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Title: Physical function and mental health in trauma intensive care patients: a 2 year cohort study

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ABSTRACT

Objectives: This study was designed to examine changes in function over time after injury and to identify factors associated with long-term recovery that may be amenable to change through intervention.

Design: Prospective cohort study

Setting: Intensive Care in a tertiary hospital in Queensland, Australia

Patients: Adult (n=123) admitted to Intensive Care for treatment of injury.

Interventions: Data were collected prior to hospital discharge and 1, 6, 12, and 24 months post injury. Data included demographics, pre-injury health, injury characteristics, acute care factors, psychosocial measures and health status. Linear mixed effects models were used to identify factors associated with physical function and mental health over time.

Measurements and Main Results: Physical function and mental health improved over time, however the averages remained below Australian norms at 24 months. Optimistic perception of illness and greater self-efficacy were potentially modifiable factors associated with improved mental health and physical function over time. Greater perceived social support, also potentially modifiable, was associated with improved mental health. Injury insurance and income were significant non-modifiable factors for mental health, with mental health gains associated with higher income. Hospital length of stay and injury insurance were non-modifiable factors linked with physical function.

Conclusions: Improvements in physical function and mental health are evident in the 24 months following injury but most patients remain below Australian population norms. Factors that were associated with physical function and mental health outcomes over time that are

potentially amenable to change include illness perception, self-efficacy and perceived social support.

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INTRODUCTION

Injury is a major cause of preventable mortality and morbidity worldwide (1-3). Injured patients experience reduced quality of life (4-6), functional ability (7-9) and psychological status that is sustained over time (10-12). Probably as a result of this reduced function, injured patients have a greater ongoing use of health services (13) than others in the community (14). Although there is widespread evidence of reduced function during recovery after injury, the predictors of that function are not fully understood. It is recognised that a range of factors influence function after injury, based on the biopsychosocial view of health (15). These include various aspects of a person's health condition including diseases, disorders and injuries and both personal (education, coping styles, character) and environmental (social attitudes and support, housing) contextual factors.

Some known predictors of recovery after injury include age, gender, education, injury type and severity, duration of hospitalisation and comorbidities (8, 9, 11, 12, 16-19), however these factors are generally not modifiable during the initial hospital stay. Initial evidence suggests that potentially modifiable factors such as early post-ICU distress (11), early physical and mental function (20), illness perception (21), self-efficacy (22-24) and depression after hospital discharge (25) may influence recovery, although the latter three factors have only been examined in those with minor or chronic injuries rather than the seriously injured patient population. Further, much of the evidence of reduced function during recovery and associated factors has been limited to relatively short time-frames of approximately one year (11, 17, 19, 26). As many of the study participants continued to report reduced function at one year, further examination of longer term outcomes was warranted.

Given the complexity of injured patients' recovery pathway, it is likely that complex healthcare interventions will be required to improve recovery. Therefore, consistent with

MRC guidance (27), measurement of associations between recovery and patient, illness and care characteristics are needed. Identification of potentially modifiable factors that influence recovery will enable development of theoretically derived, evidence-based interventions to improve physical and psychological health during recovery after injury. Outcomes of interest in this study were the physical function (PF) and mental health (MH) subscales of the SF-36v2 (28). Although the original intention had been to use the Physical Health Component Score (PCS) and Mental Health Component Score (MCS) as the outcomes of interest, the PF and MH subscale scores were chosen over these summary scores given the documented problems with correlation between the PCS and MCS (29); this decision was made prior to the commencement of analysis. The aim of this study was to examine changes in physical and psychological function over time and to identify potentially modifiable factors related to improved recovery in trauma intensive care patients.

MATERIALS AND METHODS

A prospective cohort of trauma patients who required admission to ICU in a tertiary referral hospital in south-east Queensland, Australia were consecutively recruited from June 2008 to August 2010. Injured patients were those allocated an injury code within the International Classification of Diseases, 10th Revision – Australian Modification (ICD-10-AM), in other words those patients injured through physical force such as road traffic crashes, falls, physical violence, and recreational injury. Patients were excluded for the following reasons: (1) spinal cord injuries with sensory and/or motor loss; (2) burn injuries to >20% body surface area; (3) traumatic brain injuries with a Glasgow Coma Score <14 after 24 hours or on extubation; (4) history of psychosis or self-inflicted injury; (5) inability to communicate in English; (6) prisoners; (7) people without a home telephone; (8) palliative care/patients expected to die. The detailed methods and baseline demographic, injury and clinical characteristics, have been reported elsewhere (10). We briefly describe the methods below.

Data were collected from hospital records and directly from the participants prior to hospital discharge, with follow-up at 1, 6, 12, and 24 months after acute hospital discharge. Follow-up questionnaires were posted to participants asking them to complete the questionnaires within the next week, without assistance from family members or friends and return them via mail or provide data to the research assistant during phone interview. The national death registry was searched for all participants who could not be located at follow-up.

Information was collected on demographic and socioeconomic details, pre-injury health, injury characteristics and acute care factors. There is ample evidence that health prior to critical injury or illness affects long term recovery (30-32) therefore it was essential that pre-injury health be incorporated into analysis. Two methods exist for measurement of pre-injury health including proxy measure and retrospective measure by the patient; given the inconsistent results reported in regard to the proxy measure of health status (33) we used patients' retrospective self-report of health status (34) in line with other studies conducted in the severely injured trauma population(35). Other factors measured included psychosocial factors (self-efficacy [SE] (36), illness perception [IP] (37), perceived social support [MSPSS] (38), post-traumatic stress disorder [PTSD] symptoms using the PTSD Checklist – Civilian version [PCL], (39) psychological distress using the Kessler Psychological Distress Scale [K10] (40)) and health status using the Medical Outcome Study Short Form-36 Version 2 [SF-36] (28) (see Table 1 for details). The outcomes of interest were the physical function (PF) and mental health (MH) subscales of the SF-36.

Data analysis

Categorical data are reported as percentages and continuous data are reported as mean and standard deviation (SD) or median and interquartile range (IQR). Comparisons of the characteristics of responders (those who completed 24 month follow-up) and non-responders

(those who did not complete 24 month follow-up) were made using chi-square or Fisher's exact test, t-test for differences in means, and nonparametric tests for rank differences. Summary scores for PF and MH domains are presented as standardised scores using a population mean of 50 and standard deviation of 10 (41). Mixed effect regression models with a random intercept per subject were used to find predictors of long-term health whilst accounting for repeated data from the same subjects.

A multi-staged modelling process was used to determine predictors of long-term health. Important predictors were identified by first using regression tree analysis (42) to reduce the large number of variables down to a subset of less than ten, and then an exhaustive search to identify the best set of predictors for the mixed regression models. Exhaustive model selection searches across all possible models and find subsets of variables that yield a 'good' model based on the Akaike Information Criteria (AIC). The AIC provides the criteria for model selection, where the model with a lower AIC is favoured (43). This is a feasible approach when the number of variables is moderate and is considered a good starting point when dealing with a larger number of competing factors (44). Predictors identified were then used in the mixed regression models to estimate predictors of outcome over the 24 months of follow-up. Model results are expressed as unstandardized coefficients (means), 95% confidence intervals and *p* values. Model diagnostics included assessment of influential observations and residual checks to assess normality assumption for linear mixed models. To check for collinearity amongst predictors and model over-fitting we used the variance inflation factor (VIF) dropping variables that had a VIF over 5.

Logistic regression was used to identify predictors of drop-out using baseline variables (which had almost no missing data), and to estimate inverse probability weights (IPWs) to compensate for drop-out (45). The variables used to predict drop-out were: time (6, 12, 24 months), age, gender, ethnicity, smoking status, education, and hospital and ICU

length of stay. Weighting the observed data with IPWs to account for drop-outs had little impact on final model estimates (IPWs: median 1.5, range 1.1 to 3.9), indicating minimal impact of drop-outs for these results. Data analyses were performed using Stata 11 (Statacorp/Texas) and R (3.0.2).

Ethical Considerations

This study received approval from Griffith University (NRS/16/08/HREC) and Princess Alexandra Hospital (2008/059) Human Research Ethics Committees. All participants provided written informed consent in hospital and reconfirmed this verbally prior to each data collection point.

RESULTS

Two-hundred and seven patients were identified as eligible, of these 123 patients consented and provided baseline (in-hospital) data. Response rates reduced over the 24 month period but remained over 56% at all follow-up (Figure 1). Study participants were similar in characteristics to the total cohort of eligible trauma patients in the study ICU over the period of recruitment where females represented one fifth of the trauma caseload, patients averaged 40 years of age and stayed in ICU for approximately 4 days. Those participants who completed data collection (i.e. responders) were older than those who were lost to follow-up (i.e. non-responders) and reported better psychological health on both the K10 and the PCL at one month (Table 2), but were similar in regard to all other measures. We compensated for this informative drop-out in our regression models.

Characteristics of participants

Detailed baseline, 1 and 6 month characteristics of the cohort are published elsewhere (10). In summary, the majority of participants were male and young and spent an average of 3 days in ICU and 20 days in hospital after experiencing serious injury (Table 3). Injuries involved head, face and neck (n=40, 33%), thorax (n=31, 25%), lower extremities (n=27,

22%) and other injuries (n=25, 20%). Two-thirds were the result of a road traffic crash and 15% from falling (Table 3).

Mental and physical health over 24 months

There was improvement in both physical function (PF) and mental health (MH) subscale scores over time, yet both still remained below Australian population norms (Figure 2). The largest improvement in PF was evident in the first 12 months following injury, when PF scores improved by an average 9 units. A smaller improvement occurred from 12 to 24 months. Although mental health was not as far below the population norms as physical function, it increased by an average of only 4 units over time (Table 4). Similar changes in all SF-36 domains were reported over the 24 month follow-up (Figure 3). Average physical function scores at 6, 12 and 24 months were significantly different from one month scores, whereas there were no statistically significant differences in mean mental health scores over time.

Psychological health

Post-traumatic stress symptom scores (PCL) improved significantly from one to six months (p=0.02), although a two unit increase is not considered as clinically significant {Weathers, 2013 #32156}. Mean scores at 12 and 24 months remained high but were not significantly different from one month scores (Table 5). The percentage of patients considered symptomatic for PTSD on the PCL remained constant over time, at around 20% at each follow-up. Five out of the 15 participants considered symptomatic at 24 months showed no PTSD symptoms at any prior follow-up. The remaining 10 were symptomatic at some point prior, with half reporting PTSD symptoms at all four follow-up points. From the 54 participants considered non-symptomatic at 24 months, 17% reported PTSD symptoms at least once in a previous time.

Psychological distress scores on the K10 showed little change over time. Two-thirds of participants were classified medium or high risk for psychological distress at one month. Although this percentage decreased over time, more than 50% of patients remained at medium to high risk of psychological distress throughout the 24 month period. All participants classified as high risk for psychological distress at 24 months (n=8) had been medium to high risk at some prior follow up, and three were high risk at all four follow-ups. Around 60% of participants at low to no risk at 24 months (n=29) reported medium to high risk for psychological distress at a prior follow-up point, only 12 participants reported low to no risk at all four follow-ups. There was no significant change in mean K10 scores over time (Table 5).

Self-efficacy increased (i.e. better perceived ability to undertake tasks and achieve results) slightly from one to six months, but then remained unchanged at 12 to 24 months; changes in mean scores over time were not statistically significant. There was a gradual decline in illness perception over time, (which is viewed as positive as the perception of the influence the injury has had on one's life reduces) the largest reduction occurring over the first six months post discharge. Mean perception scores at 6, 12 and 24 months were all significantly lower than one month scores (Table 5).

Perceived social support reduced from 1 month to 12 months post hospital discharge, with perceived family support showing the most significant decline. There were negligible changes from 6 months onward for all sources of social support other than family support (Table 5).

Predictors of physical function and mental health over time

Illness perception and self-efficacy were both associated with physical function and mental health over the 24 months of follow-up (Table 6 and 7). Higher illness perception scores were associated with poorer physical function (β=-1.4, 95% CI -2.4 – -0.4, p=0.006)

and mental health (β=-2.3, 95% CI -3.2 – -1.4, p<0.0001). Higher self-efficacy scores were associated with better physical function (β=1.8, 95% CI 1.2 – 2.4, p<0.0001) and mental health (SE: β=1.5, 95% CI 0.9 – 2.1, p<0.0001).

Longer hospital length of stay was predictive of lower physical function over the 24 months of follow-up (β=-1.7, 95% CI -2.5 – -0.9, p<0.0001). Increased perceived social support (β=2.0, 95% CI 1.1 – 2.8, p<0.0001) and increased income (p<0.0001) were associated with improved mental health over time while having insurance such as traffic or work insurance that covered the injury (e.g. work cover) was associated with poorer mental health over time (β=-2.6, 95% CI -4.9 – -0.2, p<0.03) .

DISCUSSION

Participants in this study had treatment in ICU as a result of traumatic injury and were followed for 24 months, with 68% retention at 12 months and 56% at 24 months. They have reported reduced physical function and mental health throughout the first 24 months after hospital discharge which is consistent with other similar cohorts in USA and Europe (6-8, 16, 18, 46, 47). More than half of the participants reported medium to high risk of psychological distress at all follow-up times and approximately one-fifth of participants reported symptoms of post-traumatic stress. This may be an under-representation of the extent of the problem given that participants in our study who were lost to follow-up reported high incidence and levels of psychological distress at baseline. Illness perception and self-efficacy were significantly associated with both physical function and mental health.

As expected, participants reported poorest health status one month after hospital discharge. Physical function dropped significantly at this time and improved markedly by six months with continued improvement over time. In contrast mental health was not as low one month post discharge and only improved slightly over time. This significant drop and rapid improvement in physical function and more moderate reduction and improvement in mental

health is consistent with that reported in some trauma ICU cohorts in other countries (18, 48) although there are occasional reports in conflict with this. In a Greek cohort of 85 patients using the EQ-5D severe problems of anxiety were reported in a greater proportion of patients, with more than 60% of patients reporting severe anxiety 6 months after injury, with similar problems in mobility and self-care (46). Follow-up interviews in this Greek study were all conducted in person and this may have influenced the higher levels of compromise in comparison to the current study where self-report was used, although previous examination of the effect of data collection method has found clinical interview resulted in less compromised, rather than more compromised, quality of life results when compared to self-report (49).

The pattern of recovery seen in our cohort was similar to that reported in Australian trauma cohorts not specific to ICU with outcomes measured up to 12 months post-injury (32, 35, 50). The function reported by the current cohort also represents a more severe reduction than that reported by several Australian ICU medical and surgical cohorts (51-53), however this pattern is consistent with other studies where trauma patients have reported more disability than other critical illness survivors (54, 55). Importantly, participants in our cohort reported physical aspects of function (physical function and role function – physical) 8 – 9 points below Australian population norms and some emotional aspects of function (social function and role function – emotional) 7 – 10 points below Australian population norms at 24 months. Given 5 points is considered a clinically important difference (56), and almost all domain scores of the SF-36 exceeded this benchmark at 24 months, this represents a persistent and important reduction in function. In this study we did not record rehabilitation activities undertaken by study participants, although in anecdotal conversations with participants at each of the follow-up points very few were undertaking structured rehabilitations programs, instead using ad hoc visits to physiotherapists etc to assist their

physical recovering. Consideration of the potential of both inpatient and outpatient rehabilitation programs is important in developing future strategies {Parker, 2013 #32716}.

Slightly more than 20% of participants were classified as symptomatic using the PCL which is consistent with that identified in a systematic review of 26 predominantly general ICU studies conducted over the past 15 years {Wade, 2013 #32501}. Importantly, although the incidence of reduced psychological function was reasonably consistent over time, this consisted of different individuals, with few individuals reporting consistent function. Fluctuations in psychological health have also been reported in a cohort of more than 1000 injured individuals (57). Similarly, O'Donnell et al (58) reported that of 73 (9%) of 834 injury patients who had PTSD at 12 months 22 patients had no or minimal symptoms at 3 months and a further 17 had partial or subsyndromal PTSD at that time. The additional finding in our own data that some patients who had high risk of psychological distress or were symptomatic of PTSD at early follow-up points, but reported improved psychological health at later follow-up points, emphasises the different recovery pathways that injured individuals experience.

Variable pathways of recovery appear to not be limited to psychological health, but have also been reported in regard to cognitive function after critical illness (59). These various recovery patterns probably occur as a result of the complex interaction of personal and environmental factors that are recognised as influencing function, disability and health (60). These findings in different cohorts suggest we need to ensure there are multiple screening strategies and interventions available at various points in the recovery pathway. They also suggest we would benefit from identifying those who have no dysfunction, or recover spontaneously despite early dysfunction, as the characteristics of these patients may help to identify strategies that should be incorporated into effective interventions (61).

A further consideration is whether any reduction in health status or function is due to ICU admission and associated treatment, or the injury and/or the hospitalisation. In our cohort the mechanism of injury was the only injury characteristic that was associated with outcome, and only with mental health but not physical function. We only studied patients who had been admitted to ICU, however in a cohort of more than 800 trauma patients admitted to five hospitals in Australia the sub-group of patients admitted to ICU were significantly more likely to develop PTSD than those patients not admitted to ICU suggesting that ICU admission itself may contribute to dysfunction(62). In contrast, in a cohort of more than 11000 general patients in Canada and the USA the amount of reduction in HRQoL associated with hospitalisation was no different for those patients admitted to ICU than those patients admitted to hospital but not to ICU (31).

Although many studies have examined the factors associated with health status following both injury and ICU admission, the majority of factors that have been examined have been non-modifiable after the injury occurs, e.g. female, co-morbid disease (12), perceived threat to life, persistent physical problems, previous emotional problems, previous anxiety disorder and involvement in litigation/compensation (63). Non-modifiable factors that have been identified in this study as being associated with health status included income, hospital length of stay and injury insurance. Of interest, insurance for the injury was associated with reduced mental health; although this might seem counter-intuitive it has been reported by others (64). The relationship with reduced mental health might reflect the integration between the biological, psychological and social aspects of health. A number of participants described the challenges of their care being covered by insurance, particularly after they left hospital; for example appointments with allied health personnel could not be made until they were approved by the insurance provider and some participants felt they were ready to return to work but were not allowed to until the insurance provider gave permission.

Whether the presence of health insurance leads to increased use of post-discharge services such as allied health visits has not been explored in the injury setting, but has been found in people with chronic illness{Skinner, 2014 #32717} and should be explored to inform national debate and interventions related to health insurance.

The purpose of identifying factors associated with recovery is to inform the development of relevant interventions and identify patients most likely to benefit. Given the relationship between multiple factors affecting recovery, and the changing nature of health status reported by patients, it is likely that relevant interventions will be complex in nature. These interventions are more likely to be effective if developed and tested in a systematic manner that is consistent with the MRC process of development based on evidence, theory and modelling followed by feasibility and then effectiveness testing (27). Importantly, a number of factors found to be associated with recovery that are potentially amenable to change through intervention have been identified in this study. Self-efficacy has been identified as a factor related to health status in other groups of injured patients (22) although there is not yet evidence of the ability to improve this characteristic in this group of people. Some success has been achieved in improving self-efficacy in people with rheumatic disease (65) and caregivers of cancer patients (66), although the impact on wider health status is inconsistent. There is also some evidence that other types of early psychological interventions might be beneficial for injured patients. O'Donnell and colleagues (67) tested the effectiveness of a stepped early psychological intervention in a group of 46 patients at high risk for psychological dysfunction following traumatic injury. Initial testing suggests patients who received the intervention of 4–10 sessions of CBT experienced treatment benefit.

Although the effect sizes (unstandardized regression coefficients) for illness perception and self-efficacy in the current study were relatively small, studies in other populations suggest delivery of an intervention to achieve an improvement of 20% is feasible

(65-67) which might translate to an increase of 5 points in SF-36 domains, in other words an improvement that is considered an important difference. The lengthy time that patients spend in acute wards after ICU discharge may provide an opportunity to commence interventions designed to continue post-hospital discharge and could incorporate a combination of individual instruction and generic information presented within a manual or on an audio-visual disk supplemented by follow-up phone calls or visits. Interventions specifically aimed at improving both self-efficacy and illness perception appear to have potential and might target education about symptom management (e.g. pain) and physical and emotional strategies to enhance rehabilitation and recovery.

An obvious strength of the current study is the longitudinal nature and repeated measurement of recovery in the study participants. However the limitations of being a single-centre study and retention of only 56% at 24 months should be noted. This is particularly important given the differences in baseline characteristics of those retained in the study compared to those who were lost to follow-up (although we attempted to compensate for this loss in our analysis). Although disappointing, this retention rate compares favourably with other similar cohorts, with retention rates ranging from 76% in 1906 patients in the USA (11) and 68% in 332 patients in the Netherlands at 12 months (12) to 41% in 241 patients in the USA at 12 months (68) and 39% in 146 patients in Sweden at 24 months (48). When designing studies to test the effectiveness of interventions designed to improve recovery it is essential to incorporate strategies, and associated funding, for detailed and multi-dimensional follow-up of patients to improve the likelihood of high retention rates. A further limitation is that participants were able to return questionnaires via the post or to provide responses by telephone – we did not record the method of response or examine the influence of this difference. Finally, it should be noted that no a priori sample size calculation was undertaken due to the lack of background information concerning the factors that were incorporated into

this study; however given we have identified significant p-values in the presence of 'minimal' effect sizes for some predictors (i.e. mean change of 1.8 for outcome physical function for a one unit of change in self-efficacy) this suggests sufficient power existed to detect relatively small changes.

CONCLUSIONS

Patients reported a range of areas of reduced physical and psychological function throughout 24 months following injury requiring admission to ICU. Although improvements in physical function and mental health are evident over this time period, many patients remain below Australian population norms. Factors associated with physical function and mental health outcomes over time that are potentially amenable to change include illness perception, self-efficacy and perceived social support. Development of interventions that target these characteristics may prove beneficial.

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Table 1. Measures of variables

Construct	Measure	Items	Score range & categories
Self-efficacy	Self-Efficacy Scale (SES)(36)	6 items measuring participants' confidence in undertaking daily activities and achieving results; these items related to: fatigue; physical discomfort; emotional distress; other symptoms or health problems; different tasks and activities; non-medicine related activities to reduce illness effects	1-10 Likert scale per response Total SES generated via average response from items Higher score indicates patients' confidence in undertaking daily activities.
Illness perception	Brief Illness Perception Questionnaire (BIPQ)(37)	8 items to assess the cognitive and emotional representations of injury, in other words how participants respond to the threat to their health; items related to: consequences; timeline; personal control; treatment control; identity; concern; understanding; emotional response	0-10 scale per response Total score range: 0 to 80 Higher score reflects a perception that the injury exerted more influence on the participants' life.
Perceived social support	Multidimensional Scale of Perceived Social Support (MSPSS)(38)	12 items describing perceived adequacy of support from family, friends and significant other	1-7 Likert scale per response Total score range: 8 to 84 Higher score indicates greater participants' perceived social support.
Post-traumatic stress	PTSD Checklist – Civilian version (PCL) (69)	17 items describing: intrusive recollect; flashbacks; upset by reminders; distressing dreams; physical reactions to reminders; avoid thoughts; avoid reminders; psychogenic amnesia; anhedonia; estrangement from others; psychic numbing; foreshortened future; sleep difficulty; irritability; concentration impaired; hypervigilant; exaggerated startle	1-5 Likert scale per response Total score range: 17 to 85 Higher score indicating more post-traumatic stress. Considered symptomatic if rated 'moderately' or above on at least 1 B item (questions 1-5), 3 C items (questions 6-12) and 2 D items (questions 13-17). 10 unit change considered clinically meaningful
Psychological distress	Kessler Psychological Distress Scale (K10)(40)	10 items describing: depressed mood; motor agitation; fatigue; worthless guilt; anxiety	1-5 scale of frequency Total score range: 1 to 50 Higher scores indicate greater distress; Cut points: 10 – 15 – low or no risk; 16

			– 29 – medium risk; 30 – 50 – high risk.
Health status	Short Form-36 (SF-36)(70)	8 sections describing: vitality; physical functioning; bodily pain; general health perceptions; physical role functioning; emotional role functioning; social role functioning; mental health	Weighted sums of the questions in each section which are transformed into: Total score scale: 0 – 100 Lower score indicates more disability.
Pre-injury health	Physical function sub-scale of the Medical Outcome Study SF-36	10 items describing physical functioning.	1-3 Likert scale per response Total score range: 10 to 30 Low score indicating perceived limitation with physical functioning including activities of daily living.

Table 2. Baseline characteristics and comparison of responders and non-responders at 24 months

	Baseline (in-hospital)	**24 months**		
	Responders n=123	Responders n=69	Non-Responders n=54	**p-value** [a, ^]
Frequency (%)				
Male	102 (83)	58 (84)	44 (82)	
Female	21 (17)	11 (16)	10 (19)	0.71
Median (IQR)				
Age (years)	37 (28–55)	44 (29–60)	34 (27–47)	**0.03**[*]
ISS[c]	19 (13–29)	17 (12–29)	19 (14–29)	0.68
APACHE III	41 (28–53)	41 (29–52)	41 (28–53)	0.88
ICU LOS[d]	2.9 (1.2–7.7)	3.0 (1.4–7.3)	2.7 (1.2–7.7)	0.98
Hospital LOS	20.2 (9.7–39.2)	20.2 (10–38.6)	20.0 (8.6–40.4)	0.73
	1 months (first survey)[#]	**24 months**[#]		
	Responders n= 93	Responders n=61	Non-Responders n=32	**p-value** [b, ^]
Median (IQR)				
K10 Score	20 (14–26)	16 (13–25)	24 (19–30)	**0.002**[*]
PCL Score	29 (22–40)	27 (21–36)	35 (25–48)	**0.02**[*]
Frequency (%)				
PCL symptomatic				
Yes	18 (81)	9 (15)	9 (28)	
No	75 (19)	52 (85)	23 (72)	0.12
K10 (CRUfAD)				
Low or no risk	33 (36)	29 (48)	4 (13)	
Medium risk	47 (51)	27 (44)	20 (63)	
High risk	13 (14)	5 (8)	8 (25)	**0.002**[*]
Mean (SD)				
Physical function	30.2 (14)	30.5 (15)	29.8 (12)	0.83
Mental health	43.1 (12)	44.4 (12)	40.5 (13)	0.14
PCS[e]	32.6 (10)	32.7 (11)	32.6 (10)	0.99
MCS[e]	40.6 (16)	42.3 (15)	36.9 (18)	0.14

a. Responder and non-responder comparisons for demographics, injury & acute care characteristics are based on in-hospital (baseline) data; b. Comparisons of psychological and physical health status are based on psychological scores provided at 1 month (first data collection point for psychological scores); c.Injury Severity Score from QTR data n=121 (data not available for 2 participants due to poisoning being coded as injury but not assigned an ISS); d. Length of Stay (LOS); e. Physical and Mental Component Score from SF-36v2; ^ Comparisons of responders and non-responder characteristics tested with Chi-square or Fisher's exact test, t-test for differences in

means, and nonparametric tests for rank differences; # Due to limited data unable to calculate/impute scores for several participant/s.

Table 3. Demographic characteristics: Baseline, 1, 6, 12 and 24 months

	Baseline n=123	1 month n=93	6 months n=88	12 months n= 84	24 months n= 69
Marital Status			**Frequency (%)**		
Married/De facto	57 (47)	47 (51)	43 (49)	40 (48)	37 (54)
Never married	40 (33)	30 (32)	28 (32)	26 (31)	18 (26)
Separated/Divorced	21 (17)	14 (15)	15 (17)	17 (20)	13 (19)
Widowed	4 (3)	2 (2)	2 (2)	1 (1)	1 (2)
	(1 missing)				
Employment					
Full time work	64 (52)	39 (42)	30 (34)	32 (39)	27 (41)
Part time/casual	25 (20)	7 (8)	14 (16)	14 (17)	8 (12)
Retired	12 (10)	10 (11)	12 (14)	9 (11)	8 (12)
Student/other	6 (5)	11 (12)	10 (11)	5 (6)	6 (9)
Disability benefit	7 (6)	13 (14)	7 (8)	13 (16)	7 (11)
Unemployed	9 (7)	12 (13)	15 (17)	9 (11)	10 (15)
		(1 missing)		(2 missing)	(3 missing)
			Median (IQR)		
Hours of work/week	40 (37–50)	40 (37–50)	38 (33–45)	40 (31–47)	38 (30–45)
Household Income ($AUD)					
$0 – 29 999	43 (35)	39 (43)	40 (46)	34 (42)	24 (36)
$30 000 – 59 999	42 (34)	24 (26)	26 (30)	26 (32)	18 (27)
$60 000 – 89 999	25 (21)	16 (18)	10 (12)	11 (14)	12 (18)
$90 000 or more	12 (10)	12 (13)	11 (13)	10 (12)	13 (19)
	(1 missing)	(2 missing)	(1 missing)	(3 missing)	(2 missing)
Private Health Insurance					
Yes	32 (26)	24 (26)	24 (27)	25 (30)	26 (38)
No	91 (74)	69 (74)	64 (73)	59 (70)	43 (62)
Type of Health Insurance [a]					
Hospital only	5 (16)	2 (8)	2 (9)	2 (9)	4 (16)
Extra only	1 (3)	3 (13)	1 (4)	2 (9)	1 (4)
Both	26 (81)	19 (79)	20 (87)	18 (82)	20 (80)
			(1 missing)	(3 missing)	(1 missing)
Injury Insurance					
Yes	38 (31)	28 (30)	28 (32)	31 (37)	25 (36)
No	85 (69)	65 (70)	60 (68)	53 (63)	44 (64)

[a] Only includes participants who indicated 'yes' to private health insurance

Table 4. Mean norm-based SF-36 scores at 1, 6, 12 & 24 months [a, b]

	1 month	6 months	12 months	24 months
SF-36 Domains		**Mean (SD)**		
Physical function	30.2 (13.8)	39.1 (14.7)	40.5 (14.1)	42.0 (14.3)
Role function-physical	25.8 (10.4)	36.2 (15.3)	39.2 (15.0)	40.9 (14.6)
Bodily Pain	35.5 (11.4)	42.4 (11.9)	44.7 (12.5)	44.8 (12.3)
General health	45.6 (9.7)	45.3 (11.1)	45.3 (11.1)	46.3 (10.2)
Vitality	40.9 (10.1)	45.8 (11.0)	45.4 (11.2)	46.9 (11.8)
Social function	32.2 (13.8)	40.2 (13.3)	41.1 (14.1)	42.6 (12.7)
Role function-emotional	30.9 (22.2)	37.4 (18.1)	38.5 (19.4)	40.4 (17.8)
Mental health	43.1 (12.1)	43.3 (13.0)	43.2 (12.3)	44.4 (12.2)
Physical component summary	32.7 (10.4)	40.9 (13.2)	42.8 (11.7)	43.7 (12.3)
Mental component summary	40.6 (15.7)	42.6 (14.0)	42.4 (13.8)	44.6 (12.5)

[a] Norm-based scores for domains and summary score are calculated from raw scores using Australian population norms (SAHOS); scores are interpreted with a population mean of 50 and
standard deviation of 10, [b] Due to missing data n=88-93 at 1 month, n=86-88 at 6 month, n=83-84 at 12 months and n = 65-68 at 24 months

Table 5. Psychosocial recovery over 24 months[#]

	1 month n=93	6 months n=88	1 vs. 6 mths, p-value^	12 months n=84	1 vs. 12 mths, p-value^	24 months n=69	1 vs. 24 mths, p-value^
Post Traumatic Stress Symptoms				**Median (IQR)**			
PCL score [a]	29.0 (22.0–40.0)	31.0 (24.0–46.0)	0.02*	31.0 (23.0–44.0)	0.12	30.0 (23.0–41.0)	0.08
Symptomatic - PCL: n (%)[a]	18 (19%)	20 (23%)		18 (22%)		15 (22%)	
Psychological Distress				**Mean (SD)**			
K10 total score [b]	20.6 (7.9)	19.8 (8.3)	0.25	19.4 (8.5)	0.08	19.3 (8.1)	0.36
K10 (CRUfAD) [b]				**Frequency (%)**			
Low or no risk	33 (35.5)	35 (39.8)		34 (41.0)		29 (42.6)	
Medium risk	47 (50.5)	42 (47.7)		37 (44.5)		31 (45.6)	
High risk	13 (14.0)	11 (12.5)		12 (14.5)		8 (11.8)	
Perceived Self-Efficacy				**Mean (SD)**			
Self-Efficacy Scale [c]	6.6 (2.3)	6.9 (2.4)	0.42	6.9 (2.5)	0.27	6.9 (2.7)	0.64
Illness Perception							
BIPQ [d]	42.5 (13.7)	38.3 (18.0)	0.004*	38.2 (17.5)	0.001*	36.9 (20.1)	0.001*
Social Support							
MPSS total score [e]	5.6 (1.1)	5.3 (1.3)	0.02*	5.4 (1.1)	0.02*	5.4 (1.2)	0.13
Family	5.8 (1.2)	5.4 (1.5)	0.004*	5.4 (1.3)	0.005*	5.5 (1.2)	0.07
Friends	5.3 (1.3)	5.1 (1.3)	0.22	5.1 (1.2)	0.07	5.2 (1.3)	0.33
Significant Other	5.8 (1.3)	5.5 (1.5)	0.06	5.6 (1.3)	0.20	5.6 (1.5)	0.27

a. PTSD Checklist – Civilian Version (PCL-C): Symptom severity score range (17–85) higher scores indicate more symptoms of post-traumatic stress, Symptomatic on PCL: PTSD symptoms consistent with diagnosis of PTSD; b. Kessler Psychological Distress Scale: Score range (10–50) higher scores indicate greater distress, Clinical Research Unit for Anxiety and Depression, University of New South Wales (CRUfAD) cut-off scores for levels of psychological distress; c. Self-Efficacy 6-Item Scale: Score range (1-10) higher score indicates a greater level of perceived self-efficacy; d. Brief Illness Perception Questionnaire: Score range (0-80) higher score indicates a more threatening view of injury; e.

Multidimensional Scale of Social Support (MSPSS): Score range (1–7) higher scores indicate greater perceived social support; [#]Due to limited data unable to calculate/impute scores for several participant/s (n=88-93 at 1 month, n=86-88 at 6 month, n=82-84 at 12 months and n=65-69 for 24 months); ^ Univariate mixed effect regression with a random intercept per subject; * Significant at $p<0.05$.

Table 6. Predictors of physical function (SF-36) over 24 months

Predictors/Factors		Mean [95% CI]^	p-value
(Intercept)		27.7 [20.0, 35.7]	-
Month	6 months	7.4 [5.3, 9.4]	<0.0001
	12 months	9.2 [7.2, 11.3]	<0.0001
	24 months	10.4 [8.1, 12.6]	<0.0001
Hospital length of stay (per 10 days)		-1.7 [-2.5, -0.9]	<0.0001
Illness perception score (per 10 units)		-1.4 [-2.4, -0.4]	0.006
Self-efficacy score (per 1 unit)		1.8 [1.2, 2.4]	<0.0001
Education	Primary/Secondary (8,9,10)	Ref	-
	Secondary (11,12)	3.3 [-1.4, 7.9]	0.19
	Trade/Vocation	1.4 [-2.4, 5.1]	0.50
	University	-0.4 [-5.8, 4.9]	0.88
Marital Status	Married	Ref	-
	Never married	1.9 [-1.1.1, 5.0]	0.24
	Separated/Divorced/Widowed	0.5 [-3.0, 3.9]	0.79
Injury insurance (e.g. work cover)	No	Ref	-
	Yes	-2.6 [-5.4, 0.0]	0.058

AIC for best model= 2323

^ Unstandardised regression coefficients: represent the mean change/difference over 24 months in physical function score for unit(s) of change in predictor variables, holding all other predictors in the model constant (i.e. For every 1 unit change in self-efficacy score, mean physical function score increased by 1.8 units over time).

Table 7. Predictors of mental health (SF-36) over 24 months

Predictors		Mean [95% CI]^	p-value
(Intercept)		30.5 [21.9, 38.9]	-
Illness perception score (per 10 units)		-2.3 [-3.2, -1.4]	<0.0001
Social support (MSPSS) (per 1 unit)		2.0 [1.1, 2.8]	<0.0001
Self-efficacy score (per 1 unit)		1.5 [0.9, 2.1]	<0.0001
Employment	Full-time	Ref	-
	Part-time/casual	-2.1 [-5.3, 1.0]	0.21
	Retired	-1.1 [-5.1, 2.8]	0.59
	Student/other	0.4 [-2.9, 3.8]	0.80
	Disability benefits	1.0 [-2.3, 4.3]	0.58
	Unemployed	-2.5 [-5.9, 0.7]	0.14
Income	$0-$29,000	Ref	-
	$30,000-$59,999	4.6 [2.1, 7.2]	<0.0001
	$60,000-$89,999	6.0 [2.9, 9.3]	<0.0001
	$90,000 or more	6.0 [2.6, 9.4]	0.0001
Injury insurance (e.g. work cover)	No	Ref	
	Yes	-2.6 [-4.9, -0.2]	0.03
Mechanism of injury	Road traffic crash	Ref	-
	Fall	0.9 [-0.24, 4.2]	0.61
	Collision	-5.2 [-11.2, 0.7]	0.10
	Other	-2.7 [-5.9, 0.5]	0.12

AIC for best model = 2126

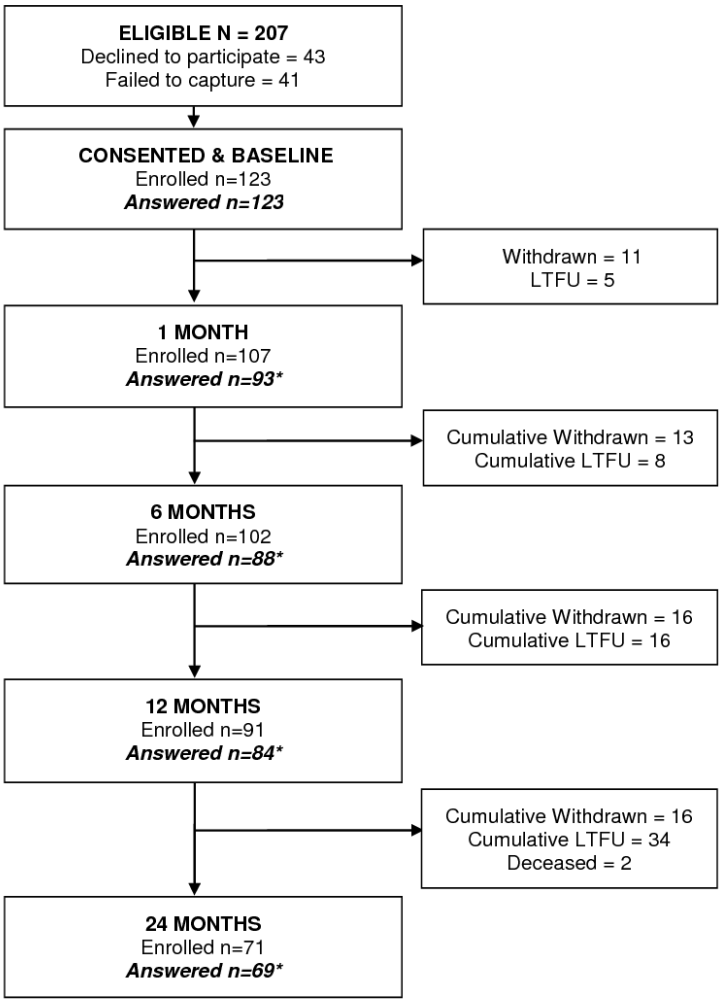

Figure 1. Participant flow through study

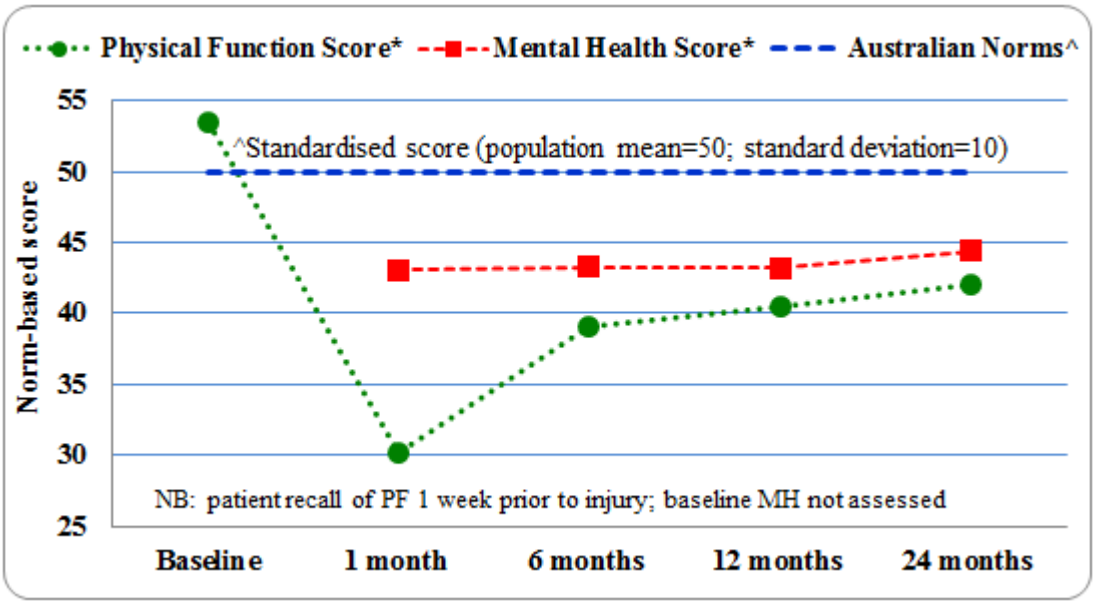

Figure 2. Physical health (PH) and mental health (MH) over 24 months

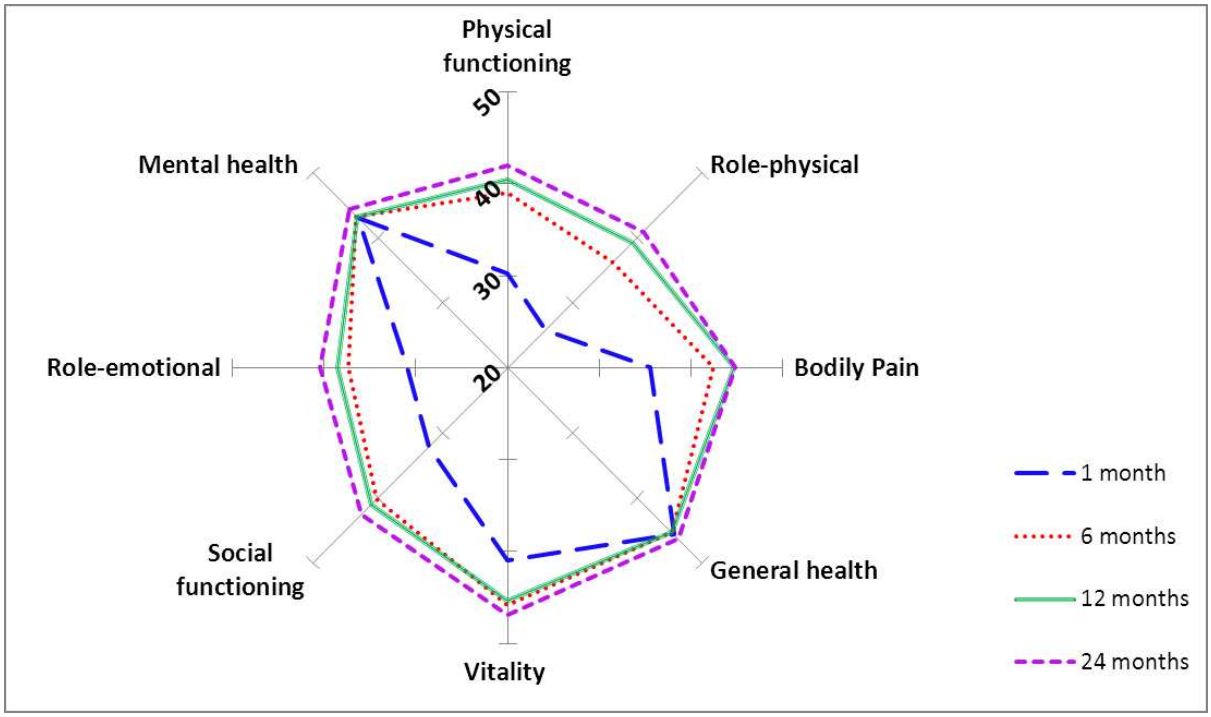

Figure 3. SF-36 domains over 24 months