Validity of Special Judo Fitness Test in Iranian Male Wrestlers

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ABSTRACT. In assessment of high-intensity exercise performance, strong linear relations have been found between laboratory and field measures of anaerobic fitness. The present study aimed to determine the validity of the special judo fitness test among Iranian male wrestlers. Thirty well-trained male wrestlers performed the special judo fitness test (the Ippon seoi nage technique) in 3 series of 15, 30, and 30 s with 10-s rest interval between trials. Also, a 30-s Wingate test on a cycle ergometer was used to measure anaerobic fitness in the laboratory condition. Heart rate (HR) and blood lactate concentration were measured at baseline, immediately after, and 1 min after trials. In addition, the fatigue index was calculated. Data were analyzed using a paired t test and Pearson’s correlation coefficient (p < .05). There was a significant correlation between the results of HR changes and lactate concentration changes between the two tests: r(29) = 0.88, p < .01, and r(29) = 0.89, p ≤ .01, respectively. The Bland-Altman and the intraclass correlation coefficient methods revealed medium agreement between test and retest of the special judo fitness test on test index (ICC = 0.4399; ± 1.96, 95% CI [−1.82, 2.76]). The special judo fitness test is a valid field test to assess anaerobic fitness of male wrestlers. The test can be used as a field test to evaluate anaerobic fitness in wrestling.

Keywords: anaerobic fitness, wrestling, test

Over the past two decades, athletes have become more powerful, and athletic performances have continued to improve in conjunction with improvements in exercise training prescription. This has resulted in an increased interest in the measurement of anaerobic fitness. Accurate anaerobic fitness assessment is paramount for athletes, given that many sports involve rapid rest to high-intensity exercise transitions such as sprinting and jumping movements. Wrestling, as a combative sport, place unique metabolic stresses on the body (Kraemer et al., 2004; Nemet et al., 2004). For example, the blood lactic acid concentrations in response to a wrestling match can be more than 19 mmol·L\(^{-1}\) (Kraemer et al., 2001). Therefore, the sport of wrestling is one of the most demanding sports from a metabolic perspective, and it is a sport where the requirement of absolute strength and power is critical (Kraemer, 2002; Uutter et al., 2002).

The sudden release of large amounts of energy to produce such high-intensity performances can be provided in the main by the nonmitochondrial energy pathways involving adenosine triphosphate-phosphocreatine (ATP–PCr) degradation and glycolysis (Brooks, Fahey, White, & Baldwin, 2000). Identifying critical components of athletic performance and the ability to track and monitor improvements is a goal and priority for those involved with sports and athletics on the amateur and professional levels. Such components can be considered physiological and psychological in nature. A physiological measure that incorporates neuromuscular and metabolic components is required to determine anaerobic fitness, an integral contributor to athletic performance (Bompa, 1993).

Anaerobic power involves the exertion of force at a given distance in shortest time as possible (Baker & Davies, 2002). The ability of the body’s musculature to generate significant amounts of power is considered to be a strong predictor of athletic success (Babij, Matthews, & Rennie, 1983). At present, anaerobic fitness tests are implemented in clinical and field settings and assess an athlete’s capability to produce power and speed in a short period of time or over a relatively short distance. Determining an individual’s maximal oxygen uptake (VO\(_2\) peak) has long been acknowledged as a valid and reliable test for determining aerobic
power (Frose, & Houston, 1987). Recently, as a clinical measure, the Wingate anaerobic power test on a cycle ergometer has been considered the most valid and reliable test in assessing peak power and anaerobic capacity (Beneke et al., 2002; Inbar et al., 1996). The most common field tests used to evaluate anaerobic fitness and performance in athletes are the vertical jump test and the 40-yard dash (Iakiapeivska, 2000). In some sports, special fitness test have been used to evaluate athletic performance. For example, in the sport of judo, the special judo fitness test (SJFT) is commonly used to evaluate judo-specific performance. There are some similarities between wrestling and judo; judo is a dynamic, high-intensity intermittent combat sport that requires complex skills and tactical excellence for success (Degoutte et al., 2003; Franchini et al., 2008; Franchini et al., 2009). In addition, because judo is a sport where training should be directed to different physical abilities (e.g., power, strength, endurance) to allow the athlete to perform his or her technical and tactical actions with better quality, physical conditioning plays an important role in the training and competitive processes. In this way, it is important to have specific tests to evaluate athletes’ physical fitness to improve their training routine and contribute to a higher level of performance in competitions (Harrison et al., 2006). Franchini and colleagues (2011) showed that when using the SJFT, coaches are evaluating mainly their athletes’ anaerobic alactic system, which can be considered to be the most predominant system contributing to the actions (techniques) performed in the match.

The most valid measures of performance use sport specific skill components that are closely related to the sport itself. Functional movements that are used and are considered an integral part of a given sport should be addressed when deciding on an appropriate test. Sport-specific functional movements that may require short bursts of speed and change of direction should be incorporated into methods that measure anaerobic fitness. The ability to produce high rates of power output is essential for performance in many sports (Baltzopoulos, Eston, & McLaren, 1988). Freestyle wrestling is one of the main styles of amateur competitive wrestling. Freestyle wrestling is practiced in two 3-min periods with a 30-s rest between rounds in current international competition. A wrestler wins the match when he or she has more points at the end of the match. A wrestling match requires tremendous physical activity, power, and strength of body musculature as well as isometric force for various wrestling techniques (Scott et al., 1991). Power in wrestlers is related to quick and explosive effort that leads to wrestling success. Anaerobic fitness is important in wrestling because of the need of short-duration and high-intensity performance. The Wingate test can be used to reflect the maximum ability of wrestlers to generate power (Lansky & Mike, 1999). So, our hypothesis is that the SJFT is predominantly anaerobic and is a valid test to evaluate anaerobic fitness of wrestlers.

**Method**

**Participants**

Thirty well-trained male wrestlers (age = 24.9 ± 3.4 years, weight = 77.7 ± 19.7 kg, body fat = 13.2% ± 2.3%) volunteered to participate in this study. All wrestlers had at least 6 years of training experience. All participants were well-trained wrestlers who were fully trained as if preparing for a competition season. The wrestling ethics committee approved ethical procedures. After being fully informed of the nature of the testing and experimental procedures, each participant read and signed an informed consent form. Body composition and physiological characteristics of the subjects were measured before the testing.

**Procedures**

Testing was completed over a 4-week period. Week 1 consisted of cycle ergometer and field test familiarization periods. These were performed at the same relative time interval as the experimental protocols themselves. Anthropometric data were also collected and recorded during this period. Individual subject body mass, stature, and body composition was determined using a calibrated Body Composition Analyzer (Inbody 3.0, Seoul, Korea).

Cycle ergometry testing and field measures (test and retest) were commenced in week 2 and continued in weeks 3 and 4, respectively. All participants returned to perform the remaining test with 1 week intervening between experimental conditions and were instructed to avoid heavy exercise during the 24 hr preceding the tests. In both tests, changes of blood lactate and HR were measured. Experienced medical technicians collected blood samples at two intervals: before the first round (5 min after warm-up) and 3 min after two tests. Samples were collected each time from a different finger (Iakiapeivska, 2000). Lactate concentrations were determined using Accurate Lactate Analyzer (Lactate Scout, Sailauf, Germany). HR was measured immediately and 1 min after the cessation of the test by Sport-tester device (Polar F4 Electro, Kempele, Finland).

**WAnT**

The WAnT consists of 30-s, all-out supramaximal cycling against a high-resistance set relative to the subject’s body mass. The test–retest reliability of mean power output (MP) in the WAnT has been evaluated extensively and has been found to be very reliable (test–retest reliability of MP 0.90 to 0.97 in children, young adults, elderly adults, healthy and disabled individuals, athletes, and nonathletes; Bar-Or, 1987). Weinstein and colleagues (1998) showed that peak lactate concentration [La], peak HR, and plasma volume changes (ΔPV) after the WAnT are reliable measures.
A 30-s Wingate test on a Monark 864E (Monark Exercise, Vansbro, Sweden) was used to measure anaerobic power in the laboratory condition. Load was set at 7.4 N·kg$^{-1}$ of body mass. Saddle heights were adjusted to accommodate partial knee flexion of between 170° to 175° (with 180° denoting a straight leg position) during the down stroke. Feet were firmly supported by toe clips and straps. All participants were instructed to remain seated during the test and were verbally encouraged to perform maximally. All subjects performed a standardized 5-min warm-up before experimental data collection (Baker & Davies, 2002). Subjects were given a rolling start at 60 (rpm) for a 5-s period before resistive force application. On the command "go", participants pedaled maximally, the resistive force applied simultaneously, and data capture initiated. Indices of performance were calculated from flywheel revolutions using an inertia corrected computer program (Baltzopoulos et al., 1988; Iakiapievsk, 2000). Peak power output, mean power output, end power output and fatigue index [FI = (peak power – minimum power) /peak power] protocol were stored on computer for future analysis.

SJFT

SJFT was applied as described elsewhere (Franchini et al., 1998; Sterkowicz, 1995). The test is performed in three series of 15, 30, and 30 s, with 10-s rest interval between them. During these series, the athlete throws two other wrestlers (6 m apart from each other) as many times as possible using the Ippon-seoi-nage technique that is similar to the buttocks technique in wrestling (see Figure 1). The test index was calculated using the following equation. A lower index indicates a better performance (Sterkowicz, 1995).

\[
\text{Index} = \frac{\text{HR}_{\text{after}} + \text{HR}_{\text{1 min}}}{\text{total number of throws}}
\]

Statistical Analysis

Means and standard deviations were used to describe quantitative variables. Data were analyzed by the two statistical models. Graphical Bland-Altman and the intraclass correlation coefficient (ICC) methods were used to assessment of the possible agreement between test and retest of SJFT on the test index, and Pearson’s correlation coefficient (r) was used to examine the relations of the WAnT and SJFT variables. Also, paired-samples t test was used to compare the variables in the two testing protocols. The level of significance was set at $p < .05$.

RESULTS

Table 1 shows descriptive statistics of SJFT and WAnT; Also, ICCs for test–retest reliability of SJFT series are presented in this table. Table 2 shows indices, HR (immediately after and 1 min after), and lactate concentration (before and 3 min after) for SJFT and WAnT. According to the SJFT classificatory table presented by Franchini and colleagues (2009), participants in this study were classified as “good” with average total throws equal 27.

As shown in Table 2, there are significant relations between SJFT and WAnT indices ($r[29] = 0.93, p < .001$), HR immediately after two tests ($r[29] = 0.92, p < .001$), HR 1 min after tests ($r[29] = 0.91, p < .001$), lactate concentration before tests ($r[29] = 0.96, p < .001$), and lactate concentration 3 min after tests ($r[29] = 0.89, p < .001$).

Also, results showed good test–retest reliability for SJFT index (ICC = 0.867, effect size = 0.33), HR immediately after SJFT (ICC = 0.751), HR 1 min after SJFT (ICC = 0.869), lactate concentration 3 min after SJFT (ICC = 0.897).

TABLE 1 Descriptive Statistics of SJFT and WAnT and Test–Retest Reliabilities ($n = 30$)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Test</th>
<th>Retest</th>
<th>ICC</th>
</tr>
</thead>
<tbody>
<tr>
<td>SJFT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Series A (n)</td>
<td>6 ± 1</td>
<td>7 ± 1</td>
<td>0.887</td>
</tr>
<tr>
<td>Series B (n)</td>
<td>11 ± 2</td>
<td>11 ± 1</td>
<td>0.856</td>
</tr>
<tr>
<td>Series C (n)</td>
<td>10 ± 2</td>
<td>11 ± 1</td>
<td>0.869</td>
</tr>
<tr>
<td>Total Throws (n)</td>
<td>27 ± 3</td>
<td>29 ± 2</td>
<td>0.870</td>
</tr>
<tr>
<td>WAnT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak power (W)</td>
<td>807.30 ± 197.17</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Mean power (W)</td>
<td>459.43 ± 118.41</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Minimum power (W)</td>
<td>254.33 ± 65.83</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

FIGURE 1 Representation of positions in special judo fitness test.
0.894). The Bland-Altman and the ICC methods revealed medium agreement between the test and retest of the SJFT on test index (ICC = 0.4399; ± 1.96, 95% CI [−1.82, 2.76]).

DISCUSSION/CONCLUSION

Franchini and colleagues (2009) presented classificatory norms for total number of throws, HR (immediately after and 1 min after) and index in the SJFT. According to this classification, the subjects in the present study were classified as “good” (Franchini et al., 2009). The classificatory table can help coaches using the SJFT to classify their athletes’ level and to monitor their physical fitness progress.

According to the results of the present study, SJFT as an anaerobic test may be useable instead of WAnT to evaluate anaerobic fitness in wrestling. Some previous studies on the SJFT reported that number of throws in series A, B, and C were correlated positively with performance in upper body (Franchini et al., 1999) and lower body (Sterkowicz, Zuchowicz, & Kubica, 1999). For example, Sterkowicz and colleagues (1999) concluded that the SJFT was an appropriate testing procedure in the assessment and evaluation of specific judo abilities, given that laboratory testing mainly does not assess parameters needed by judo coaches and competitors. Franchini and colleagues (2005) studied relations between the Wingate test, the SJFT, and simulated combat. Blood lactate after the SJFT correlated with blood lactate after combat, indicating similarity of metabolic demands in these events. In addition, this study demonstrated that morphological, physiological, and technical actions during combat were correlated with each other’s.

The time structure of the SJFT is intermittent in nature with very short intervals (10 s), which can accentuate the metabolites accumulation (lactate for example) and low phosphocreatine resynthesis. These factors (lower glycolytic flux and creatine phosphate [CP] system impairment) would anticipate the requirements of aerobic metabolism and the consequent decrease in performance in the last series, contributing to the fatigue index observed in the subsequent series. Also, Franchini and colleagues (2011) showed that the higher alactic contribution seems to be a consequence of the high-intensity efforts performed during the test, and its intermittent nature. Thus, when using the SJFT, coaches are evaluating mainly their athletes’ anaerobic alactic system, which can be considered to be the most predominant system contributing to the actions (techniques) performed in the match.

The effort-pause ratio during judo combats is between 2:1 and 3:1, with 20-s and 30-s effort periods and 10-s of pause. Thus, judo combats rely on all three metabolisms, with the anaerobic alactic system being responsible by the short duration powerful actions during technique applications, the anaerobic lactic system being responsible for the maintenance of high-intensity actions during longer periods (e.g., grip dispute), while the aerobic system is responsible for the recovery processes between high-intensity actions and matches (Franchini et al., 2013). Nilsson and colleagues (2002) reported that in wrestling, the mean periods of work and rest were 37.2 s and 13.8 s, respectively. On the other hand, the effort-pause ratio during wrestling combats is almost 3:1 (Nilsson et al., 2002).

In conclusion, other factors that can explain the capability of the SJFT to correctly discriminate the level of the wrestlers anaerobic fitness are (a) the time structure of the SJFT are based on real combat time structure, which has effort’s duration of about 30 s and interval of about 10 s as expressed in other studies (Castarlenas & Planas, 1997; Monteiro, 1995; Sikorski, Michalak, & Bobrowska, 1987), resulting in similar physiological requirement in both the SJFT and WAnT; (b) blood lactate concentration after the SJFT was very similar to that found after WAnT as presented in the previous researches (Franchini et al., 1998), indicating that the anaerobic glycolysis requirement was similar in both activities; and (c) HR did not differ between the two tests, suggesting a similar cardiovascular stress during both tests.

Practical Applications

There are a variety of methods to measure anaerobic fitness of athletes, including tests that can be applied in the field or in the laboratory. Much of the recent research with regard to anaerobic fitness of athletes has been undertaken using laboratory testing to measure anaerobic power and capacity. Field tests are an alternative method to measure the fitness of

<table>
<thead>
<tr>
<th>Variable</th>
<th>SJFT (test)</th>
<th>SJFT (retest)</th>
<th>ICC and limits of agreement</th>
<th>WAnT</th>
<th>r</th>
<th>ICC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Index (%)</td>
<td>12.63 ± 1.55</td>
<td>12.06 ± 0.69</td>
<td>(0.439;−1.82 to 2.76)</td>
<td>67.96 ± 1.88</td>
<td>0.93</td>
<td>0.867</td>
</tr>
<tr>
<td>HR 1min after (beat.min⁻¹)</td>
<td>177 ± 15</td>
<td>178 ± 4</td>
<td>—</td>
<td>180 ± 17</td>
<td>0.92</td>
<td>0.751</td>
</tr>
<tr>
<td>Lactate Before (mmol.L⁻¹)</td>
<td>2.65 ± 0.54</td>
<td>2.82 ± 0.51</td>
<td>—</td>
<td>2.58 ± 0.55</td>
<td>0.96</td>
<td>0.952</td>
</tr>
<tr>
<td>Lactate 3min after (mmol.L⁻¹)</td>
<td>12.50 ± 1.45</td>
<td>11.36 ± 1.03</td>
<td>—</td>
<td>12.77 ± 2.05</td>
<td>0.89</td>
<td>0.894</td>
</tr>
</tbody>
</table>

Note. All relations are significant at p < .001.
athletes without the expense, time and expertise required for the laboratory testing, especially in developing countries. SJFT as a valid and reliable field test to evaluate anaerobic fitness in judo may be usable to evaluate anaerobic fitness in wrestling.

REFERENCES


