



The Burden and Epidemiology of Injury in Track and Field

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1.1 Introduction

Track and field (athletics) is an Olympic sport composed of several different disciplines (www.worldathletics.org/our-sport): sprints, hurdles, jumps, throws, combined events, middle and long distances, marathon, and race walking. It is internationally governed by the World Athletics (www.worldathletics.org), founded in 1912, and previously called International Association of Athletics Federations (IAAF). There are currently 214 members federations (countries or territories) affiliated to World Athletics, which places World Athletics among the world's largest sporting organizations. Based on the number of athletes, this is the first sport at the Olympic Games; for example, at the 2016 Olympics Games athletes registered for track and field represented 21% of all registered athletes (second

sport was aquatics with 13%, and then, other sports represented less than 5% of athletes) [1].

As for many sports, the practice of track and field leads to a risk of injuries [2]. Indeed, all these track and field disciplines involved the musculoskeletal system (i.e., muscle, tendon, bone, cartilage, ligament, and soft tissue). When the load resulting from the practice exceeds the capabilities of the musculoskeletal system, there is a risk of failure of the musculoskeletal structure resulting in an injury. Injury has a negative impact on practice, because it can decrease training participation, decrease performance, and lead to pain [3]. Even if the injury is a minor anatomical lesion or leads to minor resounding on practice, there will be an impact, on the musculoskeletal (e.g., imbalance between injured and uninjured sides) and psychological (e.g., lack of confidence or fear of recurrence) aspects. All the consequences can not only affect the sports practice, but can also have a negative impact on other domains of life (e.g., social, professional, family, school, financial) in the short or long term [2].

Taken into account the number of athletes practicing track and field whatever their levels in addition to the risk of injuries, the prevention of injuries in track and field represents an important area for athletes and all stakeholders, such as coaches, health professionals, family, sports scientists, managers, sponsors, and international and national governing bodies [2, 4–6]. In order to reach this injury prevention challenge, Van

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Mechelen et al. [7] described a four-step methodological sequence of evidence-based injury prevention. The first step of this sequence consists in understanding the extent of the problem and describes the incidence and severity of injuries. This fundamental first step is of interest since it allows having a clear basis of the magnitude of the problem. It is also useful for long-term monitoring and for comparison if prevention measures are implemented. In addition, for clinical practice, it can help health professionals by anticipating the most frequent injuries and thus the need for medical provision. Thus, having a clear knowledge of the epidemiology of injuries is of great interest for injury prevention in track and field.

Given the impact of the data collection methodology on the quality of the data and thus the resulting information [8, 9], a great attention should be done to methodology of epidemiological studies in order to interpret results. The study design, the definition of injury and its characteristics, the exposure, the data collection procedures, and data analyses are key points of the methodology of epidemiological studies [5, 6, 10, 11]. To date, there is a consensual method for injury data collection during championships that has been developed by the International Olympic Committee (IOC) [12] and used in track and field at the IAAF World Championships in Athletics [13–17], the European Athletics Championships [18–21], and the French national championships [22]. This methodology has provided reliable and comparable data for this particular context of international championships [8, 23]. However, if we broaden the focus to the whole track and field season, we find that only a few studies exist and that they use different methods [4, 24–33], which does not allow a true comparison of the data, and could explain why injury data should now be presented separately between championships and whole season. A method was developed in 2014 at a consensus meeting of international and national athletics federations [11], and the IOC recently updated a consensus statement on methods for recording and reporting of epidemiological data on injury and illness in sport 2020 [10]

that are expected to implement long-term cohort follow-ups over one or more seasons with a comparison between studies.

1.2 Injuries during Championships

1.2.1 Injuries during International Track and Field Championships

Injury data have been collected at a number of major championships following the IOC consensus methods for multi-event championships [12]. At each event, physicians and/or physiotherapists from the national medical teams and the local organizing committee prospectively collected new injuries occurring among athletes registered in the championships based on the same injury definitions (i.e., medical attention injury) and classifications and using a paper-based report form. This allowed description of the number, incidence, and characteristics of injuries in this context. These injury surveillance studies have allowed the collection of a large amount of data by combining all together these data. Indeed, a total of 2191 injuries were collected from 20 international championships from 2007 to 2019 among 19,066 registered athletes (unpublished data). This resulting in a clear vision of injuries that athletes can suffer during international championships [34–38].

The injury rates varied with sex and disciplines [35, 37]. From 14 international championships between 2007 and 2014, the number of injuries per 1000 registered athletes was significantly higher for male than female athletes (110.3 ± 6.8 vs. 88.5 ± 6.7 injuries per 1000 registered athletes, respectively; relative risk = 1.25 (confidence interval 95%: 1.13 to 1.32)) [35]. The injury location varied with sex: Male athletes suffered more injuries of the thigh, the lower leg, and the hip/groin than female athletes [35]. The injury type also varied according to sex: Male athletes suffered more muscle injuries than female athletes, while female athletes suffered

more stress fractures than male athletes [35]. The injury rate also varied between disciplines, with a higher injury rate in combined events, marathon, and long-distance running [37]. Injury characteristics significantly varied between disciplines for location, type, cause, and severity, in both male and female athletes: Thigh muscle injuries were the main injury diagnoses in sprints, hurdles, jumps, combined events and race walking, lower leg muscle injuries in marathon, lower leg skin injury in middle and long distances, and trunk muscle and lower leg muscle injuries in throws [37]. The first injury was hamstring muscle injury (about 17% of all injuries), with higher proportion in sprints and other disciplines requiring sprint capabilities [36]. A summary of the key findings regarding injuries occurring during international track and field championships is presented in Table 1.1.

For three of the international championships studied, data collection on athletes' health was extended to the 4 weeks before the championships [16, 17, 20]. It was found that about 30% of the athletes participating in these studies reported an injury complaint in this preparation period, including a third who had to decrease their training load and about 4% who could not practice at all [16, 17, 20]. These injury complaints appeared to be overuse injuries mainly because there was a gradual onset and they existed for more than 4 weeks. These results support that an important proportion of high-level athletes are living and training with an injury complaint, suggesting that injury unfortunately is part of the athletes' life, and even more supporting the need for injury prevention.

1.2.2 Injuries during National Track and Field Championships

The methods used during international track and field championships [12, 13] have also been used for national championships. This allows providing information for athletes with a level just below the international level.

During the French national track and field outdoor championships, such injury surveillance

studies have been carried out since 2014. From 2014 to 2019, the incidence was about 50 injuries per 1000 registered athletes, the thigh was the first injury location (about 30% of all injuries), and muscle was the first injury type (about 30% of all injuries), and explosive disciplines (i.e., combined events, sprints, hurdles, and jumps) were those accounting for the most important number of injuries (unpublished data).

During the 2010 French combined event championships, an incidence of 477 injuries per 1000 registered athletes was reported and the most common diagnosis was muscle injury to the thigh (18%) [22].

During 3 years of Penn Relay Carnival, Opar et al. [39] reported an incidence of 10 injuries per 1000 registered athletes. Hamstring muscle strain was the most prevalent injury accounting for 24% of injuries, with higher rates in male than female athletes [39].

During the 2016 track and field Olympic trials, Bigouette et al. [40] reported an incidence of 60 injuries per 1000 registered athletes. Hamstring strains were the most prevalent injuries with about 17% of all injuries, and jumps and long distances were the disciplines with the most number of injuries per registered athletes.

1.2.3 Conclusion Injuries During Championships

Although such context of championships represents few days in the season (3 to 9 days compared to the other 357 to 363 days), this represents the goal of the season for athletes and their stakeholders, and injuries have a negative impact on the performance [38]. Therefore, it is of interest to have a clear view of the "risks" in this very important period. All these studies provide an interesting and relevant overview of the injuries during track and field championships, especially for high-level athletes (Table 1.2). One of the learnings is that injury number, incidence, and characteristics varied with sex and disciplines; it is therefore important to analyze and provide such information separately by sex and disciplines. All these data allow athletes and all stakeholders

1	Thigh muscle (24.0)	Thigh muscle (15.5)	Thigh muscle (8.7)	Knee tendon muscle (3.0), lower leg trunk muscle (3.0)	Thigh muscle (45.6)	Lower leg skin (25.9)	Foot skin (18.9)	Lower leg muscle (19.4)	Foot others (10.6)
2	Upper extremity skin (4.3)	Knee skin (9.9)	Lower leg muscle (4.4), Achilles tendon (4.4)		Ankle ligament (22.8)	Thigh muscle (13.7), lower leg muscle (13.7)	Knee skin (8.1)	Foot skin (17.2)	Thigh muscle (7.0)
3	Trunk muscle (3.8)	Upper extremity skin (8.5)			Lower leg muscle (16.3), trunk ligament (16.3)		Thigh muscle (6.7), Achilles tendon (6.7)	Knee ligament (8.6), trunk muscle (8.6)	

The data presented in this table are from the article by Edouard et al. [37] and have been collected during 14 international championships between 2007 and 2018

Table 1.2 Key points regarding injury characteristics occurring during the whole season

	Sprints	Hurdles	Jumps	Throws	Combined events	Middle and long distances and marathon
Main injuries	Thigh and hamstring muscle injuries	Thigh and hamstring muscle injuries	Thigh and hamstring muscle injuries	Shoulder and elbow injuries	Thigh muscle injuries	Lower leg injuries
	Achilles tendinopathy	Lower leg injuries	Achilles and patellar tendinopathy	Low back pain	Back injuries	Achilles tendinopathy
	Back injuries		Knee injuries		Upper extremity injuries	Overuse knee injuries
			Ankle sprain		Achilles and patellar tendinopathy	Stress fracture
			Low back pain			

around them having a clear basis and information to orient injury prevention approach toward these championships. However, there is a need to continue these data collections in other populations of athletes for reaching an understanding of injury epidemiology in all athletes practicing track and field whatever their age and level.

1.3 Injuries During the Whole Season

The whole season represents a significantly larger period in the athletes' life and practice than championships. And this also represents a significantly higher period of exposure to the risk of injuries. However, information on injuries in track and field during the whole season is not as important as for the championships. Methodological issues are probably one explanation of the fact that there are few studies during the whole season [4].

1.3.1 Injuries During the Whole Season in National-Level Athletes

Below are summarized the main results of three studies collecting injury data over one season in national-level athletes. This is not an exhaustive report of the scientific literature, but these results

present an overview of the current knowledge on this population.

In a questionnaire-based retrospective study of 147 national-level athletes over about 12 months of training, D'Souza [26] reported that 61% of athletes had at least one injury during the season. The locations and types of injuries varied by event, with a high prevalence of shin splints in middle- and long-distance runners, ankle injuries in throwers, and thigh injuries in jumpers.

In another questionnaire-based retrospective study of 95 national-level athletes over about 12 months of training, Bennell and Crossley [24] reported that 76% of athletes had at least one injury during the season, with an incidence of 3.9 injuries per 1000 h of track and field practice. The main injuries were stress fractures (20.5%), hamstring muscle injuries (14.2%), and knee overuse injuries (12.6%). Overuse was the most frequent cause (72%). The mode of onset varied by event: more sudden injuries in the explosive events (sprints, hurdles, jumps, and combined events) and more gradual injuries in the endurance events (middle distance, marathon) and background training.

In a prospective study of 292 national-level athletes over 12 months, Jacobsson et al. [30] reported that 68% of those studied had at least one injury during the season and the injury incidence was 3.6 per 1000 h of track and field practice. Of the injuries, 96% were caused by overuse, and 51% evolved for more than 3 weeks. The

main locations were the Achilles tendon, the foot and ankle, the thigh and hip, and the lower leg. The main complaints were hamstring injury among sprinters and jumpers, Achilles tendinopathy and shin splints among middle-distance runners, and lower back pain among throwers.

Although the methods (i.e., study design, injury definition, and data collection) were not similar between these studies, it seems that there are similar and consistent results on injury prevalence, incidence, and characteristics. Between 61 and 76% of the national-level athletes had at least one injury during the entire track and field season [24, 26, 30]. The incidence was reported as 3.6–3.9 injuries per 1000 h of track and field practice [24, 26, 30]. The location and type of injuries varied according to the disciplines, with a high prevalence of Achilles tendinopathy and “shin splints” in middle and long distances, ankle injuries and low back pain in throwers, and thigh and hamstring muscle injuries in sprinters and jumpers [24, 26, 30]. The injury mode of onset was more sudden in explosive disciplines and more gradual in endurance disciplines [24]. Overuse was the most frequent cause of track and field injury (72–96%) [24, 30].

1.3.2 Injuries During the Whole Season in Specific Population

Other studies provided an overview of the magnitude of the problem in specific population.

In combined events, in a prospective study over four athletic seasons (1994–1998) of 69 selected French combined event athletes, Edouard et al. [29] reported 39 injuries in 14 heptathletes and 47 injuries in 18 decathletes. The injury rate per 100 athletes per season for the heptathletes and the decathletes was 33 and 30, respectively. Of the injuries suffered, 41% affected the tendons and 23% affected the muscles. The most common diagnoses were knee tendinopathy (14%), followed by lower leg muscle injuries (13%), thigh muscle injuries (11%), and Achilles tendinopathy (11%). The causes of injuries were mainly overuse (49%) or acute trauma (43%).

In pole vault, in a prospective study of 140 pole vaulters over two seasons, Rebella et al. [41] reported an incidence of 26.4 injuries per 100 athletes, with ankle sprains representing a third of the cases. In a second prospective study of 150 pole vaulters over one season, Rebella [42] reported an incidence of 7.9 injuries per 1000 athlete exposure, with most injuries being in the low back pain, hamstring, and lower leg.

In youth and junior elite athletes, in a prospective cohort study of 70 athletes over 30 weeks, Carragher et al. [43] reported that 77% of athletes had at least one injury during the period, 44% at least one acute injury, and 53% at least one overuse injury. The prevalence of injury was similar between male and female athletes, but varied between explosive and endurance disciplines: higher prevalence of injuries in explosive than endurance disciplines. The prevalence of acute injuries was higher in explosive than endurance disciplines, while prevalence of overuse injuries was similar between both discipline categories. The main injury diagnoses of acute injuries were lower leg strain/tear in male endurance athletes (25%), trunk muscle cramps/spasms in male explosive athletes (31.6%), and hamstring strain/tear in female explosive athletes (21.1%). The main injury diagnoses of overuse injuries were knee tendinopathy in male endurance athletes (29.4%), lower leg muscle cramps in female endurance athletes (28.6%), and hamstring muscle cramps/spasms in both male explosive athletes (40.0%) and female explosive athletes (21.1%).

These are maybe not the only studies reporting information on injuries in specific track and field populations, but these studies provide some relevant insights that could help to orient injury prevention strategies by taking into account all the spectrum of specificities of track and field.

1.3.3 Characteristics of Injuries According to Disciplines During the Whole Season

Although studies used different definitions of injuries and injury characteristics, and the results are often only descriptive (no comparison), it

seems that the injury characteristics (location and/or diagnosis) are quite constant over studies and clearly varied according to disciplines [24, 26, 30, 31, 44, 45]. In summary, these studies reported that athletes participating in sprints suffered more of thigh/hamstring [24, 26, 30, 31, 44, 45], Achilles tendon [30, 45], and/or back [26]; in hurdles: thigh [24] and/or lower leg [26]; in middle and long distances: lower leg [24, 26, 30, 31], foot/ankle/Achilles tendon [30, 31, 44, 45], back/hip [44], hamstring [45], and/or knee [24, 31, 45]; in jumps: thigh/hamstring [24, 26, 30, 31], knee [26], back [24], and/or Achilles [30, 31, 45]; in throws: back [26, 30, 31, 45], upper extremity [45], ankle [26], and/or knee [30, 31]; and in combined events: thigh [24, 30, 31], back [24], upper extremity [45], knee [31], and/or foot/ankle/Achilles [30]. This could be interpreted (probably with some caution) as specific disciplines lead to specific constraints and injuries whatever the circumstances and population [37].

1.3.4 Conclusions on Injuries During the Whole Season

There are currently and to our knowledge only few studies reporting injury data during the whole track and field season. This justifies increasing efforts on performing prospective injury surveillance studies on different populations of track and field athletes. However, the currently available results provide some relevant inputs to orient athletes and their stakeholders toward injury prevention strategies.

1.4 Conclusion

In light of all these results, it can be first said that we are beginning to identify and detail extent of the problem, especially among elite high-level populations taking part in major international championships. Although the data on injuries over the whole season come from only a few studies using different methodologies, it provides a first basis to move forward to prevention, and it supports the need for further studies. Thus, fur-

ther epidemiological injury data collections would still seem to be relevant and necessary. Second, we can say that track and field is composed of several disciplines with different physical, mechanical, technical, and psychological demands, which lead to different constraints on the musculoskeletal system, and consequently different injuries according to these disciplines. The overall picture that has been shown in the present chapter is that the most common injury problems experienced are hamstring muscle injuries (especially in sprints, hurdles, and jumps), Achilles tendinopathies (in sprints, middle and long distances, and jumps), knee overuse injuries (in sprints, middle and long distances), shin splints and/or stress fractures (in sprints, middle and long distances), ankle sprains (in jumps), and low back pain (in jumps and throws).

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