

Unreported Concussion in High School Football Players

Implications for Prevention

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Objective: To investigate the frequency of unreported concussion and estimate more accurately the overall rate of concussion in high school football players.

Design: Retrospective, confidential survey completed by all subjects at the end of the football season.

Setting and Participants: A total of 1,532 varsity football players from 20 high schools in the Milwaukee, Wisconsin, area were surveyed.

Main Outcome Measurements: The structured survey assessed (1) number of concussions before the current season, (2) number of concussions sustained during the current season, (3) whether concussion during the current season was reported, (4) to whom concussion was reported, and (5) reasons for not reporting concussion.

Results: Of respondents, 29.9% reported a previous history of concussion, and 15.3% reported sustaining a concussion during the current football season; of those, 47.3% reported their injury. Concussions were reported most frequently to a certified athletic trainer (76.7% of reported injuries). The most common reasons for concussion not being reported included a player not thinking the injury was serious enough to warrant medical attention (66.4% of unreported injuries), motivation not to be withheld from competition (41.0%), and lack of awareness of probable concussion (36.1%).

Conclusions: These findings reflect a higher prevalence of concussion in high school football players than previously reported in the literature. The ultimate concern associated with unreported concussion is an athlete's increased risk of cumulative or catastrophic effects from recurrent injury. Future prevention initiatives should focus on education to improve athlete awareness of the signs of concussion and potential risks of unreported injury.

Key Words: brain concussion, head injury, athletic injuries.

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Sports-related concussion is now recognized as a major public health concern¹ and has become the focus of increasing interest from clinicians and researchers in sports medicine.² The retirement of several high-profile professional athletes due to recurrent cerebral concussion has created an increased awareness of the dangers and potentially long-term sequelae associated with concussion. The volume of athletes participating in organized sports at the high school level creates an even greater concern about the potential effects of concussion in young sports participants.

The Centers for Disease Control and Prevention estimate that approximately 300,000 sports-related concussions occur annually in the United States.¹ The high incidence of cerebral concussion in contact sports is well documented, but has been studied most extensively in organized football.³ Concussion incidence rates in high school football were estimated to be 20%⁴ in the 1980s, but more recent studies have reported incident rates of 3-6%.^{3,5-7} There is a general consensus among sports medicine professionals, however, that the rate of concussion in contact and collision sports is higher than the incidence of recorded injuries.

The diagnosis of sports-related concussion is perhaps the most elusive challenge facing sports medicine clinicians. There is no biologic marker for the detection of concussion or any diagnostic tests with perfect sensitivity and specificity. The detection and diagnosis of concussion on the sports sideline are complicated further by a player's tendency to under-report or mask symptoms in anticipation of a more rapid return

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to play. The potential consequences of returning to contact or collision sports while still symptomatic from an initial concussion can be catastrophic,⁸⁻¹⁰ which amplifies concern about the risks associated with a player's continued participation after an unreported concussion. Some authors have raised concerns, however, that athletes themselves may not be sufficiently aware of the signs, symptoms, and potential effects of concussion.^{11,12} Studies have reported on the link between a lack of knowledge about the potential consequences from head injury, failure to recognize concussion signs and symptoms, and the likelihood that athletes continue sports participation while experiencing head injury symptoms, especially among football players.¹³

The current study was designed to investigate the frequency of unreported concussion among high school football players to estimate more accurately the overall prevalence of concussion in high school football players. In addition, reasons that players did not report concussive events were surveyed to formulate better recommendations for injury prevention strategies. The main objectives of prevention initiatives are to increase a player's likelihood of reporting a concussion and to reduce the risks of recurrent or catastrophic injury associated with unreported head injury.

MATERIALS AND METHODS

A total of 1,532 varsity football players from 20 high schools in the Milwaukee, Wisconsin, area were surveyed as part of their enrollment in a larger study investigating the acute effects and recovery following sports-related concussion. All players completed a questionnaire on history and frequency of previous concussion at the time of their initial enrollment in the study.

Players were then administered a confidential questionnaire at the end of the football season (Appendix A). Specifically, players were asked to report on the number of concussions sustained before the current football season. Players also were asked whether they had sustained a concussion as part of participation during the current football season. Players were provided the following definition and description to determine whether they had sustained a concussion: A concussion is a blow to the head followed by a variety of symptoms that may include any of the following: headache, dizziness, loss of balance, blurred vision, "seeing stars," feeling in a fog or slowed down, memory problems, poor concentration, nausea, or throwing up. Getting "knocked out" or being unconscious does not always occur with a concussion.^{14,15} The questionnaire and definition of concussion were not based on any specific injury classification system or concussion grading scale, but were intended to provide respondents with a representative description of concussion signs and symptoms.

Players were asked whether they had reported their injury and to whom it was reported. The following options were provided, and players were informed that they should identify

all individuals to whom they reported their concussion: athletic trainer, coach, parent, teammate, or other party. The reasons why a player did not report a concussion also were surveyed. Players could select one or more reasons for not reporting their concussion from the following: didn't think it was serious enough, didn't know it was a concussion, didn't want to be pulled out of the game or practice, didn't want to let down teammates, or other reason. A total of 92.3% (n = 1,532) of all players enrolled (n = 1,659) during the preseason baseline testing responded to the postseason questionnaire. This study was approved by the institutional review board for the protection of human research subjects at the host institutions of the investigators.

Descriptive statistics were calculated to determine the rates of reported and unreported concussion and frequency distributions for other variables. κ values were calculated from cross-tabulations to determine respondent agreement on preseason and postseason surveys regarding reported concussion history. χ^2 analyses were conducted to investigate factors associated with the likelihood of a player reporting a concussive injury during the current season.

RESULTS

Overall, 30.4% and 29.9% of respondents reported a previous history of concussion on the preseason and postseason survey, respectively. Preseason and postseason survey data on concussion history were highly reliable (92.1% respondent agreement; $\kappa = 0.821$, $P < 0.0001$). Of respondents who reported a previous history of concussion, the frequency distributions for the number of previous concussions reported on the preseason and postseason surveys are illustrated in Figure 1.

A total of 229 players (15.3% of respondents) reported that they sustained a concussion, as defined by the postseason

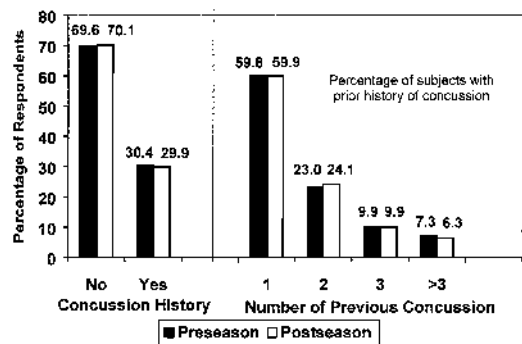


FIGURE 1. Reported history and frequency of previous concussions on preseason and postseason survey. *Notes:* Preseason survey n = 1,659; postseason survey n = 1,532 (92.3% response rate). Figures for number of previous concussion are based only on subjects who reported a history of concussion (preseason n = 505; postseason n = 458). There was 92.1% respondent agreement in reported history of concussion on preseason and postseason surveys ($\kappa = 0.814$; $P < 0.0001$).

survey, during the current football season. Of the respondents who reported sustaining a concussion during the football season, only 47.3% reported the event. Injured players who reported their concussion most commonly did so to a certified athletic trainer providing clinical coverage to the varsity football team at their school. Injuries were reported less frequently to coaching staff, parents, teammates, or other parties. The frequency distribution for injury reporting is provided in Table 1.

The most common reason for a concussion not being reported was that the injured player did not think it was serious enough to warrant medical attention. A player's motivation not to be withheld from participation and a lack of knowledge regarding the signs of concussion were common, but less frequent, factors contributing to a player not reporting an injury. The frequency distribution for reasons why concussions were not reported is provided in Table 2. There was no significant relationship between a player's prior history of concussion ($\chi^2 = 0.10$; $P = 0.43$) or number of previous concussions ($\chi^2 = 10.03$; $P = 0.19$) and the likelihood of reporting a concussive injury during the current football season.

DISCUSSION

Concussion at all levels of competitive football is considered by sports medicine professionals and players alike as a relatively common occurrence. More recent studies have suggested a significant decline in the rate of reported concussions relative to studies reported in the 1980s,^{3,4,7} but most agree that published studies likely underestimate the overall rate of concussion for athletes participating in contact or collision sports. Results from the current study examining reported and unreported concussion reflect a higher prevalence of concussion among high school football players than that reported in prospective studies that focused on assessment of reported injuries only.^{5,16} Taking into consideration the frequency of unreported concussions, the current study suggests that closer to 15% of high school football players sustain a concussion each season.

TABLE 1. Concussion Reporting Data*

Concussion Reported to:	Percentage of Subjects
Certified athletic trainer	76.7
Coach	38.8
Parent	35.9
Teammate	27.2
Other (eg, family physician, student)	11.7

*Categories are not mutually exclusive; subjects were asked to check all that apply.

TABLE 2. Reasons Why Concussions not Reported*

Why Concussion not Reported	Percentage of Subjects
Did not think it was serious enough	66.4
Did not want to leave the game	41.0
Did not know it was a concussion	36.1
Did not want to let down teammates	22.1
Other reasons	9.8

*Categories are not mutually exclusive; subjects were asked to check all that apply.

Players who fail to report a probable concussion while participating in contact or collision sports expose themselves to a heightened risk for cumulative or more serious effects associated with a second injury if they continue to participate while still symptomatic following their initial concussion. The ultimate concern in this regard is the potential for catastrophic events associated with sports-related concussion, such as "second impact syndrome."⁸⁻¹⁰ Second impact syndrome occurs when an athlete sustains a second concussion while still symptomatic from an earlier head injury. A rapid course of neurologic deterioration is observed, typically without opportunity for medical intervention to reverse the complications, culminating in death or severe disability. Most instances of documented second impact syndrome stem from either a player not reporting an initial concussion or a reported injury being improperly assessed and managed. An athlete's awareness of signs of injury and willingness to provide a valid symptom report are crucial to the sports medicine professional's ability to diagnose and manage sports concussion.¹³

Our results indicating that high school football players often do not report a probable concussion because they do not think it is sufficiently serious was unexpected based on historical stereotypes. It has long been thought that football players were reluctant to report a concussion based solely on competitive factors—their motivation not to be withheld from competition. The current survey results suggest, however, that lack of knowledge related to the risks and potential consequences of concussion play an equal or greater role in high school football players not reporting a probable concussion. The most common reason for an injury not being reported was that the player did not think the injury was serious enough to warrant medical attention. More than one third of players who failed to report their injury did not recognize that they had sustained a probable concussion based on their symptoms. When provided with a definition of concussion and a description of injury signs and symptoms, these players more readily recognized and admitted to sustaining a concussion over the course of the football season.

These findings indicate the need for educational initiatives to inform young athletes of the effects and potential consequences of concussion, which likely would have implications for preventing negative outcomes associated with sports concussion, including second impact syndrome.⁸⁻¹⁰ Preparation meetings could be offered to educate athletes, parents, coaches, and others affiliated with athletic programs on the signs and symptoms of concussion and to dispel many of the myths about head injury (eg, that one must be rendered unconscious to have sustained a concussion). Multimedia (eg, instructional videos, interactive classroom presentations, Web-based programs) approaches also could be used to disseminate information on concussion management. Ultimately the efficacy of educational programs in reducing the rate of recurrent concussion and negative clinical outcomes should be evaluated in controlled studies.

These survey results indicate that certified athletic trainers are the professionals most frequently called on to evaluate and manage concussion in high school football players. These injuries rarely were reported directly to a team or family physician. Even parents were less likely than the certified athletic trainer to learn of the player's concussion. These data support the need for a systematic plan for injury reporting and management that incorporates trained sports medicine professionals. Advances in the education and training of physicians, certified athletic trainers, and other sports medicine professionals are critical to improve the standard of care in concussion assessment and management.

Our results are limited by many factors inherent to survey research. We assumed a valid response from players based on their retrospective recount of concussive injuries during a period of approximately 3 months before the survey administration. The consistency in previous concussion history and frequency demonstrated on preseason and postseason surveys supports the reliability and accuracy of player self-reports. Their recollection of why an injury was not reported also may be altered from the actual experience of injury during a sporting event. The definition of concussion implemented in this study was meant to be descriptive to the athlete, while addressing the main signs and symptoms addressed by various systems for classifying severity of sports concussion.^{14,17-19} Recent definitions are more inclusive in terms of mechanisms that potentially can cause concussion and the scope of signs and symptoms.²⁰ It is unclear how our results may have been affected if a different description and definition of concussion were offered to respondents. Despite these limitations, our findings raise significant concerns about the actual prevalence of concussion in high school football players and the propensity on the part of athletes not to report a probable concussion. Obtaining prospective data on unreported injuries, whether concussion or other forms of injury, is often difficult to accomplish. We intend to compare self-report survey results with more objective injury surveillance data as part of other ongoing

sports concussion studies to determine better the gap between identified and unidentified concussion in competitive sports.

SUMMARY

These findings support the suspicion by sports medicine professionals that the prevalence of concussion in high school football is higher than that documented in the literature. Players seem to be largely unaware of common signs and symptoms indicating concussion and the potential seriousness of continued participation in contact or collision sports after an initial concussion. Future prevention initiatives should focus on education to increase athlete awareness of concussion and its risks and promotion of open lines of injury report.

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Appendix A. Questionnaire

Varsity Football Players: Please fill in the following information. Your answers are completely private. Please print clearly.

Name: _____	School: _____
Age: _____	Year in School: _____

USE THE FOLLOWING DEFINITION OF CONCUSSION TO ANSWER THE QUESTIONS BELOW

- **Definition of Concussion:** *A concussion is a blow to the head followed by a variety of symptoms that may include any of the following: headache, dizziness, loss of balance, blurred vision, “seeing stars,” feeling in a fog or slowed down, memory problems, poor concentration, nausea, or throwing-up. Getting “knocked out” or being unconscious does NOT always occur with a concussion.*

1. Did you ever have a concussion before this football season?

_____ Yes → How many concussions before this football season? _____
 _____ No

2. How many times total before this football season were you “knocked out” or unconscious from a concussion? _____

NOW TELL US ABOUT THIS FOOTBALL SEASON:

1. Did you have any concussions playing football this season? (Check “Yes” if you think you might have had a concussion -- even if you did not tell anyone)

_____ Yes → How many concussions do you think you had this football season? _____
 (go to #2)
 _____ No (If No, stop here; You are done with questionnaire)

2. Did you report your concussion to anyone?

_____ Yes (go to #2a below)
 _____ No (go to #3 below)

2a. To whom did you report your concussion? (check all that apply):

_____ Athletic Trainer _____ Coach _____ Parent _____ Teammate
 _____ Other (who?) _____

3. If you did not report your concussion to anyone, why not? (check all that apply)

_____ Didn’t think it was serious enough _____ Didn’t know it was a concussion
 _____ Didn’t want to be pulled out of the game or practice _____ Didn’t want to let down teammates
 _____ Other (why?): _____