

The Relationship between the Special Judo Fitness Test and Aerobic Fitness in a Sample of Saudi Judo Athletes

Mohammad Ali Alahmadi*

Doctoralahmadi@gmail.com

Abstract

This study aimed to identify the relationship between the special judo fitness test (SJFT) and aerobic fitness in a sample of Saudi judo athletes. Fourteen judo athletes (mean \pm SD, age, 17.1 ± 4.1 years; body mass, 66.7 ± 21 kg; height, 160.2 ± 13.6 cm) undertook the SJFT and a maximal multistage 20-m shuttle run test to estimate maximal oxygen consumption (VO_{2max}). The mean (\pm SD) of the index of the SJFT and VO_{2max} were 16.2 ± 1.6 and 46.2 ± 5.2 ($ml/kg/min^{-1}$), respectively. The SJFT index was in an inverse direct relationship with VO_{2max} ($r = -0.71$, $p0.02$). We conclude that aerobic fitness is associated with judo performance. Our findings corroborate those of other studies on elite judo athletes, who are required to maintain high aerobic fitness levels.

Keywords: Aerobic Fitness, Judo Fitness Test.

* Department of Physical Education and Sport Sciences Taibah University.

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العلاقة بين اختبار لياقة الجودو الخاص واللياقة الهوائية لدى بعض لاعبي الجودو السعوديين

محمد علي الأحمدي*

ملخص

هدفت هذه الدراسة إلى التعرف إلى العلاقة بين اختبار لياقة الجودو الخاص (Special judo fitness test) واللياقة الهوائية لدى بعض رياضيي الجودو السعوديين. شارك في الدراسة 14 من لاعبي الجودو (متوسط \pm الانحراف المعياري، العمر: 17.1 ± 4.1 سنة؛ الوزن: 66.7 ± 21 كجم؛ الطول: 160.2 ± 13.6 سم)، وقد أجري لهم اختبار لياقة الجودو الخاص، واختبار متعدد المراحل (Shuttle run test) لتقدير الاستهلاك الأقصى للأكسجين (VO_2max). أظهرت نتائج الدراسة أن متوسط \pm انحراف معياري لمؤشر اختبار لياقة الجودو الخاص 16.2 ± 1.6 ، والاستهلاك الأقصى للأكسجين 46.2 ± 5.2 (مل/كجم/دقيقة)، على التوالي. كما أظهرت النتائج أن مؤشر اختبار لياقة الجودو الخاص ارتبط ارتباطاً عكسياً مع الاستهلاك الأقصى للأكسجين ($r=0.71$ مستوى الدلالة 0.02). يمكن الاستنتاج من هذه الدراسة أن هناك علاقة ارتباطية بين اللياقة الهوائية واختبار لياقة الجودو الخاص. وبذلك تتفق النتائج التي توصلنا إليها مع الدراسات الأخرى التي أجريت على لاعبي الجودو، والمطالبين بالحفاظ على مستوى عالي من اللياقة الهوائية.

الكلمات الدالة: اللياقة الهوائية، اختبار لياقة الجودو.

* كلية الآداب، قسم اللغة الإنجليزية والترجمة، جامعة الزرقاء .

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Introduction:

The special judo fitness test (SJFT) is the most widely used test to evaluate judo athletes, in which physical fitness is related to SJFT performance (Lopes-Silva et al. 2018). As the main variable in judo performance, the SJFT is essential in evaluating physical characteristics among judo athletes. This is particularly the case during training programs as the test provides information regarding both the physiological variables that judo athletes should improve and the effectiveness of a given training program. SJFT scores allow coaches to classify their athletes according to classificatory levels developed for both male and female judo athletes (Franchini et al., 2011b; Franchini et al., 2009b; Franchini, Takito and Bertuzzi 2005; Sterkowicz-Przybycień and Fukuda 2014). To achieve a high rank in martialarts, the athlete must attain excellent physical fitness levels, and high-ranked judo athletes typically have excellent SJFT index levels. A lower index score indicates a higher physical fitness level (Franchini et al., 2017).

In addition to SJFT as a key component of the evaluation of judo athletes' physical characteristics, aerobic fitness may have a positive influence on judo-related performance, particularly when judo athletes attempt to maintain high attack rates during a match (Almansba et al. 2010; Azevedo et al., 2007; Franchini et al. 2007; Lech et al. 2010). In addition, maximal oxygen uptake (VO_2max) has been used as a measure of aerobic capacity in judo athletes (Torres-Luque et al., 2016). Aerobic capacity is related to reduced blood lactate accumulation after combat (Franchini et al. 2004). Research has demonstrated faster lactate removal after matches in judo athletes who used active recovery (Franchini et al. 2009a). Moreover, aerobic fitness appears to be among the determination variables that maintain intensity when judo athletes are required to engage in several high-intensity bouts with only short recovery periods between each. For example, a study found that judo players exhibiting higher levels of aerobic fitness showed better performance in high-intensity intermittent activities (Franchini et al., 2007).

Research suggests that aerobic capacity represented by VO_2max may be associated with intermittent high-intensity effort, such as during SJFT. A significant positive correlation between the number of throws during SJFT and estimated VO_2max has been identified (Detanico et al. 2012; Franchini et al. 2007; Garbouj et al. 2016; Sterkowicz 1999; Wolska-Paczoska, Smulskij and Jagiello 2009). The positive influence of higher VO_2max on high-intensity intermittent exercise performance has already been confirmed

in judo athletes to some extent by the correlation between $VO_2\text{max}$ as an indicator of aerobic fitness and the SJFT index. Earlier studies have shown that the SJFT index is related to estimated $VO_2\text{max}$ (Franchini et al. 2007; Hesari et al. 2013). However, although elite athletes' physical and physiological characteristics are well established worldwide, no study to date has studied aerobic fitness levels in relation to SJFT performance among Saudi judo athletes. This study fills this gap and evaluates this relationship to provide useful information regarding the physical fitness that judo athletes require to enhance their performances. To the best of our knowledge, the relationship between aerobic fitness variables and judo-related performance—namely, the SJFT—has not been determined in Saudi elite judo athletes. Therefore, this study aimed to determine the relationship between aerobic fitness and SJFT in a sample of Saudi elite judo athletes.

Methods:

1- Participants and study procedure:

Fourteen Saudi male judo athletes (mean \pm SD, age, 17.1 ± 4.1 years; body mass, 66.7 ± 21 kg; height, 160.2 ± 13.6 cm) participated in this study. The study protocol and procedures were approved by the local ethics committee in our department according to international ethical guidelines. All participants signed an informed consent form. Saudi Judo athletes were included if they answered “No” to all the questions in the Physical Activity Readiness Questionnaire. Saudi Judo athletes suffering from any musculoskeletal disorder and those with a history of cardiovascular disease or other serious health concerns were not included.

2- Measurements:

2.1 Anthropometry:

Body weight was measured to the nearest 100 g using a portable digital scale (Seca, Germany), and height was measured to the nearest 0.1 cm using a portable stadiometer (Seca, Germany).

2.2 The special judo fitness test:

The SJFT has been thoroughly described by Franchini et al. (1998) and Artioli et al. (2005). Three athletes in the same weight class and of similar

height are required to perform the SJFT, which comprises three periods (A—15 s; B and C—30 s) separated by 10-second recovery intervals. The athlete begins the test positioned between two partners who are standing 3 m apart. During each period, the athlete being evaluated throws the other two participants as many times as possible using the ippon-seoi-nage technique within the tested time. The test subject's heart rate is measured immediately after the test has concluded and again one minute later. In this study, a heart rate monitor (Polar RS400) was used for this purpose. The SJFT index was then calculated as follows:

$$\text{Index} = (\text{Heart rate after} + \text{Heart rate 1 min after}) / \text{total number of throws.}$$

2.3 Twenty-meter shuttle run test:

Each judo athlete performed the 'shuttle run test', in accordance with the method proposed by Leger et al. (1982). The shuttle run test consists of 20-m sprints with participants required to increase speed during each run. Audible signals indicated when the athletes should change the pace. Participants had to run back and forth on a 20-m course in the gymnasium and touch the 20 m line. The test began with a speed of 8.5 km/h that was increased by 0.5 km/h at each one-minute interval. The participants were verbally encouraged throughout the test, and they continued until they could not reach the line three times consecutively after the signal had sounded. VO_2max was estimated based on the speed that the judo athlete achieved in their last period before fatigue using the following equation (Leger and Lambert 1982):

$$\text{VO}_2\text{max} = 5.857 \times \text{speed (km/h)} - 19.458.$$

3- Statistical Analysis:

Data were analyzed using the statistical software package SPSS, version 21. Descriptive statistics were presented as mean values and standard deviation (SD). The Pearson product-moment correlation coefficient was used to determine the relationship between the SJFT, the number of throws, and VO_2max . Statistical significance was set at $p < 0.05$.

Results:

The descriptive data of the participants' anthropometric measurements are presented in Table 1. The mean (\pm SD) of the SJFT index was 16.2 ± 1.6 . Physiological variables are shown in Table 2. The mean (\pm SD) of the index of the SJFT and VO_2 max were 16.2 ± 1.6 and 46.2 ± 5.2 ($ml/kg/min^{-1}$), respectively. The SJFT index showed an inverse relationship with VO_2 max ($r = -0.71$, $p < 0.02$) (Table 3). The results also showed that the number of throws achieved during the SJFT test was positively correlated with estimated VO_2 max ($r = 0.56$, $p = 0.09$). However, this positive coefficient did not reach significance at the 0.05 level.

Table(1) Anthropometric measurements of Saudi judo athletes (N= 14)

Variables	Mean (\pm SD)
Age (years)	17.1 ± 4.1
Body mass (kg)	66.7 ± 21
Height (cm)	160.2 ± 13.6

Table (2) Physiological variables of Saudi judo athletes

Variables	Mean (\pm SD)
Number of throws	21.5 ± 2.1
Heart rate after the test (beats/min)	186 ± 12
Heart rate 1 min after the test (beats/min)	161 ± 17
SJFT index	16.2 ± 1.6
VO_2 max ($ml/kg/min^{-1}$)	46.2 ± 5.2

\pm SD: standard deviations; SJFT: special judo fitness test; VO_2 max: maximal oxygen consumption; kg: kilogram; cm: centimeter;

Table(3) Pearson product correlation coefficients

	SJFT index	Number of throws
VO ₂ max (ml/kg/min ⁻¹)	r = -0.71 (p 0.02)	r = 0.56 (p 0.09)

Discussion:

To the best of our knowledge, this is the first study to correlate SJFT with aerobic fitness in judo athletes in Saudi Arabia. Our study's main finding is that a significant negative correlation exists between the SJFT index and VO₂max ($r = -0.71$, $p 0.02$). The positive influence of a higher VO₂max measurement on high-intensity intermittent exercise performance has already been confirmed by the correlation between VO₂max as an indicator of aerobic fitness and SJFT index scores in judo athletes. Our findings are similar to those of earlier studies that demonstrated a negative correlation between the SJFT index and estimated VO₂max in elite judo athletes (Franchini et al. 2007; Hesari et al. 2013). Franchini et al. (2007) conducted a study among 22 male members of the Brazilian judo team and reported a significant correlation between SJFT scores (average: 12.02) and maximal aerobic power (VO₂max = 48.9 ml/kg/min⁻¹) estimated using the Cooper test ($r = -0.52$, $p 0.05$). Hesari et al. (2013) also conducted a study among 19 elite judo athletes (aged 24.3 ± 3.1 years) and found that the SJFT index was in an inverse relationship with VO₂max (54.4 ml/kg/min⁻¹), estimated using a graded exercise test (Bruce protocol test) on a treadmill ($r = -0.87$, $p 0.01$). In the current study, although a positive correlation was found between estimated VO₂max and number of throws in the SJFT index ($r = 0.56$, $p 0.09$), this correlation was not statistically significant. Previous studies found a significant positive correlation between the number of throws in the SJFT and estimated VO₂max in female (Detanico et al. 2012; Wolska-Paczoska, Smulskij and Jagiello 2009) and male judo athletes (Franchini et al. 2007; Garbouj et al. 2016; Sterkowicz 1999).

Cardio-vascular fitness is believed to have a significant effect on judo-related performance, particularly when athletes are required to maintain high attack rates during a match (Almansba et al. 2010; Azevedo et al. 2007; Franchini et al. 2007; Lech et al. 2010). Earlier studies have shown that aerobic capacity is related to lower blood lactate accumulation after combat (Franchini et al. 2004) and that lactate is removed faster after a match in

judo athletes who use active recovery (Franchini et al. 2009a). Aerobic fitness also appears to be among the determination variables in maintaining intensity when judo athletes must perform several high-intensity bouts with only short recovery periods in between. For example, an earlier study found that judo players exhibiting higher aerobic fitness levels also performed better in high-intensity intermittent activities (Franchini et al. 2007). High levels of aerobic fitness ($VO_2\text{max}$) have been shown to positively impact high-intensity intermittent exercise performance (SJFT), as confirmed by the correlation between $VO_2\text{max}$ and SJFT in judo athletes. This relationship suggests that the aerobic energy system may play an important role in delaying fatigue during SJFT. This role may act both centrally, at the cardiac level ($VO_2\text{max}$), and peripherally, at the muscular level (anaerobic threshold, Onset of blood lactate accumulation) (Garbouj et al. 2016). Moreover, $VO_2\text{max}$ appears to be associated both with increased aerobic contribution to sprint recovery bouts and enhanced ability to resist fatigue during intense intermittent exercising (Tomlin and Wenger 2002). Physiological reasons may explain why a high level of aerobic fitness is important for judo performance. The first reason may be related to athletes' ability to delay the combination of increased hydrogen (H^+) and increased inorganic phosphate (Pi) during combat (Bonitch-Domínguez et al. 2010). The second reason may be related to their ability to recover more quickly between consecutive judo matches (Feriche et al. 2007).

The present study demonstrated that the mean (\pm SD) SJFT index for the Saudi judo athletes was 16.2 ± 1.6 . When we compared this SJFT value to those of international elite judo athletes, our determined SJFT index value was higher (SJFT = 12.7–13.2) (Casals et al. 2017). Our participants' lower SJFT performance in comparison with that of international elite judo athletes is likely related to the participants' lower aerobic power capacity. Most judo athletes have $VO_2\text{max}$ values of between 44 and 65 (ml/kg/min^{-1}), regardless of the protocols and exercise modes (Franchini et al. 2011a; Franchini et al. 2007; Nikolova, Dimitrova and Mladenov 2020; Torres-Luque et al. 2016). $VO_2\text{max}$ ($46.2 \text{ ml/kg/min}^{-1}$) measurements in our study were similar to those of international judo athletes, which does not explain why the SJFT index scores in the present study were poor. Although a negative correlation was found between the SJFT index and $VO_2\text{max}$ in this study, Saudi judo athletes demonstrated poor performance expressed by the SJFT index but similar $VO_2\text{max}$ compared with international judo athletes in different countries. The poor SJFT index and higher aerobic fitness levels of our judo athletes may suggest that judo, as a combat sport, is

an aerobic rather than aerobic in nature rather than aerobic. A recent study has reported that high-level judo athletes exhibit upper-body peak power during the Wingate test. The study created a suggested normative classificatory table to be used as a reference for evaluating judo athletes' an aerobic capabilities (Franchini 2019).

Our findings indicated that the SJFT index showed an inverse relationship with aerobic fitness as measured by estimated VO_{2max} . The moderate to high correlation between the SJFT and VO_{2max} may confirm previously reported findings that judo athletes with higher aerobic capacity exhibit better performance in high-intensity intermittent bouts. Moreover, our findings corroborate those of other studies on elite judo athletes who are required to maintain high levels of aerobic fitness. It is recommended that future studies investigate the relationship between an aerobic fitness (such as the Wingate test) and SJFT. This relationship may partially explain the poor SJFT index observed in the present study.

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