POSSIBLE JUDO PERFORMANCE PREDICTION BASED ON CERTAIN MOTOR ABILITIES AND TECHNICAL KNOWLEDGE (SKILLS) ASSESSMENT

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Abstract:

The influence of strength and agility and of the level of judo-related technical knowledge – judo skills – on the successful application of that knowledge in a bout - that is, on the performance in competition – was investigated on a sample of 131 physical education (PE) students of a judo class, aged 18-21, from Split, Croatia. The group of predictor variables consisted of: 9 measures of strength and agility, 2 measures of anthropometric status, and 2 grades of judo skills (technical knowledge). The individual judo performance (success) prediction probability, based on the proposed set of predictor variables, is fairly high. The general determination coefficient quotes **0.63**, whereas the determination coefficient based exceptionally on motor variables quotes **0.30**. The general judo skills grade alone (TEHNK) explains **54%**, whereas the *zempo kaiten* fall grade (TMPAD) explains **24%** of the entire judo performance (success in a bout) variability. The proposed group of the 10 predictor variables (9 measures of motor abilities and the zempo kaiten fall grade) explains 57% of the entire judo performance variability.

Relative to the weight categories, the largest individual contribution to the explanation of the overall judo performance variability has been registered for the variables measuring arm strength. The examinees with the greater arm strength were more successful in fights because they had stronger arms to block their rivals' counter actions and because they were able to impose their favourable preparatory postures to perform their techniques. Within particular weight categories the shorter, but heavier contestants were more successful – their arms were stronger, both relatively and absolutely, and they were more agile and manifested better judo skills (technical knowledge).

The following manifest measures had a significant influence on the possible judo performance prediction: the judo skills (technical knowledge) grade, the arm and shoulder strength measure, manifested as the absolute, relative and static force application, and the ground coordination measure. It is feasible to consider these variables as relevant to judo. The *zempo kaiten* fall grade can be taken as a good relevant measure of the level of judo skills in beginners instead of the comprehensive technical skill grade.

Key words: *judo, performance, skills (technical knowledge), strength, prediction*

INTRODUCTION

Success in judo is measured by the effectiveness manifested in a bout, that is, in a sports fight. Judo is a sport event characterised by skilfulness and power. Engagement in judo exercises makes an athlete's body stronger. But the martial art of judo is much more than a manifestation of physical power. It is a battle of wits, a game of outmanoeuvring between two judokas, two masters who are seeking to establish each other's superiority by applying their individual abilities of both body and mind in the best possible way. The judo combat, a sporting contest, unfolds, similar as in other martial arts, under strict rules. It is a highly demanding activity in which the participants must manifest the maximum level of concentration. Fundamental principles and concepts of the art of judo are: focus of attention, high concentration, balance resuming and breaking, timing, relaxation, and efficiency (free interpretation of the first principle "Seiryoku zenyo" or, in English, "Maximum efficiency with minimum effort", established in 1922 by Jigoro Kano; according to Kuleš, 1991).

To be successful in judo according to the aforementioned principles, it is obvious that the quality of the level of techniques (skills) is of crucial importance. This means trained, perfected technical skills, that is a state of mind called knowing judo, comes first and only then other abilities, predominantly with regard to the necessity of imposing and manifesting one's own superiority over an opponent, become prominent.

Numerous tests are used nowadays to monitor general and sport-specific athletic condition and preparation of judokas and to predict the probable successfulness in a judo combat. Motor abilities on which the assumptions about somebody's capability for successfulness rest are primarily: coordination and strength. Therefore, progress of a judo trainee is usually measured by the direction and level of changes in all, for success most important, ability and in their relationships. The selection of a comprehensive battery of tests enables getting a good insight in the other abilities, as well.

Yet, the very foundation of performance and sport achievement in judo is the properly acquired and highly mastered (to perfection) techniques on the one hand, and their efficient application in sport combat. It is well known from the theory of teaching-learning that numerous factors are decisively responsible in the process of acquiring new materials. In judo, as in almost all other human activities, the most important factor of learning is the cognitive one (Wechsler, 1958; Reber, 1985:35).

However, for cognitive factor to be realised in effective learning, certain predispositions are indispensable. In sport, the predispositions are certain characteristics and abilities of athletes, as well as their capacity to be developed up to a maximum. Morphological and conative characteristics of a person are understood under the term 'characteristics', and under 'abilities', the cognitive and motor abilities. Experience has made it well-known that judo is an art, but that skilfulness cannot be manifested if it is not accompanied by a certain physical strength (Kuleš, 1970). Strength and power as abilities are in general well-investigated. A contributory portion of strength varies across diverse sports activities or events. In judo, strength plays a significant role because it is a specific ability to perform a precise kind of work, that is a precondition to skills, art, or technical knowledge to be manifested. To get an insight into somebody's capacities and aptitudes for a particular activity and to know which approach to the teaching-learning process is the quickest and the best one is the core of any such work, motor learning as well. Certain indicators are indispensable in the efforts to accomplish the abovementioned. Since in several previous research studies coordination was found to be an extremely necessary ability in judo (for example, Kuleš, 1990, found that the following factors are very important: body coordination, quick execution of complex motor tasks, agility, quick reorganisation of motor stereotypes), it must be a crucial factor in success as well. The structure of the judo related coordination differs somewhat from the basic measures of coordination. It is a complex, sensible motor system, a singularity of sequentially related movements. The very integration of elements in a unity and anticipation in the motor processing are important factors in the process of acquiring judo skills. Therefore, these factors are even more important in the manifestation of the acquired and refined skills (technical knowledge) in judo competition performance. The mentioned characteristics put judo among the most demanding sports. To get an accurate insight into indicators of judoka's state of preparedness, that is, into the elements of condition which are the signs of the entire status of an athlete, is a crucial link in the process of sports selection, in sports preparation, in introducing corrections training and in the general execution of the training process.

PARTICIPANTS AND METHODS

SAMPLE OF PARTICIPANTS

The sample of participants was comprised of 131 male freshmen students, aged 18 – 21 years, from the Department of Physical Education at the Faculty of Natural Sciences, Mathematics and Education in Split, Croatia, who regularly attended and participated in judo classes iover the period from 1995 till 1997 (in 1995 – 42 students; 1996 – 46 students, and in 1997 – 43 students). The judo course is a compulsory part of the physical education Bachelor study curriculum, taught in the 1st semester of the study. The physical education (PE) students are generally selected during the enrolment classification process (the basic criteria are: acceptable health status, normal conative characteristics, and satisfactory level of motor abilities and motor knowledge - skills development). Therefore, all the participants are adult beginners in judo, meaning they have not been engaged in wrestling or judo prior to the study.

SAMPLE OF VARIABLES

The predictor variables in the presented research on possibilities to predict performance have been chosen according to the criterion of accessibility to every judo trainer in any judo sports club. To conduct measurements on these variables one needs no extra equipment no material resources and no special training in measurement procedures.

CRITERION VARIABLE

Performance and/or success in a bout has been chosen as the criterion variable **(SHIAI).** Performance or success scores have been obtained out of a total of 524 judo matches across four weight categories (up to 71 kg, 78 kg, 86 kg and over 86 kg). The IFJ (International Federation of Judo) rules were applied in all the matches. Three judges were engaged for every bout. Each examinee had four matches for victory 2 points were awarded, a tie/draw 1 point, and a lost match zero points. Each contestant could have achieved from 0 to 8 points.

PREDICTOR SET OF VARIABLES

Predictor group of variables was comprised 13 variables: two quality grades of judo skills (technical knowledge), nine measures of motor abilities, and two measures of anthropometric status. In the applied regression analysis the group of variable predictors was introduced in the analysis in six ways: the first regarded only the grade of technical quality (judo skills), the second only the grade of the quality of falls, the third included only the nine motor variables, the fourth all the variables, except for the technique of falling quality grade, the fifth focuses on the nine motor variables and the falling technique grade, whereas the sixth set implied all the motor variables and two anthropometric variables for the manifest motor space across the weight categories.

***Figure 1**. The predictor variables and sets of regression analysis*

				SET					
		Predictor variables		1.	2.	3.	4.	5.	6.
1.	1.	Overall skills (technical knowledge) grade	(TEHNK)	yes			yes		
2.	1a.	Falling technique grade	(TMPAD)		yes		yes	yes	
3.	1.	Side steps	(MOKUS)			yes	yes	yes	yes
4.	2.	Supine crawl	(MOPUZ)			yes	yes	yes	yes
5.	3.	Supine crab-like movements forwards - backwards	(MOKNR)			yes	yes	yes	yes
6.	4.	Judo suit test	(MOKIM)			yes	yes	yes	yes
7.	5.	Sit-ups with load on the floor	(MRPRG)			yes	yes	yes	yes
8.	6.	Push-ups on the floor	(MRSKL)			yes	yes	yes	yes
9.	7.	Pull-up hang	(MIVIS)			yes	yes	yes	yes
10.	8.	Bench-press	(MBENC)			yes	yes	yes	yes
11.	9.	1RM bench press /ATTEZ	(MBENT)			yes	yes	yes	yes
12.	*1.*	*Body height*	***(ATVIS)***				yes		yes
13.	*2.*	*Body weight*	***(ATTEZ)***				yes		yes

* yes - Variables currently in the equation; DV: SHIAI

The overall judo skills (technical knowledge) grade **(TEHNK)** is a compound variable consisting of: breakfalling techniques, throwing techniques, holding or pinning techniques, joint hold or locks techniques, and strangling techniques. Three well experienced judo masters (4th Dan), who have been judo teachers and trainers for many years, assessed the technical knowledge or judo skills using a 7-grade scale (1-7). The technical elements that the examinees/PE students should have mastered were the contents of a regular judo course curriculum, taught three times a week during 15 weeks in the 1st semester of the study. The same technique performance assessment procedure, the closing, evaluation part of the teaching process, was applied to all the participants in February of each year. Each participant demonstrated his skill with a partner who offered no resistance (tori-uke relationship). Prior to the evaluation, the judges have agreed on clearly defined criteria and conformed to the list in which the required marks for the following techniques performances were registered:

breakfalling techniques (TMPAD): 1. *yoko ukemi* (*hidari* and *migi*), 2.*ushiro ukemi*, and 3. *zempo kaiten ukemi* (*hidari* and *migi*). The following elements have been evaluated: starting or preparatory position, beginning of the breakfall, contact of individual parts of the body with the mat, amortisation with an arm (slapping the mat), and force application;

throwing techniques: 1.*de-ashi-barai*, 2.*osoto-gari*, 3.*ouchi-gari*, 4.*sasaetsuri-komi-ashi*, 5. *uki-goshi*, (*o-goshi*), 6. *harai-goshi*, 7. *ippon-seoi-nage* (*morote-seoi-nage*), 8.*sukui-nage*, 9.*morote-gari*, 10.*tai-otoshi*, 11.*uki-waza*, and 12. *tomoe-nage*. The following elements in the complex throwing technique execution have been evaluated: arm- and leg-action in breaking the opponent's posture or balance, as well as the direction of force implementation (**kuzushi**), the way of positioning or making contact *tori-uke* for a particular throw (**tsukuri),** as well as the throwing action itself (**kake)**, power, timing and speed of execution;

grappling/holding techniques: osae komi waza: 1.*kesa*, 2.*kami-shiho*, 3.*yoko-shiho*, 4.*tate-shiho*, and 5.*kata gatame*; **kansetsu waza**: 1.*juji-gatame* and 2.*yoko ude-hishigi juji gatame*; **shime waza**: 1.*hadaka*, and 2.*sankaku-jime*. The following elements have been evaluated: exactness and correctness of the preparatory move, equilibrium of the supporting points of the dynamic system *tori-uke*, body contact for a particular ground technique execution, and control (firmness) of the hold.

***Zempo kaiten* fall grade (MTPAD):** the examinee performs *migi* and *hidari* falls alternately on the 10 x 10 m mat (tatami) with changes of direction by 90 degrees, so moving in a form of a rectangle along the borders of the combat area (the red border line 1 m wide). He performs a total of 4 falls to the right and 4 falls to the left. The final grade of an entity has been derived as the average point grade from 8 marks (on a 7-point scale; 1-7), given for the 8 falls executed.

Side steps (MAKUS) The coordination test consisting of shuffle, dragging side steps six times over a distance of 4 m between two lines. The test is performed 6 times and the time is measured.

Supine crawl (MOPUZ) is a judo specific situation-related test. The examinee performs crawling movements in the supine position (lying on his back) over an 18m distance by pushing off with his legs in the direction of his head and by help from his upper arms. At the start, the shoulders of the subject must be on the starting line and the task is finished when he passes over the finish line in the same way. The crawling time is measured in seconds with a precision of 0.1 sec. The test measures power and coordination of the body and its extremities.

Supine crab-like movements forwards-backwards (MOKNR). The examinee, wearing his judo suit (judogi), moves in the back support position over a 36.48 m distance on a flat surface (mat) once. The starting, initial position is the back support, on "all fours", from which a tested starts forward to the line at a distance of 18.24 cm. Once the indicated line is touched by one of his legs, he moves backwards (like a crab) to the starting line, which is, in this case, the finishing line as well. The finishing line should be crossed completely, with the whole body. The time is measured in seconds with a precision of 0.1 sec. The test measures power and coordination of the body and its extremities.

Judo suit (judogi) test (MOKIM) is executed four times on a polygon surface constructed of seven 1x1m mats, arranged in an L-shape. The examinee is in a prone position, with arms extended above his head, lying across the first mat. On the starting command "Now!" he starts to roll sideways over the three mats to the fourth, the corner one, where he stands up, assumes arched front support position (prone position on "all fours"; hands and feet) and starts to move backwards in that position over the other three mats to the judo suit, rolled up like a cylinder on the last one. The subject must take the judogi between his knees with no help from his hands and return in arched front support position, on all

four forwards over the three mats to the corner one. Then he turns by 90 degrees, assuming the position with his back towards the starting mat, which is to become the finishing line. Keeping the judo suit between his knees all the time, he must perform backward rolls (tumbling over backwards) until he crosses the finish line. If the examinee drops the cylindrical requisite, he must take it back as before. The time of the task performance is measured. The test is aimed at ground coordination measurement.

Sit-ups with load on the floor (MRPRG) The all-out test is performed once on the floor with legs extended. It measures the repetitive strength of the trunk. The examinee starts from a sitting position (his legs are fixed) by placing a 20kg barbell on his chest and he lies down on his back. The task is to perform as many sit-ups as possible (till exhaustion) with the barbell on his chest.

Push-ups on the floor (MRSKL) test measures the repetitive strength of arms and shoulders. The result is the number of correctly executed push-ups in one minute.

Pull-up hang (MIVIS) measures the time in seconds during which the examinee can hold the under grip pull-up hang with his chin above the horizontal bar. The static strength of arms and shoulders is measured.

Bench press (MBENC) with a 40kg load all-out test, measuring repetitive (dynamic) strength of arms and shoulders. The number of repetitions is measured once.

1RM bench press /ATTEZ (MBENT) The examinee executes the 1RM bench press. The result is obtained by dividing the lifted load by body weight (e.g. body weight = 100kg; load lifted = 90kg; the variable value = 0.9)

Body weight (ATTEZ) was obtained according to the IBP procedures.

Body height (ATVIS) was obtained according to the IBP procedures.

DATA PROCESSING METHODS

Multiple regression analysis, the backward module from the software package Statistica ver. 5.0 (running on the personal computer PSI 586 under the OS Windows 98) was employed as the basic data processing method, whereas the Ridge Regression module was used to process the obtained data across the weight categories of the sample. To start with, all the variables were processed by standard descriptive procedures to obtain computed basic statistical parameters such as arithmetic means, standard deviations, minimum and maximum values, coefficients of *skeweness* and *kurtosis* of distribution of the obtained results, as well as the intercorrelations among the variables. The *Reliability/Item Analysis* module from the package Statistica 5.0 was utilised to verify the reliability of the two predictor grades in the two variables concerning technical skills (overall judo skills grade – TEHNK, falling technique grade - TMPAD). Applied processing methods provided the author with a vast amount of output data. In this article only the selected results, indispensable for the interpretation, are presented.

DISCUSSION

The analysis of the basic descriptive parameters of the results obtained in all the

***Table 1**: Descriptive Statistics*

Variables	Valid N	Mean	Mini.	Max.	Std.Dev.	Skew.	Kurt.
SHIAI	131	4.00	0.00	8.00	2..35	.07	-.88
TEHNK	131	3.90	1.00	7.00	1.42	-.00	-.80
TMPAD	131	3.68	1.00	7.00	1.73	.40	-.93
TOSAE	131	18.01	10.10	31.40	4.95	.83	-.10
ATVIS	131	184.29	171.00	205.00	6.32	.69	.51
ATTEZ	131	78.21	61.50	102.00	7.69	.72	.81
MIVIS	131	60.56	24.00	110.00	18.82	.41	-.25
MRSKL	131	27.89	13.00	47.00	6.56	.59	.03
MRPRG	131	25.95	12.00	37.00	4.06	-.13	.57
MBENC	131	75.38	50.00	115.00	12.12	.56	.52
MBENT	131	.97	.63	1.40	.13	.31	.90
MOPUZ	131	12.94	6.85	23.10	3.58	.29	-.82
MOKNR	131	16.89	11.96	26.00	2.99	.69	.20
MOKIM	131	13.39	9.00	20.86	2.41	.61	.53
MOKUS	131	8.55	7.08	11.42	.88	1.18	1.58

SHIAI – performance (success) in a judo bout); TEHNK – overall skills (technical knowledge) grade; MTPAD – falling technique grade; MOKUS – side steps; MOPUZ – supine crawl; MOKNR – supine crab-like movements forwards-backward; MOKIM – judo suit test; MRPRG – sit-ups with load on the floor; MRSKL – push-ups on the floor; MIVIS – pull-up hang; MBENC – bench press; MBENT – 1 RM bench press / ATTEZ; ATVIS – body height; ATTEZ – body weight

variables (Table 1) shows normalcy of distribution.

With regard to relation between body height and body weight, it can be stated that the average is in favour of body height when compared to body weight. According to the Vandervalian index the sample is on average appropriate to the somatotype with a somewhat increased body mass (+4 kg), which corresponds to the athletic somatotype. It has been determined by observation that no entity has enhanced body mass because of fat tissue. According to the Brok index, the examinees are somewhat lighter (-6 kg) when compared to the proportion of body height, which corresponds to the somatotypes of weight-lifters, wrestlers, boxers, or judokas.

The metric characteristics of the variables concerning judo skill grades **(overall skills grade - TEHNK** and falling technique grade - **MTPAD)** this is a case of descriptive grade, meaning that the judges' assessment is a subjective perception, experience expressed as a numeral on a numerical scale, it is feasible to consider even the smaller values of correlations as satisfactory (.80 - .90). In the regression analysis the grades given for the quality of execution of techniques (the overall skills grade – TEHNK, and the falling technique grade - TMPAD) are derived as the values of examinees on the first principal component and as such they were utilised in statistical processing.

From Table 3 it is obvious that the correlations are among certain variables significant, whereas between others the correlations are insignificant or they are significant, but in a reverse, negative direction. The largest correlation with the criterion variable judo performance in a bout **(SHIAI)** has been established by the predictor variable the overall judo skills grade **(TEHNK) 0.79,** then in

***Table 2**: Reliability/Item Analysis*

a)

Variables	ΣMean	Std. Dv.	Valid N	Cronbach alpha	Stand. alpha	Average inter-item corr.
TEHNK	11.04	5.20	131	.98	98	.94
MTPAD	11.70	4.27	131	.94	94	.85

b)

Judge	Mean if deleted	Var. if deleted	StDv. if deleted	Itm-Totl Correl.	Squared Multp. R	Alpha if deleted
1 TEHNK	7.47	12.02	3.47	**.96**	**.92**	.96
2 TEHNK	7.40	12.16	3.49	**.95**	**.90**	.97
3 TEHNK	7.22	11.97	3.46	**.94**	**.89**	.97
1 TMPAD	7.87	8.46	2.91	**.88**	**.78**	.92
2 TMPAD	7.82	7.95	2.82	**.89**	**.80**	.91
3 TMPAD	7.72	8.40	2.90	**.87**	**.75**	.92

c) Analysis of Variance

Variables	Σof Sq	df	M. Sq.	F	p
TEHNK	4.37	2	2.19	10.47	.00
MTPAD	1.57	2	.79	2.23	.11

TEHNK – overall skills (technical knowledge) grade; MTPAD – falling technique grade;

are satisfactory (Table 2, a-c). Based on the results obtained it can be stated that both the coefficient of reliability and of the objectivity range are within satisfactory limits (90 and higher). The interobservers' agreement is slightly larger in the variable *overall judo skills grade* than in the *zempo kaiten* fall grade. It has been normally expected, since the first variable is a composite one, consisting of a greater number of individual items (24), which eventually have significantly smaller contribution to the deviation from the average value in the final assessment grade. Since the descending succession come **the** variables measuring strength **(**1RM bench press/ ATTEZ - **MBENT,** bench press – **MBENC,** and pull-up hang **- MIVIS),** and two variables measuring coordination **(the** judo suit test - **MOKIM** and side steps - **MOKUS)**. Further, it is noticeable that the variable body height **(ATVIS)** is in negative correlation with the criterion **(-0.19)** and with some measures of strength **(MRSKL; MIVIS** and **MBENT)**, whereas it has not established any significant relations with the measures of coordination. The variable body weight **(ATTEZ)**

shows neutral behaviour. Further, all the motor measures have significant and positive correlations with the variable **overall skills (technical knowledge) grade**, among which the largest correlations have been determined between one measure of strength (relative bench press - **MBENT .49)** and one measure of coordination (the judo suit test - **MOKIM -.35)**[1] .

From the results in Table 4 it is obvious that it is possible to explain about 54% of the criterion variability (judo performance - (SHIAI) if the prediction is based only on the overall skills (technical knowledge) grade (TEHNK), whereas significantly less amount of variability can be explained by the *zempo kaiten* fall grade (MTPAD) alone - 24% only.

The judo skills (technical knowledge) evaluation data make the performance prediction highly possible.

In the third case (Table 6) it was possible to successfully predict about 30% of the criterion variable, performance/success in a judo bout (SHIAI), only on the basis of the information inherent to the results obtained from the group of 9 predictor motor variables.

Individually the largest and significant regression coefficients have been registered (Tables 6 and 6a) for the variables of the absolute arm and shoulder repetitive power (bench press - MBENC β=0.42) and coordination on the floor (the judo suit test - MOKIM β = -0.28). Kuleš (1970) and Lucić (1988) obtained similar, but greater values (55%) in the research studies using 10 motor variables which covered the motor space of coordination, repetitive and explosive power. The amount and quality of information inherent in a particular group of predictor variables or in a complex predictor variable play an important role in the prognosis of a certain criterion.

***Table 3**: Correlations*

Variables	SHIAI	TEHNK	TMPAD	ATVIS	ATTEZ	MIVIS	MRSKL
SHIAI	1.00	**.79**	**.70**	**-.19**	-.03	**.31**	**.35**
TEHNK	**.79**	1.00	**.68**	-.10	-.01	**.31**	**.34**
TMPAD	**.70**	**.68**	1.00	-.05	.10	**.20**	.15
ATVIS	**-.19**	-.10	-.05	1.00	**.64**	**-.24**	**-.30**
ATTEZ	-.03	-.01	.10	**.64**	1.00	-.08	-.14
MIVIS	**.31**	**.31**	**.20**	**-.24**	-.08	1.00	**.44**
MRSKL	**.35**	**.34**	.15	**-.30**	-.14	**.44**	1.00
MRPRG	.15	**.19**	.08	-.06	-.00	**.25**	**.41**
MBENC	**.40**	**.39**	**.30**	.10	**.53**	**.36**	**.47**
MBENT	**.47**	**.48**	**.27**	**-.34**	-.11	**.45**	**.65**
MOPUZ	-.12	**-.20**	-.09	.02	.03	-.13	**-.34**
MOKNR	-.14	**-.26**	-.10	.06	.12	**-.24**	**-.34**
MOKIM	**-.35**	**-.40**	**-.43**	.08	.01	-.04	-.15
MOKUS	**-.19**	**-.21**	**-.21**	-.08	.01	.06	-.09

Correlations (continuation)

Variables	MRPRG	MBENC	MBENT	MOPUZ	MOKNR	MOKIM	MOKUS
SHIAI	.15	**.40**	**.47**	-.12	-.14	**-.35**	**-.19**
TEHNK	**.19**	**.39**	**.48**	**-.20**	**-.26**	**-.40**	**-.21**
TMPAD	.08	**.30**	**.27**	-.09	-.10	**-.43**	**-.21**
ATVIS	-.06	.10	**-.34**	.02	.06	.08	-.08
ATTEZ	-.00	**.53**	-.11	.03	.12	.01	.01
MIVIS	**.25**	**.36**	**.45**	-.13	**-.24**	-.04	.06
MRSKL	**.41**	**.47**	**.65**	**-.34**	**-.34**	-.15	-.09
MRPRG	1.00	**.19**	**.24**	-.16	-.24	-.17	-.18
MBENC	**.19**	1.00	**.77**	-.07	-.14	-.12	.04
MBENT	**.24**	**.77**	1.00	-.12	-.26	-.17	.03
MOPUZ	-.16	-.07	-.12	1.00	.37	.41	**.52**
MOKNR	**-.24**	-.14	**-.26**	**.37**	1.00	.28	.14
MOKIM	-.17	-.12	-.17	**.41**	**.28**	1.00	**.56**
MOKUS	-.18	.04	.03	**.52**	.14	**.56**	1.00

SHIAI – performance (success) in a judo bout); TEHNK – overall skills (technical knowledge) grade; MTPAD – falling technique grade; MOKUS – side steps; MOPUZ – supine crawl; MOKNR – supine crab-like movements forwards-backward; MOKIM – judo suit test; MRPRG – sit-ups with load on the floor; MRSKL – push-ups on the floor; MIVIS – pull-up hang; MBENC – bench press; MBENT – 1 RM bench press / ATTEZ; ATVIS – body height; ATTEZ – body weight;

Table 4: *Regression Summary for Dependent Variable: SHIAI (set 1)*

R=.73 Rc=.54 Adjusted Rc=.53
F(1,129)=149.04 p<.00 Std.Error of estimate:1.61

a)

Variables	BETA	St. Err.of BETA	B	St. Err.of B	t (129)	p-level
TEHNK	.73	.06	.97	.08	12.21	.00

b) Variables currently in the Equation; DV: SHIAI

Variables	Beta in	Partial Cor.	Semipart Cor.	Tolerance	R-square	t (129)	p-level
TEHNK	.73	.73	.73	1.00	.00	12.21	.00

SHIAI – performance (success) in a judo bout); TEHNK – overall skills (technical knowledge) grade;

Table 5*: Regression Summary for Dependent Variable: SHIAI (set 2)*

R=.49 Rc=.24 Adjusted Rc=.24
F(1,129)=41.63 p<.00 Std.Error of estimate:2.05

a)

Variables	BETA	St. Err.of BETA	B	St. Err. of B	t (129)	p-level
TMPAD	.49	.08	1.05	.16	6.45	.00

b) Variables currently in the Equation; DV: SHIAI

Variables	Beta in	Partial Cor.	Semipart Cor.	Tolerance	R-square	t (129)	p-level
TMPAD	.49	.49	.49	1.00	0.00	6.45	.00

SHIAI – performance (success) in a judo bout); TMPAD – falling technique grade;

The determination coefficient becomes significant and the largest, quoting **0.63** (Table.7) when all 12 variables have been included in the regression equation (with the exception of the variable the *zempo kaiten* fall grade - TMPAD, inherent in the overall judo skill grade - TEHNK).

The overall judo skills (terchnical knowledge) grade (TEHNK β= 0.79) has the largest individual and the most significant contribution to the criterion variability explanation. The more detailed analysis, performed by means of the stepwise regression module, has revealed two additional predictor variables as having a significant influence on the criterion variable. These two variables are: absolute arm strength of a relative type (1RM bench press/ ATTEZ - MBENT β =0.12), and the negative influence of body height (ATVIS β = -0.11). The influence of these two variables is not large, but it has been registered at the significance level of .04. As the same relation has been noticed in the table of correlations (Table.3), and in the additional correlation with the overall skills grade (TEHNK) as well, it can be assumed that their influence has been partially assimilated in the latter variable. Nevertheless, it is still significant, so it must be taken into account in predicting the criterion variable.

The predictor variable overall skills (technical knowledge) grade is a compound variable. Therefore it is qualitative information, however the measurement procedure (observation and evaluation) is very time and work consuming. This was the main reason for including the falling technique *grade* (**TMPAD)** and 9 motor tests in the next stage of the judo combat success prediction. The accordingly arranged predictor group of 10 variables has brought considerable amount of information allowing for **57%** of the criterion variability (judo performance or success in a bout – **SHIAI**) to be explained. Two variables have the largest individual contribution to the overall

***Table 6**: Regression Summary for Dependent Variable: SHIAI (set 3)*

R=.55 Rc=.30 Adjusted Rc=.29
F(2,128)=27.38 p<.00 Std.Error of estimate: 1.98

a)

Variables	BETA	St. Err.of BETA	B	St. Err. of B	t (128)	p-level
MBENC	.42	.08	7.51	1.33	5.65	.00
MOKIM	-.28	.08	-.28	.07	-3.77	.00

b) Variables currently in the equation; DV: SHIAI

Variables	Beta in	Partial Cor.	Semipart Cor.	Tolerance	R-square	t (128)	p-level
MBENC	.42	.45	.42	.97	.03	5.65	.00
MOKIM	-.28	-.32	-.28	.97	.03	-3.77	.00

SHIAI – performance (success) in a judo bout); MOKIM – judo suit test; MBENC – bench press;

performance variability explanation: the *zempo kaiten* fall grade **(MTPAD)** and absolute arm strength of the relative type **(**1RM bench press/ ATTEZ - **MBENT**). Their partial correlations with the criterion variable are rather high and significant (Table 8).

If we compare the difference between the explained criterion variability in the former and the latter way of calculating, then the latter one is quicker, simpler and more economic. Due to the crucial necessity of getting quick and correct, but at the same time profound information in the processes of training and selection, the latter selection of predictor variables may be considered more appropriate for usage in practice.

The results confirm and justify the practice of the so-called **"kohaku"** tournaments in judo clubs, the tournaments on which judokas of the same quality (judo level) compete, meaning that all the contestants in a particular category are of approximately the same technical knowledge and have similar training experience (years of engagement in judo training). Opportunities for orientation and selection are much higher in that case because the judo specific and required abilities, responsible for success in the art of judo, become prominent in such contests.

In Table 3 the significant and positive correlation (0.53) between body mass (ATTEZ) and bench press (MBENC) is presented, whereas the relation of body mass with the maximum strength (MBENT) is not significant, but shows tendencies of decreasing (-0.11). Body height (ATVIS) is not significantly correlated in this sample with the bench press variable, whereas with the 1RM bench press/ATTEZ (MBENT) variable it has established a significant, but negative correlation (-0.34). The influence of body height on the performance (success) in a bout (SHIAI) is dynamic – it is significant and negative in the lighter weight categories (Table 9, ATVIS β = - 0.48), but it becomes less significant in the heavier weight categories showing the transformation tendency towards a positive direction. Since body mass and body height are in significant correlation, and since the influence of the arm and shoulder maximum strength of a relative type (the smaller the body mass, the larger the manifestation of that strength) has a negative relation with body height, the taller examinees with smaller body mass are in a disadvantageous position in a judo bout. Namely, their body mass is mostly a product of their skeletal system, whereas in shorter subjects of the same body mass it is mainly a product of useful muscular mass. Drviš (1996) obtained the same results on a similar sample.

The largest individual contribution to judo performance prediction has been registered for the following variables: the overall judo skills (technical knowledge) grade, the falling technique grade, the arm and shoulder maximum strength measure, and ground coordination. It is feasible to consider these variables as relevant to judo.

When the relationships among variables is considered through weight categories (Table 6), it becomes obvious that strength of arms and shoulders is a predominant ability in judo combat performance and success (Kuleš, 1970).

a possible variability explanation for this case, based on the predictor group of the total of 11 variables (9 motor and two anthropometric variables) ranges from 51% to 57%.

More liberal interpretation is allowed here since the author has dealt with a sample selected for its

***Table 7**: Regression Summary for Dependent Variable: SHIAI (set 4)*

R=.79 Rc=.63 Adjusted Rc=.62
F(1,129)=215.10 p<.00 Std.Error of estimate:1.44

a)

Variables	BETA	St. Err.of BETA	B	St. Err. of B	t (129)	p-level
TEHNK	**.79**	**.05**	**1.86**	**.13**	**14.67**	**.00**

b) Variables currently in the equation; DV: SHIAI

Variables	Beta in	Partial Cor.	Semipart Cor.	Tolerance	R-square	t (129)	p-level
TEHNK	**.79**	**.79**	**.79**	**1.00**	**.00**	**14.67**	**.00**

Variables not in the equation; DV: SHIAI

Variables	Beta in	Partial Cor.	Semipart Cor.	Tolerance	Min. Tolerance	t (128)	p-level
MIVIS	.07	.11	.07	.90	.90	1.26	.21
MRPRG	-.00	-.00	-.00	.96	.96	-.00	1.00
MRSKL	.08	.13	.08	.88	.88	1.47	.14
MOKIM	-.04	-.06	-.04	.84	.84	-.72	.47
MOPUZ	.05	.08	.05	.96	.96	.86	.39
MOKUS	-.02	-.03	-.02	.96	.96	-.38	.70
MOKNR	.07	.11	.06	.93	.93	1.20	.23
ATTEZ	-.02	-.03	-.02	1.00	1.00	-.34	.74
MBENT	**.12**	**.18**	**.11**	**.77**	**.77**	**2.03**	**.04**
MBENC	.10	.16	.10	.85	.85	1.80	.07
ATVIS	**-.11**	**-.18**	**-.11**	**.99**	**.99**	**-2.08**	**.04**

c) Summary of Stepwise Regression; DV: SHIAI

Variables	Step + in/-out	Multiple R	Multiple R-square	R-square change	F - to entr/rem	p-level	Variabls included
MIVIS	-1	.82	.67	-.00	.16	.69	11
MRPRG	-2	.82	.67	-.00	.17	.68	10
MRSKL	-3	.82	.67	-.00	.40	.53	9
MOKIM	-4	.82	.67	-.00	.52	.47	8
MOPUZ	-5	.82	.67	-.00	1.04	.31	7
MOKUS	-6	.81	.66	-.00	1.38	.24	6
MOKNR	-7	.81	.66	-.01	2.02	.16	5
ATTEZ	-8	.81	.65	-.01	2.22	.14	4
MBENT	-9	.81	.65	-.00	.36	.55	3
MBENC	**-10**	**.80**	**.64**	**-.01**	**4.69**	**.03**	**2**
ATVIS	**-11**	**.79**	**.63**	**-.01**	**4.32**	**.04**	**1**

SHIAI – performance (success) in a judo bout); TEHNK – overall skills (technical knowledge) grade; MTPAD – falling technique grade; MOKUS – side steps; MOPUZ – supine crawl; MOKNR – supine crab-like movements forwards-backward; MOKIM – judo suit test; MRPRG – sit-ups with load on the floor; MRSKL – push-ups on the floor; MIVIS – pull-up hang; MBENC – bench press; MBENT – 1 RM bench press / ATTEZ; ATVIS – body height; ATTEZ – body weight;

motor abilities criteria, whereas their judo skills are at approximately the same level.

Namely, in the lighter weight category of the participants (>71 kg) body heightt **(ATVIS)** has a significant negative influence, whereas the static strength of the arm **(MIVIS)** has a positive influence. Height is in this category a relevant, but negative characteristic – if body mass is distributed in a way that the centre of gravity is positioned higher, then the stability angle of the entire physical system is smaller, and yet this angle is responsible for the capacity to preserve and resume one's own balance on the one hand, and to disturb the opponent's equilibrium, on the other.

The ability to move on the floor (the ground movement technique), expressed as the supine crawl variable **(MOPUZ)** is a significant ability among participants in the weight category up to 78 kg. The other motor variables (relative bench press- MBENT; bench press - MBENC; the judo suit test MOKIM; pull-up hang - MIVIS) participate in the regression equation, but none of

them have reached the level of individual significance in the prognosis. Two variables are individually significant in the heavier category up to 86 kg: arms and shoulders maximum strength of a relative type (MBENT β=.42) and arms and shoulders static strength (MIVIS β=.28).

The other four variables participate in the equation (the judo suit test - MOKIM, side steps - MOKUS, supine crawl – MOPUZ, and body weight - ATTEZ), but they have no individual

***Table 8**: Regression Summary for Dependent Variable: SHIAI (set 5)*

R=.76 Rc=.57 Adjusted Rc=.57
F(2,128)=87.87 p<.00 Std.Error of estimate:1.53

a)

Variables	BETA	St. Err.of BETA	B	St. Err. of B	t (128)	p-level
MBENT	.30	.06	5.33	1.06	5.04	.00
MTPAD	.62	.06	1.46	.14	10.41	.00

b) Variables currently in the equation; DV: SHIAI

Variables	Beta in	Partial Cor.	Semipart Cor.	Tolerance	R-square	t (128)	p-level
MBENT	.30	.41	.29	.93	.07	5.04	.00
FPAD	.62	.68	.60	.93	.07	10.41	.00

SHIAI – performance (success) in a judo bout); MTPAD – falling technique grade; MBENT – 1 RM bench press / ATTEZ;

significant influence. In the heaviest category, over 86 kg, two variables have attained more than the threshold of significance: static strength of arms (pull-up hang - MIVIS β=.87) and the ground coordination (the judo suit test - MOKIM β=.-56), similar to the lightest weight category. Arms and shoulders maximum strength of the relative type (1<rm bench press/ATTEZ - MBENT) is also in the equation, but it is not individually significant.

The proposed group of predictor variables (motor abilities tests) has a very high prognostic value for a possible judo performance assessment. The abilities of the selected sample (PE students) are closer to the abilities of athletes in a general sense, meaning their physical abilities over-exceed their skills (technical knowledge). The technical knowledge of judo, the mastering and perfection of judo skills are undoubtedly very important, corroborated in this article. Therefore, skills acquisition and perfection should be the most regarded part of judo training, especially in the beginning of a systematic engagement in judo. First is knowledge – a certain quality of acquisition and mastering diverse techniques – and only then comes the application of the skills learned, for which the focused force, specific power is needed, and the latter is measurable by various tests. The question arises: Why is the arm and shoulder strength so important in judo? The logical answer is: arms are the beginnings, openings and the ends or conclusions of most judo techniques – from assuming and imposing one's own guard or initial position to the ground techniques application arms play a predominant role (Lucić, 1988; Sertić, 1988). On defence arms are very important, too – from establishing contact with the opponent to the counter actions, the purpose of which is to prevent the rival from force implementation (static or isometric strength). It would not be appropriate to state that any other abilities are not important, especially in the cases of relatively large differences in skill levels (technical knowledge). In fact, coordination, speed of movements, balance, flexibility, and endurance may be even more significant in the phase of the acquisition and mastering of judo techniques. But in a group of technically and skilfully comparable persons, that is in a group of judo athletes, physical conditioning assumes a more important position in the performance and sports achievements (victory in a bout). In that sense, strong arms, both absolutely and relatively, and strength endurance, related to other topological regions of the body (i.e. trunk and legs) as well, become really decisive. The MOPUZ test (the supine crawl) has appeared in the research as a potentially relevant measure for judo, whereas the same has not been confirmed for the MOKNR test (the supine crab-like movements – within the coordination tests set small correlations have been established with the judo

***Table 9**: Ridge Regression Summary for Dependent Variable: SHIAI (set 6)*

Variables	Beta in	Partia Cor.	Semipart Cor.	Tolerance	Min. Tolerance	t	p-level
-71	**R=.75**		**R_c =.57**	adjusted Rc=.47			
n=22	**F (4,17)=5.56**		**p <.01**	std. error of estim.:1.73			
MIVIS	**.46**	**.59**	**.48**	**1.07**	**-.07**	**2.99**	**.01**
ATVIS	**-.48**	**-.59**	**-.48**	**.99**	**.01**	**-2.99**	**.01**
MOPUZ	**-.24**	**-.33**	**-.23**	**.98**	**.02**	**-1.47**	**.16**
ATTEZ	**-.16**	**-.24**	**-.17**	**1.09**	**-.09**	**-1.04**	**.31**
-78	**R=.71**		**R_c =.51**	adjusted Rc =.45			
n=47	**F (5,41) =8.55**		**p<.00**	std. error of estim.:1.59			
MBENT	.31	.21	.15	.24	.76	1.38	.17
MOPUZ	-.25	-.33	-.25	.98	.02	-2.28	**.03**
MOKIM	-.14	-.20	-.14	.96	.04	-1.28	.21
MBENC	.29	.20	.14	.24	.76	1.28	.21
MIVIS	-.14	-.19	-.13	.91	.09	-1.22	.23
-86	**R=.73**		**R_c=.53**	adjusted Rc =.47			
n=48	**F (6,41) =7.84**		**p<.00**	std.error of estim.:1.73			
MBENT	.42	.50	.39	.87	.13	3.69	.00
MOKIM	-.21	-.24	-.17	.63	.37	-1.59	.12
MIVIS	.28	.35	.25	.81	.19	2.38	.02
ATTEZ	.18	.25	.17	.97	.03	1.63	.11
MOKUS	-.22	-.23	-.16	.56	.44	-1.53	.13
MOPUZ	.17	.22	.15	.77	.23	1.43	.16
+86	**R=.71**		**R_c=.51**	adjusted Rc =.36			
n=14	**F (3,10) =3.46**		**p <.06**	std. error of estim.:1.95			
MIVIS	.87	.66	.62	.51	.49	2.81	.02
MOKIM	-.56	-.60	-.52	.87	.13	-2.35	.04
MBENT	-.34	-.35	-.26	.57	.43	-1.16	.27

SHIAI – performance (success) in a judo bout); TEHNK – overall skills (technical knowledge) grade; MTPAD – falling technique grade; MOKUS – side steps; MOPUZ – supine crawl; MOKNR – supine crab-like movements forwards-backward; MOKIM – judo suit test; MRPRG – sit-ups with load on the floor; MRSKL – push-ups on the floor; MIVIS – pull-up hang; MBENC – bench press; MBENT – 1 RM bench press / ATTEZ; ATVIS – body height; ATTEZ – body weight

suit test – **MOKIM**, and the side steps tes - **MOKUS**). The **judo suit test (MOKIM)** is undoubtedly a relevant test for judo. It has the greatest linear correlations with the criterion variable and the skills (technical knowledge) grades (overall skills grade – TEHNK, and falling technique grade - MTPAD) variables. It is one of the better constructed coordination assessment tests, designed by Professor Branimir Kuleš from the Faculty of Kinesiology (former Faculty of PE) University of Zagreb, Croatia. The fact that no correlation has been obtained between the **judo suit test** and the tests measuring strength indicates that the former measuring instrument is a distinctively pure measure of coordination, and as such it should be included by all means in the judo aptitude and the athletic condition status diagnostic procedures. The choice of other tests, that is, their appropriateness has been justified by the results obtained in this experiment, since it has been determined that they significantly increase the predictability of a judoka's capacity and readiness for a good performance and success in combat. Therefore, they should be utilised in the processes of: orientation and selection, training effects control, following-up of physical and skill progression, and the final selection. The work has undoubtedly confirmed the crucial importance of adequate measuring instruments selection in a modern approach to the training periodisation and modelling. The very high correlations obtained between particular tests suggest there is a possibility of obtaining an insight into somebody's capabilities to attain desirable sports achievements by using even a smaller number of tests than has been proposed in this article.

CONCLUSION

High correlations between the criterion variable *judo performance* **(SHIAI)** and the proposed group of predictor variables has been established by regression analysis. Prediction of somebody's abilities to be efficient or successful in application is fairly high if the judoka in question is successful in the tests of the selected predictor group of variables. It is possible, with a high percentage, to predict someone's performance in a judo bout on

the basis of all the proposed predictor variables, including the 9 motor tests, 2 measures of morphological characteristics and grade of the overall judo skill (technical knowledge). The variable **overall judo skills (technical knowledge) grade (TEHNK)** has the greatest individual contribution to somebody's performance and sport achievement prediction. The level of prediction determination is decreased if it is founded only on the insight into the motor abilities' status, with no information about the level of technical condition (preparedness) or technical knowledge. Significant contribution is registered also for the variables assessing **strength of arms and shoulders,** which is represented here by the measures of absolute power (1 RM) and strength endurance, and **coordination**. When combined with the motor measures, the ***zempo kaiten*** **fall grade** significantly determines the possible explanation of the criterion variability. The value of the determination approximates values obtained on the basis of all 12 predictor variables, which offers a good opportunity to predict probable performance and success, noting that this inference is with regard to a sample of beginners.

Results of the issue analysis – judo performance (success) in a combat across the weight categories indicate that the **strength measuring tests** have the largest contribution, especially those regarding the strength of arms and shoulders, together with the **coordination test**, expressed as **the judo suit test**. The examinees whose hold is more firm and persistent, and whose arms are stronger have been more successful in combats because they have been able to block the opponent's counterattacks on the one hand, and to impose their own guards and technique execution by applying greater force on the other. Within a particular weight category the shorter, but heavier contestants have been more successful, that is, they have been more efficient in bouts, they have stronger arms, both relatively and absolutely, and a higher level of agility.

This research has confirmed the notion of experienced judo practitioners that judo is a sports event founded on skill (art), strength, knowledge, timing, balance and coordination of mind and body. The origin of this highly respected martial art of applying knowledge and skill in a contest lies within an individual, in his/her innate abilities which can be enhanced and transformed by continuous and hard exercise. The author presumes that the obtained results and the relationships between prognostic tests and performance criterion may be corroborated in a more detailed way by further investigations on larger samples of authentic judo competitors.

REFERENCES

1. Horga, S. (1993). *Psihologija sporta*. [*Psychology of Sport*. In Croatian.] (pp. 31-66), Zagreb: Fakultet za fizičku kulturu.

2. *Illustrated Kodokan Judo* (1970). Kodansha, Tokyo, Japan, pp. 14-23.

3. Kuleš, B. (1970). *Prognostička valjanost manifestnih i latentnih motoričkih varijabli za predviđanje uspjeha u judo borbi. Magistarski rad, [Prognostic value of the manifest and latent motor variable for success in a judo bout prediction. Master of Science thesis*. In Croatian.] Zagreb: Fakultet za fizičku kulturu.

4. Kuleš, B., J. Lucić (1987). Metrijske karakteristike testova za procjenu situaciono-motoričkih sposobnosti judaša za borbu u parteru. [Metric characteristics of tests aimed at assessing situational-motor abilities of judoists to fight on the ground. In Croatian.] *Kineziologija*, 19(1),51-57.

5. Kuleš, B. (1985). Relativna efikasnost juda. [Relative efficiency of judo. In Croatian.] *Kineziologija* 17(1),75-80.

6. Kuleš, B. (1990). *Judo*. Zagreb: Športska tribina

7. Kuleš, B. J. Lucić (1994). Povezanost situacijsko-motoričkih testova za judo i uspješnosti u judo borbi. ?[Relations of the judo situational-motor tests and success in a judo combat. In Croatian.]?? *Kineziologija* 26(1-2),55-59.

8. Lucić, J. (1988). *Povezanost nekih antropometrijskih dimenzija sa uspjehom u izvođenju tehnika juda i judo borbi u parteru i stojećem stavu*. Magistarski rad, [*Relations of certain anthropometric dimensions with the judo techniques performance and success in a judo bout on the ground and standing. Master of Science thesis*. In Croatian.] Zagreb: Fakultet za fizičku kulturu.

9. Marić, J. (1982). *Utjecaj antropometrijskih i motoričkih dimenzija na rezultate u rvanju klasičnim načinom*. *Disertacija*. [*Influence of anthropometric and motor dimensions on results in Greek-Roman wrestling. Doctoral thesis*. In Croatian.] Zagreb: Fakultet za fizičku kulturu.

10. Metikoš, D., Hofman, E., Pintar, Ž., Oreb G. (1989). *Mjerenje bazičnih motoričkih dimenzija sportaša*. *[Measurement of the Basic Motor Dimensions*. In Croatian.] Zagreb: Fakultet za fizičku kulturu, pp. 24-25, 81-82.

11. Medved, R. and associates (1987). *Sportska medicina*. [*Sports Medicine.* ?In Croatian.] ?Zagreb: JUMENA

12. Milanović, D. (1993). Osnove teorije treninga. In: D. Milanović and M. Kolman (Eds.) *Priručnik za sportske trenere*, (pp. 397-486). *[?Fundamentals of Theory of Training. Handbook for Coaches*.? In Croatian?] ?Zagreb: Fakultet za fizičku kulturu, Hrvatski olimpijski odbor, Zagrebački športski savez.

13. Reber, A.S. (1985). *Dictionary of Psychology*. London: Penguin Books.

14. Wechsler, D. (1958). *The measurement and appraisal of adult intelligence*. Baltimore: Williams & Wilkins Comp.

15. Sertić, H. (1988). *Povezanost skupa situaciono-motoričkih i antropometrijskih varijabli s uspjehom u judo borbi u parteru i izvođenjem parterne tehnike*. (Diplomski rad) [*Relations of the situational-motor and anthropometric set of variables with success in a judo ground bout and the ground techniques performance*. Graduation thesis. In Croatian.] Zagreb: Fakultet za fizičku kulturu.

16. Sertić, H. (2000). *Relacije nekih motoričkih, antropometrijskih i konativnih varijabli s uspjehom u borbi, brzinom učenja i kvalitetom izvođenja tehnike bacanja u judu*. *(Disertacija) [Relations between some motor, anthropometrical and conative variables with success in a judo bout, with the speed of acquisition and with the quality of executing the throwing techniques in judo. Doctoral thesis*. In Croatian.] Zagreb: Fakultet za fizičku kulturu Sveučilišta u Zagrebu.

17. Drviš, I. (1996). *Utjecaj longitudinalne dimenzionalnosti tijela na uspješnost borenja u judu*. (Seminarski rad) [*Influence of the longitudinal dimensionality of body on success in a judo bout*. Seminar work. In Croatian] Zagreb: Institut za kineziologiju Fakulteta za fizičku kulturu.

[1] The variables: supine crawl (MOPUZ), supine crab-like advance-retreat motion (MOKNR), judo suit test (MOKIM) and side steps (MOKUS) are reversely scaled, meaning the better result must be presented by the lower value, so, consequently, the negative correlation is, in fact, a positive, good result.

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MOGUĆNOST PREDVIĐANJA USPJEŠNOSTI U JUDU NA TEMELJU PROCJENA NEKIH MOTORIČKIH SPOSOBNOSTI I TEHNIČKOG ZNANJA

SAŽETAK

UVOD

Uspješnost u judu, sportu vještine i snage, mjeri se učinkovitošću u borbi koja je nadmudrivanje dva borca. Judaška borba vrlo je zahtjevna i od natjecatelja traži visok stupanj koncentracije Za uspjeh u judu odlučujuća je kvaliteta izvedbe i primjene tehnike, no ona se ne može postići niti doći do izražaja ako potrebne osobine, morfološke i konativne, kao i sposobnosti (kognitivne i motoričke) nisu optimalno razvijene. Među posljednjima se za judo najvažnijima smatraju koordinacija i snaga. Koordinacija je bitan čimbenik uspjeha u judu kojega je struktura specifična, drugačija od elementarnih mjera koordinacije. Radi se o nizu povezanih pokreta koji tvore jednu motorički osmišljenu cjelinu udruženu sa sposobnošću anticipacije u motoričkom procesiranju. Za praćenje i procjenu spremnosti judaša u uporabi su mnogi testovi kojima se procjenjuje moguća uspješnost u borbi. Stjecanje uvida u nečije mogućnosti i spoznaja koji je način poučavanja i učenja najbrži i najbolji za pojedinog sportaša vrlo su važne pretpostavke za uspješno motoričko učenje, kao i za proces selekcije, načina pripremanja te programiranja i kontrole trenažnog procesa, a u konačnici i za sportski uspjeh.

ISPITANICI I METODE

UZORAK ISPITANIKA

Ispitanici su bili studenti (n = 131) Zavoda za fizičku kulturu Fakulteta prirodoslovno-matematičkih znanosti i odgojnih područja u Splitu. Redovito su pohađali nastavu kolegija Judo u prvom semestru svoga studija. Uzorak je izabran iz opće populacije mladića u dobi od 18. do 21. godine na temelju razredbenog postupka za upis na studij (uredan zdravstveni status, normalne konativne osobine, zadovoljeni zahtjevi na provjeri motoričkih sposobnosti i motoričkih znanja). Ispitanici su odrasli početnici u judu.

UZORAK VARIJABLI

Izabrane varijable dostupne su svakom treneru u klubu, a ne iziskuju nikakve posebne materijalne troškove ni posebno osposobljavanje.

Kriterijska varijabla - je uspjeh u borbi **(SHIAI).** Iz ukupno 524 sportske borbe (prema pravilima IFJ) unutar četiri službene težinske kategorije izračunati su osvojeni bodovi. Svaku borbu sudila su tri suca. Svaki ispitanik borio se u 4 borbe i mogao je osvojiti od **0** do **8** bodova – za pobjedu 2 boda, za neriješen ishod 1 bod, za poraz 0 bodova.

Prediktorski skup varijabli - sastojao se od ukupno 13 varijabli: dvije ocjene kvalitete znanja tehnike (opća ocjena za izvedbu svih tehnika – TEHNK, i ocjena samo *zempo kaiten* pada – TMPAD, u tori-uke demonstraciji; tehnike su propisane nastavnim planom i programom kolegija Judo), 9 testova motoričkih sposobnosti (koraci u stranu - MOKUS, puzanje na leđima - MOPUZ, kretanje naprijed natrag u uporu pred šakama – MOKNR, kimono-test - MOKIM, pretkloni iz ležanja s opterećenjem na prsima - MRPRG, sklekovi na tlu - MRSKL, izdržaj u visu u zgibu pothvatom - MIVIS, potisak utega s klupe - MBENC, 1 maksimalni potisak s klupe kroz tjelesna težina – MBENT; neke su varijable detaljno opisane u Metikoš, D., Hofman, E., Pintar, Ž. i G. Oreb (1989). Mjerenje bazičnih motoričkih dimenzija sportaša. Fakultet za fizičku kulturu Sveučilišta u Zagrebu, Zagreb) i dvije mjere za procjenu antropometrijskog statusa ispitanika (tjelesna visina – ATVIS, i tjelesna težina - ATTEZ).

METODE OBRADE REZULTATA

Prvo su sve varijable obrađene standardnim deskriptivnim postupcima za izračunavanje osnovnih statističkih parametara. U regresijsku analizu (*Multiple Regression modul backward*, a za obradu rezultata uzorka po težinskim kategorijama modul *Ridge Regression* iz programa Statistica 5.0 na osobnom računalu tip PSI 586 pod OS Windows 98) skup varijabli prediktora uključivao se na šest načina: 1) samo ocjena kvalitete tehnike, 2) samo ocjena tehnike pada, 3) samo 9 motoričkih varijabli, 4) sve varijable osim varijable pad, 5) 9 motoričkih varijabli i ocjena pada te 6) sve motoričke varijable i dvije varijable antropometrijskog statusa za manifestni motorički prostor po težinskim kategorijama. Radi provjere pouzdanosti prediktorskih varijabli ocjene tehničkog znanja (TEHNK i TMPAD) korišten je i modul *Reliability/Item Analysis* iz programa statistica 5.0.

REZULTATI I RASPRAVA

Analiza osnovnih deskriptivnih parametara rezultata svih izabranih varijabli pokazuju da je distribucija normalna (tablica 1). Metrijske karakteristike varijabli ocjena tehnika **(TEHNK** i **TMPAD)** su zadovoljavajuće (tablice 2 a-c) Može se zaključiti po vrijednostima da se. koeficijenti pouzdanosti i objektivnosti nalaze u granicama koje zadovoljavaju (.90 i više). Korelacije između ispitivača su nešto veće u varijabli ocjena tehnike (kompozitna ocjena) nego u ocjeni zempo kaiten pada. U obradi rezultata u regresijskoj analizi ocjene za kvalitetu tehnika (TEHNK i TMPAD) izvedene su kao vrijednosti ispitanika su na prvoj glavnoj komponenti i tako korištene u statističkoj obradi (tablica 2).

Iz tablica korelacija (tablica 3) uočava se da su između nekih varijabli korelacije značajne, a nekih neznačajne ili značajne, a negativnog smjera. Najveću korelaciju sa kriterijskom varijablom **(SHIAI)** od svih prediktorskih varijabli ima ocjena kvalitete ukupne tehnike **(TEHNK .79)**, zatim varijable koje su mjere snage **(MBENT, MBENC** i **MIVIS)** i dvije varijable koje su mjere koordinacije **(MOKIM** i **MOKUS)**. Dalje se opaža da je varijabla tjelesna visina **(ATVIS)** u negativnoj korelaciji s kriterijem **(-.19)** i s većim brojem mjera snage **(MRSKL; MIVIS** i **MBENT),** dok sa mjerama koordinacije nema značajnu povezanost. Tjelesna težina ponaša se neutralno. Sve su motoričke mjere u značajnoj i pozitivnoj korelaciji s varijablom **ocjena ukupne tehnike**, a najveće korelacije ostvaruju jedna mjera snage **(MBENT .49)** i jedna mjera koordinacije **(MOKIM -.35)**. Samo na temelju ocjene tehničkog znanja (TEHNK) moguće je objasniti oko 54% varijabiliteta kriterijske varijable, dok se približno 24% kriterija može objasniti samo ocjenom zempo kaiten pada (tablica 4). Podaci o kvaliteti znanja tehnike daju visoku mogućnost predviđanja nečijeg uspjeha (tablica 5), dok se samo 30% kriterijskog varijabiliteta može predvidjeti na temelju informacija koje nosi skup 9 motoričkih varijabli (tablica 6). Pojedinačno najveće i značajne regresijske koeficijente imaju varijable repetitivna snaga ruku i ramenog pojasa (MBENC β=.42) i koordinacije na tlu (MOKIM β = -.28). Kada se u regresijsku jednadžbu uključilo 12 varijabli (bez TMPAD), koeficijent determinacije se značajno povećao - **.63** (tablica 7). Najveći pojedinačni i značajan doprinos u objašnjenju ukupnog varijabiliteta kriterija ima ukupna ocjena tehnike (TEHNK β = .79). Detaljnijom analizom po modulu Stepwise registriran je značajan utjecaj još dvije varijable; a to su apsolutna snaga ruku relativnog tipa (MBENT β=.12) i negativan utjecaj tjelesne visine (ATVIS β= -.11). Prediktorska varijabla ukupna ocjena tehničkog znanja je informacijama bogata složena varijabla, ali je mjerenje dugotrajno i kompliciranо. Zato je za procjenu uspjeha u borbi u slijedećem postupku (tablica 8) uzeta varijabla **TMPAD** i **9 motoričkih testova**. Na taj način uređeni prediktorskih skup od 10 varijabli dao je značajnu informaciju kojom se objašnjava **57%** varijabiliteta kriterija **(SHIAI)**. Dvije varijable imaju najveći pojedinačni doprinos objašnjenu ukupnog varijabiliteta: ocjena zempo kaiten pada **(TMPAD)** i apsolutna snaga ruku relativnog tipa **(MBENT**). Parcijalne korelacije s kriterijskom varijablom su vrlo visoke i značajne (tablica br. 8). Potonji način prikupljanja informacija je brži, jednostavniji i ekonomičniji, pa se predloženi skup od 10 varijabli može preporučiti kao podesniji za praksu. Utjecaj tjelesne visine na uspjeh u borbi **(SHIAI)** je značajan i negativan u lakšim težinskim kategorijama (tablica 9, **ATVIS β =- 48**), dok je u većim težinskim kategorijama taj utjecaj sve manji i kako se ide prema težoj kategoriji raste u pozitivnom smjeru. Kako su tjelesna masa i tjelesna visina u značajnoj korelaciji, a utjecaj maksimalne snage ruku relativnog tipa (iskazivanje te snage je veće za manju tjelesnu masu) u negativnoj je vezi s tjelesnom visinom, to su ispitanici višeg rasta, a manje tjelesne mase u nepovoljnijem položaju u judo borbi, jer im skeletni sustav najviše pridonosi tjelesnoj masi, dok je u ispitanika nižih rastom, a iste tjelesne mase, veći udio korisne mišićne mase To je na sličnom uzorku utvrdio i Drviš (1996). Najveći pojedinačni doprinos prognoziranju nečijeg rezultata imaju četiri varijable: ocjena (kvaliteta) tehničkog znanja juda, ocjena padova i maksimalna snaga ruku i ramenog pojasa te koordinacija na tlu. Te varijable se pouzdano mogu smatrati relevantnima za judo sport. Razmatrajući odnose kroz težinske kategorije u tablici 9 uviđa se da su snaga ruku i ramenog pojasa dominantne sposobnosti za uspjeh u judo borbi. Moguće objašnjenje varijabiliteta za ovaj slučaj na temelju prediktorskog skupa ukupno 11 varijabli, dvije mjere antropometrijskog statusa i 9 motoričkih mjera se kreće od **51-57 %**.

ZAKLJUČAK

Regresijskom analizom utvrđena je velika povezanost kriterijske varijable uspjeha u borbi **(SHIAI)** s izabranim skupom prediktorskih varijabli Na temelju svih prediktorskih varijabli, a one se sastoje od 9 motoričkih testova, 2 morfološka obilježja i ocjene ukupnog tehničkog

znanja moguće je u visokom postotkum predvidjeti nečiji uspjeh u judo borbi. Najveći pojedinačni doprinos prognoziranju nečijeg rezultata ima **ocjena kvalitete tehničkog znanja juda**. Značajan utjecaj imaju i varijable koje procjenjuju **snagu ruku i ramenog pojasa** i varijabla procjene **koordinacije**. U kombinaciji s motoričkim mjerama, ocjena kvalitete samo **zempo kaiten pada** značajno pridonosi mogućoj predikciji uspjeha (vrijednost se približava onoj koja je postignuta na temelju svih 12 prediktorskih varijabli). Predikciji uspjeha u borbi s aspekta težinskih kategorija najviše doprinose testovi **mjere snage** te koordinacija iskazana **kimono testom.**. U borbi su bili uspješniji ispitanici jačega hvata, čvršćih ruku, jer su mogli blokirati protivničke akcije, a vlastitom snagom nametnuti svoj gard i izvesti tehniku. Unutar kategorija uspješniji su bili niži, a teži ispitanici snažnijih ruku, u apsolutnom i relativnom smislu, i oni okretniji. Rad potvrđuje da je judo sport vještine i snage, znanja i umješnosti primjene tog znanja, a da su za to odgovorne sposobnosti koje čovjek posjeduje i vježbanjem razvija. Valjalo li rezultate rada i odnose prognostičkih testova s kriterijem uspjeha provjeriti u novom istraživanju na većem uzorku judaša-natjecatelja.

Ključne riječi: *judo, uspješnost, tehnika, snaga, predviđanje, testiranje, primjena.*