

## Abstract

**Background:** Despite evidence of persistent physiological deficits beyond self-report symptom resolution in individuals who have sustained a mild traumatic brain injury (mTBI), clinicians continue to use self-report of symptoms to guide return to activity decisions. While recent research indicates the benefit in measuring heart rate variability (HRV) following concussion to identify subtle impairments of the autonomic nervous system (ANS), this non-invasive objective measure has been less extensively studied in military personnel who have sustained a mTBI. Due to the physical demands inherent to the profession and potentially unreliable nature of self-reporting associated with the “warrior culture”, there exists a need to investigate proposed autonomic dysfunction in the population of active duty servicemembers with mTBI to make appropriate return to duty (RTD) decisions. The Clinical Practice Guideline on Concussion and the Defense and Veterans Brain Injury Center (DVBIC) guideline for Healthcare Providers treating mTBI recommend physical exertional testing as part of return to activity/duty screening. Despite this recommendation, no standardized and ecologically valid tests currently exist.

**Purpose:** The objective of this current single site study is to evaluate two specific tasks which are clinically feasible and induce an appropriate level of exercise stress to assess ANS balance through measurement of HRV.

**Subjects:** 25 Individuals who have sustained a concussion in the prior 72 hours and 25 age-matched military personnel will participate. Current enrollment includes 25 healthy controls, and 12 individuals post-concussion.

**Methods:** Once enrolled, servicemembers who have sustained concussion are tracked for a 2-week period until their symptom self-report improves to a low or minimal level, at which time a single test session is scheduled. Heart rate is monitored for the 30-minute test session with a Polar10 Heart Rate monitor linked via Bluetooth to collect HRV data. The protocol consists of a period of baseline rest followed by a two-minute push up task and 6-minute stepping task in a counterbalanced order with recovery periods following each. Symptom report at each phase of testing is monitored in order to assure safety. The tasks selected in this testing protocol were chosen based on their military relevance and previous findings suggesting their ability to safely challenge performance physiologically in the acute time period following injury.

**Results:** While all data has been collected for the healthy servicemember (SM) population, service members with concussion continue to be actively recruited and tested. Overall, the healthy SM population was able to successfully complete both tasks consistent with our criteria. Thus far SMs with mTBI have not been consistent in completing tasks. Six of the twelve SMs did not complete the Step task (50%), one was stopped because he reported an RPE of 17, couldn't keep cadence, and reported symptom increase, three had a HR >85% of age-predicted HR max, and two others reported symptom increase. Six SMs did not complete the push-up test, 4 of which were stopped by the examiner for safety reasons (symptoms, RPE, HR) and two did not reach the minimum APFT standard for push-ups based on age. Preliminary findings indicate exertional conditions of both tasks provoke impairments not evident in a resting state.

**Clinical relevance:** This study intends to investigate cardiac vagal control (CVC) in servicemembers with mTBI during rest, activity, and recovery phases of the protocol in the acute period post injury. The findings from this study could help to fill gaps in acute concussion care in the military context, inform return to duty decision making, guide rehabilitation interventions, and minimize risk for re-injury with premature RTD.