Injuries in elite Korean fencers: an epidemiological study

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ABSTRACT

Purpose We aimed to assess the risk of injury associated with training activities in a population of elite Korean fencers training for the Olympic games.

Methods We analysed the incidence of sports injuries, based on data prospectively collected over an 8-year period (January 2008 to December 2015) at the National Training Center in Seoul, Korea. The population of elite fencing athletes was stratified according to fencing category (sabre, epee and foil), sex, injury location (body region and site) and injury severity (mild or level I injury, requiring treatment for 1–3 days; moderate or level II injury, requiring treatment for 4–7 days; and severe or level III injury, requiring treatment for ≥8 days).

Results A total of 1176 injuries were recorded during the study period, with an average of 3.3 injuries per athlete annually. Of these, over half (52.6%) were mild injuries, with most injuries occurring in the lower extremity (47.2%), followed by injuries to the upper extremity (26.4%), trunk (21.4%), and head and neck area (5.0%). For all weapon categories, there was a significant difference between male and female athletes in terms of injury location and severity ($p \leq 0.005$).

Conclusions We hope that our data describing injury location and severity according to weapon category and sex can help one understand the circumstances that lead to injuries in elite Korean fencers and can be used in the development of programmes to reduce the incidence of sports injuries and enhance athletic performance.

INTRODUCTION

Fencing is one of only four sports included in every Olympic Games of the modern era.[1] With the recognition of Korean fencers as world class athletes, the popularity of fencing has been increasing, as have the expectations regarding the outcome of their athletic performance at international fencing competitions. Therefore, elite South Korean fencers are involved in an increasing number of training activities, performing exercises at a higher intensity and for a longer duration. While these activities are critical for maximising athletic performance,[2] they significantly increase the risk for sports injury in fencers. According to epidemiology studies carried out during the Olympics, fencing was associated with lower injury rates compared with those noted for soccer or Tae Kwon Do.[3 4] However, while combat sports athletes are matched within the same weight category,[5] fencers are matched according to weapon category (sabre, epee and foil), leading to entirely different styles of play, traits and tactics.[6] It is unclear whether this also leads to a different incidence and nature of sports injuries. Specifically, although there are several reports regarding fencing-related injuries,[7–11] epidemiological studies involving elite fencers are rare. Furthermore, most studies involve short follow-ups, typically up to 1 year, and are focused around special sports events. Wild *et al*[8] did report on sports injuries noted in German fencers over a period of 5 years, but performed no statistical analysis on their data.

The IOC aims to develop programmes to prevent sports injuries and help enhance the performance of Olympic athletes.[12] In an effort to collect data on the circumstances in which injuries of various severity occur, a prospective surveillance programme was initiated at the National Training Center in South Korea, which hosts the training of elite athletes who are expected to represent South Korea at international sporting events such as World Championships and the Olympic Games. In the present study, we analysed sports injury data prospectively recorded during the 8-year period since the initiation of the surveillance programme. In this study, we aimed to analyse the specific patterns of injury for each of the main weapon categories (sabre, epee and foil), and to investigate potential sex-specific differences regarding fencing injuries.

MATERIALS AND METHODS

Participants

This study included fencers evaluated as top-ranked candidates for participation at high-level international competitions, who trained at the Korea National Training Center over the course of 8 years, between January 2008 and December 2015. Annually, the centre hosted an average of 15 elite fencers (7 male, 8 female) for each weapon category (sabre, epee foil). Athletes trained on average 4.5 hours/day, 5 days a week. Over the course of a year, the athletes were present at the training centre for 11 months (47.7 weeks), totalling 1073 hours of training.

Data collection

Data regarding the match details (date, weapon category), characteristics of the fencer (name, sex) and characteristics of the injury (body region, site, severity) were recorded using daily injury report forms issued by the IOC.[4] Sports injury was defined as acute or chronic musculoskeletal signs and symptoms owing to fencing activities during competition or training sessions.[13 14] The athletes were assessed by one of three sports medicine specialists available on site over the course of the study period (2008–2010, 2010–2012 and 2013–2015), who filled in the daily injury report forms on site,

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before referring the athletes to the clinic of the Korea National Training Center.

Multiple injuries in a single athlete were classified according to the affected body region. Data were stratified according to weapon category (sabre, epee foil), sex of the athlete and location of the injury. The severity of the injury was classified as follows: mild injury, requiring 1–3 days of treatment (level I); moderate injury, requiring 4–7 days of treatment (level II); and severe injury, requiring 8 or more days of treatment (level III).[15 16] The injury location was classified based on the practice of the IOC during the 2012 London Olympics, which represented the most recent Olympic competition at the time the study was initiated. We defined the following affected body regions and injury sites: head and neck area (head, face, neck/cervical spine), upper extremity (shoulder/clavicle, upper arms, elbow, forearm, wrist, hand, finger, thumb), trunk (sternum/ribs, thoracic spine/upper back, abdomen, lumbar spine/lower back, pelvic/sacrum/buttock) and lower extremity (hip, groin, thigh, knee, lower leg, Achilles tendon, ankle, foot/toe).[4]

Statistical analysis

The examined variables included sex, fencing weapon category (sabre, epee and foil), injury location (body region and site) and injury severity. Descriptive statistics were used to examine injury patterns. In order to compare injury severity and location between groups defined based on fencing weapon category or sex, χ^2 tests were applied. Injury rates were calculated per year and per 1000 hours of training or per 1000 athlete exposures (AE), and the groups were compared in terms of z-scores and Poisson's ratios. All statistical analyses were performed using SPSS V.23.0 for Windows (IBM Corp, Armonk, New York, USA), and the significance level was set at 0.05.

RESULTS

A total of 1176 injuries (table 1) were recorded during the study period, of which 95% occurred while training at the facility, and the remaining 5% were treated at the on-site clinic after the athlete returned from a competition without having received adequate treatment. The difference between male and female fencers in terms of distribution of injuries per weapon category was statistically significant (p=0.021).

Table 1 Injury location (body region and site) in elite Korean fencers

	N (%)		
	Men	Women	Total
Site			
Head	NA (0.0)	NA (0.0)	NA (0.0)
Face	NA (0.0)	NA (0.0)	NA (0.0)
Neck/cervical spine	26 (4.5)	33 (5.5)	59 (5.0)
Head and neck	26 (4.5)	33 (5.5)	59 (5.0)
Shoulder/clavicle	53 (9.2)	57 (9.5)	110 (9.4)
Upper arms	3 (0.5)	1 (0.2)	4 (0.3)
Elbow	29 (5.0)	19 (3.2)	48 (4.1)
Forearm	14 (2.4)	9 (1.5)	23 (2.0)
Wrist	35 (6.1)	23 (3.8)	58 (4.9)
Hand	17 (2.9)	8 (1.3)	25 (2.1)
Finger	22 (3.8)	13 (2.2)	35 (3.0)
Thumb	6 (1.0)	1 (0.2)	7 (0.6)
Upper extremity	179 (31.0)	131 (21.9)	310 (26.4)
Sternum/ribs	9 (1.6)	10 (1.7)	19 (1.6)
Thoracic spine/upper back	30 (5.2)	31 (5.2)	61 (5.2)
Abdomen	2 (0.3)	1 (0.2)	3 (0.3)
Lumbar spine/lower back	57 (9.9)	58 (9.7)	115 (9.8)
Pelvic/sacrum/buttock	17 (2.9)	37 (6.2)	54 (4.6)
Trunk	115 (19.9)	137 (22.9)	252 (21.4)
Hip	4 (0.7)	22 (3.7)	26 (2.2)
Groin	5 (0.9)	7 (1.2)	12 (1.0)
Thigh	41 (7.1)	56 (9.3)	97 (8.2)
Knee	58 (10.1)	61 (10.2)	119 (10.1)
Lower leg	41 (7.1)	39 (6.5)	80 (6.8)
Achilles	18 (3.1)	16 (2.7)	34 (2.9)
Ankle	67 (11.6)	67 (11.2)	134 (11.4)
Foot/toe	23 (4.0)	30 (5.0)	53 (4.5)
Lower extremity	257 (44.6)	298 (49.7)	555 (47.2)
Total	577	599	1176

Data provided as absolute incidence and frequency of injury at a specific site or in a specific body region, relative to the total number of injuries noted over the entire observation period.
NA, not available.

Injury rates

The total injury rate per athlete was 3.3 injuries/year. For sabre, epee and foil, respectively, the annual injury rates were 3.9 (male 4.4; female 3.5), 3.2 (male 3.0; female 3.4) and 2.7 injuries/year (male 2.9; female 2.4).

The average time spent in training was 1074 hours/year per athlete, suggesting an overall injury rate of 3.0 injuries/1000 hours of training. However, the injury rate differed with the weapon category (figures 1 and 2). For sabre, the injury rate was 3.7 injuries/1000 hours of training, with significantly higher rates in male than in female fencers (4.1 vs 3.3 injuries/1000 hours of training; z=4.6277; p<0.001). For epee, the injury rate was 3.0 injuries/1000 hours of training, with significantly lower rates in male than in female fencers (2.8 vs 3.2 injuries/1000 hours of training; z=2.3188; p<0.02). For foil, the injury rate was 2.5 injuries/1000 hours of training, with significantly higher rates in male than in female fencers (2.7 vs 2.2 injuries/1000 hours of training; z=2.8485; p<0.004).

In terms of exposure, the total injury rate was 13.7 injuries/1000 AE, with significantly higher rates in male than in female fencers (14.4 vs 13.1 injuries/1000 AE; z=6.007; p<0.0001). For sabre, the injury rate was 16.5 injuries/1000 AE, with significantly higher rates in male than in female fencers (18.4 vs 14.8 injuries/1000 AE; z=9.6012; p<0.0001). For epee, the injury rate was 13.5 injuries/1000 AE, with significantly lower rates in male than in female fencers (12.5 vs 14.3 injuries/1000 AE; z=4.8081; p<0.002). For foil, the injury rate was 11.1 injuries/1000 AE, with significantly higher rates in male than in female fencers (12.4 vs 10.1 injuries/1000 AE; z=6.1309; p<0.001).

In men, sabre was associated with a significantly higher injury rate than those noted for epee (z=7.2938, p<0.001) or foil (z=7.4613, p<0.001), while epee and foil did not differ in terms of injury rate (z=0.1823, p=0.855). In women, sabre and epee were relatively similar in terms of injury rate (z=0.5970, p<0.55), but both were associated with higher injury rates than that noted for foil (z=6.1408, p<0.001; z=5.5437, p<0.001; respectively).

Injury location and severity

Injuries occurred most commonly in the lower extremity (47.2%), followed by the upper extremity (26.4%), trunk (21.4%), and head and neck area (5.0%), with a significantly different distribution of the affected body region in male and female fencers

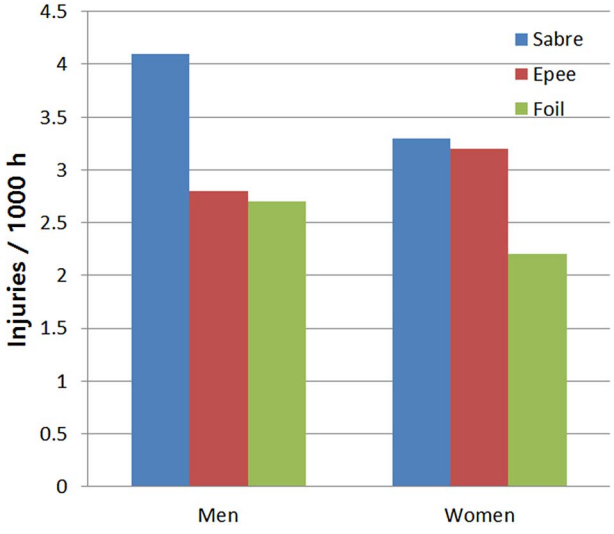

Figure 1 Injury rates per 1000 hours of training for each fencing weapon category.

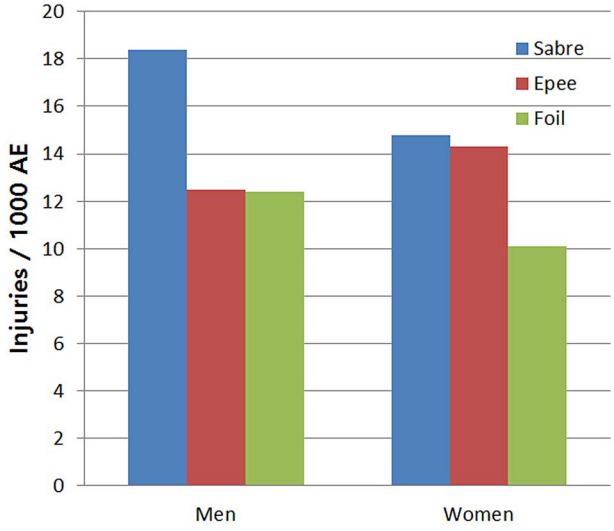

Figure 2 Injury rates per 1000 athlete exposures (AE) for each fencing weapon category.

(p=0.005). The ankle, knee, lumbar spine/lower back, shoulder and thigh were the most common sites of injury (table 1).

More than half of the reports (52.6%) indicated level I injuries, followed by level II and III injuries with an overall prevalence of 18.9% and 28.6%, respectively. Male and female athletes differed significantly in terms of the severity of their injuries (p=0.008), as did athletes involved in fencing using different weapon categories (p<0.001). However, while injury severity varied with weapon category in male athletes (p<0.02), this was not the case in female athletes (p=0.567).

For all weapon categories, level I injuries prevailed (typically, >50%), followed by injuries of levels III and II (tables 2–4). In terms of affected body region, injuries to the lower extremity prevailed (typically, 47%), followed by injuries to the upper extremity, trunk, and head and neck area. For sabre, male and female athletes differed significantly in terms of the body region most likely to incur injury (p=0.019), as well as in terms of injury severity (p<0.001) and distribution of injuries with a certain severity in various body regions (p<0.001). However, for epee and foil, male and female athletes showed similar trends in terms of the body region most likely to incur injury (p=0.334 and p=0.545, respectively), as well as in terms of injury severity (p=0.589 and p=0.762, respectively), but differed significantly regarding the distribution of injuries with a certain severity in various body regions (p=0.026 and p=0.009, respectively).

DISCUSSION

We aimed to better understand the pattern of sports injuries among elite Korean fencers by assessing the association of injury rate, location and severity with sex and weapon category (sabre, foil, epee). Until now, there have been very few studies analysing injuries among elite national fencers. Previous prospective studies conducted at the Korea National Training Center only differentiated between acute and chronic injuries,[17 18] and did not consider weapon category or injury severity. Although differences in study design preclude a direct comparison between our results and those of previous studies, there are similarities regarding average injury rate (here 3.3 injuries/year; previously reported 3.1 injuries/year) and most frequently observed injury site (ankle: here 11.4%; previously reported 15.4%).

Furthermore, it is important to note that we used an injury severity classification system that focused on overuse injuries, and not one that focused on acute injuries, because we believe that most injury events recorded in our study represent overuse injuries. The pool of Korean fencers is quite small, and many top-level fencers participate in multiple national competitions, training for many hours. These athletes accumulate fatigue and recurrent damage to the joints and muscles, which increases their risk of injury, especially given the high level of performance expected in these competitions and training activities.

Injury patterns in elite fencers around the world

Two previous studies analysing data from regional[19] and national[20] fencing competitions in Italy reported injury information in 358 and 801 fencing athletes, respectively. In these studies, the most affected body region was the upper extremity, followed by the lower extremity, head and neck area, and trunk. These results differed from those reported by our two epidemiological studies undertaken at the Korea National Training Center, where most injuries occurred in the lower extremity, and the fewest occurred in the head and neck area. Another interesting difference was that injuries to the trunk were very rare (none reported in the Italian fencing athletes), whereas we found an incidence of 21% for injuries to the trunk (especially to the lumbar and thoracic spine).

Regarding weapon category, we found that sabre fencing was associated with a higher incidence of injury, followed by epee and then foil, while the report regarding the Italian national competition suggested that foil fencing had the highest incidence of injury (18.6%), followed by epee (8.9%) and then sabre (9.2%).[20] These discrepancies are most likely related to national differences in training methods, athletes' build and specific skills used during the match.[21] While sabre was previously reported to have the highest incidence of sports injury, no difference was noted between the incidences of foil and epee fencing.[11]

Considering the variation in reported injury sites and mechanisms,[22] further research is warranted to assess the specific injury patterns during competition and training. Such information is useful to build strategies for injury prevention based on the specific circumstances of elite athletes. Moreover, developing preventive strategies to be applied during training may be even more important, as practice sessions are longer than

Table 2 Injury severity and affected body region in sabre fencers

	N (%)							
	Level I		Level II		Level III		Total	
Region	Men	Women	Men	Women	Men	Women	Men	Women
Head and neck	8 (0.14)	12 (0.19)	2 (0.04)	0 (0.00)	2 (0.04)	0 (0.00)	12 (0.22)	12 (0.19)
Upper extremity	60 (1.07)	23 (0.36)	8 (0.14)	18 (0.28)	16 (0.29)	7 (0.11)	84 (0.15)	48 (0.75)
Trunk	30 (0.54)	21 (0.33)	4 (0.07)	17 (0.27)	11 (0.20)	11 (0.17)	45 (0.08)	49 (0.77)
Lower extremity	56 (1.00)	48 (0.75)	12 (0.21)	22 (0.34)	36 (0.64)	47 (0.73)	104 (1.86)	117 (1.83)
Total	154	104	26	57	65	65	245	226

Data provided as absolute incidence and frequency of injury in a specific body region, relative to the total number of injuries noted over the entire observation period. Injury severity was defined as: mild or level I injury, requiring treatment for 1–3 days; moderate or level II injury, requiring treatment for 4–7 days; and severe or level III injury, requiring treatment for ≥8 days.

Table 3 Injury severity and affected body region in epee fencers

	N (%)							
	Level I		Level II		Level III		Total	
Region	Men	Women	Men	Women	Men	Women	Men	Women
Head and neck	4 (0.07)	6 (0.09)	4 (0.07)	5 (0.08)	1 (0.02)	1 (0.02)	9 (0.16)	12 (0.19)
Upper extremity	29 (0.52)	25 (0.39)	8 (0.14)	9 (0.14)	13 (0.23)	14 (0.22)	50 (0.89)	48 (0.75)
Trunk	17 (0.30)	33 (0.52)	4 (0.07)	6 (0.09)	12 (0.21)	13 (0.20)	33 (0.59)	52 (0.81)
Lower extremity	41 (0.73)	44 (0.69)	15 (0.27)	27 (0.42)	19 (0.34)	36 (0.56)	75 (1.34)	107 (1.67)
Total	91	108	31	47	45	64	167	219

Data provided as absolute incidence and frequency of injury in a specific body region, relative to the total number of injuries noted over the entire observation period. Injury severity was defined as: mild or level I injury, requiring treatment for 1–3 days; moderate or level II injury, requiring treatment for 4–7 days; and severe or level III injury, requiring treatment for ≥8 days.

Table 4 Injury severity and affected body region in foil fencers

	N (%)							
	Level I		Level II		Level III		Total	
Region	Men	Women	Men	Women	Men	Women	Men	Women
Head and neck	3 (0.05)	6 (0.09)	1 (0.02)	1 (0.02)	1 (0.02)	2 (0.03)	5 (0.09)	9 (0.14)
Upper extremity	22 (0.39)	14 (0.22)	10 (0.18)	11 (0.17)	13 (0.23)	10 (0.16)	45 (0.80)	35 (0.55)
Trunk	23 (0.41)	25 (0.39)	8 (0.14)	5 (0.08)	6 (0.11)	6 (0.09)	37 (0.66)	36 (0.56)
Lower extremity	32 (0.57)	36 (0.56)	14 (0.25)	11 (0.17)	32 (0.57)	27 (0.42)	78 (1.39)	74 (1.16)
Total	80	81	33	28	52	45	165	154

Data provided as absolute incidence and frequency of injury in a specific body region, relative to the total number of injuries noted over the entire observation period. Injury severity was defined as: mild or level I injury, requiring treatment for 1–3 days; moderate or level II injury, requiring treatment for 4–7 days; and severe or level III injury, requiring treatment for ≥8 days.

competitions, leading to significantly more muscle fatigue and thus increased risk of injury.[18]

While European fencers are typically known to use a technique that relies on elegance and strength, Korean fencers prefer to use a technique based on speed (fast footwork in particular) in an attempt to overcome their relatively smaller build compared with that of their European opponents. Specifically, the technique involves fast and small steps and allows control of distance from the opponent. Hwang and colleagues reported that the maximum pace of elite Korean fencers is 80 steps per minute, which represents double the pace of elite European fencers.[23] This is most likely the reason why most sports injuries noted in elite Korean fencers are injuries to the lower extremity, while this was not the case for Italian fencers.[19 20]

Gambaretti *et al*[24] suggested that injuries occurred more frequently during training (77%) than during competition (23%). While this study did not differentiate between injuries that occurred during training and those that occurred during competition, previous prospective studies conducted at the Korean National Training Center confirmed that the incidence of sport injuries was higher during training than during competitions.[18] In the past, skill training mainly involved conventional methods, whereas nowadays training varies according to weapon category, and involves a mixture of interval training, weight training, physical training and coordination/balance training. Thus, the discrepancy in the results from this study and those of previous studies could be explained in terms of the different training methods applied.

Injury mechanisms in elite fencers

We found that the ankle, knee and lower back were the most commonly affected body regions. While traumatic injuries are less common, the inherent asymmetry of the sport, repetitive movements required for many techniques and the sometimes awkward positions required for those same techniques make fencers more prone to certain types of overuse injuries. As is the case with most other sports, ligament sprains and muscle strains are the predominant types of injuries among fencers,[1–5] and accounted for most of the injuries recorded in our study.

Tendinitis and torn tendons are relatively common problems for fencers, primarily in the forearm and wrist of the weapon arm.[11] Indeed, we found that elbow and shoulder injuries were predominantly found on the weapon side, and consisted mostly of injury to the radial epicondyle of the elbow and the humerus.

On the other hand, injuries to the lower extremity did not occur predominantly on the weapon side, and injuries to the Achilles tendon occurred predominantly on the non-weapon side. We found a high incidence of knee injury and patellofemoral pain. Thigh injury is often noted concomitantly with patellofemoral pain, and hamstring strains are often associated with quadriceps strains. Knee injuries frequently occur secondary to high valgus stress on the joint; moreover, overtraining and improper stance in an 'en garde' position carry a higher risk of patellar tendinitis, where inflammation and pain make it difficult to execute proper fencing footwork.[25] Injuries to the ankle joint are frequent, and most commonly occur in the components of the lateral collateral ligament (posterior talofibular, calcaneofibular and anterior talofibular ligaments).[26] Ankle injuries typically occur because of slips and falls, and the injured fencers often state that the incident involved excessive lunge motion,[26 27] which is consistent with the fact that achieving high performance in the kick lunge motion poses additional demands on posture and femoral muscle strength.[27]

Lower back injuries typically occur during extreme trunk rotations or imbalance while attempting a stab. Fencing relies on quick movements of the lower extremity and requires excellent balance and flexibility.[28] Such sudden movements can lead to overextension of joints, which carries a high risk of pulling muscles in the arms, legs and back,[25] as well as a risk of injury resulting in ligament and muscle damage. While injury to the lower back is very common in all sports,[8 29] fencers may experience it as a combination of concomitant conditions such as sacroiliac joint syndrome, hamstring injury and abdominal strain. Furthermore, we found that the distribution of affected body regions is different for each weapon category, which is in line with previous reports[29] and can be explained by the different dynamics and skill sets required for performance in each weapon category, as well as the specific competition time and training methods.

Moyer and Konin[30] reported another type of injury occasionally noted in fencers, which was related to heat illness or exhaustion caused by wearing heavy protective fencing gear during long periods of competition; no such injuries were reported in our study.

Sex-specific differences in injury patterns of elite fencers

Lee *et al*[31] insisted that the incidence of sports injuries increases with the experience of the athlete. We noted that male sabre and foil fencers displayed a higher annual injury rate than that noted for female fencers. German female fencers were previously reported to have an injury rate three times higher than that noted in their male counterparts, but no statistical analysis was carried out.[8] The discrepancy between the findings in Korean and German fencers is most likely related to differences in training methods, physical build and style of play.

Significant differences between the sexes or different weapon categories were noted regarding the incidence of level I and II injuries ($p<0.009$ and $p<0.022$, respectively) but not regarding that of level III injuries ($p<0.183$). Overall, we found that male fencers had more injuries of level I, while female fencers had more injuries of levels II and III ($p=0.008$). It is expected that this sex-specific difference is related to physical build, which also leads to different situations during the match, as athletes tend to adapt their strategy and use different skill sets according to their physical build and strength relative to those of their opponent.[32]

Injury prevention

While serious injuries or injuries requiring a long recovery period appear to be relatively rare among fencers, there is a real risk of sustaining numerous minor injuries that may be preventable.[7–11] The following represent essentially common sense suggestions likely to be confirmed in the future by appropriate research. Since sprains and strains occurring in the lower extremities were the most common injuries noted in our study, and the most frequently cited cause of injury was inadequate warm-up, it results that proper warm-up and stretching may help prevent fencing injuries.[1 11] Many athletes admit avoiding performing sufficient warm-up and stretching exercise, while a significant number state that instructors and coaches do not place enough or any emphasis on these aspects of training.[11] Therefore, the first recommendation for preventing fencing injuries is to educate fencing instructors and coaches on the importance of proper techniques of warming up and stretching prior to practice and competition. Additional measures likely to help reduce the incidence of injury among fencers include prophylactic strengthening and proprioceptive training of the musculature of the knee (hamstring and quadriceps) and ankle.

Overtraining seems to be a problem limited to elite fencers who train on a daily basis throughout the year, as can also be deduced from the comments submitted by fencers in the survey organised by the US Fencing Association.[33] To alleviate the effect of overtraining, it is suggested that instructors and coaches emphasise the need for adequate general physical conditioning before and during the fencing season.[33]

Although injuries among fencers are often related to fatigue and improper conditioning, poor technique is also a cause of injury. However, injuries related to poor technique vary with weapon category, and can probably be best addressed by ensuring the availability of adequately trained and experienced instructors and coaches who can quickly identify and correct faulty technique in this technique-oriented sport.

Implications

In this study, the athletes were observed over a relatively long period. Moreover, a detailed analysis regarding the incidence, location and severity of the injuries was performed. Further analyses considered also the influence of weapon category, which is expected to be relevant for assessing the risk of sport injury and developing preventive measures.

CONCLUSIONS

Nearly half of all injuries noted among elite Korean fencers were considered minor. Male and female fencers differed significantly in terms of injury incidence ($p=0.008$) and affected body region ($p=0.005$). Sports injuries to the lower extremity

prevailed (47.2%), followed by injury to the upper extremity (26.3%), trunk (21.4%), and head and neck area (5%). The ankle, knee, lumbar spine/lower back, shoulder and thigh were common sites of injury.

Limitations

This study has several limitations. First, multiple injuries in a single athlete were classified by the affected body region. We were not able to factor in one athlete who left the centre in midseason because of severe injury or personal reasons. However, every injury that occurred at the training facility had to be reported and handled within the on-site facilities, which made for consistent data gathering. Finally, we did not have any information regarding the biomechanical mechanisms of injury. Our data came from daily injury report forms, which are filled in on site as soon as an athlete reports injury symptoms. These forms include only the results of the initial assessment before the athlete is referred to the clinic, and therefore do not specify the diagnosis.

What are the findings?

- In elite Korean fencers, the incidence and severity of sports injuries differs significantly between the sexes.
- Injuries to the ankle, knee, lumbar spine/lower back, shoulder and thigh were reported, with almost half of the injuries occurring in the lower extremity.

How might it impact on clinical practice in the future?

- The study provides valuable information that can help develop programmes and training protocols to prevent the type of sports injuries occurring in elite fencers.

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Contributors KJP was responsible for the conception and design of the study. Both authors contributed to interpretation of the findings and had full access to all data. The final manuscript was approved by both authors.

Competing interests None declared.

Ethics approval The study design was approved by the Korean Olympic Committee.

Provenance and peer review Not commissioned; externally peer reviewed.

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