GAME STATS Report

INTRODUCTION

Given the current interest of injury rate during football kickoffs, policy makers at all levels of play (NFL, NCAA, NFHS, and youth) have been reviewing current rules and considering potential rule changes addressing this phase of play as a means of increasing player safety. To ensure they have specific high school football injury data available to drive evidence-based discussions of this issue, the NFHS contracted with Dr. Dawn Comstock at the Colorado School of Public Health to conduct a sub-study within US high schools participating in her High School RIO™ sports injury surveillance study reporting football data in fall 2018. Dr. Comstock and her research team collected data in this supplemental football pilot study, called *GAME STATS,* to provide the NFHS Sports Medicine Advisory Committee and Football Rules Committee with high school level information about injury rates and patterns in different phases of play. This data will support discussions as these groups consider how best to keep high school football players as healthy and safe as possible while they enjoy playing football.

METHODS

Sample Recruitment and Data Collection

To be eligible to participate in the *GAME STATS* supplemental football pilot study, schools were required to be enrolled in the 2018/19 High School RIO™ study and assigned to report football injury and exposure data. Eligible schools received at least three e-mails from Dr. Comstock's team introducing and explaining the *GAME STATS* study and notifying schools that participants would receive a $100 participant incentive (in the form of a gift card) in addition to their High School RIO™ participant incentive (an average of $300 per school per academic year). Additionally, eligible schools were assured that their decision to participate in the *GAME STATS* study or not would in no way influence/alter/interfere with their participation in the 2018/19 High School RIO™ study.

A total of 70 (45.8%) of the 153 eligible schools were enrolled in the *GAME STATS* study. Schools participating in *GAME STATS* were asked to have a certified athletic trainer (AT), collect and report information regarding the number of different types of plays that occur during football games using a supplementary football information survey for every football game that occurred in a given week (see appendix for survey). Schools were permitted to report retrospective game data. Certified athletic trainers were able to complete the survey online or fill

out a hard copy which they could email, fax, or mail back to High School RIO™. Throughout the *GAME STATS* study the AT for each school continued to report injury data to High School RIO™ as they normally would.

Data Management

Football injury data from the 2018/19 High School RIO™ study was merged with game data obtained from *GAME STATS*. Injuries were matched to game data based on school, level of play, and date of football game. Furthermore, injuries were considered to be a match if they occurred one day prior or within four days after the date of game to adjust for errors in entry of injury date as well as injuries sustained during games but not brought to the AT's attention until some days time after the competition.

"Blow-out" a dichotomous variable, was created to designate games that ended with a substantial score difference. Games that ended with a score difference of greater than 35 points were considered to be a blow-out game. The cutoff for the score difference to determine a blow-out was based on the distribution of the score differences reported to *GAME STATS*. Additionally, another dichotomous variable was created to identify games that ended with a score difference of less than or equal to 7 points (reflective of close games).

Data Analysis

Data analysis was performed in SAS, Version 9.4 [SAS Institute Inc, Cary, NC]. Overall football injury rates for schools that reported data to *GAME STATS* were calculated based on injury and exposure data collected from the 2018/19 High School RIO™ study and *GAME STATS* supplemental football pilot study. Overall football injury rates were reported per 1,000 athletic exposures. Football injury rates by phase of play (general play offense, general play defense, punts: receiving team, punts: kicking team, kickoffs: receiving team, and kickoffs: kicking team) were calculated based on injury case counts obtained from the 2018/19 High School RIO™ study and phase of play data obtained from *GAME STATS*. Injury rate by phase of play was reported per 1,000 plays. Following is an example of the phase of play injury rate calculation for general play offense:

$$\textbf{Injury Rate} = \frac{\textbf{\# injuries during offensive general play}}{\textbf{total \# offensive general plays}} * \mathbf{1,000}$$

Rate of injury by phase of play were compared using rate ratios with 95% confidence intervals. Phase of play was collapsed into three categories: general play, kickoffs, and punts. Rate of injury during punts were used as the reference group. Rate ratios with a 95% confidence interval that excluded 1.00 were determined to be significant. Following is an example of the rate ratio calculation comparing the rate of injury during kickoffs to the rate of injury during punts:

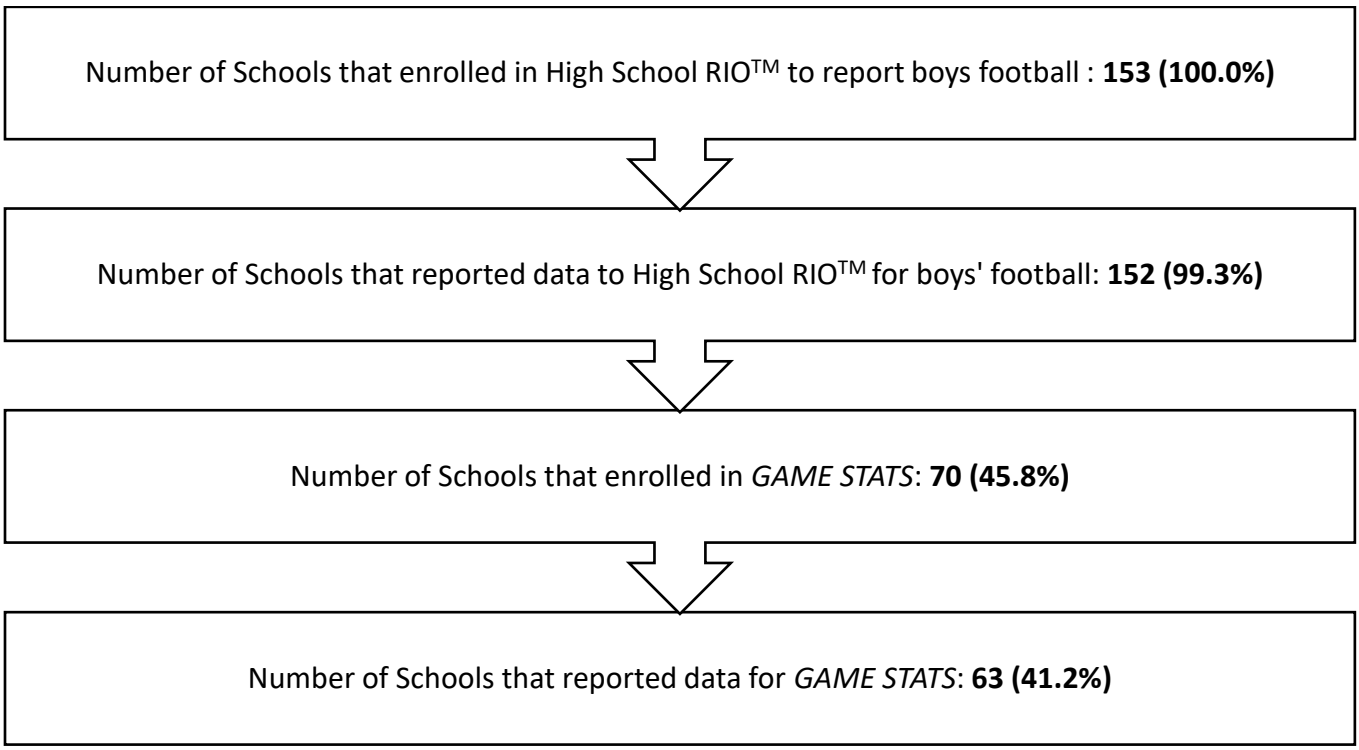
$$\textbf{Rate Ratio} = \frac{\textbf{\# injuries during kickoffs/total \# kickoffs}}{\textbf{\# injuries during punts /total \# punts}}$$

Phase of play injury rate by blow-outs were compared using rate ratios with 95% confidence intervals. Games that did not result in a blow-out was utilized as the reference group. Rate ratios along with their corresponding 95% confidence intervals were reported by phase of play. Rate ratios with a 95% confidence interval that excluded 1.00 were determined to be significant. Similar analyses were conducted to compare close games to games that did not end with a score difference of less than or equal to 7 points.

RESULTS

Of the 153 eligible schools reporting football injury data from the 2018/19 High School RIO™ study, 70 (45.8%) enrolled in *GAME STATS.* Of the 70 schools enrolled in *GAME STATS*, a total of 63 (90.0%) schools reported supplementary football game phase of play exposure data by completing the study survey (see appendix for survey) (Figure 1). Overall, football game phase of play exposure information for a total of 607 games were reported to *GAME STATS*. On average, schools reported data for 9.63 (± 3.10) games, with the number of game reported by each school ranging from 3 through 19. The majority of schools that reported game data were located in the South (31.7%), followed by Midwest (30.2%), Northeast (23.8%), and West (14.3%).

Figure 1. Flow Chart of Schools That Enrolled in High School RIO™ and *GAME STATS*, 2018/19.



Demographic characteristics of schools participating in the 2018/19 High School RIO™ study and *GAME STATS* are present in Table 1.

Table 1. Demographic Characteristics of Schools That Reported Football Data to High School RIO™ and *GAME STATS*, 2018/19.

	HS RIO™ n (%)	*GAME STATS* n (%)
Region		
South	42 (27.5%)	20 (31.7%)
Midwest	41 (26.8%)	19 (30.2%)
Northeast	39 (25.5%)	15 (23.8%)
West	31 (20.3%)	9 (14.3%)
Type of School		
Public	129 (84.3%)	50 (79.4%)
Private	24 (15.7%)	13 (20.6%)
School Size		
1,000 students or less in grades 9 - 12	80 (52.3%)	38 (60.3%)
More than 1,000 students in grades 9 - 12	73 (47.7%)	25 (39.7%)

Overall the demographic characteristics of schools participating in *GAME STATS* were similar to the larger study population of the 2018/19 High School RIO™ high schools.

GAME STATS summary statistics are present in Table 2 and 3.

Table 2. *GAME STATS* Summary Statistics: Level of Play, When the Game Ended, and Whether Game Ended in a Blow-out or was a Close Game. *GAME STATS* Data 2018/19

		Games n (%)
Level of Play	Varsity	553 (91.1)
	Freshman	24 (4.0)
	JV	30 (4.9)
When did the game end?	End of Regulation	601 (99.0)
	Overtime	4 (0.7)
	Other*	2 (0.3)
Did the game end in a blow-out? **	No	463 (76.3)
	Yes	144 (23.7)
Did the game end with a score difference of ≤ 7 points?	No	468 (77.1)
	Yes	139 (22.9)

*Other includes games that ended due to inclement weather.

**Games that ended with a score difference of greater than 35 points were considered to be a blow-out game.

The majority of games reported to *GAME STATS* were varsity games (91.1%) and almost all games ended at regulation (99.0%) (Table 2). A total of 144 (23.7%) games ended with a score difference greater than 35 points and 139 (22.9%) games ended with a score difference of ≤ 7 points. (Table 2).

Table 3. *GAME STATS* Summary Statistics: Phase of Play and Game Score. *GAME STATS* Data 2018/19

	Mean (SD)	Min	Max
Phase of Play			
Number of general plays: offense*	52.92 (12.65)	16	104
Number of general plays: defense*	53.31 (13.26)	20	93
Number of kickoffs: kicking team	4.54 (2.33)	0	12
Number of kickoffs: receiving team	4.34 (2.33)	0	11
Number of punts: kicking team	3.15 (2.14)	0	11
Number of punts: receiving team	3.18 (2.26)	0	21
Game Score			
Final score of your opponent	23.62 (16.66)	0	75
Final score of your team	24.97 (16.24)	0	75
Final score difference**	1.35 (27.44)	-61	70

*General plays do not include special teams.
**Final score difference was calculated by subtracting the opponent's teams final score from the final score of the school reporting data to GAME STATS.

On average, the final score difference for games reported to *GAME STATS* was 1.35 points. However, the difference in final scores varied by a large amount as seen in the wide range of -61 to 70 and the standard deviation of 27.44 (Table 3).

Overall football injury rates specifically for schools that reported data to *GAME STATS* are presented in Table 4.

Table 4. Overall Football Injuries Rates (per 1,000 Athletic Exposures) Among Schools that Reported Data to *GAME STATS*. High School RIO™ Data 2018/19.

	Injuries n (%)	Athletic Exposures	Rate per 1,000 AE's	Rate Ratio (95%CI)*
Competition	674 (61.7%)	40,841	16.50	8.23 (7.26, 9.33)
Practice	378 (34.6%)	188,512	2.01	Ref
Total**	1,092 (100.0%)	229,326	4.76	-

*95% confidence intervals excluding 1.00 were considered significant.
**7 (0.6%) injuries were classified as other and 33 (3.0%) injuries were missing information on type of play.

Competition injury rates were 8.23 times higher than practice injury rates and this difference was statistically significant (95%CI: 7.26, 9.33) (Table 4).

Injury rates by type and severity of injury and phase of play are presented in Tables 5 and 6.

Table 5. Injury Rates (per 1,000 plays) by Type of Injury and Phase of Play. High School RIO RIO™ and *GAME STATS* Data 2018/19.

Phase of Play (n=73,710)	Overall		Concussions		Fractures		Sprain/Strains	
	Number of Injuries	*Injury Rate (per 1,000 plays)*	*Number of Injuries*	*Injury Rate (per 1,000 plays)*	*Number of Injuries*	*Injury Rate (per 1,000 plays)*	*Number of Injuries*	*Injury Rate (per 1,000 plays)*
General Play Offense* ***(n=32,123)***	156	4.86	19	0.59	23	0.72	73	2.27
General Play Defense* ***(n=32,357)***	119	3.68	28	0.87	14	0.43	52	1.61
Punts: Receiving Team ***(n=1,932)***	3	1.55	1	0.52	1	0.52	0	0.00
Punts: Kicking Team ***(n=1,912)***	4	2.09	1	0.52	0	0.00	1	0.52
Kickoffs: Receiving Team ***(n=2,632)***	9	3.42	4	1.52	2	0.76	2	0.76
Kickoffs : Kicking Team ***(n=2,754)***	7	2.54	3	1.09	1	0.36	3	1.09

*General plays do not include the special teams plays (i.e., kick offs or punts).
Note: Cell sizes less than 10 should be interpreted with caution.

Overall data was available for 73,710 unique plays during the 607 games reported in this study, for an average of 121.4 plays per game. General plays for both offense and defense had the highest injury rates (4.86 and 3.68 per 1,000 plays, respectively), while punts for both receiving and kicking team had the lowest injury rates (1.55 and 2.09 per 1,000 plays, respectively) (Table 5). Concussion rates were highest among kickoffs for both receiving and kicking team (1.52 and 1.09 per 1,000 plays, respectively).

Table 6. Injury Rates (per 1,000 plays) by Severity of Injury and Phase of Play. High School RIO RIO™ and *GAME STATS* Data 2018/19.

Phase of Play (n=73,710)	Overall		Injury Resulting in Surgery		Time Loss >3 Weeks	
	Number of Injuries	*Injury Rate (per 1,000 plays)*	*Number of Injuries*	*Injury Rate (per 1,000 plays)*	*Number of Injuries*	*Injury Rate (per 1,000 plays)*
General Play Offense* (n=32,123)	156	4.86	11	0.34	41	1.28
General Play Defense* (n=32,357)	119	3.68	15	0.46	39	1.21
Punts: Receiving Team (n=1,932)	3	1.55	0	0.00	1	0.52
Punts: Kicking Team (n=1,912)	4	2.09	0	0.00	1	0.52
Kickoffs: Receiving Team (n=2,632)	9	3.42	1	0.38	5	1.90
Kickoffs : Kicking Team (n=2,754)	7	2.54	1	0.36	4	1.45

*General plays do not include the special teams plays (i.e., kick offs or punts).
Note: Cell sizes less than 10 should be interpreted with caution.

Severity of injury did not differ substantially by phase of play (Table 6)

Comparisons of injury rates by phase of play are presented in Table 7.

Table 7. Comparison of Injury Rates (per 1,000 plays) by Phase of Play. High School RIO™ and *GAME STATS* Data 2018/19.

Phase of Play* (n=73,710)	Overall			Concussions		
	Number of Injuries	*Injury Rate (per 1,000 plays)*	Rate Ratio (95% CI)**	*Number of Injuries*	*Injury Rate (per 1,000 plays)*	Rate Ratio (95% CI)**
Punts ***(n=3,844)***	7	1.82	Ref	2	0.52	Ref
General Plays ***(n=64,480)***	275	4.26	2.34 (1.11, 4.95)	47	0.73	1.40 (0.34, 5.76)
Kickoffs ***(n=5,386)***	16	2.97	1.63 (0.67, 3.96)	7	1.30	2.50 (0.52, 12.02)

*Phase of play was collapsed in three categories. General plays do not include special teams plays (i.e., kick offs or punts).
**95% confidence intervals excluding 1.00 were considered statistically significant.
Note: Cell sizes less than 10 should be interpreted with caution.

The injury rate in general plays was 2.34 times higher than injury rate in punts (95%CI: 1.11, 4.95) and this difference was statistically significant (Table 7). The injury rate in kickoffs was 1.63 times higher than injury rate in punts (95%CI: 0.67, 3.96), however this difference was not statistically significant. Similarly, although the injury rate in general plays was higher than the injury rate in kickoffs (RR:1.44, 95%CI: 0.87, 2.37) this difference was not statistically significant. Although concussion rates were higher in kickoffs (RR:2.50) and general plays (RR:1.40) compared to punts, these differences were not statistically significant.

Phase of play injury rates by whether the game ended in a blow-out is presented in Table 8.

Table 8. Phase of Play Injury Rates (per 1,000) by Whether Game Ended in A Blow-out[ŦŦ]. High School RIO™ and *GAME STATS* Data 2018/19.

Phase of Play	Injury Rate Blow-out (per 1,000 plays)	Injury Rate No Blow-out (per 1,000 plays)	Rate Ratio** (95% CI)
General Play Offense*	6.01	4.55	1.32 (0.93, 1.88)
General Play Defense*	3.45	3.74	0.92 (0.59, 1.44)
Punts: Receiving Team	0.00	2.03	-
Punts: Kicking Team	0.00	2.68	-
Kickoffs: Receiving Team	5.93	2.55	2.32 (0.62, 8.61)
Kickoffs : Kicking Team	4.03	1.99	2.02 (0.45, 9.01)

[ŦŦ]Games that ended with a score difference of greater than 35 points were considered to be a blow-out game.
*General plays do not include special teams plays (i.e., kick offs or punts).
**Games that did not result in a blow-out was the reference group. 95% confidence intervals excluding 1.00 were considered significant.
Note: Cell sizes less than 10 should be interpreted with caution.

Across the six phases of play no significant differences in injury rates were noted between games that ended in a blow-out and games that did not end in a blow-out (Table 8). However, for offensive general plays, the rate ratio was found to be on the border line of statistical significance with injury rates in games that ended in a blow-out being 1.32 times higher than the injury rate in games that did not end in a blow-out (95%CI: 0.93, 1.88). The rates of injury were more than twice as high in kickoffs for both receiving teams and kicking teams during games that ended in a blow-out compared to games that did not end in a blow-out (RR:2.32 and RR:2.02, respectively) but these differences were not statistically significant.

Phase of play injury rates by whether the game ended in a score difference of ≤ 7 points is presented in Table 9.

Table 9. Phase of Play Injury Rates (per 1,000) by Whether Game Ended in A Score Difference of ≤ 7 points. High School RIO™ and *GAME STATS* Data 2018/19.

Phase of Play	Injury Rate Score Diff. ≤ 7 points (per 1,000 plays)	Injury Rate Score Diff. > 7 points (per 1,000 plays)	Rate Ratio** (95% CI)
General Play Offense*	4.67	4.91	0.95 (0.66, 1.38)
General Play Defense*	3.30	3.79	0.87 (0.56,1.35)
Punts: Receiving Team	2.15	1.36	1.57 (0.14, 17.31)
Punts: Kicking Team	3.99	1.42	2.82 (0.40, 19.94)
Kickoffs: Receiving Team	3.55	3.38	1.05 (0.22, 5.03)
Kickoffs : Kicking Team	1.80	2.73	0.66 (0.08, 5.47)

*General plays do not include special teams plays (i.e., kick offs or punts).
**Games that resulted in a score difference of >7 points was the reference group. 95% confidence intervals excluding 1.00 were considered significant.
Note: Cell sizes less than 10 should be interpreted with caution.

Across the six phases of play no significant differences in injury rates were noted between games that ended in score difference of ≤ 7 points and games that did not end in a score difference of ≤ 7 points (Table 9). The rate of injury was approximately three times as high in punts for kicking teams during games that ended in a score difference of ≤ 7 points compared to games that did not end in a score difference of ≤ 7 points (RR:2.82) but this difference was not statistically significant

CONCLUSIONS

Although injury rates among US high school football players varied by phase of play, type of injury, and whether games were blow-outs or close games, few statistically significant differences were observed. Overall data was available for 73,710 unique plays during the 607 games reported in this study, an average of 121.4 plays per game. Although this is a substantive amount of data, there were relatively small numbers of injuries sustained during some phases of play. Thus, caution should be used when interpreting the results in this report.

Overall injury rates were highest in general play offense then defense, followed by kickoffs receiving team then kicking team, and lowest in punts receiving team then kicking team. This indicates that, while additional rule changes to reduce injury rates during kickoffs may effectively further reduce injury rates, this phase of play is already safer than general play. However, concussion rates were highest in kickoffs receiving team then kickoffs kicking team, followed by general play defense then general play offense, and lowest in both punts receiving team and kicking team. This indicates that any rule changes focused on kickoffs should aim to prevent concussions.

Some have hypothesized that injury rates may be higher in blow-outs due to one team being so dramatically outmatched by their opponent or, alternatively that injury rates may be higher in close games due to the potentially increased intensity as both teams strive to win. Neither of those hypotheses were borne out in this study. Although 23.7% of reported games ended in blow-outs and another 22.9% of games ended in close games, there were no statistically significant differences noted in any phase of play in either blow-outs or close games.

The largest potential limitation of this study was the potential lack of generalizability. Because a true evaluation of generalizability is not possible (due to lack of data from non-participating schools) the closest surrogate available was evaluated. Although only 41.2% of the eligible high schools participated in the *GAME STATS* supplemental football pilot study, the demographic characteristics of schools participating in *GAME STATS* were similar to the larger study population of the 2018/19 High School RIO^{TM} study. High school injury rates per 1,000 AEs reported in this study (overall: 4.76, competition: 16.50, and practice: 2.01) were similar to the injury rates reported by the original sample of in the 2017/18 High School RIO^{TM} study (overall: 4.33, competition: 14.13, and practice: 2.14). Additionally, participating school ATs were able to compile and submit the requested data without any reports of difficulty indicating capturing similar data in future studies should be feasible if there is an interest/need.

APPENDIX

GAME STATS Survey

Supplemental Football Pilot Study, High School RIO™ 2018/2019

Schools participating in GAME STATS are being asked to complete the survey below for <u>every</u> football game that occurs in a given week. Individual forms need to be completed for each level of play (i.e., Freshman, JV, and Varsity games). For example, if there was one freshman, one JV, and one varsity game in a week, three forms will need to be completed, one for each level of play for which stats are available. If your school only collects stats for varsity games that is fine, just complete a form for each varsity game.

Because this pilot study was started mid-season, it is ok if you are only able to provide information for your remaining games. However, if you have stats for games that have already been played, please complete one form for each game for which you have stats.

1. School name: _____
2. Date of game: _____
3. Level of play? (please only check one option)

   Freshmen ☐
   JV ☐
   Varsity ☐

4. Final score for your team? _____
5. Final score for your opponent? _____
6. When did the game end? (please only check one option)

   At the end of regulation ☐
   In overtime ☐

<u>Number of plays/snaps in this game by type of play</u>:

7. Number of kickoffs:

   Receiving team _____

   Kicking team _____

8. Number of punts:

   Receiving team _____

   Kicking team _____

9. Number of general plays (i.e., not special teams' plays) where you were on

   Offense_____

   Defense_____