



Top 10 Concussion Research Articles of 2015

This top 10 list of concussion research articles from 2015 was developed by a team of Defense and Veterans Brain Injury Center (DVBIC) clinical staff and is provided for health professionals. The articles cover a range of topics related to concussion, or mild traumatic brain injury (TBI), prevention, diagnosis and treatment. The specific topics include: advances in imaging, mild TBI diagnosis, functional and social outcomes, self-report of mild TBI in service members, rest and activity restriction after concussion, sports-related concussion and helmet use, and chronic traumatic encephalopathy. Listed below and categorized by topic are the summaries of the abstracts from the articles. Click on the links provided to access the complete abstract or full article on PubMed, a service of the U.S. National Library of Medicine.

How were the articles selected?

DVBIC staff with a variety of clinical backgrounds reviewed approximately 250 abstracts from the TBI clinical research literature published in 2015. Each participant selected five articles that highlighted what they felt were leading advancements in the field of TBI research. These articles were then voted on. The 10 articles that received the highest number of votes were selected to be featured in this top 10 concussion research articles of 2015 list. DVBIC staff that participated in this review include:

- Inbal Eshel, MA, CCC-SLP (*Speech-Language Pathologist*)
- Donald Marion, M.D. (*Neurosurgeon*)
- Dorothy Kaplan, Ph.D. (*Neuropsychologist*)
- Gary McKinney, MS, CBIS (*Health Care Program Specialist, Retired Army Medic*)
- Capt. Cynthia Spells, LCSW, MVF-CSW, ACSW, BCD (*Social Worker*)
- Mike Thomas, DO, MPH&TM (*Preventive Medicine Physician*)
- Felicia Johnson, PA (*Physician Assistant*)
- Keith Main, Ph.D. (*Researcher/Imaging Expertise*)

PREVENTION

1. [Sports-Related Concussion in Helmeted vs. Unhelmeted Athletes: Who Fares Worse?](#)

Athletes from two regional databases were assessed for acute neurocognitive and symptom changes after sports related concussion (SRC) in helmeted vs. unhelmeted conditions. Athletes were matched by age, gender, number of prior concussions, and days to post-concussion test, yielding a final cohort of 138 athletes: 69 each in helmeted vs. unhelmeted groups. Gender, prior concussions, and days to post-concussion test were similar in each group. Using group mean change scores and RCI methodology, there was no significant difference between the helmeted and unhelmeted groups in four neurocognitive tests and one total symptom score. In other words, helmet status was unrelated to neurocognitive scores and total symptoms in athletes after suffering a SRC.

DIAGNOSIS

2. [Detection of Subtle Cognitive Changes After mTBI Using a Novel Tablet-Based Task](#)

This study examined the potential for novel tablet-based tasks, modeled after eye tracking techniques, to detect subtle sensorimotor and cognitive deficits after mild traumatic brain injury (mTBI). Patients admitted to the emergency department with mTBI were tested on the Pro-point and Anti-point tasks, a current standard cognitive screening test (i.e., the Standard Assessment of Concussion [SAC]), and another eye movement-based tablet test, the King-Devick^(®) (KD).

Within hours after injury, mTBI patients showed significant slowing in response times, compared with both orthopedic and age-matched control groups, in the Pro-point task, demonstrating deficits in sensorimotor function. Mild TBI patients also showed significant slowing, compared with both control groups, on the Anti-point task, even when controlling for sensorimotor slowing, indicating deficits in cognitive function. Performance on the SAC test revealed similar deficits of cognitive function in the mTBI group, compared with the age-matched control group; however, the KD test showed no evidence of cognitive slowing in mTBI patients, compared with either control group. Further, measuring the sensitivity and specificity of these tasks to accurately predict mTBI with receiver operating characteristic analysis indicated that the Anti-point and Pro-point tasks reached excellent levels of accuracy and fared better than current standardized tools for assessment of concussion. Findings suggest that these rapid tablet-based tasks are able to reliably detect and measure functional impairment in cognitive and sensorimotor control within hours after mTBI. These tasks may provide a more sensitive diagnostic measure for functional deficits that could prove key to earlier detection of concussion, evaluation of interventions, or even prediction of persistent symptoms.

3. Factors Associated with Inconsistency in Self-Reported Mild Traumatic Brain Injury Over Time Among Military Personnel in Iraq

Background estimates of the prevalence of mTBI among military personnel and combat veterans rely almost exclusively on retrospective self-reports, but the reliability of these reports has received little attention. This study was done to examine the consistency of reporting of mTBI over time and identify factors associated with inconsistent reporting. A longitudinal cohort of 948 U.S. National Guard soldiers deployed to Iraq completed self-report questionnaire screening for mTBI and psychological symptoms while in-theater 1 month before returning home (time 1, T1) and one year later (time 2, T2). Most respondents (n = 811, 85.5%) were consistent in their reporting of mTBI across time. Among those who were inconsistent in their reports (n = 137, 14.5%), the majority denied mTBI at T1 and affirmed mTBI at T2 (n = 123, 89.8%). Respondents rarely endorsed mTBI in-theatre and later denied mTBI (n = 14, 10.2% of those with inconsistent reports). Post-deployment post-traumatic stress symptoms and non-specific physical complaints were significantly associated with inconsistent reporting of mTBI. It was observed that inconsistency in retrospective self-reporting of mTBI status is associated with current post-traumatic stress symptoms and non-specific physical health complaints.

TREATMENT

4. Prolonged Activity Restriction After Concussion: Are We Worsening Outcomes?

Most clinical practice guidelines advise cognitive and physical rest after injury including withdrawal from normal life activities such as school attendance, sports participation, and technology use until symptoms resolve, based primarily on expert consensus. But activity restriction itself may contribute to protracted recovery and other complications. Williamson's Activity Restriction Model of Depression, formulated more than 20 years ago, is central to this hypothesis. We review research evidence for potential harms of prolonged activity restriction and report an mTBI case as an example of how an "activity restriction cascade" can unfold. According to this model psychological consequences of removal from validating life activities, combined with physical deconditioning, contribute to the development and persistence of postconcussive symptoms after mTBI in some youth. A modification to mTBI guidelines that emphasizes prompt reengagement in life activities as tolerated is encouraged.

5. Benefits of Strict Rest After Acute Concussion: A Randomized Controlled Trial

The efficacy of strict rest to improve concussion recovery and outcome was evaluated in 88 patients aged 11 to 22 years presenting to a pediatric ED within 24 hours of concussion. Participants underwent neurocognitive, balance, and symptom assessments in the ED and were randomized to strict rest for 5 days (n=45) versus usual care (n=43) (1-2 days rest, followed by stepwise return to activity). Patients completed a diary used to record physical and mental activity level, calculate energy exertion, and record daily postconcussive symptoms. Neurocognitive and balance assessments were performed at 3 and 10 days postinjury. Postdischarge, both groups reported a 20 percent decrease in energy exertion and physical activity levels. As expected, the intervention group reported less school and after-school attendance for days 2 to 5 postconcussion (3.8 vs 6.7 hours total, $P < .05$). There was no clinically significant difference in neurocognitive or balance outcomes. However, the intervention group reported more daily postconcussive symptoms (total symptom score over 10 days, 187.9 vs 131.9, $P < .03$) and slower symptom resolution.

6. **Persistent Sleep Disturbances Independently Predict Poorer Functional and Social Outcomes 1 Year After Mild Traumatic Brain Injury**

To investigate the effect of sleep disturbances on functional and social outcomes after mild traumatic brain injury a total of 374 mild traumatic brain injury patients were assessed from an outpatient traumatic brain injury clinic in a tertiary trauma center within three months of injury and followed up every three months for one year. At each visit, symptoms of concussion and psychological distress and indices of functional and social outcomes were measured with the Rivermead Postconcussion Questionnaire, 28-item General Health Questionnaire, and Rivermead Head Injury Follow-up Questionnaire, respectively. The percentages of subjects reporting sleep disturbances at each time point were 71.9%, 57.2%, 55.1%, and 53.7%, respectively. For functional and social outcomes, significant effects of time, group, and time X group interaction were found. Persistent sleep disturbance ($P = 0.011$) and higher symptom burden at six months postinjury ($P < .0001$) were independent predictors of poorer outcome. The authors concluded that sleep disturbance, independent of psychological distress, is an important prognostic factor of functional and social outcomes after mild traumatic brain injury.

OUTCOMES

7. **Chronic Traumatic Encephalopathy in Contact Sports: A Systematic Review of All Reported Pathological Cases**

A systematic review was performed using PubMed and MEDLINE and included all neuropathologically confirmed cases of chronic traumatic encephalopathy (CTE) in the medical literature to date, from the first published case in 1954 to August 1, 2013 ($n = 153$). The demographics, including the primary source of mTBI, age and cause of death, ApoE genotype, and history of substance abuse, when listed, were obtained from each case report. The demographics of American football players found to have CTE are also presented separately in order to highlight the most prevalent group of CTE cases reported in recent years. These 153 case reports of CTE represent the largest collection to date. We found that a history of mTBI was the only risk factor consistently associated with CTE. In addition, we found no relationships between CTE and age of death or abnormal ApoE allele. Suicide and the presence of premorbid dementia was not strongly associated with CTE. We conclude that the incidence of CTE remains unknown due to the lack of large, longitudinal studies. Furthermore, the neuropathological and clinical findings related to CTE overlap with many common neurodegenerative diseases. Our review reveals significant limitations of the current CTE case reporting and questions the widespread existence of CTE in contact sports.

8. **Clinical and Imaging Assessment of Acute Combat Mild Traumatic Brain Injury in Afghanistan**

A prospective observational study of 95 U.S. military service members with mTBI enrolled within seven days from injury in Afghanistan, and 101 healthy controls, was done to evaluate whether diffusion tensor imaging (DTI) will noninvasively reveal white matter changes not present on conventional MRI in acute blast-related mild traumatic brain injury (mTBI), and to determine correlations with clinical measures and recovery. Significantly greater impairment was observed in participants with mTBI in cognitive functioning and balance (BESS). The largest effect size in ANAM performance decline was in simple reaction time. Fractional anisotropy was significantly reduced in mTBI compared with controls in the right superior longitudinal fasciculus. No abnormalities were detected with conventional MRI. Time to return to duty correlated with ANAM simple reaction time decline. In summary, somatic, behavioral, and cognitive symptoms and performance deficits are substantially elevated in acute blast-related mTBI. Postconcussive symptoms and performance on measures of posttraumatic stress disorder, depression, and neurocognitive performance at initial presentation correlate with return-to-duty time.

9. **Long-Term Structural Changes After mTBI and Their Relation to Post-Concussion Symptoms**

This study was done to investigate sustained structural changes in the long-term (>1 year) after mild traumatic brain injury (mTBI) and their relationship to ongoing post-concussion syndrome (PCS). Sixteen participants with mTBI had less prefrontal grey matter and lower fractional anisotropy (FA) in the anterior corona radiata and internal capsule compared with nine subjects with no history of concussion. Furthermore, PCS severity was associated with less parietal lobe grey matter and lower FA in the corpus callosum. Thus, there is evidence for both white and grey matter damage in participants with mTBI over one year after injury. Furthermore, these structural changes are greater in those that report more PCS symptoms, suggesting a neurophysiological basis for these persistent symptoms.

10. Cognitive Reserve and Persistent Post-Concussion Symptoms - A Prospective Mild Traumatic Brain Injury (mTBI) Cohort Study

To determine if there is a difference in cognitive performance between post-concussion syndrome (PCS) and recovered mTBI patients, and if a lower cognitive reserve is a risk factor for developing PCS, a prospective inception cohort study 122 adult patients were recruited from emergency departments within 24 hours of an mTBI. Three months post-injury, participants completed the Rivermead Post Concussion Symptoms Questionnaire and a neuropsychological assessment. A healthy control group (n = 35) were recruited. The estimate of cognitive reserve was based upon sub-test Information from Wechsler Adult Intelligence Scale and international classifications of educational level and occupational skill level. Mild TBI patients showed reduced memory performance. Patients with lower cognitive reserve were 4.14-times more likely to suffer from PCS. The conclusion was that lower cognitive reserve appears to be a risk factor for PCS and indicates individual vulnerabilities.

For further information or questions, please contact [Dr. Donald Marion](#), DVBIC senior clinical consultant.