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Knowledge Gained From the Brief Traumatic Brain Injury Screen—Implications for Treating Canadian Military Personnel

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ABSTRACT Objective: To compare physical and mental health outcomes of Canadian military personnel with probable mild traumatic brain injury (mTBI) to outcomes of those without and to report implications for collaboration and treatment. Methods: One hundred forty-seven soldiers attending the Operational Stress Injury Clinic at Parkwood Hospital, London, Ontario, were screened for mTBI and completed several other measures of mental and physical health. Scores from these measures were compared across two groups (positive vs. negative screens for mTBI) using an independent samples *t*-test. Results: Thirty-four of 147 participants screened positively for mTBI. Soldiers with probable mTBI were more likely to have poorer physical health but were less likely to engage in problem drinking than those who screened negatively for mTBI. Conclusions: In this initial study, we found that the wide range of physical and mental health difficulties experienced by Canadian military personnel with probable mTBI necessitates an interdisciplinary collaborative care model.

INTRODUCTION

Although mild traumatic brain injury (mTBI) is not a new concept,¹ assessment and treatment of persistent symptoms can be challenging and require a coordinated approach. Clinical evidence suggests that cases may best be handled by a primary care provider working in collaboration with an array of health-care professionals familiar with the military and capable of managing all symptoms associated with the condition.² Furthermore, early identification of traumatic injury may assist in identifying effective treatment modalities for this clinical population, which is already vulnerable to multiple risk factors that can impede progress. Regrettably, no single diagnostic test is able to confirm the presence of mTBI. Diagnosis relies on several pertinent criteria: characteristic symptoms, neurocognitive findings, a plausible timeline from the occurrence of the suspected contributory injury, and exclusion of all other alternatives.³ The Brief Traumatic Brain Injury Screen (BTBIS) is a 3-question screening tool designed to facilitate the diagnostic process by identifying military service personnel who may require further medical and clinical evaluation for mTBI following an injury during combat, training, or other opera-

tions. Developed and clinically validated by the Defense and Veterans Brain Injury Center (DVBIC), the BTBIS has been recommended for use in both the United States and Canada.⁴ The objective of this study was to compare several physical and mental health outcomes of veterans with probable mTBI with outcomes of those for whom such an injury was not identified during screening and to subsequently develop a practical framework for coordinating the special assessment and treatment needs of military personnel with mTBI.

METHODS

Standard Protocol Approvals, Registrations, and Patient Consents

Approval for this research project was received from the Office of Research Ethics of the University of Western Ontario's (approval review number: 15798E). Upon intake at the clinic, all clients provided informed written consent that information collected during their assessment may be used for clinical review and program development.

Data Collection

A convenience sample of 147 Canadian military veterans and still-serving personnel attending the Operational Stress Injury (OSI) Clinic at Parkwood Hospital, London, Ontario, between January 2008 and March 2010 was included in the study. Individuals were referred to the clinic for assessment and treatment of potential OSIs by either their Veterans Affairs Canada (VAC) case managers (in the case of veterans) or their base surgeons (in the case of still-serving members). All individuals completed a number of psychological assessment tools upon intake to the clinic, including the BTBIS, the Post-Traumatic Stress Disorder (PTSD) Checklist—Military Version (PCL-M), the 36-Item Short Form Health Survey (SF-36), and the Alcohol

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Use Disorder Identification Test (AUDIT). Clients were enrolled in the study at intake, and the results of these questionnaires were recorded in an electronic database.

Case Definition

The BTBIS was used to identify cases (probable mTBI) and controls (no mTBI). Individuals were placed in the “probable mTBI” group if they endorsed an injury (reported at least one injury on the BTBIS) and indicated that they had lost consciousness for a defined period of time (ranging from less than 1 minute to longer than 20 minutes) following the injury. Those who did not report an injury or a loss of consciousness (LOC) for any amount of time following an injury acted as the control group. Patient charts were reviewed for verification of a possible head injury; this verification frequently came from the participants’ self-reports contained in their initial intake or psychological assessment or from their VAC referral forms, which include supporting medical information. The LOC criterion was required for inclusion in the probable mTBI group because of symptom overlap across related OSIs, which might have otherwise artificially inflated the number of probable mTBI cases.

Measures

The AUDIT is used to (a) identify persons with hazardous and harmful patterns of alcohol consumption, (b) identify alcohol dependence, (c) identify some consequences of harmful drinking, and (d) help identify excessive drinking as the cause of a presenting illness.⁵ The overall AUDIT score was used in this study.

The BTBIS, or 3 Question DVBIC TBI Screening Tool, consists of three questions: the first verifies that an injury occurred (“Did you have any injury(ies) during your deployment from any of the following?”); the second determines whether a LOC or an altered mental state resulted from the injury (“Did any injury received while you were deployed result in any of the following?”); and the third inquires about symptoms, which may be related to an mTBI. A positive screen (defined as the confirmation of an injury and subsequent alteration of mental status) on the BTBIS does not convey a diagnosis but does indicate that the individual should be further evaluated for mTBI or concussion.⁶

The PCL is a standardized, self-administered, 17-item scale composed of the key symptoms of PTSD. It exists in two versions—the PCL-C, which is a general tool used for any traumatic event, and the PCL-M, which is specific to traumatic experiences in the military. Using a 5-point scale, users rank by each symptom how affected they have been over the past month. Responses range from “Not at all” (1) to “Extremely” (5). A total score indicating the severity of PTSD symptoms (range 17–85) is tabulated by summing up item responses.⁷

The SF-36 is a health survey consisting of 36 questions, which assesses concepts of functional health and well-being and provides psychometrically based physical and mental

health summary measures.⁸ The 8 measures of functional health assessed in this survey are as follows: (1) limitations in physical activities; (2) limitations in social activities; (3) limitations in usual role activities (due to physical health problems); (4) bodily pain; (5) general mental health (psychological distress and well-being); (6) limitations in usual role activities (due to emotional problems); (7) vitality, energy, and fatigue; and (8) general health perceptions.⁹ It also provides physical component summary (PCS) and mental component summary (MCS) scores, which were the SF-36 components used in the analysis of this project.

Statistical Analysis

Predictive Analytics SoftWare Statistics v. 17.0 (SPSS Inc., Chicago, Illinois) was used to perform independent samples *t*-tests for equality of means. Mean overall scores on the PCL-M, the AUDIT, and the PCS and MCS components of the SF-36 were compared across the two groups (probable mTBI vs. no mTBI).

RESULTS

The majority of participants were male (93.9%), had completed at least secondary school (78.8%), were not currently pensioned by VAC (56.7%), and had an annual income of <\$59,999 (62.7%). The average age of all individuals was 45.9 years.

Of the 147 soldiers screened, 34 (23%) endorsed an injury and subsequent LOC (Table I). Blast injury was the most commonly reported type of injury (22.2%), followed by falls (20.5%). Individuals in the probable mTBI group rated lower AUDIT scores (*M* = 4.88 vs. 8.81; *t*[1, 146] = 2.418; *p* < 0.05), indicating fewer symptoms of problem drinking, and lower PCS scores (*M* = 28.32 vs. 35.63; *t*[1, 145] = 2.701; *p* < 0.05), indicating poorer physical health than individuals without probable mTBI (Table II). Mean PCL-M scores did not differ significantly across groups (*M* = 59.74 vs. 57.06; *t*[1, 145] = -0.89; *p* = 0.37). Additionally, the difference between mean MCS scores was not statistically significant (*M* = 24.68 vs. 21.12; *t*[1, 145] = -1.332; *p* = 0.19).

TABLE I. Mean PCL-M, AUDIT, PCS, and MCS Scores—Probable mTBI vs. No mTBI

Measure	Group	<i>n</i>	Mean	Standard Deviation
PCL-M	Probable mTBI	34	59.74 ^a	15.810
	No mTBI	113	57.06	15.192
AUDIT	Probable mTBI	34	4.88	7.113
	No mTBI	113	8.81 ^a	8.637
PCS	Probable mTBI	34	28.32 ^b	12.784
	No mTBI	113	35.63	14.120
MCS	Probable mTBI	34	24.68	14.491
	No mTBI	113	21.12 ^b	13.412

^aHigher scores indicate greater severity of symptoms. ^bLower scores indicate poorer health.

TABLE II. Independent Samples *t*-Test

Measure	<i>t</i> -Test for Equality of Means		Significance (Two-Tailed)
	<i>t</i>	<i>df</i>	
PCL-M			
Equal Variances Assumed	-0.891	145	0.374
Equal Variances Not Assumed	-0.872	52.686	0.387
AUDIT			
Equal Variances Assumed	2.418	146	0.017*
Equal Variances Not Assumed	2.684	64.752	0.009
PCS			
Equal Variances Assumed	2.701	145	0.008*
Equal Variances Not Assumed	2.850	59.314	0.006
MCS			
Equal Variances Assumed	-1.332	145	0.185
Equal Variances Not Assumed	-1.278	51.201	0.207

**p* < 0.05.

DISCUSSION

The homogeneity of mean PCL-M and MCS scores between groups may be at least partially explained by shared treatment-seeking behaviors across groups. We would therefore expect to see greater variation in PTSD symptomatology if we compared our study participants to a cohort of military personnel who have not sought formal assessment and treatment for injuries sustained during their military service.

The results also indicate that soldiers sustaining probable mTBI do not report symptoms and behaviors consistent with an increased risk of problem drinking but do have poorer physical health outcomes than soldiers who did not sustain mTBI (Fig. 1). It is not surprising that individuals who suffered a physical injury reported a greater number of physical health problems and thus a lower PCS score. The significantly lower mean AUDIT score in the probable mTBI group is perhaps more intriguing.

The literature on the association between mTBI and substance use is equivocal. One body of evidence suggests that the finding in this study is atypical, given research suggesting that many individuals with mTBI or other serious injuries (i.e., spinal cord injuries) use alcohol to self-medicate for pain.^{10,11} A conflicting evidence base suggests that individuals with mTBI may be less likely to abuse alcohol than those without as their memory may have been impacted by the head injury, in turn sparing them the desire to use alcohol as a coping mechanism for any traumatic events experienced.¹² It might also be that individuals with mTBI underreport problematic drinking habits because of hypervigilance or paranoia, in particular, concerns of still serving members about the future of their military career, or that those with mTBI simply omit a history of drinking habits because of poor functional recall. Regardless, the use of alcohol following mTBI likely adversely affects treatment, and treatment for alcohol abuse or dependence should be considered when appropriate, in addition to other standard treatments for PTSD and related OSIs.^{13,14}

As is the case with most cross-sectional research, without knowing the preinjury substance use status of participants,

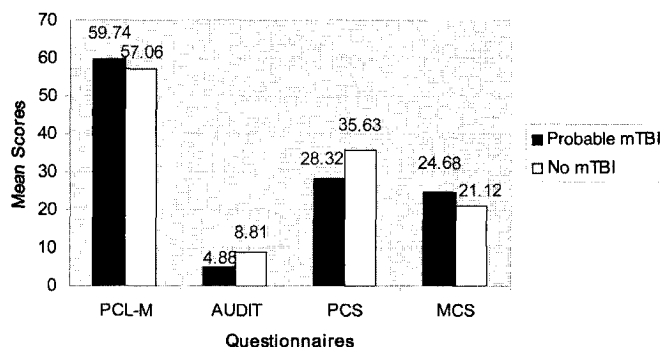


FIGURE 1. Comparison of mean scores—probable mTBI vs. no mTBI.

the directionality of the relationship cannot be determined and causality cannot be inferred. Furthermore, the use of self-report questionnaires for identifying mTBI and other health outcomes or behaviors can also result in recall bias, especially if disordered brain functioning is suspected.¹⁵ Prospective behavioral sampling, especially in terms of pre-injury substance use or substance use risk factors, would be useful.

Complicating the retrospective study of mTBI are the ambiguity of symptoms and, more importantly, the overlap between a number of symptoms of PTSD and mTBI.¹⁶ A wide variety of symptoms have been noted to occur directly after brain injury. These symptoms can be cognitive, somatic, or psychological in nature and often include memory, attention, and concentration deficits; disordered sleep patterns, headaches, and ringing in the ears; and emotional and behavioral issues, including depression, anxiety, and irritability—many of these are symptoms of PTSD and other psychiatric disorders, as well as a number of medical conditions.¹ However, items included on the BTBIS such as LOC, dizziness, balance problems, and tinnitus are not typically considered symptoms of PTSD and, therefore, can be proposed as categorical discriminatory indicators of mTBI when coupled with a confirmed head injury.⁹

Additionally, the lack of a standard international definition for mTBI has led to controversial evidence regarding the impact of head injury on other health-related behaviors and outcomes. This, however, is a limitation of all studies conducted in this field. The current lack of a gold standard for the assessment of mTBI further contributes to the subjectivity of case definition and diagnosis and inconsistent guidelines for the treatment of mTBI, which may result in conflicting treatment strategies and health policies.¹⁷

Despite a complicated and often comorbid clinical landscape among OSIs, this study provides several implications for treatment. The associations between mTBI, PTSD, and physical health symptoms suggest that individuals with suspected mTBI would benefit from the use of an integrated rehabilitation team. The involvement of physiotherapists and chronic pain specialists is recommended as they may be able to offer treatment to help relieve the burden of physical pain

and improve health-related quality of life outcomes negatively impacted by physical limitations. The outcomes of this study, particularly the low PCS score in the probable mTBI group, suggest that dealing concurrently with physical complaints may be necessary to facilitate improved mental health outcomes. It is well-known that somatic complaints contribute to the psychiatric sequelae of depression and anxiety. Deployment-related stress and unresolved somatization may interfere with the individual's ability to cope with psychological distress and consequently impede the realization of therapeutic goals.¹⁸

Social workers and occupational therapists should also be included in the circle of care as many individuals with mTBI indicated experiencing difficulties with social role functioning. Previous research on members of the general population who experience an mTBI have demonstrated that impaired psychosocial functioning resulting from mTBI can act as a greater barrier to rehabilitation than cognitive deficits.¹⁹⁻²¹ Aspects of social functioning that have been shown to deteriorate as a result of mTBI in general populations include loss of gainful employment, interference with interpersonal relationships, limited social support and self-isolation, reduced emotional perception, and reduced social competence.²²⁻²⁵ Although these studies are limited to the general population, clinical observation suggests that similar problems are faced by clients of the OSI Clinic of Parkwood Hospital. In fact, one might expect to see these psychosocial barriers to rehabilitation manifest with greater severity in military personnel who are struggling to reintegrate into civilian society after leaving the Canadian Forces. Occupational therapists and social workers may be able to assist military personnel with impaired psychosocial functioning resulting from mTBI by offering supportive therapy, assisting with vocational skills-building, and providing strategies for improving interpersonal relationships and building social connections.

Speech language pathologists, optometrists, and ophthalmologists may also be useful in the rehabilitation process, given that the neurological consequences that follow a head/brain injury may include sensory disorders, motor disorders, and speech motor control disorders, though the speech motor control disorders are more likely to be restricted to individuals with moderate to severe TBI.²⁶ Weichel et al. found that 21% of individuals with combat-related TBI also experienced ocular trauma.²⁷ The authors of this study also noted that the impact of sensory dysfunction, such as vision loss, on the treatment of PTSD and other comorbid psychiatric disorders, as well as other TBI-related outcomes, is unknown. Improving access to optometrists and ophthalmologists could increase our understanding of these effects.

Psychologists and psychiatrists should continue to act as integral members of the collaborative team, focusing their efforts on improving mental health outcomes and reducing the severity of mental health complaints. Psychiatrists can assist in the rehabilitation process by making certain that individuals with mTBI completely understand and comply with

their medication regimen as mTBI has been shown to impair memory function²⁸ and may impact medication adherence. Other studies have shown that psychologists can contribute to the rehabilitation of individuals with mTBI by providing psychoeducation about mTBI and comorbid conditions.^{29,30} Additionally, therapy focused on building resilience and positive coping mechanisms in conjunction with traditional cognitive rehabilitation therapies may prove beneficial for individuals with cognitive deficits resulting from mTBI.³¹

It has been suggested that neuropsychological testing post-deployment may be useful in evaluating behavioral and cognitive deficits, both at baseline and for measuring treatment outcomes.³²⁻³⁴ However, it is worth noting that a number of researchers have cautioned against a heavy reliance on neuropsychology to identify impairments associated with mTBI as some studies have shown little to no difference in neuropsychological testing scores between individuals with mTBI and those without.³⁵⁻³⁷ Additionally, previous studies demonstrate that cognitive impairments associated with mTBI have a tendency to diminish over time, making assessment post-deployment increasingly complicated as the length of time between the occurrence of the injury and subsequent neuropsychological testing increases.^{38,39} However, the clear advantage to administering neuropsychological assessment tools to individuals with suspected mTBI is their sensitivity to detect effort and malingering by measuring response consistency. These assessment tools provide the neuropsychologist with the ability to distinguish between those who have a veritable cognitive impairment and those who simply put forth poor effort.⁴⁰⁻⁴²

It is also imperative to consider all possible opportunities for rehabilitation such as encouraging involvement in peer groups (such as the OSI Social Support program), providing referrals to appropriate associations and networks, and arranging for acute care or postacute care when necessary. Clinicians should take military culture into consideration when treating soldiers with mTBI as military personnel may respond more positively to therapy when they feel their health concerns are being addressed in the context of their military career and culture.

The wide range of symptoms experienced by military personnel with indicators of mTBI necessitates an integrated array of specialized health-care professionals. Integrated treatment of mTBI, though not yet widely studied, offers a promising approach to treating the multifaceted symptoms of mTBI and accelerating recovery. Future research should be directed toward evaluating the impact of a collaborative health-care model on the short- and long-term health outcomes of military personnel with mTBI.

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