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ORIGINAL REPORT

ASSOCIATION BETWEEN PSYCHIATRIC STATE AND OUTCOME FOLLOWING TRAUMATIC BRAIN INJURY

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Objective: **This study aimed to explore the relationship between current post-traumatic brain injury psychiatric disorders and psychosocial outcome.**
Design: **A total of 100 participants and 87 significant others were interviewed using the Structured Clinical Interview for DSM-IV Diagnosis.**
Participants: **Participants with mild to very severe traumatic brain injury up to 5.5 years post-injury.**
Methods: **The Sydney Psychosocial Reintegration Scale assessed changes in vocational status, relationship status and independent living status.**
Results: **The vocational domain of the Sydney Psychosocial Reintegration Scale revealed the greatest degree of change. Current depression and/or anxiety contributed significantly more variance to the regression models than did any other variables. Pre-injury psychiatric disorders and substance use disorders were not predictive of any outcome variables. Longer post-traumatic amnesia duration, fewer years of education, male gender and greater time post-injury were predictive of certain outcome domains. There were no significant differences between traumatic brain injury participants' self-report and the reports of their significant others regarding psychiatric symptoms or outcome measures.**
Conclusion: **The presence of current depression and anxiety are strongly related to poor outcome in terms of vocational status, relationship status and independence. The causative direction of these relationships is unclear. Using a 3-domain outcome measure has shed some light on the factors that contribute to different aspects of outcome following traumatic brain injury.**

Key words: traumatic brain injury, psychiatric disorders, outcome.

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Traumatic brain injury (TBI) is associated with long-term cognitive, behavioural and emotional problems that have a significant impact on capacity for work, functional independence and relationships (1, 2). Factors such as age, education and injury severity, especially as measured by duration of post-traumatic amnesia (PTA), have been shown to influence outcome (3–5). The reported frequency of psychiatric disorders following TBI is higher than in the general population, 2 prospective follow-up studies finding the most common disorders to be major depression and anxiety (6, 7). One longitudinal study involving consecutively admitted TBI participants found that 46% endorsed clinically significant symptoms of depression at one month post-injury and 30% did so between 3 and 5 years post-injury (8). Prospective follow-up studies have likewise shown high rates of post-TBI substance use (6, 9). However, relatively little is known of the association between psychiatric disorders and outcome following TBI, as compared with that of other psychosocial, demographic and injury-related variables.

Presence of depressive symptomology has been linked with poorer outcome on the Glasgow Outcome Scale (GOS) across the spectrum of injury severity; one study had predominantly mild TBI participants assessed at one year post-injury, and another a consecutive sample of moderate to severely injured individuals at 6 and 12 months post-injury (10, 11). Two studies, one a prospective case-controlled study (12) and one a longitudinal cohort study (7), both basing diagnoses on structured clinical interviews, found those with prolonged or chronic depression showed poorer outcome than those with no depression or resolved depression, although the causal direction of the association remains unclear. Although older adults (aged 60 or 65+ years) have shown reduced rates of psychiatric morbidity compared with younger adults in 2 studies with consecutive participants (one on average a month post-injury (13) and one on average one year post-injury (14)), those older adults who had depression exhibited reduced independence, greater distress and poorer psychosocial functioning in another prospective follow-up study with consecutive participants (15).

There have been very few studies investigating the association between anxiety disorders and outcome following TBI. One study found that presence of panic disorder, agoraphobia or generalized anxiety disorder (GAD) was associated with greater physical and emotional problems, which impacted negatively on social roles and general health (16). Alcohol use disorders have been associated with poorer vocational outcomes, particularly when co-morbid with depression (17).

Numerous definitions and measures have been used to assess "successful outcome", including return to work (1) or recovery of social functioning (18). As important as these individual

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factors are, outcome is multi-dimensional and complex and cannot be comprehensively understood from the single score obtained on scales such as the GOS or extended GOS (GOS-E). Examination of the association between psychiatric disorders and specific aspects of functional outcome following TBI, including living skills, vocational and leisure activities and relationships, could enhance our ability to address these problems. Self-awareness of changes may be lacking in more severely injured individuals (19), so that a secondary informant should also be interviewed to ascertain these changes.

This study aimed to investigate outcome following TBI in the domains of occupational activity, relationships and independent living skills, independently and together, and its association with pre-injury and current DSM psychiatric diagnoses relative to that of other demographic and injury related variables. It was hypothesized that participants with TBI would show a decline in psychosocial functioning relative to pre-injury in the domains of occupation, interpersonal relationships and living skills, as reported by both the TBI participant and a significant other. The second hypothesis was that the presence of a psychiatric disorder would make a unique negative contribution in the prediction of outcome in the domains of occupation, relationships and independent living, in addition to demographic and injury-related variables.

METHODS

Participants

Participants were the same as those enrolled in a study of the frequency of psychiatric disorders following mild-severe TBI (20). They were 100 community-based participants with TBI, recruited from the database of all head injury patient admissions to the referring hospital. All had been discharged from inpatient treatment and had had access to comprehensive rehabilitation in the context of a no-fault accident compensation scheme available regardless of socio-economic background. Patients with TBI were routinely advised to abstain from substance use for at least the first year post-injury. Participants were considered eligible if they were aged 17–70 years at the time of injury (maximum age 75 years at the time of assessment), had a lowest recorded Glasgow Coma Scale score (GCS) < 15, had the cognitive capacity to participate in the research project as determined by their neuropsychologist, were proficient in English and had no history of previous TBI or neurological disorder such as epilepsy, stroke, brain tumour or degenerative disease.

Measures

A semi-structured interview was utilized to obtain demographic information including age, education, pre-injury employment, current medications, current living situation, and current employment status. Injury-related information and verification of psychiatric history was obtained with consent from the participant's medical file.

Structured Clinical Interview for DSM-IV-TR (SCID-IV) Axis I. This is a structured clinical interview that was used to diagnose pre-injury and current psychiatric disorders. It was administered twice, first retrospectively to diagnose lifetime pre-injury psychiatric diagnoses and secondly to diagnose post-injury psychiatric diagnoses, both current and resolved. The clinical computerized version of the SCID-IV covers mood, anxiety, psychotic, substance use, somatoform, eating and adjustment disorders (21).

Sydney Psychosocial Reintegration Scale (SPRS) (22). Form A of the SPRS is a 12-item self-report questionnaire; one version for the TBI individual and another for their significant other. It was used in the current study to document post-TBI changes in the domains of occupational activities (OA), interpersonal relationships (IR) and living skills (LS) on a 0–24 point scale. The overall scores on the SPRS range from 0–72. Higher scores are indicative of better outcome. The SPRS has been shown to have sound psychometric properties, (22) strong correlation with the GOS-E and consistency between self-report and significant other responses (23).

Alcohol Use Disorders Identification Test (AUDIT) (24). This is a 10-item questionnaire used to assess alcohol consumption and alcohol-related problems over the previous 12 months. It has good test-retest reliability, construct validity and sensitivity in healthcare and psychiatric populations (25). Scores above 8 represent hazardous alcohol use (24).

Drug Abuse Screening Test (DAST) (26). This is a 20-item questionnaire regarding use of drugs other than alcohol in the past 12 months. It has high concordance (75–85%) with DSM-III diagnoses for a drug disorder and sound psychometric properties in psychiatric populations (25). A cut-off score of 5/6 has been shown to be optimal in detecting substance use disorders (26).

Procedures

An independent researcher identified patients with TBI, injured between July 2000 and July 2005, who were 0.5–5.5 years post-injury. Of the 720 participants on the database, 550 met eligibility criteria. In order to have a sample representative of a range of time-points post-injury, this group was divided into 5 groups (0.5–1.49, 1.5–2.49, 2.5–3.49, 3.5–4.49 and 4.5–5.5 years post-injury). A stratified random sampling technique was used to obtain the study sample by entering individual SPSS codes into a random number generator program from the website www.random.org. Participants were contacted sequentially until there were 5 equal groups of 20, centring around means of 1–5 years post-injury. Written informed consent was obtained from each participant. Participants identified a relative or friend to be interviewed, preferably at the same time, in order to verify reported psychiatric symptoms and report on psychosocial outcome. Thirteen people either declined to nominate a significant other (SO), or the SO declined to be interviewed; however 91 SOs completed the SPRS. To determine inter-rater reliability, 12 of the participants were also assessed by a clinical psychologist trained in administering the SCID ($r = 0.92$). Both administrators had completed psychopathology courses within doctoral training and training in administration of the SCID under supervision of an experienced clinical psychologist.

Data analysis

Data were analysed using SPSS 15 for Windows. Frequency measures were obtained for post-injury disorders. Co-morbidity rates were calculated using frequency and Cohen's kappa statistics. For bivariate comparison of patients' and SOs' SPRS ratings and of the SPRS ratings with predictors, Pearson's correlations and *t*-tests were used. Predictor variables were age, gender, years of education, pre-injury and post-injury work status (working or studying/not working or studying), location of residence (metropolitan/rural), lowest pre-intubation GCS scores, PTA duration (measured prospectively with the Westmead PTA Scale), current AUDIT and DAST scores, current relationship status (partnered/not partnered), time post-injury, pre-injury psychiatric disorders and/or presence of any current psychiatric disorders (depression, anxiety, substance use or any disorder). Current work status and current relationship status were not entered into the regressions for SPRS work, SPRS relationship and overall SPRS equations respectively due to the fact that this information was part of what the scales measured. All bivariate statistical tests were performed 2-tailed unless otherwise specified.

For the prediction of SPRS scores from multiple predictors, blockwise multiple linear regression analyses were performed. Patients' and SOs' scores on the overall SPRS total and the 3 domains of the SPRS (work/leisure, relationships and independence) were entered as

the dependent variables in each regression. The significant predictors from the bivariate analyses were entered as independent variables in blocks. Demographic and injury-related predictors were entered as a first block, followed by pre-injury psychiatric history as a second block (only where this was significantly associated with the outcome variable), and current psychiatric disorders as a third block, in order to consider the relative contribution of each set of predictors. In the tables, all results are for the final block. In all linear regressions, Mahalanobis distance did not exceed critical values.

RESULTS

Participants

Males accounted for 71% of participants. Mean age at assessment was 37.18 years (standard deviation (SD) = 14.19, range 19–74 years) and mean years of education was 11.70 (SD = 2.65, range 6–18 years). Average time post-injury was 2.98 years (SD = 1.47, range 0.5–5.5 years). Mean length of inpatient stay was 41.59 days (SD = 27.59, range 5–134 days). Participants had a mean lowest pre-intubation GCS score of 9.10 (SD = 4.12, range 3–14) and a mean duration of PTA of 20.77 days (SD = 17.85, range 1–77 days). Forty-one percent were in a relationship and 59% were single, separated, widowed or divorced. Thirty-nine percent lived with a partner, 22% alone, 28% with family and 11% in shared accommodation. Amongst the SOs, there were 36 partners (29 female), 38 parents (35 female), 5 siblings, 6 friends and 6 children (8 male and 9 females). Of the participants, 41% were not in the work force (unemployed, retired or stay-at-home parents), 12% were students, 9% worked part-time and 38% full-time. There were no statistically significant differences between each year group (1–5 years) on measures of GCS, PTA, age, gender or years of education. The participants in this study also did not differ significantly from the main database group from which they were drawn in terms of gender, education, PTA, GCS or age.

Prior to injury, 17% had had major depression, 13% had had anxiety disorders and 41% a substance use disorder. Thirty-four percent of participants were diagnosed with current depression, all but 2 having major depression, with one case of dysthymia (a further 12% had resolved post-TBI depression), 36% with at least one current anxiety disorder, (14 cases generalized anxiety disorder, 11 cases post-traumatic stress disorder, 7 specific phobia, 6 with panic disorder, 6 with social phobia, one with obsessive-compulsive disorder and one with agoraphobia (a further 2% had resolved) and 17% with a current substance use disorder (a further 4% had resolved). There were significant associations between pre-injury and post-injury depression, (Cohen's kappa = 0.22, $p = 0.006$), pre- and post-TBI anxiety (Cohen's kappa = 0.30, $p < 0.001$) and pre- and post-TBI substance use disorders (Cohen's kappa = 0.42, $p < 0.001$). However two-thirds of cases of depression and anxiety had developed for the first time since the injury. There were no differences in diagnoses obtained as reported by the participant in comparison with their SO report.

Hypothesis 1: SPRS (self) and SPRS (significant other) ratings of changes in various psychosocial domains pre- to post-injury

Results obtained on the SPRS are set out in Table I. Within each domain there was a wide range of reported scores ranging from 0 (extreme) to 24 (no change). Changes in work skills and leisure activities were most common, followed by changes in relationships and then independent living status. Paired sample *t*-tests revealed no significant differences between reports of TBI participants and their SOs on any individual domain or on total scores. Total SPRS scores based on reports from TBI participants were highly correlated with those of their SOs ($r = 0.75$, $p < 0.001$).

Table I. *Summary of scores from Sydney Psychosocial Reintegration Scale (SPRS): Self-reports and significant others*

	TBI participants		Significant others	
SPRS domain	Mean (SD)	Range	Mean (SD)	Range
OA	15.28 (6.33)	0–24	15.46 (5.82)	2–24
IR	17.44 (5.66)	3–24	17.92 (5.19)	4–24
LS	20.19 (3.80)	5–24	20.30 (3.58)	7–24
Total	52.91 (14.42)	15–72	53.68 (13.09)	18–72

TBI: traumatic brain injury; OA: occupational activities; IR: interpersonal relationships; LS: living skills; SD: standard deviation..

Hypotheses 2: prediction of outcome as measured by SPRS scores

Pearson's correlations and independent sample *t*-tests revealed that lower scores (i.e. poorer outcomes) on the SPRS Total TBI (participant)-rated scores were significantly associated with longer PTA, less education, longer time post-injury, older age, presence of pre-injury psychiatric disorder and presence of current depression or anxiety (significant predictors from bivariate analyses presented in Table II). Lower education, current depression and current anxiety were significantly associated with poorer SPRS SO-ratings. Pre-injury employment status was not significantly associated with occupational outcome in the bivariate analyses.

Blockwise multiple linear regression analysis with the SPRS Total scores as the dependent variables were computed (see Table II). For the TBI-rated total SPRS score, demographic and injury related variables (block 1) accounted for 20.7% of the variance in the dependent variable ($p < 0.001$), pre-injury psychiatric disorders (block 2) accounted for an additional 4.7% of variance ($p = 0.02$), and post-injury disorders (block 3) added another 21.7% ($p < 0.001$); 47% variance explained by the full model ($p < 0.001$). In the full model, longer PTA, current depression and anxiety were predictive of lower (worse) scores on the SPRS Total (TBI-rated). For SPRS Total SO-rated scores, the intermediary block for pre-injury psychiatric status was not conducted as pre-injury psychiatric status showed no significant correlation in the bivariate analysis. Demographic and injury related variables (block 1) accounted for 13.1% of the variance in the dependent variable ($p = 0.001$), while post-injury disorders (block 2) added another 23.9% ($p < 0.001$); 37% variance explained by the full model ($p < 0.001$). In the full model, lower SPRS total scores (SO-rated) were predicted by lower education, current anxiety and depression. Tolerance values ranged from 0.55 to 0.94 for SPRS Total TBI scores and from 0.89 to 0.99 for SPRS Total SO scores.

Table II. *Predictors of traumatic brain injury (TBI) participants' and relatives' total Sydney Psychosocial Reintegration Scale (SPRS) scores*[1]

		SPRS total scores			
		Participant		Significant other	
Predictor		Bivariate comparisons[2] Pearson's *r*	Multivariate analysis: multiple regression Standardized beta	Bivariate comparisons[2] Pearson's *r*	Multivariate analysis: multiple regression Standardized beta
PTA		–0.23*	–0.25**	–0.18	
Years of education		0.28**	0.15	0.36**	0.24*
Time post-injury		–0.24*	–0.14	–0.17	
Age		–0.27**	–0.04	–0.20	
		Mean (SD)		Mean (SD)	
Any pre-injury psychiatric disorder	Yes	50.12 (14.76)*	–0.06	51.31 (14.07)	
	No	55.94 (13.55)		56.00 (11.74)	
Depression	Yes	42.82 (14.47)**	0.25*	44.42 (13.04)**	0.31*
	No	58.11 (11.39)		58.47 (10.34)	
Anxiety	Yes	43.33 (14.69)**	0.35**	45.83 (13.77) **	0.25*
	No	58.30 (11.19)		57.54 (10.93)	

*$p < 0.05$ (two-tailed); **$p < 0.01$(two-tailed).
[1]Both bivariate and multivariate analyses are shown; significant predictors from the bivariate analyses were entered as independent variables in the multiple regression analyses.
[2]Bivariate statistical tests: Pearson's correlations and Student's *t*-tests.
PTA: post-traumatic amnesia; SD: standard deviation.

Prediction of outcome on the SPRS occupational activities (OA) domain

Bivariate analyses (Pearson's correlations and *t*-tests; see Table III) revealed that TBI participants reporting worse outcome in the OA domain were significantly older, had less education, were more likely to have a pre-TBI psychiatric illness, and to have a current depressive or anxiety disorder. For the SPRS (SO), older age, less education, current depression or anxiety were significantly associated with poor occupational functioning. There was a trend for those with a pre-TBI psychiatric illness to have poorer ratings in this domain; however, the difference between groups was not significant.

Blockwise multiple linear regression analysis revealed a significant model. For the TBI-rated OA scores, demographic and injury related variables (block 1) accounted for 14.4% of the variance in the dependent variable ($p < 0.01$), a further

Table III. *Predictors of Sydney Psychosocial Reintegration Scale (SPRS) occupational activities domain scores (participant self-report and significant other)*[1]

		SPRS occupational activities			
		Participant		Significant other	
Predictor		Bivariate comparisons[2] Pearson's *r*	Multivariate analysis: multiple regression Standardized beta	Bivariate comparisons[2] Pearson's *r*	Multivariate analysis: multiple regression Standardized beta
PTA		–0.17		–0.17	
Years of education		0.30**	0.13	0.34**	0.15
Time post-injury		–0.15		–0.11	
Older age		–0.31**	–0.16	–0.25*	–0.15
		Mean (SD)		Mean (SD)	
Gender	Men	15.21(6.06)		14.81 (5.36)	
	Women	15.45 (7.06)		17.00 (6.62)	
Any pre-injury disorder	Yes	13.81 (6.40) *	–0.15	14.51 (6.08)	
	No	16.87 (5.92)		16.39 (5.45)	
Currently depressed	Yes	10.82 (5.72) **	0.29**	11.39 (5.73) **	0.42**
	No	17.58 (5.37)		17.57 (4.67)	
Currently anxious	Yes	11.36 (6.22) **	0.22*	12.53 (6.12) **	0.05
	No	17.48 (5.29)		16.90 (5.13)	

*$p < 0.05$ (two-tailed); **$p < 0.01$ (two-tailed).
[1]Both bi-and multivariate analyses are shown; significant predictors from the bivariate analyses were entered as independent variables in the multiple regression analyses.
[2]Bivariate statistical tests: Pearson's correlations and Student's *t*-tests.
PTA: post-traumatic amnesia; SD: standard deviation.

significant change in variance was observed with the addition of pre-injury psychiatric status in block 2, which added 6.5% of the variance ($p < 0.01$) and then again with the third block of current psychiatric diagnoses, which added 16.4% ($p < 0.001$); 37.3% variance was explained by the overall model ($p < 0.001$). In the full model, current depression and anxiety were predictive of lower (worse) scores on the TBI-rated OA scale. For the OA SO report, demographic and injury related variables (block 1) accounted for 14.8% of the variance ($p = 0.001$) while post-injury disorders (block 2) added another 18.1% ($p < 0.001$); 33% variance explained by the full model ($p < 0.001$). In the full model, lower SPRS total scores (SO-rated) were predicted by lower education, current anxiety and depression. Presence of current depression was the sole predictor of poor scores on SO report (Table III). Tolerance values ranged from 0.58 to 0.87 for TBI report and from 0.49 to 0.78 for SO report in the OA domain.

Prediction of outcome on SPRS interpersonal relationships (IR) domain

Bivariate statistics (Pearson's correlations and *t*-tests) predicting IR domain scores from the bivariate analyses are detailed in Table IV. Using the TBI report version, there were significant relationships between poor outcome on the IR scale and older age, less education, longer PTA, not currently working or studying, longer time post-injury and presence of current depression and current anxiety. On SPRS (SO) report, male gender, less education, current unemployment, current depression and anxiety were significantly associated with poor relationship status.

The blockwise multiple linear regression analyses for the IR scale revealed significant models. On TBI participant report, demographic and injury related variables (block 1) accounted for 26.7% of the variance in the dependent variable ($p < 0.001$), while post-injury disorders (block 2) added another 18% ($p < 0.001$); 44.7% variance explained by the full model ($p < 0.001$). In the full model, lower IR scores (TBI-rated) were predicted by longer duration of PTA, longer time post-injury and current anxiety. On SO report, demographic and injury related variables accounted for 14.6% of the variance ($p < 0.01$) in block 1, while post-injury psychiatric disorders in block 2 added another 17.7% of the variance ($p < 0.001$); 32.3% variance explained by the full model ($p < 0.001$). Male gender and current anxiety were predictive of poor outcome according to SO reports in the IR domain (see Table IV). Tolerance values for the TBI report ranged from 0.56 to 0.92, and from 0.50 to 0.93 for the SO report.

Prediction of outcome on the SPRS living skills (LS) domain

Associations between significant predictors of LS domain scores from the bivariate analyses are detailed in Table V. On TBI report, significant predictor variables for a post-injury decline in independence in LS were longer PTA, not currently working or studying, current depression and current anxiety. On SPRS (SO) report, less education, current unemployment, current depression and current anxiety were significantly associated with a decline in independent living status.

The blockwise multiple linear regressions revealed significant models. For the TBI-rated LS score, demographic and injury re-

Table IV. *Predictors of Sydney Psychosocial Reintegration Scale (SPRS) interpersonal relationships domain scores (participant self-report and significant other)*[1]

		Interpersonal relationships			
		Participant		Significant other	
Predictor		Bivariate comparisons[2] Pearson's *r*	Multivariate analysis: multiple regression Standardized beta	Bivariate comparisons[2] Pearson's *r*	Multivariate analysis: multiple regression Standardized beta
PTA		–0.23*	–0.25**	–0.14	
Years of education		0.24*	0.14	0.28**	0.12
Time post-injury		–0.33**	–0.23*	–0.16	
Older age		–0.22*	0.04	–0.13	
		Mean (SD)		Mean (SD)	
Currently employed	Yes	18.62 (5.22)*	0.05	19.22 (4.50)**	0.07
	No	15.73 (5.90)		15.63 (5.58)	
Gender	Men	17.29 (5.50)		17.20 (5.33)*	0.21*
	Women	17.79 (6.11)		19.63 (4.47)	
Any pre-injury disorder	Yes	16.82 (5.57)		17.02 (5.72)	
	No	18.10 (5.71)		18.80 (4.49)	
Currently depressed	Yes	13.91 (5.82)**	0.15	14.97 (5.36)**	0.21
	No	19.26 (4.66)		19.45 (4.42)	
Currently anxious	Yes	13.78 (5.77)**	0.37**	15.07 (5.45)**	0.30*
	No	19.50 (4.47)		19.33 (4.46)	

*$p < 0.05$ (two-tailed); **$p < 0.01$(two-tailed).
[1]Both bi-and multivariate analyses are shown; significant predictors from the bivariate analyses were entered as independent variables in the multiple regression analyses.
[2]Bivariate statistical tests: Pearson's correlations and Student's *t*-tests.
PTA: post-traumatic amnesia; SD: standard deviation.

Table V. *Predictors of Sydney Psychosocial Reintegration Scale (SPRS) living skills domain scores (participant self-report and significant other)*[1]

		Living skills			
		Participant		Significant other	
Predictor		Bivariate comparisons[2] Pearson's *r*	Multivariate analysis: multiple regression Standardized beta	Bivariate comparisons[2] Pearson's *r*	Multivariate analysis: multiple regression Standardized beta
PTA		–0.25*	–0.26**	–0.16	
Years of education		0.19		0.38**	0.26*
Time post-injury		–0.16		–0.19	
Older age		–0.17		–0.15	
		Mean (SD)		Mean (SD)	
Currently employed	Yes	21.09 (3.34)**	0.12	21.34 (2.71)**	0.13
	No	18.90 (4.10)		18.45 (4.19)	
Gender	Men	20.00 (3.89)		19.96 (3.57)	
	Women	20.65 (3.61)		21.07 (3.55)	
Any pre-injury disorder	Yes	19.48 (4.18)		19.77 (4.02)	
	No	20.95 (3.22)		20.80 (3.04)	
Currently depressed	Yes	18.09 (4.83)**	0.21**	18.07 (21.45)**	0.17
	No	21.27 (2.60)		21.45 (2.66)	
Currently anxious	Yes	18.19 (4.45)**	0.26**	18.23 (4.29)**	0.29*
	No	21.31 (2.87)		21.31 (2.68)	

*$p<0.05$ (two-tailed); **$p<0.01$(two-tailed).
[1]Both bi-and multivariate analyses are shown; significant predictors from the bivariate analyses were entered as independent variables in the multiple regression analyses.
[2]Bivariate statistical tests: Pearson's correlations and Student's *t*-tests.
PTA: post-traumatic amnesia; SD: standard deviation.

lated variables (block 1) accounted for 14.4% of the variance in the dependent variable ($p=0.001$), and post-injury disorders (block 2) added another 15.8% ($p<0.001$); 30.2% variance explained by the full model ($p<0.001$). In the full model, longer PTA, current depression and anxiety were predictive of lower (worse) scores on the LS domain (TBI -rated). For SO-rated scores, demographic and injury related variables (block 1) accounted for 20.4% of the variance in the dependent variable ($p<0.001$), while post-injury disorders (block 2) added another 15.2% ($p<0.001$); 35.6% variance explained by the full model ($p<0.001$). In the full model, lower IR scores (SO-rated) were predicted by lower education and current anxiety. Tolerance values ranged from 0.67 to 0.99 on TBI report and from 0.50 to 0.78 on SO report.

On the SPRS Total and individual domain scores, for both TBI participant and SO report, the following predictor variables were not significantly correlated with any of the outcome variables in bivariate analyses: pre-injury employment status, location of residence (city vs country), lowest GCS score, pre- and post-injury substance use disorders, current relationship status and current AUDIT and DAST scores.

DISCUSSION

The first aim of this study was to investigate the nature of psychosocial outcome 0.5–5.5 years following TBI across a number of domains using the SPRS. As hypothesized, most participants demonstrated a decline in function across all domains; however, some reported no change. Decline in work/leisure activities was most common, followed by relationships and then independent living status. There was a strong association between ratings made by the TBI participant and their SO. However there was a substantial amount of unshared variance, reflected in some differences between self and SO-rated predictors of outcome across each domain. This reinforces the importance of considering a range of perspectives when investigating outcome following TBI.

The second aim was to examine the association between outcomes in each domain of the SPRS and clinically diagnosed pre- and post-injury psychiatric disorders relative to that of demographic and injury-related variables. Presence of current anxiety and/or depression accounted for a substantial proportion of variance in the regression analyses, over and above the contribution of other predictors, as rated by self and SO on each domain and overall scores. The fact that the SO ratings also revealed this strong association mitigates against the likelihood that depressed or anxious TBI participants demonstrated a reporting bias.

The finding of a strong association between depression and poor outcome is consistent with previous research (7, 16, 17, 27). Fann et al. (16) found depressed participants to be more functionally impaired. Gomez-Hernandez et al. (27) and Hibbard et al. (7) found an association between depression and impaired IR in the first year post-injury and an average of 7 years later, respectively. Presence of clinically diagnosed depression has also previously been associated with unemployment in patients assessed in the first year post-injury (17) and at 2, 5 or 10 years post-injury (28). Given that the current study included participants up to 5.5 years post-injury, it appears that this association between depression and unemployment represents a long-term vulnerability. However, the severity of depressive symptoms may fluctuate over

time post-injury (8). Long-term unemployment may compound social isolation and lowered self-esteem, (2, 29) creating or perpetuating depressive conditions and creating a complex interplay between all of these outcome domains measured. However, the direction of causation is unclear at this time. It could also be that the brain injury itself causes depression, which in turn contributes to cognitive dysfunction and avoidance of certain activities, resulting in poorer vocational outcomes, problems in IR and greater dependence in living skills.

Anxiety disorders were more commonly associated with poor outcome across all domains of the SPRS than were depression or substance abuse disorders. This is one of the first studies to comprehensively examine a range of anxiety disorders and their effect on specific aspects of outcome, which is clearly very significant. There is a need for further research to examine the nature and cause of these associations. Whether anxiety is caused directly by the injury or occurs as a consequence of the experience of cognitive and functional disability remains unclear. Whichever is the case, given the strength of this association, anxiety represents an important potential focus for intervention.

Pre-injury psychiatric status was significantly associated with SPRS Total score and the OA domain when rated by the TBI participant and a similar pattern of results was obtained for SO-rated OA scores, although this was not statistically significant. The association failed to reach significance in the multivariate analyses, once post-injury psychiatric status was entered into the equation. It is also possible that current psychiatric status is more strongly associated with the global psychiatric status of patients with TBI and their employment status than previous psychiatric status. Since the presence of pre-injury psychiatric disorders was significantly related to the presence of post-injury disorders, there may be a mediating relationship, such that pre-injury psychiatric status predicts current psychiatric status, which in turn is related to outcome. However, it should also be noted that two-thirds of cases of depression and anxiety had developed for the first time since the injury. Moreover, there was no significant relationship between pre-injury psychiatric status and outcome in the IR or LS domains. It is possible that a previous psychiatric history predisposes one to more severe effects of the TBI, particularly in the vocational outcome domain, which seems to be affected most by the TBI. Tolerance values in the regression analyses were within acceptable limits, suggesting that multicollinearity was not a significant issue in this sample.

Pre- or post-injury substance abuse was not related to outcome in any domain. There was a significant decline in substance use post-injury, possibly influenced by the instruction to abstain from substance use for at least a year after injury. The association between post-injury substance use and functional outcome is complex, as those who are most disabled or not working may have less means of gaining access to alcohol and drugs. This contention is supported by the finding of 2 previous studies that those engaging in hazardous alcohol use post-injury are more likely to be employed (9, 30). The fact that pre-injury work status was not predictive of post-injury work status may be explained by the fact that a dichotomous variable may have been too discrete to measure change. A variable such as "pre-injury work stability" (8) may have been more suitable.

Of the other predictor and indicator variables examined, lower education was most strongly associated with poorer outcomes in terms of SPRS Total and the LS domain. Age was significant only in the bivariate analyses. These 2 variables have been associated with poorer functional outcome in a number of previous studies (1, 8, 31–35). The only gender effect emerged when the TBI participant was a male, in which case the SO was more likely to report negative changes in IR. As in previous studies, (1, 3, 32, 36, 37) longer PTA duration showed a significant association with outcome across most domains. The findings of this study are consistent with those of Dikmen et al. (8), suggesting the strain on IR, or at least the injured person's awareness of these changes, appears to increase with time post-injury. This highlights the importance of conducting outcome studies and providing support over more than one year post-injury.

The broad range of factors showing a significant association with outcome is also reflective of the complex nature of determinants of psychosocial outcome. These findings underscore the importance of using a variety of measures and perspectives to assess outcome. Examining the 3 domains of the SPRS separately enabled clarification of which variables were contributing to different aspects of outcome, thus reinforcing the usefulness of such a scale.

The findings of the current study should be interpreted within the context of certain limitations. The study had a retrospective, cross-sectional design including participants who had been hospitalized with mild to very severe TBI from 0.5 to 5.5 years post-injury. The current findings although representative of a broad range of TBI individuals in terms of injury severity and time post-injury; may not be applicable to those people with TBI who have not been hospitalized. The current study considered current disorders rather than post-injury disorders as a whole, as the assessments of outcome and psychiatric status were made at the same time. However, 18% of post-injury psychiatric disorders had resolved by the time of interview, and this may have affected outcome. Given the cross-sectional design of the current study, it is difficult to determine the direction of causality between psychiatric state and functional outcome. A prospective, longitudinal follow-up study that assesses psychiatric state, outcome and variables such as social support, coping skills and cognitive skills may help to disentangle the timing of onset of psychiatric disorders in relation to experience of and awareness of injury-related changes (38). A closer examination of the overlap between injury-related symptoms and somatic symptoms associated with psychiatric disorders after injury would also be fruitful in clarifying the aetiology of these disorders and their association with outcome (38). These are important directions for future research. The reporting of pre-injury psychiatric disorders may have been unreliable at this long time after injury. However TBI participants' reports were verified by their SOs, with no significant differences in reports which would have resulted in differing diagnoses.

In conclusion, the current study has clearly demonstrated the significant relationship between post-TBI anxiety and depression and poorer outcome across the domains of occupation, interpersonal relationships and living skills. Whilst numerous other variables, including education, age, gender,

time post-injury and PTA duration may interact with depressive and anxiety conditions to contribute to poorer outcomes, the strength and consistency of this association with all aspects of outcome highlights the importance of addressing anxiety and depression in those who have experienced TBI. The direction of causation is unclear and further, prospective studies including a broader range of variables will be required to clarify this. However, regardless of this direction, the importance of early diagnosis and management of these disorders as they emerge over the years following injury is paramount.

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