Trauma/Critical Care

Long-term social dysfunction after trauma: What is the prevalence, risk factors, and associated outcomes?

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ABSTRACT

Background: Social functioning—the ability to participate in organized or informal family, friend, or peer groups and communal activities—is intertwined with physical and emotional health. Although trauma can have a lasting effect on both the physical and emotional well-being of patients, little is known about the long-term impact of injury on social functioning. We sought to determine the prevalence of, risk factors for, and outcomes associated with long-term social dysfunction after trauma.

Methods: Adults with moderate-to-severe injuries managed at three Level I trauma centers were contacted at 6 to 12 months after injury to inquire about social dysfunction. Demographics, socioeconomic parameters, and injury-related and hospital course information were also obtained. A stepwise backward logistic regression model was fitted to determine independent risk factors of social dysfunction, and multiple logistic regression models were used to determine associations between social dysfunction and post-traumatic stress disorder, functional limitations, and return to work.

Results: Of the 805 screened patients, 45.2% reported social dysfunction. Patients with social dysfunction were more likely to be African American, be Medicaid beneficiaries, be of lower education, require mechanical ventilation, be discharged less often to home, have a lower mean age and had longer hospital stays. In multivariable analysis, low education, longer hospital stay, past psychiatric illness, and African-American race independently increased the risk for social dysfunction. Furthermore, patients with social dysfunction were more likely to screen positive for post-traumatic stress disorder (odds ratio: 16.25 [95% confidence interval: 9.49–27.85]), be experiencing functional limitations (odds ratio: 2.80 [95% confidence interval: 1.76-4.44]), and to not have returned to work (odds ratio: 5.65 [95% confidence interval: 3.92–8.14]).

Conclusion: Lower educational attainment, long hospital stay, past pyschiatric illness, and African-American race appear to predispose to social dysfunction after trauma, which in turn is associated with a positive post-traumatic stress disorder screen, functional limitations, and delayed return to work.

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Background

Social functioning defines the ability of individuals to participate in organized or informal family, friend, or peer groups and in communal activities.[1] As social invididuals, humans tend to place great value on daily social interactions, and, when these are limited, quality of life may be affected.[2] Impairment in social functioning has been shown to negatively affect not only physical and mental health outcomes, but also survival: A comprehensive meta-analysis of 148 prospective studies investigating the impact of social relationships on death risk found an increased likelihood of mortality with weaker social relationships.[3] Similarly, a seminal study assessing patient-reported outcomes at 12 and 18 months after trauma demonstrated that declines in the level of social network satisfaction were associated with long-term adverse functional outcomes,[4] although whether a poorer recovery affects social rehabilitation or the opposite may be difficult to determine. Social functioning can also have a profound impact in the recovery trajectory after major trauma. A study by Soberg et al[5] found that having higher social functioning during the first 2 years after injury improved mental health outcomes 10 years later.

Social dysfunction (SocDys) is defined as the lowered ability of an individual to interact with his family, friends, and peer groups and to participate in shared activities at past established levels.[1] Research has focused for the most part on establishing an association between trauma, particularly traumatic brain injury (TBI), and social functioning. Not surprisingly, patients with moderate-to-severe TBI experience greater SocDys compared with the general population, likely because of the lower post-traumatic mental functioning.[6] However, SocDys has also been described in mild TBI patients.[7,8] An association between major trauma and SocDys may be intuitively inferred and attributed to the following factors that come into play after major trauma:

- The time away from daily social norms (family, work, and friend organized and informal interactions) that are typically required for the treatment of and recovery from their injuries;
- The functional limitations that lower the ability to actively participate in their social networks;
- The emotional difficulties, attributable to the injury, that limit the desire for social interactions; and
- The pain or other lingering symptoms—the relief of which may take priority over social involvement.

Despite these obvious inferences, little is known about the complex interactions at play among injury type and severity, baseline patient factors, degree of resulting SocDys, and long-term outcomes after trauma. With this study, using data from a prospective multi-institutional trauma center collaboration, we aim to determine the long-term prevalence of SocDys after major injury; identify risk factors predisposing to SocDys; and determine whether an association exists between SocDys and other long-term outcomes after trauma such as post-traumatic stress disorder (PTSD), functional limitations, and return to work (RTW).

Methods

Data source

Data from the Functional Outcomes and Recovery after Trauma Emergencies (FORTE) project were utilized for thist study. The FORTE project is a multi-institutional initiative that began in 2015 at three academic Level I trauma centers in Boston, MA, with the aim to prospectively collect long-term patient-reported outcomes after trauma. Participating institutions are the Brigham and Women's Hospital, Massachusetts General Hospital, and Boston Medical Center. The FORTE project began collecting data in December 2015 at Brigham and Women's Hospital and in June 2016 at Massachusetts General Hospital and Boston Medical Center. The FORTE project has approval from the Partners Healthcare Institutional Review Board.

Patients

Adult trauma patients with moderate-to-severe injuries (Injury Severity Score $\geq$ 9) admitted to participating centers for further trauma care between December 2015 and April 2018 and a complete follow-up interview at 6 to 12 months after injury were identified from the FORTE registry and included in the present study. Interviewees were requested to answer to the best of their ability with information pertaining to their postinjury health trajectory and status. Patients involving proxy response and those with incomplete covariates or outcome data were excluded. Further details about the recruitment and data collection procedures have been outlined in a elsewhere.[9]

Social dysfunction, risk factors, and long-term outcomes
Social dysfunction prevalence

SocDys was assessed 6 to 12 months after injury using the Short Form 12 (SF-12) Health Survey. The SF-12 is a well-validated and recognized tool to assess health-related quality of life.[10] One of the domains of the SF-12 is social functioning. In this domain, social functioning is assessed with the following question: "During the last four weeks, how much of the time has your physical health or emotional problems interfered with your social activities, like visiting with friends, relatives etc.?" SocDys was defined as a response of one of the following options: all of the time, most of the time, some of the time, and a little of the time. This corresponds to an SF-12 Social Functioning subdomain score of 47 or less, which in comparison with general population norms (mean of 50 and standard deviation [SD] of 10) is defined as significantly lower.

Risk factors for social dysfunction

Patient and injury-related factors included in the trauma registry and the FORTE database were considered. These factors include age, race, educational attainment, sex, baseline comorbidities, insurance type, injury type and severity, past major psychiatric illness, systolic blood pressure at admission, hospital length of stay (LOS), need for mechanical ventilation, need for intensive care unit stay, discharge disposition, and presence of clinically significant head injury (as decreased mental function would limit ability to participate in social interactions).

Other long-term outcomes

In the present study, 3 long-term trauma outcomes were used to investigate their cross-sectional associations with SocDys: PTSD positive screening, presence of functional limitations, and RTW. These outcomes were assessed at the same follow-up interview when SocDys was determined (6–12 months after injury). PTSD screening was performed using the Breslau abbreviated scale.[11] A positive answer in a minimum of 4 of the 7 questions of the instrument was considered a positive screening for PTSD. A score of 4 out of 7 on this abbreviated scale has 80% sensitivity and 97% specificity for a diagnosis of PTSD.[11] Functional limitations were assessed using the functional engagement 8-item domain of the Trauma Quality of Life instrument, a trauma-specific quality-of-life tool,[12] and was defined as having 1 or more trauma-related limitations for activities of daily living. RTW was assessed with 2

questions asking whether the patient had been working or not the month before the injury and at the time of the interview.

Statistical analysis

Patient demographics, clinical, and injury-related data were described and compared between patients with and without SocDys. Results are summarized using frequencies and percentages for dichotomous and categorical variables, and with mean and standard deviation or median and interquartile range, depending on data normality for continous variables. Variables of interest were compared between groups, using the t test or the Wilcoxon rank-sum test for continous variables as appropriate, and χ^2 tests or the Fisher exact test for categorical variables as indicated.

Using variables statistically significant at a $P < .05$ level identified from comparisons between patients with and without SocDys, a stepwise backward logistic regression model was fitted to determine independent risk factors of SocDys. Unadjusted and adjusted associations between SocDys and PTSD, functional limitations, and RTW were established using multiple logistic regression models. Models were adjusted for variables having been identified to affect long-term trauma outcomes,[13] and a fixed term with the time of follow-up was incorporated in all the models to account for the fact that the interviews were conducted at different time points between 6 and 12 months after injury. Missing data were handled using a complete case analysis approach, excluding patients with missing data in the predictor, covariates, or outcome variables. All statistical analyses were performed in STATA v 14.0 (StataCorp, College Station, TX, USA).

Results

A total of 1,984 patients were eligible for inclusion in the FORTE project. Of these, 760 declined to participate or were lost to follow-up. Of the remaining 1,224 patients, 419 caregiver or incomplete
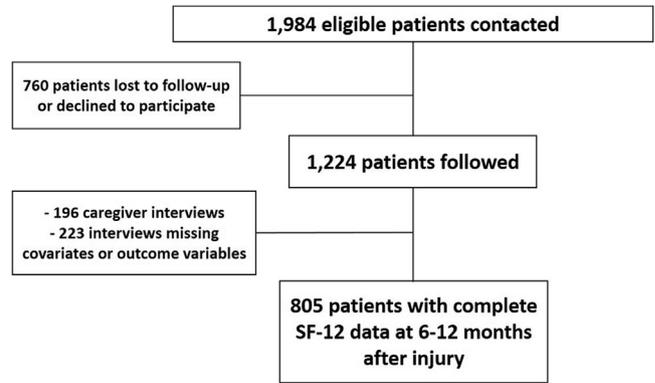
Fig 1. Study flowchart

interviews were excluded, resulting in 805 patients for the analysis. The study flowchart is presented in detail in Figure 1.

Social dysfunction prevalence

SocDys was identified in 45.2% (364 of 805) of the trauma patients interviewed, and the distribution of SocDys degree of severity is summarized in Figure 2. Mean SF-12 Social Functioning scores were 33.69 (SD 10.1) for patients with SocDys and 56.6 (SD 0) for patients without SocDys (population norm: 50 [SD 10]). Patient demographics and injury-related characteristics of patients with and without SocDys are summarized in Table I.

Risk factors for social dysfunction

Patients with and without SocDys were comparable in terms of injury-related factors (severity and mechanism). However, compared with patients without SocDys, patients with SocDys were more likely to be African American (AA), have low education
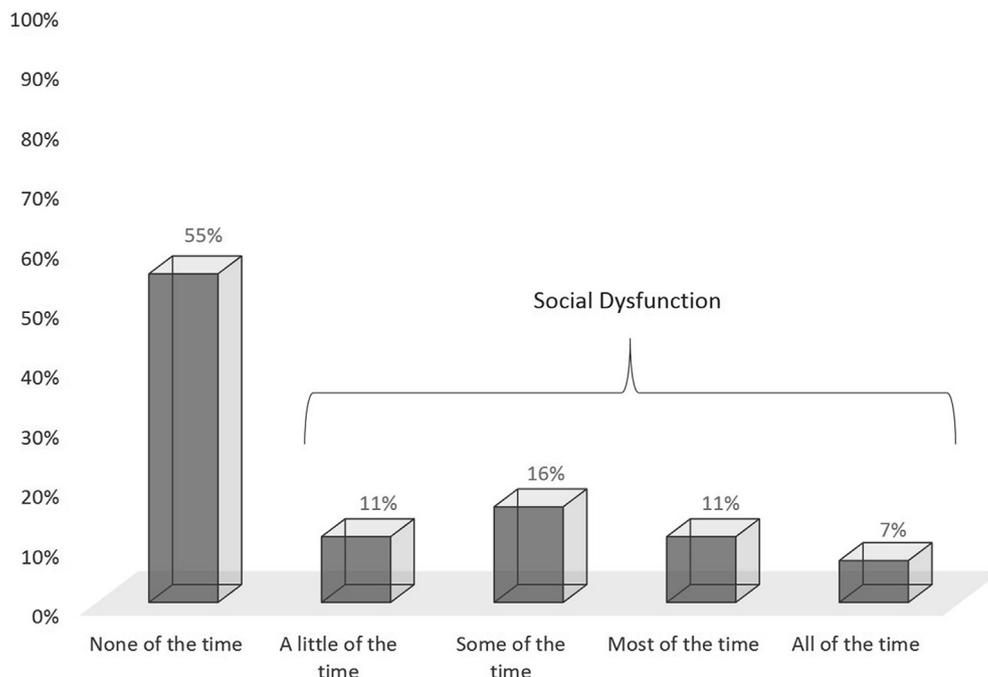
Fig 2. Distribution of responses to the following question: "During the last four weeks, how much of the time has your physical health or emotional problems interfered with your social activities, like visiting with friends, relatives etc.?" ($n = 805$).

Table I

Comparison of patient demographics, clinical, and injury-related characterstics between patients with and without social dysfunction

	Social dysfunction n = 364 (45%)	No social dysfunction n = 441 (55%)	P value
Age in years, mean (SD)	53 (20.8)	58 (20.5)	**.003**
Age by quartiles			**.001**
18−37	101 (28%)	102 (23%)	
38−60	111 (31%)	95 (22%)	
61−73	74 (20%)	127 (29%)	
> 73	78 (21%)	117 (27%)	
Sex			.946
Male	203 (56%)	247 (56%)	
Female	161 (44%)	194 (44%)	
Race			< .001
African American	69 (19%)	40 (9%)	
Other	295 (81%)	401 (91%)	
Education			< .001
High school or lower	207 (57%)	158 (36%)	
Greater than high school	157 (43%)	283 (64%)	
Insurance			< .001
Medicaid/MassHealth/FreeCare	51 (14%)	29 (7%)	
Private/Medicare/other	313 (86%)	412 (93%)	
Injury type			.232
Falls	191 (53%)	261 (59%)	
Road traffic injuries	118 (32%)	132 (30%)	
Blunt assault	13 (4%)	12 (3%)	
Penetrating injuries	26 (7%)	18 (4%)	
Other	16 (4%)	18 (4%)	
Injury Severity Score, mean (SD)	14.2 (7.1)	14.2 (7.2)	.907
Injury severity distribution			.763
Moderate injuries (ISS 9−15)	253 (70%)	297 (67%)	
Severe injuries (ISS 16−24)	71 (19%)	95 (22%)	
Critical injuries (ISS > 24)	40 (11%)	49 (11%)	
Systolic blood pressure at admission	141.5 (27.7)	142.2 (25.5)	.742
Past major psychiatric illness			< .001
Yes	75 (21%)	38 (9%)	
No	285 (79%)	389 (91%)	
Significant head injury (AIS ≥ 2)			.782
Yes	127 (35%)	158 (36%)	
No	237 (65%)	283 (64%)	
ICU admission			.624
Yes	139 (38%)	161 (37%)	
No	225 (62%)	280 (63%)	
Mechanical ventilation			< .001
Yes	57 (16%)	34 (8%)	
No	307 (84%)	407 (92%)	
Hospital length of stay (days), mean (SD)	7.4 (8.6)	5.6 (5.2)	< .001
Discharge disposition			.006
Home	107 (29%)	159 (36%)	
Home with health services	57 (16%)	84 (19%)	
Rehabilitation facility	147 (40%)	161 (37%)	
Nursing home/skilled nursing facility	36 (9%)	31 (7%)	
Other	17 (5%)	6 (1%)	

ISS, injury severity score.

(high school or less), have required mechanical ventilation, have lower mean age, have a higher prevalence of past major psychiatric illness, and longer hospital LOS (all *P* < .05), although injury severity was not dissimilar (Table I).

In stepwise backward logistic regression analysis, we identified that patients with AA race (odds ratio [OR]: 1.85 [95% confidence interval [CI]: 1.18−2.90]; *P*: .007), low education (OR: 2.12 [95% CI: 1.57−2].86; *P* < .001), longer hospital LOS (OR: 1.04 [95% CI: 1.01−1.07]; *P*: .003), and past major psychiatric illness (OR: 2.73 [95% CI: 1.77−4.22]; *P* < .001) had higher odds of SocDys (all *P* < .05, area under receiver operating characteristic curve: 0.67 [Fig 3]; Hosmer-Lemeshow goodness of fit test: *P*: .052; Table II).
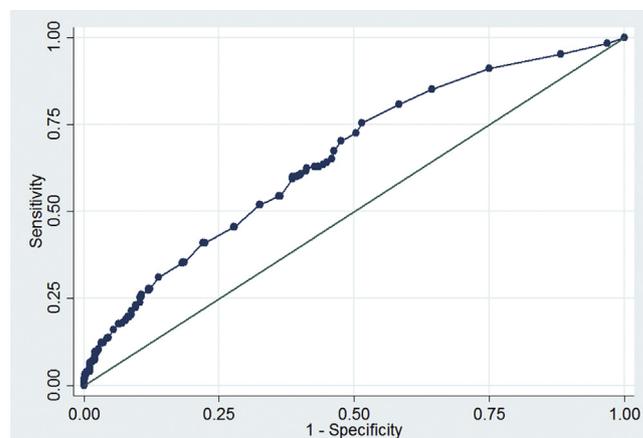

Fig 3. Area under receiver operating characterstic (ROC) of stepwise backward logistic regression analysis looking at risk factors for social dysfunction.

Table II

Multiple logistic regression model of factors associated with social dysfunction

	Adjusted OR	Adjusted 95% CI	P value
African-American race	1.85	(1.18−2.90)	**.007**
Education—High school or lower	2.12	(1.57−2.86)	< .001
Hospital length of stay	1.04	(1.01−1.07)	**.003**
Past major psychiatric illness	2.73	(1.77−4.22)	< .001

Social dysfunction and long-term outcomes after trauma

SocDys was associated with other poor long-term mental and physical outcomes after trauma. Table III presents the unadjusted and adjusted associations among SocDys and PTSD, functional limitations, and RTW. Patients with SocDys were more likely to screen positive for PTSD (OR: 16.25 [95% CI: 9.49−27.85]; *P*: <0.001), have injury-related functional limitations (OR: 5.65 [95% CI: 3.92−8.14]; *P*: < .001), and have not returned to work (OR: 2.80 [95% CI: 1.76−4.44]; *P*: < .001] compared with patients without SocDys.

Discussion

In this study, using prospectively collected data from a multi-institutional collaboration, we found that almost half of trauma patients exhibited at least some degree of SocDys at 6 to 12 months after injury. Furthermore, we identified that AA race, low educational attainment (high school or less), lengthy hospital stays, and history of a major psychiatric illness were predictors of SocDys, which in turn was associated with other poor long-term trauma outcomes, such as PTSD, persistent functional limitations, and delayed RTW.

Historically, physical and mental consequences after trauma have received greater attention than problems in social functioning. Therefore, there are fewer studies that we can use to compare our findings. SocDys was identified in 45.2% (364 of 805) of the trauma patients interviewed. Although another study has found that, overall, trauma patients report greater impairment in social functioning, none of this work has estimated the prevalence of SocDys.[14] Data on the prevalence of SocDys are scarce even in other fields of medicine. One of the few studies that have analyzed the prevalence of long-term SocDys revealed that 41% of patients treated for childhood craniopharyngioma had long-term SocDys.[15] Although it is a patient population very different from ours, the

Table III
Unadjusted and adjusted associations between social dysfunction and long-term outcomes after trauma

	Overall	Social dysfunction	No social dysfunction	P value[*]	Adjusted OR (95% CI)[†]
PTSD	181 (23%)	158 (44%)	22 (5%)	< .001	16.25 (9.49–27.85)
Functional limitation[‡]	245 (30%)	180 (50%)	65 (15%)	< .001	5.65 (3.92–8.14)
No return to work	166 (39%)	106 (55%)	59 (26%)	< .001	2.80 (1.76–4.44)

[*] Unadjusted P value.
[†] Adjusted for age, education, gender, baseline comorbidities, insurance type, injury type and severity, hospital length of stay, need for mechanical ventilation, ICU stay, and clinically significant head injuries.
[‡] Functional limitation for at least 1 activity of daily living.

prevalence of SocDys was also substantial, which unveils the importance of investigating the oftentimes forgotten social component in the recovery after injury or other acute medical condition.

Consistent with literature that reports racial disparities in trauma,[16,17] we found that AA race was an independent predictor of SocDys. Research has provided valuable data about the differences between AA and non-AA patients to achieve optimal long-term outcomes after traumatic injuries.[18,19] Shafi et al[18] found that AA, Asians, and Hispanic patients had higher risk-adjusted odds of moderate-to-severe disability 6 months after TBI. Nevertheless, these studies focus on racial and ethnic disparities in long-term functional outcomes in patients with traumatic brain injury,[18,19] as opposed to a general trauma patient population. Furthermore, the majority of research examining the effect of race on trauma outcomes have prioritized the use of mortality as the outcome measure,[20,21] and data on the effect of race on functional and quality-of-life outcomes after injury are limited. Our group has demonstrated, pooling data from 7 studies,[16] that AA patients experience greater mortality compared with their white counterparts of similar age, sex, baseline comorbidities, injury type, and severity. In our current project, we show that long-term differences in social functioning exist when stratified by race. Further research needs to be done to determine whether this finding is associated with racial disparities long after discharge.

In addition to race, this study found that lower educational level (high school or lower) was associated with higher odds of SocDys. Several pathways through which education may affect health have been described elsewhere,[22] one of the most widely accepted being related to health literacy—the individual's capacity to obtain, process, and understand health information. Thus far, several studies have demonstrated that a lack of health literacy leads to poorer health outcomes in several patient populations. Specifically in surgical patients, however, health illiteracy has been associated with prolonged hospitalizations,[23] poorer postoperative recovery, and lower social functioning.[24]

In this study, longer LOS was the third factor shown to increase the odds of SocDys. This is consistent with work by Holbrook et al[25] in which they reported that LOS of 7 days or longer was associated with poorer general well-being 6 months postinjury. Furthermore, extended hospital LOS has been associated with noncompliance with postdischarge follow-up,[26] which can perhaps be in part explained by some degree of SocDys. Longer hospitalizations after trauma may reflect either the severity of illness; complications that may have arisen during the index admission; or administrative, insurance, and discharge difficulties.[27] Patients with lengthy hospital stays commonly require complex surgical and nonprocedural interventions and are more likely to experience complications. Moreover, they are frequently discharged to postacute care facilities.[27] Thus, even with long periods of inpatient care, the greater aspect of the recovery process takes place at locations with limited involvement from healthcare professionals and, in the majority of cases, with limited access to patients' usual social network.

The fourth factor that was associated with SocDys is having had a diagnosed major psychiatric illness before the traumatic event. The mechanisms in how these two are connected still unclear, but it is likely that a common pathway is shared with other long-term mental consequences like PTSD, anxiety, or depression.[13] With these in mind, the interplay of the aforementioned factors can negatively influence psychologic coping mechanisms and result in poorer social functioning.[28] However, it is also important to acknowledge that the receiver operating characteristic curve of the model was 0.67, which can be interpreted as a weak predictive model, and that there are other risk factors not measured in this project that may be playing an important role.

In addition to exploring the risk factors for SocDys after traumatic injuries, we determined independent associations between SosDys and long-term functional outcomes after trauma. Our results showed that SosDys was an independent risk factor for PTSD, functional limitations, and lack of RTW, which is consistent with research that has shown that recovery is influenced by the quality and sources of social relations.[29,30] For example, Prang et al[30] analyzed data of 1,649 patients (victims of a transport accident) and found that closer and more stable social relations had a positive impact on RTW and were associated with better physical and mental health.

We observed greater rates of PTSD in our SocDys subjects. The higher prevalence of PTSD in patients with SocDys is not surprising given the close relationship between social functioning and mental health. It is known that adequate social functioning has a positive impact on the prevention of affective disorders after injury.[28,31] Santini et al[31] found that adequate social relationships play an important protective role against the onset of depression, even in people with disabilities. Although it may be rational to postulate a causal relationship of SocDys to PTSD, the reverse may also be true: Adequate social functioning protects against the development of PTSD.[32] However, the onset of PTSD after traumatic events can be a powerful life stressor that may pervasively affect social interactions, leading to SocDys long-after traumatic injury.

Not surprisingly, patients with reported SocDys were also more likely to have functional limitations and less likely to have returned to work, which in turn further limited access to their work-related social networks, further affecting social functioning. Mackenzie et al[33,34] have highlighted the paramount role of social support in the ability of individuals for returning to work after injury. They showed that the adjusted odds of working full time at 12 months after injury were higher if one or more confidants were identified. Social networks, in addition to improving an individual's ability to cope, may provide other resources that are important for job mobility after injury.[33,34] Thus, it is important for clinicians to include family or close friends in early discussions after trauma with the aim of improving communication between the trauma survivor and his/her social network.

The current project has several limitations that must be interpreted in the context of the study design. First, the FORTE study is a multi-institutional collaboration with a response rate of >40%, with

a significant probability of selection bias. We minimized this probability by comparing patient characteristics of participants versus nonparticipants. Although statistically significant, differences in Injury Severity Score, insurance, extremities AIS, and discharge disposition between participants and nonparticipants, they were not practically significant (all <5% difference). There were no significant differences in patient variables (eg, age, education, race, etc), which were observed to be factors of the predisposition of SocDys. The second limitation is the inability to determine patients' baseline social functioning and the lack of a control group drawn from a similar patient population, such as hospitalized patients or patients with mild injuries. These two elements prevent us from establishing the extent to which the traumatic injury is responsible for the observed results. However, we can compare the SF-12 social functioning scores per group with the US population norms so that the results can be put into context, warning that our patient population might not represent the average trauma population of the United States. Third, this study only captures patients at 6 months' or 12 months' post-injury. Longitudinal and longer follow-up is needed to further characterize the recovery trajectories of trauma patients related to social functioning. Fourth, this study is limited to the analysis of the association between variables available in the trauma registry and SocDys. Several other factors are not commonly measured by trauma registries, such as social factors that are likely to play an important role in social functioning, and therefore the predictors for these outcomes are limited to those we collect and describe. Last, the association between SocDys and the other long-term outcomes (PTSD, functional limitations, and RTW) are cross sectional, and as such, we cannot infer any causal relationship and not even elucidate the direction of the association.

In this study we demonstrate that the burden of SocDys after trauma is significant and that education level, hospital LOS, past psychiatric illness, and AA race are independent predictors for long-term SocDys. SocDys in turn is also associated with PTSD, functional limitations, and lack of RTW. A superior objective of advanced trauma systems would be to help trauma victims also regain their preinjury functional and social health. Stakeholders in trauma management and policy should aim to implement strategies that work toward that goal, minimizing the deleterious effects of long-term SocDys after trauma.

Conflict of interest

The authors have indicated that they have no conflict of interest regarding the content of this article.

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