

Virtual Mentor

American Medical Association Journal of Ethics
July 2014, Volume 16, Number 7: 559-564.

POLICY FORUM

Addressing Concussion in Youth Sports

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When medical professionals discuss injury prevention in the school-aged population, the focus is usually on motor vehicle safety (seat belt, booster seat, car seat use, and so on), domestic violence (e.g., teen dating violence), and bicycle helmet use. Recently, sports safety has become another focal point for youth injury prevention with the recent enactment of state concussion laws [1]. Unfortunately, research on concussion prevention in sports is still lacking in many places, as is the translation of that research into knowledge and clinical practice for medical professionals. The Institute of Medicine (IOM) Committee on Sports-Related Concussions in Youth, of which I was privileged to be a member, recently published a report, *Sports-Related Concussions in Youth: Improving the Science, Changing the Culture* [2]. In just under two years, the committee was able to complete an exhaustive review of the literature and put together a report documenting the evidence and concepts behind neurological development and concussion diagnosis, management, and prevention. This report discusses youth ranging in age from elementary-school children to young adults, including military personnel and their dependents. Leaders were brought in from various fields to serve on the committee, and expert speakers and public testimony were heard during the deliberations for the report.

So how can we reduce concussions among young athletes? To create injury prevention strategies for sport, one must understand the rules and goals of the sport in question. There should be accurate epidemiologic data on injury frequency and type to enable recognition, management, and prevention of injuries.

Obstacles

One major difficulty in collecting data on which to base injury prevention strategies is the lack of large epidemiologic studies and comprehensive injury surveillance systems for youth sports. There are three commonly cited injury surveillance systems, each of which is limited in a different way. The NCAA Injury Surveillance system provides robust information on injuries that occur in collegiate athletics, but that data does not tell us about high-school athletics or recreational activities. High School RIO (Reporting Injuries Online) has worked with the National Federation of State High School Associations to create an Internet-based injury surveillance system for high-school athletics, which is significant but does not account for recreational activities or private sports. Finally, the Consumer Product Safety Commission's National Electronic Injury Surveillance System (NEISS), which collects information from emergency visits to registered hospitals involving consumer products like a lacrosse helmet or a baseball, may tell us more about

recreational activities than the NCAA or High School RIO, but it is limited by its focus on emergency department visits. This does not inform us about injuries treated by primary care physicians, at home, or by school-based or club-based athletic trainers. Even used together, these surveillance reports do not give a complete picture of sports injuries in young people.

Another barrier to getting accurate data is that athletes underreport their injuries. A 2004 study by McCrea [3] showed that only 47.3 percent of affected athletes reported a concussion. Many of these athletes felt a concussion was not serious enough to warrant reporting and said they did not want to be withheld from competition. Self-reporting of symptoms plagues concussion research in particular because there is no single test that can confirm or exclude the diagnosis of concussion. Concussion incidence may well be underreported, since many athletes will not recognize symptoms as an injury and even deny their existence in order to continue participation. Therefore, I believe that injury rates are higher than what is currently reported in the medical literature.

Even if we formulate recommendations, implementing them across the board can be difficult because not all sports are overseen by central bodies. Participation in extreme sports, which are largely recreational rather than part of school leagues, is significantly increasing, with the number of skateboarders, for example, increasing 178 percent from 1995 to 2005 [5] and up 14 million US participants [4]. A study presented at the 2014 Annual Meeting of the American Academy of Orthopaedic Surgeons (AAOS) attempted to quantify the injury risk for participants in the extreme sports of mountain biking, motocross, skateboarding, surfing, snow machining, snow skiing, and snowboarding [4]. This study revealed that skateboarding, snowboarding, and skiing carried the highest incidence of head and neck injury and that concussion was the most common head and neck injury in extreme sports. Enforcing change in unregulated, primarily recreational activities of this kind is much harder than regulation and rule creation for structured, organized leagues like high school or Pop Warner football. This means it is difficult to implement standards in a way that will protect all athletes.

Recommendations

To truly improve injury prevention and reduce concussion incidence, we need to accomplish several things:

1. Establish a national injury surveillance program to determine with accuracy the incidence of sports-related concussion in youth. The IOM believes that a better understanding of the true incidence of concussion will allow researchers to target injury prevention strategies to needed groups and better evaluate their effectiveness [2].
2. Undertake further research to establish objective markers (i.e., biomarkers) for diagnosing concussion to reduce the dependence on self-reporting and to inform evidence-based, age-specific guidelines for concussion management.

As the IOM report points out, the most widely used guidelines, the “Zurich 2” guidelines, are based primarily upon clinical experience rather than evidence [6, 2]. Support for further research into the short-term and long-term outcomes after concussion, such as health-related quality of life, is important.

3. Promote appropriate age-related rules, techniques, and standards of play [2]. The NFHS, state interscholastic high school athletic associations, and many national governing bodies for sport work diligently to evaluate these issues and improve participant safety for organized school sports. But not all private or club sports are affiliated with national governing bodies and most recreational athletes do not participate under the oversight of a governing body, so educating those athletes is difficult but paramount.
4. In order to prevent false claims of protection and concussion reduction, implement stricter oversight of the companies that produce protective equipment. Both the IOM and the AAOS agree on the need for further research and advocacy to improve protective equipment and establish a biomechanical threshold for concussion [2, 4]. There is evidence that helmet use reduces head injury risk in skiing, snowboarding, and bicycling, but the effect on concussion risk is inconclusive, and use in other sports did not impact concussion risk [7]. There is also no evidence that helmet “add-ons” reduce concussion risk [8]. Equipment manufacturers are creating sensors in mouthguards and helmets that light up after certain levels of impact, but since there is no scientifically established biomechanical threshold for concussion, these levels may not be clinically meaningful.
5. Improve medical care at sporting events [4]. Many organized contact sports are played without trained medical personnel on the sideline. The National Athletic Trainers Association (NATA) estimates that only about 40 percent of US high schools had access to a full- or part-time athletic trainer in 2013 [9], and many club and private sports have no athletic trainer affiliation. A single athletic trainer would have a difficult time covering even one high school’s football players alone, given that there are often freshman, sophomore, junior varsity and varsity teams all participating at the same time, not to mention equivalent teams for boys’ or girls’ soccer during the same season. Many club sport tournaments, including higher-risk sports like soccer, lacrosse, and rugby, often have no on-site medical personnel. Improving medical coverage at athletic competitions is critical: it should be the expectation, rather than the exception, that on-site medical coverage is present for all high-risk and contact or collision sports.
6. Improve medical education about concussion. This includes better concussion education for students entering health professions but also improved education for health care professionals after graduation [10, 11]. A study found that only 26.6 percent of general pediatricians were somewhat or very familiar with recently passed concussion legislation and that only 14.6

percent of general pediatricians used concussion consensus guidelines in their practice [12]. An informed primary care clinician can provide crucial anticipatory guidance for safe sport participation, like reminders to wear helmets and use the proper protective equipment.

7. Promote appropriate coding of injuries, such as the use of E codes to document emergency visits. Consistent proper use of E codes, which can fall by the wayside during busy times, will help the NEISS become a more accurate system.
8. Improve awareness of concussion among the public and education on concussion among coaches, officials, and athletes. Coaching education has been shown to positively impact the ability of youth sports coaches to recognize concussion [13]. The NFHS and Centers for Disease Control and Prevention have created free online webinars for coach, athlete, and lay public concussion education. With these online educational tools, access to high-quality information is easy enough that athletic organizations can make educational sessions mandatory for all coaches and officials.

Every state currently has a concussion law that includes promoting awareness of concussion, immediate removal of a player with a suspected concussion, no same-day return to play for those with concussions, and requirement of written medical clearance prior to return to play [14]. The laws are unique to each state and need to be understood by health care professionals, sports organizations and coaches, and athletes and families. Ideally, each state law should protect all young athletes, not just those in school-based athletics, especially since the efforts of the NFHS and each state high school athletic association do not currently affect recreational play environments.

9. Change injury culture in sport: encourage athletes to report their injuries and foster an environment in which athletes who report injuries and take appropriate precautions are not considered weak or “soft” [2].

The health, economic, and education implications of youth concussion in the US are significant. Policymakers at all levels of government and health care professionals are in a position to enact community and national policy changes to improve the safety of our young athletes. These changes will not only help with concussion recognition and management, but also increase safe participation in sport, which improves health outcomes for all [1].

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