

A Prospective Study of High School Wrestling Injuries*

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ABSTRACT

We performed a prospective study to evaluate injury patterns in a large population of high school wrestlers during one season. Preseason screening was performed on 458 male wrestlers from 14 different high schools. Certified athletic trainers submitted detailed weekly team and individual injury reports. There were 219 injuries in 418 wrestlers followed throughout the season for an overall injury incidence of 52 injuries per 100 wrestlers per season and an injury rate of 6.0 injuries per 1000 exposures. The most commonly injured areas were the shoulder (24%) and knee (17%). Injured wrestlers were an average of 5 months older and had a 32% higher experience level than noninjured wrestlers. Wrestlers with ligamentous laxity suffered fewer shoulder injuries than the other wrestlers. The majority of injuries occurred in practice (63%), although the injury rate was higher in match competitions. Sixty-eight percent of practice injuries occurred during hard wrestling, 23% during drills, and 9% during conditioning. The most common wrestling situation resulting in injury was the takedown position (68%). Our results show that the older and more experienced wrestler may be at greater risk of injury. Hard wrestling during practice and the takedown position resulted in the highest occurrence of injury.

Wrestling has remained a popular sport throughout the United States at all levels of competition. The National Federation of State High School Associations' 1998 Sports

Participation Survey found that the sport of wrestling ranked sixth in the number of male participants (229,176) and eighth in the number of schools participating (8900).³⁰ Intercollegiate wrestling remains popular, but there has been a steady decline in the overall number of programs and participants. In 1996, there were 257 schools with wrestling teams and 6345 wrestlers. These numbers have decreased from the peak in the early 1970s when there were more than 9000 wrestlers on nearly 400 collegiate teams.²²

There are few reports in the literature documenting high school wrestling injuries and fewer still that follow these athletes throughout an entire season. Requa and Garrick²⁵ studied four high schools during a 2-year period and found the most commonly injured area to be the spine and trunk (34%, 60 of 176), followed by the lower extremities (33%, 58 of 176) and the upper extremities (29%, 51 of 176). Lorish et al.¹⁸ documented the types of injuries in adolescent and preadolescent boys at two large wrestling tournaments. The primary areas injured were the upper extremity (33%, or 73 of 221 injuries) and neck and back (24%, or 53 of 221 injuries). In addition, older wrestlers and perhaps heavier wrestlers were reported to have an increased risk of injury. Strauss and Lanese²⁹ studied four wrestling tournaments involving athletes ranging from age 9 to the college level. Nine- to 14-year-old boys were the least frequently injured (3.8%, 11 of 291) per tournament, with high school and college-aged wrestlers being more frequently injured (12%, 91 of 758). They also found a wide variety of injuries, with the most common being knee and ankle sprains. Although these studies found most injuries to be minor, the authors still recommended the attendance of medical personnel at all wrestling activities because of the potential for injury.

The purpose of our study was to prospectively evaluate injuries in a high school wrestling population followed for an entire season. The main objective was to identify common injury patterns as well as potential areas in which prevention measures might be instituted.

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MATERIALS AND METHODS

Preseason Screening

Fourteen high school wrestling teams were enrolled in the study after consent was obtained from the school officials, coaches, and certified athletic trainers. Preseason screening was performed on 458 participating athletes from 14 different high schools during the first 3 weeks of the practice season. Screening consisted of a questionnaire and a standard preseason participation physical. Physical examinations of the large joints were performed to identify any existing injuries or other gross abnormalities. All wrestlers were examined for generalized ligamentous laxity using six standardized tests^{4,5,12,28}: 1) thumb to forearm, 2) small finger metacarpophalangeal joint hyperextension of more than 90°, 3) elbow hyperextension of more than 10°, 4) knee hyperextension of more than 10°, 5) ankle hyperextension of more than 45°, and 6) palms to floor (with the knees straight). All six standardized tests were performed to allow direct comparison with prior studies, although the efficacy of these tests has been previously questioned.

Definitions of Injury and Injury Exposure

An injury was defined as any significant condition limiting function that caused an athlete to seek medical care by a trainer or physician, caused a practice or match to be discontinued, and resulted in lost time from athletic participation for 1 or more days.^{16,21,31} Aggravations or reinjuries during the 3-month season were not included as new injuries. All medical conditions and skin conditions were excluded from the calculation of total injury incidence and rate, but they are reported for informational purposes. An injury exposure was defined as one wrestler participating in either one practice or one match in which he was exposed to the possibility of athletic injury.²¹

Weekly School and Individual Injury Reports

Each participating high school had weekly school and individual injury reports completed by an on-site certified athletic trainer. Athletic trainers completed the reports by screening athletes who came through the training room as well as by weekly communication with the wrestling coaching staff and team members. Weekly school injury reports consisted of the number of practice hours, number of match competitions, and the number of wrestlers participating to determine injury exposure rates. The match competitions were divided into varsity and nonvarsity. The number of wrestlers actually participating was carefully monitored weekly by recording the number of wrestlers joining the team or quitting the team in addition to those out with an injury. The total number of injuries each week was reported, as was the number of wrestlers returning from an injury.

An individual injury report was completed for every new injury or illness throughout the entire 3-month season. The report consisted of individual data including weight

class, varsity versus nonvarsity, diagnosis, side injured, position of the wrestler during injury, type of move causing the injury, mechanism of injury, and whether the injury occurred in practice or match competition. Comparisons using weight class and varsity versus nonvarsity were made only for injuries occurring in matches to help correct for over- or underrepresentation of participants in these groups. The diagnosis was subdivided into anatomic region and type of injury. Practice exposure was counted by hours of practice and subdivided into drills ("practicing moves"), conditioning, and hard wrestling ("live wrestling"). Match competition was subdivided into first, second, and third periods (injuries occurring in overtime were included with third period occurrences). The treatment of injuries was recorded and included who treated the wrestler, treatment modalities, and compliance with treatment. Compliance was defined as excellent if all treatment recommendations were followed, good if most treatment recommendations were followed with no increased risk of injury, fair if some treatment recommendations were followed with possible increased risk of injury, and poor if no treatment recommendations were followed.

Follow-up was performed until the wrestler returned to competition or quit the team so that the total number of lost practices or matches was recorded. Lost time was cumulative and included any reinjuries. Season-ending injuries were excluded from the overall determination of lost time since they occurred at different times throughout the season and would therefore provide misleading numbers. Forty wrestlers quit for noninjury-related reasons before the completion of the season, leaving a total of 418 wrestlers followed the entire season. Twenty athletes quit for social reasons (for example, breaking student athlete or team rules, or for disciplinary problems), 7 for academic reasons, and 13 for personal reasons.

In-Season Injury Surveillance

Each of the team trainers or coaches was contacted on a weekly basis to confirm timely submission of the school and individual injury reports. All injury reports were reviewed by the authors for discrepancies or missing information. The individual trainers, coaches, or wrestlers were then contacted to correct or add all information as completely as possible.

Statistical Analysis

Chi-square analyses were performed to determine the statistical significance of relations between nominal variables (for example, hand dominance versus lead leg with takedown). Factorial analysis of variance (ANOVA) was employed to determine the statistical significance of effects of measured parameters on injury occurrence. The statistical analysis was performed using StatView 4.01 software (Abacus Concepts, Berkeley, California).

RESULTS

Overall Injury Incidence and Rates

There were 219 injuries in the 418 wrestlers followed throughout the season for an overall injury incidence of 52 injuries per 100 wrestlers per season. Sixty-three wrestlers had multiple injuries, which included 50 with 2 injuries, 8 with 3 injuries, 4 with 4 injuries, and 1 with 5 injuries. There was a total of 36,473 practice or match exposures during the 3-month season, giving an overall injury rate of 6.0 wrestling injuries per 1000 exposures.

What Injuries Occurred (Injury Regions and Types)

The most commonly injured regions were the shoulder (24%) and knee (17%) (Fig. 1). Shoulder injuries included 32 rotator cuff muscle strains, 10 acromioclavicular joint separations, 7 shoulder subluxations or dislocations, and 3 shoulder contusions. Knee injuries included 15 knee contusions, 10 meniscus tears, 6 medial collateral ligament tears, 4 cases of prepatellar bursitis, 2 ACL tears, and 1 case of patellar tendinitis.

The most common injury types were muscle strains (30.6%), joint sprains (22.8%), and bruises (16%) (Table 1). The most common type of muscle strain involved the rotator cuff (48%, $N = 32$) and the most common joint sprains were in the ankle (38%, $N = 19$). Forty-three percent of all bruises involved the knee ($N = 15$), followed by 20% in the chest region ($N = 7$). All lacerations involved the mouth (five), eye (three), or head (one). The "other" injury category included four cases of prepatellar bursitis, three brachial plexus stingers, three external ear hematomas (cauliflower ear), three cerebral concussions, and one nasal hematoma. No catastrophic injuries or fatalities were encountered in our study population.

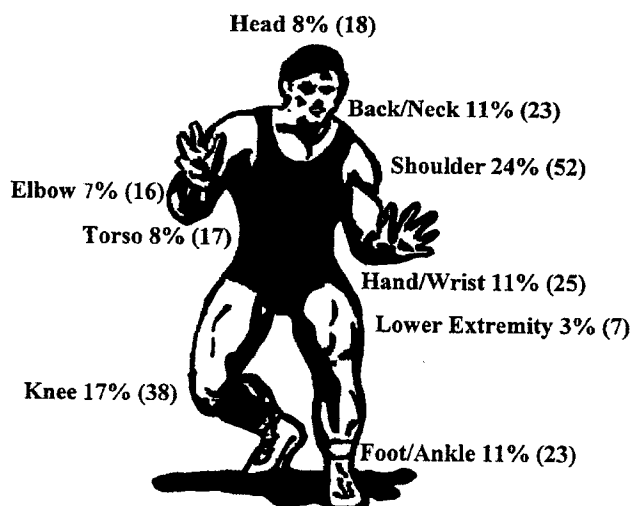


Figure 1. Anatomic regions of the body injured by percent of total injuries and the actual number of injuries (in parentheses).

TABLE 1
Types of Injuries Seen in the Study Population

Injury	Percentage	N
Muscle strain	30.6	(67)
Joint sprain	22.8	(50)
Bruise	16.0	(35)
Fracture	4.6	(10)
Cartilage tear	4.6	(10)
Separation	4.6	(10)
Laceration	4.1	(9)
Dislocation	2.7	(6)
Subluxation	2.7	(6)
ACL tear	0.9	(2)
Other	6.4	(14)

Who Was Injured

The preseason screening revealed some useful information about the wrestling population studied. The average age of the wrestlers screened was 15.6 ± 1.3 years (range, 14 to 19). The injured wrestlers were an average of 5 months older than the uninjured wrestlers ($P = 0.0019$). There was a positive correlation between a wrestler's hand dominance and the lead leg used during takedowns ($P < 0.0001$). No statistically significant relationship could be established between the lead leg used during takedowns and the occurrence of injury in that leg during takedowns.

The average number of years of wrestling experience was 3.1 ± 2.5 years (range, 0 to 13). Injured wrestlers had significantly more years of wrestling experience than the uninjured wrestlers ($P = 0.0002$). The average years of experience was 3.7 ± 0.2 for the injured wrestlers and 2.8 ± 0.1 for the uninjured wrestlers ($P < 0.0001$). One hundred twenty-two wrestlers (29%) stated they wrestled year-round in collegiate ("high school" style) and freestyle ("Olympic" style) wrestling competitions. Wrestlers who wrestled year-round had a slightly higher number of injuries (31%, 38 of 122) than did the seasonal wrestlers (27%, 80 of 296), but this difference was not statistically significant ($P = 0.21$).

The profile of the injured wrestlers showed a trend toward varsity wrestlers in the middle weights. Varsity wrestlers composed approximately 44% of the entire study population (202 of 458) and accounted for 60% of all injuries (131 of 219). In addition, 54% of injuries ($N = 118$) occurred in the middle one-third of weight classes, versus 22% ($N = 48$) for the lower weights and 24% ($N = 53$) for the upper weights. Twenty-eight injuries (13%) occurred in the 160-pound weight class alone. All weight classes were equally represented in the varsity wrestlers, but not in the nonvarsity. The nonvarsity weight classes tended to have more participants in the middle weights and this may have affected the number of injuries.

Sixty-five percent of all wrestlers in the preseason screening (298 of 458) reported at least one previous injury sustained from many different athletic and nonathletic activities. Six percent of these wrestlers (18 of 298) sustained reinjuries of these conditions during the season. In addition, several wrestlers reported preexisting medi-

cal conditions, with the most common being asthma. Two of these wrestlers had exacerbations of their asthma that resolved without difficulty but resulted in lost time.

Ten wrestlers were injured, treated, and then reinjured during the time period studied. The reinjuries included five wrestlers with rotator cuff strains. These wrestlers were treated for an average of 12 days before returning to activity with subsequent reinjury an average of 24 days after the original injury. Other reinjuries included two shoulder subluxations, two cauliflower ears, and one chest contusion.

Generalized Ligamentous Laxity Testing

Of the 458 wrestlers who underwent preseason screening, 187 (41%) had at least one positive generalized ligamentous laxity test. When looking specifically at wrestlers who sustained shoulder injuries, subjects who had at least one positive test for generalized ligamentous laxity had half the number of shoulder injuries of the other wrestlers (lax, 17; others, 35) ($P < 0.01$). The most commonly positive test was the palms-to-floor test (21%, 96 of 458). Only 46 (10%) wrestlers had 2 or more positive tests, and only 10 (2%) had 3 or more positive tests. When the palms-to-floor test was removed, 91 (20%) wrestlers demonstrated at least one positive test, 20 wrestlers (4%) had 2 positive tests, and only 3 wrestlers (0.7%) had 3 positive tests.

Where and When Injuries Occurred

The majority of injuries occurred in practice (138 injuries in practice [63%] and 81 injuries in matches [37%]). The total number of practice-exposures (average of 2 hours) was 27,588, and the total number of match competition-exposures (average of 6 minutes) was 8885. The calculated injury rates were 5 injuries per 1000 practice-exposures and 9 injuries per 1000 match competition-exposures. Of the 138 practice injuries, 94 (68%) occurred during live wrestling, 32 (23%) occurred during drills (practicing moves), and 12 (9%) occurred during conditioning. Information detailing the amount of time spent during each of these types of practicing was not included in the original data collection.

We found no statistically significant time period when more injuries occurred in either practices or matches, although trends were observed. Sixty-seven percent of all practice injuries ($N = 92$) occurred during the last half of practice ($P = 0.37$). Similar findings were seen in match competition, in which 42% ($N = 34$) and 36% ($N = 29$) of injuries occurred in the second and third periods, respectively, versus only 22% ($N = 18$) in the first period.

How Injuries Occurred

The most common wrestling situation resulting in injury was the takedown position (68%, 149 of 219), in which both wrestlers are in the standing position attempting to take the other down to the mat. Fifty-eight percent (86 of 149) of takedown injuries occurred in the wrestler who was in the defensive position while being taken down.

TABLE 2
Mechanisms of Injury

Mechanism	Percentage	N
Direct force	42	(92)
Twisting	23	(50)
Stretch	13	(29)
Indirect force	8	(18)
Fall	7	(15)
Overuse	6	(13)
Other	1	(2)

Other defensive wrestling situations resulting in injuries included riding or pinning moves (20%, 44) and escape moves (11%, 24).

The most common mechanisms of injury were direct forces or blows (42%) and twisting forces (23%) (Table 2). Only 6% of all injuries were reported to be due to overuse or repetitive activity. We could not accurately determine specific wrestling moves that caused injury because of inconsistency in the reporting of the offending maneuvers. In addition, many of the injuries were not the result of specific wrestling moves but rather the individual wrestling situation. No injuries were specifically reported as caused by illegal actions, although four injured wrestlers won match competitions based on penalty defaults on their opponents.

Time Lost From Injury and Season-Ending Injuries

The mean total time lost from injury was 5 days (range, 1 to 39). The mean number of practices missed secondary to injury was 4 (range, 0 to 28). The mean number of match competitions missed was 1 (range, 0 to 8). The injury type resulting in the most lost time without being season-ending was fractures (mean, 24 days; range, 11 to 37). Season-ending injuries accounted for an additional 1078 lost days from wrestling and were excluded from the overall determination of lost time.

Twenty-three wrestlers sustained season-ending injuries, with the most common being knee (44%) and shoulder injuries (22%) (Table 3). Common specific injuries included knee meniscus tears (22%, 5 of 23) and subluxations or dislocations of the shoulder (13%, $N = 3$) and elbow (13%, $N = 3$). In addition, there were two ACL tears, two grade II medial collateral ligament tears, and one case of chronic peripatellar bursitis. The majority of season-ending injuries occurred during match competition

TABLE 3
Percentage and Number of Season-Ending Injuries by Body Part Injured

Area injured	Percentage	N
Knee	44	(10)
Shoulder	22	(5)
Elbow	13	(3)
Wrist/hand	9	(2)
Neck	4	(1)
Abdomen	4	(1)
Ankle	4	(1)

TABLE 4
Primary Treatment Provider

Provider	Percentage	N
Trainer	46	(101)
Orthopaedic surgeon	38	(83)
Family physician	14	(31)
Coach	1	(1)
Other	1	(3)

(61%, $N = 14$) and with the wrestler in a defensive take-down position (65%, $N = 15$). Three season-ending injuries occurred in the preseason, 11 during the first half of the season, and 9 during the last half of the season.

Treatment and Compliance

The type of treatment provided among the different high schools was fairly consistent. The primary medical care provider was the athletic trainer in 46% of the cases (Table 4). Orthopaedic surgeons (38%), family physicians (14%), coaches (1%), and others (1%) composed the remainder of medical care providers. The primary treatment modalities were ice (76%, $N = 166$), rest (47%, $N = 103$), and physical therapy (32%, $N = 70$). Other less commonly used modalities included taping (11%), bracing (6%), and casting (5%). Thirteen injuries (6% of injuries) required surgery during the season.

Compliance with treatment overall was found to be good, with patient compliance for 188 of the injuries reported as either excellent (54%) or good (32%). The compliance in 22 injuries was fair (10%), and for 9 injuries (4%) the wrestlers were rated as poor because of noncompliance with any recommendations. The less compliant wrestlers had a wide variety of injuries including eight shoulder muscle strains, four shoulder subluxations, three hand fractures, and three finger joint sprains.

Skin Infections

There were 19 skin infections (5%) in the 418 wrestlers followed the entire season. The most common diagnosis was impetigo located on either the head or neck region and the upper extremity. All infections were treated by the patient's family physician and school trainers with oral medications, local wound care, ointments, and rest. The average total days lost was 5 (range, 2 to 19 days). State high school athletic competition rules required all athletes to obtain written physician's clearance before any inter-school match competition.²⁴

DISCUSSION

We have detailed, in a prospective study, the anatomic regions, the diagnoses, and the mechanisms of injury common to a large population of high school wrestlers. Our goal was to provide objective data to all involved in the sport including medical personnel, coaches, officials, parents, and athletes. Several recommendations can be made in support of a potentially safer environment. More expe-

rienced wrestlers may be at an increased risk of injury and thus require increased supervision. More practice injuries occurred during live wrestling than during other types of practice, so limiting the amount of live wrestling may be beneficial. More injuries were also seen during takedowns in the defensive wrestler, so coaches and referees should closely supervise or monitor this during practices and matches. Skin infections were still found to be prominent in our wrestling population, so cleansing and isolation methods should be continued.

Many authors have examined adolescent and preadolescent injuries in a wide range of sports.^{1-3, 6, 10, 11, 19, 20} Football has consistently ranked first in overall injury rates in studies performed in the United States.^{1, 3, 6, 10, 11, 19, 20} Wrestling has also ranked high in overall injury rates compared with other sports, ranking no less than fourth in most published studies.^{1, 3, 7, 11, 19, 20} Garrick and Requa^{11, 25} found 75 injuries per 100 athletes in wrestling compared with 81 injuries per 100 athletes in football. Beachy et al.,³ in a recent 8-year study, found that in male sports, wrestling ranked only behind football in the number of injuries, injury rates, and time lost to injury. De Løes,⁷ in a study involving the Swiss organization "Youth and Sports," found wrestling had 6.3 injuries per 10,000 hours versus ice hockey with 8.6 injuries per 10,000 hours.

Recently reported statistics by the National Collegiate Athletic Association (NCAA) showed wrestling to rank second only behind spring football in injury rate per 1000 athlete-exposures (9.6 versus 9.8).^{14, 23} Previous studies reporting on the sport of wrestling have documented a wide range of injury rates, from 10% to 70%, depending on the definition of injury, the population being studied, and whether a tournament or a season was evaluated.^{8, 9, 13-15, 18, 25-27, 29-31} Adolescent and preadolescent wrestlers^{13, 18, 29} have tended to have lower injury rates than collegiate or world-class wrestlers.^{8, 14, 15, 26, 27, 29, 31} Our study found an overall injury incidence of 52 injuries per 100 wrestlers per season, with 6.0 injuries per 1000 exposures. Our injury incidence was lower than that cited by Requa and Garrick²⁵ in a high school population and lower than those of studies following collegiate or world-class athletes throughout one or more seasons^{14, 26, 27, 31} or at tournaments.^{8, 15} The lower injury incidence and rate found in the present study may be due to our injury definition, which excluded minor injuries, as well as the potential for underreporting of injuries when dealing with multiple schools.

Potential risk factors for overall injury have been studied at many different levels of wrestling. Most studies have found no statistically significant relationship between injury and weight class.^{8, 13-15, 29, 31} Loris et al.¹⁸ found a trend toward increased injury with increasing weight, but this proved to be not statistically significant with multiple regression analysis. The present study showed a trend toward more injuries in the middle weights (54%), but this was not statistically significant. Several studies have found that prior injury predisposes an athlete to injury,^{8, 25, 29, 31} but we found no strong relationship between previous injury and new injury in our study population. Other risk factors that have shown no

significant relationship to injury include period of the match,³¹ score of the match,¹⁵ successive tournament matches,^{8,18,29} and years of experience.³¹ We did find an increased risk of injury in wrestlers with 3 or more years of experience, but we did not study match scores or tournament-related variables. One might attribute this observation to an increased use of more advanced, high-risk wrestling maneuvers or a more aggressive wrestling style. Coaches, trainers, and physicians should make additional efforts with these wrestlers to advocate safe wrestling maneuvers and injury prevention techniques.

The most often injured regions of the body in our study were the shoulder (24%) and knee (17%). No prior study has found shoulder injuries to be the most common anatomic region of injury. Shoulder injury rates have ranged from 12.7%¹⁵ to 29%.¹⁷ Previous studies have found the most commonly injured areas to be the spine and trunk,²⁵ head and neck,^{8,15,26} knee,^{9,14,27,31} lower extremity,²⁹ and upper extremity.^{17,18} The lack of a consensus among these reports is due in part to the variable methods of grouping injuries in associated anatomic regions.

Generalized ligamentous laxity testing and correlation with injury occurrence is a controversial area. Our findings support previous studies in other sports that found no correlation between positive tests and the overall occurrence of injury.^{12,28} We did find, however, that a subgroup of wrestlers with at least one positive test for ligamentous laxity had half the shoulder instability injuries that wrestlers with no positive test had.

Previous studies agree with the current findings of higher overall injury occurrence in practices versus higher rates of injury in match competitions.^{9,14,25,31} The majority of practice injuries occurred during live wrestling as opposed to drills or conditioning.²⁵ We found an almost twofold increase in injury rate per 1000 exposures in match competition, which is similar to other studies finding threefold³¹ or fourfold¹⁴ increases. When injury rates are calculated per minute of wrestling, the rate increases to almost 40 times that of practice injuries. These findings demonstrate the high intensity of physical activity and potential risk for injury during the shorter match competitions. It is unlikely that it will ever be possible to protect wrestlers from injury during match competitions without significantly limiting the wide variety of moves encountered or markedly increasing the amount of protective equipment. Since more injuries were found in the pre-season, a more practical approach may be to focus on practice techniques such as improving conditioning before live wrestling. In addition, since a significant number of practice injuries still occurred in both the first and second half of the season, better supervision or limitation of live wrestling activity may be warranted.

We hypothesized that more injuries would occur at the end of practices or matches when the athletes were more fatigued and thus more vulnerable to injury. We found no statistically significant time period when more injuries occurred in either practices or matches. Previous studies have documented similar findings of no conclusive time period for high injury occurrence in either practices³¹ or match competitions.^{29,31} Kersey and Rowan¹⁵ found that

52% of the 110 injuries they recorded occurred in the third period during the 1980 NCAA Championships. These results may be misleading since their injury definition included any condition requiring an injury time-out, when a wrestler may be trying to rest during the third period.

The most common wrestling situation resulting in injury was the takedown position, especially for wrestlers who are in the defensive position. Previous studies have demonstrated similar findings.^{8,9,25,27,31} Strauss and Lanese²⁹ found equal numbers of takedown and mat injuries in all age groups, except for a 2:1 ratio favoring takedown injuries among collegiate wrestlers. The higher occurrence of injury in the takedown position is likely attributable to the high intensity, speed, and forces involved when trying to take the opponent to the mat. There is also a higher likelihood of more time spent in this position due to the increasing emphasis on takedown moves for scoring points.

The most common mechanisms of injury we found were direct forces or blows (42%) and twisting forces (23%). This differs slightly from findings by Snook,²⁷ who reported 90 injuries and found that 42% were twisting injuries, 24% were related to falls, and 11% were related to direct blows. Wroble et al.³¹ reported indirect forces as the most common mechanism of injury, followed by torsion and direct impact injuries. They also found a low rate of overuse knee injuries, similar to the 6% seen in the current study.

The type of treatment provided during the season by the different high schools was fairly consistent. The first medical provider in the majority of cases, whether it was a practice or a match, was the athletic trainer. This was due mainly to the on-site presence and availability of the trainers at the schools. Orthopaedic surgeons and family physicians also played significant roles. Ice, rest, and physical therapy remained the mainstays of treatment; only 6% of the injuries resulted in surgery during the season. This rate of surgery is similar to that found in collegiate wrestlers¹⁴ and slightly higher than in previous reports on all sports where the rates ranged from 1% to 3%.^{1,11,19,25}

Compliance with medical treatment has been an infrequently studied topic in the sports injury literature. Wroble et al.³¹ previously reported that 50% of the University of Iowa wrestlers were noncompliant with medical recommendations. The authors suggested that this non-compliance was due to the intensity of competition and the willingness to wrestle with an injury to avoid losing a varsity position or national ranking. We found an 86% excellent or good compliance with treatment in our high school wrestling population. Although this is a subjective measurement, we believe the high rate of compliance may be due to the greater control over the athlete's return to competition by trainers, coaches, and parents in high school-aged athletes.

CONCLUSIONS

We have demonstrated the significant incidence and rate of injuries in a high school wrestling population compared with other studies on either wrestling alone or all sports.

This is the first wrestling study to report the shoulder as the most commonly injured region of the body, although a wide variety of injuries were observed. Specific areas of high injury occurrence were identified and include hard wrestling during practice and the takedown position during either practice or match competitions. The older and more experienced wrestler may be at greater risk of injury. Wrestlers with ligamentous laxity may have a decreased risk of shoulder injury. This information should be helpful in focusing the education and training of persons caring for wrestler's injuries or supervising their practices and matches.

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