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A systematic review of the association between fault or blame-related attributions and procedures after transport injury and health and work-related outcomes

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ABSTRACT

Attributions of fault are often associated with worse injury outcomes; however, the consistency and magnitude of these impacts is not known. This review examined the prognostic role of fault on health, mental health, pain and work outcomes after transport injury. A systematic search of five electronic databases (Medline, Embase, CINAHL, PsycINFO, Cochrane Library) yielded 16,324 records published between 2000 and January 2018. Eligibility criteria were: adult transport injury survivors; prospective design; multivariable analysis; fault-related factor analysed; pain, mental health, general health or work-related outcome. Citations (n = 10,558, excluding duplicates) and full text articles (n = 555) were screened manually (Reviewer 1), and using concurrent machine learning and text mining (Reviewer 2; using Abstrackr, WordStat and QDA miner). Data from 55 papers that met all inclusion criteria were extracted, papers were evaluated for risk of bias using the QUIPS tool, and overall level of evidence was assessed using the GRADE tool. There were six main fault-related factors classified as: fault or responsibility, fault-based compensation, lawyer involvement or litigation, blame or guilt, road user or position in vehicle, and impact direction. Overall there were inconsistent associations between fault and transport injury outcomes, and 60% of papers had high risk of bias. There was moderate evidence that fault-based compensation claims were associated with poorer health-related outcomes, and that lawyer involvement was associated with poorer work outcomes beyond 12 months post-injury. However, the evidence of negative associations between fault-based compensation claims and work-related outcomes was limited. Lawyer involvement and fault-based compensation claims were associated with adverse mental health outcomes six months post-injury, but not beyond 12 months. The most consistent associations between fault and negative outcomes were not for fault attributions, per se, but were related to fault-related procedures (e.g., lawyer engagement, fault-based compensation claims).

Abbreviations: ANOVA, analysis of variance; AOR, adjusted odds ratio; ARR, adjusted risk ratio; BAC, blood alcohol content level; BICRO, brain injury community rehabilitation outcome scale; CI, confidence interval; ED, emergency department; EQ-5D, Euroqol-5 dimensions; FRI, functional rating index; GCS, Glasgow coma scale; GOS-E, Glasgow outcome score-extended; GI, gastro-intestinal; HRQoL, health-related quality of life; IES-R, impact of events scale-revised; IRSAD, index of socioeconomic advantage and disadvantage; ISS, injury severity score; LOE, loss of earnings; MCS, mental component score; M, mean; Med, median; PCS, physical component score; MD, mean difference; MRI, magnetic resonance image; MSNP, moderate to severe neck pain; MSK, musculoskeletal; MVA, motor vehicle accident; MVC, motor vehicle collision; NR, not reported; NS, not significant; OR, odds ratio; PEQ, peritraumatic emotions questionnaire; PTCI, posttraumatic cognitions inventory; PTSD, post-traumatic stress disorder; PTSD-I, post-traumatic stress disorder interview; QoL, quality of life; QoLIBRI, quality of life after brain injury; Ref, reference group; RM-ANOVA, repeated measures analysis of variance; RR, risk ratio; RTW, return to work; R1, Reviewer 1; R2, Reviewer 2; SD, standard deviation; SE, standard error; SF12, short form 12 health survey; SF36, short form 36 health survey; T1, baseline assessment (time 1); T2, first follow up assessment (time 2); VAS, visual analogue scale; WAD, Whiplash associated disorders; WC, worker's compensation; WCI, ways of coping inventory; 95% CI, 95% confidence interval

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1. Introduction

In the wake of an injurious event, an injury survivor may attribute responsibility for the event to themselves, another (including an individual, organisation or animal), environmental conditions, or to no-one or nothing at all. Psychological and legal processes may also be implicated in shaping an injured person's perception of the event, and can impact on recovery outcomes. In the context of trauma recovery, attributing fault to another is frequently found to be associated with adverse recovery outcomes, including worse mental health outcomes (Mayou and Bryant, 2001; Ryb et al., 2009; Thompson et al., 2014a; Gabbe et al., 2015; Guest et al., 2017), poorer function (Gabbe et al., 2015; Gopinath et al., 2015a), and longer time to return to work (Gabbe et al., 2015; Murgatroyd et al., 2016a). The relationship between fault attributions and injury outcomes has been explored across a range of populations including people who sustained workplace injuries (Chibnall and Tait, 2010), mild traumatic brain injury (Iverson et al., 2018), musculoskeletal injury (Murgatroyd et al., 2015), whiplash injury (Ferrari, 2015), and transport injury (Gabbe et al., 2015). However, to date there has been little systematic evaluation of the level of evidence for the association between fault and transport injury outcomes.

After transport injury, compensation scheme design provides an added layer of complexity to understanding the role of fault attributions in recovery. Outcomes have been shown to be worse in claimants who engage with a tort or fault-based scheme, for which they must prove that another person was responsible for the crash (Giummarra et al., 2016). However, it is notable that some injured people hold different attributions of responsibility to the formal assessments made and recorded during crash investigations by the police (Gabbe et al., 2015), which may give rise to perceptions of injustice if the injured person is held principally accountable for the crash. After transport injury, perceptions of injustice may lead to negative impacts on attitudes towards the fairness of compensation or legal systems (Elbers et al., 2016; Murgatroyd et al., 2016a), and could lead to difficulty coping with the impacts of injury.

To add further complexity, fault attributions are not necessarily categorical or absolute. For example, although pedestrians and cyclists should typically be given the right of way on the roads, there are circumstances in which their conduct may contribute to a transport crash or the injuries sustained in a transport crash. This is reflected in the legal concept of contributory negligence. In such cases, the damages payable to these road users in a negligence action will be reduced in proportion to their degree of responsibility for the crash and their own injuries (Luntz et al., 2017). A pedestrian struck while crossing the road against traffic signals, or while intoxicated, may face such a discount. Similarly, even though passengers are typically not considered to be liable in motor vehicle collisions, they may nonetheless be responsible for distracting or disturbing a driver (Vollrath et al., 2002). Moreover, in some Australian jurisdictions, legislation requires that an injured passenger's damages be reduced if they failed to wear a seatbelt, or if they elected to get into a car with an intoxicated driver (Luntz et al., 2017).

To date, many studies have reported on the association between fault and injury outcomes, including factors such as attribution of fault or responsibility, blame, guilt, culpability, lawyer use, or having a fault-based compensation claim. However, the consistency and magnitude of these effects on injury outcomes has not been examined or synthesised. This systematic review therefore sought to generate an explicit, rigorous, and transparent synthesis and critique of the research examining the impacts of fault-related attributions on transport injury outcomes. Given the scale of potentially relevant literature for this topic, while we sought to identify all research on this topic, the review was not intended to be an exhaustive summary of every study ever published on the topic. Rather, we sought to synthesis all available contemporary research to understand the current state of the evidence, identify gaps, provide recommendations for future research, and identify implications for targeted interventions, policies or practices that may improve transport injury recovery.

2. Method

The review protocol was prospectively registered to PROSPERO (CRD42018084123).

2.1. Search strategy

Five electronic databases were searched on January 15, 2018, including Medline, Embase, CINAHL, PsycINFO and Cochrane Library. The search strategy included a combination of population, exposure and outcome keywords and Medical Subject Heading (MeSH) or EMTREE terms specific to injury, transport (e.g., motor vehicle, crash, collision, traffic), health-related quality of life, mental health (e.g., depression, anxiety, posttraumatic stress disorder, PTSD), pain, and work (e.g., sick leave, work disability, return to work). See Tables A1, A2, A3, A4 and A5 in Supplementary data for copies of each executed search, including all terms used.

2.2. Inclusion and exclusion criteria

The review was restricted to prospective observational and cohort empirical studies published in English, using multivariable analyses, with a minimum sample of 50 cases. Studies that found no significant univariable association between fault attribution and outcomes were eligible for inclusion; however, studies that found a significant univariable relationship had to also report multivariable analyses to adjust for confounding factors to be eligible. Studies were considered prospective if they followed a sample or population over time, or if they used data from a population data source (e.g., administrative claimant data). Papers were only included if they were published after 2000 as the meta-data and algorithms used by the machine learning screening software Abstrackr (Beta Version; Rhode Island, United States of America) were unlikely to be accurate for publications prior to that date (Jonnalagadda et al., 2015). This restricted the review to studies evaluating the most recent health, trauma, injury compensation and justice-related procedures and systems. The sample size limitation ($n = 50$) was implemented as some statistical guidelines recommend the broad rule of thumb that multivariable regression analyses require a sample of $n = 50 + 8\,m$, where $m =$ the number of predictors or covariates (Green, 1991); however, we acknowledge that in reality sample size estimates should be made in line with anticipated effect sizes within a specific population, and may result in substantially smaller (Austin and Steyerberg, 2015) or larger (Bujang et al., 2019) sample sizes than our selected rule of thumb. Evaluations of specific interventions, management strategies or interventions were excluded.

2.2.1. Population

Studies were eligible if they included a predominantly adult population (> 50% aged > =15 years old), who sustained traumatic injuries in transport-related crashes. Studies had to primarily include transport-injury cases (50–100% of all cases), or report results across injury mechanisms such that transport injury cases could be isolated (e.g., injury cases were separated into transport, falls, assault). Transport injury was defined as any circumstance involving at least one vehicle that operates on the road (i.e., bicycles, automobiles, trucks, buses, motorcycles), and excluded those that operate on rails (i.e., trains, trams, light rail). Studies were excluded if the sample sustained terror-related transport injuries, or psychological injuries in the absence of physical trauma (e.g., witnessing trauma). Eligibility was not restricted by injury severity.

2.2.2. Outcomes

Studies had to measure at least one outcome more than four-weeks post-injury, including general or physical health and function (e.g., health-related quality of life, disability, function, recovery), mental health (e.g., diagnosis or symptom severity of PTSD, depression, or anxiety), pain (e.g., presence of chronic pain, pain severity, pain-related disability), or work (e.g., return to work, duration of sick leave). Potential secondary outcomes included job satisfaction, patient satisfaction, return to usual work, pain-related cognitions (e.g., catastrophizing, fear avoidance or self-efficacy), and other psychological outcomes such as travel anxiety, and suicidal ideation.

2.3. Study selection

Citations and papers were independently screened based on title and abstract by two reviewers. Both reviewers independently screened citations using the web-based software Abstrackr. Reviewer 1 manually coded the relevance of every citation and Reviewer 2 coded citations for relevance until no further studies were predicted to be relevant. Abstrackr uses an active learning algorithm (using uni-grams and bi-grams in citation titles, abstracts and keywords) from judgements made by the reviewer to generate predictions of relevance (Wallace et al., 2012). Once predictions are generated, the citations are sorted according to the predicted relevance, expediting the identification of potentially relevant papers.

Full text papers were obtained for all potentially eligible citations. Again, Reviewer 1 manually assessed all full text papers for eligibility, and Reviewer 2 used text mining (Wordstat, Version 7.1.21, and QDA Miner, Version 5.0.21; Provalis, Montreal, Canada) to identify studies that included fault-related terms in the methods and results. A fault-term dictionary (Table B1 in Supplementary data) was developed through consultation with 18 experts in injury, transport and compensation research and practice, and included terms such as fault, blame, compensation, lawyer, and insurance. Reviewer 2 manually screened all papers containing a fault-related term to determine whether it met the population, design, exposure and outcome criteria. Any disagreements regarding eligibility were resolved through discussion, and consultation with the other authors. The full team discussed eligibility of 10 papers as the design of these studies raised queries about the interpretation of the inclusion criteria, including whether the study included appropriate “fault” indicators (e.g., Osti et al., 2005; Rebbeck et al., 2006; Beck et al., 2017) whether the study was prospective (e.g., studies that recruited participants presenting for treatment in the sub-acute period; Bostick et al., 2013; Kazmierczak et al., 2016), whether descriptive reporting of a lack of effects in univariate analyses was sufficient (McCauley et al., 2001; Miettinen et al., 2004), and whether the analyses were multivariable (e.g., path analysis that treated simultaneous measurements as correlated; O’Donnell et al., 2007).

2.4. Data extraction

Two reviewers used customised forms on Covidence (Veritas Health Innovation, Melbourne, Australia) supplemented with Excel spreadsheets to extract study data. The following data were extracted from each paper: (1) study country; (2) cohort characteristics, including cohort source, sample size, gender distribution, age, injury type, injury severity, injury setting; (3) study inclusion and exclusion criteria; (4) study design; (5) all fault-related variables; (6) covariates included in multivariable analyses; (7) timing of follow up assessments; (8) study outcomes, including unadjusted and adjusted effects; (9) measurement tools and their implementation; (10) loss to follow up; (11) presence of missing data; and (12) the analytic approach. Extracted outcome data included any measurement and analysis of pain, mental health, other health-related outcomes, and occupational outcomes. Where necessary, additional data were requested from study authors.

2.5. Risk of bias assessment

Risk of bias was assessed for each study using the Quality In Prognostic Studies (QUIPS) tool (Hayden et al., 2006). Specifically, seven overarching areas of potential bias were assessed: (1) study participant selection (e.g., inclusion and exclusion criteria, recruitment strategy); (2) study attrition (e.g., reporting of loss to follow up); (3) prognostic factor measurement (e.g., selection and implementation of measures); (4) outcome measurement; (5) confounder measurement (e.g., use of stratification, matching, and multivariable techniques to adjust for confounders); (6) analytic approach (e.g., statistical power, handling of missing data); and (7) selective reporting. Two reviewers independently assessed each paper against the risk of bias criteria with each criterion coded as “high”, “low”, or “unclear” risk of bias. Each paper was given an overall risk of bias assessment of “high”, “moderate”, or “low”. Papers were graded as having high overall risk of bias if they had high risk of bias for one or more items in four or more domains, or if they had high risk of bias for most items in three of the six domains. Where an item had high risk of bias in three of the overarching domains, half of the items in two domains, or most items within at least one domain, the paper was judged to have moderate risk of bias. Papers that were underpowered and did not describe the handling of missing data were also categorised as having moderate risk of bias, at a minimum. Papers were judged to have low risk of bias if they had low risk of bias across all domains, excluding items SA2, SA3, AA2 and AA3 (Table C1 in Supplementary data). Disagreements in risk of bias assessments were resolved through discussion.

2.6. GRADE of evidence

The quality and level of evidence across all papers was evaluated using the Grading of Recommendations, Assessment, Development and Evaluation (GRADE) working group recommendations with respect to the sample, prognostic factors, outcome measurement, follow-up and analysis (Guyatt et al., 2014). Using the GRADE approach, the overall level of evidence can be judged to be strong, moderate, or limited based on the number of papers published, the study design and quality, and the consistency and direction of results. In accordance with a previous review by Murgatroyd et al. (2015), the level of evidence was downgraded where fault-related variables demonstrated both an association with worse outcomes or no association with outcomes for a specific outcome. The level of evidence was summarised across the body of studies included, and with respect to follow up periods of less than six months, six months, 12 months, and greater than 12 months.

2.7. Data synthesis

The evidence was summarised using narrative synthesis. Both unadjusted and adjusted effect sizes of risk and odds ratios are reported. Meta-analyses were not performed due to heterogeneity in samples (particularly in regard to injury severity and mechanism), fault measurement, and outcome timing and measurement.

3. Results and discussion

3.1. Overview of included studies

The search identified 16,324 records (Fig. 1), of which 5,765 duplicates were removed, 10,559 records were screened, and 689 potentially relevant records were identified for full text screening. Fifty-five papers from 38 studies were included in the review. Table 1 provides a summary of the cohort information, inclusion and exclusion criteria, and outcome measures. Details of study recruitment, inclusion and exclusion criteria, and detailed loss to follow up data for each study are provided in Table D1 in Supplementary data.

Eight papers were from the Etude de Suivi d’une Population

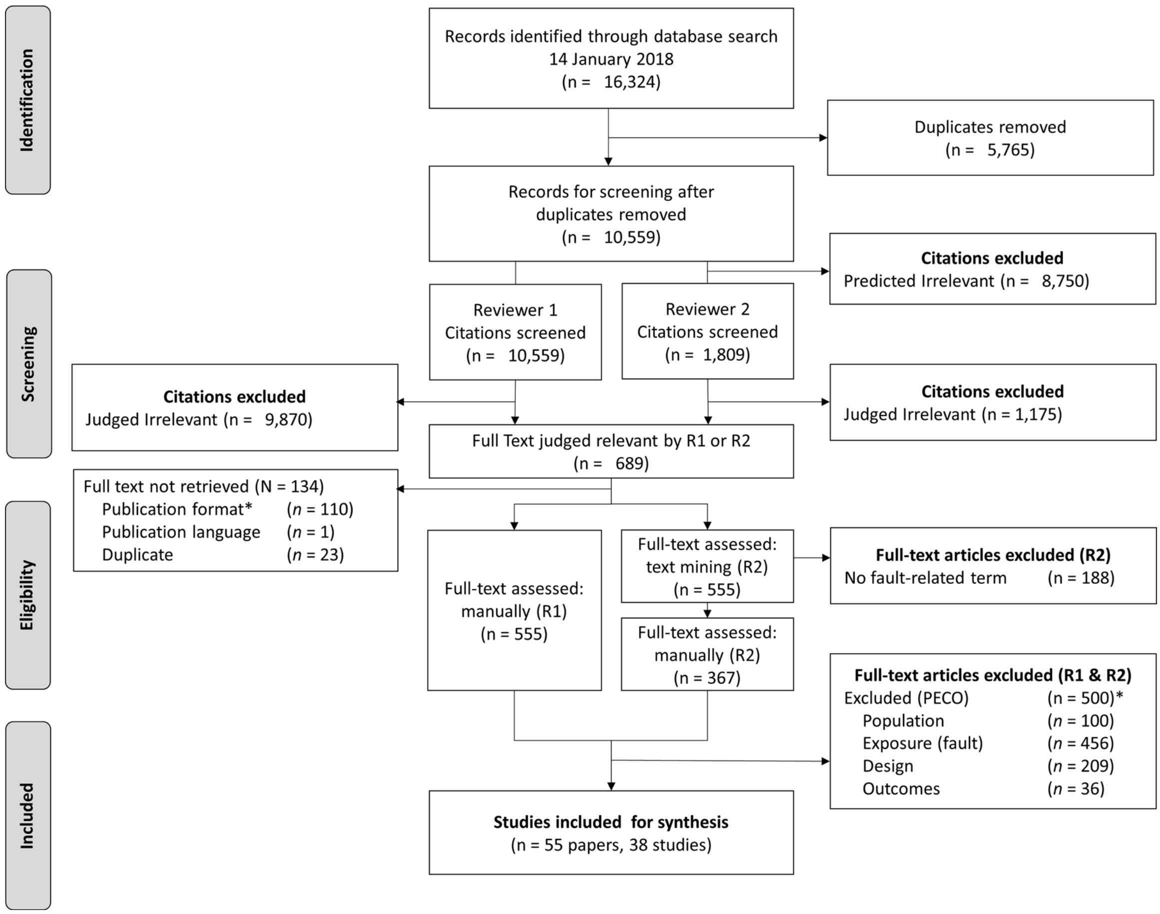

Fig. 1. PRISMA diagram.
Figure notes: Total number of citations identified: Medline (n = 4291), Embase (n = 7482), PsychINFO (n = 1315), CINAHL (n = 2667), Cochrane (n = 569).
* Publication format = conference abstract (n = 83), additional duplicates (n = 23), non-empirical (n = 17), dissertation (n = 10), or language other than English (n = 1). Full text exclusions based on PECO criteria could have met multiple exclusion criteria.

d'Accidentés de la Route dans le Rhône (ESPARR) cohort, which collected data up to five years post-injury from a cohort of road trauma patients recruited in emergency and intensive care units in the Rhone administrative department in France between October 2004 and December 2005 (Chossegros et al., 2011; Fort et al., 2011; Nhac-Vu et al., 2011; Hours et al., 2014; Nhac-Vu et al., 2014; Tournier et al., 2014, 2016; Pelissier et al., 2017). Two papers were from the Tachikawa Cohort of Motor Vehicle Accident Study of adults who sustained severe physical injuries in motor vehicle collisions and were admitted to the intensive care unit of the National Disaster Medical Center in Tokyo (Matsuoka et al., 2008; Nishi et al., 2013). Two papers were from the CRASH project, a multicentre emergency department (ED)-based cohort study from the United States that focuses on adults involved in minor motor vehicle collisions who did not require hospital admission (McLean et al., 2014; Auvergne et al., 2016). Three papers were based on a cohort of people involved in road trauma recruited from the Accident and Emergency Department of the John Radcliffe Hospital in Oxford (Mayou and Bryant, 2001; Mayou et al., 2001; Mayou and Bryant, 2002). Three papers included a cohort of people identified using the New South Wales Motor Accident Authority Personal Injury Registry Database between March 2010 and December 2010 (Elbers et al., 2015; Gopinath et al., 2015a, b). Four papers included adults who sustained motor vehicle related orthopaedic trauma and were admitted to hospitals in New South Wales, Australia, including two papers with admissions between August 2004 and October 2005 (Harris et al., 2008, 2011), and two papers with admissions between November 2007 and February 2011 (Murgatroyd et al., 2016a, b).

Sixty-six percent of papers (n = 36) were based on studies in predominantly fault-based compensation settings, where people involved in motor vehicle collisions could pursue compensation for their economic and non-economic loss only if another party was at fault. Studies with fault-based compensation settings were conducted in Australia (11 papers), France (nine papers), the United Kingdom (nine papers), Japan (three papers), the United States of America (two papers), Norway (one paper) and Spain (one paper). Papers examining outcomes in "no fault" compensation settings were from Australia (six papers), Canada (four papers), the United States of America (four papers), and Finland, Hong Kong, Israel and Sweden (one paper each). One Canadian study compared claimants from both "no fault" and fault-based compensation schemes following the change in compensation scheme design in Saskatchewan in 1995 (Carroll et al., 2007).

3.2. Risk of bias

Risk of bias assessments for each paper are summarised in Table 2. Overall, 60.0% (n = 33) of papers had high risk of bias. Just over half of all papers had high risk of bias for one or more aspects of participant selection (n = 28, 59.9%), with the most common bias due to failure to indicate when the initial data were collected (n = 13, 23.6%). Fifty-three papers (96.4%) had high risk of bias for at least one aspect of study attrition, with most papers failing to describe attempts to collect information from participants who did not complete the study (n = 44, 80.0%); having incomplete follow up data for more than 20% of the baseline sample (n = 38, 69.1%); and lacking clear and complete descriptions of loss to follow up (n = 36, 65.5%). Overall, 24 papers (43.6%) had high risk of bias for at least one aspect of prognostic factor

Table 1
Study characteristics.

Author (Year)	Country (State/s)	**Baseline cohort characteristics** (age in years; sex; inception source; compensation type; percent MVC; injury type and severity)	Fault variables	**Assessment times** (response rate (RR) percent or loss to follow up (LTFU))	Outcomes (measures)
Littleton et al. (2011)	Australia (ACT)	N = 95; age (M = 37, SD = 14); sex (39% male); CPT insurance claimant database; Fault-based (small provisions for no-fault); 100% MVC; MSK injury (mild-moderate severity)	● Lawyer involved ● Compensation claim	T1: *M* = 8.6 days 6m (13% LTFU) 12m (14% LTFU)	HR-QoL (SF-36 PCS & MCS) Anxiety (HADS) Depression (HADS) Pain Intensity (FRI) Pain-related Disability (FRI)
Elbers et al. (2015)	Australia (NSW)	N = 417; age (M = 45, *SD* = 17); sex (39% male); Personal Injury Register database of the NSW Accidents Authority; Fault-based (small provisions for at fault party); 100% MVC; mixed trauma (mild-moderate severity).	● Lawyer involved ● Claim settled at 2m, 12m, and 24m	T1: 2m 12m (22% LTFU) 24m (31% LTFU)	Anxiety or depression (EQ-5D-3L)
Gopinath (2015a)	Australia (NSW)	As per Elbers et al. (2015).	● Participant at fault	T1: 2m 12m (32% LTFU) 24m (40% LTFU)	Work status Work duties (full or modified) Problems with usual activities (EQ-5D, usual activities dimension)
Gopinath (2015b)	Australia (NSW)	N = 364; age (M = 45, SD = 16); sex (37% male); all else as per Elbers et al. (2015).	● At fault (based on lodgement of “Accident Notification Form” claim)	T1: 2m 12m (22% LTFU) 24m (31% LTFU)	Pain severity (NRS)
Guest et al. (2017)	Australia (NSW)	N = 6,341; age (M = 43-44, SD = 16); sex (41% male); Personal Injury Register of the State Insurance Regulatory Authority; Fault- based (small provisions for at fault party); 100% MVC; MSK injury (mild-moderate severity).	● At fault ● Road user (driver, passenger, motorcycle driver, motorcycle passenger, pedestrian, pedal cyclist, other)	T1: claim lodgement (m = 21days) 24m (0% LTFU)	Psychological distress (medical reports and assessments; ICD-10-AM diagnoses)
Harris (2007)	Australia (NSW)	N = 363; age (M = 48,SD = NR); sex (72% male); Hospital Trauma Registry; Fault-based, 63% MVC; major trauma.	● Claim settled ● Lawyer involved ● Blame (self, another, don’t know)	T1: NR (registry) 1 to 6y (53% RR)	Patient satisfaction (“How satisfied are you with your progress since the injury?”)
Harris (2008)	Australia (NSW)	N = 306; age (M = 38, SD = NR); sex (72% male); Fault-based; 100% MVC; orthopaedic injury.	● Compensation claim ● Lawyer involved ● Blame (self, another, don’t know)	T1: < 7 days 6m (24% LTFU)	HR-QoL (SF-36 PCS & MCS)
Harris (2011)	Australia (NSW)	As per Harris et al. (2008).	● As per (2008) ● Road user (car driver or passenger, motorcyclist, pedestrian or pedal cyclist)	T1: < 7 days 6m (24% LTFU)	Pain (SF-36 bodily pain questions summed)
Murgatroyd (2016b)	Australia (NSW)	N = 452; age (M = 40, SD = 17); sex (75% male); trauma admissions; Fault-based; 100% MVC; orthopaedic injury.	● Claim lodged	T1: < 14 days 6m (30% LTFU) 12m (37% LTFU) 24m (46% LTFU)	HR-QoL (SF-36 PCS & MCS) PTSD (PCL-C) Global change (GRC)
Murgatroyd (2016a)	Australia (NSW)	N = 334; Age (M = 36, SD = 14); sex (80% male); all else as per Murgatroyd (2016a).	● Participant at fault ● Claim lodged by 6m ● Lawyer involved at 6m	T1: < 14 days 6m (33% LTFU) 12m (40% LTFU) 24m (49% LTFU)	Days to RTW
Silove et al. (2003)	Australia (NSW)	N = 102; age (M = 33, SD = NR); sex (67% male); ED admissions; Fault-based; 100% MVC; mild to major trauma.	● Personally responsible ● Compensation claim (intend to claim)	T1: < 14 days 18m (19% LTFU)	Psychological conditions (CIDI, DSM-III-R)
Fitzharris et al. (2005)	Australia (VIC)	N = 57; age (M = 36, SD = 13); sex (60% male); trauma admission; No fault; 100% MVC, mild-moderate trauma.	● Personally responsible (level) ● Other’s responsibility (level)	T1: before d/c 2m (NR LTFU)	Pain severity (HAQ) Depression (BDI-II)
Gabbe et al. (2015)	Australia (VIC)	N = 2,605; Age (M = 43, SD = 19); sex (67% male); VOTOR registry cohort; No fault, 100% MVC, orthopaedic injury.	● Claimant and police report of whether another vehicle was at fault for the crash	T1: registry inception 12m (13% LTFU)	Functional recovery (GOS-E) Health status (EQ-5D-3L) RTW
Jeavons et al. (2000)	Australia (VIC)	N = 72; age (M = 32, SD = NR); sex (53% male); Trauma presentation; No fault; 100% MVC; mild to major trauma.	● “Blame or responsibility” (accident cognitions, not otherwise defined incl. target of cognition)	T1: < 14 days 3m (14% LTFU) 6m (14% LTFU)	PTSD (IES; PTSD-I) General mental health (GHQ)

(*continued on next page*)

Table 1 (*continued*)

Author (Year)	Country (State/s)	**Baseline cohort characteristics** (age in years; sex; inception source; compensation type; percent MVC; injury type and severity)	Fault variables	**Assessment times** (response rate (RR) percent or loss to follow up (LTFU))	Outcomes (measures)
O'Donnell et al., 2007O'Donnell et al. (2007)	Australia (VIC)	N = 253; age (M = 36, SD = 14; sex (75% male); trauma admission; No fault; 74% MVC, mild to major trauma	● Self-blame (using PTCI)	T1: < discharge 3 m (5% LTFU) 12 m (16% LTFU)PTSD (CAPS)	PTSD (CAPS)
Thompson et al. (2014a)	Australia (VIC)	N = 934; age (M = 43, SD = 16); sex (56% male); compensation claimant client outcomes survey; No fault; 100% MVC; mild to major trauma.	● Attribution of personal responsibility (1 = not at all/2 = partially/ 3 = totally)	T1: NR (claim lodgement) < = 6 years post-injury (~ 29% RR)	HR-QoL (SF12 MCS, PCS) Traffic anxiety Persistent pain from crash (> 3 months)
Thompson et al. (2014b)	Australia (VIC)	N = 1,109; age (M = 41, SD = 13); sex (65% male); compensation claimants, client outcomes survey; No fault, 100% MVC; mild to major trauma	● As per Thompson et al. (2014a).	T1 assessment was up to 6-years post-injury, and time between assessments NR T2 (69% LTFU)	RTW T1: Depression (SF12 item 11) T2: Depression (DASS-21)
Bethune et al. (2017)	Canada (Ontario)	N = 871; age (NR); sex (NR); concussion cases following ED admission; No fault, 71% MVC; mild TBI.	● Road user (driver, pedestrian, passenger)	T1: 3m 3m (38% RR) 6m (43% LTFU)	Suicidal ideation. General mental health (GHQ)
Hartling et al. (2002)	Canada (Ontario)	N = 353; age (40% 18-30 years, 42% 31-50 years, 18% 51-70 years); sex (33% male); No fault, 100% MVC; WAD.	● Position in vehicle (driver, front passenger, back passenger)	T1: < 14 days 6m (5% LTFU)	WAD presence WAD severity
Suissa (2003)	Canada (Quebec)	N = 2,627; age (M = 36, SD = NR); sex (36% male); Compensation claimants; No fault, 100% MVC; WAD.	● Direction of impact (rear-end, 90 degrees or head-on) ● Road user (driver, passenger or pedestrian)	T1: claim lodgement, seven year follow up period	Recovery (days to last income replacement payment)
Carroll et al. (2007)	Canada (Saskatchewan)	N = 7127; age (24% < 24 yrs, 16% 24-29 yrs, 25% 30-39 yrs, 16% 40-49 yrs, 21% > 50yrs); sex (40% male); compensation claimants; Fault-based & no-fault; 100% MVC, WAD injury.	● Lawyer involved ● Compensation claim (fault vs no fault scheme Position in the vehicle (not defined) ● Direction of impact (front, rear, driver's side, passenger's side)	T1: 6 weeks 4m, 8m, and 12m (LTFU NR)	Jaw pain and symptoms
Phillips et al. (2010)	Canada (Saskatchewan)	N = 6,021; age (M = 39-45, SD = 14-16); sex (39% male); compensation claimants; No fault, 100% MVC; WAD.	● Direction of impact (front, rear, side or other)	T1: < 6 weeks 6w, 3m, 6m, 9m 12m (59% complete follow-up)	Depression (CES-D)
Miettinen et al. (2004)	Finland	N = 312; age (M = 42, SD = ~14); sex (36% male); compensation claimants; No fault; 100% MVC; WAD.	● Position in vehicle (driver, front passenger, back passenger, unknown)	T1: NR (as soon as possible > claim lodgement) 12m (42% LTFU)	Sick leave duration Depression (BDI) General mental health (GHQ)
Bayen et al. (2017)	France	N = 504; age (M = ~32, SD = ~14); sex (81% male); Fault-based; 53% MVC; TBI.	● Litigation	T1: < discharge 12m (73% LTFU) 4y (74% LTFU) Note: 252 died by 12m, another 7 died by 4y.	Function (GOS-E; BICRO) Neuropsychological function (NRS-r) Anxiety (HADS) Depression (HADS) QoL (QoLIBRI) RTW
Chossegros et al. (2011)	France	N = 541/1,168 recruited; age (6% 16-18 yrs, 26% 18-24 yrs, 22% 25-34 yrs, 21% 35-44 yrs, 12% 45-54 yrs, 6% 55-64 yrs, 6% > 65yrs); sex (62% male); ESPARR cohort study; Fault-based; 100% MVC; hospitalised trauma.	● Personally responsible ● Litigation ("pressing charges") ● Road user (four wheel vehicle, motorcycle, pedal bicycle, pedestrian or other)	T1: < 7 days 6m (53.7% LTFU)	PTSD (PCL-C)
Fort et al. (2011)	France	N = 792; age (56% < 35 years); sex (64% male); all else as per Chossegros et al. (2011).	● Personally responsible ● Intend to litigate at T1 ● Litigation by 6m	T1: < 7 days 6m and/or 12m (23% LTFU) T1: < 7 days	Complete or partial RTW
Hours et al. (2014)	France	N = 548; age (34% 16-24 yrs, 28% 25-34 yrs, 20% 35-44 yrs, 8% 45-54 yrs, 10% ≥ 55 yrs); sex (49% male); minor trauma; all else as per Chossegros et al. (2011).	● Personally responsible ● Litigation (intend)	12m (31% LTFU)	HR-QoL (WHOQOL-BREF: physical function score, mental score, social score, environmental score)
Nhac-Vu et al. (2011)	France	N = 324; age (35% 16-24 yrs, 33% 25-44yrs, 24% 45-64yrs, 8% > =65yrs); sex (76%	● Road user (motor vehicle driver, motor cycle driver, pedal cyclist, pedestrian/ passenger/ other)	T1: < 7 days 12m (15% LTFU)	Health state (How would you describe your health status today? fully recovered /

(*continued on next page*)

Table 1 (*continued*)

Author (Year)	**Country (State/s)**	**Baseline cohort characteristics** (age in years; sex; inception source; compensation type; percent MVC; injury type and severity)	**Fault variables**	**Assessment times** (response rate (RR) percent or loss to follow up (LTFU))	**Outcomes (measures)**
		male); major trauma; all else as per Chossegros et al. (2011).			improved but not recovered / stabilised / deteriorated)
Nhac-Vu et al. (2014)	France	N = 616; age (M = 36.9, SD = 16.5); sex (60% male); all else as per Chossegros et al. (2011).	● Personally responsible ● Road user (motor vehicle, motor cycle driver, pedal cyclist, pedestrian/ passenger)	T1: < 7 days 12m (24% LTFU)	HR-QoL (WHOQOL-BREF: physical function score, mental score, social score, environmental score) PTSD (PCL-C) Post-concussion syndrome (WHO-ICD-10) Health state (as per Chossegros et al. (2011)) Social and environmental impacts Recovery complications (e.g., pain, non-union, sensory sequelae) Medications
Pelissier et al. (2017)	France	N = 224; age (23% 16-24 yrs, 26% 25-35 yrs, 23% 35-45 yrs, 28% > =45 yrs); sex (80% male); major trauma; all else as per Chossegros et al. (2011).	● Personally responsible ● Road user group (pedestrian or skater, motor vehicle occupant, motorcycle, pedal cycle)	T1: < 7 days 3y (37% LTFU)	RTW
Tournier et al. (2014)	France	N = 1168; age (M = 30-44 yrs, SD = 11-20); sex (61% male); major trauma; all else as per Chossegros et al. (2011).	● Compensation claim (intend to claim) ● Road user (motor vehicle, motor cycle, pedestrian, pedal cyclist)	T1: < 7 days 2y (22% LTFU)	Health state (as per Chossegros et al. (2011)) Impact on occupational outcomes (social, work, usual activities and financial difficulties)
Tournier et al. (2016)	France	N = 546; age (28% 16-24 yrs, 28% 25-34 yrs, 26% 35-44 yrs, 8% 45-54 yrs, 10% > =55yrs); sex (49% male); minor trauma; all else as per Chossegros et al. (2011).	● Compensation claim (intend to claim)	T1: < 7 days 5y (36% LTFU)	HR-QoL (WHOQOL-BREF: overall, and specific domains of physical function score, mental score, social score, environmental score)
Wu et al., 2006Wu et al. (2006)	Hong Kong	N = 596; age (M = 39 yrs, SD = 14); sex (66% male); ED admission; No fault; 100% MVC; minor to major trauma (most mild-moderate).	● Litigation (intend) litigate ● Road user (driver, passenger, pedestrian)	T1: 1w (4% LTFU) 1m (29% LTFU) 3m (43% LTFU) 6m (55% LTFU)	PTSD symptoms (IES-R) General mental health (GHQ)
Naim et al. (2014)	Israel	N = 577; age (M = 35, SD = 12); sex (62% male); ED admission; No fault; 100% MVC; minor injuries.	● Position in vehicle (driver, passenger)	T1: < 24 hours 3m (28% LTFU)	PTSD diagnosis (CAPS)
Matsuoka et al. (2008)	Japan	N = 188; age (M = 37, SD = 16); sex (71% male); Tachikawa study, trauma centre admissions; Fault-based; 100% MVC; major trauma (ICU admission).	● Road user (passenger/ pedal cyclist/ pedestrian vs motor vehicle/cycle driver) ● Feeling of self-reproach	T1: < 22 days 4-6w (47% LTFU)	Full or partial PTSD (CAPS) Psychiatric illnesses (MINI; DSM-3-TR)
Nishi et al. (2013)	Japan	As per Matsuoka et al. (2008).	● Road user (passenger/ pedal cyclist/ pedestrian vs motor vehicle/cycle driver)	T1: < 22 days 6m (65% LTFU)	PTSD (CAPS)
Matsumoto et al. (2013)	Japan	N = 1,003 (506 WAD injury, 497 control); Age (M = 50, SD = 15); sex (52% male); Fault-based, 100% MVC, WAD vs healthy controls	● Position in vehicle (driver, front passenger, rear passenger)	T1: < 14 days 11y (35% LTFU)	Modic changes on MRI
Pape et al. (2007)	Norway	N = 1,310; age (M = 36, SD = NR); sex (53% male); Insurance claimants; Fault-based; 100% MVC; minor-moderate injuries with neck pain	● Direction of impact (rear/frontal; rear vs frontal/side)	T1: < 12 weeks 3y (51% LTFU)	Chronic neck pain (daily severe/very severe pain based on frequency and severity ratings)
Cobo et al. (2010)	Spain	N = 682; age (M = 36, SD = 14); sex (33% male); patients of the Physical Medicine and Rehabilitation centre; Fault-based; 100% MVC; WAD	● Position in vehicle (driver, front passenger, rear passenger)	T1: 1st medical visit (m = 29 days) 6m (19% LTFU)	Pain severity (VAS)
Ottosson et al. (2007)	Sweden	N = 318; age (M = 39, SD = 15); sex (46% male); ED admissions; No fault; 100% MVC; minor to major trauma.	● Injury caused by counterpart or other ● Insurance or legal problems	T1: "at inclusion" (timing NR) 1m (10% LTFU) 6m (25% LTFU)	Recovery (do you feel recovered? Y/N)

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Table 1 (*continued*)

Author (Year)	Country (State/s)	**Baseline cohort characteristics** (age in years; sex; inception source; compensation type; percent MVC; injury type and severity)	Fault variables	**Assessment times** (response rate (RR) percent or loss to follow up (LTFU))	Outcomes (measures)
Wynne-Jones et al. (2006)	UK	N = 1,499; age (M = 41, SD = NR); sex (49% male); Insurance claimants; Fault-based; 100% MVC; injury types/severity NR.	• Direction of impact (rear, front, rear & front (shunt), side, other)	T1: Median 23 days 12m (54% LTFU)	Widespread pain (manikin; (pain above & below waist on the left & right side of the body, and in the axial skeleton)
Pobereskin (2005)	UK (Devon and Cornwall)	N = 503; age (M = 43, SD = NR); sex (34% male); police crash records; Fault-based; 100% MVC; neck pain or WAD.	• Compensation claim	T1: contact < 14 days, Med = 77 days 6m & 12m (sent to 391 with neck pain at T1; 20% LTFU) 24m (sent to 236 with compensation claim at 12m; 14% LTFU)	WAD (chronic or late WAD)
Spearing et al. (2012)		N = 403; age (M = 41-43, SD = NR), sex (32% male); All else as per Pobereskin (2005).	• Compensation claim	T1: as per (2005) 24m	Neck pain (VAS)
Atherton et al. (2006)	United Kingdom (Manchester)	N = 765; age (Med = 34, IQR: 25-44), sex (44% male); four EDs; Fault-based; WAD.	• Position in vehicle (driver, pedestrian) • Direction of impact (rear, front, shunt, side, other)	T1: < 24h 1m (18% LTFU) 3m (27% LTFU) 12m (30% LTFU)	Neck pain (persistent neck pain based on pain lasting > = one day in the previous week)
Ehring et al. (2008)	United Kingdom (England)	N = 53; age (M = 34, SD = 9); sex (74% male); ED presentations; Fault-based, 100% MVC; all trauma excluding minor injury.	• Road user (driver, passenger, pedal cyclist, motor cyclist) • Guilt or shame (using PEQ)	T1: < 12 hours (72% RR) 2w (0%) 6m (0%)	PTSD (PDS) Depression (BDI)
Mayou and Bryant (2001)	United Kingdom (Oxford, England)	N = 1,148; age (M = 32, SD = 13); sex (55% male); ED presentations; Fault-based; 100% MVC; minor to moderate severity trauma.	• Blame (self, yes/no) • Compensation Claim • Participant prosecuted for a driving offence	T1: before discharge or soon after. 3m (25% LTFU) 12m (33% LTFU)	Phobic Travel Anxiety General Anxiety (HADS) PTSD (PTSS) Depression (HADS)
Mayou et al. (2001)		As per Mayou and Bryant (2001).	• Blame (self, yes/no) • Compensation claim (intend to claim) • Road user (passenger vs driver, pedal cyclist or pedestrian)	As per Mayou and Bryant (2001)	As per Mayou and Bryant (2001).
Mayou and Bryant (2001)		As per Mayou and Bryant (2001).	• Blame (self, yes/no) • Compensation claim (lodged by 3m)	As per Mayou and Bryant (2001) 3y (53% LTFU)	As per Mayou and Bryant (2001).
Mayou and Bryant (2002)		As per Mayou and Bryant (2001).	• Litigation • Settled claim	T1 (16% LTFU) 3m (23% LTFU) 12m (32% LTFU) 3y (52% LTFU)	PTSD severity (PSS) PTSD diagnosis (PSS)
Ryb et al. (2009)	USA (MD)	N = 406 (not incl. 32 who died); age (M = 40, SD = NR), sex (44% male); Crash Injury Research and Engineering Network (CIREN) database; fault-based; most moderate to severe trauma	• Culpability • Driver position	T1: in hospital 6m (10% LTFU) 12m (22% LTFU)	PTSD (interview about 7 PTSD-related clusters; PTSD defined by > = 3/7 cluster symptoms, but not DSM diagnosis criteria)
Platts-Mills et al. (2017)	USA (FL, MA, MI, NY, NJ)	N = 256; age (65% 65-74 yrs, 35% > = 75 yrs); sex (43% male); ED presentations; No fault; 100% MVC; minor to moderate trauma. *Note*: only demographics of final sample reported, not baseline cohort.	• Participant at fault • Direction of impact (rear) • Position in vehicle (passenger)	T1: during ED visit 6m (12% LTFU)	PTSD (IES-R)
Auvergne et al. (2016)	USA (FL, MA, MI, NY)	N = 943; age (M = 36, SD = 13); sex (39% male); ED admissions (CRASH cohort study); No fault; 100% MVC; minor trauma not requiring admission.	• Direction of impact (rear, front, no impact)	T1: during ED visit 6w (9% LTFU) 6m (11% LTFU) 12m (9% LTFU)	Post-concussion syndrome severity (RPCSQ)
McLean et al. (2014)	As per Auvergne et al. (2016)	N = 948; all else as Auvergne et al. (2016).	• Direction of impact (rear vs other) • Position in vehicle (driver vs passenger) • Fault (Another person/ the participant/ nobody)	T1: during ED visit 6w (9% LTFU)	Widespread pain (> = 7 regions of pain; RPS) Pain severity (NRS) with moderate-severe neck pain defined as > = 4/10
	USA (PA)		• Self blame (WCI)		PTSD diagnosis (SCID)

(*continued on next page*)

Table 1 (*continued*)

Author (Year)	Country (State/s)	Baseline cohort characteristics (age in years; sex; inception source; compensation type; percent MVC; injury type and severity)	Fault variables	Assessment times (response rate (RR) percent or loss to follow up (LTFU))	Outcomes (measures)
Dougall et al. (2001)		N = 115; age (M = 35, SD = 13); sex (54% male); ED/trauma presentation or police reports; No fault; 100% MVC; major trauma.		T1: 2-3 weeks (M = 34 days) 1m (6% LTFU) 3m (NR% LTFU) 6m (25% LTFU) 12m (35% LTFU)	
McCauley et al., 2001McCauley et al. (2001)	USA (TX)	N = 115 TBI, 85 general trauma; age (M = 33-35, SD = 13); sex (23% male); ED or trauma admissions; Fault-based; 69% MVC, TBI and general trauma.	● Compensation claim ● Litigation	T1: ~1 month 1m (39% RR) 3m (14% LTFU)	Post-concussion syndrome (SCID)

measurement, and 19 (34.5%) had high risk of bias for one or more aspect of outcome measurement, particularly failure to justify the tools used to measure prognostic factors (n = 15, 27.3%) or outcomes (n = 16, 29.1%). Twenty-three papers (41.8%) had high risk of bias for at least one aspect of measurement and adjustment for confounders. Eighteen papers (32.7%) failed to account for confounders in the study design. All but one paper (Murgatroyd et al., 2016b) had high risk of bias for at least one aspect of the analytic approach, and most papers did not describe or use appropriate methods for handling missing data (n = 49, 89.1%). Of the 55 papers that were included, 11 (20.0%) had high risk of bias for selective reporting.

3.3. Prognostic factors

Fault variables were classified into six main categories: (1) Attributions of responsibility or fault (pooled sample, n = 18,132); (2) Feelings of blame or guilt (pooled sample, n = 5,100); (3) Litigation or lawyer involvement (pooled sample, n = 13,239); (4) Lodgement or settlement of a fault-based compensation claim (pooled sample, n = 19,797); (5) Position in the vehicle or type of road user (henceforth referred to as road user; pooled sample, n = 27,620); and (6) Direction of impact (pooled sample, n = 22,852). Attributions of responsibility included both legal responsibility (e.g., culpability, prosecution for driving offences) and attributions of fault. Fault attributions were most often recorded with respect to whether the injured person was at fault, with only two studies classifying whether another was responsible (Ottosson et al., 2007; Gabbe et al., 2015). Lawyer involvement and litigation were included as a proxy indicator of fault as people who consult a lawyer or pursue legal proceedings typically do so in the context of fault (i.e., when someone else was at fault for the crash), particularly in fault-based compensation schemes where there can be greater incentives for lawyers to litigate or represent a client who is not at fault. However, we acknowledge that injured people may consult a lawyer in “no fault” settings for assistance in lodging a compensation claim. Road user group was included as a fault-related variable to enable comparison of outcomes between groups who are commonly considered to have reduced legal responsibility (e.g., passengers and pedestrians vs drivers). Likewise, direction of impact was considered a potential indicator of fault as people injured in a rear-end collision may be considered to have reduced responsibility for the collision.

3.4. GRADE

The overall evidence for an association between fault and outcomes was mostly either inconsistent (n = 9) or limited (n = 12), predominantly because few studies had low risk of bias (Table 3). One exception was that there was moderate evidence that fault-based compensation claims were associated with poorer health-related outcomes, but this association did not extend to work-related outcomes. Another exception was that there was moderate evidence for an association between lawyer involvement and worse work outcomes after the first 12-months post-injury. Fault-related factors either had no association or a negative association (i.e., leading to worse outcomes) with the exception of two studies. One found positive associations with better outcomes after adjusting for “reverse causality” (Spearing et al., 2012), and the other found that people who lodged an “at fault” claim in an otherwise fault-based scheme had higher risk of not returning to usual activities 12 months post-injury (Gopinath et al., 2015a). A detailed summary of the GRADE assessments across specific time periods is provided in Table E1 in Supplementary data.

3.5. Outcomes

3.5.1. Fault attribution, responsibility or culpability

There was inconsistent evidence of an association between fault attribution, health-related outcomes and pain, and limited evidence of

Table 2
Risk of bias.

Author (Year)	Overall	Participant Selection PS1	PS2	PS3	PS4	Study Attrition SA1	SA2	SA3	SA4	Outcome Measurement OM1	OM2	OM3	Prognostic factor Measurement PM1	PM2	PM3	Measurement and confounders CM1	CM2	CM3	Analytic Approach AA1	AA2	AA3	AA4	Selective Reporting SR1
Littleton et al. (2011)	LOW	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-
Elbers et al. (2015)	HIGH	-	-	-	-	-	+	+	+	-	-	-	-	-	-	-	+	-	-	-	+	+	+
Gopinath et al. (2015a)	HIGH	-	-	+	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+
Gopinath et al. (2015b)	LOW	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-
Guest et al. (2017)	MOD	-	-	-	-	-	-	-	-	+	-	+	+	-	+	-	-	-	-	-	+	-	-
Harris et al. (2007)	HIGH	-	-	-	-	-	-	+	+	+	+	+	-	-	-	+	-	-	+	+	+	-	-
Harris et al. (2008)	MOD	-	+	-	-	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-
Harris et al. (2011)	HIGH	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-	-	+	-	-	+	+	-
Murgatroyd et al. (2016b)	LOW	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
Murgatroyd et al. (2016a)	LOW	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+
Silove et al. (2003)	HIGH	-	-	+	-	-	+	+	-	-	-	-	-	-	-	+	+	+	+	+	+	-	-
Fitzharris et al. (2005)	HIGH	-	+	+	-	+	+	+	-	-	-	-	+	-	-	+	+	-	-	+	+	+	-
Gabbe et al. (2015)	MOD	-	-	-	+	+	+	-	+	-	-	-	-	-	-	-	-	-	-	-	+	-	-
Jeavons et al. (2000)	HIGH	+	-	+	-	-	+	-	+	+	-	+	-	+	-	-	+	+	-	+	+	+	-
O'Donnell et al., 2007O'Donnell et al. (2007)	HIGH	-	-	-	-	+	+	-	+	-	-	-	-	-	-	+	+	+	+	+	-	+	-
Thompson et al. (2014a)	MOD	-	-	+	+	+	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	+	-
Thompson et al. (2014b)	HIGH	-	-	+	+	+	+	+	+	+	-	-	-	-	-	+	+	-	-	-	+	-	-
Bethune et al. (2017)	HIGH	+	-	-	-	+	+	+	+	-	-	-	+	+	-	+	+	+	-	-	+	+	+
Suissa (2003)	HIGH	-	-	-	+	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-	+	-	-
Carroll et al. (2007)	HIGH	-	-	-	-	+	+	-	+	+	+	+	+	+	+	+	-	-	+	-	+	+	+
Hartling et al. (2002)	HIGH	+	-	-	-	+	+	-	+	-	-	-	+	+	+	+	+	-	-	-	+	-	-
Phillips et al. (2010)	MOD	-	-	-	-	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+
Miettinen et al. (2004)	HIGH	-	-	-	+	+	+	-	+	+	+	+	-	-	-	-	+	-	-	-	+	+	-
Bayen et al. (2017)	HIGH	-	-	-	+	+	+	+	-	-	-	-	+	-	-	-	-	-	-	+	+	-	-
Chossegros et al. (2011)	MOD	-	-	-	-	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-
Fort et al. (2011)	MOD	+	-	-	+	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-
Hours et al. (2014)	MOD	-	-	-	-	+	+	+	-	-	-	+	-	-	-	-	-	-	-	-	+	-	-
Nhac-Vu et al. (2011)	MOD	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-	-	-	+	+	-	-
Nhac-Vu et al. (2014)	HIGH	-	-	-	-	-	+	+	-	-	-	-	+	+	+	-	-	-	-	-	+	-	-
Pelissier et al. (2017)	MOD	-	-	-	-	+	-	+	+	-	-	+	-	-	-	-	-	-	-	+	+	-	-
Tournier et al. (2014)	MOD	-	-	-	+	-	-	+	-	-	+	-	-	-	-	-	-	-	-	-	+	-	-
Tournier et al. (2016)	HIGH	-	-	-	+	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-	+	-	+
Wu et al., 2006Wu et al. (2006)	HIGH	+	-	-	-	+	+	+	-	-	-	-	+	+	+	-	+	-	-	+	-	-	-
Naim et al. (2014)	LOW	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-
Matsuoka et al. (2008)	MOD	-	-	-	-	-	+	+	+	-	-	-	-	-	-	-	-	-	-	+	+	-	-
Nishi et al. (2013)	MOD	-	-	-	-	-	-	+	-	-	-	-	+	-	+	-	-	-	-	+	-	-	-
Matsumoto et al. (2013)	HIGH	+	-	+	-	+	+	+	+	+	-	-	+	-	-	+	-	+	+	-	+	+	-
Pape et al. (2007)	HIGH	-	-	-	-	+	+	+	-	+	+	-	-	+	+	-	-	-	-	-	+	-	-
Cobo et al. (2010)	MOD	-	-	-	-	+	+	-	+	-	-	-	-	-	-	-	-	-	-	-	+	-	-
Ottosson et al. (2007)	HIGH	-	-	-	+	+	+	+	-	-	-	+	-	+	-	-	-	-	-	+	+	-	-
Wynne-Jones et al. (2006)	HIGH	-	+	-	-	+	+	+	-	-	-	-	-	+	-	-	+	-	-	-	+	-	-
Pobereskin (2005)	HIGH	-	-	+	-	+	-	-	+	-	+	+	+	+	+	-	+	-	-	-	+	-	-
Spearing et al. (2012)	MOD	-	-	-	-	+	+	-	+	-	-	-	-	-	-	-	+	-	-	-	+	+	-
Atherton et al. (2006)	HIGH	-	-	+	-	+	+	+	-	+	+	+	-	+	+	+	+	-	-	-	+	-	-
Ehring et al. (2008)	HIGH	-	-	-	-	+	+	+	+	-	-	+	-	-	+	+	+	+	-	+	+	-	-
Mayou and Bryant (2001)	HIGH	-	-	-	-	+	+	+	+	-	-	+	+	-	+	+	-	-	+	-	+	+	+
Mayou et al. (2001)	HIGH	-	-	-	+	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-	+	-	-
Mayou and Bryant (2002)	HIGH	-	-	-	-	+	+	+	+	+	-	+	-	+	+	-	-	-	+	+	+	+	+
Mayou et al. (2002)	HIGH	+	+	+	+	+	+	+	+	-	-	-	-	+	-	-	+	-	+	-	+	+	-
Ryb et al. (2009)	HIGH	+	-	-	-	-	+	+	+	-	+	+	+	+	+	+	+	-	-	-	+	-	-

(continued on next page)

Table 2 (*continued*)

Platts-Mills et al. (2017)	MOD	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-
Auvergne et al. (2016)	LOW	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-	-	-	-	+	-	-
McLean et al., 2014McLean et al. (2014)	HIGH	-	-	-	-	+	+	-	-	-	-	-	-	-	+	-	-	-	+	+	+	+	+
Dougall et al. (2001)	HIGH	+	-	-	-	+	+	+	-	-	-	-	-	-	+	-	-	-	-	+	+	+	-
McCauley et al., 2001McCauley et al. (2001)	HIGH	+	-	+	-	+	-	+	+	-	-	-	-	-	-	+	+	+	-	+	+	-	-

Notes: + indicates high risk of bias, - indicates low risk of bias. *Risk of bias domains defined as:* **PS1**. Inclusion and exclusion criteria are clearly defined for the study population; **PS2**. The source of the population and recruitment methods are clearly defined; **PS3**. The study used representative sampling techniques; **PS4**. The time at which initial measures were taken is clearly stated (if this was not reported code as high); **SA1**. Loss to follow up is clearly and completely described including reason for attrition; **SA2**. Attempts to collect information from those who did not complete the study are described (if not reported code as high); **SA3**. Data is complete for at least 80% of the baseline sample (if not reported code as high); **SA4**. No significant differences between key characteristics and outcomes of participants who completed the study and those who did not, or the analyses adjusted for any characteristics that were associated with loss to follow-up; **OM1**. The measured outcomes have been clearly defined (includes follow-up duration); **OM2**. Standardised or validated measures have been used; **OM3**. Justification of the measures used, and their implementation (i.e., operationalised classifications/scaling), was given; **PM1**. The measured prognostic factors have been clearly defined; **PM2**. Standardised or validated measures have been used; **PM3**. Justification of the measures used, and their implementation (i.e., operationalised classifications/scaling), was given; **CM1**. Potential confounders are clearly defined and measured; **CM2**. Potential confounders are accounted for within the study design (e.g., stratification, matching); **CM3**. Multivariable techniques have been used to adjust for potential confounders; **AA1**. Sufficient information is included to determine that the analytic approach used was appropriate for the study design used (if power is not reported, base this on the variables:cases ratio with 1:20 = low, 1 < 20 = high); **AA2**. The analysis was sufficiently powered to test the study hypothesis (if not reported code as high); **AA3**. Approaches for handling missing data are defined and appropriate (e.g., multiple imputation, mixed linear modelling) (if not reported code as high, if reported but not adjusted for code as high); **AA4**. Sufficient data is presented for results to be interpreted; **SR1**. There was no selective reporting of results.

an association between personal responsibility (i.e., not being responsible), worse mental health and poorer work outcomes (Table 4).

3.5.1.1. Health-related outcomes. Four papers reported no significant association between fault attributions and physical health, recovery, or health-related quality of life up to 12 months post-injury in cohorts with heterogeneous injury severity (Ottosson et al., 2007; Hours et al., 2014; Nhac-Vu et al., 2014; Thompson et al., 2014a). The study by Nhac-Vu et al. (2014) observed no association between fault attribution and outcome profiles derived from self-report of the physical and mental health, social, environmental and financial impacts of injury following injury hospitalisation. However, in the only study to extensively adjust for demographic and injury-related variables (e.g., education level, geographic remoteness, and the cause, type and severity of the injuries sustained), Gabbe et al. (2015) found that people who attributed fault to another or denied that they were at fault had 43% and 48% lower risk, respectively, of achieving a complete functional recovery by 12 months following orthopaedic injury compared to people who did not attribute fault to another. Moreover, people who denied being at fault for the crash also had a 32% greater risk of not returning to usual activities (Gabbe et al., 2015). On the contrary, Gopinath et al. (2015a) found that people who lodged an "at fault" claim for medical expenses or loss of earnings up to $5,000 in an otherwise fault-based scheme had a 29% greater risk of not returning to usual activities 12 months after mild to moderately severe injuries compared to people who did not lodge an "at fault" claim. However, it may be that these latter associations were due to population biases; that is, perhaps only people with more serious injuries, living more significant impacts from the injury, or living with greater socioeconomic stresses, choose to lodge an "at fault" claim in this setting. All studies examining health-related outcomes had moderate to high risk of bias, predominantly due to inadequate handling of missing data and loss to follow up, which may have influenced the quality of this evidence.

3.5.1.2. Psychological outcomes. There was limited overall evidence of an association between fault attributions and psychological outcomes, and inconsistent evidence for each individual follow up time point. All papers had either a high or moderate risk of bias.

Two papers found no association between personal feelings of responsibility and psychological outcomes using several measures (i.e., General Health Questionnaire 28-item version, Impact of Event Scale, Posttraumatic Stress Disorder Interview; Jeavons et al., 2000; Fitzharris et al., 2005) in the Victorian "no fault" compensation system with people who sustained heterogeneous injuries. Fitzharris et al. (2005) reported an association between "mixed" responsibility (i.e., both parties shared responsibility for the crash) and PTSD symptoms between six and eight weeks post-injury relative to people who were personally responsible. However, these studies had high overall risk of bias, did not use representative sampling techniques, and were underpowered. Three papers reported that people who believed that they were not responsible for the crash had worse PTSD symptoms six months following minor-moderate (Platts-Mills et al., 2017), moderate-severe (Ryb et al., 2009) or heterogeneous hospitalised injury (Chossegros et al., 2011); however, after adjusting for covariates including age, sex, and collision characteristics (e.g., position in the vehicle, whether the collision was life-threatening, whether the participant felt helpless), this relationship only remained significant in the two papers that took place in fault-based compensation settings (Ryb et al., 2009; Chossegros et al., 2011). That is, Ryb et al. (2009) found that people who *were* culpable for causing the crash had 41% lower odds of having PTSD six months post-injury, but not at one-year post-injury, while Chossegros et al. (2011) found that people who *were not* responsible for the crash had 2.1 times greater odds of having PTSD six months post-injury. In a cohort of claimants in a "no fault" compensation scheme, people who attributed fault to another had a 24% increased risk of experiencing problems with anxiety or depression 12

Table 3
Overall grade of evidence for health-related, mental health, pain and work outcomes.

Prognostic fault factor	Health-related outcomes	Author (Year)	Mental health outcomes	Studies	Pain outcomes	Studies	Work outcomes	Studies
At fault or responsible	Inconsistent (worse outcomes)	Gabbe et al. (2015), Gopinath et al. (2015a), Hours et al. (2014), Nhac-Vu et al. (2014), Ottosson et al. (2007), Thompson et al. (2014a)	Limited (worse outcomes)	Chossegros et al. (2011), Fitzharris et al. (2005), Gabbe et al. (2015), Guest et al. (2017), Jeavons et al. (2000), Mayou and Bryant (2001), Platts-Mills et al. (2017), Ryb et al. (2009), Silove et al. (2003), Thompson et al. (2014a)[a], Thompson et al. (2014b)[a]	Inconsistent (worse outcomes)	Gabbe et al. (2015), Gopinath et al. (2015b), McLean et al. (2014)	Limited (worse outcomes)	Fort et al. (2011), Gabbe et al. (2015), Gopinath et al. (2015a), Murgatroyd et al. (2016a), Pelissier et al. (2017), Thompson et al. (2014b)
Blame or guilt	Limited (worse outcomes)	Harris et al. (2007), Harris et al. (2008)	Inconsistent (worse outcomes)	Dougall et al. (2001), Ehring et al. (2008), Harris et al. (2008), Jeavons et al. (2000), Matsuoka et al. (2008), Mayou and Bryant (2001), Mayou et al. (2001), O'Donnell et al. (2007)	Limited (worse outcomes)	Harris et al. (2011), Mayou and Bryant (2002)	n/a	None
Lawyer involved or litigation	Inconsistent (worse outcomes)	Bayen et al. (2017), Harris et al. (2007), Harris et al. (2008), Hours et al. (2014), Littleton et al. (2011), Ottosson et al. (2007)	Limited (worse outcomes)	Bayen et al. (2017), Chossegros et al. (2011), Elbers et al. (2015), Harris et al. (2008), Hours et al. (2014), Littleton et al. (2011), McCauley et al. (2001), Wu et al. (2006)	Limited (no association)	Harris et al. (2011), Littleton et al. (2011)	Limited (worse outcomes)	Bayen et al. (2017), Fort et al. (2011), Murgatroyd et al. (2016a)
Fault-based compensation claim	Moderate (worse outcomes)	Harris et al. (2007), Harris et al. (2008), Littleton et al. (2011), Murgatroyd et al. (2016b), Ottosson et al. (2007), Tournier et al. (2014), Tournier et al. (2016)	Limited (worse outcomes)	Elbers et al. (2015), Harris et al. (2008), Littleton et al. (2011), Mayou et al. (2001), Mayou and Bryant (2001), Mayou and Bryant (2002), McCauley et al. (2001), Murgatroyd et al. (2016b), Silove et al. (2003)	Limited (worse outcomes)	Carroll et al. (2007), Harris et al. (2011), Littleton et al. (2011), Mayou and Bryant (2002), Pobereskin (2005), Spearing et al. (2012)	Moderate (no association)	Murgatroyd et al. (2016a)
Position in the vehicle and road user group	Inconsistent (worse outcomes)	Nhac-Vu et al. (2011), Nhac-Vu et al. (2014), Tournier et al. (2014), Matsumoto et al. (2013)	Limited (no association)	Bethune et al. (2017), Chossegros et al. (2011), Ehring et al. (2008), Guest et al. (2017), Matsuoka et al. (2008), Mayou et al. (2001), Miettinen et al. (2004), Naim et al. (2014), Nishi et al. (2013), Platts-Mills et al. (2017), Ryb et al. (2009), Wu et al. (2006)	Inconsistent (worse outcomes)	Atherton et al. (2006), Carroll et al. (2007), Cobo et al. (2010), Harris et al. (2011), Hartling et al. (2002), McLean et al. (2014)	Inconsistent (worse outcomes)	Miettinen et al. (2004), Pelissier et al. (2017), Suissa (2003)
Direction of impact	Limited (no association)	Matsumoto et al. (2013)	Limited (no association)	Auvergne et al. (2016), Phillips et al. (2010), Platts-Mills et al. (2017)	Inconsistent (worse outcomes)	Atherton et al. (2006), Carroll et al. (2007), Hartling et al. (2002), McLean et al. (2014), Pape et al. (2007), Wynne-Jones et al. (2006)	Inconsistent (worse outcomes)	Suissa (2003)

Notes: Strong evidence = > 2 high quality cohort studies with consistent results; moderate evidence = > 1 high quality cohort study or > 2 moderate quality cohort studies with consistent results; limited evidence = > 1 moderate quality cohort study or > 1 low quality cohort studies with consistent results; inconsistent evidence = inconsistent results regardless of study quality. Level of evidence was downgraded where results were inconsistent. [a]Paper did not have a distinct follow up time point.

Table 4
Association between legal responsibility (culpability or prosecution) or attribution of fault or responsibility to self and/or another and health-related, mental health, pain and return to work outcomes after transport-related injury.

Author (Year)	Risk of bias	Analytic approach	Variables included in multivariable analysis	Fault variable	Outcomes
Health-related outcomes (HR-QoL, function)					
Gabbe et al. (2015)	Moderate	Multiple linear regression and Poisson regression.	Age, sex, comorbidities, education, geographic remoteness, major trauma status, prior work, orthopaedic injury group, head injury, chest/abdominal injury, other injury and cause of injury	Fault attribution (another at fault)	**Complete functional recovery** (GOS-E) at 12 m: not at fault (ARR = 0.6, 95%CI: 0.5, 0.7), admit fault (ARR = 0.67, 95%CI: 0.39, 1.14); deny fault (ARR = 0.5, 95%CI: 0.4, 0.8). **Overall Health status** (EQ-5D) at 12 m: not at fault (MDadj = -0.09, 95%CI: -0.1, -0.1), admit fault (MDadj = -0.06, 95%CI: -0.13, 0.002); deny fault (MDadj = -0.1, 95%CI: -0.1, -0.03). **Problems with usual activities** (EQ-5D) at 12 m: not at fault (ARR = 1.3, 95%CI: 1.2, 1.4), admit fault (ARR = 1.2, 95%CI: 1.0, 1.5); deny fault (ARR = 1.3, 95%CI: 1.2, 1.5).
Gopinath et al. (2015a)	High	Logistic regression, modified Poisson regression	n/a (NS)*	Participant at fault	**Return to usual daily activities** at 12 m (RR = 1.3, 95%CI: 1.0, 1.6) and 24 m (RR = 1.4, 95%CI: 1.1, 1.6)
Ottosson et al. (2007)	High	Chi square test	n/a (NS univariate effects reported and cause variable not included in multivariable analyses)	Responsibility (who caused the injury?)	**Recovery at 1 m**: counterpart (62%), other (38%); and at 6 m: counterpart (53%), other (47%); p = 0.06.
Thompson et al. (2014a)	Moderate	Structural equation modelling	Education, gender, age, injury type, claim duration, responsibility, employment status, vulnerable road user	Personally responsible	**Physical health** factor (SF12 PCS & bodily pain): responsibility standardized direct effect = -0.05, $p > .05$
Hours et al. (2014)	Moderate	ANOVA, Modified Poisson regression	Age and sex	Personally responsible	**HR-QoL** (overall score, and four domain scores) at 12 m: NS (data not reported)
Nhac-Vu et al. (2014)	High	Multiple correspondence analysis, multinomial logistic regression	n/ a (NS)*	Personally responsible	Five 12 m **outcome groups** with varying general health, physical, mental, social, environmental, and financial profiles. Group membership not associated with responsibility (only reported n/%/NS).
Mental health outcomes					
Gabbe et al. (2015)	Moderate	Poisson regression.	Age, sex, comorbidities, education, geographic remoteness, major trauma status, prior work, orthopaedic injury group, head injury, chest/abdominal injury, other injury and cause of injury	Fault attribution (based on whether another was at fault)	**Problems with anxiety or depression** (EQ-5D) at 12 m: not at fault (ARR = 1.2, 95%CI: 1.1, 1.4), admit fault (ARR = 1.3, 95%CI: 1.0, 1.6); deny fault (ARR = 1.3, 95%CI: 1.1, 1.6).
Mayou and Bryant (2001)	High	NR	n/a (NS)*	Participant prosecuted for a driving offence	**Psychological condition** at 12 m: The 9% of participants prosecuted for driving offences had similar outcomes to the remainder, but were less likely to report travel anxiety (data NR).
Ryb et al. (2009)	High	Univariate and multivariable logistic regression	Age, gender, prior assault, family member fatality, any fatality in crash, history of depression.	Participant culpable	**PTSD** at 6 m: no (OR = 1.0, ref), yes (OR = 0.5, 95%CI: 0.3, 0.8; AOR = 0.6, 95%CI: 0.4, 1.0) **PTSD** at 12 m: no (OR = 1.0, ref), yes (OR = 0.6, 95%CI: 0.4, 1.03; AOR = 0.7, 95%CI: 0.4, 1.3)
Guest et al. (2017)	Moderate	Logistic regression with backward elimination	IRSAD (quintiles), sex, employment status, fault, required rehabilitation, ambulance transportation	Participant at fault	**Psychological distress** within 24 m, not at fault (OR = 1.0, ref), and at fault (OR = 0.3, 95%CI: 0.2, 0.5; AOR = 0.3, 95% CI: 0.2, 0.4).
Platts-Mills et al. (2017)	Moderate	Forward step-wise logistic regression	Age, sex, ethnicity, social support, education, pre-injury health, road user, impact direction, fault, life threatening, felt hopeless, ED (pain, physical, emotional), last 2w (pain severity/ interference, recent opioid use, bed rest)	Participant at fault	**PTSD** at 6 m: at fault (RR = 1.0, ref), not at fault (ARR = 1.2, 95%CI: 0.5, 2.5).
Chossegros et al. (2011)	Moderate	Multivariable logistic regression	Sex, road user, NISS, PTA, history of psychological disorder, separation in year before crash.	Personally responsible	**PTSD** at 6 m: responsible (AOR = 1.0, ref), not responsible (AOR = 2.1, 95%CI: 1.0, 4.2).
Silove et al. (2003)	High	Logistic regression	n/a (NS univariate effects described only, and fault variable not included in multivariable analyses)	Personally responsible	**Psychological conditions** at 18 m: NS (data not reported)
Fitzharris et al. (2005)	High	Chi square, ANOVA; multiple regression	Overall body pain, pre-crash SF36 MCS, LOS > 7d, responsibility for MVC	Personally responsible	**Depression** at 6-8w: other vs self (Badj = -0.8, p = 0.06), mixed vs self (Badj = -0.9, p = 0.04).
Jeavons et al. (2000)	High	Bivariate correlations	n/a (NS univariate effects reported only, and fault-related variables not included in multivariable analyses)	Personally responsible	**PTSD (IES)** at 3 m ($r^2 = 0.06$, $p > 0.05$) and 6 m ($r^2 = -0.05$, $p > 0.05$)

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Table 4 (*continued*)

Author (Year)	Risk of bias	Analytic approach	Variables included in multivariable analysis	Fault variable	Outcomes
					PTSD (PTSD-I) at 3 m ($r^2 = 0.02$, $p > 0.05$) and 6 m ($r^2 = -0.08$, $p > 0.05$) **General mental health** at 3 m ($r^2 = 0.07$, $p > 0.05$) and 6 m ($r^2 = -0.01$, $p > 0.05$)
Thompson et al. (2014a)	Moderate	Structural equation modelling	Education, gender, age, injury type, claim duration, responsibility, employment status, vulnerable road user	Personally responsible	**Mental health** factor (SF12 MCS and travel anxiety): Standardized direct effect = 0.37, $p < 0.001$
Thompson et al. (2014b)	High	Logistic regression, mediation analysis	Age, gender, injury group, claim duration.	Personally responsible	**Depression symptoms**: Those not at all responsible for the MVC were 2.9 to 3.2 times more likely to have depression symptoms c.f. those totally responsible for the MVC
Pain outcomes					
Gabbe et al. (2015)	Moderate	Poisson regression.	Age, sex, comorbidities, education, geographic remoteness, major trauma status, prior work, orthopaedic injury group, head injury, chest/abdominal injury, other injury and cause of injury	Fault attribution (another at fault)	**Problems with pain or discomfort** (EQ-5D) at 12 m: not at fault (ARR = 1.3, 95%CI: 1.2, 1.4), admit fault (ARR = 1.3, 95%CI: 1.1, 1.5); deny fault (ARR = 1.2, 95%CI: 1.1, 1.4).
Gopinath et al. (2015b)	Low	Logistic regression, modified Poisson regression	n/a (NS)*	Participant at fault	**Pain severity** at 12 m, not at fault (M = 4.98 95%CI: 4.5, 5.5) and at fault (M = 4.1 95%CI: 2.7, 5.5), p = 0.23. **Pain severity** at 24 m, not at fault (M = 4.5, 95%CI: 3.8, 5.1) and at fault (M = 4.8, 95%CI: 2.6, 7.0), p = 0.54.
McLean et al. (2014)	High	Log-binomial regression with robust estimation with Least Absolute Shrinkage and Selection Operator (LASSO) Regression.	n/a (NS)*	Participant at fault	**MSNP** at 6 w, participant at fault v nobody at fault: litigants (RR = 0.98, 95%CI: < 0.5, > 2.5); non-litigants (RR = 0.8, 95%CI: < 0.5, 1.4) **Widespread pain** at 6 w, participant at fault v nobody at fault: litigants (RR = 1.9, 95%CI: 0.5, > 4.0); non-litigants (RR = 0.6, 95%CI: < 0.5, 1.4).
Work outcomes					
Gabbe et al. (2015)	Moderate	Poisson regression.	Age, sex, comorbidities, education, geographic remoteness, major trauma status, prior work, orthopaedic injury group, head injury, chest/abdominal injury, other injury and cause of injury	Fault attribution (another at fault)	**RTW** at 12 m: not at fault (ARR = 0.9, 95%CI: 0.9, 1.0), admit fault (ARR = 1.0, 95%CI: 0.9, 1.3); deny fault (ARR = 0.9, 95%CI: 0.8, 1.1).
Murgatroyd et al. (2016a)	Low	Log-rank test of survival distributions, R-square analysis and concordance index (c-index)	n/a (NS)*	Participant at fault	**Days to RTW** within 2y: at fault (Med = 203d), not at fault (Med = 250d), p = 0.04; $R^2 = 0.23$, C-index = 0.70.
Gopinath et al. (2015a)	High	Logistic regression, modified Poisson regression	n/a (NS)*	Participant at fault	**RTW** at 12 m, not at fault (RR = 1.0, ref), at fault (RR = 0.91, 95%CI: 0.70, 1.18); RTW at 24 m, not at fault (RR = 1.0, ref), at fault (RR = 1.03, 95%CI: 0.80, 1.31) Resumed **full work duties** at 12 m, not at fault (RR = 1.0, ref), at fault (RR = 1.1, 95%CI: 1.1, 1.2); RTW at 24 m (RR = 1.1, 95%CI: 1.0, 1.2) **Sustained RTW**: not at fault (RR = 1.0, ref), at fault (RR = 0.9, 95%CI: 0.7, 1.3)
Thompson et al. (2014b)	High	Logistic regression, mediation analysis	Age, gender, injury group, claim duration.	Personally responsible	**RTW**: Those not responsible/ partially responsible 2 times less likely to RTW than those totally responsible. Responsibility indirectly associated with RTW via depression (NR as effect size/beta or % indirect).
Fort et al. (2011)	Moderate	Logistic regression	n/ a (NS)*	Personally responsible	**Late RTW vs "normal" RTW for injury severity** in 12 m: not responsible (OR = 1.0, ref), responsible (OR = 0.78, 95%CI: 0.5, 1.3), do not know (OR = 0.77, 95%CI: 0.3, 2.1).
Pelissier et al. (2017)	Moderate	Chi square test	n/ a (NS)*	Personally responsible	**RTW** within 3 years: Not responsible (56% RTW), responsible (54% RTW), don't know (55% RTW), NS.

Notes: B = unstandardized coefficient, β (beta) = standardized coefficient. Time is reported in days (d), weeks (w), months (m) or years (y).

* Univariate effects reported, and fault variable not included in multivariable analyses.

Table 5
Association between blame or guilt-related appraisals and health-related, mental health, pain and return to work outcomes after transport-related injury.

Author (Year)	Risk of bias	Analytic approach	Variables included in multivariable analysis	Fault variable	Outcomes
Health-related outcomes (HR-QoL, function)					
Harris et al. (2008)	Moderate	t-test/ANOVA	n/a (NS)*	Blame (self/ another/ don't know)	**SF-36 PCS** at 6 m: Self (M = 43.4, 95% CI: 41.1, 45.6) another (M = 35., 95% CI: 33.3, 37.1), don't know (M = 41.8, 95% CI: 38.6, 44.9), $p < 0.0001$
Harris et al. (2007)	High	Chi square test with Mantel-Haenzel test for trend	n/a (NS)*	Blame (self/ another/ don't know)	**Recovery satisfaction** up to 6y: blame self (M = 84% satisfied) vs blame another (M = 59% satisfied), $p < 0.0001$
Harris et al. (2008)	Moderate	t-test/ANOVA	n/a (NS)*	Blame (self/ another/ don't know)	**SF-36 MCS** at 6 m: Self (M = 47.9, 95% CI: 45.0, 50.9), another (M = 41.5, 95% CI: 39.0, 44.0), don't know (M = 47.2, 95% CI: 43.1, 51.2), p = 0.003
Mental health outcomes					
Jeavons et al. (2000)	High	Bivariate correlations	n/a (NS)*	"Blame or responsibility" (responses range from 1 = yes, 2 = partial, 3 = no)	**PTSD (IES)** at 3 m ($r^2 = 0.1$, $p > 0.05$) and 6 m ($r^2 = -0.2$, $p > 0.05$) **PTSD (PTSD-I)** at 3 m ($r^2 = 0.02$, $p > 0.05$) and 6 m ($r^2 = -0.1$, $p > 0.05$) **General mental health** at 3 m ($r^2 = 0.1$, $p > 0.05$) and 6 m ($r^2 = -0.6$, $p > 0.05$)
O'Donnell et al. (2007)	High	Intercorrelation, path analysis with backward elimination	Acute PTSD, 3 m PTSD, 12 m PTSD, negative self cognitions (acute and 3 m), negative world cognitions(acute and 3 m), self blame (acute and 3 m)	Blame (self, using PTCI)	**PTSD symptoms** at 3 m: acute self-blame ($r^2 = -0.01$, $p > .01$; direct effect: -0.2, $p < .01$), 3 m self-blame ($r^2 = 0.1$, $p > .01$; direct effect: NR). **PTSD symptoms** at 12 m: acute self-blame ($r^2 = -0.03$, $p > .01$; direct effect = 0.11, $p > .05$), 3 m self-blame ($r^2 = 0.03$, $p > .01$; direct effect, -0.2, $p < .01$)
Dougall et al. (2001)	High	Correlation coefficient	n/a (NS)*	Blame (self, using WCI)	**PTSD diagnosis** at 6 m ($r^2 = -0.003$, $p > .05$) and 12 m ($r^2 = 0.03$, $p > 0.05$).
Mayou and Bryant (2001)	High	Logistic regression	Gender, negative emotion, prior emotional problems, accident frightening, not to blame, serious injury, anger	Blame (self; yes/no)	**Psychological condition** (PTSD, phobic travel anxiety, general anxiety or depression) at 12 m: yes (RR = 1, ref), no (RR = 1.5, $p < .05$; AOR = 1.7, 95%CI: 1.2, 2.5).
Mayou et al. (2001)	High	Logistic regression	n/a (NS)*	Blame (self; yes/no)	At 12 m: **Phobic Travel Anxiety**: yes (RR = 1.0, ref), no (RR = 1.9, $p < 0.05$), **General Anxiety**: no (RR = 1.0, ref), yes (RR = 1.5, $p > 0.05$), **PTSD**: no (RR = 1.0, ref), yes (RR = 1.6, $p > 0.05$), **Depression** (NS, data NR).
Matsuoka et al. (2008)	Moderate	Logistic regression	Sex, previous trauma, family history of psychopathology, history of psychiatric illness, sense of life threat, feeling of self-reproach, road user, education, heart rate, ISS, IES-R intrusion subscale	Feeling of self-reproach (no/ yes)	**Full/partial PTSD**: No (OR = 1.0, ref), yes (OR = 1.5, 95%CI: 0.6, 3.9; AOR = 0.9, 95%CI: 0.3, 3.3) **Psychiatric illnesses**: No (OR = 1.0, ref), yes (OR = 1.5, 95%CI: 0.6, 3.6; AOR = 1.0, 95%CI: 0.3, 2.9)
Ehring et al. (2008)	High	Correlation	n/a (NS)*	Guilt or shame (self; using PEQ)	**PTSD** at 2 w: $r^2 = 0.4$, $p < .05$, and at 6 m: $r^2 = 0.2$, $p > .05$ **Depression** at 2 w ($r^2 = 0.01$, $p > 0.05$) and 6 m ($r^2 = 0.2$, $p > 0.05$).
Pain outcomes					
Mayou and Bryant (2002)	High	Logistic regression	n/a (NS)*	Blame (self; yes/no)	**Pain** at 12 m in WAD patients: yes (RR = 1.0, ref), no (RR = 3.7, $p < .05$), and patients with bony injury: yes (RR = 1.0, ref), no (RR = 3.3, $p < 0.05$).
Harris et al. (2011)	High	t-test/ANOVA	n/a (NS)*	Blame (self/ another/ don't know)	**Neck Pain** at 6 m: self (M = 2.9, 95%CI: 2.5, 3.4), another (M = 3.8, 95%CI: 3.4, 4.2), don't know (M = 2.9, 95%CI: 2.3, 3.6), p = 0.008.

Notes: B = unstandardized coefficient, β (beta) = standardized coefficient. Time is reported in days (d), weeks (w), months (m) or years (y).
* Univariate effects reported, and fault variable not included in multivariable analyses.

months after orthopaedic injury than people who did not attribute fault to another person (Gabbe et al., 2015). People who were prosecuted for driving offences had a lower risk of reporting travel anxiety in a cohort who had presented to the ED after minor to moderate severity injuries, but demonstrated no difference in risk of adverse psychological outcomes (i.e., anxiety, depression, or PTSD) compared to people who were not prosecuted (Mayou and Bryant, 2001).

There was inconsistent evidence that fault was associated with mental health outcomes beyond the first 12 months post-injury. Silove et al. (2003) reported no association between feeling personally responsible for the crash and PTSD or major depression 18 months post-injury in a heterogeneous cohort of people who were admitted to the ED, whereas Guest et al. (2017) found that people who lodged a compensation claim who were at fault had a 75% lower risk of having psychological distress within two years of injury. However, it should be noted that the study by Guest et al. (2017) included administrative data on conditions identified through medical examination and only included people who sustained musculoskeletal injuries with a settled compensation claim in a predominantly fault-based compensation setting, whereas Silove included patients admitted to hospital following transport injury and administered clinical interviews to identify the presence of psychological conditions. It is likely, therefore, that the study by Guest et al. under-identified the presence of psychological conditions, particularly in those at fault who have fewer entitlements to claim in the predominantly fault-based compensation setting in NSW, Australia.

3.5.1.3. Pain outcomes. The association between fault attribution and pain outcomes was inconsistent. One study provided limited evidence of no association between fault and widespread pain, and moderate to severe neck pain, six weeks after minor injury (McLean et al., 2014); however this study was underpowered, had a high risk of selective reporting, and an overall high risk of bias. Another study with low risk of bias provided moderate evidence of no association between fault and pain severity at both one and two years following injury of mild to moderate severity (Gopinath et al., 2015b). Comparatively, Gabbe et al. (2015) found that people who believed that another was at fault, even if the police did not agree (i.e., the “deny fault” group), had a 20% higher risk of experiencing pain or discomfort 12 months after orthopaedic injury compared to people who did not attribute fault to another.

3.5.1.4. Work outcomes. Evidence of an association between fault attribution and work outcomes was limited, with inconsistent evidence of an association at 12 months post-injury, and limited evidence of an association after 12 months. Three papers found that people who attributed fault to another had worse return to work post-injury. First, Gabbe et al. (2015) found that people who sustained orthopaedic injuries and attributed fault to another had an 8% lower risk of having returned to work 12 months post-injury compared to people who did not attribute fault to another. Similarly, in one of just six high quality papers identified in this review, patients with orthopaedic injuries who reported that they were not at fault took a median of 250 days to return to work after injury compared to just 203 days for people who were at fault (Murgatroyd et al., 2016a). Lastly, Thompson et al. (2014b) found that people with heterogeneous injury severity who were either not responsible or partially responsible for the crash had two times lower odds of returning to work than people who accepted complete responsibility.

Two studies from fault-based compensation settings found that responsibility for the crash was not related to return to work 12 months or three years post-injury, or with sustained return to work between 12 and 24 months following mild to moderately severe (Gopinath et al., 2015a) or major trauma (Pelissier et al., 2017). However, among people who did return to work, those who lodged an “at fault” claim had a 10% higher risk of resuming full work duties, as opposed to modified duties, compared to people who did not lodge an “at fault” claim (Gopinath et al., 2015a). Responsibility for the crash was not associated with returning to work late in the first 12 months following injury hospitalisation, where late return to work was defined as the upper quartile of time taken to return to work, even after adjusting for injury severity, lawyer involvement and pain (Fort et al., 2011).

3.5.2. Blame or guilt

When considered together, the evidence of an association between feelings of blame (most often measured as self-blame) or guilt and outcomes was limited for health and pain-related outcomes, and inconsistent for mental health outcomes (Table 5). No studies examined the relationship between feelings of blame or guilt and work outcomes. It should be noted that while blaming oneself likely indicates that the individual feels some personal responsibility for the crash, this does not necessarily mean that they do not also attribute some responsibility or blame to another person.

3.5.2.1. Health-related outcomes. Two papers from the same fault-based compensation system provided limited evidence of an association between blame and poorer recovery or recovery satisfaction. In the first paper, which had high risk of bias, Harris et al. (2007) reported that just 59% of people who sustained serious injuries and blamed another for causing their injuries were satisfied with their recovery compared with 84% of people who blamed themselves; however, this study did not clearly define how recovery satisfaction was measured, did not describe factors associated with loss to follow up, and was underpowered. The second paper by Harris et al. (2008) found that orthopaedic trauma patients who blamed themselves had higher physical functioning (SF36 Physical Component Score (PCS)) than those who blamed another; however, this did not remain significant after adjusting for covariates such as age, gender and other claim-related factors (e.g., claim made, lawyer involvement). The latter paper had moderate risk of bias as it did not fully report loss to follow up, handling of missing data, and did not report the coefficients for the relationship between predictors and outcomes.

3.5.2.2. Psychological outcomes. Seven studies examined the relationship between feelings of blame or guilt and mental health outcomes. The evidence of a negative association with mental health outcomes was inconsistent. Six studies had high risk of bias and one had moderate risk of bias (Matsuoka et al., 2008), and most studies inadequately reported study attrition and used inappropriate analytic approaches. Mayou and Bryant (2001) found that people who did not blame themselves had a 71% increase in risk of having one of several psychological conditions including PTSD, phobic travel anxiety, general anxiety, or depression one-year post-injury in a cohort with minor to moderately severe trauma compared to those who blamed themselves. However, another paper using the same cohort, found that while people who did not blame themselves had a 90% increase in risk of having phobic travel anxiety, there was no increase in their risk of having general anxiety, PTSD or depression (Mayou et al., 2001). Another study found that self-blame in the acute injury phase, and three months post-injury were associated with PTSD symptoms three months following similar types of injuries of minor-moderate severity (O’Donnell et al., 2007), but not at 12 months post-injury. Similarly, Ehring et al. (2008) reported a correlation between feelings of guilt or shame and PTSD symptoms two weeks following moderate to severe injury, but not at six months post-injury. Another study found that people who blamed themselves had better mental health six months following orthopaedic injury than those who did not blame themselves, as demonstrated by a higher mean SF36 Mental Component Score (MCS; Harris et al., 2008). However, other studies have found no association between self-blame and general anxiety (Jeavons et al., 2000; Ehring et al., 2008), or between self-blame and PTSD in patients with mild to major trauma over follow up periods ranging from one to 12 months post-injury in cohorts with heterogeneous injury severity ranging from minor to major trauma (Jeavons et al., 2000; Dougall et al., 2001; Matsuoka et al., 2008). These findings suggest that self-blame may not be consistently associated with mental health outcomes beyond the acute post-injury period.

3.5.2.3. Pain outcomes. Although two papers provided limited evidence that self-blame was prognostic of pain in predominantly fault-based compensation systems, both studies had high risk of bias due to inadequate reporting of study attrition and inappropriate analytic approach. First, Mayou and Bryant (2002) found that people with minor to moderate trauma who did not blame themselves had a 3.3 to 3.7 times greater risk of reporting pain 12 months post-injury compared to those who blamed themselves, but this study did not adjust for all factors associated with loss to follow up (e.g., having a manual occupation). Second, Harris et al. (2011) found that people who blamed themselves for their orthopaedic injury reported lower levels of bodily pain relative to those who blamed another; however, participant selection and recruitment was not fully disclosed in this paper making it unclear whether representative sampling techniques were used.

3.5.3. Lawyer involvement or litigation

Several aspects of lawyer involvement were identified including the variables "lawyer", "lawyer involvement", consulting a lawyer, intent to litigate or press charges, litigation, and "insurance or legal problems"; however, the actual role of the lawyer when "involved" was typically not defined. While using a lawyer or engaging in litigation likely indicates that another party was at fault and a lawyer was required to assist in demonstrating this for the client (e.g., in a fault-based compensation claim) it is not uncommon for people who are at fault for the crash to also seek legal representation in compensation schemes with "no fault" benefits (Ioannou et al., 2016). It is possible that people sought legal advice because they were confused or frustrated with the compensation system to begin with, but did not require a lawyer for fault-related procedures. In fact it is possible that there is shared responsibility in many circumstances, and that someone lodging for damages or compensation with or without the support of a lawyer may nonetheless have had some responsibility in the incident. Interactions with lawyers may also alleviate feelings of blame, particularly where lawyers have successfully helped the injured person to obtain compensation. Alternatively, lawyers may exacerbate pre-existing perceptions of blame by perpetuating external attributions of fault during the pursuit of compensation. Moreover, there is evidence that people are more likely to engage in lawyer use or litigation if they have worse health or pain following neck injury, creating a reverse causality bias that should be accounted for when making inferences related to lawyer involvement (Spearing et al., 2012). Finally, while it would be in breach of professional responsibilities, there could be instances where a lawyer encourages their client to delay or refrain from returning to work or to report persistent symptoms or disability to enhance their claim for benefits. Taking these factors into consideration, overall there was inconsistent evidence of an association between lawyer use or litigation and health-related outcomes, limited evidence of an association with worse mental health and work-related outcomes, and limited evidence of no relationship between engaging in legal services or procedures and pain outcomes (Table 6).

3.5.3.1. Health-related outcomes. While the overall evidence was inconsistent for an association between lawyer involvement and health-related outcomes, there was limited evidence for an association with health-related outcomes 12 month post-injury. Harris et al. (2008) reported that patients who sustained orthopaedic injuries in a predominantly fault-based compensation system and used a lawyer scored an average of 7.63 points lower on the SF36 PCS six months post-injury, indicating worse overall physical health. However, Littleton et al. (2011) found no significant effects on the SF36 PCS at 12 months post-injury in a similar cohort of people with mild to moderately severe musculoskeletal injuries.

The evidence for a relationship between litigation and recovery or health-related quality of life was inconsistent. Hours et al. (2014) found that minor trauma patients who intended to litigate at baseline had worse overall quality of life and a 60% higher risk of not being recovered after 12 months. Likewise, after major trauma, 24% fewer major trauma patients who reported lawyer involvement were satisfied with their recovery up to six years post-injury (Harris et al., 2007); however, selection biases may have influenced the sample characteristics in that study such that patients who had worse outcomes could have been more likely to participate. Other studies have found no association between litigation and quality of life or recovery after minor to major trauma (Ottosson et al., 2007), or severe traumatic brain injury (Bayen et al., 2017).

3.5.3.2. Psychological outcomes. The overall evidence of a relationship between lawyer use or litigation and mental health outcomes was inconsistent; however, there was moderate evidence of an association with worse outcomes six months post-injury, and limited evidence of a relationship 12 months post-injury. However, the association between lawyer involvement and poorer mental health, particularly in the first six months post-injury, may be attributable to the adversarial and often stressful nature of being involved in litigation or compensation-related legal proceedings, and not due to fault attribution per se (Hickling et al., 2005; Grant et al., 2014), or the tendency that peoplwho have worse injuries or outcomes disproportionately choose to involve a lawyer (Spearing et al., 2012).

Lawyer involvement was associated with worse mental health in two papers from fault-based compensation settings that had limited "no fault" benefits, such that people who obtained legal representation scored an average of 7.7 points lower on the SF36 MCS that those who did not have legal representation after orthopaedic or musculoskeletal injuries (Harris et al., 2008; Littleton et al., 2011). Although one paper had low risk of bias and the other moderate risk of bias, neither study adjusted for the impact of injury severity on lawyer use. Two papers reported that people who intended to litigate, or who actually proceeded with litigation, had worse mental health outcomes, including a 2.1-fold increase in the risk of having PTSD six months following hospital admission compared to those who did not litigate (Wu and Cheung, 2006; Chossegros et al., 2011), adjusting for demographic and injury-related characteristics.

The evidence was inconclusive for an association between lawyer involvement and anxiety and depression outcomes, with three out of four studies having high risk of bias. Elbers et al. (2015) reported a 3.1-fold increase in risk of having problems with anxiety or depression on the EQ-5D one year post-injury for people who had lawyer involvement after injury of mild to moderate severity, but found no difference in risk two years post-injury and therefore did not include lawyer use in the multivariable analyses. Moreover, the study by Elbers et al. (2015) did not clearly report which variables were included as covariates, and therefore it was unclear whether factors that were associated with loss to follow up were included as covariates in the multivariable analyses. The study by Bayen et al. (2017), which was underpowered and had high risk of bias, reported that litigation was associated with both anxiety and depression in people with traumatic brain injury four years post-injury. However, other studies found that litigation or lawyer involvement were not associated with neuropsychological function after brain injury (Bayen et al., 2017), or post-concussion syndrome (McCauley et al., 2001) and mental quality of life scores (Hours et al., 2014) after ED or trauma admission.

3.5.3.3. Pain outcomes. Two papers provided limited evidence of no association between lawyer involvement and pain. First, Littleton et al. (2011) provided moderate evidence of no association between having legal representation and pain severity or pain-related disability 12

Table 6
Association between lawyer involvement or litigation and health-related, mental health, pain and return to work outcomes after transport-related injury.

Author (Year)	Risk of bias	Analytic approach	Variables included in multivariable analysis	Fault variable	Outcomes
Health-related outcomes (HR-QoL, function)					
Littleton et al. (2011)	Low	Linear mixed models, backwards linear regression	SF36 PCS & FRI analyses: n/a (univariate effects reported only as fault variables not significant in backwards regression) SF36 MCS analysis: baseline MCS, gender, lawyer involvement	Lawyer involved	**SF-36 PCS** at 12 m: univariate effects NR, and NS in adjusted model
Harris et al. (2007)	High	Chi square test with Mantel-Haenzel test for trend	n/a (NS)*	Lawyer involved	**Recovery satisfaction** up to 6y: No lawyer (M = 80% satisfied) vs lawyer (M = 56% satisfied), $p < 0.0001$
Harris et al. (2008)	Moderate	Backwards step-wise multiple linear regression	PCS analysis: Age, gender, lawyer involvement, number of fractures MCS analysis: age, lawyer, annual income	Lawyer involved	**SF-36 PCS** at 6 m: No lawyer (M = 42.5, 95%CI: 40.5, 44.6), lawyer (M = 34.7, 95%CI: 33.2, 36.3), $p < 0.0001$; MDadj = -7.63, $p < 0.0001$
Hours et al. (2014)	Moderate	ANOVA, Modified Poisson regression	Age and sex	Litigation (intend to litigate)	**Overall QoL** at 12 m: β = -10.6, SE = 2.6, $p < .0001$ **QoL: Social score** at 12 m: NS (data not reported) **QoL: Environmental score** at 12 m: NS (data not reported) **Overall health state** at 12 m: do not intend to litigate (RR = 1.0, ref), intend to litigate (RR = 1.6, 95%CI: 1.1, 2.3)
Bayen et al. (2017)	High	Multivariable linear or logistic regression	Age, gender, education, alcohol/drug abuse, prior psychiatric disorder, transport injury, ISS, work-related MVC, GOS, litigation	Litigation	**Function** (GOS-E) at 4y: AOR = 0.4, 95%CI: 0.20, 0.88. **Function** (BICRO) at 4y: B = 14, 95%CI: 1.9, 26.4 **QoL** (QoLIBRI) at 4y: B = −4.00, 95%CI: -11.9, 3.9
Ottosson et al. (2007)	High	Chi square test	n/a (NS)*	Insurance or legal problems	**Recovery at 6 m:** more participants were non-recovered if they had insurance problems (56%) vs those with no insurance problems (44%), p = 0.02. Recovery was not associated with having legal problems (data not reported).
Mental health outcomes					
Hours et al. (2014)	Moderate	ANOVA, Modified Poisson regression	Age and sex	Litigation (intend to litigate)	**QoL (mental score)** at 12 m: NS (data not reported)
Wu et al., 2006Wu et al. (2006)	High	Linear growth modelling, adjusting for time (1 w, 1 m, 3 m, 6 m, in weeks)	Gender, age, history of psychiatric consultation, history of traumatic experience, emotional support, pedestrian, passenger, injury of other victims, injury severity, GCS score, required surgery, days of hospitalisation, days of sick leave, heart rate, perceived threat of life, intend to litigate.	Litigation (intend to litigate)	**PTSD symptoms** over 6 m: There was a faster drop in intrusion symptoms (but not hyperarousal, avoidance or total IES) for those planning litigation (B = -0.01, SE = 0.00, β = -0.2, $p < 0.05$).
Bayen et al. (2017)	High	Multivariable linear or logistic regression	Age, gender, education, alcohol/drug abuse, prior psychiatric disorder, transport injury, ISS, work-related MVC, GOS, litigation	Litigation	**Neuropsychological function** at 4y: B = 2.9, 95%CI: -0.35, 6.1. **Anxiety** at 4y: B = 1.8, 95%CI: -0.009, 3.50 **Depression** at 4y: B = 3.0, 95%CI: 1.1, 4.8
Chossegros et al. (2011)	Moderate	Multivariable logistic regression	sex, road user, pressing charges, NISS, PTA, pain > 6 m	Litigation	**PTSD** at 6 m: No (AOR = 1.0, ref), Yes (AOR = 2.1, 1.0, 4.6), Undecided (AOR = 2.6, 1.1, 7.1).
McCauley et al. (2001)	High	Chi-square test	n/a (NS)*	Litigation	**Post-concussion syndrome** at 3 m: NS (p = 0.92)
Littleton et al. (2011)	Low	Linear mixed models, backwards linear regression	SF36 PCS & FRI analyses: n/a (univariate effects reported only as fault variables not significant in backwards regression) SF36 MCS analysis: baseline MCS, gender, lawyer involvement	Lawyer involved	**SF36 MCS** at 12 m: β_{adj} = -6.5, p = 0.03
Elbers et al. (2015)	High	Multiple forward step-wise logistic regression	Gender, pre-injury health, catastrophizing, lawyer, claims management satisfaction.	Lawyer involved	**EQ-5D anxiety/ depression** at 12 m (AOR = 3.1, 95%CI 1.8, 5.4) and at 24 m: NS.
Harris et al. (2008)	Moderate	Backwards step-wise multiple linear regression	PCS analysis: Age, gender, lawyer involvement, number of fractures MCS analysis: age, lawyer, annual income	Lawyer involved	**SF-36 MCS** at 6 m: No lawyer (M = 48.0, 95%CI: 45.8, 50.1), lawyer (M = 40.2, 95%CI: 37.4, 42.9), $p < 0.0001$; MDadj = -7.68, $p < 0.0001$
Pain outcomes					
Littleton et al. (2011)	Low	Linear mixed models, backwards linear regression	SF36 PCS & FRI analyses: n/a (univariate effects reported only as fault variables not significant in backwards regression) SF36 MCS analysis: baseline MCS, gender, lawyer involvement	Lawyer involved	**Pain severity and disability** (FRI) at 12 m: univariate effects NR, and NS in adjusted model
Harris et al. (2011)	High	Backwards multiple linear regression	Gender, lawyer, education level	Lawyer involved	**SF36 Neck Pain** at 6 m: No lawyer (M = 3.0, 95%CI: 2.7, 3.3), lawyer (M = 3.8, 95%CI: 3.3, 4.3), p = 0.003; MDadj = 1.4, 95%CI: 0.81-2.41.
Work outcomes					

(*continued on next page*)

Table 6 (*continued*)

Author (Year)	Risk of bias	Analytic approach	Variables included in multivariable analysis	Fault variable	Outcomes
Murgatroyd et al. (2016a)	Low	Log-rank test of survival distributions	n/a (NS)*	Lawyer involved	**Days to RTW** within 2y: lawyer by 6 m (Med = 199d), no lawyer (Med = 122d), p = 0.007.
Fort et al. (2011)	Moderate	Logistic regression	Gender, age, education level, occupational skill level, MVC during personal or work journey, ISS, intend to press charges	Litigation (intend to litigate)	**Late RTW vs "normal" RTW for injury severity** in 12 m: not litigating (OR = 1.0, ref), intend to litigate (OR = 3.3, 95%CI: 1.9, 5.9; AOR = 3.4, 95%CI: 1.8, 6.2) do not know (OR = 1.0, 95%CI: 0.6, 1.6; AOR = 1.0, 95%CI: 0.6, 1.6).
Bayen et al. (2017)	High	Multivariable linear or logistic regression	Age, gender, education, alcohol/drug abuse, prior psychiatric disorder, transport injury, ISS, work-related MVC, GOS, litigation	Litigation	**RTW** at 4y: AOR = -1.1, 95%CI: -2.0, -0.2
Fort et al. (2011)	Moderate	Logistic regression	Gender, age, education level, occupational skill level, MVC during personal or work journey, ISS, pressed charges, pain, physical sequelae	Litigation	**Late RTW vs "normal" RTW for injury severity** in 12 m: no litigation (AOR = 1.0, ref), litigated by 6 m (AOR = 3.0, 95%CI: 1.4, 6.4), do not know (AOR = 3.5, 95%CI: 0.4, 34.5)

Notes: B = unstandardized coefficient, β (beta) = standardized coefficient. Time is reported in days (d), weeks (w), months (m) or years (y).
* Univariate effects reported, and fault variable not included in multivariable analyses.

months following musculoskeletal injury in one of the few studies judged to have low overall risk of bias. There was limited evidence of an association between lawyer involvement and pain, with Harris et al. (2011) reporting a mean increase of 0.80 for a neck pain score derived from the SF36 (ranging from 0 to 10) for people who engaged in lawyer use following orthopaedic injury; however, these findings did not remain significant after adjusting for gender and education. The study proposed that increased pain scores may have resulted from a combination of the adversarial and stressful nature of the legal system, attempts to pursue secondary gain and coaching from lawyers; however, as there were no injury severity or baseline pain measures included in analyses, it is possible that people who approached lawyers were already experiencing poor health or pain.

3.5.3.4. Work-related outcomes. Three papers provided limited evidence of a relationship between lawyer involvement or litigation and return to work. Bayen et al. (2017) reported that 41% of patients with severe traumatic brain injury who did not engage in litigation had returned to work four years after injury, compared to just 25% of people who did litigate; however, this study was underpowered, examined a mixed trauma cohort that was not exclusive to people injured in road accidents, and had high overall risk of bias. Another study with low risk of bias found that lawyer involvement was associated with a median increase of 77 days in time to return to work, but reported no association after adjusting for baseline variables such as age, sex, injury severity and occupation after orthopaedic injury (Murgatroyd et al., 2016a). People who litigated had a three-fold increase in the odds of returning to work late, and people who merely intended to press charges during early recovery following hospitalisation for injury had an even larger increase in the odds of late return to work (Fort et al., 2011). This suggests that the act of using a lawyer or engaging in litigation alone are not associated with worse occupational outcomes, but perhaps that perception of injustice and attribution of fault that leads to the decision to litigate plays a larger role, and these effects are probably established very early post-injury.

3.5.4. Compensation claim

There was moderate evidence of an association between intending to claim, or claiming compensation, in a fault based or predominantly fault based compensation setting and health-related outcomes (Table 7). The evidence of an association between compensation claims and mental health or pain-related outcomes was limited, and there was moderate evidence of no association between having a compensation claim and work-related outcomes. It should be noted that in some fault-based compensation settings, people are eligible for compensation provided they are less than 50% responsible for the injury event. Moreover, some fault-based settings provide some lmited benefits for people who are at-fault. Therefore, while lodging a compensation claim likely indicates that another person was at least partly responsible in these settings, it does not necessarily excuse the injured person from feelings of guilt or personal responsibility regarding the injury event.

3.5.4.1. Health-related outcomes. There was moderate overall evidence of a relationship between compensation claims and health-related outcomes including physical health, recovery and recovery satisfaction. Specifically, there was moderate evidence for an association between having a fault-based compensation claim and health-related outcomes six months post-injury, strong evidence for outcomes measured at 12 months post-injury, and limited evidence for health-related outcomes measured after 12 months.

Three papers, two of which had low risk of bias and one of which had moderate risk of bias, found that people who lodged a fault-based compensation claim had worse physical health up to two years post-injury with mean differences ranging from 3.0 to 6.3 points on the SF12 PCS following orthopaedic and musculoskeletal injury (Harris et al., 2008; Littleton et al., 2011; Murgatroyd et al., 2016b). However, as

Table 7
Association between compensation claim-related procedures and health-related, mental health, pain and return to work outcomes after transport-related injury.

Author (Year)	Risk of bias	Analytic approach	Variables included in multivariable analysis	Fault variable	Outcomes
Health-related outcomes (HR-QoL, function)					
Tournier et al. (2014)	Moderate	Weighted multivariable logistic regression analysis	Age and sex	Fault-based compensation claim (intend to claim)	**Health state** at 2y: No or don't know (OR = 1, ref), yes (AOR = 2.6, 95%CI: 1.6, 4.2) **Ion occupation/ study** at 2y: No or don't know (OR = 1, ref), yes (AOR = 2.3, 95%CI: 1.5, 3.6) **Impact on familial/ affective life** at 2y: No or don't know (OR = 1, ref), yes (AOR = 2.0, 95%CI: 1.3, 3.2) **Impact on leisure/sport activity** at 2y: No or don't know (OR = 1, ref), yes (AOR = 2.6, 95%CI: 1.6, 4.0) **Financial difficulties** at 2y: No or don't know (OR = 1, ref), yes (AOR = 2.5, 95%CI: 1.6, 4.1)
Tournier et al. (2016)	High	Chi square tests, fisher's exact test, t-test, kruskal-wallis test; Poisson regression	Age, gender, educational level, intend to lodge a complaint, psychological history, PTSD, whiplash grade 1 or 2	Fault-based compensation claim (intend to claim)	**Unsatisfactory health** at 5y: ARR = 1.6, 95%CI: 1.1, 2.4.
Harris et al. (2008)	Moderate	t-test/ANOVA	n/a (NS)*	Fault-based compensation claim	**SF-36 PCS** at 6 m: None (M = 42.7, 95% CI: 40.4-45.0) vs CPT (M = 36.4, 95% CI: 34.7, 38.0) $p < 0.0001$
Murgatroyd et al. (2016b)	Low	Mixed linear analysis	Mixed model: age, gender, ISS, IRSAD, education level, language, BMI, alcohol risk, fault, vehicle type, premorbid neck pain, crash location, preinjury health, time, claim status by time	Fault-based compensation claim (lodged by 6 m)	**SF-36 PCS** at 6, 12 and 24 m: MDadj = -3.0, 95%CI: -4.7, -1.2. **Global change** at 6, 12 and 24 m: MDadj = -0.66 (95%CI: −1.2, -0.2).
Littleton et al. (2011)	Low	Linear mixed models	n/a (NS)*	Fault-based compensation claim	**SF-36 PCS** at 12 m: MD = -5.5, p = 0.001
Harris et al. (2007)	High	Backward step-wise logistic regression.	Current employment, mechanism (MVA vs other), chronic illness present, claim status (lodged/ settled)	Fault-based compensation claim (settled by 1-6y)	**Recovery dissatisfaction** up to 6y: No claim (AOR = 1.0, ref), claim settled (AOR = 1.2, 95%CI: 0.6, 2.5), claim not settled (AOR = 5.2, 95% CI: 2.8, 9.7)
Mental health outcomes					
Elbers et al. (2015)	High	Multiple forward step-wise logistic regression	n/a (NS)*	Fault-based compensation claim (settled at 2 m, 12 m, and 24 m)	**EQ-5D anxiety/ depression**: NS (data not reported, described only in discussion)
Elbers et al. (2015)	High	Multiple forward step-wise logistic regression	Gender, pre-injury health, catastrophizing, lawyer, claims management satisfaction.	Fault-based compensation claim dissatisfaction	**EQ-5D anxiety/ depression** at 12 m: NS; at 24 m: AOR = 2.7, p = 0.004.
Mayou et al. (2001)	High	Logistic regression	n/a (NS)*	Fault-based compensation claim (intend to claim)	At 12 m: **Phobic Travel Anxiety** (RR = 1.7, $p < 0.05$), **General Anxiety** (RR = 1.9, $p < 0.05$), **PTSD** (RR = 4.0, $p < 0.05$), **Depression** (NS, data NR).
Silove et al. (2003)	High	Logistic regression	n/a (NS)*	Fault-based compensation claim (intend to claim)	**Psychological conditions** at 18 m: NS (data not reported)
Harris et al. (2008)	Moderate	t-test/ANOVA	n/a (NS)*	Fault-based compensation claim	**SF-36 MCS** at 6 m: None (M = 47.4, 95% CI: 44.8-50.1), Yes (M = 42.6, 95% CI: 40.2, 45.0), p = 0.008
Murgatroyd et al. (2016b)	Low	Mixed linear analysis	Mixed model: age, gender, ISS, IRSAD, education level, language, BMI, alcohol risk, fault, vehicle type, premorbid neck pain, crash location, preinjury health, time, claim status by time	Fault-based compensation claim (lodged by 6 m)	**SF-36 MCS** at 6, 12 and 24 m: MDadj = -3.4, 95%CI: −5.6, -1.3. **PTSD** at 6, 12 and 24 m: MDadj = 3.4 (95%CI: 0.9, 6.0).
Littleton et al. (2011)	Low	Linear mixed models	n/a (NS)*	Fault-based compensation claim	At 12 m: **SF36 MCS** (NS), **anxiety** (MD = 1.7, p = 0.0048), **depression** (NS)
Mayou et al. (2002)	High	Correlations, stepwise multiple regression.	Persistent health problems, negative interpretation, litigation, dissociation, rumination, sex.	Fault-based compensation claim (lodged by 3 m)	**PTSD severity** at 3y: β = 0.17 (p/95%CI NR); $r^2 = 0.32$, $p < 0.002$. **PTSD diagnosis** at 3y: $r^2 = 0.19$, $p < 0.002$ (actual p-values for r^2 not reported.

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Table 7 (*continued*)

Author (Year)	Risk of bias	Analytic approach	Variables included in multivariable analysis	Fault variable	Outcomes
Mayou et al. (2002)	High	Biserial correlations	n/a (NS)*	Fault-based compensation claim (settled by 12 m or 3y)	**PTSD severity** at 3y if claim not settled at 12 m (r^2 = 0.3, p < 0.002.) or 3y (r^2 = 0.3, p < 0.002.) **PTSD diagnosis** at 3y if claim not settled at 12 m (r^2 = 0.2, p < 0.002). or 3y (r^2 = 0.3, p < 0.002).(Actual p-values for r^2 not reported).
McCauley et al. (2001)	High	Chi-square test	n/a (NS)*	Fault-based compensation claim	**Post-concussion syndrome** at 3 m: NS (p = 0.96)
Mayou and Bryant (2001)	High	NR	n/a (NS)*	Fault-based compensation claim	**Psychological condition** at 12 m: seeking compensation related to worse physical, psychological and social outcomes, but claimants also had more severe injury and loss (data NR).
Pain outcomes					
Littleton et al. (2011)	Low	Linear mixed models	n/a (NS)*	Fault-based compensation claim	**Pain intensity** at 12 m: MD = 0.4, p = 0.005
Harris et al. (2011)	High	t-test/ANOVA	n/a (NS)*	Fault-based compensation claim	**SF36 Bodily Pain** at 6 m: No claim (M = 2.8, 95% CI: 2.5, 3.1), claim made (M = 3.8, 95%CI: 3.4, 4.2), p = 0.0002
Carroll et al. (2007)	High	NR	n/a (NS)*	Fault scheme vs no-fault scheme compensation claim	**Jaw pain and symptoms** at 6 w, 4 m, 8 m and 12 m: fault scheme vs no fault scheme p < 0.10 but NS in multivariable model (data NR, but described in discussion).
Pobereskin (2005)	High	Chi square test, logistic regression	Neck pain VAS, struck car stationary, arm pain, days of neck pain per week.	Fault-based compensation claim	**WAD** at 12 m: no late WAD (54% lodged claim), late WAD (95% lodged claim), p < 0.005. No claim (OR = 1.0, ref), lodged claim (AOR = 4.1, 95%CI = 1.6, 10.3).
Spearing et al. (2012)	Moderate	Multivariate regression with ordinary least squares	Compensation, age, gender, neck pain VAS, post-collision head-ache, history of neck pain, awareness of impending crash, unskilled employment.	Fault-based compensation claim	**Neck pain** (VAS) at 24 m: B(adj) = 8.2 95%CI: 4.6, 11.7.
Mayou and Bryant (2002)	High	Logistic regression	**WAD analysis**: lodged claim, anger. **Other soft tissue injury analysis** (claim not included in multivariable analysis). **Bony injury analysis**: lodged claim, negative interpretation	Fault-based compensation claim (lodged by 3 m)	**Pain** at 12 m for claimants vs non-claimants (RR = 1.0, ref) in WAD patients (RR = 4.8, p < 0.01; ARR = 4.3, 1.6, 11.1), other soft tissue patients (RR = 2.3, p < 0.05), and patients with bony injury (RR = 4.76, p < 0.01; ARR = 4.6, 95%CI: 1.4, 6.8).
Work outcomes					
Murgatroyd et al. (2016a)	Low	Log-rank test of survival distributions	n/a (NS)*	Fault-based compensation claim (lodged by 6 m)	**Days to RTW** within 2y: yes (Med = 178d), no (Med = 120d), p = 0.08.

Notes: B = unstandardized coefficient, β (beta) = standardized coefficient. Time is reported in days (d), weeks (w), months (m) or years (y).

* Univariate effects reported, and fault variable not included in multivariable analyses.

previously discussed, people with external attributions of fault have a higher risk of poor long-term functional recovery and may therefore be more likely to lodge a compensation claim. People who merely intended to lodge a claim had twice the risk of reporting that their injury impacted on their familial or affective life, had 2.3 times higher risk that their injury impacted on their work or study, and had 2.6 times higher risk that their injury impacted on leisure or sport activities two years following major trauma (Tournier et al., 2014). Another study reported that 56% of people who had not recovered by six months post-injury reported experiencing insurance problems; however, this study was underpowered and comprised participants with injury severity ranging from minor to major (Ottosson et al., 2007).

Lodging a compensation claim was associated with recovery dissatisfaction in two papers from fault-based settings. One study with moderate risk of bias reported a 60% increase in the risk of not being satisfied with recovery five years after the collision resulting in hospitalisation (Tournier et al., 2016). Harris et al. (2007) found that people with unsettled compensation claims, but not people with settled claims, after major trauma had 5.2 times greater odds of reporting recovery dissatisfaction compared to people without a claim. These findings were suggested to result from the uncertainty associated with unsettled claims and the adversarial nature of the fault-based claims process (Harris et al., 2007). However, it should be noted that the study by Harris et al. (2007) was underpowered, used an unvalidated measure of recovery satisfaction, and had high risk of bias. Follow up time was also highly variable, with recovery satisfaction being measured between one and six years post-injury.

3.5.4.2. Psychological outcomes. Overall, the evidence of an association between fault-based compensation claims and mental health outcomes was limited; however, there was moderate evidence of an association six months post-injury. Mayou and Bryant (2001) found that having a fault-based compensation claim was associated with worse psychological conditions 12 months post-injury, but this study had high risk of bias and included a sample with heterogeneous injury severity. Notably, the study by Mayou and Bryant (2001) did not adjust for several factors associated with loss to follow up including age, hospital admission, and whether participants were working at baseline. On the contrary, Silove et al. (2003) reported no association 18 months post-injury (but did not present any data of this lack of association), and this study also comprised a cohort with heterogeneous injury severity. Two other papers found that compensation claims were associated with worse mental health using the SF36 MCS following orthopaedic injury (Harris et al., 2008; Murgatroyd et al., 2016b), one of which had low risk of bias and adjusted for several demographic and crash related variables such as injury severity, preinjury health, and claim status. Although a third study, which had low risk of bias, found no relationship between having a compensation claim and mental health on the SF36 MCS following musculoskeletal injury, this study only included claim status in univariate analyses (Littleton et al., 2011).

Two out of three papers examining anxiety outcomes found significant associations between compensation claim status and anxiety. Mayou et al. (2001) reported a 70% increased risk of phobic travel anxiety and 90% increased risk of general anxiety 12 months post-injury for people who intended to lodge a compensation claim. One study with low risk of bias also reported greater HADS-Anxiety scores in people who had a fault-based compensation claim after musculoskeletal injury (Littleton et al., 2011), however, another stated that there was no association between claim settlement and anxiety but did not present supporting data (Elbers et al., 2015). There was evidence suggesting no relationship between intending to lodge a claim (Elbers et al., 2015), or claim settlement (Mayou et al., 2001) and depression symptoms in people with mild to moderate severity injuries. Compensation claim dissatisfaction was associated with a 2.7-fold increase in the risk of having anxiety and depression two years post-injury, but not at 12 months post-injury (Elbers et al., 2015). These findings suggest that it is not having a compensation claim that is associated with worse mental health problems, but rather difficulties or stress that may arise during the process of lodging a fault-based compensation claim.

Three papers, only one of which had low risk of bias, found that having a fault-based compensation claim was associated with having PTSD up to three years post-injury in cohorts with heterogeneous injury severity (Mayou et al., 2001, 2002) or orthopaedic injuries (Murgatroyd et al., 2016b). Furthermore, Mayou et al. (2002) found an association even after claims were settled, suggesting that worse recovery was not the result of secondary gain (where outcomes would be expected to improve after claim settlement). Two other studies found no association between having a compensation claim and post-concussion syndrome (McCauley et al., 2001), or PTSD 12 months post-injury (Littleton et al., 2011). Although the latter study had low risk of bias it only included univariate analysis of claim status, and did not include pedestrians.

3.5.4.3. Pain outcomes. Overall evidence of an association between fault-based compensation claims and pain was limited, and only two studies did not have high risk of bias. Claimants were found to have a 2.3 to 4.8 fold increase in the risk of having pain 12 months after whiplash injury (Mayou and Bryant, 2002), and higher pain levels six (Harris et al., 2011) and 12 months (Littleton et al., 2011) after acute fractures and musculoskeletal injuries, respectively. Spearing et al. (2012) reported an association between having a fault-based compensation claim and neck pain 24 months following neck injury, with claimants demonstrating an increase of eight points on a 100-point visual analogue scale (VAS). However, when this study evaluated the differences between analyses examining health status as a function of compensation-related factors, versus compensation-related factors as a function of health status, they concluded that compensation and neck pain were endogenous variables. Spearing et al. (2012) then tested a final model that accounted for potential reverse causality, and found that people with compensation claims actually had better pain outcomes than those without a compensation claim by approximately 19 points on a 100-point scale. In the only other paper to adjust for injury-related factors including level of neck pain and days of pain per week, Pobereskin (2005) found that having a fault-based compensation claim was associated with 4.1 times higher odds of having neck pain 12 months after whiplash injury. Another study with high risk of bias reported an association between the incidence of jaw pain in people with whiplash and type of compensation scheme (fault based or “no fault”) in univariate analyses, but not in the multivariable model (Carroll et al., 2007); however, this study did not report the coefficients from these analyses nor did they clearly report the factors associated with loss to follow up.

3.5.4.4. Work-related outcomes. The study by Murgatroyd et al. (2016a), which had low risk of bias, provided moderate evidence of no association between fault-based compensation claim lodgement within six months and the median days to return to work within two years of orthopaedic trauma.

3.5.5. Road user

The evidence for the relationship between type of road user and health, pain, or work-related outcomes was inconsistent, and there was limited evidence of no association between road user and mental health outcomes (Table 8). The inconsistency in this body of evidence suggests that road user is a relatively weak indicator of fault, likely because being a pedestrian or a passenger does not always indicate that another person was responsible for causing the injury incident. While pedestrians and passengers are not considered to have legal responsibility in many jurisdictions, they may nonetheless share in the responsibility for the crash through contributory negligence.

3.5.5.1. Health-related outcomes. Four papers provided inconsistent overall evidence for the relationship between road user and health-

Table 8
Association between crash-related characteristics (position in the vehicle, road user group) and health-related, mental health, pain and return to work outcomes after transport-related injury.

Author (Year)	Risk of bias	Analytic approach	Variables included in multivariable analysis	Fault variable	Outcomes
Health-related outcomes (HR-QoL, function)					
Matsumoto et al. (2013)	High	Chi square tests	n/ a (NS)*	Position in vehicle	**Modic changes on MRI** at 11y: driver (14%), front passenger (11%), rear passenger (0%), p = 0.53.
Nhac-Vu et al. (2011)	Moderate	Poisson regression with backwards elimination	n/ a (NS)*	Road user	**Health state** at 12 m: pedestrian/passenger/other (RR = 1.0, ref), pedal cyclist (RR = 0.9, 95%CI: 0.8, 1.1), motor/quad-cycle driver (RR = 0.8, 0.7, 1.0), motor vehicle driver (RR = 0.9, 95%CI: 0.8, 1.0).
Nhac-Vu et al. (2014)	High	Multiple correspondence analysis, multinomial logistic regression	n/ a (NS)*	Road user	Five 12 m **outcome groups** identified with varying impacts on general health, physical, mental, social, environmental and financial outcomes. Outcome group at 12 m not associated with road user group (motor vehicle, motor cycle driver, pedal cyclist, pedestrian/ passenger).
Tournier et al. (2014)	Moderate	Weighted multivariable logistic regression analysis	Age and sex	Road user	**Health state** at 2y: NS **Impact on occupation/ study** at 2y: motor vehicle (OR = 1, ref), motorcycle (AOR = 0.9, 95%CI: 0.6, 1.5), pedestrian (AOR = 0.3, 95%CI: 0.2, 0.6), pedal cyclist (AOR = 1.0, 95%CI: 0.5, 1.9) **Impact on familial/ affective life** at 2y: NS **Impact on leisure/sport activity** at 2y: motor vehicle (OR = 1, ref), motorcycle (AOR = 1.7, 95%CI: 1.1, 2.5), pedestrian (AOR = 0.8, 95%CI: 0.5, 1.4), pedal cyclist (AOR = 0.8, 95%CI: 0.5, 1.5) **Financial difficulties** at 2y: NS
Mental health outcomes					
Bethune et al. (2017)	High	Chi-square and t-tests; Multivariate logistic regression	NR which variables included in multivariable analyses	Road user	**Suicidal ideation** in passengers at 3 m (AOR = 3.22, 95%CI: 1.22, 8.41) and 6 m (AOR = 4.59, 95%CI: 1.45, 14.50). (note: NR if ref = drivers or all other road users)
Guest et al. (2017)	Moderate	Logistic regression	n/ a (NS)*	Road user	**Psychological distress** in driver (OR = 1.0, ref), passenger (OR = 1.36, 95%CI: 1.12, 1.66), motorcycle driver (OR = 0.56, 95% CI: 0.36, 0.86), motorcycle passenger (OR = 0.89, 95%CI: 0.21, 3.78), pedestrian (OR = 1.23, 95%CI: 0.83, 1.83), pedal cyclist (OR = 0.43, 95%CI: 0.32, 3.45), other (OR = 1.05, 95% CI: 0.32, 3.45)
Chossegros et al. (2011)	Moderate	Multivariable logistic regression	M1: Sex, road user, NISS, PTA, history of psychological disorder, separation in year before crash. M2: sex, road user, pressing charges, NISS, PTA, pain > 6 m	Road user	**PTSD** at 6 m: Four wheel vehicle (AOR = 1.0, ref), motorcycle (M1: AOR = 0.40, 95%CI: 0.2, 0.9, M2: AOR = 0.4, 0.1, 0.9), pedal bicycle (M1: AOR = 0.3, 95%CI: 0.1, 1.1; M2: AOR = 0.5, 95%CI: 0.1, 1.9), pedestrian/other (M1: AOR = 1.5, 95%CI: 0.7, 3.5; M2: AOR = 1.9, 95%CI: 0.7, 5.0).
Ehring et al. (2008)	High	Correlation	n/ a (NS)*	Road user	**PTSD** at 2 w and 6 m: driver, passenger, pedal cyclist, motor cyclist: NS (data NR) **Depression** at 2 w and 6 m: driver, passenger, pedal cyclist, motor cyclist: NS (data NR)
Mayou et al. (2001)	High	Logistic regression	Road user, low confidence as passenger, previous emotional problems, found the MVC frightening	Road user	At 12 m: **Phobic Travel Anxiety** other (RR = 1.0, ref), passenger (RR = 2.6, p < 0.05, ARR = 3.1, 95%CI: 1.7, 5.5), **General Anxiety** other (RR = 1.0, ref), passenger (RR = 1.5, p < 0.05), **PTSD**: other (RR = 1.0, ref), passenger (RR = 1.0, NS) **Depression** (NS, data NR) (Note: other = driver, cyclist or pedestrian)
Wu et al. (2006)	High	Linear growth modelling, adjusting for time (1 w, 1 m, 3 m, 6 m, in weeks)	Gender, age, history of psychiatric consultation, history of traumatic experience, emotional support, pedestrian, passenger, injury of other victims, injury severity, GCS score, required surgery, days of hospitalisation, days of sick leave, heart rate, perceived threat of life, intend to litigate.	Road user	**PTSD symptoms** over 6 m: There was a slower change in hyperarousal symptoms (but not total IES, intrusion or avoidance) for pedestrian vs driver (B = 0.01, SE < 0.01, β = 0.2, p < 0.05). NS for passengers or other road user group vs driver.

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Table 8 (*continued*)

Author (Year)	Risk of bias	Analytic approach	Variables included in multivariable analysis	Fault variable	Outcomes
Matsuoka et al. (2008)	Moderate	Logistic regression	Sex, previous trauma, family history of psychopathology, history of psychiatric illness, sense of life threat, feeling of self-reproach, road user, education, heart rate, ISS, IES-R intrusion subscale	Road user	**Full/partial PTSD** at 4-6 w: motor vehicle/cycle drivers (OR = 1.0, ref), non-drivers (passenger/ pedal cyclist/ pedestrian; OR = 3.2, 95%CI: 1.2, 8.4; AOR = 3.9, 95%CI: 0.7, 21.8) **Psychiatric illnesses** at 4-6 w: drivers (OR = 1.0, ref), non-drivers (OR = 2.4, 95%CI: 1.0, 5.0; AOR = 2.0, 95%CI: 0.5, 7.7)
Nishi et al. (2013)	Moderate	Chi square test, wilcoxon rank sum test, t-test; univariate and multivariate logistic regression.	Age, sex, history of psychiatric illness, family history of psychiatric illness, education, non-driver, sense of life threat, heart rate, respiratory rate, ISS	Road user	**PTSD at 6 m**: non-driver (passenger, pedal cyclist, pedestrian; OR = 1.0, ref), driver (motorcycle, motor vehicle; OR = 3.8, 95%CI: 0.9, 16.3; AOR = 1.53, 95%CI: 0.2, 10.1)
Miettinen et al. (2004)	High	Chi square tests, logistic regression	n/ a (NS)*	Position in vehicle	**Depression** at 12 m: driver, front passenger, rear passenger: NS (data NR) **General mental health** at 12 m: driver, front passenger, rear passenger: NS (data NR)
Platts-Mills et al. (2017)	Moderate	Forward step-wise logistic regression	n/a	Position in vehicle	PTSD at 6 m: driver (RR = 1.0, ref), passenger (ARR = 1.4, 0.8, 2.5).
Naim et al. (2014)	Low	Chi square test; Hierarchical logistic regression	Gender, road user, baseline PTSD and depression symptoms	Position in vehicle	**PTSD diagnosis** at 3 m: passenger (17% with PTSD) vs driver (5.2% with PTSD), $p = 0.002$; B = 0.5, SE = 0.03 $\beta = 1.66$, $p > 0.05$.
Ryb et al. (2009)	High	Univariate and multivariable logistic regression	Age, gender, prior assault, family member fatality, any fatality in crash, history of depression.	Position in vehicle	**PTSD** at 6 m: driver (OR = 0.79, 95%CI: 0.4, 1.5) **PTSD** at 12 m: driver (OR = 1.29, 95%CI: 0.6, 2.8)
Pain outcomes					
Carroll et al. (2007)	High	Logistic regression	Sex, age, hit head in the collision, prior body discomfort, prior symptoms, % body in pain, neck pain intensity, headache intensity.	Position in vehicle	**Jaw pain and symptoms** at 6 w, 4 m, 8 m and 12 m: position in vehicle (not defined) $p < 0.10$, but NS in multivariable model (data NR, but described in discussion).
Hartling et al. (2002)	High	Logistic regression	n/ a (NS)*	Position in vehicle	**WAD presence** at 6 m: driver (OR = 1.0, ref), front passenger (OR = 0.8, 95%CI: 0.5, 1.5), rear passenger (OR = 0.9, 95%CI: 0.3, 2.9).
McLean et al. (2014)	High	Log-binomial regression with robust estimation with Least Absolute Shrinkage and Selection Operator (LASSO) Regression.	**Litigant analysis**: age, employment, no health insurance, direction of impact, road user, mod neck pain in ED, peritraumatic distress, predisposition to anger **Non-litigant analysis**: position in vehicle NS, and not included in multivariable analyses.	Position in vehicle	**MSNP** at 6 w, driver vs passenger: litigants (RR = 0.8, 95%CI: 0.5, 1.2); non-litigants: (RR = 1.0, 95%CI: 0.7, 1.4; ARR = NS (data NR) **Widespread pain** at 6 w, driver v passenger: litigants (RR = 1.0, 95%CI: 0.6, 1.6); non-litigants (RR = 0.9, 95%CI: 0. 5, 1.7).
Cobo et al. (2010)	Moderate	t-test	n/ a (NS)*	Position in vehicle	**Pain severity** at 6 m for driver: yes (M = 3.39, SD = 2.05), no (M = 3.63, SD = 1.97), $p = 0.09$; co-pilot: yes (M = 3.53, SD = 1.95), no (M = 3.46, SD = 2.06), NS; passenger: yes (M = 3.73, SD = 2.18), no (M = 3.46, SD = 2.02), NS.
Atherton et al. (2006)	High	Poisson regression	Age, sex.	Position in vehicle	**Neck pain** (Y/N) over 1, 3, 12 m: driver (RR = 1.0, ref), passenger (RR = 1.2, 95%CI: 0.9, 1.7).
Harris et al. (2011)	High	t-test/ANOVA	n/ a (NS)*	Road user	**Bodily Pain** at 6 m: driver/ passenger (M = 3.9, 95%CI: 3.5, 4.3), motorcyclist (M = 2.7, 95%CI: 2.3, 3.2), pedestrian or pedal cyclist (M = 3.7, 95% CI: 2.9, 4.4), $p = 0.0008$
Work outcomes					
Miettinen et al. (2004)	High	Chi square tests, logistic regression	n/ a (NS)*	Position in vehicle	**Sick leave duration** within 12 m driver, front passenger, rear passenger: NS (data NR)
Suissa (2003)	High	Cox proportional hazards	Gender, age, > 1 dependent, marital status, employment, vehicle type, fatalities, road user, crash counterpart (moving), direction of impact, seatbelt use, speed limit	Road user	**Recovery time** (income payment duration) up to 7y in people with WAD injuries only: driver (ARR = 1.0, ref), passenger or pedestrian (ARR = 0.9, 95%CI: 0.7, 0.99) **Recovery time** up to 7y in people with WAD and other injuries: driver (ARR = 1.0, ref), passenger or pedestrian (ARR = 0.8, 95%CI: 0.7, 0.9)
Pelissier et al. (2017)	Moderate	Chi square test	n/ a (NS)*	Road user	**RTW** within 3 years: pedestrian/skater (60% RTW), motor vehicle occupant (55% RTW), motorcycle occupant (55% RTW), pedal cyclist (53% RTW), NS.

Notes: B = unstandardized coefficient, β (beta) = standardized coefficient. Time is reported in days (d), weeks (w), months (m) or years (y).
* Univariate effects reported, and fault variable not included in multivariable analyses.

Table 9
Association between crash-related characteristics (direction of impact) and health-related, mental health, pain and return to work outcomes after transport-related injury.

Author (Year)	Risk of bias	Analytic approach	Variables included in multivariable analysis	Fault variable	Outcomes
Health-related outcomes (HR-QoL, function)					
Matsumoto et al. (2013)	High	Chi square tests	n/ a (NS)*	Direction of impact	**Modic changes on MRI** at 11y: front-end (6.5%), rear-end (18%), double crash (10%), other (5.3%), p = 0.53.
Platts-Mills et al. (2017)	Moderate	Forward step-wise logistic regression		Direction of impact	PTSD at 6 m: other (RR = 1.0, ref), rear ended: ARR = 1.1, 95%CI: 0.7, 1.9.
Auvergne et al. (2016)	Low	RM-ANOVA	n/ a (NS)*	Direction of impact	**Post-concussion syndrome** at 6 m and 12 m: rear end (M = 1.3, 95%CI: 1.2-1.5), front end (M = 1.2, 95%CI: 1.0, 1.3), other/no damage (M = 1.3, 95%CI: 1.07, 1.47), p = 0.27
Phillips et al. (2010)	Moderate	Multivariable multinomial logistic regression	Age, gender, annual family income, education, income, direction of impact, % body in pain, neck pain intensity, low back pain intensity, dizziness, vision problems, hearing problems, numbness in arms/hands, anxiety, fracture, prior MSK pain, prior headache, prior GI problems, prior mental health problems, prior general health	Direction of impact	Over 6 w, 3 m, 6 m, 9 m, 12 m: **Resolved vs never depressed**: frontal (AOR = 1.0, ref), rear (AOR: 0.7, 95%CI: 0.5, 0.8), side (AOR: 0.8, 95%CI: 0.66, 1.08), other (AOR = 1.0, 95%CI: 0.6, 1.6).
					Resolved & recurred vs never depressed: frontal (AOR = 1.0, ref), rear (AOR = 0.8, 95%CI: 0.6, 1.1), side (AOR = 0.9, 95%CI: 0.6, 1.2), other (AOR = 0.8, 95%CI: 0.4, 1.5). **Persistent vs never depressed**: frontal (AOR = 1.0, ref), rear (AOR = 0.7, 95%CI: 0.5, 1.2), side (AOR = 0.8, 95%CI: 0.5, 1.39), other (AOR = 1.00, 95%CI: 0.4, 2.5). **Late onset vs never depressed**: frontal (AOR = 1.0, ref), rear (AOR = 1.0, 95%CI: 0.8, 1.4), side (AOR = 0.8, 95%CI: 0.6, 1.1), other (AOR = 0.7, 95%CI: 0.4, 1.5).
Wynne-Jones et al. (2006)	High	Forward stepwise Poisson regression	n/ a (NS)*	Direction of impact	**Widespread pain** at 12 m: from rear (RR = 1.0, ref), from front (RR = 1.0, 95%CI: 0.5, 1.8), shunt-rear & front impact (RR = 1.3, 95%CI: 0.3, 5.5), side (RR = 0.5, 95%CI: 0.1, 1.01), other (RR = 2.0, 95%CI = 0.6, 6.7)
Atherton et al. (2006)	High	Poisson regression	Age, sex.	Direction of impact	**Neck pain** (Y/N) over 1, 3, 12 m: rear (RR = 1.0, ref), front (RR = 0.9, 95%CI: 0.6, 1.5), rear shunt (RR = 1.2, 95%CI: 0.6, 2.1), side (RR = 1.4, 95%CI: 0.9, 1.9), other (RR = 0.6, 95%CI: 0.2, 2.0).
Hartling et al. (2002)	High	Logistic regression	n/ a (NS)*	Direction of impact	**WAD presence** at 6 m: rear impact: no (OR = 1.0, ref), yes (OR = 1.2, 95%CI: 0.4, 3.6); hit vehicle in front: no (OR = 1.0, ref), yes (OR = 1.4, 95%CI: 0.8, 2.4).
Carroll et al. (2007)	High	Logistic regression	Sex, age, hit head in the collision, prior body discomfort, prior symptoms, % body in pain, neck pain intensity, headache intensity. Not clear if fault-related variables retained in multivariable analysis	Direction of impact	**Jaw pain and symptoms** at 6 w, 4 m, 8 m and 12 m p < .10 but NS in multivariable model (data NR, but described in discussion).
Pape et al. (2007)	High	Multivariable backwards stepwise logistic regression	Pre-injury: neck/shoulder pain; crash: impact direction; early: neck/ shoulder pain, memory problems; 3y symptoms: work status, weakness/ tiredness, sleep, bodily tension, limitations from pain, pain distribution.	Direction of impact	**Chronic neck pain** at 3y: “rear-end vs. frontal or side” (OR = 1.0, ref), “rear-end or frontal” (OR = 2.7, 95%CI: 1.6, 4.8; AOR = 4.1, 95%CI: 1.7, 10.8).
McLean et al., 2014McLean et al. (2014)	High	Log-binomial regression with robust estimation with Least Absolute Shrinkage and Selection Operator (LASSO) Regression.	**Litigant analysis**: age, employment, no health insurance, direction of impact, road user, mod neck pain in ED, peritraumatic distress, predisposition to anger	Direction of impact	**MSNP** at 6 w, rear-ended vs other impact direction: litigants (RR = 1.2, 95%CI: 1.1, 1.3; ARR = 1.3, 95%CI: 1.1, 1.6); non-litigants (RR = 1.3, 95%CI: 1.0, 1.6)

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Table 9 (*continued*)

Author (Year)	Risk of bias	Analytic approach	Variables included in multivariable analysis	Fault variable	Outcomes
			Non-litigant analysis: impact direction NS, and not included in multivariable analyses.		**Widespread pain** at 6 w, rear-ended vs other impact direction: litigants (RR = 1.3, 95%CI: 1.0, 1.8; ARR = 1.5, 95%CI: 1.0, 2.2); non-litigants (RR = 1.1, 95%CI: 0.7, 1.6)
Suissa (2003)	High	Cox proportional hazards	Gender, age, > 1 dependent, marital status, employment, vehicle type, fatalities, road user, crash counterpart (moving), direction of impact, seatbelt use, speed limit	Direction of impact	**Recovery time** (last LOE payment) up to 7y in people with WAD injuries only: head-on or 90⁰ (ARR = 1.0, ref), rear-end (ARR = 0.85, 95%CI: 0.76, 0.95) **Recovery time** up to 7y in people with WAD and other injuries: rear-end head-on or 90⁰ (ARR = 1.0, ref), rear-end (ARR = 1.01, 95%CI: 0.87, 1.17)

Notes: B = unstandardized coefficient, β (beta) = standardized coefficient. Time is reported in days (d), weeks (w), months (m) or years (y).
* Univariate effects reported, and fault variable not included in multivariable analyses.

related outcomes, three of which were based on data from the ESPARR cohort. In one study that was underpowered and had a moderate risk of bias, pedestrians and passengers had a 10% higher risk of not achieving a full recovery within two years of major trauma compared with drivers (Nhac-Vu et al., 2011). Tournier et al. (2014) found that pedestrians had a 70% lower risk of reporting impacts on work or study in the first year of major trauma compared to people who were in motorised four-wheel vehicles; however, drivers and passengers of motor vehicles were not analysed separately, which may be problematic given that they are unlikely to share the same level of fault in the collision. However, Nhac-Vu et al. (2014) found that road user group was not associated with recovery time or experiencing impacts of the injury on family life, involvement in sports and leisure activities, or financial difficulties after injury hospitalisation. In another study, Matsumoto et al. (2013) found no difference in the development of orthopaedic changes to the spine (i.e., "spinal modic changes") 11 years after whiplash injury in passengers compared with drivers.

3.5.5.2. Psychological outcomes. Overall, there was limited evidence of no association between road user group and mental health outcomes, particularly up to six months post-injury. Four of 12 papers examining the association between road user and mental health outcomes reported significant associations, predominantly in patients with mild to moderate trauma. Findings included a 36% increased risk of psychological distress in passengers with musculoskeletal injuries (Guest et al., 2017), slower reductions in hyperarousal symptoms for pedestrians compared to drivers (Wu and Cheung, 2006), a 3.2- to 4.6-fold increased risk of suicidal ideation in people with mild traumatic brain injury (Bethune et al., 2017), and a 2.6- and 1.5-fold increased risk of passengers having phobic travel or general anxiety, respectively (Mayou et al., 2001) in samples with heterogeneous injury severity. However, three of these papers had high risk of bias due to inadequate or unclear reporting of the measures used and high levels of loss to follow up. Nine papers, one of which had low risk of bias and four of which had moderate risk of bias, found no prognostic relationship between road user and PTSD up to 12 months post-injury (Mayou et al., 2001; Wu and Cheung, 2006; Ehring et al., 2008; Matsuoka et al., 2008; Ryb et al., 2009; Chossegros et al., 2011; Nishi et al., 2013; Naim et al., 2014; Platts-Mills et al., 2017). Matsuoka et al. (2008) found that non-drivers (i.e., passengers, pedestrians and cyclists) had 2.4 times greater odds of being diagnosed with a psychiatric illness (e.g., minor depression, or partial PTSD) and 3.2 times greater odds of developing full or partial PTSD within four to six weeks following major trauma in univariate analyses. However, these findings did not remain significant after adjusting for sex, education, injury severity and pre-injury mental health, highlighting that these relationships were probably confounded by other demographic and injury-related factors. Three papers with high risk of bias provided evidence of no association between road user group and depression outcomes (Mayou et al., 2001; Miettinen et al., 2004; Ehring et al., 2008).

3.5.5.3. Pain outcomes. Overall, the evidence was inconsistent regarding the association between road user and pain-related outcomes, with five papers having high risk of bias, and one having moderate risk of bias. Moreover, most of the studies examining the association between road user and pain included patients with less severe injury, including whiplash injuries or other injuries that did not require hospitalisation. Carroll et al. (2007) stated that position in the vehicle was associated with jaw pain 12 months after whiplash injury; however, this association was not significant after adjusting for factors such as age, sex, post collision symptoms and head injury, and these results were only described and not reported. Another paper reported increased mean body pain for motor vehicle occupants compared to pedestrians and cyclists who sustained orthopaedic injuries, but did not analyse drivers and passengers separately (Harris et al., 2011). Four studies reported that road user group was not associated with neck pain

(Atherton et al., 2006; Cobo et al., 2010), whiplash associated disorders (Hartling et al., 2002) or widespread pain (McLean et al., 2014).

3.5.5.4. Work-related outcomes. Three papers provided inconsistent evidence of a relationship between type of road user and work-related outcomes, all of which had moderate to high risk of bias. Suissa (2003) provided limited evidence that passengers and pedestrians had 10–20% lower rates of return to work over the first seven years post-injury. Another paper with moderate risk of bias found no difference in recovery and return to work following major trauma in relation to type of road user, but this study did not separate drivers and passengers (Pelissier et al., 2017). Likewise, Miettinen et al. (2004) reported no association between sick leave duration and position in the vehicle after whiplash injury, but this study did not include pedestrians or pedal cyclists.

3.5.6. Direction of impact

There was limited evidence of no association between the direction of impact, general health and mental health outcomes, and inconsistent evidence for a relationship with pain and work-related outcomes (Table 9). However, while people who crash into a vehicle in front of them may be considered to have legal responsibility in most circumstances, those drivers may still attribute responsibility or blame to the other driver impacted in the rear (e.g., if they stopped without warning, swerved in front of them, or had faulty brake lights). It should be noted, therefore, that the direction of impact may be limited as an indicator of fault, like road user group.

3.5.6.1. Health-related outcomes. A single study with high overall risk of bias provided limited evidence of no association between direction of impact and spinal modic changes after whiplash injury (Matsumoto et al., 2013).

3.5.6.2. Psychological outcomes. Three papers examined the association between direction of impact and mental health outcomes, one of which had low risk of bias and two of which had moderate risk of bias. These studies provided limited evidence of no association between direction of impact and mental health outcomes including PTSD, post-concussion syndrome and depression up to 12 months post-injury. First, there was moderate evidence that people who sustained minor to moderate trauma in rear-end collisions did not have a higher risk of having PTSD symptoms compared to other types of collisions (Platts-Mills et al., 2017), nor did they have worse post-concussion syndrome symptoms (Auvergne et al., 2016). Although only one paper examined the association between direction of impact and depression, the evidence was inconsistent. That is, although people who sustained a whiplash injury in rear-end collisions did not have increased odds of developing persistent or late onset depression, they had 35% lower odds of having early onset depressive symptoms that later resolved compared with having no depressive symptoms at all in the first 12 months post-injury, relative to people who were involved in front impact crashes (Phillips et al., 2010).

3.5.6.3. Pain outcomes. The evidence was limited regarding the relationship between the direction of impact and pain outcomes, and all six studies had high overall risk of bias. In the only study to examine outcomes beyond 12 months post-injury, Pape et al. (2007) reported that people who sustained minor to moderate injuries with neck pain in a rear-end collision or a "shunt" collision (i.e., hit from the rear or the front and rear) had 4.1 times greater odds of having chronic neck pain than people impacted from the front or side only three years post-injury. However, it was unclear how pain distribution was measured and whether the outcome measure was validated. Baseline measures were also taken up to 12 weeks post-injury, as opposed to the remaining studies, all of which collected baseline measures within six weeks of injury. Direction of impact was associated with a 20% increase in the risk of experiencing moderate to severe neck pain, and a 50% increase in the risk of having widespread pain in litigants six weeks after injury, but no association was found in non-litigants who sustained minor injuries (McLean et al., 2014). Another four papers reported no significant differences in jaw, neck or widespread pain after injury in a rear-impact collision compared to other directions of impact (Hartling et al., 2002; Atherton et al., 2006; Wynne-Jones et al., 2006; Carroll et al., 2007).

3.5.6.4. Work outcomes. Suissa (2003) provided inconsistent evidence that direction of impact was prognostic of duration of income replacement in "no fault" compensation claimants following whiplash injury. While the results showed that people injured in rear-end collisions who had a whiplash associated disorder had a 15% lower rate of recovery relative to those injured in other types of collisions, there was no association for people who sustained other types of injuries in addition to whiplash injury. It therefore appears that the direction of impact exacerbated outcomes only in those with whiplash injury; however, whiplash injury is probably also more common after a rear-end collision.

4. General discussion

The findings summarised in this review highlights that there is inconsistent evidence for an association between fault attributions and outcomes after transport-related traumatic injury. The most consistent evidence was that people who had a fault-based compensation claim had worse health-related outcomes, but did not have worse work-related outcomes, whereas there was limited evidence that people who involved a lawyer or engaged in litigation had worse work outcomes. People who interacted with lawyers and fault-based compensation schemes also had worse mental health outcomes, but only at six months post-injury. Among studies with lower risk of bias, attributing responsibility to *another* was associated with poorer outcomes (health, pain, mental health and work); however, there was inconsistent evidence that feeling personally responsible or blaming oneself led to worse outcomes, especially general health and pain outcomes. An exception to this conclusion is that not being personally responsible was associated with worse mental health (e.g., PTSD) and work outcomes between 12 months and six years post-injury. However, it was notable that the overall association between fault attribution and work outcomes was limited. Crash circumstances (i.e., rear-end collision) and road users (e.g., pedestrians and passengers) typically indicative of injury events in which the injured person had reduced responsibility did not lead to worse outcomes, particularly when adjusting for other important demographic and injury-related characteristics.

4.1. Fault attribution, injury severity and outcomes

Overall, the consistency of the findings appeared to vary in relation to injury severity. Physical health outcomes were not consistently associated with fault-related characteristics in studies that included a wide range of injury severities. However, fault, blame, lawyer use or the intent to claim was typically associated with worse health outcomes in cohorts with injuries that had more well defined injury severity in the respective sample whether that be minor injuries, minor to moderately severe injuries (including musculoskeletal or orthopaedic injuries), or major trauma.

Mental health outcomes were fairly consistently worse in relation to fault-attribution in cohorts comprising predominantly serious injuries, but the findings were more variable in studies with participants who had minor to moderate severe injuries. For instance, several studies comprising minor to moderately severe injuries found no association between fault-related characteristics (fault, litigation, intent or lodgement of fault-based compensation claim) and PTSD, anxiety or depression, whereas self-blame was consistently associated with lower

PTSD symptoms and better mental health scores. After serious injury, however, fault was more consistently associated with worse PTSD, the intent or actual engagement with litigation was associated with worse mental health, PTSD, anxiety and depression, and non-drivers had higher rates of mental health conditions or suicidal ideation.

All studies examining pain outcomes comprised cohorts with minor to moderate severity injuries. These studies reported conflicting effects for the association between fault on pain, lower risk of pain in people who blamed themselves, and more severe pain in those who had a fault-based compensation claim. Lawyer use or road user group had no clear relationship with pain.

Finally, work outcomes were not associated with fault-related characteristics in people with minor to moderately severe injury (except for lower rates of RTW in passengers and pedestrians in two studies), whereas studies comprising samples with heterogeneous injury severity had worse RTW in people who intend to litigate or engaged in litigation. Overall, it was notable that while in several studies, the association between fault-related characteristics and outcomes did not remain significant when adjusting for injury characteristics and/or injury severity (Harris et al., 2008; Matsuoka et al., 2008; Murgatroyd et al., 2016a; Platts-Mills et al., 2017).

4.2. Implications for policy, practice and future research

Overall, attributing responsibility to another tended to be associated with worse mental health outcomes, engagement with a fault-based compensation scheme was associated with negative health, mental health and pain outcomes, and lawyer use was associated with worse mental health and work outcomes. However, caution should be used when interpreting these effects. For instance, it may be that people who seek fault-based damages are also more likely to use a lawyer, and may also have sustained more severe injuries or developed more pronounced feelings of injustice (Ioannou et al., 2017). Therefore many fault-related exposures may in fact be proxy indicators of broader justice-related complexities than the attribution of responsibility. This is especially likely if we take into account the potential for reverse causality whereby people have been found to have better pain outcomes after compensable injury (Spearing et al., 2012). Alternatively, it is possible that the process of lodging a compensation claim, especially in a fault-based scheme, or engaging with adversarial court-based proceedings with the assistance of a lawyer, causes secondary harm and elicits greater stress and uncertainty (Murgatroyd et al., 2015; Giummarra et al., 2016; Ioannou et al., 2016). Whatever the effect, it is clear from the present review that factors indicating *legal* responsibility of others, which involve stressful bureaucratic and adversarial processes, have a more consistent relationship with poor outcomes than subjective perceptions of *personal* responsibility, including self-blame or responsibility (Chossegros et al., 2011). To reduce the likelihood of these types of harms, it would be beneficial to review policies and practices of fault-based compensation schemes, and perhaps even provide more equitable access to support to all injured parties regardless of the role in the crash, as they do in "no fault" schemes. Moreover, specific procedural factors within fault-based compensation schemes probably contribute to fault-related harms, and their removal has been found to lead to improved outcomes, such as the removal of payments for pain and suffering (Cameron et al., 2008). Replacing lump sum payments with intermittent payments may also reduce financial stress and improve perceptions of fairness (Elbers et al., 2016), which may thereby reduce negative impacts on mental health after compensable injury.

Crash-related circumstances, especially the direction of impact, appear to be poor predictors of injury outcomes, especially when adjusting for other demographic, health and injury-related factors. These findings extend the conclusions from a previous systematic review that showed no effect of impact direction on pain after acute whiplash injury (Cote et al., 2001), except in insurance-based cohorts (Scholten-Peeters et al., 2003). While passengers, pedestrians (Mayou and Bryant, 2003; Curtis et al., 2009; Murgatroyd et al., 2016a) and those in certain crash circumstances (e.g., rear-end collisions; Phillips et al., 2010) often have reduced legal responsibility, it is possible that the injured person nonetheless feels partially responsible for the crash, or has feelings of self-blame or guilt over the crash and its impacts on themselves or others. These crash-related characteristics are probably therefore weak proxy indicators of responsibility in isolation.

While several studies examined the relationship between blame, most of which measured self-blame, or guilt and health, pain and mental health outcomes, no studies examined their association with work-related outcomes. The overall level of evidence of an effect of blame on outcomes was limited and inconsistent, and most studies found either no relationship, or that those who do blame another or *do not* blame themselves had worse outcomes including general physical and mental health, PTSD, phobic travel, general anxiety, and poor satisfaction with recovery; however, these effects did not seem to endure over time (O'Donnell et al., 2007; Ehring et al., 2008). Blame is a complex psychological construct that does not always concur with attributions of responsibility as someone may blame themselves (e.g., for failing to be more cautious) despite recognising that another party was *responsible* for the injury incident. Importantly, self-blame may provide insight into the injured persons sense of control or agency during the injury event, which could extend to their beliefs about whether they would act differently in the future (Karl et al., 2009). On the contrary, blaming others may indicate that the injured person holds "defensive" attributions about the event (Stewart, 2005), believing that it was probably controllable and preventable but that the preventive actions were the responsibility of the other person and not themselves. Further research is required to examine these potential associations.

People who not only attribute responsibility to another, particularly those navigating complex compensation-related procedures or engaging with a lawyer, may benefit from compassionate case management within the first year post-injury to ensure that they receive treatment and support that aids their recovery. This may extend to primary treatment of their physical recovery given that perceptions of injustice reduce as the impacts of the injury reduce during rehabilitation (Yakobov et al., 2016). Psychosocial interventions may also be helpful to facilitate adaptation and coping with the impacts of their injury using treatments with a cognitive behavioural therapy framework with a focus on forgiveness (e.g., see Wade and Worthington, 2005; Bae et al., 2015).

5. Limitations

Some limitations of this review, and of the included studies should be addressed. We used text mining and machine learning to expedite the review process, knowing that the benefits to workflow increased the risk of missing a very small number of relevant studies (Rathbone et al., 2015). While it is possible that we did not identify all relevant papers in this review a separate evaluation of the study methods suggest that the methods were not detrimental (Giummarra et al., 2019). We therefore concur with previous studies that text mining methods are beneficial for reducing the workload demands of conducting systematic reviews, a growing concern in systematic review methods (Ananiadou et al., 2009; O'Mara-Eves et al., 2015). We also excluded studies published prior to the year 2000, in line with previous studies using text mining (Jonnalagadda et al., 2015) because the meta-data and algorithms used by the machine learning software were likely to be inaccurate for those citations. Nonetheless, the papers that were included in this review are considered to be representative of contemporary settings, policies, and research in injury and compensation-related research, allowing us to make inferences regarding the relationship between fault and recovery outcomes that are relevant in the 21st Century. We included prognostic factors of lawyer use, rear-end collision and some specific road user types (passengers and pedestrians) as potential indicators of fault; however, as mentioned earlier these may not be reliable indicators of fault.

Limitations of the included papers and studies should also be considered when generalising these findings. The majority of included papers had a high risk of bias with many lacking adequate reporting of loss to follow up and the handling of missing data. Future prospective studies must take better care to ensure that their research adheres to reporting guidelines, such as the STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) guidelines (von Elm et al., 2008). Second, the majority of studies were conducted in western industrialised countries (Australia, France, the United Kingdom and the United States of America) and were published in English, and so the findings may not generalise to all settings and countries with different compensation systems, traffic laws and driving conditions. Another key consideration, as highlighted by Spearing et al. (2012), is that some studies may inadvertently misattribute that fault-related characteristics (e.g., compensation claim lodgement) have a causal relationship with health or work-related outcomes; however people are more likely to engage in compensation or litigation (especially in fault-based settings) if they had a more severe injury, experienced worse pain, or had lower health status. Finally, while several studies measured blame, intention to litigate or compensation claim-related procedures over time most studies only measured fault-related attributions soon after injury. It is not known whether these attributions are reliable, particularly in people with limited recollection of the injury event or loss of consciousness, or whether attributions of fault impact on injury outcomes through other cognitive and emotional processes, such as perceptions of fairness, forgiveness, anger or posttraumatic stress.

6. Conclusions

In conclusion, this review highlights some of the complexities of fault-related attributions. The general lack of high quality studies, in addition to the wide variability in the measures used and the populations studied, likely explain some of the inconsistent evidence for associations between fault on recovery outcomes after transport injury. Overall, it appears that attributions of *personal* responsibility or blame are not consistently prognostic of health and work-related outcomes after transport injury, unless they lead to engagement with lawyers or lodgement of fault-based compensation claims. Attribution of responsibility to another, however, does appear to be associated with a range of worse health and work-related outcomes. Moreover, the effects of fault-related attributions or procedures seem to be most pronounced within the first year post-injury, or in those with unsettled claims, and are not consistently maintained beyond that period. There is considerable evidence that fault-based compensation claims are associated with worse health outcomes, and further research is required to examine whether changes in policy and practice within those schemes can improve outcomes.

Protocol registration

The review protocol was registered to PROSPERO (CRD42018084123) on 11th January 2018, and updated on 7th March 2018 to specify additional investigators.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.aap.2019.105333.

References

Ananiadou, S., Rea, B., Okazaki, N., Procter, R., Thomas, J., 2009. Supporting systematic reviews using text mining. Soc. Sci. Comput. Rev. 27 (4), 509–523.
Atherton, K., Wiles, N.J., Lecky, F.E., Hawes, S.J., Silman, A.J., Macfarlane, G.J., Jones, G.T., 2006. Predictors of persistent neck pain after whiplash injury. Emerg. Med. J. 23, 195–201.
Austin, P.C., Steyerberg, E.W., 2015. The number of subjects per variable required in linear regression analyses. J. Clin. Epidemiol. 68 (6), 627–636.
Auvergne, L., Bortsov, A.V., Ulirsch, J.C., Peak, D.A., Jones, J.S., Swor, R.A., Domeier, R.M., Lee, D.C., Rathlev, N.K., Hendry, P.L., Mclean, S.A., 2016. Association of epidemiologic factors and genetic variants influencing hypothalamic-pituitary-adrenocortical axis function with postconcussive symptoms after minor motor vehicle collision. Psychosom. Med. 78 (1), 68–78.
Bae, S.M., Hyun, M.H., Ra, Y.S., 2015. Mediating effects of forgiveness and emotion-focused coping on post-traumatic stress disorder symptoms caused by physical injury and perceived threat. Asia. Pac. 7 (2), 164–172.
Bayen, E., Jourdan, C., Ghout, I., Pradat-Diehl, P., Darnoux, E., Nelson, G., Vallat-Azouvi, C., Charenton, J., Aegerter, P., Ruet, A., Azouvi, P., 2017. Negative impact of litigation procedures on patient outcomes four years after severe traumatic brain injury: results from the Paris-traumatic brain injury study. Disabil. Rehabil. 1–8.
Beck, B., Ekegren, C.L., Cameron, P., Edwards, E.R., Bucknill, A., Judson, R., Page, R., Hau, R., Stevenson, M., Gabbe, B.J., 2017. Predictors of recovery in cyclists hospitalised for orthopaedic trauma following an on-road crash. Accid. Anal. Prev. 106, 341–347.
Bethune, A., Da Costa, L., Van Niftrik, C.H.B., Feinstein, A., 2017. Suicidal ideation after mild traumatic brain injury: a consecutive Canadian sample. Arch. Suicide Res. 21 (3), 392–402.
Bostick, G.P., Carroll, L.J., Brown, C.A., Harley, D., Gross, D.P., 2013. Predictive capacity of pain beliefs and catastrophizing in whiplash associated disorder. Injury 44 (11), 1465–1471.
Bujang, M.A., Sa'at, M., Tg-Abu-Bakar-Sidik, T.M.I., 2019. Determination of minimum sample size requirement for multiple linear regression and analysis of covariance based on experimental and non-experimental studies. Epidemiol. Biostat. Public Health 14, e12117–1.
Cameron, I.D., Rebbeck, T., Sindhusake, D., Rubin, G., Feyer, A.M., Walsh, J., Schofield, W.N., 2008. Legislative change is associated with improved health status in people with whiplash. Spine 33 (3), 250–254.
Carroll, L.J., Ferrari, R., Cassidy, J.D., 2007. Reduced or painful jaw movement after collision-related injuries: a population-based study. J. Am. Dent. Assoc. 138 (1), 86–93.
Chibnall, J.T., Tait, R.C., 2010. Legal representation and dissatisfaction with workers' compensation: implications for claimant adjustment. Psychol. Inj. Law 3 (3), 230–240.
Chossegros, L., Hours, M., Charnay, P., Bernard, M., Fort, E., Boisson, D., Sancho, P.-O., Yao, S.N., Laumon, B., 2011. Predictive factors of chronic post-traumatic stress disorder 6 months after a road traffic accident. Accid. Anal. Prev. 43 (1), 471–477.
Cobo, E.P., Mesquida, M.E., Fanegas, E.P., Atanasio, E.M., Pastor, M.B., Pont, C.P., Prieto, C.M., Gómez, G.R., Cano, L.G., 2010. What factors have influence on persistence of neck pain after a whiplash? Spine 35 (9), E338–343.
Cote, P., Cassidy, J.D., Carroll, L., Frank, J.W., Bombardier, C., 2001. A systematic review of the prognosis of acute whiplash and a new conceptual framework to synthesize the literature. Spine (Phila Pa 1976) 26 (19), E445–58.
Curtis, K., Dickson, C., Black, D., Nau, T., 2009. The cost and compensability of trauma patients. Aust. Health Rev. 33 (1), 84–92.
Dougall, A.L., Ursano, R.J., Posluszny, D.M., Fullerton, C.S., Baum, A., 2001. Predictors of posttraumatic stress among victims of motor vehicle accidents. Psychosom. Med. 63 (3), 402–411.
Ehring, T., Ehlers, A., Cleare, A.J., Glucksman, E., 2008. Do acute psychological and psychobiological responses to trauma predict subsequent symptom severities of ptsd and depression? Psychiatry Res. 161 (1), 67–75.
Elbers, N.A., Akkermans, A.J., Lockwood, K., Craig, A., Cameron, I.D., 2015. Factors that challenge health for people involved in the compensation process following a motor vehicle crash: a longitudinal study. BMC Public Health 15 (1), 339.
Elbers, N.A., Collie, A., Hogg-Johnson, S., Lippel, K., Lockwood, K., Cameron, I.D., 2016. Differences in perceived fairness and health outcomes in two injury compensation systems: a comparative study. BMC Public Health 16 (1), 658.
Ferrari, R., 2015. A prospective study of perceived injustice in whiplash victims and its relationship to recovery. Clin. Rheumatol. 34 (5), 975–979.
Fitzharris, M., Fildes, B., Charlton, J., Tingvall, C., 2005. The relationship between perceived crash responsibility and post-crash depression. Ann. Proc./Assoc. Adv. Automot. Med. 49, 79–92.
Fort, E., Bouffard, E., Charnay, P., Bernard, M., Boisson, D., Laumon, B., Hours, M., 2011. Return to work following road accidents: factors associated with late work resumption. J. Rehabil. Med. 43 (4), 283–291.
Gabbe, B.J., Simpson, P.M., Cameron, P.A., Ekegren, C.L., Edwards, E.R., Page, R., Liew, S., Bucknill, A., De Steiger, R., 2015. Association between perception of fault for the crash and function, return to work and health status 1 year after road traffic injury: a registry-based cohort study. BMJ Open 5 (11), e009907.

Giummarra, M.J., Lau, G., Gabbe, B.J., 2019. 2019 Evaluation of Text mining to reduce screening workload for injury-focused systematic reviews. Inj. Rev.. https://doi.org/10.1136/injuryprev-2019-043247.
Giummarra, M.J., Ioannou, L., Ponsford, J., Cameron, P.A., Jennings, P.A., Gibson, S.J., Georgiou-Karistianis, N., 2016. Chronic pain following motor vehicle collision: a systematic review of outcomes associated with seeking or receiving compensation. Clin. J. Pain 32 (9), 817–827.
Gopinath, B., Jagnoor, J., Harris, I.A., Nicholas, M., Casey, P., Blyth, F., Maher, C.G., Cameron, I.D., 2015a. Prognostic indicators of social outcomes in persons who sustained an injury in a road traffic crash. Injury 46 (5), 909–917.
Gopinath, B., Jagnoor, J., Nicholas, M., Blyth, F., Harris, I.A., Casey, P., Cameron, I.D., 2015b. Presence and predictors of persistent pain among persons who sustained an injury in a road traffic crash. Eur. J. Pain 19 (8), 1111–1118.
Grant, G.M., O'Donnell, M.L., Spittal, M.J., Creamer, M., Studdert, D.M., 2014. Relationship between stressfulness of claiming for injury compensation and long-term recovery: a prospective cohort study. JAMA Psychiatry 71 (4), 446–453.
Green, S.B., 1991. How many subjects does it take to do a regression analysis. Multivariate Behav. Res. 26 (3), 499–510.
Guest, R., Tran, Y., Gopinath, B., Cameron, I.D., Craig, A., 2017. Psychological distress following a motor vehicle crash: Evidence from a statewide retrospective study examining settlement times and costs of compensation claims. BMJ Open 7 (9), e017515.
Guyatt, G., Oxman, A.D., Akl, E.A., Kunz, R., Vist, G., Brozek, J., Norris, S., Falck-Ytter, Y., Glasziou, P., Debeer, H., Jaeschke, R., Rind, D., Meerpohl, J., Dahm, P., Schünemann, H.J., 2014. Grade guidelines: 1. Introduction & grade evidence profiles and summary of findings tables. J. Clin. Epidemiol. 64 (4), 383–394.
Harris, I., Dao, A.T., Young, J., Solomon, M., Jalaludin, B.B., Rae, H., 2007. Factors predicting patient satisfaction following major trauma. Injury 38 (9), 1102–1108.
Harris, I.A., Young, J.M., Jalaludin, B.B., Solomon, M.J., 2008. The effect of compensation on general health in patients sustaining fractures in motor vehicle trauma. J. Orthop. Trauma 22 (4), 216–220.
Harris, I.A., Young, J.M., Jalaludin, B.B., Solomon, M.J., Harris, I.A., Young, J.M., Jalaludin, B.B., Solomon, M.J., 2011. Predictors of neck pain after motor vehicle collisions: a prospective survey. J. Orthop. Surg. 19 (3), 317–321 (10225536).
Hartling, L., Pickett, W., Brison, R.J., 2002. Derivation of a clinical decision rule for whiplash associated disorders among individuals involved in rear-end collisions. Accid. Anal. Prev. 34 (4), 531–539.
Hayden, J.A., Cote, P., Bombardier, C., 2006. Evaluation of the quality of prognosis studies in systematic reviews. Ann. Intern. Med. 144 (6), 427–437.
Hickling, E.J., Blanchard, E.B., Hickling, M.T., 2005. The psychological impact of litigation: compensation neurosis, malingering, ptsd, secondary traumatization, and other lessons from mvas. DePaul L. Rev. 55, 617.
Hours, M., Khati, I., Charnay, P., Chossegros, L., Tardy, H., Tournier, C., Perrine, A.-L., Luauté, J., Laumon, B., 2014. One year after mild injury: comparison of health status and quality of life between patients with whiplash versus other injuries. J. Rheumatol. 41 (3), 528–538.
Ioannou, L., Braaf, S., Cameron, P., Gibson, S.J., Ponsford, J., Jennings, P.A., Arnold, C.A., Georgiou-Karistianis, N., Giummarra, M.J., 2016. Compensation system experience at 12 months after road or workplace injury in victoria, australia. Psychol. Inj. Law 9 (4), 376–389.
Ioannou, L.J., Cameron, P.A., Gibson, S.J., Gabbe, B.J., Ponsford, J., Jennings, P.A., Arnold, C.A., Gwini, S.M., Georgiou-Karistianis, N., Giummarra, M.J., 2017. Traumatic injury and perceived injustice: fault attributions matter in a "no-fault" compensation state. PLoS One 12 (6), e0178894.
Iverson, G.L., Terry, D.P., Karr, J.E., Panenka, W.J., Silverberg, N.D., 2018. Perceived injustice and its correlates after mild traumatic brain injury. J. Neurotrauma 35 (10), 1156–1166.
Jeavons, S., Greenwood, K.M., Horne, D.J., 2000. Accident cognitions and subsequent psychological trauma. J. Trauma. Stress 13 (2), 359–365.
Jonnalagadda, S.R., Goyal, P., Huffman, M.D., 2015. Automating data extraction in systematic reviews: a systematic review. Syst. Rev. 4, 78.
Karl, A., Rabe, S., Zöllner, T., Maercker, A., Stopa, L., 2009. Negative self-appraisals in treatment-seeking survivors of motor vehicle accidents. J. Anxiety Disord. 775–781.
Kazmierczak, I., Strelau, J., Zawadzki, B., 2016. Post-traumatic cognitions as a mediator of the relationship between sense of coherence and post-traumatic stress disorder after motor vehicle accidents. Transp. Res. Part F Traffic Psychol. Behav. 41 (Part A), 38–44.
Littleton, S.M., Cameron, I.D., Poustie, S.J., Hughes, D.C., Robinson, B.J., Neeman, T., Smith, P.N., Littleton, S.M., Cameron, I.D., Poustie, S.J., Hughes, D.C., Robinson, B.J., Neeman, T., Smith, P.N., 2011. The association of compensation on longer term health status for people with musculoskeletal injuries following road traffic crashes: emergency department inception cohort study. Injury 42 (9), 927–933.
Luntz, H., Hambly, D., Burns, K., Dietrich, J., Foster, N., Grant, G.M., Harder, S., 2017. Torts: Cases and Commentary, 8th ed. Lexis Nexis, Chatswood NSW Australia.
Matsumoto, M., Ichihara, D., Okada, E., Toyama, Y., Fujiwara, H., Momoshima, S., Nishiwaki, Y., Takahata, T., 2013. Modic changes of the cervical spine in patients with whiplash injury: a prospective 11-year follow-up study. Injury 44 (6), 819–824.
Matsuoka, Y., Nishi, D., Nakajima, S., Kim, Y., Homma, M., Otomo, Y., 2008. Incidence and prediction of psychiatric morbidity after a motor vehicle accident in japan: the tachikawa cohort of motor vehicle accident study. Crit. Care Med. 36 (1), 74–80.
Mayou, R., Bryant, B., 2001. Outcome in consecutive emergency department attenders following a road traffic accident. Br. J. Psychiatry 179 (6), 528–534.
Mayou, R., Bryant, B., Ehlers, A., 2001. Prediction of psychological outcomes one year after a motor vehicle accident. Am. J. Psychiatry 158 (8), 1231–1238.
Mayou, R., Bryant, B., 2002. Psychiatry of whiplash neck injury. Br. J. Psychiatry 180 (5), 441–448.
Mayou, R., Ehlers, A., Bryant, B., 2002. Posttraumatic stress disorder after motor vehicle accidents: 3-year follow-up of a prospective longitudinal study. Behav. Res. Ther. 40 (6), 665–675.
Mayou, R., Bryant, B., 2003. Consequences of road traffic accidents for different types of road user. Injury 34 (3), 197–202.
Mccauley, S.R., Boake, C., Levin, H.S., Contant, C.F., Song, J.X., 2001. Postconcussional disorder following mild to moderate traumatic brain injury: anxiety, depression, and social support as risk factors and comorbidities. J. Clin. Exp. Neuropsychol. 23 (6), 792–808.
Mclean, S.A., Ulirsch, J.C., Slade, G.D., Soward, A.C., Swor, R.A., Peak, D.A., Jones, J.S., Rathlev, N.K., Lee, D.C., Domeier, R.M., Hendry, P.L., Bortsov, A.V., Bair, E., 2014. Incidence and predictors of neck and widespread pain after motor vehicle collision among us litigants and nonlitigants. Pain 155 (2), 309–321.
Miettinen, T., Airaksinen, O., Lindgren, K.A., Leino, E., 2004. Whiplash injuries in finland - the possibility of some sociodemographic and psychosocial factors to predict the outcome after one year. Disabil. Rehabil. 26 (23), 1367–1372.
Murgatroyd, D.F., Casey, P.P., Cameron, I.D., Harris, I.A., 2015. The effect of financial compensation on health outcomes following musculoskeletal injury: systematic review. PLoS One 10 (2).
Murgatroyd, D.F., Harris, I.A., Tran, Y., Cameron, I.D., Murgatroyd, D., 2016a. Predictors of return to work following motor vehicle related orthopaedic trauma. BMC Musculoskelet. Disord. 17, 1–13.
Murgatroyd, D.F., Harris, I.A., Yvonne, T., Cameron, I.D., Tran, Y., 2016b. The association between seeking financial compensation and injury recovery following motor vehicle related orthopaedic trauma. BMC Musculoskelet. Disord. 17, 1–14.
Naim, R., Wald, I., Lior, A., Pine, D.S., Fox, N.A., Sheppes, G., Halpern, P., Bar-Haim, Y., 2014. Perturbed threat monitoring following a traumatic event predicts risk for post-traumatic stress disorder. Psychol. Med. 44 (10), 2077–2084.
Nhac-Vu, H.-T., Hours, M., Charnay, P., Chossegros, L., Boisson, D., Luauté, J., Javouhey, E., Ndiaye, A., Laumon, B., 2011. Predicting self-reported recovery one year after major road traffic accident trauma. J. Rehabil. Med. 43 (9), 776–782.
Nhac-Vu, H.T., Hours, M., Chossegros, L., Charnay, P., Tardy, H., Martin, J.L., Mazaux, J.M., Laumon, B., 2014. Prognosis of outcome in adult survivors of road accidents in France: one-year follow-up in the esparr cohort. Traffic Inj. Prev. 15 (2), 138–147.
Nishi, D., Noguchi, H., Yonemoto, N., Nakajima, S., Kim, Y., Matsuoka, Y., 2013. Incidence and prediction of post-traumatic stress disorder at 6 months after motor vehicle accidents in japan. Psychosom. J. Consult. Liaison Psych. 54 (3), 263–271.
O'Donnell, M.L., Elliott, P., Wolfgang, B.J., Creamer, M., 2007. Posttraumatic appraisals in the development and persistence of posttraumatic stress symptoms. J. Trauma. Stress 20 (2), 173–182.
O'mara-Eves, A., Thomas, J., Mcnaught, J., Miwa, M., Ananiadou, S., 2015. Using text mining for study identification in systematic reviews: a systematic review of current approaches. Syst. Rev. 4 (1), 5.
Osti, O.L., Gun, R.T., Abraham, G., Pratt, N.L., Eckerwall, G., Nakamura, H., 2005. Potential risk factors for prolonged recovery following whiplash injury. Eur. Spine J. 14 (1), 90–94.
Ottosson, C., Pettersson, H., Johansson, S.E., Nyren, O., Ponzer, S., 2007. Recovered? Association between self-perceived recovery and the sf-36 after minor musculoskeletal injuries. Qual. Life Res. 16 (2), 217–226.
Pape, E., Brox, J.I., Hagen, K.B., Natvig, B., Schirmer, H., 2007. Prognostic factors for chronic neck pain in persons with minor or moderate injuries in traffic accidents. Accid. Anal. Prev. 39 (1), 135–146.
Pelissier, C., Fort, E., Fontana, L., Charbotel, B., Hours, M., 2017. Factors associated with non-return to work in the severely injured victims 3 years after a road accident: a prospective study. Accid. Anal. Prev. 106, 411–419.
Phillips, L.A., Carroll, L.J., Cassidy, J.D., Cote, P., 2010. Whiplash-associated disorders: Who gets depressed? Who stays depressed? Eur. Spine J. 19 (6), 945–956.
Platts-Mills, T., Nebolisa, B., Flannigan, S., Richmond, N., Domeier, R., Swor, R., Hendry, P., Peak, D., Rathlev, N., Jones, J., Lee, D., Jones, C., Mclean, S., 2017. Post-traumatic stress disorder among older adults experiencing motor vehicle collision: a multicenter prospective cohort study. Am. J. Geriatr. Psychiatry 953–963.
Pobereskin, L.H., 2005. Whiplash following rear end collisions: a prospective cohort study. J. Neurol. Neurosurg. Psychiatr. 76 (8), 1146–1151.
Rathbone, J., Hoffmann, T., Glasziou, P., 2015. Faster title and abstract screening? Evaluating abstrackr, a semi-automated online screening program for systematic reviewers. Syst. Rev. 4, 80.
Rebbeck, T., Sindhusake, D., Cameron, I.D., Rubin, G., Meyer, A., Walsh, J., Gold, M., Schofield, W.N., 2006. A prospective cohort study of health outcomes following whiplash associated disorders in an Australian population. Inj. Prev. 12 (2), 93–98 (1353-8047).
Ryb, G.E., Dischinger, P.C., Read, K.M., Kufera, J.A., 2009. Ptsd after severe vehicular crashes. Annals of Advances in Automotive Medicine Annual Scientific Conference 53 177–193.
Scholten-Peeters, G.G., Verhagen, A.P., Bekkering, G.E., Van Der Windt, D.A., Barnsley, L., Oostendorp, R.A., Hendriks, E.J., 2003. Prognostic factors of whiplash-associated disorders: a systematic review of prospective cohort studies. Pain 104 (1-2), 303–322.
Silove, D., Blaszczynski, A., Manicavasager, V., Tyndall, K., Petridis, A., Hillman, K., 2003. Capacity of screening questionnaires to predict psychiatric morbidity 18 months after motor vehicle accidents. J. Nerv. Ment. Dis. 191 (9), 604–610.
Spearing, N.M., Connelly, L.B., Nghiem, H.S., Pobereskin, L., 2012. Research on injury compensation and health outcomes: ignoring the problem of reverse causality led to a biased conclusion. J. Clin. Epidemiol. 65 (11), 1219–1226.
Stewart, A.E., 2005. Attributions of responsibility for motor vehicle crashes. Accid. Anal. Prev. 37 (4), 681–688.
Suissa, S., 2003. Risk factors of poor prognosis after whiplash injury. Pain Res. Manag. 8 (2), 69–75.

Thompson, J., Berk, M., O'Donnell, M., Stafford, L., Nordfjaem, T., 2014a. Attributions of responsibility and recovery within a no-fault insurance compensation system. Rehabil. Psychol. 59 (3), 247–255.

Thompson, J., O'Donnell, M., Stafford, L., Nordfjaern, T., Berk, M., 2014b. Association between attributions of responsibility for motor vehicle crashes, depressive symptoms, and return to work. Rehabil. Psychol. 59 (4), 376–385.

Tournier, C., Charnay, P., Tardy, H., Chossegros, L., Carnis, L., Hours, M., 2014. A few seconds to have an accident, a long time to recover: consequences for road accident victims from the esparr cohort 2 years after the accident. Accid. Anal. Prev. 72, 422–432.

Tournier, C., Hours, M., Charnay, P., Chossegros, L., Tardy, H., 2016. Five years after the accident, whiplash casualties still have poorer quality of life in the physical domain than other mildly injured casualties: analysis of the esparr cohort. BMC Public Health 16 (1), 1–13.

Vollrath, M., Meilinger, T., Krüger, H.-P., 2002. How the presence of passengers influences the risk of a collision with another vehicle. Accid. Anal. Prev. 34 (5), 649–654.

Von Elm, E., Altman, D.G., Egger, M., Pocock, S.J., Gotzsche, P.C., Vandenbroucke, J.P., 2008. The strengthening the reporting of observational studies in epidemiology (strobe) statement: guidelines for reporting observational studies. J. Clin. Epidemiol. 61 (4), 344–349.

Wade, N.G., Worthington, E.L., 2005. In search of a common core: a content analysis of interventions to promote forgiveness. Psychotherapy 42 (2), 160–177.

Wallace, B.C., Small, K., Brodley, C.E., Lau, J., Trikalinos, T.A., 2012. Deploying an interactive machine learning system in an evidence-based practice center: abstrackr. In: Proceedings of the 2nd ACM SIGHIT International Health Informatics Symposium. ACM, Miami, Florida, USA. pp. 819–824.

Wu, K.K., Cheung, M.W.L., 2006. Posttraumatic stress after a motor vehicle accident: a six-month follow-up study utilizing latent growth modeling. J. Trauma. Stress 19 (6), 923–936.

Wynne-Jones, G., Jones, G.T., Wiles, N.J., Silman, A.J., Macfarlane, G.J., 2006. Predicting new onset of widespread pain following a motor vehicle collision. J. Rheumatol. 33 (5), 968–974.

Yakobov, E., Scott, W., Thibault, P., Sullivan, M.J., 2016. Treatment-related reductions in disability are associated with reductions in perceived injustice following treatment of whiplash injury. Psychol. Inj. Law 9 (1), 41–47.