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SPORT MEDICINE

# Knowledge of Concussions by High School Coaches in a Rural Environment

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## Abstract

*The purpose of this study was to determine the knowledge and opinions on concussions of high school coaches from a geographically large yet rural state in the northern Rocky Mountains of the United States. Few medical issues in sport are more important, or have had as much publicity recently, as concussions. The exposure gleaned from tragic health issues among professional athletes post-concussion has motivated college and professional sport agencies to modify and enact strict guidelines in the diagnosis and treatment of suspected concussions. Yet underdiagnosis and mistreatment by some (former University of Michigan coach in 2014) highlight the need for continued education and enforcement of the current guidelines. Obviously, when a head coach from a major NCAA Division I university still places an athlete's health in jeopardy by disregarding a head injury, it is imperative that coaches' knowledge of concussions in smaller, more rural and remote programs is considered as well. We used a commercial electronic product to survey coaches across the state. Coaches responded voluntarily with their opinions and their current knowledge of issues related to concussions. The*

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*purpose was to identify the current status of knowledge and attitudes in hopes that any weaknesses can be addressed in additional coach education opportunities.*

Over 300,000 sport-related concussions occur each year in the United States, but that number relates only to athletes who lost consciousness and reported it. According to numerous sources, the number of sport-related concussions each year is between 2 million and 4 million (Covassin, Elbin, & Sarmiento, 2012; Grady, 2010; Guskiewicz & McLeod, 2011). Approximately one third of those concussions occur in young athletes at precollegiate levels (Martineau, Kingma, Bank, & McLeod, 2007; Murphy et al., 2012; Yard & Comstock, 2009). That population is even more susceptible to long-term effects and extended recovery times than are adults (Gessel, Fields, Collins, Dick, & Comstock, 2007; Grady, 2010).

Because of no universal definition, a concussion is difficult to understand and diagnose (Cantu, 2001; Covassin, Elbin, Stiller-Ostrowski, & Kontos, 2009; Guskiewicz et al., 2004; Martineau et al., 2007). In 2001, an international group of experts defined concussion as a complex brain injury caused by biomechanical forces that affects numerous body functions (Aubry et al., 2002; McCrory et al., 2013). To date, that definition is still accepted. Therefore, any force directed on a player that is transmitted to the head may result in a concussion (Aubry et al., 2002; McCrory et al., 2013). The resulting concussion may cause temporary neurological impairment lasting for varying amounts of time and may affect vision, balance, sleep, and concentration. Loss of consciousness (LOC) is NOT required for a concussion to be diagnosed. Likewise, magnetic resonance imaging (MRI) or computed tomography (CT) scans rarely show signs of concussions (Aubry et al., 2002; McCrory et al., 2013).

Because concussions are not easy to define, determining occurrence and grading severity is difficult. According to the National Athletic Trainers' Association (NATA), there is no universal grading scale for concussions (Guskiewicz et al., 2004). Many scales are focused primarily on occurrence of LOC or if posttraumatic amnesia (PTA) exists (Cantu, 2001). Cantu (2001) described two types of PTA: (a) *retrograde amnesia,* which is a failure to remember events that occurred prior to receiving a concussion, and (b) *anterograde*

*amnesia,* which is a failure to remember events after the concussion has occurred.

The NATA lists a grading scale for concussions with three divisions (Guskiewicz et al., 2004). In this scale, a Grade 1 concussion is characterized as no LOC, some confusion, and other signs and symptoms *that resolve themselves in less than* 15 min. In Grade 2, LOC has still not occurred, but there is some confusion, and signs and symptoms *last longer than* 15 min. Finally, a concussion is rated Grade 3 when LOC has occurred.

Though there are many approaches to grading concussions, all emphasize diagnostic signs and symptoms. Many of these are self-reported and are therefore different between players (Guskiewicz et al., 2004). The more common signs and symptoms are *headache; nausea; vomiting; drowsiness; dizziness; balance problems; sleeping problems; sensitivity to light or noise; trouble studying or concentrating; memory problems;* or *changes in attitude,* such as *irritability* or *nervousness* (Aubry et al., 2002; Guskiewicz et al., 2004; Martineau et al., 2007; Oliaro, Anderson, & Hooker, 2001). Basically, a qualified medical diagnosis should be performed with any change of an individual's normal functioning after a suspected blow to the head or body.

Some signs and symptoms, however, are not self-reported, so other tests are needed to help in assessing a concussion. Mental status screenings, postural stability assessments, neuropsychological testing (Guskiewicz et al., 2004; Martineau et al., 2007; Oliaro et al., 2001), and cranial nerve testing (Oliaro et al., 2001) are used to test for signs and symptoms that are not self-reported. These tests require trained health professionals, so coaches should know whom to contact in their community.

In every case, all suspected concussions have the potential to be serious health issues and should not be overlooked or ignored. A concussion is an invisible brain injury with the possibility of long-term implications. Regardless of the grading scale, concussions must be identified and treated appropriately. Likewise, a proper *return-to-play* progression should be followed to ensure the safe and healthy return of an athlete to competition. Athletes should not return to practice or play until cleared by a health care professional trained in the care of concussions.

In rural, sparsely populated locales, a majority of high schools rarely have athletic trainers or medical personnel present at practices, and the coaches are responsible for diagnosis and medical referral. The primary concern is the injured player, but the effect of failing to diagnose and refer a player with a suspected concussion may affect the future of the coach and the whole program. It is imperative that coaches have the current knowledge and understanding to address these issues as quickly and accurately as possible.

## Method

The participants in this study were high school coaches from a geographically large rural state in the Northern Rockies, USA. After permission was received from the institutional review board and the staff of the state athletic association, coaches from a neighboring state completed a pilot study that resulted in minor modifications of wording. The survey was then administered electronically to determine current knowledge and opinions of high school coaches on concussions.

The questions used were identical or slightly modified from works by Covassin et al. (2012), Hossler and Goldenberg (1995), and McLeod, Schwartz, and Bay (2007; see Table 1). The survey contained questions that covered issues such as *the knowledge of signs and symptoms of concussions, appropriate action when a concussion is suspected, return-to-play guidelines,* and *the seriousness of a concussion* and the opinions of coaches as to whether *the threat of concussions was overemphasized.*

## Results

Fifty-three coaches completed the survey, with all coaches responding to the 5-point Likert scale and 52 answering the true and false questions. The demographics of the respondents and their school classifications are shown in Table 2. Thirty-seven of the respondents reported having at least one player who sustained a medically diagnosed concussion in the past 3 years (Table 3).

**Table 1**
*Knowledge Questions (True/False/I Don't Know)*

| Question | True | False | I don't know | Total |
|---|---|---|---|---|
| A loss of consciousness always occurs when a player has a concussion. | 0.0% (0) | 96.2% (50) | 3.8% (2) | 52 |
| Concussion may be caused either by a direct blow to the head, face, neck, or elsewhere on the body with an impulsive force transmitted to the head. | 92.3% (48) | 1.9% (1) | 5.8% (3) | 52 |
| Concussion is considered a form of traumatic brain injury. | 88.5% (46) | 5.8% (3) | 5.8% (3) | 52 |
| The diagnosis of concussions is easy because there are just a few true signs or symptoms. | 3.8% (2) | 82.7% (43) | 13.5% (7) | 52 |
| If the athlete has lost consciousness or is not coherent, then a cervical spine injury should be suspected. | 42.3% (22) | 13.5% (7) | 44.2% (23) | 52 |
| The helmet, shoulder pads, and other equipment should not be removed if a player remains lying on the playing surface after a suspected concussive blow. | 63.5% (33) | 9.6% (5) | 26.9% (14) | 52 |
| Simple assessment of orientation to person, place, and time is not a reliable screen for a sport-related concussion. | 59.6% (31) | 25.0% (13) | 15.4% (8) | 52 |
| Cognitive evaluation should include situation-relevant questions, such as name of opponent, score of the game, and time remaining in the game. | 69.2% (36) | 15.4% (8) | 15.4% (8) | 52 |

**Table 1 (cont.)**

| Question | True | False | I don't know | Total |
|---|---|---|---|---|
| Balance problems and visual tracking deficits are common concussion findings, but any focal neurological deficits should be referred immediately to emergency medical personnel. | 90.2% (46) | 0.0% (0) | 9.8% (5) | 51 |
| High school–aged athletes take longer to heal from a concussion than do older athletes. | 13.7% (7) | 37.3% (19) | 49.0% (25) | 51 |
| If your athlete clearly shows signs and symptoms of concussion at the time of initial evaluation, it is never appropriate to return the player back to play the same day as the injury regardless of the skill level or resolution of symptoms while on the sideline. | 94.2% (49) | 3.8% (2) | 1.9% (1) | 52 |
| Concussion is a common injury in the preadolescent and adolescent student-athletes. | 59.6% (31) | 15.4% (8) | 25.0% (13) | 52 |
| Once a concussion is sustained, athletes are more likely to experience a second concussion, even if the second blow is relatively mild. | 92.3% (48) | 5.8% (3) | 1.9% (1) | 52 |
| If your athlete clearly shows signs and symptoms of concussion at the time of initial evaluation, you should only return to play if the parent/guardian at the event gives his/her permission. | 0.0% (0) | 98.1% (51) | 1.9% (1) | 52 |

**Table 2**
*Demographics of the Participants*

| Demographic information | % (Total responses) |
|---|---|
| Gender | |
| Male | 32.1 (17) |
| Female | 67.9 (36) |
| Classification of Schools (by number enrolled and % total in state) | |
| Class AA (900 or more students)....8% | 35.8 (19) |
| Class A (370–899)....12% | 47.2 (25) |
| Class B (130–369)....22% | 11.3 (6) |
| Class C (129 or less)....58% | 5.7 (3) |
| Years of Coaching Experience | |
| 1–5 Years | 17 (9) |
| 6–10 Years | 34 (18) |
| 11–15 Years | 11.3 (6) |
| 16–20 Years | 11.3 (6) |
| 21+ Years | 26.4 (14) |
| Sports Coached | |
| Soccer | 22.6 (14) |
| Football | 17.7 (11) |
| Basketball | 14.5 (9) |
| Track and Field | 9.7 (6) |
| Volleyball | 9.7 (6) |
| Softball | 6.5 (4) |
| Tennis | 4.8 (3) |
| Cross Country | 4.8 (3) |
| Wrestling | 3.2 (2) |
| Golf | 3.2 (2) |
| Swimming | 1.6 (1) |
| Cheerleading | 1.6 (1) |

**Table 3**
*Number of Medically Diagnosed Concussions in the Past 3 Years at Practice and Game/Match/Event*

| Number of concussions | Total responses |
|---|---|
| 0 | 30.2% (16) |
| 1–3 | 45.3% (24) |
| 4–6 | 15.1% (8) |
| 7–9 | 3.8% (2) |
| 10 or more | 5.7% (3) |

Most of the coaches were certified in first aid and believed it was their job to educate their players about the risks and implications of a concussion (Table 4). Nearly all (96%) of the respondents knew that loss of consciousness does not always occur in players and believed it is a form of traumatic brain injury (89%). Forty-eight coaches (92%) remarked that any blow to the body that transmits a force to the brain can cause a concussion. However, barely half (52%) of the coaches knew that a cervical spine injury should be suspected if an athlete loses consciousness.

Regrettably, only seven coaches (13%) knew and 25 (48%) did not know that high school athletes take longer to recover from a concussion than do older athletes. On the other hand, 31 (60%) responded that a concussion is a common injury in the preadolescent and adolescent population. Finally, most coaches (95%) agreed that if a head injury is suspected, the athlete should not return to participation the same day, and the same number agreed that not even a parent or guardian can give permission for same-day return.

**Table 4**
*Opinion Questions on a 5-Point Likert Scale*

| Question | Agree strongly | Agree | No opinion | Disagree | Disagree strongly | Total responses |
|---|---|---|---|---|---|---|
| The current emphasis on concussion in sport has been overly sensationalized in terms of injury rate. | 1.9% (1) | 15.1% (8) | 20.8% (11) | 43.4% (23) | 18.9% (10) | 53 |
| It is not the coach's responsibility to educate players about the characteristics of concussions. | 1.9% (1) | 11.3% (6) | 3.8% (2) | 39.6% (21) | 43.4% (23) | 53 |
| Prior to the start of my team's practice, I screen the players' medical releases for evidence of prior concussions and injuries. | 26.4% (14) | 45.3% (24) | 18.9% (10) | 5.7% (3) | 3.8% (2) | 53 |
| I am currently certified in first aid by an accepted organization (Red Cross, American Heart Association, etc.). | 71.7% (38) | 13.2% (7) | 0.0% (0) | 11.3% (6) | 3.8% (2) | 53 |
| After a concussion, only medical professionals should authorize a return to play for the athlete. | 73.6% (39) | 18.9% (10) | 0.0% (0) | 3.8% (2) | 3.8% (2) | 53 |
| After a player has had a concussion, his/her parent or legal guardian can legally permit them to return to play/practice. | 0.0% (0) | 1.9% (1) | 3.8% (2) | 36.5% (19) | 57.7% (30) | 52 |

## Discussion

Although common in sports, concussions remain a poorly understood injury. It has been estimated (Esquivel, Haque, Keating, Marsh, & Lemos, 2013; Gessel et al., 2007; Murphy et al., 2012) that concussions account for 8.9%–13.2% of all injuries for high school athletes. However, because many high schools do not have adequate access to proper medical personnel during practices or games (Table 5), it is imperative that coaches are educated on this topic. The lack of immediate access to medical staff is even more critical in rural communities. Esquivel et al. (2013) found that, even in a heavily populated state where athletic trainers were regularly (two thirds of the time) present at games, no medical support staff were present at over 75% of practices. Likewise, Covassin et al. (2012) found that 70% of the coaches in private youth programs had never received formal education on concussions prior to completing the Centers for Disease Control and Prevention's (CDC) Heads Up: Concussion in Youth Sports program.

**Table 5**
*Access to Professional Medical Personnel at Practices and Games (Certified Athletic Trainer, Physician, etc.)*

| Access | Total responses |
|---|---|
| At practice? | |
| Yes | 58.5% (31) |
| No | 41.5% (22) |
| At games? | |
| Yes | 79.2% (42) |
| No | 20.8% (11) |

The understanding and science of brain injury is still growing and subject to clinical judgment (McCrory et al., 2013), and concussions remain a common injury in high school athletes (Grady, 2010). In addition to loss of playing time, the inability to concentrate or focus on tasks may affect the student athletes' academics, social existence, and home life. In this study, a staggering 86% of respondents did not know or believe that younger athletes took longer to recover from a head injury. That is tragic. Of coaches in this study,

62.3% did not believe that the emphasis on concussions was overly sensationalized, but 17% did. Coaches must understand that regardless of high school athletes' age or size, their central nervous systems are still developing and take longer to recover from a concussion than does an adult's (Gessel et al., 2007; Grady, 2010; McCrory et al., 2013). Young athletes who return too early to practice or play are more at risk of yet another concussion that often causes more severe and longer lasting impairments (Yard & Comstock, 2009).

Historically, LOC was a prerequisite for diagnosis of concussions, but in 1999 the CDC determined that it was reported in less than 10% of diagnosed concussions (Grady, 2010). Many grading scales are still focused on LOC or PTA, but those symptoms occur only in 4%–6% of concussions (Gessel et al., 2007). Therefore, LOC and PTA are not valid predictors of the severity of injury or the time required to return to play (McCrory et al., 2013). Obviously, LOC is serious, but it is not required for the diagnosis of a concussion.

In addition, coaches should also be aware that if athletes lose consciousness, they should be treated as if a cervical spine injury is suspected (Bailes, Petschauer, Guskiewicz, & Marano, 2007; Grady, 2010; McCrory et al., 2013; Oliaro et al., 2001). In that case, the athlete should be put on a spine board and sent to the hospital for further evaluation (Bailes et al., 2007). Additionally, equipment (helmets, shoulder pads, etc.) should not be removed in these cases because this could cause further spinal damage (Bailes et al., 2007; Grady, 2010; Swartz et al., 2009).

When a concussion is suspected, an athlete should not be allowed to return to play the same day as the injury (Grady, 2010). In the state where this study was completed, young athletes showing any signs or symptoms of a head injury are to be removed from participation and are not to return until a *licensed health care professional* gives *written* clearance to return to play according to the Dylan Steigers Protection of Youth Athletes Act (2013). This act makes it *illegal* for coaches, athletic trainers, and officials to allow an athlete to return to organized sport activities after a suspected head injury without the approval of a licensed health care professional regardless of resolution of symptoms or pressure from parents and guardians. Even with this enactment, 5.7% of the coaches *did not know* that a player should not be allowed to return the same day as the injury and

7.6% of the respondents *did not agree* that *only* a licensed physician could legally authorize a player to return to play.

All coaches should also understand and follow current return-to-play guidelines. The CDC and the National Federation of High Schools list the five steps for return to play for athletes returning from a concussion:

**Progressive activity recommendations:** Athletes should only progress to the next level of exertion if they are NOT experiencing ANY symptoms at the current level.

- Step 1: Light exercise—5 to 10 min exercise bike or walking; NO weight lifting
- Step 2: Moderate running in gym or field without equipment; limited head movement
- Step 3: Noncontact training drills in full equipment—begin light weight training
- Step 4: Full contact practice in training
- Step 5: Return to game/practice

A PLAYER SHOULD DISCONTINUE IMMEDIATELY AND GET REEVALUATED BY A CERTIFIED HEALTH CARE PROFESSIONAL **IF SIGNS OR SYMPTOMS RETURN.**

Suspected head injuries not only include concussions, but also may be accompanied by skull fractures, subdural hematoma, and cervical injuries. Some head injuries cause rapid deterioration in health, and others may take hours or days to manifest complications (Yard & Comstock, 2009). If not recognized immediately, these injuries may be fatal. One reason for immediately evaluating an athlete with a possible head injury is not only to check for a concussion, but also to rule out additional serious injuries.

Parents usually have their child's best interests in mind, but many times do not understand the effects of certain injuries. Therefore, it is important for the coach to be educated in the area of injury prevention and management and to engage in proactive parent and player education programs. The overall safety of adolescent and preadolescent participants should be a priority, especially in regard to their developing central nervous systems.

The number of coaches who failed to respond from athletic programs in smaller communities is an additional concern. The majority (80%) of high schools in this rural state have 369 students or less. Yet only six coaches (11%) from those schools responded to the survey. In addition, the National Federation of High Schools has documented turnover nationally of high school coaches at about 25%, but in this state, the annual coach turnover is approximately 40%, with less than half of coaches being certified teachers in the schools. These two variables contribute significantly to the continued need for annual, ongoing coach education.

In all athletics involving young players, parents entrust their children to coaches assuming they will provide a safe and fun environment. If coaches fail to recognize concussions, are not certified in first aid, or endanger players by allowing them to return to play too early, they put their athletes at risk of serious injury. Because many schools in rural areas do not have access to proper medical help, it falls on the coaches to know the health history of their athletes and how to recognize and manage injuries. Thirteen percent of the coaches surveyed did not believe it was their responsibility to educate their players on concussions and almost 10% admitted they did not screen their players' medical histories for evidence of prior concussions or injuries. Finally, it is well documented that all coaches should be certified in first aid to deal with any injury, but 15% of the respondents were not.

Although limited by the number of participants, this study emphasizes the importance of continued coach education and proper training in medical concerns. Further studies should be focused on schools in rural areas with smaller student populations, in an attempt to evaluate their needs. Because of the low number of responses from these schools, our findings were limited to athletic programs that were more likely to employ an athletic trainer or to have proper medical support available during practices and games. It can be assumed that if more coaches from the smaller programs had responded, even greater needs would have been identified. Concussions are serious with many unseen implications. The education of coaches, parents, and players needs continued emphasis to protect young athletes, coaches, and programs everywhere.

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