Incidence of Concussion in High School Football Players of Ohio and Pennsylvania

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ABSTRACT

Football injuries account for more concussions than any other sport in North America. A 1977 survey of high school football players in Minnesota found that 19% of players reported at least one concussion (characterized by loss of awareness) during a season. These results have not been confirmed in subsequent studies. This study sought to estimate the incidence of concussion among high school football players in our region, establish the frequency of the most common symptoms, and determine the duration of subsequent restriction from participation in the sport. The athletic boards of area high schools distributed a three-page survey to 450 high school football players. Of the 450 surveys distributed, 234 (52%) were returned, only 1 of which was excluded because of contradictory information. The incidence of concussion in football players was 47.2% (110/233, \( P < .001 \) versus a previously determined rate of 19%). Eighty-one of 233 players (34.9%) had multiple concussions. A total of 376 concussions were reported. The distribution of severity of the 376 reported concussive events was grade I, 87.8%; grade II, 9.9%; and grade III, 2.4%. Only 12 athletes were required to stop play for one or more games. The incidence of high school football players sustaining a concussion is much higher than previously established. The majority of these are mild (grade I) concussions. Further research is needed since multiple low-grade concussions may incur cumulative neuropsychologic impairments. (J Child Neurol 2001;16:83–85).

Concussions are a frequent occurrence, representing greater than 75% of all head injuries.\(^1\) The accurate frequency of concussion is not known because most people do not seek medical care for the milder variety of this common head injury. Because head injuries associated with sporting events are usually witnessed, they are most accurately quantified when they occur in that setting.

Concussions are more common in football than in any other North American sport.\(^2\) In a survey of 3063 high school football players in one season, 19% of players reported at least one concussion characterized by loss of consciousness or loss of awareness.\(^3\) Analysis of the National Athletic Injury/Illness Reporting System data,\(^4,5\) which followed players of 49 college teams over an 8-year span, found an incidence of 5.3 cases per 100 players per year.\(^6\) Subsequent studies confirming these data have not been done.

Pediatric neurologists often evaluate athletes who have sustained concussion. The purpose of this study was to estimate the incidence of concussion in high school football players in our region. We also set out to establish the frequency of the most common symptoms and duration of subsequent restriction from participation in the sport.

METHODS

Immediately following the end of the 1996–97 football season, a questionnaire-based study was performed. Two large school districts agreed to participate in the study. The superintendent of one western Pennsylvania school district and the athletic director of the Cuyahoga County school district distributed surveys to athletes. A stamped, return envelope was provided with each survey.

The first page of the survey briefly described the purpose of the study and emphasized anonymity. Personal information requested included age, weight, position played, a brief medical history, and frequency of practices and games. The second page included verbatim definitions of mild, moderate, and severe head injury, corresponding to concussion grades I, II, and III of the Cantu guidelines.\(^7\) The Cantu guideline was selected because the

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Received May 18, 1999. Received revised March 15, 2000. Accepted for publication March 24, 2000.

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criteria are stated in a clear and practical manner. The term “concussion” was omitted because of the common misconception that loss of consciousness is a mandatory component. Athletes were requested to record and grade all head injuries sustained in the 1996–97 season and note the extent of medical care received for the injuries.

The third page inquired about the presence and duration of symptoms that occurred after a head injury. Common symptoms listed were headache, dizziness, diplopia, difficulty with speech or concentration, and memory impairment. Athletes were questioned on the duration (if any) of being unable to participate or restricted from participating in football because of the head injury. There was space for impromptu responses.

Data were tallied by one author (WL) and analyzed by an epidemiologist (JL). If a range of values was reported, the mean value was calculated (e.g., 1–2 head injuries were calculated as 1.5). If the terms “few” or “many” were used, they were replaced with 2 or 3, respectively.

Before the survey was conducted, we discussed the need for an informed consent with our Institutional Review Board. Our concern was that proper consent would require parental involvement and destroy any attempt at confidentiality. Any perception by the athletes or their coaches that the survey was not completely anonymous could invalidate the results. Because the nature of the study required anonymity and because the study was being conducted as a retrospective anonymous survey, the informed consent requirement was waved.

RESULT

A total of 450 surveys were distributed, and 234 replies were received (52%). One survey was excluded as it had contradictory information. Of 233 athletes, 110 (47.2%) reported having experienced at least one concussion (P < .001 versus previously established rate of concussion of 19%). Multiple concussions were noted in 81 of 233 (34.9%) players.

Multiple concussions were common. Eighty-one of 110 athletes (73.6%) who reported concussion had reported multiple concussions. Therefore, for those athletes who did suffer at least one concussion, the mean number of concussions was 3.41, and the projected overall rate of concussion was 161 cases per 100 athletes per year. Using the Cantu guidelines, 7 87.8% of all concussions were classified as grade I, 9.9% as grade II, and 2.4% as grade III. The odds ratio for repeated concussion (of any type) was 2.79.

Individual symptoms after head injury were varied. Dizziness was the most common symptom, experienced by 43% of players, including 16 of 123 who had not reported a concussion. The dizziness was usually brief (minutes or less) but lasted days in 3 of the players. Headache was the second most common symptom, reported by 25.3% (59/233) of all athletes.

Diplopia was noted by 54 of the 233 (23.8%) players surveyed. Duration of diplopia was less than a few minutes in all. Thirty-nine of the 233 (16.7%) experienced difficulty with concentration. Amnesia (or loss of memory) occurred in 10.7% (25/233) of players. The amnesia was brief in all but two, who noted that symptoms persisted for hours to days. Speech problems were experienced by 15 (16.7%) and persisted after the game in only 2.

The majority of athletes, 75 of the 110 (68%), with concussion did not stop playing. Only 12 of 110 (10.9%) athletes stopped play for greater than one practice or game. If the Cantu guidelines had been rigorously observed, almost 50% of players with concussions would have had their season terminated.

DISCUSSION AND CONCLUSIONS

The incidence of concussion in this study of high school football players was 47.2 of 100, significantly higher than the previous figure of 19% established by Gerberich et al. 3 The case rate was 161 cases per 100 athletes per year, almost 30 times the rate established by the National Athletic Injury/Illness Reporting System data. 6

The discrepancy between these results and the outcome in other studies may be explained by several factors. We adhered to the Cantu guidelines 7 for the definitions of the grades of concussion, whereas the Gerberich et al study used the definitions given by the Committee on Head Injury Nomenclature of the Congress of Neurologic Surgeons. 8 Although the criteria are similar for higher grades of concussion, parameters for a grade I concussion were defined differently. The Congress of Neurologic Surgeons committee defines a grade I concussion as “no loss of consciousness, but there is a loss of awareness-short term memory loss that can occur as long as 10 to 15 minutes following a blow and/or loss of intermediate and old memories.” Therefore, an athlete experiencing momentary dizziness or confusion would be classified as a grade I concussion in our study but not necessarily by the Minnesota survey. Gerberich et al acknowledged that their statistics were “conservative” and that they likely underestimated the frequency of low-grade concussions. 5

Each study reporting sports injuries has used different methods of collecting data and criteria for injury. The National Athletic Injury/Illness Reporting System study relied on medical support staff to diagnose concussion, with the vague definition of immediate impairment of neural function. 4–6 The concussion was reportable only if it necessitated that the athlete stops play. It is our observation that athletes and their coaches often do not recognize brief confusion or dizziness as a concussion. They are reluctant to stop playing even if they are injured, adhering to the unacceptable creed of “playing hurt.” Therefore, most low-grade concussions, which involve mild subjective symptoms, would not be accounted for in the National Athletic Injury/Illness Reporting System study.

We designed our study with the intention of omitting the term “concussion” in preference for the term “head injury.” There is a misconception that concussion necessarily includes a period of loss of consciousness. Our method of data collection ensured a higher likelihood to accurately identify grade I concussions with a retrospective questionnaire.
Our questionnaire was anonymous because athletes may underestimate the extent of their injuries if they believed that parents or coaches would gain access to the information. Designing a brief survey specific to the topic of head injuries ensured more accurate responses.

Despite the different outcomes of absolute numbers of concussions, similar trends were found in the Minnesota study and our own. The majority of concussions were low grade. Most players did not stop play, even for brief periods of time (69% in the Minnesota study versus 68% in our own). Players with a history of previous concussion had an increased risk of subsequent head injury (4 in the Minnesota study versus 2.79 in the current study).

Our study was not designed to quantify neuropsychologic outcome of mild concussion in high school football players. However, the survey results did indicate that athletes did have subjective complaints, albeit short lived, which were indicative of post-traumatic neuropsychologic syndrome. Prior studies in both the pediatric literature and the adult literature have examined the effects of mild head trauma. They generally agree that “a single uncomplicated mild head injury produces no permanent disabling neurobehavioral impairment in the great majority of patients, who are free of preexisting neuropsychiatric disorder and substance abuse.”

The neuropsychologic effects of repeated concussions may be cumulative. Amateur soccer players in the Netherlands and American college football players who experienced multiple head traumas had significantly lower scores of neuropsychologic testing when compared to their baseline functioning.

In conclusion, the incidence of concussions in high school football players of Ohio and Pennsylvania is much higher than suggested by previously established reports. The difference may be due to different methodology, created by inclusion of lower-grade concussions. Post-traumatic symptoms, particularly dizziness, headache, and diplopia, are common even with mild head injury but usually short lived (seconds to hours). Prior studies have proven that a single, uncomplicated mild concussion portends little long-term neuropsychologic impairment. However, the effects of multiple, repeated, low-grade head injuries can be cumulative. Further research is needed as high school athletes may be at significant risk for sustained neuropsychologic deficits.

References