

[Primary Care]

Reported Concussion Rates for Three Division I Football Programs: An Evaluation of the New NCAA Concussion Policy

Kelly G. Kilcoyne, MD,*† Jonathan F. Dickens, MD,† Steven J. Svoboda, MD,‡ Brett D. Owens, MD,‡ Kenneth L. Cameron, PhD, MPH, ATC,‡ Robert T. Sullivan, MD,§ and John-Paul Rue, MD||

Background: There has been increased interest in the number of concussions occurring in college football over the past year. In April 2010, the National Collegiate Athletic Association (NCAA) published new guidelines for the diagnosis and treatment of concussions in student athletes.

Purpose: To determine the number of concussions that occurred on 3 collegiate Division I military academy football teams prior to and following recent changes in the NCAA concussion management policy.

Study Design: Descriptive epidemiology study.

Methods: Injury reports were reviewed from 3 Division I military academy football teams. The number of concussions that occurred over the 2009-2010 and 2010-2011 seasons, including those sustained in practice and game situations, was determined for each team. Incidence rates were compared using the exact binomial method.

Results: The combined concussion incidence rate doubled from 0.57 per 1000 athlete exposures in the 2009-2010 season to 1.16 per 1000 athlete exposures in the 2010-2011 season (incidence rate ratio, 2.04; 95% CI, 1.2-3.55; $P = 0.01$). The combined numbers of concussions for the 2009-2010 and 2010-2011 seasons were 23 (40,481 exposures) and 42 (36,228), respectively.

Conclusion: The combined incidence rate of concussions for the 2010-2011 season doubled from the previous season after the implementation of new NCAA policies on concussion management. While the institution of a more formalized concussion plan on the part of medical staff is one possible factor, another may have been the increased recognition and reporting on the part of players and coaches after the rule change.

Keywords: concussion; mild traumatic brain injury; incidence; NCAA

Concussions are common injuries in young athletes, but diagnosis and treatment remain a challenge.^{2,18} Controversy exists regarding the best method to detect concussions, the short- and long-term risks following multiple concussions, and the timing of return to play. Additionally, few studies provide long-term outcomes following concussions in young athletes. Increased public attention and research demonstrating the adverse effects of concussions has prompted new guidelines for concussion management protocols in collegiate athletics.^{4,6,10,11}

It is estimated that over 1.5 million sports concussions occur each year.¹³ This number is more than 4 times that of previous

estimates by the Centers for Disease Control and Prevention of 300,000, as it only included concussions associated with loss of consciousness.^{13,19} However, even these new numbers are likely an underestimation, as athletes, for various reasons, often underreport and minimize the importance of concussion.^{6,11} In certain instances, the athlete may not recognize the symptoms of concussion if it is mild and the symptoms subtle.¹⁴ In other instances, the athlete may not want to report symptoms for fear of missing current and future games.

On April 29, 2010, the National Collegiate Athletic Association (NCAA) released a new concussion management plan that provided a best practices model for concussion treatment.

From †Walter Reed National Military Medical Center, Bethesda, Maryland, ‡United States Military Academy, John A. Feagin, Jr. Sports Medicine Fellowship, Keller Army Hospital, West Point, New York, §United States Air Force Academy, Colorado Springs, Colorado, and ||United States Naval Academy, Annapolis, Maryland

*Address correspondence to Kelly G. Kilcoyne, MD, Walter Reed National Military Medical Center, 8901 Wisconsin Ave, Bethesda, MD 20889 (e-mail: Kelly.g.kilcoyne@us.army.mil).

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The new policy highlighted 3 important changes in the concussion surveillance program: (1) all student athletes must sign a statement that they will report all concussion signs and symptoms to the medical staff, (2) student athletes must have a baseline cognitive assessment and postinjury cognitive assessments are encouraged, and (3) the student athlete diagnosed with a concussion shall be removed from sport for a minimum of 1 day, and return to play is at the authority of the team physician. The effect of these policies on concussion surveillance and treatment has not been reported. The purpose of this study is to determine the number of concussions that occurred on 3 collegiate Division I football teams during the 2 most recent seasons (2009-2010 and 2010-2011) to compare the incidence of concussion before and after the implementation of these new policies. The authors hypothesized that the number of reported concussions and the concussion rates would be consistent among the 3 teams and from season to season.

MATERIALS AND METHODS

Design and Setting

A retrospective cohort study was conducted to examine changes in the incidence rate of concussion following the implementation of the new NCAA concussion management policy. Injury surveillance reports were reviewed for 3 NCAA Division I football teams: the United States Military Academy, the United States Naval Academy, and the United States Air Force Academy. The data contained in each injury report were created and updated by the athletic trainers at each institution, who recorded data on a wide array of injuries over the course of an entire season. The data were prospectively collected and retrospectively reviewed. Based on a review of data from each institution, the number of concussions that occurred over the 2009-2010 and 2010-2011 seasons, including those sustained in practice and game situations, was determined for each team. Institutional Review Board approval was obtained at each institution included in the study.

Subjects

All subjects included in the study were men between the ages of 18 and 22 years who were on the varsity football roster at their respective institution for the 2009-2010 and/or the 2010-2011 season.

Injury Definition and Surveillance

Regardless of the institution, and in accordance with the NCAA Injury Surveillance System definition of a reportable injury, a concussion was defined as an injury that occurred as a result of participation in organized intercollegiate practice or competition that required medical attention by a team-certified athletic trainer or physician that resulted in restriction of student athlete play for 1 or more calendar day after injury and was documented in the injury report by the athletic trainer

as a concussion.³ The concussion management plans from all 3 institutions were compared, and all 3 followed similar criteria with respect to identification, evaluation, management, and return to play. According to team physicians and athletic trainers at each institution, similar policies were followed, although possibly less formalized, by health care providers at each institution prior to the most recent season (2010-2011).

Outcome Measures

The primary outcome of interest was the annual incidence rate of concussion injuries per 1000 athlete exposures during the study period. The incidence rate for an injury or illness is defined as the number of new cases occurring during a specific period of time in a population at risk for experiencing the injury.¹² Incidence rates are calculated by dividing the total number of injuries observed in a population by a measure of exposure or person-time at risk to injury.¹² In the current study, an athlete exposure was defined as 1 athlete participating in 1 practice or a game in which he was exposed to injury. The number of athlete exposures per season was estimated by multiplying the number of players by the number of athletes participating in each game or practice session during the season. There were small variations in the number of practices and games between the 3 teams, mainly because of participation in bowl games. However, the number of practices and games was fairly consistent between the same team over the 2 consecutive seasons.

Statistical Analysis

The annual incidence rates of concussion for the 2009-2010 and 2010-2011 seasons were calculated, along with the 95% confidence intervals, by dividing the total number of concussions by the total number of athlete exposures and multiplying by 1000. The incidence rates for the 2009-2010 and 2010-2011 seasons were compared by calculating the incidence rate ratio and 95% confidence interval using the 2009-2010 season as the referent category. Similarly, the annual incidence rate with 95% confidence intervals was calculated for each team for the season prior to and the season following implementation of the new NCAA concussion management policy. The incidence rates for the 2009-2010 and 2010-2011 seasons were also compared within each team by calculating the incidence rate ratio and 95% confidence interval using the 2009-2010 season as the referent category. All statistical analyses were completed using STATA/SE software version 10.1 (StataCorp, College Station, Texas).

RESULTS

The incidence rate and number of concussions increased at each institution after the implementation of the new NCAA concussion management policy (Figure 1). Overall, the incidence rate across all 3 institutions was 2 times higher in 2010-2011 when compared with 2009-2010 (incidence rate ratio [IRR], 2.04; 95% CI, 1.20-3.55; $P = 0.01$). Similar increases were observed across all 3 institutions when they were examined independently (Table 1). The incidence rate of concussion at institution A was

Table 1. Incidence rates and incidence rate ratios for concussion by institution prior to and following the adoption of the new NCAA concussion policy^a

	2009-2010 Season				2010-2011 Season				IRR	95% CI	P
	Concussions, n	AE, n	IR per 1000 AE	95% CI	Concussions, n	AE, n	IR per 1000 AE	95% CI			
Team A	7	8910	0.79	0.32-1.62	11	8810	1.25	0.62-2.23	1.59	0.56-4.84	0.35
Team B	11	15715	0.70	0.35-1.25	22	14496	1.52	0.95-2.30	2.17	1.01-4.95	0.03
Team C	5	15856	0.32	0.10-0.74	9	12922	0.70	0.32-1.32	2.21	0.66-8.40	0.16
Overall	23	40481	0.57	0.36-0.85	42	36228	1.16	0.84-1.57	2.04	1.20-3.55	0.01

^a2009-2010 season prior to the adoption of the new NCAA concussion policy used as the referent category for IRR calculations. NCAA, National Collegiate Athletic Association; AE, athlete exposures; IR, incidence rate; IRR, incidence rate ratio.

1.59 times higher in the 2010-2011 season compared to the 2009-2010 season, a 58% increase. Similarly, the incidence rate of concussion was 2.16 (117% increase) and 2.2 (119% increase) times higher during the 2010-2011 season at institutions B and C, respectively. The increase in the incidence rate of concussion at institutions A and C did not reach significance when examined independently (institution A, *P* = 0.35; institution B, *P* = 0.16), while there was a significant increase in the incidence rate of concussion at institution B (*P* = 0.03).

DISCUSSION

Among increased awareness and public scrutiny surrounding concussion in professional, collegiate, and high school sports,¹⁷ the NCAA Executive Committee adopted a new policy that required NCAA institutions to have a concussion management plan on file as of April 2010.^{6,11} The goal of this new policy is to ensure that student athletes that exhibit or experience signs and symptoms of a concussion are identified, removed from practice or competition, and thoroughly evaluated by a health care provider. The policy mandates that an athlete diagnosed with a concussion cannot return to sport for the remainder of the day. Incidence rates within and across 3 NCAA Division I military academy football programs were evaluated to determine the potential impact of this policy decision.

The incidence rate for concussion prior to adoption of the new NCAA concussion management policy was similar to the incidence rate for concussion previously reported among NCAA football players. Using data from the NCAA injury surveillance system, Gessel et al⁸ reported an overall incidence rate for practices and games of 0.61 per 1000 athlete exposures during the 2005-2006 NCAA football season. In the current study, the overall concussion incidence rate for practices and games was 0.56 per 1000 AE during the 2009-2010 NCAA football season prior to the adoption of the new concussion management policy. In contrast, after adoption of the new policy, notable increases in the incidence rate of concussion were observed within each of the 3 programs and a significant twofold increase across all 3 programs combined.

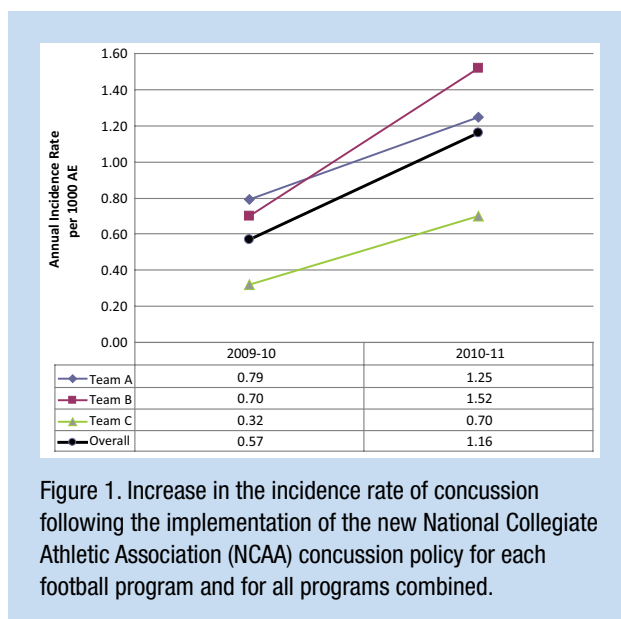


Figure 1. Increase in the incidence rate of concussion following the implementation of the new National Collegiate Athletic Association (NCAA) concussion policy for each football program and for all programs combined.

Limited data are available on trends for the incidence rate of concussion in collegiate football. Dick et al⁵ reported on the incidence rate for concussion in collegiate football players over a 16-year period; however, they did not examine trends over time. Hootman et al⁹ reported a 7% annual increase in the incidence rate of concussion for 15 NCAA sports, including football, over a 16-year period. While comparisons between the current study and that by Hootman et al are difficult because the study included 14 other sports in addition to football, the annual increase observed in the current study far exceeds the expected 7% annual increase based on this prior study.

The twofold increase in the combined concussion incidence rate between the 2 consecutive seasons could be explained by several factors. While the institution of a more formalized concussion plan on the part of medical staff is one possible factor, another difference may have been from previous underrecognition and underreporting on the part of players and coaches prior to the new policy. The true incidence

of concussion may not have increased substantially but an increased awareness and enhanced screening programs led to better identification of concussed athletes following implementation of the new policy. The new NCAA policy mandates that players and coaches notify a health care provider when experiencing or witnessing a player with signs and symptoms of concussion. This reflects a clear change in approach that places substantially more responsibility on the coaches and athletes to identify the signs and symptoms of concussion, but it also places the responsibility on them to report these injuries to the institution's sports medicine team. This is accomplished in part by having all players sign a formal statement that they will comply with this mandate at the beginning of each competitive season and through educational programs for players and coaches on the signs, symptoms, and potential long-term consequences of concussions.⁶ Despite these advances in improved awareness and the implementation of more systematic and objective screening tools, the diagnosis of concussion remains largely in the realm of clinical judgment on an individual basis and dependent on the player to be truthful and forthcoming about injury and related symptoms.^{1,15,16}

The issue of sports-related concussion has recently gained attention in the public and medical communities and has resulted in a culture change in its management.⁷ Several states have recently passed new laws and guidelines related to the management and return-to-participation criteria following concussion that are similar to the new NCAA concussion management policy. Despite these policy changes, which may result in the increased number of concussed athletes identified, it remains unclear whether the new NCAA policy will substantially reduce the incidence of catastrophic injury and the long-term consequences of concussion and traumatic brain injury among athletes.

Limitations associated with the current study should be noted. The conclusions drawn from this study, based on included data, are limited to military academy football and may not reflect trends in NCAA Division I football as a whole. Because this study relied on a retrospective review of injury surveillance data at 3 institutions, there is the inherent risk of bias. Also, as the definition of concussion varies even in the literature, it could be argued that the diagnosis of concussion may have been slightly variable among the institutions. Each institution has certified athletic trainers as well as board-certified, fellowship-trained orthopedic surgeons available at every practice and game. Additionally, all of the Division I football programs included in the study have similar populations and medical resources and follow similar return-to-play protocols, each following the standards for diagnosis and treatment set forth by the NCAA in the NCAA sports medicine handbook for each season, respectively.^{10,11} Finally, both the procedures surrounding the diagnosis and management of concussion and the medical staff itself did not vary from season to season at any of the institutions. Sample size should also be noted as a limitation; however, similar patterns were observed across all 3 institutions.

CONCLUSION

The combined incidence rate of reported concussions from 3 Division I military academy football programs for the 2010-2011 season doubled from the previous season after the implementation of new NCAA policies on concussion management.

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