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Reliability and validity of karate agility test

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Abstract
The purpose of the study was to determine reliability and validity of constructed karate agility test which is specific for kumite match. The research group of 8 karatekas were from local karate clubs in Nitra, Slovakia and were in high fitness level as members of Slovak National Team participated in kumite on average M = 8 years, SD = 2.27 years. The average age of the group was M = 17.87 years, SD = 0.83, average height M = 171 cm, SD = 6.37 and average weight M = 67.12, SD = 10.52.
We monitored participants in karate agility test (n = 8). The decisive criterium was time and also the correctness of performing exercises at individual posts, specially kumite techniques, which were judged by karate experts - qualified referees. The criterion was the time for which the proband completed the entire track. Differences between variables were assessed by paired t – test and interactions between the variables by Pearson correlation coefficient "r". We evaluated the significance of differences and relationships at the 5% and 1% level of significance (p - value). We evaluated the internal realiability of the test by ICC coefficient and Cronbach´s Alpha. The most positive interactions are found between the measurement no. 3 and the measurement no. 4 (r = .981, p <.01). To determine reliability of agility test we used intraclass correlation coeficient (ICC) with good reliability (0.8233) and Cronbach´s Alpha with excellent internal consistency (0.9610).
We considered the construction of karate agility test in kumite reliable and valid. The construction of karate agility test in kumite has been fit and proper to be used to measure the karate agility in kumite category.

Keywords: agility, reliability, validity, karate, kumite

Introduction
To provide a good quality research, reliability and validity are the two most important methods when measuring any diagnostic tool. The term reliability refers to the consistency of a measure. Although, no diagnostical tool achieves perfect precision and consistency, it is the researcher's task to create or obtain a tool with the highest possible reliability, which guarantees, that the results will be evaluated and interpretable (Methods, Elumalai, 2021) [16]. In statistics, reliability refers to consistency measurement. Reliability is affected by 3 basic factors - range of diagnostic tool, homogeneity of diagnostic tool and difficulty of the tasks.
Validity is the ability of a diagnostic tool to identify what was intended to be found. It is the relationship of a diagnostic tool to theory, that formed the basis for the development of this tool. We distinguish several types of validity and the corresponding ways of determining it – construct validity, content validity and criterion validity. Construct validity is the extent to which the measure 'behaves' in a way consistent with theoretical hypotheses and represents how well scores on the instrument are indicative of the theoretical construct. In the field of pedagogy, this type of validity is understood as skill, knowledge, ability, etc.. Thus, a construct in understanding a particular human trait or characteristic. The researcher should develop his diagnostic tool according to the theory which fulfills the given construct. We can use several methods to determine the construct validity by evaluating the diagnostic tool with experts, where tehy assessed the items of the diagnostic tool. A comparison of the results of a given tool with a similar tool as another method determines the tightness of the relationship between the two results is determined using a correlation coefficient. The third way of construct validation of a diagnostic tool is using a statistical method called factor analysis. The tool is administered to individuals and the results are subjected to this analysis. This method shows to what extent the diagnostic tool consist of given factors (Lawrence, 1994) [14].
The purpose of our research was to determine reliability and validity of constructed karate agility test which is specific for kumite match.

Material and Methods
To determine reliability and validity we constructed karate agility test (fig.1) specific for kumite. The data collection was approved by the karate coach. The participants involved to test the reliability and validity were karate athletes who are specializing in kumite category. Eight karatekas participated in our study. They were from local karate clubs in Nitra, Slovakia and each of them hold brown and black belt in goju-ryu and shito-ryu karate style. Participants were in high fitness level as members of Slovak National Team so they participated in national and international competitions in kumite and compete on average M = 8 years, SD = 2.27 years. The

average age of the group was M = 17.87 years, SD = 0.83, average height M = 171 cm, SD = 6.37 and average weight M = 67.12, SD = 10.52.

First, participants were given the instructions on the agility test and each participant had tried the agility test without the measurement. Participants were tested twice in a row in one day. The better result was reported. After one week the test was repeated. The agility test was repeated overall four times each week. Three qualified karate referees were evaluated karatekas and reported the data. The decisive criterium in this test was not only time, but also the correctness of performing exercises at individual posts, specifically those where the proband must perform kumite techniques. These techniques were judged by karate experts - qualified referees. The test criterion was the time for which the proband completed the entire track. The final time also takes into account a possible penalty, based on the judges' assessment as follows:

- a penalty of 0.3 seconds is given for contact with an obstacle or in the event of a small mistake, for omitting a strike or kick (for each omission of technique 0.3 second);
- a penalty of 0.5 seconds is given for incorrect technique of jumping over the hurdle or incorrect technique of side guard during running around the obstscle;
- a penalty of 1 second is given for omitting or dropping an obstacle;
- the proband is disqualified if he omits some track posts (Čierna and Pučovský, 2018) [7].

We defined the files with descriptive statistics (M - mean, SD – standart deviation, Min - minimum, Max - maximum, CI - upper & lower confidence interval, Shapiro-Wilk – normality test). Differences between variables were assessed by paired t – test and interactions between the variables by Pearson correlation coefficient "r". We evaluated the significance of differences and relationships at the 5% and 1% level of significance (p - value). We evaluated the internal realiability of the test by ICC coeficient (Koo & Li 2016; Liljequist *et al* 2019; scale: <0.5 poor reliability, 0.5-0.75 moderate reliability, 0.75-0.90 good reliability, >0.90 excellent reliability) [12, 15] and Cronbach´s Alpha (Kopalle & Lehmann 1997; Cho and Hun 2018; Cho 2020; Sijtsma 2009; scale: <0.5 - unaccetable, 0.5-0.6 - poor, 0.6-0.7 - questionable, 0.7-0.8 - acceptable, 0.8-0.9 good, >0.9 excellent) [13, 3, 2, 17].

Karate Agility Test

Design of karate agility test (Czaková, 2021) [6] is an agility track (figure 1) assembled on a mat of tatami panels, on an area of 7x7 m^2, each tatami panel is an area of 1x1 m^2. The track consists of 10 consecutive posts (figure 2), which the competitor must pass gradually in the order. To perform this test, the proband must wear a kimono, all protectors and a belt.

1st exercise–Tie the belt.

Karateka stands at the start in heko dachi position with forearms below, exactly as at the start in a regular kumite match. He/she holds the belt folded in hands. On the sound stimulus starts tying the belt. When the belt is tied correctly, karateka runs to the exercise no. 2.

2nd exercise–Coordination Ladder.

Karateka performs a high skipping exercise through a 5-meters long coordination ladder. First he/she places both feet alternately inside the ladder surface and then passes through the feet outside the surface to the side.

3rd exercise–Strikes.

Karateka takes a fighting stance and performs 4 strikes to the 2 meters high pole: left guard front strike and back strike, then immediately changes to the right guard where he also strikes, from the front and then from the back fist to the marks represent head and solar plexus (kizami tzuki & gyaku tzuki chudan). Then he/she runs to the exercise no. 4.

4th exercise–Hurdles.

There are 4 hurdles in a row, which karateka must to jump over the smaller ones and crawl the large ones. The jump hurdles are 0.5 meter high and the crawl hurdles are 1 meter high. There is 0.5 meters distance between the jump and crawl hurdles and karateka has to repeat the jump and crawl exercise 2 meters further on the second pair of hurdles. Then karateka runs to the exercise no. 5.

5th exercise–Kicks.

Karateka takes a fighting stance and performs 4 kicks to the 2 meters high pole: 2 left guard kicks to the head and solar plexus and then the same kicks on the right guard and runs to the exercise no. 6.

6th exercise–Obstacles.

Karateka turn his/her back and takes a fighting stance, then starts to run backwards in this stance around the obstacles in a row and alternately changes the guard. The distance between the obstacles are 2 meters. The last obstacle is marked in different color, so karateka knows that he/she can turns and runs forward to the exercise no. 7.

7th exercise–Combos.
Karateka takes a fighting stance and performs a combination of two strikes (kizami tzuki & gyaku tzuki chudan) and one kick (mawashi geri jodan) just on the left guard. The strikes and kick are aimed to the marked places to the 2 meters high pole. After performing the combination, karateka runs to the exercise no. 8.

8th exercise–Bosu.
Karateka jumps from one foot to the other over 4 bosu balls. Bosu balls are 1 meter apart. Then he/she runs to the exercise no. 9.

9th exercise–Combos.
Karateka takes a fighting stance and performs a combination of two strikes (kizami tzuki & gyaku tzuki chudan) and one kick (mawashi geri jodan) just on the right guard. The strikes and kick are aimed to the marked places to the 2 meters high pole. After performing the combination, karateka runs to the exercise no. 10.

10th exercise–Sprint.
Karateka performs 5 meters long sprint at the end of which there is a timer. Karateka stops the timer by himself/herself.

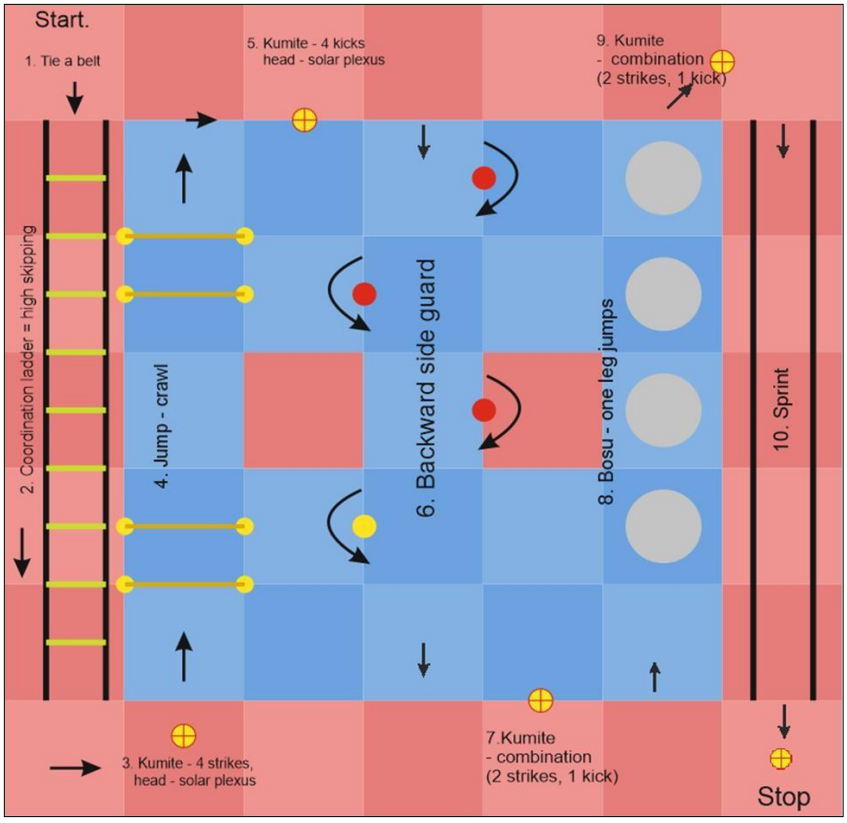

Fig 1: Karate Agility Test

Fig 2: Karate Agility Track

Results

The aim of the survey was to determine the reliability and validity of karate agility test. We present the descriptive characteristics of all measurements with the normality of distribution using Shapiro – Wilk test and statistical significance (p – value) in table 1. The box plot (figure 3) displays the distribution of data – minimum, first quartile (Q1), median, third quartile (Q3) and maximum. We found positive correlations between all measurements (r = .916, p <.01; r = .956, p <.01; r = 930, p <.01; r = .976, p <.01; r = .980, p <.01; r = .981, p <.01). The most positive interactions are found between the measurement no. 3 and the measurement no. 4 (r = .981, p <.01) (table 2).

Table 1: Descriptive characteristics in karate agility test

	M	SD	Min	Max	Shapiro-Wilk	p
Mea_1	49,135	4,317	43,76	55,53	0,928	0,498
Mea_2	43,336	2,761	40,58	49,23	0,867	0,140
Mea_3	42,729	3,028	38,74	48,32	0,962	0,829
Mea_4	41,853	5,524	35,60	52,78	0,916	0,395

Legend: M - mean, SD – standard deviation, Min – minimum, Max – maximum,
p – statistical significance

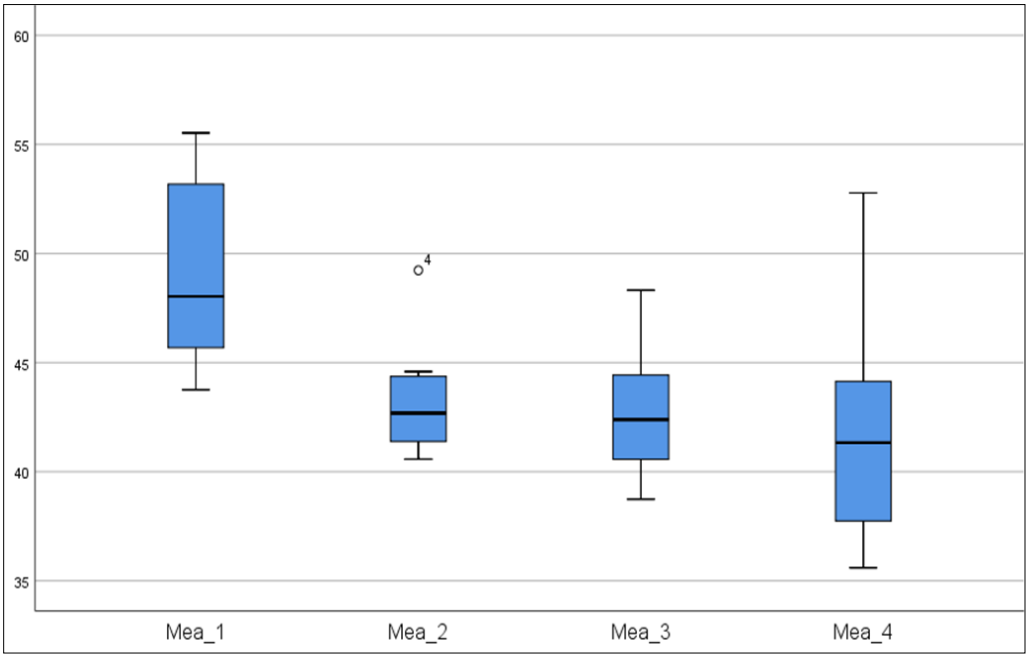

Fig 3: Box plot of descriptive statistics in karate agility test

Table 2: Interactions between measurements

		Mea_2	Mea_3	Mea_4
Mea_1	r	,916**	,956**	,930**
	p	0,001	0,000	0,001
Mea_2	r	1	,976**	,980**
	p		0,000	0,000
Mea_3	r		1	,981**
	p			0,000

We stated confidence interval (table 3) and we were 95% confident differences between the measurements. Differences between measurement 1 and measurement 2, confidence interval = [4.039, 7.558]. Differences between measurement 1 and measurement 3, confidence interval = [5.006, 7.807]; measurement 1 and measurement 4, confidence interval = [5.451, 9.114]; measurement 2 with measurement 3, confidence interval = [0.032, 1.183]; measurement 2 with measurement 4, confidence interval = [-0.916, 3.884] and measurement 3 wiht measurement 4, confidence interval = [-1.312, 3.065].

Table 3: Confidence interval of differences between the measurements

				95% CI of the Diff			
	M	SD	SEM	Lower	Upper	t	p
Mea_1 <> Mea_2	5,799	2,105	0,744	4,039	7,558	7,792	0,000

Mea_1 <> Mea_3	6,406	1,675	0,592	5,006	7,807	10,816	0,000
Mea_1 <> Mea_4	7,283	2,191	0,775	5,451	9,114	9,400	0,000
Mea_2 <> Mea_3	0,607	0,688	0,243	0,032	1,183	2,496	0,041
Mea_2 <> Mea_4	1,484	2,871	1,015	-0,916	3,884	1,462	0,187
Mea_3 <> Mea_4	0,876	2,618	0,925	-1,312	3,065	0,947	0,375

To determine reliability of agility test we used intraclass correlation coeficient (ICC). The ICC turned out to be 0.8233. We would conclude that an ICC can be rated with good reliability (0.75 < = > 0.9). To determine internal consistency of karate agility test we used Cronbach´s Alpha (Cronbach, 1951) [3]. The Cronbach´s Alpha turned out to be 0.9610 and we would conclude that it can be rated with excellent internal consistency $\alpha \geq 0.9$ (figure 4).

Cronbach's alpha	Internal consistency
$\alpha \geq 0.9$	Excellent
$0.9 > \alpha \geq 0.8$	Good
$0.8 > \alpha \geq 0.7$	Acceptable
$0.7 > \alpha \geq 0.6$	Questionable
$0.6 > \alpha \geq 0.5$	Poor
$0.5 > \alpha$	Unacceptable

Fig 4: Cronbach´s Alpha values

Discussion

The study aimed to find the reliability and validity of karate agility test. The data were recorder as a time trought the stopwatch. The mistakes were judged by qualified referees. We found the test high reliable and valid. Methods based on intraclass correlation coefficient provides an indication of 'relative reliability'. Since these methods are highly influenced by the range of measured values, researchers should be cautious in even if a correlation is above 0.9, relative reliability should has acceptable conclusion; the new sample of participating individuals involved in an experiment should has the results of the cerrelation between the test and retest extrapolated and comparing the test-retest correlations between different reliability studies (Baumgarter, 1989) [1].

Based on the reliability test, Dewangga *et al*. (2021) [9] in the research of Karate Agility Test Construction in Kata Category using Cronbach alpha, the r-table is 0.444, Cronbach´s Alpha is 0.802. If the Cronbach alpha value is greater than the r-table, the result can be said to be reliable. Because of value more than 0.7 the karate agility test in kumite category has high reliability. In quantitative research validity is the extent to which any measuring instrument measures what it is intended to measure (Thatcher, 2010) [19]. Authors Dewangga *et al*. (2021) [9] provided the analysis of content validity using Aiken formula and found out the item score taking has fit with a value of V 0.80. The Aiken value of 0.81 to 1.00 indicated that the agreement between the experts was high (Hendriyadi, 2017) [11]. Based on empirical validity test of the Pearson moment product, Dewangga *et al*. (2021) [9] found the r-table (0.444), r-count (test 1) is 0.927, r-count (test 2) is 0.903, significance value is 0.000. If the r-count is bigger than the r-table and the significance value is <0.05, it can be concluded that the result is valid. Thus, the karate agility test instrument in kata category can be said to be valid. Taati, Arazi, Bridge & Franchini (2022) [18]

aimed to propose a new multidimensional taekwondo-specific test to estimate aerobic power, anaerobic fitness, and agility. The taekwondo-specific aerobic-anaerobic-agility (TAAA) test comprised six 20-s intervals of shuttle sprints over a 4-m distance, and the execution of roundhouse kicks alternating the legs at the end of each distance, with 10-s rest intervals between the sets. The multiple linear regression revealed that the difference between heart rate (HR) after and 1 minute after the TAAA test ($p < 0.001$), and body mass index (BMI; $p = 0.006$) were significant to estimate VO_{2max}. Likewise, there was a very large ($R = 0.79$) and large ($R = 0.55$) correlation between the average and maximum number of kicks performed in the TAAA test and the WAnT mean and peak power, respectively ($p < 0.001$).

Authors Veale, Pearce & Carlson (2010) [20] tested reliability and validity of a reactive agility test (RAT) for Australian Football with 20 elite junior players. Test-retest reliability reported a strong correlation (0.91), with no significant difference ($p = .22$) between the mean results (1.74 ± 0.07 s and 1.76 ± 0.07 s) obtained (split 2+3). Nonparametric tests (Kruskal-Wallis and Mann-Whitney) revealed both AF groups performed significantly

faster on all measures than the control group (ranging from P = .001 to .005), with significant differences also reported between the two AF groups (ranging from p = .001 to .046). Stepwise discriminant analyses found total time discriminated between the groups, correctly classifying 75% of the participants. According to Ellis *et al*. in Gore (2000, p. 132) [10], majority of tests purported to assess agility are tests for change of direction speed. Several facts explain that the agility training parameters with specific skill movements can improve the athlete's performance better than general skill training (Dewanga and Tomoliyus, 2020) [8].

Conclusion

We considered the construction of karate agility test in kumite reliable and valid, based on the results of processing our data and discussion. The construction of karate agility test in kumite has been fit and proper to be used to measure the karate agility in kumite category.

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