

Effectiveness of the Women's Lacrosse Protective Eyewear Mandate in the Reduction of Eye Injuries

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Background: In an effort to minimize the risk of catastrophic eye injury, US Lacrosse initiated mandatory use of protective eyewear in women's lacrosse in the 2004-2005 season.

Purpose: The authors compared eye injury rates in girls' scholastic lacrosse before and after implementation of protective eyewear. They also compared head/face injury rates, concussion rates, and overall injury rates before and after the rule change to assess possible unintended consequences of the change.

Study Design: Cohort study; Level of evidence, 3.

Methods: The study group included female scholastic lacrosse players in the 25 public high schools in Fairfax County, Virginia, during the 2004-2009 spring seasons. Injury rates were compared with those from the same data source for the 2000-2003 seasons. Premandate versus postmandate injury rates were adjusted for athlete exposures, or total opportunities for injury throughout the season.

Results: The rate of eye injuries was reduced from 0.10 injuries per 1000 athlete exposures (AEs) in 2000 through 2003 before the use of protective eyewear to 0.016 injuries per 1000 AEs in 2004 through 2009 (incident rate ratio [IRR], 0.16; 95% confidence interval [CI], 0.06-0.42). The rate ratio of head/face injuries excluding concussion also decreased (IRR, 0.44; 95% CI, 0.26-0.76). There was no change in the rate ratio of total injuries involving all body parts (IRR, 0.93; 95% CI, 0.82-1.1) after introduction of protective eyewear. However, the rate ratio of concussion increased (IRR, 1.6; 95% CI, 1.1-2.3).

Conclusion: The use of protective eyewear in women's lacrosse was associated with a reduction in the number of eye injuries. The number of head/face injuries decreased in this study group after introduction of protective eyewear, and there was no change in overall injury rates. The reason for the increase in concussion rate cannot be determined conclusively based on this study, but the authors speculate that this increase resulted largely from increased recognition and diagnosis because overall injury rates do not indicate rougher play with introduction of protective equipment.

Keywords: women's lacrosse; eye injuries; protective eyewear; injury prevention

Women's lacrosse is played by 12 players: a goalkeeper, 5 attackers, and 6 defenders. In contrast to the men's game, which allows purposeful contact and requires

protective equipment, women's lacrosse does not allow intentional body-to-body contact, and stick checking must be directed away from an opponent's head and body toward the pocketed end of the stick only. The higher contact men's game requires mandatory use of helmets with full face guards, shoulder pads, padded gloves, and mouthpieces. Protective equipment was not required for the women's game until relatively recently, when US Lacrosse focused on eye injury as a potentially preventable catastrophic injury in women's lacrosse. Study findings of higher rates of eye and face injuries in women's lacrosse compared with men's lacrosse, with the primary mechanism of direct contact from ball or stick,⁸ led to consideration of mandatory protective eyewear in the women's game. Although eye injuries accounted for a very small percentage of total injuries in the women's game,⁸ the cost of protective eyewear was relatively low (\$25-\$90 each) compared with the potential lifelong personal and financial impact of catastrophic orbit fracture or lost sight in young female players. Anecdotally, immediate

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Figure 1. Photograph shows female lacrosse player wearing the protective eyewear mandated by US Lacrosse in the women's game in 2005. Besides a mandatory mouth piece, no other protective equipment is worn in the women's game (Photograph courtesy of US Lacrosse).

medical costs of \$78 000 were reported for 1 adult female player with serious eye injury (US Lacrosse, personal communication, August 30, 2011), with the expectation of additional future costs and personal impact. Based on research^{2-4,6,8-10,14} and recommendations by the American Academy of Pediatrics and the American Academy of Ophthalmology, US Lacrosse recommended the use of protective eyewear meeting current ASTM lacrosse standards for 2004 and mandated the use of eyewear (Figure 1) in the women's game at the youth, scholastic, and collegiate levels in 2005. The effect of this mandate on eye injury in the women's game has not been studied.

The introduction of protective eyewear in the women's game was intended to minimize the risk of catastrophic eye injury. A concern with this intervention was whether wearing eye protection would result in increased head/face injuries as a result of a stick or ball glancing off the eyewear and impacting other areas of the head/face. An additional concern was that the introduction of protective

equipment might encourage greater risk taking among players that would result in rougher play¹² with a possible increase in overall injury rate.

The objective of this study was to evaluate the effect of the protective eyewear mandate on eye injury rates in scholastic girls' lacrosse and to assess whether an increase occurred in head/facial injuries outside the protected area and in overall injuries in the girls' game.

MATERIALS AND METHODS

Institutional review board approval for the study was obtained. Data were prospectively gathered for each of the 25 high schools in a large public school system over a consecutive 10-year period (2000-2009). This study period included 4 years before the mandate (2000-2003) and 6 years after the mandate (2004-2009). The study population included 9430 player-seasons over the study period, with each student-athlete considered unique in each season played.

During the study period, each school employed 2 certified athletic trainers (ATs). All schools used a district-mandated electronic medical record-keeping program for injury surveillance, Sports Injury Management Systems software (Flan-tech, Iowa City, Iowa). As an official part of their daily job responsibilities, the certified ATs recorded all injuries and illnesses in the record-keeping system. A systemwide program supervisor monitored the record-keeping program to maximize compliance and data quality. A certified AT was available daily and was on site for all games.

An injury was defined as a reportable event during official scholastic games or practices that warranted medical intervention, monitoring, and possible alteration of the athlete's participation status. Eye injuries included injuries directly to the eye (globe), eyelid, eyebrow, or eye orbit. Head/face injuries included injuries to the nose, mouth, teeth, tongue, face, forehead, cheek, chin, jaw, and head (nonconcussion). Concussion was defined as an event brought to the attention of the certified AT and determined to be concussion through examination by the AT, as described in previous research.⁷ A combined total was calculated that included all injuries to all body parts.

Incidence rates and rate ratios were based on 1000 athlete-exposures (AEs), with AE defined as 1 athlete's participation in a practice or competition. Incidence rate ratios comparing the pre- and postintervention periods were calculated with 95% confidence intervals (CIs). All analyses were performed using R: A Language and Environment for Statistical Computing, version 2.9.1 (R Foundation for Statistical Computing, Vienna, Austria).

RESULTS

There were a total of 3864 player-seasons (212 520 AEs) in the pre-eyewear mandate group and 5566 player-seasons (306 130 AEs) in the post-eyewear mandate group. The total number of eye injuries decreased from 22 before the mandate to 5 after the mandate. The eye injury rate per

TABLE 1
Rates of Injury Before (2000-2003) and After (2004-2009) Introduction of Protective Eyewear in Women's Lacrosse^a

Body Part	2000-2003		2004-2009		Rate Ratio (95% CI)
	Frequency	Rate (per 1000 AEs)	Frequency	Rate (per 1000 AEs)	
Eye	22	0.10	5	0.016	0.16 (0.06-0.42)
Head/face	33	0.15	21	0.07	0.44 (0.26-0.76)
Concussion	38	0.18	86	0.28	1.6 1.1-2.3
All injuries	406	1.9	543	1.8	0.93 0.82-1.1

^aTotal athlete-exposures (AEs): 212520 in 2000-2003 and 306130 in 2004-2009. CI, confidence interval.

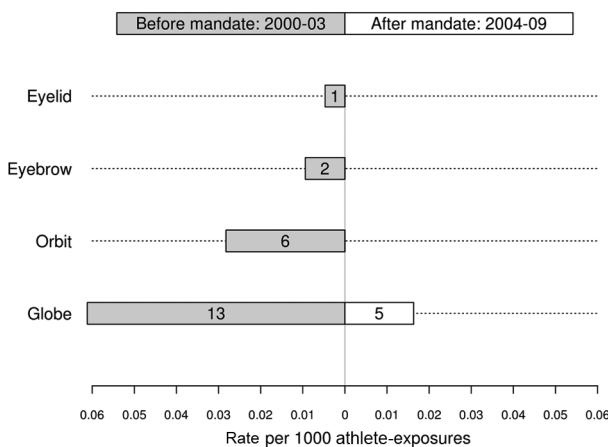


Figure 2. Eye injuries by area of the eye, before and after introduction of mandated eyewear. Values inside the graph bars indicate number of injuries.

1000 AEs was 0.10 before the eyewear intervention and was reduced to 0.016 after the intervention (Table 1). The rate ratio of 0.16 indicates a significant reduction in the rate of eye injuries after the eyewear mandate (incident rate ratio [IRR], 0.44; 95% CI, 0.26-0.76). There was no change in all injuries to all body parts combined (IRR, 0.93; 95% CI, 0.82-1.1) after introduction of protective eyewear. However, a significant increase in concussion was observed (IRR, 1.6; 95% CI, 1.1-2.3).

Injuries to all areas of the eye decreased after the eyewear mandate (Figure 2). All 5 eye injuries reported after the mandate were injuries to the globe. Based on descriptive text in the medical record, 4 of the 5 eye injuries that occurred in the post-eyewear mandate period took place in practice scenarios. In 3 of the 4 incidents, the player was not wearing protective eyewear. In the fourth incident, the player was wearing the polycarbonate design of eyewear available in 2004, which has since evolved to the wireframe design now used in the game. Two of these injuries were caused by ball contact, 1 resulted from body

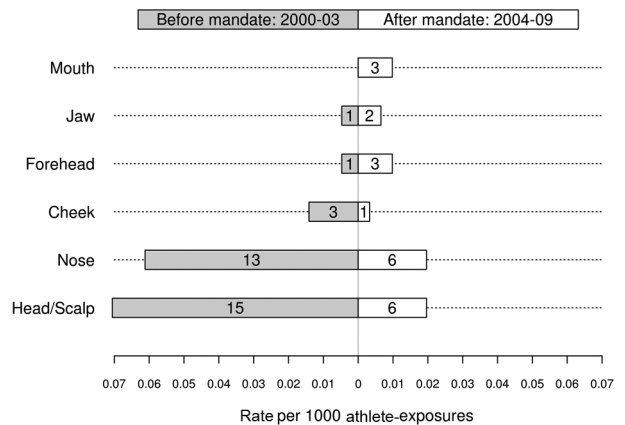


Figure 3. Head/face injuries by area of head and face, before and after introduction of mandated eyewear. Values inside the graph bars indicate number of injuries.

contact, and 1 had undetermined cause. In the fifth eye injury, a case of eye inflammation, it is not clear from the medical record whether an injury caused the inflammation. Head/face injuries after the eyewear mandate were relatively evenly distributed among the specific sites measured (Figure 3).

DISCUSSION

The findings suggest the mandated protective eyewear in girls' lacrosse achieved the desired goals of reducing eye injury, with a concomitant decrease in head/face injury. The number of eye injuries and the eye injury rate were significantly reduced after the mandated use of eye protection in women's lacrosse. The findings of decreased head/face injuries suggest that use of the equipment conferred benefit to other areas of the head/face, as sticks or balls were deflected away from the eyes. Overall injury rate did not change over the study period, suggesting that the change in equipment did not result in generally rougher play. No definitive conclusions about the reason for

increased concussion incidence rate can be drawn from this study. However, this increase may reflect the increased awareness and diagnosis of concussion that was observed in 12 scholastic contact and noncontact sports over the past decade.⁷ Given the collective increase across all sports in the concussion rate in the absence of rules or equipment changes, it appears likely that the increase seen in girls' lacrosse was not associated primarily with the use of protective eyewear.

Four of the 5 eye injuries reported in the post-eyewear mandate group in this study involved circumstances where eyewear was not being worn or a previous version of the current standard eyewear was in use. The fifth incidence of eye injury involved eye inflammation without clear connection to injury, as described in the medical record. The data indicate that injuries to the eyelid, eyebrow, eye orbit, and eye globe were virtually eliminated after mandated use of eyewear, with the exception of the injuries that occurred when the standard eyewear was not being worn. The fact that these injuries all occurred to the eye globe with potential for devastating injury further reinforces the importance of the protective effect of the mandated eyewear.

This study may support further efforts to evaluate the effectiveness of injury prevention interventions overall and in scholastic sport in particular. A limited number of studies have documented the effectiveness of an intervention in the prevention of sports injuries at the youth amateur, collegiate, and professional levels. Caraffa et al¹ reported a significant reduction in anterior cruciate ligament injuries after proprioceptive training designed to prevent these injuries. Junge et al⁵ noted a decrease in injury rate after introduction of a program focusing on education and supervision of coaches and players. A significant decrease in number of illness and injury days has been reported after cognitive behavioral stress management in collegiate rowers,¹¹ and rate of adductor strain decreased in National Hockey League players after an intervention program focused on functional strengthening of the adductor muscles.¹³

This study is limited in that it used historical administrative data and did not include a comparison group. Mandatory use of protective eyewear across women's lacrosse did not allow incorporation of a control group in the study design. Use of a control group might have allowed more definitive conclusions regarding the increase in concussion rate. However, we used the same database, the same age groups, and the same level of play throughout the study period, and these data are the best currently available for study. Also, although the district studied is one of the largest in the country, it may not represent a typical setting.

In conclusion, the use of protective eyewear in women's lacrosse effectively reduced the number of eye injuries. Head/face injuries decreased in this study group after

introduction of protective eyewear, and there was no change in overall injury rate. The reason for the increase in concussion rate cannot be determined conclusively based on this study, but we speculate that this increase resulted largely from increased recognition and diagnosis because overall injury rates do not indicate rougher play with the introduction of protective equipment.

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