
WHAT’S KNOWN ON THIS SUBJECT: Shoulder injuries are common among high school athletes. These injuries, both traumatic and overuse, contribute to significant time loss from athletic activity. Understanding sport-specific injury patterns is critical for development of targeted injury prevention programs.

WHAT THIS STUDY ADDS: This study is the most comprehensive analysis of high school shoulder injuries to date, providing national injury estimates while examining injury rates, diagnoses, severity, and mechanisms of injury in 9 interscholastic sports.

abstract

OBJECTIVES: The objective of this study was to describe shoulder injuries in a nationally representative sample of high school athletes playing 9 sports. A national estimate of shoulder injuries among high school athletes was subsequently calculated.

METHODS: Injury data were collected in 9 sports (boys’ football, soccer, basketball, wrestling, and baseball; girls’ soccer, volleyball, basketball, and softball) during the 2005–2006 through 2011–2012 academic years from a nationally representative sample of high schools via High School Reporting Information Online.

RESULTS: During the 2005–2006 through 2011–2012 academic years, high school athletes in this study sustained 2798 shoulder injuries during 13 002 321 athlete exposures, for an injury rate of 2.15 per 10 000 athlete exposures. This corresponds to a nationally estimated 820 691 injuries during this time period. Rates of injury were higher in the playing 9 sports. A national estimate of shoulder injuries among high school athletes was subsequently calculated.

RESULTS: During the 2005–2006 through 2011–2012 academic years, high school athletes in this study sustained 2798 shoulder injuries during 13 002 321 athlete exposures, for an injury rate of 2.15 per 10 000 athlete exposures. This corresponds to a nationally estimated 820 691 injuries during this time period. Rates of injury were higher in competition as compared with practice (rate ratio = 3.17 [95% confidence interval: 2.94–3.41]). The highest rate of injury was in football (4.86) and the lowest in girls’ soccer (0.42). The most common types of injury were strain/sprain (37.9%) and dislocation/separation (29.2%). Boys were more likely than girls to sustain their injuries after contact with another person or with the playing surface. Surgical repair was required for 7.9% of the injuries. Time loss from athletic participation varied among sports, with 40.7% of athletes returning within 1 week, whereas 8.2% were medically disqualified for their season/career.

CONCLUSIONS: High school shoulder injury rates and patterns varied by sport and gender. Prospective epidemiologic surveillance is warranted to discern trends and patterns to develop evidence-based interventions to prevent shoulder injuries. Pediatrics 2014;133:272–279

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KEY WORDS

shoulder injuries, epidemiology, high school athletes

ABBREVIATIONS

AE—athlete exposure
AT—athletic trainer
CI—confidence interval
GC—gender-comparable
IPR—injury proportion ratio
RIO—Reporting Information Online
RR—rate ratio

Dr Robinson conceptualized the study, analyzed and interpreted the data, drafted the initial manuscript, and coordinated manuscript revisions; Ms Corlette provided the study file, helped with data analysis, critically reviewed the manuscript, and contributed to manuscript revisions; Ms Collins helped with data analysis, critically reviewed the manuscript, and contributed to manuscript revisions; Dr Comstock designed the nationwide data collection system of high school athletic injuries from which this study is drawn, provided access to the data set, critically reviewed the manuscript, and contributed to manuscript revisions; and all authors approved the final manuscript as submitted.

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Athletic participation is common among adolescents, with more than half of all high school students participating in school-sanctioned sports during the 2011–2012 academic year.1 Sport participation is beneficial to overall health, but carries with it a significant risk of injury. Shoulder injuries are noted to be among the top 3 most common body sites of injury among high school football players,2,3 the most common site among high school and collegiate wrestlers,4 and the fifth most common site among all high school athletes.5 Types of sports-related shoulder injury are varied but can generally be categorized as either acutely traumatic or secondary to overuse.6 Short-term effects of shoulder injuries include pain and reduction in athletic participation, whereas long-term effects can result in lifelong shoulder pain, instability, and osteoarthritis.7 Previous epidemiologic surveys of shoulder injuries in athletes have focused on their occurrence in specific sports.9–17 the mechanics of shoulder injuries in repetitive throwing sports,18–21 risk factors of specific body part injuries (including shoulder) in specific sports,5,22–25 and diagnosis of particular types of shoulder injuries.6,26–28 One previous study investigated all shoulder injuries among high school athletes during 2 academic years.29 To date, no study has compared shoulder injury rates and patterns across multiple high school sports over many years, while simultaneously calculating national estimates of shoulder injuries among all US high school athletes.

Our objective was to describe high school shoulder injuries among athletes participating in 9 sports (football, soccer, basketball, wrestling, and baseball for boys, and soccer, volleyball, basketball, and softball for girls) by using a nationally representative sample over the academic years 2005–2006 through 2011–2012. Additionally, we calculated national estimates of shoulder injuries in each sport and compared shoulder injury rates by sport and gender. Having a more detailed understanding of the patterns of sports-related shoulder injuries will aid in the development of targeted, evidence-based interventions to reduce their occurrence.

METHODS

Data Collection
We analyzed data from the National High School Sports-Related Injury Surveillance System, High School Reporting Information Online (RIO), an Internet-based sports injury surveillance system, which has been described previously.30–34 Briefly, annual invitations to participate in High School RIO were sent to high schools with 1 or more National Athletic Trainers’ Association-affiliated certified athletic trainers (ATs) with valid e-mail addresses. Each responding high school was then assigned to 1 of 8 strata based on school population (enrollment ≤1000 or >1000) and US census geographic region.35 For the 9 sports included in the study since 2005–2006 (boys’ football, boys’ and girls’ soccer, girls’ volleyball, boys’ and girls’ basketball, boys’ wrestling, boys’ baseball, and girls’ softball), 100 high schools were randomly chosen 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 chosen to maintain the 100-school study population. ATs from participating high schools logged onto the study Web site weekly during the academic year to report injury incidence and athlete exposure (AE) information.

Definition of Injury and Exposure
An AE was defined as 1 athlete participating in 1 practice or competition. ATs reported any injury that (1) occurred as a result of participation in an organized practice or competition; (2) required medical attention by an AT or physician; and (3) resulted in restriction of the athlete’s participation for 1 or more days. All fractures were also reported, even if no time was lost from sports participation. 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, ATs were able to view all data they submitted and update reports as required.

For this study, a shoulder injury was defined as any injury to the proximal humerus, scapula, clavicle, acromioclavicular joint, and surrounding tendons, ligaments, and musculature. A small number (77) of injuries were removed from the sample for several reasons. This included injuries recorded in multiple concurrent body parts (including shoulder), shoulder injuries described as skin infections, and shoulder injuries sustained outside of scholastic competition or practice.

Statistical Analysis
Analyses of our data were performed by using SPSS software, version 19.0 (IBM SPSS Statistics, IBM Corporation). Rates and rate comparisons were calculated by using unweighted case counts for the original sample for all 9 sports. Additional weighted analyses were calculated by using national estimates from data reported by the 100 randomly selected high schools where the weights account for the total number of US schools and the number of participating study schools in each stratum.

Injury rates were calculated as the number of injuries per 10,000 AEs. We also calculated injury rate ratios (RRs) and injury proportion ratios (IPRs) with P values and 95% confidence intervals (CIs). CIs not including 1.00 and
P values < 0.05 were considered statistically significant. An RR or IPR >1.00 suggests increased risk, whereas an RR or IPR <1.00 suggests reduced risk. Example RR and IPR calculations are as follows:

\[
RR = \frac{\text{number of competition injuries/number of competition AEs}}{\text{number of practice injuries/number of practice AEs}}
\]

\[
IPR = \frac{\text{# of baseball shoulder injuries resulting in fracture among boys/# of total baseball shoulder injuries among boys}}{\text{# of softball shoulder injuries resulting in fracture among girls/# of total softball shoulder injuries among girls}}
\]

This study was approved by the Nationwide Children’s Hospital Human Subjects Review Board, Columbus, OH.

### RESULTS

During the 2005–2006 through 2011–2012 academic years, ATs reported 2798 shoulder injuries during 13 002 321 AEs, for an overall rate of 2.15 shoulder injuries per 10 000 AEs in the 9 sampled sports (Table 1). These 2798 injuries correspond to an estimated 820 691 shoulder injuries occurring in high school athletes during the same academic period.

<table>
<thead>
<tr>
<th>No. of Injuriesa</th>
<th>No. of Exposures</th>
<th>Injury Rate (per 10 000 AEs)</th>
<th>Risk Ratio (95% CI)b</th>
<th>Nationally Estimated No. of Injuries</th>
</tr>
</thead>
</table>

**Overall total** 2798 13 002 321 2.15 820 691

**Competition** 1515 3 528 305 4.29 3.17 (2.94–3.41)c 445 121

**Practice** 1283 9 474 016 1.35 2.75 1.00 375 570

**Boys’ football total** 1707 3 513 977 4.86 3.17 (2.94–3.41)c 445 121

**Competition** 965 587 976 16.41 6.47 (5.88–7.12)c 273 751

**Practice** 742 2 926 001 2.54 205 403

**Girls’ soccer total** 46 1 090 820 0.42 205 403

**Competition** 28 326 817 0.86 1.00 36 879

**Practice** 18 764 003 0.24 7514

**Boys’ sports total** 2505 8 626 396 2.90 715 734

**Competition** 1382 2 133 024 6.48 3.75 (3.46–4.05)c 398 344

**Practice** 1123 6 493 372 1.73 317 390

**Girls’ sports total** 293 4 375 925 0.67 104 957

**Competition** 133 1 013 949 1.12 1.89 (1.22–2.93)c 15 096

**Practice** 40 315 152 1.27 15 096

**Boys’ wrestling total** 480 1 313 803 4.06 116 421

**Competition** 231 286 439 7.79 2.84 (2.37–3.41)c 59 307

**Practice** 249 835 364 2.74 57 114

**Boys’ baseball total** 179 1 203 847 4.06 116 421

**Competition** 87 425 918 2.04 1.73 (1.29–2.32)c 29 612

**Practice** 92 777 029 1.18 29 612

**Girls’ softball total** 80 911 814 0.88 32 080

**Competition** 40 315 152 1.27 1.89 (1.22–2.93)c 40 736

**Practice** 40 315 152 1.27 40 736

**Boys’ GCb sports total** 338 9 890 616 0.85 120 158

**Competition** 186 1 248 809 1.49 2.68 (2.16–3.32)c 65 283

**Practice** 152 2 732 007 0.56 54 873

**Girls’ GCb sports total** 202 5 204 437 0.62 73 844

**Competition** 114 1 013 949 1.12 2.68 (2.17–3.17)c 40 736

**Practice** 88 2 240 488 0.39 33 108

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a Twenty-two injuries out of original 2820 that did not list whether injury occurred during competition or practice were excluded from the analyses.

b Practice is the referent category for all risk ratios.

c Designates statistically significant risk ratios (95% CI excludes 1.00).

d GC sports include soccer, basketball, and baseball/softball.
school athletes participating in these sports nationwide during this period. More than half of these recorded injuries were sustained in boys’ football (58.4%), with another 14.2% in boys’ wrestling and 7.8% in boys’ baseball. Injury rates per 10,000 AEs were also highest in boys’ football (4.86) and boys’ wrestling (4.06). Shoulder injuries constituted 8.4% of all injuries to US high school athletes over the course of the study period.

Shoulder injury rates were significantly higher in competition as compared with practice overall (RR: 3.17 [95% CI: 2.94–3.41]) as well as in 8 of the 9 sports individually. The only sport with significantly lower rates of injuries in competition as compared with practice was girls’ volleyball (RR: 0.51 [95% CI: 0.31–0.85]). When comparing all 9 sports, boys had double the risk of injury during competition versus practice as compared with girls (RR: 3.75 [95% CI: 3.46–4.05] vs 1.78 [95% CI: 1.41–2.24]). When comparing only gender-comparable (GC) sports (soccer, basketball, and baseball/softball), risk of injury among boys and girls in competition as compared with practice was equal (RR: 2.68 [95% CI: 2.16–3.32] vs 2.86 [95% CI: 2.17–3.78], respectively).

Among all shoulder injuries, 84.3% were new and 15.4% were recurrences. New injuries outnumbered recurrent injuries in all sports (Fig 1). Of the 9 sampled sports, boys’ and girls’ basketball had the highest percentage of shoulder injury recurrences (29.4% and 20.4%, respectively), whereas boys’ and girls’ soccer had the lowest percentage of recurrences (9.8% and 3.2%, respectively). Surgery was required more often with recurrent (22.1%) than with new (5.2%) shoulder injuries.

Characteristics of Shoulder Injuries
Sprains/strains (37.9%) and dislocations/separations (29.2%) made up more than two-thirds of all shoulder injuries and were also the most common types of shoulder injury among both boys and girls (Table 2). When comparing all 9 sampled sports, boys were more likely than girls to sustain fractures (IPR = 2.20 [95% CI: 1.05–4.59]), and trended toward higher rates of contusions (IPR = 1.56 [95% CI: 0.82–2.97]) and dislocations/separations (IPR = 1.26 [95% CI: 0.98–1.63]). Girls trended toward higher rates of strains/sprains (IPR = 1.10 [95% CI: 0.91–1.32]) than their male counterparts. Among GC sports, differences in injury types between boys and girls were not statistically significant.

In terms of injury mechanism in all 9 sports, boys were significantly more likely than girls to sustain their injury by contact with another person (IPR = 3.07 [95% CI: 2.35–4.01]). Girls conversely were more likely than boys to sustain their injury by contact with the playing apparatus (IPR = 4.84 [95% CI: 2.77–8.48]) or by noncontact (IPR = 4.14 [95% CI: 3.32–5.16]). When comparing GC sports, differences in injury mechanisms between boys and girls were not statistically significant.

The overwhelming majority (>90% in both boys and girls) of athletes did not require surgery for their shoulder injury. Among all 9 sports, boys were more likely to require surgery than girls (IPR = 2.89 [95% CI: 1.57–5.31] vs 2.43 [95% CI: 1.14–5.20], respectively). Nearly 90% of the total shoulder injuries requiring surgery were sustained in boys’ football (66.6%), boys’ wrestling (13.1%), and boys’ baseball (8.1%). Boys’ basketball and boys’ football were the sports with the highest percentage of shoulder injuries requiring surgery (13.1% and 9.0%, respectively).

Time to return to activity among all 9 sports is shown in Table 3, with 40.7% of all athletes returning to play their sport within 1 week, whereas 8.2% were medically disqualified (for season or career). Boys were statistically significantly more likely than their female counterparts to be medically disqualified from the season or for their career both when comparing all 9...
sports (IPR = 4.41 [95% CI: 2.11–9.22]) as well as the subset of GC sports (IPR = 3.72 [95% CI: 1.50–9.21]). Many shoulder injuries were relatively minor because 40.0% of boys and 45.5% of girls were able to return to play within 1 week of initial injury. Notably, 10.6% of shoulder injuries sustained in boys’ basketball and 10.5% sustained in boys’ soccer resulted in medical disqualification for the season or were career-ending injuries. Girls’ soccer injuries were also severe, with 25.1% of shoulder injuries keeping the athlete out of play for more than 3 weeks.

**DISCUSSION**

Our study, the most comprehensive examination to date of shoulder injuries among high school athletes, revealed that an estimated 820,691 shoulder injuries were sustained by athletes participating in the 9 sports of interest during the 7 academic years from 2005–2006 through 2011–2012. Shoulder injury rates varied significantly by sport, gender, and setting (competition versus practice). Many of these injuries resulted in the athlete’s medical disqualification for the season or even for his or her career; whereas a small but not negligible percentage of these athletic injuries required surgical intervention. With more than half of all high school students participating in interscholastic athletics,1 and with the recent emphasis upon limiting unnecessary health care costs in the United States, it behooves health care providers, ATs, and policy makers to develop and implement evidence-based interventions to prevent shoulder injuries in this population.

Shoulder injuries occurred at a rate of 2.15 per 10,000 AEs in our 7-year study, a finding strengthening an earlier High School RIO study,29 which revealed a rate of 2.27 shoulder injuries per 10,000 AEs in a similar population over 2 academic years. Injury rates in our High School RIO study were significantly skewed by boys’ football (4.86 per 10,000 AEs, and 58.4% of all shoulder injuries) and boys’ wrestling (4.06 per 10,000 AEs, and 14.2% of all shoulder injuries), which is consistent with earlier studies of shoulder injuries in high school15,29 and collegiate16,17,36,37 athletes. Our study sought to mitigate the skewing influence of these 2 sports on the overall injury rate by also comparing a subset of GC sports (boys’ and girls’ soccer, boys’ and girls’ basketball, and baseball/softball). Not surprisingly, the overall boys’ (0.85) and girls’ (0.62) injury rates in GC sports were significantly lower than the injury rate in all 9 sports combined (2.15). Targeting football- and wrestling-specific interventions to limit shoulder injuries with a focus on appropriate protective equipment, an emphasis on proper tackling and wrestling technique, and stricter enforcement of rules by referees may result in significantly lower numbers of shoulder injuries in this population.38,39

More than 3 times as many shoulder injuries in our study were sustained during competition as compared with

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>All Sports</td>
<td>Total, %</td>
</tr>
<tr>
<td>Type of injury</td>
<td></td>
</tr>
<tr>
<td>Strain/sprain</td>
<td>37.9</td>
</tr>
<tr>
<td>Contusion</td>
<td>10.1</td>
</tr>
<tr>
<td>Fracture</td>
<td>9.6</td>
</tr>
<tr>
<td>Dislocation/separation</td>
<td>29.2</td>
</tr>
<tr>
<td>Other</td>
<td>13.2</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
<tr>
<td>Mechanism</td>
<td></td>
</tr>
<tr>
<td>Contact with another person</td>
<td>55.7</td>
</tr>
<tr>
<td>Contact with playing surface</td>
<td>25.5</td>
</tr>
<tr>
<td>Contact with playing apparatus</td>
<td>2.9</td>
</tr>
<tr>
<td>No contact/overuse Injury</td>
<td>14.4</td>
</tr>
<tr>
<td>Other</td>
<td>1.5</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
<tr>
<td>Need for surgery</td>
<td></td>
</tr>
<tr>
<td>Surgery</td>
<td>7.9</td>
</tr>
<tr>
<td>No surgery</td>
<td>92.1</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
<tr>
<td>GC sports&lt;sup&gt;c&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Type of injury</td>
<td></td>
</tr>
<tr>
<td>Strain/sprain</td>
<td>36.3</td>
</tr>
<tr>
<td>Contusion</td>
<td>8.0</td>
</tr>
<tr>
<td>Fracture</td>
<td>10.6</td>
</tr>
<tr>
<td>Dislocation/separation</td>
<td>26.5</td>
</tr>
<tr>
<td>Other</td>
<td>18.6</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
<tr>
<td>Mechanism</td>
<td></td>
</tr>
<tr>
<td>Contact with another person</td>
<td>25.1</td>
</tr>
<tr>
<td>Contact with playing surface</td>
<td>32.0</td>
</tr>
<tr>
<td>Contact with playing apparatus</td>
<td>4.3</td>
</tr>
<tr>
<td>No contact/overuse Injury</td>
<td>35.5</td>
</tr>
<tr>
<td>Other</td>
<td>3.2</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
<tr>
<td>Need for surgery</td>
<td></td>
</tr>
<tr>
<td>Surgery</td>
<td>6.5</td>
</tr>
<tr>
<td>No surgery</td>
<td>93.5</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>

<sup>a</sup> Groups without asterisks were used as referent (ie, for strain/sprain, boys were used as the referent group).

<sup>b</sup> Statistically significant (95% CI excludes 1.00).

<sup>c</sup> Includes soccer, basketball, and baseball/softball.
Girls’ volleyball was the only sport in which participants were more likely to be injured in practice than in competition, consistent with the earlier High School RIO study but countering other findings of no difference between practice and competition injuries among collegiate volleyball players. Higher rates of competition injury in the other sports likely reflect the fact that competitions tend to be more physically demanding of athletes and often place a high value on individual risk-taking. Additionally, of the 9 sports studied, volleyball has the least amount of athlete–athlete contact during competition. Other epidemiologic research of high school and collegiate athletic injuries has consistently demonstrated similar elevated rates among athletes in competition when compared with practice. Although higher rates of injury in competition may be inevitable for the reasons above, more research is needed to identify game- or competition-based interventions to limit shoulder injuries.

Our study revealed that the predominant types of shoulder injuries were sprains and dislocations/separations, consistent with earlier studies of shoulder injuries among similar populations of athletes. Our study also demonstrated similar elevated rates among athletes in competition when compared with practice. Although higher rates of injury in competition may be inevitable for the reasons above, more research is needed to identify game- or competition-based interventions to limit shoulder injuries.

### Table 3: Shoulder Injury Severity by Sport, National High School Sports-Related Injury Surveillance Study, United States, 2005–2006 Through 2011–2012 School Years

<table>
<thead>
<tr>
<th>Sport</th>
<th>Count</th>
<th>%</th>
<th>Count</th>
<th>%</th>
<th>Count</th>
<th>%</th>
<th>Count</th>
<th>%</th>
<th>Count</th>
<th>%</th>
<th>Count</th>
<th>%</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys’ football</td>
<td>65,052</td>
<td>14.0</td>
<td>132,680</td>
<td>29.6</td>
<td>60,191</td>
<td>13.0</td>
<td>80,518</td>
<td>17.4</td>
<td>49,945</td>
<td>10.8</td>
<td>42,558</td>
<td>9.2</td>
<td>32,688</td>
</tr>
<tr>
<td>Boys’ soccer</td>
<td>35,022</td>
<td>9.6</td>
<td>86,547</td>
<td>23.7</td>
<td>32,757</td>
<td>9.0</td>
<td>65,148</td>
<td>17.8</td>
<td>66,525</td>
<td>18.2</td>
<td>38,388</td>
<td>10.5</td>
<td>40,980</td>
</tr>
<tr>
<td>Girls’ soccer</td>
<td>15,989</td>
<td>7.9</td>
<td>37,857</td>
<td>18.5</td>
<td>31,553</td>
<td>15.5</td>
<td>46,055</td>
<td>22.6</td>
<td>51,075</td>
<td>25.1</td>
<td>235</td>
<td>1.3</td>
<td>18,949</td>
</tr>
<tr>
<td>Girls’ volleyball</td>
<td>58,988</td>
<td>20.4</td>
<td>11,637</td>
<td>39.7</td>
<td>60,087</td>
<td>22.6</td>
<td>21,887</td>
<td>7.5</td>
<td>13,733</td>
<td>4.7</td>
<td>498</td>
<td>1.7</td>
<td>1,001</td>
</tr>
<tr>
<td>Boys’ basketball</td>
<td>44,433</td>
<td>24.8</td>
<td>27,519</td>
<td>15.4</td>
<td>18,577</td>
<td>10.4</td>
<td>28,979</td>
<td>16.7</td>
<td>30,246</td>
<td>16.9</td>
<td>18,849</td>
<td>10.6</td>
<td>929</td>
</tr>
<tr>
<td>Girls’ basketball</td>
<td>42,352</td>
<td>22.2</td>
<td>47,500</td>
<td>24.9</td>
<td>16,547</td>
<td>8.7</td>
<td>40,765</td>
<td>21.4</td>
<td>21,491</td>
<td>11.3</td>
<td>667</td>
<td>3.5</td>
<td>1,522</td>
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<tr>
<td>Boys’ wrestling</td>
<td>12,070</td>
<td>10.8</td>
<td>23,808</td>
<td>21.3</td>
<td>16,691</td>
<td>14.9</td>
<td>21,937</td>
<td>19.1</td>
<td>15,339</td>
<td>13.7</td>
<td>10,581</td>
<td>9.3</td>
<td>12,913</td>
</tr>
<tr>
<td>Boys’ baseball</td>
<td>9,986</td>
<td>15.9</td>
<td>13,995</td>
<td>22.2</td>
<td>11,682</td>
<td>13.7</td>
<td>12,146</td>
<td>19.3</td>
<td>7,979</td>
<td>12.7</td>
<td>3,874</td>
<td>6.1</td>
<td>6,558</td>
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<tr>
<td>Girls’ softball</td>
<td>5,838</td>
<td>18.3</td>
<td>7,999</td>
<td>25.1</td>
<td>6,083</td>
<td>21.3</td>
<td>5,829</td>
<td>18.3</td>
<td>2,988</td>
<td>9.4</td>
<td>645</td>
<td>2.0</td>
<td>1,819</td>
</tr>
<tr>
<td>Overall total</td>
<td>112,703</td>
<td>14.2</td>
<td>210,046</td>
<td>26.5</td>
<td>108,895</td>
<td>13.7</td>
<td>140,250</td>
<td>17.7</td>
<td>94,567</td>
<td>11.9</td>
<td>64,807</td>
<td>8.2</td>
<td>62,278</td>
</tr>
<tr>
<td>Boys’ total</td>
<td>95,044</td>
<td>13.7</td>
<td>181,894</td>
<td>26.2</td>
<td>90,675</td>
<td>13.1</td>
<td>123,553</td>
<td>17.8</td>
<td>82,941</td>
<td>12.0</td>
<td>62,741</td>
<td>9.1</td>
<td>56,087</td>
</tr>
<tr>
<td>Girls’ total</td>
<td>17,659</td>
<td>17.6</td>
<td>28,152</td>
<td>28.0</td>
<td>18,220</td>
<td>18.1</td>
<td>16,697</td>
<td>16.6</td>
<td>11,628</td>
<td>11.6</td>
<td>20,662</td>
<td>2.1</td>
<td>6,191</td>
</tr>
<tr>
<td>Boys’ GC total</td>
<td>17,922</td>
<td>15.3</td>
<td>25,409</td>
<td>21.6</td>
<td>13,794</td>
<td>11.7</td>
<td>21,639</td>
<td>18.4</td>
<td>17,657</td>
<td>15.0</td>
<td>9,002</td>
<td>8.2</td>
<td>11,386</td>
</tr>
<tr>
<td>Girls’ GC total</td>
<td>11,671</td>
<td>16.4</td>
<td>16,515</td>
<td>23.2</td>
<td>11,613</td>
<td>16.3</td>
<td>14,509</td>
<td>20.3</td>
<td>10,253</td>
<td>14.4</td>
<td>1,582</td>
<td>2.2</td>
<td>5,190</td>
</tr>
</tbody>
</table>

* Medical disqualification from season or for career.
* Other category includes athletes who chose not to continue, were released from team, or whose season ended before recovery from injury.
* GC sports include soccer, basketball, and baseball/softball.
necessary to prevent shoulder injuries, whereas in non- or partial-contact sports like boys’ baseball, girls’ softball, and girls’ volleyball with more emphasis on performing repetitive movements, an increased focus on technique coupled with a decrease in numbers of repetitions would also likely be beneficial.

Although the large majority of athletes with shoulder injuries in our study did not require surgery in their management, boys were almost twice as likely as girls to require surgery for their shoulder injury, which is consistent with previous studies.

Boys shoulder injury, which is consistent as girls to require surgery for their management of high school athletes excluded from previous studies. At the other extreme, our study is the first to report sport-specific rates of medical disqualification secondary to injury, with more than 10% of shoulder injuries resulting in medical disqualification for the season or for an athlete’s career in the sports of boys’ basketball and boys’ soccer.

This study is not without limitations. Generalizability to all US high schools is limited by the fact that the High School RIO surveillance system only collects data at high schools with National Athletic Trainers’ Association-affiliated ATs. Because of the training acquired by these ATs, however, we can expect an overall higher quality and consistency of data collection. Data were only collected on those injuries resulting in at least 1 day of time lost. This suggests that our data are an underestimation of total shoulder injuries sustained during this time period. Additionally, our definition of an AE as a single athlete’s participation in 1 practice or competition is less precise than a time-based measure. This, however, is consistent with other injury surveillance models, especially in cases where 1 reporter (an AT) is responsible for recording injuries occurring at different sites concurrently. Finally, we report on only 9 of the 20 total High School RIO sports, because data from the remaining 11 sports are not complete through our entire study period and because we are currently unable to compute national injury estimates in all 20 sports.

CONCLUSIONS

The shoulder is among the most commonly injured body sites in high school athletes. This study represents the largest, most comprehensive epidemiologic investigation of high school shoulder injuries to date. Investigations into the rates and patterns of shoulder injuries across both boys’ and girls’ sports as described in this study increase our understanding of injury risk factors and spur the development of injury prevention programs. Continued prospective surveillance is necessary to monitor injury rates, to gain further information about risk factors leading to shoulder injuries, and ultimately to inform the development, implementation, and evaluation of evidence-based interventions to prevent future shoulder injuries.

ACKNOWLEDGMENTS

This and all other studies reporting data from the High School RIO surveillance system would not be possible without the cadre of dedicated high school ATs who participate by reporting injury data.

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