Ocular Injury Rates in College Sports

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ABSTRACT

YOUN, J., R. E. SALLIS, G. SMITH, and K. JONES. Ocular Injury Rates in College Sports. *Med. Sci. Sports Exerc.*, Vol. 40, No. 3, pp. 428–432, 2008. **Purpose:** To determine the rate of eye injury sustained in 12 college sports in order to assess whether there is a high risk of ocular eye injury in some sports. **Methods:** From the fall of 1990 through the spring of 2006 at an NCAA Division III college, all ocular injuries that occurred while participating in a varsity sport and reported to the training room were retrospectively analyzed to obtain an ocular injury rate per sport. **Results:** This study included 5921 participants during a 16-yr period. During this time, 10 ocular injuries were sustained in five different sports. Five (50%) occurred while playing men's basketball, one (10%) in women's basketball, two (20%) in men's water polo, one (10%) in baseball, and one (10%) while playing women's soccer. **Conclusion:** The rate of ocular injury as a result of participation in baseball, basketball, cross-country, football, golf, soccer, swimming and diving, track and field, water polo, softball, or volleyball is very low. Hence, any discussion with athletes regarding the utility of eye protection while participating in any of these sports should focus on the athlete's past ocular history instead of the sport to be played. **Key Words:** EYE, PREVENTION, COUNCILING, PROTECTION

In 2003, more than 40,000 sports- and recreation-related eye injuries were reported in the United States (7). Thirty percent of ocular injuries among children younger than 15 yr of age are sports related. A 2004 policy statement from the American Academy of Pediatrics and American Academy of Ophthalmology classified sports as "high risk," "moderate risk," "low risk," or "eye safe" based on the number of eye injuries in each sport (2). Unfortunately, participation rates and severity of injury were unavailable, making it impossible to determine the risk of eye injury in different sports. In addition, counting the total number of eye injuries associated with a sport or using the percentage of all eye injuries sustained while playing a sport creates a bias towards those sports with higher participation levels.

Baseball and basketball consistently account for the highest percentages of ocular trauma sustained in sports in the United States, and they are accordingly categorized as "high risk" in the 2004 pediatric consensus statement (2). However, in Australia the majority of sports-related eye injuries are caused by squash, badminton, Australian rules football, and cricket (4). At the Moorfields Eye Hospital in Scotland, soccer accounts for the highest percentage of sports-related ocular trauma (1). These discrepancies likely can be attributed to the differing participation levels in each sport in these countries.

Few studies have calculated injury rates. The National Basketball Association Eye Injury Study (1995) reports a rate of 1.44 ocular eye injuries per 1000 game exposures. Of these injuries, 50.9% were abrasions or lacerations, 28.8% contusions, and 11.9% corneal abrasions (9). Similarly, a study of ocular trauma in major league baseball players (1994) estimated an ocular injury rate of 1.9 eye injuries per 100,000 player-innings; 52.3% of these injuries involved players struck by a batted ball (of which 54.5% were at bat and 45.5% in the field or sidelines) and another 19% of the injuries resulted from eye rubbing or getting dirt in an eye (8).

It is desirable to know the ocular injury rate associated with specific sports in order to negate the participation bias inherent in more popular sports. Such information will allow physicians and athletes to discuss more accurately the likelihood of eye injury associated with participation in a specific sport and hence the utility of prophylactic eye protection. This is particularly important for athletes with significant prior ocular medical histories, such as severe myopia, diabetes mellitus, previous eye injury, or previous eye surgery. In this study, we obtained the ocular injury rate in 12 college sports at an NCAA Division III college during a 16-yr period.

METHODS

From the fall of 1990 through the spring of 2006 at an NCAA Division III level college, 18- to 22-yr-old male and

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female varsity athletes competed in the following 12 intercollegiate varsity sports: baseball, basketball, cross-country, football, golf, soccer, swimming and diving, tennis, track and field, water polo, softball, and volleyball. All athletic injuries seen in the training room at Pomona College were evaluated by the same head athletic trainer. The trainer completed a standardized injury surveillance report for each injury. Ocular injury reports were retrospectively compiled and categorized by sport, injury, mechanism of injury, gender, use of protective eye wear, and setting (game versus practice). Ocular injury was defined as a medical problem to the external (eyelid, conjunctiva, lacrimal gland) or internal (sclera, cornea, iris, lens, retina) eye that arose as a result of sport participation that required a visit to the training room. Only injuries resulting in an injury report being completed were used in this study. Such injuries involved evaluation by an ACT (certified athletic trainer) leading to the development of a diagnosis and treatment plan in consultation with a board-certified physician as needed. Return of an athlete for the same injury was not logged as a new injury. However, two ocular injuries occurring simultaneously (corneal abrasion and subconjunctival hemorrhage) in the same athlete were logged as one injury.

Injuries were categorized for the following sports: baseball, basketball, cross-country, football, golf, soccer, swimming and diving, tennis, track and field, water polo, softball, and volleyball. Baseball, golf, and football only involved male participants. Softball and volleyball only involved female participants. Basketball, cross-country, soccer, swimming and diving, tennis, track and field, and water polo include both male and female participants.

RESULTS

The study included 5921 participants during a 16-yr period. During this time, 10 ocular injuries were sustained while participating in a sport. These 10 injuries occurred in five different sports. Five (50%) occurred while playing men's basketball, one (10%) occurred while playing women's basketball, two (20%) occurred while playing men's water polo, one (10%) occurred while playing baseball, and one (10%) occurred while playing women's soccer. The mechanisms and types of injuries by sport are demonstrated in Table 1. The following eight sports did not have any instances of ocular trauma: cross-country, swimming and diving, football, golf, tennis, track and field, volleyball, and softball.

In basketball, five of the six injuries (83%) were lacerations, and one of six (17%) was a corneal abrasion and a concurrent subconjunctival hemorrhage. In water polo, one of the two injuries was a laceration, and the other was a corneal abrasion. Baseball accounted for one ocular injury, which was a laceration while fielding a hit ball. A female soccer player suffered a hyphema after being struck by a kicked soccer ball.

TABLE 1. Nature of injuries.

Sport	Injury	Mechanism of Injury
Men's basketball	Laceration	Elbow
Men's basketball*	Laceration	Elbow
Men's basketball*	Laceration	Hand
Men's basketball	Laceration	Head butt
Men's basketball**	Corneal abrasion and subconjunctival hemorrhage	Hand
Women's basketball	Laceration	Elbow
Men's water polo	Laceration	Hand
Men's water polo	Laceration	Hand
Women's soccer	Hyphema	Kicked ball
Baseball	Laceration	Batted ball

* Injury occurred during practice.
** Injuries occurred simultaneously.

Two of these 10 injuries occurred during men's basketball practice sessions; the remaining eight injuries occurred during official events. Each of the two practice injuries occurred at separate times and with separate mechanisms of injury. One athlete was struck by an opponent's elbow, and the other by a hand. The injuries that occurred during practice are excluded from the calculations of injury rates because there are no data on the total number of practices, the length of the practices, or the number of players participating in practices.

The total number of eye injuries sustained while participating in an official event (game, match, or meet, depending on the sport), excluding practice, was used to obtain the value for ocular injury incidence. Participant exposure was measured by the total number of events and the number of players involved in each event. For sports with fixed time limits (such as basketball and soccer), exposure was also measured by the total number of minutes played. For example, there were a total of 442 men's basketball games played, each lasting 40 min with five players on the court at all times. Thus, the number of game exposures was $5(442) = 2210$, and the number of minute exposures was $5(442)(40) = 88{,}400$.

DISCUSSION

The primary goal of this study was to determine the rate of ocular injury in specific sports. Rate determination was possible when the number of events and participants were known quantities. This is in contrast to the majority of studies that do not have this information available and simply report the number of injuries attributed to a specific sport, making it difficult to assess the riskiness of sports participation and to compare risks across sports. For instance, in our study men's basketball accounted for three of eight (37.5%) eye injuries—suggesting that it is a very dangerous sport. However, this is an injury rate of only one injury per 736.7 game exposures, or one injury per 29,466.7 minute exposures.

Similarly, there was one eye injury in women's basketball, men's baseball, and women's soccer, suggesting that

these are all equally risky sports. But there were substantial differences in the number of games played (425, 714, and 324 respectively) and in the number of game participants (5, 9, and 11 respectively). In addition, women's soccer games are 90 min long, compared with 40-min basketball games. Thus, the injuries per game exposure are quite different: 1/2215 for women's basketball, 1/6246 for men's baseball, and 1/3564 for women's soccer. The injuries per minute exposure are even more disparate: 1/85,000 for women's basketball versus 1/320,760 for women's soccer. The results of these calculations in all applicable sports are shown in Table 2.

The low ocular injury rates obtained in this study suggest that any discussion regarding the use of protective eye wear in these sports should focus on the athlete's past medical history instead of the sport to be played. Significant risk factors would include myopia, diabetes mellitus, previous eye injury, and previous eye surgery. Appropriate eye protection that conforms to the American Society for Testing and Materials standards specific for each sport should be recommended.

The most severe ocular injury sustained in this study was a hyphema after being struck by a kicked soccer ball. This correlated with data from a study done at the Massachusetts Eye and Ear Infirmary where soccer injuries resulted in the highest percentage of hyphemas (5). Thus, in any discussion regarding the possibility of sustaining eye trauma in a specific sport, the likelihood of sustaining a specific type of ocular injury is another important factor to be considered.

In 1982, the NCAA Injury Surveillance System was developed to provide data on injury trends in intercollegiate athletics. Data are collected yearly from a sample of NCAA member institutions. The NCAA Injury Surveillance System reports an ocular injury rate per 1000 exposures, with *exposure* being defined as one athlete participating in one practice or game where he or she is exposed to the possibility of athletic injury. For sports with fixed time limits and participants, exposure was measured by the total number of players participating in the game regardless of the amount of participation in that game (3). For example, if there was a men's basketball team with 10 players on the team, and each player played in every game regardless of minutes played per game during a 30-game season, then the total participant exposure for the season was 10(30) = 300. In this study, exposure was quantified by the total number of participants competing in an event at one point in time, not the total number of players playing in each game. For example, in men's basketball there are five players on the court at all times. Regardless of whether 10 players play in each game of the 30-game season, the total participant exposure for the season is 5(30) = 150. The benefit of this system is that it allows a more accurate injury rate per minute exposure. A disadvantage of this system is that it does not allow one to track the rate of repetitive injuries in the same athlete as is possible with the NCAA system of exposure calculation. In comparing the results of the data collected by the NCAA Injury Surveillance System from the 1990–1991 season through the 2003–2004 seasons, as shown in Table 3, and the ocular injury rates of this study, as shown in Table 4, the rates were higher in our study for men's basketball, women's basketball, men's baseball, and women's soccer (no comparison data available for men's water polo). One explanation may be that this is a direct result of the differences in exposure calculations. Using the NCAA's definition of exposure

TABLE 2. Injuries by sport.

Sport	Number of Injuries	Number of Events[a]	Players per Event	Minutes per Event	Injuries per Event[b]	Injuries per Minute[b]
Men's basketball[c]	3	442	5	40	1/736.1	1/29,467
Women's basketball	1	425	5	40	1/2125	1/85,000
Men's basketball	1	714	9		1/6426	
Women's softball[d]	0	561	9		0/5049	
Men's water polo[d]	2	629	7	28	1/2201	1/123,284
Women's water polo	0	442	7	28	0/3094	0/86,632
Men's soccer	0	323	11	90	0/3553	0/319,770
Women's soccer	1	324	11	90	1/3564	1/320,760
Men's football	0	153	11	60	0/1683	0/100,980
Men's golf	0	238	6		0/1428	
Men's tennis	0	425	12		0/5100	
Women's tennis	0	408	12		0/4896	
Women's volleyball	0	442	6		0/2652	
Men's cross-country	0	136	?			
Women's cross-country	0	136	?			
Men's track	0	221	?			
Women's track	0	221	?			
Men's swimming	0	221	?			
Women's swimming	0	221	?			

[a] Events are games for basketball, baseball, softball, water polo, soccer, and football; matches are for golf, tennis, and volleyball; and meets are for cross-country, track, and swimming.

[b] Injuries per event and injures per minute are calculated from player game exposures and player minute exposures; for example, in men's basketball, there were three injuries in 5(442) = 2210 game exposures and 5(442)(40) = 88,400 minute exposures.

[c] The two injuries sustained during basketball practice, as noted in Table 1, were not included in the injury rate calculations, because of an inability to quantify exposures that occurred during practice.

[d] Eye protection is mandatory in men's water polo and in women's softball when batting.

TABLE 3: NCAA ISS game ocular trauma data (5) 1990–91 through 2003–2004.

Sport	Year	Level	Number of Schools	Rate (per 1000-Game Exposure)
Men's basketball	1990–1991 through 2003–2004	All divisions	1590 or 114 per year	0.16
Men's basketball	1990–1991 through 2003–2004	Division 3	606 or 43 per year	0.10
Men's soccer	1990–1991 through 2002–2003	All divisions	1179 or 91 per year	0.11
Men's soccer	1990–1991 through 2002–2003	Division 3	562 or 43 per year	0.10
Women's basketball	1990–1991 through 2003–2004	All divisions	1634 or 117 per year	0.10
Women's basketball	1990–1991 through 2003–2004	Division 3	643 or 46 per year	0.06
Women's soccer	1990–1991 through 2002–2003	All divisions	1197 or 92 per year	0.09
Women's soccer	1990–1991 through 2002–2003	Division 3	514 or 40 per year	0.05
Women's softball	1990–1991 through 2003–2004	All divisions	1293 or 92 per year	0.04
Women's softball	1990–1991 through 2003–2004	Division 3	539 or 39 per year	0.05
Men's baseball	1990–1991 through 2003–2004	All divisions	1373 or 98 per year	0.04
Men's baseball	1990–1991 through 2003–2004	Division 3	571 or 40 per year	0.04
Men's football	1990–1991 through 2003–2004	All divisions	1702 or 122 per year	0.02
Men's football	1990–1991 through 2003–2004	Division 3	619 or 44 per year	0.04
Women's volleyball	1990–1991 through 2003–2004	All divisions	1589 or 114 per year	0.01
Women's volleyball	1990–1991 through 2003–2004	Division 3	579 or 41 per year	0.01

Adapted from the NCAA Injury Surveillance System 1990–1991 through the 2003–2004 seasons.

results in a higher number of exposures and thus a lower injury rate in comparison with the definition of exposure used in this study. This highlights the point that differences in exposure calculations may have a large impact when comparing injury rates between individual studies. On the other hand, the ocular injury rates obtained from the NCAA Injury Surveillance System were higher than the rates from this study for women's softball, men's soccer, men's football, and women's volleyball. Explanations for this difference in injury rates may be a direct result of total number of participants because the NCAA Injury Surveillance System has a significantly higher number of participants than this study.

Several limitations to this study should be noted. Only males participated in baseball, golf, and football; only females participated in volleyball and softball. Gender differences that may be present within these sports could not be analyzed. The absence of any documented contusions is likely to be a result of athletes not reporting such injuries to the team trainer. Contusions, while typically a relatively mild injury, indicate a recent ocular injury that may result in more serious injury such as a posterior vitreous detachment. The number of athletes wearing nonmandatory protective eye wear is unknown; thus, the number of incidences of ocular trauma prevented is unknown. Information regarding the amount of sports time missed because of injury, and whether or not the injuries had serious complications such as permanent visual changes, was not available in the standardized injury surveillance report that was retrospectively reviewed in this study. The NCAA Injury Surveillance System injury definition was one that restricted participation for at least 1 d, and, as a result, minor eye injuries may not have been reported. In addition, some NCAA Injury Surveillance System injuries may have inadvertently been associated with facial injuries instead of ocular trauma, which may have also led to underreporting of ocular injuries (6). Statistical analysis comparing the incidence of eye trauma between men's versus women's sports and among different sports was not performed because of the overall low incidence of ocular trauma found in this study. Attempting such calculations with such a low incidence would have resulted in an analysis of poor statistical significance.

TABLE 4. Pomona College ocular injury rate per 1000 exposures.

Sport	Rate
Men's basketball	1.36
Women's basketball	0.47
Men's baseball	0.16
Women's softball	0.00
Men's water polo	0.45
Women's water polo	0.00
Men's soccer	0.00
Women's soccer	0.28
Men's football	0.00
Men's golf	0.00
Men's tennis	0.00
Women's tennis	0.00
Women's volleyball	0.00
Men's cross-country	0.00
Women's cross-country	0.00
Men's track	0.00
Women's track	0.00
Men's swimming	0.00
Women's swimming	0.00

CONCLUSION

This study does not include sports such as lacrosse and ice hockey, which involve high-speed projectiles and sticks with players in close proximity and which inherently may lead to more significant ocular trauma, thus increasing the value of mandatory prophylactic eye protection. The rate of ocular injury as a result of participation in baseball, basketball, cross-country, football, golf, soccer, swimming and diving, track and field, water polo, softball, or volleyball is very low. Hence, any discussion with athletes regarding the utility of eye protection while participating in any of these sports should focus on the athlete's past ocular history instead of the sport to be played.

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