


Understanding Injuries During the European Athletics Championships: An Epidemiological Injury Surveillance Study

 © by IAAF
29:4; 7-16, 2014

by Pascal Edouard, Juan-Manuel Alonso, Frédéric Depiesse and Pedro Branco

ABSTRACT

Injury data collection represents the first step in injury prevention. The aim of this study was to understand the incidence and characteristics of injuries suffered during the five European Athletics Championships (outdoors and indoors) staged from 2009 to 2013. All newly occurring injuries were reported by national medical teams and/or local organising committee physicians on a standardised injury report form. On average, 79% of all the national medical teams (54% of all countries) participated in the project, covering an average of 86% of the registered athletes. The authors summarise and analyse the data collected and then discuss the practical implications of their work. They conclude that 1) future research should be focused on better understanding the relationships between muscle physiology and biomechanics of performance, the risk factors and mechanisms of both the main injuries observed (hamstring strains, lower leg strains, ankle sprains), and the overuse injuries (prevalence, characteristics, risk factors...) and 2) injury prevention measures should be focused on the preparation of muscles for all movements and constraints (eccentric training), prevention measures against hamstring strains, and the prevention of overuse injuries.

AUTHORS

Pascal Edouard, MD, PhD, is a member of the Medical Commission of the French athletics federation.

Juan-Manuel Alonso, MD, PhD, is the Chair of the IAAF Medical and Anti-doping Commission.

Frédéric Depiesse, MD, MSc, DO, chairs the Medical Commission of the French athletics federation and is a member of the European Athletics Medical and Anti-Doping Commission.

Pedro Branco, MD, chairs the European Athletics Medical and Anti-doping Commission and is a member of the IAAF Medical and Anti-Doping Commission.

Introduction

Athletes' health protection and injury prevention are important goals for the International Olympic Committee (IOC)^{1,2}, the International Association of Athletics Federations (IAAF)³⁻⁶, and European Athletics (EAA)⁷⁻⁹. Indeed, injuries and illnesses can be major problems in the athlete's life that could lead to stopping a competition, a season, or a career, as well as to long term damage^{10,11}.

Since prevention is better than treatment, it is of interest to develop injury prevention measures. With this aim, VAN MECHELEN et al.¹² described a methodology for injury prevention research in a four-step sequence: 1) determining the magnitude of the problem by epidemiological studies consisting in injury data collection, 2) determining the injury mechanisms and risk factors, 3) developing injury prevention measures based on the injury mechanisms and risk factors, 4) implementing injury prevention measures and evaluating its effectiveness.

Injury data collection represents the first step in injury prevention¹². Therefore, it is fundamental for athletics to conduct injury surveillance studies in order to determine the magnitude of the injury problem for athletes as well as the characteristics of the main injuries. These epidemiological data will help to determine the direction of research for the second step, which should be focused on the most relevant injuries (most frequently and/or most severe). These epidemiological data will also help physicians, physiotherapists, scientists, coaches, athletes to focus their attention on specific injury problems, training and/or rehabilitation conditions. It can also provide information on risk factors (intrinsic risk factors or predispositions: gender and age; external risk factors: circumstances of practice and discipline)¹³.

With this aim, injury data have been collected during the international athletics championships on the specific population of high-level athletes since 2007 by the IAAF³⁻⁶ and since 2009 by the EAA⁷⁻⁹. In this context, the aim of this study was to summarise the incidence and characteristics of newly incurred injuries during European Athletics Championships from 2009 to 2013, in order to discuss the future direction of injury prevention measures and researches.

Methods

Study design, injury definition and data collection procedure

The present study used the methodology of injury surveillance validated by the IOC¹,

and implemented by the IAAF and EAA during international athletics competitions³⁻⁹. Since 2009 all injuries newly occurring during the European Athletics Championships were reported daily by the national medical teams (physicians and/or physiotherapists) and/or by the local organising committee (LOC) physicians on a standardised injury report form. The injury report form published by JUNGE et al.¹ was applied in the 2009 championships. The injury report form was updated with more details for injured body parts and injury for the championships from 2010 to 2013.

An injury was defined as "all musculoskeletal injuries (traumatic and overuse) newly incurred during competition or training regardless of the consequences with respect to the athlete's absence from competition or training"^{1,4}.

Injuries were recorded during five European Athletics Championships (outdoors and indoors) from 2009 to 2013.

Confidentiality and Ethical approval

All athletes were informed that their medical information would be used for scientific purpose and injury prevention. Information to athletes was provided with the event welcome bags and also distributed to the team doctors/physiotherapists during the medical meetings. The athletes' gender and date of birth was used to avoid duplicate reporting from national medical teams and LOC physicians and to provide information on age, gender and national federation. All injury reports were stored in a locked filing cabinet and were made anonymous after the championships. Confidentiality of all information was ensured so that no individual athlete or team could be identified. Ethical approval was obtained from the Saint-Etienne University-Hospital Ethical Committee.

Data analysis and calculation of incidences

In cases where a single injury incident resulted in more than one injured body part and/or type of injury, each body part and/or type of injury was counted as a separated injury. If in-

Table 1: Number of athletes and injuries, and incidences (\pm 95%CI) during European Athletics Championships from 2009 to 2013

European Championships - hips	Registered athletes	Total injuries	Incidence of Total injuries per registered	Total TLI	Incidence of Total TLI per registered	Competing athletes	Total IC-injuries	Incidence of Total IC-injuries per competing athletes	Total IC-TLI	Incidence of IC-TLI per competing athletes
Barcelona 2010	1371	51	37.2 \pm 10.0	25	18.2 \pm 7.1	1428	35	24.5 \pm 8.0	21	14.7 \pm 6.2
Helsinki 2012	1352	126	93.2 \pm 15.5	58	42.9 \pm 10.8	1318	109	82.7 \pm 14.9	55	41.7 \pm 10.8
Torino 2009 (indoor)	565	35	61.9 \pm 19.9	13	23.0 \pm 12.4	564	35	62.1 \pm 19.9	13	23.0 \pm 12.4
Paris 2011 (indoor)	593	30	50.6 \pm 17.6	8	13.5 \pm 9.3	585	25	42.7 \pm 16.4	8	13.7 \pm 9.4
Göteborg 2013 (indoor)	577	60	104.0 \pm 24.9	24	41.6 \pm 16.3	564	58	102.8 \pm 25.1	24	42.6 \pm 16.7
ECH Outdoor	2723	177	65.0 \pm 9.3	83	30.5 \pm 6.5	2746	144	52.4 \pm 8.3	76	27.7 \pm 6.1
ECH Indoor	1735	125	72.0 \pm 12.2	45	25.9 \pm 7.5	1713	118	68.9 \pm 12.0	45	26.3 \pm 7.6
Total	4458	302	67.7 \pm 7.4	128	28.7 \pm 4.9	4459	262	58.8 \pm 6.9	121	27.1 \pm 4.8

95%CI: 95% confident interval; TLI: Time-loss injuries; IC: In-competition

Table 2: Location of injuries and time-loss injuries incurred during European Athletics Championships (ECH) from 2009 to 2013

	All injuries (n and %)				Time-loss injuries (n and %)			
	Total ECH	ECH Outdoor	ECH Indoor	Total ECH	ECH Outdoor	ECH Indoor	Total ECH	
TOTAL	302	177	125	128	83	45		
Face	2	0.7	1	0.6	1	0.8	0	
Head	0	0.0	0	0.0	0	0.0	0	
Neck	6	2.0	3	1.7	3	2.4	0	
Thoracic	4	1.3	3	1.7	1	0.8	1	
Sternum	1	0.3	1	0.6	0	0.0	1	
Lumbar spine	14	4.6	8	4.5	6	4.8	2	
Abdomen	2	0.7	1	0.6	1	0.8	0	
Pelvis	11	3.6	5	2.8	6	4.8	2	
Shoulder	5	1.7	0	0.0	5	4.0	2	
Upper arm	2	0.7	1	0.6	1	0.8	0	
Elbow	5	1.7	1	0.6	4	3.2	1	
Forearm	2	0.7	0	0.0	2	1.6	0	
Wrist	3	1.0	2	1.1	1	0.8	1	
Hand	5	1.7	2	1.1	3	2.4	1	
Finger	1	0.3	0	0.0	1	0.8	0	
Thumb	0	0.0	0	0.0	0	0.0	0	
Hip	5	1.7	1	0.6	4	3.2	1	
Groin	10	3.3	10	5.6	0	0.0	4	
Thigh	76	25.2	49	27.7	27	21.6	15	
Knee	38	12.6	20	11.3	18	14.4	6	
Lower leg	57	18.9	36	20.3	21	16.8	4	
Achilles tendon	12	4.0	6	3.4	6	4.8	2	
Ankle	20	6.6	12	6.8	8	6.4	6	
Foot	21	7.0	15	8.5	6	4.8	2	

Table 3: Types of injuries and time-loss injuries incurred during European Athletics Championships (ECH) from 2009 to 2013

	All injuries (n and %)			Time-loss injuries (n and %)		
	Total ECH	ECH Outdoor	ECH Indoor	Total ECH	ECH Outdoor	ECH Indoor
TOTAL	302	177	125	128	83	45
Concussion	0	0.0	0	0	0.0	0
Fracture	2	0.7	1	2	1.6	1
Stress fracture 1	0.3	0	0.8	0.8	0.0	2.2
Other bone injury	5	1.7	5	2	1.6	2
Dislocation	1	0.3	0	1	0.8	0
Tendon rupture4	1.3	1.7	0.8	3.1	3.6	2.2
Ligamentous rupture	3	1.0	2	3	2.3	2
Sprain	28	9.3	18	16	12.5	9
Lesion of meniscus or cartilage	4	1.3	1	2	1.6	1
Strain	27.2	32.4	20.0	41.4	45.8	33.3
Contusion	43	14.3	28	16	12.5	12
Tendinopathy	18	6.0	10	3	2.3	1
Arthritis	1	0.3	1	1	0.8	1
Fascitis	2	0.7	1	1	0.8	1
Impingement	3	1.0	0	0	0.0	0
Laceration	50	16.6	18	5	3.9	1
Dental injury	0	0.0	0	0	0.0	0
Nerve injury	2	0.7	2	0	0.0	0
Muscle cramps	44	14.6	26	16	12.5	10
Apophyseose	0	0.0	0	0	0.0	0
Other	8	2.7	3	0	0.0	0

formation on the circumstances of the injury was missing, further research was performed (e.g. comparison of date of injury with date of competition), injuries that occurred on the day of competition were considered as in-competition injuries⁶. In the present study, the same definitions and calculation of indices were used for all championships, which caused slightly different numbers of athletes and injuries, and incidences compared to previous publications⁷⁻⁹.

The calculation of the medical team participation, the injury report forms response rate, the coverage of athletes and the completeness of data allow determining the acceptance and performance of the injury surveillance system. The number of registered athletes (population at risk), competing athletes (athletes exposed to the competition, including athletes who did not start ("DNS")), and participations (athletes' exposure in competition) were calculated using a list of athletes registered for each championship provided by the EAA and the competition schedule published on the EAA's internet database (<http://www.european-athletics.org>). The incidences of injury were calculated in accordance with the IOC approach¹ and previous athletics studies³⁻⁹. Data were analysed and presented using frequencies and percentages. All data were processed using Excel. Significance was accepted at $P < 0.05$.

Results

Injury surveillance system

On average, 79% of all the registered national medical teams (54% of all registered countries) participated in the injury surveillance projects, covering an average of 86% registered athletes, with an average injury report forms response rate of 86%. No athlete refused that his/her data were used for scientific research. Completeness of injury data averaged 97.2%.

Incidences of injuries

A total of 302 injuries were reported, representing an incidence of 68 injuries per 1000

registered athletes (95% Confidence Interval (CI): 60-75). 128 injuries lead to time-loss (TLI), representing an incidence of 29 injuries per 1000 registered athletes (95% CI: 24-34). 262 (87% of all injuries) occurred during competition, and were called in-competition injuries, representing an incidence of 59 injuries per 1000 competing athletes (95% CI: 52-66), including 46% of in-competition time-loss injuries (IC-TLI). Incidences of each championship and overall calculation are reported in Table 1.

Characteristics of injuries

The characteristics of injuries are reported in Table 2 for location, Table 3 for types, Table 4 for causes and Table 5 for event group.

The thigh was the most frequently injured (25%), with posterior thigh (hamstring) involved in 47 cases (16% of all injuries), followed by lower leg (19%). The most frequent types of injury were strains (27%), followed by laceration (17%), muscle cramps (15%) and contusion (14%). The most common diagnosis was hamstring strain (11%). Overuse injuries were dominant (36%), followed by non-contact trauma (21%).

Discussion

The summary of several international championships provides relevant data of injury risk among high-level athletes.

Injury surveillance system

The injury surveillance system is well accepted with overall good values of medical team participation, athletes' coverage and response form rate. Few data are missing, since there are high rates of completeness. We observed an increase in all these scores from the European Athletics Championships in 2009 to 2013, suggesting an improvement in the medical team participation with the time. Thus, this injury surveillance methodology seems to be relevant to collect injury data among high-level athletes during European Athletics Championships. It is relevant to continue this injury surveillance during future European Athletics

Championships, as a routine, in order to monitor injury incidences and characteristics and to evaluate potential changes in these parameters with implementation of injury prevention measures.

Incidence of injuries

Incidence of injuries during European Athletics Championships was lower overall than during the IAAF World Championships in Athletics³⁻⁶. This can be explained by the fact that i) the European Athletics Championships induce a lower injury risk than the IAAF World Championships in Athletics (lower number of athletes, fewer days of competition, fewer preliminary rounds, fewer disciplines), ii) that the performance injury surveillance system was lower for two championships - 2010 (outdoors) and 2011 (indoors), which may lead to an underestimation of the injury incidence, iii) that 2012 European Athletics Championships took place during the same year as the Olympic Games (about one month earlier) and was probably a secondary objective for athletes, and iv) that injury prevention strategies provided by IAAF³ and EAA are becoming effective. In football, lower injury risk has also been reported during European Championships compared with the World Cup¹⁴.

Incidences were almost similar during outdoor and indoor European Athletics Championships.

A high number of injuries occurred during competition (87%), in comparison with IAAF World Championships in Athletics³⁻⁶. That could be explained by the fact that the European Athletics Championships had a lower number of days of competition, suggesting that athletes competed more than trained during European Championships, or arrived in championships for competing only.

Characteristics of injuries

The characteristics of the recorded injuries were in agreement with previous studies³⁻⁹. The main injury location was the thigh, following by the lower leg and the knee. The

main type of injury was strain. Hamstring strain was the most important diagnosis (data not presented)³⁻⁹. The fact that most of injuries involved the lower limb muscles is in agreement with the fact that the most events involve the lower limbs, and the muscle are the main effector of performance. Indeed, since lower limbs muscles are always involved for performance (higher power, higher strength, higher velocity, higher endurance) in different contraction modes (concentric, eccentric, plyometric), they are more at risk of injuries. Thus, injury prevention research should be focused on better understanding the relationships between muscle physiology and the biomechanics of performance, and injury prevention measures should be focused on the preparation of muscles.

Overuse injuries were dominant injury causes, although their percentages in the European Athletics Championships were lower than during previous IAAF World Championships in Athletics (43.5-59.4%)³⁻⁵. Moreover, about 20% of the injury causes were non-contact trauma, which is higher than during previous IAAF World Championships in Athletics (12.4-13.2%)³⁻⁵. To better understand these overuse injuries, the recording of pre-participation injuries at the beginning of the championships would seem to be relevant⁹. Overuse injury prevention measures could be: treating acute injuries at an early stage, eliminating periods of overtraining, and improving preventative strengthening and recovery programs³.

Practical Implications

The aims of athletes, coaches, and medical staff are similar: to improve performance and to prevent injuries. Injury prevention contributes to better performances, and well-conducted training contributes to injury prevention. Thus, sports science and medical research enquiries should be conducted together. The results of this study could have an impact in both of these areas and help coaches, physicians and athletes to practice athletics safely and with better performance.

Table 4: Causes of injuries and time-loss injuries incurred during European Athletics Championships (ECH) from 2009 to 2013

	All injuries (n and %)			Time-loss injuries (n and %)		
	Total ECH	ECH Outdoor	ECH Indoor	Total ECH	ECH Outdoor	ECH Indoor
TOTAL	287	172	115	124	80	44
Overuse (gradual onset)	46	16.0	25	14.5	21	18.3
Overuse (sudden onset)	57	19.9	45	26.2	12	10.4
Non-contact trauma	60	20.9	40	23.3	20	17.4
Recurrence	20	7.0	13	7.6	7	6.1
Contact with another athlete	33	11.5	20	11.6	13	11.3
Contact with moving object	9	3.1	1	0.6	8	7.0
Contact: immobile	17	5.9	9	5.2	8	7.0
Violation of rules	0	0.0	0	0.0	0	0.0
Field of play conditions	19	6.6	0	0.0	19	16.5
Weather condition	2	0.7	2	1.2	0	0.0
Equipement failure	2	0.7	0	0.0	2	1.7
Other	22	7.7	17	9.9	5	4.3

Table 5: Number and percentage of injuries and time-loss injuries incurred during European Athletics Championships (EHC) from 2009 to 2013 by event group

	All injuries (n and %)			Time-loss injuries (n and %)		
	Total ECH	ECH Outdoor	ECH Indoor	Total ECH	ECH Outdoor	ECH Indoor
TOTAL	302	177	125	128	83	45
Sprints	81	26.8	55	31.1	26	20.8
Hurdles	26	8.6	10	5.6	16	12.8
Middle distances	26	8.6	12	6.8	14	11.2
Long distances	57	18.9	37	20.9	20	16.0
Marathon	4	1.3	4	2.3	0	0.0
Race walking	2	0.7	2	1.1	0	0.0
Jumps	52	17.2	28	15.8	24	19.2
Throws	18	6.0	15	8.5	3	2.4
Combined events	36	11.9	14	7.9	22	17.6

Future injury prevention research should be focused on better understanding:

- the relationships between muscle physiology and biomechanics of performance,
- hamstring strains (why is this muscle group more at risk in athletes?),
- risk factors and mechanisms of the main injuries (hamstring strains, lower leg strains, ankle sprains),
- overuse injuries (prevalence, characteristics, risk factors...).

This research should be conducted with collaboration between medical staff, scientists, coaches and athletes. This will help to increase knowledge on the second step of the injury prevention sequence and develop adapted injury prevention measures.

Future development of injury prevention measures should be focused on:

- preparation of muscle for all movements and constraints (eccentric training),
- prevention measures against hamstring strains (e.g. appropriate treatment and rehabilitation of first and/or previous hamstring strain, and exercises to improve muscle hamstring flexibility and to balance hamstring/quadriceps strength imbalances...),
- prevention of overuse injuries (early diagnosis, treatment and adaptation of the training when athlete presents a pain and/or an injury).

Work to implement new findings in this area will require close collaboration between athletes, coaches and medical staff.

Conclusions

Injury data collection represents the first step in systematic injury prevention. Therefore, it is fundamental for the sport of athletics to continue to conduct injury surveillance studies in order to determine the magnitude of the problems for athletes and the characteristics of the main injuries they suffer¹¹. This epidemiological data will help to determine the direction of future injury prevention research and measures.

Acknowledgments

The authors would like to thank European Athletics for its help and support for this project.

Please send all correspondence to:

Dr Pascal Edouard
Pascal.Edouard42@gmail.com

References

1. JUNGE, A.; ENGBRETSSEN, L.; ALONSO, J.M.; RENSTROM, P.; MOUNTJOY, M.; AUBRY, M. & DVORAK, J. (2008). Injury surveillance in multi-sport events: the International Olympic Committee approach. *Br J Sports Med*, 42 (6): 413-421.
2. MOUNTJOY, M. & JUNGE, A. (2013). The role of International Sport Federations in the protection of the athlete's health and promotion of sport for health of the general population. *Br J Sports Med*, 47 (16): 1023-1027.
3. ALONSO, J.M.; EDOUARD, P.; FISCHETTO, G.; ADAMS, B.; DEPIESSE, F. & MOUNTJOY, M. (2012). Determination of future prevention strategies in elite track and field: analysis of Daegu 2011 IAAF Championships injuries and illnesses surveillance. *Br J Sports Med*, 46 (7): 505-514.
4. ALONSO, J.M.; JUNGE, A.; RENSTROM, P.; ENGBRETSSEN, L.; MOUNTJOY, M. & DVORAK, J. (2009). Sports injuries surveillance during the 2007 IAAF World Athletics Championships. *Clin J Sport Med*, 19 (1): 26-32.
5. ALONSO, J.M.; TSCHOLL, P.M.; ENGBRETSSEN, L.; MOUNTJOY, M.; DVORAK, J. & JUNGE, A. (2010). Occurrence of injuries and illnesses during the 2009 IAAF World Athletics Championships. *Br J Sports Med*, 44 (15): 1100-1105.
6. FEDDERMANN-DEMONT, N.; JUNGE, A.; EDOUARD, P.; BRANCO, P. & ALONSO, J.M. (2014). Injuries in 13 international Athletics championships between 2007-2012. *Br J Sports Med*, 48 (7): 513-522.
7. EDOUARD, P.; DEPIESSE, F.; HERTERT, P.; BRANCO, P. & ALONSO, J.M. (2013). Injuries and illnesses during the 2011 Paris European Athletics Indoor Championships. *Scand J Med Sci Sports*, 23 (4): e213-218. doi: 210.1111/sms.12027. Epub 12012 Nov 12028.
8. EDOUARD, P.; DEPIESSE, F.; BRANCO, P. & ALONSO, J.M. (2014). Analyses of Helsinki 2012 European Athletics Championships injury and illness surveillance to discuss elite athletes risk factors. *Clin J Sport Med*, 24 (5): 409-415.
9. EDOUARD, P.; JACOBSSON, J.; TIMPKA, T.; ALONSO, J.M.; KOWALSKI, J.; NILSSON, S.; KARLSSON, D.; DEPIESSE, F. & BRANCO, P. (2014). Extending in-competition Athletics injury and illness surveillance with pre-participation risk factor screening: A pilot study. *Phys Ther Sport*, Jun 10. pii: S1466-853X(14)00036-4.
10. EDOUARD, P.; MOREL, N.; SERRA, J.-M.; PRUVOST, J.; OULLION, R. & DEPIESSE, F. (2011). [Prevention of musculoskeletal injuries in track and field. Review of epidemiological data]. *Sci Sports*, 26: 307-315.
11. EDOUARD, P.; BRANCO, P. & ALONSO, J.M. (2014). Challenges in Athletics injury prevention: conducting athletics prospective epidemiological injury and illness surveys. *Br J Sports Med*. 48 (7): 481-482.
12. VAN MECHELEN, W.; HLOBIL, H. & KEMPER, H.C. (1992). Incidence, severity, aetiology and prevention of sports injuries. A review of concepts. *Sports Med*, 14 (2): 82-99.
13. BAHR, R. & KROSSHAUG, T. (2005). Understanding injury mechanisms: a key component of preventing injuries in sport. *Br J Sports Med*, 39 (6): 324-329.
14. DVORAK, J.; JUNGE, A.; DERMAN, W. & SCHWELLNUS, M. (2011). Injuries and illnesses of football players during the 2010 FIFA World Cup. *Br J Sports Med*, 45 (8): 626-630.