

Specific fitness level in Fudokan Karate competitors at different levels of advancement

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Summary

Introduction. High level of athletic performance depends on multiple factors with motor training being the most important one. The goal of this paper was to determine whether and how the level of specific fitness of karate competitors changed, depending on their ranks.

Material and methods. The sample included 16 competitors from Polish Fudokan Karate Team. A battery of tests was applied in order to obtain information about selected motor features of the subjects, namely strength, endurance and speed.

Results. The level of specific fitness of karate competitors increases proportionally to their rank. Endurance and speed are believed to be the most important features affecting the competitors' performance level. For every fitness parameter, the desired features were determined at every rank to be included in the specifically designed model of sport championship.

Conclusions. The applied battery of tests was designed based on the previous achievements of karate competitors and coaches' experience. It will serve the development of sport-specific training program.

Introduction

Fudokan Karate has recently emerged as one of the most rapidly expanding karate styles. Unlike its sport version, or Kyokushin Karate, it does not involve division into weight categories, according to the principle that our opponent can be of different height or body mass. Thanks to no limitations of weight, height or body build, everyone can participate in training. Not only more experience gained, but also better motor training of karate competitors may contribute to their performance improvement.

To meet these requirements, it is necessary to create fitness models, which would help competitors and trainers to achieve the desired level of performance. Such models enable recognition of optimal proportions of motor traits development at different levels of advancement.

Each athlete involved in martial arts should have adequate muscle power, necessary for moving and punching. Besides, karatekas should develop maximal speed of muscle contraction (also from complete relaxation) [1]. Then, they are able to react with maximal speed to their opponents' actions.

Muscle strength, in turn, is necessary for muscle contraction after application of a given technique.

The strength itself, although very important, is insufficient for successful performance. Speed is necessary for effective use of the techniques developed. The higher the speed of action, the greater the strength at the moment of target action performance.

Apart from physical features, karatekas should also have such traits as courage and ability of stress coping, which are necessary to meet any challenge, such as karate competition, or endurance and patience, which are very important traits during long periods of preparation for competitions [2].

Material and methods

The goal of this study was to define specific fitness of Fudokan karatekas at different levels of advancement.

The sample included Polish Fudokan Karate team competitors. The studied cohort comprised 16 competitors from three age categories: juniors – 4 competitors, youth – 7 competitors and seniors – 5 competitors. The participants were

male karatekas having different ranks (from 4 KYU to 2 DAN) and different training record (from 3 to 15 years). The subjects' parameters are presented in Table 1.

The following fitness tests were applied:

1. Strength test, lifting maximal weight involving the workout of different muscle groups, used when performing karate techniques. It was developed by shihan Maciej Grubski, the world, European and Polish champion in Fudokan Karate. The participants made maximum three trials, the third one with maximal load applied. The test included the following exercises:
 - Trial 1 – Bench press. It measures the strength of thoracic muscles, involved while performing hand techniques.
 - Trial 2 – Military press. This trial measures the strength of dorsal muscles, necessary to perform adequate hand techniques. The hand technique training (particularly block or round attack) may be compared to bow stretching. The clavicle pulleys also help to retreat the arm after punch.
 - Trial 3 – Ez-bar preacher curl. The trial measures strength of muscles responsible for forearm flexion (biceps, arm and forearm reversing muscles. These muscles play a very important role in hand techniques – after the applied technique they retreat the hand to the baseline position.
 - Trial 4 – Behind-neck forearm extension. The purpose of this trial is to measure the strength of triceps muscles of the upper limbs during hand blows.
 - Trial 5 – Dumb bell squat. It measures the strength of shoulder girdle and lower limb muscles, mainly quadriceps muscles of the thigh. These muscles play an important role during dynamic leg pull up for kicks and during kicks.
 - Trial 6 – Lying shank curl. It measures strength of rear muscles of the thigh (mainly biceps) which play a very important role in leg retreating after kicks. The quicker the leg returns to the baseline position after a kick, the more difficult it is to catch the leg and spin during kumite fight.
 - Trial 7 (right hand) and 8 (left hand) – Dumb-bell press. The trial measures the strength of the shoulder girdle, necessary to perform hand techniques requiring strength. All the muscles of the shoulder girdle should be tightened so as not to lose balance after blow.
2. Endurance test. The test involves the biggest number of round kicks in 90 seconds (the time corresponding to kumite fight). The competitor kicks the punch bag at chest level.
3. Speed test. The competitors have to perform the biggest number of repetitions in the shortest time. They punch and kick the shields held by the partner.
 - a. The speed of blows while standing [3] – in fighting position, combination of two simple blows: kizami-zuki jodan (simple blow at head level with hand to leg stepped forward), gyaku-zuki chudan (simple blow at trunk level with the hand opposite to the leg stepped forward). The trial involves 30 combinations of simple blows. The blows were made at shields held by the partners; one at head level and the other one at trunk level.
 - b. Speed trial while hitting with the leg – the subject made 30 round kicks in fighting position, with the leg

Tab. 1. Characteristic of the studied sample

No	INITIAL	BODY HEIGHT	BODY MASS		RANK	TRAINING RECORD
1	D.S.	169	58	16	brown belt 2 KYU	6
2	D.Z.	185	76	17	black belt 1 DAN	9
3	J.M.	177	80	18	brown belt 2 KYU	9
4	P.K.	193	112	18	brown belt 3 KYU	8
5	M.G.	178	78	19	black belt 1 DAN	8
6	D.G.	167	68	19	brown belt 3 KYU	8
7	M.M.	176	86	19	black belt 1 DAN	8
8	Sz.J.	173	83	20	black belt 1 DAN	8
9	K.D.	183	77	21	black belt 2 DAN	8
10	K.T.	181	88	21	black belt 2 DAN	8
11	S.Sz.	183	94	21	black belt 1 DAN	10
12	B.A.	171	74	22	black belt 2 DAN	14
13	G.K.	170	78	30	black belt 1 DAN	15
14	W.T.	178	74	30	blue belt 4 KYU	3
15	P.Ś.	184	84	36	black belt 1 DAN	3
16	J.Ma.	181	115	38	black belt 1 DAN	10

stepped forward (ashi-mawashi-keri). Full kicks were counted from the moment when the foot touched the ground. The subjects kicked the shields held by their partners.

- c. Hip torsion speed trial – the subject was tied with the belt above the right hip; then he assumed the fighter position with left hip torsion, tightening the belt. At the command prompt, the subject performed 30 quick hip torsions. Belt pulls were counted.

Results

Strength test

Analysis of strength tests results with the weight (lifted during consecutive trials), calculated as the percentage of body mass (Fig. 1), revealed the changes as compared with the results expressed in kilograms (Tables 2-3). The average results of the first (bench press) and the second (military press) trial, obtained by the subjects with master ranks (1 DAN i 2 DAN) were almost identical (1% difference in fa-

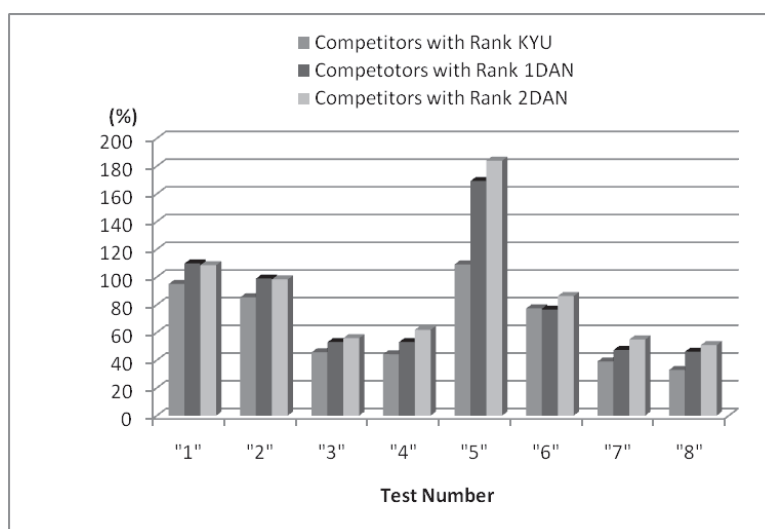


Fig. 1. Average strength tests results in competitors with different ranks (% of body mass)

Tab. 2. Results of bench press test (1) military press (2) ez-bar preacher curl (3) and behind-head arm extension (4)

No	Initial	Body mass	TRIAL 1 Bench press		TRIAL 2 Military bench press		TRIAL 3 Ez-bar preacher curl		TRIAL 4 Behind-head arm extension	
			kg	% of mass	kg	% of mass	kg	% of mass	kg	% of mass
1.	D.S.	58	66	114	60	103	31,5	54	37	64
2.	D.Z.	76	83	109	75	99	42	55	40	53
3.	J.M.	80	60	75	60	75	35	44	25	31
4.	P.K.	112	68	61	65	58	35	31	30	27
5.	M.G.	78	105	135	90	115	45	58	-	-
6.	D.G.	68	98	144	70	103	40	59	42	62
7.	M.M.	86	92	107	85	99	49	57	36	42
8.	Sz.J.	83	83	100	75	90	45	54	52	63
9.	K.D.	77	83	108	75	97	45	58	52	68
10.	K.T.	88	100	114	85	97	47	53	53,5	61
11.	S.Sz.	94	100	106	95	101	46,5	49	52	55
12.	B.A.	74	77	104	75	101	42,5	57	42,5	57
13.	G.K.	78	120	154	90	115	55	71	57	73
14.	W.T.	74	60	81	65	88	30	41	28	38
15.	P.Ś.	84	65	77	80	95	35	42	37,5	45
16.	J.Ma.	115	105	91	90	78	45	39	47	41

Tab. 3. Results of the tests: dumb bell squat (5), lying shank curl (6), dumb bell press with the right (7) and left hand (8)

No	Initial	Body mass	TRIAL 5 dumb bell squat		TRIAL 6 lying shank curl		TRIAL 7 – right hand (R) and TRIAL 8 – left hand (L) Dumb bell press			
							R		L	
			kg	% of mass	kg	% of mass	kg	% of mass	Kg	% of mass
1.	D.S.	58	105	181	50	86	30	52	20	34
2.	D.Z.	76	155	204	70	92	37	49	37	49
3.	J.M.	80	65	81	60	75	22	28	22	28
4.	P.K.	112	80	71	60	54	32	29	22	20
5.	M.G.	78	135	173	65	83	38	49	43	55
6.	D.G.	68	90	132	62	91	36	53	36	53
7.	M.M.	86	130	151	50	58	43	50	38	44
8.	Sz.J.	83	155	187	70	84	35	42	32	39
9.	K.D.	77	155	201	70	91	42	55	37	48
10.	K.T.	88	160	182	70	80	52	59	48	55
11.	S.Sz.	94	175	186	90	96	52	55	46	49
12.	B.A.	74	125	169	65	88	38	51	37	50
13.	G.K.	78	170	218	60	77	48	62	48	62
14.	W.T.	74	60	81	60	81	25	34	22	30
15.	P.Ś.	84	125	149	60	71	25	30	25	30
16.	J.Ma.	115	100	87	60	52	48	42	48	42

our of the competitors with 1 DAN rank). In the remaining trials, the best average results were obtained by the competitors with 2 DAN. The differences between the results of this group and the group with 1 DAN rank were from 3% (for the third trial – ez-bar preacher curl) to 15% (in trial 5 – dumb bell squat). The group with KYU ranks obtained the lowest results. The difference between this group and the group with 2 DAN was between 9% and 75%. In trial 6 (lying shank curl), the mean results of KYU and 1 DAN subjects were identical (77%).

Endurance test

The length of the endurance test was correspondent to the length of kumite fight (90 seconds – effective fight time). The goal of this trial was to determine how many lower limb techniques the competitor is able to perform within 90 seconds (Table 4).

As there are no norms for reference, the test results equal to 85 repetitions and below were considered below average. The results from 86 to 95 repetitions were regarded average and above these values, they were regarded above average.

If we accept the rank as a criterion (Fig. 2), the endurance level of Fudokan karatekas looks different. The average number of repetitions is directly proportional to the competitor's rank. The competitors who were the holders of student grades obtained the lowest result (85 repetitions). The competitors with 1 DAN master grade made 97 repetitions on average (12 repetitions more than the practitioners with KYU rank). The group with 2 DAN rank made 112 repetitions – the result higher than that of 1 DAN holders by 15 repetitions. The difference

between the results of 2 DAN holders and KYU holders was 27 repetitions.

Speed test

Among the 16 competitors, only three obtained the result below 9 s in the first trial. The time of kicks was from 17.42 to over 21 s. The difference in the results obtained during the third trial was over 3 seconds.

Differences in speed test results according to the competitors' ranks

If we accept the competitors' ranks as criteria (Fig. 3), we can notice improvement in time of performance of all the trials. Fig. 3 illustrates this correlation. The competitors with KYU ranks required the longest time to perform the trials.

During all the trials, the difference between the most advanced practitioners and the competitors with 1 DAN rank was over 1 second. During the trial involving kicks while standing (1), the average time obtained from the former was 8.81 s (1.53 s better than that of 1 DAN group), during trial 2 – 17.59 s (1.30 s higher), and during the hip torsion trial (3) – 9.97 s (1.34 s higher).

Discussion

Physical fitness of martial arts practitioners was discussed by several authors. In 1992, Sterkowicz published two papers reporting his attempt to diagnose physical fitness in

karatekas with different ranks. He performed 9 tests, as he had found out that their diagnostic value is adequate to control the training process in karate. The author claims that simple blows in the trunk and shuto uchi blows may be applied to replace the "Tameshiwari" (board smashing) [4]. The next paper (based on Eurofit tests) allowed the author to conclude that Karatekas – particularly when heavy weight, have substantial strength of the abdominal muscles (on average, their score was 89. points), while 5 those belonging to light weight categories have strong arms and shoulders (average score – 84 points) [5].

The same author investigated motor fitness of karate instructors and determined their aerobic and anaerobic fitness [3]. The sample comprised 41 competitors whose mean age was 25 years and training record – 9 years. A battery of

tests measuring specific fitness was applied [according to 4], including the trials of right simple blow in the trunk (gyakuzuki chudan) (7) and shuto uchi (8).

The trials 7 and 8 (dumb bell press) revealed that only 6 competitors obtained the same results of blows with the right and left hand (Table 3). This may indicate equal development of strength in both limbs. It is particularly essential as lateralization may affect the fight efficiency. As found by Starosta [6], equal distribution of strength at both sides is a desirable factor in multiple sports including combat sports. In most of the strength tests, as it was expected, the highest results were obtained by the competitors with the highest rank, 2 DAN (Fig. 3). Only during the first two trials (bench press and military press) the group with 1 DAN grade had better results; the results of the third trial were equal.

Tab. 4. Results of the endurance test (kicks – 90 seconds)

No	INITIAL	AGE	RANK	RESULT (number of repetitions)
1.	D.S.	16	borwn belt 2 KYU	90
2.	D.Z.	17	black belt 1 DAN	100
3.	J.M.	18	brown belt 2 KYU	88
4.	P.K.	18	brown belt 3 KYU	81
5.	M.G.	19	black belt 1 DAN	102
6.	D.G.	19	brown belt 3 KYU	101
7.	M.M.	19	black belt 1 DAN	93
8.	Sz.J.	20	black belt 1 DAN	96
9.	K.D.	21	black belt 2 DAN	115
10.	K.T.	21	black belt 2 DAN	109
11.	S.Sz.	21	black belt 1 DAN	110
12.	B.A.	22	black belt 2 DAN	112
13.	G.K.	30	black belt 1 DAN	117
14.	W.T.	30	blue belt 4 KYU	67
15.	P.Ś.	36	black belt 1 DAN	76
16.	J.Ma.	38	black belt 1 DAN	82

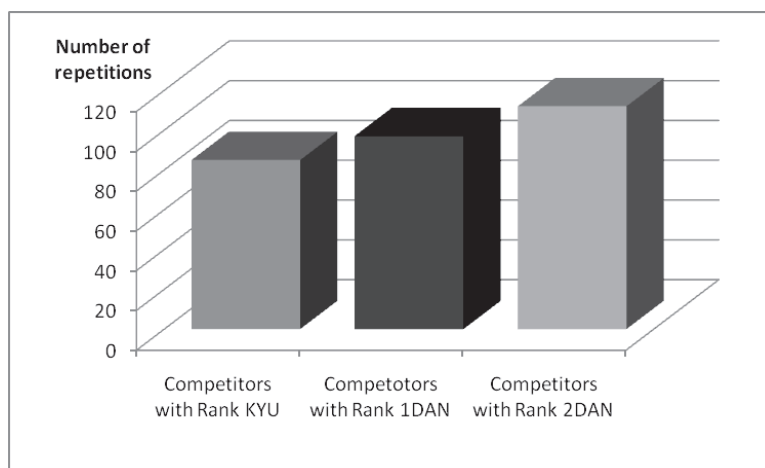


Fig. 2. Average results of the endurance test according to the competitors' rank (x)

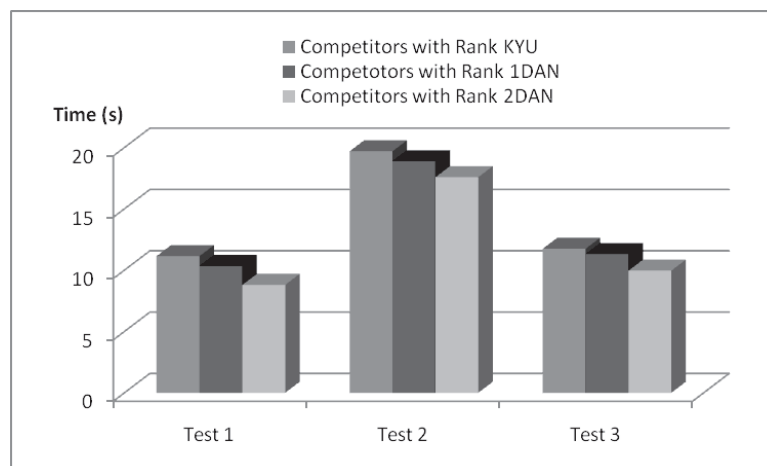


Fig. 3. Average results of the speed test according to the competitors' ranks

In karate, biceps contraction results in retreating the hand after punch. Many competitors focus their attention on punch rather than retreating the hand and preparing for the application of subsequent techniques. In theory, 2 DAN holders with longer training record and more experienced, should obtain better results. Ignoring this element in the training process may result from lack of progress and thus, poorer outcome in trial 3 in this group of competitors, as compared to the practitioners with lower ranks – 1 DAN.

The competitors with student grades (KYU) obtained the worst results for strength among all the studied groups of competitors, according to their ranks.

As for reference values for all the studied groups, it seems that bench press and military press involving several groups of muscles, require the result corresponding to 100% of body mass. The minimal threshold of relative strength for the trials 3 and 4, 7 and 8 should amount to approximately 50%. In the trials measuring lower limb strength, the minimal value of relative strength should be 150% and 70% for the trails: 5 and 6 respectively.

Witkowski and colleagues [7] discussed endurance in combat sports. They applied a 30-second test with a punch bag to assess endurance, focusing on heart rate values obtained from this test. Although the subjects were taekwondo and kickboxing competitors, they concluded that strength development was necessary as a fundamental for the remaining motor features used in combat sports. Moreover, it is of note that contemporary combat sports requirements exceed the typical requirements for one specific discipline, hence the training should involve not only one sport-specific elements.

The result of endurance tests for karate practitioners with student grades should be at least 80 kicks, for 1 DAN holders – at least 90 kicks (approximately 1 kick per second) and for 2 DAN holders – at least 100 kicks. In the studied cohort, 100% of the highest rank holders and 6 among 8 1 DAN holders met this criterion. One subject with student grade did not meet the criterion (Table 4).

Evaluation of the speed in Kyokushin Karate competitors was made by Sterkowicz [4] using analogical trials. Most of

the studied Fudokan competitors obtained better results than Kyokushin karatekas. The better results of Fudokan competitors may be due to different training methods than these applied in the early 90 s, when Sterkowicz carried out his research. Currently, the training aims at the improvement of motor fitness. Within several years, the methods of training have been significantly modified. The difference may also result from the trained techniques placing lesser emphasis on hip workout, fighter position or methods of attack.

When comparing the results of different groups according to the competitors' ranks, we noted that Fudokan group obtained better results than Kyokushin group, by 0.2 s and 1.2 s respectively in consecutive trials – kicks in standing position and hip torsion. In the second trial, Kyokushin karatekas obtained better results, on average by 0.2 s. The poorer outcome of Fudokan karatekas may result from the differences in the principles of both karate styles. In Kyokushin karate, hand attacks are allowed only in the trunk and kicks – both in the trunk and head. Hence the competitors' lower limbs are better trained. In Fudokan karate, hand and leg attacks are allowed in chudan (trunk) and jodan (head) zones. Kumite fight involves more attacks and blocks with the upper limbs, which may be the reason of better results in trials 1 and 3.

A similar correlation was noted between the rank and speed of attacks by Filoch. He believes that the time of attack shortens proportionally to the rank [8].

As compared with Fudokan karatekas with student grades, the group of soldiers, also with student grades in combat sports, obtained worse results [9]. This may indicate that karate considerably contributes to the development of speed, the element which is essential in military service, police and similar service.

The best competitor's time in speed test was 17.42 s. It took him about 0.58 s to make one kick. The slowest competitor made 30 kicks in 21.10 s, so one kick took about 0.7 s. The difference between the results of these competitors is about 0.12 s. In the trial measuring punch speed, the quickest competitor made to combined simple punches (kizamizu-

ki, gyakuzuki) in 0.29 s while the slowest one did it in 0.42 s, which makes 0.13 s difference.

The comparison presented above indicate the speed of kumite fight, when only fractions of seconds determine whether the fight is won or lost. Frequently, even minor differences in time are essential.

The karate training applied in this study resulted in comprehensive fitness development. This confirms Bujak's finding that karatekas have the highest level of fitness among all youth athletes involved in combat sports [10].

Conclusions

The study let us draw the following conclusions:

1. The model values of physical fitness in Fudokan Karate competitors with different ranks include:
 - Competitors with KYU ranks should focus on learning and development of karate techniques. In such strength trials as bench press, military press and dumb bell squat, KYU holders should obtain the result equal to 80% of their body mass, while in the remaining trials the minimal result should be equal to 40% of body mass. An optimal result of endurance test should involve 80-85 repetitions for this group. As for speed tests, measuring speed of punch from standing position, speed of kicks and hip torsion speed, the results in this group should amount to 11 s, 19 s and 11.50 s respectively.

- For 1 DAN holders, the minimal strength threshold in consecutive trials should be the following: 100% of body mass for bench press and military press, 50% of body mass for ez-bar preacher curl, behind-neck shoulder extension and dumb bell press with the right and left hand, 150% for the dumb bell squat and 70% for lying shank curl. As for endurance test, the competitors should make minimum 90 kicks. In speed trials, the time should be shorter by 10 s, 18.30 s and 10.80 s compared with the student rank holders.
 - The most advanced competitors, 2 DAN holders, should obtain the highest results in all speed tests. The time should be 1 second shorter than that obtained from 1 DAN holders – 9 s, 17.50 s and 10 s respectively for all speed trials. In endurance test, the number of repetitions should exceed 100. The results of strength tests should be similar in 2 DAN and 1 Dan holders.
2. In case of two parameters, namely speed and endurance, a correlation is noted between the improvement of motor traits and the competitor's rank. In six among eight strength trials (ez-bar preacher curl, dumb bell squat, lying shank curl, dumb bell press with the right and left hand) such a correlation was also noted.
 3. The applied battery of tests may be used for measuring sport-specific fitness in Fudokan karatekas. The tests have been used for many years to assess the fitness of athletes involved in combat sports.

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