

ORIGINAL RESEARCH

Work Productivity Loss After Mild Traumatic Brain Injury



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Abstract

Objectives: To examine the completeness of return to work (RTW) and the degree of productivity loss in individuals who do achieve a complete RTW after mild traumatic brain injury (MTBI).

Design: Multisite prospective cohort.

Setting: Outpatient concussion clinics.

Participants: Patients (N=79; mean age, 41.5y; 55.7% women) who sustained an MTBI and were employed at the time of the injury. Participants were enrolled at their first clinic visit and assessed by telephone 6 to 8 months postinjury.

Interventions: Not applicable.

Main Outcome Measures: Structured interview of RTW status, British Columbia Postconcussion Symptom Inventory (BC-PSI), Lam Employment Absence and Productivity Scale (LEAPS), Mini International Neuropsychiatric Interview, and brief pain questionnaire. Participants who endorsed symptoms from ≥ 3 categories with at least moderate severity on the BC-PSI were considered to meet *International Classification of Diseases, 10th Revision* criteria for postconcussional syndrome. RTW status was classified as complete if participants returned to their preinjury job with the same hours and responsibilities or to a new job that was at least as demanding.

Results: Of the 46 patients (58.2%) who achieved an RTW, 33 (71.7%) had a complete RTW. Participants with complete RTW had high rates of postconcussional syndrome (44.5%) and comorbid depression (18.2%), anxiety disorder (24.2%), and bodily pain (30.3%). They also reported productivity loss on the LEAPS, such as “getting less work done” (60.6%) and “making more mistakes” (42.4%). In a regression model, productivity loss was predicted by the presence of postconcussional syndrome and a comorbid psychiatric condition, but not bodily pain.

Conclusions: Even in patients who RTW after MTBI, detailed assessment revealed underemployment and productivity loss associated with residual symptoms and psychiatric complications.

Archives of Physical Medicine and Rehabilitation 2018;99:250-6

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Supported by a Specific Priorities Research Grant from WorkSafeBC (grant no. RS2014-SP03), and by a Clinician-Scientist Career Development Award from the Vancouver Coastal Health Research Institute.

Disclosures: G.L.I. has been reimbursed by the government, professional scientific bodies, and commercial organizations for discussing or presenting research relating to mild TBI and sport-related concussion at meetings, scientific conferences, and symposiums. He has a clinical practice in forensic neuropsychology involving individuals who have sustained mild TBIs. He is a co-investigator, collaborator, or consultant on grants relating to mild TBI funded by several organizations. He acknowledges unrestricted philanthropic support from ImPACT Applications, Inc. N.D.S. has a private practice in neuropsychology that includes consultation roles with professional sport organizations and disability insurance providers. W.J.P. has a clinical practice in forensic neuropsychiatry involving individuals who have sustained TBIs.

In most observational studies, 60% to 90% of patients return to work (RTW) within 6 months after a mild traumatic brain injury (MTBI).¹⁻¹⁴ Although encouraging, there is evidence that some of these patients do not return to their preinjury level of employment. For example, in a cohort of patients who returned to work after being admitted to the hospital with MTBI, only 28.5% (6 of 21 patients) resumed their preinjury level of employment, with the remainder returning to modified duties or reduced hours.¹⁵ Larger inception cohort studies have reported more favorable rates. Of patients who RTW in some capacity after MTBI, 70% to 80% did so completely.^{12,14} Taken together, these data suggest caution

about treating RTW as a dichotomous variable and using it as a proxy for functional outcome in MTBI research.

RTW rates may also overestimate recovery after MTBI if some patients who RTW have residual symptoms that affect their productivity. There is a large literature on productivity loss (or “presenteeism”) attributable to various health problems.¹⁶ The costs of productivity loss outweigh that of absenteeism and disability leave.¹⁶ Conditions such as depression and chronic pain are well known to reduce work output and interpersonal effectiveness at work.¹⁶ Less is known about productivity loss after MTBI. In a structured interview of patients with mild to moderate TBI who achieved an RTW (N=160), half (46%) reported ongoing difficulties with remembering or concentrating at work.¹² In another study¹⁴ that included patients with TBI of all severities, one third of patients who returned to their preinjury level of employment reported residual cognitive (eg, memory, thinking speed, concentration) or behavioral problems (eg, irritability, apathy), or both. Of note, incomplete RTW and productivity loss may be associated with both MTBI and factors that are peripherally related (eg, comorbid orthopedic injury) or unrelated to MTBI.¹²⁻¹⁴

The present study aimed to better characterize the completeness of RTW after MTBI and the degree of productivity loss in individuals who do achieve a complete RTW. We describe vocational outcomes in a cohort of clinic-referred patients who were employed before their MTBI. We hypothesized that a proportion of those who RTW will do so incompletely—that is, with modified duties or hours, accommodations, or to a less demanding job. We further hypothesized that some patients who achieved a complete RTW would report productivity loss associated with residual postconcussional symptoms and comorbid conditions such as depression and bodily pain. The present study findings should add to our understanding of the vocational impact of MTBI.

Methods

Participants were recruited from consecutive referrals to 4 outpatient concussion specialty clinics in the greater Vancouver area from March 2015 to February 2017. Two of these clinics operate in the public health sector, for people with nonworkplace injuries, and 2 are private clinics that can be accessed by workers' compensation claimants. The eligibility criteria were as follows: (1) aged 18 to 65 years; (2) sustained an MTBI by the World Health Organization Neurotrauma Task Force operational definition¹⁷ within the past 6 months; (3) fluent in English; and (4) employed before injury. The present study received approval from

the University of British Columbia Behavioural Research Ethics Board, the Vancouver Coastal Health Research Institute, and the Fraser Health Research Institute.

Participants were evaluated on presentation to the clinic (mean \pm SD: 11.7 \pm 6.4wk postinjury) and again 4 to 5 months later (31.7 \pm 6.1wk postinjury), after completing any rehabilitation. Figure 1 displays participants' flow through the study. Demographic and injury characteristics were obtained by structured interview in an initial in-person assessment. In a telephone follow-up assessment, participants were interviewed about their RTW status and completed self-report measures. Figure 2 shows the questions participants were asked about their RTW status and how participants were classified on the basis of these questions into complete, partial, and no RTW groups. The follow-up assessment also included the measures listed below.

British Columbia Postconcussion Symptom Inventory

The British Columbia Postconcussion Symptom Inventory (BC-PSI)¹⁸ is a rating scale for physical, cognitive, and emotional symptoms designed to map onto the *International Classification of Diseases, 10th Revision* (ICD-10) criteria for postconcussional syndrome (PCS). Frequency and severity ratings are combined into item scores. Participants met diagnostic criteria for PCS if they endorsed symptoms as being of moderate severity or worse (ie, item scores ≥ 3) in at least 3 categories, as defined by the ICD-10. A total score on the BC-PSI was also created by summing the item scores.

Lam Employment Absence and Productivity Scale

The Lam Employment Absence and Productivity Scale (LEAPS)¹⁹ is a standardized measure of absenteeism and presenteeism with adequate psychometric properties,²⁰ originally developed for major depressive disorder. On the LEAPS, respondents are asked how much work they missed over the past 2 weeks because of feeling unwell, and to rate how often they experienced troublesome symptoms and productivity problems when at work. Higher ratings indicate more problems. A total score is calculated by summing the item ratings (4a–4g). The factor analytic-derived productivity subscale (LEAPS-P) is calculated by summing items 4d through 4f and represents a more psychometrically pure measure of productivity loss.¹⁹

Mini International Neuropsychiatric Interview

The Mini International Neuropsychiatric Interview (MINI)^{21,22} is a brief structured interview for identifying psychiatric disorders. It has been validated against comprehensive diagnostic evaluations.^{21,22} There have been several iterations of the MINI. The mood, anxiety, and substance use disorder modules from version 6.0, based on the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* were used in the present study.

Bodily pain

In order to better capture chronic bodily pain associated with the index injury (vs pain from preexisting or unrelated conditions), we classified participants as having a comorbid pain condition if they

List of abbreviations:

BC-PSI	British Columbia Postconcussion Symptom Inventory
ICD-10	International Classification of Diseases, 10th Revision
LEAPS	Lam Employment Absence and Productivity Scale
LEAPS-P	LEAPS productivity subscale
MINI	Mini International Neuropsychiatric Interview
MTBI	mild traumatic brain injury
PCS	postconcussional syndrome
RTW	return to work

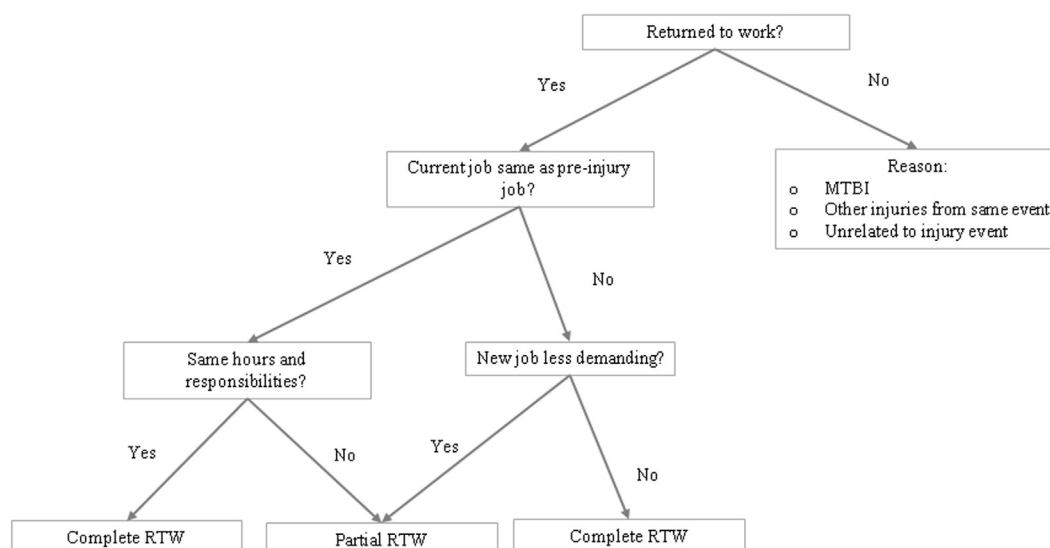


Fig 1 Classification of return to work status.

reported (1) requiring urgent medical attention for nonhead injuries associated with the index MTBI, and (2) moderate or worse current pain (ie, item rating of 2 or 3 on Likert scale with a range of 0–3) in a body region other than the head when assessed at follow-up.

Statistical analysis

Pairwise group differences were examined with *t* tests for continuous variables and chi-square tests for proportions. Contrasts below a *P* value of .05 were considered significant. We did not correct for

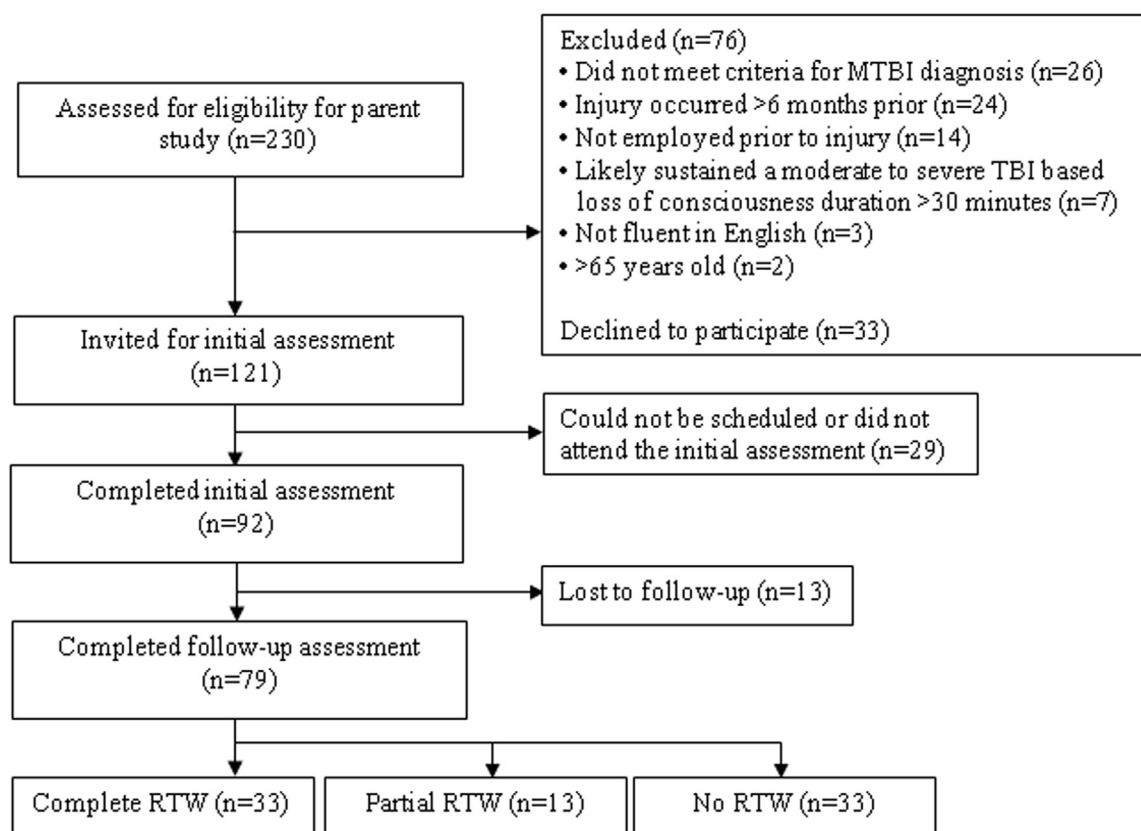


Fig 2 Participants' flow through the study.

multiple comparisons because most statistical tests evaluated a different hypothesis, and this is exploratory-phase research.²³ Linear regression was performed within the complete RTW group. Three dichotomous predictors were simultaneously entered into the model predicting LEAPS: PCS, any psychiatric disorder (depression, an anxiety disorder, or substance use disorder), and bodily pain. We initially performed these analyses with the LEAPS total score, and then performed sensitivity analyses with the LEAPS-P, a more unidimensional measure of productivity loss.

Results

Participants who were lost to follow-up ($n=13$) were similar to retained participants ($n=79$) with respect to age (mean age, 38.2y vs 41.5y; $t_{90}=0.926$, $P=.357$), sex (46.2% vs 55.7% women; $\chi^2=.410$, $P=.522$), education (52.2% vs 38.5% with a post-secondary degree; $\chi^2=.966$, $P=.326$), and ethnicity (61.5% vs 75.9% white; $\chi^2=.120$, $P=.273$). Of the 79 participants assessed at follow-up, 46 (58.2%) achieved an RTW, with 33 (71.7%) of those having a complete RTW and the remainder classified as

having a partial RTW because of ongoing modified duties, hours, or accommodation or because they returned to a different, less demanding job. The demographic and clinical profiles of the complete, partial, and no RTW groups are shown in table 1. No major differences in RTW rates based on age, sex, education, ethnicity, or occupational status were apparent, although some of these cell sizes were very small, preventing robust statistical testing. As expected, participants who were not working at the follow-up assessment generally had the highest group proportions of PCS, psychiatric comorbidity, and bodily pain. A similar proportion of participants with workplace MTBI ($n=37$) versus nonworkplace MTBI ($n=42$) had complete RTW (43.2% vs 40.5%), PCS (58.3% vs 69.4%), any psychiatric comorbidity (50.0% vs 50.0%), and bodily pain (37.1% vs 35.7%). For the total sample, those who met criteria for depression, an anxiety disorder, or who had bodily pain reported more productivity loss on the LEAPS total score ($n=23$; mean \pm SD, 9.09 ± 5.14) than those who did not have any of these comorbidities ($n=23$, 4.30 ± 3.43 ; $t_{44}=3.71$, $P=.001$, Cohen's $d=1.10$). Similar differences were apparent on the LEAPS-P (mean \pm SD: 3.17 ± 2.35 vs 1.30 ± 1.72 ; $t_{44}=3.08$, $P=.004$, Cohen's $d=.91$).

Table 1 Demographic and clinical characteristics of the sample, stratified by RTW status

Characteristics	Full Sample (N = 79)	Complete RTW (n = 33)	Partial RTW (n = 13)	No RTW (n = 33)
Age (y)	41.5 \pm 12.0	39.6 \pm 11.3	41.8 \pm 13.2	43.4 \pm 12.4
Sex (women)	44 (55.7)	17 (51.5)	6 (46.2)	21 (63.6)
Education				
Less than high school diploma	6 (7.6)	3 (9.1)	1 (7.7)	2 (6.1)
High school diploma	18 (22.8)	6 (18.2)	3 (23.1)	9 (27.3)
Some college, no degree	13 (16.5)	8 (24.2)	3 (23.1)	2 (6.1)
College diploma	11 (13.9)	2 (6.1)	1 (7.7)	8 (24.2)
Bachelor's degree	24 (30.3)	12 (36.4)	2 (15.4)	10 (30.3)
Postgraduate degree	7 (8.9)	2 (6.1)	3 (23.1)	2 (6.1)
Occupational category				
Manual labor	17 (21.5)	9 (27.3)	5 (38.5)	3 (9.1)
Skilled craft or trade	11 (13.9)	3 (9.1)	2 (15.4)	6 (18.2)
Sales and service	8 (10.1)	2 (6.1)	1 (7.7)	5 (15.5)
Clerical	5 (6.3)	1 (3.0)	1 (7.7)	3 (9.1)
Management/professional	18 (22.8)	9 (27.3)	2 (15.4)	7 (21.2)
Other	20 (25.3)	9 (27.3)	2 (15.4)	9 (27.3)
Ethnicity				
White	60 (75.9)	22 (66.7)	10 (76.9)	27 (81.8)
Asian-Canadian	11 (13.9)	6 (18.2)	2 (15.4)	3 (9.1)
First Nations	5 (6.3)	3 (9.1)	1 (7.7)	1 (3.0)
Other	3 (3.8)	2 (6.1)	0 (0)	1 (3.0)
Seeking or receiving administrative disability benefits	25 (31.7)	2 (15.4)	4 (30.8)	19 (57.6)
Hired lawyer for injury compensation claim	23 (29.1)	7 (21.2)	4 (30.8)	12 (36.4)
Prior unsuccessful attempt(s) to RTW	15 (19.0)	10 (30.3)	3 (23.1)	2 (6.1)
ICD-10 criteria for PCS	46 (58.2)	16 (44.5)	8 (61.5)	22 (66.7)
BC-PSI total score	20.0 \pm 13.4	15.0 \pm 13.2	19.5 \pm 10.8	25.0 \pm 13.0
LEAPS total score	6.7 \pm 4.9	6.2 \pm 5.5	7.8 \pm 3.0	NA
LEAPS-P score	2.2 \pm 2.2	2.0 \pm 2.4	2.8 \pm 1.6	NA
MINI diagnosis of major depressive disorder	23 (29.1)	6 (18.2)	2 (15.4)	15 (45.5)
MINI diagnosis of any anxiety disorder	28 (35.4)	8 (24.2)	6 (46.2)	14 (42.4)
MINI diagnosis of substance use disorder	7 (8.9)	1 (3.0)	2 (15.4)	4 (12.1)
Bodily injury with current pain	29 (36.7)	10 (30.3)	2 (15.4)	17 (51.5)

NOTE. Values are mean \pm SD or n (%).

Abbreviation: NA, not applicable.

Of note are the high (absolute) proportions of PCS, psychiatric comorbidity, and bodily pain in the complete RTW—a group of patients who reported fully returning to their preinjury level of employment. The analyses that follow focus on this complete RTW group. Participants with complete RTW reported some missed work over the past 2 weeks on the LEAPS as follows: 63.6% missed no work, 6.1% missed <1 full shift, and 21.2% missed 1 to 2 shifts, and 9.1% missed >2 shifts. Participants in the complete RTW also reported productivity loss on the LEAPS. The most frequently endorsed items were “getting less work done” ($n=20$; 60.6%), “making more mistakes” ($n=12$; 42.4%), “having interpersonal difficulties” ($n=12$; 36.4%), and “doing poorer quality work” ($n=9$; 27.3%). The LEAPS total score ($r=.74$, $P<.001$) and LEAPS-P ($r=.71$, $P<.001$) correlated strongly with postconcussion symptom severity (BC-PSI total score). Participants with workplace MTBI ($n=16$) and nonworkplace MTBI ($n=17$) reported a similar degree of productivity loss (LEAPS mean total score: 5.13 vs 7.29, $t_{31}=1.14$, $P=.265$; LEAPS-P mean score: 1.38 vs 2.65, $t_{31}=1.53$, $P=.137$).

Participants in the complete RTW group returned to work at a median of 14.5 weeks (interquartile range, 8–24wk) before the follow-up assessment. We considered the possibility that individuals who had recently returned to work may have exacerbated postconcussion symptoms related to physical or cognitive exertion, or both, whereas those who had been back at work for longer may have built up their activity tolerance or experienced further recovery, or both. The Pearson correlation between the RTW assessment interval and the BC-PSI total score was in the expected direction but did not reach significance ($r_{33}=-.233$, $P=.214$). Time since RTW was also not significantly related to the LEAPS total score ($r_{33}=.148$, $P=.435$) or LEAPS-P ($r_{33}=.116$, $P=.528$). In summary, the timing of RTW did not appear to strongly influence the primary outcomes of interest in this study.

In a linear regression analysis, the LEAPS total score was the dependent variable. Three dichotomous predictors—PCS, any psychiatric diagnosis, and bodily pain—were entered simultaneously. The overall model was significant ($F_{3,28}=18.2$, $P<.001$), explaining two thirds of the variance in productivity loss ($R^2=.669$). There was no problematic multicollinearity (variance inflation factors all <2.0 and conditional indices all <10). The presence/absence of PCS ($\beta=.547$, $t=4.55$, $P<.001$) and any psychiatric comorbidity ($\beta=.437$, $t=3.70$, $P=.001$) each uniquely predicted work impairment, with a similar magnitude. Bodily pain was not a significant predictor in the multivariable model ($\beta=.038$, $t=.329$, $P=.745$). The same regression analysis with LEAPS-P as the dependent variable produced similar results ($F_{3,28}=12.24$, $P<.001$, $R^2=.576$, $\beta=.439$ for PCS; $\beta=.471$ for psychiatric comorbidity; $\beta=.053$ for bodily pain).

Discussion

By conducting a detailed assessment of RTW status, we discovered underemployment and productivity loss in patients who would normally be considered to have a “good” outcome because they resumed working after MTBI. Specifically, 1 in 4 patients who had returned to work were still on modified duties, working reduced hours, or receiving accommodations, or took a different, less demanding job. This rate of incomplete RTW is similar to that found in prior studies^{12,14} that recruited from emergency departments. The present study also demonstrated residual

problems in the group of patients with complete RTW—that is, those who returned to their preinjury jobs, with the same hours and responsibilities. About half reported multiple cognitive, physical, and emotional symptoms of at least moderate severity, sufficient to meet ICD-10 criteria for PCS. Rates of comorbid psychiatric disorders and bodily pain were also high in this group. Participants with complete RTW reported productivity loss. When considered together in a multivariable regression model, having PCS or a psychiatric condition each significantly predicted productivity loss. In summary, the most important findings from this study were that RTW after MTBI is sometimes incomplete and that even when complete, there can be productivity loss associated with residual symptoms and psychiatric comorbidity.

Absenteeism and productivity loss could threaten the long-term stability of employment.²⁴ It is noteworthy that prior unsuccessful RTW attempts were common (20%–30%) in the complete and partial RTW groups (see table 1). This may suggest that a subset of workers are in fragile employment situations, at high risk for another failed RTW. However, considering all kinds of injuries (not only MTBI), approximately 20% of injured workers take multiple RTW attempts before achieving a durable RTW, while another 10% fail despite multiple attempts.²⁵ So, multiple attempts is not necessarily an indicator for eventual RTW failure. Further longitudinal research is needed to document the durability of RTW after MTBI and identify factors associated with durable versus unstable RTW.

The overall rate of RTW in this sample (58.2% by about 6mo postinjury) was somewhat lower than in most prior studies^{1-4,6-14} recruited from consecutive emergency department visits or hospital admissions. This is not surprising because we recruited from outpatient concussion clinics, where patients are referred (most often by a family physician or disability claim manager) or self-refer because of an atypically slow recovery. Our sampling method may also explain the relatively high rates of psychiatric comorbidity compared with unselected MTBI samples.^{26,27}

Study limitations

As mentioned, our sample was probably representative of patients who present to outpatient specialty clinics for MTBI care, but not of the broader MTBI population. Although the dropout rate was similar or lower than most longitudinal MTBI studies, attrition bias could have influenced the present findings. There is some prior evidence that participants with favorable recoveries tend to drop out of research at higher rates.²⁸ RTW status and productivity loss were both assessed by patient self-report and could have been distorted by response bias. Symptom exaggeration may have been less likely because our participants were assessed in a research context²⁹ and the focus was on individuals who fully returned to their preinjury employment, most (85%) of whom perceived to be no longer eligible for injury benefits or compensation. Participants in this study were followed up to an average of 6 to 8 months postinjury. We do not know whether the residual symptoms or work modifications/accommodations documented at this time point are permanent. Some may have achieved a fuller RTW with a complete restoration in productivity if observed for a longer period. There may be important differences between occupational categories with respect to rates of RTW and productivity loss after MTBI. We did not have a sufficient sample size to investigate this possibility. The MINI was administered by a trained research assistant under the supervision of a psychologist. Diagnostic interviews conducted by a mental health professional may have been more accurate.

Another limitation is that the present study did not include control groups of healthy workers or workers who sustained nonbrain injuries. To some degree, the concussion-like symptoms and work productivity problems that participants reported may be preexisting or caused by nonbrain injury factors (eg, life stress). Future studies should include injured workers presenting to specialty clinics for bodily injuries not involving the head.

Conclusions

The present study findings caution against using a binary RTW variable as an endpoint in MTBI research. Individuals who RTW after MTBI sometimes do so incompletely or have residual symptoms and productivity loss. More granular functional outcome measures could better characterize recovery from MTBI and improve prognostic modeling. Clinicians who support patients with MTBI to RTW should be aware that incomplete symptom resolution and RTW can be compatible. RTW may be better characterized as a stage of recovery rather than an outcome.³⁰ Temporary accommodations likely facilitate a successful RTW.^{31,32} The economic and psychological benefits of RTW³³ must be weighed against the risk of premature, unsuccessful RTW. The present study also suggests that some workers may require ongoing clinical support after initiating an RTW to effectively manage their residual symptoms and maintain employment. Telephone coaching on symptom management may be a feasible and cost-effective strategy to meet these needs.^{34,35} The present findings also suggest that screening for psychiatric complications should continue past the point of RTW.

Keywords

Cranio-cerebral trauma; Occupational health; Post-concussion syndrome; Presenteeism; Rehabilitation; Return to work

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Acknowledgments

We thank research assistants Mary Ellen Johnson and Sabrina Khan as well as the clinical staff at our recruitment sites, including Kelsey Davies, Jennifer Loffree, Grace Boutilier, and Trish Mahoney (GF Strong Rehab Centre), Deanna Yells, Heather MacNeil, and Rod Macdonald (Fraser Health Concussion Clinic), Denise Silva and Lesley Norris (Back in Motion), and Karilyn Lao, Wayne Tang, and Cyrus Huang (LifeMark). We also thank Joukje van der Naalt, PhD (University of Groningen) for raising the hypothesis that participants who recently returned to work at the time of the follow-up assessment may have been experiencing an activity-related symptom exacerbation, when preliminary data from the present study were presented March 29-April 1, 2017 at the 2017 World Congress of the International Brain Injury Association in New Orleans.

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