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Correlation between the performance of taekwondo athletes in an Adapted Anaerobic Kick Test and Wingate Anaerobic Test

Mariana Paulino Oliveira, Leszek Antoni Szmuchrowski, Cristiano Arruda Gomes Flor, Reginaldo Gonçalves, Bruno Pena Couto

Load Evaluation Laboratory. Federal University of Minas Gerais, Brazil

Abstract

Background & Study Aim: To characterize the energy demands of taekwondo, researchers have verified the relevant contribution of anaerobic energy supply to athletes during fights. To evaluate anaerobic capacity, the Wingate Anaerobic Test (WAnT) was developed, which is based on the use of the lower limbs. For assessing anaerobic power using a more specific taekwondo technique, an adapted test was created, Adapted Anaerobic Kick Test (AAKT), which consists of a repeated execution of the kick technique *banda chagui*. A comparison between the results of these tests allows a verification of the validity of the utilization of WAnT as a task for assessing performances in taekwondo. The aim of this study was to correlate the results between WAnT and AAKT for the lower limbs.

Material and Methods: The study included 15 individuals (10 males and 5 females), all of them Brazilian taekwondo athletes from UFMG Sports Training Center (mean age 20.17 ± 1.89 years), mean body mass (63.82 ± 9.22 kg) and mean height (170.08 ± 9.87 cm).

Results: A significant correlation was founded in the comparison between the WAnT and AAKT results. It was founded a strong correlation between three parameters, the relative peak power and higher kick frequency, index fatigue WAnT and index fatigue AAKT, and relative average power and average kick frequency.

Conclusion: These findings identified the WAnT is appropriate for assessing peak anaerobic power and capacity of taekwondo competitors.

Key words: anaerobic • exercise • martial arts • sports performance

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Corresponding author: Leszek Antoni Szmuchrowski. Universidade Federal de Minas Gerais (UFMG). Coordenador do Laboratório de Avaliação da Carga (LAC) - EEFFTO. Supervisor de Atletismo CTE – UFMG, Brazil; e-mail: szmuchrowski95@gmail.com

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Introduction

Taekwondo is a Korean martial art sport, became a full-medal sport at the 2000 Summer Olympics in Sydney and has been an Olympic sport since then [1]. The athletic performance in taekwondo may be determined by a competitor's technical, tactical, psychological, and physical characteristics. The actions in the sport are characterized by short durations, high intensity and require specific fast, high and spinning kicks [2]. Hence of this intermittent characteristic [3] the energy demands of taekwondo include the relevant contribution of both aerobic and anaerobic power. However is the anaerobic power the determinant fitness for the success in the fight [4].

The taekwondo championship matches are typically structured across three 2-min rounds with a 1-min interval separating each round [5]. Thus Taekwondo athletes repeatedly perform brief periods of high intense exercises, such as fighting attacks (1 to 5 seconds) alternate with periods of low intense exertion (non-fighting or pause). Consequently, in the fighting attacks the primary energy system is the phosphagen system. This system supplies energy for high-intensity exercises that last up to approximately 10 seconds in the form of adenosine triphosphate (ATP) and creatine phosphate (CP) [6]. In high-intensity exercises, such as kick, the most used technique in taekwondo competition draw a rapid decrease in the ability to generate power, possibly as a result of a depletion of PCr and an production of lactic acid [7].

Training effectiveness in sport is measured with the best possible performance in the most important competitions [8]. Therefore understand the specific characteristics of taekwondo is essential to develop an adequate training program and for choose the best methods for assessing fitness. In selection of the tasks of training evaluation, for a particular sport, the focus should be on those actions and abilities which have the most significant influence on sport performance [9], and on those which are predominantly under prevailing influence of energy demands [10].

The Wingate Anaerobic Test 30s (WAnt) constitutes the most common method of assessing peak anaerobic power and capacity of taekwondo competitors [4]. While this test assess the anaerobic power from the lower limbs, it is not a specific test to evaluate the physical condition of taekwondo athletes. Although, WAnt constitutes a universal method of assessing peak anaerobic power and capacity and it is the most used method for taekwondo competitors, the WAnt is done in a cycle ergometer and, consequently the technique used is very different for the specific technique required for taekwondo match. However, no studies have been compared the results from the WAnT to the results from a similar composition to WAnt, but with specific taekwondo gestures. Thus, the proposal of this study was to correlate the results between the WAnt test and Adapted Anaerobic Kick Test.

Material and methods

Subjects

The study included 15 individuals (10 males and 5 females), all of them Brazilian taekwondo athletes from UFMG Sports Training Center, mean age 20.17 ± 1.89 years, mean body mass (63.82 ± 9.22 kg) and mean height (170.08 ± 9.87 cm). All volunteers were aware of the procedures of the study and gave their consent for participation before undergoing the tests. The study was submitted to the Ethical Committee of the Federal University of Minas Gerais (Belo Horizonte, Brazil).

Procedures

In addition to measuring the anthropometric variables, the athletes performed the Adapted Anaerobic Kick Test (AAKT) and the Wingate Anaerobic Test (WAnT) for lower limbs. The tests were carried out at different meetings. At the first meeting, the volunteers performed the AAKT and at second meeting, the taekwondo athletes performed the WAnT for lower limbs.

Adapted Anaerobic kick Test (AAKT) Protocol

To perform the Anaerobic Kick Test, athletes were placed with the foot would kick standing on a contact mat. The volunteers were instructed to kick, with the preferred member, the taekwondo targe pad positioned at the height of the iliac crest of the individual as soon as possible, so they were allowed (Figure 1). The test was performed in 30 seconds with the highest possible frequency of *banda chagi* technique. The athletes were also instructed to perform the movement as quickly as possible and a verbal encouragement was given during the 30-second test. The first kick was done with the preferred member in the back. Starting from the second kick, the preferred member was positioned on a contact mat and forward throughout the remaining time of the test. A contact sensor was coupled in the target pad for measuring the kick time, which corresponded to the loss of contact of the kicking foot to the mat until contact with the targe pad.

Only kicks performed with the front leg were considered for the analysis, the parameters were: higher kick frequency (higher frequency of kicks performed

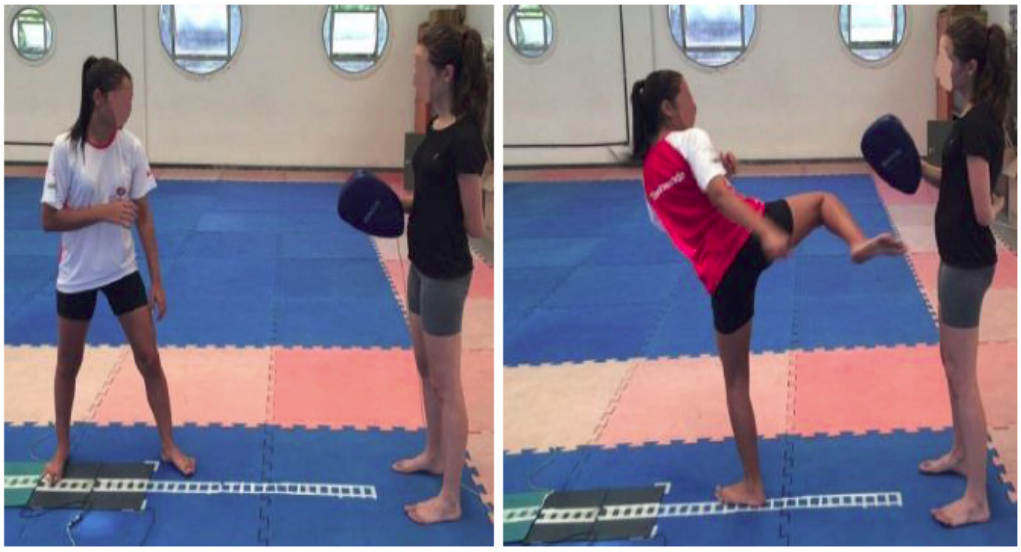

Figure 1. *Banda chagi* kick

during 3 seconds: kicks/s); lower kick frequency (lower frequency of kicks performed during 3 seconds: kicks/s); average kick frequency (average frequency of kicks performed during 30 seconds: kicks/s); fatigue index (percentage reduction of the maximum frequency kick to minimum frequency kick: %); time to higher kick frequency (time from start to the higher frequency of kicks performed during 3 seconds).

Wingate Anaerobic Test (WAnT) Protocol

Before beginning the WAnT for lower limbs, the athletes performed a specific warm up protocol. The Hidrofit Maxx cycle ergometer was utilised. The athletes executed a 2-minute warm up, and the test was executed in 30 seconds with the highest possible frequency of pedalling. In the warm up, the load utilised was 1.5% of the athlete's body mass. After the warm up, a 2-minute recovery interval was performed. After this interval, the athletes executed the WAnT for lower limbs with load fixed in 7.5% of the athlete's body mass for 30 seconds. The athletes were instructed to spin the cycle ergometer at the highest possible speed and a verbal encouragement was given during the 30-second test. The test data were obtained by a computer connected to the cycle ergometer with the MCE 5.1. Software (JBA Zb. Staniak, Poland). After the end of the test, the load was removed, and the volunteers continued to spin the cycle ergometer for 60 seconds more in a moderate rhythm.

Instrumentation

Contact mat fixed to the ground was used. There was one computer connected to mat and contact sensor, containing the Multisprint Full program version 3.5.7 (Hidrofit Ltda. Brazil). The mat used the AAKT was marked with the footage in centimeters between the mat positions and the place where the target pad would be positioned.

An armored inertial sensor was inside to a specific taekwondo target pad (Figure 2). The sensor, in its interior, has a mass in form of coil spring that in the moment of the feet contact with the target pad closed the electric circuit.

Statistical Analysis

Were performed data descriptive analysis and the results are presented in mean and standard deviation. To verify the normality of the data was performed the Shapiro-Wilk Test was realized. The correlation between the results of WAnt and the AAKT was done by the Pearson Correlation Coefficient. The significance level was 0.05. Statistical tests were performed on SPSS statistical package.

Results and Discussion

All the analyzed data showed normal distribution according to Kolmogorov-Smirnov test. The Table 1 presents the mean values, and it respective standards deviations from the values obtained from AAKT and the Table 2 values obtained from WAnt.

Table 1. Mean and standard deviation of the variables from AAKT

Variable	Mean	SD
Higher Kick Frequency (kicks.s^{-1})	2.47	0.25
Lower Kick Frequency (kicks.s^{-1})	1.52	0.24
Average Kick Frequency (kicks.s^{-1})	2.09	0.25

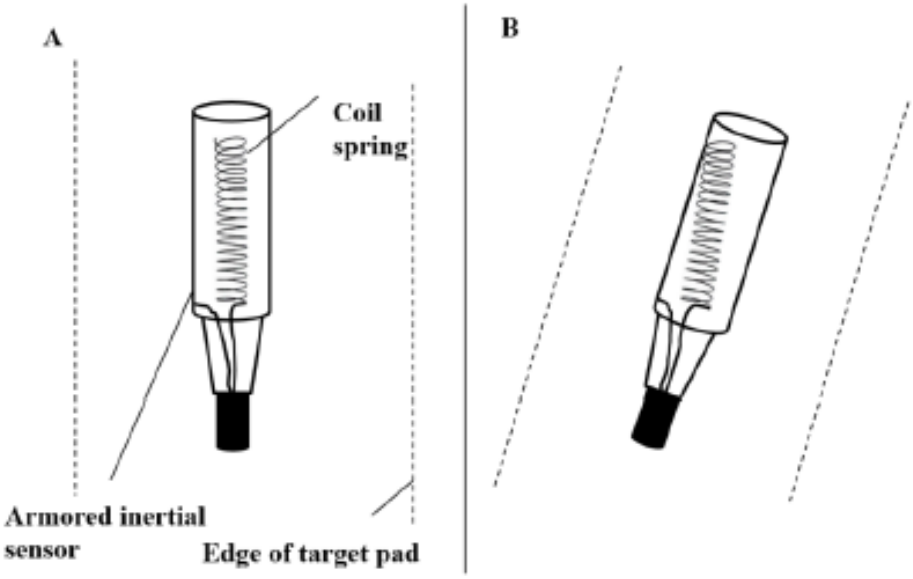

Figura 2: Coupled inertial sensor inside the target pad: (A) – before the kick contact; (B) – after the kick contact (closed eletronic circuit between the coil spring and the

Variable	Mean	SD
Time to Higher Kick Frequency (s)	3.751	0.888
Fatigue Index (%)	37.57	10.49

Table 2. Mean and standard deviation of the variables from Want

Variable	Mean	SD
Absolute Peak Power (W)	649.67	92.35
Relative Peak Power (W/Kg)	10.29	1.28
Time To Peak Power (s)	5.68	1.07
Index Fatigue (%)	37.32	9.30
Average Absolut Power. (W)	546.80	80.14
Relative Average Power (W/Kg)	8.80	0.92

A significant correlation between the results of AAKT and the results of WAnT for lower limbs was found (Table 3). A strong correlation was obtained between the relative peak power and higher frequency (r = 0.851), index fatigue in WAnT and AAKT (r = 0.863) and relative average power and average kick frequency (r = 0.865). A moderate correlation was obtained between the absolute peak power and higher frequency (r = 0.543). The only two low correlations were between the time to peak power and time to higher frequency (r = 0.307) and average absolut power and average frequency (r = 0.412).

The aim of the study was to correlate the results between the WAnT and AAKT. A significant correlation was founded in the comparison between the WAnT and AAKT results. It was founded a strong correlation between three parameters, the relative peak power and higher kick frequency, index fatigue WAnT and index fatigue AAKT, and relative average power and average kick frequency. These results indicate use of a non-specific test not compromised the assessing peak anaerobic power and capacity of taekwondo competitors. Thus, the WAnt is adequate for this purpose.

Table 3. Results on the Pearson's correlation coefficients of the variables of WAnt and Anaerobic Kick Test

Variables	r
Absolute Peak Power X Higher Kick Frequency	0.543
Relative Peak Power X Higher Kick Frequency	0.851
Time To Peak Power X Time To Higher Kick Frequency	0.307
Index Fatigue WAnT X Index Fatigue AAKT	0.863
Average Absolut Power X Average Kick Frequency	0.412
Relative Average Power X Average Kick Frequency	0.865

Szmuchrowski et al. [10] proposed a comparison between the lower and upper limb results between the WAnT and a judo specific test, Special Judo Fitness Test. These authors found no significant correlation between the results of WAnT for upper limbs and the results of WAnT for lower limbs and Special Judo Fitness Test indicators. They concluded WAnT most likely does not have enough specificity to adequately evaluate the anaerobic capacity in judokas. Despite, in the presente study the unique difference between the WAnt and the AAKT was the used exercise. In Szmuchrowski et al. [10] research, were two differences, the used exercise and the intermittent caractheristic of the Special Judo Fitness Test.

More studies are needed to investigate the results from WAnT to the results from anaerobic test that uses not only taekwondo techniques, such as kicks, but also induces changes in the intensity similar to a taekwondo combat. Based on these results, the parameters of the WAnt relativized by body mass demonstrated a high correlation with the results from the WAnt. The possible explanation of these finding is the WAnt was carried out in a cycle ergometer, so the body mass was relativized.

Conclusion

These findings identified the WAnT is appropriate for assessing peak anaerobic power and capacity of taekwondo competitors. As a final point, more studies are needed to compare the results from WAnT to results from anaerobic test that uses taekwondo techniques and induces changes in the intensity similar to a taekwondo combat [10].

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