[Athletic Training]

Gender Differences in Concussion Reporting Among High School Athletes

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Background: An athlete's lack of concussion knowledge could lead to significant underreporting and injury mismanagement. To provide more effective management strategies of concussions in adolescent athletes, further examination of reporting behaviors is of critical importance.

Hypothesis: The hypotheses for this study were as follows: (1) Girls are more likely to report concussion, (2) girls are more likely to report future concussions after an educational intervention, and (3) a difference in rationale for not reporting concussion will be found between sexes.

Study Design: Cross-sectional, cohort design.

Level of Evidence: Level 3.

Methods: Survey answers were collected on 454 high school athletes (212 girls, 242 boys; mean age, 15.7 ± 1.15 years). Individual team meetings lasting approximately 30 minutes were held to collect data and provide an educational lecture. Participants were randomly provided an iClicker to submit a response to questions asked.

Results: Girls were more likely to report a concussion ($\chi^2 = 8.32$, $df = 3$, N = 454, $P = 0.040$) and more likely to report future concussions after educational intervention ($\chi^2 = 8.54$, $df = 2$, N = 454, $P = 0.014$). There were no differences between sexes regarding rationale for not reporting a concussion ($\chi^2 = 6.42$, $df = 4$, N = 454, $P = 0.170$).

Conclusion: There is concern these athletes still fail to understand the severity and potential sequelae of concussion injury. Both sexes cited that concussion is not a serious enough injury to warrant reporting to a medical professional.

Clinical Relevance: High school athletes recover more slowly from concussions compared with college athletes; therefore, educating this population and promoting the importance of being knowledgeable regarding concussion recognition may increase reporting prevalence.

Keywords: concussion; reporting; sex; high school

Concussions and associated complications continue to garner the attention of the media, athletes, coaches, parents, and health care professionals. To recognize concussion, athletic trainers and other medical personnel often rely on athletes to self-report. As we continue to encourage the shift in mindset regarding concussion in the context of severity, from an inconsequential "getting your bell rung" to a serious threat to an athlete's overall health and well-being, it is critical that medical personnel understand the driving forces for reporting concussion. Furthermore, understanding potential sex differences in reporting patterns is of equal importance to ensure the development of more effective concussion management strategies.

In the context of reporting behaviors, current research suggests there is significant underreporting of concussion among adolescent athletes, especially boys.[9,10,16,18] Additionally, athletes report a greater number of concussion symptoms on a computer-based test when compared with verbal or written methods, suggesting that athletes are lying about the severity of their concussion injury.[5] These reporting behaviors cause concern among medical personnel as adolescents have a protracted recovery rate when compared with an adult brain

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The authors report no potential conflicts of interest in the development and publication of this article.
DOI: 10.1177/1941738116651856

after concussion[6] and are at greater risk for poorer outcomes.[1,3,6,8]

Knowledge and attitude toward concussion are associated with reporting behaviors in adolescent athletes, where improved knowledge of concussion injuries exhibited improved concussion reporting practices.[13] Therefore, further investigation of potential sex differences in concussion reporting practices may necessitate customized educational intervention approaches.

The aim of this study was to determine sex differences in the reporting of concussions, specifically: (1) who is more likely to report concussion, (2) who is more likely to report future concussions after an educational intervention, and (3) whether there is a different rationale for not reporting concussion injury.

METHODS

Participants

The university's institutional review board, the high school district, and the high school district's traumatic brain injury team approved this study. Data were collected on 454 high school athletes (212 girls, 242 boys; mean age, 15.7 ± 1.15 years) from 1 school district. Data from multiseason athletes were only included from their first session. Data were collected on 10 different sports, including football, cheerleading, boys'/girls' soccer, boys'/girls' basketball, wrestling, volleyball, and boys'/girls' lacrosse.

Parental/guardian consent was obtained for minor athletes, and all participants signed an approved informed consent form prior to data collection.

Procedures and Data Collection

Individual team meetings were scheduled with the high school coaching staff, and investigators traveled to the different schools to collect data and provide an educational lecture. Meetings were held in either classrooms or team rooms at each high school.

Participants were randomly provided an iClicker (AV-iQ) for data collection purposes. The iClickers were not specifically assigned to students to ensure anonymity. The iClickers allowed students to submit a response (A, B, C, D, or E) to questions asked. All responses were totaled and collected in the primary investigator's computer.

Customized survey questions were asked to obtain the background information and previous medical history (PMH) and to gain insight regarding the athletes' personal perceptions and knowledge of concussion. After the questions regarding concussion perception, a brief educational summary of the specific aspects of concussion was provided. Construct validity was determined by providing the survey to 2 different groups for comparison analysis: a group of college students with no formalized education in concussion injuries and a group of senior-level athletic training students with formalized concussion education and training. The survey scores were compared between the 2 groups using a *t* test, and the senior-level athletic training students had a significantly greater mean rank, $t(19) = 5.0$, $P = 0.000$, $d = 0.88$.

The reliability of the instrument was assessed using a test-retest Pearson coefficient (r). A group of 15 college students participating in an introductory human movement science course were asked to complete the survey and were asked to take the same survey 12 days later. The educational lecture was not given to this population; however, students did score slightly higher on the retest (7.1) compared with the original test (6.9); there was still a high correlation between testing dates ($r = 0.656$).

Educational Lecture

A PowerPoint presentation (Windows) was used to deliver the educational lecture and the same information was provided to all teams (see PowerPoint presentation online, available at http://sph.sagepub.com/content/by/supplemental-data). Each educational session lasted approximately 25 minutes. Information for the educational lecture was derived from current research and position/consensus statements. The questions for data collection purposes were directly embedded into the PowerPoint lecture, allowing for better audience engagement. All sessions began with collection of background information from participants. After baseline questions, participants were asked their personal perceptions/knowledge regarding specific areas of concussion. After specific questions, basic information regarding the specific topic area of concussion was given. For example, after participants answered the question, "Do you believe concussions would have an impact on your learning/education," we provided basic information on how concussions may impact their academic performance. Topic areas included in the educational lecture were: mechanism of injury, signs/symptoms, long-term side effects, impact on education/learning, baseline testing, and return-to-play (RTP) protocols. Questions used for data collection purposes were asked prior to the educational content, as the purpose of this study was not to assess the educational intervention.

Statistical Analysis

Data were analyzed using PASW, version 18. Chi-square statistics were used to analyze a majority of the variables collected. Statistical significance was established a priori as $\alpha \leq 0.05$.

RESULTS

Female and male participants were significantly different in the reporting of their concussion injury ($\chi^2 = 8.32$, $df = 3$, $N = 454$, $P = 0.040$). Boys were more likely to not report a concussion injury (Figure 1). Female and male participants were also significantly different regarding whether they would be more likely to report a concussion after the educational intervention ($\chi^2 = 8.54$, $df = 2$, $N = 454$, $P = 0.014$). Girls reported being more likely to report future concussion injuries after an educational lecture (Figure 2).

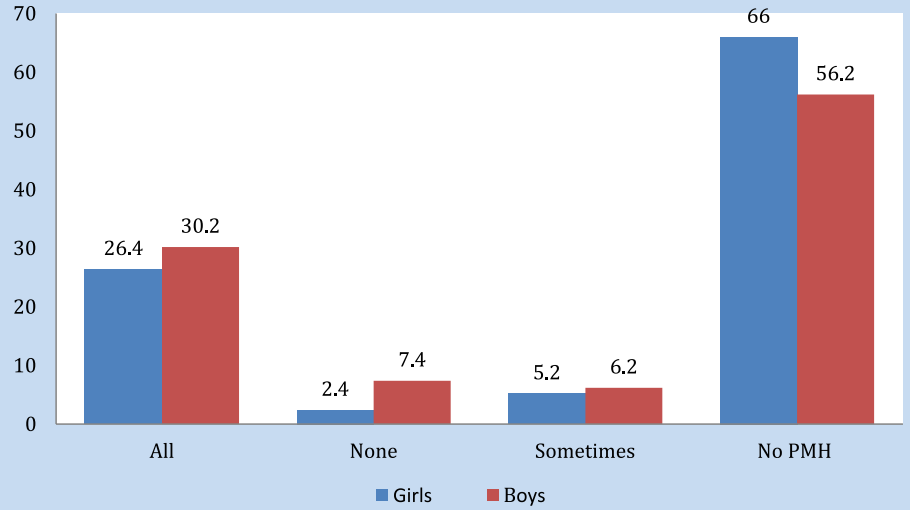

Figure 1. Percentage of girls and boys reporting concussion. PMH, previous medical history.

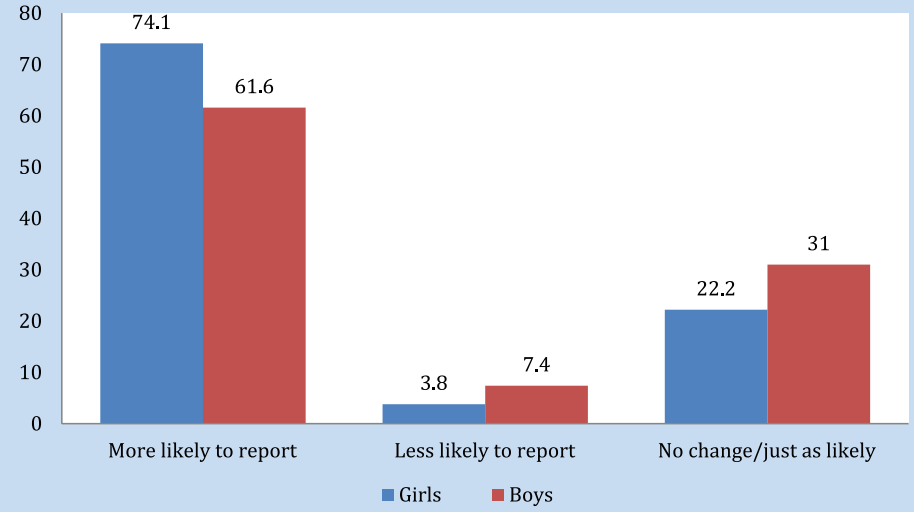

Figure 2. Percentage of girls and boys regarding their likelihood to report future concussion after the educational intervention.

Female and male participants were not significantly different regarding their rationale for not reporting a concussion (χ^2 = 6.42, *df* = 4, N = 454, *P* = 0.170) (Figure 3), their belief that the importance of a game/event should impact RTP decisions after a concussion (χ^2 = 2.78, *df* = 1, N = 454, *P* = 0.095), and whether they would falsify the severity of a concussion to RTP more quickly (χ^2 = 0.63, *df* = 1, N = 454, *P* = 0.429).

Female and male participants were not significantly different in the number of previous concussions they believe they sustained pre–educational intervention (χ^2 = 6.71, *df* = 4, N = 454, *P* = 0.152) or after educational intervention (PMH was reassessed after the educational intervention) (χ^2 = 6.312, *df* = 3, N = 454, *P* = 0.097).

While there was no difference between sexes and reported concussion history after the educational intervention, there was a difference within each population. Prior to the educational intervention, all participants were asked how many concussions they believed they had sustained in their life. After the educational intervention, the same question was asked. A paired-samples *t* test indicated that girls realized they sustained a greater number of concussions after educational intervention, *t*(211) = −9.49, *P* < 0.001, *d* = 0.65. The difference was statistically significant and considered typical using Cohen's 1988 guidelines. A paired-samples *t* test indicated that boys also realized they had sustained a greater number of concussions after educational intervention, *t*(241) = −7.59, *P* < 0.001, *d* = 0.49. The difference was statistically significant and considered typical using the same guidelines (Table 1).

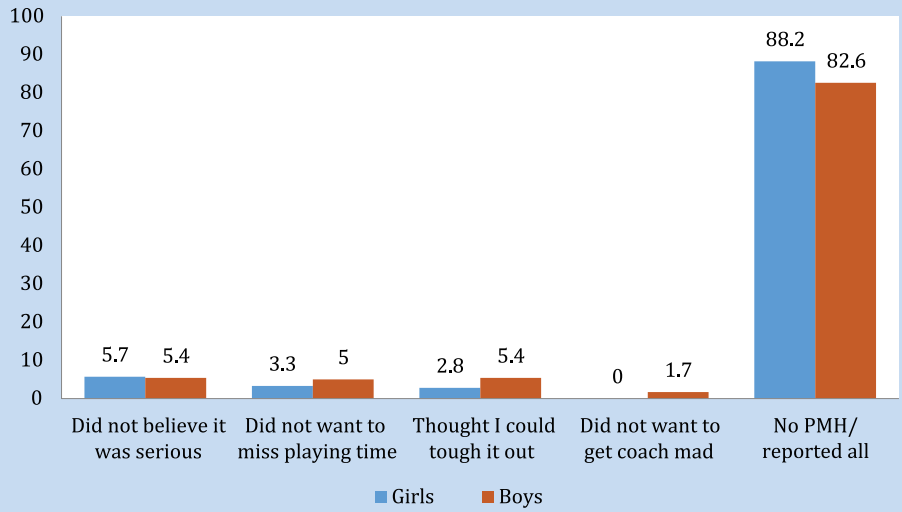

Figure 3. Percentage of girls and boys on their rationale for not reporting concussion. PMH, prior medical history.

Table 1. Percentage of PMH concussion injuries by sex before and after educational intervention

	0	1	2	3+
Female: Before	67	19.3	5.7	4.2
Female: After	36.8	28.8	22.6	11.8
Male: Before	57.9	27.3	6.6	2.5
Male: After	34.7	36.8	14.9	13.6

PMH, prior medical history.

DISCUSSION

There are several variables that can be attributed to high school athletes' reporting of a concussion injury. Girls were more likely to report possible concussions, and this coincides with previous reports,[9,10] posing serious concern.[11] Multiple concussions are associated with prolonged recovery times.[1,4] Younger brains are more vulnerable and are at risk for poorer outcomes when compared with an adult brain,[6] primarily because of the differences in the brain's physiology.[7,12]

The most common rationale expressed for not reporting a concussion was the belief the injury was not serious. Similar, previous results found 69% of participants continued to play while still experiencing symptoms from a concussion.[15] Additionally, high school football players often do not have appropriate knowledge of symptoms and the potential consequences associated with a concussive injury.[2]

Although nonsignificant, concerning results were seen when asked whether the importance of an event or game should dictate RTP decisions. Reporting was relatively equal, with 46.7% (n = 99) of girls and 54.5% (n = 132) of boys believing the game/event should dictate RTP procedures. These numbers are significantly greater than those reported in 2006[17] and suggest that high school athletes do not fully comprehend the serious nature of a concussion injury, leading to dramatic underreporting.[10,17]

While there were no differences between sexes pre- and postlecture regarding concussion history, both sexes reported sustaining more concussions after educational intervention. Expecting athletes to understand concussion is not appropriate; all clinicians should preface a request for concussion history with an explanation of concussion.[16]

Given the difference between sexes regarding reporting behaviors after educational intervention and the shared commonality in reporting rationale as well as RTP protocols, concussion education initiatives should continue to focus on improving attitudes and beliefs and promoting better care-seeking behaviors.[14]

Limitations

Only 1 school district participated in this study. Incorporating additional school districts would improve the generalizability of these results.

CONCLUSION

Understanding sex differences concerning perception of concussion can aid in recognition and treatment of concussion, especially in the high school athlete. Educating this population and promoting the importance of being knowledgeable regarding concussion recognition may increase reporting prevalence. Improving self-reported symptom presence and severity is important in protecting these individuals from returning to activity too soon and potentially sustaining a more severe secondary injury.

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