Comparing Sports Injuries in Men and Women

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Objective: To compare the pattern of injury between men and women in seven collegiate sports to determine if gender-specific factors exist which could be modified to reduce the risk of injury to female athletes. Design: Retrospective cohort study of injury reports compiled by certified athletic trainers between Fall 1980 and Spring 1995. Setting: An NCAA division III College. Participants: Eighteen to 22 year-old male and female college athletes competing in seven like sports (basketball, cross-country running, soccer, swimming, tennis, track and water polo) at the intercollegiate level, playing similar number of contests and using the same facilities. Main outcome measures: Analyses of injury patterns, classified by sport and anatomic location, for men and women in seven like sports. Results: A total of 3,767 participants were included in the study, with 1874 sports-related injuries reported among the men and women's teams. Of these injuries, 856 (45.7%) were sustained by female and 1018 (54.3%) by male athletes. Overall, no statistically significant gender difference was found for injuries per 100 participant-years (52.5 for female athlete versus 47.7 for males). A statistically significant gender difference in injury incidence ($p < 0.001$) was seen for two sports: swimming and water polo. Female swimmers reported more back/neck, shoulder, hip, knee and foot injuries; and female water polo players reported more shoulder injuries. When evaluating all sports concurrently, female athletes reported a higher rate of hip, lower-leg and shoulder injuries, while male athletes reported a higher rate of thigh injuries. Conclusion: Except for some minor gender differences in total injuries for two sports and several differences in total injuries by anatomic location, our data suggest very little difference in the pattern of injury between men and women competing in comparable sports. The increased rate of shoulder injury among female swimmers probably resulted from the more rigorous training philosophy of their coach. Thus, no gender-specific recommendations can be suggested for decreasing the incidence of injury to female athletes competing in these sports.

Key words: Athletic injuries, comparative study, collegiate sports injuries, epidemiology of injuries, gender differences, injury patterns, sex characteristics.

Introduction

Since the introduction of parity legislation (Title IX of the Educational Assistance Act) in 1972, more women have been competing in collegiate athletics. The increasing participation of women in competitive sports has been accompanied by a rise in the number of injuries. Several studies have shown women to be at much higher risk for sustaining injury to the anterior cruciate ligament (ACL) [1, 2, 6]. The gender-related differences shown for ACL injury in the knee led us to question whether other significant gender differences exist when comparing men's and women's sports injuries.

Few studies have compared the wide range of men's and women's sports injuries from an epidemiologic standpoint. Whiteside [12] used the National Athletic Injury/Illness Reporting System (NAIRS) records for a 3-year period to compare male and female injury patterns and found similar gender patterns of injury in basketball, gymnastics and softball/baseball. More recently, Lanese et al. [7] prospectively studied 8 matched men and women's varsity teams at Ohio State University over a single season and discovered very few gender differences in injury patterns except for some minor differences in gymnastics. Shively et al. [9] also compared injury rates sustained by boys and girls playing 8 similar high school sports and found no statistically significant gender differences in overall or individual injury rates.

It would be desirable to identify gender-specific patterns of injury in the female athlete to help plan prevention and treatment strategies. Specifically, we sought to evaluate whether female athletes were sustaining different types and numbers of sports-related injuries compared with men participating in like sports. To do this we compared male and female intercollegiate injury data for 7 sports at an NCAA Division III college, over a 15 year period.

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Methods

From the Fall of 1980 through the Spring of 1995 (15 seasons), all athletic injuries seen in the training room at Pomona College were evaluated by the same head athletic trainer. The athletic trainer then completed a standardized injury surveillance report for each injury. Injury reports were retrospectively compiled and categorized by gender, sport and anatomic site of injury. Injury was defined as a medical problem that arose as a result of sport participation which required a visit to the training room. Only injuries resulting in an injury report being completed were used in this study. Such injuries would involve evaluation by an ATC (Certified Athletic Trainer) leading to development of a diagnosis and treatment plan and consultation with a physician as needed. Return of an athlete for the same injury was not logged as a new injury. However, a new injury in the same athlete was logged as a new injury.

Injuries were categorized for the following gender-matched sports: Basketball, cross-country running, soccer, swimming, tennis, track, and water polo. Incomplete data were available for women's water polo (which became a varsity sport during the 1987 season) and women's soccer (which became a varsity sport during the 1985 season). Categories for anatomic location of injury included the face, back/neck, shoulder, arm, hand/wrist, hip, thigh, knee, lower leg, ankle, foot and other. The study excluded medical illnesses as well as injuries not attributable to team sport participation. We also tallied the number of anterior cruciate ligament (ACL) injuries, which were diagnosed clinically with orthopedic corroboration.

Statistical analysis

For the 12 anatomic locations in each of the 7 sports, Fisher's exact test (based on the hypergeometric distribution) was used to compare the percentage of the female and male participants who sustained injuries. The Fisher's exact test was used throughout because of the relatively small number of injuries. Hypergeometric distribution is a calculated probability distribution that is used when comparing small populations. A Chi-square goodness-of-fit statistic was used to compare the gender differences in the total number of injuries in each sport. The total number of injuries was divided proportionately by the number of female and male participants, assuming females and males were equally likely to be injured. The injury rates were then expressed as 100 participant years (as shown in Table **1**). These numbers are extrapolations from the data which represent the number of injuries expected per 100 participants, each competing for a single season.

For example, if 100 female basketball players competed for a single season, then one could expect to see 112 total injuries, 29 of which would be ankle injuries.

Results

The study included 3767 participants over a 15-year period for which we analyzed 1874 athletic injury reports. There were 1018 (54.3%) injuries sustained by male athletes and 856 (45.7%) sustained by female athletes. Overall, female athletes had more injuries (52.5 per 100 participant-years) than their male counterparts (47.7 per 100 participant-years), however this difference was not statistically significant.

There was no statistically significant gender difference found in the pattern of injury for the sports of basketball, cross-country, soccer, tennis and track. Only 2 sports, swimming and water polo, showed a statistically significant gender difference ($p < 0.001$) in their pattern of injury. More specifically, female swimmers had more back/neck, shoulder, hip, knee and foot injuries than their male counterparts, while female water polo players had more shoulder injuries (see Table **1**). We found that 23 men and 19 women had sports-related injuries severe enough to require surgery.

Overall, no statistically significant gender difference was found for anatomic location of injury in the ankle, arm, back/neck, face, foot, hand/wrist or knee in all sports. The higher rate of shoulder injuries among female swimmers and water polo players contributed to a higher overall rate of shoulder injuries

Table 1 Number of site-specific injuries per 100 participants-years for each sport by sex

	Basketball		Track		Swimming		Soccer		Tennis		Water Polo		Cross Country		Total	
	Fem	Males	Fem	Males	Fem	Males	Fem	Males	Fem	Males	Fem	Males	Fem	Males	Fem	Males
Ankle	29.32	38.01	5.51	6.53	1.75	0.73	19.52	15.12	7.77	7.22	1.47	0.00	6.09	3.81	9.31	10.12
Arm	5.76	2.58	0.55	1.41	1.17	1.10	0.48	0.27	1.55	2.22	0.00	0.31	0.00	0.00	1.29	1.08
Back/Neck	3.66	8.49	2.20	4.22	8.19	1.45+	5.24	3.71	2.07	5.00	0.00	0.00	2.03	0.48	3.80	3.37
Face	7.86	14.76	0.00	0.20	0.29	0.00	1.43	0.53	0.00	0.00	0.00	0.00	0.00	0.00	1.16	2.01
Foot	7.33	4.06	5.79	4.82	2.05	0.00	4.29	6.10	6.22	2.22	1.47	0.00	3.35	6.19	4.41	3.51
Hand/Wrist	9.95	12.18	0.00	1.20	1.46	0.36	0.95	1.33	2.59	1.11	1.47	1.54	0.00	0.00	2.02	2.44
Hip	5.76	6.64	5.23	2.21	2.34	0.00*	3.81	2.39	3.63	1.67	1.47	0.31	6.60	2.86	4.17	2.25*
Knee	17.28	21.03	3.86	5.42	5.85	1.45*	18.57	15.92	4.66	6.11	2.94	0.93	5.08	6.19	7.90	8.20
Lower leg	3.14	5.17	8.26	4.62	0.58	0.00	10.48	4.51*	6.22	5.56	0.74	0.00	7.61	6.19	5.39	3.61*
Shoulder	5.24	3.69	1.65	1.81	21.05	6.55+	1.90	1.33	5.18	7.22	8.09	3.40*	0.00	0.00	6.92	3.09+
Thigh	10.99	8.49	7.99	13.86*	0.29	0.00	5.71	9.28	1.55	5.58	0.74	0.31	3.55	2.86	4.53	6.79*
Other	5.76	1.85	0.55	0.40	2.05	0.36	1.43	2.12	1.04	1.67	0.00	0.31	0.00	2.86	1.53	1.22
Total	112.04	126.94	41.60	46.79	47.08	12.37+	73.81	62.60	42.49	45.56	18.38	7.10+	34.52	31.43	52.45	47.68

*$p < 0.01$, +$p < 0.001$

among female athletes. Females also had more hip injuries in every sport except basketball, although the differences were statistically significant only in track and swimming. In addition, females had more lower leg injuries in every sport but basketball, although the differences were statistically significant only for track and soccer. In contrast, male basketball players had more back/neck and facial injuries than their female counterparts. Male athletes also had a higher overall rate of thigh injuries, primarily due to an increased rate found in male tennis and track athletes (see Table **1**).

Only 13 ACL tears were identified in our sample population, which represented 0.69% of all reported injuries and 4.3% of all knee injuries. ACL injuries were reported in only two sports: Basketball (4 females and 3 males) and soccer (5 females and 1 male). Because of the low total number of ACL tears in our sample, the higher rate of ACL tears seen in female athletes compared with males did not appear statistically significant.

Discussion

The primary goal of this study was to investigate differences in injury pattern between men and women. This study has several advantages over previous ones that sought to compare injury patterns between male and female athletes. First, we compared men's and women's injuries at a single NCAA Division III institution, where participants competed under comparable conditions, using the same or similar facilities and playing surfaces. In addition, athletes were generally exposed to similar coaching philosophies and participated at similar levels of competition. Moreover, all of the injuries were evaluated by the same athletic trainer throughout the entire study. Last, we compared gender differences over a 15-year period rather than just a single season. This approach provided a fairly large sample size of nearly 2000 injuries, thus enhancing the statistical validity.

Patterns of injury in athletes have generally been assumed to be sport-specific and not gender-specific. Because men have traditionally been the most visible participants in the majority of sports, data on such elements as equipment, training, techniques, and coaching styles have been based largely on the male experience. The increase in participation of women has led to growing concern that female athletes may be at greater risk for certain injuries than their male counterparts [1,4,6]. If it is found that women are more at risk than men for certain types of sports-related injury, there may be modifiable factors that could reduce the relative risk of injury for the female athlete.

Previous authors have described a greater incidence of certain injuries among female athletes in various sports. Specifically, a greater incidence of ankle injuries in collegiate female basketball players [12], knee injuries in female basketball players [11], and knee and ankles injuries in elite female soccer players [3] as compared to their male counterparts have been shown. Our data did not demonstrate gender differences with regard to the incidence of ankle or knee injuries in any sport except swimming. Female swimmers and female water polo players also sustained a higher number of shoulder injuries than their male counterparts. We believe that the more rigorous training regimen used by the women's coach may have contributed to the higher number of injuries this study found in these female athletes competing in water sports.

More recently, studies have clearly documented a much greater incidence of ACL injury among female versus male athletes in basketball and soccer [1,2,6]. Anatomic, hormonal, and biomechanical differences between men and women have been postulated as reasons why female athletes are more predisposed to sustaining an ACL injury [5,8,10]. Thirteen athletes, 9 women and 4 men, sustained an ACL injury in our study. Although twice as many women were diagnosed with this injury, no statistical significance was calculated as a result of the small sample size.

The patterns of injury found in our study demonstrated much more gender similarity than difference. Although female athletes had a somewhat greater overall injury rate (52.5 compared with 47.7 for men, or 4.8 more injuries for women per 100 participant-years), this was not statistically significant. Only minor differences in injury pattern were found for swimming and water polo.

Some limitations to this study should be noted. Studies with this many variables (seven sports, two sexes, and twelve body parts) are likely to yield "significant" findings based on chance alone. The few statistically significant differences we found between men and women in this study could be explained by this fact. Also, our study did not analyze injury trends over time, a factor which could be valuable when assessing injury patterns. Finally, we were unable to obtain the amount of time lost from sports because of injury, thus losing an opportunity to further assess severity of injury.

Conclusion

This study found more similarities than differences in the pattern of injury among male and female athletes competing in 7 like sports at the same Division III college over a 15-year period. Although we did find some minor gender differences in total injuries for two sports (swimming and water polo), along with several differences in total injuries by anatomic location, these differences do not appear to be of any clinical significance. As in previous studies, female athletes in soccer and basketball had a higher rate of ACL injuries than their male counterparts. However, due to the small total number of ACL injuries in our sample, these differences were not statistically significant. We also found that rate of injury requiring surgery was similar in men and women.

With the exception of ACL injuries, these findings do not suggest any clinically significant difference in the overall pattern of injury between male and female athletes competing in basketball, cross-country, soccer, swimming, tennis, track and water polo. Future research based on these data could focus on the prevention of ACL injuries in women through modification of training techniques, equipment, or both.

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