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Stability of employment after traumatic brain injury

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Abstract

Although substantial information exists about factors related to who returns to work and time taken to return to work after traumatic brain injury (TBI), less is known about the stability of the work experience after the injury. One hundred sixty-five workers with complicated mild to severe traumatic brain injury were followed for 3 to 5 years postinjury. Work stability definitions included amount of time worked (amount of time worked divided by time observed postinjury) and maintenance of uninterrupted employment once a person returned to work. Amount of time worked was significantly and systematically related to brain injury severity, neuropsychological functioning at 1-month postinjury, and preinjury characteristics such as prior work stability and earnings. However, once persons returned to work, the ability to maintain uninterrupted employment was largely related to premorbid characteristics such as being older, higher income before the injury, or a preinjury job with benefits. It was also related to higher neuropsychological functioning at 1-month postinjury (reflecting the combined effects of premorbid functioning and traumatic brain injury severity), but not related to neurologic indices of severity. (*JINS*, 2005, *11*, 807–816.)

Keywords: Head injuries, Work, Neuropsychology, Risk factors, Prognosis, Outcome assessment (health care)

INTRODUCTION

Gainful employment is a very important part of most adults' lives. Unemployment following traumatic brain injury (TBI) is a large problem, with injury predominantly occurring in young adults at the beginning of their productive years and resulting in financial and social burden at the individual, family, and societal level. Successful return to work is significantly related to the individual's social integration and satisfaction with life (O'Neill et al., 1998) and benefits society enormously by reducing the financial burden of supporting previously healthy workers.

Considerable research has been conducted on return-to-work rates and factors relating to return to work following TBI (Fraser et al., 1988; Dikmen et al., 1994; Sherer et al., 2002a, 2002b; Ownsworth & McKenna, 2004). Although research has identified many variables that are related to who returns and the time it takes to return, very little is known about the stability of the work experience after the TBI survivor reenters the workforce. Information is needed about job stability and factors related to it in order to identify those who can successfully maintain their jobs and those who will need a vocational rehabilitation intervention. Some information has been reported about job retention in the British army following TBI (McLeod et al., 2004), but these results pertain to the unique job situation found within the military and are limited in their ability to generalize to the civilian population. A few studies have provided a glimmer of information about work stability in the civilian population, and it is evident that some of those who return to employment are unable to remain employed. For example, Fleming et al. (1999) evaluated outcome on an average of 3.5 years after TBI in a group of people who had attended a rehabilitation program. They reported that 46% of their sample was working at follow-up, 13.5% had returned to work but were no longer working, and

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the remaining participants had not returned to work. Johnson (1998) surveyed a group of people with severe TBI 10 years postinjury. He reported that 42% of the sample had stable employment, defined as employment for 5 or more years, 19% had unstable employment, involving multiple jobs, and the remaining 39% did not work at all or made one attempt only to resume employment. Johnson also noted that there were few changes in vocational outcome after the first two years postinjury. Kreutzer et al. (2003) conducted a longitudinal investigation of work stability following TBI in a group of 186 participants who had received comprehensive inpatient rehabilitation. Participants were considered to be stable workers if they were working at each of the follow-up evaluations that occurred at 1, 2, and 3 or 4 years postinjury. Participants were classified as unstable workers if they were only working at 1 or 2 of the 3 follow-up points. Using this definition, 34% of the sample had stable employment, 27% had unstable employment, and the remainder were not employed at any follow-up period. They report that demographics (higher preinjury educational level, being married, nonminority race, older age), less severe brain injuries (represented by the Disability Rating Scale score at 1-year postinjury, shorter length of unconsciousness), and driving a vehicle in the year postinjury were all related to stable employment.

Although these prior investigations have highlighted the importance of this topic, they chiefly provide only a snapshot view of work retention at specified times postinjury, so it is difficult to know how accurately the prior results portray work stability. For example, using Kreutzer et al.'s definition, people could be classified as having stable employment because they happened to be working at each of the follow-ups, but in fact may have worked multiple jobs for short periods of time. Alternatively, people could be classified as having unstable employment because they happened to be not working at one of the follow-ups, but may have worked most of the observed period.

The purpose of this project is to characterize work stability by examining the history of work retention postinjury over the entire follow-up period in a group of representative participants. This project attempts to answer the following questions:

1. What are the employment stability outcomes following complicated mild to severe TBI?
2. What are the relationships between employment stability outcomes and individual and injury characteristics?
3. How well do participant and injury characteristics predict employment stability outcomes?

METHOD

Research Participants

The 165 participants of this study represent a subgroup of TBI participants who were preinjury workers and participants of the Valproate Prophylaxis of Posttraumatic Seizures study (Temkin et al., 1999; Dikmen et al., 2000), a clinical trial followed by a prospective, longitudinal investigation of outcome following TBI. Preinjury workers were people who were working at the time of the injury or whose main activity was identified as work regardless of their employment status at the time of the injury. The selection criteria included at least one of the following: depressed skull fracture, penetrating brain injury, computed tomography (CT) evidence of cerebral contusion, intracerebral, subdural, or epidural hematoma. Participants were excluded if they had a history of preinjury seizures, significant brain injury or other neurologic condition, were pregnant, did not have adequate liver function, or if they were younger than age 14. Participants were injured between 1991 and 1994 and evaluated at 1, 6, and 12 months postinjury. A final follow-up was conducted at 3 to 5 years postinjury. A total of 314 participants were entered into the study during the period of enrollment that allowed inclusion into the 3 to 5 year follow-up. Of these, 34 expired and 19 were removed from the study because of inability to get signed consent within 72 hours (an Institutional Review Board (IRB) time limit to obtain written consent for emergency medical research). Another 63 participants were removed from this project because they identified their preinjury major activity as student, homemaker, or retired or there was no information about their preinjury major activity. Of the remaining 198 participants, 176 were successfully followed up at 3 to 5 years postinjury (89% follow-up rate). However, 7 people were unable to provide any information about job stability and 4 were removed because their postinjury work situation consisted of odd jobs with questionable estimates of number of actual months worked. The 19 participants removed from the study because of inability to get signed consent and the sample studied here do not differ significantly on age, gender, or TBI severity evaluated by the Glasgow Coma Scale (GCS), but the removed group had more non-Caucasians ($p < .05$).

The final assessment occurred at 3 years postinjury for 56% of the participants, at 4 years postinjury for 39%, and at 5 years postinjury for 5% of the participants. One participant was evaluated at 2 years postinjury.

Demographic and injury characteristics are described in Table 1. This sample was predominantly male, consistent with other representative series of TBI. On average, participants were in their mid-30s, had a high school education, were of white race, and were single. The group represented complicated mild to severe TBIs. Complicated mild injuries are those with Glasgow Coma Scale (Teasdale & Jennett, 1974) scores in the mild range of 13–15 and CT abnormalities, which occurred in 57% of this sample. The majority of participants were working 20 hours or more a week at the time of the injury (81%), with 4% working less than 20 hours per week or doing temporary work or odd jobs, and 15% were not working. There were no significant changes in regional economic conditions, especially for nontechnical types of work occupations from preinjury to postinjury during the time-span of this study (U.S. Department of Labor, Bureau of Labor Statistics, 2005).

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Table 1. Demographic and severity characteristics

N	165
Mean age (*SD*)	35.1 (11.2)
Male (%)	84
White (%)	88
Mean education (yrs) (*SD*)	12.7 (2.2)
Single (%)	66
Preinjury work situation	
≥ 20 hours/week (%)	81
<20 hours/week (%)	4
Not working (%)	15
Activity at time of injury	
Moving vehicle related (%)	58
Falls (%)	15
Assault (%)	16
Other (%)	11
TBI severity	
Glasgow Coma Scale	
3–8 (%)	18
9–12 (%)	25
13–15 (%)	57
Time to Follow Commands	
≤ 24 hours (%)	56
1–6 days (%)	22
7–13 days (%)	9
≥ 14 days (%)	13
CT evidence	
Contusion (%)	79
Depressed skull fracture (%)	19
Subdural hematoma (%)	38
Epidural hematoma (%)	28
Intracerebral hematoma (%)	10
Penetrating head injury (%)	4

Measures

Demographic information, preexisting conditions, preinjury work stability, preinjury yearly earnings, TBI severity, other system injury severity, neuropsychological functioning at 1-month postinjury, and litigation postinjury were examined to determine their relationship to work stability postinjury.

Demographics and preinjury characteristics

Demographic information included age, years of education, and gender. Preexisting conditions were obtained by a structured interview and included: alcohol problem in the year preinjury indicated by a Short Michigan Alcoholism Screening Test (Selzer et al., 1975) score of 3 or greater, one or more problems resulting from illegal drug use in the year before the injury (e.g., been in trouble, interfered with major activity, drug addiction, treatment for a drug problem), and arrest record at anytime preinjury.

Income earned from working in the year before the injury was divided into 5 groups: less than $3,000, $3,000 to 9,999, $10,000 to 19,999, $20,000 to 29,999, and $30,000 or more. Preinjury work stability was defined as working half time or more at the time of the injury in a job held for at least 6 months. Participants with an unstable preinjury work situation were either not working at the time of the injury, employed less than half-time, or employed at least half time but for under 6 months. Job stability was also examined by determining if the last job held prior to the injury included benefits.

Brain injury and other system injury severity

TBI severity was evaluated with the initial, postresuscitation Glasgow Coma Scale (Teasdale & Jennett, 1974) score obtained in the emergency department. The Glasgow Coma Scale is a measure of coma depth that evaluates eye opening, verbalization, and motor movement with scores ranging from 3 (no verbal, motor, or eye opening response) to 15 (oriented). TBI severity was also evaluated by Time to Follow Commands, defined as the time until the Motor score of the Glasgow Coma Scale reaches 6 (follows simple commands) consistently. Other system injury severity was assessed by the Abbreviated Injury Scale (AIS) Extremities score representing the most severe injury sustained to the upper or lower extremities (*The Abbreviated Injury Scale*, 1990).

Neuropsychological performance

Neuropsychological outcome at 1-month postinjury was assessed by the WAIS Performance Intelligence Quotient (PIQ), the WAIS Digit Symbol subtest, the Trail Making Test Part B, the Selective Reminding Test Sum of Recall, and Tapping with the dominant hand (Wechsler, 1955; Buschke, 1973; Reitan & Wolfson, 1993). The PIQ and Digit Symbol subtest are standardized scores corrected for age. The other measures are raw scores.

Litigation

Participants were considered involved with litigation if they said, due to the injury, they had sued or were planning on suing another party or insurance company over the 3 to 5 year period they were observed. Litigation information was collected for study purposes only and was not added to the person's medical chart, thereby potentially decreasing bias.

Dependent Measures

The participant's postinjury job history since the injury was obtained at 3 to 5 years postinjury with a structured interview. Job stability was determined by number of months worked full-time, number of full-time jobs held, and by maintenance of employment once returned to full-time work. Jobs were counted as full-time if the participant worked ≥20 hours per week for a period greater than 1 week. Partial months of full-time work were rounded up to 1 month if the job was held for ≥2 weeks within the month. Stable seasonal jobs (e.g., school teacher) were counted as employ-

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ment for 12 months out of the year. Amount of time worked since the injury was calculated as the number of months worked half-time or more divided by the number of months observed between injury and the 3 to 5 year evaluation [modification of Monthly Employment Ratio (Wehman et al., 1993)]. Work stability outcomes were grouped to examine the relationships between postinjury employment and individual and injury characteristics. Amount of time worked was examined in four groups: never returned to full-time work, returned but worked 50% or less of the time observed, worked 51 to 89% of the time, and worked 90% or more of the time observed. For participants who returned to full-time work, groups were also formed based on maintenance of employment once they returned to full-time work. Maintenance of employment was defined as uninterrupted full-time work of ≥20 hours per week, regardless of number of jobs held. Failure to maintain employment involved periods of unemployment between jobs and/or a decrease in hours resulting in less than half-time work.

Statistical Analyses

Number of jobs, the amount of time worked over the time period observed, and maintenance of employment were examined descriptively to determine employment outcomes following TBI.

Preinjury, injury severity and neuropsychological outcome variables were compared across the work groups formed by amount of time worked, number of full-time jobs, and maintenance of employment. Data were analyzed using chi-square or Fisher's exact tests for categorical variables and Kruskal-Wallis distribution free analysis of variance for continuous variables. Participants who were too impaired neurologically to be tested on neuropsychological variables at 1-month postinjury were assigned a score equal to one worse than the worst observed. Significant main effects were subjected to *post hoc* analyses with an accepted alpha level of .001 to reduce the risk of Type 1 error due to multiple subgroup comparisons.

Predictors of amount of time worked were analyzed with stepwise multiple linear regression on the uncategorized variable to determine how well participant and injury characteristics predict employment outcome. Predictors of maintenance of employment were analyzed with logistic regression. Predictors included age, education, gender, preexisting conditions, preinjury yearly earnings, preinjury work stability, TBI severity evaluated by time to follow commands, other system injury severity, and neuropsychological outcome at 1-month postinjury. Age at the time of the injury was divided into five categories: less than 25, 25 to 29, 30 to 39, 40 to 49, and 50 or greater. Education was divided into three groups: less than a high school education, high school graduate, and college graduate. Preinjury earnings were grouped into five categories: less than $3,000, $3,000 to 9,999, $10,000 to 19,999, $20,000 or more, and a final group of 12 participants who were missing this information. For the logistic regression of maintenance of employment, those with incomes less than $3000 were combined with the $3000 to 9,999 category, due to the small number of participants who returned to work and had earned less than $3000, none of whom maintained employment. The AIS Extremity score was divided into two groups, severe injury represented by an AIS score of 3 or higher versus a score of 2 or less. Trail Making Test Part B was recoded so that all values greater than 175 seconds were set to 175 seconds. Because 20 cases were missing one or more neuropsychological measures at 1-month postinjury, these people were included in the regression analysis and given a score equal to the mean of the observed scores, and a variable was added for each neuropsychological measure to indicate whether the variable was missing. The variable indicating missing and that for the value were considered as a pair for inclusion in the regression. Litigation was entered after all other variables. After significant main effects were determined, interactions between significant predictors were examined.

RESULTS

A description of work stability for the entire group is summarized in Table 2. Median scores indicate that the participants, on average, had one full-time job and spent 68% of the time working since the injury. A further breakdown of the data shows 26% of the participants did not return to full-time work, 17% worked ≤50%, 30% worked 51–89%, and 27% of the participants spent 90% or more of the time working over the time they were observed. Participants were about evenly split between maintaining (46%) and not maintaining employment (54%) after they first returned to work.

Work groups, based on the amount of time worked since injury, are summarized in Table 3. This table is organized in roughly chronological manner, with demographics and variables descriptive of preinjury status listed first, followed by injury severity variables, and finally neuropsychological measures obtained 1-month postinjury. Significant *post hoc* comparisons between subgroups are represented by the same letter. Five participants were unable to provide any information about amount of time worked and were excluded

Table 2. Work stability

N	165
Median amount of time spent working (%)	68
Worked 0% of the time (%)	26
Worked ≤50% of the time (%)	17
Worked 51–89% of the time (%)	30
Worked ≥90% of the time (%)	27
Median total jobs	1
1 job (%)	35
2 jobs (%)	15
3 jobs (%)	12
≥4 jobs (%)	13
Maintained uninterrupted employment (%)	46

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Table 3. Participant characteristics by amount-of-time-worked groups

	Amount of Time Worked Since Injury				
	0	1–50%	51–89%	≥90%	*p*
Demographics					
n	41	27	49	43	
Mean age (*SD*)	36 (12)	32 (10.5)	5 (12)	37 (10)	.292
Mean education (*SD*)	12.2 (2.5)	12.4 (2.0)	12.6 (1.6)	13.6 (2.6)	.075
Male (%)	95	82	71	86	.022
Preexisting conditions					
SMAST ≥ 3 in year pre (%)	38	26	24	10	.037
Drug problem in year pre (%)	8	18	4	0	.016
Arrest record anytime pre (%)	68	56	45	38	.034
Preinjury work stability					
Unstable (%)	54[A]	52	22	19[A]	<.001
Last job preinjury had benefits (%)	62	33[AB]	76[A]	79[B]	<.001
Preinjury yearly earnings					.003
<$3000 (%)	26	8	6	0	
$3,000–$9,999 (%)	11	19	11	2	
$10,000–$19,999 (%)	14	35	33	12	
$20,000–$29,999 (%)	14	15	24	42	
≥ $30,000 (%)	34	23	26	44	
TBI severity					
Median GCS	11	13	14	15	.014
[Interquartile ranges]	[6.5–14.75]	[8–15]	[9–15]	[11.25–15]	
Median TFC Group	1–3 days[A]	1–3 days	6–24 hrs	1–5 hrs[A]	<.001
[Interquartile ranges]	[1–5 hrs to 14–20 days]	[1–5 hrs to 14–20 days]	[within 1 hr to 4–6 days]	[within 1 hr to 6–24 hrs]	
Other system injury severity					.344
With no extremity injury (%)	61	41	57	63	
AIS Extremities mild or moderate (%)	24	48	33	32	
AIS Extremities severe or worse (%)	15	11	10	5	
Median NP at 1 month [Interquartile ranges]					
PIQ	75[A]	89.5[B]	96	107.5[AB]	<.001
	[untestable–93]	[63.5–98]	[87.25–107.25]	[98–114.75]	
Digit Symbol	4[AB]	6.5[C]	8[A]	10[BC]	<.001
	[untestable–7]	[5–8]	[7–10]	[8.75–12]	
SRCL	36[AB]	67.5	79[A]	80[B]	<.001
	[untestable–73]	[41.75–80.5]	[58–89]	[73.5–88]	
Trails B	282[AB]	102[C]	81.5[A]	58[BC]	<.001
	[untestable–100]	[246.5–62.5]	[123.75–62]	[71.5–46]	
Tapping D	43[A]	47	49.5	55[A]	<.001
	[untestable–51.5]	[40.5–57.25]	[43–58]	[50–59]	

Note. 12/17 variables had missing values including 5 measures with < 5% missing, 6 measures with > 5% but < 10% missing, and GCS with 11% missing. With Bonferroni correction, significant differences ($p \leq .001$) between pairs of subgroups are indicated by the same letter. Abbreviations: AIS = Abbreviated Injury Scale, Digit Symbol = WAIS Digit Symbol subtest, GCS = Glasgow Coma Scale, NP = neuropsychological assessment, PIQ = WAIS Performance Intelligence Quotient, SMAST = Short Michigan Alcoholism Screening Test, SRCL = Selective Reminding Test Sum of Recall, Tapping D = Tapping with the dominant hand, TFC = Time to Follow Commands, Trails B = Trail Making Test Part B.

from these analyses. As can be seen in Table 3, all of the neuropsychological measures administered at 1-month postinjury showed highly significant differences, with steadily improving neuropsychological scores as time spent working increased. For example, the median PIQ score was 75 for those who did not return to full time work, it was 89.5 for those who worked ≤ 50%, it rose to 96 for those who worked 51–89% of the time, and was 107.5 for people who worked at least 90% of the time. Other factors that significantly differentiated the work groups included severity of TBI, preinjury work stability, and preinjury earnings. Time to follow command and, to a lesser extent, Glasgow Coma Scale score systematically differed, showing steadily decreasing head injury severity as the amount of time worked increased.

Participants who did not return to work had a significantly higher rate of preinjury unstable work history (54%) than participants who worked at least 90% time after the injury (19%). Preinjury yearly earnings were also significantly different between the work groups. The group that worked at least 90% of the time since the injury had the highest preinjury yearly earnings. Gender and preexisting conditions were nominally significant but should be interpreted with caution given the number of analyses conducted. Age, education, and other system injury severity were not significantly different among the work groups.

Work stability based on maintenance of employment is summarized in Table 4. Table 4 is organized in the same chronological manner as Table 3 with an additional set of variables at the end describing postinjury employment. Participants who maintained employment once they had returned to work had significantly fewer jobs and worked significantly more time after the injury than those who did not maintain uninterrupted employment. For example, the group that maintained employment held on average 1 job and worked 93% of the time observed compared to the nonmaintainers who held an average 2.5 jobs and worked 68% of the time. Job maintenance was significantly related to older age, a preinjury job with benefits, higher preinjury yearly earnings, and better neuropsychological functioning at 1-month postinjury.

Work stability based on total number of full-time jobs was not related to most variables. In addition, the amount of time worked since the injury did not differ significantly between those who held 1, 2, 3, or 4 or more positions. Older workers and those with higher preinjury income held fewer jobs after injury ($p < .01$).

Looking at multiple predictors with stepwise selection, Digit Symbol at 1-month postinjury, preinjury earnings, and arrest record anytime before the injury together explained 43% of variance in time working after injury ($r^2 = .428$, $F = 15.053$, $p < .001$).[a] Litigation did not significantly predict amount of time working after other variables were taken into account. Significant predictors of maintenance of employment with logistic regression included PIQ at 1-month postinjury, preinjury earnings, and arrest record at anytime before the injury (model chi-square = 34, $df = 6$, $p < .001$).[b] Interactions did not significantly improve either prediction.

DISCUSSION

The results of this study indicate that complicated mild to severe TBIs have significant and disruptive effects on employment of preinjury workers over 3 to 5 years following the injury. As a group, these preinjury workers on average held one job and worked 68% of the time they were observed. Twenty-six percent of the participants did not return to full time work. Seventeen percent worked up to half of the time, 30% worked 51–89% of the time, and 27% worked 90% or more of the time observed. Focusing on the group of participants who returned to work, 46% maintained stable, uninterrupted employment.

The relationship between employment stability outcomes and injury and individual characteristics varied depending on how stability was defined. Time spent working (or amount of time worked) was clearly related to the severity of the TBI as evidenced by systematic and significant relationships between time working groups, and measures of TBI severity. It was also significantly related to neuropsychological functioning at 1-month postinjury, which likely reflects the combined effects of TBI severity and premorbid functioning. In addition, amount of time working was also related to preinjury characteristics such as prior work stability and earnings. On the other hand, the severity of the TBI was not as clearly related to maintenance of uninterrupted employment once the person had returned to work. Maintenance of employment was related to neuropsychological functioning at 1-month postinjury (again, reflecting both premorbid functioning and TBI severity effects), but actual measures of TBI severity such as Glasgow Coma Scale score and Time to Follow Commands were not significantly different, suggesting the possibility that premorbid functioning may be more important for employment maintenance in those who are able to return to work. Other factors that were significantly related to maintenance of employment included age, preinjury earnings, and preinjury work stability. Participants who failed to maintain stable uninterrupted employment were younger, had lower preinjury earnings, and had a preinjury job that did not provide benefits. These variables were highly correlated among themselves indicating that failure to maintain employment is related to demographics of employment (e.g., young persons beginning their working careers) and the premor-

[a]Unstandardized regression coefficients were constant = .468, Digit Symbol = .051, Digit Symbol missing indicator = −.042, Missing earnings = −.138, Earnings < $3000 = −.339, Earnings = $3000–$9999 = −.125, Earnings = $10,000–19,999 = −.073, Earnings ≥ $20,000 (Ref) = 0, Arrested = −.111.

[b]Variables in the equation were constant = −2.631, PIQ = .036, PIQ missing indicator = .811, Missing earnings = −.796, Earnings <$3000–9999 = −2.223, Earnings = $10,000–$19,999 = −1.925, Earnings ≥ $20,000 (Ref) = 0, Arrested = −.987

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Table 4. Participant characteristics by employment maintenance

	Maintenance Groups		
	No	Yes	*p*
Demographics			
n	64	55	
Mean age (*SD*)	32 (10)	38 (10)	<.001
Age ≤ 25 (%)	38	9	<.001
Mean education (*SD*)	12.6 (1.7)	13.2 (2.6)	.377
Male (%)	78	80	.826
Preexisting conditions			
SMAST ≥ 3 in year pre (%)	25	13	.160
Drug problem in year pre (%)	8	4	.457
Arrest record anytime pre (%)	53	35	.064
Preinjury work stability			
Unstable (%)	33	22	.220
Last job preinjury had benefits (%)	55	82	.003
Preinjury yearly earnings			<.001
<$3000 (%)	8	0	
$3000–$9,999 (%)	15	4	
$10,000–$19,999 (%)	36	14	
$20,000–$29,999 (%)	21	36	
≥ $30,000 (%)	20	46	
TBI severity			
Median GCS	14	14	.602
[Interquartile ranges]	[9–15]	[11–15]	
Median TFC	6–24 hrs	1–5 hrs	.137
[Interquartile ranges]	[within 1 hr to 4–6 days]	[within 1 hr to 4–6 days]	
Other system injury severity			.814
No extremity injury (%)	58	53	
AIS Extremities mild or moderate (%)	31	42	
AIS Extremities severe or worse (%)	11	5	
Median NP at 1 month			
[Interquartile ranges]			
PIQ	95.5	105.5	.002
	[85.25–105.75]	[95.5–113]	
Digit Symbol	8	9.5	.006
	[6–9.75]	[7.75–11]	
SRCL	76	78.5	.316
	[59.25–88]	[68–87.25]	
Trails B	82.5	63	.007
	[141.5–61.25]	[92.75–50.5]	
Tapping D	50.5	55	.028
	[44.75–56]	[47.5–58.5]	
Postinjury employment			
Median number of jobs	2.5	1	<.001
	[1–3.75]	[1–2]	
Median amount of time worked	68%	93%	<.001
	[38%–85%]	[84%–96%]	

Note. 11/19 variables had missing values including 5 measures with ≤5% missing, and 6 with >5% and ≤10% missing. See abbreviations in Table 3 footnote.

bid functioning of the individuals rather than due to the severity of the injury alone. This relationship is most clearly demonstrated by examining factors related to total number of full-time jobs. Total number of full-time jobs was not related to the severity of the brain injury or to postinjury neuropsychological functioning. The amount of time worked did not differ among those working one to four or more jobs. It was only related to the age of the participant and their preinjury earnings, with younger participants and those who made less money before the injury having more jobs after the injury. It is possible that if we had a more severely injured sample or we had been able to observe participants

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for longer than a maximum of 5 years, an effect of the injury severity on maintenance of employment or number of jobs would become more apparent.

Prediction of work stability postinjury was best obtained by a combination of neuropsychological functioning at 1-month postinjury, preinjury annual earnings, and an arrest record anytime before the injury, for both maintenance of employment and amount of time worked. The role that neuropsychological functioning at 1-month plays and what it represents was discussed earlier. Preinjury earnings likely reflects the combination of job level/job skills and prior work stability. For maintenance of employment, the age of the person is related on its own, however, in the multivariate analysis, its effect is captured by preinjury earnings, which additionally represents various elements of the work experience, such as younger people usually holding lower level jobs and having a shorter time with the employer. Having an arrest record at anytime preinjury occurred in a substantial number of cases. The study did not formally ascertain reasons for being arrested. However, a review of the comments recorded by the examiners at the time of the interview suggests that many of the arrests involved alcohol and/or substance use (e.g., driving under the influence, consumption of alcohol as a minor, disorderly conduct associated with alcohol, possession of illegal drugs). It is possible, that the presence or absence of an arrest record prior to the injury captured preexisting conditions in a more comprehensive manner than our other preexisting variables that measured a problem only in the year before the injury. Additionally, such a record may be a proxy for the seriousness of the substance abuse problems. Regardless, an arrest record seems to provide a unique set of information about work stability that is not explained by neuropsychological functioning at 1-month postinjury and preinjury earnings.

The results are similar in our current study on amount of time worked and our prior investigation (Dikmen et al., 1994) of time to first return-to-work using a different sample. A comparison of the results of these two studies shows that many of the same factors that are related to amount of time worked (i.e., injury severity, neuropsychological performance at 1-month postinjury, preinjury work stability, and earnings) are also ones that are related to time it takes to first return to work. This raises the question of whether these variables relate to amount of time worked, only because time to first return-to-work is counted as time not worked when calculating amount of time worked. This can largely be ruled out because similar variables relate to job maintenance, that is, whether one is continuously employed once one first returns to work. By its definition, maintenance excludes any time it takes to return to work.

It is difficult to discuss these findings in relationship to other studies, given the differences in the samples studied, the variables examined, and the definitions of work stability used. In spite of the differences, severity of injury and associated level of neuropsychological functioning were important predictors of stability of work in both this study and that reported by Kreutzer et al. (2003). In addition, younger age was significantly related to work instability in the Kreutzer et al. (2003) study and in our results when instability was defined as inability to maintain employment. On the other hand, Johnson (1998) did not find an age effect. Differences between studies on age of participants may be an important determining factor.

The effect of litigation on employment outcome postinjury has been examined with mixed findings. Some researchers (Paniak et al., 2000; Reynolds et al., 2003) have reported that those involved in litigation take longer to return to work than those who are not involved. Other studies (Fraser et al., 1988; Hanlon et al., 1999) have found no relationship between litigation and vocational outcome at a particular point in time and Johnson (1998) found no evidence for a delay in return-to-work due to pending compensation over the 10-year period of observation. Our findings, in this consecutively enrolled, prospectively followed sample, indicate no effect of litigation on amount of time working once significant factors (i.e., Digit Symbol, earnings, arrest record) are controlled.

It is necessary to discuss possible limitations of this study. First, although this sample included cases ranging in severity from complicated mild to severe brain injuries, approximately two-thirds of the sample had complicated mild TBIs. Conclusions about the relationship of preinjury and injury factors to outcome may be very different in a more severely injured sample. Second, the follow-up period of this study ranged from 2 to 5 years postinjury with more than half (56%) followed for only 3 years postinjury, which may have produced limited estimates of employment and work stability compared to a longer follow-up period. Third, TBI participants were asked to describe their work history at their final evaluation, 2 to 5 years postinjury. Often, participants were unsure of some of the precise details of their situation, so the data examined here may not be completely accurate. Neurobehavioral examiners attempted to reconcile histories with information provided at earlier interviews at 1, 6, and 12 months postinjury whenever possible. Nevertheless, it was difficult for many participants to be certain about some start and stop dates of individual jobs, for example. Thus, the information provided here must be thought of as an estimate only. We expect, however, that if we had obtained more accurate information we would have found stronger relationships between preinjury factors, TBI severity and postinjury employment stability.

The results of this study together with prior literature indicate that TBI can have negative effects on employment, whether one looks at the fraction of cases employed at a fixed time after injury (Dikmen et al., 1995; Sander et al., 1996; Gollaher et al., 1998; Sherer et al., 2002b; Dikmen et al., 2003; Doctor et al., 2005), the time it takes to return to work (Dikmen et al., 1994), or the stability of employment as described by amount of time worked or maintenance of employment. Variables that consistently predict such employment outcomes include severity of the brain injury, and even more importantly, associated level of early neuropsychological functioning, preinjury characteristics of

the individual, and their employment history. The results of this study also indicate that persons with low preinjury earnings (a proxy for young age, limited work experience, and/or problematic preinjury employment), arrest record (a proxy for substance abuse and/or psychosocial problems), and low early neuropsychological level of functioning (a proxy for a combination of premorbid cognitive abilities and severity of the brain injury) will face the most significant challenges with respect to employment. However, once persons return to work, premorbid characteristics such as limited preinjury work history and lower neuropsychological functioning postinjury are prominently related to problems with maintaining uninterrupted employment.

These results indicate that a multi-pronged approach may be necessary to address successful employment postinjury. First, a comprehensive vocational evaluation that includes neuropsychological assessment would be necessary to explore realistic vocational goals. It is critical to identify those individuals who, due to cognitive limitations, will need particularly intensive intervention to include work site assessments and more behaviorally oriented supports (e.g., job coaching, co-worker as mentor, etc.) with on-the-job training programs. Secondly, drug and alcohol prevention programs need to be fully utilized when appropriate. Finally, younger individuals, with limited work experience, will need aggressive job development for better paying jobs with more benefit structure whenever possible. The work option must present itself as a truly desirable option, consistent with prior recommendations (Wehman et al., 1993, 1995). Once persons have returned to work, interventions aimed at maintaining stable work patterns appear to be necessary, particularly for this younger group who are experiencing multiple challenges to staying employed.

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