



**TESTIMONY OF JOEL S. BRENNER, MD, MPH, FAAP
ON BEHALF OF THE AMERICAN ACADEMY OF PEDIATRICS**

“Protecting School-Age Athletes from Sport-Related Concussion Injury”

**COMMITTEE ON ENERGY AND COMMERCE HEALTH SUBCOMMITTEE
U.S. HOUSE OF REPRESENTATIVES**

September 8, 2010

AAP Department of Federal Affairs
The Homer Building
601 Thirteenth Street, N.W.
Suite 400 North
Washington, D.C. 20005
202-347-8600 / 800-336-5475 / Fax 202-393-6137

Good afternoon. Chairman Pallone, Representative Pascrell, I appreciate the opportunity to testify today at this field hearing before the House Energy and Commerce Subcommittee on Health regarding sport-related concussions in children and adolescents. My name is Joel Brenner, MD, MPH, FAAP, and I am proud to represent the American Academy of Pediatrics (AAP), a non-profit professional organization of 60,000 primary care pediatricians, pediatric medical sub-specialists, and pediatric surgical specialists dedicated to the optimal physical, mental, and social health and well-being for all infants, children, adolescents, and young adults.

I currently am the Medical Director of the Sports Medicine Program at The Children's Hospital of The King's Daughters in Norfolk, Virginia, as well as Associate Professor of Pediatrics at Eastern Virginia Medical School. I am an active member of the Virginia High School League's Sports Medicine Advisory Committee, for which I was acutely involved in the creation, passage and implementation of a new concussion law protecting student athletes in the Commonwealth of Virginia. I also am a member, and current chair-elect, of the American Academy of Pediatrics' Council on Sports Medicine and Fitness.

As a pediatrician board certified in primary care sports medicine, adolescent medicine and pediatrics, I am intimately aware of the dangers sport-related concussions have on our youth. In my clinical practice I often see 10 to 12 new concussion cases among school-aged athletes each week. This fall as student-athletes return to the playing fields we must remember the unique medical needs of children and take appropriate action to minimize the harmful impact of concussions on our nation's youth.

Unique Impact of Concussion on Children

Sport-related concussions pose a unique risk to the pediatric population. Children and adolescents are still undergoing a significant period of brain development and thus are even more susceptible to the damaging effects of a concussion. The young athlete's immediate job is to go to school to learn and form new memories. However, a young athlete suffering from a concussion is often not able to attend school or function normally due to the brain injury.

The long-term effects of concussions in athletes of all ages are cause for considerable concern. Children's developing brains are exceptionally vulnerable. Three months after a concussion, children 8 to 16 years of age have been found to experience persistent deficits in processing complex visual stimuli.¹ Further, athletes with two or more concussions demonstrate statistically significant lower grade-point averages compared with similar students without a history of concussion.²

Children and adolescent athletes are also at particularly high risk of experiencing second-impact syndrome, a condition that occurs when an athlete who has sustained an initial head injury sustains a second head injury before the symptoms associated with the first have fully cleared.³ Second impact syndrome can result in diffuse cerebral swelling and death.⁴ All reported cases of second-impact syndrome have been in athletes younger than 20 years of age.⁵

While sport-related concussions are increasingly common in youth and high school sports, the long-term effects of this traumatic brain injury are still relatively unknown. More research is needed to better understand the impact of concussions in children across the life-course. A current lack of longitudinal studies that track high school and younger athletes who sustained concussions leaves us with more questions than conclusive answers.

We are certain however that concussion is not a condition that can just be "toughed out" but rather a serious medical injury of unique concern to children and adolescents. Age-appropriate concussion prevention and management techniques are vital to reducing the risk of serious long-term injury and complications among young athletes.

Current Data on Concussions in the United States

It is commonly reported that 300,000 sport-related concussions occur each year; however, a recent review estimates that in fact as many as 3.8 million recreation- and sport-related concussions occur annually in the United States.^{6,7} This marked discrepancy highlights the difficulty in accurately accounting for concussions and the current gaps in evidence.

Underreporting of concussions and the lack of systematic, widespread injury surveillance in youth sports both contribute to the challenging task of accurately capturing the scope of concussions in the United States.^{8, 9}

The number of children visiting the emergency department (ED) for concussion is on the rise. A study published this month in AAP's professional journal *Pediatrics* found that 50 percent of pediatric concussions seen in the ED were sport-related, and younger children, between the ages of 8 and 13 years, accounted for 40 percent of the sport-related concussions in the ED. Another striking finding from this report was that between 1997 and 2007 the number of visits to the ED for sport-related concussions in organized team sports increased significantly despite an overall decrease in sport participation among youth ages 7 to 17 years. Specifically, ED visits for sport-related concussions doubled among 8 to 13 year-old children and increased by more than 200 percent among the 14 to 19 year-old group.¹⁰

Concussions represent an estimated 8.9 percent of all high school athletic injuries.¹¹ Data are significantly lacking on concussions in grade school and middle school athletes, highlighting the need for more research about concussions in this younger age group.

The catastrophic nature of concussion in children and adolescents must also not be overlooked. Since 1945, more than 90 percent of the head injury-related fatalities from sports recorded by the National Center for Catastrophic Sports Injury Research occurred in athletes in high school or younger.¹²

In short, concussions are a very real concern for athletes of all ages, and especially so for the child and adolescent population.

Clinical Perspective: Signs and Symptoms

Concussions can cause symptoms that interfere with children's school performance, social and family relationships, and participation in sports. The traditional signs and symptoms of

concussion fall into four broad categories: physical, cognitive, emotional, and sleep.¹³ Headache is the most frequently reported concussion symptom.¹⁴ While not as common, loss of consciousness and amnesia may both be important indicators of more serious injury.¹⁵ Immediate motor symptoms, such as convulsive movements or tonic posturing, are rare yet they can accompany a concussion.¹⁶ It is possible that symptoms of concussion may not appear until several hours after initial injury.¹⁷

The signs and symptoms of a concussion typically resolve in 7 to 10 days in the majority of cases, however for some athletes recovery may take weeks or months. Unresolved symptoms lasting for an extended period of time could be concern for complications, including the previously mentioned second-impact syndrome as well as postconcussion syndrome. Postconcussion syndrome was most recently defined as the presence of cognitive, physical, or emotional symptoms of a concussion lasting longer than expected, with a threshold of 1 to 6 weeks of persistent symptoms following a concussion to make the diagnosis.¹⁸ Such severe cases emphasize the importance of evaluating and monitoring young athletes following a concussion.

Many factors can complicate the recognition of concussion in children. Concussions have many signs and symptoms, many of which may overlap with other medical conditions. For example, some concussion symptoms are similar to depression, anxiety, and attention-deficit disorders and for children with pre-existing mental health disorders concussions may exacerbate those symptoms. Athletes may not recognize that they have concussion symptoms because of poor understanding of the condition or from cognitive impairment due to the injury itself. Additionally, young athletes may not be forthcoming with their concussion symptoms for fear of being restricted from further sports participation.¹⁹

Diagnostic Tools

Identifying and diagnosing the signs and symptoms of concussion may involve several different tools and approaches depending on the nature of injury. There is no single best method for

diagnosis; rather a comprehensive evaluation may require a range of approaches from a sideline physical exam and comprehensive history to neuropsychological testing.

Any pediatric or adolescent athlete who is suspected of sustaining a concussion should be evaluated by a health care professional. Whether the athlete is initially evaluated on the athletic field sideline, in a physician office, or in the emergency department, a neurologic exam, inquiry into symptoms, and assessment of cognitive function should be performed. If a concussion is identified, the athlete should be removed from the remainder of the practice or game(s) on that day.²⁰ The athlete should continue to be monitored for several hours after the injury to evaluate for any deterioration of his or her condition. Even if an athlete's symptoms clear on the same day of the concussion and the assessment in the office or emergency department is normal, the athlete should not be allowed to return to play that same day.

If there is concern for a structural brain abnormality, neuroimaging should be considered, though the results of conventional neuroimaging typically come back normal following a concussive injury. Evidence exist that routine imaging using computed tomography (CT) or magnetic resonance imaging (MRI) contributes little to the evaluation and management of concussion.²¹

Instead, neuropsychological testing has become more commonplace in the evaluation of an athlete with a concussion. Such testing provides a means to an objective measure of brain function. Neuropsychological testing is one of several tools in the concussion assessment but does not independently determine whether an athlete has experienced a concussion or when the athlete may safely return to play.^{22, 23}

At this time, there are no evidence-based guidelines or validated protocols that address when to administer the computerized neuropsychological test following a concussion. The optimum timeframe for repeating baseline neuropsychological testing, if conducted, is still not well-established, especially for the developing brain. A study that evaluated high school athletes with pencil-and-paper neuropsychological testing found stabilization of baseline scores between the 9th and 10th grades.²⁴ It is also important to consider that there is a lack of published baseline data in athletes younger than 12 years. There is currently no established, validated computerized

neuropsychological test for the grade school athlete, although at this time a computerized test for use in athletes younger than 12 years is being developed.²⁵

Concussion Management and Return to Play

The goal of managing a young athlete with a concussion is to hasten recovery by ensuring that the athlete is aware of and avoids activities and situations that may slow recovery. Treating young athletes with a concussion is uniquely challenging, because their brains are still developing. Unfortunately, the lack of published data on the preadolescent athlete hinders evidence-based decision making in this age group.²⁶ It is important to stress to children and adolescent athletes as well as their parents to allow adequate time for full physical and cognitive recovery. To prevent exacerbation of symptoms and allow for continued recovery, both physical and cognitive rest is recommended.

Athletes with concussion often have difficulty attending school and focusing on schoolwork, taking tests, and trying to keep up with assignments, especially in math, science, and foreign language classes. Reading, even for leisure, commonly worsens symptoms. Teachers and school administrators should also be notified of the injury and asked to work with students to modify workloads to avoid exacerbation of concussion symptoms.

Following a concussion, all athletes should be withheld from physical exertion until they are asymptomatic at rest. With the proposed injury to the brain, increased energy demand in the brain from physical activity may exacerbate symptoms and has the potential to prolong recovery.²⁷ An athlete in the acute phase of a concussion should be restricted from physical activity. Special consideration must be given to when children return to physical activities and play. Given that the recovery course is longer for younger athletes,²⁸ a more conservative approach to return to play should be adopted for this group. When considering young athletes' return to physical activity, coaches, parents, and trainers should remember the important phrase, "when in doubt, sit them out."

Legislative Action

The American Academy of Pediatrics supports the establishment of federal guidelines for concussion management, and believes the prevention, identification, treatment, and management of concussions in children and adolescents is of the utmost importance. We commend Representative Pascrell (D-NJ) for introducing H.R. 1347, Concussion Treatment and Care Tools, or ConTACT, Act of 2009, and drawing attention to the important issue of sport-related concussion among school-aged children. The adoption of federal concussion management guidelines and standards for when student athletes should return to play following a concussion are important steps in protecting the health and safety of America's children.

The lack of comprehensive national concussion management guidelines jeopardizes children's health and has prompted the AAP to take action to address this deficiency. AAP's Council on Sports Medicine and Fitness has combined its professional expertise with current medical literature to devise a list of recommendations for the management of sport-related concussion in children and adolescents. It is our expectation that this clinical report and these recommendations can serve as starting points for the development of federal standards and contribute to the national dialogue on pediatric concussion management.

AAP Recommendations

The American Academy of Pediatrics' Council on Sports Medicine and Fitness has devised a comprehensive clinical report on sport-related concussion in children and adolescents. The full report and recommendations can be found in this month's journal of *Pediatrics*, and I would like to share the most important points with you today:

1. Pediatric and adolescent athletes should never return to play while symptomatic at rest or with exertion. Athletes also should not be returned to play on the same day of the concussion, even if they become asymptomatic. The recovery course is longer for younger athletes than for college

and professional athletes, and a more conservative approach to return to play is warranted for this age group.

2. Any pediatric or adolescent athlete sustaining a concussion should be evaluated by a health care professional, ideally a physician, with experience in concussion management and should receive medical clearance before returning to play.

3. Athletes with a concussion should rest, both physically and cognitively, until their symptoms have resolved both at rest and with exertion. Teachers and school administrators should work with students to modify workloads to avoid exacerbation of symptoms.

4. Neuropsychological testing can be helpful to provide objective data to athletes and their families following a concussion. Neuropsychological testing is only one tool in the complete management of a sport-related concussion and does not alone make a diagnosis or determine when return to play is appropriate.

5. Retirement from contact or collision sports may be necessary for the athlete with a history of multiple concussions or with long symptomatic courses following his or her concussion.

The American Academy of Pediatrics believes these recommendations and guidance should be included in any federal action on this issue. It should also be noted that timely medical attention for any athlete suspected of sustaining a concussion is important, and the presence of an athletic trainer or similarly-qualified professional for sideline evaluation is ideal. Even with the promising advances of computerized neuropsychological testing and recent investments in prevention, early diagnosis, and treatment of concussions in young athletes, requiring all schools and other organizations that sponsor or conduct high risk activities to have an athletic trainer or similarly-qualified professional on site would not only improve concussion management but also help decrease other morbidities at the same time.

Conclusion

The American Academy of Pediatrics applauds Chairman Pallone and Representative Pascrell for convening this hearing today to bring added attention to the important issues surrounding concussions in school-aged children. As another school year is upon us and children of all ages are returning to athletic fields and playgrounds across the country, education on sport-related concussion is integral to improving awareness, recognition, and management. Thank you for the opportunity to share my clinical perspective with you today.

AAP is grateful for the Committee's continued commitment to child health, and we hope that you will consider us a partner in efforts to reduce the occurrence of sport-related concussions in our nation's youth.

I thank you for this opportunity to testify and look forward to your questions.

¹ Brosseau-Lachaine O, Gagnon I, Forget R, Faubert J. Mild traumatic brain injury induces prolonged visual processing deficits in children. *Brain Inj.* 2008;22(9):657-668.

² Moser RS, Schatz P, Jordan BD. Prolonged effects of concussion in high school athletes. *Neurosurgery.* 2005;57(2):300-306.

³ Halstead ME, Walter KD. Clinical Report – Sport-Related Concussion in Children and Adolescents. *Pediatrics.* 2010;126(3):597-615.

⁴ Cantu RC, Voy R. Second impact syndrome: a risk in any contact sport. *Phys Sportsmed.* 1995;23(6):27-34.

⁵ McCrory P. Does second impact syndrome exist? *Clin J Sport Med.* 2001;11(3):144-149.

⁶ Langlois JA, Rutland-Brown W, Walk MM. The epidemiology and impact of traumatic brain injury: a brief overview. *J Head Trauma Rehabil.* 2006;21(5):375-378.

⁷ Thurman J, Branche CM, Sniezek JE. The epidemiology of sports-related traumatic brain injuries in the United States: recent developments. *J Head Trauma Rehabil.* 1998;13(2):1-8.

⁸ McCrea M, Hammeke T, Olsen G, Leo P, Guskiewick K. Unreported concussion in high school football players: implications for prevention. *Clin J Sport Med.* 2004;14(1):13-17.

⁹ Williamson IJS, Goodman D. Converging evidence for the under-reporting of concussions in youth ice hockey. *Br J Sports Med.* 2006; 40(2):128-132.

-
- ¹⁰ Bakhos LL, Lockhart GR, Myers R, Linakis JG. Emergency Department Visits for Concussion in Young Child Athletes. *Pediatrics*. 2010;126(3):550-556.
- ¹¹ Gessel LM, Fields SK, Collins CL, Dick RW, Comstock RD. Concussions among United States high school and collegiate athletes. *J Athl Train*. 2007;42(4):495-503.
- ¹² Mueller FO. Catastrophic head injuries in high school and collegiate sports. *J Athl Train*. 2001;36(3):312-315.
- ¹³ US Department of Health Services, Centers for Disease Control and Prevention. Heads Up: Facts for Physicians About Mild Traumatic Brain Injury (MTBI). Available at: www.cdc.gov/NCIPC/pubs/tbi_toolkit/physicians/mtbi/mtbi.pdf.
- ¹⁴ Blinman TA, Houseknecht E, Snyder C, Wiebe DJ, Nance ML. Postconcussive symptoms in hospitalized pediatric patients after mild traumatic brain injury. *J Pediatr Surg*. 2009;44(6):1223-1228.
- ¹⁵ Collins MW, Iverson GL, Lovell MR, McKeag DB, Norwig J, Maroon J. On-field predictors of neuropsychological and symptom deficit following sports-related concussion. *Clin J Sport Med*. 2003;13(4):222-229.
- ¹⁶ McCrory P, Meeuwisse W, Johnston K, et al. Consensus statement on Concussion in Sport 3rd International Conference on Concussion in Sport held in Zurich, November 2008. *Clin J Sport Med*. 2009;19(3):185-200.
- ¹⁷ McCrory P, Johnston K, Meeuwisse W, et al. Summary and agreement statement of the 2nd International Conference on Concussion in Sport, Prague 2004. *Br J Sports Med*. 2005;39(4):196-204.
- ¹⁸ Jotwani V, Harmon KG. Postconcussion syndrome in athletes. *Curr Sports Med Rep*. 2010;9(1):21-26.
- ¹⁹ Halstead et al.
- ²⁰ McCrory et al. Consensus statement on Concussion in Sport 3rd International Conference on Concussion in Sport held in Zurich, November 2008.
- ²¹ McCrory et al. Consensus statement on Concussion in Sport 3rd International Conference on Concussion in Sport held in Zurich, November 2008.
- ²² McCrory et al. Consensus statement on Concussion in Sport 3rd International Conference on Concussion in Sport held in Zurich, November 2008.
- ²³ McCrory et al. Summary and agreement statement of the 2nd International Conference on Concussion in Sport, Prague 2004.
- ²⁴ Hunt TN, Ferrara MS. Age-related differences in neuropsychological testing among high school athletes. *J Athl Train*. 2009;44(4):405-409.
- ²⁵ Halstead et al.
- ²⁶ McCrory P, Collie A, Anderson V, Davis G. Can we manage sport related concussion in children the same as in adults? *Br J Sports Med*. 2004;38(5):516-519.
- ²⁷ Majerske CW, Mihalik JP, Ren D, et al. Concussion in sports; postconcussive activity levels, symptoms, and neurocognitive performance. *J Athl Train*. 2008;43(3):265-274.
- ²⁸ Sim A, Terryberry-Spohr L, Wilson KR. Prolonged recovery of memory functioning after mild traumatic brain injury in adolescent athletes. *J Neurosurg*. 2008;108(3):511-516.