Relationship Between Psychiatric Disorders and 1-Year Psychosocial Outcome Following Traumatic Brain Injury

Kate Rachel Gould, DPsych; Jennie Louise Ponsford, PhD; Lisa Johnston, PhD; Michael Schönberger, PhD

Objective: To investigate the relationship of psychiatric functioning with psychosocial functioning at 1 year following traumatic brain injury (TBI), after controlling for relevant demographic, injury-related, and concurrent factors.

Design: Prospective 1-year longitudinal study.

Participants: Participants were 122 individuals with TBI and 88 proxy informants.

Setting: Rehabilitation hospital.

Main Measures: The Structured Clinical Interview for DSM-IV-TR (Diagnostic and Statistical Manual of Mental Disorders [Fourth Edition, Text Revision]) Axis I Disorders, Hospital Anxiety and Depression Scale, Sydney Psychosocial Reintegration Scale, and Glasgow Outcome Scale—Extended.

Results: At 1 year postinjury, occupational activities were the area of most change after TBI followed by interpersonal relationships and independent living skills, according to the Sydney Psychosocial Reintegration Scale. The majority of participants were rated as having moderate disability on the Glasgow Outcome Scale—Extended. After controlling for relevant background factors, preinjury, acute postinjury, and concurrent psychiatric disorders were significantly related to 1-year psychosocial outcome.

Conclusion: Screening in the acute postinjury stage for presence of preinjury psychiatric history or current distress may help identify individuals who require more intensive rehabilitation and psychiatric support and more active postdischarge monitoring. Further research exploring potential causal mechanisms for these findings is required. Keywords: anxiety disorders, brain injuries, craniocerebral trauma, depression, mental disorders, neuropsychology, outcome, psychosocial, substance-related disorders.

Traumatic brain injury (TBI) is one of the leading causes of disability, and for survivors of TBI, the impact may be life-long. Outcome following TBI is often poor, with many studies demonstrating difficulty in returning to work and social relationships, and independent living. Understanding the acute predictors of poor outcome may enable more accurate prognosis and indicate which individuals may require additional support.

Previous research has identified a few demographic and injury factors associated with poor outcome including greater injury severity, age, and cognitive impairment. The relationship between gender and outcome is currently unclear, and while some studies have found a relationship between poor outcome and male gender, others have found females to be more impaired after injury, and some have found no effect of gender on employment. There is emergent evidence that poorer functional outcome may also be associated with the presence of psychiatric disorders, such as anxiety and depression, which are common following TBI. However, many outcome studies have not examined the influence of psychological functioning. Previous studies have also been limited by use of rating scales to determine the presence of depression or...
anxiety, which may be confounded by inclusion of organically based somatic symptoms such as fatigue and reduced concentration, artificially inflating symptom rates. Few studies have utilized diagnostic clinical interviews to assess the relationship between psychiatric disorders and functional outcome and most of these have focused on depression. In a prospective study of 77 older adults with mild to moderate TBI, depression within 2 months of injury, as measured with the Structured Clinical Interview for DSM-IV Disorders (SCID), was shown to be related to impaired activities of daily living at 1 year postinjury.28 As participants with a preinjury history of schizophrenia, bipolar disorder, or drug abuse were excluded, the findings of this study are not able to be generalized to the wider TBI population, up to half of whom have a preinjury psychiatric history.21,22 Unfortunately, many previous studies have excluded participants with a psychiatric history.13,23,29

While several studies have found that postinjury psychiatric disorders, diagnosed using the SCID, were related to poor outcome, preinjury psychiatric disorders were not predictive of worse outcome.12,30–33 Importantly, in 2 of these studies,12,30 preinjury psychiatric disorders were determined 4 to 5 years postinjury and this retrospectively recall may be unreliable, particularly given the likely presence of cognitive impairment. Other studies were prospective, but limited by assessment of only depression12,33 or mild TBI31 for whom the extent of brain injury and lasting disability is generally far less than in individuals with moderate to severe injuries. Pre- and postinjury substance use disorders are inconsistently related to outcome, with some studies finding no relationship12 and others finding a relationship between preinjury substance use and poorer outcome.34–36

Thus, the relationship between preinjury psychiatric disorders and later psychosocial outcome is unclear, with previous studies being limited by use of rating scales and retrospective recall several years postinjury, and most studies have focused on depression. In addition, studies that have investigated the relationship between concurrent psychiatric disorder and functional outcome have often failed to control for the effect of other potential mediating17,38 postinjury factors such as pain12,28,35 and coping style.12,28,30,35 No studies have prospectively examined the relationship between a range of psychiatric disorders as identified using the SCID with psychosocial outcome, while accounting for other important demographic, injury-related, and concurrent factors.

The aim of the present study was to prospectively investigate these relationships following moderate to severe TBI using the SCID. It was hypothesized that presence of a preinjury and/or postinjury psychiatric disorder would be predictive of poorer psychosocial outcome at 1 year postinjury. It was also expected that poorer outcome would be associated with concurrent factors such as pain and maladaptive coping style.

METHODS

Participants

Participants were recruited from consecutive TBI admissions to a rehabilitation hospital. Inclusion criteria were complicated mild (ie, posttraumatic amnesia [PTA] duration <1 day, Glasgow Coma Scale [GCS] score 13–15, and presence of intracranial abnormalities on neuroimaging),39,40 moderate, or severe TBI; age at injury 16 to 80 years; no previous TBI or other neurological disorder; residence in Australia postdischarge; and sufficient cognitive and English ability to complete interviews according to the treating neuropsychologist. Patients with premorbid psychiatric history, learning or behavioral problems were not excluded. A previous study reported on findings of 102 participants, and focussed on the frequency and postinjury course of psychiatric disorders in the first year postinjury.41 A further 20 participants were assessed and included in the current sample. Of 430 admissions (August 2005–December 2008), 276 were approached (64.2%), 142 were ineligible (33%), and 12 were not able to be contacted (2.8%). The main reasons for eligibility were presence of an additional neurological condition (24.8%), insufficient cognitive capabilities (21.2%), and inadequate English language skills (16.8%). Of those approached, 172 were recruited (62.3%). There were no significant differences between participants and eligible nonparticipants on gender ($\chi^2 = 0.7, df = 1, P = .403$), age ($t = 0.355, df = 286, P = .723$), PTA duration ($t = −0.445, df = 262, P = .656$), or GCS score ($t = −0.291, df = 279, P = .771$). Participants had significantly more years of education ($t = −2.294, df = 224, P = .023$), which may be an artefact of different approaches to determining years of education between the hospital admission staff and researchers, the latter employing consistent standard criteria.

Procedure

A detailed overview of the procedures has been reported elsewhere.41 Hospital and university ethics approvals and written informed consent were obtained. Participants completed the initial assessment during their inpatient admission or soon after discharge. The mean time between injury and initial assessment was 58.5 days (SD = 42.1), with 82% assessed within 100 days postinjury. One-year follow-up was completed by 122 (70.9%) of the 172 participants, with 10 participants later meeting exclusion criteria, 18 withdrawing from the study, and 22 lost to follow-up.
Measures

A structured interview was employed at the initial assessment to obtain participants’ demographic information (age, gender, employment, and relationship status), family history of psychiatric disorder, use of counselling services, and prescription of psychiatric medication. Information regarding the injury, that is, PTA duration, GCS score, computed tomographic (CT) scan result, orthopedic injuries sustained, and previous health or psychiatric problems, was obtained from medical files with written consent.

Diagnoses of depressive, anxiety, substance use, and other DSM-IV-TR (Diagnostic and Statistical Manual of Mental Disorders [Fourth Edition, Text Revision]) disorders were made at both assessments using a semistructured clinical interview, the SCID—Research Version.42 Diagnoses were corroborated by a proxy informant for 72.1% of participants. There was agreement between the participant and the informant regarding preinjury psychiatric diagnoses in 84.5% of cases, and 74.5% were concordant for postinjury disorders.

Brief self-report measures of 1-week anxiety and depression symptom severity (Hospital Anxiety and Depression Scale [HADS]43,44), 12-month drug use (Drug Abuse Screening Test [DAST]45) and alcohol use (Alcohol Use Disorders Identification Test [AUDIT]46,47), and 24-hour pain severity (Brief Pain Inventory48) were completed at each assessment. The National Adult Reading Test49 was administered once to provide an estimate of premorbid intellectual function. Two subscales of the Coping Scale for Adults50 dealing with the problem and nonproductive coping were used to examine coping style at 1 year. These subscales have the highest reliability in TBI.51

One-year outcome was measured using 2 scales. The Sydney Psychosocial Reintegration Scale—Form A (SPRS)52 was developed specifically for use in TBI populations. It consists of 12 statements, with 4 items corresponding to the 3 domains of occupational activities (OA), interpersonal relationships (IR), and independent living skills (LS). Ratings of each statement relate to change because of the injury and are rated on a 7-point scale. Higher scores indicate better psychosocial reintegration. The total score for the SPRS ranges from 0 to 72, with scores for the domains ranging from 0 to 24. The SPRS has high internal consistency ($\alpha = 0.90$), interrater reliability ($r_i = 0.95$), and 1-month stability ($r_s = 0.90$).52 The SPRS was administered to the individual with TBI and their proxy informant.

The Glasgow Outcome Scale—Extended (GOSE)33,54 is an 8-point scale, which describes overall function relative to preinjury. It extends the 5 GOS55 categories of death, vegetative state, severe disability (SD), moderate disability (MD), and good recovery (GR) by dividing the last 3 categories into upper and lower bands. The final rating is based on the lowest level of outcome indicated by responses regarding consciousness, independence inside and outside the home, major social roles (work, social and leisure activities, relationships), and return to normal life. The questionnaire can be administered to the individual with the TBI, a relative/caregiver, or independent person, such as by a researcher or clinician.56 Interrater reliability of the GOSE is very good ($\kappa_w = 0.85$)58 and it is considered to have high validity.53 In this study, the responses by the individual with TBI were used to guide the researchers’ ratings, resulting in a somewhat more objective measure.

Written consent was also obtained for access to inpatient neuropsychological assessment scores. The measures for which the most data was available were Wechsler Adult Intelligence Scale—Third Edition57 subtests: Picture Completion, Digit Symbol Coding, Similarities, Block Design and Digit Span; Rey Complex Figure Test58; Trail Making Test—Parts A and B59,60; and Rey Auditory Verbal Learning Test.61

DATA ANALYSIS

Statistical analyses were performed with SPSS (Windows, Version 17; SPSS, Inc, Chicago, Illinois). Paired two-sample t tests and Pearson’s correlations were used to compare TBI participants with their proxy informants’ SPRS scores. Dependent variables were GOSE category and SPRS total score at 12 months postinjury. Bivariate analyses (SPRS: the Pearson correlations, Student t tests, and analyses of variance; GOSE: Kruskal-Wallis $\chi^2$, chi-square, Spearman correlations, and Mann-Whitney U tests) were conducted to assess the associations between the dependent variables and demographic, injury, psychiatric, and concurrent variables. Significant predictors from bivariate analyses were entered into regression analyses; standard multiple regressions were conducted for the SPRS and Generalized Linear Models for ordinal dependent variables were conducted for the GOSE. In the first set of regressions, SPRS and GOSE were predicted from demographic and injury-related variables only. Subsequent to this, SPRS and GOSE were predicted from relevant background variables, and each of the following predictors was included in separate individual regressions, 1 at a time: preinjury use of counselling services or medication, preinjury and initial SCID diagnoses, and initial scores on the HADS, AUDIT, and DAST. In the second set of regressions, SPRS and GOSE were predicted from concurrent factors, and then individual concurrent psychiatric variables (SCID and HADS) were regressed separately while controlling for the relevant concurrent factors.

www.headtraumarehab.com
TABLE 1  Demographic and injury severity information (n = 122, 78.7% male)

<table>
<thead>
<tr>
<th>Demographic/Injury Severity Information</th>
<th>Mean (SD)</th>
<th>Range</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at injury, y</td>
<td>34.89 (16.17)</td>
<td>16–77</td>
<td></td>
</tr>
<tr>
<td>Education, y</td>
<td>12.45 (2.6)</td>
<td>7–22</td>
<td></td>
</tr>
<tr>
<td>IQ (NART estimate)</td>
<td>106.01 (6.5)</td>
<td>87–121</td>
<td></td>
</tr>
<tr>
<td>PTA, d</td>
<td>23.64 (22.58)</td>
<td>0.05–121</td>
<td></td>
</tr>
<tr>
<td>Mild (&lt;1)</td>
<td></td>
<td></td>
<td>4.1%</td>
</tr>
<tr>
<td>Moderate (1–7)</td>
<td></td>
<td></td>
<td>22.1%</td>
</tr>
<tr>
<td>Severe (8–28)</td>
<td></td>
<td></td>
<td>44.3%</td>
</tr>
<tr>
<td>Very severe (&gt;28)</td>
<td></td>
<td></td>
<td>29.5%</td>
</tr>
<tr>
<td>GCS score</td>
<td>9.15 (4.33)</td>
<td>3–15</td>
<td>37.7%</td>
</tr>
<tr>
<td>Mild (13–15)</td>
<td></td>
<td></td>
<td>14.8%</td>
</tr>
<tr>
<td>Moderate (9–12)</td>
<td></td>
<td></td>
<td>47.5%</td>
</tr>
</tbody>
</table>

Abbreviations: GCS, Glasgow Coma Scale; IQ, intelligence quotient; NART, National Adult Reading Test; PTA, posttraumatic amnesia.

RESULTS

Table 1 contains demographic and injury severity details for the 122 participants. Participants were generally young males with high school education, average premorbid intelligence, and moderate to severe TBI. Of the 99 individuals who underwent a CT brain scan on the day of their injury, 88.9% were noted to have an intracranial abnormality.

Preinjury psychiatric characteristics

More than half of the sample had a preinjury psychiatric disorder (54.1%). Substance use disorders were the most frequent (36.1%), followed by anxiety (22.1%) and depressive (21.3%) disorders. More than a third of those sampled had a family history of a psychiatric disorder (38.7%). Preinjury use of counselling services was reported by 29.7% and psychiatric medication by 27.8%. Harmful level of preinjury alcohol use was reported by 37.4% on the AUDIT and drug use was reported by 12.3% on the DAST.

Postinjury psychiatric characteristics

At the initial assessment, 25.4% had a current psychiatric disorder (13.9% anxiety, 8.2% depressive, and 8.2% substance use), 16.1% had HADS depression scores in the clinical range, and 15.2% had HADS anxiety scores in the clinical range. At the 12-month assessment, 45.9% were diagnosed with a psychiatric disorder (31.1% depressive, 28.7% anxiety, and 7.4% substance use), 27.7% had HADS depression in the clinical range, 32.8% had HADS anxiety in the clinical range, 16% reported harmful level alcohol use on the AUDIT, and 3.4% reported harmful level drug use on the DAST.

Psychosocial outcome at 12 months postinjury according to SPRS

The SPRS was completed by 115 participants with TBI at an average of 12.9 months postinjury (SD = 1.1; range, 11–16) and proxy-informant ratings were available for 88 participants. As can be seen in Table 2, OA were rated as most impaired because of the injury by both raters, followed by IR and independent LS. The variability in scores also followed this pattern, with OA having the lowest range, indicating “extreme” change for some individuals, whereas the lowest ratings of interpersonal activities were in the “moderate” range. In addition, there were significant differences of small size between raters of both independent LS and total SPRS score (Cohen $d = 0.27$ and $0.26$, respectively). On further analysis, the magnitude of this difference in total SPRS score was not related to preinjury psychiatric history ($t = 1.03$, df = 75, $P = .31$), age at injury (Pearson correlation = 0.18, $P = .12$), years of education (Pearson correlation = –0.02, $P = .86$), or GCS score (Pearson correlation = –0.17, $P = .14$). Greater discrepancy in the scores was significantly associated with longer duration of PTA (Pearson correlation = 0.41, $P < .001$). Interestingly, less discrepancy was found between raters when the TBI individual had a psychiatric disorder at 1 year postinjury: mean = 0.03 and SD = 11.47 for those with a disorder and mean = 5.09 and SD = 11.73 for those without.

TABLE 2  Outcome on the SPRS at 12 months postinjury

<table>
<thead>
<tr>
<th>TBI Participant (n = 115)</th>
<th>Proxy Informant (n = 79)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean (SD)</td>
<td>Range</td>
</tr>
<tr>
<td>Occupational activities</td>
<td>14.79 (5.72)</td>
</tr>
<tr>
<td>Interpersonal relationships</td>
<td>19.35 (4.89)</td>
</tr>
<tr>
<td>Independent living skills</td>
<td>21.61 (2.51)</td>
</tr>
<tr>
<td>Total</td>
<td>55.75 (11.1)</td>
</tr>
</tbody>
</table>

Copyright © 2011 Lippincott Williams & Wilkins. Unauthorized reproduction of this article is prohibited.
Psychiatric Disorders and 1-Year Psychosocial Outcome Following TBI

without a disorder, and this difference approached significance \( t = 1.88, \text{df} = 75, P = .06 \).

There were 79 participants for whom both self and proxy ratings were available. Of note, in comparison to all TBI participants who completed the SPRS, the mean self-rating of the 79 participants was slightly higher, that is, independent LS \((M = 21.72, \text{SD} = 2.62)\) and total score \((M = 56.99, \text{SD} = 10.63)\), which may have biased the comparison. On an individual basis, there were significant correlations between the 2 raters for OA (Pearson correlation \( = 0.63, P < .001 \)), IR (Pearson correlation \( = 0.37, P = .001 \)), independent LS (Pearson correlation \( = 0.46, P < .001 \)), and total score (Pearson correlation \( = 0.55, P < .001 \)). Given the incomplete data available for proxy informants, the self-report of the TBI individual on the SPRS was used as the dependent variable in further analyses.

**Psychosocial outcome at 12 months postinjury according to GOSE**

The GOSE was available for 114 participants with TBI. No individuals were rated in the lowest 2 outcome categories (death and vegetative state) because of the exclusion criteria. No participants were in the lower severe disability category, upper severe disability was rated for 5.3%, lower MD for 38.6%, upper MD for 30.7%, lower GR for 19.3%, and upper GR for 6.1%.

**Relationship between GOSE and SPRS at 12 months postinjury**

As can be seen in Figure 1, there was a strong relationship between the 2 outcome measures, in the expected direction (Spearman correlation \( = 0.653, P < .001 \)).

**Prediction of 12-month psychosocial outcome by demographic and injury variables**

Bivariate analyses were conducted with 12-month outcome according to SPRS and GOSE as the dependent variables and the preinjury demographic and injury factors as predictors. The significant associations are displayed in Table 3.

When these significant variables were entered into regressions, duration of PTA \((P = .004)\), back injury \((P = .045)\), and limb injury \((P = .024)\) were significant individual predictors of SPRS. Duration of PTA \((P < .001)\) and limb injury \((P = .006)\) were significant individual predictors of GOSE. These variables constituted the background factors against which the influence of preinjury and initial psychiatric functioning on outcome was examined.

**Prediction of 12-month psychosocial outcome by preinjury and initial psychiatric functioning**

Individual regressions were conducted to examine the relationships between each of the preinjury and initial psychiatric functioning variables on psychosocial outcome, while taking into account significant demographic and injury associations. Family history of a psychiatric disorder and preinjury use of psychiatric medication were not significantly associated with either outcome measure and were not analyzed further. The results of the regressions are displayed in Table 4.

The results indicated that poorer psychosocial functioning at 1 year postinjury on the SPRS was predicted by preinjury substance use disorder, diagnosis of depression at the initial assessment, and higher scores on HADS anxiety and HADS depression at the initial assessment. The effect was strongest for initial HADS depression score. Poorer outcome on the GOSE at 1 year postinjury was predicted by presence of a preinjury anxiety and depressive disorder, preinjury use of counselling services, anxiety disorder at the initial assessment, and higher HADS anxiety score at the initial assessment. The effect was strongest for initial anxiety disorder.

**Concurrent associations with SPRS outcome**

Poorer outcome on the SPRS at 12 months postinjury was significantly associated with greater current pain (Pearson correlation \( = -0.55, P = .004 \)), use of non-productive coping mechanisms \((F = 6.58, \text{df} = 4, P < .001)\), unemployment \((t = -6.09, \text{df} = 109, P < .001)\), and not being able to drive \((t = -3.54, \text{df} = 109, P < .001)\). In a multiple regression with these variables (excluding employment due to multicollinearity), all these variables remained significant, and these constituted the background concurrent factors of outcome on the SPRS. Poorer outcome on the SPRS at 12 months postinjury was significantly associated with concurrent presence of depressive \((t = 4.79, \text{df} = 113, P < .001)\) and anxiety disorders \((t = 5.95, \text{df} = 113, P < .001)\) and greater HADS symptoms of depression (Pearson correlation \( = -0.69, P < .001)\).
TABLE 3  Significant demographic and injury predictors of 12-month outcome on the SPRS and GOSE

<table>
<thead>
<tr>
<th></th>
<th>SPRS</th>
<th>GOSE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P</td>
<td>Statistic</td>
</tr>
<tr>
<td>Age at injury</td>
<td>.045</td>
<td>Pearson correlation = −0.188</td>
</tr>
<tr>
<td>Posttraumatic amnesia duration, d</td>
<td>.015</td>
<td>Pearson correlation = −0.228</td>
</tr>
<tr>
<td>Back injury</td>
<td>.027</td>
<td>t = 2.235, df = 110</td>
</tr>
<tr>
<td>Chest injury</td>
<td>.025</td>
<td>t = 2.269, df = 112</td>
</tr>
<tr>
<td></td>
<td>.03</td>
<td>t = 2.2, df = 112</td>
</tr>
</tbody>
</table>

Abbreviation: NS, nonsignificant.

*P < .001) and anxiety (Pearson correlation = −0.59, P < .001). Concurrent substance use disorders, AUDIT and DAST scores were not associated with SPRS. As can be seen in Table 4, when the significant psychiatric variables were entered into a multiple regression, which controlled for the significant background concurrent factors, SPRS was still associated with anxiety diagnosis and HADS anxiety and depression but not depression diagnosis.

Concurrent associations with GOSE outcome

Poorer outcome on the GOSE at 12 months postinjury was significantly associated with greater current pain (Kruskal-Wallis $\chi^2 = 12.27$, df = 4, $P = .015$), unemployment ($\chi^2 = 49.95$, df = 4, $P < .001$), and not being able to drive ($\chi^2 = 13.94$, df = 4, $P < .008$). In a multiple regression with these variables (excluding employment due to multicollinearity), all these variables remained significant, and these constituted the background concurrent factors of outcome on the GOSE. Poorer outcome on the GOSE at 12 months postinjury was significantly associated with concurrent presence of depressive ($\chi^2 = .007$, df = 4, $P = .007$) and anxiety disorders ($\chi^2 = 11.84$, df = 4, $P = .019$) and greater symptoms of depression (Kruskal-Wallis $\chi^2 = 27.5$, df = 4, $P < .001$) and anxiety (Kruskal-Wallis $\chi^2 = 17.53$, df = 4, $P = .002$). Concurrent

TABLE 4  Relationship between 1-year outcome and psychiatric functioning

<table>
<thead>
<tr>
<th></th>
<th>SPRS</th>
<th>GOSE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P</td>
<td>Standardized Beta Coefficients</td>
</tr>
<tr>
<td>Preinjury and injury predictors$^a$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preinjury anxiety disorder</td>
<td>.412</td>
<td>−0.077</td>
</tr>
<tr>
<td>Preinjury depressive disorder</td>
<td>.057</td>
<td>−0.173</td>
</tr>
<tr>
<td>Preinjury substance use disorder</td>
<td>.023</td>
<td>−0.204</td>
</tr>
<tr>
<td>Preinjury use of counselling service</td>
<td>.120</td>
<td>−0.144</td>
</tr>
<tr>
<td>Initial anxiety disorder</td>
<td>.611</td>
<td>−0.047</td>
</tr>
<tr>
<td>Initial depressive disorder</td>
<td>.022</td>
<td>−0.210</td>
</tr>
<tr>
<td>Initial substance use disorder</td>
<td>.630</td>
<td>−0.045</td>
</tr>
<tr>
<td>Initial HADS anxiety score</td>
<td>.014</td>
<td>−0.225</td>
</tr>
<tr>
<td>Initial HADS depression score</td>
<td>.002</td>
<td>−0.292</td>
</tr>
<tr>
<td>Concurrent predictors$^b$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12-Month anxiety disorder</td>
<td>.015</td>
<td>−0.267</td>
</tr>
<tr>
<td>12-Month depressive disorder</td>
<td>.138</td>
<td>−0.174</td>
</tr>
<tr>
<td>12-Month HADS anxiety score</td>
<td>.000</td>
<td>−0.466</td>
</tr>
<tr>
<td>12-Month HADS depression score</td>
<td>.000</td>
<td>−0.492</td>
</tr>
</tbody>
</table>

Abbreviations: GOSE, Glasgow Outcome Scale—Extended; HADS, Hospital Anxiety and Depression Scale; SPRS, Sydney Psychosocial Reintegration Scale.

$^a$Prediction of SPRS by multiple regressions of individual psychiatric variables while controlling for PTA duration, back injury, and limb injury. Prediction of GOSE by ordinal regressions of individual psychiatric variables while controlling for PTA duration and limb injury.

$^b$Prediction of SPRS by multiple regressions of individual psychiatric variables while controlling for driving status, coping style and pain. Prediction of GOSE by ordinal regressions of individual psychiatric variables while controlling for coping style and pain.
substance use disorder, AUDIT and DAST scores were not associated with GOSE. As shown in Table 4, when the significant psychiatric variables were entered into a multiple regression, which controlled for the significant background concurrent factors, SPRS was still associated with diagnosis of depression and anxiety and HADS anxiety and depression.

DISCUSSION

The aim of this study was to prospectively investigate the relationship between psychiatric functioning and psychosocial outcome at 1 year following TBI. According to both TBI individual and proxy informant SPRS ratings, OA was the area most changed because of the injury, followed by IR and independent LS. This finding was consistent with a previous study of examining outcome 0.5 to 5 years postinjury. Postinjury outcome was variable, and participants were rated as minimally changed according to self and proxy-informant ratings, whereas almost 70% were rated as having an MD according to a researcher-rated global measure. There was a moderate correlation between these 2 measures, with greater variability in those with poorer outcome. There were small significant differences between the 2 raters of the SPRS, with TBI individuals providing slightly higher ratings of their independent living and total score. This difference was found to be associated with longer PTA duration. Participants with more severe injuries may show reduced self-awareness, leading to higher self-ratings of functioning than by their informants. The finding that there was less variability in those with a concurrent psychiatric disorder may reflect a mediation relationship, whereby higher levels of awareness are associated with both a reactive emotional response and more accurate judgment of their current situation. Previous studies have shown that there is high concordance and no significant differences between self and other report on this scale.

Effect of injury and demographic factors on 1-year outcome

A similar constellation of older age, greater injury severity, and presence of orthopedic injury factors was found to predict worse functional outcome on both measures at 1 year postinjury. Gender was not related to outcome. These findings are consistent with previous research on the effects of age, injury severity, and lack of effect for gender. Previous studies have indicated that reduced limb functioning and other physical injuries are associated with less favorable outcome following TBI. Pain is associated with limb injuries following TBI, and the significant relationship between concurrent pain and outcome might play a role in explaining this finding; however, orthopedic injury could also be associated with greater physical limitation in returning to preinjury activities and roles. Early cognitive functioning during inpatient admission was not associated with outcome at 1 year postinjury. Previous studies have found associations between cognitive impairment and poorer psychosocial outcome; however, these factors were tested and compared concurrently as opposed to predicting later outcome from earlier cognitive performance, as in the current study.

Relationship between concurrent factors and 1-year outcome

Most previous studies have not included determinants of other theoretically important concurrent factors when investigating the relationship between psychiatric disorder and psychosocial outcome. Pain, usually manifested as headache, is an important and common complication of TBI, which may have a complex relationship with psychiatric disorder. Accordingly, it should be considered when investigating the relationship between psychiatric disorder and outcome; however, the majority of studies have not done so. One study found that a single-item assessment of pain was associated with postinjury depression diagnosis but not preinjury psychiatric disorder. Depression may be related to changes in coping style. Nonproductive coping style has previously been associated with symptoms of anxiety and depression and long-term outcome following TBI. Return to driving has been associated with return to work status postinjury and reflects an important aspect of independence with implications for social opportunities. The results of the current study contribute to this literature with the findings that greater pain and not being able to drive were significantly and independently associated with both measures of poor outcome, and nonproductive coping style was also related to worse outcome on the GOSE. Furthermore, the results of this study also indicated that after controlling for these factors, concurrent psychiatric disorders were related to psychosocial outcome, the specific findings of which will be addressed in greater detail later.

Relationship between psychiatric disorders and 1-year outcome

After accounting for relevant demographic and injury-related variables, preinjury and initial psychiatric functioning was found to significantly and independently predict 1-year psychosocial functioning. Although previous research has examined the relationship between concurrent psychiatric and psychosocial functioning postinjury, few studies have examined the effect of earlier or preinjury psychiatric functioning on later postinjury
psychosocial outcome. The current findings support the relationship between preinjury substance use and worse postinjury outcome\(^{14,15}\) and suggest that individuals who utilized maladaptive coping styles preinjury continue to do so postinjury. In support of this, although postinjury substance use was not associated with outcome, there was a significant association between concurrent nonproductive coping style and poor outcome on the SPRS, which may indicate that although individuals did not generally use substances to help them cope, possibly because of hospital recommendations for abstinence in the first year postinjury, they utilized other ineffective mechanisms that were associated with poor outcome. These findings suggest that it is important to monitor whether individuals return to substance use beyond 1 year and indicate that those with a preinjury substance use history may be assisted by early support in developing adaptive coping styles.\(^{76}\)

Preinjury depressive disorder was significantly associated with outcome on the GOSE and approached significance in predicting outcome on the SPRS. Conversely, depressive disorder at the initial assessment was significantly related to outcome on the SPRS and not related to outcome on the GOSE. Concurrent depressive disorder was significantly associated with GOSE but not SPRS after controlling for background factors. The present findings suggest that results may differ depending on how outcome is measured and argue for inclusion of several measurements of outcome, with a global or domain specific focus and from different viewpoints, such as subjective self-report, proxy informant, or researcher rated. The use of different measurement tools in the literature may explain the discrepant findings in previous studies, such as between 2 prospective studies examining symptoms of depression in the first year postinjury, one of which found that depression symptoms at baseline were associated with, but not the cause of, work dissatisfaction at 6, 9, and 12 months postinjury.\(^{77}\) The other study found that symptoms of depression between 1 and 6 months postinjury were not significantly associated with psychosocial functioning at 6 to 12 months postinjury.\(^{78}\)

Preinjury and initial anxiety disorder was significantly associated with 1-year GOSE but not SPRS. A cross-sectional study also found that preinjury psychiatric disorder diagnosed using the SCID was related to SPRS total score between 0.5 and 5 years postinjury but did not remain significant in regression analysis, likely because of inclusion of concurrent factors.\(^{12}\) The current findings suggest that individuals with a history of anxiety and worry are more likely to have reduced global functioning, even if they do not rate themselves as having poorer recovery. However, at 1 year postinjury, concurrent anxiety disorders were significantly associated with both the GOSE and SPRS.

**Relationship between the HADS and outcome**

With the 1 exception, more symptoms of anxiety and depression on the HADS at the initial and 12-month assessments were significantly associated with poorer 1-year psychosocial outcome as rated by the SPRS and GOSE. The relationship between initial HADS depression and GOSE approached significance. These results suggest that poor psychosocial outcome is not only associated with presence of a disorder, as determined by the SCID, but also with the severity of the symptoms. Consistent with the current findings, associations have been reported between HADS and outcome on the SPRS\(^{13}\) and GOSE\(^{79}\) at 10 years postinjury, with concurrent HADS depression approaching significance with GOSE.\(^{79}\)

**CONCLUSION**

The findings of this study demonstrate that 1-year psychosocial outcome is significantly and independently related to psychiatric disorders present preinjury, early postinjury, and concurrently. However, the results do not shed light on whether individuals are depressed or anxious in response to difficulties with adjustment and changes in returning to premorbid activities and roles or whether individuals experience impairment as a result of both injury related and psychiatric effects. An analysis of the causal relationship between postinjury psychiatric functioning and preinjury psychosocial functioning is required. Two studies mentioned previously investigated the temporal relationship between depression and outcome,\(^{77,78}\) but no studies have examined the temporal relationship between anxiety and outcome.

Participants who had a preinjury history of disorder, but were not necessarily distressed at the time of the injury, were also at risk for poorer outcome. Presence of preinjury psychiatric history may not be consistently documented in medical records,\(^{22}\) and rehabilitation clinicians should therefore actively investigate whether such a history exists. These individuals may benefit from more intensive social and vocational input and monitoring for later reemergence of a postinjury injury psychiatric disorder as has been shown to occur.\(^{41}\) Depression soon after the injury may impair participation in rehabilitation programs and social interaction in the acute postinjury stages and continue to impact recovery even after resolution of the depression.\(^{80}\) Increased psychological and psychosocial rehabilitation efforts, continued postdischarge support for those at risk, and timely treatment for individuals with a psychiatric diagnosis are vital if outcomes are to be improved.

It could be considered a limitation that the results of this study may not apply to individuals with mild...
TBI who do not require rehabilitation, but the findings are likely to be representative of individuals who enter the rehabilitation system, as study participants did not differ from nonparticipating patients in a service that treats 30% to 50% of the rehabilitation admissions in the state. Quantification of the CT results and details regarding coma duration were not available and limit the use of this information in determining predictors of outcome. It is important to note that most participants in the current study had access to multidisciplinary inpatient and community rehabilitation services in a no-fault state-wide insurance program. Despite this, the majority of participants experienced postinjury psychiatric disorders, many for the first time. Clinicians need to carefully assess for preinjury psychiatric disorders and monitor these conditions postinjury. Further research is required into the relationship between psychiatric and psychosocial outcome beyond the first year, the causal relationship between these factors, efficacious treatment of psychiatric disorders, and whether psychosocial or psychiatric treatment can improve outcome.

REFERENCES


