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Title: Concussion Symptoms and Symptom Resolution Time in US High School Athletes, 2007/08-2014/15

Authors:

Matthew John Kraeutler, MD¹, Dustin Currie, MPH², John Bradley Schrock, BA¹, Eric C. McCarty, MD¹, Dawn Comstock, PhD².

¹University of Colorado School of Medicine, Boulder, CO, USA, ²Colorado School of Public Health, Aurora, CO, USA.

Objectives: There has been increased interest in sports-related concussions from the professional level down to youth leagues in recent years. Symptom types and resolution time are the metrics most often used to monitor concussions. The purpose of this study is to investigate how concussion symptoms, symptom resolution time, and use of diagnostic imaging have changed among US high school athletes from the 2007/08 through 2014/15 academic years.

Methods: This study analyzed concussions occurring in all sports available in the High School Reporting Information Online (RIO) database from 2007/08 through 2014/15. Chi-square tests for trend were used to calculate symptom and diagnostic imaging trends over time. Statistical significance was determined at $p < 0.05$.

Results: The prevalence of each of the following symptoms was found to significantly decrease over the time period analyzed in athletes diagnosed with a concussion: amnesia ($p < 0.0001$), confusion/disorientation ($p < 0.0001$), dizziness/unsteadiness ($p < 0.01$), loss of consciousness (LOC, $p < 0.0001$), and tinnitus ($p < 0.0001$). Among all athletes diagnosed with a concussion, the prevalence of LOC was 6.6% in 2007/08 and decreased to 2.4% in 2014/15. The prevalence of each of the following symptoms was found to significantly increase over the time period analyzed in athletes diagnosed with a concussion: drowsiness ($p < 0.01$), irritability ($p < 0.0001$), light sensitivity ($p < 0.0001$), and noise sensitivity ($p < 0.0001$). The prevalence of concentration difficulty, headaches, hyper-excitability, and nausea did not change significantly over time. The average concussion symptom resolution time has significantly increased over time ($p < 0.0001$). The use of diagnostic plain radiographs, magnetic resonance imaging (MRI), and computed tomography (CT) scans all significantly decreased over the time period analyzed ($p < 0.0001$ for each diagnostic test).

Conclusion: From the 2007/08 to 2014/15 academic years, the prevalence of various symptoms changed significantly in US high school athletes diagnosed with a concussion. The decrease in severe symptoms (LOC, amnesia, disorientation) and the increase in less recognizable symptoms (drowsiness, irritability) may point to a lower threshold used by healthcare providers in diagnosing concussions in more recent years. Improved education among healthcare providers has likely led to increased recognition of lingering symptoms in athletes diagnosed with concussions, thereby leading to a longer average symptom resolution time. Furthermore, the significant reduction in use of all forms of diagnostic head imaging demonstrates an increased recognition of concussions as functional disturbances rather than physical abnormalities detectable on imaging.