (4 trials including 2 for subacute WAD)	Trials did not demonstrate evidence of benefit or inferiority for pain. Specifically - advice: focus on activation compared with rest: 2 studies WAD moderate evidence of no difference in pain, disability or quality of life at 6 months and 1 year. Only one study to compare with manual therapy and exercise (Kongsted et al)	I (9)

Table 4.4 Continued

NUMBER	AUTHOR	YEAR	STUDY QUESTION	STUDIES INCLUDED	TREATMENT/ INTERVENTION GROUPINGS	STUDY OUTCOME	LEVEL OF EVIDENCE (AMSTAR SCORE)
Tsys5	Shaw, L., Descarreaux, M., Bryans, R., Duranleau, M., Marcoux, H., Potter, B., Ruegg, R., Watkin, R., White, E.[80]	2010	Effect of chiropractic management of clients with WAD on health status	Acute (Borchgrevink et al 1998) (Kongsted et al 2007) (Oliveira et al 2006) (Ferrari et al 2005) (Brison et al 2005) (Bonk et al 2000) (Schnabel et al 2004) (Crawford et al 2004) (Gennis et al 1996) (McKinney et al 1989) (Mealy et al 1986) (Hendriks et al 1996) (Osterbauer et al 1992) (Pennie et al 1990) (Rosenfeld et al 2003). Subacute: (Provinciali et al 1996) (Scholten-Peeters 2006) (Soderlund et al 2000) (Bunkertorp et al 2006) (Fialka et al 1989)		Acute: low quality evidence (4 controlled studies satisfying best evidence synthesis) suggests early mobilisation, information/instruction, unsupervised and supervised CROM exercise within multimodal treatment regimens improve pain and CROM. Subacute: low quality evidence (2 controlled studies satisfying best evidence synthesis) suggests multimodal treatment: posture instruction, mobilisation, massage and CROM exercise improves pain	I (8)
Tsys6	Mercer, C., Jackson, A., Moore, A.[87]	2007	Examine evidence relating to the physiotherapy treatment of acute, subacute or chronic whiplash	(Mealy et al 1986) (McKinney et al 1995) (Foley-Nolan et al 1992) (Provinciali et al 1996) (Borchgrevink et al 1998) (Bonk et al 2000) (Pennie et al 1990) (Fitz-Ritson et al 1995) (Gennis et al 1996) (Rosenfeld et al 2000) (Soderlund et al 2000)		Acute WAD: there is strong evidence that active exercise started within 4 days of injury reduces pain, and education on self-management decreases symptoms, and individuals should be encouraged to return to normal activity ASAP. There is moderate evidence that manual mobilisation techniques should be considered for the reduction of pain. There is consensus opinion that soft collars should not be used, and active exercise, advice and education should all be included early. Subacute: there is strong evidence that a multimodal program (manual therapy, postural training and psych input) helps decrease pain and return to work. There is moderate evidence that kinaesthetic exercise is not a benefit. There is consensus opinion that soft tissue techniques may help reduce pain, deep neck muscle retraining may be effective in improving function and manual therapy may help improve function and reduce pain	I (3)
Tsys7	Verhagen, A., Scholten-Peeters, G., van Wijngaarden, S., de Bie, R., Bierma-Zeinstra, S.[81]	2007	Effectiveness of conservative treatment for patients with grade 1 or 2 whiplash injuries	Acute: (Mealy et al 1986) (Foley-Nolan et al 1992) (Aigne et al 2006) (Brison et al 2005) (Oliveira et al 2006) (Ferrari et al 2005) (Fialka et al 1989) (Gennis et al 1996) (Bonk et al 2000) (Borchgrevink et al 1998) (Crawford et al 2004) (McKinnet et al 1989) (Pennie et al 1990) (Rosenfeld et al 2000) (Schnabel et al 2004) (Soderlund et al 2000) Subacute: (Buketorp et al 2006) (Scholten-Peeters et al 2006) (Provinciali et al 1996)	Passive (patient not actively involved in exercises or activities) or active (patient actively participated) treatment compared with placebo or no treatment	No clear conclusions can be drawn about the most effective therapy for WAD patients. There is a trend that active interventions are probably more effective than passive interventions but no clear conclusion can be drawn	I (9)

Table 4.4 Continued

NUMBER	AUTHOR	YEAR	STUDY QUESTION	STUDIES INCLUDED	TREATMENT/ INTERVENTION GROUPINGS	STUDY OUTCOME	LEVEL OF EVIDENCE (AMSTAR SCORE)
Tsys8	Drescher, K., Hardy, S., MacLean, J., Schindler, M., Scott, K., Harris, S.[88]	2008	In adults with acute WAD, do neck stabilisation and postural exercises have an effect on pain, ROM and time off work?	(Bunketorp et al 2006) (Crawford et al 2004) (Rosenfeld et al 2000) (Rosenfeld et al 2003) (Rosenfeld et al 2006) (Schnabel et al 2004) (Vassiliou et al 2006) (Soderlund et al 2000)	Interventions – postural exercises, neck stabilisation exercises	Moderate evidence to support the use of postural exercise for reducing pain and time off work. Conflicting evidence on the use of neck stabilisation exercises in treatment of WAD and moderate evidence to suggest that active interventions (postural and neck-stabilisation) are more effective than soft collars. No evidence to support the use of postural or neck stabilisation exercises for increasing CROM	I (9)
Tsys9	Rushton, A., Wright, C., Heneghan, N., Eveleigh, G., Calvert, M., Freemantle, N.[91]	2011	Investigation of the effectiveness of physiotherapy outpatient management for WAD	(Dehner et al 2009) (Ask et al 2009) (Scholten-Peeters et al 2006) (Vassiliou et al 2006) (Schnabel et al 2004) (Soderlund et al 2000) (Bonk et al 2000)	Active versus standard treatment for pain or ROM, and specific intervention versus control for pain or ROM	There is some evidence that active physiotherapy intervention reduces pain and a change in ROM Rot. There is no evidence that active physiotherapy affects disability. There is some evidence that specific physiotherapy (kinesio taping, magnetic therapy and manipulation) reduces pain	I (10)

Table 4.5 Recommendations and NHMRC grade of recommendation for evidence from 2005-2012

INTERVENTIONS	GRADE OF RECOMMENDATION
EVIDENCE OF BENEFIT	
Exercise/activation/advice to stay active is effective in the management of acute WAD	B
Educational interventions may be effective for the management of acute WAD	C
Manual therapy/manipulation may provide some benefit in the management of acute WAD	C
Kinesio taping may be effective in the management of acute WAD	C
Trigger point needling may offer some benefit in the management of acute WAD	D
NO EVIDENCE OF BENEFIT	
Immobilisation (collars, rest) is ineffective for the management of acute WAD	A
Botulinum toxin A injections are ineffective in the management of acute WAD	A
An implementation strategy for physiotherapists may not be effective in the management of acute WAD	C
Laser acupuncture appears to be ineffective in the management of acute WAD	D
The addition of cyclobenzaprine to ibuprofen appears not to be effective in the management of acute WAD	D

Table 4.6 Interventions where no further evidence has been found since last review

INTERVENTIONS
NO FURTHER EVIDENCE HAS BEEN FOUND SINCE LAST REVIEW
Simple analgesics
Multimodal treatment
McKenzie therapy
Methylprednisolone
Kinaesthetic exercises
Traction
Postural advice
Acupuncture
Cervical pillows

Appendix A
Prognosis search strategy

Search strategy specifics for the systematic review with reference to the prognosis of WAD databases

	SEARCH TOTAL	EXCLUDE BY TITLE	TOTAL
Embase	416	234	182
Cinahl	312	182	130
PsychINFO	110	62	48
Medline (Ovid)	1353	979	388
Ahmed	66	29	37
Web of Science	96	24	72
PEDro	43		43
Cochrane Library	283	271	12
Additional search (journals: Pain, Spine, Journal of Rehabilitation Medicine), systematic reviews			4
Subtotal	2697	1781	916
Duplicates			497
TOTAL			454

Abstract screen

REASON FOR ELIMINATION	
Treatment study	95
Outcome study	49
Review	79
Case study	4
Editorial/comment	15
Not whiplash	114
Conference abstract	3
TOTAL	95

Detailed review: additional screening

REASON FOR ELIMINATION	
Recruitment >6 weeks post injury	24
Alternate outcome measure	4
Not prognostic	21
Outcome measured at <6 months post injury	5
TOTAL PAPERS FOR INCLUSION	41

Appendix B
Treatment search strategy

MEDLINE (OVID)
1. Randomized controlled trial in PT
2. Controlled clinical trial in PT
3. Randomized controlled trials
4. Random allocation
5. Double blind method
6. Single blind method
7. 1 OR 2 OR 3 OR 4 OR 5 OR 6
8. Clinical trial in PT
9. Explode Clinical trials
10. Placebos
11. Research design
12. Volunteer
13. Random
14. 8 OR 9 OR 10 OR 11 OR 12 OR 13
15. 7 AND 14

Key words then included: whiplash, whiplash-associated disorders, whiplash injury, neck pain. Filters: English, 2005 – 2012.

Appendix C
AMSTAR Checklist

1. Was an 'a priori' design provided? The research question and inclusion criteria should be established before the conduct of the review.	☐ Yes ☐ No ☐ Can't answer ☐ Not applicable
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.	☐ Yes ☐ No ☐ Can't answer ☐ Not applicable
3. Was a comprehensive literature search performed? At least two electronic sources should be searched. The report must include years and databases used (for example Central, EMBASE, and MEDLINE). Key words and/or MESH terms must be stated and where feasible the search strategy should be provided. All searches should be supplemented by consulting current contents, reviews, textbooks, specialised registers, or experts in the particular field of study, and by reviewing the references in the studies found.	☐ Yes ☐ No ☐ Can't answer ☐ Not applicable
4. Was the status of publication (that is, 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 (from the systematic review), based on their publication status, language etc.	☐ Yes ☐ No ☐ Can't answer ☐ Not applicable
5. Was a list of studies (included and excluded) provided? A list of included and excluded studies should be provided.	☐ Yes ☐ No ☐ Can't answer ☐ Not applicable
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 analysed, for example age, race, sex, relevant socioeconomic data, disease status, duration, severity, or other diseases should be reported.	☐ Yes ☐ No ☐ Can't answer ☐ Not applicable
7. Was the scientific quality of the included studies assessed and documented? 'A priori' methods of assessment should be provided (for example, for effectiveness studies if the author(s) chose to include only randomised, double-blind, placebo controlled studies, or allocation concealment as inclusion criteria); for other types of studies alternative items will be relevant.	☐ Yes ☐ No ☐ Can't answer ☐ Not applicable
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.	☐ Yes ☐ No ☐ Can't answer ☐ Not applicable

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 (that is, Chi-squared test for homogeneity, I^2). If heterogeneity exists a random effects model should be used and/or the clinical appropriateness of combining should be taken into consideration (that is, is it sensible to combine?).	☐ Yes ☐ No ☐ Can't answer ☐ Not applicable
10. Was the likelihood of publication bias assessed? An assessment of publication bias should include a combination of graphical aids (for example, funnel plot, other available tests) and/or statistical tests (for example, Egger regression test).	☐ Yes ☐ No ☐ Can't answer ☐ Not applicable
11. Was the conflict of interest stated? Potential sources of support should be clearly acknowledged in both the systematic review and the included studies.	☐ Yes ☐ No ☐ Can't answer ☐ Not applicable

Appendix D Glossary

Adverse prognostic indicators	Factors that have been associated with adverse outcomes.
Cervical pillows	Commercially made contoured pillows.
Cold hyperalgesia	Cold hyperalgesia could be assessed. In research environment/studies cold hyperalgesia in people with WAD has been identified by increased cold pain thresholds (CPT) and early presence of cold hyperalgesia is a predictor of poor physical and mental health outcomes. CPT is usually measured using laboratory equipment that lowers the temperature over an area of skin until both cold and pain are felt. The expense of these devices precludes their clinical use. Sensation of pain and time to pain on application of ice to the skin have been suggested as appropriate clinical alternative to identify cold hyperalgesia, however this method needs further validation.
Consensus	Majority view of all members of the working group. The basis for recommendations in the absence of evidence.
Exercise	May be either a direction to increase activity or a prescription for a specific set of exercises.
IES	Impact of Events Scale.
Immobilisation	To prevent motion of the neck, usually by application of a cervical collar.
Manipulation	A technique of treatment applied to joints for the relief of pain and improvement of motion. It is a single high velocity, low amplitude movement applied passively to the joint towards the limit of its available range.
Manual and physical therapies	Methods of treatment (e.g. manipulative and exercise therapy) used in the rehabilitation of persons with musculoskeletal disorders. They are non-invasive, non-pharmaceutical methods of treatment.
Manual therapy	Manual therapy consists of a range of interventions, including hands-on techniques such as joint mobilisation. Such techniques are usually low-velocity and low amplitude movements.
MVA	Motor vehicle accident.
MVC	Motor vehicle collision.
NDI	Neck Disability Index.
NSAIDs	Non-steroidal anti-inflammatory drug(s).
Passive joint mobilisation	A technique of treatment applied to joints for the relief of pain and improvement of motion. Mobilisation is the passive application of repetitive, rhythmical, low velocity, small amplitude movements to the joint within or at the limit of its available range.
Passive modalities	Electrotherapeutic agents that are applied for the relief of pain and assisting the resolution of the inflammatory response. They are administered passively to the patient.
PEMT	Pulsed electromagnetic treatment.
Postural advice	Specific instructions on posture.
QTF	Quebec Task Force.
RCT	Randomised controlled trial.
ROM	Range of motion.
Soft collars	Foam neck supports.

Specialised examinations	Specialised tests that are not routinely performed as part of a physical examination and that often require specialised testing equipment. These include EEG, EMG and specialised peripheral neurological tests.
Specialised imaging techniques	All radiological techniques except plain film radiology.
Spray and stretch	Techniques where a coolant spray is applied to a painful area as a precursor to stretching.
TENS	Transcutaneous electrical nerve stimulation, a non-invasive low frequency electrical stimulation that is applied through the skin with the aim of introducing an afferent barrage to decrease the perception of pain.
Traction	A passive, longitudinal force of a vertebral segment that can be applied manually or mechanically with the aim of inducing subtle vertebral distraction for duration of the procedure.
VAS	Visual Analogue Scale.
Whiplash-associated disorders (WAD)	Whiplash is an acceleration-deceleration mechanism of energy transfer to the neck. It may result from motor vehicle collisions, the impact of which may result in bony or soft tissue injuries, which in turn may lead to a variety of clinical manifestations.
Work alteration	Modification of work duties and/or work environment to accommodate an injured worker.

Appendix E
Outcome measures for the assessment of WAD

Visual Analogue Scale (VAS) for pain

The VAS[97] for pain consists of a 10cm line with two end-points representing 'no pain' and 'pain as bad as it could possibly be'. Patients with WAD are asked to rate their pain by placing a mark on the line corresponding to their current level of pain. The distance along the line from the 'no pain' marker is then measured with a ruler giving a pain score out of 10.

The Neck Disability Index (NDI)

The NDI[98] (see below) is designed to measure neck-specific disability and is based on the Oswestry Disability Questionnaire.[99] The questionnaire has 10 items concerning pain and activities of daily living including personal care, lifting, reading, headaches, concentration, work status, driving, sleeping and recreation. Each item is scored out of 5 (with the 'no disability' response given a score of 0) giving a total score for the questionnaire out of 50. Higher scores represent greater disability. The result can be expressed as a percentage or as raw scores (out of 50). The NDI is translated into over 20 languages.

In the Guidelines, use of the raw score is recommended.

Impact of Event Scale (IES)

The IES was developed by Horowitz, Wilner and Alvarez to measure current subjective distress related to a specific event.[100] The IES is a self-report measure of posttraumatic disturbance and is very widely used.

The scale is reproduced with permission of the author.

SCORING METHOD	Each item is scored:
Not at all	0
Rarely	1
Sometimes	3
Often	5

The item scores are summed. A total score of 25 or more, at 3 to 6 weeks after injury is in the 'moderate' range. A score of >43 is 'severe'.

The Neck Disability Index (NDI)

Instructions

This questionnaire has been designed to give your health professional information as to how your neck pain has affected your ability to manage in everyday life. Please answer every section and mark only the ONE box in each section which applies to you. We realise you may consider that two of the statements in any one section relate to you, but please just mark the box which most closely describes your problem.

Section 1 – Pain intensity	☐ I have no pain at the moment. ☐ The pain is very mild at the moment. ☐ The pain is moderate at the moment. ☐ The pain is fairly severe at the moment. ☐ The pain is very severe at the moment. ☐ The pain is the worst imaginable at the moment.
Section 2 – Personal care (Washing, dressing, etc.)	☐ I can look after myself normally without causing extra pain. ☐ I can look after myself normally but it causes extra pain. ☐ It is painful to look after myself and I am slow and careful. ☐ I need some help but manage most of my personal care. ☐ I need help every day in most aspects of self care. ☐ I do not get dressed, I wash with difficulty and stay in bed.
Section 3 – Lifting	☐ I can lift heavy weights without extra pain. ☐ I can lift heavy weights but it gives extra pain. ☐ Pain prevents me from lifting heavy weights off the floor, but I can manage if they are conveniently positioned, for example, on a table. ☐ Pain prevents me from lifting heavy weights, but I can manage light to medium weights if they are conveniently positioned. ☐ I can lift very light weights. ☐ I cannot lift or carry anything at all.
Section 4 – Reading	☐ I can read as much as I want to with no pain in my neck. ☐ I can read as much as I want to with slight pain in my neck. ☐ I can read as much as I want with moderate pain in my neck. ☐ I cannot read as much as I want because of moderate pain in my neck. ☐ I can hardly read at all because of severe pain in my neck. ☐ I cannot read at all.
Section 5 – Headaches	☐ I have no headaches at all. ☐ I have slight headaches, which come infrequently. ☐ I have moderate headaches which come infrequently. ☐ I have moderate headaches which come frequently. ☐ I have severe headaches which come frequently. ☐ I have headaches almost all the time.

Section 6 – Concentration	☐ I can concentrate fully when I want to with no difficulty. ☐ I can concentrate fully when I want to with slight difficulty. ☐ I have a fair degree of difficulty in concentrating when I want to. ☐ I have a lot of difficulty in concentrating when I want to. ☐ I have a great deal of difficulty in concentrating when I want to. ☐ I cannot concentrate at all.
Section 7 – Work	☐ I can do as much work as I want to. ☐ I can only do my usual work, but no more. ☐ I can do most of my usual work, but no more. ☐ I cannot do my usual work. ☐ I can hardly do any work at all. ☐ I cannot do any work at all.
Section 8 – Driving	☐ I can drive my car without any neck pain. ☐ I can drive my car as long as I want with slight pain in my neck. ☐ I can drive my car as long as I want with moderate pain in my neck. ☐ I cannot drive my car as long as I want because of moderate pain in my neck. ☐ I can hardly drive at all because of severe pain in my neck. ☐ I cannot drive my car at all.
Section 9 – Sleeping	☐ I have no trouble sleeping. ☐ My sleep is slightly disturbed (less than 1 hr sleepless). ☐ My sleep is mildly disturbed (1-2 hrs sleepless). ☐ My sleep is moderately disturbed (2-3 hrs sleepless). ☐ My sleep is greatly disturbed (3-5 hrs sleepless). ☐ My sleep is completely disturbed (5-7 hrs sleepless).
Section 10 – Recreation	☐ I am able to engage in all my recreation activities with no neck pain at all. ☐ I am able to engage in all my recreation activities, with some pain in my neck. ☐ I am able to engage in most, but not all, of my usual recreation activities because of pain in my neck. ☐ I am able to engage in a few of my usual recreation activities because of pain in my neck. ☐ I can hardly do any recreation activities because of pain in my neck. ☐ I cannot do any recreation activities at all.

Impact of Event Scale (IES)

On _____ you experienced a motor vehicle accident.

Below is a list of comments made by people after stressful life events. Please check each item, indicating how frequently these comments were true for you DURING THE PAST SEVEN DAYS. If they did not occur during that time please mark the 'NOT AT ALL' column.

	NOT AT ALL	RARELY	SOMETIMES	OTHER
1. I thought about it when I didn't mean to.				
2. I avoided letting myself get upset when I thought about it or was reminded of it.				
3. I tried to remove it from memory.				
4. I had trouble falling asleep or staying asleep because pictures or thoughts about it came into my mind.				
5. I had waves of strong feelings about it.				
6. I had dreams about it.				
7. I stayed away from reminders about it.				
8. I felt as if it hadn't happened or it wasn't real.				
9. I tried not to talk about it.				
10. Pictures about it popped into my mind.				
11. Other things kept making me think about it.				
12. I was aware that I still had a lot of feelings about it but I didn't deal with them.				
13. I tried not to think about it.				
14. Any reminder brought back feelings about it.				
15. My feelings were kind of numb.				

Appendix F
Examples of exercises to assist clinicians

See recommendation T2 on page 27 of the Guidelines.

The following exercises can be used as a guide by practitioners when providing primary care to people with WAD.

For people with WAD

The exercises are designed to restore the movement and muscle control around your neck and to reduce unnecessary postural strain and muscle pain.

When you are performing the exercises, stop and contact your doctor or therapist if you notice:

- dizziness, light headedness, blurred vision, fainting or disorientation
- sudden pain shooting down your arm, or numbness or weakness in your arm or hand
- unusually severe neck pain, and/or
- that exercises consistently produce a headache, which persists.

For each exercise:

- move smoothly and slowly, without sudden jerks; the key is precision and control
- keep your mouth and jaw relaxed; keep your lips together, teeth slightly apart and let your tongue rest on the roof of your mouth
- gently hold your shoulders back and down so that they are relaxed while you are doing all exercises (see posture correction exercise, exercise 4, below)
- in movement exercises, try to move the same distance to each side. If one side is stiffer, move gently into the stiffness. Move to that direction a little more often
- expect some discomfort, but remember exercises should not cause severe pain.

Neck exercises while lying down

Lie down with a soft pillow under your neck, and with your knees bent up.

1. The chin nod exercise

Gently and slowly nod your head forward as if to say ‘yes’.

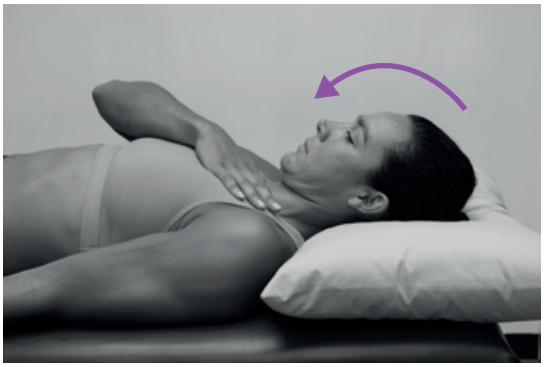
Feel the muscles at the front of your neck.

Stop the nodding action just before you feel the front muscles hardening.

Hold the nod position for five seconds and then relax.

Gently move your head back to the normal start position

Repeat up to 10 times.



2. Head rotation

Gently turn your head from one side to the other.

Look where you are going.

Progressively aim to turn your head far enough so your chin is in line with your shoulder and you can see the wall in line with your shoulder.

Repeat 10 times to each side.

3. Shoulder blade exercise

This exercise will relax and ease any tension in the muscles on top of your shoulders and it will give you pain relief.

a. Lie on your right side with your arm resting up on two pillows.

b. Roll your left shoulder blade back and across your ribs towards the centre of your back.

   Hold the position for 10 seconds.

Repeat five times.

Repeat lying on the left side for the right shoulder blade.

Exercises while sitting

4. Correct postural position

Correct your posture regularly by gently straightening up your lower back and pelvis (sit tall).

Now gently draw your shoulder blades back and down.

Gently tuck your chin in. Hold the position with ease for at least 10 seconds.

This position will prevent and ease muscle pain and tension in your neck and shoulder muscles.

Repeat the correction regularly, every half hour during the day.

You can do this exercise at work, in the car, on a train or bus and sitting at home.

5. Neck retraction

a. Sit in the correct postural position described in exercise 4.

b. Gently draw your head back, sliding your chin back horizontally and keeping your nose pointing straight ahead. You should feel the retraction movement at the base of your neck and your neck should stay long.

Repeat this 10 times every hour when sitting.

Neck movement exercises

Sit in the correct postural position as described in exercise 4.

6. Rotation

Gently turn your head from one side to the other.

Look where you are going, progressively aim to see the wall in line with your shoulder.

This exercise is similar to the exercise you did lying down, only this time you do it sitting.

Repeat 10 times.

7. Side bending

Gently tilt your head towards your shoulder and feel the gentle stretch in the muscles on the side of your neck.

Perform the movement to both sides.

Repeat 10 times.

8. Bending and extension

Gently bend your head towards your chest.

Lead the movement with your chin.

Moving the chin first, bring your head back to the upright position and gently roll it back to look up towards the ceiling.

Leading with your chin, return your head to the upright position.

Repeat 10 times.

Neck strengthening (exercises 9 to 11) should only be started later in your recovery. If you are unsure when to begin this, ask your treating health professional.

9. Neck strengthening exercises (isometric, no movement exercise)

Sit in the correct postural position as described in exercise 4.

Make sure your chin is relaxed and slightly down.

Place your right hand on your right cheek.

Gently try to turn your head into your fingers to look over your right shoulder but allow no movement.

Hold the contraction for five seconds.

Use a 10 per cent to 20 per cent effort, no more!

Repeat with the left hand on the left cheek.

Do five repetitions of the holding exercise to each side.

Neck strengthening exercises whilst in the safe four-point kneeling position.

Firstly, adopt the four-point kneeling position.

Begin by ensuring your knees are directly under your hips, and your hands directly under your shoulders.

Your lower back should be in a neutral position; that is, with a natural arch.

Gently draw your belly button to your spine (10 per cent effort).

Push gently through your shoulder blades, so that your upper back is level.

Draw your shoulders gently away from your ears, or toward your hips.

Lift your head up so that it is level with your shoulders, but maintaining a gentle chin tucked or nod position.

Once you can hold the safe four-point kneeling position, proceed with the neck movement exercises as described below.

10. Neck bending and extension in the four-point kneeling position

a. Adopt the safe four-point kneeling position.

b. Slowly look up toward the ceiling as far as you can go. Hold for 5 to 10 seconds.

c. Follow this by slowly bending your neck, leading the movement with a chin tuck or nodding action.

   Continue the neck bending movement as far as possible, aim for your chin to touch your chest.

   Throughout this movement you should hold the neutral lower back and shoulder blade posture described above.

   Perform 5 to 10 repetitions.

11. Neck rotation in the four-point kneeling position

Adopt the safe four-point kneeling position.

Slowly rotate your head (turn your neck to one side).

It is important to maintain the gentle chin tuck or nod position throughout the movement.

Also, make sure your head stays level with your body, and does not drop down.

If you do this exercise correctly, you should be looking over your shoulder at the end of the movement.

It helps to do this exercise positioning yourself side-on to a mirror so that you can check your head position.

Repeat to the other side.

Perform 5 to 10 repetitions.

Appendix G

NHMRC Evidence Statement Form[101]

KEY QUESTION(S):	EVIDENCE TABLE REF:
1. Evidence base Number of studies, level of evidence and risk of bias in the included studies	A One or more level I studies with a low risk of bias or several level II studies with a low risk of bias
	B One or two level II studies with a low risk of bias or SR/several level III studies with a low risk of bias
	C One or two level III studies with a low risk of bias or level I or II studies with a moderate risk of bias
	D Level IV studies or level I to III studies/SRs with a high risk of bias
2. Consistency If only one study was available, rank this component as 'not applicable'	A All studies consistent
	B Most studies consistent and inconsistency can be explained
	C Some inconsistency, reflecting genuine uncertainty around question
	D Evidence is inconsistent
	NA Not applicable (one study only)
3. Clinical impact (Indicate in the space below if the study results varied according to some unknown factor (not simply study quality or sample size) and thus the clinical impact of the intervention could not be determined)	A Very large
	B Moderate
	C Slight
	D Restricted
4. Generalisability (How well does the body of evidence match the population and clinical settings being targeted by the Guideline?)	A Evidence directly generalisable to target population
	B Evidence directly generalisable to target population with some caveats
	C Evidence not directly generalisable to the target population but could be sensibly applied
	D Evidence not directly generalisable to target population and hard to judge whether it is sensible to apply
5. Applicability (Is the body of evidence relevant to the Australian healthcare context in terms of health services/delivery of care and cultural factors?)	A Evidence directly applicable to Australian healthcare context
	B Evidence applicable to Australian healthcare context with few caveats
	C Evidence probably applicable to Australian healthcare context with some caveats
	D Evidence not applicable to Australian healthcare context
Other factors (Indicate here any other factors that you took into account when assessing the evidence base (for example, issues that might cause the group to downgrade or upgrade the recommendation)	

Evidence statement matrix

Please summarise the development group's synthesis of the evidence relating to the key question, taking all the above factors into account.

COMPONENT	RATING	DESCRIPTION
1.	Evidence base	
2.	Consistency	
3.	Clinical impact	
4.	Generalisability	
5.	Applicability	

Indicate any dissenting opinions

Recommendation

WHAT RECOMMENDATION(S) DOES THE GUIDELINE DEVELOPMENT GROUP DRAW FROM THIS EVIDENCE? Use action statements where possible.	GRADE OF RECOMMENDATION

Unresolved issues

If needed, keep note of specific issues that arise when each recommendation is formulated and that require follow-up.

Implementation of recommendation

Please indicate yes or no to the following questions. Where the answer is yes please provide explanatory information about this. This information will be used to develop the implementation plan for the guidelines.

Will this recommendation result in changes in usual care?		Yes ☐ No ☐
Are there any resource implications associated with implementing this recommendation?		Yes ☐ No ☐
Will the implementation of this recommendation require changes in the way care is currently organised?		Yes ☐ No ☐
Is the guideline development group aware of any barriers to the implementation of this recommendation?		Yes ☐ No ☐

References

1. Motor Accidents Authority, *Guidelines for the Management of Whiplash Associated Disorders*. Sydney, 2001.
2. Spitzer, W.O., *Scientific monograph of the Quebec Task Force on Whiplash-Associated Disorders: Redefining 'whiplash' and its management.* Spine, 1995. **20**: p. 1-73.
3. Motor Accidents Authority, *Guidelines for the Management of Whiplash Associated Disorders for health professionals.* Sydney, 2nd Edition 2007.
4. Bossuyt, P.M. and J.B. Reitsma, *The STARD initiative.* The Lancet, 2003. **361**(9351): p. 71.
5. McGinn, T.G., G. H. Guyatt, P.C. Wyer, C.D., Naylor, I.G., Stiell, and W. S. Richardson, *Users guide to the medical literature XXII: How to use articles about clinical decision rules.* Journal of the American Medical Association, 2000. **284**(1): p. 79-84.
6. Kamper, S.J., M.J. Hancock, and C.G. Maher, *Optimal designs for prediction studies of whiplash*. Spine, 2011. **36**(25S): p. S268-S274.
7. Maher, C.G., C. Sherrington, R.D. Herbert, A.M. Moseley, and M. Elkins, *Reliability of the PEDro scale for rating quality of randomized controlled trials.* Physical therapy, 2003. **83**(8): p. 713-721.
8. Shea, B.J., J.M. Grimshaw, G.A.Wells, M. Boers, N. Andersson, C. Hamel, A.C. Porter, P. Tugwell, D. Moher and L.M. Bouter, *Development of AMSTAR: a measurement tool to assess the methodological quality of systematic reviews.* BMC medical research methodology, 2007. **7**(1): p. 10.
9. Anderson, S.E., C. Boesch, H. Zimmermann, A. Busato, J. Hodler, R. Bingisser, .E.J. Ulbrich, A. Nidecker, C.H. Buitrago-Téllez, H.M. Bonerl, P. Heini, S. Schaeren, and M. Sturzenegger, *Are there cervical spine findings at MR imaging that are specific to acute symptomatic whiplash injury? A prospective controlled study with four experienced blinded readers.* Radiology, 2012. **262**(2): p. 567-75.
10. Chien, A., E. Eliav, and M. Sterling, *Hypoesthesia occurs in acute whiplash irrespective of pain and disability levels and the presence of sensory hypersensitivity*. Clin J Pain, 2008. **24**(9): p. 759-66.
11. Dehner, C., B. Heym, D. Maier, S. Sander, M. Arand, M. Elbel, E. Hartwig, and M. Kramer, *Postural control deficit in acute QTF grade II whiplash injuries.* Gait Posture, 2008. **28**(1): p. 113-9.
12. Dispenza, F., R. Gargano, N. Mathur, C. Saraniti, and S. Gallina, *Analysis of visually guided eye movements in subjects after whiplash injury.* Auris Nasus Larynx, 2011. **38**(2): p. 185-9.
13. Elliott, J., A. Pedler, J. Kenardy, G. Galloway, G. Jull, and M. Sterling, *The temporal development of fatty infiltrates in the neck muscles following whiplash injury: an association with pain and posttraumatic stress. PLoS ONE* [Electronic Resource], 2011. **6**(6): p. e21194.
14. McLean, S.A., L. Diatchenko, Y.M. Lee, R.A. Swor, R.M. Domeier, J.S. Jones, C.W. Jones, C. Reed, R.E. Harris, W. Maixner, D.J. Clauw, and I. Liberzon, *Catechol O-methyltransferase haplotype predicts immediate musculoskeletal neck pain and psychological symptoms after motor vehicle collision.* Journal of Pain, 2011. **12**(1): p. 101-107.
15. Pedler, A. and M. Sterling, *Assessing Fear-Avoidance Beliefs in Patients With Whiplash-associated Disorders: A Comparison of 2 Measures.* Clinical Journal of Pain, 2011. **27**(6): p. 502-507.
16. Solarino, B., F. Coppola, G. Di Vella, M. Corsalini, and N. Quaranta, *Vestibular evoked myogenic potentials (VEMPs) in whiplash injury: a prospective study.* Acta Otolaryngol, 2009. **129**(9): p. 976-81.
17. Sterling, M. and A. Pedler, *A neuropathic pain component is common in acute whiplash and associated with a more complex clinical presentation.* Man Ther, 2009. **14**(2): p. 173-9.
18. Sterling, M., *Differential development of sensory hypersensitivity and a measure of spinal cord hyperexcitability following whiplash injury.* Pain, 2010. **150**(3): p. 501-6.
19. Ulbrich, E.J., S. Eigenheer, C. Boesch, J. Hodler, A. Busato, C. Schraner, . . .M. Sturzenegger, *Alterations of the transverse ligament: an MRI study comparing patients with acute whiplash and matched control subjects.* AJR. American Journal of Roentgenology, 2011. **197**(4): p. 961-7.
20. Ulbrich, E.J., S.E. Anderson, A. Busato, S. Abderhalden, C. Boesch, H. Zimmermann, P. Heini, J. Hodler, and M. Sturzenegger, *Cervical muscle area measurements in acute whiplash patients and controls.* J Magn Reson Imaging, 2011. **33**(3): p. 668-75.
21. Valenza, M.C., G. Valenza, E. Gonzalez-Jimenez, A.I. De-la-Llave-Rincon, M. Arroyo-Morales, and C. Fernandez-de-las-Penas, *Alteration in Sleep Quality in Patients with Mechanical Insidious Neck Pain and Whiplash-Associated Neck Pain.* American Journal of Physical Medicine & Rehabilitation, 2012. **91**(7): p. 584-591.

22. Vetti, N., J. Krakenes, E. Damsgaard, J. Rorvik, N.E. Gilhus, and A. Espeland, *Magnetic resonance imaging of the alar and transverse ligaments in acute whiplash-associated disorders 1 and 2: a cross-sectional controlled study.* Spine (Phila Pa 1976), 2011. **36**(6): p. E434-40.
23. Kamper, S.J., T. Rebbeck, C.G. Maher, J.H. McAuley, and M. Sterling, *Course and prognostic factors of whiplash: a systematic review and meta-analysis.* Pain, 2008. **138**: p. 617-629.
24. Ameratunga, S., S.T. Tin, J. Connor, and R. Norton, *Chronic neck pain following car crashes: A population-based study from Auckland, New Zealand.* Internal Medicine Journal, 2010. **40**(10): p. 704-709.
25. Atherton, K., N.J. Wiles, F.E. Lecky, S.J. Hawes, A. J. Silman, G.J. Macfarlane, and G.T. Jones, *Predictors of persistent neck pain after whiplash injury.* Emergency Medicine Journal, 2006. **23**(3): p. 195-201.
26. Berglund, A., L. Bodin, I. Jensen, A. Wiklund, and L. Alfredsson, *The influence of prognostic factors on neck pain intensity, disability, anxiety and depression over a 2-year period in subjects with acute whiplash injury.* Pain, 2006. **125**(3): p. 244-256.
27. Borenstein, P., M. Rosenfeld, and R. Gunnarsson, *Cognitive symptoms, cervical range of motion and pain as prognostic factors after whiplash trauma.* Acta Neurologica Scandinavica, 2010. **122**(4): p. 278-285.
28. Buitenhuis, J., P.J. de Jong, J.P.C. Jaspers, and J.W. Groothoff, *Catastrophizing and causal beliefs in whiplash.* Spine, 2008. **33**(22): p. 2427-33; discussion 2434.
29. Buitenhuis, J., P.J. de Jong, J.P.C. Jaspers, and J.W. Groothoff, *Work disability after whiplash: a prospective cohort study.* Spine, 2009. **34**(3): p. 262-267.
30. Buitenhuis, J., P.J. de Jong, J.P.C. Jaspers, and J.W. Groothoff, *Relationship between posttraumatic stress disorder symptoms and the course of whiplash complaints.* Journal of Psychosomatic Research, 2006. **61**(5): p. 681-689.
31. Buitenhuis, J., J.P.C. Jaspers, and V. Fidler, *Can kinesiophobia predict the duration of neck symptoms in acute whiplash?* Clinical Journal of Pain, 2006. **22**(3): p. 272-277.
32. Carroll, L.J., J.D. Cassidy, and P. Cote, *The role of pain coping strategies in prognosis after whiplash injury: Passive coping predicts slowed recovery.* Pain, 2006. **124**(1-2): p. 18-26.
33. Carroll, L.J., R. Ferrari, and J.D. Cassidy, *Reduced or painful jaw movement after collision-related injuries: a population-based study.* Journal of the American Dental Association (JADA), 2007. **138**(1): p. 86-93.
34. Carroll, L.J., L.W. Holm, R. Ferrari, D. Ozegovic, and J.D. Cassidy, *Recovery in whiplash-associated disorders: do you get what you expect?* Journal of Rheumatology, 2009. **36**(5): p. 1063-1070.
35. Carroll, L.J., Y. Liu, L.W. Holm, J.D. Cassidy, and P. Cote, *Pain-related emotions in early stages of recovery in whiplash-associated disorders: Their presence, intensity, and association with pain recovery.* Psychosomatic Medicine, 2011. **73**(8): p. 708-715.
36. Carstensen, T.B.W., L. Frostholm, E. Oernboel, A. Kongsted, H. Kasch, T.S. Jensen, and P. Fink, *Post-trauma ratings of pre-collision pain and psychological distress predict poor outcome following acute whiplash trauma: a 12-month follow-up study.* Pain, 2009. **139**(2): p. 248-59.
37. Carstensen, T.B.W., L. Frostholm, E. Oernboel, A. Kongsted, H. Kasch, T.S. Jensen, and P. Fink, *Are there gender differences in coping with neck pain following acute whiplash trauma? A 12-month follow-up study.* European Journal of Pain, 2012. **16**(1): p. 49-60.
38. Cobo, E.P., M.E.P. Mesquida, E. P. Fanegas, E.M. Atanasio, M.B.S. Pastor, C.P. Pont, . . . L.G. Cano, *What factors have influence on persistence of neck pain after a whiplash?* Spine, 2010. **35**(9): p. E338-E343.
39. Elliott, J., A. Pedler, J. Kenardy, G. Galloway, G. Jull, and M. Sterling, *The temporal development of fatty infiltrates in the neck muscles following whiplash injury: an association with pain and posttraumatic stress.* PloS one, 2011. **6**(6): p. e21194.
40. Gabel, C.P., B. Burkett, A. Neller, and M. Yelland, *Can long-term impairment in general practitioner whiplash patients be predicted using screening and patient-reported outcomes?* International Journal of Rehabilitation Research, 2008. **31**(1): p. 79-80.
41. Goldsmith, R., C. Wright, S. Bell, and A. Rushton, *Cold hyperalgesia as a prognostic factor in whiplash associated disorders: a systematic review.* Manual Therapy, 2012(in press): p. 1-9.
42. Gun, R.T., O.L. Osti, A. O'Riordan, F. Mpelasoka, C.G.M. Eckerwall, and J.F. Smyth, *Risk factors for prolonged disability after whiplash injury: A prospective study.* Spine, 2005. **30**(4): p. 386-391.
43. Hendriks, E.J.M., G.G.M. Scholten-Peeters, D. A. W. M. Van Der Windt, C. W. M. Neeleman-Van Der Steen, R. A. B. Oostendorp, and A.P. Verhagen, *Prognostic factors for poor recovery in acute whiplash patients.* Pain, 2005. **114**(3): p. 408-416.

44. Holm, L.W., L.J. Carroll, J.D. Cassidy, E. Skillgate, and A. Ahlbom, *Widespread pain following whiplash-associated disorders: incidence, course, and risk factors.* The Journal of Rheumatology, 2007. **34**(1): p. 193-200.
45. Holm, L.W., L.J. Carroll, J.D. Cassidy, E. Skillgate, and A. Ahlbom, *Expectations for recovery important in the prognosis of whiplash injuries.* Plos Medicine, 2008. **5**(5): p. 0760-0767.
46. Ichihara, D., E. Okada, K. Chiba, Y. Toyama, H. Fujiwara, S. Momoshima, Y. Nishiwaki, T. Hashimoto, J. Ogawa, M. Watanabe, T. Takahata, and M. Matsumoto, *Longitudinal magnetic resonance imaging study on whiplash injury patients: minimum 10-year follow-up.* Journal of Orthopaedic Science, 2009. **14**(5): p. 602-10.
47. Johansson, M.P., M. S. B.Liane, T. Bendix, H. Kasch, and A. Kongsted, *Does cervical kyphosis relate to symptoms following whiplash injury?* Manual Therapy, 2011. **16**(4): p. 378-383.
48. Kasch, H., E. Qerama, A. Kongsted, F.W. Bach, T. Bendix, and T.S. Jensen, *The risk assessment score in acute whiplash injury predicts outcome and reflects biopsychosocial factors.* Spine, 2011. **36**(25 Suppl): p. S263-7.
49. Kasch, H., E. Qerama, A. Kongsted, T. Bendix, T.S. Jensen, and F.W. Bach, *Clinical assessment of prognostic factors for long-term pain and handicap after whiplash injury: A 1-year prospective study.* European Journal of Neurology, 2008. **15**(11): p. 1222-1230.
50. Kivioja, J., R. Jensen, and U. Lindgren, *Early coping strategies do not influence the prognosis after whiplash injuries.* Injury-International Journal of the Care of the Injured, 2005. **36**(8): p. 935-940.
51. Kongsted, A., T. Bendix, E. Qerama, H. Kasch, F.W. Bach, L. Korsholm, and T.S. Jensen, *Acute stress response and recovery after whiplash injuries. A one-year prospective study.* European Journal of Pain, 2008. **12**(4): p. 455-463.
52. Kongsted, A., L.V. Jørgensen, C. Leboeuf-Yde, E. Qerama, L. Korsholm, and T. Bendix, *Are altered smooth pursuit eye movements related to chronic pain and disability following whiplash injuries? A prospective trial with one-year follow-up.* Clinical Rehabilitation, 2008. **22**(5): p. 469-479.
53. Kongsted, A., J.S. Sorensen, H. Andersen, B. Keseler, T.S. Jensen, and T. Bendix, *Are early MRI findings correlated with long-lasting symptoms following whiplash injury? A prospective trial with 1-year follow-up.* European Spine Journal, 2008. **17**(8): p. 996-1005.
54. Ozegovic, D., L.J. Carroll, and J. David Cassidy, *Does expecting mean achieving? The association between expecting to return to work and recovery in whiplash associated disorders: a population-based prospective cohort study.* Eur Spine J, 2009. **18**(6): p. 893-9.
55. Phillips, L.A., L.J. Carroll, J.D. Cassidy, and P. Cote, *Whiplash-associated disorders: Who gets depressed? Who stays depressed?* European Spine Journal, 2010. **19**(6): p. 945-956.
56. Sterling, M., J. Hendrikz, and J. Kenardy, *Compensation claim lodgement and health outcome developmental trajectories following whiplash injury: A prospective study.* Pain, 2010. **150**(1): p. 22-8.
57. Sterling, M., J. Hendrikz, and J. Kenardy, *Similar factors predict disability and posttraumatic stress disorder trajectories after whiplash injury.* Pain, 2011. **152**(6): p. 1272-1278.
58. Sterling, M., G. Jull, and J. Kenardy, *Physical and psychological factors maintain long-term predictive capacity post-whiplash injury.* Pain, 2006. **122**(1-2): p. 102-108.
59. Sterling, M., G. Jull, B. Vicenzino, J. Kenardy, and R. Darnell, *Physical and psychological factors predict outcome following whiplash injury.* Pain, 2005. **114**(1-2): p. 141-148.
60. Sterling, M. and J. Kenardy, *The relationship between sensory and sympathetic nervous system changes and posttraumatic stress reaction following whiplash injury—a prospective study.* Journal of Psychosomatic Research, 2006. **60**(4): p. 387-393.
61. Sterling, M., J. Hendrikz, J. Kenardy, E. Kristjansson, J.P., Dumas, K. Niere, J. Cote, S. Deserres, K. Rivest and G. Jull, *Assessment and validation of prognostic models for poor functional recovery 12 months after whiplash injury: a multicentre inception cohort study.* PAIN, 2012(0).
62. Vetti, N., J. Krakenes, G.E. Eide, J. Rorvik, N.E. Gilhus, and A. Espeland, *Are MRI high-signal changes of alar and transverse ligaments in acute whiplash injury related to outcome?* Bmc Musculoskeletal Disorders, 2010. **11**.
63. Walton, D., J. Pretty, J. Macdermid, and R. Teasell, *Risk factors for persistent problems following whiplash injury: results of a systematic review and meta-analysis.* Journal of Orthopaedic & Sports Physical Therapy, 2009. **39**(5): p. 334-350.
64. Williams, M., E. Williamson, S. Gates, S. Lamb, and M. Cooke, *A systematic review of physical prognostic factors for the development of late whiplash syndrome.* Spine, 2007. **32**(25): p. E764-E780.

65. Williamson, E., M. Williams, S. Gates, and S. Lamb, *A systematic review of psychological factors and the development of late whiplash syndrome.* Pain, 2008. **135**: p. 20-30.
66. Yang, X.Q., P. Cote, J.D. Cassidy, and L. Carroll, *Association between body mass index and recovery from whiplash injuries: A cohort study.* American Journal of Epidemiology, 2007. **165**(9): p. 1063-1069.
67. Pedler, A. and M. Sterling, *Assessing fear-avoidance beliefs in patients with whiplash-associated disorders: a comparison of 2 measures.* Clin J Pain, 2011. **27**(6): p. 502-7.
68. Dickersin, K., S. Chan, T. Chalmers, H. Sacks, and H. Smith, *Publication bias and clinical trials*. Clinical Trials, 1987. **8**: p. 343-353.
69. Teasell, R.W., J.A. McClure, D. Walton, J. Pretty, K. Salter, M. Meyer, K. Sequeira, and B. Death, *A research synthesis of therapeutic interventions for whiplash-associated disorder: Part 1 - Overview and summary.* Pain Research and Management, 2010. **15**(5): p. 287-294.
70. Shea, B., J. M. Grimshaw, G. A.Wells, M.Boers, N. Andersson, C. Hamel, . . . L.M. Bouter, *Development of AMSTAR: a measurement tool to assess the methodological quality of systematic reviews.* BMC Medical Research Methodology, 2007. **7**(10).
71. Dehner, C., E. Hartwig, P. Strobel, M. Scheich, F. Schneider, M. Elbel, . . ., *Comparison of the relative benefits of 2 versus 10 days of soft collar cervical immobilization after acute whiplash injury*. Archives of Physical Medicine and Rehabilitation 2006 Nov;87(**11**):1423-1427, 2006.
72. Aigner, N., C. Fialka, C. Radda, and V. Vecsei, *Adjuvant laser acupuncture in the treatment of whiplash injuries: a prospective, randomized placebo-controlled trial.* Wien Klin Wochenschr, 2006. **118**(3-4): p. 95-9.
73. Oliveira, A., R. Gevirtz, and D. Hubbard, *A psycho-educational video used in the emergency department provides effective treatment for whiplash injuries.* Spine, 2006. **31**(15): p. 1652-1657.
74. Brison, R.J., L. Hartling, S. Dostaler, A. Leger, B.H. Rowe, I. Stiell, . . ., *A randomized controlled trial of an educational intervention to prevent the chronic pain of whiplash associated disorders following rear-end motor vehicle collisions [with consumer summary].* Spine 2005 Aug 15;30(16):1799-1807, 2005.
75. Kongsted, A., E. Qerama, H. Kasch, F.W. Bach, L. Korsholm, T.S. Jensen, and T. Bendix, *Education of patients after whiplash injury: Is oral advice any better than a pamphlet?* Spine, 2008. **33**(22): p. E843-E848.
76. Scholten-Peeters, G.G.M., C.W.M. Neeleman-van der Steen, D. van der Windt, E.J.M. Hendriks, A.P. Verhagen, and R.A.B. Oostendorp, *Education by general practitioners or education and exercises by physiotherapists for patients with whiplash-associated disorders? A randomized clinical trial.* Spine, 2006. **31**(7): p. 723-731.
77. Teasell, R.W., J.A. McClure, D. Walton, J. Pretty, K. Salter, M. Meyer, K. Sequeira, and B. Death, *A research synthesis of therapeutic interventions for whiplash-associated disorder (WAD): Part 2 - Interventions for acute WAD.* Pain Research and Management, 2010. **15**(5): p. 295-304.
78. Teasell, R.W., J.A. McClure, D. Walton, J. Pretty, K. Salter, M. Meyer, K. Sequeira, and B. Death, *A research synthesis of therapeutic interventions for whiplash-associated disorder (WAD): Part 3 - Interventions for subacute WAD.* Pain Research and Management, 2010. **15**(5): p. 305-312.
79. Haines, T., A.R. Gross, S. Burnie, C.H. Goldsmith, L. Perry, and N. Graham, *A Cochrane review of patient education for neck pain.* Spine Journal, 2009. **9**(10): p. 859-871.
80. Shaw, L., M. Descarreaux, R. Bryans, M. Duranleau, H. Marcoux, B. Potter, R. Ruegg, R.E. Watkin, and R E. White, *A systematic review of chiropractic management of adults with whiplash-associated disorders: Recommendations for advancing evidence-based practice and research.* Work-a Journal of Prevention Assessment & Rehabilitation, 2010. **35**(3): p. 369-394.
81. Verhagen, A.P., G. Scholten-Peeters, S. van Wijngaarden, R.A de Bie, and S.M.A. Bierma-Zeinstra, *Conservative treatments for whiplash.* Cochrane Database of Systematic Reviews, 2007(2).
82. Ask, T., L.I. Strand and J.S. Skouen, *The effect of two exercise regimes; motor control versus endurance/ strength training for patients with whiplash-associated disorders: a randomized controlled pilot study [with consumer summary].* Clinical Rehabilitation 2009 Sep;23(9):812-823, 2009.
83. Rosenfeld, M., A. Seferiadis, and R. Gunnarsson, *Active involvement and intervention in patients exposed to whiplash trauma in automobile crashes reduces costs: a randomized, controlled clinical trial and health economic evaluation.* Spine, 2006. **31**(16): p. 1799-804.
84. Bunketorp, L., M.Lindh, J. Carlsson, and E. Stener-Victorin, *The effectiveness of a supervised physical training model tailored to the individual needs of patients with whiplash-associated disorders — a randomized controlled trial.* Clinical Rehabilitation, 2006. **20**(3): p. 201-217.

85. Vassiliou, T., G. Kaluza, C. Putzke, H. Wulf, and M. Schnabel, *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): p. 69-76.
86. Dehner, C., M. Elbel, P. Strobel, M. Scheich, F. Schneider, G. Krischak, and M. Kramer, *Grade II whiplash injuries to the neck: what is the benefit for patients treated by different physical therapy modalities?* Patient Safety in Surgery 2009 Jan 16;3(2):Epub, 2009.
87. Mercer, C., A. Jackson, and A. Moore, *Developing clinical guidelines for the physiotherapy management of whiplash associated disorder (WAD).* International Journal of Osteopathic Medicine, 2007. **10**(2-3): p. 50-54.
88. Drescher, K., S. Hardy, J. MacLean, M. Schindler, K. Scott, and S. Harris, *Efficacy of postural and neck stabilization exercises for persons with acute whiplash-associated disorders: a systematic review.* Physiotherapy Canada, 2008. **60**: p. 215-223.
89. Kongsted, A., E. Qerama, H. Kasch, T. Bendix, F.W. Bach, L. Korsholm, and T.S. Jensen, *Neck collar, "act-as-usual" or active mobilization for whiplash injury? A randomized parallel-group trial.* Spine, 2007. **32**(6): p. 618-626.
90. Picelli, A., G. Ledro, A. Turrina, C. Stecco, V. Santilli, and N. Smania, *Effects of myofascial technique in patients with subacute whiplash associated disorders: A pilot study.* European Journal of Physical and Rehabilitation Medicine, 2011. **47**(4): p. 561-568.
91. Rushton, A., C. Wright, N. Heneghan, G. Eveleigh, M. Calvert, and N. Freemantle, *Physiotherapy rehabilitation for whiplash associated disorder II: a systematic review and meta-analysis of randomised controlled trials*. BMJ Open, 2011: p. 1-13.
92. Khwaja, S.M., M. Minnerop, and A.J. Singer, *Comparison of ibuprofen, cyclobenzaprine or both in patients with acute cervical strain: a randomized controlled trial.* Canadian Journal of Emergency Medicine, 2010. **12**(1): p. 39-44.
93. Carroll, A., M. Barnes, and C. Comiskey, *A prospective randomized controlled study of the role of botulinum toxin in whiplash-associated disorder.* Clin Rehabil, 2008. **22**(6): p. 513-9.
94. Tough, E.A., A.R. White, S.H. Richards, and J.L. Campbell, *Myofascial trigger point needling for whiplash associated pain – A feasibility study.* Manual Therapy, 2010. **15**(6): p. 529-535.
95. Gonzalez-Iglesias, J., C. Fernandez-De-Las-Penas, J. Cleland, P. Huijbregts, and M. Del Rosario Gutierrez-Vega, *Short-term effects of cervical kinesio taping on pain and cervical range of motion in patients with acute whiplash injury: A randomized clinical trial.* Journal of Orthopaedic and Sports Physical Therapy, 2009. **39**(7): p. 515-521.
96. Rebbeck, T., C.G. Maher, and K.M. Refshauge, *Evaluating two implementation strategies for whiplash guidelines in physiotherapy: a cluster-randomised trial.* Australian Journal of Physiotherapy 2006;52(3):165-174, 2006.
97. Scott, J. and E. Huskisson, *Graphic representation of pain.* Pain, 1976. **2**(2): p. 175-184.
98. Vernon, H. and S. Mior, T*he Neck Disability Index: a study of reliability and validity.* J Manipulative Physiol Ther, 1991. **14**(7): p. 409-15.
99. Fairbank, J., J. Couper, J. Davies, and J. O'Brien, *The Oswestry low back pain disability questionnaire.* Physiotherapy, 1980. **66**(8): p. 271-273.
100. Horowitz, M., N. Wilner, and W. Alvarez, *Impact of Event Scale: a measure of subjective stress.* Psychosom Med, 1979. **41**(3): p. 209-18.
101. Hillier, S., K. Grimmer-Somers, T. Merlin, P. Middleton, J. Salisbury, R. Tooher, and A. Weston, *FORM: an Australian method for formulating and grading recommendations in evidence-based clinical guidelines.* BMC Medical Research Methodology, 2011. **11**(1): p. 23.

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