EPIDEMIOLOGY OF SPORTS INJURIES IN KOREAN ELITE FEMALE FENCING ATHLETES: A PROSPECTIVE COHORT STUDY

EPIDEMIOLOGIA DAS LESÕES ESPORTIVAS EM ATLETAS COREANAS DE ESGRIMA DE ELITE: UM ESTUDO PROSPECTIVO DE COORTE

EPIDEMIOLOGÍA DE LAS LESIONES DEPORTIVAS EN ATLETAS COREANAS DE ESGRIMA DE ÉLITE: UN ESTUDIO PROSPECTIVO DE COHORTE

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ABSTRACT

Objectives: We aimed to assess the risk of injury associated with training activities of Korean elite female fencing athletes by weapon category. Methods: We prospectively collected 2021 data on 80 elite female fencing athletes at the Korean Training Center. Injury incidence rates were expressed as Poisson rates with a 95% confidence interval. We used χ2 tests to compare injury locations and recovery times by weapon category. Results: A total of 233 injuries were recorded, averaging 3.27 (95% CI, 2.86–3.72) injuries per 1,000 training hours. The sabre had the highest injury incidence rate, followed by the epee and the foil. Injuries to fencing athletes were the most common in the lower extremities (46.35%), followed by the upper extremities (24.03%), trunk (20.17%), and head and neck area (9.44%). The weapon category did not affect the body regions (p=0.425). However, recovery time differed significantly by body region (p=0.021). Conclusion: The weapon category was found to affect the injury incidence rate. In addition, recovery time varied depending on body region. Further research is needed to clarify these results. ***Level of evidence II; Therapeutic studies - investigation of treatment results.***

Keywords: Prospective studies; Injury; Epidemiology.

RESUMO

Objetivos: Nosso objetivo foi avaliar o risco de lesão associado às atividades de treinamento de acordo com a categoria de arma de atletas coreanas de esgrima de elite. Métodos: A partir de 2021, coletamos prospectivamente dados de 80 atletas de elite de esgrima no Centro de Treinamento Coreano. As taxas de incidência de lesões foram expressas como taxas de Poisson com intervalo de confiança de 95%. Usamos o teste de χ2 para comparar os locais de lesão e os tempos de recuperação de acordo com a categoria da arma. Resultados: Um total de 233 lesões foi registrado, com média de 3,27 (IC 95%, 2,86–3,72) lesões por 1.000 horas de treinamento. O sabre teve a maior taxa de incidência de lesões, seguido pela espada e pelo florete. As lesões dos atletas de esgrima foram mais comuns nos membros inferiores (46,35%), seguidas pelos membros superiores (24,03%), tronco (20,17%) e região da cabeça e pescoço (9,44%). A categoria da arma não influenciou as regiões do corpo (p = 0,425). No entanto, o tempo de recuperação diferiu significativamente de acordo com a região do corpo (p = 0,021). Conclusão: Verificou-se que a categoria de arma afeta a taxa de incidência de lesões. Além disso, o tempo de recuperação variou de acordo com a região do corpo. São necessárias mais pesquisas para esclarecer esses resultados. ***Nível de evidência II; Estudos terapêuticos – investigação de resultados de tratamento.***

Descritores: *Estudos prospectivos; Lesão; Epidemiologia.*

RESUMEN

Objetivos: Nuestro objetivo fue evaluar el riesgo de lesión asociado a las actividades de entrenamiento según la categoría de arma en atletas coreanas de esgrima de élite. Métodos: A partir de 2021, recopilamos prospectivamente datos de 80 atletas de esgrima de élite en el Centro de Entrenamiento de Corea. Las tasas de incidencia de lesiones se expresaron como tasas de Poisson con un intervalo de confianza del 95%. Usamos la prueba de χ2 para comparar el local de las lesiones y los tiempos de recuperación según la categoría de arma. Resultados: Se registró un total de 233 lesiones, con un promedio de 3,27 (IC 95 %, 2,86–3,72) lesiones por cada 1000 horas de entrenamiento. El sable tuvo la tasa de incidencia de lesiones más alta, seguido por la espada y el florete. Las lesiones de los atletas de esgrima fueron más frecuentes en las extremidades inferiores (46,35%), seguidas de las extremidades superiores (24,03%), tronco (20,17%) y región de la cabeza y cuello (9,44%). La categoría de arma no afectó las regiones del cuerpo (p=0,425). Sin embargo, el tiempo de recuperación difirió significativamente según la región del cuerpo (p=0,021). Conclusión: Se constató que la categoría de arma afecta la tasa de incidencia de lesiones. Además, el tiempo de recuperación varía según la región del cuerpo. Se necesitan más investigaciones para aclarar estos resultados. ***Nivel de evidencia II; Estudios terapéuticos – investigación de resultados de tratamiento.***

Descriptores: *Estudios prospectivos; Lesión; Epidemiología.*

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INTRODUCTION

Fencing is one of the combat sports included in the Olympics;[1] fencing uses "weapon" to combine asymmetric body movements with force, explosive force, and force absorption, which apply high physiological needs to the body.[2] These repetitive movements induce increased injury rates among fencing players. An epidemiological study on sports injuries sustained during the 2012 Olympic Games in London showed that fencing athletes had a high incidence of sports-related injuries.[2] A sports injury refers to a condition in which an athlete is not permitted to participate in sporting activities for more than a day due to an injury sustained during sports-related activities that require medical staff attention.[3] Sports injuries have an adverse effect on an athlete's performance and on their lives, often leading to retirement from the sport.[4] Fencing athletes are classified as sabre, epee, and foil according to the weapon and rules of the game, this is divided into leading to entirely different traits, tactics and styles of play.[5]

The International Olympic Committee (IOC) has developed a sports injury prevention program. The primary requirement for developing a sports injury prevention program is to investigate sports injury dynamics. The subsequent requirement is the identify the factors that affect the occurrence of sports injuries.[6] However, research examining injury patterns according to the weapon category is rare. Therefore, epidemiological studies concerning sports injuries in fencing athletes and factors affecting sports injuries in these athletes are limited.[1] This study aimed to analyze sports injury and investigate the relationship between injury pattern and weapon category among elite female fencing athletes trained to participate at international level. Our study is to address the link between weapon category and sports injury risk in fencing athletes in general and female fencing athletes in particular and may have crucial implications for sport safety.

METHODS

Study population

The study was conducted on elite female fencing athletes, aged 18 or older, who participated in high-level international competitions and trained at the Korea Training Center between January 2021 and December 2021. The center hosts an of 80 female fencing athletes according to for each weapon category (27 sabre, 27 epee and 26 foil) (Table 1). The study was undertaken in accordance with the Helsinki Declaration. These elite athletes underwent training for an average of 4.5 hours/day, 5 days/week, and participated in the study for 43 weeks on average. The Ethics Committee of our institution waived the requirement for written informed participant consent due to the retrospective design of the study.

Data collection

Data for epidemiological analysis were collected concerning all acute and chronic sports-related injuries that had occurred from January 2021 to December 2021. When an athlete sustained a sports injury, the location and type of injury were classified by one of three sports medical experts in rehabilitation, orthopedic surgery, or family medicine residing at the Korea Training Center, based on the IOC consensus statement.[7] To prevent data from being missed, if multiple injuries occurred during the same incident to an athlete, each injury was recorded separately. Severity of injury was classified as follows: level I, mild injury requiring 1–3 days of recovery time; level II, moderate injury requiring 4–7 days of recovery time; and level III, severe injury, requiring ≥ 8 days of recovery time.[8-10]

Table 1. General characteristics of the subjects.

	Total (SD)	Sabre (SD)	Epee (SD)	Foil (SD)
N	80	27	27	26
Hours of training	71.244	23.368	23.909	23.967
Age (years)	28.28 (4.44)	26.33 (4.06)	27.38 (4.53)	31.38 (3.38)
Height (m)	166.28 (4.13)	166.88 (2.69)	167.80 (4.31)	164.10 (4.82)
Weight (kg)	60.26 (5.96)	60.30 (6.30)	61.04 (4.43)	59.44 (7.45)
BMI ($kg \cdot m^{-2}$)	21.78 (1.88)	21.64 (2.21)	21.70 (1.68)	22.00 (1.91)

Statistical analyses

The general characteristics of all the athletes were analyzed using technical statistics. The variables analyzed included injury locations (body site and areas) and recovery times; technical statistics were used to investigate injury patterns. Using the chi-square test, we compared the injury locations and recovery time according to weapon category. The injury rate was calculated by the Poisson ratio per 1,000 hours of training, used a 95% confidence interval (CI). This was calculated excluding hours that were not involved in training due to injury. The injury incidence rate over 1,000 hours was calculated as follows: (total injuries / total training hours × 1,000). The statistical significance level was set at $\alpha = .05$, and SPSS version 27.0 for Windows (IBM Corp, Armonk, NY, USA) software was used for all statistical analyses.

RESULTS

Injury incidence rates

A total of 233 injuries were recorded, with an average of 2.91 injuries per year per athlete. No differentiation was made regarding whether the athletes' injuries were acute or chronic. The overall injury rate was 3.27 (95% CI, 2.86–3.72) injuries per 1,000 training hours. Sabre had a higher injury incidence rate, followed by the epee and, foil (Table 2).

Injury location and type of injury

Injuries occurred most commonly in the lower extremity (46.35%), followed by the upper extremity (24.03%), trunk (20.17%), and head and neck area (9.44). The sites of injury according to the weapon category were similar (p=0.425). The most common injury sites for all athletes were the knee, lumbosacral, ankle, and shoulder (Table 3). The most common types of injury were injuries to the muscle (36.91%), ligament (28.76%), cartilage (17.60%), tendon (11.16%), and bone (5.58%) tissues (Table 4).

Recovery time

Among all fencing athletes, 54.08% of injuries were classified as level I, 21.03% as level II, and 24.09% as level III. The recovery time according to the weapon category were similar (p=0.603). However, recovery time was significantly different among the body regions (p = 0.021) (Table 5).

DISCUSSION

This study aimed to analyze sports injury and investigate the relationship between injury pattern and weapon category among elite female fencing athletes trained to participate at international level.

Injury incidence rates

A total of 233 injuries were recorded, averaging 2.91 injuries per year per athlete. Injuries were not recorded as being acute or chronic. The overall injury rate was 3.27 (95% CI, 2.86–3.71) injuries per 1,000 training hours. While a direct comparison is difficult due to differences in research design, three studies have investigated sports injuries that athletes sustained during the 2008 Beijing Olympics,[11] the 2012 London

Table 2. Injury incidence rates of training for weapon category.

weapon category	Injury Incidence Rate (95%CI)		p value
Sabre - Epee	3.94 (3.17 a 4.83)	3.10 (2.43 a 3.89)	0.142
Sabre - Foil	3.94 (3.17 a 4.83)	2.80 (2.17 a 3.55)	0.039
Epee - Foil	3.10 (2.43 a 3.89)	2.80 (2.17 a 3.55)	0.603

Table 3. Injury location (body region and site) in elite Korean Fencing athletes.

Site	No (%)		
	Sabre	Epee	Foil
Head	4 (4.53)	4 (5.41)	2 (2.99)
Neck	5 (5.43)	4 (5.41)	3 (4.88)
Head and neck	9 (9.78)	8 (10.81)	5 (7.46)
Shoulder	6 (6.52)	7 (9.46)	8 (11.94)
Upper arms	2 (2.17)	2 (2.70)	1 (1.49)
Elbow	3 (3.26)	2 (2.70)	2 (2.99)
Forearm	2 (2.17)	1 (1.35)	3 (4.48)
Wrist	3 (3.26)	2 (2.70)	4 (5.97)
Hand	1 (1.09)	2 (2.70)	5 (7.46)
Upper extremity	17 (18.48)	16 (21.62)	23 (34.33)
Chest	2 (2.17)	-	1 (1.49)
Thoracic Spine	5 (5.43)	4 (5.41)	2 (2.99)
Lumbosacral	10 (10.87)	11 (14.86)	8 (11.94)
Abdomen	2 (2.17)	1 (1.35)	1 (1.49)
Trunk	19 (20.65)	16 (21.62)	12 (17.91)
Hip/groin	4 (4.35)	3 (4.05)	2 (2.99)
Thigh	7 (7.61)	6 (8.11)	6 (8.96)
Knee	13 (14.13)	11 (14.86)	8 (11.94)
Lower Leg	7 (7.61)	3 (4.05)	5 (7.46)
Ankle	11 (11.96)	8 (10.81)	4 (5.97)
Foot	5 (5.43)	3 (4.05)	2 (2.99)
Lower extremity	47 (59.09)	34 (45.95)	27 (40.30)
Total	92 (100.00)	74 (100.00)	67 (100.00)

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.

Table 4. Injury type in elite korean Fencing athletes.

Tissue	Pathology type	No (%)	Total
Muscle	Strain	59 (25.32)	86 (36.91)
	Muscle tear	6 (2.58)	
	Muscle rupture	3 (1.29)	
	Muscle contusion	18 (7.73)	
Tendon	Tendinosis	23 (9.87)	26 (11.16)
	Tendon rupture	3 (1.29)	
Bone	Bone stress injury	3 (1.29)	13 (5.58)
	Bone contusion	10 (4.29)	
Cartilage/ Synovium/Bursa	Cartilage injury	12 (5.15)	41 (17.60)
	Arthritis	14 (6.01)	
	Synovitis/capsulitis	6 (2.58)	
	Bursitis	9 (3.86)	
Ligament/ Joint capsule	Joint sprain (ligament tear or acute instability episode)	67 (28.76)	67 (28.76)

Table 5. Statistical results of injuries in elite Korean Fencing athletes.

Injury	No (%)					
	Level I	Level II	Level III	df	x^2	p value
Sabre	47 (51.08)	23(25.00)	22 (23.91)	4	2.736	0.603
Epee	44 (59.46)	11 (14.86)	19 (25.68)			
Foil	35 (52.24)	15 (22.39)	17 (25.37)			
Head and neck	16 (72.73)	4 (18.18)	2 (9.09)	6	14.955	0.021
Upper extremity	29 (51.79)	16 (28.57)	11 (19.64)			
Trunk	32 (68.09)	7 (14.89)	8 (17.02)			
Lower extremity	49 (45.37)	22 (20.37)	37 (34.26)			

Olympics,[2] and 2016 Rio Olympics.[12] The data from these studies were reported only in terms of a general diagnosis of the sports injuries, as well as the incidence rate, number of injuries, and injury characteristics. More than 5% of the fencing participants in the 2008 Beijing Olympics,[11] and the 2012 London Olympics,[2] and more than 10% of the fencing participants in the 2016 Rio Olympics,[12] sustained sports-related injuries. Although this rate was lower than injury rates reported for football (soccer), taekwondo, and water polo, the injury rate has increased in fencing every successive Olympics game. This is likely to be because elite athletes participated in more high-risk activities, with a desire to win the match possibly being considered more crucial than the risk of injury.[13] Other possible reasons may have included differences in coaching supervision and healthcare levels.[14] Causes of injury vary from sport to sport; however, in football, taekwondo, water polo, and fencing athletes, most injuries are due to contact with other competitors or contact with moving objects.[11] In our study, Sabre had a higher injury incidence rate than foil. This may be due to differences in game rules. Sabre are scored by a part of the blade being cutting or thrusting on the opponents upper extremity and head. However, foil are scored only by thrusting the opponents torso.[15] Therefore, the sabre is more likely to be exposed to injury than foil. However, the fencers who previously participated in the Italian singles championships were the most injured of the foil, followed by Epee and Sabre.[16] This discrepancy may be due to the difference between training and the competition. It is most likely because athletes use a variety of skills during training and not all training hours are used for open combat.[17] Further research is needed to assess specific injury patterns during competition and training, taking into account the diversity of reported injury areas and mechanisms. This information is useful for establishing an injury prevention strategy based on specific circumstances of elite athletes. Furthermore, since practice sessions are longer than competition sessions, developing preventive strategies to apply during training may be more important.

Injury location and type of injury

In this study, injuries were found to be most common in the lower extremity, followed by the upper extremity, trunk, and head and neck. Moreover, previous studies have reported similar injury site data for fencing competitions.[16,18,19] Due to different study designs, a direct comparison of our results with those of previous studies was not possible; however, most injuries have been reported to have occurred in the upper extremity, based on study findings involving fencing athletes attending the United States University Student's Association,[18] the Italian youth Championships,[19] and Italian singles championships,[16] which differed from our finding that injuries were most common in the lower extremity. These differences may be related to differences in body structure, training methods, and combat styles. Several international fencing athletes use techniques that rely on strength and fight with weapon;[20] however, Korean athletes frequently use foot techniques (fast footwork, in particular);[21] therefore, there is a higher incidence of lower extremity injuries among Korean athletes. The most commonly injured tissues were the muscle, followed by the ligament, cartilage, tendon, and bone, and our findings were consistent with those of previous studies.[16,18,19]

Recovery time

Previous studies have reported that most induced injuries are not serious; however, no specific definitions are provided for the serious and very serious categories of injuries.[16,18,19] Hence, it is not comparable to our research; however, it is difficult to define the severity of sports injuries.[22] Currently, most studies use the time loss required to define the severity of sports injuries; however, the time loss depends on whether the player still attends the practice session.[23] Using a simple time loss definition

has serious drawbacks.[23] First, injuries that occurred after Friday night's game end could be resolved next Monday's practice time.[22] Second, the subjective judgment of the player about the severity of injury affects the decision of whether to attend the practice session.[22]

In our study, recovery time was significantly different by body regions. level I injuries occurred most commonly in the head and neck; level II injuries occurred most commonly in the upper extremity; level III injuries occurred most commonly in the lower extremity. However, other studies lacked information on the recovery time due to the body region, so we could not compare our results with previous observations. Nevertheless, the difference in the severity of injury depending on the body part may be due to the combat style. As mentioned earlier, Korean frequently use foot technology (especially fast footwork),[21] so level III injury can be concentrated on the lower extremity.

Strengths and limitations

First, closely watched 80 fencing athletes over the course of 10 months. Thus, totaling 71244 hours in training. Second, the recovery time(defined as training loss time), the detailed analysis of injury location were performed at very high inclusion rates. Third, all injuries that occurred at the training facility were reported and processed within the site facility to ensure consistent data collection. Fourth, our study considered the influence of injury location on recovery time. Finally, we analyzed the injury patterns according to the weapon category. There are several limitations to our research as well. There was no information about the injury mechanism(cause of injury and training load). Finally, there was no information about the biomechanical mechanism of the injury.

CONCLUSIONS

In our study, weapon category was found to affect the injury incidence rate. In addition, Recovery time varies depending on the body regions. however, further research is needed to clarify these results. Our findings may assist in developing methods to improve performance and prevent injuries among elite female fencing athletes.

All authors declare no potential conflict of interest related to this article

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