Fair Play as an Injury Prevention Intervention: Do Yellow Card Accumulation Policies Reduce High School Soccer Injuries?

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Abstract

Objectives: Evaluate yellow card policies’ (YCPs) effectiveness in reducing competition contact injuries (CCIs). Design: Retrospective cohort. Setting: High schools. Participants: Soccer players from High School (HS) Reporting Information Online participating schools, 2005/06 to 2017/18. Independent Variables: Athlete exposure (AE), CCIs from HS competitions collected from states with/without YCPs. Main Outcome Measures: Rate and rate ratio (RR) of athlete–athlete CCIs recorded by athletic trainers were compared between states with/without YCPs and pre-YCPs/post-YCPs among the states with YCPs using Poisson regressions. Proportions of severe athlete–athlete CCIs were also described in states with/without YCPs. Results: Fifteen states implemented YCPs between 2005/06 and 2017/18; 901 athlete–athlete CCIs occurred during 352 775 competition AEIs in states with YCPs, and 3525 injuries during 1 459 708 competition AEIs in states without YCPs. There was no significant difference in injury rates between schools in states with/without YCPs (RR 1.07; 95% confidence interval [CI]: 0.97-1.17). Among states with YCPs, injury rates were not significantly different between pre-YCP and post-YCP implementation (RR 1.15; 95% CI: 0.98-1.34). Although a significantly lower proportion of injuries resulting in >3 weeks’ time loss (TL) occurred in states with YCPs (injury proportion ratio 0.81; 95% CI: 0.66-0.997), no significant differences were observed in proportions of other severe athlete–athlete CCIs between states with/without YCPs. Conclusions: Yellow card policies were ineffective in lowering HS soccer athlete–athlete CCI rates, although injuries resulting in >3 weeks’ TL were less prevalent in states with YCPs. Implementation of YCPs alone, without proper enforcement, may not be a sufficient injury prevention strategy.

Key Words: soccer, yellow card, injury prevention

INTRODUCTION

Soccer remains a popular sport among American high school (HS) athletes, with >450 000 boys and nearly 400 000 girls participating during the 2017/18 school year.1 Although all sports participation carries injury risk,2 contact/collision sports have higher injury rates than noncontact sports due to risks associated with athlete–athlete contact. Although rules are designed to promote fair competition and protect participants from injury, foul play—inadvertent or intentional—occurs at all levels of sport. Collins et al3 reported that 0.7% to 14.0% of HS sport-related injuries in 9 popular sports were attributed to foul play, an often overlooked risk factor. Preventative interventions focusing on rule change may present an opportunity for reducing injuries resulting from foul play.3 Kriz et al4 recently demonstrated that a Fair Play (FP) rule change in HS boys’ varsity ice hockey was associated with a significant reduction in overall injuries, concussion/closed head injuries, and combined subgroups of concussion/closed head injury and upper-body injury.

In HS soccer, yellow cards are given for minor offenses and considered a first warning. Two yellow cards equal a red card. Yellow cards may be given to players for any one of these reasons: unsporting behavior, dissent by word or action, incidental use of profanity/vulgar language, time-wasting, a series of fouls, failing to retreat the required distance, entering the pitch without permission of the referee, and leaving the pitch without the referee’s permission.5,6 High school soccer yellow card accumulation policies (YCPs) were initially enacted in 1992 in Massachusetts. As of 2018, 15 of the 50 National Federation of State High School Associations (NFHS) member state associations and 2 NFHS affiliate associations have implemented soccer YCPs (Table 1). Although YCPs differ slightly from state to state,7,8 players and/or coaches are typically suspended for 1 regular season game if they accumulate 3-5 yellow cards during the

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regular season, and both individual players and teams can be disqualified from playoff participation if they exceed a yellow card foul threshold. It is important to note that to date, prospective injury surveillance data have not been captured by individual states pre-YCP or post-YCP intervention, making comprehensive scientific evaluation of the effectiveness of these policies impossible.

Although HS state-specific soccer YCPs have been in place in the United States for >25 years and have more recently been adopted elsewhere internationally,9 the effectiveness of YCPs as an injury prevention strategy has not been formally evaluated. Our objective was to retrospectively evaluate the effectiveness of HS soccer YCPs in reducing athlete–athlete contact injuries during competition. This was accomplished by comparing athlete–athlete contact injury rates in states with and without YCPs and by comparing athlete–athlete contact injury rates pre-YCP/post-YCP implementation among states with YCPs, using High School Reporting Information Online (HS RIO), a national sports injury surveillance database.

We hypothesized the following: (1) athlete–athlete contact injury rates in soccer competitions were lower in states with YCPs, (2) in states with YCPs, athlete–athlete contact injury rates were lower after implementation, and (3) severe injuries [concussion, fracture, anterior cruciate ligament (ACL) injury, injury resulting in surgery, and injury resulting in >3 weeks’ time loss (TL)] were less prevalent in states with YCPs.

**METHODS**

**Study Design and Participants**

In this retrospective cohort study, YCP data from 1992 to 2018 were collected by the lead author (P.K.K.) through Internet searches and personal communication with each state’s interscholastic league administrators. The YCP data were then merged with soccer injury data spanning the 2005/06 to 2017/18 academic years captured by HS RIO. In California, only the Central Section of the California Interscholastic Federation had a YCP during the study period (Table 1); thus, California HS data were excluded from the data set and analysis. In addition, data before the 2005/06 academic year—the first year that HS RIO captured injury data and athletic exposures—were also excluded, as both pre-YCP and post-YCP implementation data were essential to the study. Consequently, data were included from states that implemented YCPs between 2005/06 and 2017/18 and from states with no YCPs during this time interval.

Among schools in states that adopted YCPs during the study, years before the implementation date were categorized as “No YCP” and years after the implementation date were categorized as “With YCP.” High School Reporting Information Online, developed and maintained by an author (R.D.C.), captures data for a large national HS sports injury surveillance study. The methodology of this surveillance system has been previously described.10 In brief, HS RIO annually collects athlete exposures (AEs) and injuries occurring in organized competitions and practices from a national sample of US HSs with a certified athletic trainer (AT) available to report data. Additional information about HS RIO is available online in annual reports (http://www.ucdenver.edu/academics/colleges/PublicHealth/research/ResearchProjects/piper/projects/RIO/Pages/Study-Reports.aspx).

Because YCPs apply to soccer competitions and not practices, this study included only HS soccer competition-related injuries and AEs captured by HS RIO. Furthermore, because YCPs are implemented to reduce foul play, which in soccer primarily means illegal athlete–athlete contact, this study analyzed only those injuries reported as resulting from athlete–athlete contact. Given the nature of the study design (retrospective study analyzing deidentified data captured by an institutional review board–approved prospective longitudinal surveillance program, no intervention performed, and

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**TABLE 1. High School Soccer Yellow Card Accumulation Policy Implementation Date by State**

| State          | Academic Year Implemented |
|----------------|---------------------------|
| California*    | 2010/11 (Central Section only) |
| Connecticut    | 1994/95                   |
| Idaho          | 2013/14                   |
| Illinois       | 2014/15                   |
| Indiana        | 2009/10                   |
| Maine          | 2016/17                   |
| Massachusetts  | 1992/93                   |
| Missouri       | 2006/07                   |
| New Hampshire  | 2007/08                   |
| New Mexico     | 2012/13                   |
| New York       | 2007/08                   |
| North Carolina | 2002/03                   |
| Oklahoma       | 2007/08                   |
| Rhode Island   | 2008/09                   |
| Wisconsin      | 2000/01                   |
| All other states | No YCP as of the 2017/18 academic yr |

* In California, only the Central Section has implemented a YCP. Consequently, data from California high schools were eliminated from the analyses in this study.
data presented only in aggregate), informed consent was not obtained from the HS soccer players whose injury data were analyzed. Institutional review board approval for this evaluation study was granted from Rhode Island Hospital.

**Measures**

In HS RIO, a reportable soccer competition injury was defined as one that (1) occurred as a result of an organized HS soccer competition, (2) required medical attention from a team physician, AT, personal physician, or emergency department/urgent care facility, and (3) resulted in restriction of the athlete’s participation for one or more days beyond the day of injury. For each injury, the AT completed a detailed report that included date of injury, exposure (eg, soccer competition), injury characteristics (eg, body site, diagnosis, severity, and TL.), and circumstances leading to injury (eg, mechanism and specific activity at time of injury). A competition AE was defined as 1 athlete participating in 1 soccer competition.

**Rate of athlete–athlete contact injury** was defined as the number of athlete–athlete contact injuries sustained in soccer competitions during the study period divided by the total number of competition AEs in the same period multiplied by 10 000.

For the purpose of this study, severe injury was defined as any of the following: concussions, fractures, ACL injuries, injuries that resulted in surgical intervention, and injuries that resulted in >3 weeks’ TL that included injuries categorized as “returned to activity in 22 days or more,” “medical disqualification for season,” or “medical disqualification for career.”

Presence of YCP was defined as whether or not a YCP was in effect at the time of injury in the injured player’s state of HS attendance.

**Statistical Analysis**

Descriptive statistics delineated the number and rates of soccer-specific athlete–athlete contact injuries sustained during competition in states with and without YCPs. Poisson regressions were used to estimate rate ratios (RRs) and 95% confidence intervals (CIs), comparing the rate of athlete–athlete contact injuries occurring in soccer competitions in states with versus without YCPs and pre-YCPs and post-YCPs implementation among states with YCPs as well as stratified by boys’ soccer and girls’ soccer. The Poisson regression models used states without YCPs (or pre-YCPs) as the referent category with a log link function and the logarithm of the AEs as an offset, adjusting for sex. Finally, injury proportion ratios (IPRs) and 95% CI for proportions of severe athlete–athlete contact injuries sustained during soccer competition in HSs in states with and without YCPs were calculated using logistic regressions. A statistical significance level was set as 0.05. All analyses were conducted in SAS 9.4 (SAS Institute Inc. Cary, NC).

**RESULTS**

During the study period, HSs from 47 of the 50 NFHS member states associations in addition to the District of Columbia were represented (Table 1). Regionally, New England and the Upper Midwest had the most states with YCPs. Overall, 901 athlete–athlete contact injuries occurred during 352 775 competition AEs in HSs in states with YCPs, and 3325 athlete–athlete contact injuries occurred during 1 459 708 competition AEs in HSs in states without YCPs (Table 2). There was no significant difference in athlete–athlete contact injury rates between schools in states with and without YCPs overall (RR = 1.07; 95% CI: 0.97-1.17) or in either boys’ (RR = 1.10; 95% CI: 0.99-1.22) or girls’ (RR = 1.02; 95% CI: 0.92-1.13) soccer.

In states with YCPs, there was no significant difference in overall athlete–athlete contact injury rates before and after states’ implementation of YCPs (RR = 1.15; 95% CI: 0.98-1.34) (Table 3). Similarly, no statistically significant relationship was observed in boys’ (RR = 1.21; 95% CI 0.95-1.53) or in girls’ (RR = 1.10; 95% CI: 0.90-1.35) soccer.

When examining the rates of athlete–athlete contact injuries sustained during soccer competition over the course of time by academic year, girls’ soccer had higher injury rates compared with boys’ soccer (Figure 1A, B). For most of the study years, the injury rates were higher among HSs in states with YCPs than those in states without YCPs, and this pattern was observed in both boys’ and girls’ soccer. Among severe athlete–athlete contact injuries (Table 4), a significantly lower proportion of injuries that resulted in >3 weeks’ TL occurred in states with YCPs (IPR = 0.81; 95% CI: 0.66-0.997) compared with states without YCPs, whereas the proportions of other severe injuries, including concussion, fracture, ACL injury, and injury requiring surgical intervention did not differ between states with and without YCPs.

**DISCUSSION**

Our retrospective cohort study, analyzing data captured by a large national HS sports injury surveillance study over a 13-year period, unexpectedly found no significant difference in rates of athlete–athlete contact injuries during soccer competitions in states with/without YCPs and among states with YCPs, no significant change in athlete–athlete contact competition injury rates after YCP implementation. To the best of our knowledge, this is the first study to assess the effectiveness of a FP rule change outside of evaluations of youth and HS ice hockey rule interventions in the United States and Canada.11–15 Our results did not support the effectiveness of HS soccer YCPs reducing athlete–athlete contact injuries. In addition, although the prevalence of injuries that resulted in >3 weeks’ TL was significantly lower in states with YCPs than in states without YCPs, HS soccer YCPs were not effective in reducing the prevalence of other categories of severe injuries evaluated in this study. In 2014, the Institute of Medicine’s Committee on Sports-Related Concussions in Youth acknowledged that while some evidence from youth ice hockey and soccer demonstrates that rule modification and enforcement of player safety and FP policies contributes to a reduction in sports-related injuries, including concussion, more research is necessary to measure the effectiveness of rules in reducing concussion and other sport injury occurrence.16 The unexpected results of this study reinforce this call for further research. Previous research has identified athlete–athlete contact as the leading mechanism of injury in HS soccer.17,18 Yellow card policies aim to reduce foul play, which in soccer is primarily illegal athlete–athlete contact. Thus, intuitively, YCPs should be expected to be an
effective way to reduce HS soccer athlete–athlete competition injuries. Additional studies are needed to determine why this injury prevention strategy has not demonstrated its effectiveness in US HS soccer.

Yellow card policies have been implemented by state HS associations in the United States for 25 years, initially by Massachusetts in 1992/93 and most recently by Maine in 2016/17, in an effort to curtail unsportsmanlike conduct. Yellow card policies have been lauded not only for their effectiveness in deterring aggressive play but for opening up constructive dialog between coaches, players, and administrators. Yellow card policies have not been flawless—they are dependent on officials who observe an athlete engaged in foul play giving the player a yellow card and then also logging all cards into the state associations’ system. In addition, team yellow card limit setting by states need to be stringent enough to discourage dangerous athlete–athlete contact while allowing room for yellow cards not issued for such unsportsmanlike actions (eg, equipment violations). Most states with YCPs have amended their policies after review and comparison with other states’ experiences. Unfortunately, it is unclear if the specific components of various states’ YCPs are evidence based. To the best of our knowledge, there is no data evaluating the compliance with YCPs after their implementation. For example, do officials give out fewer yellow cards after a state implements a YCP because of the increased pressure associated when such an action can result in lost playing time in future games for an athlete? Better understanding officials’ response to YCPs would help determine if YCPs are ineffective as an injury prevention strategy in general or if they merely need to be better enforced.

Given states’ experiences with YCPs reported in the media and state HS association communications, our study results were unexpected. No significant difference in overall contact injury rates between schools in states with/without YCPs nor significant change in overall contact injury rates after states’ adoption of YCPs leads us to believe that policy enactment without enforcement could be a possible explanation for our findings. Alternative explanations could include (1) FP rule changes may take several seasons to reduce foul play as educational efforts directed at players, coaches, and officials require time for implementation and widespread adoption, (2) initial rule changes and their associated enforcement may have been inadequate or inconsistent, (3) the effectiveness of YCPs may have been influenced by other factors not accounted for in our analysis, or (4) the YCPs may have been implemented in states with lower injury rates to begin with, making it more difficult to detect a significant reduction in injury rates.

### Table 2

|            | # Injuries | # Competition AEs | Rate per 10 000 AE | IRR (95% CI)* |
|------------|------------|-------------------|--------------------|---------------|
| Overall    |            |                   |                    |               |
| With YCP†  | 901        | 352 775           | 25.5               | 1.07 (0.97-1.17) |
| No YCP     | 3525       | 1 459 708         | 24.1               | Ref           |
| Boys’ soccer |          |                   |                    |               |
| With YCP   | 430        | 188 626           | 22.8               | 1.10 (0.99-1.22) |
| No YCP     | 1625       | 783 851           | 20.7               | Ref           |
| Girls’ soccer |         |                   |                    |               |
| With YCP   | 471        | 164 149           | 28.7               | 1.02 (0.92-1.13) |
| No YCP     | 1900       | 675 857           | 28.1               | Ref           |

* IRR, injury rate ratio, which is calculated based on Poisson regression as the ratio of injury rate in schools with YCPs (With YCP) to injury rate in schools without YCPs (No YCP).
† “No YCP” includes data from all study years for high schools in states that have not implemented YCPs and data from study years before YCP implementation for high schools in states that implemented YCPs during the study period.
“With YCP” includes data from all study years for high schools in states that implemented YCPs before the start of the study period and data from study years after YCP implementation for high schools in states that implemented YCPs during the study period.

### Table 3

|            | # Injuries | # Competition AEs | Rate per 10 000 AE | IRR (95% CI)* |
|------------|------------|-------------------|--------------------|---------------|
| Overall    |            |                   |                    |               |
| Post-YCP†  | 374        | 150 703           | 24.8               | 1.15 (0.98-1.34) |
| Pre-YCP    | 285        | 130 686           | 21.8               | Ref           |
| Boys’ soccer |          |                   |                    |               |
| Post-YCP   | 169        | 81 031            | 20.9               | 1.21 (0.95-1.53) |
| Pre-YCP    | 118        | 68 262            | 17.3               | Ref           |
| Girls’ soccer |         |                   |                    |               |
| Post-YCP   | 205        | 69 672            | 29.4               | 1.10 (0.90-1.35) |
| Pre-YCP    | 167        | 62 424            | 26.8               | Ref           |

* IRR, injury rate ratio, which is calculated based on Poisson regression as the ratio of injury rate after YCP implementation (Post-YCP) to injury rate before YCP implementation (Pre-YCP).
† “Pre-YCP” includes data from all study years before YCP implementation for high schools in states that implemented YCPs during the study period.
“Post-YCP” includes data from all study years after YCP implementation for high schools in states that implemented YCPs during the study period.
punishments are not strict enough to deter malicious play, (3) YCP adoption by individual states results in a transient (i.e., 1-2 season) but not sustained decrease in injury rates after implementation, (4) states that choose to adopt YCPs have inherently higher rates of foul play than states without YCPs, or (5) YCPs, despite their intentions, are largely ineffective deterrents of foul play in HS soccer because foul play has significant potential to affect the outcome of a game or a team’s ability to advance in tournament play by targeting/purposefully injuring an opposing team’s skill player(s).

Despite no significant effects of YCPs on overall contact injury rates, our study demonstrated that injuries resulting in >3 weeks’ TL were less prevalent in states with YCPs. Cairns et al. have previously described the significance of TL injuries >21 days and their resultant impact on collegiate student athletes. Missing >21 days represents a significant portion of the season in any sport and can have ramifications for HS athletes seeking exposure for college recruitment purposes and for some, opportunities to continue their education and athletic careers beyond HS. Although it is very difficult to

| Injury                          | With YCP # (%)†‡ | No YCP # (%) | IPR (95% CI)§ |
|---------------------------------|------------------|--------------|---------------|
| Concussion                      | 247 (27.4)       | 945 (26.8)   | 1.03 (0.88-1.22) |
| Fracture                        | 72 (8.0)         | 321 (9.1)    | 0.87 (0.66-1.13) |
| ACL                             | 34 (3.8)         | 120 (3.4)    | 1.11 (0.76-1.64) |
| Injury resulted in surgical intervention | 51 (5.7) | 199 (5.7) | 1.00 (0.73-1.38) |
| Injury resulted in >3 weeks’ TL§ | 124 (13.8)       | 581 (16.5)   | 0.81 (0.66-1.00) |

† “No YCP” includes data from all study years for high schools in states that have not implemented YCPs and data from study years before YCP implementation for high schools in states that implemented YCPs during the study period. “With YCP” includes data from all study years for high schools in states that implemented YCPs before the start of the study period and data from study years after YCP implementation for high schools in states that implemented YCPs during the study period.
‡ IPR, injury proportion ratio, which is calculated based on logistic regression with No YCP as the referent category.
§ For each category of injury above, % indicates what proportion of all athlete–athlete contact injuries sustained during soccer competition were accounted for by the specific injury category.
§ Injury resulted in >3 weeks’ TL includes the following categories: “returned to activity in 22 days or more,” “medical disqualification for season,” or “medical disqualification for career.”
§ The precise upper limit of the 95% CI equals 0.997.
quantify the effect of a >21 days TL injury compared with a ≤21 days TL injury, it can be surmised that injuries requiring longer time to return to sport have a negative effect on health-related quality of life for student athletes, including deleterious effects on education. Injury prevention initiatives involving rule changes such as YCPs have the potential to reduce the burden of serious injuries and the associated morbidity among student athletes.

Our study had several limitations. First, our data were from the HS RIO sample and was limited to HSs with certified ATs. Although a sampling strategy has been used by HS RIO to enroll a representative sample, our results are not generalizable to schools without ATs. Second, although using ATs, trained sports medical professionals, as data reporters improve data quality and consistency, our results might be underestimated because only injuries that came to the AT’s attention and resulted in ≥1 day of TL from play were included. Third, we were unable to adjust for the clustering or other potential covariates in our Poisson regression model due to the limitation of injury data we had, which were not collected at an individual athlete level rather at a school level, with participating schools varying by year. Fourth, 15 of 50 Unites States have adopted YCPs over a 25-year period. This slow uptake may be an indication that either there is a perception among state HS associations that YCPs are not effective interventions, or states with YCPs have alerted other states that YCPs are difficult to implement (eg, it is challenging to get officials to comply with YCPs or report yellow cards, knowing their decisions may lead to suspensions of players and disqualifications that may affect tournament eligibility and results). Finally, this study only examined the effects of the presence or absence of the state YCPs on the soccer injury outcomes without collecting data on these states’ compliance with YCPs after their implementation or capturing the variations in these YCPs. Future studies measuring the impact of YCPs should account for variations in the provision, interpretation, implementation, and enforcement of YCPs among schools within and across states.

Despite these limitations, our study lays the groundwork for future longitudinal cohort studies assessing game-related injuries before and after a FP rule change, such as YCPs. Using ATs to collect injuries and athletic exposures could provide essential data to assist state HS associations and other youth sport organizations with policy and rule implementation aimed at reducing athlete–athlete contact injury risk. The effects of state level YCP enforcement, documented illegal activity/foul play, and FP education need to be considered by future studies assessing the impact of HS soccer YCPs. In addition, our study’s unexpected findings highlight the importance of evaluating the effectiveness of injury prevention efforts, such as YCPs, after their implementation. Ineffective interventions should be revised and re-evaluated while effective interventions should be widely adopted.

CONCLUSIONS

Among HS boys’ and girls’ soccer players, playing in states with YCPs did not lower athlete–athlete contact injury rates, although injuries resulting in ≥3 weeks’ TL were less prevalent in states with YCPs. Athlete–athlete contact injury rates were not significantly lower in states after adoption of YCPs. States considering implementation of any injury prevention policy or rule should always capture injury data preimplementation and postimplementation to assure accurate evaluation of the effectiveness of the intervention.

Without collecting this data, implementation of an injury prevention policy may have unintended negative consequences that would require the intervention to be withdrawn. Finally, enactment of YCPs alone, without proper enforcement, may not be a sufficient injury prevention strategy. Further studies assessing the impact of HS soccer YCPs need to consider the effects of state level YCP enforcement, documented illegal activity/foul play, and FP education.

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