Reaction times after mTBI; a comparison across multiple domains

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BACKGROUND

Reaction time, typically assessed using a computerized seated cognitive task, can be impaired in people following mild Traumatic Brain Injury (mTBI).

There is limited research on reaction time in standing and stepping tasks- important for optimal performance in athletes and military personnel.

The purpose of this study was to describe reaction times across different domains, including seated cognitive, standing balance, and postural stepping reactions.

METHODS

Participants

One hundred and fifty-two participants with subacute mTBI (2 – 12 weeks post injury) who were still reporting imbalance. (Table 1).
We compared mTBI data with healthy control data from current (W81XWH-17-1-0424) and previously completed study (W81XWH-15-0620).

Table 1. Participant Demographics presented as mean and (SD)

	mTBI (n = 152)	Healthy (n = 89)
Age (years)	36 ±12	35 ± 12
Gender (M/F/Other)	30 / 117 / 5	31 / 58
Days Since Injury	45 ±21	N/A
Neurobehavioral Symptom Inventory (out of 88)	40±14	N/A

Procedures

Participants completed reaction time assessments in 3 domains:

1. Seated Computarized Cognitive Simple Reaction Time: Assessed with Automated Neuropsychological Assessment Metrics (ANAM) using a tablet (**Figure 1A**).
2. Standing Balance (Sensorimotor Time Delay): A Central Sensorimotor Integration test (CSMI) identified the time delay that accounted for body sway evoked repeated 2° peak-to-peak pseudorandom rotations of the stance surface and the visual surround, with eyes open (Peterka, 2002, 2018) (**Figure 1B**).
3. Compensatory Stepping Reaction: Wearable sensors (Opals; APDM) used during the push and release test (MiniBESTest) measured the stepping reaction (El-Gohary M, et al., 2017; Morris A et al., 2022). A validated custom algorithm processed raw inertial data from the sensors to determine the time-to-stabilization — the sensorimotor reaction time to recover balance in a stable position once the examiner removed support (**Figure 1C and 1D**).

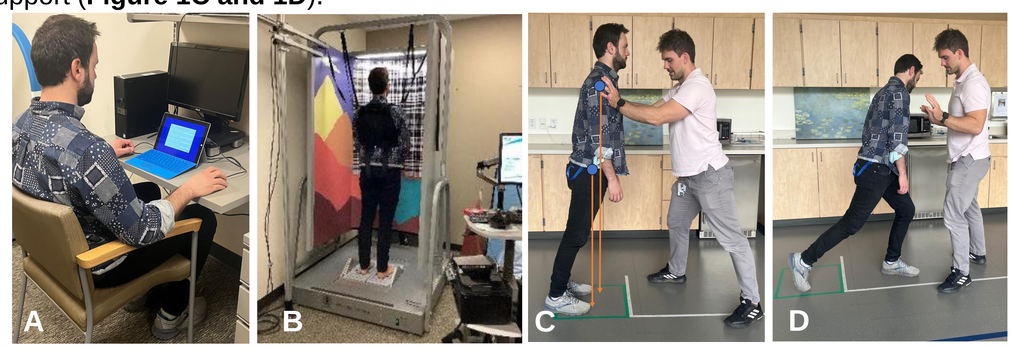

Figure 1. **A**) ANAM test **B**) CSMI test for standing balance **C**) Instrumented Push and Release Test from the miniBESTest **D**) Subject recovers balance.

RESULTS

Reaction times were longer (worse) in mTBI compared to healthy controls across the 3 outcome measures.

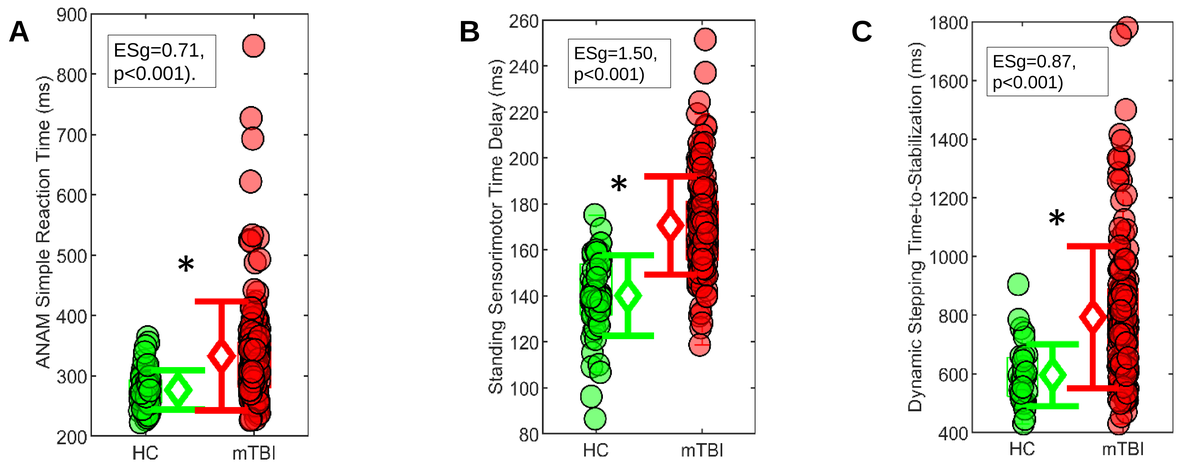

Figure 2. Individual data with mean and standard deviation for healthy controls (green) and mTBI (red) for ANAM Reaction Time (**A**), Standing Balance Sensorimotor Time Delay (**B**) and Dynamic Stepping Time-to-Stabilization (**C**).

There were only weak correlations between the 3 reaction time measures.

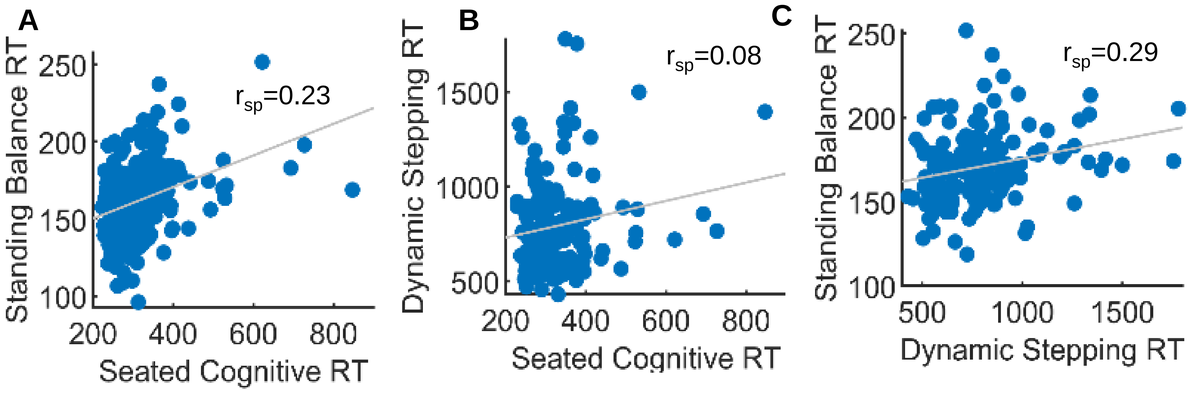

Figure 3: Spearman Correlations for Standing Balance Sensorimotor Time Delay and ANAM reaction time (**A**). Dynamic Stepping Time-to-Stabilization and ANAM reaction time (**B**). Standing Balance Sensorimotor Time Delay and Dynamic Stepping Time-to-Stabilization (**C**).

CONCLUSIONS

- **All reaction time measures were significantly slower in the mTBI group.**
- **However, there are no strong relationships between these tasks, which suggests that these are separate domains of impairment.**
- **Clinical Message Takeaway – a person who recovers in computerized seated cognitive reaction times (cleared for return) may not be recovered in gross sensorimotor balance reactions. This may explain the increased musculoskeletal injury risk after mTBI.**

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