Student athlete concussions and postconcussion syndrome

ADHD as a risk factor

Marc R. Nuwer, MD, PhD, Jamie M. Nuwer, MD, and Jack W. Tsao, MD, DPhil

Neurology: Clinical Practice October 2018 vol. 8 no. 5 377-378 doi:10.1212/CPJ.0000000000000529

Correspondence

Dr. Nuwer
MRN@UCLA.edu

RELATED ARTICLE

Sport concussion and attention deficit hyperactivity disorder in student athletes: A cohort study

Page 403

Concussion affects an estimated 1.1 million persons in the United States annually and 1 person in 3 during their lifetime.^{1,2} Approximately 20% of head injuries are related to sports or physical activities.³ Concussion, known medically as mild traumatic brain injury, is a topic of considerable public interest, given the growing awareness about chronic traumatic encephalopathy among professional athletes. Student athletes have an increased risk of concussions compared with nonathlete students, which raises concerns about consequences.

In this issue of *Neurology® Clinical Practice*, Iaccarino et al.⁴ evaluated attention-deficit hyperactivity disorder (ADHD) among student athletes. They measured functions with standardized scales such as the Behavior Rating Inventory of Executive Function, British Columbia Post-concussion Symptom Inventory, and Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT). They reported that student athletes with ADHD are more likely to sustain 1 or multiple concussions and experience prolonged postconcussion symptoms. Students with ADHD may be 5 times more likely to sustain a sports-related concussion. They acknowledge that their study is complex and that simple scales do not always fit these complex clinical situations. Their findings are similar to those reported by Liou et al.⁵

Inattentiveness and impulsiveness are likely risk factors contributing to sports-related concussions. This is a reasonably believable observation: that inattentive or impulsive students with ADHD find themselves in harm's way far more often than other student athletes—with an alarmingly high rate of injury.

Postconcussion symptom recovery duration is harder to assess. Concussion symptoms can be difficult to separate from ADHD baseline symptoms. No intrasubject baseline was used for comparison in this study. Many postconcussion symptoms present as a clinical picture similar to ADHD itself.⁶ The standardized scales can be hard to use in these settings. For example, the ImPACT scale itself is open to discussion about its subjectivity. A player can bias the test by deliberately scoring low in preseason baseline testing. One wonders how ImPACT scores among ADHD persons differ from those of the general population irrespective of a concussion. The ImPACT concussion scale has known inaccuracies among ADHD students,⁷ and its validity is open to debate.⁸ Mood disorder, migraine, and other confounders also cloud assessment of a concussion recovery picture. International guidelines suggest that the likely duration of symptoms after a sports-related concussion is less than a month.⁹ A prolonged recovery duration among ADHD students remains unclear.

Subthreshold ADHD refers to patients with too few ADHD symptoms to make a formal ADHD diagnosis, usually persons having only 4 or 5 of the 9 ADHD inattention criteria required for diagnosis by the *Diagnostic and Statistical Manual of Mental Disorders* (DSM–5). This term is less familiar to most neurologists. Iaccarino et al. included subthreshold ADHD

Department of Neurology (MRN), David Geffen School of Medicine at UCLA; Department of Clinical Neurophysiology (MRN), Ronald Reagan UCLA Medical Center; Sports and Family Medicine (JMN), Bay Health Center, Palo Alto, CA; Departments of Neurology, Pediatrics, and Anatomy & Neurobiology (JWT), the University of Tennessee Health Science Center, and the Department of Neurology (JWT), Memphis Veterans Affairs Medical Center, Children's Foundation Research Institute, Le Bonheur Children's Hospital, Memphis, TN.

Funding information and disclosures are provided at the end of the article. Full disclosure form information provided by the authors is available with the full text of this article at Neurology.org/cp.

subjects in their study and go on to say, “subjects with subthreshold ADHD have a similar level of morbidity and dysfunction as those with the full ADHD.” They have only a modest number of subthreshold subjects—too few to draw conclusions with confidence based on these data alone.

A problem arises if subthreshold ADHD is the basis for treating student athletes with stimulant medications. Those medications improve performance for both ADHD and non-ADHD persons, leading the World Anti-Doping Agency¹⁰ to ban those substances during competitions unless the athlete presents a physician’s note attesting to a diagnosis of ADHD. There is no exemption for subthreshold ADHD. Many symptoms for subthreshold ADHD might provide a back door for athletes to claim a basis for using performance-enhancing drugs, an undesirable situation.

Overall, this remains an interesting area of convergence of several topics of current interest, each ripe for further research: sports-related concussion, chronic traumatic encephalopathy, ADHD, and use of performance-enhancing medication in sports. Issues in the Iaccarino et al. report needing more study include subthreshold ADHD in sport-related concussion and the duration of sport-related postconcussion symptom among patients with ADHD.

The study by Iaccarino et al.⁴ is relevant for the practicing physician in emphasizing the increased risk of concussion among student athletes who have ADHD. The likelihood of a concussion may be five times that of student athletes without ADHD or subthreshold ADHD, and those with ADHD are more predisposed to multiple concussions. Coaches, trainers, team physicians, physical education teachers, prescribers of ADHD medications, and parents of youth athletes should be made aware of this. Students with ADHD, and their parents in the case of youth athletes, should be counseled about the increased likelihood of concussion in sports. Risks of return to play should be discussed clearly when any residual symptoms remain, with physician advice to avoid return to play when significant symptoms remain.

Author contributions

M.R. Nuwer: drafting/revising the manuscript. J.M. Nuwer: drafting/revising the manuscript. J.W. Tsao: drafting/revising the manuscript.

Study funding

No targeted funding reported.

Disclosure

M.R. Nuwer has received travel reimbursement from the American Clinical Neurophysiology Society; serves on the editorial boards of *Neurology Clinical Practice* and the *Journal of Clinical Neurophysiology*; is an honorary consulting editor for *Clinical Neurophysiology*; receives research grant support as investigator of studies for the Congressionally Directed Medical Research Programs (SC130209), the NIH/National Institute of Neurological Disorders and Stroke (1R01NS078494-01A1), and the United States Army Medical Research Acquisition Activity (11S01944); has received personal compensation for book royalties from Cambridge University Press; holds stock/stock options in CortiCare; and has provided expert medical testimony for trials and depositions as a medical expert and treating physician. J.M. Nuwer has provided expert medical testimony for depositions as a medical expert. J.W. Tsao serves on the editorial board of *Neurology: Clinical Practice*; receives publishing royalties from Springer; and owns stock in Biogen and Illumina. Full disclosure form information provided by the authors is available with the full text of this article at Neurology.org/cp.

References

1. Nuwer MR, Hovda DA, Schrader LM, Vespa PM. Routine and quantitative EEG in mild traumatic brain injury. *Clin Neurophysiol* 2005;116:2001–2025.
2. Langlois JA, Rutland-Brown W, Thomas KE. Traumatic Brain Injury in the United States: Emergency Department Visits, Hospitalizations, and Deaths. Atlanta: Centers for Disease Control and Prevention, National Center for Injury Prevention and Control; 2004.
3. Sosin DM, Sniezek JE, Thurman DJ. Incidence of mild and moderate brain injury in the United States, 1991. *Brain Inj* 1996;10:47–54.
4. Iaccarino MA, Fitzgerald M, Pulli A, et al. Sport concussion and attention deficit hyperactivity disorder in student athletes: a cohort study. *Neurol Clin Pract* 201X;8:403–411.
5. Liou YJ, Wei HT, Chen MH, et al. Risk of traumatic brain injury among children, adolescents, and young adults with attention-deficit hyperactivity disorder in Taiwan. *J Adolesc Health* 2018;63:233–238.
6. Lewandowski LJ, Lovett BJ, Coddling RS, Gordon M. Symptoms of ADHD and academic concerns in college students with and without ADHD diagnoses. *J Atten Disord* 2008;12:156–161.
7. Manderino L1, Gunstad J. Collegiate student athletes with history of ADHD or academic difficulties are more likely to produce an invalid protocol on baseline ImPACT testing. *Clin J Sport Med* 2018;28:111–116.
8. Abeare CA, Messa I, Zuccato BG, Merker B, Erdodi L. Prevalence of invalid performance on baseline testing for sport-related concussion by age and validity indicator. *JAMA Neurol* 2018;75:697–703.
9. McCrory P, Meeuwisse W, Dvorak J, et al. Consensus statement on concussion in sport: the 5th international conference on concussion in sport held in Berlin, October 2016. *Br J Sports Med* 2017;51:838–847.
10. World Anti-Doping Agency. The 2015 Prohibited List International Standard: The World Anti-Doping Code. Published September 20, 2014. Section S6. Stimulants. Page 8–9. Available at: wada-ama.org/sites/default/files/resources/files/wada-2015-prohibited-list-en.pdf. Accessed August 6, 2018.