

**Objective:** Patients with persistent post-concussion symptoms (PPCS) experience prolonged recovery (e.g., headache, fatigue, or dizziness) lasting >2 months post injury. These symptoms are thought to be maintained by several biopsychosocial factors including dysregulated stress responses, such as pain catastrophizing, that may drive behavioral avoidance and contribute to mood symptoms and cognitive difficulties. Conditions with similar symptomatology to PPCS (e.g., anxiety disorders, somatosensory disorders, chronic pain, etc.) also exhibit maladaptive thought patterns like pain catastrophizing as well as decrements in certain aspects of cognitive performance; however little is known about how pain catastrophizing might relate to neuropsychological performance in youth with PPCS. Therefore, the purpose of this study was to examine the relationship between pain catastrophizing and neuropsychological performance in youth participants with PPCS.

**Participants and Methods:** A prospective case-control study design was used to examine 29 participants between the ages of 13 to 23. Participants were divided into two groups: 1) patients with PPCS (2-16 months post-injury; n = 15) and 2) age-matched, non-injured controls (n = 14). Participants completed the Pain Catastrophizing Scale (PCS) to determine degree of catastrophic thinking related to pain experience and the Beck Depression Inventory (BDI). Neuropsychological performance was assessed using the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) and a modified version of the Paced Auditory Serial Addition Test (PASAT) where performance was evaluated by total correct and error type (i.e., commission and omission) across 5 trials. ANCOVA was used to compare group differences in pain catastrophizing and neuropsychological tests scores while controlling for age and linear regressions examined the relationship between PCS total score and each neuropsychological test score while controlling for level of depression.

**Results:** Overall, the PPCS group reported significantly higher levels of pain catastrophizing on the PCS compared to the control group ( $p < 0.01$ ). For neuropsychological performance, the PPCS group scored significantly lower than the control group on List Learning ( $p < 0.01$ ), Semantic Fluency ( $p < 0.05$ ), and List Recall ( $p < 0.01$ ) on the RBANS and made significantly higher omission errors (but not commission) on the PASAT ( $p < 0.01$ ). Higher pain catastrophizing

was also associated with poorer neuropsychological performance on the exact same tasks the PPCS group performed worse than controls. There was no significant interaction by group in the impact of PCS scores on neurocognitive performance.

**Conclusions:** Compared to controls, youth PPCS patients reported higher levels of pain catastrophizing. Additionally, pain catastrophizing was associated with poorer neuropsychological performance. These findings suggest that increased pain catastrophizing after head injury could contribute to poorer cognitive performance in youth. As such, interventions that target maladaptive cognitive coping styles like pain catastrophizing may be especially helpful for patients with PPCS.

**Categories:** Concussion/Mild TBI (Child)

**Keyword 1:** neuropsychological assessment

**Keyword 2:** pediatric neuropsychology

**Correspondence:** Emily Ellen Carter, The Pennsylvania State University, eec5302@psu.edu

## 69 Reducing the Economic Burden of Concussion: A Remote Model of Neuropsychological Care in Rural America

Erin A McLean<sup>1,2</sup>, Lana Sabbagh<sup>3</sup>, Jonathan Lichtenstein<sup>4,1</sup>

<sup>1</sup>Dartmouth-Hitchcock Medical Center, Lebanon, NH, USA. <sup>2</sup>Hofstra University, Hempstead, NY, USA. <sup>3</sup>Dartmouth College, Hanover, NH, USA. <sup>4</sup>Geisel School of Medicine at Dartmouth, Lebanon, NH, USA

**Objective:** When neuropsychologists serve as consultants to schools, concussion management programs are associated with fewer referrals, faster cognitive recovery, and reduced incidence of protracted recovery compared to programs with physician consultants. However, accessing neuropsychological services can be challenging due to geographical and financial barriers. Particularly in rural areas, travel associated with post-concussion management can represent as a significant financial and time burden. Increasing accessibility to neuropsychologists has the potential to address these concerns, while also providing quality care to more

individuals. The current study aims to assess the cost-effectiveness and clinical outcomes of a remote, neuropsychologist-led consultation model of concussion management. We hypothesized that this remote model would save patients both money and time, while also improving patient outcomes.

**Participants and Methods:** 604 high school concussion cases occurring between May 2019 and May 2022 were reviewed; 571 were included in the current analysis. The sample was 51% male with a mean age of 15.8 years (SD=1.32). All students took ImpACT tests following suspected concussions, with tests administered at the school by certified athletic trainers or nurses. Test results were electronically reviewed by the consulting neuropsychologist. Interpretations and recommendations were then sent via email to the school official. Cognitive recovery, defined as the days from the injury to the final ImpACT test, and incidence of repeat concussions, or concussions occurring within 3 months of a previous concussion, were used as indicators of patient outcomes. Financial burden was determined by calculating the round-trip distance in miles from the patient's school to the neuropsychologist's medical center, then multiplying this number by the 2022 standard mileage reimbursement rate of \$0.63/mile to determine the travel cost for a single consultation.

**Results:** The sample consisted of 571 individual concussion cases and 1,285 total ImpACT tests. An average of 2.25 tests were administered for each concussion case (SD=0.90), with an average of 18.47 days to the final test (SD=16.59). 8 concussions (1.4% of total concussions) occurred within 3 months of a previous injury. The distance from schools to the closest available neuropsychologist ranged from 2.4 to 102 miles. The remote nature of the consultation model allowed for patients to avoid up to 204 miles, or up to 4.5 hours, of driving for each consultation. Thus, patients saved anywhere from \$3.00 to \$127.50 in travel costs per consultation.

**Conclusions:** The remote nature of this consultation model yielded a similar cognitive recovery time to previous literature, indicating that it may be as effective as in-person consultation. Repeat concussions represented less than 1.5% of concussion cases, indicating that care was successful enough to prevent second concussions in the majority of the sample. The remote nature of the model also

saved patients time (up to 4.5 hours of driving) and money (up to \$127.50 in travel costs). Thus, a remote consultation model has the potential to increase access to first-rate concussion care in rural settings, while also being cost- and time-effective for patients.

**Categories:** Concussion/Mild TBI (Child)

**Keyword 1:** concussion/ mild traumatic brain injury

**Keyword 2:** teleneuropsychology

**Keyword 3:** sports-related neuropsychology

**Correspondence:** Erin A. McLean, Dartmouth-Hitchcock Medical Center and Hofstra University, erin.a.mclean@hitchcock.org

## 70 Neuropsychological Consulting in Concussion Management: Remote Models Increase Access to Care

Erin A McLean<sup>1,2</sup>, Lana Sabbagh<sup>3</sup>, Jonathan Lichtenstein<sup>4,1</sup>

<sup>1</sup>Dartmouth-Hitchcock Medical Center, Lebanon, NH, USA. <sup>2</sup>Hofstra University, Hempstead, NY, USA. <sup>3</sup>Dartmouth College, Hanover, NH, USA. <sup>4</sup>Geisel School of Medicine at Dartmouth, Lebanon, NH, USA

**Objective:** Neuropsychological assessment is the cornerstone of concussion management, and the nature of its delivery can vary widely. While literature concerning post-concussion care typically revolves around in-person evaluation, the proliferation of computerized neuropsychological tests (CNTs) has allowed for some distance between concussion patients and the neuropsychologist. In the wake of a global pandemic, several papers describing the use of telehealth for concussion care have emerged; however, the small samples found in these studies may suggest that access to care remains an issue. Additionally, telehealth may not be a sustainable fee-for-service approach as CMS aims to curtail telehealth reimbursement for behavioral health clinicians. The objective of the present study is to describe a remote neuropsychological consultation model of concussion management and evaluate its productivity and impact in a rural setting.

**Participants and Methods:** In this model, a neuropsychologist based at an academic medical center in the northeastern United States