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Psychological distress following a motor vehicle crash: compelling evidence from a state-wide retrospective study examining settlement times and costs of compensation claims

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3 Psychological distress following a motor vehicle crash: compelling evidence from a state-
4 wide retrospective study examining settlement times and costs of compensation claims
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44 compensation, post-traumatic stress disorder
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Abstract

Objective: To determine whether psychological distress associated with musculoskeletal injuries sustained in a motor vehicle crash (MVC), regardless of time of onset, impacts compensation outcomes such as claim settlement times and costs. Second, to identify factors routinely collected by insurance companies that contribute to psychological distress during the compensation process.

Design: State-wide retrospective study.

Data Source: Analysis of the New South Wales state-wide (Australia) injury register for MVC survivors who lodged a compensation claim from 2011 to 2013.

Participants: 6,341 adults who sustained a musculoskeletal injury, and who settled a claim for injury compensation after a MVC. Participants included those diagnosed with psychological distress (n=607) versus those not diagnosed (n=5,734).

Main Outcome Measures: Time to settlement and total costs of compensation claims, as well as socio-demographic and injury characteristics that may contribute to elevated psychological distress, such as socioeconomic disadvantage, prior claim history, and injury severity.

Results: Psychological distress in those with a musculoskeletal injury was associated with significantly longer settlement times (an additional 17 weeks) and considerably higher costs (an additional A\$41, 575.00, or 4.3 times more expensive). Multivariate logistic regression analysis identified risk factors for psychological distress including being female, social disadvantage, unemployment prior to the claim, not being at fault in the MVC, requiring ambulance transportation and rehabilitation as part of recovery.

Conclusions: Results provide compelling evidence that psychological distress has an adverse impact on people with musculoskeletal injury as they progress through compensation. Findings suggest additional resources should be directed toward claimants

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3 who are at risk (e.g. the socially disadvantaged or those unemployed prior to the claim), the
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5 aim being to reduce risk of psychological distress and subsequent risk of increased settlement
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7 times and claim costs. Prospective studies are now required that investigate treatment
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9 strategies for those at risk of psychological distress associated with a MVC.
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Strengths and limitations of this study

- This is the first study to investigate the impact of psychological distress in all claimants experiencing a musculoskeletal injury and who lodge and settle their compensation claim for a MVC over a 2 year period in the state of NSW. It was revealed that the presence of psychological distress greatly increased settlement times and costs.
- The study identified risk factors associated with an increased likelihood of psychological distress after a MVC.
- The study has the potential to change medical practice and insurance policy for those at risk of psychological distress following a MVC.
- It was not possible to determine whether psychological distress was present prior to the MVC, as this information is not routinely collected by insurance companies.

INTRODUCTION

Motor vehicle crashes (MVC) remain a major source of physical injury and distress. For example, in the UK there were 194,477 reported casualties in a traffic accident in 2014¹ while in Australia in 2013 the rate of annual hospitalised injuries associated with a MVC was 151.7 per 100,000.² Psychological distress associated with a MVC has been shown to be substantial and prevalent.³⁻⁷ A recent meta-analysis investigated the extent of psychological distress associated with a MVC.³ Regardless of whether the psychological distress occurred prior to or after the MVC, the study revealed that traumatic brain injury, spinal cord injury and musculoskeletal injury (i.e. whiplash) resulted in significantly elevated levels of distress³ and psychological distress has been shown to remain elevated for at least 3 years post-MVC.³⁸⁻¹⁰ Recent prospective research found 1 in 2 persons suffered elevated rates of psychological distress (e.g. depression) soon after the MVC and many of these continue to experience elevated distress 12 months after the MVC.⁹ Factors such as more severe physical injury, older age, and past negative emotional reactions to distress were associated with elevated psychological distress 12 months post-MVC.⁹ For the purpose of this study, psychological distress is defined as an unpleasant mental condition perceived as disturbing and which can impede daily functioning, with mental symptoms including agitation, fatigue, confusion, loss of motivation and depressed mood.

Research suggests the compensation process following a MVC increases distress, for example, health outcomes of people who lodge injury-related compensation claims are more likely to have higher levels of distress than those who do not claim.¹¹⁻¹⁷ Furthermore, preliminary research suggests when a person has experienced a physical injury as well as psychological distress, the cost of their claim has been shown to double.¹⁸ Other research has found poorer outcomes for claimants who were not at-fault compared to those at-fault.¹⁹ The potential negative impact of psychological distress in the claims process is clearly undesirable

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3 in terms of complicating medical treatment for the injured person, and challenging policy
4 direction and effectiveness for insurers. A more desirable outcome is to minimise time spent
5 in the compensation process, because this would likely reduce the negative impact on the
6 individual's health, and contain claim costs for healthcare systems and insurers.²⁰
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11 Musculoskeletal injuries are common following a MVC and often lead to
12 compensation claims²¹⁻²³ and the risk of developing psychological distress with this physical
13 injury is high.^{3 24} Musculoskeletal injuries typically involve soft tissue injuries to the lower
14 back, shoulders, hips and knees as well as whiplash injuries, and account for more than
15 65,000 injuries in Australia each year following a MVC, at a cost in excess of A\$950m.²⁵
16 Barriers to recovery from MVC-related musculoskeletal injuries include high initial pain
17 intensity,^{26 27} being female,^{20 28} involvement in the compensation claims process^{14 20} and
18 elevated psychological distress.^{29 30} Furthermore, recent research found significantly
19 increased levels of psychological distress for MVC related whiplash-associated disorder
20 (WAD) compared to controls.^{3 31}
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34 A review of research that focussed on disability arising from a MVC concluded that
35 there was a need to clarify rates of disability arising from a MVC, especially with regard to
36 methodological issues and complicating factors like compensation.³² This is also true for the
37 impact of psychological distress following a MVC, including the influence of involvement in
38 compensation claims.^{3 9} Research in this area has been limited by uncertain diagnoses of
39 psychological distress disorders and small sample sizes. In contrast, the research presented in
40 this paper has addressed many of the limitations of prior research. For instance, it utilised a
41 database of 6,341 persons with musculoskeletal injury from the state-wide injury register of
42 the New South Wales (NSW) State Insurance Regulatory Authority (SIRA), the authority that
43 administers the NSW Compulsory Third Party (CTP) scheme. This state-wide register also
44 provides records with confirmed diagnoses of psychological distress, based on the
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3 International Statistical Classification of Disease and Related Health Problems, Tenth
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5 Revision, Australian Modification (ICD-10-AM),³³ regardless of when the psychological
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7 distress was first diagnosed. The NSW CTP scheme is a fault based scheme with limited
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9 access to entitlements for those at fault. Its purpose is to compensate those with injuries who
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11 were not at fault in the MVC with the claim requiring police and medical reports as evidence,
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13 in addition to a personal injury claim form.³⁴ An estimated 55% of all NSW MVC-related
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15 injuries result in the lodgement of a CTP claim.³⁵
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19 The objective of this research was to analyse the data of all NSW MVC survivors who
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21 sustained a musculoskeletal injury and who settled their claim over a two year period.
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23 Compensation outcomes of those without diagnosed psychological distress were then
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25 compared to those with diagnosed psychological distress. Specifically, the aim was to
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27 determine the impact of psychological distress, regardless of time of onset, on claim
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29 settlement times and total costs.³⁴ A further aim was to determine factors, routinely collected
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31 by NSW CTP insurance companies and collated by SIRA, that predict elevated risk of having
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33 psychological distress. Accordingly, findings should address 2 key research questions: 1.
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35 whether psychological distress is associated with longer claim time to completion and greater
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37 claim costs, and 2. what injury or demographic characteristics are associated with
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39 psychological distress. The findings should be beneficial for informing general practitioners
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41 and insurer policymakers, and thus improve healthcare practices for injury-related
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43 compensation claimants.
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49 **METHOD**

50 **Participants**

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52 Permission was sought and granted on 22nd November 2016 from SIRA to access a total of
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54 24,164 claims from the Personal Injury Register (PIR) of SIRA to determine their potential
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3 inclusion in the analysis. The PIR contains all MVC-related claims that occur in NSW.
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5 Inclusion criteria consisted of i) the injured adult (18+) having a musculoskeletal injury and
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7 ii) the claim had been lodged and also settled over a 27 month period (October, 2011-
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9 December, 2013). Claims which had been lodged but not settled, and claims involving
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11 catastrophic injuries such as spinal cord injury and severe traumatic brain injury were
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13 excluded (catastrophic injury related claims are directed toward an alternative scheme in
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15 NSW). This resulted in 6,341 participants who had experienced a MVC and sustained a
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17 musculoskeletal injury, and who lodged and settled a claim in NSW, Australia between
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19 October 2011 and December 2013 (27 months). The combined cohort data was received from
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21 SIRA in de-identified form and therefore human research ethics approval was deemed not to
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23 be required.
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29 **Measurements**

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31 Musculoskeletal injury severity was assessed using the New Injury Severity Score (NISS)
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33 which computes the simple sum of squares of the three most severe injuries identified by the
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35 abbreviated injury scale (AIS).³⁶ The Index of Relative Socioeconomic Disadvantage (IRSD)
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37 was calculated from the Socio Economic Index for Areas (SEIFA) which ranks areas in
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39 Australia according to relative socio-economic advantage and disadvantage.³⁷ Rehabilitation
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41 Indicator refers to whether the claimant required rehabilitation as part of their recovery plan.
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43 Presence of psychological distress, such as post-traumatic stress disorder or major depressive
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45 disorders, was determined using the ICD-10-AM Classification of Mental and Behavioural
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47 Disorders: Clinical Descriptions and Diagnostic Guidelines³⁸ at some time within the claims
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49 process (the database is progressively updated over the duration of the claim). Psychological
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51 distress was determined from sources such as reports and independent assessments from
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53 General Practitioners, Psychiatrists, and Psychologists. It is recognised that psychological
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3 distress could be present prior to the claimant's MVC, and that this has the potential to
4 influence psychological distress post-MVC.³ However, timing of onset of psychological
5 distress was not the aim of this research given such information is not routinely collected by
6 NSW insurance companies and is therefore not collated by the NSW regulatory authority. Of
7 the 6,341, those with musculoskeletal injury without psychological distress numbered 5,374
8 (90.4%) and those with both musculoskeletal injury and psychological distress numbered 607
9 (9.6%).

19 **Statistical analysis**

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22 A retrospective design was employed to analyse the PIR datasets of all NSW MVC survivors
23 at the time of their claim lodgement (both minor claims, that is, 'Accident Notifications
24 Forms' and full claims) over 27 months, and who met the inclusion criteria. Reporting was
25 guided by the relevant checklist (see STROBE Statement in supplemental file 1). Descriptive
26 statistics were used to summarise demographic and claim/accident characteristics of the
27 participants by psychological distress status. The differences in the demographics and claim
28 characteristics between those that claimed compensation and those that did not were
29 compared using analysis of variance (ANOVA) tests for continuous variables and chi-square
30 tests for categorical variables. In order to determine predictive factors, logistic regression was
31 employed. Only statistically significant socio-demographic and injury variables from Table 1
32 were included in the logistic regression analysis from which unadjusted odds ratios were
33 determined. Following this, all the variables were again used in backward elimination ($P < .05$)
34 logistic regression, and adjusted odds ratios calculated.

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Logistic regression can provide information on factors that are associated with having
psychological distress and advantages of employing this statistical methodology include its
ability for isolating predictors, and for producing odds ratios.³⁹ Whilst Table 1 showed there

was a significantly higher probability ($P < .01$) for those who had psychological distress also having legal representation (61.0%) compared to musculoskeletal injury only claimants (18.9%), this injury characteristic was excluded from the logistic regression as legal representation can be instigated not only at the time of the claim lodgement, but at any time throughout the claims process, thus making it difficult to establish its predictive association with psychological distress. Again, it should be noted that psychological distress can develop before the injury, as well as at any time throughout the claims process.

All variables selected for the logistic regression have been investigated in prior studies for their relevance to injury outcomes following MVC.^{11 40} To determine the predictive capacity of the logistic regression model, ROC estimates were calculated. The ROC plots the true-positive rate (sensitivity) against the false-positive rate ($1 - \text{specificity}$) in detecting factors that influence greater time to claim settlement and elevated costs for MVC claimants with musculoskeletal injuries with and without psychological distress.

RESULTS

Socio-demographic and injury characteristics are shown in Table 1. All factors shown in Table 1 were either pre-injury factors or assessed at the time of lodging the claim, except for legal representation which can potentially occur at any time during the claims process. Mean days from MVC to lodgement of a minor 'no fault' claim (Accident Notification Form) was 23 days ($SD=22.8$) and to full claim lodgement was 110 days ($SD=84.0$).

Table 1 Socio-demographic and injury characteristics of NSW MVC claimants 2011-2013

Variable	Musculoskeletal Injury (<i>n</i> =5734)	Musculoskeletal Injury + Psych Distress (<i>n</i> =607)	P
Age (years), Mean (SD)	42.8 (16.3)	44.4 (15.9)	0.02
New Injury Severity Score, No (%)			0.02

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3	Minor- moderate 1-8	5259 (91.9)	539 (88.8)	
4	Serious 9-15	348 (6.1)	54 (8.9)	
5	Severe- critical 16-75	114 (2.0)	14 (2.3)	
6	Index of Relative Socioeconomic Disadvantage, Mean (SD)	1017.0 (86.4)	986.5 (89.2)	<0.01
7	Index of Relative Socioeconomic Disadvantage, No (%)			<0.01
8	Most disadvantaged	983 (17.4)	182 (30.3)	
9	Disadvantaged	803 (14.2)	72 (12.5)	
10	Average	1007 (17.8)	113 (18.8)	
11	Advantaged	853 (15.1)	95 (15.8)	
12	Most advantaged	1996 (35.4)	136 (22.6)	
13	Male, No (%)	2417 (42.2)	212 (34.9)	<0.01
14	Employment Status, No (%) (Yes)	4197 (73.2)	364 (60.0)	<0.01
15	Occupation skill level, No (%)			<0.01
16	Managers and Administrators	567 (9.9)	34 (5.6)	
17	Professionals	1026 (17.9)	34 (5.6)	
18	Para-professionals	213 (3.7)	74 (12.2)	
19	Tradespersons	257 (4.5)	17 (12.2)	
20	Clerks	600 (10.5)	26 (4.3)	
21	Sales persons and Personal Service workers	680 (11.9)	63 (10.4)	
22	Plant and Machine Operators and Drivers	225 (3.9)	64 (10.5)	
23	Labourers and related workers	537 (9.4)	22 (3.6)	
24	At Fault* (No), No (%)	4866 (87.9)	568 (96.1)	<0.01
25	Prior Claim (Yes), No (%)	620 (10.8)	86 (14.2)	0.012
26	Economic Loss Claim (No), No (%)	3101 (54.1)	329 (54.2)	0.96
27	Weekly Earnings, Mean (SD)	1212.4 (2832.6)	1001.4 (659.4)	0.23
28	Legal Representation, (Yes), No (%)	1085 (18.9)	370 (61.0)	<0.01
29	Accident Notification (Days), Mean (SD)	22.6 (22.9)	23.9 (21.4)	0.32
30	Notification of Claim (Days), Mean (SD)	112.7 (86.7)	97.5 (69.1)	<0.01
31	Rehabilitation Indicator, No (%)			<0.01
32	Required	398 (6.9)	127 (20.9)	
33	Possibly Required	2920 (50.9)	287 (47.3)	
34	Not Required	1844 (32.2)	171 (28.2)	
35	Role			<0.01
36	Driver	3764 (65.6)	386 (63.6)	
37	Passenger	1120 (19.5)	156 (25.7)	
38	Rider	404 (7.0)	23 (3.8)	
39	Pillion	22 (0.4)	2 (0.3)	
40	Pedestrian	237 (4.1)	30 (4.9)	
41	Cyclist	159 (2.8)	7 (1.2)	
42	Other	28 (0.5)	3 (0.5)	
43	Ambulance (yes)	2179 (38.0)	300 (49.4)	<0.01
44	Hospital (yes)	1405 (24.5)	173 (28.5)	<0.01

Note. For some variables there were missing values; total number will therefore not always equal 6,341.

* At fault claims are minor claims that are capped at payment of A\$5,000.00.

Table 2 shows a breakdown of musculoskeletal injury types for the sample separated by musculoskeletal injury only compared to musculoskeletal injury + psychological distress.

Whilst it is accepted that a MVC survivor is vulnerable to sustaining several different categories of injuries (for example, whiplash and lumbar and other soft tissue injuries), Table 2 shows the most common musculoskeletal injury was soft tissue, followed by whiplash injuries.

Table 2 Breakdown of musculoskeletal injury types by musculoskeletal injury versus musculoskeletal injury with psychological distress from 2011- 2013.

Musculoskeletal Injury Type	Musculoskeletal Injury Only (%)	Musculoskeletal Injury + Psychological Distress (%)	Total
Soft Tissue	4630 (89.78)	527 (10.21)	5157
Whiplash	3746 (89.44)	442 (10.55)	4188
Skin	2133 (86.81)	324 (13.18)	2457
Lumbar	1256 (84.69)	227 (15.30)	1483
Chest	985 (86.10)	159 (13.89)	1144
Seatbelt	672 (84.31)	125 (15.68)	797
Thoracic	634 (86.84)	96 (13.15)	730
Upper Limb Joint	441 (87.67)	62 (12.32)	503
Upper Limb Fracture	432 (93.50)	30 (6.49)	462
Lower Limb Fracture	413 (93.43)	29 (6.56)	442
Lower Limb Joint	229 (87.40)	33 (12.59)	262
Face	82 (85.41)	14 (14.58)	96
Abdomen	49 (90.74)	5 (9.25)	54
Neck	4 (80.00)	1 (20.00)	5
Spinal Contusion	2 (100.00)	0 (0.00)	2
Finger Amputation	2 (100.00)	0 (0.00)	2

Claim settlement times, costs and legal representation

ANOVA results confirmed a significant difference between musculoskeletal injury and musculoskeletal injury + psychological distress claim settlement times ($F=392.82$, $df=1$, 6339, $P<.001$). Mean days to claim settlement from accident date was significantly longer for musculoskeletal injury + psychological distress compared to musculoskeletal injury only (353.81 days; $SD=164.83$; 95% CI 340.67-366.95 versus 231.65 days; $SD=142.08$; 95% CI

227.97-235.32 respectively). This difference was significantly longer for musculoskeletal injury + psychological distress claimants (mean difference 122.16 days or 17.45 weeks).

ANOVA results also confirmed a significant difference in claim costs between musculoskeletal injury and musculoskeletal injury+ psychological distress claimants ($F=444.03$, $df=1$, 6339, $P<.001$). Mean claim costs for musculoskeletal injury only claimants was \$12,421.13; $SD=37,071.78$; 95% CI 11,461.39-13,380.87. Mean claim costs for musculoskeletal injury + psychological distress claimants was A\$53,996.52; $SD=96,693.42$; 95%CI 46,288.92-61,704.11. This is an overall mean increase of A\$41,575.39 or 4.3 times more expensive per case. To understand better the effect of injury severity on claim costs, a further ANOVA was conducted with serious and above musculoskeletal injury removed. This did not change the findings. Mean cost for musculoskeletal injury was A\$10,034.54 ($SD=28,378.90$; 95%CI 9,267.37-10,801.71). Mean cost of musculoskeletal injury + psychological distress was A\$43,262.87 ($SD=61,927.97$; 95% CI 38,023.02-48,502.71, and this was significantly greater for the musculoskeletal injury + psychological distress group ($F=516.71$, $df=1$, 6,607, $P=.000$). Musculoskeletal injury + psychological distress claimants were also significantly more likely ($P<.01$) to involve legal representation (61.0% compared to 18.9%).

Impact of socio-demographic and injury characteristics on probability of psychological distress

Table 1 presents the factors at the time of the MVC and claim lodgement that either increase or decrease the probabilities of musculoskeletal injury claimants being diagnosed with psychological distress. Age, economic loss (defined as yes/no) associated with the injury and claim, weekly earnings and hospitalisation did not significantly increase the probability of psychological distress. Socioeconomic disadvantage increased the probability of experiencing

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3 psychological distress (Mean musculoskeletal injury 1,017.9, SD=86.4; Mean
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5 musculoskeletal injury + psychological distress 986.5, SD=89.2, $P<.01$). For example, over
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7 40% of those with psychological distress were socially disadvantaged compared to 31% of
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9 those without psychological distress. There was a significant difference ($P<.01$) between
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11 male and female claimants in terms of probability of also having psychological distress, that
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13 is, 65.1% were female who had a musculoskeletal injury + psychological distress compared
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15 to 57.8% with only musculoskeletal injury. Claimants who were unemployed were more
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17 likely to have psychological distress ($P<.01$) compared to those employed. 4,197 (73.2%) of
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19 those working at the time of lodging their claim did not have psychological distress compared
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21 to 364 (60.0%) of those with musculoskeletal injury + psychological distress. 620 (10.8%) of
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23 those with a history of a prior claim did not have psychological distress, whereas 86 (14.2%)
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25 did have psychological distress suggesting those with a claim history are more likely to have
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27 psychological distress in addition to their musculoskeletal injury ($P=.01$). Those with a
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29 musculoskeletal injury + psychological distress were more likely to have a serious injury
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31 severity score ($P=.02$). Those with a musculoskeletal injury + psychological distress were
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33 also more likely to be not at fault (96.1% compared to 87.9% for musculoskeletal injury
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35 only). It is noted here, however, that data taken from an 'at fault' scheme necessarily means
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37 there are limited at-fault claimants reducing confidence in its association with psychological
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39 distress. No significant difference was found between the two groups in terms of number of
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41 days taken for notifying the insurer of the MVC (either via a minor claim, that is, Accident
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43 Notification Form, or a full claim). However in terms of days taken to notify the insurer of
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45 the claim lodgement, those who had psychological distress were more likely to notify
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47 lodgement of their claim sooner ($P<.01$). It was also more likely that the claimant will require
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49 rehabilitation if they have psychological distress ($P<.01$). A larger portion of passengers had
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51 psychological distress, whereas motorbike riders and cyclists were less likely to have
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psychological distress ($P<.01$). If an ambulance was required at the time of the MVC, the claimant was significantly more likely to have psychological distress in addition to their musculoskeletal injury ($P<.01$), and similarly, if the claimant attended hospital they were more likely to have psychological distress ($P<.01$) than if hospitalisation was not required.

Logistic regression analysis of significant socio-demographic and injury characteristics

All socio-demographic and injury characteristics that were found to significantly differentiate between the two groups were entered into a logistic regression to determine their unadjusted and adjusted predictive power of psychological distress. Table 3 shows that six variables were associated with the presence of psychological distress. Being unemployed, being female, being socio-economically disadvantaged, not being at fault, requiring an ambulance at the time of their MVC and needing rehabilitation, were all found to be significant contributors to an increased risk of having psychological distress. The area under the ROC curve for this group of six variables was 70%. Adding non-significant variables to the logistic regression did not significantly add to this percentage, providing validity for the predictive capacity of the model.

Table 3 Logistic regression results showing predictors for claimants who experience psychological distress.

Variable	Unadjusted OR (95% CI)	P	Adjusted OR (95% CI)	P
Age	1.01 (1.00, 1.01)	0.02		
New Injury Severity Score		0.03		
Minor- moderate 1-8	1.00			
Serious 9-15	1.51 (1.12, 2.04)	0.007		
Severe– critical 16-75	1.20 (0.68, 2.10)	0.53		
Index of Relative Socioeconomic Disadvantage		<0.001		<0.001
Most disadvantaged	1.65 (1.28, 2.12)	<0.001	1.55 (1.18, 20.6)	0.002
Disadvantaged	0.83 (0.61, 1.13)	0.24	0.87 (0.62, 1.23)	0.43
Average	1.00		1.00	
Advantaged	0.99 (0.74, 1.32)	0.96	1.07 (0.77, 1.48)	0.70
Most advantaged	0.61 (0.47, 0.79)	<0.001	0.60 (0.45, 0.81)	0.001

Male	0.73 (0.62, 0.87)	<0.001	0.72 (0.59, 0.88)	0.001
Employment Status (Yes)	0.55 (0.46, 0.65)	<0.001	0.71 (0.58, 0.87)	0.001
At Fault (Yes)	0.29 (0.19, 0.45)	<0.001	0.25 (0.15, 0.40)	<0.001
Prior Claim (Yes)	1.36 (1.07, 1.73)	0.013		
Rehabilitation Indicator		<0.001		<0.001
Required	1.00		1.00	
Possibly Required	0.31 (0.24, 0.39)	<0.001	0.37 (0.29, 0.48)	<0.001
Not Required	0.29 (0.23, 0.38)	<0.001	0.36 (0.27, 0.48)	<0.001
Other	0.12 (0.08, 0.19)	<0.001	0.17 (0.08, 0.38)	<0.001
Role		<0.001		
Driver	1.00			
Passenger	1.36 (1.12, 1.66)	0.002		
Rider	0.56 (0.36, 0.86)	0.008		
Pillion	0.89 (0.21, 3.78)	0.87		
Pedestrian	1.23 (0.83, 1.83)	0.30		
Cyclist	0.43 (0.32, 3.45)	0.03		
Other	1.05 (0.32, 3.45)	0.94		
Transportation by Ambulance (yes)	1.47 (1.22, 1.77)	<0.001	1.44 (1.19, 1.76)	<0.001
Hospital (yes)	1.14 (0.94, 1.38)	0.19		
	ROC=	0.70		

Note. Adjusted odds ratios (OR), 95% confidence intervals (95% CI). P-values are shown.

Sensitivity analysis

Sensitivity analysis was conducted with a subset of those that had post-traumatic stress disorder (PTSD) only. In this subset those with other types of psychological distress were excluded from the analysis. For those with PTSD diagnosis only (n=83), SEIFA, fault and rehabilitation indicators were significant predictors. Although employment and sex were no longer significant in this model, the effect sizes for all predictors were greater in this PTSD only subset, indicating that no-significance is likely a result of reduced power in the sample. The overall performance of the model was greater in the PTSD only subset with a concordance index of 0.764 compared to 0.695 in the original model.

DISCUSSION

In NSW, Australia a MVC fault based system is legislated which provides compensation for people injured in MVCs that were the fault of another vehicle owner or driver. The driver at

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3 fault is the person who was driving the vehicle considered most at fault in the accident.³⁵
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5 Analysis of the PIR data of all NSW compensation claimants over 27 months between 2011
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7 and 2013 who met the inclusion criteria revealed that almost 10% of claimants will be
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9 diagnosed with elevated psychological distress such as depression or PTSD, or a distressing
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11 condition involving significantly elevated anxiety and depressive mood. For comparison, the
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13 Australian prevalence of elevated psychological distress such as PTSD is estimated at
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15 0.9±0.1% and depression is estimated at 3.5±0.2%.⁴¹ The prevalence of musculoskeletal
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17 injury with a comorbid depression has been estimated at 29.51±3.21.⁴² Furthermore, prior
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19 research has consistently found levels of psychologically distressing symptomatology to
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21 range between 20-40% for people sustaining injury in a MVC, irrespective of whether they
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23 have made a compensation claim.³ The current findings reported in this paper suggest a much
24
25 lower percentage of psychological symptomatology. Nevertheless, the psychological data
26
27 presented in this paper are reporting disorders rather than symptomatology. Distress
28
29 associated with the claims process has been documented,³ and the significant escalations in
30
31 time to claim settlement and cost increases revealed in this study warrant action for their
32
33 amelioration. Prevalence differences found in prior studies may well be a factor of employing
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35 prospective research designs and research- based diagnostic assessments. However, the
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37 current findings have considerable consequences given they are based on outcomes from
38
39 every MVC casualty in NSW over a 27 month period with a defined injury (musculoskeletal)
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41 and who settled their claim. Furthermore, the diagnosis of psychological distress was based
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43 on international mental health criteria (ICD-10-AM) and sourced from treating clinicians and
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45 independent medical/psychological assessments.
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52 The findings also confirmed that the presence of psychological distress is associated
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54 with substantially increased claim settlement times, a mean increase of the total cost of the
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56 claim by over A\$40,000. Legal representation was also significantly more likely in those with
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3 psychological distress. These findings provide compelling evidence, confirming that the
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5 presence of psychological distress during the claims process (regardless of whether it was
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7 pre-morbid or not), results in potentially adverse outcomes for the wellbeing of affected
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9 individuals and for insurance and regulatory organisations with increased settlement times
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11 and costs.

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14 The identification of the factors that are likely to elevate risk of psychological distress
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16 during the claims process for injury compensation following a MVC provide healthcare
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18 professionals and insurance companies/regulatory bodies some scope for ameliorating the
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20 risk of escalating claim settlement times and costs. The current study provided evidence for
21
22 six independent predictors of psychological distress during the claim process. It is not
23
24 surprising that unemployment, social disadvantage and a history of prior claims are risk
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26 factors for increased psychological distress given they are somewhat related factors, and that
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28 prior research has indicated their contribution to poorer mental health status.^{43 44} It is
29
30 acknowledged that prior mental health problems can predispose people to elevated
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32 psychological distress after their MVC,^{3 9} however there is no avenue available for assessing
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34 the impact of this influence given such a predisposing factor is not routinely collected by
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36 insurance companies. Nevertheless, strategies and resources will need to consider this risk
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38 factor. Similarly, it is not surprising that being female is a risk factor for distress during the
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40 claims process given higher prevalence rates of psychological distress for females are
41
42 consistently reported across general populations.⁴⁴ This would suggest resources directed at
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44 females to prevent escalation of distress in the claims process appears warranted.

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47 Transportation by an ambulance at the time of their accident is perhaps related to severity of
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49 the injury, and future research will be needed to clarify this risk factor. Requiring
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51 rehabilitation was also found to be a significant predictor of psychological distress perhaps
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53 suggesting that some claimants who become psychologically distressed may be receiving
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3 rehabilitation regardless of their physical injury severity. This suggests that early intervention
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5 for psychological distress may well reduce the need for extended rehabilitation. Similarly,
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7 resources directed at those who are not at fault of the MVC may help reduce the risk of
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9 psychological distress negatively impacting on the claim's expected settlement times and cost
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11 trajectories. For example, related to at fault status, previous research has found a relationship
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13 between perceived injustice and the high prevalence of occupational disability in whiplash
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15 injuries.⁴⁵ Changing to a no fault scheme may reduce the association between fault status and
16
17 increased claim settlement times and costs.
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21 Limitations of this study need to be discussed. It was not possible to determine pre-
22
23 injury presence of psychological distress. It is expected that the presence of pre-injury
24
25 psychological distress would have a considerable impact on the presence of psychological
26
27 distress during the claims process. However, arguably, proxy measures of pre-injury
28
29 psychological distress existed in the study, namely social disadvantage and unemployment,
30
31 both highly related to the presence of psychological disorder.⁴³ These two measures were
32
33 found to predict psychological distress during the claim process. Nevertheless, research with
34
35 access to pre-injury health data shows that diagnosed psychological/psychiatric illness prior
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37 to injury is a significant risk factor for psychological distress following a MVC incident.⁴⁶
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39 Due to the data being collected in a fault based CTP scheme, very few claimants were at
40
41 fault, and this may have been a factor in its predictor status of psychological distress. Clearly,
42
43 the predictive capacity of fault status requires further research. The inclusion of only settled
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45 claims has the potential to exclude more claims in which psychological distress played a role
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47 given their propensity to be more lengthy for the claimant. It was also not possible to know
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49 with a high level of accuracy what psychological condition was experienced.
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54 This retrospective cohort study has positive implications at several systemic levels.
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56 First, the results reported in this paper can assist general practitioners provide improved
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3 healthcare support to their clients knowing that those presenting with psychological distress
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5 in addition to their musculoskeletal injury may require additional support such as referral to a
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7 clinical psychologist or psychiatrist early in the claims process to reduce the risk of the claim
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9 becoming more complex and subsequently more lengthy and expensive. Second, assuming
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11 the goal of insurance companies is to support a claimant through the process of compensation
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13 with effective injury management and timely return to work, the results presented suggest
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15 there are known targets for change (psychological distress), and that specific predictors
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17 available in insurers' personal injury databases can effectively identify who is likely to
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19 benefit from specific distress management strategies. This suggests changes to healthcare
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21 protocols and practices are warranted. For example, in accordance with previous research,
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23 directing additional resources such as screening and treating psychological conditions of
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25 claimants who are at higher risk⁹ regardless of whether their psychological condition pre-
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27 dated their MVC provides opportunity for reducing time and costs involved with
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29 compensation claims.
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4
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6
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12
13 interpretation of data, drafting of the manuscript and revision based on the comments of the
14
15 co-authors. BG and IC contributed to the study design and revision based on comments of
16
17 reviewers. All authors approved the submitted manuscript for publication.
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23 **Declaration of Interest** None.
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27 **Data Sharing Statement** No additional data available.
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34 data have been analysed and reported in this publication.
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STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract Page 1-2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found Page 2
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported Pages 5-7
Objectives	3	State specific objectives, including any prespecified hypotheses Page 7
Methods		
Study design	4	Present key elements of study design early in the paper Page 8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection Pages 7-9
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up Pages 7-8
		(b) For matched studies, give matching criteria and number of exposed and unexposed N/A
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable Pages 8-9
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group Pages 8-9
Bias	9	Describe any efforts to address potential sources of bias 19
Study size	10	Explain how the study size was arrived at Page 9
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why Page 8-9
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding Page 9-10
		(b) Describe any methods used to examine subgroups and interactions N/A
		(c) Explain how missing data were addressed Page 9-10
		(d) If applicable, explain how loss to follow-up was addressed N/A
		(e) Describe any sensitivity analyses Page 13 & 16

Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed Page 7-8 (b) Give reasons for non-participation at each stage Page 7-9 (c) Consider use of a flow diagram N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders Page 7-8 & 10-11 (b) Indicate number of participants with missing data for each variable of interest N/A (c) Summarise follow-up time (eg, average and total amount) N/A
Outcome data	15*	Report numbers of outcome events or summary measures over time N/A
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included Page 15-16 (b) Report category boundaries when continuous variables were categorized N/A (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses N/A
Discussion		
Key results	18	Summarise key results with reference to study objectives Pages 16-20
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias Page 19
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence Page 17-20
Generalisability	21	Discuss the generalisability (external validity) of the study results Page 19-20
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based Page 21

*Give information separately for exposed and unexposed groups.

1 **Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and
2 published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely
3 available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at
4 <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is
5 available at <http://www.strobe-statement.org>.
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For peer review only

BMJ Open

Psychological distress following a motor vehicle crash: compelling evidence from a state-wide retrospective study examining settlement times and costs of compensation claims

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Primary Subject Heading:	Rehabilitation medicine
Secondary Subject Heading:	Mental health, Rehabilitation medicine
Keywords:	motor vehicle crash, psychological distress, musculoskeletal injury, compensation, post traumatic stress disorder

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4 wide retrospective study examining settlement times and costs of compensation claims
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14 Rebecca Guest^a, Yvonne Tran^a, Bamini Gopinath^a, Ian D Cameron^a, Ashley Craig^a
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43 **Key Words:** motor vehicle crash, psychological distress, musculoskeletal injury,
44 compensation, post-traumatic stress disorder
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47 **Word count 3896 Tables 3 Figures 0**
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Abstract

Objective: To determine whether psychological distress associated with musculoskeletal injuries sustained in a motor vehicle crash (MVC), regardless of time of onset, impacts compensation outcomes such as claim settlement times and costs. Second, to identify factors routinely collected by insurance companies that contribute to psychological distress during the compensation process.

Design: State-wide retrospective study.

Data Source: Analysis of the New South Wales state-wide (Australia) injury register for MVC survivors who lodged a compensation claim from 2011 to 2013.

Participants: 6,341 adults who sustained a musculoskeletal injury, and who settled a claim for injury after an MVC. Participants included those diagnosed with psychological distress (n=607) versus those not (n=5,734).

Main Outcome Measures: Time to settlement and total costs of claims, as well as socio-demographic and injury characteristics that may contribute to elevated psychological distress, such as socioeconomic disadvantage, and injury severity.

Results: Psychological distress in those with a musculoskeletal injury was associated with significantly longer settlement times (an additional 17 weeks) and considerably higher costs (an additional A\$41, 575.00, or 4.3 times more expensive). Multivariate logistic regression analysis identified risk factors for psychological distress including being female, social disadvantage, unemployment prior to the claim, not being at fault in the MVC, requiring ambulance transportation and rehabilitation as part of recovery.

Conclusions: Results provide compelling evidence that psychological distress has an adverse impact on people with musculoskeletal injury as they progress through compensation. Findings suggest additional resources should be directed toward claimants who are at risk (e.g. the socially disadvantaged or those unemployed prior to the claim), the

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3 major aim being to reduce risk of psychological distress, such as post-traumatic stress
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5 disorder, and associated risk of increased settlement times and claim costs. Prospective
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7 studies are now required that investigate treatment strategies for those at risk of psychological
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9 distress associated with an MVC.
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Strengths and limitations of this study

- This is the first study to investigate the impact of psychological distress in all claimants experiencing a musculoskeletal injury and who lodge and settle their compensation claim for an MVC over a 2 year period in the state of NSW. It was revealed that the presence of psychological distress greatly increased settlement times and costs.
- The study identified risk factors associated with an increased likelihood of psychological distress after an MVC.
- The study has the potential to change medical practice and insurance policy for those at risk of psychological distress following an MVC.
- It was not possible to determine whether psychological distress was present prior to the MVC, as this information is not routinely collected by insurance companies.

INTRODUCTION

Motor vehicle crashes (MVC) remain a major source of physical injury and distress. For example, in the UK there were 194,477 reported casualties in a traffic accident in 2014¹ while in Australia in 2013 the rate of annual hospitalised injuries associated with an MVC was 151.7 per 100,000.² Psychological distress associated with an MVC has been shown to be substantial and prevalent.³⁻⁷ A recent meta-analysis investigated the extent of psychological distress associated with an MVC.³ Regardless of whether the psychological distress occurred prior to or after the MVC, the study revealed that traumatic brain injury, spinal cord injury and musculoskeletal injury (i.e. whiplash) resulted in significantly elevated levels of distress³ and psychological distress has been shown to remain elevated for at least 3 years post-MVC.³⁸⁻¹⁰ Recent prospective research found 1 in 2 persons suffered elevated rates of psychological distress (e.g. depression) soon after the MVC and many of these continue to experience elevated distress 12 months after the MVC.⁹ Factors such as more severe physical injury, older age, and past negative emotional reactions to distress were associated with elevated psychological distress 12 months post-MVC.⁹ For the purpose of this study, psychological distress is defined as an unpleasant mental condition perceived as disturbing and which can impede daily functioning, with mental symptoms including agitation, fatigue, confusion, loss of motivation and depressed mood.

Research suggests the compensation process following an MVC increases distress, for example, health outcomes of people who lodge injury-related compensation claims are more likely to have higher levels of distress than those who do not claim.¹¹⁻¹⁷ Furthermore, preliminary research suggests when a person has experienced a physical injury as well as psychological distress, the cost of their claim has been shown to double.¹⁸ Other research has found poorer outcomes for claimants who were not at-fault compared to those at-fault.¹⁹ The potential negative impact of psychological distress in the claims process is clearly undesirable

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3 in terms of complicating medical treatment for the injured person, and challenging policy
4 direction and effectiveness for insurers. A more desirable outcome is to minimise time spent
5 in the compensation process, because this would likely reduce the negative impact on the
6 individual's health, and contain claim costs for healthcare systems and insurers.²⁰
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11 Musculoskeletal injuries are common following an MVC and often lead to
12 compensation claims²¹⁻²³ and the risk of developing psychological distress with this physical
13 injury is high.^{3 24} Musculoskeletal injuries typically involve soft tissue injuries to the lower
14 back, shoulders, hips and knees as well as whiplash injuries, and account for more than
15 65,000 injuries in Australia each year following an MVC, at a cost in excess of A\$950m.²⁵
16
17 Barriers to recovery from MVC-related musculoskeletal injuries include high initial pain
18 intensity,^{26 27} being female,^{20 28} involvement in the compensation claims process^{14 20} and
19 elevated psychological distress.^{29 30} Furthermore, recent research found significantly
20 increased levels of psychological distress for MVC related whiplash-associated disorder
21 (WAD) compared to controls.^{3 31}
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34 A review of research that focussed on disability arising from an MVC concluded that
35 there was a need to clarify rates of disability arising from an MVC, especially with regard to
36 methodological issues and complicating factors like compensation.³² This is also true for the
37 impact of psychological distress following an MVC, including the influence of involvement
38 in compensation claims.^{3 9} Research in this area has been limited by uncertain diagnoses of
39 psychological distress disorders and small sample sizes. In contrast, the research presented in
40 this paper has addressed many of the limitations of prior research. For instance, it utilised a
41 database of 6,341 persons with musculoskeletal injury from the state-wide injury register of
42 the New South Wales (NSW) State Insurance Regulatory Authority (SIRA), the authority that
43 administers the NSW Compulsory Third Party (CTP) scheme. This state-wide register also
44 provides records with confirmed diagnoses of psychological distress, based on the
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3 International Statistical Classification of Disease and Related Health Problems, Tenth
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5 Revision, Australian Modification (ICD-10-AM),³³ regardless of when the psychological
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7 distress was first diagnosed. The NSW CTP scheme is a fault based scheme with limited
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9 access to entitlements for those at fault. Its purpose is to compensate those with injuries who
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11 were not at fault in the MVC with the claim requiring police and medical reports as evidence,
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13 in addition to a personal injury claim form.³⁴ An estimated 55% of all NSW MVC-related
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15 injuries result in the lodgement of a CTP claim.³⁵
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19 The objective of this research was to analyse the data of all NSW MVC survivors who
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21 sustained a musculoskeletal injury and who settled their claim over a two year period.
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23 Compensation outcomes of those without diagnosed psychological distress were then
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25 compared to those with diagnosed psychological distress. Specifically, the aim was to
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27 determine the impact of psychological distress, regardless of time of onset, on claim
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29 settlement times and total costs.³⁴ A further aim was to determine factors, routinely collected
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31 by NSW CTP insurance companies and collated by SIRA, that predict elevated risk of having
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33 psychological distress. Accordingly, findings should address 2 key research questions: 1.
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35 whether psychological distress is associated with longer claim time to completion and greater
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37 claim costs, and 2. what injury or demographic characteristics are associated with
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39 psychological distress. The findings should be beneficial for informing general practitioners
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41 and insurer policymakers, and thus improve healthcare practices for injury-related
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43 compensation claimants.
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49 **METHOD**

50 **Participants**

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52 Permission was sought and granted on 22nd November 2016 from SIRA to access a total of
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54 24,164 claims from the Personal Injury Register (PIR) of SIRA to determine their potential
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3 inclusion in the analysis. The PIR contains all MVC-related claims that occur in NSW.
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5 Inclusion criteria consisted of i) the injured adult (18+) having a musculoskeletal injury and
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7 ii) the claim had been lodged and also settled over a 27 month period (October, 2011-
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9 December, 2013). Claims which had been lodged but not settled, and claims involving
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11 catastrophic injuries such as spinal cord injury and severe traumatic brain injury were
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13 excluded (catastrophic injury related claims are directed toward an alternative scheme in
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15 NSW). This resulted in 6,341 participants who had experienced an MVC and sustained a
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17 musculoskeletal injury, and who lodged and settled a claim in NSW, Australia between
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19 October 2011 and December 2013 (27 months). The combined cohort data was received from
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21 SIRA in de-identified form and therefore human research ethics approval was deemed not to
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23 be required.
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29 **Measurements**

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31 Musculoskeletal injury severity was assessed using the New Injury Severity Score (NISS)
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33 which computes the simple sum of squares of the three most severe injuries identified by the
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35 abbreviated injury scale (AIS).³⁶ The Index of Relative Socioeconomic Disadvantage (IRSD)
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37 was calculated from the Socio Economic Index for Areas (SEIFA) which ranks areas in
38
39 Australia according to relative socio-economic advantage and disadvantage.³⁷ Rehabilitation
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41 Indicator refers to whether the claimant required rehabilitation as part of their recovery plan.
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43 Presence of psychological distress, such as post-traumatic stress disorder or major depressive
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45 disorders, was determined using the ICD-10-AM Classification of Mental and Behavioural
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47 Disorders: Clinical Descriptions and Diagnostic Guidelines³⁸ at some time within the claims
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49 process (the database is progressively updated over the duration of the claim). Psychological
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51 distress was determined from sources such as reports and independent assessments from
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53 General Practitioners, Psychiatrists, and Psychologists. It is recognised that psychological
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3 distress could be present prior to the claimant's MVC, and that this has the potential to
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5 influence psychological distress post-MVC.³ However, timing of onset of psychological
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7 distress was not the aim of this research given such information is not routinely collected by
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9 NSW insurance companies and is therefore not collated by the NSW regulatory authority. Of
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11 the 6,341, those with musculoskeletal injury without psychological distress numbered 5,374
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13 (90.4%) and those with both musculoskeletal injury and psychological distress numbered 607
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15 (9.6%).
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18 19 20 **Statistical analysis** 21

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23 A retrospective design was employed to analyse the PIR datasets of all NSW MVC survivors
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25 at the time of their claim lodgement (both minor claims, that is, 'Accident Notifications
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27 Forms' and full claims) over 27 months, and who met the inclusion criteria. Reporting was
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29 guided by the relevant checklist (see STROBE Statement in supplemental file 1). Descriptive
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31 statistics were used to summarise demographic and claim/accident characteristics of the
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33 participants by psychological distress status. The differences in the demographics and claim
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35 characteristics between those that claimed compensation and those that did not were
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37 compared using analysis of variance (ANOVA) tests for continuous variables and chi-square
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39 tests for categorical variables. In order to determine predictive factors, logistic regression was
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41 employed. Only statistically significant socio-demographic and injury variables from Table 1
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43 were included in the logistic regression analysis from which unadjusted odds ratios were
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45 determined. Following this, all the variables were again used in backward elimination ($P < .05$)
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47 logistic regression, and adjusted odds ratios calculated.
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52 Logistic regression can provide information on factors that are associated with having
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54 psychological distress and advantages of employing this statistical methodology include its
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56 ability for isolating predictors, and for producing odds ratios.³⁹ In order to determine
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3 predictive factors, logistic regression was employed. Potential predictor variables from the
4 socio-demographic and injury variables from Table 1 were considered and significant
5 variables were retained for the logistic regression analysis. Univariate analysis on the
6 significant variables was conducted from which the unadjusted odds ratios were determined.
7 Following this, variables for the final model were selected using a backward elimination
8 technique based on changes in likelihood ratios. Significant variables ($P < .05$) from the
9 logistic regression were used in the final model and adjusted odds ratios calculated. Whilst
10 Table 1 showed there was a significantly higher probability ($P < .01$) for those who had
11 psychological distress also having legal representation (61.0%) compared to musculoskeletal
12 injury only claimants (18.9%), this injury characteristic was excluded from the logistic
13 regression as legal representation can be instigated not only at the time of the claim
14 lodgement, but at any time throughout the claims process, thus making it difficult to establish
15 its predictive association with psychological distress. Again, it should be noted that
16 psychological distress can develop before the injury, as well as at any time throughout the
17 claims process.

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36 All variables selected for the logistic regression have been investigated in prior
37 studies for their relevance to injury outcomes following MVC.^{11 40} To determine the
38 predictive capacity of the logistic regression model, ROC estimates were calculated. The
39 ROC plots the true-positive rate (sensitivity) against the false-positive rate (1 – specificity) in
40 detecting factors that influence greater time to claim settlement and elevated costs for MVC
41 claimants with musculoskeletal injuries with and without psychological distress.

42 43 44 45 46 47 48 49 50 51 **RESULTS**

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54 Socio-demographic and injury characteristics are shown in Table 1. All factors shown in
55 Table 1 were either pre-injury factors or assessed at the time of lodging the claim, except for
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3 legal representation which can potentially occur at any time during the claims process. Mean
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5 days from MVC to lodgement of a minor 'no fault' claim (Accident Notification Form) was
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7 23 days (SD=22.8) and to full claim lodgement was 110 days (SD=84.0).
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12 Table 1 Socio-demographic and injury characteristics of NSW MVC claimants 2011-2013
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14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60	Variable	Musculoskeletal Injury (n=5734)	Musculoskeletal Injury + Psych Distress (n=607)	P
	Age (years), Mean (SD)	42.8 (16.3)	44.4 (15.9)	0.02
	New Injury Severity Score, No (%)			0.02
	Minor- moderate 1-8	5259 (91.9)	539 (88.8)	
	Serious 9-15	348 (6.1)	54 (8.9)	
	Severe- critical 16-75	114 (2.0)	14 (2.3)	
	Index of Relative Socioeconomic Disadvantage, Mean (SD)	1017.0 (86.4)	986.5 (89.2)	<0.01
	Index of Relative Socioeconomic Disadvantage, No (%)			<0.01
	Most disadvantaged	983 (17.4)	182 (30.3)	
	Disadvantaged	803 (14.2)	72 (12.5)	
	Average	1007 (17.8)	113 (18.8)	
	Advantaged	853 (15.1)	95 (15.8)	
	Most advantaged	1996 (35.4)	136 (22.6)	
	Male, No (%)	2417 (42.2)	212 (34.9)	<0.01
	Employment Status, No (%) (Yes)	4197 (73.2)	364 (60.0)	<0.01
	Occupation skill level, No (%)			<0.01
	Managers and Administrators	567 (9.9)	34 (5.6)	
	Professionals	1026 (17.9)	34 (5.6)	
	Para-professionals	213 (3.7)	74 (12.2)	
	Tradespersons	257 (4.5)	17 (12.2)	
	Clerks	600 (10.5)	26 (4.3)	
	Sales persons and Personal Service workers	680 (11.9)	63 (10.4)	
	Plant and Machine Operators and Drivers	225 (3.9)	64 (10.5)	
	Labourers and related workers	537 (9.4)	22 (3.6)	
	At Fault* (No), No (%)	4866 (87.9)	568 (96.1)	<0.01
	Prior Claim (Yes), No (%)	620 (10.8)	86 (14.2)	0.012
	Economic Loss Claim (No), No (%)	3101 (54.1)	329 (54.2)	0.96
	Weekly Earnings, Mean (SD)	1212.4 (2832.6)	1001.4 (659.4)	0.23
	Legal Representation, (Yes), No (%)	1085 (18.9)	370 (61.0)	<0.01
	Accident Notification (Days), Mean (SD)	22.6 (22.9)	23.9 (21.4)	0.32
	Notification of Claim (Days), Mean (SD)	112.7 (86.7)	97.5 (69.1)	<0.01
	Rehabilitation Indicator, No (%)			<0.01
	Required	398 (6.9)	127 (20.9)	
	Possibly Required	2920 (50.9)	287 (47.3)	
	Not Required	1844 (32.2)	171 (28.2)	
	Role			<0.01
	Driver	3764 (65.6)	386 (63.6)	
	Passenger	1120 (19.5)	156 (25.7)	

Rider	404 (7.0)	23 (3.8)	
Pillion	22 (0.4)	2 (0.3)	
Pedestrian	237 (4.1)	30 (4.9)	
Cyclist	159 (2.8)	7 (1.2)	
Other	28 (0.5)	3 (0.5)	
Ambulance (yes)	2179 (38.0)	300 (49.4)	<0.01
Hospital (yes)	1405 (24.5)	173 (28.5)	<0.01

Note. For some variables there were missing values; total number will therefore not always equal 6,341.

* At fault claims are minor claims that are capped at payment of A\$5,000.00.

Table 2 shows a breakdown of musculoskeletal injury types for the sample separated by musculoskeletal injury only compared to musculoskeletal injury + psychological distress. Whilst it is accepted that an MVC survivor is vulnerable to sustaining several different categories of injuries (for example, whiplash and lumbar and other soft tissue injuries), Table 2 shows the most common musculoskeletal injury was soft tissue, followed by whiplash injuries.

Table 2 Breakdown of musculoskeletal injury types by musculoskeletal injury versus musculoskeletal injury with psychological distress from 2011- 2013.

Musculoskeletal Injury Type	Musculoskeletal Injury Only (%) n=5,734 (90.43%)	Musculoskeletal Injury + Psychological Distress (%) n=607 (9.57%)	Total
Soft Tissue	4630 (89.78)	527 (10.21)	5157
Whiplash	3750 (89.43)	443 (10.56)	4193
Skin	2133 (86.81)	324 (13.18)	2457
Lumbar	1256 (84.69)	227 (15.30)	1483
Chest	985 (86.10)	159 (13.89)	1144
Seatbelt	672 (84.31)	125 (15.68)	797
Thoracic	634 (86.84)	96 (13.15)	730
Upper Limb Joint	441 (87.67)	62 (12.32)	503
Upper Limb Fracture	432 (93.50)	30 (6.49)	462
Lower Limb Fracture	413 (93.43)	29 (6.56)	442
Lower Limb Joint	229 (87.40)	33 (12.59)	262
Face	82 (85.41)	14 (14.58)	96
Abdomen	49 (90.74)	5 (9.25)	54
Spinal Contusion	2 (100.00)	0 (0.00)	2
Finger Amputation	2 (100.00)	0 (0.00)	2

Note. Percentages in columns are row percentages showing the percentage of the total for each musculoskeletal injury type in the musculoskeletal distress only versus musculoskeletal + psychological distress categories.

Claim settlement times, costs and legal representation

ANOVA results confirmed a significant difference between musculoskeletal injury and musculoskeletal injury + psychological distress claim settlement times ($F=392.82$, $df=1$, 6339, $P<.001$). Mean days to claim settlement from accident date was significantly longer for musculoskeletal injury + psychological distress compared to musculoskeletal injury only (353.81 days; $SD=164.83$; 95% CI 340.67-366.95 versus 231.65 days; $SD=142.08$; 95% CI 227.97-235.32 respectively). This difference was significantly longer for musculoskeletal injury + psychological distress claimants (mean difference 122.16 days or 17.45 weeks).

ANOVA results also confirmed a significant difference in claim costs between musculoskeletal injury and musculoskeletal injury+ psychological distress claimants ($F=444.03$, $df=1$, 6339, $P<.001$). Mean claim costs for musculoskeletal injury only claimants was \$12,421.13; $SD=37,071.78$; 95% CI 11,461.39-13,380.87. Mean claim costs for musculoskeletal injury + psychological distress claimants was A\$53,996.52; $SD=96,693.42$; 95%CI 46,288.92-61,704.11. This is an overall mean increase of A\$41,575.39 or 4.3 times more expensive per case. To understand better the effect of injury severity on claim costs, a further ANOVA was conducted with serious and above musculoskeletal injury removed. This did not change the findings. Mean cost for musculoskeletal injury was A\$10,034.54 ($SD=28,378.90$; 95%CI 9,267.37-10,801.71). Mean cost of musculoskeletal injury + psychological distress was A\$43,262.87 ($SD=61,927.97$; 95% CI 38,023.02-48,502.71, and this was significantly greater for the musculoskeletal injury + psychological distress group ($F=516.71$, $df=1$, 6,607, $P=.000$). Musculoskeletal injury + psychological distress claimants were also significantly more likely ($P<.01$) to involve legal representation (61.0% compared to 18.9%).

Impact of socio-demographic and injury characteristics on probability of psychological distress

Table 1 presents the factors at the time of the MVC and claim lodgement that either increase or decrease the probabilities of musculoskeletal injury claimants being diagnosed with psychological distress. Age, economic loss (defined as yes/no) associated with the injury and claim, weekly earnings and hospitalisation did not significantly increase the probability of psychological distress. Socioeconomic disadvantage increased the probability of experiencing psychological distress (Mean musculoskeletal injury 1,017.9, SD=86.4; Mean musculoskeletal injury + psychological distress 986.5, SD=89.2, $P<.01$). For example, over 40% of those with psychological distress were socially disadvantaged compared to 31% of those without psychological distress. There was a significant difference ($P<.01$) between male and female claimants in terms of probability of also having psychological distress, that is, 65.1% were female who had a musculoskeletal injury + psychological distress compared to 57.8% with only musculoskeletal injury. Claimants who were unemployed were more likely to have psychological distress ($P<.01$) compared to those employed. 4,197 (73.2%) of those working at the time of lodging their claim did not have psychological distress compared to 364 (60.0%) of those with musculoskeletal injury + psychological distress. 620 (10.8%) of those with a history of a prior claim did not have psychological distress, whereas 86 (14.2%) did have psychological distress suggesting those with a claim history are more likely to have psychological distress in addition to their musculoskeletal injury ($P=.01$). Those with a musculoskeletal injury + psychological distress were more likely to have a serious injury severity score ($P=.02$). Those with a musculoskeletal injury + psychological distress were also more likely to be not at fault (96.1% compared to 87.9% for musculoskeletal injury only). It is noted here, however, that data taken from an 'at fault' scheme necessarily means

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2
3 there are limited at-fault claimants reducing confidence in its association with psychological
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5 distress. No significant difference was found between the two groups in terms of number of
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7 days taken for notifying the insurer of the MVC (either via a minor claim, that is, Accident
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9 Notification Form, or a full claim). However in terms of days taken to notify the insurer of
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11 the claim lodgement, those who had psychological distress were more likely to notify
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13 lodgement of their claim sooner ($P<.01$). It was also more likely that the claimant will require
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15 rehabilitation if they have psychological distress ($P<.01$). A larger portion of passengers had
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17 psychological distress, whereas motorbike riders and cyclists were less likely to have
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19 psychological distress ($P<.01$). If an ambulance was required at the time of the MVC, the
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21 claimant was significantly more likely to have psychological distress in addition to their
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23 musculoskeletal injury ($P<.01$), and similarly, if the claimant attended hospital they were
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25 more likely to have psychological distress ($P<.01$) than if hospitalisation was not required.
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32 **Logistic regression analysis of significant socio-demographic and injury characteristics**

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34 All socio-demographic and injury characteristics that were found to significantly differentiate
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36 between the two groups were entered into a logistic regression to determine their unadjusted
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38 and adjusted predictive power of psychological distress. Table 3 shows that six variables
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40 were associated with the presence of psychological distress. Being unemployed, being
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42 female, being socio-economically disadvantaged, not being at fault, requiring an ambulance
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44 at the time of their MVC and needing rehabilitation, were all found to be significant
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46 contributors to an increased risk of having psychological distress. The area under the ROC
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48 curve for this group of six variables was 70%. Adding non-significant variables to the logistic
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50 regression did not significantly add to this percentage, providing validity for the predictive
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52 capacity of the model.
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Table 3 Logistic regression results showing predictors for claimants who experience psychological distress.

Variable	Unadjusted OR (95% CI)	P	Adjusted OR (95% CI)	P
Age	1.01 (1.00, 1.01)	0.02		
New Injury Severity Score		0.03		
Minor- moderate 1-8	1.00			
Serious9-15	1.51 (1.12, 2.04)	0.007		
Severe– critical 16-75	1.20 (0.68, 2.10)	0.53		
Index of Relative Socioeconomic Disadvantage		<0.001		<0.001
Most disadvantaged	1.65 (1.28, 2.12)	<0.001	1.55 (1.18, 20.6)	0.002
Disadvantaged	0.83 (0.61, 1.13)	0.24	0.87 (0.62, 1.23)	0.43
Average	1.00		1.00	
Advantaged	0.99 (0.74, 1.32)	0.96	1.07 (0.77, 1.48)	0.70
Most advantaged	0.61 (0.47, 0.79)	<0.001	0.60 (0.45, 0.81)	0.001
Male	0.73 (0.62, 0.87)	<0.001	0.72 (0.59, 0.88)	0.001
Employment Status (Yes)	0.55 (0.46, 0.65)	<0.001	0.71 (0.58, 0.87)	0.001
At Fault (Yes)	0.29 (0.19, 0.45)	<0.001	0.25 (0.15, 0.40)	<0.001
Prior Claim (Yes)	1.36 (1.07, 1.73)	0.013		
Rehabilitation Indicator		<0.001		<0.001
Required	1.00		1.00	
Possibly Required	0.31 (0.24, 0.39)	<0.001	0.37 (0.29), 0.48)	<0.001
Not Required	0.29 (0.23, 0.38)	<0.001	0.36 (0.27, 0.48)	<0.001
Other	0.12 (0.08, 0.19)	<0.001	0.17 (0.08, 0.38)	<0.001
Role		<0.001		
Driver	1.00			
Passenger	1.36 (1.12, 1.66)	0.002		
Rider	0.56 (0.36, 0.86)	0.008		
Pillion	0.89 (0.21, 3.78)	0.87		
Pedestrian	1.23 (0.83, 1.83)	0.30		
Cyclist	0.43 (0.32, 3.45)	0.03		
Other	1.05 (0.32, 3.45)	0.94		
Transportation by Ambulance (yes)	1.47 (1.22, 1.77)	<0.001	1.44 (1.19, 1.76)	<0.001
Hospital (yes)	1.14 (0.94, 1.38)	0.19		
	ROC=	0.70		

Note. Adjusted odds ratios (OR), 95% confidence intervals (95% CI). P-values are shown.

Sensitivity analysis

Sensitivity analysis was conducted with a subset of those that had post-traumatic stress disorder (PTSD) only. In this subset those with other types of psychological distress were excluded from the analysis. For those with PTSD diagnosis only (n=83), SEIFA, fault and rehabilitation indicators were significant predictors. Although employment and sex were no

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3 longer significant in this model, the effect sizes for all predictors were greater in this PTSD
4 only subset, indicating that no-significance is likely a result of reduced power in the sample.
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7 The overall performance of the model was greater in the PTSD only subset with a
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10 concordance index of 0.764 compared to 0.695 in the original model.
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12 13 14 **DISCUSSION**

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16 In NSW, Australia an MVC fault based system is legislated which provides compensation for
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18 people injured in MVCs that were the fault of another vehicle owner or driver. The driver at
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20 fault is the person who was driving the vehicle considered most at fault in the accident.³⁵
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22 Analysis of the PIR data of all NSW compensation claimants over 27 months between 2011
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24 and 2013 who met the inclusion criteria revealed that almost 10% of claimants will be
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26 diagnosed with elevated psychological distress such as depression or PTSD, or a distressing
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28 condition involving significantly elevated anxiety and depressive mood. For comparison, the
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30 Australian prevalence of elevated psychological distress such as PTSD is estimated at
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32 0.9±0.1% and depression is estimated at 3.5±0.2%.⁴¹ The prevalence of musculoskeletal
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34 injury with a comorbid depression has been estimated at 29.51±3.21.⁴² Furthermore, prior
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36 research has consistently found levels of psychologically distressing symptomatology to
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38 range between 20-40% for people sustaining injury in an MVC, irrespective of whether they
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40 have made a compensation claim.³ The current findings reported in this paper suggest a much
41
42 lower percentage of psychological symptomatology. Nevertheless, the psychological data
43
44 presented in this paper are reporting disorders rather than symptomatology. Distress
45
46 associated with the claims process has been documented,³ and the significant escalations in
47
48 time to claim settlement and cost increases revealed in this study warrant action for their
49
50 amelioration. Prevalence differences found in prior studies may well be a factor of employing
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52 prospective research designs and research- based diagnostic assessments. However, the
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3 current findings have considerable consequences given they are based on outcomes from
4 every MVC casualty in NSW over a 27 month period with a defined injury (musculoskeletal)
5 and who settled their claim. Furthermore, the diagnosis of psychological distress was based
6 on international mental health criteria (ICD-10-AM) and sourced from treating clinicians and
7 independent medical/psychological assessments.
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14 The findings also confirmed that the presence of psychological distress is associated
15 with substantially increased claim settlement times, a mean increase of the total cost of the
16 claim by over A\$40,000. Legal representation was also significantly more likely in those with
17 psychological distress. These findings provide compelling evidence, confirming that the
18 presence of psychological distress during the claims process (regardless of whether it was
19 pre-morbid or not), results in potentially adverse outcomes for the wellbeing of affected
20 individuals and for insurance and regulatory organisations with increased settlement times
21 and costs.
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32 The identification of the factors that are likely to elevate risk of psychological distress
33 during the claims process for injury compensation following an MVC provide healthcare
34 professionals and insurance companies/regulatory bodies some scope for ameliorating the
35 risk of escalating claim settlement times and costs. The current study provided evidence for
36 six independent predictors of psychological distress during the claim process. It is not
37 surprising that unemployment, social disadvantage and a history of prior claims are risk
38 factors for increased psychological distress given they are somewhat related factors, and that
39 prior research has indicated their contribution to poorer mental health status.^{43 44} It is
40 acknowledged that prior mental health problems can predispose people to elevated
41 psychological distress after their MVC,^{3 9} however there is no avenue available for assessing
42 the impact of this influence given such a predisposing factor is not routinely collected by
43 insurance companies. Nevertheless, strategies and resources will need to consider this risk
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3 factor. Similarly, it is not surprising that being female is a risk factor for distress during the
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5 claims process given higher prevalence rates of psychological distress for females are
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7 consistently reported across general populations.⁴⁴ This would suggest resources directed at
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9 females to prevent escalation of distress in the claims process appears warranted.
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11 Transportation by an ambulance at the time of their accident is perhaps related to severity of
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13 the injury, and future research will be needed to clarify this risk factor. Requiring
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15 rehabilitation was also found to be a significant predictor of psychological distress perhaps
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17 suggesting that some claimants who become psychologically distressed may be receiving
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19 rehabilitation regardless of their physical injury severity. This suggests that early intervention
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21 for psychological distress may well reduce the need for extended rehabilitation. Similarly,
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23 resources directed at those who are not at fault of the MVC may help reduce the risk of
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25 psychological distress negatively impacting on the claim's expected settlement times and cost
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27 trajectories. For example, related to at fault status, previous research has found a relationship
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29 between perceived injustice and the high prevalence of occupational disability in whiplash
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31 injuries.⁴⁵ Changing to a no fault scheme may reduce the association between fault status and
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33 increased claim settlement times and costs.
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39 Limitations of this study need to be discussed. It was not possible to determine pre-
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41 injury presence of psychological distress. It is expected that the presence of pre-injury
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43 psychological distress would have a considerable impact on the presence of psychological
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45 distress during the claims process. However, arguably, proxy measures of pre-injury
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47 psychological distress existed in the study, namely social disadvantage and unemployment,
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49 both highly related to the presence of psychological disorder.⁴³ These two measures were
50
51 found to predict psychological distress during the claim process. Nevertheless, research with
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53 access to pre-injury health data shows that diagnosed psychological/psychiatric illness prior
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55 to injury is a significant risk factor for psychological distress following an MVC incident.⁴⁶
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3 Due to the data being collected in a fault based CTP scheme, very few claimants were at
4 fault, and this may have been a factor in its predictor status of psychological distress. Clearly,
5 the predictive capacity of fault status requires further research. The inclusion of only settled
6 claims has the potential to exclude more claims in which psychological distress played a role
7 given their propensity to be more lengthy for the claimant. It was also not possible to know
8 with a high level of accuracy what psychological condition was experienced.
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16 This retrospective cohort study has positive implications at several systemic levels.
17 First, the results reported in this paper can assist general practitioners provide improved
18 healthcare support to their clients knowing that those presenting with psychological distress
19 in addition to their musculoskeletal injury may require additional support such as referral to a
20 clinical psychologist or psychiatrist early in the claims process to reduce the risk of the claim
21 becoming more complex and subsequently more lengthy and expensive. Second, assuming
22 the goal of insurance companies is to support a claimant through the process of compensation
23 with effective injury management and timely return to work, the results presented suggest
24 there are known targets for change (psychological distress), and that specific predictors
25 available in insurers' personal injury databases can effectively identify who is likely to
26 benefit from specific distress management strategies. This suggests changes to healthcare
27 protocols and practices are warranted. For example, in accordance with previous research,
28 directing additional resources such as screening and treating psychological conditions of
29 claimants who are at higher risk⁹ regardless of whether their psychological condition pre-
30 dated their MVC provides opportunity for reducing time and costs involved with
31 compensation claims.
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6
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13 interpretation of data, drafting of the manuscript and revision based on the comments of the
14
15 co-authors. BG and IC contributed to the study design and revision based on comments of
16
17 reviewers. All authors approved the submitted manuscript for publication.
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23 **Declaration of Interest** None.
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34 data have been analysed and reported in this publication.
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STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract Page 1-2 (b) Provide in the abstract an informative and balanced summary of what was done and what was found Page 2
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported Pages 5-7
Objectives	3	State specific objectives, including any prespecified hypotheses Page 7
Methods		
Study design	4	Present key elements of study design early in the paper Page 8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection Pages 7-9
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up Pages 7-8 (b) For matched studies, give matching criteria and number of exposed and unexposed N/A
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable Pages 8-9
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group Pages 8-9
Bias	9	Describe any efforts to address potential sources of bias 19
Study size	10	Explain how the study size was arrived at Page 9
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why Page 8-9
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding Page 9-10 (b) Describe any methods used to examine subgroups and interactions N/A (c) Explain how missing data were addressed Page 9-10 (d) If applicable, explain how loss to follow-up was addressed N/A (e) Describe any sensitivity analyses Page 13 & 16

Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed Page 7-8 (b) Give reasons for non-participation at each stage Page 7-9 (c) Consider use of a flow diagram N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders Page 7-8 & 10-11 (b) Indicate number of participants with missing data for each variable of interest N/A (c) Summarise follow-up time (eg, average and total amount) N/A
Outcome data	15*	Report numbers of outcome events or summary measures over time N/A
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included Page 15-16 (b) Report category boundaries when continuous variables were categorized N/A (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses N/A
Discussion		
Key results	18	Summarise key results with reference to study objectives Pages 16-20
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias Page 19
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence Page 17-20
Generalisability	21	Discuss the generalisability (external validity) of the study results Page 19-20
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based Page 21

*Give information separately for exposed and unexposed groups.

1 **Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and
2 published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely
3 available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at
4 <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is
5 available at <http://www.strobe-statement.org>.
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