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ORIGINAL ARTICLE

Personality changes and return to work after severe traumatic brain injury: a prospective study

Alexandre P. Diaz,[1,2] Marcelo L. Schwarzbold,[1] Maria E. Thais,[1] Gisele G. Cavallazzi,[1] Roseli Schmoeller,[1] Jean C. Nunes,[1] Alexandre Hohl,[1] Ricardo Guarnieri,[1,2] Marcelo N. Linhares,[1,2] Roger Walz[1,3]

[1]*Center of Applied Neurosciences (CeNAp), Hospital Universitário da Universidade Federal de Santa Catarina (HU-UFSC), Florianópolis, SC, Brazil.* [2]*Neurosurgery Service, Hospital Governador Celso Ramos, Florianópolis, SC, Brazil.* [3]*Department of Clinical Medicine, HU-UFSC, Florianópolis, SC, Brazil.*

Objective: To evaluate predictors of non-return to work (nRTW) among social, demographic, clinical, and psychiatric variables after severe traumatic brain injury (TBI) in a cohort of Brazilian patients.
Methods: Prospective study. Forty-three community-dwelling individuals treated at a Level I trauma center at the time of TBI were evaluated 18 months after trauma. Measures included DSM-IV-TR criteria for personality changes after TBI and Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-I) to assess psychiatric diagnosis. Hospitalization variables included Glasgow Coma Scale scores, pupil examination findings, associated limb trauma, Marshall computed tomography classification, and blood glucose levels.
Results: After multiple logistic regression analysis, only the diagnosis of personality changes was found to be independently associated with nRTW, with an adjusted odds ratio of 10.92 ($p = 0.02$, 95% confidence interval 1.41-84.28).
Conclusions: In this study, personality changes were an independent predictor of nRTW after severe TBI. Ways to predict risk factors associated with personality changes after severe brain injury could aid in identification of early and effective interventions that might ease the burden associated with this condition.

Keywords: Traumatic brain injury; return to work; mental disorders

Introduction

Traumatic brain injury (TBI) is a worldwide public health problem due to its high incidence, mortality, and morbidity.[1] Among working-age men, who represent the highest risk group, traffic accidents and falls account for almost 80% of moderate/severe TBI.[2,3] Morbidity associated with severe TBI is highly prevalent and may result in long-term disability and burdens to the family and society at large.[4]

The direct and indirect costs of TBI are estimated (likely underestimated) at 20 billion Euros per year in Europe alone.[5] Sixty percent of these costs are indirect (i.e., lost production due to work absence or early retirement), which are higher than the total costs (direct and indirect) of brain disorders such as epilepsy, brain tumors, and Parkinson's disease. Approximately 50% of the total costs of brain trauma are due to severe TBI.[6]

Return to competitive work is an important outcome to be evaluated following severe TBI, not only due to the costs associated with work incapacity but also because work activity is associated with social integration, self-esteem reinforcement, and perceived health-related quality of life.[7]

According to a systematic review, 60% of victims of TBI do not return to work.[8] Among the factors associated with non-return-to-work (nRTW) after TBI, older age has been found to be a predictor,[9] as have longer hospital stays,[10] higher injury severity, lower physical functioning,[11] litigation,[12] poor cognitive performance,[13] and higher duration of posttraumatic amnesia (PTA).[14] Psychiatric disorders and cognitive and behavioral impairments are frequent and may have a notable effect on quality of life after severe TBI,[15,16] as well as an association with nRTW after injury.[12,13] In most cases, return to work (RTW) occurs within the first year after the TBI.[7]

A lack of epidemiologic studies on TBI is apparent in Brazil, where an estimated annual incidence of 341 cases per 100,000 population has been reported.[17] Additionally, Koizumi et al. found an annual inpatient admission rate due to TBI of 0.36 per 1,000 for the city of São Paulo,[18] with the majority of these patients being of working age.

The objective of the present study was to evaluate predictors of nRTW among social, demographic, clinical, and psychiatric variables after severe TBI in a cohort of Brazilian patients.

Correspondence: Alexandre Paim Diaz, Centro de Neurociências Aplicadas (CENAP), Universidade Federal de Santa Catarina, CEP 88040-970, Trindade, Florianópolis, SC, Brazil.
E-mail: alexandrepaimdiaz@gmail.com
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Methods

Study sample

The sample comprised community-dwelling individuals treated at Hospital Governador Celso Ramos, a Level I trauma center, at the time of TBI. This hospital assists a population of approximately 800,000 inhabitants of the metropolitan area of Florianópolis, state of Santa Catarina, Brazil. From May 2006 to March 2011, 135 consecutive patients living in the Florianópolis metropolitan area were admitted to the intensive care unit (ICU) with severe TBI. Forty five (33%) died during hospitalization, four (3%) died after hospital discharge, and two (1.5%) remained in a persistent vegetative state after hospitalization. Among the 60 eligible patients, 43 (72%) completed psychiatric and health-related quality of life (HRQOL) assessment (Figure 1). The study protocol was approved by the Human Research Ethics Committee of Universidade Federal de Santa Catarina (UFSC). Written informed consent was obtained from relatives and patients. Psychiatric interviews were performed a mean (standard deviation) of 17.8 (5.7) months after TBI, between June 2008 and May 2012. The inclusion criteria were as follows: 1) patients with severe TBI as defined by a Glasgow Coma Scale (GCS) score of 8 or lower on admission; 2) age 16 years or older at the time of injury; and 3) residing in the Florianópolis metropolitan area. Patients with gunshot wounds were excluded from the study because of the different mechanisms of injury involved and small number of cases.

Psychiatric assessment

Patients were interviewed at the outpatient clinic of the university hospital by two board-certified psychiatrists (APD and MLS) blinded to all hospitalization variables. Interviews were carried out in two 1.5-hour sessions with a 30-min break. Additionally, all interviews were conducted with a patient relative present, most often the parents or a close relative, who provided additional information as necessary for more comprehensive and reliable data collection. Due to the length of the evaluations, patients and their relatives were advised they could request a break at any point during the interview. The Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-I),[19] cross-culturally translated and validated in Brazil,[20] was applied to assess Axis I psychiatric diagnosis. Personality changes, which are not covered as a diagnosis by the SCID-I, were determined using DSM-IV-TR criteria.[21] Panic disorder, obsessive-compulsive disorder, generalized anxiety disorder, and posttraumatic anxiety disorder were all grouped as a dichotomous variable ''anxiety disorder.'' Also aiming a dimensional approach, depressive and anxiety symptoms were quantified using the validated Brazilian version of the Hospital Anxiety and Depression Scale (HADS).[22] The HADS is an instrument used to measure depression and anxiety in patients with general medical conditions.[23] Personality changes due to a general medical condition is a diagnosis distinct from personality disorders, and ''is characterized by a marked change in personality style and traits from a previous level of functioning. Patients must show evidence of a causative organic factor antedating the onset of the personality change.''[24] This diagnosis was assessed mainly using information gained from the relative during the interview. Thus, for the purposes of this study, ''personality changes'' were considered to be personality changes in general, more specifically those occurring due to severe head trauma.

Covariates

Hospitalization variables were collected prospectively at admission, and included GCS, pupil examination findings, associated limb trauma, Marshall computed tomography

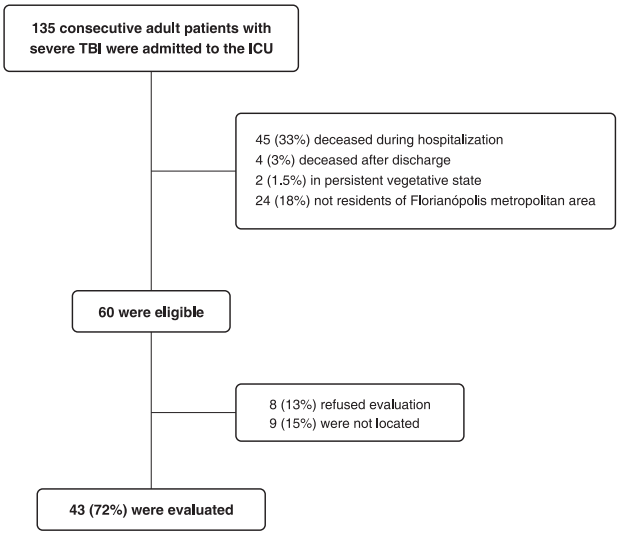

Figure 1 Sampling flow for psychiatric evaluation of adults consecutively admitted to an intensive care unit (ICU) due to severe non-missile TBI an average of 18 months following trauma.

classification, and blood glucose level. These variables were chosen due to their association with worse outcome in previous studies conducted by our group.[3,16,25] We also evaluated whether there was a difference in RTW between patients who were on psychotropic medications at the time of evaluation and those who were not. Information about posttraumatic seizures was collected from the patient or their caregiver.

Sociodemographic variables included sex, age, and educational attainment at the time of trauma and marital status and litigation at the time of psychiatric evaluation. Educational attainment was expressed in years of formal schooling and categorized as follows, taking into account the low mean educational attainment of our sample (10 ± 4.8 years) and the structure of the Brazilian educational system: 0-4 years of schooling, corresponding to the first stage of primary education; 5-8 years of schooling, corresponding to the second stage of primary education; and > 8 years of schooling, corresponding at least to an incomplete secondary education. As one's occupation person is not necessarily suited to one's educational attainment, we also included a variable categorized as low or vocational/higher education required for the occupation performed before TBI. "Vocational/higher education required" was considered when the patient's occupation before TBI required at least technical knowledge. Two university students were considered as having "vocational/higher education required". Litigation was considered when the patient was receiving disability benefits due to medical reasons or had judicial issues related to the accident.

PTA was evaluated retrospectively at the time of psychiatry evaluation. A validated assessment[26] was administered, which consisted of asking the patients which and when was their first declarative memory of facts or events they were able to recall after the TBI. The variable general medical condition was considered positive if the patient reported any chronic medical condition at the time of evaluation. Physical functioning was evaluated on the basis of three of the eight domains of the Medical Outcomes Study 36-item Short-Form Health Survey (SF-36).[27] This instrument assesses quality of life factors, including physical functioning, role limitations related to physical health, and bodily pain.

The participants were asked about the type of occupation they performed at the time of brain injury and at evaluation. RTW was considered positive if the person was employed in a competitive job at evaluation (18 months after TBI), regardless of whether the job was full-time or part-time.

Statistical analysis

A series of univariate analysis were conducted to determine predictors of nRTW among demographic, social, clinical, and psychiatric variables. Continuous variables were analyzed by Student's *t* test or the Mann-Whitney *U* test depending on whether the distributions violated assumptions for parametric testing determined by a one-sample Kolmogorov-Smirnov test. Categorical variables were analyzed by binary logistic regression. The magnitude of the association between nRTW and the independent variables was measured by the crude odds ratio (crude OR) and respective 95% confidence interval (95%CI). Thereafter, we performed a multiple logistic regression including only the variables associated with nRTW with a p-value < 0.20 on univariate analysis. The magnitude of the association between nRTW and the associated variables was measured by the adjusted odds ratio (adjusted OR) and respective 95%CI. In the final model of multiple logistic regression analysis, a p-value < 0.05 was considered significant. The Hosmer-Lemeshow goodness-of-fit test was applied to verify the extent to which the model provided better fit than a null model with no predictors. Statistical analyses were carried out in SPSS version 17.0 and OpenEpi 2.3.1.

Results

Seventeen patients (39.5%) had sustained TBI due to a motorcycle crash, 10 (23.2%) due to automobile crashes, three (7%) due to assault, seven (16.3%) due to falls, three (7%) had been struck by a vehicle, and one patient (2.3%) due to a bicycle accident. Information on the cause of TBI was unavailable for two patients. Table 1 shows the variable distribution of the evaluated eligible patients and statistical analysis of associations between independent variables and outcome. The mean age at TBI was 31 ± 12 years, and more than 80% of the patients were male.

None of the participants had received any vocational rehabilitation after TBI.

Four patients who were not employed at the time of TBI (three unemployed and one on disability benefits due to a medical condition) were employed at the time of psychiatric evaluation. Only one patient remained unemployed after TBI and was grouped as nRTW.

Of the 14 subjects with a diagnosis of personality changes after severe TBI in our sample, six were classified as apathetic (42.8%), three as aggressive (21.4%), three as disinhibited (21.4%), and two (14.4%) were classified in the combined (apathetic/aggressive) subtype according to DSM-IV-TR criteria.

Univariate analysis showed an association between educational attainment and nRTW. Personality changes, long duration of posttraumatic amnesia, poor physical role functioning domain scores on the SF-36, presence of a general medical condition, and litigation were also shown to be significantly associated with nRTW.

However, multiple logistic regression (Table 2) showed that only the diagnosis of personality changes was found to be independently associated with nRTW, with an adjusted OR of 10.92 (p = 0.02, 95%CI 1.41-84.28). The Hosmer-Lemeshow goodness-of-fit test had a p-value of 0.44, indicating that the model's estimates fit the data at an acceptable level. The accuracy of the model was 80.49% (95%CI 65.99-89.77); sensitivity was 80% (95%CI 54.81-92.95), and specificity 80.77% (95%CI 62.12-91.49); the positive predictive value was 70.59%

Table 1 Sociodemographic, psychiatric, clinical, and general physical health variables associated with non-return to work 18 months after severe traumatic brain injury

Variables	All patients n=43 (%)	Return to work		Crude odds ratio (95%CI)	p-value
		Yes, n=27 (63%)	No, n=16 (37%)		
Sociodemographic variables					
Sex					
Female	7 (16.3)	6 (85.7)	1 (14.3)	1.0	
Male	36 (83.7)	21 (58.3)	15 (41.7)	4.29 (0.5-39.4)	0.20
Age (years)					
Mean ± standard deviation	31.16±11.9	30.30±12.3	32.63±11.5	N/A	0.54
Years of schooling					
> 8 years	29 (67.4)	21 (72.4)	8 (27.6)	1.0	
5-8 years	7 (16.3)	4 (57.1)	3 (42.9)	1.97 (0.4-10.8)	0.43
⩽ 4 years	7 (16.3)	2 (28.6)	5 (71.4)	6.56 (1.0-40.9)	0.04
Marital status					
Married	19 (44.2)	12 (63.2)	7 (36.8)	1.0	
Single	24 (55.8)	15 (62.5)	9 (37.5)	1.03 (0.3-3.6)	0.96
Educational attainment required by occupation*					
Low	22 (53.7)	14 (63.6)	8 (36.4)	1.0	
Vocational/higher	19 (46.3)	11 (57.9)	8 (42.1)	1.27 (0.4-4.5)	0.71
Litigation†					
No	28 (66.7)	20 (71.4)	8 (28.6)	1.0	
Yes	14 (33.3)	6 (42.9)	8 (57.1)	3.34 (0.9-12.7)	0.08
Psychiatric variables					
HADS†‡					
Mean ± standard deviation	10.12±8.1	9.96±8.4	10.40±7.8	N/A	0.87
Depressive disorder‡					
No	31 (72.1)	20 (64.5)	11 (35.5)	1.0	
Yes	12 (27.9)	7 (58.3)	5 (41.7)	1.30 (0.3-3.6)	0.96
Personality changes‡					
No	29 (67.4)	24 (82.8)	5 (17.2)	1.0	
Yes	14 (32.6)	3 (21.4)	11 (78.6)	17.60 (3.6-87.1)	< 0.0001
Anxiety disorder‡§					
No	34 (79.1)	23 (67.6)	11 (32.4)	1	
Yes	9 (20.9)	4 (44.4)	5 (55.6)	2.61 (0.6-11.7)	0.21
Alcohol/other drug dependence‡					
No	35 (81.4)	21 (60)	14 (40)	1.0	
Yes	8 (1.6)	6 (75)	2 (25)	0.50 (0.1-2.8)	0.43
Clinical variables					
Posttraumatic amnesia‡					
⩽ 1 month	22 (51.2)	18 (81.8)	4 (18.2)	1.0	
> 1 month	21 (48.8)	9 (42.9)	12 (57.1)	6 (1.50-24.0)	0.01
Psychotropic medication use					
No	24 (55.8)	17 (70.8)	7 (29.2)	1.0	
Yes	19 (44.2)	10 (52.6)	9 (47.4)	2.19 (0.62-7.7)	0.22
Posttraumatic seizures					
No	29 (67.4)	19 (65.5)	10 (34.5)	1.0	
Yes	14 (32.3)	8 (57.1)	6 (42.9)	1.42 (0.39-5.26)	0.59
Glasgow Coma Score*‖					
7-8	15 (36.6)	9 (60)	6 (40)	1.0	
5-6	11 (26.8)	9 (81.8)	2 (18.2)	0.33 (0.1-2.1)	0.24
3-4	15 (36.6)	7 (46.7)	8 (53.3)	1.71 (0.4-7.3)	0.47
Pupils*‖					
Isocoric	29 (70.7)	17 (58.6)	12 (41.4)	1.0	
Anisocoric	12 (29.3)	8 (66.7)	4 (33.3)	0.71 (0.17-2.9)	0.63
General medical condition‡					
No	30 (69.8)	21 (70)	9 (30)	1.0	
Yes	13 (30.2)	6 (46.2)	7 (53.8)	2.72 (0.7-10.4)	0.14
Length of ICU stay, days†					
Mean ± standard deviation	11.83±9.01	11.89±10.20	11.73±6.65	N/A	0.96
Associated limb trauma¶‖					
No	27 (67.5)	17 (63)	10 (37)	1.0	
Yes	13 (32.5)	8 (61.5)	5 (38.5)	1.06 (0.3-4.1)	0.93

Continued on next page

Table 1 Continued

Variables	All patients n=43 (%)	Return to work: Yes, n=27 (63%)	Return to work: No, n=16 (37%)	Crude odds ratio (95%CI)	p-value
Marshall CT classification**[‖]					
I-III	16 (43.2)	10 (62.5)	6 (37.5)	1.0	
IV-VII	21 (56.8)	13 (61.9)	8 (38.1)	1.03 (0.3-3.9)	0.97
Blood glucose level, mg/dL[††‖]					
Mean ± standard deviation	149.2±40.3	146.9±32.5	152.07±49.6	N/A	0.72
Physical health					
SF-36, Physical Functioning[†‡]					
IQI > 25 (good)	32 (76.2)	22 (68.8)	10 (31.2)	1.0	
IQI ⩽ 25 (poor)	10 (23.8)	5 (50)	5 (50)	2.2 (0.5-9.4)	0.29
SF-36, Physical Role Functioning[†‡]					
IQI > 25 (good)	24 (57.1)	19 (79.2)	5 (20.8)	1.0	
IQI ⩽ 25 (poor)	18 (42.9)	8 (44.4)	10 (55.6)	4.75 (1.2-18.4)	0.02
SF-36, Bodily Pain[†‡]					
IQI > 25 (good)	32 (76.2)	22 (68.8)	10 (31.2)	1.0	
IQI ⩽ 25 (poor)	10 (23.8)	5 (50)	5 (50)	2.2 (0.5-9.4)	0.29

95%CI = 95% confidence interval; CT = computed tomography; HADS = Hospital Anxiety and Depression Scale; IQI = interquartile interval; ICU = intensive care unit; SF-36 = 36-item Short-Form Health Survey.
* Two missing; [†] one missing; [¶] three missing; ** six missing; [††] nine missing.
[‡] Data collected at evaluation 18 months after the severe traumatic brain injury.
[§] Panic disorder, obsessive-compulsive disorder, generalized anxiety disorder, and posttraumatic anxiety disorder were all pooled as a dichotomous variable "anxiety disorder."
[‖] At admission.

(95%CI 46.87-86.72); and the negative predictive value was 87.50% (95%CI 69-95.66).

Discussion

In our study, only the diagnosis of personality changes after severe TBI remained associated with nRTW on multiple logistic regression. In the context of head trauma rehabilitation, RTW is one of the most important outcomes for evaluation, both for personal and family reasons and for health and public costs.[7] The identification of predictors of RTW after severe TBI should include not only social, demographic, and clinical variables related to the trauma, but also aspects associated with mental health, due to the high prevalence of psychiatric disorders after severe TBI and their evident relationship with incapacity for work.[16,28]

In our patients, variables that could be typically associated with death[3] or work incapacity after brain injury, such as age, length of hospital stay, physical functioning, GCS (considering scores between 3 to 8), and PTA,[9-11,14] did not remain independently associated with nRTW after multiple logistic regression analysis. In a study by Stulemeijer et al., formal education was independently associated with nRTW; however, their sample comprised patients with more advanced education levels and mild TBI, thus limiting comparison with our data.[29] A more reliable way to analyze education level than simply years of schooling is to evaluate the level of knowledge required for the pre-injury occupation of the patient. Differing from our results, a multicenter study of 1,341 consecutive patients by Walker et al. found an independent association between type of pre-injury job and nRTW, with those in more complex and well-paying jobs more likely to return to their working status.[30] In our study, all patients who returned to work after severe TBI returned to a job similar (in terms of knowledge required) to the one they performed prior to injury.

Even though the use of psychotropic medications at the time of evaluation and the diagnosis of depression, anxiety disorders, or substance-related disorders were not associated with nRTW 18 months after severe TBI, we do not know if these conditions could be related to poor work performance or negatively influence work stability after the period covered by our study.

Wang et al. reported a 19.9% prevalence of posttraumatic seizures in a sample of 553 patients with severe TBI.[31] The higher prevalence in our sample, 32.3%, may have been influenced by information bias, since this data was not collected from medical reports, but from patients and caregivers themselves during interview. The mortality rate of our sample, 33%, is consistent with that found in the literature for severe TBI, which is about 34%.[32]

In individuals who have sustained TBI, social and behavioral changes after the injury can be associated with the cognitive impairment acquired due to primary and secondary lesions related to the trauma, particularly those related to executive functions.[33] Thus, at least part of the personality changes displayed by the patient could be associated with this cognitive impairment, which, in turn, is related to the ability of the patient to return to their work activities. In a study by Benedictus et al., the cognitive performance of patients with moderate to severe TBI was associated with RTW independently of their level of functional independence.[13]

Thirty-seven percent of patients in our sample did not return to work after severe TBI, a lower proportion compared to the literature when including only

Table 2 Multiple logistic regression showing the independent variables associated with non-return to work 18 months after severe traumatic brain injury

Predictors	All patients n=43 (%)	Return to work: Yes, n=27 (63%)	Return to work: No, n=16 (37%)	Crude odds ratio (95%CI)	p-value	Adjusted odds ratio (95%CI)	p-value
Sociodemographic variables							
Years of schooling							
> 8 years	29 (67.4)	21 (72.4)	8 (27.6)	1.0		1.0	
5-8 years	7 (16.3)	4 (57.1)	3 (42.9)	1.97 (0.4-10.8)	0.43	3.9 (0.30-49.6)	0.30
⩽ 4 years	7 (16.3)	2 (28.6)	5 (71.4)	6.56 (1.0-40.9)	0.04	5.4 (0.3-98.4)	0.26
Litigation							
No	28 (66.7)	20 (71.4)	8 (28.6)	1.0		1.0	
Yes	14 (33.3)	6 (42.9)	8 (57.1)	3.34 (0.87-12.7)	0.08	4.38 (0.52-36.49)	0.17
Psychiatric variables							
Personality changes							
No	29 (67.4)	24 (82.8)	5 (17.2)	1.0		1.0	
Yes	14 (32.6)	3 (21.4)	11 (78.6)	17.6 (3.6-87.1)	< 0.0001	10.92 (1.4-84.3)	0.02
Clinical variables							
Posttraumatic amnesia							
⩽ 1 month	22 (51.2)	18 (81.8)	4 (18.2)	1.0		1.0	
> 1 month	21 (48.8)	9 (42.9)	12 (57.1)	6 (1.5-24.0)	0.01	2.29 (0.3-17.9)	0.43
General medical condition							
No	30 (69.8)	21 (70)	9 (30)	1.0		1.0	
Yes	13 (30.2)	6 (46.2)	7 (53.8)	2.72 (0.7-10.4)	0.14	1.97 (0.3-13.1)	0.48
Physical health							
SF-36 Physical Role Functioning							
IQI > 25 (good)	24 (57.1)	19 (79.2)	5 (20.8)	1.0		1.0	
IQI ⩽ 25 (poor)	18 (42.9)	8 (44.4)	10 (55.6)	4.7 (1.2-18.4)	0.02	1.9 (0.3-13.7)	0.53

95%CI = 95% confidence interval; IQI = interquartile interval; SF-36 = 36-item Short-Form Health Survey.
Hosmer-Lemeshow goodness-of-fit test: p = 0.44. Accuracy of the model: 80.49% (95%CI 66.0-89.77); sensitivity: 80% (95%CI 54.81-92.95); specificity: 80.77% (95%CI 62.12-91.49); positive predictive value: 70.59% (95%CI 46.87-86.72); negative predictive value: 87.50% (95%CI 69-95.66).

prospective evaluations: 60% for the Lippert-Grumern et al. study (n=51, 2 years after TBI)[34] and 52% for the Sigurdardottir et al. study (n=41, 1 year after the TBI).[35]

Our use of a community-dwelling sample probably allowed us to find a large portion of those patients who had a more favorable recovery, thus increasing the percentage of individuals who have returned to their work activities.

Some limitations of our study include its small sample size, absence of control for cognitive performance, and lack a more thorough characterization of work-specific issues, such as how long patients had worked in their pre-injury jobs, work stability, and factors related to the job market and to job satisfaction. We also were unable to evaluate the working status of patients who were not located and of those who refused evaluation.

Another limitation is the lack of specific information about brain lesion topography and its potential association with RTW. Eight of the 14 patients with personality changes had apathetic characteristics (57.1%), a result similar to that found in the literature for adult patients with TBI (61.4%).[36] Apathy is a common feature of prefrontal lesions,[37] but the absence of specific information on brain lesion topography in our study prevents us from inferring this relationship. Moreover, due to the small sample size, we could not evaluate the influence of the specific subtypes of personality changes after TBI on RTW. However, as the majority of the personality changes after TBI in our sample had apathetic characteristics, our results may be especially related to this specific subtype.

Considering the high prevalence of psychiatric disorders after severe TBI and its evident relationship with work incapacity,[28] the current lack of studies in the literature reflects the relatively low presence of psychiatric evaluation after brain injury. In general, 56% of our patients had at least one Axis I psychiatric disorder at evaluation, a prevalence higher than that found for the general Brazilian population in the same age group.[38] Unlike studies in the general population, in which common psychiatric disorders are highly associated with work disability,[39] the patients of the present study did not differ in terms of anxiety and depressive symptoms or psychiatric disorders such as major depressive disorder, anxiety disorders, or substance use disorder. However, we only evaluated whether the patient did or did not return to work at a specific point in time. The quality of work provided by the patient and their productivity and long-term stability on the job were not assessed. Similar to our results, several authors have also found an association between behavioral functioning and personality changes and not RTW.[11,13,40]

The recognition and clarification of personality changes, their implications, their phenomenology, their symptoms, and the characteristics of post-TBI deficits, as

well as of ways to predict risk factors for victims of severe TBI, could aid identification and application of early and effective interventions to mitigate the personal and family suffering as well as the direct and indirect public costs associated with this condition.

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Disclosure

The authors report no conflicts of interest.

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