


# Injuries in Combined Events: Epidemiological Data from National-Level Championships

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## ABSTRACT

*Several studies have reported that competitors in the combined events are at greater risk of injury than those in other disciplines at major international athletics events. The aim of this study was to expand current knowledge by examining the incidence and characteristics of injuries incurred in a national-level competition. At the 2010 French National Combined Events Championships, all newly occurring injuries were prospectively recorded using a methodology developed for the International Olympic Committee. Fifty-one injuries including nine time-loss injuries, were reported among 107 athletes (477 injuries and 84 time-loss injuries per 1000 athletes), a rate even higher than at elite international competitions. Interestingly, the higher risk largely concerned the younger athletes and is thus a concern because of possible impacts on their vulnerable, immature musculoskeletal structures. It was also found that approximately 72% of the injuries affected the lower limbs, thigh strain (17.6%) being the most common diagnosis, and 60% of the injuries were caused by overuse. Based on this finding, the authors conclude by recommending that preventive interventions should mainly focus on overuse and thigh injuries. This article is adapted from a paper published in the International Journal of Sport Medicine.*

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## Introduction

**T**he combined events, the decathlon for men and the heptathlon for women, are athletics competitions in which the participants run, jump, and throw, normally over two consecutive days<sup>1,2</sup>. Decathlon com-

petitions consist of the 100m, long jump, shot put, high jump and 400m on the first day; and the 110m hurdles, discus, pole vault, javelin and 1500m on the second day<sup>1-3</sup>. Heptathlon competitions consist of the 100m hurdles, high jump, shot put and 200m on the first day; and the long jump, javelin and 800m on the second day<sup>1,2</sup>. These competitions are highly demanding from both the physical and psychological standpoints, largely because of the frequency and intensity of the disciplines<sup>1,3,5,7-10</sup>. In addition to technical skills, success calls for the powerful expression of a complex combination of the five primary physical and physiological abilities: speed, strength, flexibility, endurance and coordination<sup>1,4-8</sup>.

The high demands of the combined events may lead to a greater risk of injury compared to individual athletics disciplines<sup>8,9,11-17</sup>. Indeed, it has been documented that in major international competitions, such as the IAAF World Championships in Athletics and the European Athletics Championships, the incidence of injury and the risk of time-loss due to injury are higher in the combined events compared than in the other athletics events<sup>11-13,16,17</sup>. The risk of time-loss due to injury for heptathletes and decathletes respectively was 133 and 231 time-loss injuries per 1000 competing athletes in the 2007 IAAF World Championships<sup>11</sup>, 131.6 and 137.9 in the 2009 IAAF World Championships<sup>13</sup>, 103.4 and 200.9 in the 2011 IAAF World Championships<sup>12</sup>, and 103.4 and 130.4 in the 2012 European Championships<sup>17</sup>. This compares with an overall time-loss injury risk of around 40 per 1000 competing athletes in the same competitions<sup>11-13,17</sup>. Moreover, drop-outs are frequent during international combined events competitions. Previous studies show that an average 22% of decathletes and 13% of heptathletes do not complete their competitions<sup>2,3</sup>, and that injuries appear to be an important factor in 36% of dropout cases<sup>8</sup>.

In contrast to the higher injury risk reported for elite international combined events competitions, to our knowledge, no data are available on injury risk during national- and/or youth-level competitions. With the creation of the biennial

IAAF World Youth Championships (for athletes aged 15-17 years) in 1999 and the quadrennial Youth Olympic Games in 2010, there is a trend for more and more younger athletes to seriously prepare for and take part in high-level competitions. This leads to a particular interest in the related injury and health aspects.

Although it is well known that the musculoskeletal system of a young person is immature, we may be seeing that in the quest for success in the new international-level competitions, young athletes are subject to greater training work-loads than those applied in the past and there is evidence of a higher injury risk in athletes in this age group than in adult athletes<sup>18</sup>. This is important since injuries can sometimes lead to drop out from sport and/or to long-term or even permanent damage of developing tissues and affected structures in athletes of this age<sup>14,19</sup>.

Moreover, around the world, youth- and national-level competitors represent a greater proportion of those practicing the combined events than elite athletes. Knowing the injury incidence and characteristics in these populations is relevant for injury prevention programmes specifically focused on the combined events, could help coaches to optimise performances and could help to promote the wider practice of athletics and its long-term benefits.

Therefore, the aims of this study were to survey the injuries occurring during a national-level competition, the French National Combined Events Championships, and to analyse their incidence and characteristics with particular attention to those affecting younger athletes.

## Methods

The present study used the injury surveillance methodology developed for the International Olympic Committee (IOC) for use at multi-sports events<sup>20</sup>, which has been implemented during international athletics competitions<sup>11-13</sup> and was extended to include a drop-outs survey<sup>2,8</sup>. During the 2010 French National Combined Events Championships in Saint-Eti-

enne, all newly incurred injuries and dropouts were reported on a standardised report form by the local organising committee's physician (PE) working at the medical centres in the stadium and warm-up area.

The following information was requested:

- athlete's gender and age,
- date and time of injury,
- injured body part,
- type and cause of injury,
- estimated duration of the subsequent absence from competition and/or training.

Confidentiality of all information was ensured so that no individual athlete could be identified. Ethical approval was obtained from the Saint-Etienne University-Hospital Ethical Committee (Institutional Review Board Information: IORG0004981). Due to the short duration of the championships (two days), the circumstances of each injury reported were analysed as injuries during competition. Incidence of injury and time-loss injury were calculated in accordance with the IOC approach<sup>20</sup>.

## Results

### ***Frequency and characteristics of injuries***

Thirty-nine athletes (16 females and 23 males) or 36.5% of the athletes registered for the competition incurred an injury during this study. A total of 51 injuries were reported, representing an incidence of 477 injuries per 1000 registered athletes (95% Confidence Interval, 382-571), and 55 injuries per 1000 athlete participations (95%CI: 40-70).

The ages of the injured athletes ranged between 16 and 30 years (mean±SD: 19.6±3.7yrs). Seventeen injuries occurred to athletes in the international youth age group (16.4±0.5yrs), 13 in the junior age group (18.2±0.9yrs), and 21 in the U23 (under 23 years) and senior age groups (23.1±3.2yrs). Details of injury incidence per age category are reported in Table 1.

The lower limb was affected in 72.5% of the reported injuries, followed by the trunk (13.7%), the upper limb (9.8%) and the head (3.9%). The thigh was the most frequently injured (n=12; 23.5%), followed by the knee (11.8%), the elbow (9.8%), the leg (9.8%), the ankle (9.8%), and the foot (9.8%). The most frequent types of injury were tendinopathies (27.5%) and strains (21.6%), followed by muscle cramps (15.7%) and sprains (13.7%). The most common diagnosis was thigh strain (n=9; 17.6%), followed by trunk muscle cramps (n=6; 11.8%), knee tendinopathy (n=5; 9.8%), and ankle sprain (n=5; 9.8%). Overuse injuries were dominant (60.8%), either with gradual (33.3%) and sudden onset (27.5%), followed by non-contact trauma (31.4%). No recurrent injury was reported.

Nine injuries (17.6%) were expected to result in time-loss from sport participation (training and competition), representing an incidence of 84 injuries per 1000 registered athletes (95%CI: 32-137), and 10 injuries per 1000 athlete participations (95%CI: 3-16) (Table 1). Knee tendinopathy (n=2) was the most common diagnosis which resulted in a time-loss from sport participation. Three time-loss injuries (33%) were reported in the youth age group (one hip tendinopathy, one ankle sprain and one thigh laceration) resulting in an estimated 15 days to one month of absence from sport participation. Three injuries with more than four weeks of estimated absence were reported: thigh strain, leg strain and Achilles tendon rupture (six-month absence).

### ***Frequency and characteristics of dropouts***

Among the 107 registered athletes, we recorded 14 dropouts (13.1%), which represents an incidence of 131 dropouts per 1000 registered athletes (95%CI: 67-195) (Table 1). Fifty percent involved national senior and/or U23 decathletes. Eight dropouts were caused by an injury (57.1%); five injuries were caused by a non-contact trauma (1 Achilles tendon rupture, 1 thigh strain, 1 lower leg strain, 1 ankle sprain, 1 thigh skin laceration) and 3 by overuse (1 hip, 1 knee and 1 foot tendinopathy).

Table 1: Incidence of injuries, time-loss injuries and dropouts per registered athletes, and athlete participations, of different gender and age categories

	TOTAL	Decathlon (Male)			Heptathlon (Female)		
		National senior and U23	Junior	Youth	National senior and U23	Junior	Youth
<b>Population</b>							
Registered athletes	107	27	15	17	17	14	17
Athletes participations	926	270	150	170	119	98	119
<b>Injuries</b>							
Number of injuries	51	11	9	10	10	4	7
Injuries per 1000 registered athletes	477	407	600	588	588	286	412
Injuries per 1000 athlete participations	55	41	60	59	84	41	59
Number of time-loss injuries	9	4	1	2	1	0	1
Time-loss injuries per 1000 registered athletes	84	148	67	118	59	0	59
Time-loss injuries per 1000 athlete participations	10	15	7	12	8	0	8
<b>Dropouts</b>							
Number of dropouts	14	7	1	2	2	0	2
Percentage of dropouts	13	26	7	12	12	0	12
Dropouts per 1000 registered athletes	131	259	67	118	118	0	118
Dropouts per 1000 athlete participations	15	26	7	12	17	0	17

## Discussion

The main finding of this study was the very high incidence of injury during these national and youth combined events championships. More than 30% of the registered athletes incurred an injury during this competition, corresponding in an incidence of 477 injuries per 1000 registered athletes (95%CI: 382-571). In comparison with previous injury studies in athletics, this injury incidence was higher than the figures for all events in major international athletics competitions (97 injuries per 1000 athletes at the 2007 IAAF World Championships<sup>11</sup>, 113 injuries per 1000 athletes at the 2008 Olympic Games<sup>21</sup>, 135 injuries per 1000 athletes at the 2009 IAAF World Championships<sup>13</sup>, 135 injuries per 1000 athletes at the 2011 IAAF World Championships<sup>12</sup> and 98 injuries per 1000 athletes at the 2012 European Athletics Championships<sup>17</sup>), confirming that the combined events, even in national-level competitions, lead to a greater injury risk than the individual athletics disciplines.

Moreover, the combined event injury incidence reported in our study was also higher than those reported for the combined events at the 2007 IAAF World Championships (275 injuries per 1000 athletes<sup>11</sup>), 2009 (171 injuries per 1000 athletes<sup>13</sup>), 2011 (288.1 injuries per 1000 athletes<sup>12</sup>), and European Athletics Championships 2012 (230.8 injuries per 1000 athletes<sup>17</sup>). Finally, in agreement with the previously mentioned preliminary study<sup>8</sup>, injury was an important cause of combined events drop out (57% of the drop out cases).

Interestingly, the younger population of the French National Combined Events Championships compared to the population participating in the world's top combined events competitions (19.6±3.7yrs vs. 26.3±4.7yrs in the 2007 IAAF World Championships<sup>11</sup>, 26.6±4.4yrs in the 2009 IAAF World Championships<sup>13</sup>, 26.9±4.7yrs in the 2011 IAAF World Championships<sup>12</sup> and 26.9±5.2yrs in the 2012 European Championships<sup>17</sup>) experienced a higher incidence of injury. The influence of age and level

of practice on the higher injury incidence is debatable<sup>15</sup>. On the one hand, the injury risk could increase with the level of practice as a result of the increasing intensity and workload of training and competitions; on the other hand, the injury risk could increase with the lack of physical and technical control expected in less experienced athletes<sup>15,22-24</sup>. Although the explanations are not clear, it's important to highlight that injuries in younger population affected immature musculoskeletal structures, which can lead to long-term or even permanent damage<sup>18</sup>. Therefore, the higher injury risk in this fragile population demonstrated by the present study is of great interest for clinical activities.

Injuries in the younger population, however, were potentially less dangerous than those reported in elite combined event athletes. Indeed, the combined event time-loss injury incidence was lower in our study (84 injuries per 1000 athletes) than in the 2007 IAAF World Championships (188 injuries per 1000 athletes<sup>11</sup>), the 2009 IAAF World Championships (129 injuries per 1000 athletes<sup>13</sup>), the 2011 IAAF World Championships (135.6 injuries per 1000 athletes<sup>12</sup>) and 2012 European Athletics Championships (115.4 injuries per 1000 athletes<sup>17</sup>). The majority of injuries reported in our study were caused by overuse (61%), confirming previous studies<sup>11-13,15</sup>, but this raises questions about the population of youth and non-professional athletes that normally has lower competitive or financial pressures to succeed and thus can more easily stop training or miss competitions to heal pain and/or injury. In any case, it is clear that prevention and treatment measures should be focused on overuse injuries

Finally, the most common diagnosis was thigh strain, followed by trunk muscle cramps, and then knee and ankle sprain. Thus, prevention and treatment measures should also focus on these pathologies.

## Practical Implications

Sports injuries prevent athletes from training with maximum effectiveness or competing to

the best of their ability. The results of our study could have an impact on the fields of both coaching (performance improvement) and sport medicine (injury prevention) by helping to increase the safety of the practice of combined events. The most important results to emerge are 1) highlighting the fact that injuries are frequent in youth combined events championships and appropriate medical treatments are needed in order to prevent them from leading to drop out from sport practice and/or long-term or even permanent damage of developing tissues and affected structures in this age population, and 2) highlighting the need to better define the future direction for injury prevention strategies in the combined events.

In clinical practice, attention to the prevention of overuse injuries and thigh injuries should be a focus of combined event injury prevention programmes. Prevention measures against overuse injuries could be an early diagnosis, treatment and adaptation of the training when an athlete presents a pain and/or an injury. This requires a close collaboration between athlete, coach and medical team. In addition, an overall strengthening programme should be included during the training focus on eccentric exercise on lower limb tendons.

Measures to address thigh injuries could be an appropriate part of treatment and rehabilitation of first incident and/or previous incident thigh strains. These could include exercises to improve muscle thigh flexibility and to reduce hamstring/quadiceps strength imbalances.

## Conclusion

During the 2010 French National Combined Events Championships, over one third of the registered athletes incurred an injury and the injury incidence was higher than those recorded in international elite athletics competitions. Interestingly, this higher injury risk concerned a younger population, thus affecting immature musculoskeletal structures. The most frequently injured body parts were the thigh, trunk and knee; the most frequent types were tendinopathies and strains; and the most common diagnosis was thigh strain, confirming previous studies in athletics. It is our recommendation that injury prevention interventions in the combined events should mainly focus on overuse and thigh injuries.

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