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The Epidemiology of Medial Collateral Ligament Sprains in Young Athletes

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Background: A medial collateral ligament (MCL) knee sprain is a prevalent injury in athletic populations that may result in significant time lost to injury. Remarkably little is known of the epidemiology of this injury.

Purpose: To define the incidence of MCL tears and to determine the demographic and athletic risk factors.

Study Design: Descriptive epidemiological study.

Methods: A longitudinal cohort study was performed to examine the epidemiology of isolated MCL sprains at the United States Military Academy (USMA) between 2005 and 2009. Charts and radiographic studies were reviewed by an independent orthopaedic surgeon to identify all new isolated MCL sprains resulting in time lost to sport and activity that occurred within the study period. Incidence rates (IRs) with 95% confidence intervals (CIs) were calculated per 1000 person-years at risk and by sex, sport, and level of competition. The IR per 1000 athlete-exposures (AEs) was also determined. Incidence rate ratios (IRRs) and respective 95% CIs were calculated between male and female students, intercollegiate and intramural athletes, and male and female intercollegiate athletes involved in selected sports. Chi-square and Poisson regression analyses were used to examine the relationship between the variables of interest and the incidence of MCL sprains, with statistical significance set at $P < .05$.

Results: A total of 128 cadets sustained isolated MCL injuries during 17,606 student person-years from 2005 to 2009. This resulted in an IR of approximately 7.3 per 1000 person-years. Of the 128 injuries, 114 were in male athletes (89%) and 14 were in female athletes (11%). Male cadets had a 44% higher IR than did female cadets (7.60 vs 5.36, respectively), although this was not significant ($P = .212$). Of 5820 at-risk intercollegiate athletes, 59 (53 male, 6 female) sustained an isolated MCL sprain during 528,523 (407,475 male, 121,048 female) AEs for an overall IR of 10.14 per 1000 person-years and 0.11 per 1000 AEs. The IRR of MCL sprains of men compared with women involved in intercollegiate athletics was 2.87 (95% CI, 1.24-8.18) per 1000 person-years and 2.62 (95% CI, 1.13-7.47) per 1000 AEs. Of 21,805 at-risk intramural athletes, with quarterly participation, 16 (all male) sustained isolated MCL injuries during 225,683 AEs for an overall IR of 0.07 per 1000 AEs. The IRs of MCL injuries of intercollegiate and intramural athletes did not differ significantly. In intercollegiate sports, wrestling (0.57), judo (0.36), hockey (0.34), and rugby (men's, 0.22; women's, 0.23) had the highest IRs per 1000 AEs. When examining men's intercollegiate athletics, the IRRs of wrestling (13.41; 95% CI, 1.80-595.27) and hockey (8.12; 95% CI, 0.91-384.16) were significantly higher compared with that of lacrosse. Among women's intercollegiate sports as well as intramural sports, there were no significant differences in IRs. A median of 16 days was lost to injury, with 2407 total days lost for all injuries. Grade 1 MCL injuries lost a median of 13.5 days, while higher grade injuries lost a median of 29 days.

Conclusion: Medial collateral ligament injuries are relatively common in athletic cohorts. The most injurious sports are contact sports such as wrestling, hockey, judo, and rugby. Male athletes are at a greater risk than female athletes. Intercollegiate athletes are at a greater risk than intramural athletes. The average amount of time lost per injury was 23.2 days, with greater time lost with higher grade sprains than grade 1 sprains.

Keywords: medial collateral ligament; epidemiology; knee injuries; risk factor

Medial collateral ligament (MCL) injuries are common in young athletes.[4,7,24,25,31] Most injuries occur with direct contact, placing a valgus force on the knee, or from cutting maneuvers with the foot planted, creating a valgus moment in the knee. The addition of a rotational force may injure the posterior oblique ligament as well as the MCL.[15] The 3-layer concept of the anatomy of the medial knee described by Warren and Marshall[35] notes that after the superficial sartorial fascial layer, the middle layer contains the superficial MCL and posterior oblique ligament, and the deep layer contains the true capsule of the knee

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joint and the deep MCL. Usually, MCL injuries are graded based on the American Medical Association's classification according to the medial knee opening with valgus stress placed with the knee in 30° of flexion. Grade 1 opens <5 mm, grade 2 opens between 5 and 10 mm, and grade 3 opens >10 mm.[3] The vast majority of MCL injuries are treated nonoperatively with emphasis on early rehabilitation, range of motion exercises, and weightbearing when pain free.[23] Despite the lack of surgical management, these common injuries can cause significant lost time to return to sport or activity.

Several descriptive studies have looked at sports-related knee injuries in general and note that MCL injuries are common in skiing,[6,16,18,28,29,33,34] rugby,[8,13,19] football,[5,11,14,30] soccer,[21] and ice hockey.[9,12,20,27] While these studies concentrate on MCL injuries in a single sport, there is a paucity of literature dealing with a large population of young athletes playing various sports with corresponding athlete-exposure (AE) data on MCL sprains. The purpose of this study was to determine the epidemiology of MCL injuries among the physically active population at the United States Military Academy (USMA). In addition, we desired to investigate the relationship between sex, type of sport, level of competition, and incidence of MCL injuries in a uniform cohort and to examine the effect of these injuries in terms of time lost to injury. Our hypothesis was that increased MCL injury rates would be associated with male sex, participation in contact sports, and competing at a higher level.

MATERIALS AND METHODS

Study Design and Setting

A longitudinal cohort study was performed to study the epidemiology of MCL injuries over a 4-year period between 2005 and 2009 within the student population at the USMA, West Point, New York. We utilized the Cadet Illness and Injury Tracking System (CIITS), which allows tracking of all injuries that occur within the student population to include diagnoses and time lost due to injury. The study was approved by the Institutional Review Board at Keller Army Community Hospital (KACH). The population included all students who were in attendance at the Academy during each of the 4 years. Incoming students undergo a comprehensive medical evaluation and are required to meet the United States Army's standards of medical fitness.[10] Students participate in various competitive and physically demanding activities throughout their 4 years at the USMA. Every student competes in intramural, club, or intercollegiate athletics while students at the Academy. The Department of Physical Education provides courses that are part of the core curriculum that every student is required to complete, which includes combatives, swimming, gymnastics, and boxing (men). In addition, students must take the Army Physical Fitness Test each semester, consisting of timed sets of push-ups, sit-ups, and a 2-mile run. Military field training exercises and exercise programs are completed periodically through the 4-year curriculum and can also be physically rigorous. The USMA requirements call for mandatory attendance at most of these activities, and this is documented for all sporting events, games, and practices. Documented attendance at intramural, club, or varsity sporting events allows the compilation of AE data. The closed health care system at the USMA includes sports medicine clinics at practice, training, and competition sites as well as the orthopaedic clinic at the post hospital (KACH). All injuries resulting in lost time to sport or activity are documented in the CIITS.

Injury Surveillance

Diagnoses were made by a sports medicine–trained orthopaedic surgeon based on patient history and physical examination. At times, with higher grade injuries, a magnetic resonance imaging (MRI) study was obtained to rule out concomitant knee injuries. The isolation of MCL injuries came from medical records data and clinic notes. Any MCL injury that had another concomitant knee injury, whether diagnosed with imaging or examination, was excluded from the current study. The activity was documented in all cases. Activities that were not the result of participation on an organized sports team were labeled as "other" activities and were the result of participating in physical education classes, military training, or free-time activities such as skiing. All injuries were traumatic in nature and were graded based on the American Medical Association's standards as described in the introduction.[3] Time lost to injury was measured through the CIITS via assigned limitations by the treating provider on the medical excusal form. The excusal form requires the entry of an end date for limitations of athletic or other physical activity participation and begins on the date that the injury is recorded. After the end date on physical limitations is reached, the student is expected to be able to participate fully in any required physical or sports activity. No patients underwent surgical intervention for an isolated MCL injury during the study period, and all returned to full unrestricted activity during this time.

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TABLE 1
Incidence of MCL Injuries[a]

	Total Person-Years, n	MCL Sprains, n	IR per 1000 Person-Years	IRR per 1000 Person-Years	95% CI	*P* Value	AEs, n	IR per 1000 AEs	IRR per 1000 AEs	95% CI	*P* Value
Men	14,995	114	7.60	1.42	0.81-2.68	<.212					
Women	2611	14	5.36	—[b]							
Overall	17,606	128	7.27								
Male IC athletes	4392	53	12.07	2.87	1.24-8.18	<.006	407,475	0.13	2.62	1.13-7.47	<.014
Female IC athletes	1428	6	4.2	—[b]			121,048	0.0495	—[b]		
Overall IC athletes	5820	59	10.14	12.28	7.14-22.12		528,523	0.11	1.57	0.89-2.93	<.100
Overall IM athletes	—[c]	16					225,683	0.07	—[b]		

[a]AE, athlete-exposure; IC, intercollegiate; IM, intramural; IR, incidence rate; IRR, incidence rate ratio; MCL, medial collateral ligament.
[b]Not applicable because this category was used as the referent value.
[c]Person-years at risk unable to be calculated in IM athletes because of irregularity in participation.

Data Collection

All knee ligamentous injuries occurring within the study period were identified using a combination of electronic medical records and CIITS data reviews. Isolated MCL injuries were extracted from these data, and only new injuries were included in the incidence rate (IR) calculations. The primary outcomes of interest were the IRs of isolated MCL injuries both per 1000 person-years at risk and per 1000 AEs. Person-years were calculated from July 2005 through either the incidence of an MCL injury, graduation or separation from the Academy, or the administrative end of the study period on May 23, 2009. Further, AEs were defined as 1 student participating in an activity session (practice, game, or competition). Recurrent MCL injuries were not included in IR calculations. Knowles et al[17] recommended collecting data for person-time at risk to injury as precisely as possible. We calculated IRs both by the more widely used person-years at risk, when possible, and by the more precise AEs, dividing the total number of injuries observed by the corresponding measure of person-time risk to injury. Sports medicine research trends toward the more popular AE as the denominator in figuring IRs; however, converting IRs to annual units may allow better comparisons to be made between population rates across different studies.[26]

Data Analysis

Using data extracted from the electronic medical records and the CIITS database, IRs with 95% confidence intervals (CIs) were calculated per 1000 person-years at risk by sex, sport, and level of competition for the entire student population. Also, IRs with 95% CIs were calculated per 1000 AEs among athletes by sex, sport, and level of competition. The 2 levels of competition were intercollegiate and intramural. Intercollegiate teams with both men's and women's squads included basketball, rugby, lacrosse, soccer, tennis, cross country, judo, martial arts, swimming and diving, team handball, and track and field. Men's-only intercollegiate sports were football, hockey, baseball, gymnastics, golf, and wrestling. Women's-only teams included volleyball and softball. Intramural sports consisted of football (full pads and contact; men only), basketball, flag football, combat grappling, orienteering, pass n go, Sandhurst, team handball, ultimate Frisbee, and wrestling (men only). Pass n go involves running, cutting, and pivoting and is played with a football. Sandhurst is a military team adventure race involving multiple obstacles, orienteering, and running in full combat gear. Incidence rate ratios (IRRs) and respective 95% CIs were calculated between male and female students, intercollegiate and intramural athletes, and specific sports in each category. Chi-square and Poisson regression analyses were used to examine the relationship between the variables of interest and the incidence of MCL sprains. Kaplan-Meier estimates were calculated by MCL grades on MRI to estimate the time to return to participation after an acute traumatic MCL injury, and the log-rank test was used to determine if the time to return to participation was significantly different by grade of injury on MRI (grade 1 vs grades 2 and 3). All analyses were carried out using Stata v 10.1 (StataCorp, College Station, Texas, USA), setting statistical significance at $P < .05$ for all comparisons.

RESULTS

Between 2005 and 2009, there were 489 knee ligament injuries among students at the USMA. Of these, 128 were isolated MCL sprains. There were a total of 17,606 person-years at risk during the study period, giving a total IR of 7.27 per 1000 person-years (Table 1). The distribution by sex and sport is shown in Table 2. Grading data were available for 104 of the 128 isolated MCL injuries. The majority of the injuries were low grade (76 sprains; 73%). The overall distribution of injuries was 76 grade 1 sprains (73%), 24 grade 2 sprains (23%), and 4 grade 3 sprains (4%).

Patient Sex

Within the study period, 114 male students sustained an MCL injury among a total of 14,995 person-years at risk, for an IR of 7.60 per 1000 person-years. Female students had 2611 person-years at risk and sustained 14 MCL sprains, giving an IR of 5.36 per 1000 person-years. Men had an IR 1.42 times the female rate; however, this was not significant when person-years was used as the measure of person-time at risk for injury (Table 1). Within the intercollegiate athletes though, male patients had

TABLE 2
Distribution of MCL Injuries by Sex and Sport[a]

	n
Intercollegiate sports	
Male athletes	53
Football	28
Wrestling	8
Hockey	5
Rugby	4
Judo	3
Handball	1
Martial arts	1
Soccer	1
Basketball	1
Lacrosse	1
Female athletes	6
Rugby	4
Volleyball	1
Softball	1
Intramural sports	
Male athletes	16
Football	6
Wrestling	4
Soccer	2
Sandhurst	1
Rugby	1
Pass n go	1
Handball	1
Female athletes	0
Other activities	
Men	45
Women	8
Total	128

[a]MCL, medial collateral ligament.

a significantly higher IRR of MCL injuries compared with female patients using person-years at risk (2.87; 95% CI, 1.24-8.18) and AEs (2.62; 95% CI, 1.13-7.47) as measures (Table 1).

Level of Competition

Intercollegiate athletes totaled 528,523 AEs. They sustained 59 MCL injuries (53 male, 6 female) for an IR of 10.14 per 1000 person-years and 0.11 per 1000 AEs. We were unable to determine the intramural athletes' person-years of risk because of irregularity of the participation period. In terms of AEs, intramural athletes had a total of 16 incident MCL injuries during 225,683 AEs, resulting in an IR of 0.07 MCL injuries per 1000 AEs. Overall, the IR for MCL injuries was 57% higher per 1000 AEs in intercollegiate athletes when compared with intramural athletes; however, the difference between intercollegiate athletes (IRR, 1.57; 95% CI, 0.89-2.93) versus intramural athletes was not statistically significant ($P = .100$).

Incidence by Sport

The IRs for MCL injuries in specific intercollegiate sports are shown in Table 3. Among the intercollegiate sports, wrestling (0.57), judo (0.36), hockey (0.34), and rugby (men's, 0.22; women's, 0.23) had the highest IRs per 1000 AEs. When examining men's intercollegiate athletics, the IRR of wrestling (13.41; 95% CI, 1.80-595.27) and hockey (8.12; 95% CI, 0.91-384.16) were significantly higher compared with that of lacrosse. Among women's sports, there were no significant differences in IRs between sports; however, this is likely because of the small number of observed incident MCL injuries among female athletes during the study period. The raw numbers show that 67% of female MCL injuries occurred in rugby while only 1 MCL injury occurred each in volleyball and softball.

The IRs of MCL injuries in selected intramural sports are listed in Table 4. All intramural injuries (n = 16) occurred in men. Sandhurst (0.32), football (0.27), and wrestling (0.21) had the highest IRs for MCL injuries per 1000 AEs during the study period. There were no significant differences in IRs between intramural sports.

Time Lost to Sport

Of the 128 student athletes who sustained MCL injuries, reportable time loss due to injury was available for 93 (73%). The MCL injuries resulted in a total of 2407 days lost to injury with a median time loss of 16 days (interquartile range [IQR], 24). Grade 1 injuries resulted in a median time loss of 13.5 days (IQR, 20.5), while higher grade injuries (grades 2 and 3) resulted in a median time loss of 29 days (IQR, 39) after injury. Kaplan-Meier estimates for time to return to full participation by grade of MCL injury on MRI are presented in Figure 1. Grade 2 and 3 injuries took significantly longer to return to full function when compared with grade 1 injuries ($\chi^2 = 8.53$, $P = .004$).

DISCUSSION

Our study determined that MCL injuries are common in young athletes, with an overall incidence of approximately 7.3 per 1000 person-years in our athletically diverse population. Various general injury epidemiology studies have noted the high prevalence of MCL sprains in sports.[4,22,31] A year-long Australian study found that the most commonly sprained ligament was the MCL, which occurred most often in soccer and rugby players.[4] A study involving injuries in high school athletes noted a 26% prevalence of MCL sprains among all knee injuries over the course of 1 year.[31] The strength of the present study is that it examines incident injuries in a young athletic cohort participating in multiple sports of varying competitive levels and includes AE data. Past studies involving hockey,[9,12,20] football,[5,14,30] soccer,[25] and skiing[6,16,18,28,29,33,34] discuss the prevalence of MCL injuries in the specified sport, essentially as a percentage of all encountered injuries over a specified time period, and do not estimate IRs of isolated MCL sprains.

Male intercollegiate athletes were 2.62 times more likely to sustain an MCL injury than female intercollegiate athletes. This is partially explained by the fact that 2 of the 3 sports with the greatest IRs of MCL injuries for men

TABLE 3
Incidence of MCL Injuries in Intercollegiate Sports[a]

	Participants, n	Injuries, n (%)	AEs, n	IR per 1000 Person-Years	IR per 1000 AEs	IRR per 1000 AEs	95% CI	*P* Value
Men	2842	53 (100)	304,914	18.65	0.17			
Wrestling	179	8 (15.1)	14,092	44.69	0.57	13.41	1.80-595.27	.002[c]
Judo	133	3 (5.7)	8443	22.56	0.36	8.40	0.67-440.80	.063
Hockey	111	5 (9.4)	14,547	45.05	0.34	8.12	0.91-384.16	.036[c]
Rugby	289	4 (7.6)	18,115	13.84	0.22	5.22	0.52-256.97	.131
Handball	133	1 (1.9)	5761	7.52	0.17	4.10	0.05-321.99	.392
Football	1298	28 (52.8)	181,622	21.57	0.15	3.64	0.60-148.97	.166
Martial arts	113	1 (1.9)	9432	8.85	0.11	2.51	0.03-196.67	.571
Soccer	166	1 (1.9)	13,114	6.02	0.08	1.80	0.02-141.45	.714
Basketball	93	1 (1.9)	16,157	10.75	0.06	1.46	0.02-114.81	.812
Lacrosse	327	1 (1.9)	23,631	3.06	0.04	—[b]		
Women	376	6 (100)	40,057	15.96	0.15			
Rugby	211	4 (66.6)	17,155	18.96	0.23	2.91	0.29-143.49	.366
Volleyball	82	1 (16.7)	10,433	12.20	0.10	1.20	0.02-94.26	.909
Softball	83	1 (16.7)	12,469	12.05	0.08	—[b]		

[a]AE, athlete-exposure; IR, incidence rate; IRR, incidence rate ratio; MCL, medial collateral ligament.
[b]Not applicable because this category was used as the referent value.
[c]The relative risks of an MCL injury in men's wrestling and hockey are statistically greater than in men's lacrosse.

TABLE 4
Incidence of MCL Injuries in Intramural Sports[a]

	Participants, n	Injuries, n (%)	AEs, n	IR per 1000 Person-Years	IR per 1000 AEs	IRR per 1000 AEs	95% CI	*P* Value
Total	8507	16 (100)	92,922	7.52	0.17			
Sandhurst	508	1 (6.25)	3100	7.87	0.32	3.63	0.06-69.77	.361
Football	1918	6 (37.5)	22,466	12.5	0.27	3.01	0.54-30.46	.179
Wrestling	1637	4 (25)	19,046	9.78	0.21	2.36	0.34-26.14	.344
Rugby	878	1 (6.25)	6976	4.55	0.14	1.61	0.27-31.00	.696
Pass n go	900	1 (6.25)	8791	4.44	0.11	1.28	0.02-24.60	.820
Handball	834	1 (6.25)	10,025	4.78	0.10	1.12	0.02-21.57	.895
Soccer	1832	2 (12.5)	22,518	4.37	0.09	—[b]		

[a]AE, athlete-exposure; IR, incidence rate; IRR, incidence rate ratio; MCL, medial collateral ligament.
[b]Not applicable because this category was used as the referent value.

(wrestling and hockey) are male-only sports. In addition, the sport with the highest prevalence of MCL sprains (football, with 52% of male MCL injuries) was also male only. However, when comparing the same sport with similar exposure data between sexes, the rate was fairly consistent. The male and female rugby IRs were 0.22 and 0.23 per 1000 AEs, respectively. A larger number of total female injuries for comparison in similar sports may show a similar trend, as a large high school study showed a greater overall IR for general knee injuries in female athletes versus male athletes in the matched sports of basketball and soccer.[31] All intramural MCL injuries in the current study were in men though, which was surprising given that a greater number of the intramural sports were coeducational. Certainly, a factor for this could be the overall paucity of female sports-related MCL injuries (6 injuries).

To our knowledge, this is the first study to look at IRs for isolated MCL sprains in a young athletic cohort participating in over 20 different intercollegiate sports. Male wrestling, judo, and hockey had the highest IRs, and the IR in rugby was the highest for female athletes. A Swiss study of athletic knee injuries over 10 years reported the highest risk for MCL injuries in judo and skiing but did not calculate IRs.[22] The best literature on incidence pertaining to MCL sprains seems to involve rugby. Levy et al[19] studied intercollegiate rugby players via questionnaires over 4 seasons of play and calculated an IR of 0.39 MCL sprains per 1000 AEs but did not report isolated injuries only. This is a higher number than our female rugby IR of 0.23 per 1000 AEs. An Australian study of rugby injuries in games only found an astoundingly high IR of 1.91 MCL sprains per 1000 AEs; however, only match games were counted as exposures and not practice time.[13] The greater number of injuries seen in matches compared with practices was highlighted in a 2007 United Kingdom study, which reported IRs for MCL sprains of 3.1 and 0.04 per 1000 player-hours for rugby match versus training

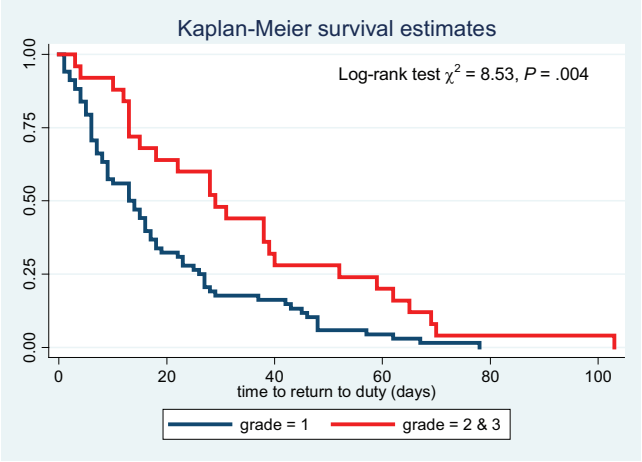

Figure 1. Kaplan-Meier survival estimates for time to return to participation by clinical grade of injury after an acute isolated medial collateral ligament injury.

injuries, respectively.[8] Interestingly, the IRs of MCL injuries in football and rugby in our study were in the moderate range for men. A recent long-term study of European professional soccer MCL injuries noted an overall injury rate of 0.33 per 1000 hours of exposure and had a similar downtime (average, 23 days) as in our current study.[21] Hockey, as well as skiing, requires the ankle to be bound within a boot, limiting ankle motion, which may make knee ligaments more susceptible to injury and explain our high IR for hockey. Wrestling had the highest IR among intercollegiate sports likely because of the large rotational torque forces involved and the valgus stresses placed on the knee during many wrestling maneuvers.

Intercollegiate athletes were more likely to sustain an MCL sprain when compared with intramural athletes, but this was not statistically significant. This could be explained by the higher level of play in intercollegiate sports. Interestingly though, football had the highest number of MCL injuries in intercollegiate sports (n = 28) but an IR of only 0.15 per 1000 AEs. Intramural football, by comparison, had the second highest IR among intramural sports (0.27 per 1000 AEs) and the highest number of MCL injuries (n = 6). This is likely because of the greater number of competition exposures in relation to practice exposures in the intramural football program compared with the intercollegiate program. Another possible explanation for this may be a disparity between both talent and experience playing full-contact football with full equipment between intercollegiate and intramural athletes. Two studies dealing with knee injuries in football players and prophylactic bracing showed higher IRs of MCL injuries than in the current study but did not single out isolated MCL injuries and singled out football exclusively.[1,2,32]

Athletes with grade 1 MCL injuries had significantly less time lost to injury than those with grade 2 or 3 injuries. In the current study, grade 1 injuries took 13.5 days to return to full duty after injury, while grade 2 or 3 injuries took over twice as long (29 days). This is clearly of clinical significance when counseling patients on expected time loss and return to function after an acute MCL injury. Derscheid and Garrick[11] looked at grade 1 and 2 MCL sprains in collegiate football players, concentrating on time lost to injury. Patients with grade 1 sprains lost an average of 10.6 days, while those with grade 2 injuries lost 19.5 days.[11] Our study differs in that more days were lost to injury, which may reflect differences in MCL injury grading or treatment strategies at the time of the study. Our study also presents a large range of time to return to sport, which may be an indication of differing patient motivation in our military health system. The previously mentioned European professional soccer study found an average of 23 ± 23 days lost to MCL injury, which compares to our findings of 23.2 ± 21.08 days lost.[21]

Limitations of our study are inherent to any large database study in that reliance on data entry is essential. Unfortunately, complete data entry was not always undertaken despite our closed health care system at the USMA. We were only able to obtain grading data on 104 of the 128 MCL sprains. Our population is a prescreened cohort subjected to extreme physical fitness requirements for selection and retention. However, the results of this study are likely generalizable to similarly active populations. We excluded any concomitant knee injuries, which allowed us to single out only isolated MCL sprains but limited our ability to compare IRs of isolated MCL injuries and multiligamentous knee injuries. A significant portion of MCL sprains did not occur during a particular intramural or intercollegiate sport, as the students are involved in other activities including military training. Categorizing these injuries to a specific sport may have added to the significance of some of our comparisons. Multiple providers evaluated the students, allowing errors in diagnosis and grading of MCL injuries. Treatment varied based on clinic protocol, with grade 2 and 3 injuries being treated with a hinged knee brace until asymptomatic. While all students were cleared for full participation in their respective sport when clinically healed, we did not assess any performance outcomes or track the level of return to play. Also, a number of the involved subsets of patients and sports had a minimal incidence of injury, which affected our statistical significance. In addition, we did not have complete data for time to return to sport for all of our organized sport MCL injuries, which also affected our statistical significance. Despite these limitations, our study represents IRs for MCL injuries in a large cohort of young athletes involved in various sports and physically rigorous activities that can guide future research in areas of injury prevention and risk reduction. A strength of our study is the large number of athletes at risk (17,606 person-years) and AEs (>750,000) captured within our closed health care system and annotated in the CIITS. As a result of our closed care system, we may more adequately assess the true incidence of isolated MCL injuries in a collegiate population.

CONCLUSION

Medial collateral ligament injuries are relatively common in young athletes. The overall IR of MCL injuries in

a young athletic cohort was 7.27 per 1000 person-years. Male intercollegiate athletes were over 2.6 times more likely to sustain an MCL injury than female intercollegiate athletes in the current study. There was no difference in the IR of MCL sprains among intercollegiate athletes when compared with intramural athletes. The intercollegiate sports of wrestling, judo, hockey, and women's rugby had the highest IRs of MCL injuries. There were 73% grade 1 MCL injuries, while 27% were grade 2 or 3; MCL sprains averaged 23.2 days of lost time per injury.

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