

KINESIOLOGY & COACHING

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Intra- and Inter-rater Objectivity of the Frequency Speed of Kick Test

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Abstract

Aim. The purpose of this study was to investigate the frequency speed of kick test (FSKT) objectivity intra- and inter-rater.

Material, Methods and Results. Two evaluators determined the performance during FSKT of fourteen taekwondo athletes. Each athlete performed the 10s version of the FSKT (FSKT_{10s}) and five sets of 10s with 10s intervals (FSKT_{mult}). The performance was recorded and analyzed posteriorly. Each evaluator analyzed the performance with one-week rest interval between them. This procedure was used to investigate intra-rater objectivity. The first count conducted by each evaluator was used to determine the inter-rater objectivity. The results obtained for intra- and inter-rater were classified as high (above 0.90) to all variables of the FSKT and low coefficient of variation (0%).

Conclusions. The FSKT presented high intra- and inter-rater objectivity and can be applied by coaches to monitor sport-specific performance.

Introduction

Taekwondo is an Olympic combat sport, characterized by high-intensity actions, followed by low-intensity actions or pauses [Bridge *et al.*, 2014; Santos *et al.*, 2020b]. The actions performed more frequently are kick techniques, with the semicircle kicks (*bandal tchagui*) being the most used one [Pyciarz 2011; Kwok 2012; Samadi, Nazem, Gharaat 2014; Gonzalez-Prado, Iglesias, Anguera 2015; Bridge *et al.* 2018; Suppiah *et al.* 2018]. This technique is executed in both offensive and defensive moments [Kazemi *et al.* 2006; Kazemi, Casella, Perri 2009; Kazemi, Perri, Soave 2010]. During the season, high-level taekwondo athletes compete many times [Bridge *et al.* 2018]. Additionally, during in-season, taekwondo athletes' physical capacity might be assessed many times in order to follow the actual performance [Ball, Nolan, Wheeler 2011].

With the aim of assessing particular taekwondo-related performance many sport-specific tests are being used [Sant'Ana, Silva, Guglielmo 2009; Oliveira *et al.* 2015; Araujo *et al.* 2017; Sant'Ana *et al.* 2017; Sant'Ana *et al.* 2019]. Concerning the evaluation of anaerobic performance, there are three commonly applied tests: the taekwondo anaerobic test (TAT) [Sant'Ana *et al.* 2014], which measures the maximal number of *bandal tchagui* during 30s as a performance criteria, with a focus on the glycolytic system; the second one, the taekwondo anaerobic intermittent kick test (TAIKT) is performed in six 5s high-intensity kicks (*bandal tchagui*) followed by 10s of rest interval between sets [Tayeh *et al.* 2019]; the third one is the Frequency Speed of Kick Test, composed of a single 10s set (FSKT_{10s}) which is used or in the high-intensity intermittent performance when the five-set version (FSKT_{mult}) is applied and prioritizes

[Santos, Valenzuela, Franchini 2015; da Silva Santos *et al.* 2016; Santos, Franchini 2016, Santos, Franchini 2018; Ferreira da Silva Santos, Herrera-Valenzuela, Franchini, 2019; Santos *et al.* 2020a]. Especially the second version seems to be more taekwondo-specific as it uses a similar time-motion as that from the official match and the technique used (*bandal tchagui*).

As the FSKT relies on the number of techniques actually applied, the intra- and inter-rater objectivity are basic key-aspects demanded to ensure that the test can be used by coaches during the season [Atkinson, Nevill 1998; Hopkins 2000; Hopkins, Schabert, Hawley 2001]. Thus, the purpose of this study was to investigate the FSKT_{10s} and FSKT_{mult} intra- and interrater objectivity. Our hypothesis was that FSKT would present intra- and inter-rater objectivity.

Material and Methods

Design and Subjects

After recording the performance of taekwondo athletes during the FSKT_{10s} and FSKT_{mult} executions, two evaluators were asked to count the number of kicks performed to determine the intra- and inter-rater objectivity, as described in Figure 1. The same evaluator registered the performance, observing the video recorded with one week of interval between assessments in order to determine the intra-rater objectivity (Figure 1). To determine the interrater's objectivity, the values registered by two independent evaluators were analyzed (Figure 1).

Two evaluators with experience in the FSKT_{10s} and FSKT_{mult} tests participated in this study. Each evaluator assessed the performance of 14 taekwondo athletes (mean \pm SD, age: 20.6 \pm 4.2 years; height: 180.4 \pm 7.0 cm; body

mass: 70.7 \pm 11.8 kg; practice time: 7.8 \pm 4.7 years) during FSKT_{10s} and FSKT_{mult} performances. The athletes were competing at regional or more prominent level (international: 21%; national: 36%; state: 36%; regional: 7%). The athletes were free from any lower injury and neuromuscular disorder. The research was approved by the Institutional Ethics Committee.

Procedures

Frequency Speed of Kick Test (FSKT_{10s}). The FSKT_{10s} was conducted as previously described [Santos, Valenzuela, Franchini 2015; da Silva Santos *et al.* 2016; Santos, Franchini 2016; Santos, Franchini 2018; Ferreira da Silva Santos, Herrera-Valenzuela, Franchini 2019; Santos *et al.* 2020a]. The FSKT_{10s} lasts for 10s and the athlete must execute as many kicks as possible, alternating right and left legs. In order to accomplish the FSKT, each athlete was placed in front of the stand bag. After a start command, the athlete performed the maximum number of kicks. The volunteers were asked to use the turning kick (*bandal tchagui*) during the test. The total number of kicks determined the FSKT_{10s} performance.

Multiple Frequency Speed of Kick Test (FSKT_{mult}). Each FSKT set was 10s long. Each athlete performed a series of five FSKT_{10s} with 10s of rest interval between sets. The variables used in order to evaluate actual performance were the number of valid kicks in each set, the sum of those kicks during the five sets, and the kicks fatigue index, as previously described (Equation 1 [Girard, Mendez-Villanueva, Bishop 2011]).

$$\text{Kick fatigue index (\%)} = \left[1 - \frac{\text{FSKT1} + \text{FSKT2} + \text{FSKT3} + \text{FSKT4} + \text{FSKT5}}{\text{Best FSKT} \times \text{Number of sets}} \right] \times 100$$

(Equation 1)

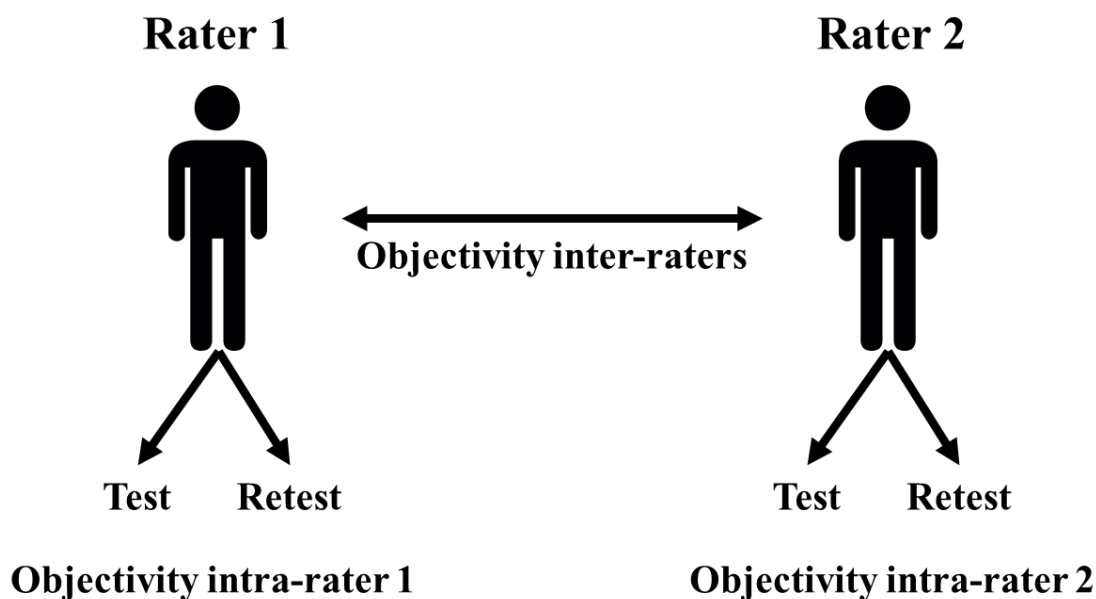


Figure 1. Experimental design.

Instructions Standardization. All instructions given to the athletes were standardized in order to avoid unintended interpretations as described in the literature [Santos, Valenzuela, Franchini 2015; da Silva Santos *et al.* 2016; Santos, Franchini 2016, Santos, Franchini 2018; Ferreira da Silva Santos, Herrera-Valenzuela, Franchini 2019; Santos *et al.* 2020a].

Video analysis. The Kinovea software (Kinovea®, Version 0.8.15) was used to count the kicks applied during FSKT. The count started when the athlete moved the attack feet and finished when he touched the bag. Valid kicks were those that hit the target during 10s. Kicks that started within the 10s period but touched the bag after 10s were not considered.

Statistical analysis

The distribution of each variable was examined using the Kolomogorov-Smirnov test. All variables presented a normal distribution. Data are shown as mean and standard deviation (SD). The Intraclass coefficient correlation (ICC) was used to investigate the objectivity of the FSKT. The present study considered an ICC over 0.90 as high, between 0.80 and 0.90 as moderate and below 0.80 as low [Vincent 2005]. The coefficient of variation (CV %) was calculated for each athlete using the following equation: $CV (\%) = 100 (SD / Mean)$. All analyzes were conducted using $\alpha=5 \%$.

Results

Table 1 contains the results registered by each evaluator and the intra- and inter-rater statistics.

Intra-rater objectivity was consistently high for the first and second evaluation of the FSKT10s (ICC=1.000 and 1.000, respectively), the FSKTtotal (ICC=0.999

and 0.999, respectively), and the kick decrement index (ICC=0.995 and 0.984, respectively). In addition, inter-rater objectivity was consistently high for the first and second evaluation of the FSKT10s (ICC=1.000), the FSKTtotal (ICC=0.998), and the kick decrement index (ICC=0.979).

Discussion

The purpose of the present study was to investigate the intra- and inter-rater objectivity during the execution of FSKT10s and FSKTmult by taekwondo athletes. The main findings of the present study were that the determination of the number of kicks presents high intra- and inter-rater objectivity. This conclusion was based on an ICC over 0.9, which was observed for all variables analyzed during this study. Additionally, there was no CV (%) for intra- and inter-rater determination.

Objectivity is an important and necessary characteristic in a performance evaluation test. The main error sources observed in a test can be associated with the equipment or rater(s). During FSKT10s, both raters presented high ICC, indicating that the FSKT single set is highly reliable, within and between raters. This characteristic is necessary during season because a test is applied during the beginning and repeated many times [Jamshidi, Mirzeai, Damirchi 2014]. Additionally, sometimes the tests are repeated by different raters. The FSKT10s can be measured by different raters, without decreasing results.

The FSKTmult was another taekwondo’s test investigated during the study. The intraclass coefficient of correlations within- and between raters during FSKT performance was high, between 0.9-1.0. The FSKTmult was used in previous studies and was observed to be responsible when applied pre and post nine weeks of training [Santos, Franchini, 2016]. But until the present

Table 1. Number of kicks during the Frequency Speed of Kick Test registered by two evaluators and the intra- and inter-rater objectivity indicators (n: athletes = 14; raters = 2).

Variables	Intra-rater objectivity								Inter-Rater objectivity	
	Evaluation 1				Evaluation 2				ICC	CV%
	Mean±SD 1	Mean±SD 2	ICC	CV%	Mean±SD 1	Mean±SD 2	ICC	CV%		
FSKT _{10s}	21±2	21±2	1.000	0	21±2	21±2	1.000	0	1.000	0
FSKT _{mult}										
FSKT ₁	21±3	21±3	1.000	0	21±3	21±3	1.000	0	1.000	0
FSKT ₂	20±2	20±2	0.993	0	20±2	20±2	0.986	0	0.986	0
FSKT ₃	19±2	19±2	1.000	0	19±2	19±2	0.989	0	0.989	0
FSKT ₄	18±2	18±2	1.000	0	18±2	18±2	1.000	0	1.000	0
FSKT ₅	18±2	18±2	0.988	0	18±2	18±2	0.989	0	0.966	0
FSKT _{total}	97±10	97±10	0.999	0	97±10	97±10	0.999	0	0.998	0
Kick decrement index (%)	8±3	8±3	0.995	0	8±3	8±3	0.984	0	0.979	0

FSKT: Frequency speed of kick test; ICC: Intraclass Coefficient Correlation; CV%: Coefficient of variation.

moment, the FSKT not was investigated as intra- and inter-measurers during FSKT. This is a highly necessary characteristic, mainly because this is the first test, using gesture specific of taekwondo (i.e. *bandal tchagui*) which the reliability is being investigated.

In summary, the high intra- and inter-raters' reliability of the FSKT10s and FSKTmult suggest that they may be useful indicators of taekwondo performance. The fact that this test presented high reliability is a necessary characteristic during a taekwondo season. Coaches and well as strength and conditioning professionals can apply FSKT many times and by different raters and yet the result is reliable, consisting of an invaluable tool for taekwondo competitive training.

Conclusions

The purpose of the present study was to investigate whether FSKT presented good reliability in the intra- and inter-raters. Our findings suggest that FSKT is a reliable tool and can be applied by different measurers during successive applications. Thus, taekwondo athletes and strength and conditioning coaches can apply FSKT to assess the performance of taekwondo athletes, even if it is applied by different evaluators, which can provide reliable information.

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Objektywizm wewnątrz- i między oceniaczami dotyczący testu częstotliwości szybkości kopnięcia

Słowa kluczowe: sport walki, sztuki walki, pomiar oceny, test sportowy

Streszczenie

Cel. Celem tego badania było zbadanie wewnętrznej i zewnętrznej obiektywności dotyczącej częstotliwości testu szybkości kopnięcia (FSKT) przez oceniaczy.

Materiał, metody i wyniki. Dwóch oceniaczy określiło wyniki czternastu zawodników taekwondo podczas FSKT. Każdy sportowiec wykonał wersję 10s FSKT (FSKT10s) i pięć zestawów 10s z interwałami 10s (FSKTmult). Relacja została nagrana i przeanalizowana później. Każdy oceniacz przeanalizował wyniki z tygodniową przerwą między nimi. Ta procedura została wykorzystana do zbadania wewnętrznej obiektywności oceniaczego. Pierwsze liczenie przeprowadzone przez każdego oceniaczego zostało wykorzystane do określenia obiektywności oceniaczy. Wyniki uzyskane dla oceny wewnętrznej i między oceniaczami zostały zaklasyfikowane jako wysokie (powyżej 0,90) dla wszystkich zmiennych FSKT oraz posiadające niski współczynnik zmienności (0%).

Wnioski. FSKT charakteryzował się wysoką obiektywnością wewnątrz- i między oceniaczami i może być stosowany przez trenerów do monitorowania wyników w poszczególnych dyscyplinach sportowych.