



Joint Federal Research Funding for Military Personnel and Veterans

Project Report Summary Template

Funding Opportunity
Development of a Functional Test Battery for Concussion/Brain Injury to Promote Recovery and Reduce Future Risk of Potential Brain and Musculoskeletal Injuries University of Toronto Principal Investigator: Dr. Michael Hutchison Project Period: April 1, 2024 – March 31, 2026
Brief Overview
This project developed and validated a new movement-based functional tests to assess readiness to return to physical and occupational duties after concussion, and to explore its value in predicting future musculoskeletal injury (MSI). The study included four distinct cohorts. First, a normative cohort of 121 University of Toronto varsity athletes was recruited to establish reference values for the movement-based functional tests. Second, a subgroup of 25 varsity athletes completed repeated exertional testing to assess the reliability of the testing protocol. Third, a concussed cohort of 60 participants was followed serially after injury to evaluate the utility of movement-based functional tests in determining readiness to return to activity following concussion. Finally, we examined the potential value of pre-season functional testing in a pre-season cohort of 69 athletes followed for subsequent injury. Collectively, this research team established the MET's reliability, demonstrated its prognostic value for concussion recovery, and identified early evidence linking pre-season movement and exertional performance to future injury risk. Findings support the MET as a promising, objective, and easily administered tool that could complement existing concussion assessment approaches for military personnel and veterans.
What is this Research About? Current concussion assessments rely heavily on symptom checklists, cognitive testing, and balance measures, which may not capture how well a person can tolerate the physical exertion and complex movement demands of military or occupational duties. This research asked whether a functional test battery that combines cardiovascular exertion, head acceleration, cognitive load, and coordination/multi-plane movement could better assess readiness to return to activity after concussion, and whether pre-season movement and exertional performance could help identify individuals at risk of future musculoskeletal injury.
What did the Research Do? The research team designed the Mutlimodal Exertional Test (MET), including a four-stage functional test battery incorporating squats, reverse lunges, hip hinges, and coordination/agility tasks of progressively increasing difficulty. The MET was first tested in a normative cohort of 121 varsity athletes, with a subset of 25 athletes used to establish its test-retest reliability. The MET was then administered alongside standard clinical concussion tools to a cohort of 60 concussed varsity athletes, assessed at six time points from 1 to 8 weeks post-injury, to evaluate its ability to predict recovery and benchmark it against existing clinical tools. Separately, 69 varsity athletes (25 male, 44 female) from

basketball, hockey, and volleyball completed pre-season exertional and jump-based movement testing and were followed for subsequent musculoskeletal injury.

What did the Research Find?

The MET demonstrated good test-retest reliability, published in a peer-reviewed journal (Pyndiura et al., 2026). A substantial proportion of athletes (approximately 50–60%) were unable to successfully complete the MET during the early stages of concussion recovery, with failure persisting beyond the resolution of self-reported symptoms, supporting its use as an objective marker of physiological recovery. MET performance at one-week post-injury was also found to predict recovery: athletes who failed the test at that stage went on to experience longer recovery than those who passed (Pyndiura et al. Accepted for Publication).

In the pre-season injury-risk cohort, injury incidence was higher among male athletes (approximately 48%) than female athletes (approximately 34%), with the difference most pronounced for lower-body injuries, where male athletes' estimated risk was roughly twice that of female athletes. Athletes who went on to sustain a musculoskeletal injury also showed consistently lower knee angle trajectories during a step-down and jump task compared with athletes who remained injury-free, suggesting the MET's movement measures are sensitive to characteristics that may relate to injury risk, though further modelling is needed to confirm their predictive value. Sex differences were also observed in the MET itself, with female athletes showing higher heart rate responses than males across all stages.

What does this Research Mean?

These findings suggest the functional, exertional based movement tasks could serve as a useful, objective addition to concussion management protocols, helping clinicians identify individuals who are not yet physically ready to return to duty and flagging those at risk of a prolonged recovery earlier in the process. The early findings linking pre-season movement and exertional performance to subsequent injury also point to a potential role for the MET in injury-risk screening, though this work is still descriptive and requires further analysis before it can inform practice. Because the MET is low-cost and easy to administer in both clinical and field settings, it may be well suited to supporting return-to-duty decisions for military personnel and veterans. Continued research on its link to future musculoskeletal injury risk, and validation in military populations, is recommended before broader implementation.

Sources

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Pyndiura KL, Di Battista AP, Richards D, Reed D, Lawrence DW, Hutchison MG. (2025). Assessing the validity of a multimodal exertional test (MET) for sport-related concussion: Differences in responses between athletes with a sport-related concussion and healthy athletes. [Oral Presentation – Refereed]. International Brain Injury Association 15th World Congress on Brain Injury; Mar 20-22.