Science & Sports (2015) 30, e73—e83

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Elsevier Masson France EM|consulte www.em-consulte.com

ORIGINAL ARTICLE

No change in maximal lower extremity power output was induced by a decathlon

Aucun changement de puissance maximale des membres inférieurs ne semble être induit par le décathlon

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Received 23 May 2013; accepted 1st February 2014
Available online 4 February 2015

KEYWORDS
Power;
Sports injury prevention;
Muscle fatigue;
Track and field;
Combined events

Summary
Objectives. — To determine the change in lower extremity power output over the course of a decathlon in order to better define/understand the functional demands represented by decathlon, the muscular mechanical capabilities determining decathlon performance, and their potential relationships with injury risk factors.
Methods. — Six national level athletes and 11 representative control participants were included in this cross-sectional controlled study implemented in field conditions during the 2010 French National Decathlon Championships. The change in lower extremity power output, and its force and velocity components, was tested on the basis of maximal squat-jump and cycling sprint measurements, at the beginning and end of each of the two days of competition.
Results. — No differences in squat-jump and cycling sprint values were found between each testing time ($P > 0.05$), while significant lower squat-jump values for control participants were reported at the second day beginning ($P < 0.05$).
Conclusions. — These preliminary results suggest that decathlon competition did not induce measurable alterations in lower extremity force, velocity or power output. In order to improve decathlon performance and injury prevention, practical information for athletes, coaches and medical teams could be: adapted wake-up and warm-up is necessary before morning events and other injury risk factors should be explored.

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http://dx.doi.org/10.1016/j.scispo.2014.02.005
0765-1597/

MOTS CLÉS
Puissance ;
Prévention des blessures en sport ;
Fatigue musculaire ;
Athlétisme ;
Épreuves combinées

Résumé
Objectifs. — Déterminer la variation de puissance des membres inférieurs au cours d'un décathlon afin de mieux définir/comprendre : les demandes fonctionnelles du décathlon, les capacités mécaniques musculaires déterminantes de la performance, et leurs relations éventuelles avec les facteurs de risque de blessures.
Méthodes. — Six athlètes de niveau national et 11 participants témoins ont été inclus dans cette étude transversale de terrain lors des championnats de France 2010. La variation de puissance des membres inférieurs a été testée au début et fin de chacun des deux jours de compétition par des squat-jump et des sprints sur cycloergomètre.
Résultats. — Il n'existait aucune différence dans les valeurs de squat-jump et sprints sur cycloergomètre entre les différents tests ($p > 0,05$), hormis chez les témoins des valeurs de squat-jump significativement plus faibles en début de deuxième journée ($p < 0,05$).
Conclusions. — Ces résultats préliminaires suggèrent que la compétition de décathlon n'induirait pas de modifications mesurables de puissance des membres inférieurs. Afin d'améliorer les performances et la prévention des blessures en décathlon, des informations pratiques pour les athlètes, entraîneurs et équipes médicales pourraient être : réaliser un réveil musculaire et un échauffement adapté avant les épreuves du matin, et d'autres facteurs de risque de blessures devraient être explorées.

1. Introduction

Decathlon is an Olympic Athletics (track and field) discipline that consists of: 100-m long jump, shot put, high jump and 400-m on the first day, and 110-m hurdles, discus, pole vault, javelin and 1500-m on the second day [1,2]. In addition to technical skills, decathlon requires a high muscular power capability to succeed in these 10 high-intensity events, especially in the lower extremity, which is mainly involved in performance. Decathlon also requires maintaining this high power output despite repeated events over two consecutive days in order to perform at best. Indeed, neuromuscular fatigue, which may be induced by repeated maximal efforts over the two days of competition, is defined as a reduction in the maximal force exerted by a muscle or a muscle group due to central and/or peripheral mechanisms [3], and may lead to decrease in field performances. Lower extremity neuromuscular fatigue has already been studied in repeated-sprint or intermittent high-intensity exercises (e.g. soccer, handball, rugby, tennis...) [4—10]. Decrease in lower extremity power output measured through jump, sprint and/or maximal voluntary contraction performances have been reported after team-sports and racket-sports matches [6—10]. Given that fatigue was evidenced during such competitive activities, we hypothesized that it would also be the case in decathlon, and that the decrease in lower extremity power output may be one of the key factors of decathlon performance. However, to the best of our knowledge, the change in lower extremity power output during this specific intermittent high-intensity discipline has not been studied. Since neuromuscular fatigue differs according to the type of muscle action, the muscular group involved and the exercises duration/intensity [11], it should be of interest to seek a more specific knowledge regarding the development of fatigue and the change in lower extremity power output over the course of a decathlon.

Furthermore, a greater injury risk has been reported in decathlon over other Athletics disciplines [12—16]. Indeed, during international championships, incidences of decathlon time-loss injury were from 115 to 200 per 1000 registered athletes compared to an overall time-loss injury risk around 45 to 70 per 1000 registered athletes [13,14,16]. Most injuries (~75%) were located on the lower extremity and involving the musculo-tendinous system (e.g. hamstring strain, lower leg strain, Achilles tendinopathy and patellar tendinopathy) [12,15—17]. In this context, a better knowledge of the neuromuscular fatigue occurrence, and especially the change in lower extremity power output, over the course of a decathlon appears of interest in a step-by-step injury prevention approach [18,19]. Indeed, decrease in lower extremity power output may lead to an increased injury risk, and could be considered as an injury risk factor [20—22]. In decathlon, the 10-events sequence could cause a decrease in lower extremity power output. Thus, there may be a relationship between this potential decathlon-related decreased power output and the higher injury risk.

To our knowledge, some studies reported data on dropout risk in decathlon [2,17,23] and on injury risk in decathlon [12—17], only two studies reported information on the physiological demands during a decathlon (blood lactate accumulation [24] and cardiovascular demands [25]), and no data is available on the change in lower extremity power output induced by a decathlon. Evaluating the changes in power output of lower extremity muscles, over the course of a decathlon, appears of interest for athletes, coaches and medical teams, to better define/understand:

- the functional demands represented by decathlon;
- the muscular mechanical capabilities determining decathlon performance;
- their potential relationships with injury risk factors.