

Original Article

## Morphological Characteristics as Predictors of Competitors Selection in Karate

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### Abstract

The research was aimed at determining the predictive values of morphological characteristics in the competitive selection of young karatekas. The research included a total of 79 karatekas, aged 11 to 13 ( $\pm 0.5$  years) of which 37 were competitors in kumite, 23 in kata, and 19 participants who competed in both disciplines. It was expected that certain differences between the examined groups of karatekas in morphological characteristics would appear, which was confirmed by the obtained results. The hypothesis that participants of different competitive orientations will differ significantly in the results of morphological characteristics has been partially confirmed. However, the tendencies of some differences registered in the oldest age of the participants, as well as the analysis of some researches conducted on the population of elite karate players, indicate the importance of forecasting definite morphological characteristics for success in a specific competitive discipline (kata or kumite).

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## **1. Introduction**

In literature, we encounter numerous attempts to define karate, with, as a rule, the emphasis is placed on polemic, mystique and overall complexity of karate research as a sort of phenomenon (Dopsaj et al., 2017; Kahrović et al., 2018a; Dewangga Yudhistira, 2020). In this regard, it seems helpful to claim that, instead of the usual question: "when and where it originated", it is more important to answer the question "what is karate" or "what can be defined as karate" (Kahrović et al., 2018b; Vveinhardt, & Kaspars, 2022; Cavedon, Milanese, Sacristani, & Zancanaro, 2023). Even though it is one of the youngest martial arts disciplines, it is also one of the most popular ones (Sánchez-Puccini, Argothy-Bucheli, Meneses-Echávez, López-Albán, & Ramírez-Vélez, 2014; Taheri Kalani, & Nikseresht, 2018; Dewangga Yudhistira, 2020; Aju, Mathew, & Prakasi, 2022; Billal, & Jahan Priyanka 2023).

Programming of training process in karate is a delicate methodological problem due to the existence of two competitive disciplines, kata and kumite (Doder, Malacko, Stanković, & Doder, 2009; Molinaro, Taborri, Montecchiani, & Rossi, 2020; Kindzer et al., 2021). Earlier involvement of children in the process of training and competition, as well as the greater interest of female population in martial arts is a tendency that has been observed recently (Dizaji, Memar, & Sadeghi, 2016; Rutkowski, Sobiech, & Chwałczyńska, 2019). Namely, after joint training, after tenth or eleventh year of life, there is a spontaneous separation of karatekas who compete in these two different disciplines and undergo different programs of competitive training (Ma, & Qu, 2017). Since karate competitions take place in kumite and kata, subject of interest in this research are morphological characteristics that contribute to the differentiation of competitors for one of these two disciplines (Przybylski, Janiak, Szewczyk, Wieliński, & Domaszewska, 2021). Morphological characteristics of human anthropological status include the processes of growth and development (Radu, Popovici, & Puni, 2015). Therefore, during this research, testing of relevant morphological characteristics was conducted, in order to determine which dimensions discriminate against these groups of competitors (Martinez-de-Quel, Alegre, Castillo-García, & Ayán, 2021).

Numerous studies clearly show that morphological characteristics are an important factor in achieving high results of elite karatekas (Katić, Blažević, Krstulović, & Mulić, 2005; Koropanovski et al., 2011; Sánchez-Puccini et al., 2014; Vidranski, Maškarin, & Jukić 2015; Malacko et al., 2015; Katanic, Bjelica, Rezić, Selimi, & Osmani, 2022). However, research in karate is in most cases conducted on a sample of seniors, while research dealing with the examination of the morphological characteristics of karate athletes of younger age categories is not proportionately represented.

There is no doubt that the examination of anthropometric measurements of young karatekas makes the karate orientation process more efficient. This actually means that we should point out the obvious lack of data on the importance of determining the morphological status of young karate athletes, as well as

examining the differences in morphological characteristics between young kata and kumite competitors (Mudrić, 2019).

Therefore, the research was aimed at determining the predictive values of morphological characteristics in the competitive selection of young karatekas. In relation to the set subject and aim of the research, as well as on the basis of previous research, the following hypothesis is given: morphological characteristics are important predictors of competitive selection in karate. The expected findings of this study could be significant in the early selection and training of karate, as well as in determining the specialization and evaluation of kata and kumite competitors.

## 2. Material and methods

### *Participants*

The sample of participants consisted of male karatekas, aged 11 to 13 ( $\pm 0.5$  years), who are in the regular training process and compete within the current system of competition in the Karate Federation of Serbia. The research included a total of 79 karatekas, of which 37 compete in kumite, 23 compete in kata, and 19 participants who compete in both disciplines (Table 1).

**Table 1.** *Participants characteristics*

Age of participants	Kumite	Kata	Kumite+kata	Total
11 years	17	6	10	33
12 years	13	5	4	22
13 years	7	12	5	24
<b>Total</b>	37	23	19	79

### *Sample of variables*

To assess the morphological characteristics of participants, 12 measuring instruments were used: body height (BH), arm length (AL), leg length (LL), shoulder width (SW), pelvic width (PW), hand width (HW), body weight (BW), mean chest circumference (MCC), upper arm circumference (UAC), upper arm fold (UAF), back skin fold (BSF), abdominal skin fold (ASF).

### *Procedures*

The measurement of anthropometric measures was carried out according to the model of the International Biological Program (IBP), designed to cover all four latent areas: longitudinal skeletal dimensionality, transverse skeletal dimensionality, body volume and mass, and subcutaneous adipose tissue.

For the purposes of the research, optimal conditions were created when measuring the participants, namely: the measurement was performed in the morning from 9 to 11 am; standard-made instruments were calibrated before

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starting the measurement of each group; the room where the measurements were taken was well lit, and the air temperature was such (18-22° C) that the minimally trained participants felt comfortable. The following participated in the organization of the measurement: trainers of participants, the main organizer of research, assistant organizer of research and the technical person in charge of storing test data.

*Statistical analysis*

The results of morphological characteristics measurements were statistically processed using descriptive statistical parameters: arithmetic mean (AM), standard deviation (SD), with 95% confidence interval, as well as multivariate analysis of variance (MANOVA), and univariate analysis of variance (ANOVA). The statistical significance was set at level  $p < 0.05$ .

**3. Results and Discussions**

The results of morphological indicators' descriptive statistics of the entire sample are shown in the table (Table 2). Although in most tests, kumite competitors had slightly higher values than kata competitors, ie kata+kumite competitors, these differences were not significant. See Table 5. for details.

**Table 2.** *Descriptive statistics of morphological variables*

Variables	Kumite		Kata		Kata+kumite	
	AM (SD)	95% CI	AM (SD)	95% CI	AM (SD)	95% CI
<b>BH</b>	162.5 (10.9)	159.0 ÷ 165.9	156.4 (8.6)	152.9 ÷ 159.9	158.8 (12.4)	153.3 ÷ 164.2
<b>AL</b>	71.1 (5.2)	69.5 ÷ 72.8	68.2 (5.0)	66.2 ÷ 70.2	68.4 (5.6)	65.9 ÷ 70.8
<b>LL</b>	93.6 (6.7)	91.4 ÷ 95.7	90.1 (5.6)	87.8 ÷ 92.4	92.7 (7.9)	89.3 ÷ 96.2
<b>SW</b>	80.1 (9.0)	77.2 ÷ 82.9	78.1 (9.8)	74.1 ÷ 82.2	77.3 (8.3)	73.6 ÷ 80.9
<b>PW</b>	10.0 (5.2)	8.4 ÷ 11.7	12.4 (6.7)	9.6 ÷ 15.1	9.6 (5.4)	7.2 ÷ 11.9
<b>HW</b>	7.6 (0.7)	7.4 ÷ 7.8	7.3 (0.6)	7.1 ÷ 7.6	7.4 (0.7)	7.1 ÷ 7.7

Legend: AM - Arithmetic mean, SD - Standard deviation, 95% CI - Confidence interval.

Morphological variables (arithmetic mean and standard deviation) with corresponding 95% confidence intervals according to age and competitive orientation are shown in the table (Table 3).

**Table 3.** Descriptive statistics of anthropometric variables  
 (by age and competitive selection)

Variables	Age	Kumite		Kata		Kata+kumite	
		AM (SD)	95% CI	AM (SD)	95% CI	AM (SD)	95% CI
<b>BH</b>	13 years	170.8 (8.1)	167.0 ÷ 174.7	161.6 (10.7)	153.0 ÷ 170.2	165.2 (12.2)	157.7 ÷ 172.8
	12 years	158.9 (6.2)	155.7 ÷ 162.2	153.1 (5.3)	148.5 ÷ 157.8	156.8 (12.5)	144.5 ÷ 169.0
	11 years	149.2 (6.4)	144.5 ÷ 153.9	155.2 (8.0)	150.7 ÷ 159.7	149.4 (5.6)	144.9 ÷ 153.8
<b>AL</b>	13 years	74.4 (4.5)	72.3 ÷ 76.5	71.9 (7.1)	66.2 ÷ 77.6	70.8 (5.9)	67.1 ÷ 74.4
	12 years	70.2 (3.3)	68.5 ÷ 71.9	66.9 (3.0)	64.2 ÷ 69.5	69.2 (4.7)	64.6 ÷ 73.8
	11 years	65.1 (3.8)	62.3 ÷ 67.9	66.9 (3.6)	64.8 ÷ 69.0	63.9 (2.5)	61.9 ÷ 65.8
<b>LL</b>	13 years	98.1 (5.1)	95.6 ÷ 100.5	92.5 (6.5)	87.3 ÷ 97.7	96.4 (8.7)	91.0 ÷ 101.8
	12 years	92.0 (4.4)	89.7 ÷ 94.3	86.7 (5.0)	82.4 ÷ 91.1	91.5 (6.1)	85.5 ÷ 97.5
	11 years	85.8 (5.7)	81.6 ÷ 90.0	90.3 (5.1)	87.4 ÷ 93.2	87.4 (3.9)	84.2 ÷ 90.5
<b>SW</b>	13 years	84.4 (10.2)	79.5 ÷ 89.2	85.8 (13.0)	75.4 ÷ 96.2	80.0 (7.2)	75.5 ÷ 84.5
	12 years	77.6 (5.6)	74.7 ÷ 80.6	74.1 (6.0)	68.8 ÷ 79.4	80.6 (5.2)	75.5 ÷ 85.6
	11 years	74.6 (6.9)	69.5 ÷ 79.7	76.0 (7.7)	71.6 ÷ 80.3	70.6 (8.8)	63.6 ÷ 77.6
<b>PW</b>	13 years	10.5 (5.8)	7.8 ÷ 13.3	12.8 (9.5)	5.3 ÷ 20.4	8.8 (4.5)	6.0 ÷ 11.6
	12 years	9.8 (4.1)	7.7 ÷ 11.9	10.6 (7.9)	3.7 ÷ 17.5	10.8 (5.9)	5.0 ÷ 16.5
	11 years	9.3 (6.0)	4.8 ÷ 13.7	12.9 (5.1)	10.0 ÷ 15.8	10.0 (7.3)	4.2 ÷ 15.8
<b>HW</b>	13 years	8.0 (0.5)	7.8 ÷ 8.3	7.9 (0.7)	7.4 ÷ 8.5	7.8 (0.7)	7.4 ÷ 8.2
	12 years	7.4 (0.7)	7.1 ÷ 7.8	7.1 (0.3)	6.8 ÷ 7.4	7.3 (0.3)	7.0 ÷ 7.6
	11 years	6.9 (0.3)	6.6 ÷ 7.1	7.1 (0.6)	6.8 ÷ 7.5	6.9 (0.4)	6.6 ÷ 7.2

Legend: AM - Arithmetic mean, SD - Standard deviation, 95% CI - Confidence interval.

Multivariate analysis of variance (Table 4) indicated that only age had a significant effect. Subsequent analysis showed that the anthropometric dimensions were significantly larger in older subjects in all cases except for pelvic width. Competitive orientation, ie cross-effect of age and competitive orientation had no significant effect.

**Table 4.** Results of multivariate analysis of variance (MANOVA) for anthropometric variables (factors age and competitive orientation)

F values		
Age	Orientation	Age x Orientation
3.28**	0.75*	1.25

Univariate analysis of variance (Table 5) showed that only age had a significant effect. The results show that anthropometric variables were significantly higher in older subjects in all cases except for the APW variable.

**Table 5.** Results of univariate analysis of variance (ANOVA) for anthropometric variables (factors age and competitive orientation)

	Age	Orientation	Age x Orientation
<b>Variables</b>	F(2;81)	F(2;81)	F(4;81)
<b>BH</b>	19.59**	0.38	0.09
<b>AL</b>	16.22**	0.29	0.37
<b>LL</b>	12.73**	0.40	0.07
<b>SW</b>	8.83**	0.75	0.45
<b>PW</b>	0.02	0.36	0.89
<b>HW</b>	20.45**	0.76	0.60

Legend: \*- p<0.05, \*\*- p<0.01.

### Discussions

The primary purpose of the study was to determine whether morphological characteristics are a predictor of success in the competitive selection of young karatekas, aged 11-13 years ( $\pm 0.5$  years). Our starting point was the basic fact that all examined (both kata and kumite competitors) in the first phase of training went through a unique process in the formation of the basic technique profile. Only in the later period of training does their spontaneous differentiation occur on the basis of morphological constitutions or under the influence of some other factors. The hypothesis was based on the differences in the requirements for the application of techniques in kata and kumite and the criteria for evaluating competitive performance, which objectively require a certain type of body constitution for one or another competitive discipline. In this regard, it is obvious that the top competitors in kata are, on average, of lower height and, in general, of "smaller body constitutions" in relation to the competitors in kumite. Kata as a competitive discipline requires a high level of standard technique of stances, movements, blocks, strikes and other technical elements, which are connected in a symbolic martial form in a precisely determined order and rhythm, which, in addition to technical perfection, must create a "real" image of a combat with an imaginary

opponent (Kahrović et al., 2018b). Therefore, this performance has a special requirement that refers to the aesthetic impression in the display of fast, explosive movements and designed martial movements, which obviously suits lower and lighter competitors (Sánchez-Puccini et al., 2014; Przybylski et al., 2021).

In this part of the analysis of the research results, we wanted to answer the following question: what differences exist in the measured morphological characteristics between kumite competitors, kata competitors and kata+kumite competitors of the same age. In order to achieve the complete insight into this issue, the analysis of differences was performed at the univariate and multivariate level with descriptive statistics of morphological variables according to age or competitive orientation. Based on the results of morphological indicators' descriptive statistics of the entire sample, we conclude that, in most tests, kumite competitors have slightly higher values than kata competitors, ie kata+kumite competitors. Compared to the other two groups of participants, kumite competitors have significantly higher values in the variables BH, AL, LL, and this difference is especially evident in older participants ( $13 \pm 0.5$  years). These results confirm the empirical observations that say that body height, legs and arms length represent constitutional benefits for success in kumite, which should be kept in mind when selecting and competitively guiding young karatekas. Multivariate analysis of variance indicated that the only significant effect was age. Subsequent analysis showed that the anthropometric dimensions were significantly higher in older subjects in all cases except for pelvic width, which can be attributed to the fact that subjects are obviously in puberty, a developmental period in which growth and development is intense and independent from the activity that someone is engaged in, and two years is a long period of time for that age. There were no significant effects of competitive orientation, ie cross-effect of age and competitive orientation.

Previous research (Sánchez-Puccini et al., 2014; Jukić, Čavala, Katić, Zagorac, & Blažević, 2017; Mala et al., 2019; Doder, Radišić, Mujanović, & Mojsilović, 2022) shows that the morphological characteristics of competitors play a significant role in achieving results in karate. Morphological characteristics also have a significant impact on specific karate tasks (Chaabene, Hachana, Franchini, Mkaouer, & Chamari, 2012), movement efficiency, strike speed, strike strength and accuracy (Przybylski et al., 2021). If we analyze the previous research from the aspect of similarity of the topic with which we started our research, we can conclude that there are very few of them. In one, the authors Doder, & Doder (2006), undertook research with the aim of determining the influence of the predictor system of morphological variables and basic motor variables on the criterion variable. The results indicate that the system of morphological variables has a statistically significant influence on the criterion variable. Young karatekas of higher body height, and thus longer limbs, had better results in performing a direct frontward kick. If we compare the results of our research with other similar research (Koropanovski et al., 2011), we can conclude that there are no major differences. The authors of that research assumed that the top competitors in

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kumite and kata differ in terms of their anthropometric measures. As in our study, kumite competitors had larger body size through body height, while differences in body composition were not significant.

However, it should be emphasized that our study has some limitations. Our study cannot be fully generalized primarily due to the age and gender of the subjects, as well as the level of competition. Nevertheless, we consider our results promising and strongly recommend future sports researches to further investigate the role and importance of morphological characteristics in karate athletes, young kata and kumite competitors, as well as examine the effects of different types of programmed exercise in order to improve the overall performance of karate athletes.

#### 4. Conclusions

The obtained results confirm the empirical observations which say that body height, arms and legs length represent constitutional benefits for success in sports fighting. Multivariate analysis of variance indicated that the only significant effect was age. Subsequent analysis showed that anthropometric dimensions were significantly larger in older subjects. There were no significant effects of competitive orientation, ie cross-effect of age and competitive orientation. The hypothesis that participants of different competitive orientations will differ significantly in the results of morphological characteristics has been partially confirmed. However, the tendencies of some differences registered in the oldest age of the participants, as well as the analysis of some researches conducted on the population of elite karate players, indicate the importance of forecasting definite morphological characteristics for success in a specific competitive discipline (kata or kumite). Obtained results of the performed research will be used in solving theoretical problems that rely on needs of the praxis, which represents a great contribution to karate sport.

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