Technical Report Chapter 3: Prognosis

Australian Clinical Guidelines for Health Professionals Managing People with Whiplash Associated Disorders, Fourth Edition

State Insurance
Regulatory Authority

NSW GOVERNMENT

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2. Abstract

Background: Around 50% of people with whiplash do not recover after injury. These people have ongoing high levels of pain and disability, seek multiple services and consequently contribute most to the rehabilitation costs. Importantly, care to these people can be delayed. Early identification of people at risk of non-recovery therefore is important to provide timely appropriate care.

Objective: To provide recommendations on: 1) Prognostic tools that are able to identify people at risk of poor outcome in the acute phase and 2) prognostic factors that are associated with poor outcome for people with both acute and chronic whiplash.

Methods: We first undertook a systematic review of databases from Jan 1995 until July 2022 to identify both prognostic tools and prognostic factors. Evidence was synthesised and extracted to identify the accuracy statistics (prognostic tools) and Odds and Risk Ratios (prognostic factors) associated with the identified critical outcomes. Strength of evidence was determined using the GRADE approach and the guideline panel then worked through the Evidence to Decision Framework to determine the strength of evidence for each recommendation.

Results: Recommendations were made from 5 prognostic tool studies, 57 acute whiplash prognostic factor studies and 6 chronic whiplash prognostic factor studies. Two prognostic tools were recommended (WhipPredict and SF-Orebro) to identify those at risk of poor prognosis. Prognostic factors with strong recommendations to assess for people with acute whiplash were symptom factors (initial pain intensity, initial neck related disability, number of painful body areas number of painful symptoms) and psychological factors (post-traumatic stress symptoms and expectations of recovery). For people with chronic whiplash similar symptom factors were conditionally recommended (e.g., initial neck pain intensity and neck disability) to identify those likely to have ongoing poor outcome.

Conclusions: Healthcare professionals are primarily recommended to administer either prognostic tool early after injury to identify both those with a good (likely to recover well) and poor prognosis. Stratified care, where care is matched to the risk profile is then recommended to be chosen from the treatment recommendations.

Keywords: Prognostic tools, prognostic factors, risk assessment

3. Suggested citation

Rebbeck, T., Papic, C., Brown, K., Carvalho-e-Silva, A. P., Chia, L., & Cameron, I. D., & (2023). Australian Clinical Guidelines for Health Professionals Managing People with Whiplash-Associated Disorders, Fourth Edition: Technical Report Chapter 3 Prognosis. State Insurance Regulatory Authority: Sydney, Australia.

4. Introduction

Whiplash-associated-disorders are the most common injury for the ~2.6 million Australians involved in a non-catastrophic MVC and are characterised by symptoms following whiplash trauma to the neck (MAA, 2009). Whilst half of those Australians injured should see rapid recovery following a MVC, the clinical course is not so clear for the remaining 50% who may develop chronic pain, disability, psychological disorders (e.g., posttraumatic stress, depression, and anxiety) and continue to report long-term interference in daily life (Campbell et al., 2018; Sterling et al., 2010).

The 2014 NSW SIRA "Guidelines for the management of acute whiplash-associated disorders – for health professionals. Sydney: third edition 2014" (SIRA, 2014) covers management of people with WAD in the first 12 weeks following an MVC. The 2008 Trauma and Injury Recovery "Clinical Guidelines for Best Practice Management of Acute and Chronic Whiplash-Associated Disorders" (TRACsa, 2008) provides some guidance on management of people with chronic WAD. However, many studies have been published since the release of these two guidelines. At present, the acute guidelines are mostly used across Australia. As per the Australian National Health and Medical Research Council (NHMRC) Standards for Guidelines, recommendations within clinical guidelines need to be based on current evidence to ensure ongoing relevance and reliability. There is a need for systematic review and collation of current evidence to update the existing Australian WAD guidelines and bridge the gap between research and clinical practice. Since the previous guidelines the GRADE process for evaluating certainty of evidence and developing clinical recommendations is being increasingly used and is now a requirement of new Australian guidelines. The overall aim of developing these guidelines is to improve health and social outcomes of people with acute and chronic WAD by providing best practice recommendations for healthcare professionals managing these people. This technical report details evidence reviews and subsequent recommendations and implementation considerations for determining the prognosis of people acute and chronic WAD.

5. Abbreviations

WAD = whiplash-associated disorders

6. Contents

7. Technical Report Chapter 3: Prognosis of acute and chronic whiplash-associated disorders

7.1. Review of evidence

7.1.1. Aims

The aims of this systematic review and guideline recommendation development were to:

1. Systematically review, summarise, and evaluate the literature for the prognosis for people with acute/ subacute (<3 months after injury) and chronic (≥3 months after injury) whiplash associated disorders (WAD). Four critical outcome measures were determined: ongoing pain, ongoing neck disability, perceived recovery, and psychological distress.
2. Synthesis evidence from the above review together with evidence already reviewed in the previous guidelines under relevant clinical questions.
3. Develop clinical recommendations and implementation considerations for the prognosis of people with acute and chronic WAD in Australia. In particular:
    a. What prognostic tools should healthcare professionals use to identify those at low and high risk of poor outcome after acute whiplash?
    b. What prognostic factors are associated with poor outcome in people with acute whiplash?
    c. What prognostic factors are associated with poor outcome in people with chronic whiplash?

7.1.2. Systematic review

Systematic review methods used in the 2014 NSW SIRA "Guidelines for the management of acute whiplash-associated disorders – for health professionals. Sydney: third edition 2014" (SIRA, 2014) and 2008 Trauma and Injury Recovery "Clinical Guidelines for Best Practice Management of Acute and Chronic Whiplash-Associated Disorders" (TRACsa, 2008) were adapted for this review to ensure a consistent methodological approach and synthesis of current evidence with that of the existing guidelines.

7.1.3. Search strategy

Database searches were performed using key words to retrieve studies specific to the population group (whiplash injury) and study design (prospective cohort studies or secondary analysis of randomised controlled trials) (Table 1). The search strategy was initially developed in the Ovid Medline database (Table 1) and adapted for database specific medical subject headings (MeSH). Searches were performed using eight electronic databases from 1 January 1995 to 31 July 2022. Databases searched were Medline, Embase, Allied and Complementary Medicine Database (Amed), PsycINFO, CINAHL, Cochrane (Systematic Reviews Database), Web of Science Core Collection, EBM Reviews, and EBM Cochrane Database of Systematic Reviews. Articles were screened for eligibility using the online software Covidence (Covidence.org: Melbourne, Australia). Following this, the previous Australian guidelines (SIRA 2014, TRACsa 2009) were cross-checked to determine any missing studies. Finally, reference lists of prognosis systematic reviews (Sarrami et al., 2017; Shearer et al., 2021; Walton et al., 2013) were screened to identity any further omissions.

Table 1: Prognosis of whiplash-associated-disorders database search strategy

Database	Search strategy		
Medline	1	Whiplash Injuries/	3379
	2	whiplash*.mp.	4164
	3	(Neck pain* adj4 whiplash*).mp.	204
	4	(Neck injur* adj4 whiplash*).mp.	45
	5	traumatic neck pain*.mp.	60
	6	traumatic neck injur*.mp.	27
	7	1 or 2 or 3 or 4 or 5 or 6	4215
	8	prognosis/	578592
	9	prognos*.mp.	1025840

	10 predict*.mp. 1995839 11 recover*.mp. 804052 12 prospective studies/ 636308 13 prospective*.mp. 1005495 14 follow-up studies/ 686866 15 follow?up.mp. 21207 16 risk factors/ 930710 17 risk factor*.mp. 1309250 18 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 5440825 19 7 and 18 1280 20 limit 19 to (english language and humans and yr="1995 – Current") 958
Embase	1 exp whiplash injury/ or (whiplash* or (neck pain* adj4 whiplash*) or (neck injur* adj4 whiplash*) or Traumatic neck injur* or Traumatic neck pain*).mp. 5836 2 exp prospective studies/ or exp longitudinal study/ or exp follow up/ or exp cohort analysis/ or exp risk factors/ or exp predictor variable/ or exp predictive validity/ or exp predictive value/ or exp predictive model/ or exp prognosis/ 4873319 3 ((inception adj1 cohort*) or (prognos* adj1 factor*) or (prognos* adj1 model*) or (prospective adj1 cohort) or predict* or recover* or prognos*).mp. 4728497 4 1 and (2 or 3) 1707 5 limit 4 to (human and english language and yr="1995 -Current") 1395 6 limit 5 to (embase and journal) 979 7 limit 6 to yr="1995 - Current" 979
Allied and Complementary Medicine (AMED)	1 Whiplash injuries/ or Whiplash.mp. 644 2 (Neck pain* adj4 whiplash*).mp. 50 3 (Neck injur* adj4 whiplash*).mp. 4 4 Traumatic neck injur*.mp. 2 5 Traumatic neck pain*.mp. 7 6 1 or 2 or 3 or 4 or 5 651 7 Prognosis/ 2158 8 Prognos*.mp. 4258 9 Predict*.mp. 14271 10 Recover*.mp. 9802 11 Prospective.mp. or prospective studies/ 8081 12 Follow up studies/ 1862 13 Follow?up*.mp. 496 14 risk factors/ 3727 15 risk factor*.mp. 7108 16 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 39165 17 6 and 16 168 18 limit 17 to english 160 19 limit 18 to journal article 141 20 limit 19 to yr="1995 -Current" 136
PsychINFO	1 exp Whiplash/ or whiplash.mp. 672 2 (Neck pain* adj4 whiplash*).mp. 34 3 (Neck injur* adj4 whiplash*).mp. 10 4 Traumatic neck injur*.mp. 3 5 Traumatic neck pain*.mp. 8 6 1 or 2 or 3 or 4 or 5 678 7 exp Prognosis/ 10210 8 Prognos*.mp. 40668 9 recover*.mp. 96684

	10 exp prospective studies/ 1213 11 prospective*.mp. 89050 12 exp risk factors/ 93225 13 risk factor*.mp. 190901 14 follow?up.mp. 19295 15 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 398512 16 6 and 15 200 17 limit 16 to (human and english language) 189 18 limit 17 to journal article 161 19 limit 18 to yr="1995 -Current"154
Cinahl	Query (((MM "Whiplash Injuries")) AND ((MH "Prospective Studies+") OR (MH "Risk Factors+") OR ("prognos* and factor*") OR ("prognos* and model*") OR ("inception cohort") OR (MH "Predictive Value of Tests")) Limiters - Published Date: 19950101-20220731; English Language; Peer Reviewed; Exclude MEDLINE records; Human Expanders - Apply equivalent subjects Narrow by SubjectAge: - all adult Narrow by Language: - english Search modes - Boolean/Phrase 55
Web of Science	(whiplash (Topic) 4,149 AND TI= ((prospective cohort) OR (inception cohort) or (prognos* factor*) or (predict* factor*) or (prognos* model*) or (predict* valid*) or (predict* model*) or (risk factor*) or (prognos*)) (#1 AND #2) AND DT==("ARTICLE") Publication date 1995-01-01 to 2022-07-31 112
EBM	EBM Reviews - ACP Journal Club <1991 to July 2022> EBM Reviews - Cochrane Database of Systematic Reviews <2005 to August 17, 2022> 1 (whiplash and (inception cohort or prospective cohort or prognos* or predict* or risk factor*)).mp. 25 2 limit 1 to yr="1995 -Current" 23
Filters	Studies published between 01-01-1995 and 31-07-2022

7.1.4. Inclusion criteria

Inclusion criteria for prognostic factor studies
For prognostic factors studies, inclusion criteria were based on the PICOTS (Population, Index Prognostic factor, Comparator prognostic factors, Outcome, Timing, Setting) recommendation (Riley et al., 2019) and Table 2. In brief, studies were eligible for inclusion if participants were people with acute or chronic whiplash (Grade I-III) and of driving age (≥16 years). Study designs eligible were prospective cohort studies or secondary analysis of randomised controlled trials (RCT's). Final inclusion criteria were if the study evaluated one or more of the four determined critical outcomes (Table 2) and reported multivariate adjusted risk ratios (RR), odds ratios (OR), hazard rate ratios (HRR), and/or correlation coefficients (e.g., B-coefficient).

Inclusion criteria for prognostic tool studies
For prognostic tool studies, inclusion criteria were also based on the PICOTS recommendations. Additional inclusion criteria were that the prognostic tool (or model) included at least two known factors associated with poor prognosis (e.g., initial pain intensity and/ or psychological distress (Table 2).

After conducting the search, studies were screened by title and abstract by two independent reviewers. Conflicts in title and abstract screening were resolved via consensus by the two reviewers. Full text screening of articles was then performed by two independent reviewers (CP, LC, AS, KB). Conflicts were resolved by consensus or consulting the third reviewer (TR).

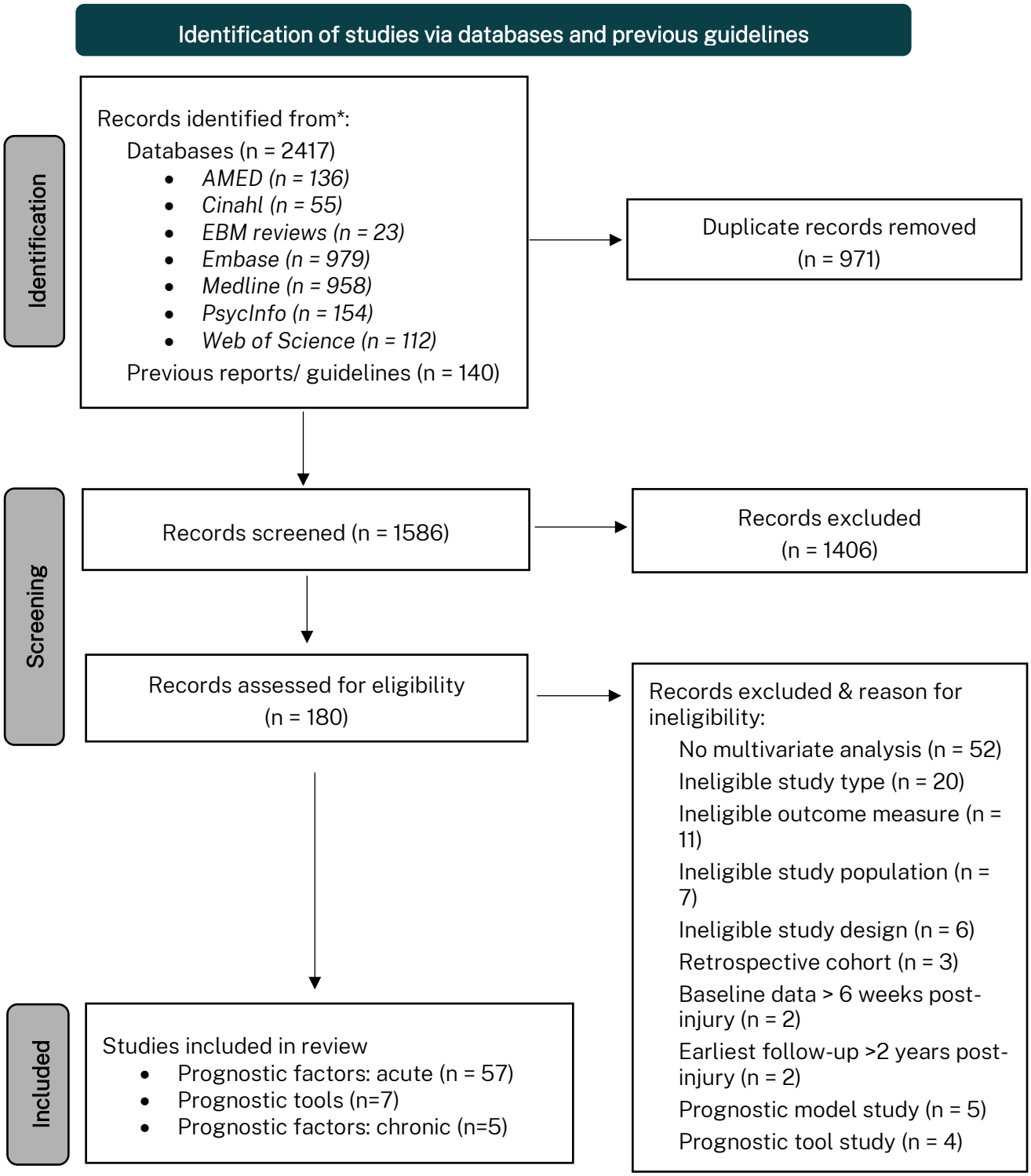
Table 2: Inclusion criteria for studies

Characteristics	Inclusion criterion
Population	• People with acute or chronic whiplash-associated disorders Grade I-III-(Spitzer, 1995). • Participants were of driving age ≥16 years. • Involved in a motor vehicle collision. • Study included an identifiable and separately analysed subgroup of people suffering from whiplash (≥50% of the total sample size).
Index and Comparator Prognostic Factors	• *Prognostic factor studies*: Included at least one index prognostic factor (initial pain or initial disability) • *Prognostic tool studies*: The tool/ model included at least two known prognostic factors associated with poor outcome (e.g., initial pain and psychological distress).
Outcome	• Evaluation of one or more critical outcomes defined in the Core Outcome Domain Set For Whiplash-Associated Disorders (CATWAD) (Chen et al., 2019): pain, neck disability, global perceived recovery and psychological distress.*
Timing	• Manuscript published between January 1995 and 31 July 2022. • Acute: Inception cohort within 6 weeks of injury. • Chronic whiplash: cohort injured >3 months previously. • One or more follow-up analyses within 2 years of injury. Time point closest to 12 months was chosen for analysis.
Setting	• All settings included (e.g., primary care, tertiary care, compensable).
Study design	• Prospective cohort study • Secondary analysis of a randomised controlled trial (RCT) when there was no effect between groups, or the control arm only was analysed. • Available in English • Multivariate analysis included.

*The guidelines panel reached consensus on these outcomes as 'critical' for developing prognosis recommendations.

A PRISMA (Page et al., 2021) flow chart of the study selection is shown Figure 1. From 1586 titles screened, 180 underwent full text screening. Result was 57 studies included for acute prognostic factors and 5 for chronic prognostic factors. Seven studies evaluating 5 prognostic tools were included.

Figure 1: Prognosis studies of whiplash-associated disorders search results



7.1.5. Selection of clinical questions

Prognostic tools were new to this edition of the guidelines, hence a single clinical question regarding this was developed (Table 3). Nine prognostic factor domains (Table 3) were identified from the previous Australian whiplash guidelines. These domains were discussed by the guideline panel to identify any missing domains. Given the volume of individual prognostic factors within each domain, the guideline panel agreed to develop recommendations from a synthesis of evidence organised under these domains for acute whiplash. Finally, given the few included studies for chronic whiplash, recommendations were considered under a single clinical question.

Table 3: Clinical questions developed for the prognosis of whiplash associated disorders

Prognostic factor	Clinical question
Acute whiplash	
Prognostic tools	What clinical prognostic tools are predictive of long-term neck pain, neck disability, non-recovery, and psychological distress in people with acute whiplash associated disorders?
1. Symptom	What initial symptom-related factors are predictive of long-term neck pain, neck disability, psychological distress, and perceived recovery in people with acute whiplash associated disorders?
2. Radiological	What initial radiological factors are predictive of long-term neck pain, neck disability, psychological distress, and perceived recovery in people with acute whiplash associated disorders? l
3. Psychological	What psychological-related factors are predictive of long-term neck pain, neck disability, psychological distress, and perceived recovery in people with acute whiplash associated disorders?
4. Sociodemographic	What initial sociodemographic factors are predictive of long-term neck pain, neck disability, psychological distress, and perceived recovery in people with acute whiplash associated disorders?
5. Crash	What crash-related factors are predictive of long-term neck pain, neck disability, psychological distress, and perceived recovery in people with acute whiplash associated disorders?
6. Physical impairment	What physical impairment factors are predictive of long-term neck pain, neck disability, psychological distress, and perceived recovery in people with acute whiplash associated disorders?
7. Pre-crash	What pre-crash factors are predictive of long-term neck pain, neck disability, psychological distress, and perceived recovery in people with acute whiplash associated disorders?
8. Compensation	What compensation-related factors are predictive of long-term neck pain, neck disability, psychological distress, and perceived recovery in people with acute whiplash associated disorders? p
9. Healthcare utilisation	What healthcare utilisation factors are predictive of long-term neck pain, neck disability, psychological distress, and perceived recovery in people with acute whiplash associated disorders?

Chronic whiplash	What factors are predictive of ongoing neck pain, neck disability, non-recovery, and psychological distress in people with chronic whiplash associated disorders?

7.1.6. Risk of bias assessment

Method for prognostic factors

Risk of bias for prognostic factors was evaluated using the Quality in Prognosis Studies (QUIPS) tool (Cochrane Prognostic Methods Group (PMG), 2022), There are assessment criteria; study participation, study attrition, prognostic factor measurement, outcome measurement, adjustment for other prognostic factors, and statistical analysis and reporting. Each criterion is evaluated as low, medium, or high risk of bias with a final overall risk of bias determined (Table 4).

Method for prognostic tools

The Prediction model Risk Of Bias Assessment Tool (PROBAST) was used to evaluate risk of bias and applicability of prognostic tool studies, under the four key domains of participants, predictors, outcome, and analysis (Wolff, 2019). Each criterion for risk of bias and acceptability is evaluated as low, unclear, or high concern, with a final overall summary outcome for risk of bias and applicability determined. Assessments of prediction model studies are presented in Table 6.

Table 4: Risk of bias assessment (QUIPS) summary table for acute whiplash prognostic studies.

First author Year	QUIPS overall score	QUIPS 1. Study participation	QUIPS 2. Study attrition	QUIPS 3. Prognostic factor measurement	QUIPS 4. Outcome measurement	QUIPS 5. Adjustment for other prognostic factors	QUIPS 6. Statistical analysis and reporting
Ameratunga 2010	**Low**	Low	Moderate	Moderate	Low	Low	Low
Andersen 2019	**Low**	Moderate	Low	Low	Low	Low	Low
Asenlof 2013	**Low**	Low	Moderate	Low	Low	Low	Low
Atherton 2006	**Moderate**	Moderate	Moderate	Moderate	Low	Low	Low
Berglund 2006	**Low**	Moderate	Moderate	Low	Low	Low	Low
Borenstein 2010	**Low**	Low	Low	Low	Low	Low	Low
Bostick 2013	**Low**	Moderate	Moderate	Low	Low	Low	Low
Buitenhuis 2006b	**Low**	Low	Low	Low	Low	Low	Low

First author Year	QUIPS overall score	QUIPS 1. Study participation	QUIPS 2. Study attrition	QUIPS 3. Prognostic factor measurement	QUIPS 4. Outcome measurement	QUIPS 5. Adjustment for other prognostic factors	QUIPS 6. Statistical analysis and reporting
Buitenhuis 2006a	**Low**	Low	Low	Low	Low	Low	Low
Buitenhuis 2008	**Low**	Low	Low	Low	Low	Low	Low
Buitenhuis 2003	**Low**	Moderate	Low	Low	Low	Low	Low
Carroll 2011	**Low**	Moderate	Low	Low	Low	Low	Low
Carroll 2009	**Low**	Moderate	Moderate	Low	Low	Low	Low
Carstensen 2015	**Low**	Moderate	Moderate	Low	Low	Low	Low
Carstensen 2009	**Low**	Moderate	Moderate	Low	Low	Low	Low
Carstensen 2012	**Low**	Moderate	Moderate	Low	Low	Low	Low
Casey 2015a	**Low**	Moderate	Low	Low	Low	Low	Low
Casey 2015b	**Low**	Moderate	Low	Low	Low	Low	Low
Cobo 2010	**Low**	Moderate	Low	Low	Low	Low	Low
Gehrt 2015	**Low**	Moderate	Moderate	Low	Low	Low	Low
Griffin 2019	**Low**	Moderate	Low	Low	Low	Low	Low
Gun 2005	**Low**	Moderate	Low	Low	Low	Low	Low
Hendriks 2005	**Low**	Moderate	Low	Low	Low	Low	Low
Holm 2007	**Low**	Low	Low	Low	Low	Low	Moderate
Holm 2008	**Low**	Low	High	Low	Low	Low	Low
Johansson 2011	**Low**	Low	Low	Low	Moderate	Low	Low
Kasch 2001	**Low**	Low	Low	Low	Moderate	Low	Low
Kongsted 2008a	**Low**	Low	Low	Low	Low	Low	Low

First author Year	QUIPS overall score	QUIPS 1. Study participation	QUIPS 2. Study attrition	QUIPS 3. Prognostic factor measurement	QUIPS 4. Outcome measurement	QUIPS 5. Adjustment for other prognostic factors	QUIPS 6. Statistical analysis and reporting
Kongsted 2008b	**Low**	Moderate	High	Low	Low	Low	Low
Kuperman 2011	**Low**	Moderate	High	Low	Low	Low	Low
Kyhlback 2002	**Low**	Low	Moderate	Low	Low	Moderate	Low
Mayou 1996	**Moderate**	High	Moderate	Moderate	Moderate	Moderate	Moderate
Mayou 1996	**Low**	Low	Moderate	Low	Low	Low	Low
Mayou 2002	**Moderate**	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Miettinen 2004a	**Moderate**	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Miettinen 2004b	**Moderate**	Moderate	Low	Moderate	Low	Moderate	Moderate
Olsson 2002	**Moderate**	Moderate	Low	Moderate	Low	Moderate	Moderate
Osterland 2019	**Low**	Low	Moderate	Low	Low	Low	Moderate
Ozegovic 2009	**Low**	Low	Moderate	Low	Low	Low	Low
Palmlof 2015	**Low**	Low	Low	Low	Low	Low	Low
Pedler 2016	**Low**	Low	Low	Low	Low	Low	Low
Pedler 2011	**Low**	Low	Moderate	Low	Low	Low	Low
Phillips 2010	**Low**	Moderate	Low	Low	Low	Low	Low
Pobereskin 2005	**Moderate**	Moderate	High	Low	Moderate	Low	Moderate
Radanov 1996	**Moderate**	Moderate	High	Low	Moderate	Low	Moderate
Ravn 2018	**Low**	Low	Low	Low	Low	Low	Low
Richter 2004	**Low**	Low	Low	Low	Low	Moderate	Low
Rydman 2018	**Low**	High	Low	Low	Low	Low	Low

First author Year	QUIPS overall score	QUIPS 1. Study participation	QUIPS 2. Study attrition	QUIPS 3. Prognostic factor measurement	QUIPS 4. Outcome measurement	QUIPS 5. Adjustment for other prognostic factors	QUIPS 6. Statistical analysis and reporting
Rydman 2017	**Low**	Low	Low	Low	Low	Low	Low
Skillgate 2016	**Low**	Low	Low	Low	Low	Low	Low
Soderlund 2003	**Low**	Low	Moderate	Low	Low	Moderate	Low
Soderlund 2018	**Low**	Low	Moderate	Low	Low	Moderate	Low
Sterling 2005	**Low**	Low	Low	Low	Low	Low	Low
Sterling 2011	**Low**	Low	Low	Low	Low	Low	Low
Sterling 2010	**Low**	Low	Low	Low	Low	Moderate	Low
Vetti 2010	**Low**	High	Low	Low	Low	Low	Low
Williamson 2015	**Low**	Moderate	Low	Low	Low	Low	Low

Risk of bias for chronic whiplash studies

Table 5: Risk of bias assessment (QUIPS) summary table for chronic whiplash prognostic studies

First author Year	QUIPS overall score	QUIPS 1. Study participation	QUIPS 2. Study attrition	QUIPS 3. Prognostic factor measurement	QUIPS 4. Outcome measurement	QUIPS 5. Adjustment for other prognostic factors	QUIPS 6. Statistical analysis and reporting
Angst 2014	Low	Low	Moderate	Low	Low	Moderate	Low
Alalawi 2022a	Moderate	Moderate	Moderate	Low	Low	Moderate	Low
Alalawi 2022b	Moderate	Moderate	Moderate	Low	Low	Moderate	Low
Rebbeck 2006	Low	Low	Low	Low	Low	Low	Low
Sullivan 2009	Low	Low	Low	Low	Low	Moderate	Low

Risk of bias for prognostic tools

Table 6: Results of Prediction model Risk Of Bias Assessment Tool (PROBAST)

Study	Risk of Bias (ROB)				Applicability			Overall	
	Participants	Predictors	Outcome	Analysis	Participants	Predictors	Outcome	ROB	Applicability
Bohman et al 2012	?	+	?	+	?	+	+	?	?
Cancelliere et al 2021	+	+	+	+	?	+	+	+	?
Griffin et al 2022	+	+	+	+	+	+	+	+	+
Ritchie et al 2013	+	+	+	+	+	+	+	+	+
Ritchie et al 2015	+	+	+	+	+	+	+	+	+
Rydman et al 2017	+	+	+	?	?	?	+	?	?
Sterling et al 2021	+	+	+	?	+	+	+	+	+
Legend: + low risk ? uncertain – high risk									

7.1.7. Data extraction and evidence synthesis

Data extraction was performed by two members of the research team (KB and LC). The following study information was extracted for each study into a custom Microsoft Excel spreadsheet: first-author, year of publication, title, aim, clinical setting, participant demographics (number, age), time between injury and initial baseline measures, follow-up time points, analysis time points, response rate at analysis time point, outcome measure, prognostic factors, modelling methods, type of adjusted prognostic effect estimates, number of variables in final multivariable model(s), and author conclusion. Outcome measures were further categorised into the critical outcomes. If there were multiple follow-up timepoints, measures of association were extracted at the follow-up timepoint closest to 12 months. Because of the wide variety of assessments, measurements, and tools used to assess psychological outcomes, we considered an outcome as psychological if the authors defined it as such, or if they were listed in this reference (Campbell et al., 2018)

7.1.8. Certainty of evidence

Method for prognostic factors

The certainty of evidence for associations between prognostic factors and critical outcomes was evaluated using the Grading of Recommendations, Assessment, Development and Evaluation (GRADE) method for prognostic factors (Foroutan et al., 2020). To develop appropriate clinical recommendations, prognostic factors were only included if included in a multivariate analysis, as prognostic outcomes are often correlated with one another and can therefore present as a source of bias. As a result, we set a clinical decision threshold of 1.2 for all risk estimates, indicative of a significant increase in the risk of poor prognosis following whiplash injury.

Certainty of evidence ratings were performed for multivariate adjusted RR/OR/HRR, which were evaluated as primary evidence, with some consideration of adjusted β-coefficients as secondary evidence. Evidence certainty was evaluated against each of the four primary GRADE domains:

1. Risk of bias: based on the risk of bias evaluation using the QUIPS scale for included studies and considering the weighting of each study (sample size) to the summarised strength of association.
2. Inconsistency: extent of heterogeneity in the study findings as evaluated by visual inspection of the associations and confidence intervals for narrative summaries, and/or heterogeneity statistics for pooled risk estimates.
3. Indirectness: extent to which the included studies were applicable to the clinical question (e.g., cohort and outcomes) and an Australian healthcare context.
4. Imprecision: i) whether there was optimal information size (>400 participants for continuous outcomes); ii) by considering the position of the estimated association and width of confidence intervals with respect to zero and the clinical decision threshold.

Method for prognostic tools

The above method for prognostic factors was modified to evaluate certainty of the predictive ability of prognostic tools for critical outcomes. Risk of bias was evaluated using the PROBAST (see section 7.1.6 for details) and inconsistency and imprecision were evaluated with respect to the reported accuracy statistics. Accuracies of 0.5 - <0.70, 0.70 - <0.90, and ≥0.90 were indicative of low, moderate, and high predictive ability (Fischer et al., 2003). A clinical decision threshold of 0.70 (moderate predictive ability) was set for tools presented in these guidelines.

7.2. Recommendation development

Evidence summaries for individual prognostic factors and prognostic tools was provided to the guideline panel prior to recommendation development meetings. This included the GRADE certainty of evidence outcomes where applicable. Where possible, videos were created that summarised the evidence in lay language (suitable for non-research guideline panel members). The panel then discussed each element within the GRADE Evidence to Decision Framework (Alonso-Coello et al., 2016). The framework was modified from the treatment framework (e.g., see P.1.5). Modification included elements such as:

- Strength of association: How substantial are the associations between explanatory factors and critical outcomes?

- Undesirable effects: How substantial are the undesirable anticipated effects when assessing these factors?

After considering all elements of the framework, the panel then proposed a recommendation on whether healthcare professionals should assess the factor to predict long-term prognosis. They then used an anonymous online voting system (Menti.com) to nominate their recommendation ranging from strongly for to strongly against (Table 7). More than 50% of votes were required to reach consensus, with a quorum of eight panel members. However, 50% was not considered sufficient to be a consensus if there is strong opposition to the result. If there is no clear consensus after the first vote, the guideline panel would critically discuss the outcome and rationale before proceeding to a second vote. When a consensus could not be reached, the Chair could choose to have the casting vote.

Clinical implementation points and subgroup considerations were developed for all recommendations that were neutral, conditional for, or strong for. These considerations were informed by the synthesis of literature presented in the evidence summary together with opinions from the guideline panel (e.g., subject matter experts, healthcare professionals, consumers).

Table 7: Prognosis recommendation classifications and their interpretation.

Recommendation classification	Interpretation
Strong for	Healthcare professionals should assess the factor in all or almost all people, in all or almost all circumstances, and in accordance with the implementation considerations to determine prognosis.
Conditional for	Healthcare professionals should assess the factor in most people, but not all, and in accordance with the implementation considerations to determine prognosis.
Neutral	Neither for nor against assessing the factor. Healthcare professionals could assess the factor in some instances, and in accordance with the implementation considerations to determine prognosis
Conditional against	Healthcare professionals should not assess the factor in most people to determine prognosis.
Strong against	Healthcare professionals should not assess the factor in all or almost all people, in all or almost all circumstances to determine prognosis.

7.3. Method limitations

The evidence synthesis and recommendation development procedures are potentially limited by the following factors:

- Calculation of pooled absolute risk is preferred when determining the certainty of evidence, as relative estimates will differ depending on the prevalence of poor outcome in all people with WAD (i.e., risk of ongoing pain, disability, poor recovery, and psychological distress at 12-months) (Foroutan et al., 2020). There were insufficient data presented in whiplash prognostic studies on prevalence of different outcomes in the entire cohort and/or heterogeneity in critical outcome measures between studies (e.g., if there were two assessment tools used to evaluate depressive symptoms). However, prevalence of poor outcome following whiplash injury is high (up to 50%) and therefore a 20% increase in risk as per our clinical threshold would indicate a significantly greater number of people with poor long-term outcomes.

PROGNOSTIC FACTOR RECOMMENDATIONS FOR ACUTE WHIPLASH

Executive Summary: Five prognostic tools and 57 prospective longitudinal cohort studies informed the recommendations for prognosis for acute whiplash (Table 8).

Table 8: Executive summary of Prognosis recommendations for people with acute whiplash

Domain	Tool / factor	Strength of recommendation / Vote summary
Prognostic tools	1. WhipPredict 2. SF-OMPSQ (Orebro)	Strong for *9/9 100% strong for*
Symptom factors	Initial pain intensity	Strong for *9/12 75% strong for; 3/12 25% conditional for*
	Initial neck disability	
	Number of painful body areas	
	Number of painful symptoms	
Psychological factors	Post-traumatic stress symptoms	Strong for *12/13 92% strong for; 1/13 8% conditional for*
	Expectations of recovery	
Psychological factors	Depression	Conditional for *8/13 62% conditional for; 5/13 38% strong for*
	Pain catastrophising	
	Coping strategies	
Physical assessment factors	Cervical ROM	Conditional for *11/12 92% conditional for; 1/12 8% strong for*
	Pain Sensitivity (cold hyperalgesia)	
Compensation factors	Claim status	Conditional for *8/10 80% conditional for; 2/10 20% neutral*
	Lawyer retention	
Pre-crash	Widespread body pain	Conditional for *Panel vote TBA*
	Chronic neck pain	
	Pre-crash general health	
	Pre-crash mental health	
Physical assessment factors	Muscle function	Neutral *11/12 92% neutral; 1/12 8% conditional for*
	Sensorimotor function	
	Sympathetic nervous system response	
	Cervical bony tenderness (manual palpation)	
	BMI	
Pre-crash	Co-morbid conditions	Neutral *Panel vote TBA*
Prognostic tools	Cancelliere et al 2021	Neutral
	Bohman et al 2012	

	PPS-WAD	*8/11 73% neutral; 2/11 18% conditional against; 1/11 5% conditional for*
Socio-demographic	Age	Conditional against *11/13 85% conditional against, 2/13 15% conditional for*
	Gender	
	Education	
	Employment status	
	Living status	
	BMI	
	Occupation	
	Income	
Health care utilisation	Primary HCP	Conditional against *6/12 50% conditional against, 3/12 strong against, 2/12 neutral, 1/12 conditional for*
	Hospital	
	GP	
Crash factors	Injury severity score	Conditional against *9/13 69% conditional against, 4/13 21% strong against*
	Head restraint	
	Head position at impact	
	Awareness of collision	
	Vehicle type (injured person)	
	Speed	
	Seatbelt	
	Self-reported collision severity	
	Position in vehicle	
	Airbag	
	Direction of impact	
Radiological factors	Imaging: MRI, Xray CT	Strong against *10/11 91% strong against, 1/11 9% conditional against*

PROGNOSTIC FACTOR RECOMMENDATIONS FOR CHRONIC WHIPLASH

Executive Summary: Five prospective longitudinal cohort studies informed the recommendations for prognosis for chronic whiplash (Table 9).

Table 9: Executive summary of Prognosis recommendations for people with chronic whiplash

Domain / Vote summary	Tool/ factor	Strength of recommendation / Vote summary

Symptom factors	Neck pain intensity	Conditional for *11/13 85% conditional for; 2/13 15% neutral*
	Neck disability	
Psychological factors	Depression	Conditional for *11/13 85% conditional for; 2/13 15% neutral*
	Perceived injustice	
Physical assessment factors	Cervical ROM	Neutral *12/13 92% neutral; 1/13 8% conditional for*
	Joint position error	
	Cervical flexor and extensor strength	
Compensation factors	Claim status	Neutral *13 votes: 12/13 92% neutral; 1/13 8% conditional for*
	Time to admit liability	
	Economic loss claim	
	Prior claim	
Previous health	Smoker	Neutral *12/13 92% neutral; 1/13 8% conditional for*
	Physical activity levels	
	Physical health	
	Previous pain episodes	
	General health	
Sociodemographic	Age	Conditional against *9/13 69% conditional against; 2 strong against, 2 neutral, 1 strong for*
	Gender	
	Employment status	
	Education status	
	Socio-economic status	
Crash factors	Driver	Conditional against *13 votes: 9/13 69% conditional against; 2 strong against, 2 neutral, 1 strong for*
	Collision speed	

Details on how the recommendations were made now follow.

8. Prognostic tools

P.1. Prognostic tools

Question: What prognostic tools are accurate in predicting poor outcome (ongoing pain, disability and non-recovery) for people with acute whiplash?

P.1.1. Summary of included studies

There were eight studies (Bohman et al 2012, Cancelliere et al 2021, Griffin et al 2022, Ritchie et al 2013 and 2015, Rydman et al 2017, Sterling et al 2021, Griffin et al 2022) evaluating 5 different prognostic tools in people with acute whiplash. In an Australian context, the most comprehensive evaluated tools were WhipPredict and the Short Form Orebro Musculoskeletal Pain Screening Questionnaire (SF-OMPSQ) where the accuracy was 74.0 (62.8 to 83.4) and 70.1 (58.6 to 80.0) respectively for the outcome of ongoing disability.

Table 10: Summary of included studies (prediction tools)

Tool name	Development, validation or both	Accuracy statistics for each outcome		
		Ongoing disability	Ongoing pain	Non-recovery
WhipPredict	Development (Ritchie 2013) Validation (Ritchie 2015) Validation (Sterling 2021)	C statistic not calculated C statistic not calculated Accuracy 74.0 (62.8 to 83.4)	Accuracy 53.1 (42.5 to 62.6)	Accuracy 55.8 (46.1 to 65.1)
WhipPredict +EOR[+]	Development (Griffin 2022)	AUC* = 0.841		AUC 0.908
SF-OMPSQ**	Validation (Sterling 2021)	Accuracy 70.1 (58.6 to 80.0)	Accuracy 66.4 (56.9 to 75.0)	Accuracy 66.4 (56.9 to 75.0)
Tool by Bohman et al 2012	Development only (Bohman 2012)			C Index 0.68 (0.65 to 0.71)
PPS WAD	Development (Rydman 2017)			AUC 0.82 (0.75 to 0.90) AUC 0.59 (0.47 to 0.72)

	Validation (Rydman 2017)			
Tool by Cancelliere et al 2021	Development (Cancelliere et al 2021) Validation (Cancelliere et al 2021)			C statistic 0.72 (0.71 to 0.75) C statistic 0.73 (0.65 to 0.80)

* EOR – expectations of recovery

***** AUC – area under the receiver operating characteristic curve

**SF-OMPSQ- Short-Form Orebro Musculoskeletal Pain Screening Questionnaire

P.1.2. Outcome: Neck pain

Table 11: Prediction tools predictive of long-term neck pain with acute whiplash

Type of prediction model evaluation[1]	First author, year	Baseline N	Factors included in analysis	Outcome	Risk of bias (PROBAST)	Factors retained in model	Accuracy statistics
Validation only WhipPredict	Sterling et al 2021 Australia NSW	202	As per derivation	Pain at 12m months (NPRS >3/10)	++	Was comparison with Orebro	Sn 93.8 (82.8 to 98.7) Sp 23.1 (13.5 to 35.2) PPV 47.4 (43.6 to 51.2) NPV 83.3 (60.5 to 62.6) Accuracy 53.1 (42.5 to 62.6)
Validation only SF-OMPSQ (Orebro)	Sterling et al 2021 Australia NSW	202	Whole questionnaire as developed by Linton et al	Pain at 12 months (NPRS >3/10)	++	Was a comparison with WhipPredict	Sn 75.0 (64.4 to 86.4) Sp 60.0 (47.1 to 72.0) PPV 58.1 (49.7 to 66.0) NPV 76.5 (65.7 to 84.7) Accuracy 66.4 (56.9 to 75.0)

GRADE certainty of evidence (pain)

WhipPredict and SF-OMPQ: There was low certainty ⊕⊕◯◯ in the evidence for WhipPredict/Orebro's predictive ability for ongoing pain (poor predictive ability). Imprecision was deemed as very serious given that the findings were from one study, the lower bound of the accuracy statistic were indicative of poor predictive ability and the number of participants was below the adequate threshold.

P.1.3. Outcome: Neck disability

Table 12 Prediction tools predictive of long-term neck disability with acute whiplash

Type of prediction model evaluation[1]	First author, year	Baseline N	Factors included in analysis	Outcome	Risk of bias (PROBAST)	Factors retained in model	Accuracy statistics	
Development WhipPredict	Ritchie l 2013 Australia-QLD	336	Symptoms: Initial disability (NDI), Initial neck pain (VAS) Sociodemographic: Age, gender Psychological: PTSD- PDS Physical: Cervical ROM, cold pain threshold	Chronic moderate/ severe disability (NDI) at 12 months	++	NDI≥40 +age ≥35 + hyperarousal[2] subscale ≥6	Sn 43.5 (31.8 to 54.9) Sp 93.8 (89.1 to 96.6) +LR 7.0 (3.8 to 12.9) -LR 0.6 (0.5 to 0.7) PPV 71.4 (55 to 84) NPV 82.3 (76 to 87)	
Validation only WhipPredict	Ritchie et al 2015 Australia -QLD	101	As above	Chronic moderate/ severe disability (NDI) at 6 months	++	NDI≥40 +age ≥35 + hyperarousal[2] subscale ≥6	Sn 43.5 (22.9 to 65.1) Sp 98.7 (92.9 to 99.9) +LR 33.9 (4.6 to 251.2) -ve LR 0.6 (0.4 to 0.8) PPV 90.9 (58.7 to 98.5)	
Validation only WhipPredict	Sterling et al 2021 Australia -NSW	202 (77 in analysis)	As above	Disability at 12 months (NDI>10%) @12m	++	As above for inclusion – was a comparison with Orebro	Sn 92.7 (82.4 to 98.0) Sp 27.3 (10.7 to 50.2) PPV 76.1 (71.0 to 80.6) NPV 60.0 (31.9 to 82.8) Accuracy 74.0 (62.8 to 83.4)	
Development WhipPredict + expectations of recovery	Griffin et al 2022 Australia-NSW	228 78 in analysis	As per derivation + expectations of recovery (0-10 scale)	NDI≥30% @12m	++	Compared accuracy statistics of WhipPredict with whip predict + EOR	WhipPredict Sn 80 Sp 69 +LR 2.57	WhipPredict +E 80 73.3 3

							-LR 0.29 PPV 63.1 NPV 83.7 AU Roc.800	0.28 67 84.6 .841
Validation only SF-OMPSQ (Orebro)	Sterling et al 2021 Australia -NSW	202	Whole questionnaire as developed by Linton et al	Disability at 12 months (NDI>10%)	++	Was a comparison with WhipPredict (above)	Sn 67.3 (53.3 to 79.3) Sp 77.3 (54.6 to 92.2) PPV 88.1 (77.0 to 94.2) NPV 48.6 (37.8 to 59.5) Accuracy 70.1 (58.6 to 80.0)	

GRADE certainty of evidence (disability)

WhipPredict: There was moderate certainty ⊕⊕⊕◯ in the evidence for WhipPredict's predictive ability for ongoing disability (moderate predictive ability): Low risk of bias (not serious). Consistent moderate to strong predictive ability findings across development and validation studies, with adequate sample size. Studies were carried out using Australian populations (indirectness, not serious). However, imprecision was deemed serious given that lower bounds of the accuracy statistics confidence intervals were indicative of poorer predictive ability.

SF-OMPSQ: There was low certainty ⊕⊕◯◯ in the evidence for the SF-OMPSQ's predictive ability for ongoing disability (moderate predictive ability). Imprecision was deemed as very serious given that the findings were from one study, the lower bound of the accuracy statistic were indicative of poorer predictive ability and the number of participants was below the adequate threshold.

P.1.4. Outcome: Perceived non-recovery

Table 13: Prediction tools predictive of long-term perceived non-recovery with acute whiplash

Type of prediction model evaluation[1]	First author, year	Baseline N	Factors included in analysis	Outcome	Risk of bias (PROBAST)	Factors retained in model	Accuracy statistics
Validation only WhipPredict	Sterling et al 2021 Australia-NSW	202 113 in analysis	Comparison of two tools WhipPredict and Orebro	GPR < 4/5-Scale - 5/5 to +5/5) @12m	++	As per derivation	Sn 88.1 (77.1 to 95.1) Sp 20.4 (10.6 to 33.5) PPV 54.7 (50.7 to 58.8) NPV 61.1 (39.6 to 79.0) Accuracy 55.8 (46.1 to 65.1)

Development and validation **WhipPredict + expectations of recovery**	Griffin et al 2022 Australia – NW	228 78 in analysis	As per derivation of Whip Predict + expectations of recovery (0-10 scale) +	NDI≥30% @12m	++	Compared accuracy statistics of WhipPredict with whip predict + EOR	WhipPredict Sn 100 Sp 60 +LR 2.5 -LR 0 PPV 8 NPV 100 AUC .844	WhipPredict +EOR 100 80.2 5.05 0 16 100 .908
Validation only **SF-OMPSQ (Orebro)**	Sterling et al 2021 Australia-NSW	202 113 in analysis	Whole questionnaire as developed by Linton et al	GPR < 4/5-Scale - 5/5 to +5/5)	++	Was a comparison with WhipPredict	Sn 71.2 (57.9 to 82.2) Sp 63.0 (48.7 to 75.7) PPV 67.7 (58.4 to 75.5) NPV 66.7 (56.0 to 75.8) Accuracy 67.3 (57.8 to 75.8)	
Development and validation **Cancelliere et al (2021)**	Cancelliere et al (2021) Canada and Sweden	D=4162 Canada V= 379 Sweden	Baseline sociodemographic, pre-injury and injury factors	Not “all better/ cured”	+?	Age, low back pain, symptoms in arms or hands, hearing problems, sleeping problems, pre-existing headache, lower recovery expectations	Development Sn 31.7 (29.8 to 33.6) Sp 89.0 (86.7 to 91.1) +LR 2.9 (2.4 to 3.5) -LR 0.77 (0.74 to 0.8) C statistic 0.72 (0.71 to 0.75) Validation Sn 60.5 (53.9 to 66.7) Sp 72.6 (61.4 to 81.5) +LR 2.2 (1.5 to 3.3) -LR 0.5 (0.4 to 0.7) C statistic 0.73 (0.65 to 0.80)	

Development and validation **PPS-WAD**	Rydman et al 2017 Sweden	N=130 D-Emergency N=142 V Insurance cohort		Non-recovery Do you feel recovered Y/N @6m	??	Education level, employment, pain and mental distress	Derivation Sn78% (65-87%) Sp78% (65-87%) PPV 77% (64-86%) NPV 79% (67-88%) Accuracy 78% AUC 0.82 (0.75 to 0.90)
							Validation Sn 67.5% (56-77%) Sp 50% (33-67%) PPV 76% (64-85%) NPV 40% (25-56%) Accuracy 62% AUC 0.59 (0.47 to 0.72)
Development only **(Bohman et al, 2012)**	Bohman et al 2012 Canada	680	25 possible factors	Global perceived recovery 6m	??	Age, number of days to reporting the collision, neck pain intensity, low back pain intensity, other pain, headache before collision and recovery expectations	C Index 0.68 (0.65 to 0.71)[1]

GRADE certainty of evidence (non-recovery)

WhipPredict: There was low certainty ⊕⊕◯◯ in the evidence for WhipPredict's predictive ability for non-recovery (moderate predictive ability). Inconsistency was rated as serious as the two studies showed poor and excellent predictive ability for the WhipPredict tool. Imprecision was deemed as serious as the number of participants was below the adequate threshold.

WhipPredict + EOR (expectations of recovery): There was very low certainty ⊕◯◯◯ in the evidence for WhipPredict+EOR's predictive ability for non-recovery (moderate predictive ability). Imprecision was deemed as very serious as the number of participants was well below the adequate threshold and confidence intervals were not available. Inconsistency was rated as serious as the findings were from a single study.

SF-OMPSQ (Orebro): There was low certainty ⊕⊕◯◯ in the evidence for Orebro's predictive ability for non-recovery (moderate predictive ability). Imprecision was deemed as very serious given that the findings were from one study, the lower bound of the accuracy statistic were indicative of poorer predictive ability.

Cancelliere et al (2021): There was low certainty ⊕⊕◯◯ in the evidence for Cancelliere's (2021) predictive ability for non-recovery (moderate predictive ability). Findings were consistent between the development and validation studies. Risk of bias using the PROBAST considers the applicability of the population and was rated as high concern as the study was not carried out in Australia. As a result, we decided to rate indirectness as very serious.

PPS-WAD: There was very low certainty ⊕◯◯◯ in the evidence for PPS-WAD's predictive ability for non-recovery (poor-moderate predictive ability). Risk of bias was deemed as serious, and findings may not be applicable to an Australian context and confidence intervals for the validation accuracy statistics spanned from poor to moderate predictive ability (indirectness was rated as very serious).

Bohman et al: There was low certainty ⊕⊕◯◯ in the evidence for Bohman's (2012) predictive ability for non-recovery (moderate predictive ability). Risk of bias was deemed as serious, and findings may not be applicable to an Australian context (indirectness was rated as serious).

P.1.5. Evidence to decision framework (prediction tools)

Table 14: Evidence to decision framework (prediction tools)

Strength of association How substantial are the accuracy statistics between the models and the critical outcomes?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Trivial ○ Small ○ Moderate ○ Large ○ **Varies** ○ Don't know	Overall, there were similar accuracy (sensitivity, specificity, AUC) statistics and risk of bias assessments amongst the prediction models. The most evaluated tools in an Australian context for whiplash are WhipPredict followed by Orebro musculoskeletal pain questionnaire. Accuracy of the predictions vary based on the outcome assessment and tool, however, the overall predictive ability for key outcomes at 12mo was moderate for the WhipPredict, Orebro, and Cancelliere et al (2021) prediction tools. PPS-WAD had low predictive ability.	WhipPredict and Orebro derived and validated in Australian populations.
Undesirable Effects How substantial are the undesirable anticipated effects when administering the prediction tool?		

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Large ○ Moderate ○ Small ○ **Trivial** ○ Varies ○ Don't know	Not measured in the studies.	Anticipated undesirable effects are trivial, given that these models can be administered by questionnaire (paper or online).
Certainty of evidence What is the overall certainty of the evidence of effects?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Very low ○ Low ○ **Moderate** ○ High ○ No included studies	Certainty of evidence ranged from low to moderate for critical outcomes for all prognostic tools.	
Balance of effects Does the balance between desirable and undesirable effects favour assessing or not assessing using these tools?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Favours not assessing ○ Probably favours not assessing ○ Does not favour either assessing or not assessing ○ Probably favours assessing ○ **Favours assessing** ○ Varies ○ Don't know	Favours assessing injured people with using one of these tools (WhipPredict or Orebro). While accuracy statistics were moderate overall, factors included in these tools are consistent with individual prognostic factors that are recommended in this guideline (e.g., initial disability, psychological distress, pain severity, duration, expectations of recovery).	WhipPredict and Orebro developed and mostly used in Australian context. These tools provide useful clinical information that should classify risk of poor outcome and inform treatment direction.
Resources required		

How large are the resource requirements (costs)?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Large costs ○ Moderate costs (acute/chronic) ○ **Negligible costs and savings** ○ Moderate savings ○ Large savings ○ Varies ○ Don't know	Less resources required for WhipPredict and Orebro as these are already in questionnaire form and are automated online. Other questionnaires are not available online or easily accessible.	These tools can be administered by questionnaire or online on whiplash navigator (https://mywhiplash.com.au/content/what-whiplash-navigator-patients). The Orebro is available from https://aci.health.nsw.gov.au/__data/assets/pdf_file/0003/212907/OMPSQ-10.pdf and mypainhub.com
Cost effectiveness Does the cost-effectiveness of the assessing the factor favour assessing or not assessing the factor		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Favours not assessing ○ Probably favours not assessing ○ Does not favour either assessing or not assessing ○ Probably favours assessing ○ Favours assessing ○ Varies ○ **No included studies**	No evidence. The studies do not measure cost-effectiveness.	These tools are freely available online.
Equity What would be the Impact on health equity?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS

○ Reduced ○ Probably reduced ○ **Probably no impact** ○ Probably increased ○ Increased ○ Varies ○ Don't know	No evidence.	Tools are presented in English at present, so there may be some inequity for people who are non-English speaking.
Acceptability Is assessing the factor acceptable to key stakeholders?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ No ○ Probably no ○ **Probably yes** ○ Yes ○ Varies ○ Don't know	Qualitative research regarding WhipPredict and Orebro indicate these questionnaires are acceptable for people to complete.	
Feasibility Is assessing the factor feasible to implement?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ No ○ Probably no ○ Probably yes (acute/chronic) ○ **Yes** ○ Varies ○ Don't know		Feasible due to self-administered questionnaires available online. The Orebro musculoskeletal pain questionnaire is implemented by healthcare professionals for other musculoskeletal pain conditions in Australia.

P.1.6. Summary of judgements (prediction tools)

Vote 1: Are you for or against clinicians administering the WhipPredict or Orebro (SF-OMPSQ*) prediction tools?

Type of recommendation

Strong recommendation for not measuring the factor(s)	Conditional recommendation to not measure the factor (s)	Conditional recommendation for either measuring the factor (s) or not	Conditional recommendation for measuring the factor (s)	Strong recommendation for measuring the factor(s)
○	○	○	○	○

Recommendation: The guideline panel strongly recommend that healthcare professionals use the WhipPredict or Orebro (SF-OMPSQ) prognostic tools to predict the risk of poor outcome in people with acute WAD.

Panel vote summary: 9/9 100% strong for

Justification

Evidence:

- Moderate predictive ability (low-moderate certainty in the evidence) for the WhipPredict and Orebro tools for critical outcomes of poor prognosis.
- These two tools had several studies that evaluated the predictive ability across multiple critical outcomes (disability, non-recovery, and psychological distress), when compared with the other tools.

Consistency:

- These tools were specifically developed (developed, validated, cross-validated) for whiplash or musculoskeletal pain conditions in Australia.
- WhipPredict is derived from known adverse prognostic factors (e.g., neck disability and psychological distress)
- Orebro is derived from known adverse prognostic factors for musculoskeletal chronic pain (e.g., pain severity, duration, expectations of recovery).

Acceptance and Feasibility:

- These tools are easy to use and interpret and are readily available online.
- These tools are already used in Australia

Implementation considerations

The choice of tool to use may depend on the clinical presentation and care pathways available. For example, the Orebro may be helpful when people have multiple areas injured, whilst WhipPredict may be more useful in people with neck pain.

How to interpret: WhipPredict is automated in MyWhiplashNavigator (www.mywhiplash.com.au). WhipPredict will stratify people at low, medium and high risk of poor outcome, based on age, neck disability and hyperarousal sub-scale scores. The Orebro will stratify people at low risk (<50/100) and high risk ≥50/100 of poor outcome and is automated on a few websites (e.g., Mypainhub.com).

What to do:

- Communicate outcome of prognostic risk tool to injured people (MyWhiplashNavigator has some recommended ways to communicate this both in written and video format.

- Match clinical pathway to the risk stratification. People at low risk (of poor outcome) recover well, require less treatment and it is important not to overtreat these people as this can lead to poor outcomes.
- For people who are med/high risk of poor outcome, consider earlier referral to whiplash specialist +/- psychologist and interventions recommended for people at med/high risk.
- Provide education around the importance of psychological health. Individualise this to the injured person with respect of their scores on the individual items.

Vote 2: Are you for or against clinicians administering the prognostic tools: Cancelliere et al (2021), PPS-WAD, and Bohman et al. (2012)?

Strong recommendation for not measuring the factor(s)	Conditional recommendation to not measure the factor (s)	Conditional recommendation for either measuring the factor (s) or not	Conditional recommendation for measuring the factor (s)	Strong recommendation for measuring the factor(s)
○	○	○	○	○

Recommendation: The guideline panel cannot recommend for or against Cancelliere et al (2021), PPS-WAD, and Bohman et al. (2012) prognostic tools to evaluate the risk of poor outcome in people with acute WAD.

Panel vote summary: 8/11 73% neutral, 2/11 18% conditional against, 1/11 5% conditional for.

Justification

Evidence:

- Moderate predictive ability for these prognostic tools, with lower certainty in the evidence (very low to low certainty in the evidence) compared with the Orebro and WhipPredict tools and evaluation of one critical outcome only.

Consistency:

- These tools have not been developed or validated in an Australian context.

Acceptability and Feasibility:

- These tools are not available online or easily accessible.

Implementation considerations

These tools may be validated in an Australian context in future and become more readily available. However, at the present time we would not recommend implementation of these tools in an Australian context over the WhipPredict or Orebro tools.

Healthcare professionals could consider implement these tools if working in the countries where these tools were validated in.

P.2. Symptom factors

Question: What initial symptom-related factors are predictive of ongoing neck pain, neck disability, psychological distress, and perceived non-recovery in people with acute whiplash associated disorders?

P.2.1. Summary of included studies

There were 26 studies that informed the recommendations regarding symptom factors and their relationship with poor outcome after whiplash (Ameratunga et al 2010, Andersen et al 2019, Asenlof et al 2013, Atherton et al 2006, Berglund et al 2008, Buitenhuis et al 2008, Cartensen et al 2015, Casey et al 2015a, Cobo et al 2010, Gehrt et al 2015, Griffin et al 2019, Gun et al 2005, Hendriks et al 2005, Holm et al 2007, 2008, Kuperman et al 2021, Pedler et al 2011,2016, Phillips et al 2010, Pobereskin et al 2005, Radanov et al 1996, Ravn et al 2019, Sterling et al 2005, 2006, Vetti et al 2010, Williamson et al 2015).

P.2.2. Outcome: ongoing neck pain

There were 8 studies that examined symptom factors associated with ongoing neck pain (measured by a pain rating scale at 12 months, or at the follow-up point nearest to 12 months). These 8 studies investigated 8 symptom factors. The strongest evidence for factors associated with ongoing pain were:

- High initial neck pain intensity (6/7 +A, 1/7 NA); meta-analysis (2 studies) OR 1.99 (0.85 to 4.68) (Figure 2)
- Higher number of symptoms (2/2 +A), meta-analysis OR 1.97 (1.30 to 2.99) (Figure 3)
- High initial neck disability (2/2 studies +A)

The remaining 5 factors had only one study examine the association of that factor (4/5 +A) (Table 15).

Table 15: Symptom-related factors predictive of long-term neck pain with acute whiplash

Prognostic factor	Number of studies	First author, year	Measure	Positive or negative association	Risk of bias (QUIPS)	Data β: Adjusted β coefficient OR: Adjusted Odds Ratio RR: Adjusted Risk Ratio	Pooled meta-analysis OR (95% CI)
High initial neck pain	6	Pobereskin 2005	Mild, mod, severe	+A	Low	**OR 1.03 (1.01-1.05)**	**1.99 (0.85-4.68)** (Figure 2)
		Holm 2007	NRS (0-30, 31-54, 55-100)	+A	Low	**OR 3.2 (1.3 to 8.0)**	
		Cobo 2010	NRS (0-10)	+A	Low	β = 0.237, p<0.001	-
		Gun 2005	SF-36 Bodily Pain (0-100)	+A	Low	β = 0.02, p<0.05	-
		Gehrt 2015	NRS (0-10)	+A	Low	**OR 2.84 (1.84-4.39), p<0.0001**	-

Prognostic factor	Number of studies	First author, year	Measure	Positive or negative association	Risk of bias (QUIPS)	Data β: Adjusted β coefficient OR: Adjusted Odds Ratio RR: Adjusted Risk Ratio	Pooled meta-analysis OR (95% CI)
		Vetti 2010	NRS (0-10) > 4	NA	Low	Multivariate NA	-
Higher number of symptoms	2	Atherton 2006	Other than pain: 6+	+A	Moderate	**OR 2.0 (1.2 to 3.2)**	**1.97 (1.30-2.99)**
		Holm 2007	Other than pain: 3+	+A	Low	**OR 1.9 (0.92 to 3.8)**	(Figure 3)
High initial neck disability	2	Atherton 2006	a) NDI 15-22 (ref 0-14) b) NDI >22/50	+A	Moderate	a) RR 1.2 (0.8 to 1.9) b) RR 1.9 (1.2 to 2.9)	-
		Sterling 2005	a) NDI 0-50 (ref-mild) b) NDI > 50 (mod / severe)	+A	Low	a) OR 1.15 (1.03, 1.28), p=0.017 b) OR 1.06 (1.01, 1.12), p=0.028	
Pain frequency	1	Pobereskin 2005	Days per week	+A	Low	OR 1.18 (1.03-1.35)	-
Presence of dizziness	1	Cobo 2010	Y/N	+A	Low	β = 0.391	-
Neurological signs or symptoms	1	Atherton 2006	Y/N	NA	Moderate	RR 1.6 (0.8-3.1)	-
Initial arm pain	1	Pobereskin 2005	VAS (0-10)	+A	Low	OR 2.23 (1.08 to 1.22)	-
Number of painful body areas	1	Holm 2007	1-3, 4-5	+A	Low	OR 2.6 (1.3 to 5.4)	-

+A positively associated with outcome, -A negatively associated with outcome, NA not associated with outcome

Figure 2: Forest plot of initial neck pain intensity (symptom), and pain (outcome)

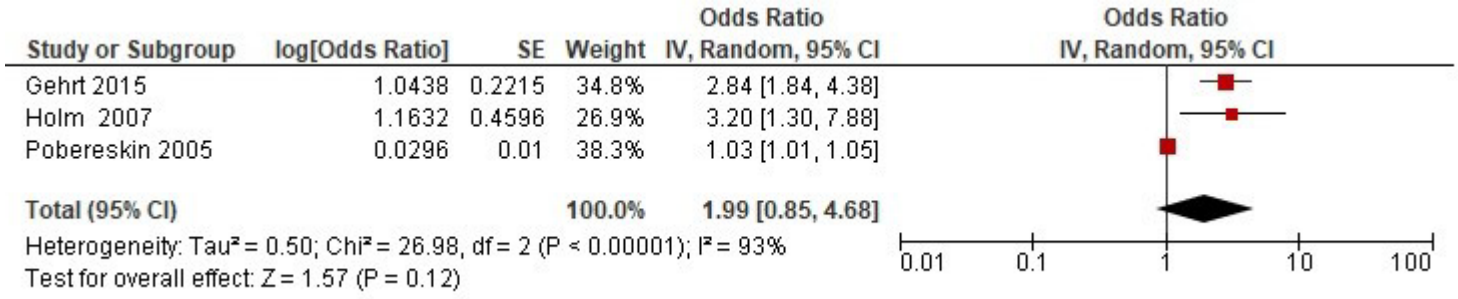
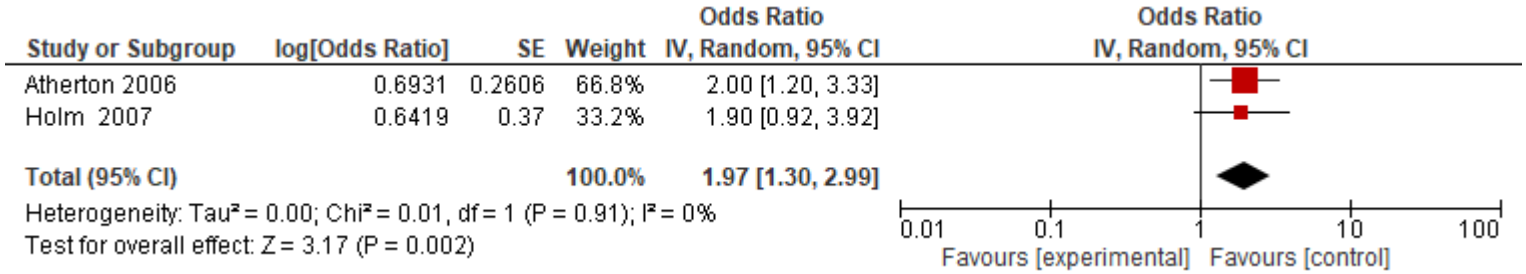


Figure 3: Forest plot of higher number of symptoms (symptom) and pain (outcome)



GRADE ASSESSMENT

High initial neck pain: Low ⊕⊕◯◯ certainty in the evidence for a trivial association between high-initial neck pain and long-term neck pain. High heterogeneity in findings between studies included in the meta-analysis, which was consistent with secondary evidence (inconsistency: serious). Imprecision was deemed serious as confidence intervals ranged from below 1.0 to very a strong association, but as the point estimate was a very strong association we decided not to rate down to very serious.

Higher number of symptoms: Moderate certainty ⊕⊕⊕◯ in the evidence for a strong association between high number of symptoms (other than pain) and long-term neck pain. Risk of bias was deemed serious as the study by Atherton (2006) made up ~3/4 of the total sample size and was overall moderate risk of bias. Findings across the two studies were homogenous (I^2=0%) and study characteristics (UK and Swedish cohorts) were appropriate to an Australian context. The pooled OR lower confidence interval was above the clinical threshold and sample size was adequate, and therefore imprecision was deemed as not serious.

High initial neck disability: Low certainty ⊕⊕◯◯ in the evidence for a moderate association between high initial neck disability and long-term neck pain. Risk of bias was deemed serious as the study by Atherton (2006) made up majority of the total sample size and was overall moderate risk of bias. Findings across the two studies were both positive associations but differed in the strength of the association (small and clinically

significant). Inconsistency was not rated down, however, the lower bound of the confidence interval in Sterling 2005 neared 1.0 and therefore imprecision was rated as serious.

Pain frequency: Low certainty ⊕⊕◯◯ in the evidence for a moderate association between pain frequency and long-term neck pain. Risk of bias was not serious (low QUIPS overall). Study was carried out in the UK and has implications for an Australian context. Inconsistency was rated down as findings were from a single study. Confidence intervals for the OR neared 1.0 and crossed the clinical threshold and therefore imprecision was deemed as serious. Study sample size was adequate.

Neurological signs: Very low certainty ⊕◯◯◯ in the evidence for a trivial association between neurological signs or symptoms and long-term neck pain. Risk of bias was deemed serious (moderate QUIPS overall). Study was carried out in the UK and has implications for an Australian context. Although sample size was adequate for precision, the RR confidence intervals crossed the clinical threshold above and below 1.0, and therefore, imprecision was deemed as very serious.

Initial arm pain: Low certainty ⊕⊕◯◯ in the evidence for a moderate association between initial arm pain and long-term neck pain. Risk of bias was not serious (low QUIPS overall). Findings were from a single study (inconsistency: serious). While the sample size was adequate, confidence intervals ranged from small to above the clinical threshold (imprecision: serious).

Number of painful body areas: Low certainty ⊕⊕◯◯ in the evidence for a strong association between number of painful body areas and long-term neck pain. Risk of bias was not serious (low QUIPS overall). Study characteristics were applicable to an Australian context (Swedish cohort). While the lower bound of the confidence interval was above the clinical threshold, findings were from a single study (inconsistency: serious) and sample size was below the threshold for precision (imprecision: serious).

P.2.3. Outcome: ongoing neck –disability

There were 13 studies that examined symptom factors associated with long-term disability (measured by a self-reported disability scale at 12 months, or at follow-up point nearest to 12 months). These 13 studies investigated 9 symptom factors. The strongest evidence for factors associated with ongoing disability were:

- High initial pain intensity (7/8 +A, 3 studies meta-analysed OR 2.43 (1.05-1.67) (Figure 4)
- Higher initial neck disability (3/3 +A, OR 1.25 (0.87 to 1.11) (Figure 5)
- no meta-analysis)
- Higher number of painful areas (3/3 +A, no meta-analysis)
- Initial headache (2/2 +A, no meta-analysis)

The remaining 5 factors had only one study examine the association of that factor with poor outcome (5/5 +ve associated) (Table 16).

Table 16: Symptom-related factors predictive of long-term neck disability with acute whiplash

Prognostic Factor	Number of studies	First author, year	Measure	Positive or negative association	Risk of bias (QUIPS)	Data *β: Adjusted β coefficient* *EFE: Estimated Fixed Effect* *OR: Adjusted Odds Ratio* *SE: Standard error*	Pooled meta-analysis OR (95% CI)
High initial neck pain	8	Berglund 2006	VAS (severe > 55/100)	+A	Low	**OR 6.4 (4.8 to 8.4)**	**2..21 (1.10 to 4.45) (Figure 4)**
		Carstensen 2015	VAS (0-10)	+A	Low	**OR 1.48 (1.31 to 1.67)**	
		Buitenhuis 2008	Pain severe Y/N	+A	Low	**OR 1.55 (1.18 to 2.03)**	
		Andersen 2019	VAS (0-10)	+A	Low	β = 0.32, p<0.001	
		Pedler 2016	VAS (0-10)	+A	Low	EFE = 2.5 (1.6 to 3.4)	
		Pedler 2011	VAS (0-10)	+A	Low	β = 0.38, p ≤0.001	
		Gehrt 2015	VAS (0-10)	**N**A	Low	**OR 1.61 (0.92-2.81)**	
		Holm 2008	NRS (0-10)	NA	Low	Multivariate NA	
High initial neck disability	3	Asenlof 2013	PDI, 0-70	+A	Low	β = 0.82 (95% CI 0.66, 0.93)	**1.25 (0.87 to 1.11) (Figure 5)**
		Buitenhuis 2008	NDI	+A	Low	**OR 1.55 (1.2 to 2.0)**	
		Sterling 2005	NDI	+A	Low	**OR 1.06 (95% CI 1.01, 1.12)**	
Number of painful areas	3	Kuperman 2021	Number of painful areas	+A	Low	β = 0.52, p<0.001	-
		Williamson 2015	Number of symptoms	+A	Low	OR 1.7 (1.07 to 2.78)	
		Holm 2008	Pain drawings (0–45)	NA	Low	Multivariate NA	
Initial headache	2	Berglund 2006	Y/N	+A	Low	OR 1.7 (1.4 to 2.1)	
		Holm 2008	NRS (0-10), stratified by: a) Moderate disability (PDI 5-21) b) High disability (PDI≥22)	**NA**	Low	Multivariate NA	-

Extent of body pain	1	Casey 2015	SF-36 Bodily Pain Scale (SF-36 BPS) (lower score = worse pain)	+A	Low	OR 0.73 (0.64 to 0.82)	
Low back pain intensity	1	Holm 2008	NRS (0-10), stratified by: a) Moderate disability (PDI 5-21) b) High disability (PDI≥22)	NA	Low	Multivariate NA	-
Number of pain-associated symptoms [a]	1	Holm 2008	Number 0-8: a) Moderate disability (PDI 5-21) b) High disability (PDI≥22)	NA	Low	Multivariate NA	-
Severity of numbness in arms	1	Holm 2008	Not reported (probably NRS) a) Moderate disability (PDI 5-21) b) High disability (PDI≥22)	NA	Low	Multivariate NA	-
Severity of ringing in ears	1	Holm 2008	Not reported	NA	Low	Multivariate NA	-

Figure 4: Forest plot of high initial neck pain (symptom) and disability (outcome)

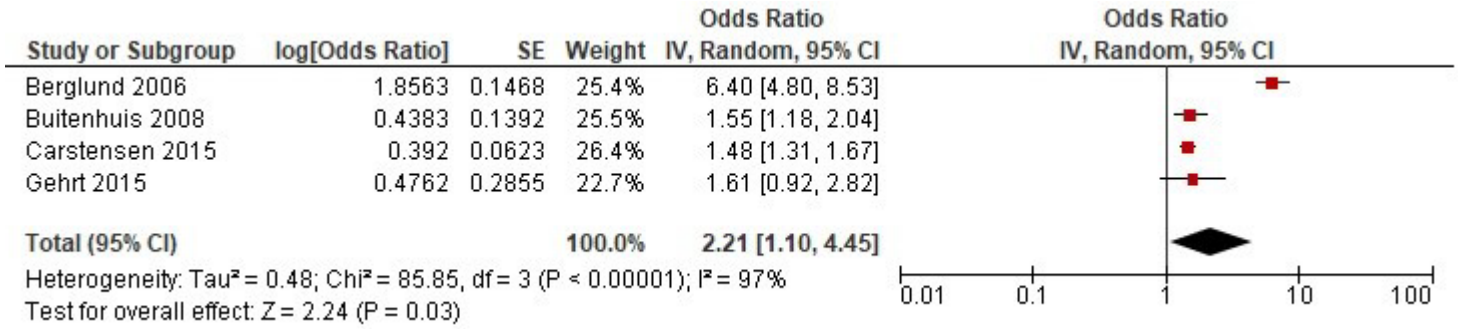
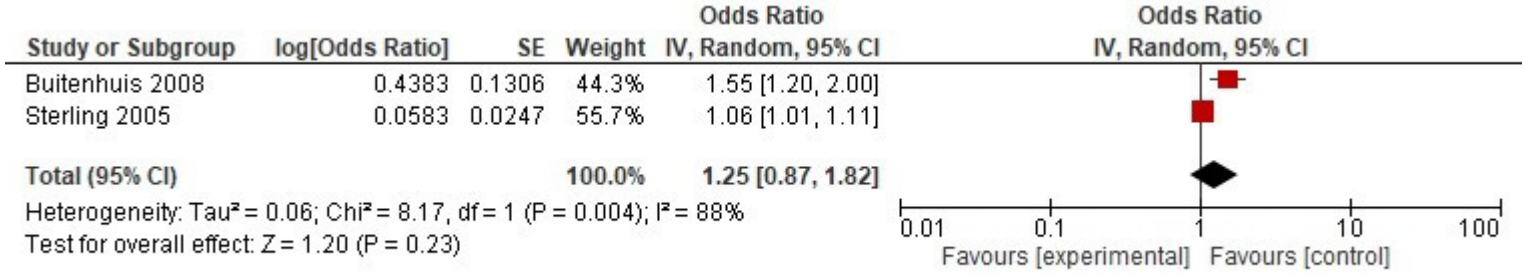


Figure 5: Forest plot of high initial neck disability and disability (outcome)



GRADE ASSESSMENT

High initial neck pain: Moderate certainty ⊕⊕⊕◯ in the evidence for a very strong association between high initial neck pain and long-term disability. All included studies were low risk of bias (QUIPS). 7/8 studies showed a positive association with long-term neck disability; however, very high heterogeneity was found in the study findings (see meta-analysis). This heterogeneity was primarily due to the study by Berglund (2006), which found a very strong association with long-term neck disability. Imprecision was not rated down despite the wide confidence intervals as the estimated effect was very strong.

Number of painful body areas: Low certainty ⊕⊕◯◯ in the evidence for a strong association between number of painful areas and long-term neck disability. Risk of bias not serious (primary and secondary studies had low QUIPS scores overall). A single primary study showed a strong association, however, secondary evidence showed mixed findings (1 sig / 1 NS) and therefore inconsistency was rated as serious. Sample size in the primary study was adequate for precision, however, confidence intervals ranged from near 1.0 to a very strong association and therefore imprecision was deemed serious.

Initial headache: Low certainty ⊕⊕◯◯ in the evidence for a moderate association between initial headache and long-term neck disability. Risk of bias not serious (low overall QUIPS scores). Study characteristics were applicable to an Australian context. Study findings were inconsistent with one study (~2/3 of total sample size) showing a strong positive association with long-term neck disability and one study showing no significant association (inconsistency: serious). While no data were reported for the study by Holm (2008), no significant association and a strong association will likely result in imprecise pooled findings, and therefore imprecision was deemed serious.

Extent of bodily pain: Low certainty ⊕⊕◯◯ in the evidence for a moderate association between extent of body pain and long-term neck disability. Risk of bias (low overall QUIPS) and indirectness (study was carried out in an Australian cohort) were not serious. While the point estimate and confidence intervals were beyond the clinical threshold, findings were from a single study (inconsistency: serious) and sample size was below the threshold for precision (imprecision: serious).

P.2.4. Outcome: Psychological distress

There was only one study that examined 7 symptom factors associated with ongoing psychological distress. Of the 7 factors, 5/6 had a +ve association with ongoing psychological distress, and 2/6 had no association (Table 17).

Table 17: Symptom-related factors predictive of long-term psychological distress with acute whiplash

Prognostic Factor	Number of studies	First author, year	Measure	Positive or negative association	Risk of bias (QUIPS)	Data
Hearing problems	1	Phillips 2010	(Y/N)	+A	Low	OR 2.89 (1.47 to 5.67), p<0.005
Initial LBP intensity	1	Phillips 2010	NRS (0-10)	+A	Low	OR 1.15 (1.08 to 1.22), p<0.005
Initial neck pain intensity	1	Phillips 2010	NRS (0-10)	+A	Low	OR 1.30 (1.17 to 1.45), p<0.005
Presence of dizziness	1	Phillips 2010	NRS (0-10)	+A	Low	OR 3.65 (2.37 to 5.61), p<0.005
Numbness, tingling in arms & hands	1	Phillips 2010	NRS (0-10)	NA	Low	OR 1.37 (0.91 to 2.06), NA
Number of painful body areas	1	Phillips 2010	Pain drawing (% BSA)	+A	Low	OR 1.02 (1.0 to 1.03), p<0.05
Vision problems	1	Phillips 2010	NRS (0-10)	NA	Low	OR 1.32 (0.76 to 2.29), NA

GRADE ASSESSMENT

The following GRADE certainty ratings were performed for associations extracted from a single study (Phillips 2010) with low risk of bias (low QUIPS overall) and total sample size below the threshold for precision (N=162). Inconsistency and imprecision were rated as serious as a baseline due to findings being from a single study and small sample size, unless otherwise indicated below.

Hearing problems: Low certainty ⊕⊕◯◯ in the evidence for a strong association between hearing problems and long-term psychological distress. The lower bound of the confidence intervals was above the clinical threshold.

Initial LBP intensity: Very low certainty ⊕◯◯◯ in the evidence for a moderate association between initial LBP intensity and long-term psychological distress. Lower bound of the confidence interval neared 1.0 and crossed the clinical threshold.

Initial neck pain intensity: Low certainty ⊕⊕◯◯ in the evidence for a moderate association between initial neck pain intensity and long-term psychological distress. The lower bound of the confidence interval was near the clinical threshold and therefore we decided not to rate down imprecision further.

Presence of dizziness: Low certainty ⊕⊕◯◯ in the evidence for a very strong association between presence of dizziness and long-term psychological distress. The lower bound of the confidence intervals was significantly above the clinical threshold.

Numbness, tingling in arms & hands: Very low certainty ⊕◯◯◯ in the evidence for a trivial association between numbness, tingling in arms and hands and long-term psychological distress. The confidence intervals ranged from below 1.0 to a strong association and therefore imprecision was rated down further to very serious.

Number of painful body areas: Low certainty ⊕⊕◯◯ in the evidence for a trivial association between number of painful body areas and long-term psychological distress.

Vision problems: Very low certainty ⊕◯◯◯ in the evidence for a trivial association between vision problems and long-term psychological distress. The confidence intervals ranged from below 1.0 to a strong association and therefore imprecision was rated down further to very serious.

P.2.5. Outcome: Perceived non-recovery

There were 4 studies that examined symptom factors associated with perceived non-recovery. These 4 studies investigated 4 symptom factors.

The strongest evidence for factors associated with perceived non-recovery was:

- High initial pain intensity (4/4 +A, 2 studies meta-analysed, OR 1.33 (0.74 to 2.40) (Figure 6).

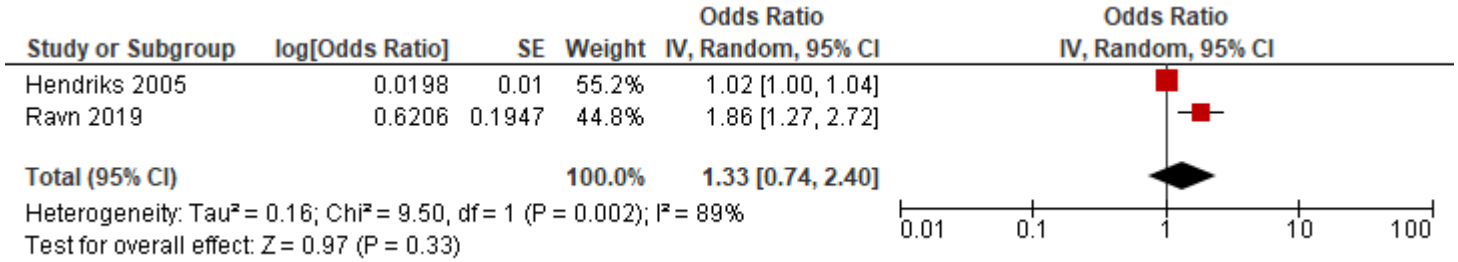
The remaining 4 factors had only one study examine the association of that factor with poor outcome (Table 18).

Table 18: Symptom-related factors predictive of long-term perceived non-recovery with acute whiplash

Prognostic Factor	Number of studies	First author, year	Baseline N	Measure	Positive or negative association	Risk of bias (QUIPS)	Data	Pooled meta-analysis OR (95% CI)
High initial neck pain		Hendriks 2005 Ravn 2019	125 253	Initial pain intensity (VAS) Neck pain intensity (VAS)	+A +A	Low Low	**OR 1.02 (1.002 to 1.04)** **OR 1.86 (1.27 to 2.73)**	**1.33 (0.74-2.40) (Figure 6)**
		Griffin 2019	215	NRS	+A	Low	*NRS not in MV model a priori.*	-
		Radanov 1996	133	VAS / NRS	+A	Moderate	VAS / NRS = 6 (b = 0.659, bx = 3.951 (no p-values)	-
Health related QoL	1	Griffin 2019	215	EQ5D-3L	+A	Low	OR 8.37 (2.04 to 33.53)	-
Work activities	1	Hendriks 2005	125	Ability to perform daily activities (0 - 100% ability)	NA	Low	OR 0.986 (0.975 to 0.998) (NS)	-

Radicular symptoms	1	Hendriks 2005	125	Yes (ref=no)	NA	Low	β = 0.947, p=NS	-
Initial headache intensity	1	Radanov 1996	133	VAS	+A	Moderate	β = 0.776, no p value	-

Figure 6: Forest plot of high initial neck pain (symptom) and perceived non-recovery (outcome)



GRADE ASSESSMENT

High initial neck pain: (N=2 primary cohorts; N=2 secondary cohorts). Low certainty ⊕⊕◯◯ in the evidence for a trivial association between high initial neck pain and long-term perceived non-recovery. Risk of bias not serious (low QUIPS overall across studies). High heterogeneity present between the two studies presented in the meta-analysis (I^2=89%, inconsistency: serious) and imprecision was deemed serious (not rated down further as 3/4 studies should significant positive associations).

Health related QoL: (N=1 cohort). Low certainty ⊕⊕◯◯ in the evidence for a huge association between health related QOL and long-term perceived non-recovery. Risk of bias was not serious (low QUIPS overall), and study was carried out in Australia. Inconsistency was rated down as findings were from a single study. Despite the lower bound of the confidence intervals being a very strong association, total sample size was below the threshold for precision, so we deemed imprecision as serious.

Work activities: (N=1 cohort). Low certainty ⊕⊕◯◯ in the evidence for a trivial association between work activities and long-term perceived non-recovery. Risk of bias not serious (low QUIPS overall). Findings were from a single study with small sample size (inconsistency and imprecision: serious).

P.2.6. Overall summary (symptom factors)

Overall summary: Considering the four outcomes, the factor with the highest evidence for association with poor outcome were high initial pain, high initial disability, higher number of initial symptoms and number of painful areas.

Table 19: Summary and tally of the number of studies and their association with the prognostic factors.

Symptom	Pain	Disability	Psychological distress	Non-recovery	Overall*	Pooled OR
High initial neck pain	5A 1NA	6A	1A	4A	A	1.99 (0.85 to 4.68) Pain 2.21 (1.10 to 4.45)- Disability 1.33 (0.74 to 2.40)- Recovery
High initial neck disability	2A	6A	1A	-	A	1.25 (0.87 to 1.11)
Higher number of symptoms	2A	-	-	-	A	1.97 (1.30 to 2.99)
Number of painful areas	1A	3A	-	1A	A	-
Pain frequency	1A	-	-	-	I	-
Presence of dizziness	1A	-	1A	-	I	-
Initial headache	-	1A	-	1A	I	-
Neurological signs or symptoms	1NA					-
Initial arm pain	1A	-	-	-	I	-
Initial reported general health	-	1A	-	1A	I	-
Other initial hearing, tingling vision			1A- 1NA		I	-
Limited initial work activities		1 NA			I- NA	-
Extent of body pain	-	I NA			I-NA	-

A= associated I= inconclusive NA= not associated

* Overall rating determined as follows: A if 2 or more studies find the factor associated with the outcome, I if only one study or two lo quality studies found the factor associated with the outcome, NA If 2 or more studies find the factor not associated with the outcome.

P.2.7. Evidence to decision framework (symptom factors)

Table 20: Evidence to decision framework (symptom-related prognostic factors)

Strength of association How substantial are the associations between explanatory factors and critical outcomes?

Judgement	Research evidence	Additional considerations
○ Trivial ○ Small ● Moderate ○ Large ○ Varies ○ Don't know	High initial pain intensity had the strongest association (compared to other symptom-related factors) with poor outcome. The strongest evidence for factors associated with ongoing pain were: i) High initial pain intensity (5/5 +ve association with poor outcome); meta-analysis (3 studies) ii) Higher number of symptoms (2/2 +ve association with poor outcome), The remaining factors (pain frequency, high initial neck disability, dizziness, initial arm pain) had only one study examine the association of the factor. It was not possible to pool all ORs due to different measurements used between studies. Where it was possible to pool ORs, the effect size ranged from large to no effect.	Strong evidence for an association between high initial pain and poor outcome. Moderate evidence for associations between high initial disability, and number of symptoms and poor outcome. There were a number of other symptom-related factors (pain frequency, high initial neck disability, dizziness, initial arm pain) but too few studies to make a recommendation.
Undesirable Effects How substantial are the undesirable anticipated effects when assessing these outcomes?		
Judgement	Research evidence	Additional considerations
○ Large ○ Moderate ○ Small ● Trivial ○ Varies ○ Don't know	Not measured in the studies.	A small proportion of people may become upset with their pain and/or disability being measured.
Certainty of evidence What is the overall certainty of the evidence of effects?		
Judgement	Research evidence	Additional considerations

○ Very low ○ Low ○ Moderate ● High ○ No included studies	**>2 studies found a positive association with poor outcome:** The strongest evidence for factors associated with ongoing pain were: - High initial pain intensity (5/5 studies, pooled OR 1.99 0.85 to 4.68), followed by - Higher number of symptoms (2/2 studies, pooled OR 1.97 (1.30 to 2.99). The strongest evidence for factors associated with ongoing disability were: - High initial pain intensity (7/7 +ve association with poor outcome), pooled OR 2.21 (1.10 to 4.45), followed by: - Higher initial neck disability (5/5 +ve association with poor outcome, followed by: - Higher number of painful areas (3/3 +ve association with poor outcome) The effect size was greatest for higher initial neck pain and disability (pooled meta-analysis OR 2.21 (1.10 – 4.45), followed by higher number of symptoms and long-term pain (pooled OR 1.97 (1.30-2.99), then higher initial pain intensity and long-term pain (pooled OR 1.99 (0.85 to 4.68).	The review findings are consistent with other evidence syntheses, such as systematic reviews and published clinical guidelines.
Values Is there important uncertainty about or variability in how much people value the main outcomes?		
Judgement	Research evidence	Additional considerations
○ Important uncertainty or variability ○ Possibly important uncertainty or variability ○ Probably no important uncertainty or variability ● No important uncertainty or variability	Not applicable.	
Balance of effects Does the balance between desirable and undesirable effects favor assessing or not assessing the factor/s?		
Judgement	Research evidence	Additional considerations

○ Favors the comparison ○ Probably favors the comparison ○ Does not favor either the intervention or the comparison ○ Probably favors the intervention ○ Favors the intervention ● Don't know ○ Don't know	Not applicable.	
Resources required How large are the resource requirements (costs)?		
Judgement	Research evidence	Additional considerations
○ Large costs ○ Moderate costs ● Negligible costs and savings ○ Moderate savings ○ Large savings ○ Varies ○ Don't know	The symptom factors in the studies were measured with free and accessible questionnaires or tools, for example: Pain intensity: numeric rating scale (NRS) or visual analogue scale (VAS) Neck Disability: Neck Disability Index (NDI) or similar questionnaire.	The NRS, VAS and NDI can be easily found on Whiplash Navigator (www.mywhiplash.com.au) or other freely available websites. People with whiplash may wish to complete the recommended measures (VAS, NRS, NDI, number of pain sites) during their consult, so they can discuss their results with their HCP, rather than completing the form prior to their consult.
Certainty of evidence of required resources What is the certainty of the evidence of resource requirements (costs)?		
Judgement	Research evidence	Additional considerations
○ Very low ○ Low ○ Moderate ○ High ● No included studies	No evidence.	VAS, NRS, NDIs are freely available to HCP's and can usually be administered within a primary HCP consultation.
Cost effectiveness Does the cost-effectiveness favour assessing or not assessing the factor?		
Judgement	Research evidence	Additional considerations

○ Favors assessing the factor ○ Probably favors assessing the factor ○ Does not favor either the assessing or not assessing the factor ○Probably favors not assessing the factor ○ Favors assessing the factor ○ Varies ● No included studies	No evidence. Cost-effectiveness is not usually measured in prognostic studies.	
Equity What would be the impact on health equity?		
Judgement	Research evidence	Additional considerations
○ Reduced ○ Probably reduced ● Probably no impact ○ Probably increased ○ Increased ○ Varies ○ Don't know	No evidence.	
Acceptability Is assessing the factor acceptable to key stakeholders?		
Judgement	Research evidence	Additional considerations
○ No ○ Probably no ○ Probably yes ● Yes ○ Varies ○ Don't know	Acceptability is not formally measured nor reported on in the studies.	Most people with whiplash would consider it acceptable to have these factors assessed (e.g., pain intensity). The NDI takes around 5 minutes to complete. People may prefer these factors to be assessed during (rather than prior to) the consultation, so that the results can be discussed with the primary HCP.
Feasibility Is assessing the factor feasible to implement?		
Judgement	Research evidence	Additional considerations
○ No ○ Probably no ○ Probably yes	Feasibility is not formally measured nor reported on in the studies.	The NRS, VAS and NDI can be easily found on Whiplash Navigator (www.mywhiplash.com.au) or other freely

● Yes ○ Varies ○ Don't know		available websites, meaning they are feasible to implement.

P.2.8. Summary of judgements (symptom factors)

Type of recommendation

Strong recommendation for not assessing the factor	Conditional recommendation for not assessing the factor	Neutral recommendation for assessing the factor	Conditional recommendation for assessing the factor	Strong recommendation for assessing the factor
○	○	○	○	●

Recommendation The guideline panel strongly recommend that healthcare professionals assess initial pain intensity, initial neck-related disability, number of painful body areas and number of symptoms to determine poor prognosis in people with acute whiplash.

(Panel vote summary: 9/12 75% strong for, 3/12 25% conditional for).

Justification

- Evidence: There are a high number of studies (n=25) of that informed this evidence. Most showed a positive associating with the outcome (e.g., 7/8 studies show an association of high initial neck pain with the outcome ongoing disability. Certainty of evidence varies, however is moderate in many cases (e.g., s Moderate certainty ⊕⊕⊕◯ in the evidence for a very strong association between high initial neck pain and long-term disability).
- Consistency: The findings are consistent with well-regarded systematic reviews on prognosis, and with previous guidelines.
- Acceptance and Feasibility: Considered acceptable and feasible
- Other factors: Some treatment studies included in this guideline have also included participants with similar characteristics (factors) seen in the prognostic studies.

Implementation considerations

How to measure and interpret:

- Measure pain intensity with a numerical rating scale (NRS). People with scores of ≥6/10 are considered at higher risk of poor recovery
- Measure neck- related disability with the Neck Disability Index (NDI). People with scores of ≥15/50 (30%) are considered at higher risk of poor recovery
- People with more than 7 painful sites are considered at risk of poor recovery

What to do:

- Consider implementation within the consultation an discuss with the person. This may require a longer consult time within a primary care setting (e.g., 10 minutes instead of 15 minutes).

P.3. Radiological factors

Question: What radiological factors are predictive of ongoing neck pain, neck disability, psychological distress, and perceived non-recovery in people with acute whiplash associated disorders?

P.3.1. Summary of Included studies

There were 4 studies that informed the recommendations regarding radiological factors and their relationship with poor outcome after whiplash (Hendriks et al 2005, Johansson et al 2011, Richter et al 2004, Vetti et al 2010).

P.3.2. Outcome: Ongoing neck pain

Four studies examined 5 radiological factors associated with long-term pain (measured by a pain rating scale at 12 months, or at follow-up point nearest to 12 months). No factors were associated with long-term pain (4 studies NA: Table 21).

Table 21: Radiological factors predictive of long-term neck pain with acute whiplash

Prognostic Factor	Number of studies	First author, year	Baseline N	Measure	Positive or negative association	Risk of bias (QUIPS)	Data
MRI	1	Vetti 2010	111	Grades 2-3 alar ligament changes (Yes vs No)	NA	Low	NS in univariate
	1	Vetti 2010	111	Grades 2-3 transverse ligament changes (Yes vs No)	NA	Low	NS in univariate
	1	Johansson 2011	171	Lack of lordosis	NA	Low	OR 1.2 (.3; 4.6)- adjusted for age and gender
X-ray	1	Richter 2004	43	Degenerative changes, lack of lordosis	NA	Low	NS in CART regression
Diagnostic imaging (not specified)	1	Hendriks 2005	125	Diagnostic imaging taken at 2 weeks	NA	Low	NS in univariate

P.3.3. Outcome: Neck disability

One study examined 2 radiological factors associated with long-term disability (NDI). The radiological factors were grades 2-3 MRI alar ligament changes, and grades 2-3 transverse ligament changes. Neither factor was associated with long-term neck disability (Table 22).

Table 22: Radiological factors predictive of long-term neck disability with acute whiplash

Prognostic Factor	Number of studies	First author, year	Baseline N	Measure	Positive or negative association	Risk of bias (QUIPS)	Data
MRI	1	Vetti 2010	111	Grades 2-3 alar ligament changes (Yes vs No)	NA	Low	NA in univariate
	1	Vetti 2010	111	Grades 2-3 transverse ligament changes (Yes vs No)	NA	Low	NA in univariate

P.3.4. Outcome: Psychological distress

No studies

P.3.5. Outcome: Perceived non-recovery

No studies

P.3.6. Summary of Outcomes: radiological factors

Overall summary: 4 studies found no association between radiological findings on MRI or X-ray (alar ligament changes, degenerative changes, lack of lordosis, diagnostic imaging at 2 weeks) and poor outcome.

Table 23: Overall summary (radiological factors)

Radiological factor	Pain	Disability	Psychological distress	Non-recovery	Overall	Pooled OR
MRI- Grades 2-3 alar and transverse ligament changes	1NA	1NA	-	-	I	-
MRI and Xray- Lack of lordosis	2NA	-	-	-	NA	-
X-ray – Degenerative changes	1NA	-	-	-	I	-
Diagnostic imaging – not specified	1NA	-	-	-	I	-

P.3.7. Evidence to decision framework: (radiological factors)

Table 24: Evidence to decision framework (radiological factors)

Strength of association How substantial are the associations between explanatory factors and critical outcomes?		
Judgement	Research evidence	Additional considerations
● Trivial ○ Small ○ Moderate ○ Large ○ Varies ○ Don't know	No associations were found for lack of lordosis on X-ray and MRI (2 studies). No association was found for alar ligament changes on MRI (1 study) and degenerative changes on Xray.	Consistent with 3 systematic reviews (SR's) and the previous guidelines that conclude radiological findings are not associated with poor outcomes in WAD. This finding is also consistent with the lack of association found in other MSK conditions.
Undesirable Effects How substantial are the undesirable anticipated effects when assessing these outcomes?		
Judgement	Research evidence	Additional considerations
○ Large ○ Moderate ● Small ○ Trivial ○ Varies ○ Don't know	Not reported in the studies.	There is a known risk associated with radiation exposure (e.g., X-ray).
Certainty of evidence What is the overall certainty of the evidence of effects?		
Judgement	Research evidence	Additional considerations
○ Very low ● Low ○ Moderate ○ High ○ No included studies	There are only 4 studies investigating different radiological techniques, hence meta-analysis was not possible.	Conclusions are consistent with recent SR's (Shearer et al. 2021, Sarrami et al. 2016) where no association was found.
Balance of effects Does the balance between desirable and undesirable effects favor assessing or not assessing the factor/s?		
Judgement	Research evidence	Additional considerations

● Favours not assessing ○ Probably favours not assessing ○ Does not favour either assessing or not assessing ○ Probably favours assessing ○ Favours assessing ○ Varies ○ Don't know	Whilst only 4 studies, all show no association and are consistent with findings from excluded studies and SR's.	Findings on MRI can be considered by injured people to be "significant" when not so. These can adversely affect outcome in some circumstances (and are known to do so for example in low back pain).
Resources required How large are the resource requirements (costs)?		
Judgement	Research evidence	Additional considerations
○ Large costs ● Moderate costs (acute / chronic) ○ Negligible costs and savings ○ Moderate savings ○ Large savings ○ Varies ○ Don't know	Costs of MRI are considered moderate.	Referral for MRI requires GP or specialist referral. If unhelpful in determining prognosis, then the cost is unnecessary for this purpose.
Certainty of evidence of required resources What is the certainty of the evidence of resource requirements (costs)?		
Judgement	Research evidence	Additional considerations
○ Very low ○ Low ○ Moderate ○ High ● No included studies	No evidence (not applicable).	
Cost effectiveness Does the cost-effectiveness favour assessing or not assessing the factor?		
Judgement	Research evidence	Additional considerations

○ Favors assessing the factor ○ Probably favors assessing the factor ○ Does not favor either the assessing or not assessing the factor ○Probably favors not assessing the factor ○ Favors assessing the factor ○ Varies ● No included studies	No evidence. Cost-effectiveness is not usually measured in prognostic studies.	
Equity What would be the impact on health equity?		
Judgement	Research evidence	Additional considerations
○ Reduced ● Probably reduced ○ Probably no impact ○ Probably increased ○ Increased ○ Varies ○ Don't know	Not reported.	Potential economic inequity if the person pays out of their own pocket, i.e., costs are not covered by claim. MRI is only available at certain facilities and may not be easily accessible for all people. e.g., Those in regional / rural areas or not driving following injury.
Acceptability Is assessing the factor acceptable to key stakeholders?		
Judgement	Research evidence	Additional considerations
○ No ○ Probably no ○ Probably yes ○ Yes ● Varies ○ Don't know	Minimal report of lack of acceptability in studies.	Whilst Xray and MRI are acceptable in some circumstances for people with whiplash, there are contraindications in some instances (e.g., metal implant and claustrophobia). The insurance industry often asked to fund imaging, hence is less acceptable for no known benefit in relation to prognosis.
Feasibility Is assessing the factor feasible to implement?		
Judgement	Research evidence	Additional considerations

● No ○ Probably no ○ Probably yes ○ Yes ○ Varies ○ Don't know	It is not feasible to routinely Xray or MRI people with WAD.	

P.3.8. Summary of Judgements (radiological factors)

Type of recommendation

Strong recommendation for not assessing the factor	Conditional recommendation for not assessing the factor	Neutral recommendation for assessing the factor	Conditional recommendation for assessing the factor	Strong recommendation for assessing the factor
●	○	○	○	○

Recommendation The guideline panel strongly recommend against referral for X-ray or MRI to determine poor prognosis in people with acute whiplash.

(Panel vote summary: 10/11 (91%) strong against, 1/11 (9%) conditional against.

Justification

- Evidence: Overall inconclusive based on 4 studies, but all find no association with the outcome.
- Consistency: Consistent with SR's and recommendations in similar MSK conditions (e.g., low back pain).
- Balance of effects: Unnecessary imaging is costly and can be associated with reporting of "normal" imaging findings being reported as abnormal.

Implementation considerations

Not recommended, therefore no implementation considerations for the purposes of prognosis.

Please refer to the assessment guidelines for recommendations on when it is reasonable to refer for imaging to establish diagnosis.

P.4. Psychological factors

Question: What initial **psychological factors** are predictive of long-term neck pain, neck disability, psychological distress, and perceived non-recovery in people with acute whiplash associated disorders?

P.4.1. Summary of Included studies

There were 35 studies that informed the recommendations regarding psychological factors and their relationship with poor outcome after whiplash (Ameratunga et al 2010, Andersen et al 2019, Asenlof et al 2013, Atherton et al 2006, Berglund et al 2006, Bostick et al 2013, Buitenhuis et al 2006a, 2006b, 2008, Carroll et al 2009, 2011, Cartensen et al 2015, Casey et al 2015 a, 2015b, Griffin et al 2019, Gun et al 2005, Hendriks et al 2005, Holm et al 2007, 2008, Kongstead et al 2008a, 2008b, Kuperman et al 2021, Mayou et al 1996, Miettinen 2004a, 2004b, Ozegovic et al 2009, Pedler et al 2016, Phillips et al 2010, Radanov et al 1996, Ravn et al 2019, Richter et al 2004, Soderlund et al 2003, Sterling et al 2005, Vetti et al 2010, Williamson et al 2015. (Table 25).

P.4.2. Outcome: Ongoing neck pain

Eighteen studies examined psychological factors associated with long-term pain. These 18 studies investigated factors such as post-traumatic stress symptoms, mood and pain beliefs. The evidence for factors associated with ongoing pain were:

- Posttraumatic Stress Symptoms (4/5 +A, 1/5 NA, meta-analysis (3 studies) OR 2.11 (1.51 to 2.95).
- Mood
    - Depression (5/6 +A, 1/6 NA meta-analysis (3 studies) OR 2.11 (0.81 to 5.54) (see 6)
    - Anxiety (1/1 +A)
    - SF-36 (mental component score or role emotional) (2/2 +A).
    - Others (2/2 +A)
- Pain Beliefs
    - Pain catastrophising (3/4 +A, 1/ 4NA
    - Fear (1/2 +A, 1/2 NA)
    - Poor coping strategies ½ +A, ½ NA
    - Low expectations of recovery 3/3 +A
    - Pain Attitudes (positive) 1/1 -A (associated with **good** outcome)
    - Other 1/1 +A

Table 25: Psychological factors predictive of long-term neck pain with acute whiplash

Prognostic Factor	Number of studies	First author (year)	Measure	Positive or negative association	Risk of bias (QUIPS)	Data β: Adjusted β coefficient OR: Adjusted Odds Ratio RR: Adjusted Risk Ratio	Pooled meta-analysis OR (95% CI)
Posttraumatic stress symptoms							
Posttraumatic stress symptoms	5	Kongsted (2008a)	Impact of Events Scale	+A	Low	OR = 2.1 (1.1 to 4.1), p<0.05	**OR = 2.11 (1.51 to 2.95) (Figure 5)**
		Vetti (2010)	Impact of Events Scale	+A	Low	OR =1.93 (1.24 to 3.00) p=0.001	
		Ameratunga (2010)	Impact of Events Scale	+A		OR = 2.93 (1.28 to 6.70)	
		Pedler (2016)	Posttraumatic Stress Diagnostic Scale	NA	Low	β = -0.01 (-0.04 to 0.02), p<0.48	-
		Buitenhuis (2006)	Post-Traumatic Stress Disorder	+A	Low	OR = 7.51 (1.58 to 35.7), p<.005	-
Mood							
Depression	6	Holm (2007)	Depressive (CES-D ≥ 16)	+A	Low	OR = 3.2 (1.6 to 6.3)	**OR = 2.11 (0.81 to 5.54) (Figure 6)**
		Carroll (2011)	Depression	+A	low	OR = 1.009 (1.004 to 1.013)	
		Ameratunga (2010)	Depression	+A		OR = 3.47 (1.54 to 7.84)	
		Sullivan (2017)	Depression (BDI)	+A	Low	β = 0.18	-
		Miettinen (2004b)	Depression (BDI)	+A	Moderate	Univariate, P< 0.01	-
		Atherton (2010)	General psych distress - GHQ	NA	Moderate	RR = 1.3 (0.8 to 2.1)	-
Anxiety	1	Carroll (2011)	Anxiety	+A	Low	OR = 1.024 (1.002 to 1.013)	-
SF-36	2	Gun (2005)	SF-36 Role emotional	+A	Low	β = 0.01, p<0.05	-
		Richter (2004)	SF-36 Role emotional1	+A		Decision tree analysis	-
Others	2	Carroll (2011)	Pain-Emotions	+A	Low		
			Frustration			OR = 1.007 (1.003 to 1.010)	-
			Anger			OR= 1.006 (1.001 to 1.01)	-
			Fear			OR = 1.005 (1.001 to 1.01)	-
		Mayou and Bryant (2002)	Anger cognition	+A	Low	OR = 2.22 (1.0 to 4.8)	-

Pain Beliefs

Pain Catastrophising	4	Sullivan (2017)	Pain Catastrophising Scale	+A	Low	β = 0.11	-
		Bostick (2013)	Pain Catastrophising Scale	+A	Low	β = 0.01 (0.0 to 0.18), p<0.05	-
		Buitenhuis (2008)	Pain Catastrophising Scale	NA	Low	OR = 0.92 (0.87 to 1.01)	-
		Berglund (2006)	Helplessness - High (Low: reference)	+A	Low	OR= 2.7 (2.1 to 3.4), p< 0.0001	-
Fear	2	Pedler (2016)	Pictorial Fear of Activities Scale–Cervical	NA	Low	β = -0.03 (-0.02 to 0.07), p= 0.64	-
			Tampa Scale of Kinesiophobia			β = 0.03(- 0.02 to 0.07), p = 0.25	-
		Buitenhuis (2006)	Tampa Scale of Kinesiophobia	+A	Low	HR = 0.47 (0.33–0.65), p<.001	-
Poor coping strategies	1	Carstensen (2012)	Poorer coping strategies:	+A	Low		
			distraction			OR = 1.03 (1.01 to 1.05), p<.003	-
			reinterpreting			OR = 1.03 (1.01 to 1.06), p<.018	-
			catastrophising			OR = 1.14 (1.1 to 1.18), p<.000	-
			praying and hoping			OR = 1.09 (1.05 to 1.13), p<.000	-
Low Expectation of recovery	3	Vetti (2010)	Low expectations of recovery	+A	Low	OR = 21.56 (2.52 to 184.16), p=0.006	-
		Bostick (2013)	Low expectations of recovery (Pain Beliefs and Perception Inventory- the permanence of pain	+A	Low	β = 0.25 (0.09 to 0.41), p<0.05	-
		Carroll (2009)	High expectations of recovery (will recover soon)2	-A	Low	HRR = 1.81 (1.34 to 2.44)1	
Pain Attitude (positives)	1	Bostick (2013)	Survey of Pain Attitudes Questionnaire	-A	Low		-
			Control 3			β = -0.19 (-0.37 to -0.01),p<0.05	-

			Medical cure			β = -0.28 (-0.47 to -0.1), p<0.05	
Other	1	Buitenhuis (2008)	Causal Beliefs Questionnaire Whiplash: Psychological CBQ-W vertebral CBQ-W whiplash Psychological	+A	Low	 OR = 2.67 (1.09 to 6.53), p<0.03 OR = 2.30 (0.98 to 5.41) OR = 2.65 (1.32 to 5.31), p<.006 OR = 2.67 (1.09 to 6.53), p<0.03	 - - - -

[1] Predicting longer duration and greater severity
[2] Expectation of positive recovery "will bet better soon" has HRR associated with resolution of neck pain. In this SR, we are reporting outcomes in reverse (that is poor recovery) hence the –ve association.
[3] Considered an adaptive belief- hence higher levels of control associated with less pain

Figure 5: Meta-analysis forest plot – Impact of Events Scale (IES) as a prognostic factor for ongoing pain

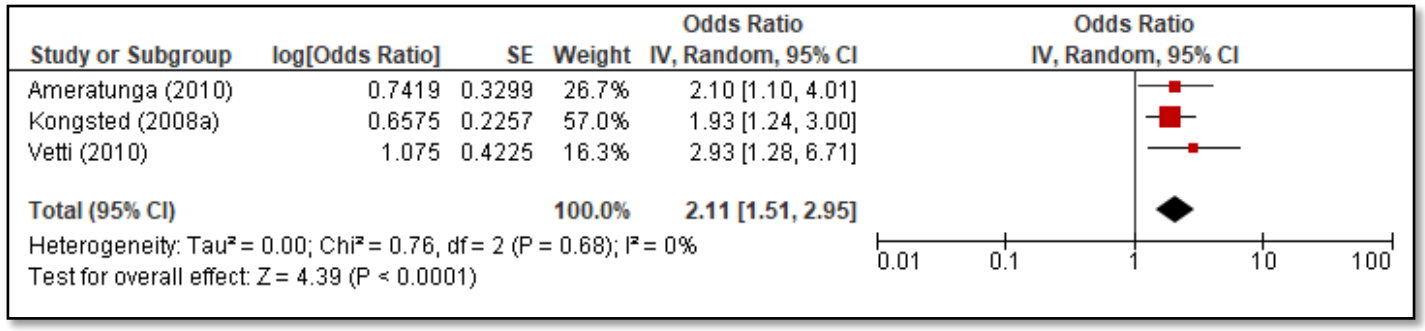
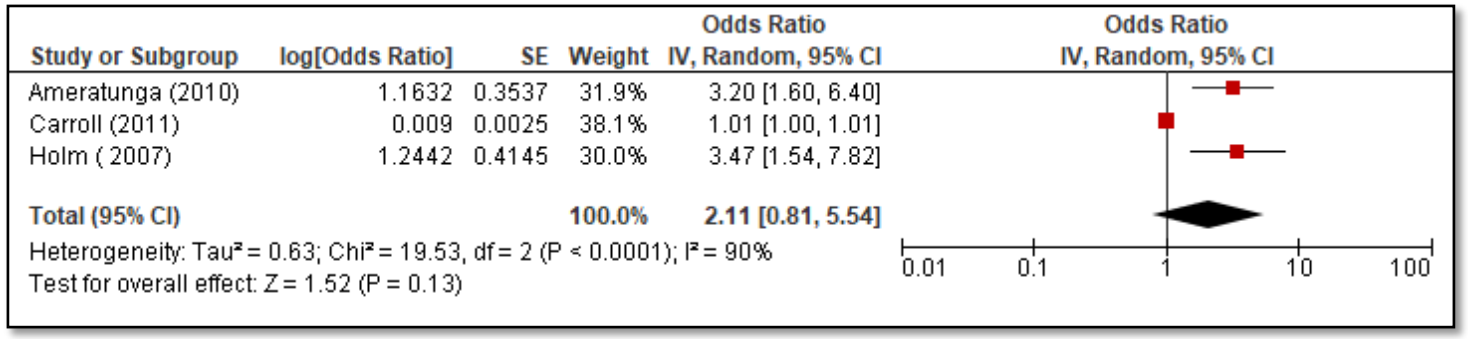


Figure 6: Meta-analysis forest plot –Depression as a prognostic factor for ongoing pain



GRADE ASSESSMENT

Post-traumatic stress symptoms: (N=4 primary cohorts; N=1 secondary cohort). High certainty ⊕⊕⊕⊕ in the evidence for a clinically significant association between PTSS and ongoing neck pain. Risk of bias not serious (low QUIPS overall across studies). Findings were consistent across studies with clinically significant associations in all primary studies, that were applicable to an Australian context. Although confidence intervals were wide across the studies (range 1.1 - 35.7). Posttraumatic stress symptoms as assessed by the IES in three studies (Kongest 2008a, Vetti 2010, Ameratunga 2010), were consistently associated with ongoing pain, with 95% CIs above the clinically significant threshold and therefore imprecision was not serious.

Depression: (N=4 primary cohorts; N=2 secondary cohorts). Low certainty ⊕⊕◯◯ in the evidence for a moderate association (inconclusive overall) between depression and ongoing neck pain. Risk of bias not serious (low QUIPS overall across primary studies). High heterogeneity was found in results from 3 studies meta-analysed (I2 = 90%); the other 3 studies showed different associations (inconsistency: serious). Combined participant sample size was adequate. However, confidence intervals ranged from below 1.0 to above the clinically significant threshold, with the point estimate above the threshold (imprecision: serious).

Pain catastrophising: (N=2 primary cohorts: N=2 secondary cohorts). Moderate ⊕⊕⊕◯ certainty in the evidence for a small association between pain catastrophising and ongoing pain. Study findings were heterogenous (different magnitudes of association across studies and no overlap of confidence interval). There were also significant differences in the type of psychometric scale used (inconsistency: serious). 3 of the 4 studies (Bostick 2013, Buitenhuis 2008, Berguland 2006) showed trivial or no significant association between pain catastrophising and ongoing pain, with confidence intervals within the clinically significant threshold (imprecision: not serious).

Poor coping strategies: (N=1 primary cohort). Moderate certainty ⊕⊕⊕◯ in the evidence for a small association between poor coping strategies and ongoing neck pain. Findings were from a single study (inconsistency: not serious) with low overall risk of bias. Sample size was adequate for precision and findings were within 1.0 and the clinical threshold (imprecision: not serious).

Low expectation of recovery: (N=2 primary cohorts; N=1 secondary cohort). Moderate certainty ⊕⊕⊕◯ in the evidence for a clinically significant association between low expectation of recovery and ongoing neck pain. Low risk of bias in all studies. While findings were consistently associated

with ongoing pain (inconsistency: serious), and the sample size was adequate, the confidence intervals varied significantly wide but above the clinical threshold (imprecision: serious).

P.4.3. Outcome: Neck disability

Twenty-one studies examined psychological factors associated with long-term disability. These 21 studies investigated posttraumatic, mood and pain beliefs. The evidence for factors associated with ongoing disability were:

- Posttraumatic Stress Symptoms 3/6 +A, 3/6 NA meta-analysis (2 studies) OR 1.55 (1.19 to 2.02) (Figure 7)
- Mood
  - Depression 2/5+A 3/5 NA
  - Anxiety ½ +A, ½ NA
  - SF-36 (mental component score or role emotional) 1/3 +A, 2/3 NA
  - Other 1/1 +A
- Pain Beliefs
  - Pain catastrophising 5/7 +A, 2/7 NA
  - Fear ¾ +A, 1/4 NA
  - Poor Coping strategies 3/4 +A 1/4 NA
  - Low expectations of recovery 5/5 +A, (OR 2.68 (1.00 to 7.18)
  - Pain Attitude (positive)- 1/1 -A (associated with **good** outcome)
  - Self-efficacy –1/1 NA

Table 26: Psychological factors predictive of long-term neck disability with acute whiplash

Prognostic Factor	Number of studies	First author (year)	Measure	Positive or negative association	Risk of bias (QUIPS)	Data *β: Adjusted β coefficient* *OR: Adjusted Odds Ratio* *RR: Adjusted Risk Ratio*	Pooled meta-analysis OR (95% CI)
Posttraumatic stress symptoms	6	Kongsted (2008a)	Impact of Events Scale	+A	Low	**OR = 2.1 (1.1 to 4.2), p<0.05**	**OR = 1.55 (1.19 to 2.02) (Figure 7)**
		Vetti (2010)	Impact of Events Scale	+A	Low	**OR =1.46 (1.1 to 1.94), p=0.007**	
		Sterling (2005)	Impact of Events Scale	+A	Low	β = 0.242 (SE =0.1)	-
		Asenlof (2013)	Impact of Event Scale	NA	Low	β =−0.12(−0.28 to 0.04), p= 0.15	-
		Kuperman (2021)	Post-Traumatic Stress Disorder (PTSD)	NA	Low	β = 0.23, p=0.07	-

		Pedler (2016)	Posttraumatic Stress Diagnostic Scale (PDS)	NA	Low	β =0.15 (-0.05 to 0.35), p =0.13	-
Mood							
Depression	5	Miettinen (2004a)	Beck's Depression Index	NA	Moderate	OR= 1.07 (0.37 to 3.11)	-
		Kuperman (2021)	HADS-Depression	NA	Low	β = 0.20, p=0.09	-
		Andersen (2019)	Depression	+A	Low	β = 0.25, p = < 0.01	-
		Williamson (2015)	Psychological distress	+A	Low	OR = 1.9 (1.05 to 3.51)	
		Griffin (2019)	DASS depression subscale	NA	Low	In stepwise analysis	
Anxiety	2	Andersen (2019)	Anxiety	NA	Low	β = - 0.06	-
		Phillips (2010)	Anxiety	+A	Low	OR = 3.17 (2.12 to 4.75)	-
SF-36	3	Gun (2005)	SF-36 Role emotional	+A	Low	β = 0.07, p<0.05	-
		Griffin (2019)	SF-12 Mental	NA	Low	In stepwise analysis	-
		Casey (2015b)	SF-36 Mental	NA	Low	Univariate analysis	
Other	1	Andersen (2019)	Attachment Scale	+A	Low	p= .042	
Pain Beliefs							-
	7	Andersen (2019)	Pain Catastrophising	+A	Low	β = 0.16, p< 0.05	-
Pain Catastrophising		Bostick (2013)	Pain Catastrophising Scale	NA	Low	β = 0.06 (-0.001 to 0.14)	
		Casey (2015b)	Pain Catastrophising Scale[1]	+A	Low	OR = 1.11 (1.06 to 1.17), p<0.01	
		Griffin (2019)	Pain Catastrophising Scale	NA	Low	In stepwise analysis	-
		Soderlund (2003)	Catastrophising	+A	Low	β = 0.65, p < 0.05	
		Casey (2015a)	Helplessness score (PCS sub-scale)	+A	Low	β = 2.16, p<0.001	-

Fear	4	Berglund (2006)	Helplessness - High (Low: reference)	+A	Low	OR= 2.2 (1.7 to 2.8), p< 0.0001	-
		Pedler (2011)	Tampa Scale of Kinesiophobia	+A	Low	β =0.341 (SE=0.341)	-
		Asenlof (2013)	Tampa Scale of Kinesiophobia	+A	Low	β =-0.06 (−0.34 to 0.14), p= 0.43	-
		Peddler (2016)	Tampa Scale of Kinesiophobia	+A	Low	β =0.27 (-0.01 to 0.54), p = 0.05	-
			Pictorial Fear of Activities Scale–Cervical Spin			β =0.18 (20.77 to 1.1), p = 0.706	-
		Andersen (2019)	Fear-avoidance	NA	Low	β = 0.05, NA	-
Poor coping strategies	4	Pedler (2016)	Coping Strategies Questionnaire Catastrophising Subscale	+A	Low	β =0.97 (0.51 to 1.4), p <0.001	-
		Williamson (2015)	Coping Strategies Questionnaire	+A	Low	OR = 1.8 (1.07 to 2.97)	-
			Use of passive coping strategies[2]				-
		Soderlund (2003)	Coping Strategies Questionnaire	+A	Low		
			Pain avoidance strategies			β = -0.19	-
			Conscious cognitive coping			β = -0.02	-
		Asenlof (2013)	Coping Strategies Questionnaire	NA	Low	β = 0.08 (−0.11 to 0.35), p = 0.30	-
Low Expectation of recovery	5	Carroll (2009)	High expectations of recovery (will recover soon)[3]	-A	Low	HRR = 2.38 (1.62 to 3.48)	-
		Vetti (2010)	Low expectation of recovery	+A	Low	**OR = 4.6(1.5 to 14.5), p ≤0.001**	**2.68 (1.00 to 7.18) (Figure 8)**
		Holm (2008)	Low Expectations for recovery [4]	+A	Low	**OR = 4.2 (2.1 to 8.5)**	-
		Griffin (2019)	OMPQ expectations	+A	Low	**OR = 0.78 (0.65 to 0.94), p=0.01**	
		Bostick (2013)	Low expectations of recovery (Pain Beliefs and Perception Inventory- the permanence of pain)	+A	Low	β = 0.14 (0.07 to 0.21), p<0.05	
Pain Attitude	1	Bostick (2013)	Survey of Pain Attitudes Scale	-A	Low		

(positive)			Control [5]			β = -0.17 (-0.32 to -0.01), p<0.05	
			Medical cure			β = -0.19 (-0.35 to -0.03), p<0.05	
			Medication			β = 0.05 (-0.13 to 0.23), p<0.05	
			Disability			β = 0.03 (-0.18 to 0.23), p<0.05	
Self-efficacy	1	Asenlof (2013)	Self-Efficacy Scale	NA	Low	β = −0.05 (−0.10 to 0.05), p = 0.50	
		Buitenhuis (2008)	Causal Beliefs Questionnaire Whiplash	+A	Low		
Others			Severe injury			β = 5.09 (SE= 2.01), p= 0.014	
			Whiplash			β = 2.39 (SE =0.73) p= 0.002	

1 Measured in severe disability trajectory.
2 Those using more passive coping strategies compared to those with less frequent use report higher odds of developing chronic disability.
3 Expectation of positive recovery "will bet better soon" has HRR associated with resolution of neck pain. In this SR, we are reporting outcomes in reverse (that is poor recovery) hence the –ve association.
4 High disability group (PDI ≤ 22); 5 Higher level of control (adaptive belief) associated with lower levels of disability.

Figure 7: Meta-analysis forest plot –IES as a prognostic factor for ongoing disability

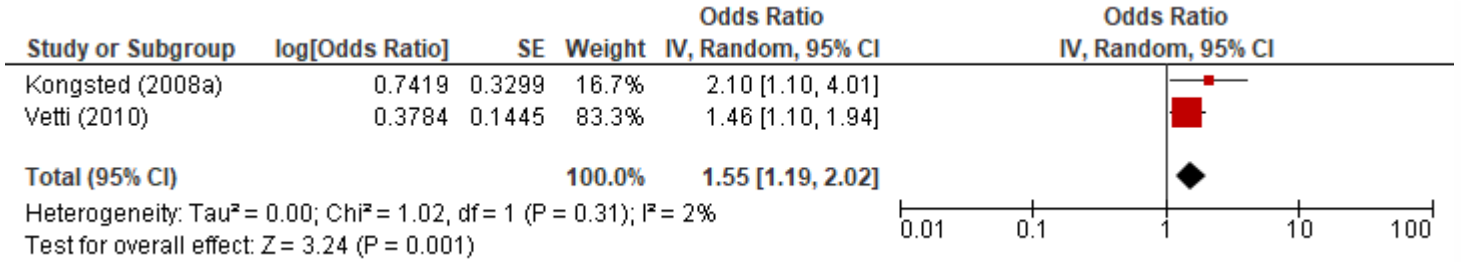
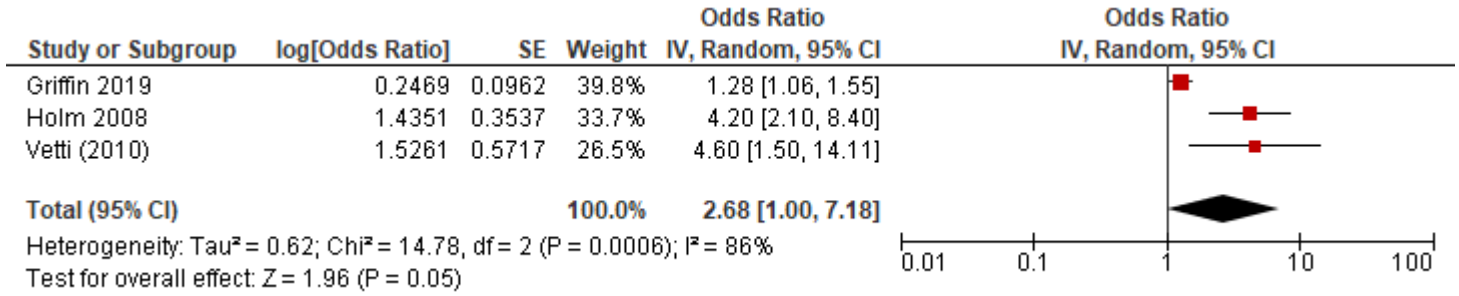


Figure 8: Meta-analysis forest plot – Low expectations of recovery as a prognostic factor for ongoing disability



GRADE ASSESSMENT

Post-traumatic stress symptoms: (N=2 primary cohorts; N=4 secondary cohorts). Moderate certainty ⊕⊕⊕◯ in the evidence for a clinically significant association between PTSS and ongoing disability. Findings were homogenous in the meta-analysis; however, inconsistency was rated down due to inconclusive results in the secondary evidence studies. Lower bound of the confidence interval was only marginally below the clinical threshold and therefore imprecision was not rated down.

Depression: (N=2 primary cohorts; N=3 secondary cohorts). Low certainty ⊕⊕◯◯ in the evidence for a small overall association between depression and ongoing disability. Inconsistent findings across studies (serious) and wide confidence intervals near 1.0 and above the clinical threshold (imprecision: serious).

Pain catastrophising: (N=2 primary cohorts; N=5 secondary cohorts). Moderate certainty ⊕⊕⊕◯ in the evidence for a moderate overall association between pain catastrophising and ongoing disability. Risk of bias overall low across all studies. Inconsistency deemed not serious as 5/7 studies showed significant associations. However, imprecision was serious as the two primary studies had varied confidence intervals that were above and below the clinically significant threshold.

Poor coping strategies: (N=1 primary cohort; N=3 secondary cohorts). Low certainty ⊕⊕◯◯ in the evidence for a moderate overall association between poor coping strategies and ongoing disability. Low risk of bias in all studies. Variable subscales across studies and findings from secondary evidence (inconsistency: serious). Imprecision deemed serious as the confidence intervals of the association from the primary study ranged from small to clinically significant.

Low expectations of recovery: (N=4 primary cohorts; N=1 secondary cohort). Moderate certainty ⊕⊕⊕◯ in the evidence for a clinically significant association between low expectation of recovery and ongoing neck disability. Low risk of bias overall in the included studies. Although heterogeneity was high across the findings in the meta-analysis, the remaining 2 studies showed significant associations with ongoing disability; 5/5 studies showed positive associations (inconsistency therefore deemed not serious). Imprecision rated as serious given that the confidence intervals presented in the meta-analysis ranged from 1.0 to huge.

P.4.4. Psychological distress

Three studies examined psychological factors associated with long-term pain. These 3 studies investigated posttraumatic and mood. The evidence for factors associated with ongoing psychological distress:

- Posttraumatic stress symptoms 1/1 NA
- Mood
  - Anxiety 1/1 +A
  - SF-36 (mental component score) 1/1 +A

Table 27: Psychological factors predictive of long-term psychological distress with acute whiplash

Prognostic Factor	Number of studies	First author (year)	Measure	Positive or negative association	Risk of bias (QUIPS)	Data *β: Adjusted β coefficient* *OR: Adjusted Odds Ratio* *RR: Adjusted Risk Ratio*	Pooled meta-analysis OR (95% CI)
Posttraumatic stress symptoms	1	Mayou (1997)	Intrusive Horrific memories	NA	Moderate	OR= 5.37 (0.93 to 31.06)	-
Mood							-
Anxiety	1	Phillips (2010)	Anxiety	+A	Low	OR =3.17 (2.12 to 4.75)	-
SF-36	1	Casey (2015b)	SF 36 Mental Component[1]	+A	Low	OR = 1.12 (1.06 to 1.18)	-

1 Moderate-low catastrophising trajectory

P.4.5. Perceived non-recovery

Five studies examined psychological factors associated with non-recovery. These five studies investigated posttraumatic, mood and pain beliefs. The evidence for factors associated with non-recovery were:

- Posttraumatic Stress Symptoms 1/1 +A
- Mood
  - Depression 1/2 +A, 1/2 NA
  - SF-12 (mental component score) 1/1 +A

  - Others 2/2 +A
- Pain Beliefs
  - Pain catastrophising 2/2 NA
  - Fear 1/1 NA
  - Low Expectation of recovery 1/2 +A, 1/2 NA

Table 28: Psychological factors predictive of long-term perceived non-recovery with acute whiplash

Prognostic Factor	**Number of studies**	**First author (year)**	**Measure**	**Positive or negative association**	**Risk of bias (QUIPS)**	**Data** *β: Adjusted β coefficient OR: Adjusted Odds Ratio RR: Adjusted Risk Ratio*	**Pooled meta-analysis OR (95% CI)**
Posttraumatic stress symptoms	1	Griffin (2019)	Impact of Events Scale*	+A	Low	Incorporated into the CPR Clinical prediction	-
Mood							
Depression	2	Ravn (2019)	Depression	+A	Low	OR =1.23 (1.07, 1.41)	-
		Griffin (2019)	DASS depression subscale	NA	Low	In stepwise analysis	
SF 12	1	Griffin (2019)	SF-12 Mental	+A	Low	OR = 1.07 (1.03 to 1.10), p=0.001	
Others	2	Radanov (1996)	Nervousness score scale	+A	Moderate	β = 1.38	
			Neuroticism score			β -1.13	
		Hendriks (2005	Higher somatisation	+A	Low	OR =1.11 (1.03 to 1.19)	
Pain Beliefs							
Pain	2	Ravn (2019)	Pain catastrophising scale	NA	Low	OR = 1.05 (0.98 to 1.13)	
Catastrophising		Griffin (2019)	Pain catastrophising scale	NA	Low	In stepwise analysis	-
Fear	1	Ravn (2019)	Fear-avoidance-beliefs	NA	Low	OR = 0.97 (0.89, 1.10)	

Low Expectation of recovery	2	Carroll (2009) Griffin (2019)	High expectations of recovery (will recover soon)[1] Expectations of recovery	-A NA	Low Low	HRR 3.62 (2.55 to 5.13) In stepwise analysis	

1 Expectation of positive recovery "will bet better soon" has HRR associated with resolution of neck pain. In this SR, we are reporting outcomes in reverse (that is poor recovery) hence the –ve association; ^Self-perceived non-recovery (Yes/No); * The IES was incorporated into the CPR Clinical prediction rule, which was associated with the outcome , # recovery measured with FRI

P.4.6. Overall summary (psychological factors)

Overall summary: Considering the 4 outcomes, the factors with the highest evidence were post-traumatic stress symptoms, depressed mood, SF 36/12, pain beliefs, coping strategies and expectations of recovery.

Table 29: Overall summary (psychological factors)

Psychological	Pain	Disability	Non-recovery	Psyche distress	Total	Overall	Pooled OR
Posttraumatic stress symptoms	4A 1NA	3A 3NA	1A	1 NA	8A 5NA	**A**	**OR = 2.11 (1.51 to 2.95) Pain** **OR = 1.55 (1.19 to 2.02) Disability**
Mood *Depression*	5A 1NA	2A 3NA	1A 1NA	-	8A 5NA	**A**	**OR = 2.11 (0.81 to 5.54) Pain**
Anxiety	1A	1A 1NA	-	1A	3A 1NA	I	-
SF-36/SF-12	2A	1A 2NA	1A	1A	5A 2NA	**A**	-
Others	2A	1A	2A	-	5A	**I (different factors)**	-
Pain Beliefs Pain catastrophising	3A 1NA	5A 2NA	2NA	-	8A 5NA	**A**	-
Poor Coping strategies	1A	3A 1NA	-	-	4A 1NA	**A**	-

Low expectation of recovery	3A	5A	1A 1NA	-	9A 1NA	**A**	OR 2.68 (1.00 to 7.18)
Fear	1A 1NA	3A 1NA	1 NA	-	4A 3NA	I	-
Pain Attitudes	1A	1A	-	-	2A	**I**	-
Self-efficacy	-	1NA	-	-	1NA	**I**	-
Others	1A	1A	-		2A	**I**	-

A= associated, I= inconclusive, NA= not associated

P.4.7. Evidence to decision framework (psychological factors)

Table 30: Evidence to decision framework (psychological factors)

Strength of association How substantial are the associations between explanatory factors and critical outcomes?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Trivial ○ Small ○ **Moderate** ○ Large ○ Varies ○ Don't know	Considering all the outcomes, strong association with poor outcome were: <u>Post-traumatic stress symptoms</u> 8/13 studies associated with poor outcome: meta-analysis OR 2.11 (1.51 to 2.95) for pain outcome and OR = 1.55 (1.19 to 2.02) for disability <u>Mood</u> Depression 8/13 studies associated with poor outcome: meta-analysis OR = 2.11 (0.81 to 5.54) for pain SF-36/SF-12 (mental components) 5/7 studies associated with poor outcome <u>Pain beliefs</u> Pain catastrophising 8/13 studies associated with poor outcome	All factors can be assessed by questionnaires that are accessible for healthcare professionals, except for SF-36/SF-12 (which is not in the public domain). These results are consistent with 3 Systematic reviews and previous guidelines.

	Low expectations of recovery 7/13 studies associated with poor outcome Coping strategies had 4/5 studies associated with poor outcome	
Undesirable Effects How substantial are the undesirable anticipated effects when assessing these factors?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Large ○ Moderate ○ Small ○ **Trivial** ○ Varies ○ Don't know	Not measured in the studies.	Timing of screening of post-traumatic stress symptoms (PTSS) is important; screening too early (<1-month) might negatively influence the persons health outcome.
Certainty of evidence What is the overall certainty of the evidence of effects?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS

○ Very low ○ **Low** ○ Moderate ○ High ○ No included studies	<u>Outcome: Ongoing pain</u> Posttraumatic stress symptoms - High certainty of the evidence (clinically significant) Depression - low certainty of the evidence (pooled results were inconclusive) Pain catastrophising – moderate certainty of the evidence (small association) Poor coping strategies - moderate certainty of the evidence (small association) Low expectation –moderate certainty of the evidence (clinically significant) <u>Outcome: Ongoing disability</u> Posttraumatic stress symptoms – Moderate certainty of the evidence (moderate association) Depression - Low certainty of the evidence (small association) Pain catastrophising – moderate certainty of the evidence (moderate association) Poor coping strategies – low certainty of the evidence (moderate association) Low expectation – moderate certainty of the evidence (clinically significant) Overall, the certainty of evidence varies from low to moderate	

Balance of effects Does the balance between desirable and undesirable effects favour assessing or not assessing these factors?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Favours not assessing ○ Probably favours not assessing ○ Does not favour either assessing or not assessing ○ Probably favours assessing ○ **Favours assessing** ○ Varies ○ Don't know	Not assessed in studies	Usually assessed by questionnaire. Whilst some people may experience distress answering these questionnaires, this can be addressed by careful initial explanation.

Resources required How large are the resource requirements (costs)?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Large costs ○ Moderate costs (acute/chronic) ○ **Negligible costs and savings** ○ Moderate savings ○ Large savings ○ Varies ○ Don't know	In the research studies, the factors were assessed using scales including: PTSS: The Impact of Events Scale Mood: Depression Anxiety and Stress Scale (DASS 21) Pain Catastrophising: Pain Catastrophising Scale Coping strategies: Coping strategies questionnaire Expectations of recovery: various (e.g., How do you think you will recover, Do you think you will recover soon and/ or the SF-OMPQ question "In your view, how large is the risk that your current pain may become persistent?".	Most of these questionnaires are found in Whiplash Navigator (www.mywhiplash.com.au and other websites). The SF-36 and SF-12 questionnaires require payment of a licence fee and are complex to score. DSM-5 is more commonly used in current clinical settings (evaluating irritability) for diagnosis of PTSD. The PCL-5 is a derivative of the DSM-5 and can be used by healthcare professionals to screen for PTSS.
Cost effectiveness Does the cost-effectiveness of the assessing the factor favour assessing or not assessing the factor		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Favours not assessing ○ Probably favours not assessing ○ Does not favour either assessing or not assessing ○ Probably favours assessing ○ Favours assessing ○ Varies ○ **No included studies**	No evidence. The studies do not measure cost-effectiveness.	
Equity What would be the Impact on health equity?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS

○ Reduced ○ Probably reduced ○ **Probably no impact** ○ Probably increased ○ Increased ○ Varies ○ Don't know	No evidence.	Primary HCP's can easily administer these questionnaires. Not all are translated to all languages.
Acceptability Is assessing the factor acceptable to key stakeholders?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ No ○ Probably no ○ Probably yes ○ **Yes** ○ Varies ○ Don't know	Most prognostic studies do not report adverse events.	Some people might find it stressful to complete these questionnaires.
Feasibility Is assessing the factor feasible to implement?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ No ○ Probably no ○ Probably yes (acute/chronic) ○ **Yes** ○ Varies ○ Don't know	It is feasible because the factors are assessed by questionnaire.	General Practitioners may lack time to administer and interpret psychological questionnaires. Primary HCPs require some knowledge of what the questionnaire is measuring and an understanding of the thresholds for referral. Referrals may be to either healthcare professionals who are expert in providing psychologically informed care or to psychologists directly. Threshold scores are listed in the implementation considerations below.

P.4.8. Conclusions (psychological prognostic factors for acute WAD)

Recommendations for psychological factors were determined over 2 votes.

Vote 1: Are you for or against clinicians assessing the following psychological factors in people with acute whiplash: post-traumatic stress symptoms and expectations of recovery?

Strong recommendation for not measuring the factor(s)	Conditional recommendation to not measure the factor (s)	Conditional recommendation for either measuring the factor (s) or not	Conditional recommendation for measuring the factor (s)	Strong recommendation for measuring the factor(s)
○	○	○	○	○

Recommendation: The guideline panel strongly recommend that healthcare professionals assess post-traumatic stress symptoms (PTSS) and expectations of recovery to determine poor prognosis in people with acute whiplash.

Panel vote summary: 12/13 92% strong for; 1/13 8% conditional for

Justification

Evidence:

- There were 35 studies overall that informed the recommendations. For PTSS, most studies show an association with the outcome (8/13) with a significant odds ratio's when meta-analysis was possible (e.g., OR = 2.11 (1.51 to 2.95) for the outcome of pain). There was a high certainty of evidence. For expectations of recovery, the majority of studies (9/10) showed an association with the outcome, (OR 2.68 (1.00 to 7.18)- 3 studies) with moderate certainty of evidence.

Consistency

- The findings are consistent with well-regarded systematic reviews on prognosis, and with previous guidelines.

Balance of effects:

- Low risk of negative consequence

Acceptance and Feasibility:

- Questionnaires able to be administered during or after an injured person's consultation. They are commonly used in Australia and are freely available on either the internet or WhiplashNavigator. Other factors: Some treatment studies included in this guideline have also included participants with similar characteristics (factors) seen in the prognostic studies.

Sub-group considerations

People at low risk of poor recovery are unlikely to present with psychological distress. They are unlikely to require assessment of these factors.

Implementation considerations

POST TRAUMATIC STRESS SYMPTOMS

How to measure and interpret:

- Screen for Post-Traumatic Stress Symptoms (PTSS) with the PCL 5. Scores of ≥34/80 could indicate a diagnosis of Post-Traumatic Stress Disorder.
- Other tools such as the DAR-5 can be used. Scores of ≥12/25 could indicate dysfunctional post-traumatic anger

Indications: Measure approx. 3-4 weeks after injury. Indicated when people show signs of PTS symptoms in interview (e.g., nightmares, flashbacks or anxiety driving)

What to do: Consider referral to psychologist by 6 weeks if not improving.

EXPECTATIONS of RECOVERY:

How to measure and interpret:

- Recommendations to ask the question "How do you think you will recover." Alternate options are "when" or "why" do think you will recover.

Considerations:

- Consider the injured person's expectations of recovery in context to their personalised model of recovery. In the absence of a personalised model of recovery it is less likely that injured people will recover.
  - What to do:
  - Provide a positive message as positive expectations of recovery are associated with actual recovery.

Vote 2: Are you for or against clinicians assessing psychological factors in people with acute whiplash: depression, pain catastrophising, coping strategies?

Strong recommendation for not measuring the factor(s)	Conditional recommendation to not measure the factor (s)	Conditional recommendation for either measuring the factor (s) or not	Conditional recommendation for measuring the factor (s)	Strong recommendation for measuring the factor(s)
o	o	o	o	o

Recommendation: The guideline panel suggest that may assess depression, pain catastrophising, and coping strategies to determine poor prognosis in people with acute whiplash.

Panel vote summary: 8/13 62% conditional for; 5/13 38% strong for

Justification

Evidence:

- Most studies showed an association of these factors with the outcome (Depression 8/13, pain catastrophising 8/13, coping strategies 4/5), however the GRADE process determined low to moderate evidence for a small to moderate association with the outcome.

Consistency

- The findings are consistent with well-regarded systematic reviews on prognosis, and with previous guidelines.

Balance of effects:

- Low risk of negative consequence

Acceptance and Feasibility:

- Questionnaires able to be administered during or after an injured person's consultation. They are commonly used in Australia and are freely available on either the internet or WhiplashNavigator. Other factors: Some treatment studies included in this guideline have also included participants with similar characteristics (factors) seen in the prognostic studies.

Sub-group considerations

People at low risk of poor recovery are unlikely to present with psychological distress. They are unlikely to require assessment of these factors.

Implementation considerations

How to measure and interpret:

Factor	**Recommended scale**	**Interpretation**
Depression	DASS 21	When moderate or severe on the scale, consider referral. ≥ 15 out of 63 could indicate a probable major depressive disorder (Guest et al., 2018)
Pain Catastrophising	Pain Catastrophising Scale	≥24/52 indicates a high level of pain catastrophising.
Coping Strategies	Coping Strategies Questionnaire	Higher scores indicate better coping strategies

What to do:

- Consider administering questionnaires according to clinical judgement. Situations where it may be indicated are i) when people are stratified as medium/ high risk of poor recovery or ii) when they present with low mood (depression), use catastrophic language (pain catastrophising) or other symptoms of psychological distress during the injured person's interview.
- When people are above the scale cut-off thresholds (defined above), consider referral to a psychologist and/or a healthcare professional with expertise in providing psychologically informed exercise or interventions recommended for the medium/high risk group (see treatment section of guideline)
- Additional training may be required for HCP's to effectively administer and interpret the questionnaires.

P.5. Sociodemographic factors

Question: What initial **sociodemographic** factors are predictive of long-term neck pain, neck disability, psychological distress, and perceived non-recovery in people with acute whiplash associated disorders?

P.5.1. Summary of included studies

There were 28 studies that informed the recommendations regarding socio-demographic factors and their relationship with poor outcome after acute whiplash (Ameratunga et al 2010, Andersen et al 2019, Atherton et al 2006, Asenlof et al 2013, Berglund et al 2006, Bostick et al 2013, Cartensen et al 2015, Cobo et al 2010, Gun et al 2005, Hendricks et al 2005, Holm et al 2008, Kasch et al 2001, Kongstead et al 2008, Kuperman et al 2021, Mayou and Bryant et al 2002, Olsson et al 2002, Osterland et al 2019, Ozegovic et al 2009, Phillips et al 2010, Pedler et al 2011, Pobereskin et al 2004, Ravn et al 2019, Rydman et al 2018, Skillgate et al 2016, Sterling et al 2005, 2011, Vetti et al 2010, Williamson et al 2015).

P.5.2. Outcome: Neck pain

There were 13 studies that examined 6 different sociodemographic-related factors associated with ongoing pain. The evidence for factors associated with ongoing pain were:

- Age: 10/11 NA, 1/11 +A
- Gender: 5/12 +A, 7/12 NA
- Lower education: 2/5 +A, 3/5 NA
- Employment: 2/3 NA, 1/3 –A
- Living situation: 2/2 NA
- Income: 1/1 NA

Table 31: Sociodemographic factors predictive of long-term neck pain with acute whiplash

Prognostic Factor	Number of studies	First author, year	Measure	+ve or -ve association	Risk of bias (QUIPS)	Data	Pooled meta-analysis OR (95% CI)
Age	11	Ameratunga (2010)	16-24 years (ref) a) 25-44 years b) 45+ years	NA +A	Low	a) OR 1.09 (0.41,2.86) b) OR 1.03 (0.38,2.84), p=0.04	

			17-24 years (ref)				
			24-30 years			RR 0.8 (0.4, 1.4)	
		Atherton (2006)	30-37 years	NA	Moderate	RR 1.1 (0.7, 1.8)	
			37-47 years			RR 1.3 (0.8, 2.0)	
			47-68 years			RR 1.5 (0.9, 2.5)	
		Berglund (2006)	Age in years	NA	Low	No data	
		Bostick (2013)	Age in years	NA	Low	No data	
		Carstensen 2012	Older age	NA	Low	OR = 1.01 (0.99, 1.03), p=0.49	
		Cobo (2010)	Older age	+A	Low	β = 0.18, p<0.001	
		Gun (2005)	Age in years	NA	Low	β = -0.013, p=NS	-
		Olsson (2002)	Age	NA	Moderate	NA in multivariate	
		Osterland (2019)	Age	NA	Low	Not included in multivariate	
		Pobereskin (2004)	Age	NA	Low	NA in multivariate	
		Vetti et al (2010)	Age	NA	Low	NA in multivariate	
Gender	12	Ameratunga (2010)]	Male vs female	NA	Low	p = 0.09	
		Atherton (2006)	Female sex	NA	Moderate	RR = 1.0 (0.7, 1.4)	
		Berglund (2006)	Female sex	NA	Low	OR = 1.3 (1.0, 1.6)	
		Bostick (2013)	Male vs female	NA	Low	No data	-
		Carstensen 2012	Female gender		Low	OR = 2.38 (1.41, 4.03), p=0.001	
		Gun (2005)	Gender	NA	Low	NA	
		Hendricks (2005)	Gender	+A	Low	OR = 4.60 (1.51, 14.02)	
		Kongsted (2008a)	Gender	+A	Low	OR = 1.9 (1.3, 2.0)	
		Mayou & Bryant (2002)	Female gender	+A	Low	RR = 9.93 (2.0, 49.6)	
		Olsson (2002)	Gender	NA	Moderate	NA in multivariate	
		Osterland (2019)	Gender	NA	Low	Not in MV analysis	

		Vetti (2010)	Female gender	+A	Low	OR = 3.25 (1.00, 10.50)	
Lower education	5	Ameratunga (2010)	<4 yrs high school ≥ 4 yrs high school / tertiary or equivalent	NA	Low	p = 0.4	
		Berglund (2006)	High (ref) Middle	+A	Low	OR = 1.0 (ref) OR = 1.6 (1.20, 2.1) OR = 1.8 (1.3, 2.4)	-
		Carstensen 2012	Having an education	NA	Low	OR 1.26 (0.7, 2.25), p=0.44	
		Hendriks (2005)	Lower education	+A	Low	OR = 3.51 (1.05, 11.10)	
		Osterland (2019)	Education	NA	Low	Not in MV analysis	
Occupation	1	Pobereskin (2004)	Occupation	NA	Low	NA in MV analysis	
Employment	2	Carstensen 2012	Employed	NA	Low	OR = 1.17 (0.53, 2.55), p=0.7	
		Cobo 2010	Self-employed (less pain)	-A	Low	β = -0.58, p=0.02	-
Living situation	2	Ameratunga (2010)	Single / unmarried Married / living with partner Separated / divorced / widowed	NA	Low	p = 0.3	-
		Carstensen 2011	Not living alone (ref) vs. living alone	NA	Low	OR = 1.43 (0.82, 2.49), p=0.2	
Income at baseline	1	Ameratunga (2010)	NZ $40K or more Less than NZ $40K	NA	Low	p = 0.08	-

P.5.3. Outcome: Neck disability

There were 11 studies that examined 5 sociodemographic-related factors associated with ongoing disability. The evidence for factors associated with ongoing disability were:

- Age: 3/11 +A, 8/11 NA
- Gender: 0/11 +A associated; 11/11 NA
- Lower education: 2/2 NA
- Living situation: 1/1 NA
- Occupation: 1/1 NA

Table 32: Sociodemographic factors predictive of long-term neck disability with acute whiplash

Prognostic Factor	Number of studies	First author, year	Measure	Positive or negative association	Risk of bias (QUIPS)	Data	Pooled meta-analysis OR (95% CI)
Age	11	Andersen (2019)	Age (years)	NA	Low	NS in all regression models	-
		Asenlof (2013)	Mean age (years)	NA	Low	Not in MV analysis	
		Bostick (2013)	Age in years	NA	Low	No data	
		Gun (2005)	Age	+A	Low	B = -0.20 (p<0.01)	
		Holm (2008)	Age	NA	Low	No data in MV analysis but NA	
		Kasch (2001)	Age>31	NA	Low	1.00 (0.69 to 1.45)	
		Pedler (2011)	Age	NA	Low	Not in MV analysis	
		Sterling (2005)	Age	+A	Low	OR 1.13 (1.03 to 1.23)	
		Sterling (2011)	Age	+A	Low	OR 1.11 (1.04 to 1.18)	
		Williamson (2015)	Age	NA	Low	Not in MV analysis	

		Vetti (2010)	Age	NA	Low	NA in MV analysis	
Gender	11	Andersen (2019)	Not reported	NA	Low	NS	-
		Asenlof (2013)	Not reported	NA	Low	Not in MV analysis	
		Bostick (2013)	Female sex	NA	Low	No data.	
		Holm (2008)	Gender	NA	Low	No data	
		Kasch (2001)	Gender	NA	Low	1.03 (0.71 to 1.48)	
		Kongsted (2008)	Gender	NA	Low	1.3 (0.8 to 2.0)	
		Kuperman (2021)	Female gender	NA	Low	NA (p=0.840)	
		Pedler (2011)	Female gender	NA	Low	NA in MV analysis	
		Sterling (2005)	Female gender	NA	Low	NA in MV analysis	
		Williamson (2015)	Gender	NA	Low	Not in MV analysis	
		Vetti et al 2010	Gender	NA	Low	NA in MV analysis	
Education	1	Holm (2008)	Education	NA	Low	NA in MV analysis	-
Living situation	1	Asenlof (2013)	Married or cohabitants, single, living with parents	NA	Low	Univariate not reported Not in MV analysis.	-

GRADE ASSESSMENT

Not performed due to no association.

P.5.4. Outcome: Psychological distress

There were 5 studies that examined sociodemographic-related factors associated with ongoing psychological distress. The evidence for factors associated with psychological distress were:

- Age: 2/5 +A, 3/5 NA
- Gender: 3/4 NA, 1/4 +A
- Income: 1/1 –A (higher income is associated with a good outcome).

Table 33: Sociodemographic factors predictive of long-term neck psychological distress with acute whiplash

Prognostic Factor	Number of studies	First author, year	Measure	Positive or negative association	Risk of bias (QUIPS)	Data	Pooled meta-analysis OR (95% CI)
Age	5	Buitenhuis (2006)	Age in years	NA	Low	OR = 1.02 (0.98, 1.06)	-
		Berglund (2006)	Age in years	NA	Low	Adjusted for in MV analysis, but no data reported.	
		Phillips (2010)	Age (24-29) Age 30-39 Age 40-49 Age >50	+A	Low	OR = 2.45 (1.11 to 5.42) OR = 2.41 (1.17 to 3.98) OR = 2.80 (1.33 to 5.88) OR = 1.99 (1.47 to 6.11)	
		Ravn et al 2019	Age	NA	Low	OR = 1.01 (0.97 to 1.04)	
		Sterling (2011)	Age	+A		OR = 1.087 (1.01 to 1.14)	
Gender	4	Berglund (2006)	Female sex	NA	Low	OR = 1.0 (0.7-1.4)	-
		Buitenhuis (2006)	Ref group not clear but implies male.	NA	Low	OR = 0.341 (0.10, 1.15)	
		Phillips (2010)	Female gender	-A	Low	OR = 0.63 (0.42 to 0.95)	
		Ravn et al 2019	Gender	NA	Low	OR = 0.70 (0.23 to 2.11)	
Income	1	Phillips (2010)	Income > $20k	-A	Low	OR = 0.46 (0.29 to 0.73)	-

[1] Outcome = persistent depressive symptoms. Higher education less likely to develop depressive symptoms, male gender MORE likely (hence female =gender less likely. Higher income less likely. * There are 3 studies by Cartensen et al (Carstensen et al., 2015; Carstensen et al., 2009; Carstensen et al., 2012) that use the same cohort. Only the 2012 study is reported.

P.5.5. Perceived non-recovery

There were 13 studies that examined 7 sociodemographic-related factors associated with non-recovery. All of these showed no association with the outcome.

- Age: 3/3 NA
- Gender: 3/3 NA
- Lower education: 3/3 NA
- Occupation: 1/1 NA
- Employment status: 2/2 NA
- Living situation: 1/1 NA
- Income: 1/1 NA

Table 34: Sociodemographic factors predictive of long-term perceived non-recovery with acute whiplash

Prognostic Factor	Number of studies	First author, year	Measure	Positive or negative association	Risk of bias (QUIPS)	Data	Pooled meta-analysis OR (95% CI)
Age	3	Ozegovic et al 2009	Age	NA	Low	Potential confounder with no association	-
		Rydman et al 2018	Age	NA	Low	NA In univariate	
		Skillgate 2016	Age	NA	Low	Was not a confounder in MV analysis	
Gender	3	Ozegovic et al 2009	Gender	NA	Low	Potential confounder with no association	-
		Rydman et al 2018	Gender	NA	Low	NA In univariate	
		Skillgate 2016	Gender	NA	Low	Was not a confounder in MV analysis	-

Education	3	Ozegovic et al 2009	Education level	NA	Low	Potential confounder with no association	
		Rydman et al 2018	Education level	NA	Low	NA In univariate	
		Skillgate 2016	Education level	NA	Low	Was not a confounder in MV analysis	-
Employment	2	Rydman et al 2018	Employment	NA	Low	NA In univariate	
		Skillgate 2016	Work status	NA	Low	Was not a confounder in MV analysis	-
Living situation	1	Ozegovic et al 2009	Marital status	NA	Low	Potential confounder with no association	-
Income	1	Ozegovic et al 2009	Income	NA	Low	Potential confounder with no association	-

P.5.6. Overall summary (sociodemographic factors)

Table 35: Overall summary (sociodemographic factors)

Sociodemographic factor	Pain	Disability	Non-recovery	Psych distress	Overall	Impression	Pooled OR
Age	1A 10NA	3A 8NA	3NA	2A 3NA	9A 21NA	NA	-
Gender	5A 7NA	1A 12NA	3 NA	1A 3NA	10A 22NA	NA	-
Lower Education	2A 3NA	2NA	3NA		2A 8NA	NA	-
Employment status	2NA 1 -A	-	2 NA		4NA 1-A	NA	-
Living situation	2NA	2NA	1NA		5NA	NA	-

Occupation	1NA	1NA			2NA	NA	-
Income	1 NA			-A	1 -A 1NA	I	-

A= associated I= inconclusive NA= not associated

P.5.7. Evidence to decision framework (sociodemographic factors)

Table 36: Evidence to decision framework (sociodemographic factors)

Strength of association How substantial are the associations between explanatory factors and critical outcomes?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
● Trivial ○ Small ○ Moderate ○ Large ○ Varies ○ Don't know	Overall, there was no strong evidence of associations between sociodemographic factors and poor outcome. Factors with no or little evidence of an association with poor outcome: age. Factors with some evidence of an association with poor outcome: gender (only in some studies), lower education, employment (self-employed, better outcome) Factors with inconclusive evidence: income (1 study, higher income associated with good outcome); (1 study, NA) Refer to results summaries for each outcome above for number of studies and frequency of associations found.	
Undesirable Effects How substantial are the undesirable anticipated effects when assessing these factors?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS

○ Large ○ Moderate ● **Small** ○ Trivial ○ Varies ○ Don't know	Trivial – part of standard consultation / history	
Certainty of evidence What is the overall certainty of the evidence of effects?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Very low ● **Low** ○ Moderate ○ High ○ No included studies	Grade certainty of evidence not performed due to lack of association	
Balance of effects Does the balance between desirable and undesirable effects favour assessing or not assessing these factors?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
● **Favours not assessing** ○ Probably favours not assessing ○ Does not favour either assessing or not assessing ○ Probably favours assessing ○ Favours assessing ○ Varies ○ Don't know	Favours not assessing for the purposes of poor prognosis.	Sociodemographic factors do not predict people at risk of poor outcome, however, may be helpful for other reasons such as: person-centred care, return to work plans, support networks, and an understanding of contextual factors. One exception is that age is included in the WhipPredict tool (see prognostic tools).
Resources required How large are the resource requirements (costs)?		

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Large costs ○ Moderate costs (acute/chronic) ● **Negligible costs and savings** ○ Moderate savings ○ Large savings ○ Varies ○ Don't know	No evidence.	Can be asked when doing a routine consult. Probably expected by people with whiplash and primary HCP's. GP's may not have enough time to ask during a routine consultation.
Certainty of evidence of required resources What is the certainty of the evidence of resource requirements (costs)?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Very low ○ Low ○ Moderate ○ High ● **No included studies**	No included studies	No cost associated, part of routine consult
Cost effectiveness Does the cost-effectiveness of the assessing the factor favour assessing or not assessing the factor?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS

○ Favours the comparison ○ Probably favours the comparison ○ Does not favour either the intervention or the comparison ○ Probably favours the intervention ○ Favours the intervention ○ Varies ● **No included studies**	No studies	
Equity What would be the impact on health equity?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Reduced ○ Probably reduced ● **Probably no impact** ○ Probably increased ○ Increased ○ Varies ○ Don't know	No impact	
Acceptability Is assessing the factor acceptable to key stakeholders?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ No ○ Probably no ○ Probably yes ● **Yes** ○ Varies ○ Don't know	Minimal report of lack of acceptability in studies.	Asking income is potentially not acceptable.
Feasibility		

Is assessing the factor feasible to implement?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ No ○ Probably no ○ Probably yes (acute/chronic) ● **Yes** ○ Varies ○ Don't know		

P.5.8. Summary of judgements (sociodemographic factors)

Type of recommendation

Strong recommendation for not measuring the factor(s)	Conditional recommendation to not measure the factor (s)	Conditional recommendation for either measuring the factor (s) or not	Conditional recommendation for measuring the factor (s)	Strong recommendation for measuring the factor(s)
○	●	○	○	○

Recommendation The guideline panel suggest that healthcare professionals do not assess socio-demographic factors to determine poor prognosis in people with acute whiplash.

(Panel vote summary: 11/13 85% conditional against, 2/13 15% conditional for

Justification

Evidence: There were 28 studies that informed the recommendations. The majority of the studies concluded no or indeterminate associations with sociodemographic factors and outcome. The exception is age, which is included as a factor in WhipPredict (see prognostic tools). Sociodemographic variables are often used in analyses as covariates with pain, disability, psychological distress.

Consistency: The recommendation is consistent with other guidelines and systematic reviews.

Acceptance and Feasibility: Most sociodemographic factors are non-modifiable or unable to be targeted in management. However, most are routinely collected to understand the person.

Implementation considerations

Healthcare professionals are not recommended to assess sociodemographic factors for the purpose of prognosis. However, these factors are often collected to understand the person, and are applicable to person-centred management, return to work and support plans.

P.6. Crash factors

What **crash** factors are predictive of long-term neck pain, neck disability, psychological distress, and perceived non-recovery in people with acute whiplash associated disorders?

P.6.1. Executive summary

There were 10 studies that informed the recommendations regarding crash factors and their relationship with poor outcome after whiplash (Ameratunga et al 2010, Atherton et al 2006, Buitenhuis et al 2006, Cartensen et al 2009, Cobo et al 2010, Gun et al 2005, Hendriks et al 2005, Phillips et al 2010, Pobereskin et al 2004, Vetti et al 2010).

P.6.2. Outcome: Neck pain

There were 9 studies that examined crash-related factors associated with long-term pain. These 9 studies investigated 11 crash-related factors. The evidence for factors associated with ongoing neck pain are as follows:

- head restraint: 1/6 +a, 5/6 NA
- speed: ¼ +A, ¾ NA
- seatbelt: 4/4 NA
- severity of collision: 4/4 NA
- awareness of impending collision 3/3 NA
- direction of collision 3/3 NA
- position in vehicle 2/2 NA
- head position at impact: 2/2 NA
- vehicle size: ½ NA, ½ +A
- airbag: 2/2 NA
- injury severity: 1/1 NA

Table 37: Crash factors predictive of long-term neck pain with acute whiplash

Prognostic Factor	Number of studies	First author, year	Measure	Positive or negative association	Risk of bias (QUIPS)	Data	Pooled meta-analysis OR (95% CI)
Head restraint	6	Atherton (2006)	Adjustable headrest Fixed headrest No headrest	NA	Moderate	Univariate NA	
		Buitenhuis (2006)	Head restraint (N:Y)	+A	Low	HR 3.06 (1.18 – 7.9), p=0.021	-
		Gun (2005)	Use of headrest	NA	Low	Multivariate NA	
		Hendriks (2005)	Head restraint & correctly positioned = No	NA	Low	Univariate NA	
		Pobereskin (2004)	Head rest absent	NA	Low	Univariate NA	
		Vetti (2010)	Head rest not used	NA	Low	Univariate NA	
Speed	4	Atherton (2006)	Own vehicle	NA	Moderate	Univariate NA	-
			Other vehicle speed	NA	Moderate	Univariate NA	
		Hendriks (2005)	Traffic situation (stationary)	NA	Low	Univariate NA	
		Pobereskin (2004)	Struck car stationary	-A	Low	OR 0.31 (0.13 to 0.71)	

		Vetti (2010)	Own car speed Relative (other) car speed	NA NA	Low Low	Univariate NA Univariate NA	
Seatbelt	4	Ameratunga (2010)	Yes, No/don't know	NA	Low	Univariate NA	-
		Atherton (2006)	Seatbelt use: Yes, No	NA	Moderate	Univariate NA	
		Hendriks (2005)	Seatbelt = No	NA	Low	B = 0.825, p=0.078	
		Vetti (2010)	Used	NA	Low	Univariate NA	
Severity of collision	4	Atherton (2006)	Low, medium, high (VAS)	NA	Moderate	Univariate associated Multivariate NA	-
		Carstensen (2009)	Not severe (ref), severe	NA	Low	OR 1.4 (0.87-2.1), p= 0.18	
		Gun (2005)	Vehicle not drivable	NA	Low	Multivariate NA	
		Pobereskin (2004)	Striking car driveable	NA	Low	Univariate associated Multivariate NA	
Awareness of impending collision	3	Atherton (2006)	Aware of impending collision	NA	Moderate	Univariate NA	--
		Hendriks (2005)	Unprepared for collision	NA	Low	Multivariate NA	
		Pobereskin (2004)	Aware of collision	NA	Low	Univariate NA	
	3	Atherton (2006)	Rear, front, rear shunt, side	NA	Moderate	Univariate NA	

Direction of collision		Cobo (2010) Vetti (2010)	Posterior Lateral Impact direction	NA NA NA	Low Low Low	Univariate NA Univariate NA Univariate NA	-
Position in vehicle	2	Atherton (2006) Cobo (2010)	Driver, passenger Driver, co-driver, passenger	NA NA	Moderate Low	Univariate NA Univariate NA	-
Head position at impact	2	Pobereskin (2005) Vetti (2010)	Head turned at impact Head turned Head injury at impact	NA NA NA	Low Low Low	Univariate NA Univariate NA Univariate NA	- -
Size of own vehicle	2	Atherton (2006) Pobereskin 2005	Car (ref) Other (van, heavy goods) Car size	 +A NA	 Moderate Low	 RR 1.8 (1.04 to 3.2) Univariate NA	-
Airbag	2	Atherton (2006) Vetti (2010)	Airbag deployed Airbag deployed	NA NA NA	Moderate Moderate Low	Univariate: associated, Multivariate NA Univariate NA	 -
Injury severity	1	Ameratunga (2010)	Injury Severity Score (ISS) ≥9	NA	Low	Univariate NA	-

P.6.3. Outcome: Neck disability

There was 1 study that examined crash-related factors associated with long-term disability. This study investigated 5 crash-related factors: head restraint, head position at impact, speed, seat belt, airbag. None of the factors were associated with disability (Table 38).

Table 38: Crash factors predictive of long-term neck disability with acute whiplash

Prognostic Factor	Number of studies	First author, year	Measure	Positive or negative association	Risk of bias (QUIPS)	Data *β: Adjusted β coefficient* *OR: Adjusted Odds Ratio* *RR: Adjusted Risk Ratio*	Pooled meta-analysis OR (95% CI)
Head restraint	1	Vetti (2010)	Use of head restraint	NA	Low	Univariate NA	-
Head position at impact	1	Vetti (2010)	Head turned at impact	NA	Low	Univariate NA	-
Speed	1	Vetti (2010)	Injured person's car speed	NA	Low	Univariate NA	-
			Relative car speed	NA	Low	Univariate NA	-
			Head injury at accident	NA	Low	Univariate NA	-
Seat belt	1	Vetti (2010)	Use of seat belt	NA	Low	Univariate NA	-
Airbag	1	Vetti (2010)	Airbag deployed	NA	Low	Univariate NA	-

P.6.4. Outcome: Psychological distress

There was 1 study that examined crash-related factors associated with ongoing psychological distress. This study examined 1 crash-related factor: direction of impact and found that this factor was not associated with psychological distress.

Table 39: Crash factors predictive of long-term psychological distress with acute whiplash

Prognostic Factor	Number of studies	First author, year	Measure	Positive or negative association	Risk of bias (QUIPS)	Data *β: Adjusted β coefficient* *OR: Adjusted Odds Ratio* *RR: Adjusted Risk Ratio*	Pooled meta-analysis OR (95% CI)
Direction of impact	1	Phillips et al. (2010)	Front (ref) Rear OR Side OR Other OR	NA	Low	Multivariate NA	-

P.6.5. Outcome: Perceived non-recovery

There were no studies that examined crash-related factors associated with non-recovery.

Overall summary: Considering the four outcomes, there is strong evidence that crash-related factors are NOT associated with poor outcome after whiplash.

P.6.6. Overall summary (crash factors)

Crash-related factor	Pain	Disability	Non-recovery	Psych distress	Overall	Pooled OR
Injury severity score	NA				NA	-
Head restraint	5NA +1A	1NA			6NA 1A	-
Head position at impact	2NA	1 NA			NA	-
Awareness of collision	3NA				NA	-
Vehicle type (injured person)	-1A 1NA				NA	-

Speed	3NA -1A	1NA			NA	-
Seatbelt	4NA				NA	-
Self-reported collision severity	4NA				NA	-
Position in vehicle	2NA				NA	-
Airbag	2NA	1NA			NA	-
Direction of impact		1NA			NA	-

A= associated I= inconclusive NA= not associated

P.6.7. Evidence to decision framework (crash factors)

Table 40: Evidence to decision framework

Strength of association How substantial are the associations between explanatory factors and critical outcomes?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
● **Trivial** ○ Small ○ Moderate ○ Large ○ Varies ○ Don't know	Most studies reported no association between crash-related factors and poorer outcome. Factors with no association: seat belt, collision severity, injury severity, awareness of impending collision, direction of impact, position in vehicle, head position at impact, airbag deployment. Factors with some evidence of association: use of head restraint (1/6 studies associated) (Buitenhuis et al., 2006), struck vehicle larger than a car (1/2 studies) (Atherton et al., 2006), vehicle struck while moving (vs stationary) (Pobereskin, 2005). Note: Most studies examined associations with pain (10/12). Only 1 study examined disability, 1 study examined	The findings are consistent with other evidence syntheses, such as systematic reviews and published clinical guidelines.

	psychological distress, and 0 studies examined non-recovery. The judgement decision is required to be trivial due to a paucity of effect size data.	
Undesirable Effects How substantial are the undesirable anticipated effects when assessing these factors?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Large ○ Moderate ○ Small ● **Trivial** ○ Varies ○ Don't know	Not measured in the studies	Re-living crash-related factors may be psychologically stressful / irritating for some people (consistent with experiences of people with lived experience).
Certainty of evidence What is the overall certainty of the evidence of effects?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Very low ○ Low ○ Moderate ○ High ○ No included studies ● Not applicable	N/A as no crash-related factors will be taken through the certainty of evidence framework.	
Balance of effects Does the balance between desirable and undesirable favour assessing or not assessing these factors?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS

○ Favours not assessing ● Probably favours not assessing ○ Does not favour either assessing or not assessing ○ Probably favours assessing ○ Favours assessing ○ Varies ○ Don't know	Not applicable.	Assessing crash-related factors is not of value for most people. However, assessment of some factors is required for determining the Canadian C-Spine rule (e.g., speed of collision).
Resources required How large are the resource requirements (costs)?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Large costs ○ Moderate costs ○ Negligible costs and savings ○ Moderate savings ○ Large savings ● Varies ○ Don't know	No evidence.	Can be asked when doing a routine consult Probably expected by people with whiplash and primary HCPs. GP's may not have enough time to ask during a routine consultation.
Cost effectiveness Does the cost-effectiveness of the assessing the factor favour assessing, or not assessing, the factor?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Favours not assessing ○ Probably favours not assessing ○ Does not favour either assessing or not assessing ○ Probably favours assessing ○ Favours assessing ○ Varies ● No included studies	Not applicable.	
Equity		

What would be the impact on health equity?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Reduced ○ Probably reduced ● Probably no impact ○ Probably increased ○ Increased ○ Varies ○ Don't know	Probably no impact	Part of routine consult
Acceptability Is assessing the factor acceptable to key stakeholders?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ No ○ Probably no ○ Probably yes ○ Yes ● Varies ○ Don't know		Probably expected by people with whiplash and HCP's. Re-living crash-related factors may be psychologically stressful / irritating for some people (consistent with experiences of people with lived experience). Consider empathy and person-centred care.
Feasibility Is assessing the factor feasible to implement?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ No ○ Probably no ○ Probably yes ○ Yes ○ Varies ● Don't know		Not recommended for implementation

P.6.8. Conclusions (crash-related prognostic factors for acute WAD)

Type of recommendation

Strong recommendation for not measuring the factor(s)	Conditional recommendation to not measure the factor (s)	Conditional recommendation for either measuring the factor (s) or not	Conditional recommendation for measuring the factor (s)	Strong recommendation for measuring the factor(s)
○	●	○	○	○

Recommendation The guideline panel suggest that healthcare professionals do not assess crash factors to determine poor prognosis in people with acute whiplash.

(Panel vote summary: 9/13 69% conditional against, 4/13 21 % strong against

Justification

Evidence: There were 10 studies informing the recommendations and of these, most studies show no association with any crash-related factor and outcome.

Consistency: The findings are consistent with systematic reviews on WAD prognosis and with previous guidelines

Acceptability and feasibility: Not efficient/ does not add value, and for some people re-living the accident can be distressing

Implementation considerations

Not recommended for prognosis. However, some crash factors (e.g., speed > 100km/hr, ejection, rollover) may need to be assessed to establish diagnosis. (See Canadian C-Spine Rule in Diagnosis section).

P.7. Physical / impairment factors

Question: What initial **physical or impairment** factors are predictive of long-term neck pain, neck disability, psychological distress, and perceived non-recovery in people with acute whiplash associated disorders?

P.7.1. Summary of Included studies

There were 10 studies that informed the recommendations regarding physical / impairment factors and their relationship with poor outcome after whiplash (Atherton et al 2006, Borenstein et al 2010, Hendriks et al 2005, Kash et al 2001, Kongsted et al 2007, Pedler et al 2016, Pobereskin et al 2005, Sterling et al 2005, 2011, Williamson et al 2015).

P.7.2. Outcome: Neck pain

There were 3 studies that examined specific physical assessment factors associated with ongoing pain. The studies evaluated 4 prognostic factors: cervical range of movement (CROM), cervical bony tenderness (by manual palpation), and sensorimotor function and body mass index (BMI). The evidence for physical assessment factors associated with ongoing pain were:

- Cervical ROM: 1/1 NA
- Manual palpation: 1/1 +A
- Sensorimotor function: 1/1: NA
- BMI: 1/1 NA

Table 41: Physical or impairment factors predictive of long-term neck pain with acute whiplash

Prognostic Factor	Number of studies	First author, year	Measure	+ or - association	Risk of bias (QUIPS)	Data *β: Adjusted β coefficient* *OR: Adjusted Odds Ratio* *RR: Adjusted Risk Ratio*	Pooled OR (95% CI)
Cervical range of movement	1	Atherton 2006	Neck limited ROM	NA	Mod	RR 0.9 (0.5 to 1.6)	-
Manual palpation	1	Atherton 2006	Cervical bony tenderness (ref=no)	+A	Mod	RR 1.5 (1.02 to 2.2)	-

Sensori-motor function	1	Kongsted 2007	Smooth pursuit neck torsion test (SPNT-diff) (electrooculography - EOG): a) Neck pain intensity (VAS, 0-3 minimal; >3 considerable)	NA	Low	B = 0.3 (-0.3 to 0.9) p=0.3	-
BMI	1	Pobereskin 2005	BMI	NA	Low	NA in multivariate	-

GRADE ASSESSMENT

Cervical ROM: Low certainty ⊕⊕◯◯ in the evidence for a trivial association between C-ROM and ongoing pain. Risk of bias was deemed serious as the findings were from one study with moderate risk of bias. Wide confidence intervals crossing the meaningful threshold above and below the (serious imprecision). Adequate sample size.

Manual Palpation: Low certainty ⊕⊕◯◯ in the evidence for a moderate association between cervical bony tenderness and ongoing pain. Risk of bias deemed serious. While the point estimate was above the threshold of significance and the sample size was adequate, the lower bound of the confidence interval neared 1.0 and the findings were from a single study, for this reason imprecision was rated as serious.

Sensori-motor function: Certainty of evidence not evaluated as these data were considered as secondary evidence.

BMI: Certainty of evidence not evaluated as no data were reported.

P.7.3. Outcome: Neck disability

There were 7 studies that examined physical assessment factors associated with ongoing disability. The studies investigated factors such as Cervical ROM, pain sensitivity, sensorimotor function and BMI. The evidence for physical assessment factors associated with ongoing disability were:

- Cervical ROM: ¾ +A, ¼ NA
- Pain sensitivity: 2/3 +A, 1/3 NA
- Sensorimotor function: 2/2 NA
- Muscle impairment / function: 1/1 NA
- Sympathetic vasoconstrictor response (SVR): 1/1 +A
- BMI: 1/1 NA

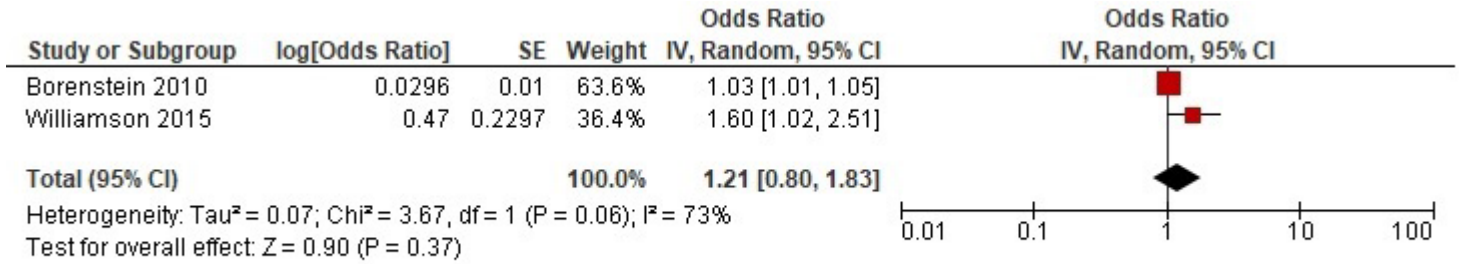
Table 42: Physical or impairment factors predictive of long-term neck disability with acute whiplash

Prognostic Factor	Number of studies	First author, year	Measure	+ or - association	Risk of bias (QUIPS)	Data *β: Adjusted β coefficient* *OR: Adjusted Odds Ratio* *RR: Adjusted Risk Ratio*	Pooled OR (95% CI)
Cervical range of movement	4	Borenstein 2010	Total CROM (cervical measurement system) (lower association indicates higher level of disability)	+A	Low	a) OR 0.97 (0.95 to 0.99), p=0.0035 (adj. for symptom easily irritated) Inverse OR 1.03 (1.01 to 1.05) b) OR 0.97 (0.95–0.99), p=0.0078 (adj. for symptom easily distracted) Inverse OR 1.03 (1.01 to 1.05)	-
		Sterling 2005	Left rotation (3 dimensions measured, only left rotation was significant); computerised electromagnetic motion-tracking device)	NA	Low	β = -0.178 (SE 0.106), p=0.05	
		Williamson 2015	C-ROM (Better= top 2/3 of scores, Restricted= bottom 1/3 of scores)	+A	Low	OR 1.6 (1.02, 2.64), p<0.001	
		Kasch 2001	C-ROM (3 planes) (lesser C-ROM is associated with greater disability)	+A	Low	Exp (B) = 2.53 (1.26, 5.11), p=0.01	
Pain sensitivity	3	Pedler 2016	Cold pain threshold (CPT) ≥ 13^0C (ref CPT<13^0C) (Thermotest system)	NA	Low	β =0.02 (-0.002 to 0.05) p=0.389 (adjusted for other variables)	-

		Sterling 2005	Pressure Pain Threshold (PPT) (pressure algometer)	NA		β = -0.003 (-0.007 to 0.004), p=0.084 (adjusted for other variables)	
			CPT (Thermotest system)	+A	Low	β = 0.505 (SE 0.199), p=0.01	
			PPT (pressure algometer)	NA		Univariate NS	
			Brachial plexus provocation test (BPPT)	NA		Univariate NS	
		Sterling 2011	CPT group ≥13^{0}C	+A	Low	OR 3.63 (1.35–9.78), p= 0.0111	
			Moderate severity (ref=mild):				
			Chronic severe (ref=mild):			OR 26.32 (4.98–139.09), p=0.0011	
Sensorimotor function		Sterling 2005	Joint position error (JPE), FastTrack system	NA	Low	Univariate NS	-
		Kongsted 2007	Smooth pursuit neck torsion test (SPNT-diff) (electrooculography - EOG):		Low		-
			Disability (VAS 0-10, 0-6 minimal; >6 considerable)	NA		a) B = -0.5 (-2.7 to 1.7) p=0.7	
Muscle impairment / function		Sterling 2005	Surface electromyography (EMG) to measure activity of superficial neck flexor muscles	NA		Univariate NS	-
Sympathetic vasoconstrictor		Sterling 2005	QI (Quotient Integrals), calculated from laser doppler flowmetry data	+A		β = -0.147 (SE 0.07), p=0.04	-

response (SVM)			(worse SVM is associated with higher disability)				
BMI	1	Kasch 2001	BMI ≥ 30 kg/m	NA	Low	Exp B 1.36 (95% CI 0.73, 2.54), p=0.33	-

Figure 9: Forest plot for cervical range of movement studies



GRADE ASSESSMENT

Cervical ROM: Moderate certainty ⊕⊕⊕◯ of a small association between C-ROM and ongoing disability. Risk of bias and indirectness were not serious. Adequate pooled sample size across the two studies presented in the meta-analysis (Figure 9) and additional secondary evidence (2 studies). Despite heterogeneity in the meta-analysis (I^2=73%), three out of four studies showed positive associations with C-ROM and the remaining study (Sterling 2005) neared statistical significance (p=0.05). Inconsistency was therefore not deemed serious. Imprecision was rated as serious as confidence intervals in the meta-analysis crossed the meaningful threshold above and below 1.0.

Pain Sensitivity: CPT: Moderate certainty ⊕⊕⊕◯ of a huge association between CPT and ongoing disability. Risk of bias low and the study was carried out in an Australian context. Despite the presence of wide confidence intervals, the lower bound was above the meaningful threshold for moderate severity. Despite the strength of the association, we decided to rate down imprecision as findings were from a single study with smaller sample size and secondary evidence from two studies showed an association in one study only.PPT: Certainty of evidence not evaluated as these data were considered as secondary evidence. Not associated in 2/2 studies.

Sensorimotor function, muscle function and BMI: Certainty of evidence not evaluated as these data were considered as secondary evidence.

P.7.4. Outcome: Psychological distress

There was 1 study that examined physical assessment factors associated with ongoing psychological distress. The study investigated pain sensitivity, namely cold pain threshold (CPT) and pressure pain threshold (PPT). The evidence was:

- PPT: chronic / severe sub-group +A
- CPT: chronic/ sever group +A

Table 43: Physical or impairment factors predictive of long-term psychological distress with acute whiplash

Prognostic Factor	Number of studies	First author, year	Baseline N	Measure	+ or - association	Risk of bias (QUIPS)	Data *β: Adjusted β coefficient* *OR: Adjusted Odds Ratio* *RR: Adjusted Risk Ratio*	Pooled OR (95% CI)
Pain sensitivity	1	Sterling 2011	N=155	CPT neck ≥13^{0}C (Thermotest system) (ref: resilient) Chronic moderate-severe	+A	Low	OR 9.70 (2.22–42.41), p=0.003	-
				PPT neck (pressure algometer) (ref: resilient) Chronic moderate-severe (lower PPT assoc. with higher psych distress)	-A	Low	OR 0.990 (0.980–1.000), p=0.0453	

GRADE ASSESSMENT

Pain Sensitivity: CPT: Moderate certainty ⊕⊕⊕◯ of a huge association between CPT and ongoing psychological distress. Risk of bias low and the study was carried out in an Australian context. Despite the presence of wide confidence intervals, the lower bound was significantly above the meaningful threshold. Despite the strength of the association, we decided to rate down imprecision as findings were from a single study with small sample size.

PPT: Moderate certainty ⊕⊕⊕◯ of a trivial association between PPT and ongoing psychological distress. Imprecision was deemed serious as findings were from a single study with small sample size.

P.7.5. Outcome: Perceived non-recovery

There was 1 study that examined physical assessment factors associated with non-recovery. This study found an association between poor CROM and non-recovery.

Table 44: Physical or impairment factors predictive of long-term perceived non-recovery with acute whiplash

Prognostic Factor	Number of studies	First author, year	Baseline N	Measure	+ or - association	Risk of bias (QUIPS)	Data *β: Adjusted β coefficient* *OR: Adjusted Odds Ratio* *RR: Adjusted Risk Ratio*	Pooled OR (95% CI)
Cervical range of movement	1	Hendriks 2005	N=125	CROM device: total score of lateral flexion, rotation, and flexion–extension in degrees	+A	Low	B =0.007 (p=0.037)*	-

*Decreased CROM associated with poorer recovery at 12m

GRADE ASSESSMENT

CROM: Certainty of evidence not evaluated as these data were considered as secondary evidence.

P.7.6. Overall summary

Table 45: Overall summary (physical or impairment factors)

Physical assessment	Pain	Disability	Non-recovery	Psych distress	Total	Overall	Key findings
Cervical range of movement	1NA	**3A** 1NA	**1A**	-	**4A** 2NA	**A**	Moderate certainty ⊕⊕⊕◯ of a small association between C-ROM and ongoing disability.
Pain sensitivity	-	**2A (CPT)** 2NA (PPT)	**3A** 1NA	**1A**	**5A** 2NA	**A**	Greater associations with CPT than PPT. E.g., huge association between CPT and ongoing severe disability [OR 26.32 (4.98–139.09)] and psychological distress [(OR 9.70 (2.22–42.41)].
Manual palpation	**1A**	-	-	-	**1A**	I	Moderate certainty in the evidence for a moderate association between cervical bony tenderness and ongoing pain.

Sympathetic vasoconstrictor response (SVR)	-	1A	-	-	1A	I	-
Muscle-impairment / function	-	1NA	-	-	1NA	I	-
Sensorimotor function	1NA	2NA	-	-	3NA	NA	-
Body Mass Index	1NA	1NA	-	-	2NA	NA	-

A= associated, I= inconclusive, NA= not associated

P.7.7. Evidence to decision framework (physical / impairment factors)

Table 46: Evidence to decision framework (physical or impairment factors)

Strength of association How substantial are the associations between explanatory factors and critical outcomes?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Trivial ○ Small ○ Moderate ○ Large ○ **Varies** ○ Don't know	Small to huge associations were found between the following physical factors in people with acute WAD and long-term poor prognosis: • Cervical range of motion (ROM) – small associations with ongoing disability and non-recovery. • Pain sensitivity* (specifically cold pain threshold (CPT)) – huge positive association with ongoing disability and psychological distress. • Cervical bony tenderness (assessed by manual palpation) – moderate association with ongoing pain. However, this finding was deemed as inconclusive as the certainty of the evidence was low given that findings were from a single trial and confidence intervals were wide.	If people with acute WAD present with clinical indicators of muscle and/or sensorimotor impairment, these factors could be assessed to inform treatment direction (detailed further in the Assessment Guidelines).

	Inconclusive or no evidence was found for muscle, sensorimotor functioning, BMI, and long-term prognosis. *Associations for pain sensitivity with critical outcomes are in different directions (positive/negative) for CPT and PPT; higher CPT and lower PPT are associated with poor outcomes.	
Undesirable Effects How substantial are the undesirable anticipated effects when assessing these factors?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Large ○ Moderate ○ Small ○ Trivial ○ **Varies** ○ Don't know	No evidence on adverse effects reported. Undesirable effects will vary depending on assessment method.	CPT / PPT testing can temporarily cause or increase acute pain. It is important to inform the injured person this may occur.
Certainty of evidence What is the overall certainty of the evidence of effects?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Very low ○ Low ○ **Moderate** ○ High ○ No included studies	The overall certainty in the evidence is moderate for specific prognostic factors with moderate to huge associations with long-term prognosis (CROM and pain sensitivity). Moderate certainty: Moderate association between cervical bony tenderness and ongoing pain. Huge association between CPT and ongoing disability. Huge association between CPT and ongoing psychological distress. Trivial association between PPT and ongoing psychological distress. Low certainty:	Certainty of evidence and strength of associations were greater for CPT than PPT for the assessment of pain sensitivity.

	Trivial association between C-ROM and ongoing pain. Small association between C-ROM and ongoing disability.	
Balance of effects Does the balance between desirable and undesirable effects favour assessing or not assessing these factors?		
Judgement	Research evidence	Additional considerations
○ Favours not assessing ○ Probably favours not assessing ○ **Does not favour either assessing or not assessing** ○ **Probably favours assessing** ○ Favours assessing ○ Varies ○ Don't know	Probably favours assessing: CROM and pain sensitivity (CPT). Does not favour assessing or not-assessing (neutral): muscle, sensorimotor, sympathetic response, cervical bony tenderness (manual palpation), and BMI.	The factor should only be assessed if it can be reasonably completed in the clinical setting and the persons clinical presentation indicates the need for assessment.
Resources required How large are the resource requirements (costs)?		
Judgement	Research evidence	Additional considerations

○ Large costs ○ Moderate costs (acute/chronic) ○ **Negligible costs and savings** ○ Moderate savings ○ Large savings ○ Varies ○ Don't know	Cold hyperalgesia (CPT) can be assessed in clinical settings using ice instead of specialised equipment (e.g., Rebbeck et al. Physical Therapy 2015; 95:1536–46).	Negligible costs associated with assessment of recommended factors. CROM assessment is commonly assessed in clinical practice using inclinometers, which are easily available (e.g., phone app). Resources on how to perform the Ice Pain Test is freely available from Whiplash Navigator https://mywhiplash.com.au/ Manual palpation of the cervical region for bony tenderness can be easily performed as part of a routine consult.
Cost effectiveness Does the cost-effectiveness of the assessing the factor favour assessing or not assessing the factor		
Judgement	Research evidence	Additional considerations
○ Favours not assessing ○ Probably favours not assessing ○ Does not favour either assessing or not assessing ○ Probably favours assessing ○ Favours assessing ○ Varies ○ **No included studies**	No evidence. The studies do not measure cost-effectiveness.	Negligible costs associated with assessing these factors.
Equity What would be the Impact on health equity?		
Judgement	Research evidence	Additional considerations
○ Reduced ○ Probably reduced ○ **Probably no impact** ○ Probably increased ○ Increased	No evidence.	Primary HCP's can easily administer these assessments as part of routine consultation and with no additional costs.

○ Varies ○ Don't know		
Acceptability Is assessing the factor acceptable to key stakeholders?		
Judgement	Research evidence	Additional considerations
○ No ○ Probably no ○ **Probably yes** ○ Yes ○ Varies ○ Don't know	Most prognostic studies do not report adverse events.	Some people may have a temporary increase in pain as a result of the assessment. How a HCP explains the purpose of the assessment to the Injured person can influence acceptability.
Feasibility Is assessing the factor feasible to implement?		
Judgement	Research evidence	Additional considerations
○ No ○ Probably no ○ Probably yes (acute/chronic) ○ **Yes** ○ Varies ○ Don't know		Some tests are minimally invasive, whilst others require specialised equipment. However, there are valid alternatives to assessing CPT that do not require specialised equipment. Resources on how to perform a CPT assessment using ice is freely available from Whiplash Navigator https://mywhiplash.com.au/

P.7.8. Conclusions (physical / impairment prognostic factors for acute WAD)

Vote 1: Are you for or against clinicians assessing the following physical assessment prognostic factors in people with acute whiplash to determine prognosis: cervical ROM, pain sensitivity, and cervical bony tenderness.

Strong recommendation for not measuring the factor(s)	Conditional recommendation to not measure the factor (s)	Conditional recommendation for either measuring the factor (s) or not	Conditional recommendation for measuring the factor (s)	Strong recommendation for measuring the factor(s)
○	○	○	○	○

Recommendation: The guideline panel suggest that healthcare professionals may assess the following physical factors in people with acute WAD to determine long-term prognosis: cervical ROM, cold hyperalgesia (e.g., Ice Pain Test).

Panel vote summary: 11/12 92% conditional for; 1/12 8% strong for.

Justification

Evidence:

- There were 10 studies that informed the recommendations for physical impairment. Of all the factors, cervical ROM and cold hyperalgesia (measured by cold pain threshold) have moderate to strong certainty of evidence of associations with critical outcomes.

Consistency:

- Findings for Cold Hyperalgesia and Cervical ROM are consistent with previous guidelines and systematic reviews.
- Cervical ROM assessment is also required to determine the grade of WAD.

Acceptability and Feasibility:

- The assessment techniques are common practice for primary HCPs when working with people with other musculoskeletal conditions.

Sub-group considerations

The assessments can be used to identify medium to high-risk sub-groups, particularly with regard to high pain sensitivity.

Implementation considerations

How to measure:

- Cervical Range of Motion (C-ROM) can be measured in clinical settings using a bubble inclinometer or inclinometer app on a phone (see assessment section). In addition to being helpful for prognosis, assessment of ROM is required to determine the WAD Grade (i.e., Classification of people as WAD grade I and II requires ROM includes decreased ROM) and can inform treatment direction.
- Cold hyperalgesia can be assessed in clinical settings using the Ice Pain Test instead of specialised equipment (Rebbeck et al., 2015;). Healthcare professionals can apply a cube of ice to the neck and upper trapezius and ask the injured person to rate their pain (NRS). People with elevated pain sensitivity can present with cold hyperalgesia e.g., NRS>5/10 for pain associated with cold (Maxwell and Sterling 2013).

Considerations:

- Assessment of mechanical hyperalgesia (e.g., pressure pain thresholds) are less helpful in terms of prognosis but could be used to inform treatment or assess outcome.
- Be cautious when testing for pain sensitivity in injured people who present with widespread pain as some people may have a temporary increase in pain as a result of the assessment. Advise people that there may be some change to their pain levels when conducting these tests.

What to do:

- Use results during testing to explain the pain type to injured people.
- Resources on how to perform CROM and Pain sensitivity assessments are freely available from Whiplash Navigator https://mywhiplash.com.au/

Vote 2: Are you for or against clinicians assessing the following physical assessment prognostic factors in people with acute whiplash to determine prognosis: muscle and/or sensorimotor functioning, sympathetic nervous system response, cervical bony tenderness (manual palpation), and BMI.

Strong recommendation for not measuring the factor(s)	Conditional recommendation to not measure the factor (s)	Conditional recommendation for either measuring the factor (s) or not	Conditional recommendation for measuring the factor (s)	Strong recommendation for measuring the factor(s)
○	○	○	○	○

Recommendation: The guideline panel cannot recommend for or against the assessment of muscle, sensorimotor, sympathetic nervous system response, cervical bony tenderness (manual palpation), and BMI in people with acute WAD for the purpose of determining long-term prognosis.

Panel vote summary: 11/12 92% neutral; 1/12 8% conditional for.

Justification

Evidence:

- Inconclusive evidence for associations with long-term prognosis due to few studies, low certainty of evidence, and non-significant associations.
- While cervical bony tenderness by manual palpation was shown to have a moderate association with ongoing disability, the certainty of the evidence was low due to wide confidence intervals nearing 1.0 at the lower bound and findings being reported from a single study.

Consistency:

- These findings are consistent with other guidelines and systematic reviews.

Sub-group considerations

These factors could be assessed for medium/high risk subgroups to inform treatment.

Implementation considerations

Assessment of physical factors have mixed evidence and are less helpful in determining prognosis.

Indications:

- Muscle and sensorimotor function could be assessed when the person's clinical presentation indicates the need for assessment. Findings from these assessments can inform treatment direction. For example, assessment of cervical flexor endurance can inform neck-specific strengthening exercises.
- Manual palpation of mid-cervical bony tenderness is a criterion that is assessed for the Canadian C-Spine rule (see Assessment Section) but is less helpful informing prognosis.

- Assessment of BMI could be an indicator of general health status and may be appropriate to assess as part of a person-centred approach to treatment.
- Sympathetic nervous system assessment is not clinically feasible.
- Resources on how to perform muscle and sensorimotor assessments are freely available from Whiplash Navigator https://mywhiplash.com.au/

P.8. Pre-crash factors

What **pre-crash** factors are predictive of long-term neck pain, neck disability, psychological distress, and perceived non-recovery in people with acute whiplash associated disorders?

P.8.1. Summary of included studies

There were 10 studies that informed the recommendations regarding pre-crash health factors and their relationship with poor outcome after whiplash (Ameratunga et al 2010, Atherton et al 2006, Cartensen et al 2009, 2015, Casey et al 2015, Griffin et al 2019, Hendriks et al 2005, Holm et al 2008, Mayou et al 1996, 2002, Osterland et al 2019, Palmlof et al 2015, Phillips et al 2010, Radanov et al 1996, Rydman et al 2017).

P.8.2. Outcome: Neck pain

Seven studies (six independent cohorts) evaluated pre-crash factors and their association with ongoing pain. The evidence for pre-crash factors associated with ongoing pain were:

- Previous neck pain: 3/3 NA
- Other pre-crash pain: 4/4 +A
- Pre-crash general health: 3/3 NA
- Mental health:3/3 +A
- Pre-injury comorbid condition: 1/3 +A, 2/3 NA

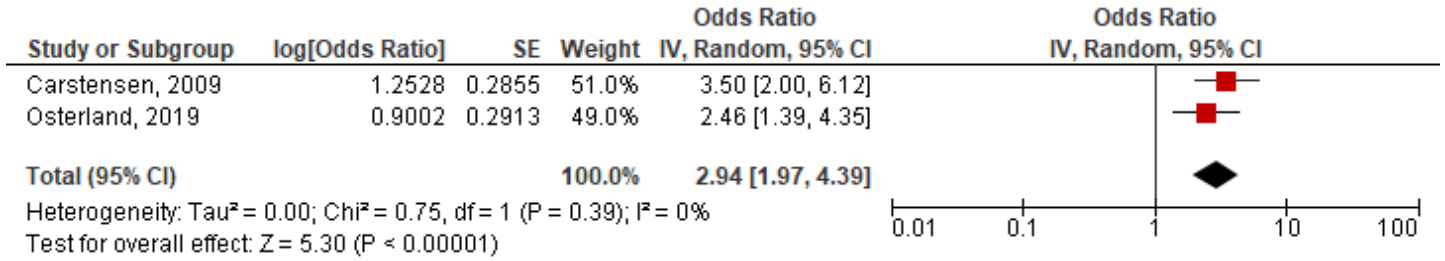
Table 47: Pre-crash factors predictive of long-term neck pain with acute whiplash

Pre-injury Prognostic Factor	Number of studies	First author, year	Measure	+ or - association	Risk of bias (QUIPS)	Data *β: Adjusted β coefficient* *OR: Adjusted Odds Ratio* *RR: Adjusted Risk Ratio*	Pooled OR
Pre-crash neck pain	3	Atherton 2006	Lifetime experience of neck pain	NA	Moderate	RR 1.2 (0.8 to 1.6) – adjusted for age/sex	
		Carstensen 2009	Pre-collision neck pain	NA	Low	OR 0.99 (0.82 to 1.2), p=0.92	-

		(2001-2003 cohort) Hendriks 2005	Pre-injury neck pain (ref: no)	NA	Low	Univariate NS	
Other pre-crash pain	4	Atherton 2006	Pre-collision 1-month period prevalence of widespread body pain	+A	Moderate	RR 1.9 (1.1 to 3.2)	**2.94 (1.97 to 4.39) (Figure 10)**
		Carstensen 2009 (2001-2003 cohort)	Pre-collision unspecified pain condition	+A	Low	**OR 3.5 (2.0 to 5.9), p<0.0001**	
		Hendriks 2005	Headache (ref: no)	NA	Low	Univariate NS	
			Pain medication use before accident (ref: no)	+A	Low	Univariate β 0.981, p=0.018	
		Osterland 2019	Pre-collision pain-related diagnosis	+A	Low	**OR 2.46 (1.39 to 4.35), p=0.002**	
Pre-injury general health	3	Ameratunga 2010	Fair or poor general health (ref: good, very good, excellent)	NA	Low	OR 1.48 (0.29 to 7.56)	-
		Atherton 2006	Fair/poor general health prior to collision (ref: excellent/good)	NA	Moderate	RR 0.7 (0.3 to 1.4) – adjusted for age/sex	
			>4 GP consultations in year prior to injury (ref: none)	NA	Moderate	RR 1.4 (0.8 to 2.2) – adjusted for age/sex	
		Carstensen 2015 (2001-2003 cohort)	Unemployment benefit	NA	Low	OR 1-62 weeks: 0.93 (0.54 to 1.62), p=0.806 OR >62 weeks: 0.85 (0.43 to 1.65), p=0.589	
Pre-crash mental health	3	Ameratunga 2010	Previous psychiatric history	NA	Low	Univariate NS	-
		Carstensen 2009 (2001-2003 cohort)	Pre-collision psychological distress (ref=none)	+A	Low	Medium: OR 1.0 (0.60 to 1.8), p=0.87 High: OR 2.1 (1.1 to 4.2), p=0.03	

		Mayou 2002	Prior emotional problem (yes, ref: no)	+A	Low	RR 4.08 (1.10 to 15.04)	
Pre-crash comorbid condition	2	Carstensen 2009, Carstensen 2015 (2001-2003 cohort)	Pre-collision persistent illness	NA	Low	OR 1.4 (0.79 to 2.4), p=0.26	-
			>12 weeks of sickness benefit (ref: none)	+A	Low	OR 3.34 (1.77 to 6.32), p<0.001	
		Hendriks 2005	Comorbidity (ref: no)	NA	Low	Univariate NS	

Figure 10: Forest plot – association between other pre-crash pain conditions (prognostic factor) and ongoing pain



GRADE ASSESSMENT

Pre-crash neck pain: Moderate ⊕⊕⊕◯ certainty in the evidence for a trivial association between pre-crash neck pain and ongoing neck pain at 12mo. Findings were consistent across studies, with inconclusive associations found in all three studies. Sample size was adequate, but imprecision was deemed serious due to confidence intervals crossing the meaningful association threshold and zero.

Other pre-crash pain: High ⊕⊕⊕⊕ certainty in the evidence for a strong association [pooled OR: 2.94 (1.97 to 4.39), Figure 10] between other pre-crash pain condition and ongoing neck pain at 12mo.Findings were consistent across the four studies that evaluated other pre-crash pain, with all four studies showing positive associations and high homogeneity in the meta-analysis. Populations were applicable to an Australian context.

Pre-injury General Health: Low ⊕⊕◯◯ certainty in the evidence for a trivial association between pre-crash general health and ongoing neck pain at 12mo.

Risk of bias was deemed not serious as the studies by Ameratunga (2010) and Carstensen (2015) were low risk and made up ~60% of the total sample. Association findings were consistent with all three studies showing non-significant findings, however imprecision was deemed very serious given the very wide confidence intervals above the meaningful threshold of association and below zero.

Pre-crash mental health: High certainty ⊕⊕⊕⊕ in the evidence of a strong association between pre-crash mental health and ongoing pain at 12mo.

Low risk of bias. Findings were consistent with strong positive associations between pre-crash mental health and ongoing pain at 12mo between the two studies (Carstensen 2009; Mayou 2002) that constituted most to the total observations. While confidence intervals were wide, the point estimates were large associations well above the meaningful threshold, and therefore, imprecision was deemed as not serious.

Pre-crash co-morbid conditions: Moderate ⊕⊕◯◯certainty in the evidence for a strong association between pre-crash sickness benefit and ongoing pain at 12 mo.

Low ⊕◯◯◯certainty in the evidence for a trivial association between pre-crash comorbid condition and ongoing pain at 12 mo. Low risk of bias. Inconsistency in study outcomes and associations (serious) that did not allow for pooled analysis. Wide confidence intervals for pre-collision persistent illness. Strong positive association for sickness benefit, indicative of a pre-crash comorbid condition.

P.8.3. Outcome: Neck disability

Four studies examined pre-crash factors associated with ongoing disability. The evidence for pre-injury factors associated with ongoing disability were:

- Previous neck pain: ½ +A, ½ NA
- Pre-crash other pain: ½ +A, ½ NA
- Pre-crash general health: ½ +A, ½ NA
- Pre-injury social support: 1/1 NA

Table 48: Pre-crash factors predictive of long-term neck disability with acute whiplash

Pre-injury Prognostic Factor	Number of studies	First author, year	Measure	+ or - association	Risk of bias (QUIPS)	Data *β: Adjusted β coefficient* *OR: Adjusted Odds Ratio* *RR: Adjusted Risk Ratio*
Pre-crash neck pain	2	Williamson 2015	Pre-injury neck pain	NA	Low	Univariate NS
		Holm 2008	Very often/everyday neck pain during month prior to MVC (ref: never or sometimes)	**+A**	Low	Univariate OR (moderate disability) 2.3 (0.9 to 6.0) Univariate OR (high disability) 6.7 (3.0 to 15)
Other pre-crash pain	2	Williamson 2015	Pre-injury other pain	NA	Low	Univariate NS
		Holm 2008	Very often/everyday headache during month prior to MVC (ref: never or sometimes)	**+A**	Low	Univariate OR (moderate disability) 1.0 (0.2 to 4.0) Univariate OR (high disability) 4.1 (1.3 to 11.0)

Pre-crash general health	2	Casey 2015[a]	Excellent/very good general health (ref: fair/poor general health)*	**+A**	Low	OR 0.18 (0.04–0.78) 0.03
		Griffin 2019	Pre-injury health (EQ5D3L)	NA	Low	Univariate OR 10.780 (0.53 to 218.25)
Social support	1	Williamson 2015	Pre-injury social support	NA	Low	Univariate NS

*reference variable was fair/poor general health, general health was positively associated with ongoing disability

GRADE ASSESSMENT

Pre-crash neck pain: Moderate ⊕⊕◯◯ certainty in the evidence for a strong association between pre-crash neck pain and ongoing disability at 12mo. Inconsistency deemed as serious as one study was non-significant, and one showed a very large association between pre-crash neck pain and high ongoing disability at 12mo. Furthermore, both studies did not adjust for other pre-crash or baseline factors.

Other pre-crash pain: Moderate ⊕⊕◯◯ certainty in the evidence for a strong association between other pre-crash pain and ongoing disability at 12mo.

Inconsistency deemed as serious as one study was non-significant, and one showed a very large association between other pre-crash pain and high ongoing disability at 12mo. Furthermore, both studies did not adjust for other pre-crash or baseline factors.

Pre-crash general health: Low certainty ⊕⊕◯◯ in the evidence for an association between pre-crash general health and ongoing disability at 12mo.

Findings were not meta-analysed as OR in the study by Griffin 2019 was not adjusted for baseline/pre-crash factors. Inconsistency was deemed serious as findings between the two studies varied, with one showing a very large association between pre-crash general health and one finding no-significant association. Huge confidence intervals were evidence in study by Griffin (2019), and therefore, imprecision was deemed serious. Optimal information size was reached for the strength of the associations.

P.8.4. Outcome: Psychological distress

Three studies examined pre-injury factors associated with ongoing psychological distress. The evidence for pre-crash factors associated with ongoing psychological distress were:

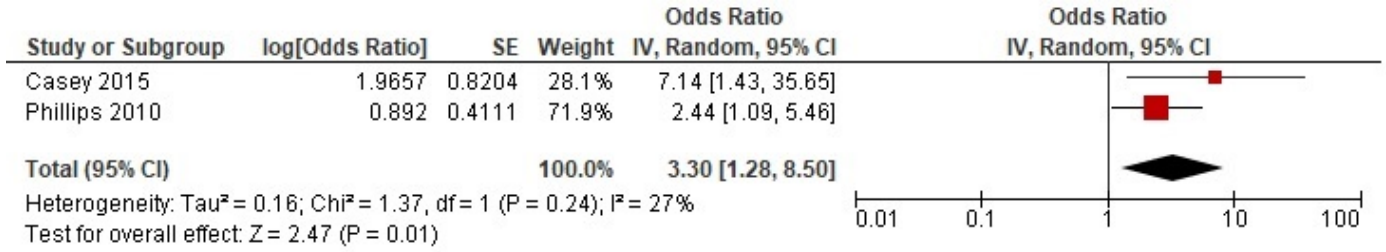
- Pre-crash other pain: 1/1 NA
- Pre-injury general health: 2/2 +A
- Pre-injury mental health: ½ +a, ½ NA
- Gastro-intestinal problems: 1/1 NA.

Table 49: Pre-crash factors predictive of long-term psychological distress with acute whiplash

Pre-injury Prognostic Factor	Number of studies	First author, year	Measure	+ or - association	Risk of bias (QUIPS)	Data *β: Adjusted β coefficient* *OR: Adjusted Odds Ratio* *RR: Adjusted Risk Ratio*	Pooled OR
Pre-crash other pain	1	Phillips 2010	Prior MSK pain (ref=no) Prior headaches (ref=no)	NA	Low	Mild: OR 0.73 (0.46 to 1.17) Severe: OR 1.18 (0.69 to 2.04) Mild: OR 0.90 (0.57 to 1.41) Severe: OR 1.16 (0.63 to 2.13)	
Pre-crash general health	2	Phillips 2010	Prior general health (ref=excellent)	**+A**	Low	Very good: OR 1.61 (0.93, 2.8) Good: OR 3.81 (2.14, 6.8) **Fair to poor: OR 2.44 (1.09, 5.47)**	**3.30 (1.28 to 8.50) (Figure 11)**
		Casey 2015	Excellent/very good general health (ref: fair/poor general health)*	**+A**	Low	OR 0.14 (0.03–0.70), p≤0.01* **Inversed OR: 7.14 (1.43 to 33.33)**	
Pre-crash mental health	2	Phillips 2010	Prior mental health problems (ref=no)	**+A**	Low	Mild: OR 3.28 (1.85 to 5.82) Severe: OR 16.78 (6.73 to 41.8)	
		Mayou 1996a, Mayou 1996b (same cohort)	Pre-accident psychological problems	NA	Moderate	Univariate NS	
			High neuroticism score (Eysenck Personality Inventory)	NA	Moderate	Univariate NS	
Pre-crash gastrointestinal problems	1	Phillips 2010	Prior GI problems (ref=no)	NA	Low	Mild: OR 1.32 (95% CI: 0.74, 2.38) Severe: OR 1.74 (95% CI: 0.89, 3.41)	

*OR was inversed (1/OR) to allow for meta-analysis.

Figure 11: Meta-analysis of pre-crash general health on ongoing psychological distress at 12mo



GRADE ASSESSMENT

Pre-crash other pain: Low ⊕⊕◯◯ certainty in the evidence for a trivial association between pre-crash other pain and ongoing psychological distress. Inconsistency was rated down as the findings were from a single study with small sample size. Imprecision was deemed serious as the confidence intervals crossed zero and the meaningful threshold.

Pre-crash general health: High certainty ⊕⊕⊕⊕ in the evidence for a strong positive association between pre-crash general health and ongoing psychological distress at 12mo [pooled OR 3.30 (1.28 to 8.50),Figure 11]. Wide confidence intervals were present for both studies in the pooled analysis, however, the associations were significant and very large. Therefore, imprecision was deemed as not serious.

Pre-crash mental health: Moderate ⊕⊕⊕◯ certainty in the evidence for a strong association between pre-crash mental health and ongoing psychological distress at 12mo.

Primary evidence was considered from the study by Phillips 2010. Inconsistency was deemed as serious as the findings were from a single trial of small sample size and findings were not consistent with secondary evidence reported in the studies by Mayou 1996. While the optimal information size was not reached, the associations for both mild and severe ongoing psychological distress were very large and huge, with the lower confidence interval bound above the meaningful threshold. As a result, imprecision was deemed as not serious.

Pre-crash gastro-intestinal problems: Low ⊕⊕◯◯ certainty in the evidence for a trivial association between pre-crash gastrointestinal and ongoing psychological distress at 12mo.

Risk of bias was low. Imprecision was deemed as very serious given that the optimal information size was not reached, and confidence intervals crossed the meaningful threshold and zero for both mild and severe psychological distress.

P.8.5. Perceived non-recovery

Four (4) studies examined pre-crash factors associated with non-recovery. The evidence for pre-crash factors associated with non-recovery were:

- Other pre-crash pain: 1/1 NA
- Pre-crash general health: 1/1 NA
- Pre-crash comorbid condition: 2/2 NA

- Genetic (COMT genotype): 1/1 NA

Table 50: Pre-crash factors predictive of long-term perceived non-recovery with acute whiplash

Pre-injury Prognostic Factor	Number of studies	First author, year	Measure	+ or - association	Risk of bias (QUIPS)	Data *β: Adjusted β coefficient* *OR: Adjusted Odds Ratio* *RR: Adjusted Risk Ratio*
Other pre-crash pain	1	Radanov 1996	History of pre-traumatic headache (ref: no)	+A	Moderate	β 3.24, p<0.05
Pre-crash general health	1	Griffin 2019	Pre-injury health (EQ5D3L)	NA	Low	Univariate OR 15.843 (0.75 to 335.67)
Pre-crash comorbid condition	2	Palmlof 2015	Self-reported cardiovascular condition (no-ref, mod/severe effect on health)	NA	Low	Women HRR 0.74 (0.50, 1.10) Men HRR 1.24 (0.84, 1.83)
		Radanov 1996	History of head trauma (ref: no)	+A	Moderate	β 2.99, p<0.05
Genetic	1	Rydman 2017	Catechol-O-methyltransferase (COMT) genotype haplotypes: Low pain sensitivity (LPS) Average pain sensitivity (APS) High pain sensitivity (HPS)	NA	Low	LPS: OR 1.0 (ref) APS: OR 0.8 (0.2-2.5) HPS: OR 0.9 (0.1-1.2)

GRADE ASSESSMENT

Other pre-crash pain: Very low ⊕◯◯◯ certainty in the evidence for an association between other pre-crash pain and non-recovery at 12mo.

Inconsistency was deemed serious as findings were from a single study of small sample size. Imprecision was deemed very serious as the optimal information size was significantly below the threshold and no confidence intervals were reported. Findings were considered as secondary evidence as no RR or OR was reported.

Pre-crash general health: Low ⊕⊕◯◯ certainty in the evidence for a trivial association between pre-crash general health and non-recovery at 12mo. While the point estimate was indicative of a huge association, Imprecision was deemed very serious as the confidence intervals were extremely large and crossed zero.

Pre-crash co-morbid condition: Moderate ⊕⊕⊕◯ certainty in the evidence for a trivial association between pre-crash comorbid condition and non-recovery at 12mo.

Risk of bias and inconsistency was deemed as not serious as the total number of observations was almost all attributed to the study by Palmlof 2015. Imprecision was deemed as serious as the confidence intervals were above the crossed the meaningful threshold as zero.

Pre-crash genetic factors; Very low ⊕◯◯◯ certainty in the evidence for a trivial association between COMT genotype and non-recovery at 12mo.Risk of bias was low. Imprecision was deemed as very serious given that the optimal information size was not reached, and confidence intervals crossed the meaningful thresholds either side of zero.

P.8.6. Overall summary (pre-crash factors)

Table 51: Overall summary (pre-crash factors)

Pre-crash	Pain	Disability	Non-recovery	Psych distress	Total	Overall	Key findings/pooled OR
Pre-crash neck pain	3NA	1A 1NA	-	-	1A 4NA	I	-
Other pre-crash pain	4A	1A 1NA	1A	1NA	6A 2NA	A	High certainty in the evidence for a strong association [pooled OR: 2.94 (1.97 to 4.39), Appendix A] between other pre-crash pain condition and ongoing pain at 12mo.
Pre-crash general health	3NA	1A 1NA	1NA	2A	3A 5NA	A	High certainty in the evidence for a strong positive association between pre-crash general health and ongoing psychological distress at 12mo [pooled OR 3.30 (1.28 to 8.50), Appendix B].
Pre-crash mental health	2A 1NA	-	-	1A 1NA	3A 2NA	A	High certainty in the evidence of a strong association [OR 2.1 (1.1 to 4.2); RR 4.08 (1.10 to 15.04)] between pre-crash mental health and ongoing pain at 12mo.
Pre-crash comorbid condition	1A 1NA	1A 1NA	1A 1NA	-	3A 3NA	I	-
Social support	-	1NA	-	-	1NA	NA	-

Gastrointestinal problems	-	-	-	1NA	1NA	NA	-
Genetic	-	-	1NA	-	1NA	NA	-

A= associated, I= inconclusive, NA= not associated

P.8.7. Evidence to decision framework (pre-crash factors)

Table 52: Evidence to decision framework (pre-crash factors)

Strength of association How substantial are the associations between explanatory factors and critical outcomes?		
Judgement	Research evidence	Additional considerations
○ Trivial ○ Small ○ Moderate ○ Large ○ **Varies** ○ Don't know	Large associations were found between other pre-crash pain conditions, pre-crash general health, and pre-crash mental health for several critical prognosis outcomes at 12mo. The association between pre-crash comorbid condition and poor prognosis following whiplash injury was inconclusive.	The associations between prior pain conditions, general health, and mental health, and prognosis following whiplash injury is consistent with other musculoskeletal pain conditions. While pre-crash comorbid conditions and other remaining factors were inconclusive for predicting poor prognosis, they are often collected as part of past-medical history and individuals with WAD may report that these factors influence their recovery. Whether these factors influence recovery could be asked during a routine consult.
Undesirable Effects How substantial are the undesirable anticipated effects when assessing these factors?		
Judgement	Research evidence	Additional considerations
○ Large ○ Moderate ○ Small ○ **Trivial** ○ Varies ○ Don't know	Not measured in the studies.	Anticipated undesirable effects are trivial, given that these outcomes can be obtained by injured person self-report during an initial interview and/or may be present in clinical past medical history documentation.

Certainty of evidence What is the overall certainty of the evidence of effects?		
Judgement	Research evidence	Additional considerations
○ Very low ○ Low ○ **Moderate** ○ High ○ No included studies	High certainty in the evidence: Other pre-crash pain and ongoing pain (large association) Pre-crash general health and ongoing psychological distress (large association) Pre-crash mental health and ongoing pain (large association) Moderate certainty in the evidence: Pre-crash neck pain and ongoing pain (trivial association) Pre-crash neck pain and ongoing disability (strong association) Pre-crash sickness benefit and ongoing pain (strong association) Pre-crash other pain condition and ongoing disability (strong association) Pre-crash comorbid condition and non-recovery (trivial association) Pre-crash mental health and ongoing psychological distress (strong association) The certainty in the evidence for the remaining outcomes ranged from low to very low. Risk of bias was generally not serious, with most studies rated as low risk of bias. Indirectness was not serious as study populations and findings were applicable to an Australian context, with populations of people recruited with acute WAD and appropriate adjustment for baseline factors in outcome analyses.	

Balance of effects Does the balance between desirable and undesirable effects favour assessing or not assessing these factors?		
Judgement	Research evidence	Additional considerations
○ Favours not assessing ○ Probably favours not assessing ○ Does not favour either assessing or not assessing ○ **Probably favours assessing** ○ Favours assessing ○ Varies ○ Don't know	A summary of the findings, including frequency of associations, is presented in Appendix C. Probably favours assessing: other pre-crash pain condition (including neck pain), pre-crash general health, and pre-crash mental health. Neutral: pre-crash comorbid condition.	The associations between prior pain conditions, general health, and mental health, and prognosis following whiplash injury is consistent with other musculoskeletal pain conditions. While some of these factors were inconclusive for predicting poor prognosis, they are often collected as part of past-medical history and individuals with WAD may report that these factors influence their recovery. Whether these factors influence recovery could be asked during a routine consult.
Resources required How large are the resource requirements (costs)?		
Judgement	Research evidence	Additional considerations
○ Large costs ○ Moderate costs (acute/chronic) ○ **Negligible costs and savings** ○ Moderate savings ○ Large savings ○ Varies ○ Don't know	Not measured in the studies.	Can be asked when doing a routine consult and does not require additional resources.
Cost effectiveness Does the cost-effectiveness of the assessing the factor favour assessing or not assessing the factor		
Judgement	Research evidence	Additional considerations

○ Favours not assessing ○ Probably favours not assessing ○ Does not favour either assessing or not assessing ○ Probably favours assessing ○ Favours assessing ○ Varies ○ **No included studies**	Not measured in the studies.	Can be asked when doing a routine consult and does not require additional resources.
Equity What would be the Impact on health equity?		
Judgement	Research evidence	Additional considerations
○ Reduced ○ Probably reduced ○ **Probably no impact** ○ Probably increased ○ Increased ○ Varies ○ Don't know	No evidence.	Can be asked when doing a routine consult.
Acceptability Is assessing the factor acceptable to key stakeholders?		
Judgement	Research evidence	Additional considerations
○ No ○ Probably no ○ Probably yes ○ **Yes** ○ Varies ○ Don't know	Follow-up rates are not indicative of acceptability for assessing these factors.	Pre-crash factors such as past-medical history is probably expected during initial consultation by injured people and primary HCPs.
Feasibility Is assessing the factor feasible to implement?		

Judgement	Research evidence	Additional considerations
○ No ○ Probably no ○ Probably yes (acute/chronic) ○ **Yes** ○ Varies ○ Don't know	-	Can be asked when doing a routine consult.

P.8.8. Conclusions (pre-crash related prognostic factors for acute WAD)

Vote 1: Are you for or against clinicians assessing the following pre-crash prognostic factors in people with acute whiplash to determine prognosis: other pre-crash pain, pre-crash general health, pre-crash mental health

Strong recommendation for not measuring the factor(s)	Conditional recommendation to not measure the factor (s)	Conditional recommendation for either measuring the factor (s) or not	Conditional recommendation for measuring the factor (s)	Strong recommendation for measuring the factor(s)
○	○	○	○	○

Recommendation: The guideline panel suggest that healthcare professionals for pre-crash other pain conditions (e.g., widespread body pain, chronic pain conditions, chronic neck pain), pre-crash general health, and pre-crash mental health in people with acute WAD to determine long-term prognosis.

Panel vote summary: 11/12 92% conditional for; 1/12 8% strong for

Justification

Evidence:

- Other pre-crash pain condition, pre-crash general health, and pre-crash mental health have large associations with critical outcomes of poor prognosis at 12months post whiplash injury (high certainty in the evidence). Assessing pre-crash neck pain for determining prognosis following whiplash injury was inconclusive overall, however, it is likely that it has a strong association with ongoing disability at 12months (moderate certainty in the evidence).

Consistency:

- The association between these factors and poor prognosis is consistent with other known musculoskeletal pain conditions.

Feasibility and Acceptability:

- These factors are easy for healthcare professionals to assess for during routine consultation and are generally expected by injured people as part of past medical history information.
- Trivial adverse effects expected.

Implementation considerations

- If a factor is identified during a routine consultation, HCPs should consider following up with a question to identify how they think the factor is influencing their recovery. For example: "How do you think [factor xx] is impacting your recovery?"

VOTE 2: Are you for or against clinicians assessing the following pre-crash prognostic factors in people with acute whiplash to determine prognosis: pre-crash comorbid conditions?

Strong recommendation for not measuring the factor(s)	Conditional recommendation to not measure the factor (s)	Conditional recommendation for either measuring the factor (s) or not	Conditional recommendation for measuring the factor (s)	Strong recommendation for measuring the factor(s)
○	○	○	○	○

Recommendation: The guideline panel cannot recommend for or against assessing for pre-crash comorbid conditions in people with acute WAD to determine long-term prognosis.

Panel vote summary: 12/12 100% neutral

Justification

Evidence:

- Inconclusive associations between pre-crash comorbid conditions and critical outcomes of poor prognosis.

Acceptability and feasibility:

- These factors are easy for healthcare professionals to assess for during routine consultation and are generally expected by injured people as part of past medical history information.
- Trivial adverse effects expected.
- While pre-crash comorbid conditions were inconclusive for predicting poor prognosis, individuals with WAD may report that these factors influence their recovery.

Implementation considerations:

- If a factor is identified during a routine consultation, HCPs should consider following up with a question to identify how they think the factor is influencing their recovery. For example: "How do you think [factor xx] is impacting your recovery?"

P.9. Compensation factors

What **compensation-related** factors are predictive of long-term neck pain, neck disability, psychological distress, and perceived non-recovery in people with acute whiplash associated disorders?

P.9.1. Executive summary

There were 10 studies that informed the recommendations regarding compensation related factors and their relationship with poor outcome after whiplash (Ameratunga et al 2010, Casey et al 2015, Gun et al 2005, Hendriks et al 2005, Kasch et al 2001, Mayoau and Bryant et al 2002, Pobereskin et al 2005, Rydman et al 2018, Sterling et al 2006, 2010).

P.9.2. Outcome: Neck pain

Three studies examined compensation factors associated with long-term pain. The evidence for factors associated with ongoing pain were:

- Consultation a lawyer: +A
- Previous claim: 1/1 +A
- Submitting a claim: 2/2 +A

Table 53: Compensation factors predictive of long-term neck pain with acute whiplash

Prognostic Factor	Number of studies	First author, year	Measure	Positive or negative association	Risk of bias (QUIPS)	Data *β: Adjusted β coefficient* *OR: Adjusted Odds Ratio* *RR: Adjusted Risk Ratio*	Pooled meta-analysis OR (95% CI)
Consulting a lawyer	1	Gun 2005*	Consulting a lawyer	+A	Low	β = -0.62 (NS)	N/A
Claim	3	Gun 2005* Pobereskin 2005^	Previous claim Compensation claim	+A +A +A	Low Low	β = -0.13 (p <0.05) OR 4.09 (1.62 to 10.32) Adj RR 4.27(1.6 to 1.1)	N/A

		Mayou and Bryant 2002	Submitting claim at one year		Low		

Outcome: * measured by improvement in Visual Analogue Pain Score, ^ measured by dichotomised with neck pain at least 1 day a week 1 year following the accident

GRADE ASSESSMENT

Claim: (N=2 primary cohorts; N=1 secondary cohort). High certainty ⊕⊕⊕⊕ in the evidence for a very strong association between compensation claim and long-term neck pain. Risk of bias not serious (low QUIPS overall for all three studies). Findings were consistent, with very strong positive associations in both primary evidence studies (inconsistency: not serious). Findings were applicable to an Australian context (UK cohorts) and lower bounds of the confidence intervals were above the clinical threshold.

P.9.3. Outcome: Neck disability

Eight studies examined compensation factors associated with long-term disability. The evidence for factors associated with ongoing disability were:

- Consulting a lawyer: 1/3 +A, 2/3 NA
- Prior claim: 2/2 +A
- Submitting a claim: 2/4 +A, 2/4 NA

Table 54: Compensation factors predictive of long-term neck disability with acute whiplash

Prognostic Factor	Number of studies	First author, year	Measure	The positive or negative association	Risk of bias assessment (QUIPS)	Data *β: Adjusted β coefficient* *EFE: Estimated Fixed Effect* *OR: Adjusted Odds Ratio* *SE: Standard error*	Pooled meta-analysis OR (95% CI)
Consulting a lawyer	3	Gun 2005* Hendriks 2005 Kasch 2001	Consulting a lawyer Retention of a lawyer Lawsuit 1m	+A NA NA	Low Low Low	β = -0.72, p=0.01 NA In Univariate	N/A
Claim	5	Casey 2015^ Gun 2005*	Prior Claim Previous claim	+A +A	Low Low	β = 12.19, p<0.001 β = -10.5, p=0.01	N/A

		Sterling 2010 Sterling 2006 Pobereskin 2005 Ameratunga 2010	 Submitting a claim Compensation status Compensation claim Claim at 5m	+A NA +A NA	Low Low Low Low	 Multivariate NA P=0.44 OR 4.09 (1.62 to 10.32)	

Outcome: ^ measured by Functional Rating Index (FRI); *measured by improvement in Neck Pain Outcome Score (NPOS).

GRADE ASSESSMENT

Claim: (N=2 primary cohorts; N=3 secondary cohorts). Low certainty ⊕⊕◯◯ in the evidence for a moderate association between compensation claim and long-term neck disability. Risk of bias not serious (low QUIPS overall for all studies). Findings were inconsistent, varying from not significant to a very strong positive associations in primary evidence studies (inconsistency: serious). Findings were applicable to an Australian context. Imprecision rated down (serious) as spread of these data would likely be wide considering the non-significant and very strong findings.

P.9.4. Outcome psychological distress

There was 1 study that examined compensation factors associated with ongoing psychological distress, finding as association.

Table 55: Compensation factors predictive of long-term psychological distress with acute whiplash

Prognostic Factor	Number of studies	First author, year	Measure	A positive or negative association	Risk of bias (QUIPS)	Data	Pooled meta-analysis OR (95% CI)
Submitting a claim	1	Sterling et al 2010	Submitting a claim	+A	Low	Multivariate NA	

^Self-perceived non-recovery (Yes/No)

P.9.5. Outcome: Perceived non-recovery

There was only one study that examined symptom factors associated with perceived recovery, finding an association.

Table 56: Compensation factors predictive of long-term perceived non-recovery with acute whiplash

Prognostic Factor	Number of studies	First author, year	Measure	A positive or negative association	Risk of bias (QUIPS)	Data	Pooled meta-analysis OR (95% CI)
Financial compensation	1	Rydman 2018^	Financial compensation (yes)	+A	Low	OR= 4.33 (1.37 to 13.66)	N/A

^Self-perceived non-recovery (Yes/No)

GRADE ASSESSMENT

Financial compensation: (N=1 primary cohort). Low certainty ⊕⊕◯◯ in the evidence for a very strong association between financial compensation and long-term perceived non-recovery. Risk of bias not serious (low QUIPS overall). Findings were from a single study (inconsistency: serious) with sample size below the threshold for precision (imprecision: serious).

P.9.6. Overall summary (compensation factors)

Table 57: Overall summary (compensation factors)

Symptom	Pain	Disability	Non-recovery	Psyche distress	Overall	Pooled OR
Consulting a lawyer	1-A	1-A 2-NA	-	-	I	-
Submitting a claim	2- A	2-A 2-NA	1A	-	I	-
Prior claim	1- A	2-A	-	-	A	-

A= associated, I= inconclusive, NA= not associated

P.9.7. Evidence to decision framework (compensation factors)

Table 58: Evidence to decision framework (compensation factors)

Strength of association How substantial are the associations between explanatory factors and critical outcomes?

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Trivial ○ Small ○ Moderate ○ Large ○ **Varies** ○ Don't know	Variability with some studies showing an association and others no association. Consulting a lawyer (2 A, 2 NA) Submitting a claim (3 A, 2 NA) Prior claim (3 A)	These conclusions are consistent with recent systematic reviews of whiplash (Shearer at al 2021; Spearing et al 2012). Association of compensation factors with poor outcome in other MSK conditions is known (e.g., Murgatroyd et al 2015).
Undesirable Effects How substantial are the undesirable anticipated effects when assessing these factors?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Large ○ Moderate ○ Small ○ **Trivial** ○ Varies ○ Don't know	Not measured in the studies.	Individual circumstances need to be taken into account; asking about claim status may negatively impact some people's health, for example, if they are not feeling well, or their recovery journey has been (or is currently) challenging. On the other hand, primary HCPs can play a pivotal role in successful recovery by informing people they can make a claim and assisting them with the paperwork to do so.
Certainty of evidence What is the overall certainty of the evidence of effects?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Very low ○ **Low** ○ Moderate ○ High ○ No included studies	Variability with some studies showing an association and others no association. Consulting a lawyer (2 A, 2 NA) Submitting a claim (3 A, 2 NA) Prior claim (3 A) Certainty of evidence varying from low to high	These conclusions are consistent with recent systematic reviews of whiplash (Shearer at al 2021; Spearing et al 2012). Association of compensation factors with poor outcome in other MSK conditions is known (e.g., Murgatroyd et al 2015).

Balance of effects Does the balance between desirable and undesirable effects favour assessing or not assessing these factors?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Favours the comparison ○ Probably favours the comparison ○ Does not favour either the intervention or the comparison ○ Probably favours the intervention ○ Favours the intervention ○ Varies ○ **Don't know**	Not applicable	
Resources required How large are the resource requirements (costs)?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Large costs ○ Moderate costs (acute/chronic) ○ **Negligible costs and savings** ○ Moderate savings ○ Large savings ○ Varies ○ Don't know	The question is usually dichotomous (e.g., did you submit a claim or engage a lawyer Y/N)	Questions can easily be asked by healthcare professionals
Certainty of evidence of required resources What is the certainty of the evidence of resource requirements (costs)?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Very low ○ Low ○ Moderate ○ High ○ **No included studies**	No evidence	Questions can easily be asked by healthcare professionals
Cost effectiveness Does the cost-effectiveness of the intervention favour assessing or not assessing these factors?		

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Favours the comparison ○ Probably favours the comparison ○ Does not favour either the intervention or the comparison ○ Probably favours the intervention ○ Favours the intervention ○ Varies ○ **No included studies**	No evidence. The studies do not measure cost-effectiveness.	
Equity What would be the impact on health equity?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Reduced ○ Probably reduced ○ Probably no impact ○ Probably increased ○ Increased ○ Varies ○ **Don't know**	No evidence.	
Acceptability Is the intervention acceptable to key stakeholders?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ No ○ Probably no ○ Probably yes ○ **Yes** ○ Varies ○ Don't know		Most if not all healthcare professionals are able to ask the question regarding submission of a claim OR hiring a lawyer.
Feasibility Is the intervention feasible to implement?		

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ No ○ Probably no ○ Probably yes (acute/chronic) ○ **Yes** ○ Varies ○ Don't know		The evidence is the same as for Acceptability (see previous row).

P.9.8. Summary of judgements (compensation factors)

Table 59: Summary of judgements (compensation factors)

Strong recommendation for not measuring the factor(s)	Conditional recommendation to not measure the factor (s)	Conditional recommendation for either measuring the factor (s) or not	Conditional recommendation for measuring the factor (s)	Strong recommendation for measuring the factor(s)
○	○	○	○	○

Recommendation: The guideline panel suggest that healthcare professionals could consider assessing whether people with whiplash have submitted a claim or retained a lawyer.

Panel vote summary: 8/10 80% conditional for, 2/10 20% neutral.

Justification

Evidence:

- There were 10 studies that informed the recommendations for compensation factors. The evidence varied, however these two factors had low to high certainty of evidence for the association.

Consistency:

- The conclusions are similar to those made by other systematic reviews of whiplash.
- Three are known associations with compensation status and retention of a lawyer and poor outcome in other MSK injuries.

Implementation considerations

- Some people may feel unsupported and not know what legal services are available. Having someone ask if they have made a claim and assisting them can make a difference to their recovery.
- For others, asking the question may negatively impact health, for example if they are already feeling unwell or have not had a good recovery and/ or claim experience.

P.10. Health care utilisation factors

What **health care utilisation** factors are predictive of long-term neck pain, neck disability, psychological distress, and perceived non-recovery in people with acute whiplash associated disorders?

P.10.1. Executive summary

There were 3 studies that informed the recommendations regarding health care utilisation factors and their relationship with poor outcome after whiplash (Buitenhuis 2008, Gun et al 2005, Skillgate et al 2016).

P.10.2. Outcome: Neck pain

There was one study that examined health care utilisation factors associated with ongoing pain. This study found that treatment by a physiotherapist or chiropractor was associated with ongoing pain.

Table 60: Health care utilisation factors predictive of long-term neck pain with acute whiplash

Ongoing pain

Prognostic Factor	Number of studies	Author, year	Measure	Positive or negative association	Risk of bias (QUIPS)	**Data** *β: Adjusted β coefficient* *OR: Adjusted Odds Ratio* *RR: Adjusted Risk Ratio*
Primary healthcare professional utilisation	1	Gun 2005	Treated by physiotherapist or chiropractor (ref: no)	+A*	Low	β = -0.94, p<0.05

*Pain outcome was 'improvement' in pain, and therefore, primary healthcare professional utilisation was positively associated with ongoing pain.

GRADE ASSESSMENT
Unable to perform grade certainty rating as the findings were considered as secondary evidence and no confidence intervals were reported.

P.10.3. Outcome: Neck disability

No studies examined health care utilisation factors associated with ongoing disability.

P.10.4. Psychological distress

One study examined three health care utilisation factors associated with ongoing psychological distress. The evidence for health care utilisation factors associated with ongoing psychological distress were:

- Hospital visit: 1/1 NA
- Hospital admission: 1/1 NA
- GP visit: 1/1 NA

Table 61: Health care utilisation factors predictive of long-term psychological distress with acute whiplash

Prognostic Factor	Number of studies	Author, year	Measure	Positive or negative association	Risk of bias (QUIPS)	Data *β: Adjusted β coefficient* *OR: Adjusted Odds Ratio* *RR: Adjusted Risk Ratio*	Pooled OR (95% CI)
Hospital utilisation	1	Buitenhuis 2008	Hospital visit (no; immediately by ambulance; immediately, on own initiative; later, after visit to GP)	NA	Low	Univariate NS (result not reported)	-
			Hospital admittance (no, <1 day, >1 day)	NA	Low	Univariate NS (result not reported)	-
GP utilisation	1	Buitenhuis 2008	GP visit (no, <1 day, <1 week, >1 week)	NA	Low	Univariate NS (result not reported)	-

GRADE ASSESSMENT

Unable to perform grade certainty rating as the findings were considered as secondary evidence and no confidence intervals were reported.

P.10.5. Perceived non-recovery

There was one study that examined health care utilisation factors associated with non-recovery. The evidence for health care utilisation factors associated with non-recovery were:

- Seeing a physician and high utilisation of physiotherapy (≥once per week): 1/1 +A
- Seeing a physician and high utilisation of chiropractor (≥once per week): 1/1 +A

Table 62: Health care utilisation factors predictive of long-term perceived non-recovery with acute whiplash

Prognostic Factor	Number of studies	Author, year	Measure ^	Positive or negative association	Risk of bias (QUIPS)	Data *β: Adjusted β coefficient* *OR: Adjusted Odds Ratio* *RR: Adjusted Risk Ratio* *HRR: Adjusted Hazard Rate Ratio**
Primary healthcare professional utilisation	1	Skillgate 2016	a) Seeing a physician & high utilisation of physiotherapy (≥once per week) [a] b) Seeing a physician & high utilisation of chiropractor [b] (ref: low utilisation)	+A* +A	Low	a) HRR 0.56 (0.48, 0.65) b) HRR 0.68 (0.55, 0.85)

[a] Ref= low utilisation, i.e., seeing a physiotherapist <4 times per month

[b] Ref= low utilisation, i.e., seeing a chiropractor <4 times per month

*Greater primary healthcare utilisation was associated with non-recovery.

GRADE ASSESSMENT

High ⊕⊕⊕⊕ certainty in the evidence for a strong positive association between primary healthcare professional utilisation and non-recovery. Low risk of bias, sample size well above the optimal information size, and findings applicable to an Australian context.

P.10.6. Overall summary (health care utilisation factors)

Table 63: Overall summary (health care utilisation factors)

Health care utilisation	Pain	Disability	Non-recovery	Psych distress	Total	Overall	Pooled OR / Key findings
Primary healthcare professional utilisation	1A		1A		**2A**	**A**	High certainty in the evidence for a strong positive association between primary healthcare professional utilisation and non-recovery.
Hospital utilisation				1NA	1NA	**I**	-
GP utilisation				1NA	1NA	**I**	-

A= associated, I= inconclusive, NA= not associated

P.10.7. Evidence to decision framework (health care utilisation factors)

Table 64: Evidence to decision framework (health care utilisation factors)

Strength of association How substantial are the associations between explanatory factors and critical outcomes?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Trivial ○ Small ○ **Moderate** ○ Large ○ Varies ○ Don't know	There was a strong positive association between greater primary healthcare professional utilisation and non-recovery and supporting evidence for an association with ongoing pain at 12mo. Associations between hospital utilisation and GP utilisation and long-term prognosis were inconclusive.	A causal relationship between primary HCP utilisation and poor outcome cannot be assumed from these studies.
Undesirable Effects How substantial are the undesirable anticipated effects when assessing these factors?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS

○ Large ○ Moderate ○ Small ○ **Trivial** ○ Varies ○ Don't know	Not measured in the studies.	Anticipated undesirable effects of assessing these factors are trivial, given that these outcomes can be obtained by injured person self-report during an initial interview and/or may be present in clinical past medical history documentation.
Certainty of evidence What is the overall certainty of the evidence of effects?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Very low ○ Low ○ Moderate ○ **High** ○ No included studies	High certainty in the evidence for a strong positive association between greater primary healthcare professional utilisation and non-recovery. Data were insufficient to evaluate the certainty of evidence for other outcomes.	Health care utilisation is not routinely included in prognostic factor studies.
Balance of effects Does the balance between desirable and undesirable effects favour assessing or not assessing these factors?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Favours not assessing ○ **Probably favours not assessing** ○ Does not favour either assessing or not assessing ○ Probably favours assessing ○ Favours assessing ○ Varies ○ Don't know	Probably favours not assessing healthcare utilisation factors for the purpose of determining prognosis.	Asking about any prior treatment is part of routine initial consultation and is useful information for primary HCPs prior to commencing treatment. People who are low risk of poor prognosis may have poorer prognosis with overtreatment.
Resources required How large are the resource requirements (costs)?		

JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Large costs ○ Moderate costs (acute/chronic) ○ **Negligible costs and savings** ○ Moderate savings ○ Large savings ○ Varies ○ Don't know	No evidence.	Can be asked when doing a routine consult and does not require additional resources. Probably expected by people with whiplash and primary HCPs.
Cost effectiveness Does the cost-effectiveness of the assessing the factor favour assessing or not assessing the factor		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Favours not assessing ○ Probably favours not assessing ○ Does not favour either assessing or not assessing ○ Probably favours assessing ○ Favours assessing ○ Varies ○ **No included studies**	No evidence.	No cost associated, part of routine consult.
Equity What would be the Impact on health equity?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Reduced ○ Probably reduced ○ **Probably no impact** ○ Probably increased ○ Increased	No evidence.	Can be asked when doing a routine consult.

○ Varies ○ Don't know		
Acceptability Is assessing the factor acceptable to key stakeholders?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ No ○ Probably no ○ Probably yes ○ **Yes** ○ Varies ○ Don't know		Previous treatment history is probably expected during initial consultation by injured people and primary HCPs.
Feasibility Is assessing the factor feasible to implement?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ No ○ Probably no ○ Probably yes (acute/chronic) ○ **Yes** ○ Varies ○ Don't know		Can be asked when doing a routine consult.

P.10.8. Summary of judgements (health care utilisation factors)

Table 65: Summary of judgements (health care utilisation factors)

Strong recommendation for not measuring the factor(s)	Conditional recommendation to not measure the factor (s)	Conditional recommendation for either measuring the factor (s) or not	Conditional recommendation for measuring the factor (s)	Strong recommendation for measuring the factor(s)
○	○	○	○	○
Recommendation: The guideline panel suggest healthcare professionals do not measure health care utilisation for the purposes of prognosis.				

Panel vote summary: 6/12 50% conditional against, 3/12 strong against, 2/12 neutral, 1/12 conditional for.

Justification

Evidence:

- Three studies informed the recommendations for health care- utilisation. While there is a strong positive association between primary healthcare professional treatment (physiotherapy or chiropractic) and non-recovery, a causal relationship cannot be inferred.

Acceptability and feasibility:

- Questions around healthcare utilisation is expected by injured people as part of a routine consultation.

Sub-group considerations:

There is an issue around over-treating people; those at low-risk require less treatment. This sub-group may recover less well if they are over-treated. It is important not to create a problem by giving unnecessary treatment.

Implementation considerations

- Healthcare professionals need to monitor their own practice, for example, by following the Clinical Framework for the Delivery of Health Services when treating people with WAD.
- Healthcare professionals also need to ensure they do not continue treatment where there is no benefit.
- Asking about healthcare utilisation might be helpful for other reasons (change of care).

P.11. Chronic whiplash

Question: What prognostic factors are associated with poor outcome (ongoing neck pain, disability and psychological distress and ongoing non-recovery) for people with chronic whiplash.

P.11.1. Summary of included studies

There were 5 studies (Alalawi 2022, Alalawi 2022b, Angst 2014, Rebbeck et al 2006, Sullivan et al 2009) that examined factors associated with poor outcome after chronic whiplash.

P.11.2. Outcome: Ongoing neck pain

One study (Angst et al 2014) investigated factors associated with ongoing pain in people with chronic whiplash. This study found symptom factors (baseline pain and function), psychological factors (low mood, pain catastrophising), sociodemographic (work status) and physical activity levels were associated with ongoing pain. Being a smoker was not associated with ongoing pain.

Table 66: Factors associated with long-term neck pain with chronic whiplash

Prognostic category	Number of studies	First author, year	Measure	+ or - association	Risk of bias (QUIPS)	Data *β: Adjusted β coefficient* *OR: Adjusted Odds Ratio* *RR: Adjusted Risk Ratio*
Symptoms	1	Angst 2014	Baseline pain (NASS)[1] Baseline function (NASS)	+A +A	Low	Regression coefficient -.86 p<.001[2] Regression coefficient -0.665 p<.001
Psychological	1	Angst 2014	Mood: depression anxiety (HADS) Catastrophising –CSQ change	+A +A	Low	Regression coefficient -0.357 p =.008 Regression coefficient 0.232 p =.04
Sociodemographic	1	Angst 2014	Work capacity at baseline	+A	Low	Regression coefficient 0.2 p =.03
Previous health	1	Angst 2014	Smoker Sport (physical activity) at baseline	NS +A	Low	Multivariate NS Regression coefficient 2.5 p =.03

1 NASS North American Spine Society cervical spine self-assessment instrument

2 Outcome was “pain relief” hence the –ve co-efficient

GRADE ASSESMENT

Certainty of evidence not evaluated as these data were considered as secondary evidence.

P.11.3. Outcome: Ongoing neck disability

Three studies examined factors associated with ongoing disability in people with chronic whiplash. The summary of the evidence is as follows:

- Symptom factors: initial disability: 1/2 +A, ½ NA; Initial pain ½ +a, 1.2 NA; extent of pain 1/1 NA, pain duration 1/1 NA
- Psychological factors: low mood: 1/2 +A, 1/2 NA; pain catastrophising I/1 NA, self-efficacy 1/1 NA.
- Sociodemographic factors: age 1/1 NA, work ability 1/1 NA
- Previous health: more pain episodes I/1 +A, poorer physical function at baseline 1/1 +A, poor previous general health 1/1 NA, lower participation in sport 1/1 NA
- Physical Assessment: poorer cervical flexor muscle strength I/1 +A, poorer cervical ROM 1/1 NA, joint position error 1/1 NA, extensor muscle strength 1/1 NA

Table 67: Factors associated with long-term disability with chronic whiplash

Prognostic Factor	Number of studies	First author, year	Measure	+ or - association	Risk of bias (QUIPS)	**Data** *β: Adjusted β coefficient* *OR: Adjusted Odds Ratio* *RR: Adjusted Risk Ratio*
Symptoms						
• **Initial disability**		Alalawi (2022)	Initial disability (NDI)	NA	Low	Univariate NS
		Alalawi (2022b)	Initial disability (NDI)	**+A**	Low	**B 0.401 (0.109 to 0.693)**
• **Initial pain**	3	Angst (2014)	**Bodily pain at baseline (SF36)**	**+A**	Low	**Regression coefficient 0.202 p=.023**
		Alalawi (2022)	Pain Intensity	NA	Low	Univariate NS
• **Extent of pain**		Alalawi (2022b)	Extent of pain	NA	Low	Sig in Univariate, NS in multivariate
• **Pain duration**		Alalawi (2022)	Pain duration	NA	Low	Univariate NS
Psychological		Alalawi (2022)	Fear avoidance (TSK)	NA	Low	Univariate NS
• **Beliefs**		Alalawi (2022b)	Self-Efficacy (SES)	NA	Low	NS in multivariate

• **Mood**		Alalawi (2022b) Angst (2014)	Mood (Anxiety and depression)-HADS **Mood (depression)-HADS**	NA **+A**	Low Low	NS in multivariate **Regression coefficient 0.250 p<.001**
Sociodemographic		Angst 2014 Alalawi (2022b)	Older age Work ability	NA NA	Low Low	NS in multivariate NS in multivariate
Previous health		Alalawi (2022) Alalawi (2022) Angst (2014) Angst (2014)	**Previous number of pain episodes** Previous general health (EQ5D) **Physical function at baseline (SF36)** Sport (physical activity at baseline)	**+A** NA **+A** NA	Low Low	**B 0.54 (0.09 to 0.99) p=.02** Univariate NS **Regression coefficient -0.622 p<.001** NS in multivariate
Physical Assessment		Alalawi (2022) Alalawi (2022) Alalawi (2022) Alalawi (2022)	Cervical ROM Joint position error **Cervical flexor muscle strength (MVC)** Cervical extensor muscle strength	NA NA **+A** NA	Low	Univariate NS Univariate NS **B -0.32 (-0.64 to -0.01) p=.04** Univariate NS

GRADE ASSESSMENT

Certainty of evidence not evaluated as these data were considered as secondary evidence or data not available

P.11.4. Outcome: Perceived non-recovery

One study examined factors associated with non-recovery for people with chronic whiplash. The summary of the evidence was:

- symptom factors: initial disability: 1/1 +A
- psychological factors: Mental health (SF36 MCS) 1/1 NA
- Sociodemographic factors: age, gender, employment, education, SE status 1/1 NA
- Crash: driver 1/1 NA
- Compensation: claim status (open vs closed) 1/1 +A, time to admit liability, economic loss claim, prior claim NA

Table 68: Factors associated with perceived non-recovery with chronic whiplash

Prognostic Factor	Number of studies	First author, year	Measure	+ or -association	Risk of bias (QUIPS)	**Data** *β: Adjusted β coefficient* *OR: Adjusted Odds Ratio* *RR: Adjusted Risk Ratio*
Symptoms	1	Rebbeck (2006)	**Initial disability (FRI)**	**+A**	**Low**	**B -0.41 p=.001**[1]
Psychological		Rebbeck (2006)	Mental health (SF 36 MCS)	NA	Low	NS in multivariate
Sociodemographic		Rebbeck (2006)	Age Gender Employment Education SE status	NA	Low	NS in univariate
Crash		Rebbeck (2006)	Driver	NA	Low	NS in univariate
Compensation		Rebbeck (2006)	**Claim status (open vs closed)** Time to admit liability Economic loss claim Prior claim	**+A** NA NA NA	Low	**B 1.41 p=o.02** NS in univariate NS in univariate NS in univariate

1 Outcome was recovery hence the negative co-efficient

GRADE ASSESSMENT

Certainty of evidence not evaluated as these data were considered as secondary evidence or data were not available.

P.11.5. Outcome: Persistent / ongoing psychological distress

One study examined factors associated with ongoing psychological distress (persistent post-traumatic stress symptoms) in people with chronic whiplash. Only perceived injustice was found to be associated with ongoing psychological distress. Symptom, sociodemographic, crash, physical assessment and other psychological factors were not associated with ongoing psychological distress.

Table 69: Factors associated with persistent / ongoing psychological distress with chronic whiplash

Pre-injury Prognostic Factor	Number of studies	First author, year	Measure	+ or - association	Risk of bias (QUIPS)	**Data** *β: Adjusted β coefficient* *OR: Adjusted Odds Ratio* *RR: Adjusted Risk Ratio*
Symptoms	1	Sullivan (2009)	Neck disability (NDI) Number of pain sites Pain severity (O-10) Time since injury Pain (MPQ-PRI)	NA NA NA NA NA	Low	OR 1.0 (0.95 to 1.2)-NS NS in multivariate NS in multivariate NS in univariate NS in multivariate
Psychological	1	Sullivan (2009)	Pain Catastrophising (PCS) Fear Avoidance (TSK) Depression (BDI) **Perceived Injustice (IEQ)**	NA NA NA **+A**	Low	NS in multivariate NS in multivariate NS in multivariate **OR 1.2 (1.0 to 1.3)**
Physical Assessment	1	Sullivan (2009)	Cervical ROM	NA		NS in multivariate
Sociodemographic	1	Sullivan (2009)	Age Gender Education	NA NA NA	Low	NS in univariate NS in univariate
Crash	1	Sullivan (2009)	Collision speed	NA	Low	NS in univariate

GRADE ASSESSMENT

Symptoms: Neck disability: Low certainty ⊕⊕◯◯ of a trivial association between neck disability and ongoing psychological distress. Risk of bias and indirectness were not serious. Imprecision was deemed very serious given that the findings were from a single study with sample size below the adequate threshold, and the confidence intervals reached the meaningful threshold and crossed 1.0. Remaining outcomes: Data were not available for evidence grading.

Psychological: Perceived injustice: Low certainty ⊕⊕◯◯ of a moderate association between perceived injustice and ongoing psychological distress. Risk of bias and indirectness were not serious. Imprecision was deemed very serious given that the findings were from a single study with sample size below the adequate threshold, and the lower bound of the confidence intervals was 1.0. Remaining outcomes: Data were not available for evidence grading.

Physical Assessment, Sociodemographic and Crash Factors: Certainty of evidence not evaluated as these data were considered as secondary evidence or data were not available for evidence grading.

P.11.6. Overall summary (chronic WAD)

Table 70: Overall summary (chronic WAD)

Factors	Pain	Disability	Non-recovery	Psych distress	Total	Overall
Symptom • Baseline pain • Baseline disability/ function • Extent of pain • Duration of pain • Pain (MPQ)	1 A 1 A - - -	1 A, 1NA 1 A, 1 NA 1 NA 1 NA -	- 1 A - - -	1 NA 1 NA 1 NA 1 NA 1 NA	**2A, 2NA** **3A, 2NA** 1 NA 2 NA 1NA	**Inconclusive** given the mixed evidence, but initial pain and disability could be considered as associated with ongoing pain.
Psychological • Mood • Beliefs (PCS) • Beliefs –fear avoidance • Beliefs- self efficacy • Poor mental health • Beliefs- perceived injustice	1 A 1 A	1 A ,1 NA - 1 NA 1 NA	1 NA	1 NA 1 NA 1 NA - - 1 A	**2A, 2 NA** 2 NA 2 NA 1 NA 1 NA **1 A**	Inconclusive given the mixed evidence, but mood could be considered associated with ongoing pain and perceived injustice with psych distress
Sociodemographic • Work status • Age • Gender • Employment • Education • SES	I A - - - - -	1 NA 1 NA - - - -	- 1 NA 1 NA 1 NA 1 NA 1 NA	- 1 NA 1 NA - 1 NA -	2 NA 3 NA 2 NA 1 NA 2 NA 1 NA	Overall sociodemographic factors NA- as none of them are associated.
Crash • Driver • Collision speed	-		1 NA 1 NA			NA – none associated

Previous Health • Smoker • Physical activity • Poorer physical health • Previous pain episodes • Poorer general health	1 NA 1 A	- 1 NA 1 NA 1 A 1 NA	-			Inconclusive given the evidence.
Physical Assessment • Cervical ROM • Joint position error • Cervical flexor strength • Cervical extensor strength		1 NA 1 NA 1 A 1 NA		1 NA		Inconclusive given the evidence
Compensation • Open clam status • Time to admit liability • Economic loss claim • Prior claim			1 A 1 NA 1 NA 1 NA			Inconclusive given the evidence

A= associated, I= inconclusive, NA= not associated

P.11.7. Evidence to decision framework (chronic WAD)

Table 71: Evidence to decision framework (chronic WAD)

Strength of association How substantial are the associations between explanatory factors and critical outcomes?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
• **Trivial** ○ Small ○ Moderate ○ Large ○ Varies ○ Don't know	Overall inconclusive evidence for all factors. However, some studies (more than 1) did find that high initial pain and disability (as assessed in the chronic phase), low mood, and perceived injustice were associated with an ongoing poor outcome.	These factors are consistent with acute whiplash and other MSK pain states.
Undesirable Effects		

How substantial are the undesirable anticipated effects when assessing these factors?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Large ○ Moderate ○ Small ● **Trivial** ○ Varies ○ Don't know	Not measured in the studies.	Anticipated undesirable effects are trivial, given that most factors can be assessed either by interview with the person or questionnaires. Psychological questionnaires are usually administered by primary HCPs who are trained in recognising any distress this may cause (even if unlikely).
Certainty of evidence What is the overall certainty of the evidence of effects?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Very low ○ Low ○ Moderate ○ High ○ No included studies	**Neck disability:** Low certainty ⊕⊕◯◯ of a trivial association between neck disability and ongoing psychological distress. **Psychological: Perceived injustice:** Low certainty ⊕⊕◯◯ of a moderate association between perceived injustice and ongoing psychological distress.	
Balance of effects Does the balance between desirable and undesirable effects favour assessing or not assessing these factors?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Favours not assessing ○ Probably favours not assessing ● Does not favour either assessing or not assessing ○ Probably favours assessing ○ Favours assessing ○ **Varies** ○ Don't know	Probably favours assessing pain and disability and low mood. Neutral – all other factors Probably favours not assessing sociodemographic in relation to poor outcome.	Consistent with acute whiplash and pragmatic.

Resources required How large are the resource requirements (costs)?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Large costs ○ Moderate costs (acute/chronic) ● **Negligible costs and savings** ○ Moderate savings ○ Large savings ○ Varies ○ Don't know		Can be asked during a routine consult and requires self- administered questionnaires.
Cost effectiveness Does the cost-effectiveness of the assessing the factor favour assessing or not assessing the factor		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Favours not assessing ○ Probably favours not assessing ○ Does not favour either assessing or not assessing ○ Probably favours assessing ○ Favours assessing ○ Varies ○ **No included studies**	No evidence.	
Equity What would be the Impact on health equity?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ Reduced ○ Probably reduced	No evidence.	Can be asked when doing a routine consult or using self-administered questionnaires.

● **Probably no impact** ○ Probably increased ○ Increased ○ Varies ○ Don't know		May be an impact on equity for questionnaires that are not translated for non-English speaking people.
Acceptability Is assessing the factor acceptable to key stakeholders?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ No ○ Probably no ● **Probably yes** ○ Yes ○ Varies ○ Don't know		Asking these factors mostly have no impact. Asking about people's mental health may have minimal psychological impact.
Feasibility Is assessing the factor feasible to implement?		
JUDGEMENT	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
○ No ○ Probably no ○ Probably yes (acute/chronic) ● **Yes** ○ Varies ○ Don't know		Feasible due to self-administered questionnaires, and / or asking during routine consult.

P.11.8. Conclusions (prognostic factors for chronic WAD)

Vote 1: Are you for or against clinicians assessing for the following prognostic factors for people with chronic WAD to determine ongoing poor outcomes: symptom (pain intensity, neck-related disability), Psychological (mood, and perceived injustice)?

Strong recommendation for not measuring the factor(s)	Conditional recommendation to not measure the factor (s)	Conditional recommendation for either measuring the factor (s) or not	Conditional recommendation for measuring the factor (s)	Strong recommendation for measuring the factor(s)
○	○	○	○	○

Recommendation: The guideline panel suggest that healthcare professionals could consider assessing: pain intensity (VAS) and neck –related disability (NDI), mood (depression/ anxiety), and perceived injustice when assessing someone with chronic whiplash for determining those at risk of ongoing poor outcome.

Panel vote summary: 11/13 85% conditional for; 2/13 15% neutral.

Justification

Evidence:

- Evidence from the 5 studies was inconclusive, however initial pain and disability and mood could be considered as associated with ongoing pain, and perceived injustice with ongoing psychological distress.

Consistency:

- Consistent with acute whiplash and other MSK conditions

Feasibility and Acceptability:

- Is feasible for healthcare professionals to assess these factors

Implementation considerations

Symptom factors: Pain Intensity and Neck Disability

How to measure and interpret:

- Measure pain intensity with a numerical rating scale (NRS). People with scores of ≥6/10 are considered to have moderate levels of pain.
- Measure neck- related disability with the Neck Disability Index (NDI). People with scores of ≥> 15/50 (30%) are considered to have moderate -> severe disability.

If assessing the person for the first time after the injury in the chronic phase, then higher scores on these measures determine risk of ongoing poor outcome

Considerations:

- Current guidelines suggest that these factors could be measured at 3-month intervals from the crash
- Elevated levels of pain, disability or mood warrant referral to an expert if people are not recovering under standard recommended care
- Primary HCP' should consider that continuing more of the same intervention if not resulting in improvement in pain or disability should flag the requirement for referral or the need for a different type of intervention (e.g., multidisciplinary care).

Tools available on MyWhiplashNavigator

https://www.mywhiplash.com.au/sites/default/files/Visual%20Analogue%20Scale%20for%20pain%20%282%29_1.pdf
https://www.mywhiplash.com.au/sites/default/files/Neck%20Disability%20Index%20(1).pdf

Psychological factors: Depression and Perceived Injustice

How to measure and interpret:

- Measure depression with the DASS 21
- Measure Perceived Injustice with the Perceived injustice Questionnaire

Considerations:

- Current guidelines suggest that these factors could be measured at 3-month intervals from the crash
- Moderate to severe scores on DASS21 warrant referral to an expert if people are not recovering under standard recommended care
- Primary HCP' should consider that continuing more of the same intervention if not resulting in improvement in pain or disability should flag the requirement for referral or the need for a different type of intervention (e.g., multidisciplinary care).

DASS 21 available on MyWhiplashNavigator https://www.mywhiplash.com.au/content/higher-risk-assessments#psychological-distress

Perceived injustice questionnaire not available at time of writing guideline but can be added to MyWhiplashNavigator during implementation.

Vote 2: Are you for or against clinicians assessing for the following prognostic factors for people with chronic WAD to determine ongoing poor outcomes: physical, compensation, and previous health?

Strong recommendation for not measuring the factor(s)	Conditional recommendation to not measure the factor (s)	Conditional recommendation for either measuring the factor (s) or not	Conditional recommendation for measuring the factor (s)	Strong recommendation for measuring the factor(s)
○	○	○	○	○

Recommendation: The guideline panel cannot recommend for or against measuring physical assessment, compensation and previous health for the purpose of determining ongoing poor outcome in people with chronic whiplash.

Panel vote summary: 12/13 92% neutral; 1/13 8% conditional for.

Justification

Evidence:

- Evidence from the 5 studies was inconclusive evidence. Most factors were not associated with the outcome, with some exceptions.

Consistency:

- This recommendation is consistent with acute whiplash guidelines

Feasibility and Acceptability:

- In light of other factors more likely to be associated, these factors would be considered less important (hence inefficient for or unnecessary for healthcare professionals to assess)

Implementation considerations

- Healthcare professionals may assess physical factors, compensation factors and previous health for other purposes in individual cases. For example, some assessment factors may be helpful to direct treatment (e.g., physical assessment) whilst others may be considered by people to be important in their recovery (e.g., previous health). In these individual circumstances clinical reasoning should prevail.

Vote 3: Are you for or against clinicians assessing for the following prognostic factors for people with chronic WAD to determine ongoing poor outcomes: socio-demographic and crash?

Strong recommendation for not measuring the factor(s)	Conditional recommendation to not measure the factor (s)	Conditional recommendation for either measuring the factor (s) or not	Conditional recommendation for measuring the factor (s)	Strong recommendation for measuring the factor(s)
○	○	○	○	○

Recommendation: The guideline panel suggest that sociodemographic and crash factors are not assessed for the purpose of determining ongoing poor outcome in people with chronic whiplash.

Panel vote summary: 9/13 69% conditional against, 2/13 15% strong against, 2/13 neutral 15%l, 1/13 7% strong for.

Justification

Evidence:

- In the 5 studies, no associations were found between these factors and poor outcome.

Consistency:

- This recommendation is consistent with acute whiplash guidelines

Feasibility and Acceptability:

- In light of other factors more likely to be associated, these factors would be considered less important (hence inefficient for or unnecessary for healthcare professionals to assess).

Implementation considerations

Not recommended to determine prognosis

9. References

9.1. References: Methods

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10. List of tables

11. List of figures

12. Appendices

A.1. Appendix A1: List of included studies – acute whiplash

ID	Author, Year	Country, Setting	Title	Baseline N	Follow-up (m)	Outcome(s)	Prognostic factors assessed*	Primary authors' conclusion
1	Ameratunga, 2010	NZ, Other setting	Chronic neck pain following car crashes: A population-based study from Auckland, New Zealand.	268	5, 18m	1-Pain	3 - PTSD; depression 4 - Age, gender, education, living situation, income 5 -ISS, seat belt use 7- Pre-injury general health (SF-36); previous psych history 8 - Disability benefit / compensation	Depressive and post-traumatic stress symptoms at 5 months were associated with an increased risk of moderate to severe neck discomfort at 18 months. Participants with and without neck discomfort had significantly reduced health-related quality of life based on Short Form-36 scores. Significant neck discomfort limiting usual function is relatively common up to 18 months following crashes.
2	Andersen, 2019	Denmark, Emergency	Attachment insecurity as a vulnerability factor in the development of chronic WAD – a prospective cohort study	205	6m	2-Disability	1 - Initial neck pain intensity (NRS), Initial neck disability (PDQ) 3 - Anxiety; Attachment (anxiety, avoidance, fear); depression (HADS); PCS, Fear avoidance (Orebro)	Attachment insecurity, measurable before onset of injury, represents a valuable pre-trauma vulnerability for less optimal recovery after whiplash injury
3	Asenlof, 2013	Sweden, Emergency	The clinical course over the first year of whiplash associated disorders (WAD): pain-related disability	73	3,6,12 m	2-Disability (PDI)	1 - Pain disability index at baseline (PDI), Pain intensity, WAD grade 3- self efficacy (Swedish SES), Fear of movement (TAMPA),	Pain-related disability at baseline was the only statistically significant predictor of pain-related disability one-year post-injury.

ID	Author, Year	Country, Setting	Title	Baseline N	Follow-up (m)	Outcome(s)	Prognostic factors assessed*	Primary authors' conclusion
			predicts outcome in a mildly affected sample.				Pain Catastrophising (CSQ), PTSD (IES) 4. marital status, age, education, employment	
4	Atherton, 2006	UK, Emergency	Predictors of persistent pain after whiplash injury	765	1,3,12 m	1-Pain	1 - NDI, no WAD symptoms, WAD grade 1 - GHQ, Modified somatic perceptions questionnaire, neurological symptoms / signs 4 - Sex, job satisfaction 5 - Own vehicle- speed and direction of vehicle, self-rated collision severity, awareness of collision, position in vehicle, headrest, seatbelt use, airbag 6 - neck ROM, neurological cervical bony tenderness 7 - Pre-crash body pain, pre-crash general health, lifetime experience of neck pain, GP consultations in year prior to collision, job satisfaction	The greatest predictors of persistent neck pain following a motor vehicle collision relate to psychological distress and aspects of pre-collision health rather than to various attributes of the collision. itself.

ID	Author, Year	Country, Setting	Title	Baseline N	Follow-up (m)	Outcome(s)	Prognostic factors assessed*	Primary authors' conclusion
5	Berglund, 2006	Sweden, Insurance	The influence of prognostic factors on neck pain intensity, disability, anxiety and depression over a 2-year period in subjects with acute whiplash injury.	2280	1, 6, 12, 24m	2 - Pain (neck pain intensity VAS) 3 – Disability (DRI) 4 - Psych function (HADS)	1 - Initial neck pain severity (mild VAS 0-30, moderate VAS 31-54, severe VAS 55-100); headache 3 - Neck complaints/perceived reduced neck movements and numbness/pain in arms/hands 3 – Helplessness (Rheum attitudes index), Health locus of control, anxiety depression (HADS), 4 – gender, age, education, income 5. position in vehicle, direction of impact, awareness of collision, use of head rest, use of seat belt, head postion at impact	Overall, initial neck pain intensity was an important prognostic factor, but acted also as an evident effect modifier. Injury severity was associated with all outcomes but was most pronounced regarding disability among those who perceived numbness/pain in arms/hands and severe initial neck pain. Initial headache influenced all outcomes. A lower level of education was associated with all outcomes but depression. Locus of control was not a factor of importance. Helplessness was related to all outcomes but was most pronounced with severe initial neck pain.
6	Borenstein, 2010	Sweden, Tertiary	Cognitive symptoms, cervical range of motion and pain as prognostic factors after whiplash trauma.	97	3yrs	2 - Disability (sick leave at 3 years)	1- symptom (shoulder, head and neck pain intensity on VAS; subjective cognitive symptoms like abnormally fatigued, forgetful, easily irritated, excessively emotional, easily distracted) 6 - physical / impairment factors (cervical range of motion)	Initial pain and reduced CROM may be related to minor tissue damage which often heals while late functionality is more dependent on other factors such as cognitive dysfunction. For patients with whiplash-associated disorders two simple questions should be asked; 'Are you currently easily irritated?' and 'Are you currently easily distracted (e.g., is it difficult for you to follow a conversation if several people are talking in the room at the same time)?'. An affirmative answer to any of these questions indicates an

ID	Author, Year	Country, Setting	Title	Baseline N	Follow-up (m)	Outcome(s)	Prognostic factors assessed*	Primary authors' conclusion
								increased risk for poor prognosis defined as sick leave 3 years later
7	Bostick, 2013	Canada, Private (Physio, GP)	Predictive capacity of pain beliefs and catastrophizing in Whiplash Associated Disorder.	72	3, 6m	2 - Pain (neck pain intensity on 11-point NRS) 3 – Disability (WDQ)	3 - Pain Beliefs and Perception Inventory (PBPI); PCS; SOPA (control, disability, emotion, harm, medical cure, medication, solicitude)	Expectancy beliefs (PBPI Permanence and SOPA Medical Cure) were negatively correlated with pain intensity at 6-months and uniquely accounted for 16% and 14% of explained variance, respectively, after controlling for baseline pain intensity, age, sex and history of WAD. Catastrophizing was also found to be predictive of future pain. The results suggest that expectancy beliefs are potentially important constructs to include in future explanatory prognosis studies. The Medical Cure and Permanence subscales of the SOPA and PBPI are tools that could be used to measure these expectancy constructs.
7a	Buitenhuis, 2006b	Netherlands, Insurance	Can kinesiophobia predict the duration of neck symptoms in acute whiplash?	211	6m	3 – Recovery (Duration of symptoms)	3 – Psychological (Kinesiophobia through TSK)	Although a higher score on the TSK-DV was found to be associated with a longer duration of neck symptoms, information on early kinesiophobia was not found to improve the ability to predict the duration of neck symptoms after motor vehicle collisions.
8	Buitenhuis, 2006a	Netherlands, Insurance	Relationship between posttraumatic stress disorder symptoms and the course of whiplash complaints.	240	1,6,12 m	2 - Pain (severity of whiplash complaints which consists of	1 - Neck pain intensity, headache intensity, back pain intensity, neck stiffness, arm pain, paresthesia severity, concentration, dizziness 3 - PTSD (self-rating scale)	PTSD was related to the presence and severity of concurrent post-whiplash syndrome. More specifically, the intensity of hyperarousal symptoms that were related to PTSD at Q1 was found to have predictive validity for the persistence and

ID	Author, Year	Country, Setting	Title	Baseline N	Follow-up (m)	Outcome(s)	Prognostic factors assessed*	Primary authors' conclusion
						11 complaint variables like severity of neck movement restriction and dizziness)	4 - Age, gender 9 - Hospital visit, medication use, GP visit, hospital admittance	severity of post-whiplash syndrome at 6- and 12-months follow-up.
9	Buitenhuis, 2008	Netherlands, Insurance	Catastrophising and causal beliefs in whiplash.	140	1,6, 12m	2 - Pain (severity of neck complaints) 3 – Recovery (Persistence of neck complaints)	1 - NDI score (mean), paresthesia, radiating pain to the arms 3 - PCS 3 - Causal beliefs of post-traumatic neck complaints (Causal Beliefs Questionnaire Whiplash (CBQ-W) developed for this study). The CBQ-W consists of the following sub-categories: psychological, severe injury, vertebral, muscular, whiplash, PCS total score. 4 – Age, gender 6 - Physical: NDI @ 12 months	The results suggest that causal beliefs may play a major role in the perceived disability and course of neck complaints after motor vehicle accidents, whereas pain catastrophizing is predominantly related to concurrent disability. The current findings are consistent with the view that an early conviction that neck complaints are caused by the medico-cultural entity whiplash has a detrimental effect on the course of symptoms.

ID	Author, Year	Country, Setting	Title	Baseline N	Follow-up (m)	Outcome(s)	Prognostic factors assessed*	Primary authors' conclusion
10	Buitenhuis, 2003	Netherlands, Insurance	Recovery from acute whiplash: the role of different coping styles.	242	4, 8, 12m	1 – Pain (neck pain duration)	1 – Symptom (coping though Utrect Coping List, neck pain intensity through 1-10 NRS, headache intensity through 1-10 NRS, neck stiffness through 1-10 NRS, severity of restricted neck movements through 1-10 NRS, extent of neck pin through 1-10 NRS, severity of paresthesia in the arms through 1-10 NRS, concentration complaints through 1-10 NRS, dizziness through 1-10 NRS, use of medication since accident Y/N, sleep disturbance Y/N, daily duration of pain in 1-5 scale, hours after accident until onset of neck complaints in hours) 4 – sociodemographic (age, gender)	The coping style during the first few weeks after the accident and the gender are related to the duration of neck complaints. (Cox regression: palliative handling relative risk=0.91, p = 0.002, seeking social support relative risk=1.06, p = 0.042 and gender relative risk=1.50, p = 0.036). Thereafter the intensity of somatic complaints plays a role. Paying attention to the coping style could contribute to the prevention of the development of late whiplash syndrome.
11	Carroll, 2011	Canada, Insurance	Pain-related emotions in early stages of recovery in whiplash-associated disorders: Their presence, intensity, and association with pain recovery.	2986	4, 8, 12m	3 – Recovery (Post-crash pain recovery)	3 – Psychological (Self-reported pain-related depression, anxiety, fear, anger, and frustration were assessed using 100-mm visual analog scales)	These findings suggest that it may be beneficial for health care providers to address emotional status related to pain in the first few weeks after a whiplash injury.
12	Carroll, 2009	Canada, Insurance	Recovery in whiplash-associated disorders: do you get what you expect?	6015	3, 6, 9, 12m	3 - Recovery (global	1 – Initial neck / shoulder pain, back pain intensity, headache	Patients' early expectations for recovery are an important prognostic factor in recovery after whiplash injury and are

ID	Author, Year	Country, Setting	Title	Baseline N	Follow-up (m)	Outcome(s)	Prognostic factors assessed*	Primary authors' conclusion
						self-assessment to question, "How well do you feel like you are recovering from your injuries")	(NRS); post-injury self-reported health 3 - Depression (Center for Epidemiological Studies—Depression Scale (CES-D)) 4 – Age, sex, marital status, highest educational level, family income	potentially modifiable. Clinicians should assess these expectations in order to identify those patients at risk of chronic whiplash, and future studies should focus on the effect of changing these early expectations.
13	Carstensen, 2015	Denmark, Other (ED or primary care)	Sick Leave within 5 Years of Whiplash Trauma Predicts Recovery: A Prospective Cohort and Register-Based Study.	719	12m	1 – Recovery (positive of negative change in health-related provisional situation) 2 – Pain (neck pain on 11-point VAS scale)	1 – Neck pain at inclusion (VAS-11) 4 – Age (older age), gender (female), education (>4 years higher education), social assistance @ baseline 7 – Pre-collision unspecified pain condition, sickness benefit, unemployment benefit 8 - Compensation (sickness benefit)	Sick leave before the collision strongly predicted prolonged recovery following whiplash trauma. Participants with acute whiplash trauma had weaker attachment to labour market pre-collision compared with the general population. Neck pain at inclusion predicted future neck pain. Acute whiplash trauma may trigger pre-existing vulnerabilities increasing risk of developing whiplash-associated disorders
14	Carstensen, 2009	Denmark, Other (ED or primary care)	Post-trauma ratings of pre-collision pain and psychological distress predict poor outcome following acute whiplash	740	12m	1 – Recovery (Work capability) 2 - Pain: neck pain,	3 – psychological (pre-collision psychological distress using Whiteley-7 and Symptom Checklist SCL-90) 4 – sociodemographic (age, gender, education, occupation)	In conclusion unspecified as opposed to specified pain (neck pain) before the collision is associated with poor recovery and high accumulation of pre-collision psychological distress is associated with considerable neck pain at follow-up.

ID	Author, Year	Country, Setting	Title	Baseline N	Follow-up (m)	Outcome(s)	Prognostic factors assessed*	Primary authors' conclusion
			trauma: a 12-month follow-up study.			VAS, 0-10. Minimal neck pain VAS 0-3, considerable neck pain VAS 4-10).	5 – crash-related (delta speed and extent of damage to the car after collision) 7 - pre-crash health (presence of pre-collision healthcare illness like nerve and joint diseases, presence of pre-collision pain problems, presence of pre-collision neck pain problems)	However, no conclusions on causality can be drawn. Personal characteristics before the collision are important for recovery and attention to pre-collision characteristics may contribute to the prevention of poor recovery after acute whiplash trauma.
15	Carstensen, 2012	Denmark, Other (ED or primary care)	Are there gender differences in coping with neck pain following acute whiplash trauma? A 12-month follow-up study.	476	12, 24m	2 – Pain (neck pain on 11-point VAS)	3 – psychological (coping variables using Coping Strategies Questionnaire, 4 – sociodemographic (age, gender, education, occupation, living conditions) 5 – crash-related (delta speed and extent of damage to the car after collision)	No interaction between coping and gender on neck pain was found, thus different coping strategies 3 months post-collision did not explain the different prognosis observed in men and women. Clinically relevant influence of 'catastrophizing' and 'praying and hoping' to prognosis was found, therefore we should identify patients predominantly using these strategies.
16	Casey, 2015a	Australia, Insurance	Course of recovery for whiplash associated disorders in a compensation setting.	246	12m	2 - Pain (pain catastrophising using PCS) 3 - Disability (Functional Rating Index (FRI))	1 – Disability- FRI, Symptom: Extent of body pain 3 – Psychological: PCS and SF 36 mental 4 – Sociodemographic: Age 7 - Pre-crash factors: General health (SF36)	There is a strong and plausible association between severe disability, clinical levels of pain catastrophising and low mental health. Claimants can be identified at claim notification based on three estimated recovery trajectories. Claim and clinical interventions can be targeted to the profile within each recovery trajectory.

ID	Author, Year	Country, Setting	Title	Baseline N	Follow-up (m)	Outcome(s)	Prognostic factors assessed*	Primary authors' conclusion
						4 - Psych function: SF36 Mental Component Score (SF36-MCS))		
17	Casey, 2015b	Australia, Insurance	Associations with legal representation in a compensation setting 12 months after injury.	246	12m	1 - Recovery (health assessed using Functional Rating Scale)	1 – symptom (Functional Rating Index) 3 – psychological (Pain catastrophising, SF 36 mental) 4 – sociodemographic (Age, gender, employment) 8 – compensation (Claim finalised, legal involvement)	This study suggests the people with lawyer involvement in their claim 12 months after injury have socio-economic disadvantage, have had a prior claim and a worse baseline health profile compared to those without a lawyer. Understanding this profile could allow for improved claims processes and targeted interventions to assist this group through any perceived complexities in the system and address the underlying reasons for lawyer participation within compensation schemes
18	Cobo, 2010	Spain, Tertiary service	What factors have influence on persistence of neck pain after a whiplash?	557	6m	2 - Pain	1- Symptom: a) Initial pain intensity (VAS) b) Northwick Park Neck Pain Questionnaire (NPH, 0-100) c) Dizziness (Y/N) 4 – age, employment, gender 5. localisation of impact, position in vehicle 7. pre-existing health problem	Our findings indicate that factors that allow us to identify patients at risk for poor recovery are age, dizziness, and initial evaluation of neck pain with VAS and cervical column functionality with NPH

ID	Author, Year	Country, Setting	Title	Baseline N	Follow-up (m)	Outcome(s)	Prognostic factors assessed*	Primary authors' conclusion
19	Gehrt 2015	Denmark, ED/GP	The role of illness perceptions in predicting outcome after acute whiplash trauma. A multicentre 12-month follow-up study.	747	12m	2 – Pain (neck pain)	1 – Neck pain at baseline (VAS-11pt) 3 – Illness perceptions (IPQ); expectation to RTW / working ability @ 3 months 3 - Age, sex, and education ("basic school <10 y" or "further education"). 6 – Affected working ability	The findings are in line with the common-sense model of illness and previous research demonstrating that patient's expectations for recovery and illness perceptions might influence the course after whiplash injury. Illness perceptions expectations may provide a useful starting point for future interventions and be targeted in the prevention of chronicity.
20	Griffin, 2019	Australia, Emergency	Evidence-based care in high- and low-risk groups following whiplash injury: a multi-centre inception cohort study.	215	12m	1 - Recovery 3 - Disability	1 - Pain (NRS), Pain Catastrophising scale (PCS), disability (NDI), General Health (short Form-12 and EQ5D3L) 3 - post-traumatic stress symptoms (IES-R), negative expectations of recovery (OMPQ), and depression, anxiety and stress (DASS) 7 - HRQL pre-injury EQ5D3L score	The therapeutic relationship was identified as one of several important predictors of recovery, suggesting that clinicians must develop rapport and understanding with their patients to improve the likelihood of recovery.
21	Gun, 2005	Australia, Emergency	Risk factors for prolonged disability after whiplash injury: A prospective study.	147	1, 3, 12m	2 - Pain	1 - SF36 8 - prior workers' compensation or third-party claim, consulting a lawyer, 9 - having attended a physiotherapist or chiropractor	The best predictors of outcome are the SF-36 scores for Bodily Pain and Role Emotional, higher scores being associated with better outcome
22	Hendriks, 2005	Netherlands, Private	Prognostic factors for poor recovery in acute whiplash patients.	125	12m	2 - Pain	1 - Symptom checklist (SCL-90),	Factors related to poor recovery were female gender, a low level of education, high initial neck pain, more severe

ID	Author, Year	Country, Setting	Title	Baseline N	Follow-up (m)	Outcome(s)	Prognostic factors assessed*	Primary authors' conclusion
							2 - Radiological or imaging in first 2 weeks, 4 - Socio- demographics (age, gender, education, marital status, etc) 5 - crash related characteristics 6 - physical health (neck pain intensity, CROM) 7 - pre-existing physical health (neck pain, headache, etc), pain medication use before accident 8 - retained a lawyer 9 -additional use of collar,	disability, higher levels of somatisation and sleep difficulties. Neck pain intensity and work disability proved to be the most consistent predictors for poor recovery. The accuracy of the predictions of the prognostic models was high, meaning that the models adequately distinguished patients with poor recovery from those regarded as recovered.
23	Holm, 2007	Canada, Insurance	Widespread pain following whiplash- associated disorders: incidence, course, and risk factors.	266	4, 6, 12m	2 – Pain (widespread pain)	1 - symptoms neck pain (VAS) and symptoms after MVC, pain drawing, CES-D 4 – demographics	Widespread pain occurred early in the course. Even though the cumulative incidence was 21%, continuous widespread pain was rare. Subjects with WAD who report early depressive symptoms and more severe neck injury symptoms are at risk of developing widespread pain after motor vehicle collision.
24	Holm, 2008	Sweden, Insurance	Expectations for recovery important in the prognosis of whiplash injuries.	1032	6m	3-Disability (Pain Disability Index)	1 -after the injury number of pain areas severity of eight pain-associated symptoms pain intensity in the neck, head, low back and other body parts anxiety	Individuals' expectations for recovery are important in prognosis, even after controlling for symptom severity. Interventions designed to increase patients' expectations may be beneficial and should be examined further in controlled studies.

ID	Author, Year	Country, Setting	Title	Baseline N	Follow-up (m)	Outcome(s)	Prognostic factors assessed*	Primary authors' conclusion
							3 -depression posttraumatic stress symptoms passive coping strategies 4 - gender age education family status 7 - prior neck pain and headache	
25	Johansson, 2011	Denmark, University Center	Does cervical kyphosis relate to symptoms following whiplash injury?	171	12m	2 – Pain (self-reported pain intensity and headache intensity during the preceding week)	1.neck pain intensity, headache 2. MRI-posture 3.psychologicla questionnaires 4. sociodemographic- age, gender 5. crash related	In conclusion, a kyphotic deformity is not significantly associated with chronic whiplash associated pain. Moreover, it is a clear clinical implication that pain should not be ascribed to a straight spine on MRI. We suggest that future trials on cervical posture focus up on the presence of kyphotic deformity rather than just on the absence of lordosis.
26	Kasch, 2001	Denmark, Emergency	Handicap after acute whiplash injury: a 1-year prospective study of risk factors	141	12m	3 – Disability (handicap as determined by a semi-structured interview)	1 – symptom (present pain on VAS; exhaustion, anxiousness, forgetfulness, sleep disturbance, irritability, impaired ability to concentrate, imbalance, dizziness, nausea, increased sensitivity to noise, tinnitus, paresthesia in upper limbs, dysphagia, blurred vision, or diplopia or other vision disturbances through semi-structured interview)	The cervical range-of-motion test has a high sensitivity in prediction of handicap after acute whiplash injury. The value of cervical range-of-motion test is further improved by additional recording of symptoms and pain intensity.

ID	Author, Year	Country, Setting	Title	Baseline N	Follow-up (m)	Outcome(s)	Prognostic factors assessed*	Primary authors' conclusion
							6 - physical / impairment factors (cervical range of motion; neck strength)	
27	Kongsted, 2008a	Denmark, Emergency	Acute stress response and recovery after whiplash injuries. A one-year prospective study.	737	12m	1 – Recovery (general health; work-related consequence) 2 – Pain (self-reported pain) 3 - Disability (neck disability)	1- SF36, neck pain, headache pain, 3- IES (total and intrusion and avoidance subscales), 4- Socio-demographics 5- Crash related data	In conclusion, the association between the acute stress reaction and persistent WAD suggests that posttraumatic stress reaction may be important to consider in the early management of whiplash injury. However, the emotional response did not predict chronicity in individuals.
28	Kongsted, 2008b	Denmark, Emergency	Are altered smooth pursuit eye movements related to chronic pain and disability following whiplash injuries? A prospective trial with one-year follow-up.	245	12m	1 – Recovery (working ability) 2 – Pain (self-reported neck pain, headache) 3 – Disability	6- Early smooth pursuit eye movement (electrooculography)	Although reduced smooth pursuit performance at one-year follow-up was associated with persistent neck pain, smooth pursuit eye movement tests are not useful as predictive or diagnostic tests in whiplash-associated disorders.

ID	Author, Year	Country, Setting	Title	Baseline N	Follow-up (m)	Outcome(s)	Prognostic factors assessed*	Primary authors' conclusion
						(neck disability)		
29	Kuperman, 2021	Israel, Emergency	Head- and neck-related symptoms post-motor vehicle collision (MVC): Separate entities or two-sides of the same coin?	223	6m	2 – Pain (head and neck symptoms)	1 - mean head pain, mean neck pain, number of post-collision painful body areas 3 - PTSD, and depression 4 - female gender	Psychological factors influence post-concussion syndrome symptoms, but not post-whiplash neck disability
30	Kyhlback, 2002	Sweden, Other setting (specialist)	Prognostic Factors in Whiplash-Associated Disorders.	83	12m	2 – Pain (Pain intensity on VAS)	1 – symptom (Pain Disability Index; self-efficacy through Self-Efficacy Scale) 4 – sociodemographic (Age; sex)	It is concluded that WAD patients' self-efficacy at an early stage after whiplash injury significantly predicts the temporal development of pain intensity and disability. It may therefore be suggested that patients' confidence in performing daily activities should be reinforced in order to optimize treatment after whiplash injury.
31	Mayou, 1996	UK, Emergency	Long-term outcome of motor vehicle accident injury.	111	≥ 2yrs	1 – Recovery (social outcome) 4 – Psychological Function (PTSD)	3 - neuroticism, immediate emotional distress 5 - memories of the accident, evidence of or alcohol intake either before the accident or at 1 year 6- severity of injury 7- pre-accident psychological problems, 8- progress of compensation proceedings	Psychological complications are important and persistent after injury in a motor vehicle accident, are associated with adverse effects on everyday activities, and pose a challenge for consultation-liaison psychiatry.

ID	Author, Year	Country, Setting	Title	Baseline N	Follow-up (m)	Outcome(s)	Prognostic factors assessed*	Primary authors' conclusion
32	Mayou, 1996	UK, Emergency	Outcome of 'whiplash' neck injury.	63	3, 12m	1 - Recovery 2 - Pain 3 – Disability 4 - Psych function	3 – psychological (Eusenck Personality Inventory; Beck Depression Inventory; Spielberger Anxiety Scale; standardized mental-state interview called the Present State Examination) 4 – sociodemographic (previous social adjustment) 5 – crash-related (nature of the accident; changes in driving behaviour and concern about travel) 9 – healthcare utilization (use of medical services)	We conclude that travel, social and psychological morbidity is substantially greater than previously recognized.
33	Mayou, 2002	UK, Emergency	Psychiatry of whiplash injury	278	12m	2 - Pain 4 - Psych	4 - Gender 3 –negative emotion, Perceived threat, Blame, Initial emotional distress, four cognitive maintaining factors 5- ISS (bony injury group only) 7-Prior emotional problems 8-Claiming compensation at 3 months	Accident and early post-accident psychosocial variables predicted pain at 1yer. Claiming compensation at 3 months predicted the pain at 1 year for those with whiplash.
34	Miettinen, 2004a	Finland, Insurance	Whiplash Injuries in Finland—The Possibility of some Sociodemographic and Psychosocial Factors to Predict the Outcome after One Year.	201	12m	3 - Disability	1- NDI, Finnish-based Work Ability Index (WAI) 3- Depression (BDI), general psychic stress (GHQ) 4- demographic data 5- features of the collision, use of seatbelt,	The education level was the only significant factor related with poor health outcome after one year follow up

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							position in the car, speed limit at the time of accident	
35	Miettinen, 2004b	Finland, Insurance	The Possibility to use Simple Validated Questionnaires to Predict Long-Term Health Problems after Whiplash Injury.	117	36m (3yrs)	3 - Disability	1 - Symptoms related to the condition of health and the injury 3 - Depression (BDI), general psychic stress (GHQ 4 - demographic data, age 5- features of the collision, use of seatbelt, position in the car, speed limit at the time of accident.	NDI questionnaire was the only risk factor related to poor outcome after whiplash injury. Experience of decrease activity level is subjected to neck pain reflected in NDI questionnaire
36	Olsson, 2002	Sweden, Emergency	Prediction of Outcome in Whiplash- Associated Disorders using West Haven-Yale Multidimensional Pain Inventory.	130	12m	2 – Pain	3- MPI questionnaire 4 - age, gender 5 - circumstances of accident	The MPI may be used at an early stage to identify patients who may develop chronic neck-pain after a traffic accident, at least in those who want a follow-up session after an initial visit to an accident and emergency department.
37	Osterland, 2019	Denmark, Emergency	Pre-collision Medical Diagnoses Predict Chronic Neck Pain Following Acute Whiplash Trauma.	719	12m	2 – Pain (neck pain)	1 - baseline neck pain 3 - acute stress response and illness perception 4 - sex, age, education 7 - Pre-collision pain related diagnoses	Precollision pain and medically unexplained symptoms predict chronic neck pain following whiplash trauma. This may indicate that a sensitization process was initiated before the collision or that individuals with pre-collision low threshold for contacting health care services maintain this behavior post-collision. The collision may trigger existing individual vulnerabilities that constitute to be a risk factor for chronic whiplash.

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38	Ozegovic, 2009	Canada, Insurance	Does expecting mean achieving? The association between expecting to return to work and recovery in whiplash associated disorders: a population-based prospective cohort study.	2335	12m	1 - Recovery (self-reported recovery)	1 - percentage of body in pain, initial neck pain intensity post-collision headache or lower back symptoms 2 - post-collision depressive symptomatology 3 - age; gender, education; marital status, income 5 - direction of impact; position in vehicle 8 -number of days from collision to completing claim form.	Those who had a positive expectation to return to work had a 42% faster rate of self-reported recovery without recurrence compared to those who did not have a positive expectation to return to work.
39	Palmlof, 2015	Sweden, Insurance	Are prevalent self-reported cardiovascular disorders associated with delayed recovery from whiplash-associated disorders: A population-based cohort study.	6021	12m	1 - Recovery (Time to recovery using Global Perceived Effect (GPE))	4 - age, level of education 7 - Self-reported cardiovascular conditions:	Our analysis suggests that CVD is not associated with recovery from WAD
40	Pedler, 2016	Australia, Emergency	Addition of posttraumatic stress and sensory hypersensitivity more accurately estimates disability and pain than fear avoidance measures alone after whiplash injury.	103	12 weeks	3 – Disability (neck disability on NDI)	1 - pain (VAS) 3 - fear avoidance beliefs (TSK-17), PFActS-C) 4 - age, sex	For both pain and disability outcomes, the most accurate model included of sensory hypersensitivity and posttraumatic stress symptoms together with FAM variables. Provide preliminary support for the additional of neurobiological and stress system components to the fear avoidance model (FAM) to explain poor outcome in patients with WAD

ID	Author, Year	Country, Setting	Title	Baseline N	Follow-up (m)	Outcome(s)	Prognostic factors assessed*	Primary authors' conclusion
43	Pedler, 2011	Australia, Emergency	Assessing Fear-Avoidance Beliefs in Patients with Whiplash-associated Disorders: A Comparison of 2 Measures.	98	6m	3 – Disability (neck disability on NDI)	1- pain (VAS), neck Disability Index (NDI). 3 -PFActS-C, Pictorial Fear of Activities Scale-Cervical; Tampa Scale of Kinesiophobia 6 -ROM, range of motion	Fear avoidance beliefs and behaviours develop quickly following whiplash injury and influence both the initial physical presentation and long-term outcome of patients with WAD. The PFActS-C may provide a measure of fear of movement which is more specific to the cervical spine in patients with WAD in comparison to the TSK-17.
44	Phillips, 2010	Canada, Insurance	Whiplash-associated disorders: Who gets depressed? Who stays depressed?	5845	3, 6, 9, 12m	4 - PSYCH: Depression: Centre for Epidemiological Studies Depression Scale (CES-D)	1 – pain (symptoms after collision; pain intensity (VAS), percentage of body in pain) 4 - Sociodemographics (gender, age, marital status, income, education) 5 – crash-related factors (position in vehicle, impact, fractures) 7 - pre-crash health (self-report general health, pre-existing comorbid conditions including mental health)	The most important characteristics in identifying those with WAD who are likely to experience depression were higher post-crash pain, other post-crash symptoms, sustaining a fractured bone, the presence of post-crash anxiety, and the presence of prior mental health problems.
45	Pobereskin, 2005	UK, Other setting	Whiplash following Rear-End Collisions: A Prospective Cohort Study'.	503	12m	2 – Pain (neck pain)	1 - Neck pain following accident, VAS 4 - age, occupation 5 - type of car, use of seatbelt, position of headrest, speeds, head injury, drivable car, head rotation at impact	Demographic variables and the presence of a compensation suit show the strongest correlation with acute and chronic neck pain following rear end collisions.

ID	Author, Year	Country, Setting	Title	Baseline N	Follow-up (m)	Outcome(s)	Prognostic factors assessed*	Primary authors' conclusion
46	Radanov, 1996	Switzerland, Insurance	Predicting recovery from common whiplash.	133	12m	1 – Recovery (recovered vs symptomatic)	1 - Initial neck pain intensity, initial headache intensity 3 - nervousness score, neuroticism score 4 - age 6 - impaired neck movement, test score on focused attention 7 - history of peritraumatic headache, history of head trauma	Authors conclude that a comprehensive assessment of whiplash patients early after trauma enables physicians to identify patients at risk of delayed recovery.
47	Ravn, 2019	Germany, Emergency	Trajectories of posttraumatic stress symptoms after whiplash: A prospective cohort study.	253	3, 6, 12m	1 – Recovery (trajectory of recovery)	1 – Pain (NRS) 1 – Pain-related disability (Pain Disability Questionnaire (PDQ)) 3 – PTSD (Harvard Trauma Questionnaire (HTQ) part IV) 3 - Pain catastrophising (PCS) 3 - Fear-avoidance-beliefs (Orebro) 3 – Depression (HADS) 4 – Age, gender	Three trajectories were identified, with the chronic trajectory suggesting that a significant subset of people does not recover from PTSD symptoms. This class also reported more pain-related disability. Pain and depression predicted membership, but did, however, not succeed in differentiating between the two high-starting trajectories, suggesting that targeting PTSD symptoms may be important to ensure recovery.

ID	Author, Year	Country, Setting	Title	Baseline N	Follow-up (m)	Outcome(s)	Prognostic factors assessed*	Primary authors' conclusion
48	Richter, 2004	Germany, Emergency	Correlation of clinical findings, collision parameters, and psychological factors in the outcome of whiplash associated disorders.	43	6m	2 – Pain (duration and severity of symptoms)	1 – symptom (Presence, location, time of onset after collision, and severity by VAS; time of onset and severity (VAS) of neck restriction; presence of vertigo, nausea, dysphagia, auditory and/or visual disturbance) 2 – radiological 3 – psychological (SF36, EQLD, FSR) 5 – crash-related (Time and location, position in vehicle, airbag deployment, restraint use, collision type, and vehicles Involved; change in vehicle velocity, time of accident) 6 - physical / impairment factors (Tenderness or pain in the upper or lower neck region, occipital region, spinous processes, axial compression pain, and active/passive range of motion) 7 - pre-crash health (Pre-existing diseases and current drug treatments)	Psychological factors were found to be more relevant than collision severity in predicting the duration and severity of symptoms in collision victims with grade 1 or 2 whiplash associated disorders.
49	Rydman, 2018	Sweden, Insurance	Long-term follow-up of whiplash injuries reported to insurance companies: a	144	2-4 yrs	1 – Recovery	1 – Initial pain (NRS, <24, 24-65, >65)	The non-recovery rate among patients making insurance claims is high, especially among those receiving financial

ID	Author, Year	Country, Setting	Title	Baseline N	Follow-up (m)	Outcome(s)	Prognostic factors assessed*	Primary authors' conclusion
			cohort study on patient-reported outcomes and impact of financial compensation.			(recovered Y/N)	3 – Level of mental distress (NRS, <5, 5-51, >51) 4 - Sex (M vs F) 4 - Age (<=25, 26-40, >=41) 4 - Highest education (<university, university) 4- Employment (employed, unemployed) 8 – Insurance company (A vs B) 8 – Financial compensation at 24 months (No, Yes)	compensation even if causal relationship cannot be determined based on this study. However, lack of association between baseline level of pain and compensation supports the compensation hypothesis.
50	Rydman, 2017	Sweden, Emergency	COMT genotype and non-recovery after a whiplash injury in a Northern European population.	133	12m	1 – Recovery (recovered Y/N)	7 – COMT genes	No association between self-reported non-recovery or pain levels and COMT haplotypes in patients with acute whiplash injuries could be detected. Independent replications are necessary to discard the hypothesis that COMT haplotypes do not influence non-recovery or pain levels in patients with acute whiplash injuries. High levels of initial pain and anxiety were associated with non-recovery, thereby confirming previously published reports.
51	Skillgate, 2016	Canada, Insurance	Effect of early intensive care on recovery from whiplash-associated disorders: Results of a population-based cohort study.	5204	6, 9, 12m	1 – Recovery (self-perceived recovery)	1 – Initial pain intensity caused by collision (NRS for each of: neck/shoulder, midback, low back, headache) 1 – Other symptoms caused by collision (each symptom reported separately): dizziness or unsteadiness, vision problems, concentration or	Our study adds to the existing evidence that early intensive care is associated with slower recovery from WAD, independent of expectation of recovery. The results have policy implications and suggest that the optimal management of WAD focus on reassurance and education instead of intensive care.

ID	Author, Year	Country, Setting	Title	Baseline N	Follow-up (m)	Outcome(s)	Prognostic factors assessed*	Primary authors' conclusion
							attendance problems, sore jaw, numbness, tingling or pain in arm or hand 3 – Expectation for recovery (slowly or never) 3 - Off work because of collision 4 – Age, sex, university graduate 5 – Have the injuries prevented you from the following (yes): daily home activities; employment; education	
52	Soderlund, 2003	Sweden, Tertiary service (hospital clinic)	Whiplash-associated disorders - predicting disability from a process-oriented perspective of coping.	59	3, 6, 12m	3 - Disability	3 - CSQ catastrophising sub-scale at 12 months, beta=-0.65, p<0.05 = MV significant CSQ sub-scales: conscious cognitive coping (MV NS); pain avoidance strategies (all MV NS); behavioural strategies (all MV NS)	The importance of coping as an explanatory factor for disability increased during the one-year follow-up. Thus, coping has a crucial role for disability. The possibility of a positive long-term outcome could therefore be improved by teaching patients to use active and adaptive coping strategies shortly after an accident.
53	Soderlund, 2018	Sweden, Emergency Specialised pain rehab clinic	Predictors before and after multimodal rehabilitation for pain acceptance and engagement in activities at a 1-year follow-up for patients with whiplash-associated disorders (WAD)—a study based on the Swedish Quality	386	12m	2 – Pain (Chronic Pian Acceptance Questionnaire)	4- Age, sex, COB, education level, 3 - outcome expectancies, 1 - pain intensity, 3-multidimensional pain inventory (MPI, 4 subscales: supporting, punishing, solicitous responses, distracting),	For engagement in activities and pain acceptance, the fear of movement appears to emerge as the strongest predictor, but patients' perceived reactions from their spouses need to be considered in planning the management of WAD.

ID	Author, Year	Country, Setting	Title	Baseline N	Follow-up (m)	Outcome(s)	Prognostic factors assessed*	Primary authors' conclusion
			Registry for Pain Rehabilitation (SQRP)				3 - Fear of movement (TSK)	
54	Sterling, 2005 / Sterling, 2006	Australia, Emergency	Physical and psychological factors predict outcome following whiplash injury. (2006 duplicate cohort: Physical and psychological factors maintain long-term predictive capacity post-whiplash injury). 2006 data used in compensation report).	80	6m	3 – Disability (NDI)	1 - Initial disability (NDI) 3 - GHQ- general health, fear avoidance (TAMPA), PTSD symptoms (IES) 4 - age, gender 6 - cervical ROM, Joint position error, neck flexion test, PPT, CPT, BPPT, SNS activity 8 - Compensation (Sterling 2006)	Higher initial NDI score (1.007–1.12), older age (1.03–1.23), cold hyperalgesia (1.05–1.58), and acute post-traumatic stress (1.03–1.2) predicted membership to the moderate/severe group. Additional variables associated with higher NDI scores at 6 months on stepwise regression analysis were: ROM loss and diminished sympathetic reactivity.
55	Sterling, 2011	Australia, Others (hospital emergency departments, primary care practices, and general advertisement)	Similar factors predict disability and PTSD trajectories after whiplash injury.	155	12m	3 – Disability (developmental trajectories of neck disability using NDI) 4 – Psychological Function (developmental trajectories of PTSD using PDS)	1 – symptom (initial pain on VAS; initial disability; sensory measures of mechanical and cold hyperalgesia and sympathetic nervous system function) 4 – sociodemographic (age; gender)	There was good correspondence of trajectory group for both disability and PTSD. These findings support the proposal of links between the development of chronic neck related disability and PTSD after whiplash injury.

ID	Author, Year	Country, Setting	Title	Baseline N	Follow-up (m)	Outcome(s)	Prognostic factors assessed*	Primary authors' conclusion
56	Sterling 2010 Australia	56	Compensation claim lodgement and health outcome developmental trajectories following whiplash injury: a prospective study.	155	3, 6, 12m	3 – Disability (developmental trajectories of neck disability using NDI) 4 – Psychological Function (developmental trajectories of PTSD using PDS)	1 -disability (NDI) 3 - PTSD diagnostic scale (PDS) 4 - age gender 5 - position in vehicle 8 - compensation claim	Following whiplash injury, there are distinct pathways of recovery for pain/ disability and PTSD symptoms. Management of whiplash should consider the detrimental association of compensation claim with psychological recovery and recovery of those with mild to moderate pain/disability levels. However, claim lodgement has no significant association with a more severe pain and disability trajectory.
57	Vetti, 2010	Norway, Emergency	Are MRI high-signal changes of alar and transverse ligaments in acute whiplash injury related to outcome?	111	12m	3 – Disability (NDI)	1 - Pain intensity (NRS), pain drawing, 2 - MRI 3 - PTSD symptoms (IES) recovery expectations 4 - education 5 - accident-related factors	High-signal changes of the alar and transverse ligaments close after injury did not affect outcome for acute WAD1-2 patients without previous neck problems. High-resolution upper neck MRI has limited value for the initial examination and follow-up of such patients.
58	Williamson, 2015	UK, Emergency	Risk factors for chronic disability in a cohort of patients with acute whiplash associated disorders seeking	599	12m	3 – Disability	1 -Disability (NDI), pain intensity, other symptoms 3 - coping strategies (CSQ), Pain catastrophizing (PCS), fear avoidance (FABQ), GHQ,	Baseline disability had the strongest association with chronic disability, but psychological and behavioural factors were also important. Treatment strategies should reflect this which may require a change to current physiotherapy

ID	Author, Year	Country, Setting	Title	Baseline N	Follow-up (m)	Outcome(s)	Prognostic factors assessed*	Primary authors' conclusion
			physiotherapy treatment for persisting symptoms.				PTSD (IES), recovery expectations 4 - age, gender, social support 6 - Neck ROM 7 - pre-existing neck pain and chronic widespread pain	approaches for acute WAD. The number of risk factors present should be considered when evaluating potential for poor outcome.

A.2. Appendix A2: List of included studies – chronic whiplash

ID	Author Year	Country, Setting	Title	Baseline N	Follow-up	Outcomes	Prognostic factors assessed*	Overall conclusion
C1	Alalawi, 2022a	UK, Others (Community setting)	Assessment of Neuromuscular and Psychological Function in People with Recurrent Neck Pain during a Period of Remission: Cross-Sectional and Longitudinal Analyses.	30	6m, 12m	2 - Number of days with pain (secondary outcome) 3 - NDI, 0-50 (primary outcome)	1 – Symptom (number of pain episodes that lasted more than 24h with at least 30 days remission over the last 12 months, neck pain duration, current pain intensity) 3 – Psychological (disability using NDI, kinesiophobia using TSK, quality of life using EQ-5D) 6 - Physical / impairment (perceived effort performing submaximal neck contractions)	This preliminary study shows that participants with recurrent neck pain presented with some degree of altered neuromuscular features and poorer psychological function with respect to healthy controls and these features were similar to those with CNP. Neck flexor weakness was predictive of future neck disability.
C2	Alalawi 2022b	UK, Others (Community setting)	Does Pain Extent Predict Ongoing Pain and Disability in Patients with Chronic Whiplash-Associated Disorders?	216	12m, 24m	3 – Disability (NDI)	6 - Pain extent (drawing, % BSA) 6 - Physical / impairment (RCT variable): NSEB: neck-specific exercise with a behavioural approach 6 - Physical / impairment (RCT variable): PPA:	Pain extent, as an independent factor, was significantly associated with perceived pain and disability in patients with chronic WAD for up to 2 years. This association was masked by neck disability, psychological health, and work ability.

ID	Author Year	Country, Setting	Title	Baseline N	Follow-up	Outcomes	Prognostic factors assessed*	Overall conclusion
							prescribed physical activity 3 - Psychological: HADS-D hospital anxiety & depression scales 3 - Disability: NDI, 0-50 6 - Physical / impairment: PSES / SES - pain self-efficacy scale, 0-200 3 - Disability: WAI: work ability index	
C3	Angst, 2014	Tertiary (Hospital clinic)	Multidimensional associative factors for improvement in pain, function, and working capacity after rehabilitation of whiplash associated disorder: A prognostic, prospective outcome study.	175	6m, at discharge	1 - Recovery (working capacity) 2 - Pain (NASS) 4 - Psych function (CSQ, HADS)	6 - Physical / impairment: SF-36 physical function 3 - Psychological: HADS (depression) 6 - Physical / impairment: SF-36 bodily pain 4 - Sociodemographic: Age 7 - Pre-existing factors: Sport (hours per week)	High functional improvement (SF-36) was associated with high reduction of HADS depression (20.5% explained variance), low baseline SF-36 function (19.3%) and high baseline depression on the HADS (12.2%), as well as serious baseline pain on the SF-36 (6.6%).
C4	Rebbeck 2006	Australia, Insurance	A prospective cohort study of health outcomes following whiplash associated disorders in an	250	6m, 24m	1 - Recovery (SF-36, FRI, CWOM)	4 – Sociodemographic (gender, age, employment status, occupation, and Index of Relative	Whiplash injury had a large effect on the health of this Australian cohort of whiplash sufferers, with only 50% of the cohort recovered at two years. Physical measures of health appear to improve over

ID	Author Year	Country, Setting	Title	Baseline N	Follow-up	Outcomes	Prognostic factors assessed*	Overall conclusion
			Australian population.				Socioeconomic Disadvantage (IRSD) score (based on education, occupation, income, family structure, ethnicity, and housing))	time, whereas mental measures of health did not. Despite this, this cohort is largely able to participate in activities and work at two years. Prevention of chronic disability may lie with concentration of resources to those who score highly on the FRI at baseline. In addition, chronic psychological ill health may be prevented by directing treatment to those with poor scores on sensitive measures of psychological ill health at baseline.
C5	Sullivan, 2009	Canada, Others (Rehabilitation clinics)	Pain, perceived injustice and the persistence of post-traumatic stress symptoms during the course of rehabilitation for whiplash injuries.	112	3.5wk, 7wk	4 – Psych function (post-traumatic stress symptoms assessed through IES)	1 – Symptom (pain severity through MPQ, pain severity through 11-point NRS) 3 - Psychological (NDI, depression through BDI, catastrophizing through PCS, fear of movement through TSK, perceived injustice through Injustice Experiences Questionnaire) 4 – Sociodemographic (age, sex, marital status, education, occupation, medication use) 5 - Crash-related (speed of collision, use	The findings are consistent with previous research showing that indicators of injury severity such as pain, reduced function and disability, and scores on pain-related psychological were associated with more severe post-traumatic stress symptoms in individuals with whiplash injuries. Contrary to expectations, indicators of pain severity did not contribute to the persistence of post-traumatic stress symptoms. Univariate analyses revealed that self-reported disability, pain catastrophizing and perceived injustice were significant determinants of the persistence of post-traumatic stress symptoms. In multivariate analyses, only perceived injustice emerged as a unique predictor of the persistence of post-traumatic stress symptoms. The results suggest that early adequate

ID	Author Year	Country, Setting	Title	Baseline N	Follow-up	Outcomes	Prognostic factors assessed*	Overall conclusion
							of head rest, use of seat belt) 6 - Physical / impairment (cervical ROM)	management of pain symptoms and disability consequent to whiplash injury might reduce the severity of post-traumatic stress symptoms. The development of effective intervention techniques for targeting perceptions of injustice might be important for promoting recovery of post-traumatic stress symptoms consequent to whiplash injury.
C6	Sullivan, 2017	Canada, Others (Rehabilitation clinics)	Return to work helps maintain treatment gains in the rehabilitation of whiplash injury	110	12m	1 - Recovery (Maintenance of treatment gains)	1 – Symptom (pain severity through MPQ, pain severity through 11-point NRS) 3 - Psychological (NDI, depression through BDI, catastrophizing through PCS, fear of movement through TSK, perceived injustice through Injustice Experiences Questionnaire) 4 – Sociodemographic (age, sex, marital status, education, occupation, medication use, return-to-work) 5 - Crash-related (speed of collision, use of head rest, use of seat belt)	The main finding of the study was that individuals who returned to work following participation in a rehabilitation intervention were more likely to maintain treatment gains than individuals who did not return to work. Return to work did not lead to amelioration in pain symptoms, but rather, work absence contributed to a worsening of pain symptoms.

ID	Author Year	Country, Setting	Title	Baseline N	Follow-up	Outcomes	Prognostic factors assessed*	Overall conclusion
							6 - Physical / impairment (cervical ROM)	

A.3. Appendix A3: List of included studies - prediction tools

ID	Author Year	Country, Setting	Title	Baseline N	Follow-up	Outcomes	Prognostic factors assessed*	Overall conclusion
T1	Bohman, 2012	Canada, Insurance	Prognosis of patients with whiplash-associated disorders consulting physiotherapy: development of a predictive model for recovery	680	6wk, 3m, 6m	1 – Recovery (global self-perceived recovery)	1 – Symptom – (number of days to reporting the collision, average pain intensity on 0-10 NRS, pain other than neck pain like headache and low back pain, activity restrictions) 3 – Psychological (expectations of recovery, SF-36, depressive mood through CES-D) 4 – Sociodemographic (Age, sex, marital status, education, and work status)	We developed a model predicting recovery from WAD, in a cohort of patients who consulted physical therapists. Our model has adequate predictive ability. However, to be fully incorporated in clinical practice the model needs to be validated in other populations and tested in clinical settings.
T2	Cancelliere, 2021	Canada and Sweden, Insurance	Predicting nonrecovery in adults with incident traffic injuries including post-traumatic headache.	4541	6m	1 – Recovery - Self-reported nonrecovery from all injuries (not “all better (cured)” on the self-	1 - Symptom (initial pain intensity, vision and hearing problems, dizziness and fatigue, loss of consciousness, post-traumatic amnesia, 2- Radiological (bone fractures) 3 - Psychological (depression, anxiety, and stress 4 - Sociodemographic (sex, age, employment	In adults with incident traffic injuries including PTH, predictors other than those related to baseline head and neck pain drive overall nonrecovery. Developing and testing interventions targeted at the modifiable predictors may help to improve outcomes for adults after traffic collision.

ID	Author Year	Country, Setting	Title	Baseline N	Follow-up	Outcomes	Prognostic factors assessed*	Overall conclusion
						perceived recovery scale)	status, education, lifestyle factors, 6 - Physical / impairment (activity limitation and participation restrictions) 7 - Pre-existing factors (general health and comorbidities, pre-existing health conditions, repeat head injuries)	
T3	Griffin, 2022	Australia, Others (public hospital emergency departments, private physiotherapy practices, insurance databases)	Do expectations of recovery improve risk assessment for people with whiplash-associated disorders? Secondary analysis of a prospective cohort study.	228	6m, 12m	1 – Recovery (Global Perceived Recovery) 3 – Disability (NDI)	1 – Symptom (average pain intensity on 0-10 NPRS, 3 – Psychological (PCS, SF-OMPSQ, IES-R, DASS, PDS) 4 – Sociodemographic (age, gender, recruitment source, educational level 7 - Pre-existing factors (co-morbidities	The addition of expectations of recovery may improve the accuracy of WhipPredict, though further validation is required.
T4	Ritchie, 2013	Australia, Others (hospital accident and emergency departments, primary care	Derivation of a clinical prediction rule to identify both chronic moderate/severe disability and full	262	12m	3 – Disability (NDI)	1 – Symptom (cold pain threshold, initial neck pain on VAS, presence of headache) 3 – Psychological (posttraumatic stress symptoms on PDS, NDI)	This study provides initial evidence for a CPR to predict both chronic moderate/severe disability and full recovery following a whiplash injury. Further research is needed to validate the tool, determine the acceptability of the proposed CPR by practitioners, and

ID	Author Year	Country, Setting	Title	Baseline N	Follow-up	Outcomes	Prognostic factors assessed*	Overall conclusion
		practices, and via general advertisement)	recovery following whiplash injury.				4 – Sociodemographic (age)	assess the impact of inclusion in practice.
T5	Ritchie, 2015	Australia, Others (hospital accident and emergency departments, primary care practices, and via general advertisement)	External validation of a clinical prediction rule to predict full recovery and ongoing moderate/severe disability following acute whiplash injury	101	6m	3 – Disability (NDI)	1 – Symptom (cold pain threshold, initial neck pain on VAS, presence of headache) 3 – Psychological (posttraumatic stress symptoms on PDS, NDI) 4 – Sociodemographic (age)	External validation of the whiplash CPR confirmed the reproducibility and accuracy of this dual-pathway tool for individuals with acute whiplash-associated disorder. Further research is needed to assess prospective validation, the impact of inclusion on practice, and to examine the efficacy of linking treatment strategies with predicted prognosis.
T6	Rydman, 2017	Sweden, Others (Emergency, insurance)	Predicting non-recovery among whiplash patients in the emergency room and in an insurance company setting.	130	6m	1 – Recovery (Y/N response to question “Do you feel recovered after your injury?”)	1 – Symptom (level of pain on VAS) 3 – Psychological (level of mental distress on VAS) 4 – Sociodemographic (employment, highest level of education)	Clinical decision rules need validation before they are used in a new setting. An instrument consisting of four questions with an excellent possibility of identifying patients with a high risk of nonrecovery after a whiplash injury in the emergency room was not as useful in an insurance company setting. The importance and type of the risk factors for not recovering probably differ between the settings, as well as the individuals.
T7	Sterling, 2021	Australia, Others (public hospital emergency departments,	Comparison of the Accuracy of WhipPredict to That of a Modified Version	202	6m, 12m	1 – Recovery (Global perceived recovery,	1 – Symptom (SF-OMPSQ) 3 – Psychological (NDI, PDSS)	Both tools showed acceptable accuracy in predicting poor recovery. The WhipPredict tool is recommended to correctly identify patients who will not recover but may falsely classify those

ID	Author Year	Country, Setting	Title	Baseline N	Follow-up	Outcomes	Prognostic factors assessed*	Overall conclusion
		private physiotherapy practices, insurance databases)	of the Short-Form Orebro Musculoskeletal Pain Screening Questionnaire to Predict Poor Recovery After Whiplash Injury.			return to work status Y/N) 2 – Pain (pain intensity on NPRS) 3 – Disability (NDI)	4 – Sociodemographic (age)	who recover well. Using the modified SF-ÖMPSQ will result in fewer patients falsely categorized as being at risk of poor recovery and may result in some people being undertreated.

*Legend to tables: Prognostic factors assessed are categorised as: 1= symptom, 2= radiological, 3= psychological, 4= sociodemographic, 5= crash, 6= physical / impairment factors 7= pre-crash health 8= compensation, 9= health care utilisation factors.

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Website www.sira.nsw.gov.au

Catalogue no. SIRA09170 | 978-0-7347-4722-8