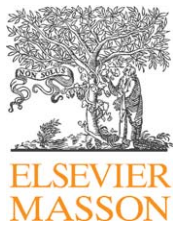
Science & Sports (2011) 26, 292—297



Disponible en ligne sur
ScienceDirect
www.sciencedirect.com

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

ORIGINAL ARTICLE

Effects of high-intense stimuli on continuous running exercise at the ventilatory threshold

Effets des stimuli d'une course de forte intensité sur un exercice de course continu au seuil anaérobie

A.S. Oliveira[a,c,*], R.A. Tibana[a], F. Aguiar[a], H.B. Oliveira[a], E.S. Barros[b], P.B. Silva[b]

[a] *Centro Universitário Unieuro, Brasilia, Distrito Federal, Brazil*
[b] *Universidade Católica de Brasilia, Distrito Federal, Brazil*
[c] *Center for Sensory-Motor Interaction, Department of Health Science and Technology, Aalborg University, Fredrik Bajers Vej 7, DK 9220, Aalborg, Denmark*

Received 16 April 2010; accepted 29 September 2010
Available online 9 December 2010

KEYWORDS
Exercise physiology;
Fatigue;
Maximal exercise;
Interval training

Summary
Aims. — To verify the effects of previous interval training session on physiological and kinematic parameters during continuous running at ventilatory threshold.
Methods. — Ten healthy male performed initially an incremental running test, in order to determine ventilatory threshold and maximal aerobic capacity. In another session, subjects performed three tasks as follows: (1) previous five-minute run at ventilatory threshold. After ten minutes rest: (2) interval training session (8 × 1-min at maximal velocity, alternated to one-minute at 50% maximal velocity). After 15 minutes rest: (3) posterior five-minute run at ventilatory threshold. Heart rate, ventilation, blood glucose and lactate concentrations, perceived exertion, stride frequency, stance period and swing period were compared before and after the interval training session.
Results. — Significant increases were found in heart rate (~12%), ventilation (~23%), blood glucose (~28%), blood lactate (230%), perceived exertion (~25%) and stride frequency (~5%) after interval training.
Conclusion. — High-intense running stimuli affect physiological, perceptual and kinematics of a constant moderate intensity running, which could influence training session programmes, considering the impairment overall running performance.

* Corresponding author.
E-mail address: oliveira@hst.aau.dk (A.S. Oliveira).

0765-1597/$ - see front matter © 2010 Elsevier Masson SAS. All rights reserved.
doi:10.1016/j.scispo.2010.09.011

MOTS CLÉS
Exercice physiologie ;
Fatigue ;
Exercice maximal

Résumé
Objectifs. — Vérifier les effets d'une séance d'entraînement par intervalles sur des paramètres physiologiques et cinématiques lors d'une course continue réalisée au seuil anaérobie.
Méthodes. — Dix sujets mâles sains ont initialement exécuté un test de course cumulatif afin de déterminer le seuil anaérobie et la vitesse aérobie maximale. Lors d'une autre séance, les sujets ont exécuté dans l'ordre les trois tâches suivantes : (1) précourse de cinq minutes au seuil anaérobie. Après dix minutes de repos, (2) séance d'entraînement par intervalles (8 × 1 minute à vélocité maximale, alternés avec une minute à 50 % de la vélocité maximale). Après 15 minutes de repos, (3) postcourse de cinq minutes au seuil anaérobie. Le rythme cardiaque, la ventilation, le taux de glucose dans le sang, la concentration d'acide lactique, la perception de l'effort, la fréquence de la marche, la phase d'appui et la phase oscillante ont été comparés avant et après la séance d'entraînement par intervalles.
Résultats. — Des augmentations significatives ont été trouvées, après l'entraînement par intervalles, pour le taux de glucose dans le sang (∼23 %), la ventilation (∼12 %), le rythme cardiaque (∼28 %), la concentration d'acide lactique (230 %), la perception de l'effort (∼25 %), ainsi que la fréquence de la marche (∼5 %).
Conclusion. — Les stimuli induits par une course de forte intensité affectent la physiologie, la perception et la cinématique d'une course constante d'intensité modérée. Ces observations pourraient influer sur les programmes d'entraînement en considérant l'altération globale de la performance de la course.

1. Introduction

Running exercises have been widely investigated concerning health benefits, kinematic influence on performance [1,2], metabolic and neuromuscular adaptations to training [3,4], musculoskeletal injuries [4] and muscle fatigue [5]. Especially interval training (INT_{TR}) has been used to promote both velocity and endurance, by its nature intimately linked to constant changes in short-term metabolic responses. It is possible to maintain running technique along the training session by using active rest intervals [3]. These stimuli induce loss of homeostasis, requiring more energy expenditure and muscular activation [6,7]. Usually, an INT_{TR} session has short-time and intense running stimulus (above the anaerobic threshold or the second ventilatory threshold [VT_2]), followed by a recovery, which may be smaller, equal or even longer than the active period of running [3].

A proper motor gesture is essential during high-intense running, since its optimization may increase running economy [8—10], and consequently performance. Increases in running speed are related to kinematics changes, such as range of motion in the knee and hip joints [11], higher stride length and stride frequency [9,10,12]. Despite the fact that higher speeds demand higher activation of some lower limb muscles [12], impaired running technique may promote undesirable muscle activations, and braking forces which eventually increase metabolic cost [2,9].

The accumulation of metabolites, such as blood lactate concentration [LAC] and extracellular K^+ is natural during INT_{TR} sessions by the high participation of the anaerobic metabolism. As consequence of this accumulation, muscle fatigue decreases the energy offer, impairs muscle activation, excitation—contraction coupling and pacing [3,6,13]. These changes during INT_{TR} sessions differ from those found during continuous running exercise [14], since high intensity stimuli require higher metabolic demands. In theory, INT_{TR} may provide improvement of running technique and conditioning at the same time, however, to our knowledge, there is a lack of information about how the performance of running exercises at preestablished indexes (as the VT_2) may be affected by high-demanding stimuli, as found during INT_{TR} sessions. Once INT_{TR} aims to promote maintenance of proper technique, it seems relevant to analyze INT_{TR} at the maximal velocity stimuli, for which the effects of fatigue are not entirely explored in terms of biomechanics and physiology after this type of task.

We hypothesized that an INT_{TR} session will strongly affect the performance of a short period of continuous running exercise at the VT_2. Physiological parameters (HR, ventilation [VE], [LAC], blood glucose concentration [GLU], perceived exertion [PE]), and kinematic parameters (as SF, stance phase duration [STA], swing phase duration [SWI]) will be affected when constant running is compared before and after the INT_{TR} session. Possibly, higher HR, VE, LAC, GLU, PE, STA, CP, and lower SWI may be found as consequence of the neurophysiological effects of the INT_{TR} session. In this way, the main objective of the present study was to verify the effects of an INT_{TR} session on physiological and kinematic parameters during continuous running at VT_2 before and after INT_{TR} session.

2. Methods

Ten healthy male, recreational running practitioners, without musculoskeletal disorders at lower limbs and back within the last 12 months, participated in this study (anthropometric parameters are showed in Table 1). They gave informed consent to participate in the study. The study was approved by the Institutional Research Ethics Committee.

2.1. Experimental design

Subjects were tested in two different days: