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EPIDEMIOLOGY OF KNEE INJURIES AMONG US HIGH SCHOOL ATHLETES, 2005/06–2010/11

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Abstract

Purpose—US high school athletes sustain millions of injuries annually. Detailed patterns of knee injuries, among the most costly sports injuries, remain largely unknown. We hypothesize that patterns of knee injuries in US high school sports differ by sport and gender.

Methods—US High school sports-related injury data were collected for 20 sports using the National High School Sports-Related Injury Surveillance System, High School RIO™. Knee injury rates, rate ratios, and injury proportion ratios were calculated.

Results—From 2005/06–2010/11, 5,116 knee injuries occurred during 17,172,376 athlete exposures (AEs) for an overall rate of 2.98 knee injuries per 10,000 AEs. Knee injuries were more common in competition than practice (RR 3.53, 95% CI 3.34–3.73). Football had the highest knee injury rate (6.29 per 10,000 AEs) followed by girls' soccer (4.53) and girls' gymnastics (4.23). Girls had significantly higher knee injury rates than boys in gender-comparable sports (soccer, volleyball, basketball, baseball/softball, lacrosse, swimming and diving, and track and field) (RR

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1.52, 95% CI 1.39–1.65). The most commonly involved structure was the MCL (reported in 36.1% of knee injuries), followed by the patella/patellar tendon (29.5%), ACL (25.4%), meniscus (23.0%), LCL (7.9%), and PCL (2.4%). Girls were significantly more likely to sustain ACL injuries in gender-comparable sports (RR 2.38, 95% CI 1.91–2.95). Overall, 21.2% of knee injuries were treated with surgery; girls were more often treated with surgery than boys in gender-comparable sports (IPR 1.30, 95% CI 1.11–1.53).

Conclusions—Knee injury patterns differ by sport and gender. Continuing efforts to develop preventive interventions could reduce the burden of these injuries.

Keywords

sports; surveillance; meniscus; ACL

INTRODUCTION

Participation in high school athletics has increased for decades(23) and will likely continue. These activities benefit young athletes by improving physical fitness and increasing academic achievement and school performance.(22) As participation increases, sports-related injuries, which can impose significant burdens on the athlete, their families, and the medical system, may also increase.(15) Among the most common sports-related injuries are knee injuries.(5)

Knee injuries pose serious health burdens to athletes of all ages in nearly every sport. (4,6,18,29) They account for 15.2% of all high school sports injuries,(13) often requiring expensive surgical treatment(8,24,25) and prolonged time lost from school and sports participation.(15,26) One international study reports youth athlete knee injury rates, but these may not represent US high school injury patterns because of country-specific differences in sport availability and participation.(5) Previous studies describing US high school sports-related knee injuries reported high rates of knee injuries, high proportions of knee injuries compared to other injuries, increased risk of reinjury, and high numbers of knee injuries requiring surgical treatment, but these were limited in geographic region, described injury patterns in general but not in detail, or did not report injury patterns across a large number of sports.(1,13,14,20,24,26) Multiple studies have investigated knee injury patterns by gender,(2,7,9-12,19) frequently reporting that knee injury rates are higher in female athletes but few studies have directly compared knee injury rates and patterns in both gender-comparable and gender-specific sports.

To our knowledge, no prior study has described US high school sports-related knee injury epidemiology over multiple academic years in a large national sample of athletes participating in a large number of sports. This study used a nationwide injury surveillance system to describe rates and patterns of knee injuries across 20 high school sports. Such information is needed to drive the development and evaluation of injury prevention programs.(28)

MATERIALS AND METHODS

Objectives

The objective of this study was to describe the epidemiology of US high school sports-related knee injuries across multiple years. Specifically, the study aims were to [1] describe rates of knee injury by sport, [2] describe patterns of knee injury by specific injured structures, and [3] describe risk factors and outcomes associated with specific knee injuries. Rates and patterns of knee injuries with national estimates were calculated for 9 sports (football, boys' and girls' soccer, girls' volleyball, boys' and girls' basketball, wrestling, baseball, and softball) for the 2005/06–2010/11 academic years. Additionally, rates and patterns of knee injuries were calculated from a convenience sample of 9 sports (girls' field hockey, girls' gymnastics, boys' ice hockey, boys' and girls' lacrosse, boys' and girls' swimming and diving, and boys' and girls' track and field) for the 2008/09–2010/11 seasons and for boys' volleyball and cheerleading for the 2009/10–2010/11 seasons.

Data collection

Data were collected using the National High School Sports-Related Injury Surveillance System, High School RIO™ (Reporting Information Online), an Internet-based sports injury surveillance system.⁽³⁾ In brief, high schools with one or more National Athletic Trainers' Association-affiliated certified athletic trainers (ATs) with valid email addresses were invited to participate. Interested high schools were categorized into eight strata based on school population (enrollment ≤ 1000 , or > 1000) and US Census geographic region.⁽²⁷⁾ For the 9 sports originally included in the High School RIO™ study (football, boys' and girls' soccer, girls' volleyball, boys' and girls' basketball, wrestling, baseball, and softball), 100 high schools were randomly selected to participate (12 or 13 from each of the 8 strata). If a school dropped out of the study, a replacement from the same stratum was randomly selected to maintain the 100-school study population.

For the additional 11 sports added since 2008/09 (girls' field hockey, girls' gymnastics, boys' ice hockey, boys' and girls' lacrosse, boys' and girls' track and field, boys' and girls' swimming and diving, boys' volleyball, and cheerleading), not enough schools volunteered to report for all sports to fill the 8 strata. Thus, rather than assembling a nationally representative sample, exposure and injury data for these sports were collected from a convenience sample of US high schools with ATs. While all participating schools were asked to report for at least ten sports, with an objective of having 100 schools reporting for each sport, schools with some of the less nationally popular sports (i.e., ice hockey, lacrosse) were enrolled even if they could not report for all sports. If an AT from a convenience sample school also reported information for athletes in one of the original 9 sports, these data were included in the overall convenience sample data but were not included in weighted national estimates.

Definition of injury and exposure

Athlete exposure (AE) was defined as one athlete participating in one practice or competition. A reportable injury was one which [1] occurred as a result of participation in an organized practice, competition, or performance (cheerleading only), [2] required medical

attention by an AT or physician, and [3] resulted in restriction of the athlete's participation for one or more days. ATs logged onto the High School RIO™ website weekly throughout the academic year to report injury incidence and athlete exposure information. For each injury, ATs completed detailed injury reports on the injured athlete (age, height, weight, etc.), the injury (site, diagnosis, severity, etc.), and the injury event (activity, mechanism, etc.). Throughout the study, reporters were able to view previously submitted information and update reports as needed.

Statistical Analysis

Data were analyzed using SPSS software, version 19.0 (SPSS, Chicago, IL), calculating rates and rate comparisons using unweighted case counts for the convenience sample of all 20 sports. Weighted analyses were used to calculate national estimates from data reported by the 100 randomly selected high schools for the 9 original sports. Weighting factors are based on the inverse probability of selection into the study based on school size and location.

Injury rates were calculated as the number of knee injuries per 10,000 AE. Injury rate ratios (RR) and injury proportion ratios (IPR) were calculated with *p*-values and 95% confidence intervals (CI). CI not including 1.00 and *p*-values < 0.05 were considered statistically significant. An RR or IPR > 1.00 suggests a risk association while an RR or IPR < 1.00 suggests a protective association. An example RR calculation is:

$$RR = \frac{\left(\frac{\# \text{competition knee injuries}}{\# \text{competition AEs}} \right)}{\left(\frac{\# \text{practice knee injuries}}{\# \text{practices AEs}} \right)}$$

An example IPR calculation is:

$$IPR = \frac{\left(\frac{\# \text{football knee injuries}}{\# \text{total football injuries}} \right)}{\left(\frac{\# \text{knee injuries in all other sports}}{\# \text{total injuries in all other sports}} \right)}$$

This study was approved by the Institutional Review Board at Nationwide Children's Hospital, Columbus, OH. No informed consent was required because only de-identified data was collected in this purely observational epidemiologic study.

RESULTS

General

From 2005/06–2010/11, 25,700 injuries occurred during 11,268,426 AEs in the 9 sports included in the original study sample for an overall rate of 22.81 injuries per 10,000 AEs. Of these injuries, 3864 (15.1%) were knee injuries, primarily ligament sprains (48.2% of all knee injuries), contusions (14.9%), and meniscal injuries (9.3%). Using our weighted analyses, we estimate 1,234,291 knee injuries occurred during the 2005/06–2010/11 academic years nationally in these 9 sports. In order to more broadly describe knee injuries

in a larger number of US high school sports, only data from all 20 sports included in the combined convenience and original samples will be discussed from this point forward.

During the 2005/06–2010/11 academic years, 5116 knee injuries were reported from the combined original and convenience samples during 17,172,376 AEs, or 2.98 knee injuries per 10,000 AEs (Table 1). The highest injury rates were in football (6.29), girls' soccer (4.53), and girls' gymnastics (4.23). The lowest rate was in boys' swimming and diving (0.15).

Exposure Type

Knee injuries were more common in competition than practice overall (RR 3.53, 95% CI 3.34–3.73) and for every sport except boys' and girls' swimming and diving, boys' and girls' track and field, and cheerleading (Table 1). The highest injury rates in competition were in football (21.08 competition knee injuries per 10,000 competition AEs), girls' soccer (10.84), and girls' gymnastics (9.36).

Overall, boys sustained 70.8% of all knee injuries, with football accounting for 62.0% of boys' knee injuries and 43.9% of all knee injuries. Knee injury rates in football were significantly higher than in girls' soccer – the sport with the second highest rate (RR 1.39, 95% CI 1.26–1.53), all other boys' sports combined (RR 3.24, 95% CI 3.03–3.46), and all girls' sports combined (RR 2.75, 95% CI 2.57–2.93). In gender-comparable sports (soccer, volleyball, basketball, baseball/softball, lacrosse, swimming and diving, and track and field), knee injury rates were significantly higher for girls than boys (RR 1.52, 95% CI 1.39–1.65). Girls had higher rates than boys in soccer (RR 1.71, 95% CI 1.50–1.95), basketball (RR 1.89, 95% CI 1.62–2.20), baseball/softball (RR 1.68, 95% CI 1.28–2.21), and track and field (RR 1.49, 95% CI 1.08–2.06).

Specific Injury Patterns

Beginning with the 2007/08 academic year, specific structures involved in knee injuries were reported. The most commonly involved structure was the medial collateral ligament [MCL] (involved in 36.1% of knee injuries, 0.80 injuries per 10,000 AEs), followed by the patella/patellar tendon (29.5%, 0.65), anterior cruciate ligament [ACL] (25.4%, 0.56), meniscus (23.0%, 0.51), lateral collateral ligament [LCL] (7.9%, 0.17), and posterior cruciate ligament [PCL] (2.4%, 0.05). The most common injury patterns were isolated patella/patellar tendon involvement (26.3%), MCL (25.1%), ACL (12.2%), meniscus (10.7%), LCL (5.1%), and ACL + meniscus (4.7%). Most isolated patella/patellar tendon injuries were dislocation/subluxations (32.7% of patella/patellar tendon injuries), contusions (24.2%), and tendonitis (16.5%).

Football and girls' soccer had the highest rate of ACL injury (1.17 per 10,000 AEs each) followed by girls' gymnastics (1.14) and girls' basketball (1.07) (Table 2). Football was the only sport with a meniscal injury rate over 1 per 10,000 AEs and had the highest rate of MCL injury (2.42 per 10,000 AE). The overall rate of ACL injury between girls and boys was similar (RR 1.01, 95% CI 0.87–1.17), but in gender-comparable sports girls had higher rates (RR 2.38, 95% CI 1.91–2.95). Girls had higher rates in softball vs. baseball (RR 4.99,

95% CI 1.86–13.36), basketball (RR 4.54, 95% CI 2.99–6.89), and soccer (RR 2.33, 95% CI 1.67–3.26).

Outcomes

The proportion of knee injuries treated with surgery overall was 21.2%, and was highest in cheerleading (40.0%), girls' lacrosse (39.3%), and girls' basketball (33.8%) (Figure 1). Knee injuries were significantly more likely to be treated with surgery than all other injuries (IPR 5.52, 95% CI 5.10–5.97). Most knee surgeries were for ligament strains (65.4%) and meniscal injuries (22.0%); 54.0% of all cartilage (meniscal) injuries and 29.6% of ligament strains were treated with surgery. Knee injury diagnosis often involved advanced diagnostic modalities including MRI, accounting for 54.0% of MRI scans for all injuries.

Girls' knee injuries were more often treated with surgery than boys overall (IPR 1.37, 95% CI 1.22–1.52) and in gender-comparable sports (IPR 1.30, 95% CI 1.11–1.53). Girls were more likely to undergo surgery than boys in soccer (IPR 1.36, 95% CI 1.04–1.77) and basketball (IPR 1.34, 95% CI 1.04–1.72). Surgery was delayed to allow continued sports participation in 10.3% of meniscal injuries and 6.8% of ACL injuries. Delayed surgical treatment of meniscal injuries occurred most frequently in gymnastics (50.0%), boys' ice hockey (28.6%), girls' field hockey (22.2%), and boys' wrestling (21.1%). Delayed surgery for ACL injuries occurred most frequently in girls' field hockey (20.0%), boys' basketball (15.0%), boys' wrestling (14.3%), boys' soccer (12.8%), and boys' lacrosse (12.0%).

The most common outcomes associated with knee injuries were loss of participation from 1 to 6 days (35.2% of all knee injuries) or 1 to 3 weeks (26.9%), though these were primarily patella and/or patellar tendon injuries. ACL sprains often resulted in restriction from participation for the duration of the season (47.9% of all ACL injuries).

Factors Associated with Knee Injury

6.5% of all knee injuries occurred while athletes were wearing knee braces. Athletes were wearing braces in 30.4% of recurrent knee injuries but only 3.4% of new knee injuries. Of the 194 knee injuries that occurred while athletes were wearing braces, 88 (45.4%) were wearing a rigid frame, 77 (39.7%) a neoprene sleeve, and 29 (14.9%) were not specified.

Mechanisms of injury varied by sport but most often involved contact with another person (50.3% of all knee injuries) (Table 3). Contact with another person was the most common mechanism of knee injury for boys' football (69.4%), boys' soccer (52.9%), girls' soccer (49.8%), boys' wrestling (50.9%), and boys' ice hockey (49.0%). Non-contact mechanisms were most common in girls' volleyball (42.9%), boys' basketball (35.3%), girls' basketball (35.7%), girls' gymnastics (57.7%), and girls' lacrosse (51.9%).

DISCUSSION

Participation in high school athletics in the US continues to increase (23) with an expectant increase in the number of injuries. Knee injuries in particular can impose serious physical and economic burdens on athletes, such as ACL reconstructive surgery which can cost over \$5000.(21) Our study, the largest, most nationally representative epidemiological study of

knee injuries among US high school athletes to our knowledge, demonstrates the importance of knee injuries and the need to develop more effective injury prevention programs to reduce the occurrence of sports-related knee injuries.

Consistent with previous high school and collegiate athletic injury studies,(1,6,13) knee injuries accounted for 15% of all high school sports injuries. Our results also supported previous reports showing higher knee injury rates in competition compared to practice. (6,13,14) Equally important, a high number of injuries were treated with surgery.(8,24,25) Consistent with a prior study,(24) we found that girls were more likely than boys to undergo surgery for knee injuries in soccer and basketball but we did not find significant gender differences specifically for ACL or meniscus injuries. Potential explanations for gender differences in treatment may include injury severity, physician treatment preferences, or athlete's personal choice. Future research should investigate gender-based differences in surgical treatment decisions.

Girls had higher knee injury rates than boys in each sport except lacrosse, which was consistent with many prior studies.(5,8,18) Collegiate men's and women's lacrosse ACL injury rates also do not differ significantly by gender.(18) Boys' and girls' lacrosse have dramatically different required protective equipment and rules regarding player-player contact, but the mechanics of player-ground contact (running, pivoting, and stopping) are similar. Thus, we expected to find knee injury rates in lacrosse to follow a similar pattern to that of basketball and soccer where girls' rates were higher than boys', but this was not the case. Investigators have suggested possible explanations and interventions aimed at reducing knee injury rates among females,(2,7,9,11,12) and potential screening tests have been suggested to evaluate female athletes at risk for ACL injury.(12) Evidence for effective physical preventive measures (e.g. functional knee bracing) is inconclusive, but focused training and therapies have been shown to be effective at reducing injury rates.(10,11,16,17)

Knee injury rates and patterns differed by sport with the highest rates among those with significant player-player contact, pivoting, jumping, and landing. Despite noteworthy gender-based differences in knee injury patterns, knee injury rates were highest among football players. Meniscal injury rates were higher and MCL injury rates were more than twice as high as in any other sport. The burden of knee injuries among football players is even greater considering that 1,109,836 US high school students participated in football during the 2010/11 academic year – more than any other sport including boys' and girls' basketball (984,777 combined) and boys' and girls' outdoor track and field (1,054,567 combined).(23) Although knee injuries in girls' sports have received considerable attention in recent years, the highest burden of knee injuries is among football players. As bracing has limited abilities to prevent ACL injuries,(16) screening measures and therapies addressing neuromuscular and biochemical risk factors in female athletes (10) may be adapted to male athletes to reduce ACL and other knee injuries among football players.

Limitations of our study should be noted. We limited our sample to high schools with ATs which restricted the potential schools that could be included. However, this ensured a medically-trained professional documented injury thus increasing the quality and consistency of our data. Additionally, because athlete exposures were unit-based rather than

time-based, we were unable to report participation/exposure rates by minute or hour of practice and competition. However, this limitation was necessary to reduce reporter burden. Additionally, data from two samples concurrently enrolled in High School RIO™, the original randomly selected nationally representative sample and the convenience sample, were combined in this report. While only the data from the randomly selected sample is nationally representative of all US high schools with regard to geographical distribution and school size, including the convenience sample data allowed a direct comparison of rates and patterns of injury across a larger number of sports since the reporting methodology for the two samples is identical. While combining the original and convenience samples may limit the generalizability of our findings, this limitation was necessary to enable the comparison across such a large number of sports. Thus, although the convenience sample may not be nationally representative it remains the largest national sample from which such high school sports related injuries have been captured to date. Finally, the convenience sample of high schools did not allow us to provide national estimates for knee injury patterns in all 20 sports. Despite these limitations, this study remains one of the largest nationwide epidemiologic studies describing knee injuries among US high school athletes.

CONCLUSION

We believe that participation in high school sports will continue to increase in the US. Knee injuries are a potentially devastating problem among US high school athletes and impose substantial time and financial burdens on athletes' families and the healthcare system. In most major gender-comparable sports, girls sustained knee injuries at higher rates than boys. Gender-specific lacrosse injuries were not significantly different, which differs from the pattern of soccer and basketball and warrants further investigation. Football players account for nearly half of all knee injuries and sustain them at rates higher than in any other sport. Injury prevention strategies should continue to be a high priority given the findings herein and the need to reduce the incidence and severity of knee injuries among US high school athletes.

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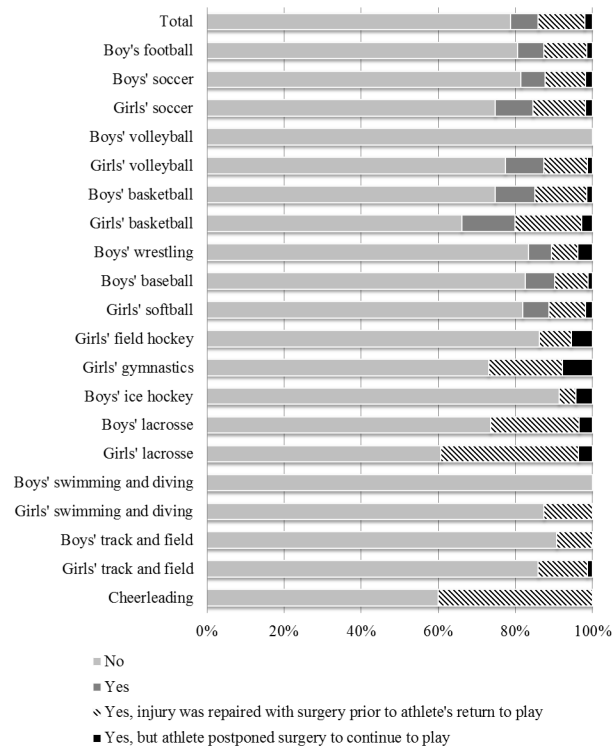


FIGURE 1. Surgical treatment decisions for all knee injuries by sport High School Sports-Related Injury Surveillance Study, United States, 2005/06–2010/11.^a

^a“Yes” or “no” were the only possible survey responses from 2005/06–2007/08. From 2008/09–2010/11, possible responses were “No”, “Yes, injury was repaired with surgery prior to athlete’s return to play,” and “Yes, but athlete postponed surgery to continue to play.”

TABLE 1

Incidence and rates of knee injury per 10,000 athlete exposures by sport and type of exposure, High School Sports-Related Injury Surveillance Study, United States, 2005/06–2010/11.

	Count	Rates			RR (95% CI) ^{a,b}	
		Total	Competition	Practice		Performance
Total	5116	2.98	6.34	1.79	0.58	3.53 (3.34–3.73)
Boys	3624	3.40	7.45	2.07		3.60 (3.37–3.84)
Girls	1492	2.29	4.78	1.31	0.58	3.65 (3.29–4.05)
Football	2247	6.29	21.08	3.27		6.45 (5.94–7.01)
Soccer						
Boys	362	2.65	5.09	1.60		3.18 (2.58–3.92)
Girls	531	4.53	10.84	1.77		6.14 (5.07–7.43)
Volleyball						
Boys ^c	1	0.28	0.84	0.00		N-A ^e
Girls	165	1.42	1.99	1.13		1.75 (1.29–2.38)
Basketball						
Boys	271	1.68	2.96	1.15		2.58 (2.04–3.28)
Girls	417	3.18	6.36	1.81		3.51 (2.89–4.27)
Wrestling	439	3.58	5.68	2.85		1.99 (1.65–2.41)
Baseball	92	0.74	1.18	0.51		2.30 (1.53–3.48)
Softball	117	1.25	2.24	0.73		3.06 (2.11–4.44)
Girls' field hockey ^d	75	2.35	3.29	1.92		1.72 (1.09–2.71)
Girls' gymnastics ^d	26	4.23	9.36	3.02		3.11 (1.43–6.76)
Boys' ice hockey ^d	49	2.22	4.63	1.07		4.34 (2.39–7.88)
Lacrosse ^d						
Boys	91	2.68	4.60	1.82		2.52 (1.67–3.80)
Girls	57	2.33	4.66	1.30		3.60 (2.11–6.13)
Swimming and diving ^d						
Boys	4	0.15	0.00	0.18		N-A ^e
Girls	8	0.25	0.16	0.28		0.59 (0.07–4.78)

	Count	Rates			RR (95% CI) ^{a,b}
		Total	Competition	Practice	
Track and field ^d					
Boys	68	0.87	1.24	0.79	1.57 (0.92–2.69)
Girls	81	1.30	1.71	1.21	1.41 (0.85–2.34)
Cheerleading ^c	15	0.41	0.34	0.37	1.38 (0.47–4.04) ^f

^aRR, rate ratio; CI, confidence interval

^bCompares the rates of knee injury during competition to the rates during practice.

^cData collected from 2009/10–2010/11.

^dData collected from 2008/09–2010/11.

^eRate ratios could not be calculated because there were no practice knee injuries.

^f“Performance” injuries were combined with “Competition” injuries for RR.

TABLE 2

Rates of anterior cruciate ligament (ACL), meniscus, and medial collateral ligament (MCL) injury per 10,000 athlete exposures by sport, High School Sports-Related Injury Surveillance Study, United States, 2005/06–2010/11.

	ACL		Meniscus		MCL	
	Rate	RR (95% CI) ^{a,b}	Rate	RR (95% CI) ^{a,b}	Rate	RR (95% CI) ^{a,b}
Total	0.56		0.51		0.80	
Boys ^c	0.26		0.22		0.28	
Girls ^c	0.61	2.38 (1.91–2.95)	0.42	1.88 (1.48–2.40)	0.44	1.57 (1.26–1.96)
Football	1.17		1.15		2.42	
Soccer						
Boys	0.50		0.35		0.50	
Girls	1.17	2.33 (1.67–3.26)	0.89	2.55 (1.71–3.78)	1.12	2.22 (1.58–3.11)
Volleyball						
Boys ^d	0.00		0.00		0.28	
Girls	0.28		0.19		0.15	0.52 (0.07–3.99)
Basketball						
Boys	0.24		0.28		0.29	
Girls	1.07	4.54 (2.99–6.89)	0.59	2.11 (1.38–3.25)	0.63	2.20 (1.44–3.35)
Wrestling	0.41		0.80		0.97	
Baseball	0.06		0.08		0.10	
Softball	0.28	4.99 (1.86–13.36)	0.22	2.81 (1.15–6.90)	0.26	2.63 (1.18–5.85)
Girls' field hockey ^e	0.31		0.34		0.25	
Girls' gymnastics ^e	1.14		0.65		0.98	
Boys' ice hockey ^e	0.09		0.36		0.59	
Lacrosse ^e						
Boys	0.79		0.44		0.76	
Girls	0.78	0.98 (0.54–1.76)	0.61	1.39 (0.68–2.84)	0.29	0.37 (0.16–0.86)
Track and field ^e						
Boys	0.05		0.13		0.05	
Girls	0.16	3.13 (0.98–9.98)	0.16	1.25 (0.52–3.01)	0.11	2.19 (0.64–7.48)

	ACL		Meniscus		MCL	
	Rate	RR (95% CI) ^{a,b}	Rate	RR (95% CI) ^{a,b}	Rate	RR (95% CI) ^{a,b}
Cheerleading ^d	0.14		0.03		0.03	

^aRR, rate ratio; CI, confidence interval

^bCompares the rates of girls' injuries to boys'.

^cOnly includes gender-comparable sports: soccer, volleyball, basketball, baseball/softball, lacrosse, and track and field.

^dData collected from 2009/10–2010/11.

^eData collected from 2008/09–2010/11.

Primary mechanisms of knee injury by sport, High School Sports-Related Injury Surveillance Study, United States, 2005/06–2010/11.

TABLE 3

	Contact with another person	No contact	Contact with playing surface	Overuse /chronic	Other ^d
Total	50.3%	22.2%	15.5%	7.1%	4.9%
Boys	58.9%	17.8%	14.2%	4.9%	4.2%
Girls	29.5%	32.8%	18.9%	12.2%	6.6%
Football	69.4%	14.7%	10.5%	2.7%	2.7%
Soccer					
Boys	52.9%	21.7%	11.4%	6.7%	7.2%
Girls	49.8%	27.1%	10.6%	8.1%	4.4%
Volleyball					
Boys ^b	0.0%	0.0%	100.0%	0.0%	0.0%
Girls	9.2%	42.9%	34.4%	9.2%	4.3%
Basketball					
Boys	31.2%	35.3%	21.6%	9.7%	2.2%
Girls	29.2%	35.7%	22.7%	8.0%	4.6%
Wrestling	50.9%	14.0%	27.0%	2.4%	5.7%
Baseball	19.6%	28.3%	28.3%	8.7%	15.2%
Softball	17.9%	25.6%	23.9%	15.4%	17.1%
Girls' field hockey ^c	9.5%	27.0%	12.2%	33.8%	17.6%
Girls' gymnastics ^c	0.0%	57.7%	38.5%	0.0%	3.8%
Boys' ice hockey ^c	49.0%	8.2%	28.6%	0.0%	14.3%
Lacrosse ^c					
Boys	34.4%	33.3%	13.3%	8.9%	10.0%
Girls	16.7%	51.9%	3.7%	22.2%	5.6%
Swimming and diving ^c					
Boys	0.0%	25.0%	0.0%	75.0%	0.0%
Girls	0.0%	28.6%	14.3%	28.6%	28.6%
Track and field ^c					

	Contact with another person	No contact	Contact with playing surface	Overuse /chronic	Other ^a
Boys	0.0%	27.3%	12.1%	56.1%	4.5%
Girls	0.0%	28.4%	22.2%	38.3%	11.1%
Cheerleading ^b	6.7%	40.0%	33.3%	13.3%	6.7%

^aIncludes "contact with out-of-bounds object" and "overuse/chronic" injuries.

^bData collected from 2009/10–2010/11.

^cData collected from 2008/09–2010/11.