

efforts in returning to work (e.g., vocational rehabilitation services, psychotherapy, interventions for decreased initiation).

**Categories:** Acquired Brain Injury (TBI/Cerebrovascular Injury & Disease - Adult)

**Keyword 1:** apathy

**Keyword 2:** stroke recovery

**Keyword 3:** vocation

**Correspondence:** Mario F. Dulay Jr., PhD, Houston Methodist Neurological Institute and Weill Cornell Medicine, mdulay@houstonmethodist.org

## 2 Contributions of Cardiovascular Disease Burden and Concussion History on Cognitive Function in Older Former National Football League Players.

Benjamin L Brett<sup>1</sup>, Alyssa Leitzke<sup>1</sup>, Zachary Y Kerr<sup>2</sup>, Neelum T Aggarwal<sup>3</sup>, Avinash Chandran<sup>4</sup>, Samuel R Walton<sup>5</sup>, Rebekah Mannix<sup>6</sup>, Landon B Lempke<sup>7</sup>, J.D. DeFreese<sup>2</sup>, Ruben J Echemendia<sup>8</sup>, Kevin M Guskiewicz<sup>2</sup>, William P Meehan III<sup>6</sup>, Michael A McCrea<sup>1</sup>

<sup>1</sup>Medical College of Wisconsin, Milwaukee, WI, USA. <sup>2</sup>University of North Carolina at Chapel Hill, Chapel Hill, NC, USA. <sup>3</sup>Rush Alzheimer's Disease Center, Chicago, IL, USA. <sup>4</sup>Datalys Center for Sports Injury Research and Prevention, Indianapolis, IN, USA. <sup>5</sup>Virginia Commonwealth University, Richmond, VA, USA. <sup>6</sup>Harvard Medical School, Boston, MA, USA. <sup>7</sup>Boston Children's Hospital, Boston, MA, USA. <sup>8</sup>Psychological and Neurobehavioral Associates, Inc., State College, PA, USA

**Objective:** Traumatic brain injury and cardiovascular disease (CVD) are modifiable risk factors for cognitive decline and dementia. Greater concussion history can potentially increase risk for cerebrovascular changes associated with cognitive decline and may compound effects of CVD. We investigated the independent and dynamic effects of CVD/risk factor burden and concussion history on cognitive function and odds of mild cognitive impairment (MCI) diagnoses in older former National Football League (NFL) players.

**Participants and Methods:** Former NFL players, ages 50-70 (N=289; mean

age=61.02±5.33 years), reported medical history and completed the Brief Test of Adult Cognition by Telephone (BTACT). CVD/risk factor burden was characterized as ordinal (0-3+) based on the sum of the following conditions: coronary artery disease/myocardial infarction, chronic obstructive pulmonary disease, hypertension, hyperlipidemia, sleep apnea, type-I and II diabetes. Cognitive outcomes included BTACT Executive Function and Episodic Memory Composite Z-scores (standardized on age- and education-based normative data), and the presence of physician diagnosed (self-reported) MCI. Concussion history was discretized into five groups: 0, 1-2, 3-5, 6-9, 10+. Linear and logistic regression models were fit to test independent and joint effects of concussion history and CVD burden on cognitive outcomes and odds of MCI. Race (dichotomized as White and Non-white due to sample distribution) was included in models as a covariate.

**Results:** Greater CVD burden (unstandardized beta [standard error]; B=-0.10[0.42], p=.013, and race (B=0.622[0.09], p<.001), were associated with lower executive functioning. Compared to those with 0 prior concussions, no significant differences were observed for those with 1-2, 3-5, 6-9, or 10+ prior concussions (ps >.05). Race (B=0.61[.13], p<.001), but not concussion history or CVD burden, was associated with episodic memory. There was a trend for lower episodic memory scores among those with 10+ prior concussion compared to those with no prior concussions (B=-0.49[.25], p=.052). There were no significant differences in episodic memory among those with 1-2, 3-5, or 6-9 prior concussions compared to those with 0 prior concussions (ps>.05). CVD burden (B=0.35[.13], p=.008), race (greater odds in Non-white group; B=0.82[.29], p=.005), and greater concussion history (higher odds of diagnosis in 10+ group compared to those with 0 prior concussions; B=2.19[0.78], p<.005) were associated with higher odds of MCI diagnosis. Significant interaction effects between concussion history and CVD burden were not observed for any outcome (ps >.05).

**Conclusions:** Lower executive functioning and higher odds of MCI diagnosis were associated with higher CVD burden and race. Very high concussion history (10+) was selectively associated with higher odds of MCI diagnosis. Reduction of these modifiable factors may mitigate adverse outcomes in older contact sport athletes. In former athletes, consideration of CVD burden is particularly pertinent when

assessing executive dysfunction, considered to be a common cognitive feature of traumatic encephalopathy syndrome, as designated by the recent diagnostic criteria. Further research should investigate the social and structural determinants contributing to racial disparities in long-term health outcomes within former NFL players.

**Categories:** Acquired Brain Injury (TBI/Cerebrovascular Injury & Disease - Adult)

**Keyword 1:** traumatic brain injury

**Keyword 2:** cardiovascular disease

**Keyword 3:** aging (normal)

**Correspondence:** Benjamin L. Brett Medical College of Wisconsin 8701 Watertown Plank Road Milwaukee, WI 53226 bbrett@mcw.edu

### 3 Factors Associated with Acute Neurobehavioral Outcomes in Suspected Abusive Head Trauma

Haley B Holm<sup>1,2</sup>, Ashley S Fournier-Goodnight<sup>1</sup>  
<sup>1</sup>Children's Healthcare of Atlanta, Atlanta, GA, USA. <sup>2</sup>Emory University, Atlanta, GA, USA

#### Objective:

Abusive head trauma (AHT) is a form of inflicted brain injury that is associated with significant neurological impairment. Given that injuries occur during infancy, cognitive deficits may not become fully apparent for years. It is useful to understand injury factors related to outcomes. A recent study by Eismann et al. (2020) used length of PICU stay as a measure of injury severity and found that it is predictive of short-term and long-term outcomes in AHT. The current study aimed to examine injury severity factors related to acute outcomes (<3 months since injury) within a population of infants admitted to an inpatient rehabilitation unit (IRU).

**Participants and Methods:** The sample consisted of 45 infants (32 male, 13 female) hospitalized with suspected AHT. Age at injury was 0-21 months (MED= 4.89 months, SD = 5.48). The majority of patients (93%) had moderate to severe injury based on length of PICU stay (4+ days) [3]. Patients were administered the Mullen Scales of Early Learning (MSEL) during IRU admission, within 3 months of injury (range: 13-68 days; MED: 31 days). Pearson bivariate correlations were used to examine the relationship between MSEL

subscales (ELC: Early Learning Composite; VR: Visual Reception; RL: Receptive Language; EL: Expressive Language; FM: Fine Motor; GM: Gross Motor) and the following factors: days since injury and hospitalization time (days in PICU, PICU/General Pediatrics, IRU, total hospitalization). *P*-values less than .05 were considered significant.

**Results:** Scores on the MSEL Early Learning Composite ranged from exceptionally low to high average (Standard Score Range: <49-111; MED: 82; SD = 18.79). Unlike prior studies, time in PICU and time in PICU/General Pediatrics were not associated with any MSEL subscales. MSEL was moderately correlated with days in IRU (ELC:  $r = -.44$ ; VR:  $r = -.37$ ; RL:  $r = -.32$ ; EL:  $r = -.36$ ; GM:  $r = -.29$ ) and total hospitalization time (ELC:  $r = -.46$ ; VR:  $r = -.42$ ; RL:  $r = -.36$ ; EL:  $r = -.37$ ; GM:  $r = -.31$ ), such that longer hospitalization was associated with lower scores. Greater days since injury was also associated with lower MSEL scores (ELC:  $r = -.45$ ; VR:  $r = -.42$ ; RL:  $r = -.40$ ; EL:  $r = -.36$ ; FM:  $r = -.33$ ; GM:  $r = -.35$ ).

**Conclusions:** These results suggest that within an inpatient rehabilitation setting, longer total hospitalization time (including time on IRU) is moderately associated with worse acute neurobehavioral outcomes. While length of PICU stay has been associated with short-term outcomes in the outpatient setting (Eismann et al., 2020), this was not found in the current inpatient sample which had more severe injuries (longer PICU stay, inpatient rehabilitation admission). Interestingly, children assessed further out from injury had worse scores on the MSEL, which has previously been noted. Though this seems counterintuitive, it may reflect that participants with more severe injuries had a longer delay before they were capable of engaging in a neurodevelopmental assessment. These findings have implications for prognosticating early outcomes of AHT in an inpatient rehabilitation setting.

**Categories:** Acquired Brain Injury (TBI/Cerebrovascular Injury & Disease - Child)

**Keyword 1:** child brain injury

**Keyword 2:** neuropsychological assessment

**Correspondence:** Haley B. Holm, Children's Healthcare of Atlanta Department of Neuropsychology, Emory University, haley.holm@choa.org