Development of new field-based tests of kick and movement speed in youth martial arts

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Summary

Introduction. The aim of the current study was to develop tests of kicking and movement speed specific to the demands of martial arts.

Material and methods. Tests of 3-kick (3-K) and 20-kick (20-K) speed, together with 3-directional jump (3-DJ) performance, were developed using a contact mat and examined for test-retest reliability. Forty youth exponents aged 13.8 ± 1.2 y completed testing.

Results. Absence of systematic bias and reliability CVs for total time of 6.8% for 20-K and 9.0% for 3-DJ suggest these to be reliable measures. The observation of systematic bias and CV of 23.1% for total time in the 3-K test show this to be a less reliable parameter.

Conclusions. The study demonstrates the potential to develop reliable and specific field-based tests for martial arts.

Introduction

Globally participation rates in martial arts come second only to participation rates in soccer [1]. Surprisingly, fitness profiling in martial arts is commonly limited to the testing of general physical abilities of strength, speed, power and endurance [2,3]. Such generic tests are likely to lack ecological validity and fail to adequately examine neural, muscular and physiological demands specific to martial art actions. Consequently, there is a need to develop ecologically valid tests of performance which more closely match the physical demands and movements observed in martial arts [4,5]. Such tests could help in evaluating training as well as aiding with talent identification and development of young exponents. Therefore the purpose of the present study was to develop field-based performance tests specific to the demands of kicking and evading opponents and to determine the reliability of these tests.

Material and methods

Forty participants (27 male, 13 female) with a mean age of 13.8 ± 1.2 y, body mass 46.8 ± 10.9 kg and stature 153.2 ± 7.4 cm completed two test sessions separated by 48 h. Ethical approval was granted by the institutional ethics committee. All participants (at least in first year training in silat) were practicing Silat Olahraga, a popular Asian martial art.

The participants completed three trials of a 3-directional jump test (3-DJ), with the best effort used for analysis. Participants stood on a contact mat (Fusion Sport, Brisbane, Australia) and then performed a series of jumps over lines marked on the floor, 1 m away from the centre of the contact mat; participants jumped forward 1 m, back to the mat, laterally to the left 1 m, back to the mat, laterally right 1 m and then back to the mat. Mean contact and flight time and total time were recorded. This test was designed to reflect the evading and attacking movement patterns observed in martial arts.

In the kick tests three kicks were chosen to reflect the need to explosively repeat kick efforts in competition, while pilot testing revealed the time taken to complete 20 kicks was similar to the average duration of work during competition [4]. Participants stood with their kicking leg on a contact mat and their stance leg in front of the contact mat. A kick pad was held by in front of the participant at chest height, reflecting the target area. Participants self-selected the distance between themselves and the kick pad using practice kicks. Emphasis was placed on speed of movement with only minimal contact with the kick pad required. The time taken from the initiation of the first kick to returning the foot to the floor after the final kick measured total kicking time, while best kick performance was measured as the fastest time between successive contacts with the ground. Participants had three attempts of the 3-K test, with a full recovery between trials and the best effort recorded. Participants had one trial of the 20-K test.
Systematic bias between trials was examined using a paired samples t-test and random variation was assessed by calculating a mean coefficient of variation. Normality of data was confirmed using a Shapiro-Wilk test.

**Results**

Reliability data are presented in Table 1. Results showed significant improvements ($p < 0.05$) in kick times from trial one to two in the 3-K test, whereas other variables showed no systematic bias. Random variation was lower in the kick tests when performance was considered as total time as compared to fastest kick time. Contact times across all kick tests averaged $108 \pm 24$ ms.

**Discussion**

The range in CVs across all 20-K and 3-DJ variables is in line with jump testing in a paediatric population [6]. Given the absence of any systematic bias and CVs below 10%, total time for the 20-K and 3-DJ tests may be considered acceptable. However, reliability of all variables for these two tests may be deemed acceptable in a practical setting and considering that random variation is greater in younger, less mature participants [7]. The presence of systematic bias in the 3-K test suggests greater familiarization is required, which would hopefully also have the advantage of reducing random variation. Viewed within the context of a skill-based test, while large, the random variation of the 3-K test is considerably lower than that associated with some skill based tests used in research [8]. Rather than profiling martial arts with tests such as maximal cycle ergometer [2] and repeated sit-ups [3] the tests introduced in the present study provide a better representation of the neuromuscular and metabolic demands of martial arts.

**Conclusions**

1. The newly developed field-based tests of kicking speed and movement agility provide a reliable method to monitor aspects of performance specific to martial arts in youth populations.

2. The newly developed tests of kicking speed and movement agility can be incorporated into existing performance test batteries to help identify talent, profile fitness and evaluate training in youth martial arts.

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