CHAPTER FOUR: THE ASSOCIATION BETWEEN COMPENSATION AND OUTCOME AFTER MOTOR VEHICLE INJURIES, A PROSPECTIVE STUDY (MOTOR VEHICLE ACCIDENT OUTCOME STUDY).

4.1 Introduction

This chapter explores the role of compensation-related factors in determining outcomes for a specific group of patients, namely those sustaining major fractures as the result of a motor vehicle accident. This study also differs from the Major Trauma Outcome Study reported in Chapter Three by being prospective, as patients were recruited at the time of presentation after their injury and then followed for six months.

The significance of motor vehicle trauma to public health has been studied extensively. Currently, road traffic injuries are the leading cause of death in high-income countries for people aged between 5 and 44 years. For the same age group, road traffic injuries are second only to HIV/AIDS as the leading cause of death worldwide.[449 450] In high-income countries, road trauma lies third, behind depression and alcohol-related disorders among the leading contributors to the burden of disease, and worldwide it lies third behind depression and HIV/AIDS.[449 450]

General health after motor vehicle trauma has been studied previously, but the effect of compensation on this outcome has not been reported. However, the role of compensation in the impact of illness after motor vehicle trauma has been studied for outcomes other than general health, particularly whiplash and psychological illness. The literature regarding this is discussed in the literature review in Chapter One, and in the discussion in Chapter Three.

The diagnosis of illnesses such as whiplash, depression and psychological stress are patient-based, and can therefore be influenced by psychosocial variables (such as compensation-related factors). By using a more objective diagnosis (specific fractures), it is hoped that biases related to the diagnosis being studied can be minimised.

The role of compensation-related factors in healing after fractures has been reported in only a few studies, none of which were specifically related to motor vehicle trauma. Five studies have been found, all of which were included in the systematic review in Chapter Two. In one study of outcome after surgery for a thoraco-lumbar burst fracture in 28 patients, 75% of whom were involved in motor vehicle trauma, compensation status was found to be the only significant predictor of outcome after two years.[364] In one study of outcome after fixation of osteochondral fractures of the knee in 123 patients, compensation status had a significantly negative effect on outcome, along with age and injury related factors.[451] In each of three separate studies of outcome after fracture of the calcaneus, compensation status was significantly associated with poor outcome, along with other anatomic factors.[350 452 453] The findings of these studies concur with the findings of other studies in the systematic review.

The outcome scores used in these studies all take into consideration patient-reported pain, and it is likely that the patients' symptoms contributed most to the poor outcomes seen in compensated patients, as there was no difference in objective outcomes such as bone healing or fracture reduction. This would indicate the outcome rating provided by the patients is influenced by psychological factors.

As mentioned previously, most studies that explore the effect of compensation status use only one criterion to classify compensation status. Although pursuit of a claim is a reasonable measure, some studies use litigation or use of a lawyer as a surrogate for compensation. This makes comparison of studies difficult, and this problem is addressed in this study which, as in Chapter Three, uses several compensation-related variables to measure compensation status. It is also hoped that this will allow better discrimination of the relative contribution to any association from the different aspects of the compensation process.

4.1.1 Study hypotheses

It is hypothesised that subjective health outcomes (physical health, mental health, back pain and neck pain) and patient satisfaction in patients with specific fractures from motor vehicle collisions will be associated with compensation status, allowing for demographic, socio-economic and injury factors, such that compensated patients will have poorer health outcomes and less satisfaction. It is also hypothesised that there will be no association between objective outcome (fracture non-union) and compensation status.

The specific hypotheses are similar to the hypotheses stated in Chapter Three and are as follows:

1. Hypothesis 1: General physical health, as measured by the physical component summary (PCS) of the SF-36 General Health Survey, will be significantly worse for patients who pursued compensation than for patients who did not pursue compensation.
2. Hypothesis 2: General mental health, as measured by the mental component summary (MCS) of the SF-36 General Health Survey, will be significantly worse for patients who pursued compensation than for patients who did not pursue compensation.

These are the same major hypotheses as the retrospective study reported in Chapter Three. The following secondary hypotheses test the main exposure variable (pursuit of compensation) against the secondary outcome measures.

3. Hypothesis 3: Neck pain will be significantly worse for patients pursuing compensation.
4. Hypothesis 4: Back pain will be significantly worse for patients pursuing compensation.
5. Hypothesis 5: Patient-rated satisfaction and recovery will be significantly lower for patients pursuing compensation.

In addition to these patient-reported outcomes, the effect of compensation status on the following outcomes will also be explored, and compared to any effect on the above patient-based outcomes.

6. Hypothesis 6: Surgeon-rated satisfaction and recovery will not be significantly associated with compensation status.
7. Hypothesis 7: Fracture-related complications will not be significantly associated with compensation status.

Comparisons between the findings of each chapter will be discussed in the final chapter, Chapter Five.

4.2 Materials and Methods

4.2.1 Study population

The study population consisted of adult (18 years and over) patients presenting acutely to one of the participating hospitals with specific fractures resulting from motor vehicle collisions. The specific fractures were fractures of the long bones (humerus, radius, ulna, femur or tibia), the pelvis, the patella, the talus, and the calcaneus.

Initially, only motor vehicle occupants with long bone fractures were included as these criteria were simple to apply, considering recruitment was being performed by many orthopaedic registrars, most of whom were not directly connected with the study. The inclusion criteria were expanded during the study to include other fractures (patella, pelvis, talus and calcaneus) and other mechanisms (motor cyclists, and pedestrians and bicyclists struck by motor vehicles), in order to increase the recruitment rate.

Fractures were chosen as the inclusion criteria for several reasons: they are objective diagnoses (not patient-based), the diagnosis can be made reliably, they set a threshold of physical trauma (to exclude patients with no objective signs of physical trauma), and because patients with these particular fractures are usually admitted to hospital (usually to undergo surgery) thus minimising bias due to selective presentation to hospital.

Patients referred for late treatment, such as reconstructive surgery, were excluded. Recruitment was required within 7 days of the injury. Patients with a cognitive inability to consent were excluded. Patients who died or moved overseas before follow-up were excluded. Attempts were made to use a health care interpreter for patients who did not speak English; the questionnaire was not translated. No upper age limit was used.

4.2.2 Study location

Fifteen public hospitals were involved in recruitment, namely, Liverpool, Bankstown, Westmead, Nepean, Blacktown, Hornsby, Gosford, Royal North Shore, Royal Prince Alfred, St Vincent’s, Prince of Wales, St George, Sutherland, Wollongong, and Canberra. All hospitals were involved in the treatment of patients after motor vehicle trauma, and all hospitals were within approximately two hours drive of the principal institution, Liverpool Hospital. All major trauma centres in Sydney were included.

4.2.3 Ethics approval

Human research ethics committee approval was granted from the University of Sydney (supervising institution), South West Sydney Area Health Service (Liverpool and Bankstown Hospital), Western Area Health Service (Nepean Hospital), ACT Health (Canberra Hospital), Western Sydney Area Health Service (Westmead and Blacktown Hospitals), Northern Sydney Area Health Service (Royal North Shore and Hornsby Hospitals), Central Coast Area

Health Service (Gosford Hospital), St Vincent's Hospital, South East Sydney Area Health Service - Eastern Zone (Prince of Wales Hospital), South East Sydney Area Health Service - Southern Zone (St George and Sutherland Hospitals), and Illawarra Area Health Service and Wollongong University (Wollongong Hospital). Approval for the changes in protocol (to change the inclusion criteria to include different fractures and mechanisms) was also granted from each of the committees. Copies of the letters of approval from the ethics committees are in Appendix 11.

4.2.4 Patient recruitment

Recruitment began on 2 August 2004 but was staggered, due to the irregularity of approval from local ethics committees. Recruitment terminated in October 2005, after recruitment of the target population of 300.

Patients were contacted on two occasions: at the time of recruitment and at the time of follow-up, six months later. At the time of recruitment, patients were approached by the orthopaedic registrar at their hospital and invited to participate in the study. They were provided with a patient information sheet and, if they agreed to participate, they were asked to sign a patient consent form and complete an initial questionnaire. At six months post injury, the final questionnaire was mailed to the patients with a cover letter and a reply-paid envelope. Data were also collected from patients' medical records, where necessary. Consent for this was included in the patient consent form.

The treating surgeons were also contacted at the time of follow-up (six months) and asked to complete a 6-month surgeon questionnaire. The patient information sheet, the cover letters, and the patient and surgeon questionnaires are provided in Appendices 12 – 15.

Several steps were taken to improve recruitment during the study. Two weeks prior to the commencement of recruitment, the registrars at each hospital who were participating in the on-call roster were contacted by telephone to inform them about the study and to get contact details (mobile telephone number) for routine contacting during the recruitment phase of the study. They were sent a packet of questionnaires, patient information sheets, patient consent forms and stamped pre-addressed envelopes for return of the questionnaires, along with a cover letter explaining their role.

Close to the time of commencing recruitment, a presentation was given to the orthopaedic departments at Nepean, Liverpool, Westmead, Royal North Shore, St George, Gosford, Canberra and Wollongong Hospitals, to familiarise the consultants and registrars with the project.

The registrars were telephoned regularly (approximately twice per week) throughout the recruitment phase so that close monitoring could be made of the progress of the study and to maintain active recruiting. Regular newsletters (approximately every three months) were circulated by mail and email to the registrars and consultants at each of the study hospitals to inform them of the progress of the study, of any changes to the inclusion criteria, and to maintain awareness of the study.

Questionnaires were mailed to patients six months after the injury. Non-responding patients were sent a reminder letter between two and four weeks after the initial mailing, and patients who did not respond to the reminder letter were contacted by telephone, where possible. Patients who were not contactable were traced through the hospital and treating doctors to check contact details.

4.2.5 Piloting of the questionnaire

4.2.5.1 Methods

The Initial Patient Questionnaire and the Six Month Patient questionnaires were piloted to validate new questions, such as job satisfaction and patient satisfaction, and to uncover any objections or difficulties patients might have with the questionnaire. Both questionnaires were piloted simultaneously on 55 trauma patients selected from one public and one private fracture clinic. All patients were post-trauma patients with fractures, but not all patients were involved in motor vehicle accidents.

The patients were asked for comments regarding the questionnaire. Specifically, the patients were asked whether they understood the instructions and the questions, and they were asked to write down any comments regarding the instructions. They were also asked to identify any questions that they found confusing or difficult to answer.

Two other questionnaires were attached to the pilot questionnaires. These were to be used as gold standards for some of the questions that had not been previously validated. The additional questionnaires were the Oswestry Disability Questionnaire[454] and the Neck Disability Index.[455] These questionnaires are commonly used and have previously been validated for patients with back pain and disability, and neck pain and disability, respectively.[402 424 454 455] These surveys were used to establish criterion validity of the low back pain and disability questions, and the neck pain and disability questions.

Test-retest reliability was also examined. Patients who completed the pilot questionnaires were posted a repeat questionnaire at a period of one to two weeks after first completing the questionnaires. The repeat questionnaire contained the Initial Patient Questionnaire and the Six Month Patient Questionnaire only.

The job satisfaction question was tested separately for criterion validity by administration of the job satisfaction question and a previously validated job satisfaction questionnaire, the Job Satisfaction Survey.[456] This was distributed to 50 people, through personal contacts. The subjects were mainly doctors, nurses and hospital clerical staff.

4.2.5.2 Results

For the pilot study, 55 patients completed the Initial Patient Questionnaire, the Six Month Patient Questionnaire, the Oswestry Disability Questionnaire and the Neck Disability Index. These patients also provided comments on the questionnaires. Thirty (55%) of the 55 initial respondents returned the second mailing of the Initial Patient Questionnaire and the Six Month Patient Questionnaire.

The results of the pilot study are listed in the order that they appear in the Initial Patient Questionnaire and the Six Month Patient Questionnaire. The SF36 questions were not analysed as these questions have been previously validated. Also, some questions in the pilot study that were not used in the main study are not reported.

Question: Highest education level.

This question has four parts and follows a pattern previously used with the patient rating their highest education level at either primary school, secondary (high) school, certificate or diploma, or bachelor degree or higher. The responses were not evenly spread with 64%(35/55) respondents selecting option 2 (secondary school). Agreement on retesting was 86% (25/29). The unweighted kappa value was 0.69 (95% CI 0.42 - 0.97). The weighted kappa value was 0.79 (95% CI 0.57 - 1.00).

Question: How would you rate your job satisfaction.

The job satisfaction question was trialed on the trauma population (55 patients). The criterion validity was tested on a separate population of 50 people, mostly with a medical, nursing or administrative background.

22% of respondents were not employed (option 5) and the majority of respondents were satisfied with their job (41% very satisfied and 32% somewhat satisfied). The test-retest reliability for this same population (n=27) showed agreement in 85% (23/27). The unweighted kappa value was 0.80 (95% CI 0.61 - 0.98). The weighted kappa value was 0.87 (95% CI 0.73 - 1.01).

Correlation with the Job Satisfaction Survey (JSS) score is shown in Table 4.1. This demonstrates positive correlation between JSS score and job satisfaction as rated on the initial patient questionnaire. It shows, however, a floor effect in the JSS score such that it was not sensitive to the lowest score in the initial patient questionnaire ("very dissatisfied"). This indicates that the question used in the initial patient questionnaire may be able to detect a broader range of job satisfaction.

Table 4.1. Mean JSS (job satisfaction survey) scores for each response.

Response	Mean JSS score	95% confidence interval
Very satisfied	157	104 – 210
Somewhat satisfied	128	96 – 161
Somewhat dissatisfied	105	54 – 157
Very dissatisfied	109	90 – 128

Question: Average yearly household income

This question is based around the median household income (including investments and spouse earnings) supplied by the Australian Bureau of Statistics.[404] The median household income at the time of formulation of the questionnaire was approximately $49,000 per year. For simplicity, and allowing for inflation, a midpoint of $50,000 was chosen. As the distribution is gathered around this median point, cut off points of $30,000 on the lower side and $75,000 on the highest side were chosen.

The spread of these responses was satisfactory, although lower than the average expected with responses 1 and 2 (incomes of $50,000 or less) making up 74% of the total. The test-retest reliability showed 83% agreement (20/24). The unweighted kappa value was 0.72 (95% CI 0.47 - 0.98). The weighted kappa value was 0.77 (95% CI 0.53 - 1.01).

Question: How would you rate your general recovery from the injury?

The proportion of responses ‘very satisfied’, ‘somewhat satisfied’, ‘somewhat dissatisfied’, and ‘very dissatisfied’, was 16%, 35%, 41% and 8%, respectively. Test-retest reliability revealed 63% agreement (17/27). The unweighted kappa value was 0.46 (95% CI 0.21 - 0.72). The weighted kappa value was 0.57 (95% CI 0.35 - 0.78).

The relatively poor correlation for this question may be explained by the fact that the patients interviewed were post-trauma patients with fractures. Consequently, they were recovering from their injuries and they would have expected to record higher rating of recovery in the second questionnaire, which was the case.

Question: Regarding your injury, who do you feel was at fault?

The three possible responses were evenly distributed, 36% selecting "I was at fault", 34% selecting "I don't know", and 30% selecting "someone else". Test-retest reliability showed agreement in 59% (16/27), a unweighted kappa value of 0.39 (95% CI 0.12 - 0.65) and a weighted kappa value of 0.38 (95% CI 0.10-0.67). This question showed poorer test-retest reliability, compared to the other questions. There was no pattern seen in the change between the initial and repeat responses. Patients' perception of fault was not expected to significantly change between the two questionnaires. This may reflect a lack of sensitivity of this question to detect a patients' perception of fault. Alternatively, it may reflect fluctuations in patients' perception of fault. The question was not changed for the final questionnaire as the responses were evenly spread and the wording was considered satisfactory.

Question: How much low back pain have you had in the past four weeks?

The distribution of responses was skewed because 47% of respondents indicated that they had no back pain. This may have been due to the fact that none of the patients had back injuries, as these are usually treated in another clinic. This question was an adaptation of one of the pain questions from the SF36, with identical responses. Agreement was 59% (17/29). The unweighted kappa value was 0.34 (95% CI 0.12-0.57). The weighted kappa value was 0.59 (0.40-0.78). Criterion validity was tested against the Oswestry Disability Index. The mean Oswestry score increased with each successive response category, and analysis of variance showed a strong association between the two scores ($F = 41.99$, 1,50 DF, $p<0.0001$).

Question: During the past four weeks, how much did low back pain interfere with your normal work (including both work outside the home and housework)?

53% of participants had no disability from back pain (option one), but the distribution of the other four options was evenly distributed (15%, 11%, 11%, and 11%). This question was also adapted from the SF36 survey, with identical responses. Test-retest reliability showed an agreement of 52% (15/29). Back pain disability showed good correlation with the Oswestry Disability Index ($F = 41.19$, 1,50 DF, $p<0.0001$).

Question: How much neck pain have you had in the past four weeks?

64% of participants had no neck pain (option 1). Test-retest agreement was 59% (17/29). This question showed satisfactory correlation with a neck disability index (NDI), with increasing NDI scores for each successive response category ($F= 11.37$, 1,48 DF, $p=0.002$).

Question: During the past four weeks, how much did neck pain interfere with your normal work (including both work outside the home and housework)?

69% of participants had no disability from neck pain (option one). Agreement was 72% (21/29). The unweighted kappa value was 0.44 (0.15-0.73). The weighted kappa value was 0.51 (0.20-0.81). This question showed good correlation with the NDI, with increasing NDI scores for each successive response category ($F= 8.44$, 1,48 DF, $p=0.006$). Some of the variants in the test-retest scores for the questions regarding neck pain and back pain may be due to fluctuations in the degree of pain. All of the questions referred to the previous four weeks, so some variation was expected as the questionnaires were answered one to two weeks apart.

Question: Are you satisfied with your progress since the injury?

64% (34/53) patients responded with ‘yes’. Test-retest reliability showed agreement in 82% (23/28). The kappa value was 0.60 (95% CI 0.29-0.91). This question was changed to improve the sensitivity, by converting the response options to a four-point Likert scale for the final version of the questionnaire. Criterion validity could not be assessed for this question. Although validated questionnaires regarding patient satisfaction exist, they usually are designed to measure patient satisfaction with treatment, rather than satisfaction with their condition. Three reviews were found addressing this measurement issue[423-425] but none of the reviews found a validated instrument. One review noted that most studies measuring patient satisfaction used a single question with a four-point scale.[424] This question was similar to the first question in the Six Month Patient Questionnaire regarding patients’ perception of their general recovery from the injury. As expected, the trend for correlation between the four-point ratings of recovery and satisfaction was significant (chi 2 7.21, 1 DF, P = 0.007).

Question: Have you retained the services of a lawyer regarding your injury?

36% (19/53) patients responded positively. Test-retest reliability showed 90% agreement (26/29), and a kappa value of 0.79 (95% CI 0.56-1.01).

4.2.5.3 Summary

Minor amendments were made to the questionnaires after piloting, as outlined above. Overall, the questionnaires showed a good distribution of responses and satisfactory test-retest reliability and, where possible, good criterion or construct reliability. Some variance in the responses was expected due to the time difference between completion of the questionnaires. Of concern, however, was the relatively poor reliability of the question regarding blame.

4.2.6 Measures

The explanatory variables were grouped as general, injury-related, socio-economic, and claim-related. All of the general, injury-related and socio-economic factors were recorded at the time of the injury from hospital records and the initial patient questionnaire (Appendix 13). The other claim-related variables and all outcome variables were recorded from the 6-month patient and surgeon questionnaires (Appendices 14, 15). The explanatory and outcome variables recorded are summarised in Table 4.2.

Table 4.2. The explanatory and outcome variables measured.

Explanatory variables	Outcome variables
General factors	PCS
Age	MCS
Gender	Neck pain
Hospital	Back pain
Country of birth	Patient-rated satisfaction
Chronic illnesses	Patient-rated recovery
Job satisfaction	Complications
Injury factors	Fracture non-union
Mechanism of injury	
Number of fractures	
Other body regions injured	
Socioeconomic factors	
Highest education level	
Annual household income	
Currently employed	
Claim-related factors	
History of compensation claims	
Claim made	
Claim type	
Lawyer involvement	
Blame (patient perception of fault)	

The mechanism of injury was classified as driver, passenger, motorcycle rider, or pedestrian/bicycle rider. The number of fractures present was a count of the number of bones fractured, and was retrieved from the treating doctors at the time of injury. The presence and number of any other body regions injured (excluding fractures) was similarly recorded.

The socio-economic factors measured were education, income and whether or not the patient was currently employed. Highest education level was categorised as primary school, secondary school, diploma or certificate, and bachelor degree or higher. Total annual household income was categorised in the same way as in Chapter Three: $0 – $30,000, $30,001 – $50,000, $50,001 - $75,000, and over $75,000. Employment was a dichotomous variable that was considered positive if an occupation was listed on the initial patient questionnaire. No consideration was given to the type of occupation or to whether the employment was full time or part time.

The claim-related variables measured were: previous claim, claim pursued, compensation system, use of a lawyer, and blame. Previous claim (a dichotomous variable) was determined from the initial patient questionnaire and was considered positive if the patient had made any previous claim for compensation (under any system). The remaining claim-related variables were measured in the same way as in Chapter Three. Claim pursuit was considered positive if the patient had made a claim for compensation related to the injury. The compensation system was categorised as workers compensation, third party or other. Use of a lawyer was considered positive if the patient had consulted a lawyer regarding their injury. Claim eligibility was not measured in this study as there was insufficient information to accurately determine this variable for the majority of patients.

PCS and MCS were calculated from the SF-36 scores, as described in Chapter Three. Neck pain and back pain were measured by repeating the two

SF-36 questions pertaining to bodily pain, and inserting the word “neck” or “low back” before the word “pain”, as described in Chapter Three. Patient and surgeon satisfaction was measured for two parameters: satisfaction with progress, and satisfaction with recovery. Each parameter was scored on a four point Likert scale, and the questions were worded similarly in the patient and surgeon quesitonnaires, to allow a comparison between patient and surgeon ratings. Fracture non-union was a dichotomous variable recorded as positive if any fracture had not healed at the 6-month follow-up (as recorded by the treating surgeons, who were asked specifically if each fracture had united).

Complications were listed in the free text response in the 6-month surgeon questionnaire. However, the presence of complications was not used as an objective outcome measure due to the open nature of the recording of complications, which allowed many complications to be listed which were based on patient complaints (e.g., pain and stiffness). Therefore, this outcome was dichotomised and considered positive if any complication was recorded, including non-union of a fracture (which was determined from a separate question).

The presence of fracture non-union was used as an objective outcome measure, as this diagnosis was provided by the treating surgeon, and is usually based on radiographic findings. This was used both as a possible explanatory variable in the analysis for each patient-based outcome, as well as a separate outcome variable.

4.2.7 Sample size calculation

It was initially estimated that there would be 12 explanatory variables for each outcome. Allowing 20 patients for each variable, a target of 240 patients was set. Allowing for 20% loss to follow-up, a recruitment target of 300 was made.

4.2.8 Statistical methods

The explanatory and outcome variables were coded and all data entered onto a spreadsheet, then imported and analysed using SAS (Cary, NC, USA). Some recoding of variables was performed during the analysis. Treating hospital was converted to a dichotomous variable (Liverpool versus all others) because of the large number of different hospitals, and the high number of patients recruited at Liverpool Hospital. Similarly, country of birth was dichotomised in to Australia and others, as the majority of patients were born in Australia, and there were a large number of other countries of birth, making statistical analysis difficult.

The number of chronic illnesses was less than in Chapter Three, with the majority of patients having none. Chronic illness was therefore dichotomised into ‘none’ and ‘one or more’.

Job satisfaction was kept as a four-part variable for the univariate analysis, and dichotomised if necessary for statistical purposes.

Mechanism of injury was divided into three parts: car, motorcycle, and pedestrian and cyclist. This was based on previous studies showing a prognostic difference between these groups,[133] and the finding that car drivers and passengers scored similarly for each outcome (therefore grouping them together as car occupants). The number of fractures was dichotomised into one versus two or more, and the number of other body regions was dichotomised into none versus one or more.

The socio-economic factors were kept in their original format, as in Chapter Three.

The claim-related factors were not changed for the statistical analysis and were analysed as in Chapter Three, with the addition of any history of claims, as a dichotomous variable. Claim type included a third category in this study: ‘other’.

One-way analyses were performed for all explanatory variables against all outcome variables using Pearson’s correlation coefficient when comparing two continuous variables, student’s t test when comparing a dichotomous variable to a continuous variable, one-way analysis of variance when testing a categorical against a continuous variable, and the chi square test when comparing categorical variables.

A multivariate analysis was performed for each outcome using explanatory variables with significance level of 0.25 or less in the univariate analysis.

Multiple linear regression was used for continuous outcome variables, and logistic regression for dichotomous outcome variables. Categorical outcome variables (such as patient and surgeon satisfaction ratings) were converted to dichotomous by simple conversion of the four-point Likert scale score.

4.3 Results

4.3.1 Patient sample

As per protocol, recruitment ceased after 300 patients were entered onto the study, but due to delays in posting responses and in communication, 306 patients were initially entered onto the study. Of the 306 patients initially entered, 232 completed follow-up questionnaires were received. There were 5 exclusions due to moving overseas or death, resulting in a follow-up rate of 77.1%. A flow chart of the patient recruitment and follow-up is given in Figure 4.1. The earliest response was at six months, and no further attempts at contact were made (and no responses accepted) after 12 months from the date of the injury.

For the 232 patients with completed follow-up, a surgeon response was only available for 141 (60.8%). Of the 91 who did not respond, 28 were unable to respond as they had not seen the patient post-injury, and 63 did not respond and no reason was given.

Characteristics of the patients are given in Table 4.3. Comparisons of patient characteristics between responding and non-responding patients at six months, and between patients for whom a six month questionnaire was or was not received by their surgeon, are given in Tables 4.4 and 4.5, respectively.

Figure 4.1. Summary of patient recruitment and follow-up.

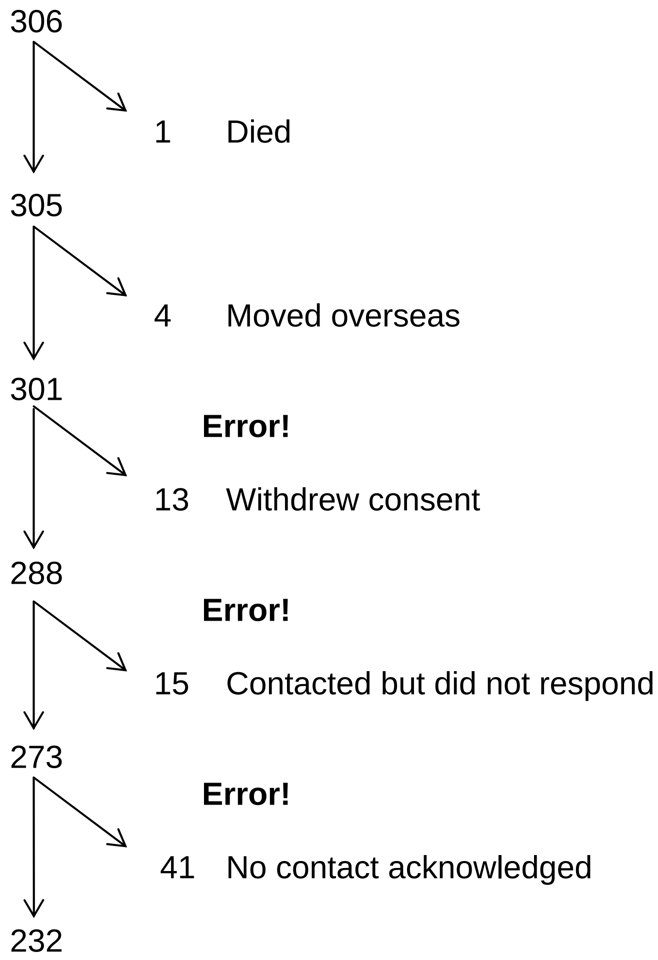

Table 4.3. Characteristics of the participants.

Variable	Category	N	%	Mean (range)
General factors				
Age (years)		232		37.9 (18 - 85)
Gender	Male	232	72.4	
	Female		27.6	
Hospital	Liverpool	232	39.7	
	Other		60.3	
Country of birth	Australia	232	73.7	
	Other		26.3	
Chronic illnesses	None	232	64.2	
	One or more		35.8	
Job satisfaction (if employed)	Very satisfied	191	59.2	
	Somewhat satisfied		36.1	
	Somewhat dissatisfied		3.7	
	Very dissatisfied		1.6	
Injury factors				
Mechanism	Car driver	221	35.8	
	Car passenger		5.9	
	Motor cycle rider		44.8	
	Pedestrian / cyclist		13.6	
Number of fractures	One	226	43.8	
	Two or more		56.2	
Other body regions injured	No	223	56.1	
	Yes		44.0	
Socioeconomic factors				
Highest education	Primary	232	2.6	
	Secondary		53.9	
	Certificate/Diploma		29.3	
	Bachelor degree		14.2	
Annual income	$0 – 30,000	228	30.3	
	$30,000 – 50,000		29.8	
	$50,000 – 75,000		21.9	
	$75,000+		18.0	
Employed at time of injury	No	232	21.1	
	Yes		78.9	
Claim-related factors				
Previous claim made	No	230	74.8	
	Yes		25.2	
Claim made	No	231	44.2	
	Yes		55.8	
Claim type (if made)	Workers comp.	130	33.1	
	Third party		56.9	
	Other		10.0	
Lawyer used	No	226	57.5	
	Yes		42.5	
Blame	Self	232	34.1	
	Someone else		47.8	
	Don’t know		18.1	

Table 4.4. A comparison of patients who did or did not respond to the follow-up questionnaire.

Variable	Responders	Non-responders	p value
Age (mean years)	37.9	34.3	0.10
Gender (% male)	81.9	72.4	0.10
Country of birth (% Australia)	73.7	76.8	0.60
Education (% primary/secondary)	56.5	66.7	0.13
Chronic illnesses (% present)	35.8	34.8	0.88
Hospital (% Liverpool)	39.7	33.8	0.37
Number of fractures (% > 1)	56.2	44.4	0.10
Income (% 0 - $50,000)	60.1	76.6	0.02
Job satisfaction (% satisfied)	94.8	92.3	0.49
Mechanism (% car occupants)	41.6	32.3	0.18
Employment (% employed)	78.9	75.4	0.54
Other injuries present (% present)	44.0	37.7	0.38

Table 4.5. Comparison of patients for whom a questionnaire was or was not received from their surgeon.

Variable	Responders	Non-responders	p value
Age (mean years)	37.9	38.0	0.99
Gender (% male)	71.2	74.4	0.60
Country of birth (% Australia)	71.9	76.7	0.42
Education (% primary/secondary)	56.2	57.0	0.90
Chronic illnesses (% present)	34.9	37.2	0.73
Hospital (% Liverpool)	48.6	24.4	0.0003
Number of fractures (% > 1)	60.1	49.4	0.17
Income (% 0 - $50,000)	65.5	50.6	0.03
Job satisfaction (% satisfied)	95.7	93.3	0.47
Mechanism (% car occupants)	46.0	34.2	0.08
Employment (% employed)	76.7	82.6	0.29
Other injuries present	44.0	43.9	0.99
Blame (%blame self)	45.5	39.5	0.43
Claim (%claim made)	57.2	53.5	0.58
Use of a lawyer (% yes)	45.8	37.4	0.22
Claim type (% workers compensation)	18.6	18.6	0.95

4.3.2 Hypothesis 1: Physical health

The PCS could be calculated for all patients. The mean score was 39.2, median 37.4, standard deviation 11.0, and scores ranged from 15.9 to 65.8. The univariate (unadjusted) associations between the explanatory variables and PCS are given in Table 4.6.

Backward stepwise regression removed the following variables in order (p values in brackets): treating hospital (0.98), current employment (0.81), blame (0.42), chronic illnesses(0.36), other injuries (0.27), mechanism (0.23), income (0.13), and claim pursuit (0.28).

The final model is given in Table 4.7. It included data from 220 patients and explained 30.5% of the variation in PCS. Interaction terms were tested in the final model and found to be not significant.

To test for confounding between the use of a lawyer and pursuit of a claim, claim pursuit was substituted for use of a lawyer in the final model, resulting in a highly significant effect for claim pursuit (effect estimate: -5.39, $p < 0.0001$).

The effect of fracture non-union was tested separately, in the sub group of 141 patients for whom surgeon follow-up was available. Fracture union was removed from the model with a p value of 0.22, resulting in no change in the final model.

Table 4.6. Unadjusted association between explanatory variables and PCS.

Variable	p value	Category (if applicable)	Mean PCS (95% CI)
General factors			
Age (years)	<0.0001		
Gender	0.0003	Male	40.8 (39.1 – 42.4)
		Female	34.9 (32.3 – 37.6)
Hospital	0.16	Liverpool	40.4 (38.3 – 42.5)
		Other	38.3 (36.4 – 40.3)
Country of birth	0.41	Australia	39.5 (37.8 – 41.2)
		Other	38.2 (35.6 – 40.7)
Chronic illnesses	0.06	None	40.2 (38.5 – 41.9)
		One or more	37.4 (34.8 – 39.9)
Job satisfaction	0.46	Very satisfied	39.8 (37.8 – 41.9)
(if employed)		Somewhat satisfied	40.3 (37.7 – 42.9)
		Somewhat dissatisfied	43.9 (35.7 – 52.1)
		Very dissatisfied	48.6 (36.0 – 61.1)
Injury factors			
Mechanism	0.003	Car driver/passenger	42.2 (39.5 – 44.9)
		Motorcycle	48.1 (45.5 – 50.7)
		Pedestrian / cyclist	41.5 (36.7 – 46.2)
Number of fractures	0.004	One	47.6 (45.1 – 50.2)
		Two or more	42.4 (40.0 – 44.8)
Other body regions	0.008	No	46.7 (44.4 – 49.1)
injured		Yes	41.9 (39.1 – 44.6)
Socioeconomic factors			
Highest education	0.95	Primary	36.9 (28.0 – 45.8)
		Secondary	39.1 (37.1 – 41.0)
		Certificate/Diploma	39.3 (36.7 – 41.9)
		Bachelor degree	39.7 (35.9 – 43.5)
Annual income	0.12	$0 – 30,000	37.3 (34.7 – 39.9)
		$30,000 – 50,000	38.4 (35.8 – 41.0)
		$50,000 – 75,000	40.4 (37.4 – 43.4)
		$75,000+	42.0 (38.7 – 45.4)
Employed (at injury)	0.02	No	35.9 (32.8 – 38.9)
		Yes	40.0 (38.5 – 41.6)
Claim-related factors			
Previous claim made	0.49	No	39.4 (37.7 – 41.0)
		Yes	38.2 (35.3 – 41.1)
Claim made	<0.0001	No	42.7 (40.4 – 45.0)
		Yes	36.4 (34.7 – 38.0)
Claim type (if made)	0.09	Workers comp.	38.7 (35.9 – 41.5)
		Third party	34.8 (32.6 – 36.9)
		Other	37.6 (32.5 – 42.8)
Lawyer used	<0.0001	No	42.5 (40.5 – 44.6)
		Yes	34.7 (33.2 – 36.3)
Blame	<0.0001	Self	43.4 (41.1 – 45.6)
		Someone else	35.2 (33.3 – 37.1)
		Don’t know	41.8 (38.6 – 44.9)
Fracture union	0.11	No	34.6 (29.7 – 39.5)
		Yes	38.9 (37.0 – 40.9)

Table 4.7. Adjusted (multivariate) associations between explanatory variables and PCS.

Variable	Group	Δ mean PCS	p value
Age	Per year	-0.18	<0.0001
Gender	Male	+3.73	0.01
Number of fractures	More than one	-3.75	0.005
Use of a lawyer	Yes	-7.63	<0.0001

Δ = change in

4.3.3 Hypothesis 2: Mental health

The MCS could be calculated for all patients. The mean score was 44.7, median 46.3, standard deviation 13.7, and scores ranged from 13.8 to 71.6. The univariate (unadjusted) associations between the explanatory variables and MCS are given in Table 4.8.

Stepwise regression removed the following variables in order (p values in brackets): gender (0.95), mechanism (0.83), claim pursuit (0.96), employment (0.96), blame (0.87), number of fractures (0.63), country of birth (0.39), and presence of other, non-orthopaedic, injuries (0.16). The final model (Table 4.9) used data from 222 patients and explained 23.1% of the variation in MCS.

Table 4.8. Unadjusted associations between explanatory variables and MCS.

Variable	p value	Category (if applicable)	Mean MCS (95% CI)
General factors			
Age (years)	0.009		
Gender	0.002	Male	46.4 (44.4 – 48.5)
		Female	40.3 (37.0 – 43.6)
Hospital	0.27	Liverpool	46.0 (43.3 – 48.6)
		Other	43.9 (41.5 – 46.3)
Country of birth	0.003	Australia	46.3 (44.3 – 48.3)
		Other	40.3 (36.9 – 43.8)
Chronic illnesses	0.78	None	44.5 (42.2 – 46.8)
		One or more	45.1 (42.2 – 48.0)
Job satisfaction	0.39	Very satisfied	46.6 (44.1 – 49.1)
(if employed)		Somewhat satisfied	45.2 (42.0 – 48.4)
		Somewhat dissatisfied	54.5 (44.3 – 64.6)
		Very dissatisfied	47.2 (31.7 – 62.8)
Injury factors			
Mechanism	0.003	Car driver/passenger	42.2 (39.5 – 44.9)
		Motorcycle	48.1 (45.5 – 50.7)
		Pedestrian / cyclist	41.5 (36.7 – 46.2)
Number of fractures	0.004	One	47.6 (45.1 – 50.2)
		Two or more	42.4 (40.0 – 44.8)
Other body regions injured	0.008	No	46.7 (44.4 – 49.1)
		Yes	41.9 (39.1 – 44.6)
Socioeconomic factors			
Highest education	0.31	Primary	37.5 (26.5 – 48.5)
		Secondary	45.3 (42.9 – 47.7)
		Certificate/Diploma	43.2 (40.0 – 46.5)
		Bachelor degree	47.0 (42.3 – 51.7)
Annual income	<0.0001	$0 – 30,000	37.9 (34.9 – 40.9)
		$30,000 – 50,000	45.3 (42.2 – 48.3)
		$50,000 – 75,000	47.4 (43.9 – 51.0)
		$75,000+	51.5 (47.6 – 55.5)
Employed (at injury)	0.003	No	39.6 (35.8 – 43.3)
		Yes	46.1 (44.1 – 48.1)
Claim-related factors			
Previous claim made	0.86	No	44.5 (42.4 – 46.6)
		Yes	44.9 (41.4 – 48.4)
Claim made	0.008	No	47.4 (44.8 – 50.1)
		Yes	42.6 (40.2 – 45.0)
Claim type (if made)	0.003	Workers comp.	47.1 (43.1 – 51.0)
		Third party	39.1 (36.1 – 42.1)
		Other	47.6 (40.4 – 54.8)
Lawyer used	<0.0001	No	48.0 (45.8 – 50.1)
		Yes	40.2 (37.4 – 42.9)
Blame	0.003	Self	47.9 (45.0 – 50.9)
		Someone else	41.5 (39.0 – 44.0)
		Don't know	47.2 (43.1 – 51.2)
Fracture union	0.28	No	39.9 (33.4 – 46.4)
		Yes	43.7 (41.2 – 46.3)

Table 4.9. Adjusted (multivariate) associations between explanatory variables and MCS.

Variable	Group	Δ mean MCS	p value
Age	Per year	-0.11	0.03
Use of a lawyer	Yes	-7.68	<0.0001
Annual household income	$0 – $30,000	*	
	$30,001 – $50,000	+6.79	0.001
	$50,001 – $75,000	+9.53	<0.0001
	Over $75,000	+12.55	<0.0001

*referent group, Δ = change in

As the type of claim (third party or workers compensation) was a significant factor on univariate analysis, an alternative analysis was performed combining claim pursuit and claim type into one variable. For both PCS and MCS as an outcome, this alternative analysis resulted in the same final model, except that claim pursuit was included as a significant predictor. However, there was no significant difference in the estimates according to type of claim.

4.3.4 Hypothesis 3: Neck pain

A combined score for neck pain, using data from the two questions regarding pain severity and effect of pain on function, was calculated for all patients. The mean score was 3.34, standard deviation 2.16, the median was 2.00, and the range was from 2 to 11. The unadjusted association between each explanatory variable and neck pain is given in Table 4.10.

Stepwise regression removed the following variables in order (p values in brackets): blame (0.82), treating hospital (0.78), mechanism (0.66), country of birth (0.66), employment (0.67), number of fractures (0.46), presence of other injuries (0.25), age (0.23), income (0.14), and claim pursuit (0.08). The final model for neck pain is given in Table 4.11. It included data from 226 patients and accounted for 18.3% of the variation in the neck pain score. Interaction terms in the final model were not significant.

Substitution of claim pursuit for use of a lawyer in the final model showed this to be highly significant ($p = 0.001$) suggesting confounding between these two variables.

The effect of fracture union was tested separately and found to be not significant in multivariate analysis ($p = 0.16$). However, inclusion of fracture union in the modelling process resulted in a different final model (Table 4.12) which included data on 227 patients and explained 21.5% of the variation in the neck pain score. The final model is similar, except that use of a lawyer was excluded ($p = 0.48$) and claim pursuit was retained, with the same effect estimate as use of a lawyer.

Table 4.10. Unadjusted association between explanatory variables and neck pain as a continuous variable.

Variable	p value	Category (if applicable)	Mean score (95% CI)
General factors			
Age (years)	0.003		
Gender	0.0004	Male	3.0 (2.7 – 3.2)
		Female	4.3 (3.6 – 5.0)
Hospital	0.19	Liverpool	3.1 (2.7 – 3.5)
		Other	3.5 (3.1 – 3.9)
Country of birth	0.03	Australia	3.1 (2.8 – 3.4)
		Other	4.0 (3.3 – 4.7)
Chronic illnesses	0.77	None	3.3 (3.0 – 3.7)
		One or more	3.4 (2.9 – 3.9)
Job satisfaction (if employed)	0.73	Very satisfied	3.3 (2.9 – 3.7)
		Somewhat satisfied	3.1 (2.6 – 3.6)
		Somewhat dissatisfied	2.7 (1.2 – 4.2)
		Very dissatisfied	4.0 (1.7 – 6.3)
Injury factors			
Mechanism	0.0008	Car driver/passenger	3.9 (3.5 – 4.3)
		Motorcycle	2.7 (2.3 – 3.2)
		Pedestrian / cyclist	3.7 (2.9 – 4.4)
Number of fractures	0.004	One	2.9 (2.6 – 3.2)
		Two or more	3.7 (3.3 – 4.1)
Other body regions injured	0.05	No	3.1 (2.8 – 3.5)
		Yes	3.7 (3.2 – 4.2)
Socioeconomic factors			
Highest education	0.004	Primary	6.5 (4.8 – 8.2)
		Secondary	3.3 (2.9 – 3.6)
		Certificate/Diploma	3.3 (2.8 – 3.8)
		Bachelor degree	3.1 (2.4 – 3.8)
Annual income	0.002	$0 – 30,000	4.1 (3.6 – 4.6)
		$30,000 – 50,000	3.2 (2.7 – 3.7)
		$50,000 – 75,000	3.0 (2.4 – 3.6)
		$75,000+	2.7 (2.0 – 3.3)
Employed (at injury)	0.03	No	4.1 (3.3 – 4.8)
		Yes	3.1 (2.9 – 3.4)
Claim-related factors			
Previous claim made	0.97	No	3.3 (3.0 – 3.7)
		Yes	3.4 (2.8 – 3.9)
Claim made	0.0002	No	2.8 (2.5 – 3.1)
		Yes	3.8 (3.4 – 4.2)
Claim type (if made)	0.89	Workers comp.	3.6 (2.9 – 4.4)
		Third party	3.9 (3.3 – 4.4)
		Other	3.8 (2.4 – 5.1)
Lawyer used	0.003	No	3.0 (2.7 – 3.3)
		Yes	3.8 (3.3 – 4.3)
Blame	0.008	Self	2.9 (2.5 – 3.4)
		Someone else	3.8 (3.4 – 4.2)
		Don’t know	2.9 (2.3 – 3.6)
Fracture union	0.23	No	4.1 (3.0 – 5.1)
		Yes	3.4 (3.0 – 3.8)

Table 4.11. Adjusted (multivariate) associations between explanatory variables and neck pain score.

Variable	Group	Δ mean score	p value
Gender	Female	+1.32	<0.0001
Use of a lawyer	Yes	+0.94	0.0004
Education level	Primary	*	
	Secondary	-3.03	0.0002
	Diploma/certificate	-2.94	0.0005
	Degree	-3.72	<0.0001
	(overall)		0.0004

*referent group, Δ = change in

Table 4.12. Adjusted (multivariate) associations between explanatory variables (including fracture union) and neck pain score.

Variable	Group	Δ mean score	p value
Gender	Female	+1.07	<0.0001
Claim pursuit	Yes	+0.94	0.0006
Education level	Primary	*	
	Secondary	-2.91	0.0005
	Diploma/certificate	-2.87	0.0008
	Degree	-3.02	0.0009
	(overall)		0.006
Annual household income	$0 - $30,000	*	
	$30,001 - $50,000	-0.55	0.12
	$50,001 - $75,000	-0.75	0.05
	Over $75,000	-1.25	0.003
	(overall)		0.03

*referent group, Δ = change in

4.3.5 Hypothesis 4: Back pain

Data regarding back pain was available on all patients. The mean back pain score was 4.16, the standard deviation 2.54, the median 3.0, and the range was from 2 to 11. The distribution was positively skewed. The unadjusted associations are given in Table 4.13.

Backward stepwise regression removed the following variables in order (p values in brackets): blame (1.00), mechanism (0.94), country of birth (0.84), claim (0.60), income (0.41), age (0.16), and number of fractures (0.16). The final model (Table 4.14) incorporated data from 226 patients and explained 14.6% of the variation in the back pain score. Interaction terms in the final model were not significant.

Table 4.13. The unadjusted associations between the explanatory variables and back pain score.

Variable	p value	Category (if applicable)	Mean score (95% CI)
General factors			
Age (years)	0.003		
Gender	0.004	Male	3.9 (3.5 – 4.2)
		Female	4.9 (4.2 – 5.6)
Hospital	0.61	Liverpool	4.1 (3.5 – 4.6)
		Other	4.2 (3.8 – 4.7)
Country of birth	0.05	Australia	4.0 (3.6 – 4.3)
		Other	4.7 (4.0 – 5.4)
Chronic illnesses	0.66	None	4.2 (3.8 – 4.6)
		One or more	4.1 (3.5 – 4.6)
Job satisfaction (if employed)	0.88	Very satisfied	3.9 (3.4 – 4.3)
		Somewhat satisfied	3.9 (3.3 – 4.4)
		Somewhat dissatisfied	3.1 (1.4 – 4.9)
		Very dissatisfied	4.0 (1.3 – 6.7)
Injury factors			
Mechanism	0.06	Car driver/passenger	4.5 (3.9 – 5.0)
		Motorcycle	3.7 (3.2 – 4.2)
		Pedestrian / cyclist	4.5 (3.6 – 5.4)
Number of fractures	0.003	One	3.6 (3.2 – 4.0)
		Two or more	4.6 (4.1 – 5.0)
Other body regions injured	0.31	No	4.0 (3.5 – 4.4)
		Yes	4.3 (3.8 – 4.8)
Socioeconomic factors			
Highest education	0.10	Primary	5.7 (3.6 – 7.7)
		Secondary	4.1 (3.7 – 4.6)
		Certificate/Diploma	4.5 (3.9 – 5.1)
		Bachelor degree	3.4 (2.5 – 4.3)
Annual income	0.001	$0 – 30,000	5.0 (4.4 – 5.6)
		$30,000 – 50,000	4.3 (3.7 – 4.9)
		$50,000 – 75,000	3.7 (3.0 – 4.4)
		$75,000+	3.2 (2.4 – 3.9)
Employed (at injury)	0.0004	No	5.3 (4.5 – 6.1)
		Yes	3.9 (3.5 – 4.2)
Claim-related factors			
Previous claim made	0.66	No	4.1 (3.7 – 4.5)
		Yes	4.3 (3.6 – 5.0)
Claim made	0.08	No	3.8 (3.4 – 4.3)
		Yes	4.4 (3.9 – 4.9)
Claim type (if made)	0.12	Workers comp.	3.7 (2.9 – 4.5)
		Third party	4.8 (4.1 – 5.4)
		Other	4.5 (3.0 – 6.0)
Lawyer used	0.002	No	3.7 (3.3 – 4.1)
		Yes	4.8 (4.2 – 5.4)
Blame	0.03	Self	3.6 (3.1 – 4.2)
		Someone else	4.6 (4.2 – 5.1)
		Don't know	3.9 (3.1 – 4.7)
Fracture union	0.59	No	4.8 (3.6 – 6.0)
		Yes	4.4 (3.9 – 4.9)

Table 4.14. Adjusted (multivariate) associations between explanatory variables and back pain score.

Variable	Group	∆ mean score	p value
Gender	Female	+0.80	0.04
Employed at time of injury	Yes	-1.04	0.01
Use of a lawyer	Yes	+1.15	0.0005
Education level	Primary	*	
	Secondary	-1.45	0.15
	Diploma/certificate	-0.92	0.37
	Degree	-2.46	0.02
	(overall)		0.01

*referent group, ∆ = change in

4.3.6 Hypothesis 5: Patient-rated satisfaction and recovery

Patient satisfaction data was complete and the results are shown in Table 4.15.

Table 4.15. Frequency of patient responses regarding satisfaction with progress since the injury.

Response	Frequency
Very satisfied	57 (24.6%)
Somewhat satisfied	116 (50.0%)
Somewhat dissatisfied	35 (15.1%)
Very dissatisfied	24 (10.4%)

The univariate analyses for categorical variables were performed using patient satisfaction as a four-part variable, but odds ratios for a poor outcome (using a dichotomous outcome) are provided in the table for easier interpretation. For age (the only continuous variable) the t test was significant (p = 0.07), with a mean age of 36.4 for satisfied patients, and 42.4 for dissatisfied patients. The univariate associations for the categorical variables are provided in Table 4.16.

Backward stepwise logistic regression removed all variables except blame. Consequently, the final model is the same as the univariate association for blame. The variables for claim pursuit or use of a lawyer (significant on univariate analysis) were not significant when they were in the same model as blame ($p = 0.25$ and 0.83, respectively).

In separate subgroup analyses, claim type was not significant ($p = 0.32$), and nor was fracture union, although there was a trend towards lower patient satisfaction when fracture non-union was present ($p = 0.08$).

Table 4.16. Univariate (unadjusted) associations between explanatory variables and patient satisfaction.

Variable	p value for overall chi^2 (MH)	Category	OR (95% CI)
General factors			
Gender	0.07 (0.04)	Female	1.00
		Male	0.44 (0.23 – 0.82)
Hospital	0.26 (0.21)	Other	1.00
		Liverpool	0.75 (0.39 – 1.45)
Country of birth	0.33 (0.30)	Other	1.00
		Australia	0.75 (0.39 – 1.45)
Chronic illnesses	0.73 (0.72)	None	1.00
		One or more	1.09 (0.59 – 2.02)
Job satisfaction	0.03 (0.58)	Very satisfied	0.76 (0.07 – 8.64)
(if employed)		Somewhat satisfied	0.42 (0.04 – 5.03)
		Somewhat dissatisfied	0.33 (0.01 – 8.18)
		Very dissatisfied	1.00
Injury factors			
Mechanism	0.28 (0.71)	Car occupant	1.00
		Motorcycle	0.72 (0.36 – 1.41)
		Pedestrian / cyclist	2.17 (0.92 – 5.12)
Number of fractures	0.81 (0.66)	One	1.00
		Two or more	1.14 (0.62 – 2.09)
Other injuries	0.67 (0.67)	No	1.00
		Yes	1.05 (0.58 – 1.92)
Socioeconomic factors			
Highest education	0.35 (0.17)	Primary	1.00
		Secondary	0.75 (0.13 – 4.27)
		Certificate/Diploma	0.72 (0.12 – 4.28)
		Bachelor degree	0.36 (0.05 – 2.50)
Annual income	0.05 (0.01)	\$0 – 30,000	1.00
		\$30,000 – 50,000	0.47 (0.22 – 0.99)
		\$50,000 – 75,000	0.41 (0.18 – 0.96)
		\$75,000+	0.34 (0.13 – 0.88)
Employed (at injury)	0.27 (0.06)	No	1.00
		Yes	0.63 (0.32 – 1.26)
Claim-related factors			
Previous claim made	0.90 (0.48)	No	1.00
		Yes	1.28 (0.66 – 2.49)
Claim made	0.02 (0.004)	No	1.00
		Yes	2.69 (1.41 – 5.13)
Claim type (if made)	0.50 (0.11)	Workers comp.	1.00
		Third party	1.77 (0.77 – 4.06)
Lawyer used	0.05 (0.008)	No	1.00
		Yes	1.74 (0.96 – 3.16)
Blame	0.001 (0.0001)	Self	1.00
		Don’t know	1.24 (0.44 – 3.47)
		Someone else	3.62 (1.72 – 7.62)
Fracture union	0.21 (0.26)	No	1.00
		Yes	0.52 (0.19 – 1.44)

MH = Mantel-Haenszel test for trend, OR = odds ratio for patient dissatisfaction

Data on patient-rated recovery were complete. The responses are provided in Table 4.17and the univariate analyses for the categorical variables are given in Table 4.18. As with the other analyses of satisfaction and recovery, the p values are given for the four-part outcome variable, and the odds ratios and multivariate analyses use the dichotomised outcomes.

The mean age in patients who felt they had recovered (responses 1 and 2) was 34.2 (95% CI 31.2 – 37.1) compared to 40.9 (95% CI 38.0 – 43.9) in those who felt that they had not significantly recovered (responses 3 and 4). This difference was statistically significant (p = 0.002).

Table 4.17. Frequency of patient responses regarding general recovery from the injury.

Response	Frequency
Back to normal	18 (7.8%)
Minor problems only	85 (36.6%)
Significant problems remain	117 (50.4%)
No significant recovery has occurred since the injury	12 (5.2%)

The final model for patient-rated recovery (Table 4.19) used data from 226 patients. Satisfactory association between predicted and observed responses was noted with 68.3% concordance and a c value of 0.75.

Substituting claim pursuit for lawyer in the final model resulted in claim becoming significant (p = 0.03)

Table 4.18. Univariate (unadjusted) associations between explanatory variables and patient-rated recovery.

Variable	p value for overall chi^2 (MH)	Category	OR (95% CI)
General factors			
Gender	0.01 (0.004)	Female	1.00
		Male	0.35 (0.18 – 0.65)
Hospital	0.13 (0.37)	Other	1.00
		Liverpool	0.74 (0.44 – 1.25)
Country of birth	0.01 (0.11)	Other	1.00
		Australia	0.76 (0.42 – 1.37)
Chronic illnesses	0.97 (0.70)	None	1.00
		One or more	1.07 (0.62 – 1.83)
Job satisfaction (if employed)	0.02 (0.05)	Very satisfied	2.61 (0.23 – 29.6)
		Somewhat satisfied	2.31 (0.20 – 26.7)
		Somewhat dissatisfied	0.33 (0.01 – 8.18)
		Very dissatisfied	1.00
Injury factors			
Mechanism	0.08 (0.36)	Car occupant	1.00
		Motorcycle	0.73 (0.41 – 1.29)
		Pedestrian / cyclist	2.21 (0.89 – 5.48)
Number of fractures	0.003 (0.0006)	One	1.00
		Two or more	2.29 (1.34 – 3.93)
Other injuries	0.635 (0.22)	No	1.00
		Yes	1.38 (0.81 – 2.36)
Socioeconomic factors			
Highest education	0.66 (0.73)	Primary	1.00
		Secondary	1.19 (0.23 – 6.14)
		Certificate/Diploma	1.35 (0.25 – 7.15)
		Bachelor degree	1.36 (0.24 – 7.75)
Annual income	0.008 (0.007)	$0 – 30,000	1.00
		$30,000 – 50,000	0.72 (0.36 – 1.43)
		$50,000 – 75,000	0.57 (0.27 – 1.19)
		$75,000+	0.54 (0.25 – 1.19)
Employed (at injury)	0.25 (0.18)	No	1.00
		Yes	0.83 (0.44 – 1.58)
Claim-related factors			
Previous claim made	0.83 (0.83)	No	1.00
		Yes	1.15 (0.63 – 2.10)
Claim made	<0.0001 (0.0001)	No	1.00
		Yes	3.89 (2.24 – 6.74)
Claim type (if made)	0.32 (0.09)	Workers comp.	1.00
		Third party	1.89 (0.85 – 4.23)
Lawyer used	<0.0001 (<0.0001)	No	1.00
		Yes	3.67 (2.08 – 6.49)
Blame	<0.0001 (<0.0001)	Self	1.00
		Don’t know	0.82 (0.38 – 1.77)
		Someone else	4.15 (2.24 – 7.70)
Fracture union	0.27 (0.08)	No	1.00
		Yes	0.34 (0.11 – 1.09)

MH = Mantel-Haenszel test for trend, OR = odds ratio for poor patient recovery

In a separate analysis, claim type was found to be not significant (p = 0.66). In another separate analysis (n = 140) the presence of fracture non-union was found to be significantly associated with poor patient recovery (p = 0.04).

Table 4.19. Adjusted (multivariate) associations between explanatory variables and patient-rated recovery.

Variable	Group	OR (95% CI)	p value
Gender	Male	0.31 (0.15 – 0.61)	0.04
Use of a lawyer	Yes	2.13 (1.01 – 4.47)	0.05
Blame	Self	1.00	
	Don’t know	0.77 (0.34 – 1.79)	0.55
	Someone else	2.86 (1.29 – 6.34)	0.01
	(overall)		0.006

OR = odds ratio for poor recovery

The mean SF-35 summary scores were compared to categories of patient-rated satisfaction and recovery, to test the association between these scores and measures of health. A strong association was seen for each variable, as shown in Table 4.20.

Table 4.20. Associations between the SF-36 summary scores and patient-rated satisfaction and recovery.

Outcome	Group	Mean PCS (95% CI)*	Mean MCS (95% CI)*
Satisfaction	Satisfied	41.6 (39.9 – 43.2)	47.6 (45.7 – 49.6)
	Dissatisfied	32.2 (30.3 – 34.1)	36.2 (32.8 – 39.6)
Recovery	Good	47.7 (46.0 – 49.5)	50.7 (48.4 – 53.0)
	Poor	32.3 (31.1 – 33.6)	40.0 (37.6 – 42.3)

* the p value for each association was <0.0001.

4.3.7 Hypothesis 6: Surgeon-rated satisfaction and recovery

Surgeon-rated satisfaction with patient progress, and surgeon-rated patient recovery were categorised as four-part variables. However, due to only one surgeon choosing the worst ranking for satisfaction, and only two surgeons choosing the worst ranking for recovery, these variables were both dichotomised into ‘good’ and ‘poor’. As the number of samples in the ‘poor’ group was low, some four-part explanatory variables (education and job satisfaction) were also dichotomised and this was performed by combining responses from the first two and last two responses, separately.

Surgeon questionnaires were only requested if a completed patient questionnaire was received, however the response rate for the surgeon questionnaire was poor (141/232, 60.8%). In 28 cases however, the treating surgeons was not able to respond because the patient had not attended for follow-up.

Surgeons rated their satisfaction with the patient’s progress since the injury as good in 124 cases (88.0%) and poor in 17 (12.1%). Surgeons rated patient recovery as good in 94 cases (66.7%) and poor in 47 (33.3%).

The univariate associations between the categorical explanatory variables and surgeon-rated satisfaction and recovery are given in Tables 4.21 and 4.22, respectively. Patients for whom surgeon satisfaction was poor were older than those who were rated good (mean ages 43.3 and 37.3, respectively, $t = -1.41$, 139 DF, p = 0.16). Similarly, patients whose recovery was rated as poor were older than those rated as good (mean ages 40.2 and 37.0, respectively, t = 1.09, 139 DF, p = 0.28).

For surgeon satisfaction, logistic regression removed the following variables in order (p values in brackets): blame (0.64), claim (0.10), age (0.13), and number of fracture (0.08). The final model, using data from 140 patients, contained fracture non-union as the only significant variable. The presence of non-union predicted surgeon dissatisfaction (OR 9.09, 95% CI 2.91 – 28.6).

For surgeons' rating of recovery, logistic regression removed variables in the following order (p values in brackets): treating hospital (0.98), blame (0.92), gender (0.83), number of fractures (0.70), use of a lawyer (0.54), income (0.41), mechanism (0.20), claim pursuit (0.09), and presence of other injuries (0.10). The only remaining variable in the model was the presence of fracture non-union, for which the odds ratio of poor recovery was 10.4 (95% CI 3.23 – 33.3)

The associations between surgeon-rated satisfaction and recovery, and the PCS and MCS scores are given in Table 4.23.

Table 4.21. Univariate (unadjusted) associations between explanatory variables and surgeon-rated satisfaction.

Variable	p value for overall chi^2 (MH)	Category	OR (95% CI)
General factors			
Gender	0.68	Female	1.00
		Male	1.28 (0.39 – 4.19)
Hospital	0.87	Other	1.00
		Liverpool	0.92 (0.33 – 2.53)
Country of birth	0.97	Other	1.00
		Australia	0.98 (0.32 – 2.99)
Chronic illnesses	0.51	None	1.00
		One or more	1.42 (0.50 – 3.99)
Job satisfaction	0.41	Satisfied	1.00
		Dissatisfied	Not estimatable
Injury factors			
Mechanism	0.52 (0.88)	Car occupant	1.00
		Motorcycle	0.57 (0.18 – 1.81)
		Pedestrian / cyclist	1.24 (0.30 – 5.19)
Number of fractures	0.24	One	1.00
		Two or more	0.55 (0.20 – 1.51)
Other injuries	0.70	No	1.00
		Yes	0.82 (0.29 – 2.28)
Socioeconomic factors			
Highest education	0.51	Certificate or higher	1.00
		Primary / secondary	0.71 (0.26 – 1.96)
Annual income	0.99 (0.89)	$0 – 30,000	1.00
		$30,000 – 50,000	1.00 (0.28 – 3.53)
		$50,000 – 75,000	1.10 (0.28 – 4.28)
		$75,000+	0.80 (0.15 – 4.33)
Employed (at injury)	0.93	No	1.00
		Yes	0.95 (0.29 – 3.14)
Claim-related factors			
Previous claim made	0.96	No	1.00
		Yes	1.03 (0.31 – 3.42)
Claim made	0.09	No	1.00
		Yes	2.81 (0.87 – 9.09)
Claim type (if made)	0.99	Workers comp.	1.00
		Third party	0.99 (0.26 – 3.79)
Lawyer used	0.26	No	1.00
		Yes	1.81 (0.64 – 5.06)
Blame	0.23 (0.17)	Self	1.00
		Don't know	0.54 (0.06 – 5.12)
		Someone else	2.12 (0.64 – 7.00)
Fracture union	<0.0001	No	1.00
		Yes	0.11 (0.04 – 0.34)

MH = Mantel-Haenszel test for trend, OR = odds ratio for surgeon dissatisfaction

Table 4.22. Univariate (unadjusted) associations between explanatory variables and surgeon-rated recovery.

Variable	p value for overall chi^2 (MH)	Category	OR (95% CI)
General factors			
Gender	0.23	Female	1.00
		Male	0.63 (0.29 – 1.35)
Hospital	0.08	Other	1.00
		Liverpool	0.52 (0.26 – 1.07)
Country of birth	0.60	Other	1.00
		Australia	0.82 (0.38 – 1.75)
Chronic illnesses	0.45	None	1.00
		One or more	0.75 (0.35 – 1.59)
Job satisfaction	0.52	Satisfied	1.00
		Dissatisfied	2.09 (0.23 – 19.3)
Injury factors			
Mechanism	0.13 (0.07)	Car occupant	1.00
		Motorcycle	0.48 (0.22 – 1.06)
		Pedestrian / cyclist	0.44 (0.13 – 1.52)
Number of fractures	0.05	One	1.00
		Two or more	2.13 (1.00 – 4.57)
Other injuries	0.02	No	1.00
		Yes	2.40 (1.16 – 4.98)
Socioeconomic factors			
Highest education	0.29 (0.28)	Primary	1.00
		Secondary	0.16 (0.02 – 1.65)
		Certificate/Diploma	0.17 (0.02 – 1.80)
		Bachelor degree	0.11 (0.01 – 1.33)
Annual income	0.23 (0.09)	$0 – 30,000	1.00
		$30,000 – 50,000	1.01 (0.43 – 2.37)
		$50,000 – 75,000	0.40 (0.14 – 1.14)
		$75,000+	0.53 (0.16 – 1.69)
Employed (at injury)	0.78	No	1.00
		Yes	1.13 (0.49 – 2.64)
Claim-related factors			
Previous claim made	0.35	No	1.00
		Yes	1.47 (0.65 – 3.32)
Claim made	0.05	No	1.00
		Yes	2.09 (1.00 – 4.36)
Claim type (if made)	0.35	Workers comp.	1.00
		Third party	1.62 (0.59 – 4.45)
Lawyer used	0.04	No	1.00
		Yes	2.17 (1.06 – 4.47)
Blame	0.35 (0.15)	Self	1.00
		Don’t know	1.46 (0.48 – 4.47)
		Someone else	1.82 (0.81 – 4.07)
Fracture union	<0.0001	No	1.00
		Yes	0.10 (0.03 – 0.31)

MH = Mantel-Haenszel test for trend, OR = odds ratio for poor recovery

Table 4.23. Associations between the SF-36 summary scores and surgeon-rated satisfaction and recovery.

Outcome	Group	Mean PCS (95% CI)*	Mean MCS (95% CI)**
Satisfaction	Satisfied	39.4 (37.5 – 41.3)	43.8 (41.2 – 46.3)
	Dissatisfied	30.1 (26.5 – 33.6)	39.8 (32.6 – 47.0)
Recovery	Good	41.7 (39.5 – 43.9)	45.7 (42.9 – 48.4)
	Poor	31.5 (29.3 – 33.7)	38.5 (34.2 – 42.9)

* p value for each association with PCS was <0.0001
** for satisfaction and MCS, p = 0.3; for recovery and MCS, p = 0.005.

4.3.8 Hypothesis 7: Fracture-related complications

Complications were present in 60 (42.6%) of 141 patients for whom the surgeon response was available. As described in the methods, the presence of complications was not used in the analysis as an objective measure of outcome because of the unstructured nature of the recording of complications. This allowed a large number of complications to be recorded that were considered subjective (dependent on patient complaints), for example, 24 (40%) of the complications were persistent pain and/or stiffness in the injured region. Apart from fracture non-union, the other complications that may be considered objective occurred in low numbers (nerve injury or irritation in 8 patients, infection in 4 patients, and residual deformity in 4 patients). Therefore, the presence of one or more fracture non-unions was used as the objective measure of outcome.

Data regarding fracture union was available for 140 patients: 19 (13.6%) had fractures that had not united according to their treating surgeon. Univariate analysis of each categorical explanatory variable and fracture union is given in Table 4.24. Age was not significantly associated with fracture union ($p = 0.89$). Due to the low number of fracture non-unions, and therefore small numbers in some cells, job satisfaction and education were dichotomised.

Multivariate analysis showed that none of the explanatory variables were significantly associated with fracture union.

Table 4.24. Unadjusted association between explanatory variables and fracture union (absence of non-union).

Variable	p value for overall chi^2 (MH)	Category	OR (95% CI)
General factors			
Gender	0.22	Female	1.00
		Male	0.44 (0.12 – 1.61)
Hospital	0.25	Other	1.00
		Liverpool	1.80 (0.66 – 4.89)
Country of birth	0.82	Other	1.00
		Australia	0.88 (0.29 – 2.62)
Chronic illnesses	0.75	None	1.00
		One or more	0.85 (0.31 – 2.32)
Job satisfaction	0.98	Satisfied	1.00
		Dissatisfied	Not estimatable
Injury factors			
Mechanism	0.93 (0.70)	Car occupant	1.00
		Motorcycle	1.19 (0.41 – 3.44)
		Pedestrian / cyclist	1.30 (0.25 – 6.67)
Number of fractures	0.19	One	1.00
		Two or more	0.49 (0.16 – 1.44)
Other injuries	0.48	No	1.00
		Yes	0.71 (0.27 – 1.87)
Socioeconomic factors			
Highest education	0.88	Certificate or higher	1.00
		Primary / secondary	1.08 (0.41 – 2.85)
Annual income	0.28 (0.77)	$0 – 30,000	1.00
		$30,000 – 50,000	0.32 (0.09 – 1.12)
		$50,000 – 75,000	0.56 (0.13 – 2.42)
		$75,000+	0.80 (0.13 – 4.76)
Employed (at injury)	0.43	No	1.00
		Yes	0.60 (0.16 – 2.19)
Claim-related factors			
Previous claim made	0.87	No	1.00
		Yes	1.10 (0.34 – 3.59)
Claim made	0.25	No	1.00
		Yes	0.55 (0.19 – 1.53)
Claim type (if made)	0.98	Workers comp.	1.00
		Third party	0.98 (0.26 – 3.75)
Lawyer used	0.25	No	1.00
		Yes	0.56 (0.21 – 1.50)
Blame	0.98 (0.87)	Self	1.00
		Don't know	0.88 (0.20 – 3.91)
		Someone else	0.91 (0.31 – 2.69)

MH = Mantel-Haenszel test for trend, OR = odds ratio for fracture union.

4.5 Discussion

4.4.1 Summary of main results

Retaining the services of a lawyer regarding an accident was strongly negatively associated with physical and mental health in patients six months after sustaining a fracture in a motor vehicle accident. Pursuit of a compensation claim was not significantly associated with general health in the same group, however there was confounding between the use of a lawyer and pursuing a claim. Both of these variables were strongly associated with physical and mental health on univariate analysis, but the effect of use of a lawyer was stronger and accounted for the effect of claim pursuit on multivariate analysis. When claim pursuit was substituted for use of a lawyer in the final models (for PCS and MCS), it was highly significant.

The type of claim (workers compensation or third party compensation) was not significantly associated with the general health outcomes. When the type of claim was included in a separate analysis, a similar final model was reached, only with claim pursuit instead of use of a lawyer, again indicating confounding between these two variables.

Apart from the age of the patient, general health was not associated with any demographic or socio-economic factors on multivariate analysis. Regarding injury severity, having more than one fracture was negatively associated with physical health, but none of the injury severity factors were associated with mental health.

As with general health, the final models for neck pain, back pain, and patient satisfaction contained only a few variables. The models for neck pain and back pain were similar, with female sex, lower education levels, and use of a lawyer being associated with increasing pain. As with the previous models, claim pursuit was only significant if use of a lawyer was excluded from the model, due to confounding between these two variables.

Patient satisfaction with progress was only associated with blame (where lower satisfaction was associated with blaming others) on multivariate analysis whereas patient-rated recovery was only associated with blame, male sex, and use of a lawyer.

Although 13.6% of patients had fractures that had not united at follow-up, fracture non-union was not significantly associated with any of the explanatory variables. While fracture non-union may have been expected to be associated with injury-severity factors, it was not expected to be associated with the demographic, socio-economic or compensation-related variables

4.4.2 Comments on methods

4.4.2.1 Study population

Confining the population to patients with certain fractures, and to motor vehicle accidents, diminishes the effect of variation in the type of injury on the outcomes. It also decreases the chance of missed patients, because patients with injuries satisfying the inclusion criteria would normally be admitted to hospital. Some variation was expected in the types of treatment provided, and in the outcomes for the different fractures included in the study, and this may have caused some bias in the results. The sample size, however, did not allow discrimination of the effects for each fracture type.

No record of refusals was kept, and considerable variation in response between hospitals was found. This was felt to be due to differences in the attitude of the recruiting orthopaedic registrars at each institution, as the recruitment rate changed for each hospital, as new registrars rotated through every six months. It is likely that there were differences in the approach of the registrars to potential patients, and that this explained the differences in the recruitment rates. Although each hospital employed several orthopaedic registrars, the job of patient recruitment was usually left to only one, thus increasing the variation between hospitals due to differences in the attitude of each registrar to the study.

Follow-up was aimed at a single time-point, six months, but difficulties in contacting some patients, and late returns from some patients, resulted in some follow-up times as long as 12 months. Although this may introduce some bias, differences in follow-up time were not considered significant enough to justify inclusion of this factor as another explanatory variable.

While the patient response rate was close to the rate expected, the surgeon response rate was poor. This was partly due to poor responses from the surgeons, and partly due to patients not seeing their treating doctors after the initial post-injury period. The poor response rate from the surgeons affected the validity of the results that relied on these responses, in particular, the complication rate and the measures of surgeon and patient satisfaction. It did not, however, affect the main outcome measures, which were patient-based. Nor did it affect the main explanatory variables, which were measured at the time of injury, and in the six-month patient questionnaire.

A comparison of responding to non-responding patients showed that non-responding patients were more likely to be younger, female, and have a lower education level. These associations were not significant, but may be explained by confounding from the only significant factor associated with a lack of response: a low income level. The poorer response in patients with low income may be due to difficulties contacting this group of patients (possibly due to address changes), or because this group were less likely to respond when contacted.

In contrast to predictors of patient response, the only significant patient factors associated with lack of surgeon response were higher income and attending a hospital other than Liverpool Hospital. The strong association between surgeon response and attendance at Liverpool Hospital can be explained by Liverpool Hospital being the coordinating centre for the study, consequently all of the orthopaedic registrars and consultants were familiar with the study, patients and surgeons could be tracked more easily, and it was easier to return the forms as the surgeons worked in the same building that was used as the study centre. The less significant association with income is probably due to confounding from this factor, as Liverpool is in a relatively low socio-economic area.

Although the high response rate in the patient follow-up is expected to diminish any selection bias, the low response rate for surgeons means that selection bias is more likely. However, apart from the treating hospital and the income level, there was no significant difference between responders and non-responders for any other variables, particularly the main explanatory variables regarding blame, claim pursuit, claim type, and use of a lawyer.

4.4.2.2 Explanatory variables

The majority of the explanatory variables used were trialed in a pilot study of the questionnaire, and the validity of these variables is discussed in the methods section of this chapter and in Chapter Three. Variables that were not used in the study in Chapter Three are discussed below.

Contraction of the treating hospital into a dichotomous variable was justified because the variable was not significantly associated with any of the outcomes, even though the contraction would have resulted in some loss of information. Similarly, the country of birth was converted to a dichotomous variable, but was not found to be a significant factor in any of the analyses.

The responses to the question on job satisfaction were biased towards the first two responses (indicating satisfaction), but a valid statistical association was still possible for the major outcome variables. The validity of this question is discussed above under Methods.

When measuring the mechanism of injury, pedestrians and bicyclists were grouped together. This was necessary because of the low numbers in these groups, but was considered reasonable, as pedestrians and bicyclists would be expected to be subjected to similar forces, and the mechanism of injury (direct impact on the body) is similar.

The measures of injury severity (number of fractures and presence of other injuries) were considered appropriate for this population, as an increasing number of fractures implies an increasing energy of impact. The presence of fracture non-union was also used as a measure of injury severity, as this has previously been shown to be strongly related to high energy injuries.[457-459]

Regarding the type of claim pursued, analysis was confined to comparing patients claiming under workers compensation, to those claiming under third party insurance. While this decreased the number of patients included in the analysis, it allowed a valid comparison of the two main compensation systems: one fault-based and one no-fault system. Including the small number of patients claiming under “other” compensation schemes would have made analysis more difficult and would not have offered any further information without knowing what the “other” schemes were.

The poor surgeon response resulted in difficulties with the multivariate analyse for these outcomes. This was overcome by grouping several of the four-part variables as dichotomous, although this resulted in some loss of definition regarding the effect of different levels of the variables.

4.4.2.3 Outcome variables

The main outcomes, PCS and MCS, are widely used measures of general health and, along with neck pain, back pain and patient satisfaction, have been discussed in Chapter Three.

Patient assessment of recovery after the injury was expected to provide a more objective opinion of the patients’ health status at the time, rather than “satisfaction with progress” which was expected to be influenced by the processes related to their injury. Patient satisfaction and patient-rated recovery were highly associated with the PCS and MCS scores, indicating that both measures are strongly influenced by health status. However, whereas the PCS was associated with gender and injury severity (number of fractures), patient satisfaction and patient-rated recovery were not associated with gender or injury severity. Interestingly, both patient satisfaction and patient-rated recovery were strongly associated with blaming others for the injury, a factor that was not associated with PCS and MCS on multivariate analysis.

The presence of complications and fracture union were included, not as predictors of other outcomes (although this was examined to a limited extent), but as objective measures of outcome that would provide a comparison for the patient-based outcomes. The presence of complications, however, was non-specific and was influenced by patient complaints (and was therefore less objective). This is supported by an observation of the responses for this outcome, which shows that the most common complication was complaints of pain and stiffness in the affected joints, rather than infections or the need for further surgery. The presence of fracture union (or non-union) was considered to be more objective, and this may explain the lack of association between fracture union and any of the possible predictors, which are mainly demographic and socio-economic factors.

4.4.2.4 Statistical analysis

The statistical analysis was similar to that performed in Chapter Three. The assumptions of the models were satisfied, and meaningful associations for patient-based outcomes could be derived. The low surgeon response rate, however, made modelling for surgeon outcomes, and use of the presence of complications as a predictor, difficult.

4.4.3 Interpretation of the results

4.4.3.1 Physical health

In the multivariate analysis, physical health was associated with age, gender, number of fractures, and use of a lawyer. The decrease in the PCS score with increasing age, and the higher scores in males, are consistent with Australian population norms.[433] Also, the lower mean PCS in patients with more than one fracture is biologically plausible and likely to be a true effect. It also validates the use of this variable as a measure of injury severity.

Physical health was not significantly associated with claim pursuit on multivariate analysis despite being strongly associated in the univariate analysis, and therefore the main hypothesis is rejected. However, physical health was strongly associated with the use of a lawyer, and it is the confounding between these two variables that led to claim pursuit being rejected from the final model, as claim pursuit is strongly associated with PCS if use of a lawyer is removed from the model, and claim pursuit and use of a lawyer were associated with each other (76.5% agreement).

Although there was confounding between these two variables, both of which were strongly associated with PCS in the univariate analysis, there was some evidence of an independent effect of claim pursuit, as this was the final predictor removed in the modelling process. Therefore, it is possible that the effect of claim pursuit may have been statistically significant (allowing for legal involvement) if the sample size was larger, as was seen in Chapter Three.

Although determinants of general health after motor vehicle accidents have been previously studied,[159 189 399 460] these studies have not examined the influence of compensation-related factors. The majority of the previous studies on the effect of compensation-related factors on outcome after motor vehicle accidents have used psychological outcomes (e.g., PTSD) or neck pain as their main outcome, rather than measures of general health. These studies are discussed elsewhere.

4.4.3.2 Mental health

As with PCS, claim pursuit was significantly associated with MCS in the univariate analysis, this association was not significant on multivariate analysis, and a strong association was seen between use of a lawyer and MCS. Claim pursuit became significant if use of a lawyer was removed from the model, indicating confounding between these variables, but it appears that the effect of claim pursuit seen in the univariate analysis was due to this confounding and, therefore, the hypothesis that MCS is related to claim pursuit is rejected.

However, the strong association between MCS and the use of a lawyer indicates that MCS is related to at least one aspect of the compensation process. The stronger association seen with legal involvement, rather than claim pursuit, still indicates that factors related to compensation may influence the outcome. It appears that legal involvement is a more important predictor than claim pursuit; this is discussed below under Implication of the Results (4.5.5).

Previous studies of outcome after motor vehicle accidents have concentrated on psychological outcomes such as PTSD, rather than measures of general health. Therefore, there are no comparable studies on which to comment regarding this outcome.

4.4.3.3 Neck pain

Claim pursuit was the variable with the strongest association with neck pain in the univariate analysis. In the multivariate analysis, claim pursuit was associated (independently of lawyer involvement and the other variables in the final model) with a lower neck pain score but was discarded from the final model with a p value of 0.08. It is likely that the effect of claim pursuit may have been significant if the sample size was larger.

The effect of claim pursuit is supported by the alternative analysis using fracture union in the model. In this model, claim pursuit was significant and use of a lawyer was discarded as not significant. This indicates confounding between these variables, as seen in other analyses in Chapter Three.

The hypothesis relating claim pursuit to neck pain is rejected, and the first model is accepted, because although inclusion of fracture union resulted in a stronger final model, the modelling process was considered less stable, as the sample size was significantly reduced (140) when fracture union was included in the analysis. However, the significant association between legal involvement and neck pain indicates that some aspect of the claim process may be significant.

The increase in reported neck pain associated with female gender, lower education level, and use of a lawyer found in this study was also found in the study in Chapter Three and, as discussed in that chapter, these findings are supported by previous studies, most of which are studies of neck pain specifically after motor vehicle accidents.

Although previous research has shown differences in neck pain between groups treated in a fault-based versus a no-fault compensation system,[117 461] there was no difference found between these two systems in this study. This may reflect differences in methodology, as the previous reports both explored differences before and after legislative change within one system, whereas this study explored differences between two different systems simultaneously. The previous reports, however, were larger, indicating that this study may have been underpowered to detect a difference between the two systems, but this is unlikely, as the type of claim (fault-based versus no-fault) was not associated with neck pain in the univariate analysis ($p = 0.9$).

Although this study did not specifically include patients who complained of neck pain or had neck injuries, neck pain is common after motor vehicle accidents, and therefore the inclusion criteria and study design are considered reasonable to allow conclusions regarding possible predictors of neck pain. The tool used to measure neck pain (and back pain) in this study has not been previously used, but it has face validity and was shown to be reliable during the pilot study of the questionnaire.

No control group was used to examine the magnitude of neck pain in patients not involved in motor vehicle accidents, but this is not expected to affect the validity of the study, as the contribution to neck pain from underlying or pre-existing symptoms would only bias the effect of any possible predictor towards the null. That significant predictors were found diminishes this criticism.

This study has advantages over previous studies of the effect of compensation on neck pain after motor vehicle accidents, as previous studies have been limited by only including legal involvement or litigation as the compensation-related predictor (rather than claim pursuit),[93 125 306 407 462 463] or by only including claimants in the study population.[107 117 124 138 462 464]

Another advantage of this study over previous research is the large number of potential predictors and confounders used, particularly with respect to compensation-related factors. The methodology and results of studies of neck pain after motor vehicle accidents are discussed in more detail in Chapters One and Three.

4.4.3.4 Back pain

As with the previous outcomes, claim pursuit was not associated with back pain, but use of a lawyer was a strong predictor. Therefore, the hypothesis regarding the effect of claim pursuit on back pain is rejected.

Unlike neck pain, the predictors of back pain after motor vehicle accidents have not been widely studied. In a similar study to the whiplash study performed by the same authors,[117] Cassidy et al demonstrated a decrease in the incidence of claims for back pain after the compensation system was changed from a tort to a no-fault system, eliminating payment for pain and suffering.[68] The primary outcome in the study by Cassidy et al was time to case closure, and this was also increased by lawyer involvement and female gender, both of which were also significant in this study. Unfortunately, the study by Cassidy et al only included claimants, and it can be criticised for using the time to case closure as the main outcome, rather than the incidence or severity of back pain.

The predictors of back pain in this study were similar to those for neck pain (gender, use of a lawyer, and education level). This is consistent with two large surveys of motor vehicle accident claimants that showed a high incidence of back pain in patients complaining of whiplash after motor vehicle accidents.[159 465] Similarities in predictors for back pain and neck pain after motor vehicle accidents is also implied by the parallel studies performed by Cassidy et al, referred to earlier, in which the incidence of neck pain and back pain claims fell after a change in the compensation system in Saskatchewan, Canada.[68 117]

This study only included patients with fractures of the extremities, and did not take into consideration any back injury. This lack of specificity for back injuries would be expected to limit the power to detect predictors of back pain. This means that the study may not have measured injury severity accurately enough when back pain was used as the outcome. However, the possible lack of representation of patients with back injuries would be expected to bias the association between any possible predictors and back pain towards having no effect. The presence then, of significant predictors in the final model, indicates that these factors are strong predictors that are probably unrelated to the nature of the accident.

4.4.3.5 Patient-rated satisfaction and recovery

The results of this study highlight the importance of blame in how patients perceive their progress and recovery after an injury.

Interestingly, blame was the strongest predictor of these two outcomes, and it is likely that confounding from this variable resulted in the loss of statistical significance for claim pursuit that was seen in the univariate analysis. As claim pursuit was not significant in either model, the hypothesis regarding the effect of claim pursuit on patient-rated satisfaction and recovery is rejected.

The associations between the presence of fracture non-union and poor ratings of satisfaction and recovery indicate that these ratings are influenced by the presence of complications, but to a lesser extent than blame.

There is no relevant literature regarding these outcome variables as they were only developed for this study. While this represents a weakness of this study, by not allowing direct comparison with similar studies, it does broaden the scope of the outcomes used.

Although the patient ratings of satisfaction with progress and recovery were highly correlated with the main outcome (the SF-36 summary scores), blame was not a significant predictor of these scores. This indicates that whereas blame may not significantly predict general health, it is a strong predictor of how happy patients are with their condition (regardless of how good or bad their condition may be).

The role of blame in patient perception of outcome after injury has been studied previously, consistently showing an association between blaming others (compared to blaming oneself) and a poor psychological outcome.[296-298 466] In that patient satisfaction may be considered a psychological outcome, this study supports these previous investigations.

4.4.3.6 Surgeon-rated satisfaction and recovery

As expected, surgeon ratings of satisfaction and recovery were not associated with claim pursuit, so this hypothesis is accepted. The only significant predictor of these ratings was the presence of fracture non-union, indicating that ratings given by surgeons are more likely to be based on objective outcomes than ratings given by patients. The surgeons' perception of pain and disability were not recorded. Although these variables may have influenced surgeon satisfaction, they were not considered valid measures of patient-reported health.

As with patient-rated satisfaction and recovery, there is no directly comparable literature regarding this outcome. While the lack of a standard for this outcome may be a criticism, it was included only as a comparator to patient ratings.

4.4.3.7 Fracture-related complications

As expected, fracture non-union was not predicted by any of the variables measured in this study. Therefore the hypothesis stating that objective fracture-related outcomes would not be associated with claim pursuit is accepted.

Factors influencing the rates of non-union after fractures received in motor vehicle accidents have been studied previously, however, the role of compensation related factors has not. However, as with surgeon-rated satisfaction, this outcome was only used in this study as an objective outcome measure to compare to the patient-based main outcome variables. The lack of association between this objective measure of outcome and the predictors of the patient-based outcomes highlights the subjective nature of these outcomes, and the importance of psychosocial factors. It also addresses the concern that the differences seen in the patient-based outcomes were due to differences in objective outcomes (such as fracture non-union).

The smaller sample size in the analysis of fracture union decreases the power of that analysis to find significant predictors, but the lack of any significant association on univariate analysis indicates that no strong predictor would have been found, even with a larger sample size.

4.4.4 Generalisability

By restricting the inclusion criteria to certain fractures and to motor vehicle trauma, the influence of the type of injury on any outcome has been controlled. However, narrowing the inclusion criteria affects generalisability, and it may be that the associations shown in this study are not applicable to other injuries, for example, head injuries or workplace (industrial) injuries. The similarity of the findings to those found in Chapter Three, which included a broad range of injuries, indicates that these results may be generalisable to populations with other injuries.

Similarly, although the results may not be valid for patients with longer follow-up, the similarity with the findings in Chapter Three would indicate that the results might not be time-sensitive.

Extrapolation of the results of this study outside the state of New South Wales should take into account the jurisdictional differences in compensation and insurance systems.

4.4.5 Implications of the results

Regarding the effect of claiming compensation on trauma outcomes, while this study did not show a significant association, it is likely that aspects of the process are still significant. Significant confounding was noted between lawyer use and claiming compensation, and although it appeared that each variable had an independent effect on several of the outcomes, the sample size may not have been large enough to find a significant independent effect of claiming compensation, which was found in the study reported in Chapter Three.

The consistent association between the use of a lawyer and poor outcome implies that some aspect of the legal involvement may be causing increased symptom reporting in patients, regardless of whether or not they pursued compensation. Although the association may be due to confounding from factors such as injury severity and presence of complications, the most objective measures of these factors (the number of fractures, and the presence of fracture non-union at six months) did not support this. In fact, there was a trend towards an association between lawyer use and fracture union, rather than non-union.

The possible mechanisms of this association have been discussed in Chapter Three, and include: the direction of patients by lawyers, regarding symptom reporting, the need to repeatedly report and consider their symptoms (for medical reports), and a higher likelihood of involvement in an adversarial environment.

The negative association between blaming others (compared to blaming oneself) and patient-ratings of satisfaction and recovery demonstrate the importance of such psychological factors in these outcomes, and that, while blame may not influence measures of general health (PCS and MCS), it may be important to the patients' well being. The association between blame and outcome after injury has been reported previously and the mechanism is likely to be related to the psychology of victimisation, retribution, and coping mechanisms.[72 110 295-297] The association, however, is also related to compensation, particularly in the fault-based, third party system, and confounding between these two variables is likely to explain why blame became a less significant predictor on multivariate analysis for most outcomes.

The difference between patient satisfaction and general health (although both were strongly associated) implies that studies relying on measures of general health after trauma may be too narrowly focussed if their aim is to measure patient wellbeing.

4.4.6 Significance to future research

Use of a lawyer, pursuit of a claim, and blame were all strongly associated with aspects of health after fracture, but due to confounding between these variables, the true effect of each was difficult to determine, as each one of the variables was significantly associated with at least one outcome, depending on the analysis performed. Future research should aim to distinguish between these variables by having a larger sample size.

Although the use of a lawyer was associated with poor outcome, this study provides no information regarding what aspect of the legal involvement may be responsible for this effect. For example, legal involvement may have increased the time involved in the claim process, symptoms may have changed after legal contact, and differing degrees of legal involvement may also influence the effect of this variable. Also, other aspects of the claim process should be considered in order to further define which aspects of the claim process best predict outcome. These other factors include the (financial) size of the claim and settlement, the timing of settlement, differences between insurance companies (e.g., liability acceptance policies, and claim processing procedures), and the degree of dispute or conflict present in the process. Other social factors, such as marital status, should also be considered. Future, larger studies may be able to include these other variables.

The association between blame and some of the outcomes indicates the importance of this psychological factor, and future research may need to include other psychological factors in trauma outcomes. Furthermore, the importance of patient satisfaction should be explored further, as this or similar factors may be important to patients after traumatic injuries. In particular, the relative importance of such factors and measures of general health could be explored.

In this study, different predictors were noted for patient-based reporting of satisfaction and recovery compared to surgeon-based reporting. Also, surgeons rated the results more positively than patients. While this difference was not explored as it lies outside the scope of this thesis, it may be useful to explore this difference further in future research.

Road trauma is a significant cause of the burden of disease, particularly in the developed world and particularly in young people. The role of factors that strongly predict poor outcome after road trauma should be studied further so that the morbidity associated with these injuries can be reduced.

4.4.7 Significance of work

This study provides useful information regarding predictors of health after road trauma. It implicates factors associated with blame and the compensation process in the poor outcomes often seen after these injuries, and reinforces other research in highlighting the importance of these factors.

The findings indicate that consideration should be given to compensation-related factors when assessing the outcome after road trauma. They also provide information that may lead to correcting factors within the compensation process that may lead to poor outcomes in this population. These factors may include the role of fault in determining compensation, and the adversarial nature of the compensation process.

4.5 Conclusion

In patients sustaining a major fracture in a motor vehicle accident, pursuit of compensation, per se, was not associated with poor general health after six months, whereas the use of a lawyer was a strong negative predictor of health for the same group. However, separation of these two variables may explain the association between compensation and poor outcome reported in other studies, as these two variables are highly correlated.

The study hypothesis, that general health would be significantly poorer in patients pursuing compensation is rejected.

CHAPTER FIVE. SUMMARY AND CONCLUSIONS

5.1 A comparison of the three main studies

The systematic review reported in Chapter Two provided a detailed summary of published studies pertaining to the effect of compensation status on outcome after surgery. This is related to outcome after injury, as the patients in these studies were undergoing surgery for injury. Apart from including a mixture of compensation types and surgical conditions, the review also highlighted problems with the previous studies in that the definition of injury was not clear. Outcomes also varied between studies, and these differences produced difficulties in providing summary estimates for the studies as a whole. These same difficulties exist when attempting to compare the systematic review (Chapter Two) to the two other studies included in this thesis (Chapters Three and Four). Indeed, the methodological issues noted in the studies included in the systematic review, as well as in the studies discussed in the literature review in Chapter One, formed the basis for the design of the studies in Chapters Three and Four.

With these limitations in mind, there are still similarities in the findings of the three main studies in this thesis. The main similarity is the consistent finding that factors related to the compensation process, in particular claim pursuit and lawyer involvement, are associated with poor outcome after injury, whether it be measured after treatment for the injury, short term, or long term, and regardless of the type of outcome measured.

Another consistent finding was that there was no evidence that the type of claim influenced the effect. Analysis of this variable was restricted to the sub group of claimants, therefore reducing the sample size, but both of the surveys included significant proportions of workers compensation and third party patients, so that any difference, if present, should have been detected. These results indicate that the claim process contributes to poor outcomes independent of type of compensation system.

In both studies, the PCS was associated with a measure of injury severity, whereas the MCS was not. This association with PCS is expected, but the lack of association between injury severity and MCS, as well as the other non-physical outcomes (PTSD and patient satisfaction) is of interest. Most of the effort in treating trauma patients is directed toward restoration of physical function. The assumption when restoring function is that improvements in physical function will cause improvements in mental well-being. While this may be the case, it appears that there are stronger predictors of mental health that are not affected by physical factors.

Female gender, use of a lawyer, and lower education levels were predictive of neck pain and back pain in both studies. Consistency between these two studies, along with support from previous studies, strengthens the findings. Whether lower education level and female gender influence reporting directly, or whether confounding exists (due, for example, to differences in work conditions) cannot be determined from this study, although both studies allowed for many possible confounders.

Similarly, patients with neck pain or back pain may be more likely to use a lawyer. However, complaints of neck or back pain were not associated with any of the indicators of injury severity, and use of a lawyer was highly associated with claim pursuit. Further, the possibility that patients with greater injuries were more likely to pursue claims is also not supported, as (in the Major Trauma Outcome Study) claim entitlement was a stronger predictor of general health than claim pursuit, indicating that the effect on outcome is not influenced by any factors related to the conscious decision to pursue a claim.

It is also of interest to note that none of the patients in the studies were selected on the basis of having a neck or back injury, and there is evidence that those who complain of neck and back pain after an accident are more likely to complain of other, more systemic complaints.[159 465] The association between legal involvement and neck and back symptoms may, therefore, be associated with increased symptom reporting in general, rather than physical injury to the spine. This may also explain the association between legal involvement and the other patient-based outcomes. The possible explanations for the association between increased symptom reporting and legal involvement include: encouraging the reporting of symptoms to maximise settlements, the need to repeatedly report symptoms for medicolegal reports and consultations, and increased and extended exposure to an adversarial environment. It is also likely that the increased symptom reporting in these patients is not consciously controlled and may represent somatisation: the presentation of physical symptoms (in the form of common and definable conditions, such as whiplash) to legitimise or express psychological stress or discomfort. Put in other words, we may be seeing the expression of an unpleasant experience (the compensation process) as pain (which is, in any case, defined as an unpleasant experience). The form that the symptoms take may be influenced by such factors as social acceptability, symptom expectation, or suggestions from doctors or lawyers.

The differences between the two clinical studies provide more information regarding the role of compensation-related factors in determining outcome after injury. In particular, the main difference between the two studies was that claim pursuit was associated with many of the outcomes in the Major Trauma Outcome Study, whereas the use of a lawyer was more strongly associated with the same outcomes in the Motor Vehicle Accident Outcome Study. Dissection of these differences shows that the associations with PCS were similar, where there was an independent association with claim pursuit and use of a lawyer, but that the association with use of a lawyer was stronger. In the second study, claim pursuit did not reach statistical significance but the effect was similar and may have reached significance with a similar sample size. The main differences between the studies was in the predictors of MCS, where the Major Trauma Outcome Study found an association with claim settlement, and the Motor Vehicle Accident Outcome Study found an association with use of a lawyer, claim pursuit not being significant. This can be explained by the difference in the variables used, as the former study divided claim pursuit into those that had settled, and those that had not. While this was not practical in the latter study, as the follow-up period was too short to allow settlement, it indicates, as suggested before, that the claim process may be the main predictor of the poor outcome, not whether or not a claim was made. A settled claim is less likely to be a disputed claim and may also be associated with less legal involvement. It is possible that legal involvement and having an unsettled claim are measuring the same thing: prolonged involvement with a stressful, adversarial dispute. The fact that these variables (an unsettled claim and legal involvement) have stronger effects on measures of pain and mental health, than on physical health, supports the hypothesis that these factors act at a psychological level.

Other differences between the two studies may explain the differences in significant predictors found, particularly the confounding between the use of a lawyer and involvement in the claims process. The Major Trauma Outcome Study had much longer follow-up, and therefore the patients were more likely to have already been involved in the claims process, whereas those in the second study would have only had limited involvement in the claims process. As legal involvement was a much stronger predictor than claim pursuit in the second study, it may be that legal involvement is a significant factor leading to poor outcome, and may have led to the poor outcome seen with claim pursuit in the Major Trauma Outcome Study. This can be explained if the involvement of a lawyer increases the likelihood of becoming involved in the claims process, or having a longer or a more adversarial involvement.

Although there is confounding between the use of a lawyer and involvement in the claims process, at least for some major outcomes, both variables have an independent effect. The third variable that confounded with these was blame.

In both studies, blame was significant for all outcomes on univariate analysis but was discarded from the models on multivariate analysis. Blame was a strong predictor of patient-rated satisfaction and recovery in the Motor Vehicle Accident Outcome Study, and was a significant predictor of PTSD in the Major Trauma Outcome Study. However, in all other analyses, it was not significant due to confounding from claim pursuit and use of a lawyer. Although patients who blame others may be more likely to pursue claims and use lawyers, the effect of these latter two factors appears to be much stronger for the major outcomes measured.

There are two other differences between the two main studies that deserve comment. The presence of chronic illnesses was a significant predictor of most outcomes in the first study, but not significant in the other. This is likely to be due to the difference in follow-up time between the two studies. The Major Trauma Outcome Study had much longer follow-up and the effect of chronic illnesses would be expected to become more significant with time. Also, the Major Trauma Outcome Study had a higher mean age (47 versus 38 years), so that chronic illnesses were more common, and were therefore more likely to reach significance for any association.

Current employment was a significant predictor in the first study but not in the second. Again, this is likely to be due to the difference in follow-up times, as most of the patients in the second study were likely to be still in employment, although possibly on sick leave.

When comparing the two main clinical studies, apart from differences that may be due to differences in methodology, the findings were similar in that involvement in the claims process, whether through legal involvement, claim pursuit, or ongoing settlement processes, was a strong and significant predictor of all major outcomes, and, although there was confounding between the compensation-related factors, in many cases these factors had an effect that was independent of the others.

The presence of an independent effect for the claim-related variables in some of the final models is evidence against collinearity, but in models that contained only one compensation-related variable, the level of confounding raises issues of collinearity between these variables. Collinearity was not thought to be present, however, as the variance inflation factors for all variables in all models were less than 2.5, considerably lower than 10 which is considered evidence of collinearity. The differences between the compensation-related variables in the studies are shown in Appendix 16.

5.2 Summary

Three separate studies were performed to explore the role of compensation in determining outcomes after injury. In each study, the systematic review, the retrospective study of major trauma patients, and the prospective study of patients with fractures resulting from motor vehicle accidents, consistent and strong associations were shown between compensation-related factors and poor outcomes such as general health, pain, PTSD, and surgery-specific scores. The possible mechanisms for these associations include: the expression of psychological stresses incurred as part of the compensation process as symptoms (such as pain and loss of function), increased exposure to lawyers and doctors who may reinforce or guide symptom reporting, or other psychological mechanisms, perhaps relating to blame. Alternatively, the effect may not be true, it may be due to confounding from other factors not measured in these studies, or due to sampling biases within the studies. However, the consistency and strength of the findings, as well as the allowance for multiple possible confounders, minimises this possibility.

The findings of these studies add to the body of knowledge regarding the role of compensation in influencing outcomes after injury. The findings represent new knowledge as they were the result of well-controlled studies, they used validated general health outcomes, and they explored aspects of the compensation process in more detail than previous studies.

Modifications of current compensation systems could be made, based on finding from this research. Possible changes to the claims process based on this research would include: the limitation of legal involvement (both in the form of lawyer presence, and use of the courts); limiting or removing compensation for specific conditions such as non-specific neck pain; shortening the time to settlement; and removing areas of contention by having more rigid guidelines and limiting the ability to challenge decisions.

Further research in this area should be directed at the mechanisms by which the association may be mediated. For example, any modifications made to the claims process should be studied to monitor their effect on patient outcomes.

This research also highlights the importance of psychological factors in determining outcome after injury and it is hoped that this study will increase the awareness of these issues in trauma patients. Further research exploring the psychological aspects of the compensation process may be helpful in predicting outcomes in injured patients. Also, more attention to psychological well being after injury may allow the identification of patients at risk of poor outcomes, and this may allow earlier and more effective interventions.

Improving the education of injured patients regarding aspects of the claims process may also improve outcomes, by adjusting expectations and minimising the stress associated with dealing with an unfamiliar and complex system. Apart from health care workers, this research is also applicable to any individuals involved in the administration of compensation systems, and the insurance industry. Increasing the awareness of potential problems associated with the claims process among those involved with managing injured patients may also lead to better patient (and claim) management.

5.3 Conclusion

This research indicates that aspects of the compensation and legal systems may be harmful to injured people, and further elucidation of these aspects may result in systems that do not add to the harm already present from the injury, while still managing them fairly and appropriately.

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Appendix 2. Coding of explanatory and outcome variables in the Major Trauma Outcome Study.

Measurement units and categories for outcome variables in the MTOS.

Outcome variable	Units / categories
Physical component summary of SF-36	Score from 0 – 100 (to 1 DP)
Mental component summary of SF-36	Score from 0 – 100 (to 1 DP)
Back pain	Integer from 2 - 11
Neck pain	Integer from 2 - 11
Patient satisfaction	Very satisfied
	Somewhat satisfied
	Somewhat dissatisfied
	Very dissatisfied
Post-traumatic stress disorder (Scale)	Integer from 17 – 85
Post-traumatic stress disorder (dichotomous)	No (score less than 44)
	Yes (score 44 or higher)

DP = decimal place

Units and categories of explanatory variables for the MTOS.

Exposure variable	Code	Units / categories
General factors		
Age at follow up	AGE	Years
Gender	SEX	Male
		Female
Time since injury	TIME	Months (12 – 72)
Past medical history	PASTILL	No. chronic diseases = 0
		No. chronic diseases = 1
		No. chronic diseases = 2
		No. chronic diseases = 3+
Injury severity factors		
ISS (Injury Severity Score)	ISS	Integers from 16 - 75
Head injury	HEADINJ	No: AIS (head) of 0, 1 or 2
		Yes: AIS (head) of 3, 4 or 5
Mechanism	MVA	No (any other mechanism)
		Yes
Length of stay in ICU	ICUDAYS	Days
ICU admission	ICUCAT	No
		Yes
Socioeconomic factors		
Education (highest level)	EDUCATE	Primary school
		Secondary school
		Certificate or diploma
		Degree
Income (annual household)	INCOME	$0 – 30,000
		$30,001 – 50,000
		$50,001 – 75,000
		Over $75,000
Occupational prestige	PRESTIGE	Prestige scale 1.0 – 9.0
Employed at injury	EMPLPRIOR	Yes
		No
Employed at follow-up	EMPLNOW	Yes
		No
Claim-related factors		
Claim made, settlement	CLAIM	No claim made
		Claim made, not settled
		Claim made, settled
Compensation system	CLAIMTYPE	Workers compensation
		Third party
		Both
Lawyer involvement	LAWYER	No
		Yes
Blame	FAULTOWN	Self
		Someone else
		Don't know
Time to settlement	TTOSETTLE	Months
Time since settlement	TSNCESETTL	Months

Appendix 3. Final model for the multivariate analysis using PTSD as a dichotomous outcome in the MTOS.

Variable	Odds ratio	95% CI	Wald chi^2 (df)	P value
Age (years)				
1st quintile (19 – 28)	3.82	1.36 – 10.78	6.42 (1)	0.011
2nd quintile (29 – 41)	6.57	2.46 – 17.59	14.06 (1)	0.0002
3rd quintile (42 – 51)	3.21	1.25 – 8.26	5.88 (1)	0.015
4th quintile (52 – 66)	1.71	0.71 – 4.14	1.42 (1)	0.23
5th quintile (67 – 91)	1.00*			
(overall association)			15.79 (4)	0.0033
Chronic illness				
None	1.00*			
1	1.99	0.98 – 4.01	3.65 (1)	0.056
2	4.77	2.13 – 10.71	14.37 (1)	0.0002
3 or more	3.62	1.28 – 10.26	5.86 (1)	0.015
(overall association)			15.04 (3)	0.0018
Current employment	4.09	2.22 – 7.53	20.37 (1)	<0.0001
Use of a lawyer	3.51	1.60 – 7.73	10.63 (1)	0.0011
Claim				
No claim made	1.00*			
Claim settled	1.04	0.44 – 2.45	0.0087 (1)	0.93
Claim not settled	2.79	1.06 – 7.37	4.29 (1)	0.038
(overall)			6.58 (2)	0.037
Blame for injury				
Blame self	1.00*			
Don't know	2.32	1.02 – 5.26	4.03 (1)	0.045
Blame others	2.33	1.14 – 4.76	5.34 (1)	0.021
(overall)			5.89 (3)	0.053

* referent group

Appendix 4. Significance of claim eligibility (CLAIMENT) when substituted for claim pursuit (CLAIMMADE) in the multivariate analyses of the MTOS.

Comparison of entitlement to claim (CLAIMENT) and pursuit of claim (CLAIMMADE) when replacing claim in the final model for PCS.

Variable used	Parameter estimate	Standard error	T value	P value	Adjusted R^2 for model
CLAIMENT	-5.03	1.65	-3.04	0.0027	0.404
CLAIMMADE	-4.44	1.55	-2.86	0.0045	0.336

Comparison of entitlement to claim (CLAIMENT) and pursuit of claim (CLAIMMADE) when replacing claim in the final model for MCS.

Variable used	Parameter estimate	Standard error	T value	P value	Adjusted R^2 for model
CLAIMENT	-3.59	2.30	-1.56	0.12	0.252
CLAIMMADE	-3.05	1.97	-1.55	0.12	0.203

Comparison of estimates of effect for CLAIMENT and CLAIMMADE in the final model using neck pain as the outcome variable.

Variable used	Parameter estimate	Standard error	T value	P value	Adjusted R^2 for model
CLAIMENT	0.54	0.45	1.21	0.34	0.197
CLAIMMADE	0.35	0.37	0.96	0.34	0.193

Comparison of estimates of effect for CLAIMENT and CLAIMMADE in the final model using back pain as the outcome variable.

Variable used	Parameter estimate	Standard error	T value	P value	Adjusted R^2 for model
CLAIMENT	1.30	0.48	2.68	0.008	0.204
CLAIMMADE	0.66	0.41	1.61	0.11	0.155

Comparison of estimates of effect for CLAIMENT and CLAIMMADE in final model for patient satisfaction.

Variable used	n	Odds ratio	95% CI	Wald chi^2	P value
CLAIMENT	178	2.63	1.14 – 6.08	5.16	0.023
CLAIMMADE	352	3.43	2.05 – 5.73	22.1	<0.0001

Comparison of estimates of effect for CLAIMENT and CLAIMMADE in final model for PTSD as a continuous variable.

Variable used	Parameter estimate	Standard error	T value	P value	Adjusted R^2 for model
CLAIMENT	3.86	2.96	1.30	0.20	0.423
CLAIMMADE	3.62	2.47	1.47	0.14	0.379

Comparison of estimates of effect for CLAIMENT and CLAIMMADE in final model for PTSD as a dichotomous variable.

Variable used	n	Odds ratio	95% CI	Wald chi^2	P value
CLAIMENT	177	1.24	0.38 – 4.11	0.13	0.72
CLAIMMADE	350	1.44	0.65 – 3.20	0.80	0.37

Appendix 5. Associations between the compensation-related variables in Chapters 3 and 4.

Association between compensation status and use of a lawyer in the Major Trauma Outcome Study (Chapter 3).

	Lawyer used	
Claim pursued	Yes	No
Yes	116	35
No	12	189

Association between compensation status and blame in the Major Trauma Outcome Study (Chapter 3).

	Blame	
Claim pursued	Others	Self
Yes	91	12
No	22	117

Association between blame and use of a lawyer in the Major Trauma Outcome Study (Chapter 3).

	Blame	
Lawyer used	Others	Self
Yes	73	10
No	39	119

Association between compensation status and use of a lawyer in the Motor Vehicle Accident Outcome Study (Chapter 4).

	Lawyer used	
Claim pursued	Yes	No
Yes	83	40
No	13	83

Association between compensation status and blame in the Motor Vehicle Accident Outcome Study (Chapter 4).

	Blame	
Claim pursued	Others	Self
Yes	94	18
No	17	61

Association between blame and use of a lawyer in the Motor Vehicle Accident Outcome Study (Chapter 4).

	Blame	
Lawyer used	Others	Self
Yes	80	6
No	28	71

Appendix 6: Table 3.22. A summary of previous studies that have analysed predictors of outcome after major trauma.

Study	Inclusion criteria	n	Time to follow up	Follow-up	Mean age	Mean ISS	% male	Compen-sation measured	SE factors measured	Outcome	Significant predictors
MacKenzie et al, 1988[395]	All trauma admissions	479	1 y	80%	25	NS	78	No	Yes	PDS, NLTCS	ISS, education, income, social support
Glancy et al, 1992[392]	All trauma admissions	441	6 m	42%	33	9	NS	Yes	Yes	Return to function	Age, ISS, litigation, income replacement, education
Ott et al, 1996[432]	Severe trauma	73	1-13 y	90%	35	NS	73	No	No	ALOS	Age, injury severity, time since injury, head injury, extremity injury
Vazquez et al, 1996[396]	ICU admission	351	2 y	95%	31	24	80	No	No	QOL	Age, ISS
Anke et al, 1997[394]	ISS>15	69	3 y	84%	33	25	70	No	Yes	Cognitive and physical impairment	Age, ISS, job status
Braithwaite et al, 1998[429]	ISS>15	158	5 y	75%	37	27	NS	No	No	Bull disability score	Extremity injury (no other variables analysed)
Holbrook et al, 1999[430]	Admission> 24 hours	780	18 m	74%	36	13	70	No	Yes	QWB	Age, days in ICU, education
Dimopoulou et al, 2004[397]	ICU admission	87	1 y	74%	31	22	85	No	No	NHP	ISS, head injury
Meerding et al, 2004[399]	Accidental injury	2702	9 m	39%	25-44	N/A	55	No	Yes	EQ-5D	Age, sex, LOS, ISS, education
Vles et al, 2005[398]	ISS>15	166	1-6 y	85%	33	23	81	No	No	EQ-5D	Sex, ISS
MTOS, 2005	ISS>15	351	1-6 y	61%	48	24	72	Yes	Yes	SF-36	See tables for PCS and MCS multivariate analysis

SE = Socioeconomic, NS = not stated, PDS = Post-census Disability Survey, NLTCS = National Long-term Care Survey, ALOS = Aachen Longtime Outcome Score, QOL = Quality of Life, QWB = Quality of Well-Being Scale, NHP = Nottingham Health Profile, EQ-5D = EuroQOL, 5 dimension measure of general health, MTOS = Major Trauma Outcome Study, m = month, y = year, > = greater than.