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Original research article

THE INFLUENCE OF MOTOR BEHAVIOR VARIABLES ON A SET KARATE KATA PERFORMANCE

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Abstract. *The aim of this study was to determine the influence of a system of motor behavior variables on set kata performance as the only criterion variable, and also to create a battery of measuring instruments for diagnostics, evaluation, monitoring and assessment of the kata performance based on their predictive validity. Eighty-two boys training karate, aged 10-14, were tested by using 12 motor variables, and 1 criterion variable. The variables' individual validity was determined by the stepwise regression analysis. The results indicated that the system of basic motor variables had a statistically significant influence at p=.00, with a multiple correlation coefficient of .67 (Ro= .67), and multiple correlation squared of .45, explaining about 45% (Ro^2= .45) of the variance. Based on the analysis of individual predictive motor behavior variables, the following had the greatest and most significant influence on the criterion variable: 30s sit-ups, the standing broad jump, 20m run, foot tapping, deep forward bend on the bench, and standing triple jump. The stepwise method isolated a reduced system of the same five motor behavior variables. According to these findings, the following battery of measuring instruments for diagnostics, evaluation, monitoring and assessment of the kata performance is recommended: the standing broad jump, standing triple jump, 20m run, 30s sit-ups, and hyperextensions on the bench.*

Key words: *10-14-year-old boys, motor skills, set kata, predictive validity.*

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INTRODUCTION

The predictive validity of variables used for the evaluation and monitoring of the anthropological status of athletes is designed, modeled and programmed on precise sports technology and methodology. These are used in order to construct a hierarchical structure, in which the most dominant and relevant anthropological characteristics and movement structures are identified by way of a regression analysis in the order of their respective influence on sports results (achievements). If there are high and statistically significant correlation coefficients and influences among them, it means that they represent meaningful and well-constructed movement structures and anthropological characteristics and abilities, which can then be taken into account when diagnosing and predicting using appropriate transformational processes and effective outcomes (Doder, D., Malacko, Stanković, & Doder, R, 2011; Sterkowicz & Franchini, 2009; Doder, D., Malacko, Stanković, & Doder, R., 2009; Doder & Malacko, 2008; Blazević, Katić & Popović, 2006; Doder, 2006; Malacko & Rađo, 2004).

Combat and kata are two types of competition in karate in all age categories. Combat is a match between two opponents with a number of technical and tactical activities and strategies aimed at the symbolic destruction of the opponent. It is a test of perfection, harmony and precision in the application of techniques.

Kata, on the other hand, consists of many attack and defense techniques, with at least twenty of them used in a particular order (Stričević, 1997). Kata, as a type of competition, represents the best way of symbolizing original traditional principles of karate (Funakoshi, 1995). There are student and master katas. There are five student katas and about fifty master katas. They are usually named after the person perfecting them.

Performance in a kata competition is assessed based on a true demonstration of the kata meaning, a full understanding of the techniques, timing, rhythm, speed, balance and focus of strength, proper breathing, good focus of attention and concentration, accurate performance of stances and appropriate tonus of leg muscles, with feet firmly on the ground, firmly toned abdominal muscles, leveled hips, as well as a correct style form that is being presented. Kata performance is also assessed by other criteria, such as the level of difficulty and the like (Doder, D., Malacko, & Doder R., 2010).

Therefore, the purpose of this study was to determine the influence of a system of motor behavior variables on set kata performance as the only criterion variable in young boys training karate. The subsequent task was to create a battery of measuring instruments for diagnostics, evaluation, monitoring and assessment of kata performance based on their predictive validity in order to meaningfully plan, program and control the effects of an operationalized training process.

THE METHOD

The sample of participants

The sample was made up of 82 boys, aged 10-14 years, from 18 different karate clubs from the Province of Vojvodina, Serbia. All of the participants were informed of the testing procedures, after which written consent forms were obtained from the parents.

Variable sample

The sample consisted of 13 variables, 1 criterion and 12 predictive motor behavior variables.

The evaluation of the kata performance was done by a group of 5 independent referees. All of the participants performed the fifth student's kata (hean godan). The referees marked each participant with marks of 1-5 (from lowest to highest), and the marks were recorded by a third party. Eventually, the average mark was calculated for each participant (Doder, 2000).

The following 12 predictive motor behavior variables for the assessment of motor skills were applied (Gredelj, Metikoš, Hošek, & Momirović, 1975):

Variables	Dimensions	Metric units
Agility in the air	*Mechanism of movement structuring*	s
Hand-tapping		fr
Foot-tapping		fr
Hyperextensions on the bench	*Mechanism of tonus regulation and synergistic action*	cm
Standing on one foot on the balance beam		s
Shoulder flexibility with a yard stick		cm
30s sit-ups	*Mechanism of regulation of excitation duration*	fr
Push-ups on parallel bars		fr
Half-squat with load		s
Standing broad jump	*Mechanism of regulation of excitation intensity*	cm
Standing triple-jump		cm
20m run with a flying start		s

Data analyses

The following central and dispersion parameters were determined for each variable: mean (M), standard deviation (S), standard error of the mean (Se), minimal value (min), and maximal value (max). The normality of distribution was tested by means of skewness (Sk) and kurtosis (Ku).

Individual influences of the motor behavior variable systems (as a system of predictive variables) on the criterion variable were analyzed by a regression analysis. In this procedure, the following univariate statistical parameters were applied: the influence of each standardized predictive variable on the criterion variable (β), testing of the significance of each predictive variable's influence on the criterion variable (t), and statistical significance of each predictive variable's influence on the criterion variable at p=.05-.00. Multivariate values were calculated based on the following parameters: multiple correlation squared (R_o^2), multiple correlation between the entire system of predictive variables and criterion variable, testing of significance by means of the F-test (F), and statistical significance of the influence of the entire system of predictive variables on the criterion variable at p= .05 - .00.

In the regression analysis, the stepwise method was used, a model that is essentially based on a gradual introduction of variables (one at a time, or step-by-step) in the order from the highest to the lowest multivariate and univariate predictive influence and its calculated statistical significance (p). The purpose of this model is to find the best possible regression procedures explaining specific criterion variables, and also to determine and analyze relative influences of each of the tested variables (expressed in percents) on the criterion variables, both as a system and individually. In this way, one can reach an optimal assessment of statistically significant predictive values of the tested variables (prognostic validity), according to their optimally reduced number, multivariate and univariate coefficients of multiple correlation (R_o), multiple correlation squared (R_o^2), and individual multiple correlation squared (R_o^2) (p), or individual predictive value expressed in percents (%).

THE RESULTS

Analyzing Table 1 below, it can be observed that most motor skills variables do not significantly deviate from the normal distribution. This indicates that the chosen tests were discriminative, except for standing on one foot on the balance beam (Sk=2.25), push-ups on parallel bars (Sk=1.64) and hyperextensions on the bench (Sk=1.17), whose result distribution was asymmetric, considering the many low scores on these tests.

Table 1. Basic statistical parameters of motor skills variables and their discrimination values.

Variables	M	S	Se	Min	Max	Sk	Ku
Agility in the air	15.30	1.79	.19	11.80	20.00	.55*	.49
Hand tapping	41.37	6.70	.74	24.00	55.00	.09*	-.16
Foot tapping	53.87	5.61	.61	32.00	66.00	-.55*	1.80
Hyperextensions on the bench	42.95	6.61	.73	17.00	53.00	-1.17	2.57
Standing on one foot on balance beam	14.31	9.57	1.05	1.70	59.20	2.25	7.69
Shoulder flexibility with a yard stick	5.99	1.19	.13	2.30	8.60	-.58*	.78
30s sit-ups	23.12	3.31	.36	15.00	34.00	-.08*	.90
Push-ups on parallel bars	1.62	2.14	.23	.00	8.00	1.64	2.07
Half-squat with load	4.69	2.05	2.26	4.00	11.40	.73*	1.08
Standing broad jump	161.13	25.61	2.82	105.00	240.00	.11*	-.01
Standing triple jump	502.20	71.15	7.85	313.00	700.00	.32*	.27
20m run with a flying start	3.83	.35	.03	3.10	4.80	.18*	-.15

Legend: M - mean, min, max – minimal and maximal result, S - standard deviation, Se – standard error of the mean, Sk - skewness, Ku – kurtosis.

Looking at Table 2, one can see that the system of predictive motor skills variables had a statistically significant influence on the criterion variable at .00 (p=.00). The multiple correlation coefficient was.67 (Ro=.67), with the multiple correlation squared of .45 (Ro^2=.45), explaining about 45% of variance.

Based on the analysis of individual predictive motor behavior variables, one can conclude that 30s sit-ups (p=.00), the standing broad jump (p=.00), the 20m run with a flying start (p=.00), foot tapping (p=.01), hyperextensions on the bench (p=.01), and the standing triple jump (p=.05), had the greatest and most significant influence statistically.

Table 2. The influence of a system of predictive motor behavior variables on the criterion variable (set kata performance).

Variables	β	E(β)	t	p
Agility in the air	.02	.11	.19	.84
Hand tapping	-.17	.11	-1.58	.11
Foot tapping	.25	.10	2.38	.01*
Hyperextensions on the bench	.29	.11	2.61	.01*
Standing on one foot on balance beam	-.10	.09	-1.09	.27
Shoulder flexibility with a yard stick	.02	.10	.27	.78
30s sit-ups	.32	.11	2.75	.00*
Push-ups on parallel bars	-.08	.11	-.71	.47
Half-squat with load	.03	.10	.33	.73
Standing broad jump	.58	.21	2.68	.00*
Standing triple jump	-2.29	.15	-1.93	.05*
20m run with a flying start	.34	.12	2.80	.00*

Ro^2=.45 Ro=.67 F=4.88 p=.00*

The stepwise analysis (Table 3) determined that a reduced system of 5 predictive basic motor behavior variables significantly influenced the criterion variable at .00 (p=.00). The multiple correlation was .67 (Ro=.67), and multiple correlation squared .45 (Ro^2=.45), accounting for some 45% of the variance.

Table 3. Predictive validity of motor behavior variables re. the criterion variable (set kata performance).

Variables	Ro	Ro^2	Ro^2 (p)	F	p
Standing broad jump	.43.	.19	.19	19.16	.00*
Hyperextensions on the bench	.50	.25	.06	6.64	.01*
30s sit-ups	.56	.31	.06	7.03	.00*
20m run from a flying start	.61	.37	.05	7.06	.00*
Standing triple jump	.63	.40	.02	3.70	.05*

Ro^2=.45 Ro=.67 F=7.59 p=.00*

Legend: R_o, multiple correlation; Ro^2, predictive validity of the whole system; Ro^2 (p), individual predictive value; F, F-ratio; p, statistical significance of the influence of the whole reduced system of variables

The analysis of individual motor behavior variables revealed that the following variables had the most significant predictive validity: the standing broad jump (p=.00), explaining 19% of the total variance, hyperextensions on the bench (p=.01), explaining 6%, 30s sit-ups (p=.00) with 6%, the 20m run with a flying start (p=.00) with 5%, and the standing triple jump (p=.05), accounting for only 2% of the total variance.

DISCUSSION

Contemporary karate sport demands contemporary approaches, concepts, forms, contents and necessary steps in the technological training process with young karate students, especially in determining the structure of anthropological characteristics, their relations and influence in achieving the highest possible athletic effectiveness, as well as that of diagnostic and predictive validity of measuring instruments with the purpose of rational modeling, assessment, planning, programming and controlling the effects of an operationalized training process (Doder, 2006; Malacko & Doder, 2008).

The predictive (prognostic) validity of the measuring instruments in a sports activity is established in order to predict the aimed sports performance based on batteries of tests of movement structures and anthropological characteristics. The procedure is run in such a way that relevant anthropological traits, abilities and characteristics are matched with sports performance or results (or situational movement structures) and their predictive validity is calculated. This relationship (that can be univariate or multivariate) is determined between an individual variable or a whole system of situational variables (criterion variable) and a system of selected predictive variables, most frequently done by regression and/or stepwise (reduced) analysis (Malacko & Popović, 2001).

In this research an assumption was made that sports technique is one of basic elements in the evaluation of a performed kata, whereas the explosive leg strength and speed of the arm's movement all represent factors on which kata efficacy is dependent. Also, repetitive strength of the abdominal musculature and flexibility of the hips and the spinal column related to explosive strength and movement speed are all relevant elements in the assessment of the quality of kata performance (Babiak & Doder, 2009; Babiak & Doder, 2010).

The results of this study demonstrated that there was a significant multivariate influence of a predictive system of variables on the single criterion variable, set kata performance, at .00 (p=.00), mostly due to the following six variables: foot tapping (representing the mechanism for movement structuring), hyperextensions on the bench (mechanism for tonus regulation and synergistic action), 30s sit-ups (mechanism of excitation duration regulation), the standing broad jump, the standing triple jump and the 20m run with a flying start (mechanism of regulation of excitation intensity). The findings suggest that explosive leg strength (mechanism of regulation of excitation intensity), repetitive strength of the abdominal musculature (mechanism of regulation of excitation duration), flexibility of the pelvic area and the spine (mechanism of tonus regulation and synergistic action), and the speed of alternate hand movement (mechanism of movement structuring) are critical for successful kata performance.

The stepwise method was used to establish a reduced system of 5 predictive motor behavior variables: the standing broad jump, hyperextensions on the bench, 30s sit-ups, the 20m run with a flying start, and the standing triple jump, ordered in the hierarchy of their respective influence on the set kata performance.

CONCLUSION

The results obtained by a multivariate and univariate regression analysis generally suggest that boys with greater explosive leg strength, better flexibility of the pelvic area and spine, and/or greater repetitive strength of the abdominal musculature, performed better and had higher predictive validity as compared to those without these characteristics.

It was also determined that a system of predictive motor behavior variables had a statistically significant influence on the criterion variable at .00 (p=.00). The multiple correlation coefficient squared was .45 (Ro^2=.45), explaining about 45% of the variance. Based on the analysis of individual predictive motor skill variables, one can conclude that 30s push-ups (p=.00), the standing broad jump (p=.00), the 20m run with a flying start (p=.00), foot tapping (p=.01), hyperextensions on the bench (p=.01), and the standing triple jump (p=.05), had the greatest and most significant influence statistically.

The stepwise analysis established that a reduced system of 5 predictive basic motor behavior variables significantly influenced the criterion variable at .00 (p=.00), explaining about 45% of the variance (Ro^2=.45). The analysis of individual motor behavior variables revealed that the following variables had the most significant predictive validity (Ro^2(p)): the standing broad jump, explaining 19% of the total variance, hyperextensions on the bench, explaining 6%, 30s sit-ups with 6%, the 20m run with a flying start with 5%, and the standing triple jump, accounting for only 2% of the total variance.

Based on their predictive (prognostic) validity, the following battery of measuring instruments for diagnostics, evaluation, monitoring and assessment of kata performance is recommended, in this hierarchical order: the standing broad jump (mechanism of regulation of excitation intensity), hyperextensions on the bench (mechanism for tonus regulation and synergistic action), 30s sit-ups (mechanism of regulation of excitation duration), the 20m run with a flying start, and the standing triple jump (mechanism of regulation of excitation intensity).

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UTICAJ MOTORIČKIH VARIJABLI NA IZVOĐENJE ZADANE KATE U KARATEU

Dragan Doder, Julijan Malacko, Veroljub Stanković, Radoslava Doder

Cilj istraživanja je bio da se utvrdi uticaj sistema motoričkih varijabli na kriterijumsku varijablu za procenu uspešnosti izvođenja zadane kate, a zatim da se izvrši konstrukcija baterije mernih instrumenata za dijagnostikovanje, procenu, praćenje i vrednovanje izvođenja zadane kate na osnovu njihove prediktorske valjanosti. Na uzorku 82 karatista, uzrasta od 10 do14 godina, bio je primenjen sistem od 12 motoričkih i jedne varijable izvođenja zadane kate, a podaci su obrađeni primenom statističke metode regresione analize i stepwise metode. Utvrđeno je da je sistem motoričkih varijabli na varijablu procene uspešnosti izvođenja zadane kate od strane ocenjivača imao statistički značajan multivarijantni uticaj na nivou p=.00, da koeficijent multiple korelacije iznosi .67 (Ro=.67), a kvadrat multiple korelacije .45, što objašnjava parcijalni varijabilitet oko 45% (Ro^2=.45). Na osnovu analize pojedinačnih motoričkih varijabli najveće i statistički značajne uticaje na varijablu imaju varijable dizanje trupa za 30 sekundi, skok u dalj iz mesta, trčanje 20 m iz visokog starta, taping nogom, duboki pretklon na klupici i troskok iz mesta, dok je stepwise metodom utvrđen redukovan sistem od 5 bazično motoričkih varijabli (skok u dalj iz mesta, duboki pretklon na klupi, dizanje trupa za 30 sekundi, trčanje 20 m i troskok iz mesta). Shodno ovako dobijenim rezultatima, može se konstruisati sledeća baterija mernih instrumenata za dijagnostikovanje, procenu, praćenje i vrednovanje izvođenja kata: skok u dalj s mesta, troskok s mesta, trčanje 20 m, dizanje trupa za 30 sekundi i duboki pretklon na klupi.

Ključne reči: *dečaci uzrasta 10-14 godina, motoričke sposobnosti, zadana kate, prediktorska valjanost.*