

Original article

Heart rate and blood lactate responses during Taekwondo training and competition

Évolution de la fréquence cardiaque et de la lactatémie au cours de l'entraînement et de la compétition de Taekwondo

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Abstract

Objective. – The study investigated physical fitness characteristics of elite Taekwondo (TKD) players as well as their heart rate (HR) response and blood lactate concentration changes during TKD specific exercises and simulated competition.

Methods. – Anaerobic and aerobic power has been evaluated in eight elite TKD players (age: 20 ± 1 years, body mass: 70.8 ± 6 kg, Ht: 179.9 ± 4 cm). We also measured heart rate and blood lactate concentration during competition and specific-exercises (front kicks during 10 s, 1 and 3 min).

Results. – Maximum oxygen uptake (VO_{2max}) and peak anaerobic power (W_{peak}) averaged 56.22 ± 2.57 ml min^{-1} kg^{-1} and 12.1 ± 1.7 W kg^{-1} , respectively. HR and blood lactate [La] concentrations increased significantly during competition ($F = 19.4$, $P < 0.001$; $F = 21.3$, $P < 0.001$) compared to the resting value. HR and [La] values were significantly correlated with those measured during 10 s ($R = 0.85$, $P < 0.05$ and $R = 0.79$, $P < 0.05$, respectively) and 3-min specific exercises ($R = 0.95$, $P < 0.01$ and $R = 0.76$, $P < 0.05$).

Conclusions. – TKD requires high levels of both aerobic and anaerobic physical fitness. The correlation between specific exercises and competition is of practical interest for TKD players and trainers.

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Résumé

Objectif. – Cette étude a examiné les caractéristiques physiques d'un groupe de taekwondoïstes de haut niveau, aussi bien que l'évolution de la fréquence cardiaque et de la lactatémie lors d'exercices spécifiques et au cours de la compétition simulée de Taekwondo.

Méthode. – Les puissances anaérobie et aérobie ont été évaluées chez huit taekwondoïstes (âge : $20 \pm$ ans, masse corporelle : $70,8 \pm 6$ kg, taille : $179,9 \pm 4$ cm). Nous avons mesuré aussi la fréquence cardiaque et la concentration sanguine de lactate lors de la compétition et lors d'exercices spécifiques (coup « ap chagé » pendant dix secondes, une et trois minutes).

Résultats. – Les valeurs de consommation maximale d'oxygène (VO_{2max}) et de pic de puissance anaérobie (W_{pic}) étaient en moyenne de $56,22 \pm 2,57$ ml min^{-1} kg^{-1} et $12,1 \pm 1,7$ W kg^{-1} respectivement. La fréquence cardiaque (FC) et les concentrations sanguines de lactate [La] augmentent significativement lors de la compétition ($F = 19,4$, $p < 0,001$; $F = 21,3$, $p < 0,001$) en comparaison avec les valeurs de repos. Ces valeurs étaient significativement corrélées avec celles mesurées pendant les exercices spécifiques de dix secondes ($r = 0,85$, $p < 0,05$ et $r = 0,79$, $p < 0,05$ respectivement) et de trois minutes ($r = 0,95$, $p < 0,01$ et $r = 0,76$, $p < 0,05$).

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Conclusion. – Le taekwondo requiert un niveau élevé d'aptitude physique aérobie et anaérobie. Les corrélations obtenues entre les exercices spécifiques et la compétition ont un intérêt pratique aussi bien pour les athlètes que pour les entraîneurs.

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Keywords: Maximum oxygen intake; Peak anaerobic power; Blood lactate; Heart rate

Mots clés : Consommation maximale d'oxygène ; Puissance maximale anaérobie ; Lactate sanguin ; Fréquence cardiaque

1. Introduction

Taekwondo (TKD), which is a very popular martial art sport, is an activity that requires many skills, a high-energy demand and sophisticated techniques. The competition consists in three rounds of 3 min each, with 1-min recovery. The competition area is 64 square-meter large. Therefore, technical and vigorous physical exercises should be included in the training program. Technical training is based on specific training, including running, rope skipping or racket—hitting that is classical exercises, which are not varied.

To train well, it is very important to know metabolic solicitations involved in such exercises. However, very few studies have focused on TKD [5,7,9]. Heller et al. [5] studied some metabolic data of Czech National Team. Their conclusion was that competitive performance during two rounds of 2 min each was related to maximum anaerobic power output. However, the competition according to the World Taekwondo Federation, consists in a three fight-round, of 3 min each, with 1 min-recovery. Thus, little is known regarding the physiological characteristics during real TKD competition. Research on TKD competition should provide precise information about the metabolic stress encountered by TKD players. This could be of interest for exercise prescription during training sessions.

In addition, few metabolic data is provided about TKD exercises [7]. Heart rate (HR) was measured during pooms (a series of movement sequences, [8]). The authors found that TKD practice rise HRs sufficiently to increase cardiorespiratory fitness [8].

Taking into account all these parameters, the purpose of this study was to evaluate HR responses and blood lactate concentration changes during competition and specific exercises, and also to verify the correlation between them.

2. Methods

2.1. Subjects

Eight male subjects from the National Tunisian TKD Team participated in the study after a written informed consent. Their physical characteristics are summarized in Table 1. They have about 7 years of training experience. They train regularly five times a week (5×1.30 h).

2.1.1. Anthropometric measurements

The height and weight were measured, as defined standardly. The arm length was measured from the acromion to the minimum wrist circumference. Leg length was measured from the midpoint of a line joining the uppermost circumference to the iliac crest, down to the minimum circumference above the ankle. The biceps, triceps, subscapular, and supra-iliac folds were measured at traditional sites and were used to predict body fat [3].

2.1.2. Metabolic measurements

We measured HR during VO_2 max-test, specific exercises and competition. Blood lactate concentration was measured during specific exercises and competition. Samples of 100 μ l arterialized capillary blood were collected from ear lobe in tubes containing sodium fluoride (antiglycolytic) and potassium oxalate (anticoagulant) as recommended in the instructions of the BioMerieux lactate PAP kit (Lyon, France). This was realized at rest, immediately after the first, the second and the third round of the competition, and at the second minute after the specific exercises. Samples were mixed well and placed on ice. They were centrifuged at 4 °C and 3000 rpm for 10 min. The supernatant was removed and frozen at –20 °C for lactate analysis by using the spectrophotometric kit method. Blood lactate values were measured by Microzym-L (France) using L-lactate O_2 oxide reductase, which catalyzes oxidation of L-lactate to pyruvate and hydrogen peroxide for later lactate analysis by using the spectrophotometric kit method (BioMerieux lactate PAP). Samples were analyzed and the average absorbance used for calculation of the concentration.

2.2. Protocols

During the first visit, maximum oxygen intake (VO_2 max) was estimated by the multistage 20 m Shuttle-test, proposed by Léger and Lambert [6]. The subject runs between two lines, 20 m distant from each other at a pace set by a tape

Table 1
Physical characteristics of subjects

	Mean \pm S.D.
Age (years)	20 \pm 1
Body mass (kg)	70.8 \pm 6
Ht (cm)	179.9 \pm 4
Leg length (cm)	105 \pm 6
Arm length (cm)	77.4 \pm 2
Body fat (%)	11.8 \pm 3

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