

# Association Between Student-Athletes' Demographics, Symptom Cluster Presentation, and Neurocognitive Performance Post-Concussion in the Primary Care Setting

Register-Mihalik JK, Herzog MM, Bloom OJ, Fonseca J, Phillips K, De Maio VJ: University of North Carolina at Chapel Hill, Chapel Hill, NC, and Carolina Family Practice & Sports Medicine, Cary, NC

**Context:** Few studies have examined concussion in the primary care setting, yet following initial field evaluation, this is often the first physician point of contact post-concussion. Understanding factors affecting presentation and outcomes in these patients is key to improving concussion care.

**Objective:** To examine the association between demographic factors, symptom cluster presentation, and neurocognitive performance at initial office visit for concussion among pediatric and adolescent student-athletes.

**Design:** Prospective cohort study.

**Setting:** Primary Care Clinic.

**Patients or Other Participants:** Pediatric and adolescent student-athletes ages 8-18, presenting to the primary care setting within 3 days of a sport-related concussion, and consenting to participate in the study (n = 133; age = 14.3 ± 2.0 years; 75 males). Patients with invalid neurocognitive scores were excluded (n = 2; final n = 131).

**Interventions:** Participants completed a standardized initial concussion visit, including a clinical exam and standardized testing that included a symptom checklist and the Immediate Post-Concussion and Cognitive Test (ImPACT). Certified athletic trainers collected data at the initial visit. Predictor variables in the univariate and multivariate analyses included age, gender, and the following symptom cluster burden scores: cognitive-migraine-fatigue (CMF—headache, dizziness, fatigue, drowsiness, sensitivity to light/noise, feeling slowed down, and difficulty remembering/concentrating), affective (AFF—sadness, nervousness, feeling more emotional), somatic (SOM—vomiting, numbness/tingling), and sleep (SLP—trouble falling asleep, sleeping less than usual).

**Main Outcome Measures:** The primary outcomes included the four ImPACT composite scores of verbal memory, visual memory, reaction time, and processing speed. Univariate correlations for all predictors and outcomes were conducted. Multivariable linear regression models were utilized to predict each of the four ImPACT composite scores. An a priori alpha level of 0.05 was used.

**Results:** Mean ImPACT scores were: visual memory = 71.8 ± 13.9; verbal memory = 81.8 ± 12.4; reaction time = 0.7 ± 0.2; processing speed = 33.7 ± 8.1. Mean total symptom and cluster burdens were: Total burden = 27.3 ± 21.3; CMF burden = 17.3 ± 11.5; AFF burden = 1.2 ± 2.6; SOM burden = 0.3 ± 0.9; SLP burden = 1.1 ± 2.3. Increased CMF burden was associated with slower reaction time scores (Beta = 0.005; P = 0.007), and lower visual memory scores (Beta = -0.392; P = 0.003), lower verbal memory scores (Beta = -0.271; P = 0.024), and lower processing speed scores (Beta = -0.210; P = 0.006). Older age was associated with higher visual memory scores (Beta = 1.384; P = 0.034), higher verbal memory scores (Beta = 1.869; P = 0.002), and higher processing speed scores (Beta = 1.573; P < 0.001). No other associations were observed (P > 0.05). While gender was associated at the univariate level with visual and verbal memory, it was not significant in any multivariable model.

**Conclusions:** There is significant variability in symptom presentation following concussion in primary care concussion patients. The CMF symptom cluster was more strongly associated with neurocognitive outcomes than other symptoms. Age was also a factor of consideration. Student-athletes with the CMF cluster of symptoms may need closer observation and specific academic adjustments based on their reported symptoms. Clinicians should be mindful of symptom cluster presentation and age when developing management plans.

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## Learning Objective:

At the conclusion of the program, participants will be able to describe demographic and symptom-related factors associated with neurocognitive outcomes acutely following concussion in young student-athletes.

## References:

1. Broglio SP, Cantu RC, Gioia GA, et al. National athletic trainers' association position statement: management of sport concussion. *J Athl Train.* 2014;49(2):245-265.
2. Kontos AP, Covassin T, Elbin RJ, et al. Depression and neurocognitive performance after concussion among male and female high school and collegiate athletes. *Arch Phys Med Rehabil.* 2012;93:1751-1756.