ORIGINAL ARTICLE

A Longitudinal Study of Major and Minor Depression Following Traumatic Brain Injury

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ABSTRACT. Hart T, Hoffman JM, Pretz C, Kennedy R, Clark AN, Brenner LA. A longitudinal study of major and minor depression following traumatic brain injury. Arch Phys Med Rehabil 2012;93:1343-9.

Objective: To examine patterns of change and factors associated with change in depression, both major (major depressive disorder [MDD]) and minor, between 1 and 2 years after traumatic brain injury (TBI).

Design: Observational prospective longitudinal study.

Setting: Inpatient rehabilitation centers, with 1- and 2-year follow-up conducted primarily by telephone.

Participants: Persons with TBI (N=1089) enrolled in the Traumatic Brain Injury Model Systems database, followed at 1 and 2 years postinjury.

Interventions: Not applicable.

Main Outcome Measure: Patient Health Questionnaire-9.

Results: Among participants not depressed at 1 year, close to three fourths remained so at 2-year follow-up. However, 26% developed MDD or minor depression between the first and second years postinjury. Over half of participants with MDD at year 1 also reported MDD the following year, with another 22% reporting minor depression; thus three fourths of those with MDD at year 1 experienced clinically significant symptoms at year 2. Almost one third of those with minor depression at year 1 traversed to MDD at year 2. Polytomous logistic regression confirmed that worse depression at year 1 was associated with higher odds of depression a year later. For those without depression at year 1, symptom worsening over time was related to year 2 problematic substance use and lower FIM motor and cognitive scores. For those with depression at year 1, worsening was associated with lower cognitive FIM, poor social support, and preinjury mental health issues including substance abuse.

Conclusions: Major and minor depression exist on a continuum along which individuals with TBI may traverse over time. Predictors of change differ according to symptom onset. Results highlight importance of long-term monitoring for depression, treating minor as well as major depression, and developing interventions for comorbid depression and substance abuse.

Key Words: Brain injuries; Depression; Mental health; Rehabilitation.

DEPRESSION IS THE most frequently diagnosed psychiatric disorder after traumatic brain injury (TBI).[1] Most studies have focused on major depressive disorder (MDD), defined as at least a 2-week duration of 5 or more symptoms listed in the *Diagnostic and Statistical Manual of Mental Disorders, edition IV* (DSM-IV),[2] including depressed mood or anhedonia. Nearly half of those with TBI experience MDD in the first year, even excluding those depressed at the time of injury.[3] Risk factors for post-TBI depression include younger age,[3,4] lower education,[3,5] being a woman,[6] and premorbid psychiatric problems,[6] including substance abuse.[5] Severity of brain injury, however, does not appear related to presence or severity of depression.[3,5,7,8]

Depression after TBI is associated with unfavorable outcomes including decreased social activity and unemployment,[9-12] reduced quality of life,[3,13] and suicide.[14] The causal relationships remain unclear, with some suggestion that depression follows participation restrictions more often than vice versa.[15] Fewer than half of those with TBI and MDD receive antidepressants or counseling.[3] To better implement treatments, and to prevent unfavorable outcomes, it is important to understand the trajectory and persistence of depressive symptoms after TBI.

There are few longitudinal studies of post-TBI depression and most have focused on the first year after injury. Pagulayan et al[15] found that the overall proportion of participants with depression decreased from 44% at 1 month to 29% at 1 year. However, some individuals improved, some deteriorated, and some were unchanged. Gould et al[16] found that rates of new psychiatric disorders, including depression, increased over the first year for participants with no prior history, and that typical risk factors (age, sex) did not predict who would be affected.

List of Abbreviations

CI	confidence interval
DSM-IV	*Diagnostic and Statistical Manual of Mental Disorders, edition IV*
GCS	Glasgow Coma Scale
MDD	major depressive disorder
MLR	multiple linear regression
PHQ-9	Patient Health Questionnaire-9
TBI	traumatic brain injury
TBIMS	Traumatic Brain Injury Model Systems

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In one of the few longitudinal studies spanning more than 1 year, Dikmen et al[5] examined 283 patients with mild-complicated to severe TBI several times during the first year and again 3 to 5 years after injury. Although most participants showed improvement and median depression scores were generally stable, 35% showed increased depression. Ashman et al[17] administered 3 structured clinical interviews spaced 1 year apart to 83 participants with self-reported chronic TBI; 35% reported depression at the first examination, 24% at the second, and 21% at the third. Thus, many people with moderate and severe TBI experience MDD beyond 1 year postinjury, and group data can obscure a variety of late change patterns. Little is known about the frequency of such patterns and how to predict them, a necessary precursor to promoting positive change and preventing deterioration in mood after TBI.

While MDD is a serious and well-studied consequence of TBI, minor depression may also be important and underrecognized. In a recent Traumatic Brain Injury Model Systems (TBIMS) study,[8] we investigated both MDD and minor depression (defined as 2–4 symptoms including depressed mood/anhedonia) and their association to functional outcomes at 1-year follow-up. Minor depression was reported by almost as many participants as MDD (22% and 26%, respectively), and risk factors were nearly identical. Moreover, there was a monotonic dose-response relationship between severity of depression and all 1-year outcomes examined. These findings were consistent with non-TBI studies showing that minor depression can have significant impact on daily activities[18-22] and health status.[21-24] Increasingly, major and minor depression are considered as existing on a continuum along which patients may traverse over time. Minor depression may thus be seen as a risk factor for MDD, a condition representing incomplete remission from MDD, and a clinically significant condition in its own right.[20,25]

This study was designed as an extension of the previous work on major and minor depression after TBI,[8] with the aim of examining the severity and longitudinal trajectory of depression over the first 2 years. The following questions were addressed: (1) What patterns of longitudinal change in presence and severity of depression are observed between 1 and 2 years post-TBI? (2) What factors are associated with various change patterns—stability, deterioration, and improvement—in depression severity between years 1 and 2, particularly: (a) factors associated with late development of depression by year 2 in those reporting no depression in year 1, and (b) factors associated with change in depression severity at year 2, either improvement or worsening, given depression at year 1.

METHODS

Participants

Participants were enrolled in the TBIMS National Database, a multicenter, longitudinal study funded by the National Institute on Disability and Rehabilitation Research.[26] All TBIMS participants are ≥16 years of age; have sustained a TBI with a Glasgow Coma Scale (GCS) score <13, loss of consciousness >30 minutes, posttraumatic amnesia >24 hours, and/or trauma-related intracranial abnormality; and have provided informed consent. All database participants who had not expired prior to rehabilitation discharge and who were due for both year 1 and year 2 follow-ups between October 2007 and March 2011 (N=1975) were considered. Of these, 104 had expired before year 2 follow-up, and 285 were unable to complete the Patient Health Questionnaire-9 (PHQ-9), described in the Measures section below, at 1 or both follow-ups because they were non-English-speaking (n=18) or too cognitively impaired (n=220). Another 47 did not complete the PHQ-9 for undocumented reasons. Of the remaining 1586 participants, 497 were lost to follow-up at 1 or both years, and 1089 constituted the study sample.

Table 1: Characteristics of Participants Included in the Sample and Those Not Included (lost to follow-up)

Demographic Variables	Included (N=1089)	Not Included (n=497)
Age, mean ± SD (y)	38.60±18.28	40.51±18.84
Sex, no. (% female)	302 (27.7)	116 (23.3)
Education, mean ± SD (y)§	12.85±2.59	11.64±3.03
Race/ethnicity, no. (%)§		
White	795 (73.0)	312 (62.8)
Black	158 (14.5)	89 (17.9)
Hispanic	93 (8.5)	78 (15.7)
Asian American/other	43 (3.9)	18 (3.6)
Preinjury employment, no. (%)‡		
Competitively employed	759 (69.8)	313 (63.6)
Unemployed	96 (8.8)	67 (13.6)
Other (retired, student, homemaker, etc)	232 (21.3)	112 (22.8)
Positive for problem substance use, no. (%)	459 (43.5)	233 (48.7)
Injury variables		
Cause of injury, no. (%)§		
Intentional	90 (8.3)	81 (16.3)
Vehicle related	615 (56.6)	246 (49.6)
Falls	241 (22.2)	117 (23.6)
Other (eg, sports)	141 (13.0)	52 (10.5)
GCS on admission,* mean ± SD	9.78±4.61	10.16±4.53
FIM total†, mean ± SD	53.04±23.17	51.07±22.54

NOTE. Statistical comparisons were made using chi-square tests for nominal variables and *t* tests for interval/ratio variables.
*N=1398; scores from 577 subjects were unobtainable because of sedation/paralysis/intubation.
†Evaluated at discharge from rehabilitation.
‡$P<.01$; §$P<.001$.

Table 1 displays demographic and injury data for the 1089 study participants compared with the 497 lost to follow-up. Consistent with prior research,[27,28] participants lost to follow-up had significantly lower education levels and were more likely to be nonwhite (particularly Hispanic), to be unemployed prior to injury, and to have sustained TBI through assault. Neither severity of injury (GCS on admission) nor overall level of disability (FIM) at hospital discharge differed between included and lost participants.

Measures

Demographic data collected at baseline (ie, during inpatient rehabilitation or from acute care records) included age, sex, race, education, and premorbid occupation. Psychosocial history variables included whether participants had received mental health treatment preinjury (for a subset of the sample only, because of timing of entry into the national database) and problematic substance use coded yes/no according to TBIMS criteria, based on those of the Centers for Disease Control and Prevention[29] and the Substance Abuse and Mental Health Services Administration.[30] Cause of injury and GCS score on emergency admission were gathered from participants' medical records. Cognitive, motor, and total FIM[31] scores representing level of independence were assigned by each participant's clinical team within 72 hours of inpatient rehabilitation discharge.

Measures at both follow-up years included employment status, problematic substance use, and cognitive and motor FIM. A social support score (0, 1, 2) was calculated from 2 items from the Participation Assessment using Recombined Tools-Objective,[32] assessing whether the participant has an ongoing intimate relationship and/or a close friend in whom to confide. Depression was measured using the PHQ-9,[33] a self-report of frequency of the 9 DSM-IV symptoms of depression from 0 (not at all) to 3 (nearly every day) over the previous 2 weeks. The PHQ-9 has excellent sensitivity and specificity as a screen for MDD[33] and minimizes false positives in TBI and non-TBI populations.[34] Using a scoring method for optimal sensitivity and specificity for MDD in moderate to severe TBI,[35] also used in the previous TBIMS study,[8] symptoms were scored positive when endorsed on at least several days (score≥1). Minor depression was defined as 2 to 4 positive symptoms, while major depression was defined as ≥5 positive symptoms; depressed mood or anhedonia had to be positive for either classification. Thus, individuals classified as having no depression either endorsed 0 to 1 symptoms on the PHQ-9, or ≥1 symptom without depressed mood or anhedonia. This is consistent with recommendations on classifying individuals who endorse symptoms other than cardinal symptoms.[36,37]

Procedure

The TBIMS project was approved and overseen by institutional review boards at all participating centers. Demographic data and psychosocial history were obtained at baseline from medical records and participant/family interview. One- and 2-year follow-up data were collected via interviews on the telephone or in person as close to the anniversaries of injury as feasible with a window of ±8 weeks for year 1 and ±12 weeks for year 2. To ensure standardized administration of validated instruments, the TBIMS follow-up interviews are conducted by trained research staff according to protocols that are overseen by a National Data and Statistical Center. For example, the FIM, which is rated by clinical staff at rehabilitation admission and discharge, is administered at follow-up by telephone using a self- or proxy report version that has been shown to be reliable and valid for this purpose.[38] Although proxy report is acceptable for some TBIMS outcome variables, self-report was used exclusively for this study because of the focus on depression.

Data Analysis

For question 1, cross-tabulation was used to determine numbers and proportions of participants in each depression category (no, minor, major) across both follow-up years. A polytomous logistic regression was performed to examine the statistical relationship among these 3 ordinal depression categories at years 1 and 2. Analysis included tests of model fit and adherence to the proportional odds assumption.

Two separate, but identical multiple linear regression (MLR) analyses were conducted to examine longitudinal change in the group who was not depressed at year 1 (question 2a) and the other group who did report depression at year 1 (question 2b). Analyses were carried out using SAS version 9.3.[a] For both MLR analyses, the dependent variable was the residual change score based on the difference between PHQ-9 scores from year 1 to year 2. This score provides an unbiased measure of change and accounts for the correlation between observations on the same individual.[39] Predictor variables for both MLR analyses were age; sex; race (white, black, Hispanic, other); problematic substance use (yes, no) at injury and at year 2; cognitive and motor FIM scores at year 2; employment status (employed, unemployed, other, eg, student) at preinjury and year 2; degree of social support at year 2 using the ordinal variable described in the Measures section above (0, 1, 2); and receipt of mental health services at any time prior to injury (yes, no). Because this last variable was added to the TBIMS database later than the others, it was available only for 605 of the 1089 participants. Therefore, it was included in the initial models for questions 2a and 2b with a plan to perform a final analysis without it, to preserve sample size, if it did not enter the model. To identify variables related to change, a backward elimination process was employed with criteria for variable retention set at $\alpha=.05$. This method, which is exploratory, guards against variable redundancy, while allowing each variable to be considered in the model. Model assumptions, such as normality and homoscedasticity, were assessed.

Analyses for question 2a (late increase in depression symptoms) were conducted on participants in the no-depression group at year 1. Excluded from this analysis were 52 participants whose PHQ-9 scores *decreased* by ≥3 points from year 1 to year 2. These participants reported secondary symptoms (eg, change in sleep or appetite) without a cardinal symptom and were thus classified as not depressed at year 1. We reasoned that improved scores for these participants would not reflect true improvement in depression; therefore, including them could obscure the relationship between predictor variables and change in depressive symptoms. The 3-point cutoff was selected on the basis of research suggesting this as a minimal degree of clinically significant change.[40] After removing these participants, question 2a was analyzed with n=520. The MLR analysis for question 2b (longitudinal change after depression observed at year 1) was conducted on the remainder of the sample, all participants who reported minor or major depression at year 1 (n=517).

RESULTS

Table 2 shows the distribution of participants in the 3 depression groups at years 1 and 2. Across follow-up years, the proportion in each group was nearly the same: 26% of participants in each of years 1 and 2 reported MDD, while 21% in year 1 and 20% in year 2 reported minor depression; 53% in year 1 and 55% in year 2 reported no depression. Despite these stable proportions, there was substantial shifting of individuals from group to group across follow-up years, as described below.

In the no depression group at year 1, there were 154 participants (14% of the sample) who endorsed ≥2 symptoms on the PHQ-9 at the level of at least several days per week, but neither of the cardinal symptoms at that level. These participants included the 52 whose secondary symptoms improved from year 1 to year 2, excluding them from the analysis for question 2a. At year 2, 133 participants (12% of the no depression

Table 2: Participants in Each Depression Group at Year 1 and Year 2 Follow-Up

	Year 2			
Year 1	No Depression	Minor Depression	Major Depression	Totals
No depression	424 (74)	95 (17)	53 (9)	572
Minor depression	104 (44)	61 (26)	69 (29)	234
Major depression	66 (23)	61 (22)	156 (55)	283
Totals	594	217	278	1089

NOTE. Row percents (ie, proportions in each category at year 1 who fell into each category at year 2) are in parentheses.

group) endorsed secondary symptoms only. A small number (30, or <3% of the total sample) endorsed ≥2 symptoms in the absence of cardinal symptoms at both follow-ups.

Question 1: Patterns of Longitudinal Change

A sizable majority (nearly three fourths) of participants with no depression at year 1 also reported no depression at year 2 (see table 2). Most who reported late development of depression did so at the level of minor depression (17% of those not depressed at year 1), with only 9% of those not depressed at year 1 reporting MDD at year 2. About three fourths of participants with MDD at year 1 also reported some level of depression at year 2. More than half remained in the MDD category at year 2, with the remainder split almost evenly among minor depression and no depression. Of participants with minor depression at year 1, 44% reported no depression and the remainder showed persistence of depression, with nearly one third traversing to MDD. Across all 3 year 1 groups, 59% of participants stayed in the same category, 21% had improved at year 2, and 20% had deteriorated.

Results of the polytomous logistic regression for question 1 confirmed that the greater the severity of depression at year 1, the more likely was the continued presence of depression at year 2. Participants with minor depression at year 1 had 3.7 times higher odds of remaining in a depression category at year 2, either major or minor, compared with participants with no depression at year 1 (95% confidence interval [CI], 2.7–4.9; $P<.001$). For those with MDD compared with no depression at year 1, the odds were much higher (odds ratio=10.4; 95% CI, 7.7–14.1, $P<.001$) that the participant would fall into a depression category at year 2. Comparison of the 2 depression groups revealed that those with minor depression at year 1 had 2.9 greater odds than those with MDD of improving to the no depression category at year 2 (95% CI, 2.1–4.0; $P<.001$).

Question 2: Factors Associated With Longitudinal Change in Depression Symptoms

As shown in table 3, in the analysis for question 2a, 3 variables were significant predictors of increased symptoms for those who were not depressed at year 1: problematic substance use at year 2, and both cognitive and motor FIM at year 2. The worse the motor and cognitive FIM scores at year 2, the greater the increase (worsening) in PHQ-9 score from year 1 to year 2.

Analysis for question 2b revealed that for participants reporting depression at year 1 (n=517), degree of social support at year 2, problematic substance use preinjury, and cognitive FIM at year 2 were all significantly associated with change in depression score (table 4). Similar to question 2a, lower cognitive FIM scores were associated with worsening in depressive symptoms. The analysis for question 2b also included participants whose depression improved, which would be associated with higher FIM scores. Preinjury problematic substance use was associated with worsening of depression between years 1 and 2, with absence of problematic use associated with improvement. With regard to social support, participants who had neither a spouse/significant other nor a close friend/confidant (score of 0) compared with those with both (score of 2) had more worsening of symptoms. However, the difference between those with a score of 1 (either a spouse/significant other, or a confidant) versus 2 did not reach significance.

For the subgroup with data on preinjury mental health treatment (n=265), variables associated with change in depression included history of such treatment, absence of social support, and cognitive FIM at year 2 (table 5). The results for cognitive FIM and social support were consistent with the model run in the full sample. Individuals who did not receive mental health treatment prior to injury reported more improvement in depressive symptoms at year 2.

Table 3: Results of MLRs for Question 2a, Factors Associated With Late Worsening in Participants Not Depressed at Year 1

Variable	Estimate	95% CI	*P*
Motor FIM at year 2	−.01	−.02 to −.002	.020
Cognitive FIM at year 2	−.12	−.15 to −.080	<.001
Problematic substance use at year 2 (yes)	.33	.13 to .530	.001

NOTE. Estimates are based on residual change scores that are not in the same units as raw scores.

Table 4: Results of MLRs for Question 2b, Factors Associated With Changes in Depression for Participants Reporting Depression at Year 1 (full sample)

Variable	Estimate	95% CI	*P*
Social support at year 2 (0 vs 2)	.54	.30 to .80	<.001
Social support at year 2 (1 vs 2)	.14	−.02 to .30	.090
Problematic substance use preinjury (no)	−.17	−.32 to −.02	.030
Cognitive FIM at year 2	−.07	−.10 to −.05	<.001

NOTE. Estimates are based on residual change scores that are not in the same units as raw scores.

DISCUSSION

This study examined the longitudinal trajectory of self-reported depression between 1 and 2 years post-TBI, particularly factors associated with late development of depression and changes in depression symptom severity. Among participants not depressed at 1 year, close to three fourths remained so at 2-year follow-up. However, it is disconcerting that the remaining 26% developed MDD or minor depression between the first and second years postinjury. Over half of the participants with MDD at year 1 also reported MDD the following year, with another 22% moving into the minor depression category. Thus, three fourths of those with MDD at year 1 experienced persistent, clinically significant symptoms at year 2. Polytomous logistic regression confirmed that worse levels of depression at year 1 are associated with higher odds of reporting clinically significant depression a year later. Odds of

Table 5: Results of MLRs for Question 2b, Factors Associated With Changes in Depression for Participants Reporting Depression at Year 1 (subsample reporting mental health treatment preinjury)

Variable	Estimate	95% CI	*P*
Social support at year 2 (0 vs 2)	.45	.07 to .82	.020
Social support at year 2 (1 vs 2)	.13	−.06 to .32	.170
Mental health treatment preinjury (no)	.35	−.60 to −.10	.004
Cognitive FIM at year 2	−.06	−.09 to −.04	<.001

NOTE. Estimates are based on residual change scores that are not in the same units as raw scores.

resolved depression at year 2 were almost 3 times worse for those with MDD compared with minor depression at year 1.

Participants with minor depression at year 1 showed the most variable longitudinal trajectory. Although 44% with minor depression reported symptom resolution 1 year later, over half endorsed symptoms at the same or worse level, with about one third worsening to the level of MDD. These results are consistent with major and minor depression being quantitatively, not qualitatively, distinct entities that patients traverse over time.[20,25]

We also attempted to identify factors associated with changes in symptom severity between years 1 and 2. For those not depressed at year 1, late worsening of symptoms was associated with 2 concurrent factors at year 2: greater cognitive and physical disability, and problematic substance use. Consistent with prior studies showing that demographic factors do not predict emergence of novel episodes of depression during the first year postinjury,[16] this late worsening pattern was *not* predicted by preinjury variables normally considered risk factors, for example age,[3,4] sex,[6] and education.[3,5] Premorbid psychiatric disturbance was not a predictor of late worsening; this contradicts some previous findings,[6] possibility because of differences in measurement.

A somewhat different picture emerged from the analysis of change (worsening or improvement) in those who *were* depressed at year 1. Again, age, sex, and education were not predictive of change. However, both preinjury treatment for mental health problems and preinjury substance abuse were significant predictors, as was the level of cognitive (but not motor) disability on the FIM at year 2. Social support was a significant predictor of change in those depressed at year 1, with a lack of either an intimate romantic relationship or a best friend/confidant being associated with more deleterious change in depression symptoms.

These findings suggest that lack of functional recovery, especially cognitive recovery, is related to worsening mood at year 2, regardless of depression at year 1. We cannot determine causal direction in this relationship. While it has been suggested that functional limitations most often precede depression,[15] it remains possible that worsening depression in our participants contributed to worse cognitive status. Similar interpretive issues apply to late-worsening depression vis-à-vis substance abuse at year 2. Interestingly, for participants who already reported depression at year 1, a worsening pattern of depression at year 2 was related not to concurrent substance abuse but to *premorbid* substance abuse and use of mental health services. It may be that substance abuse measured concurrently with late-developing depression indicates an attempt to self-medicate, whereas preinjury substance abuse and psychological instability are risk factors for persistent depression and other unfavorable long-term outcomes.[41] More research would be needed to confirm this speculation.

A substantial number of persons with TBI who were not depressed at year 1 endorsed clinically meaningful deterioration in mood at 2 years postinjury. This finding underscores the importance of monitoring for depression and promoting emotional well-being, even in those who appear to adjust well early on. Assessment and monitoring of functional abilities in conjunction with depressive symptoms may inform assessment, prevention, and treatment of depression after TBI. Our results also support ongoing screening and assessment for substance abuse as well as depression among individuals with TBI, as those with a dual diagnosis may represent a unique subgroup with clinical implications for both prognosis and response to treatment.[42]

Our finding that lack of social support may lead to continuation or worsening of depression suggests that this variable may play an important role in emotional outcomes after TBI. This is consistent with previous findings that lack of social support is associated with worse postconcussional symptoms[43] and decreased health-related quality of life,[44,45] and may affect the experience of depression after TBI.[46] Social support should be explicitly assessed by clinicians and researchers addressing the problem of posttraumatic depression, because positive social support can provide opportunities for constructive interpersonal experiences and may function as a buffer that can reduce the impact of stressors.[47]

Strengths of this study include the use of a large sample that was followed prospectively from the injury, using 3 data collection waves that afforded longitudinal analysis. However, interpretation of findings must be tempered by the fact that the MLR models explained only a small amount (<15%) of the total variance in depression score change. Clearly, more research is needed to identify and measure factors predictive of significant, long-term mood changes in this population. In addition, studies of TBI need to consider a richer variety of factors that bear on psychological outcome, not only variables associated with negative outcomes such as depression, but variables that may be associated with mental wellness or the prevention of disease, such as optimism and resilience.[48]

Study Limitations

A specific measurement limitation in this study may be the use of the PHQ-9 change score, because our analyses were complicated by participants with secondary but no cardinal symptoms of depression. Further research on the effect of secondary symptoms on PHQ-9 change scores among depressed and nondepressed TBI patients will be necessary for proper use of this instrument in longitudinal assessments. We also had limited information about participants' psychiatric history, and were able to use preinjury mental health treatment as a proxy variable only in a subset. No information about treatment received between follow-up years was available; mental health services received during this time (which may or may not include treatment for depression) would likely account for some change in depression status. Assessment of social support was similarly limited; future studies should include greater details on this potential mediator of outcome.

The generalizability of the findings is further limited by the TBIMS sample, which is restricted to participants who receive inpatient rehabilitation, excluding very severely injured and mildly injured patients. In addition, differences between included participants versus those lost to follow-up (see table 1) suggest that results may not generalize adequately to participants who are nonwhite (particularly, Hispanic) and to those with lower levels of education, worse preinjury employment histories, and intentional mechanisms of TBI.

CONCLUSIONS

Depression is an important problem after TBI and may persist for years after injury. Worse functional status, especially cognitive status, substance abuse, and lack of social support, are associated with persistent or worsening depression between 1 and 2 years after TBI, and should be monitored to help predict and prevent deterioration in mood. Additional research is needed to address the causal relations among these factors and to develop and validate effective treatments, especially for comorbid depression and substance abuse in those with cognitive impairment.

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