

COACHING & KINESIOLOGY

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Karate agility: The new competition category for children's physical development with very high test/re-test reliability

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Abstract

Background and Study Aim. Early specialisation does not guarantee later competitive success. Development of general motor skills appears to be the key factor in achieving maximum success in sports at an older age. To prevent burn-out and early specialisation, the Slovak Karate Union introduced a new competition discipline – the Karate Agility Course (KAC), where young *karateka* apply their fundamental motor skills. The aim of this research was to examine the reliability of the KAC as a new competition discipline for young karate athletes.

Material and Methods. Forty four young national level *karateka* participated in the study: 28 males (age 9.1 ± 1.8 y, body mass 40.0 ± 12.4 kg) and 16 females (age 9.9 ± 2.7 y, body mass 38.9 ± 8.8 kg). All performed the KAC for both age categories twice: test and re-test sessions were carried out on separate occasions, 1 week apart.

Results. Test and re-test results showed the KAC to be reliable. Net time and total time for 8-11 year old children did not display any difference between the test and the re-test. The SEM and ICC for both variables were $<5\%$ and $>.90$, respectively. The Bland and Altman analyses reported a mean difference (bias) \pm the 95% limits of agreement.

Conclusions. The study showed that the new KAC discipline, with effort patterns replicating karate combat demands, can be considered as a reliable, karate-specific field test for assessing karatekas' physical performance.

Introduction

Karate is a combat sport which will have its Olympic debut at the 23rd Olympic Games in Tokyo 2020. Both male and female categories will be held in two events, *kata* (karate forms) and *kumite* (combat). Karate has seen a quite rapid increase in athlete registrations for WKF competitions [WKF News Center 2018]. An athlete must go through years of sports practice and preparation to get to the highest level. The World Karate Federation organises top-level karate events even for U 14 categories (12-13 years old athletes). In Slovakia children as young as 5 years old compete in karate events [Slovensky zväz karate 2017].

Specialized training for young athletes brings with it risks of injury and burn-out, while the degree of specialisation is positively correlated with increased serious injury risk. Risk factors for injury in young athletes who specialize in a single sport include year-round,

single-sport training, participation in more competitions, decreased age-appropriate play, and involvement in individual sports that requires the early development of technical/motor skills. Adults involved in the instruction of youth sports may also put young athletes at risk of injury by encouraging increased intensity in organised practices and competition, rather than self-directed, unstructured, free play [Myer *et al.* 2015].

Many factors contribute to the desire of parents and coaches to encourage early single sport specialisation, including the desire to give the young athlete an edge in competition, pursuit of scholarships, potential professional status, and the ability to label a young athlete as elite at an early age. Despite these perceived advantages, some data suggests that early sport specialisation does not lead to a competitive advantage over athletes who participate in multiple sports such as ice hockey, swimming, gymnastics, and baseball [Feeley *et al.* 2016].

Thus, the Slovak Karate Union developed a new com-

petitive discipline. The Agility Karate Course for 5-11 year old children, to prevent early specialisation and to further popularise karate in Slovakia. Children's competition has been held in three disciplines for individuals, namely kata, kumite and karate agility. Children are divided according to sex, age and, in the case of kumite, also according to weight categories. In the agility, discipline contestants compete in one of the age categories; 5, 6, 7, 8, 9, 10, and 11-year olds. Each contestant may complete the course only once. The Karate Agility Course contains very closely defined motor skills (gallop, hop, etc.). The goal of each contestant is to complete the course in perfect technique/form in the shortest possible time. Every technical mistake/error is penalised by adding penalty time.

The Karate Agility competition is based on the sport performance of karate competition disciplines. Since the contestants must complete the course as fast as possible, the ability to react quickly, which is key in the kumite discipline, is applied the most at the start. Moori *et al.* [2008] showed an increased level of reactional abilities in karate athletes compared to the general population. After the start, while completing the individual sections of the karate agility course, acceleration speed, running speed with change of direction, explosive strength (power), dynamic balance, rhythmic ability, and co-ordination are used. According to various authors [Chaabene *et al.* 2012; Blazevic *et al.* 2006; Sterkowicz, Franchini 2009], all the above mentioned pre-requisites are essential for achieving the maximum level of sport performance in adult karate athletes.

Results of Kezic and Beslija [2010] show that karate skills in 5-7 year old karate beginners (techniques of punches, kicks, blocks, and stances) are significantly correlated with the fundamental motor skill results, $r=0.74$ (run, gallop, hop, leap, horizontal jump, and slide, striking a stationary ball, dribble, catch, kick, overhand throw and underhand roll). Cierna a Pucovsky [Augustovicova, Pucovsky 2018] found a significant relationship between general (agility performance) and special/specific motor skills performance (kata performance) by analysing the draw records data of agility and karate disciplines.

The aim of this study was to examine the reliability of the Karate Agility Course (KAC) as a new competition discipline for young karate athletes.

Methods

Subjects

Forty-four young national level karateka participated in the study: 28 males (age 9.1 ± 1.8 y, body mass 40.0 ± 12.4 kg) and 16 females (age 9.9 ± 2.7 y, body mass 38.9 ± 8.8 kg). All subjects competed in the agility discipline regularly, so they had been familiarised with the testing procedure.

Study design

After consultation with karateka, coaches, and sport scientists, a new karate-specific competition category, Agility, was developed by Slovak Karate Union. The design of Agility was based on a deep analysis of karate competition in the scientific literature so as to develop a field test that mimics the future and real competition's requirement. The test also had to be easy to use, low-cost, non-invasive and popular for children. During the Agility competition, participants have to use specific karate techniques considered the most used in competition (i.e., zuki and chudan-geri). To establish test reliability, [Hopkins 2000] participants performed the Agility twice with the maximum effort, 1 week apart, under the same conditions.

Before starting the Agility testing, karateka performed a warm-up (jogging and dynamic stretching of hip extensors, hamstrings, hip flexors, and quadriceps femoris) of 10 minutes. They then had a chance to have a walk-through of the course twice. After 10 minutes of passive rest, they performed the Agility test, wearing karate-gi, (specific clothes for karate.) The test had to be carried out on a tatami (i.e., competition karate area) with prescribed motor activities in the shortest time possible without a technical error. The time was measured by the official competition chronometer.

Each subject had to complete the course for 5-7 year-olds once and after a 10- minute recess the course for 8-11 year-olds.

Agility course for 5, 6, 7- years old children

A karateka starts on a sound signal from a seated position on the floor, with legs closed. After the start the karateka runs around a cone, continues in a sideways gallop through a slalom course, performs two punches and two kicks at a designated cone, completes ten hurdle hops with a close-feet stance over 10-12 cm tall hurdles. In the final part/stage of the course the karateka moves tennis balls from one plastic tray/plate to another one. The contestant places the last tennis ball on a designated place (a plate situated on), or by the left finish-line cone (Fig. 1). By doing this the time count is stopped.

Agility course for 8, 9, 10, 11- years old children

The course for older categories of 8, 9, 10, and 11-year-olds contains a few more tasks that are more demanding co-ordination-wise. After starting from the seated position and running around the first cone the contestant must sprint backwards, after which they must complete the slalom, perform four punches and four kicks and 10 one-legged hurdle hops over 10-12 cm tall hurdles (5 with one leg in one direction and 5 with the other leg on the way back). The last task is identical to the one used in the course for younger contestants.

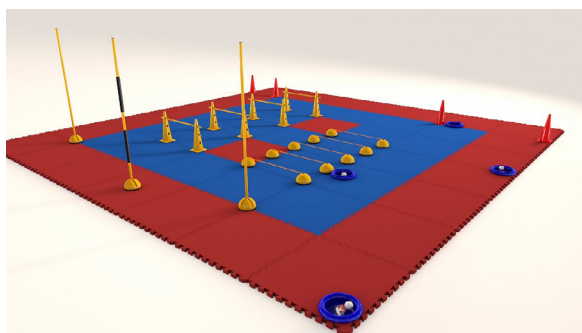
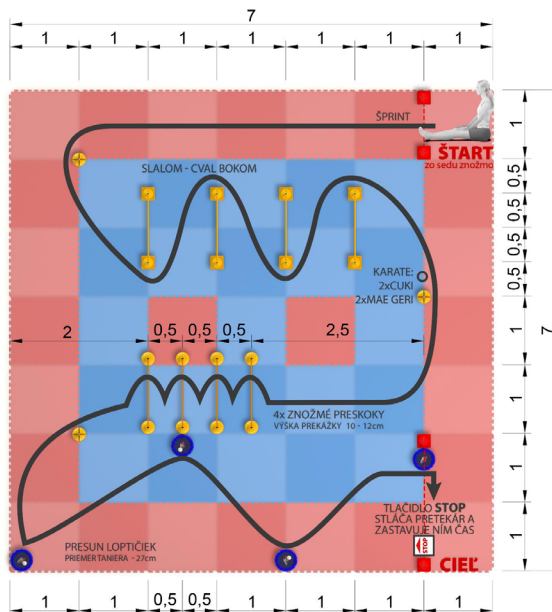


Figure 1. Competition area for 5, 6, 7- years old children

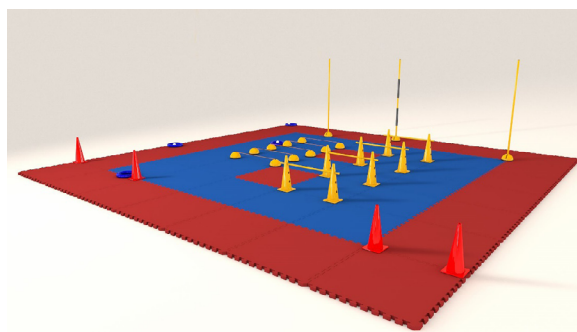
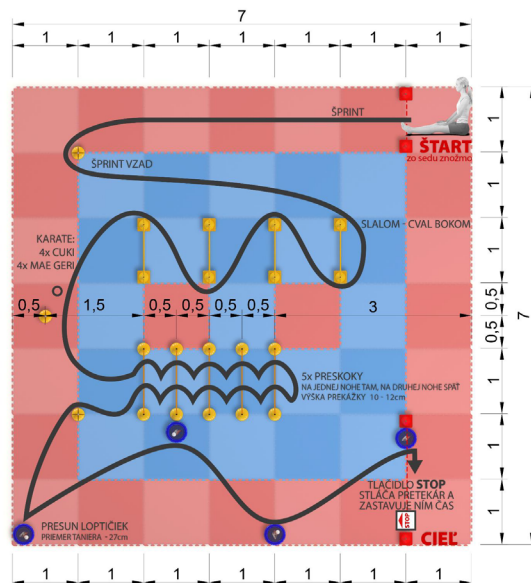


Figure 2. Competition area for 8, 9, 10, 11- years old children

Penalisations

Penalisations for both courses are identical and are given by the judge according to the rules.

Table 1. Penalisation

Penalisation	Description of technical error
0.3 s	<ul style="list-style-type: none"> • Contact with an obstacle • Minor error • For omitting a punch, or a kick (0.3 seconds for each omitted technique) • For stepping on the rubber band
0.5 s	<ul style="list-style-type: none"> • Incorrect technique of hops • Incorrect technique of the sideways gallop
1 s	<ul style="list-style-type: none"> • Omission of an obstacle • Toppling-over of an obstacle • Tennis ball bouncing out of the plate. The contestant is disqualified if any of the tasks are omitted.
Disqualification	<ul style="list-style-type: none"> • Omission of any of the tasks of the course, or movement

[Source: Slovensky zvez karate 2017].

Statistical analysis

Data analysis was performed using SPSS version 21.0 for Windows. Means ± SD were calculated for each variable (net and final time). The normality assumption was tested using the Shapiro-Wilk test for each variable before conducting any statistical parametric test.

Absolute and relative reliabilities were assessed using the typical error of measurement (standard error of measurement - SEM) as a co-efficient of variation (CV) and the intra-class correlation co-efficient (ICC), respectively.

The SEM was calculated by dividing the SD of the difference between scores by the square root of 2 [Hopkins 2000].

The smallest worthwhile change (SWC) was determined by multiplying the between-subjects SD by 0.2 (SWC_{0.2}), which corresponds to a small effect; 0.6 (SWC_{0.6}), which corresponds to a moderate effect; and 1.2 (SWC_{1.2}), which corresponds to a large effect [Hopkins *et al.* 2009].

The test's capacity to detect change is considered good when SEM ≤ SWC, satisfactory when SEM = SWC, and marginal when SEM ≥ SWC.

Minimal detectable change (MDC_{95%}), which indi-

cates the smallest change that is not due to error, was calculated as: $MDC_{95\%} =$

Any learning effect or systematic bias between samples means scores for test and re-test sessions were checked by performing a paired t-test.

The Cohen d effect size (d), which reflects the relative magnitude of the experimental treatment, was calculated. The following scale was used for the interpretation of d: *small* ($d \leq 0.2$), *medium* ($d \leq 0.5$), and *large* ($d \leq 0.8$) [Fritz et al. 2012].

Agreement between two quantitative measurements was assessed by constructing a Bland and Altman plot with 95% limits of agreement [Giavarina 2015].

The level of significance was set at $P \leq 0.05$.

Ethical considerations

This study was approved by the Ethics Committee of the Faculty of Physical Education and Sports, Comenius University, Bratislava, Slovakia (reference number 05/2019). Before the research began the volunteers signed an informed consent form.

Results

Reliability of the course for 5-7 years old children

Net and total times during the test and the retest were significantly different ($t = -3.54$, $df = 43$, $p = 0.01$, $d = 0.34$ [medium] and $t = -2.69$, $df = 43$, $p = 0.01$, $d = 0.28$ [medium], respectively).

The SEM for net time and total time were less than 5% and ICC was higher than 0.8, respectively (Table 2).

The SWCs in all variables measured from the agility was higher than the SEM, which indicates a marginal ability of the agility course to detect small, but worthwhile, variation in performance (Table 2).

The Bland and Altman analyses reported a mean difference (bias) \pm 95% limits of agreement (Figure 3, 4).

Reliability of the course for 8-11 years old children

Net and total time during the test and the re-test were not significantly different ($t = -0.62$, $df = 43$, $p = 0.54$, $d = 0.07$ [small] and $t = -0.94$, $df = 43$, $p = 0.35$, $d = 0.05$ [small], respectively).

The SEM for net time and total time were less than 5% and ICC was higher than 0.90, respectively (Table 2).

The SWCs in all variables measured from the agility was higher than the SEM, which indicates a marginal ability of the agility course to detect small, but worthwhile, variation in performance (Table 2).

The Bland and Altman analyses reported a mean difference (bias) \pm 95% limits of agreement (Figure 5, 6).

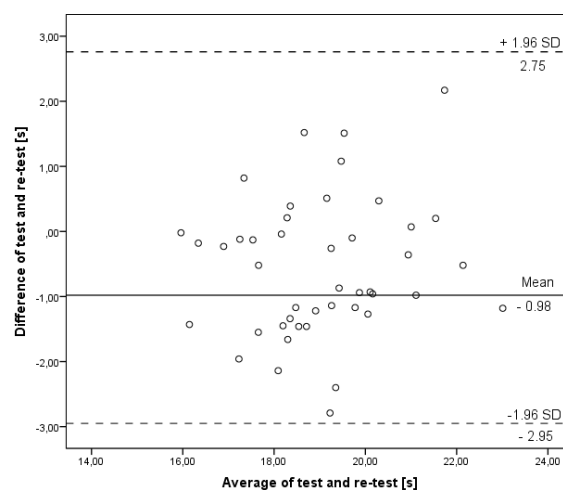


Figure 3. Bland and Altman plot for the net time in 5-7 years old children Agility course

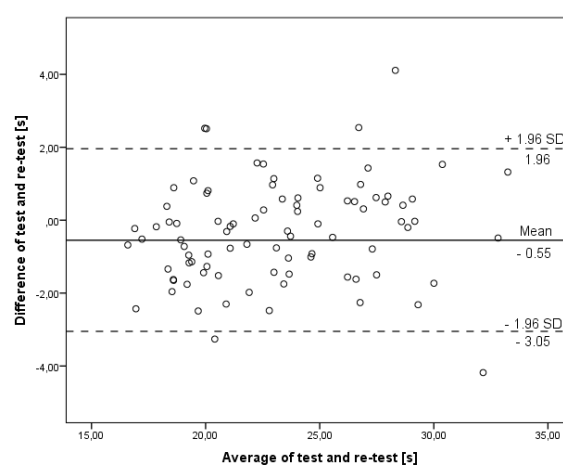


Figure 4. Bland and Altman plot for the total time in 5-7 years old children Agility course

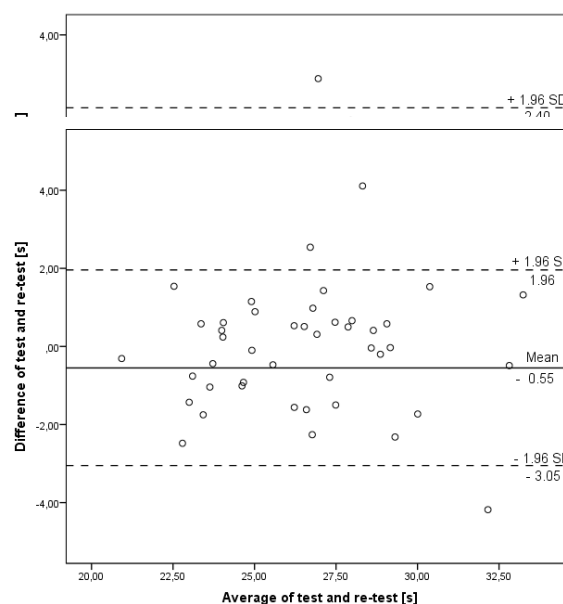


Figure 6. Bland and Altman plot for the total time in 8-11 years old children Agility course

Table 2. Performance and Reliability Results of Karate Agility During the Test and Re-test

Variable	5-7 years old children		8-11 years old children	
	Net time	Total time	Net time	Total time
Test	18.74 ± 1.72	19.69 ± 1.99	25.55 ± 2.53	26.45 ± 2.91
Retest	19.31 ± 1.59	20.21 ± 1.77	25.73 ± 2.62	26.58 ± 2.87
t	-3.54	-2.69	-0.62	-0.94
p	0.001	0.01	0.54	0.35
d	0.34	0.28	0.07	0.05
SEM	0.50 (2.61%)	0.57 (2.89%)	0.57 (2.23%)	0.67 (2.52%)
ICC (95% CI)	0.89 (0.79 - 0.94)	0.87 (0.77 - 0.93)	0.93 (0.88 - 0.96)	0.93 (0.88 - 0.96)
SWC	0.34	0.38	0.52	0.58
MDC	1.37	1.59	1.58	1.85

Discussion

For the researcher, or a trainer, it is crucial to work with a motor skills test which has the highest rate of reliability. It is one of the guarantees that their results will be valuable and well-constructed. The aim of the current research was to establish absolute and relative reliability of a new karate discipline that was designed to evaluate motor skills of young karate athletes.

Reliability results showed that all Karate agility courses for youngest karateka variables displayed a very good relative and absolute reliability between the test and re-test. A very large ICC was found ($>.90$) in conjunction with a marginal SEM expressed as CV ($CV < 5\%$) in both of the variables determined from the KAC (i.e., net time and total time). Higher, almost perfect reliability have been established at net and total time for the 8-11 years old in KAC. This would mean that, not only is the test reproducible for performance measure, but also that it consistently highlights motor skill progress. Reliability results were supported by small, and very small, effect sizes found in the net time and total time determined from both courses of KAC test and re-test sessions.

This issue was analysed by Madaiova and Cierna [2018], who found significant differences between the performances of boys and girls, and individual age categories. The performance of these children improved significantly the closer they were to the Slovak Championships.

The ability to detect small, but worthwhile, changes in performance was not very good. We could support this issue with results of Madaiova and Cierna who found that there were not only significant changes towards the peak of the sports season, but also significant differences in the net and total time between genders and age categories both in course for 5-7 years and 8-11 old children. The calculation of the MDC95% allows the quantification of the subject's performance variation necessary to be sure that the change is bigger than the measurement error. Thus, children's scores at, or above, the MDC95% would be due to the KAC's performance improvement rather than measurement error.

KAC for younger athletes is slightly less reliable than KAC for older athletes, however still enough reliable to

use at the competition and based on Madaiova and Cierna's [2018], also enough sensitive to detect differences between age categories. It seems that it is early to search for talented athletes but it has been part of many sport development projects in several countries. However, the highly specialized training process and the struggle for competitive standing during childhood and youth have been criticized [Weber 2009]. So, less specialized test as a competition discipline could be a reasonable way how to detect talented youth athletes and protect them before early specialisation strictly on karate disciplines.

For the purpose of the assessment of motor skills, and the selection of youth with talent for sports, it was necessary to come up with a test which was sufficiently reliable and valid, simple but not costly, and widely applicable for the use of testing of youth active in sports.

The results of Pucovsky and Cierna's [2018] study showed a very high correlation between General Motoric abilities (Karate Agility Course) and Special Motoric abilities (Karate kata) in young karate athletes. Coaches and sports scientists might use the KAC test with confidence that this test could identify talented children.

For instance, KAC, does not require any expensive device, or specially trained examiners, just competition results that could be used for the selection. This one test could supply many other general tests (e.g. long jump, 50 m sprint).

Conclusions

This study showed that the KAC can be considered a valid and reliable karate-specific field test for youth karateka with practical interest for selecting talented karateka.

The nature of the effort in the karate agility is very close to karate skills, as well as with respect to techniques used in karate combat (punches and kicks) The ability to recognize talented karateka could further support the constructive validity of this test. Therefore, further studies dealing with the sensitivity of the KAC should be conducted.

The KAC is the first sports-specific karate field test available in the scientific literature that tends to mimic

karate's particular effort, and it showed a good level of reliability in youth karateka.

It allows a mixture of technical and physical aspects of the training process. It is carried out on a real competition karate floor and does not require expensive equipment. Therefore, this tool can help karateka, coaches, and scientists, to assess specific endurance, and consequently it may contribute to the improvement of youth karatekas' performance level during the competition season.

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Zręczność w karate: Nowa kategoria zawodów dla rozwoju fizycznego dzieci o bardzo wysokiej niezawodności testowania/ i powtórnego testowania

Słowa kluczowe: karate, zręczność, niezawodność, test, test powtarzalny, rozwój fizyczny

Streszczenie

Tło i cel. Wczesna specjalizacja nie gwarantuje późniejszego sukcesu w zawodach. Ogólny rozwój umiejętności motorycznych wydaje się być kluczowym czynnikiem w osiągnięciu maksymalnych sukcesów w sporcie w starszym wieku. Aby zapobiec wypaleniu i wczesnej specjalizacji, Słowacki Związek Karate wprowadził nową dyscyplinę sportową pod nazwą *Kurs Agility Karate (KAC)*, w której młodzi karatecy wykorzystują swoje podstawowe umiejętności ruchowe. Celem niniejszego badania było zbadanie wiarygodności KAC-u, jako nowej dyscypliny zawodów dla młodych karateków. Materiały i metody. W badaniu wzięło udział 44 młodych karateków na poziomie krajowym: 28 mężczyzn (wiek $9,1 \pm 1,8$ y, masa ciała $40,0 \pm 12,4$ kg) i 16 kobiet (wiek $9,9 \pm 2,7$ y, masa ciała $38,9 \pm 8,8$ kg). Wszyscy wykonywali kurs KAC dla obu kategorii wiekowych dwukrotnie (sesje testowe i powtarzalne testy odbywały się w oddzielnych terminach, w odstępie 1 tygodnia). Wyniki. Wyniki testów i powtarzalnych testów wykazały, że KAC jest wiarygodny. Czas netto i czas całkowity dla dzieci w wieku 8-11 lat nie różnił się w przypadku testu i powtórnego testu. SEM i ICC dla obu zmiennych wynosiły odpowiednio $<5\%$ i $>.90$. Analizy Bland i Altman wykazały średnią różnicę (bias) $\pm 95\%$ granicy porozumienia. Wnioski. Badanie wykazało, że nowa dyscyplina KAC, z wzorcami wysiłku odtwarzającymi wymagania walki karate, może być uznana za wiarygodny, przeznaczony dla karate test terenowy do oceny sprawności fizycznej karateków.