ON YOUR MARKS, GET SET, GO!

A FLYING START TO PREVENT INJURIES IN ATHLETICS

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INTRODUCTION

The practice of athletics can lead to an increased risk for injury, with short-, medium- or long-term consequences at sporting, financial and social levels. Prevention of athletic injuries therefore represents an important area for athletes and all stakeholders (coaches, managers, family, sponsors... and especially health and sport science professionals)\(^1\). This area of concern also represents one of the major issues of international (the International Association of Athletics Federations (IAAF), the European Athletics Association (EAA)) and national sports federations (such as the French Federation of Athletics (FFA), and the Swedish Athletics Association (SAA)). Van Mechelen et al\(^3\) described a four-step methodological sequence (Figure 1) of evidence-based injury prevention. In this context, and following this four-step framework, we have described the state of the art on injury prevention in athletics, based on the experience of an international group of researchers and practitioners, illustrating the efforts made so far by the IAAF, the EAA, the FFA and the SAA for athletes’ health prevention and protection.

STEP 1: WHAT ARE THE RATES OF ATHLETIC INJURIES?

How to collect data on athletic injuries?

Epidemiological studies are needed to determine athletic injury rates. A clear reproducible and valid method is fundamental to allow the comparison of data between studies, and to allow for long-term monitoring. We list the five key points of injury surveillance methodology in Table 1.

To date, there is a consensus method for injury data collection during championships, developed by the IOC\(^4\), and introduced to athletics at the IAAF World Championships\(^5-8\) and European Championships\(^9\). Only a few studies, using different methods, analysed data from an entire athletics season; this does not allow a true comparison of the data from competition periods\(^5\). Members of international and national athletics federations recently developed a consensus statement providing definitions and methodological guidelines on how to perform epidemiological studies in athletics\(^10\). This is to support the implementation of long-term prospective cohort studies of athletes over one or more seasons.

Injury rates during international athletics championships

A total of 1510 injuries were collected from 14 international championships from 2007 to 2014, corresponding to an incidence of 100 injuries for 1000 registered athletes\(^13\). Injury risk was 25% higher for male compared to female athletes (110.3 ± 6.8 vs. 88.5 ± 6.7 injuries per 1000 registered athletes, respectively)\(^13\). The main locations of injuries were thigh, leg, knee and foot, with a higher incidence of thigh and leg injuries in male
The main type of injury was muscle strains, followed by skin lesions (abrasions and lacerations), and ligament and tendon injuries, with a higher risk in male athletes for muscle injuries, and in female athletes for stress fractures. The risk of injury varied between events, with a higher risk in combined events, marathon, middle- and long-distance running. The main injury for diagnostic imaging was hamstring muscle injury (about 17%). In the last four weeks of the 2013 World IAAF Championships, 30% of the athletes participating in this study were injured, including a third who decreased their training load and about 4% who were not able to practice.

Injury rates during the entire athletic season

Between 61-76% of athletes had at least one injury during an entire athletic season. The incidence was reported as 3.6-3.9 injuries per 1000 hours of athletics. The location and type of injury varied according to the events, 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. The injury mode of onset was more sudden in explosive events and more gradual in endurance events. Overuse was the most frequent cause of athletic injury (72-96%).

Conclusion on the injury rates in athletics

We now begin to understand the extent of the problem (Table 2), however, we need to collect more epidemiological injury data to extend this knowledge to all athletic populations and during the entire athletic season.

STEP 2: WHAT ARE THE RISK FACTORS FOR ATHLETIC INJURIES?

Epidemiological studies during international athletics championships reported the following information about athletic injury risk factors:

- Gender: male athletes had higher injury rates than females;
- Age: higher injury rates are reported in athletes over 30 years;
- Event type: injury rates varied according to events with higher injury rates in combined event, marathon, middle- and long-distances;
- Training volume: higher training volumes before previous championships was associated with higher injury rates during championships (based on a pilot study of 74 athletes);
- Injury just before a championships: an injury in the four weeks before the championships is a risk factor for a new injury during the championships.

Injury risk factors during the entire athletic season

During the entire athletic season, the results are less clear, although some trends emerged:

- Previous injury: a previous injury seems to be a risk factor for another injury;
- Gender: the influence of sex/gender remains unclear – higher risk in male or in female athletes according to studies;
- Age: lower prevalence of injuries among juniors (<20 years) and higher among older athletes;
- Training load: influence of training load (volume × intensity) was reported in one study;
- Coach: fewer injuries in athletes who trained with a coach compared to athletes training alone;
- Performance level: the influence of the performance level remains unclear – the injury incidence increased with increased level, or decreased with increased level, or no influence;
- Psychological: maladaptive coping practice of self-blame was found to be associated with increased risk of overuse injuries.

Table 1: Five keys points of injury surveillance methodology.
Injury risk factors for the first injury: Hamstring muscle injuries

Higher hamstring muscle injury rates were reported:
• at start of the season;
• in boys than in girls;
• in masters compared to young athletes;
• in 4 x 400 m compared to 4 x 100 m;
• in athletes who had a previous hamstring injury;
• if the isokinetic hamstring/quadriceps ratio at the start of the season is less than 60% at 180°/s.

Conclusion on the risk factors of injuries in athletics

Although some factors are associated with higher injury rates, our knowledge of athletic injury risk factors remain limited. We need more well-designed studies with high standards of data collection and analyses; these should be in a variety of athletic populations, taking into account event differences and the large variety of potential risk factors.

STEP 3: WHAT MEASURES MIGHT BE RELEVANT TO ATHLETICS INJURY PREVENTION?

We present ideas on injury prevention measures in Table 3. The aim is to reduce injury risk and/or severity.

For example, the Medical Commission of the FFA developed a program on improving athletes’ physical condition, “Decathlon of injury prevention”. The aim was to prepare athletes better and to prevent the most common athletic injuries, however, we have no information on how effective this initiative was to reduce injury risk and/or severity. Hamstring muscle eccentric strengthening exercises dedicated to athletes have also been proposed.

International and national federations implemented coach teaching programmes aimed at improving coaches’ knowledge and coaching skills of athlete technical movement and training.

The involvement of medical expertise in planning and delivering of athletic competitions; their influence on competition regulations and field officials’ health education, are all important measures to prevent injuries; it is often well organized for higher level events, but uncertain at lower levels.

Optimal care pathways and communication/interactions between injured

| Events | Main injuries |
| --- |
| Sprint and hurdles | Thigh and hamstring muscle injuries, Achilles tendinopathy |
| Middle- and long-distances and marathon | Achilles tendinopathy, Overuse knee injuries, Medial tibial stress syndrome (shin splits), Stress fracture |
| Jumps | Achilles tendinopathy, Patellar tendinopathy, Thigh and hamstring muscle injuries, Ankle sprain, Low back pain, Head and neck injuries |
| Throws | Shoulder and elbow injuries, Low back pain |

Table 2: Main athletic injuries by event.

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<tr>
<th>Ideas on preventing athletic injuries (based on a non-exhaustive review and authors’ experiences).</th>
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<tr>
<td>1 Systematic and sustained approach by all stakeholders: the top management of national and international athletics federations should support injury prevention and safety promotion initiatives</td>
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<td>2 Sports equipment and rules: modification of rules to improve safety, changes in competition schedules according to weather conditions, the circadian cycle</td>
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<td>3 Lifestyle: improved recovery, sleep, and/or nutrition</td>
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<td>4 Physical conditioning of athletes to improve sensorimotor control: stretching, muscular strengthening, particularly eccentric, proprioceptive, balance, increased resistance to fatigue</td>
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<td>5 Psychological approach: mental preparation, mental imagery, behavioural adaptations</td>
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<tr>
<td>6 Technical training to improve movement and biomechanics to avoid technopathies and/or technical mistakes that may result in injury</td>
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<tr>
<td>7 Coordinated and consistent medical care of athletes: medical staff, early and correct care of injury, athletes’ health monitoring</td>
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athlete stakeholders are important. It is paramount to maintain medical confidentiality and a qualified physician should always coordinate clinical care.

A model for a national-level organization of athletic sports events was developed in collaboration with the SAA. The aim was to reduce/prevent overuse injuries, by addressing organizational hierarchy drag, introducing a safety surveillance system, and providing an open forum for safety issue discussion.

We should continue to creatively seek and implement measures to prevent athletic injuries. We should base these on current and improved future knowledge of steps 1 and 2, through multidisciplinary brain-storming and/or systematic reviews of prevention measures from other sports.

STEP 4: WHAT MEASURES ARE VALIDATED FOR ATHLETIC INJURY PREVENTION?

In other sports, mainly football, injury prevention programs have been evaluated and their effectiveness reported for preventing injuries. A meta-analysis of exercise interventions including 25 randomized controlled trials, reported an overall favourable impact, especially for muscle strengthening programmes, reducing injuries with a third and halving the rate of overuse injuries.

In football, the FIFA 11+ program, consisting of strengthening exercises, balance and coordination work dedicated to football, was developed and validated scientifically for preventing football injuries. The Nordic hamstring exercise (eccentric exercises focused on hamstring) have been validated to reduce hamstring muscle injuries in football.

There is to our knowledge no study validating a measure, a programme or an injury prevention strategy specific to athletics. This should be a priority for future athletics-specific injury prevention studies.

SUMMARY AND PRACTICAL IMPLICATIONS

Following the four-step framework for injury prevention, we present the state of knowledge on athletic injury prevention, and the efforts by international and national athletics federations in this area. Scientific knowledge on injury prevention mostly relates to step 1 on injury rates; we need more high quality studies to expand and validate our current knowledge base.

Our athletic injury risk factor knowledge base on the other hand is still limited, and continued efforts to improve this is paramount. Although various preventative measures have been proposed, none of these have been scientifically validated for its effectiveness in preventing athletics injuries. This should be a priority for future research on athletic injury prevention.

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