

A comparison of pediatric freestyle and Greco-Roman wrestling injuries sustained during a 2006 US national tournament

E. E. Yard¹, R. D. Comstock^{1,2}

¹Center for Injury Research and Policy, Columbus Children's Research Institute, Children's Hospital, Columbus, OH, USA, ²College of Medicine, Department of Pediatrics and College of Public Health, Division of Epidemiology, The Ohio State University, Columbus, OH, USA

Corresponding author: Ellen E. Yard, Center for Injury Research and Policy, Columbus Children's Research Institute, Children's Hospital, 700 Children's Drive, Columbus, OH 43205, USA. Tel: 1-614-355-2866, Fax: 1-614-722-2448, E-mail: YardE@pediatrics.ohio-state.edu

Accepted for publication 6 June 2007

The purpose of this study was to compare the epidemiology of freestyle and Greco-Roman wrestling injuries sustained during a 2006 United States (US) national tournament. A prospective injury surveillance study was conducted at the US 2006 ASICS/Vaughan Cadet and Junior National Championships. There were 83 freestyle- and 55 Greco-Roman-related injuries sustained, with the rate of injury per 1000 athlete-matches higher in freestyle (7.0) compared with Greco-Roman (4.6) wrestling [Rate ratio (RR) = 1.51, 95% confidence interval (CI): 1.07–2.12]. Compared with Greco-Roman wrestling, there was a greater proportion of knee injuries in freestyle wrestling [injury proportion ratio (IPR) = 4.17, 95% CI: 1.30–13.41]. In Greco-Roman wrestling, there were greater proportions of elbow

(IPR = 9.11, 95% CI: 1.13–73.59) and head/face/neck (IPR = 1.72, 95% CI: 1.10–2.67) injuries and a greater proportion of concussions (IPR = 1.95, 95% CI: 0.92–4.12), although the latter was statistically insignificant. Greco-Roman wrestlers sustained a greater proportion of injuries from being driven into the mat (IPR = 2.97, 95% CI: 1.72–5.14). There were no statistically significant differences in injury outcome by wrestling style. The differing injury rates and patterns of injury between freestyle and Greco-Roman wrestling are likely due to the different rules between these styles that allow lower leg attacks in freestyle wrestling and encourage the use of throws in Greco-Roman wrestling.

One of the earliest sports known to man (Martin & Margherita, 1999), wrestling continues to hold worldwide popularity. In the United State (US), over 1 million boys aged 6–17 wrestled in 2003 (American Sports Data & Inc., 2004) and wrestling was the sixth most common boys' high school sport during the 2005–2006 academic year (National Federation of State High School Associations). Although wrestling can increase physical fitness and self-confidence, the sport's arduous nature has led to pediatric injury rates as high as 9.0 injuries per 1000 athlete-exposures (Pasque & Hewett, 2000) and an estimated total annual injury cost of over 650 million dollars (Caine et al., 2006).

US high school and college wrestlers typically participate in folkstyle wrestling (a style developed from freestyle wrestling that emphasizes control over one's opponent) during school-sanctioned matches and tournaments. However, many young US wrestlers also engage in freestyle or Greco-Roman wrestling, which are the two internationally accepted styles, in club or community-sanctioned matches

and tournaments. Freestyle and Greco-Roman wrestlers grapple to score points through moves such as takedowns, reversals, near falls, and falls. Freestyle wrestling allows holds and attacks to both the lower and upper extremities. However, because Greco-Roman wrestling prohibits lower extremity attacks, this style emphasizes upper body strength and throws, creating a distinct divide between these two styles.

Previous US wrestling injury research focused on folkstyle wrestling injuries occurring during tournament play (Strauss & Lanese, 1982; Kersey & Rowan, 1983), on specific injuries (Mysnyk et al., 1986; Stanish et al., 1986; Wroble & Albright, 1986; Wroble et al., 1986; Acikgoz et al., 1990; Mueller & Cantu, 1990; Giffin, 1992; Boden et al., 2002; Johnson, 2004; Boden & Prior, 2005; Lightfoot et al., 2005), or on unique cases (Berson, 1979; Cohn et al., 1986; Ron-toyannis et al., 1988; Brindle & Coen, 1998). A few studies followed college (Snook, 1982; Jarret et al., 1998) or high school (Garrick & Requa, 1978; Hoffman & Powell, 1990; Beachy et al., 1997; Powell & Barber-Foss, 1999; Pasque & Hewett, 2000;

Yard & Comstock

Comstock et al., 2006) wrestlers prospectively throughout one or more seasons. One previous study that included pediatric freestyle and Greco-Roman wrestlers did not directly compare styles (Lorish et al., 1992). The only previously identified study comparing freestyle and Greco-Roman injury patterns was conducted three decades ago and focused on adults at the US Olympic trials (Estwanik et al., 1978). Reducing injury rates among young freestyle and Greco-Roman wrestlers requires targeted injury-prevention efforts that begin with describing style-specific injury rates and patterns.

This study's objective was to compare the epidemiology of freestyle and Greco-Roman wrestling injuries sustained during a 2006 US national tournament. The specific aims were to: (1) calculate tournament injury rates among pediatric freestyle and Greco-Roman wrestlers; (2) characterize the general epidemiology of pediatric freestyle and Greco-Roman tournament injuries; and (3) compare the risk factors between pediatric freestyle and Greco-Roman tournament injuries.

Materials and methods

Data collection

A prospective injury surveillance study was conducted at the 2006 ASICS/Vaughan Cadet and Junior National Championships (July 22–29, 2006; Fargo, North Dakota, USA). Over 3000 cadet (born 1990–1991) and junior (born September 1, 1986 and after) wrestlers competed at this event, which consisted of freestyle and Greco-Roman wrestling. Although this tournament was co-ed, given the small number of female wrestlers this study reports data on the 3000 male wrestlers only.

Definition of injury and exposure

For the purpose of this study, a reportable injury was defined as any injury occurring while wrestling during the tournament for which the athlete received any level of care from the on-site tournament certified athletic trainers (ATC) that were hired to oversee treatment of all wrestlers or that required transport to an emergency department. For each injury meeting the study definition, tournament ATCs completed a paper-based injury report form that collected athlete demographic (e.g., age, gender, weight, etc.), injury specific (e.g., body site, diagnosis, outcome, etc.), and injury event (e.g., mechanism of injury, wrestling move resulting in injury, etc.) information. Responses for age, weight, and body site injured were open-ended. Outcome was categorized as whether the wrestler defaulted from or continued the match, whether the wrestler continued or discontinued the tournament, and whether the wrestler required transport to the emergency department. For diagnosis, mechanism, and move, ATCs could choose from a provided list of answers or write in their own response. Exposure, defined as one wrestler participating in one match (athlete-match), was estimated in consultation with tournament officials. It was estimated that the 3000 boys competed in a total of 11 880 matches during the tournament, with matches equally divided between freestyle and Greco-Roman wrestling. Athlete confidentiality was maintained throughout the

study by collecting only de-identified information on injury report forms.

Statistical analysis

Data were analyzed using SPSS software, version 14.0 (SPSS, Chicago, Illinois, USA), and Epi Info, version 6.0 (CDC, Atlanta, Georgia). Injury rates were calculated as the ratio of injuries per 1000 athlete-matches. Rate ratios (RR) and injury proportion ratios (IPR) were calculated with 95% confidence intervals (CI). An RR or IPR > 1.00 suggests a risk association while an RR or IPR < 1.00 suggests a protective association. CI not including 1.00 was considered to be statistically significant. For example, the calculation comparing freestyle and Greco-Roman wrestling injury rates is as follows:

$$RR = \frac{\text{Total reported freestyle injuries} / \text{total calculated freestyle athlete-matches} \times 1000}{\text{Total reported Greco-Roman injuries} / \text{total calculated Greco-Roman athlete-matches} \times 1000}$$

As an example of IPR calculation, the following compares the proportion of concussions in freestyle and Greco-Roman wrestling:

$$IPR = \frac{\text{Total freestyle concussions} / \text{total freestyle injuries}}{\text{Total Greco-Roman concussions} / \text{total Greco-Roman injuries}}$$

This study was approved by the Institutional Review Board at Columbus Children's Research Institute.

Results

Injury rates

During the study, 138 injuries were sustained during an estimated 23 760 athlete-matches, for an injury rate of 5.8 injuries per 1000 athlete-matches (Table 1). Approximately 4.6% of the 3000 competing wrestlers sustained an injury. The injury rate per 1000 athlete-matches was higher in freestyle (7.0) compared with Greco-Roman (4.6) wrestling (RR = 1.51, 95% CI: 1.07–2.12).

Characteristics of freestyle and Greco-Roman wrestling injuries

Figure 1 presents body sites of freestyle and Greco-Roman wrestling injuries. Of the 138 injury reports,

Table 1. Injury rates of pediatric freestyle and Greco-Roman wrestlers competing in a national tournament; US, 2006

	# Injuries	# Exposures	Injury rate (per 1000 athlete-matches)	RR (95% CI)
Overall	138	23 760	5.8	
Freestyle	83	11 880	7.0	1.51 (1.07–2.12)
Greco-Roman	55	11 880	4.6	1.00

CI, confidence interval; RR, rate ratio.

Comparison of pediatric freestyle and Greco-Roman wrestling injuries

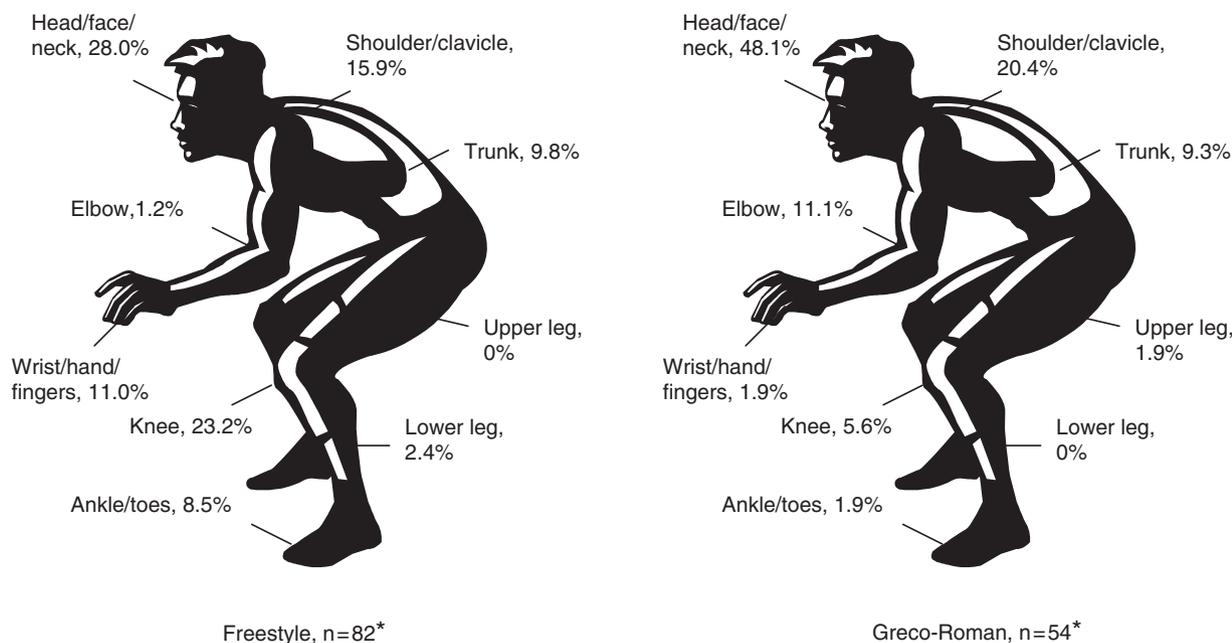


Fig. 1. Body sites of pediatric freestyle and Greco-Roman wrestling injuries. *There were two injury reports (one freestyle and one Greco-Roman) not specifying body site.

136 (98.6%) had a valid response for this question. Overall, the head/face/neck was injured most frequently (36.0%), followed by the shoulder/clavicle (17.6%) and the knee (16.2%). Freestyle wrestlers injured their head/face/neck (28.0%), knee (23.2%), and shoulder/clavicle (15.9%) most frequently while Greco-Roman wrestlers injured their head/face/neck (48.1%), shoulder/clavicle (20.4%), and elbow (11.1%) most frequently. Compared with Greco-Roman wrestling, there were greater proportions of knee (IPR = 4.17, 95% CI: 1.30–13.41) injuries in freestyle wrestling. In Greco-Roman wrestling, there were greater proportions of elbow (IPR = 9.11, 95% CI: 1.13–73.59) and head/face/neck (IPR = 1.72, 95% CI: 1.10–2.67) injuries.

Table 2 presents the diagnosis of freestyle and Greco-Roman wrestling injuries. Of the 138 injury reports, 135 (97.8%) had a valid response for injury diagnosis. Overall, sprain/strain was the most common (40.7%), followed by concussion (17.0%) and fracture (11.1%). Freestyle wrestlers most frequently sustained sprains/strains (45.7%), while Greco-Roman wrestlers most frequently sustained sprains/strains (33.3%) and concussions (24.1%). Although statistically insignificant, there was a greater proportion of concussions (24.1% and 12.3%, respectively) (IPR = 1.95, 95% CI: 0.92–4.12) in Greco-Roman wrestling.

In freestyle wrestling, the majority of sprains/strains were to the lower extremity (i.e., upper leg, knee, lower leg, and ankle/toes) (56.8%), followed by the upper extremity (i.e., shoulder/clavicle, elbow, and wrist/hand/fingers) (24.3%) and trunk (18.9%). In contrast,

Table 2. Diagnoses of pediatric freestyle and Greco-Roman wrestling injuries

	Freestyle*	Greco-Roman*	IPR (95% CI) [†]
Sprain/strain	37 (45.7%)	18 (33.3%)	1.37 (0.88–2.14)
Concussion	10 (12.3%)	13 (24.1%)	1.95 (0.92–4.12)
Fracture	10 (12.3%)	5 (9.3%)	1.33 (0.48–3.69)
Laceration	6 (7.4%)	5 (9.3%)	1.25 (0.40–3.89)
Dislocation	6 (7.4%)	2 (3.7%)	2.00 (0.42–9.54)
Traumatic bursitis	3 (3.7%)	4 (7.4%)	2.00 (0.47–8.58)
Contusion	2 (2.5%)	4 (7.4%)	3.00 (0.57–15.81)
Other	7 (8.6%)	3 (5.6%)	1.56 (0.42–5.75)

*There were three injury reports (two freestyle and one Greco-Roman) not specifying diagnosis.

[†]For IPR calculation, the style with the higher proportion (bold) was compared with the style with the lower proportion (not bold).

CI, confidence interval; IPR, injury proportion ratios.

the majority of Greco-Roman sprain/strains were to the upper extremity (55.6%), followed by the head/face/neck (22.2%) and trunk (16.7%). Freestyle fractures were most frequently to the upper extremity (40.0%), followed by the head/face/neck (20.0%) and lower extremity (20.0%). Greco-Roman fractures were to the head/face/neck (40.0%), followed by the upper extremity (20.0%), trunk (20.0%), and lower extremity (20.0%).

Figure 2 presents the outcome of freestyle and Greco-Roman wrestling injuries. Of the 138 injury reports, 127 (92.0%) had a valid response for injury outcome. Of these, the majority of injuries fell to one

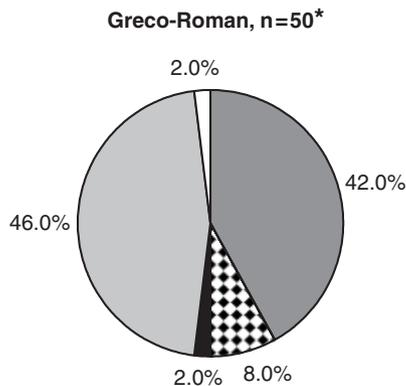
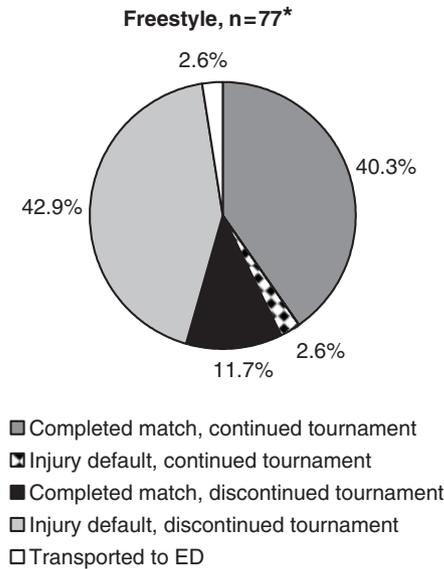


Fig. 2. Outcome of pediatric freestyle and Greco-Roman wrestling injuries.
 *There were 11 injury reports (6 freestyle and 5 Greco-Roman) not specifying outcome.

of the extremes: either the wrestler defaulted from the match and discontinued the tournament (44.1%) or the wrestler completed the match and continued the tournament (40.9%). Additionally, 2.4% of the injured wrestlers required transport to the emergency department. There were no statistically significant differences in injury outcome by wrestling style.

Injuries forcing wrestlers to discontinue the tournament were most commonly head/face/neck (31.9%), shoulder/clavicle (21.7%), and knee (14.5%) injuries, with the most frequent diagnoses being sprain/strain (42.0%), concussion (24.6%), and fracture (15.9%). There were no statistically significant differences in diagnosis forcing wrestlers to discontinue the tournament by wrestling style. Although knee injuries accounted for 22.7% of the injuries forcing freestyle wrestlers to discontinue, no Greco-Roman wrestlers discontinued the tournament because of a knee injury.

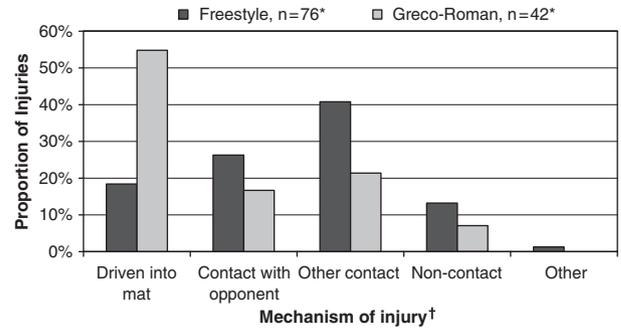


Fig. 3. Mechanism resulting in pediatric freestyle and Greco-Roman wrestling injuries.

*There were 20 injury reports (7 freestyle and 13 Greco-Roman) not specifying activity.

†“Contact with opponent” includes direct blows by the opponent, such as being hit by a head or elbow. “Other contact” includes a pulling or twisting force employed by the opponent. “Non-contact” includes rotation around a planted foot/hand.

Figure 3 presents mechanism of freestyle and Greco-Roman wrestling injuries. Of the 138 injury reports, 118 (85.5%) had a valid response for this question. Overall, “other” contact (i.e., a pulling or twisting force employed by opponent) was the most frequently cited mechanism (33.9%), followed by being driven into the mat (31.4%), contact with opponent (i.e., direct blow by opponent) (22.9%), and non-contact (i.e., rotation around a planted foot/hand, etc.) (11.0%). Freestyle injuries most frequently resulted from other contact (40.8%) while Greco-Roman injuries most frequently resulted from being driven into the mat (54.8%). Compared with Greco-Roman wrestlers (21.4%), a greater proportion of freestyle wrestlers sustained injuries following other contact (IPR = 1.90, 95% CI: 1.00–3.61). Compared with freestyle wrestlers (18.4%), Greco-Roman wrestlers sustained a greater proportion of injuries after being driven into the mat (IPR = 2.97, 95% CI: 1.72–5.14).

In freestyle wrestling, head/face/neck injuries most frequently resulted from contact with opponent (78.3%) and being driven into the mat (21.7%) while knee injuries frequently resulted from other contact (70.6%) and being driven into the mat (17.6%). Sprain/strains frequently resulted from other contact (72.7%) and non-contact (15.2%). In Greco-Roman wrestling, head/face/neck injuries resulted from being driven into the mat (57.1%) and contact with opponent (33.3%), while shoulder/clavicle injuries resulted from being driven into the mat (70.0%) and other contact (30.0%). Concussions resulted from being driven into the mat (90.9%). Among freestyle wrestlers, injuries forcing the wrestler to discontinue the tournament resulted from other contact (43.6%) and contact with opponent (20.5%). In Greco-Roman wrestling, such injuries resulted from being driven into the mat (65.0%)

Comparison of pediatric freestyle and Greco-Roman wrestling injuries

and other contact (30.0%). Of the 138 injury reports, 109 (79.0%) had a valid response for wrestling move resulting in injury, with takedown (77.1%) and being ridden (15.6%) cited most frequently. There were no statistically significant differences by style in wrestling move resulting in injury.

Discussion

This study, the first to compare freestyle and Greco-Roman pediatric wrestling injuries, found that injury rates and patterns differed between freestyle and Greco-Roman wrestling, likely due to rule differences. Freestyle wrestling permits both upper and lower extremity attacks while Greco-Roman wrestling encourages high throws because lower extremity attacks are prohibited. Although we found a relatively low aggregate injury rate of 5.8 injuries per 1000 athlete-matches, given that over half of all injured wrestlers were forced to discontinue the tournament, injuries that do occur can be devastating to an athlete who devoted months or years to training. Given the large number of young freestyle and Greco-Roman wrestlers worldwide, this paper fills a gap in the current sports-injury literature by describing differences in injury patterns among pediatric participants and thus laying the groundwork for the development and implementation of targeted preventive interventions.

We found that 4.6% of cadet and junior wrestlers participating in the 2006 US freestyle and Greco-Roman national championships were injured. Previous US freestyle and Greco-Roman wrestling injury studies found higher risks, with 12.7% of pediatric wrestlers injured at state and regional tournaments (Lorish et al., 1992) and 21.4% of adult wrestlers injured at the Olympic wrestling trials (Estwanik et al., 1978). These varying injury risks may be due to differences in injury definition, competition level, or age. Compared with freestyle and Greco-Roman wrestlers competing at state and regional tournaments, the wrestlers in our study were competing at the national championships and thus may have had more experience or been in better physical shape. Owing to the large time gap between this study and previous studies, these results also suggest that wrestling rule and style changes over time may have made wrestling safer.

Overall, freestyle and Greco-Roman match injury rates appear comparable with injury rates in other sports. Per 1000 athlete-competitions, the aggregate injury rate found at this tournament (5.8) was lower than the competition injury rate among high school football players (12.1) and higher than competition injury rates among male high school participants in

soccer (4.2), folkstyle wrestling (3.9), basketball (3.0), and baseball (1.8) (Comstock et al., 2006).

Our study found a significantly higher rate of tournament injury among freestyle compared with Greco-Roman wrestlers. Similarly, in a previous study Olympic-level freestyle wrestlers had a higher risk of injuries compared with Greco-Roman wrestlers (Estwanik et al., 1978). Although the reasons for this are unclear, one hypothesis is that freestyle wrestlers are more likely to sustain injuries because both their upper and lower extremities can be attacked, subjecting vulnerable body sites such as knees and ankles to repeated blows and straining forces. Because Greco-Roman wrestling prohibits lower extremity attacks and encourages throws, these wrestlers may spend more match time either positioning themselves for a successful throw or attempting unsuccessful throws, activities with a lower injury risk that decrease exposure to full-contact wrestling.

Overall, the injury patterns seen in this study were similar to previous pediatric (Lorish et al., 1992) and Olympic-level (Estwanik et al., 1978) freestyle and Greco-Roman injury studies, with large proportions of head/face/neck (Estwanik et al., 1978; Lorish et al., 1992) and shoulder (Estwanik et al., 1978; Lorish et al., 1992) injuries and a predominance of sprain/strains (Estwanik et al., 1978). However, we found that pediatric freestyle and Greco-Roman injury patterns were quite different from one another, with a larger proportion of lower extremity strains/sprains in freestyle wrestling and a larger proportion of head/face/neck injuries and concussions in Greco-Roman wrestling. The only previous study comparing freestyle and Greco-Roman injuries also found a greater proportion of lower extremity injuries among Olympic-level freestyle wrestlers (Estwanik et al., 1978). Lower extremity injuries among freestyle wrestlers are likely sustained when their legs are twisted or strained as they either use their legs to secure a hold or defend against an attack. Meanwhile, because Greco-Roman wrestlers cannot attack their opponent's legs or use their legs in defense, their legs have limited exposure to injury.

The higher prevalence of head/face/neck injuries and concussions among Greco-Roman wrestlers found in our study likely stems from the increased frequency of throws in Greco-Roman wrestling, as we found that most head/face/neck injuries and concussions among Greco-Roman wrestlers were due to being driven into the mat. In a typical throw, the defensive wrestler is lifted above the opponent's shoulders and thrown to the ground in a high-velocity manner, typically landing on their head or shoulders. Although freestyle wrestlers are allowed to throw their opponent, throws are less common among freestyle wrestlers because the defender can grab onto their attacker's legs to prevent the throw.

Yard & Comstock

Surprisingly, differences in the proportion of head/face/neck injuries and concussions between freestyle and Greco-Roman wrestlers were not seen among Olympic-level wrestlers (Estwanik et al., 1978). There are a few potential reasons for this. Throws may be less common at the Olympic level because wrestlers possess a higher skill level and thus are better able to thwart their opponent's attacks. Additionally, more experienced Olympic-level wrestlers may be more proficient in protecting their heads during landing when these throws do occur. Finally, due to either the older age of the wrestlers or the time period during which the Olympic study was conducted (almost 30 years before our study), these Olympic-level wrestlers may not have requested ATC attention following potential concussions.

This study is not without limitations. Only injuries coming to the attention of the tournament ATCs were recorded. However, this ensured that all injury reports were completed consistently and accurately, thus improving data quality. The large number of wrestlers at this tournament along with the large number of matches taking place concurrently limited the feasibility of calculating the precise number of participating wrestlers and matches. However, these numbers were estimated in consultation with a tournament official and thus provide a reliable estimate of total exposure. Finally, the limited number of injuries in some subgroup analyses resulted in inadequate power to show statistical significance. However, even without statistical significance there appears to be clinically significant differences between pediatric freestyle and Greco-Roman injury risk and patterns. Given that this is the largest comparison of pediatric freestyle and Greco-Roman injuries to date, the preventive implications presented here are quite valuable.

This study highlights style-specific wrestling injury patterns that may be useful in driving the development of targeted injury-prevention interventions. Because wrestlers in both styles sustained large proportions of head/face/neck injuries, coaches of young wrestlers should emphasize techniques that minimize potentially dangerous contact, and coaches and parents should encourage athletes to always wear appropriate headgear and mouthguards. ATCs, referees, and parents should be trained in the proper identification and management of concussions among young wrestlers. Coaches of Greco-Roman wrestlers should

ensure that beginning wrestlers are technically competent and capable of withstanding the forces exerted on the body while executing and receiving throws before allowing wrestlers to compete. Greco-Roman coaches should also emphasize safety during throws among both the attacker and defender. Because freestyle wrestlers sustained a high proportion of knee injuries, referees should be vigilant for wrestlers attacking their opponent's legs with illegal techniques and freestyle coaches should emphasize methods for protecting knees and ankles.

This study found that pediatric freestyle and Greco-Roman wrestling injury patterns differed by style. Freestyle wrestlers sustained a higher proportion of lower extremity injuries while Greco-Roman wrestlers sustained higher proportions of head/face/neck injuries and concussions. Additionally, we were able to identify that pulling/twisting forces delivered by the opponent along with direct blows from an opponent resulted in a larger proportion of freestyle injuries, while being driven into the mat caused a larger proportion of Greco-Roman wrestling injuries.

Perspectives

To our knowledge, this is the first study comparing the rates and patterns of pediatric freestyle and Greco-Roman wrestling. Future studies should continue to examine injury rates and patterns among freestyle and Greco-Roman wrestlers of various ages, skill levels (e.g., amateur, intermediate, etc.), and in various settings (e.g., practice, competition, etc.) to determine whether the trends found here remain consistent. Also, video analyses that identify specific circumstances leading to injury would provide wrestling coaches and ATCs with additional, scientifically based evidence for developing targeted injury-prevention interventions.

Key words: sports, injury, tournament, risk factors.

Acknowledgements

We thank the Health South certified athletic trainers for serving as data reporters, and we thank the tournament officials from USA Wrestling for allowing this study to take place and for assisting with estimates of athlete exposure. This report was funded by Dollamur Sport Surfaces. The content of the report is solely the responsibility of the authors and does not necessarily reflect the official view of Dollamur Sport Surfaces.

References

- Acikgoz B, Ozgen T, Erbenli A, Peker S, Bertan V, Saglam S. Wrestling causing paraplegia. *Paraplegia* 1990; 28: 265–268.
- American Sports Data and Inc. The super-study of sports participation: Vol. II – recreational sports 2003. Hartsdale, NY: American Sports Data Inc., 2004.
- Beachy G, Akau CK, Martinson M, Olderr TF. High school sports injuries. A longitudinal study at Punahou school: 1988 to 1996.

Comparison of pediatric freestyle and Greco-Roman wrestling injuries

- Am J Sports Med 1997; 25: 675–681.
- Berson BL. Surgical repair of pectoralis major rupture in an athlete. Case report of an unusual injury in a wrestler. Am J Sports Med 1979; 7: 348–351.
- Boden BP, Lin W, Young M, Mueller FO. Catastrophic injuries in wrestlers. Am J Sports Med 2002; 30: 791–795.
- Boden BP, Prior C. Catastrophic spine injuries in sports. Curr Sports Med Rep 2005; 4: 45–49.
- Brindle TJ, Coen M. Scapular avulsion fracture of a high school wrestler. J Orthop Sports Phys Ther 1998; 27: 444–447.
- Caine D, Caine C, Maffulli N. Incidence and distribution of pediatric sport-related injuries. Clin J Sport Med 2006; 16: 500–513.
- Cohn BT, Brahms MA, Cohn M. Injury to the eleventh cranial nerve in a high school wrestler. Orthop Rev 1986; 15: 590–595.
- Comstock R, Knox C, Yard E, Gilchrist J. Sports-related injuries among high school athletes – United States, 2005–06 school year. CDC Morb Mortal Wkly Rep 2006; 55: 1037–1040.
- Estwanik JJ, Bergfeld J, Canty T. Report of injuries sustained during the United States Olympic wrestling trials. Am J Sports Med 1978; 6: 335–340.
- Garrick JG, Requa RK. Injuries in high school sports. Pediatrics 1978; 61: 465–469.
- Giffin CS. Wrestler's ear: pathophysiology and treatment. Ann Plast Surg 1992; 28: 131–139.
- Hoffman HS, Powell JW. Analysis of NATA high school injury registry data on wrestling. J Athl Train 1990; 25: 125.
- Jarret GJ, Orwin JF, Dick RW. Injuries in collegiate wrestling. Am J Sports Med 1998; 26: 674–680.
- Johnson R. Herpes gladiatorum and other skin diseases. Clin Sports Med 2004; 23: 473–484, x.
- Kersey RD, Rowan L. Injury account during the 1980 NCAA wrestling championships. Am J Sports Med 1983; 11: 147–151.
- Lightfoot AJ, McKinley T, Doyle M, Amendola A. ACL tears in collegiate wrestlers: report of six cases in one season. Iowa Orthop J 2005; 25: 145–148.
- Lorish TR, Rizzo TD Jr., Ilstrup DM, Scott SG. Injuries in adolescent and preadolescent boys at two large wrestling tournaments. Am J Sports Med 1992; 20: 199–202.
- Martin WR, Margherita AJ. Wrestling. Phys Med Rehabil Clin N Am 1999; 10: 117–140, vii.
- Mueller FO, Cantu RC. Catastrophic injuries and fatalities in high school and college sports, fall 1982–spring 1988. Med Sci Sports Exerc 1990; 22: 737–741.
- Mysnyk MC, Wroble RR, Foster DT, Albright JP. Prepatellar bursitis in wrestlers. Am J Sports Med 1986; 14: 46–54.
- National Federation of State High School Associations. 2005–06 high school athletics participation survey. Retrieved November 2006, from http://nfhs.org/core/contentmanager/uploads/2005_06NFHSParticipationsurvey.pdf
- Pasque CB, Hewett TE. A prospective study of high school wrestling injuries. Am J Sports Med 2000; 28: 509–515.
- Powell JW, Barber-Foss KD. Injury patterns in selected high school sports: a review of the 1995–1997 seasons. J Athl Train 1999; 34: 277–284.
- Rontoyannis GP, Pahtas G, Dinis D, Pournaras N. Sudden death of a young wrestler during competition. Int J Sports Med 1988; 9: 353–355.
- Snook GA. Injuries in intercollegiate wrestling. A 5-year study. Am J Sports Med 1982; 10: 142–144.
- Stanish WD, Rubinovich M, Armason T, Lapenskie G. Posterior cruciate ligament tears in wrestlers. Can J Appl Sport Sci 1986; 11: 173–177.
- Strauss RH, Lanese RR. Injuries among wrestlers in school and college tournaments. JAMA 1982; 248: 2016–2019.
- Wroble RR, Albright JP. Neck and low back injuries in wrestling. Clin Sports Med 1986; 5: 295–325.
- Wroble RR, Mysnyk MC, Foster DT, Albright JP. Patterns of knee injuries in wrestling: a six year study. Am J Sports Med 1986; 14: 55–66.