

KINESIOLOGY & COACHING

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Is the Special Judo Fitness Test Index discriminative during formative stages? Age and competitive level differences in U13 and U15 children

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Abstract

Aim. The aim of the present study was to perform SJFT in children to analyse differences between groups of age and competition level. **Methods.** Thirty-four male children *judo* athletes aged under 13 (U13) and under 15 (U15) years-old were recruited from a local gym (amateurs) and the Spanish National Judo Team (SNT) and classified in three groups: U13 amateur, U15 amateur and U15 SNT. Children performed the SJFT in similar height and weight pairs. Age comparisons revealed no difference in SJFT index given the lower number of throws during the SJFT for U13 children (95% CI_{high} = <23 vs. >22 and >23 throws) but the faster heart rate (HR) recovery (95% CI_{high} = < 150 vs. >150 and >147 bpm) compared to the U15 amateur and SNT groups.

Results. Competitive level comparisons between U15 amateur and SNT revealed no difference in SJFT performance (throws, HR and index). Thus, the SJFT index is not a proper variable to detect differences between groups at these ages.

Conclusions. These findings open the challenge to design appropriate conditioning test for children to better measure performance and develop adequate training and teaching plans during formative years. These findings open the challenge to design appropriate conditioning test for children during formative years to better measure performance and develop adequate training and teaching plans.

Introduction

In the last 20 years, judo coaches and researchers have widely used the Special Judo Fitness Test (SJFT), considered one of the basic instruments in monitoring the training progress of highly qualified competitors [Sterkowicz 1995; Sterkowicz, Franchini 2001]. Its resulting index – formula based on total of throws (TT) and heart rate (HR) – seems to be reliable and consistent tool for physical condition assessment in junior and senior athletes from different competitive levels [Sterkowicz-Przybycien *et al.*, 2017].

Few studies have used this test in cadet athletes [Agostinho *et al.* 2015, 2018]. In the first study, Agostinho *et al.* [2015] used the SJFT as one of the tests that

composed a physical test battery during a 2-year training period, and demonstrated that training load (determined either as session-rating of perceived exertion or as rating of perceived exertion only) was able to predict more than 55% of the variation in physical performance. More recently, Agostinho *et al.* [2018] has proposed a classificatory table for SJFT performance for male and female high-level cadet judo athletes, reporting values similar to those in senior judo athletes. Taking together, these studies suggest that the SJFT is responsive to training load manipulation across a typical 2-year training program and that high-level cadets can achieve performance in this test which is similar to lower level senior judo athletes. Nevertheless, there is a lack of reports about the use and efficiency of this test in young athletes [Drid

et al. 2012]. Moreover, no study was found comparing the performance in the SJFT between cadet judo athletes from different competitive levels or with younger judo athletes.

To date, the SJFT is the most used tool to evaluate judo performance in terms of strength and cardiovascular capacity. Although the validity of SJFT has been checked in professional and high-level athletes, there is a need to evaluate how useful it is to discriminate between better and poorer judo athletes during formative stages. However, given the body composition, strength and cardiovascular differences in the childhood, the use of SJFT to determine athletes competitive level in children is debatable. A better knowledge on children performance is essential to design proper training and teaching plans in initial stages, to optimize athletes' adaptations and development since the beginning of their competitive live. Thus, the aim of the present study was to perform SJFT in 12 to 15 years old children to analyse differences between groups of age and competition level.

Methods

Participants

We contacted a total of 34 Spanish children judo athletes (12 to 15 years-old), who agreed to participate in this investigation. Informed consent was provided by all participants' parents, ensuring data confidentiality according to the ethical principles of the Declaration of Helsinki. Participants were required to meet following inclusion criteria: not having any injury, medically diagnosed pathology that impaired their ability to complete the test, and not taking medication that may alter the HR response. Participants were divided according to age and level of competition. Age groups were defined by under-13 years-old (U13) and under-15 years-old (U15) athletes. Two levels of competition were distinguished: amateur (regular children from a local gym, competing in regional and some national championships) and the Spanish National Judo Team (SNT). The final sample was composed by 34 children judo athletes, divided into three groups: U13 amateur male children ($n = 12$), U15 amateur male children ($n = 10$) and U15 SNT male children ($n = 12$).

Procedures

On the first day, participants provided self-reported sociodemographic and judo competition's level information. Then, height, body mass, and body composition assessment were carried out. Finally, evaluators gave a detailed explanation of the SJFT test instructions for participants' familiarization purposes. On the second

day, participants were submitted to the SJFT after warming-up. To guarantee consistency of the measure, they were grouped in three considering similar body mass (± 5 kg differences) and height (± 5 cm differences) between athletes. The experimental protocol was evaluated and approved by the University Ethics Committee.

Measures

Body composition measures included height (Seca 220 telescopic), body mass, body mass index, and percentage of body fat (Tanita SC-240MA). Measures from the SJFT were registered by two experienced evaluators following the protocol described elsewhere [Sterkowicz 1995; Franchini *et al.* 2011]. The test was performed on the *tatami* with three judo athletes. Briefly, the test is executed as follows: the athlete who is being tested (*tori*) stands in between the other two athletes (*ukes*), who are positioned 3 m apart from the tested athlete on opposite ends. At the *hajime* (start) command, the athlete attempts at throwing the two assistants by *Ippon seoi nage* technique as many times as possible, in three separate series of 15s, 30s and 30s with 10 s intervals between them. One of the evaluators recorded the total of throws (TT) completed in each stage, while the other registered the heart rate (HR) immediately after the test and 1 min later, using a heart rate monitor (Polar RS 300X SD). These data were used to calculate the performance index (Index = HR after + HR 1 min after/TT). The smaller the index, the better the test performance. All these measures were obtained by trained and experienced evaluators. The variables of this test were reported to reliable when the interclass correlation coefficient was calculated: total number of throws – between 0.73 [Franchini *et al.* 1999] and 0.88 [Iredale 2003] index – between 0.84 [Iredale 2003] and 0.89 [Franchini *et al.* 1999]. Iredale [2003] also reported that the typical error was 2.58% for the total number of throws and 4.85% for the index.

Statistical Analysis

Descriptive analyses included means, standard deviation, frequencies and 95% confidence interval (CI) of body composition and the SJFT performance variables. Factorial analysis of variance (ANOVA) and post-hoc pairwise comparisons were used to identify the effects of age and competitive level on the SJFT variables (TT, HR after, HR after 1 min, and final index). Significant interaction were further investigated using unpaired t-tests with Bonferroni correction [Field 2007]. Effect size (ES) was estimated by calculating partial eta squared ($\eta_p^2 = F^* df_{effect} / F^* df_{effect} + df_{error}$) between groups interpreted as: 0.06 small; 0.14 medium; > 0.14 large [Fritz, Morris, Richler 2012]. The statistical analysis was conducted using SPSS (IBM SPSS Statistics for Windows, version 20.0; Armonk, NY, USA)

Results

Characteristics of the study participants are shown in table 1. Older groups (U15) had larger judo practice experience compared to U13 ($F_{2,31} = 3.72$; $p = 0.04$; $\eta_p^2 = 0.19$, large) and higher stature ($F_{2,31} = 5.94$; $p < 0.01$; $\eta_p^2 = 0.28$, large).

Table 2 presents the SJFT performance and HR responses in the groups investigated. Results from SJFT Index were statistically similar between U13 and U15 groups ($F_{2,31} = 2.45$; $p = 0.10$; $\eta_p^2 = 0.14$, medium). No differences were found in HR right after the test ($F_{2,31} = 2.84$; $p = 0.07$; $\eta_p^2 = 0.15$, large). However, TT differed between groups ($F_{2,31} = 5.45$; $p < 0.01$; $\eta_p^2 = 0.26$, large), with higher values for the U13 compared to U-15, both amateur and the SNT ($p = 0.03$ and $p = 0.02$, respectively). A significant difference between groups was also found for HR 1 min after the SJFT ($F_{2,31} = 6.34$; $p < 0.01$; $\eta_p^2 = 0.29$, large), with lower values for the U13 compared to U15 amateur and the SNT groups ($p < 0.01$ and $p = 0.04$, respectively).

Discussion

The main findings of the present study were that (1) younger children (U13) presented a lower number of throws during the SJFT, but presented a faster HR recovery, compared to the U15 groups, (2) the current test design and formula for elite athletes appears not to dis-

criminate between amateur children and the National Team in U15 group of age. These findings open the challenge to design an appropriate conditioning test for children during formative years to better measure performance and develop adequate training and teaching plans. To the best of our knowledge, this is the first time exploring the SJFT index differences between age group and competitive level in children judo athletes.

Considering the classificatory table for SJFT index developed with high-level cadet judo [Agostinho *et al.* 2018], the U13 athletes in the present study are classified as very poor, the U15 amateur are classified as poor and the U15 SNT are classified as regular.

The total number of throws during the SJFT has been reported to be correlated to mean power in both upper- [$r = 0.70$, Franchini *et al.* 1999] and lower-body Wingate tests [$r = 0.94$, Sterkowicz *et al.* 1999]. Thus, it is probable that the U13 had a lower maturational status compared to the U15 groups, and this difference could be responsible by the different in the anaerobic capacity development. Indeed, investigation with cadet judo athletes reported lower mean and peak power during Wingate test compared to junior judo athletes [Little 1991]. Moreover, investigations with grapplers [Little 1991; Terbizan, Seljevold 1996] and with non-athletes [Inbar, Bar-Or 1986; Blimkie *et al.* 1988; Falk, Bar-Or 1993; Mateus *et al.* 2015] suggested that differences in anaerobic capacity between pre-adolescents, adolescents and adults are probably related to maturational aspects, such as higher testosterone release, increased

Table 1. Characteristics of the study participants.

Characteristics	U13 amateur (n=12)	U15 amateur (n=10)	U15 SNT (n=12)
Age (years)	12.3 ± 0.7*	14.6 ± 0.8	14.0 ± 0.1
Judo practice (years)	4.5 ± 2.9*	6.6 ± 2.0	6.7 ± 1.1
Weight (kg)	51.0 ± 12.2	65.5 ± 10.6	61.9 ± 11.9
Height (cm)	152.9 ± 8.2*	167.4 ± 5.2	164.0 ± 6.5
BMI (kg/m ²)	21.7 ± 3.5	23.4 ± 3.4	22.9 ± 3.4
Body fat (%)	19.4 ± 5.3	20.9 ± 8.9	21.0 ± 5.4

*Differences between groups. SNT: Spanish National Judo Team.

Table 2. Special Judo Fitness Test (SJFT) measures comparing age group and competition.

Age group		TT	HR after (bpm)	HR 1min after (bpm)	Index
U13 amateur (n=12)	<i>M ± SD</i>	20 ± 4*	195 ± 9	138 ± 19*	16.25 ± 2.74
	<i>95% CI</i>	(18 - 23)	(189 - 201)	(126 - 150)	(14.51 - 18.00)
U15 amateur (n=10)	<i>M ± SD</i>	24 ± 3	191 ± 8	159 ± 14	14.94 ± 2.49
	<i>95% CI</i>	(22 - 26)	(185 - 195)	(150 - 170)	(13.16 - 16.72)
U15 SNT (n=12)	<i>M ± SD</i>	24 ± 2	187 ± 8	155 ± 11	14.27 ± 1.16
	<i>95% CI</i>	(23 - 25)	(182 - 192)	(147 - 162)	(13.53 - 15.01)

Data are presented in means and standard deviation (*M ± SD*) and 95% Confidence Interval (lower - higher); *Different from U-15. TT: Total throws. HR: Heart rate. SNT: Spanish National Judo Team.

muscle mass and glycolytic activity for the more mature athletes. Considering that the SJFT has been reported to be predominantly anaerobic [Franchini, *et al.* 2011] an increased glycolytic activation and the higher muscle mass in the U15 groups, would explain their better performance during this test. One limitation of our study is that sexual maturation was not assessed, which does not allow us to infer if this was the cause of the difference between these groups, but considering the typical development phases in these ages [Malina *et al.* 2004] it is likely that this was the case, although some contribution from the judo training experience is also expected. In fact the U15 groups had greater training experience than the U13 group.

The faster HR recovery observed in the U13 group compared to the U15 groups maybe associated to the commonly faster HR recovery reported in children compared to adults [Turley 1997]. Factors as a faster vagal reactivation and greater decrease in total peripheral resistance in boys compared to men, are also factors that may contribute to a faster HR decay after effort, as the initial rapid component of HR recovery depends on vagal reactivation [Dipla *et al.* 2013], but a faster clearance rate of metabolites accumulated during exercise can also be contributing factors [Falk, Dotan 2006; Ratel *et al.* 2006]. In fact, Dipla *et al.* [2013] reported that the lower time constants of HR during the first minute of recovery in children compared to adults in their study suggested that the vagal participation is maturity dependent. However, as maturity was not assessed in our study and the age difference is small between these groups, the contribution of these factors remains to be investigated.

Consequently, as the index in the SJFT is calculated summing HR immediately after and 1-min after the test and dividing this result by the total number of throws, and the U13 group presented lower values in HR 1-min after and total number of throws in the SJFT compared to the U15 groups, the index did not differ between them. Thus, the SJFT is not a proper variable to detect differences between groups at these ages. Besides, caution should be used when assessing judo athletes longitudinally in ages where maturation and changes in the physiological variables affecting the SJFT responses can rapidly vary. Additionally, no change was observed between the two U15 groups, indicating that at this age other factors are probably more important to determine performance than the physical fitness components assessed by the SJFT, like the technique *tokui waza* [Rodriguez *et al.* 2016], anthropometric and specific strength attributes [Arazi *et al.* 2017] or tactical behavior [Courel-Ibnez *et al.* 2014]. This is different than observed in seniors, where the SJFT has been reported to discriminate elite and non-elite judo athletes [Franchini *et al.* 2005; Sterkowicz-Przybycien *et al.* 2017].

In conclusion, the SJFT appears to have some limitations to detect performance differences between judo

athletes during formative years. These findings open the challenge to design appropriate conditioning test for children to better measure performance and develop adequate training and teaching plans during formative years.

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Czy Indeks Indywidualnych Testów Sprawnościowych Judo jest różnicujący na etapach kształtowania osobowości? Różnice ze względu na wiek i poziom zaawansowania w kategoriach wiekowych do 13 i do 15 lat

Słowa kluczowe: podstawy, ocena, metodologia, ocena, sport walki, uczenie się

Abstrakt

Cel. Celem niniejszych badań było przeprowadzenie testu sprawnościowego SJFT u dzieci w celu analizy różnic w różnych grupach wiekowych i o różnym poziomie zaawansowania.

Metoda. W badaniu wzięło udział 33 zawodników w wieku do 13 lat (U13) i do 15 lat (U15) pochodzących z miejscowej siłowni (amatorzy) i hiszpańskiej drużyny judo (SNT). Zostali oni podzieleni na trzy grupy: amatorzy do 13 lat, amatorzy do 15 lat i zawodnicy drużyny judo do 15 lat. Dzieci o podobnym wzroście i wadze wykonały testy w parach. Porównania wiekowe nie wykazały różnicy w indeksie SJFT, biorąc pod uwagę mniejszą liczbę rzutów podczas testu SJFT dla dzieci w kategorii wiekowej do 13 (95% CI_{high} = <23 vs.> 22 i> 23 rzutów), ale szybsze tętno (HR) (95% CI_{high} = <150 vs.> 150 i> 147 uderzeń / min) w porównaniu do grup amatorskich i profesjonalnych do lat 15.

Wyniki. Porównywanie poziomu zaawansowania pomiędzy amatorami do 15 lat i z drużyny judo nie wykazało różnicy w wynikach testu SJFT (rzuty, HR i wskaźnik). Zatem indeks SJFT nie jest odpowiednią zmienną do wykrywania różnic w tych grupach wiekowych.

Wnioski. Ustalenia te stawiają wyzwanie do zaprojektowania odpowiedniego testu kondycyjnego dla dzieci w latach kształtowania się ich osobowości, aby lepiej zmierzyć wydajność i opracować odpowiednie plany szkoleniowe i dydaktyczne.